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## Description of the Proposed Program

### **Program Background**

Virginia Commonwealth University requests approval for a Master of Science (MS) degree program in Digital Forensics & Incident Response (DFIR). The proposed degree program would be located in the College of Humanities & Sciences, Department of Forensic Science. The target date of the program's initiation is Fall 2024.

The purpose of the proposed MS in Digital Forensics & Incident Response degree program is to equip students with the necessary knowledge and skill set to effectively collect, analyze, and preserve a variety of digital evidence for forensic purposes, as well as identify, combat, and respond to network and cloud-based threats and/or attacks. The degree program will prepare students for a wide range of jobs, such as digital forensic examiners/analysts, computer forensic examiners/analysts, cyber forensic analysts/investigators, incident responders, security and threat assessment analysts, etc. Graduates will be prepared to work in law enforcement agencies, federal government agencies (e.g., Federal Bureau of Investigation, Drug Enforcement Agency, Homeland Security, etc.), private digital/computer/cyber forensic companies, additional counterintelligence / counterterrorism agencies, etc. Through experiential learning, the degree program will expose students to accessing and preserving evidence from a variety of operating systems, platforms, mobile devices, and malware. They will perform independent research in the field of Digital Forensics and/or Incident Response, extract data from and build case files from complex mock evidence, and be able to evaluate the use, potential and limitations of digital forensic laboratory techniques. Graduates of the proposed program will graduate with industry-relevant certifications specific to digital forensics data recovery. Furthermore, students who complete the program will be able to discuss and apply their understanding of the other professional responsibilities of a forensic examiner, including ethical concerns, report writing, rules of evidence and expert testimony. The program will address current needs in Virginia and the nation as a whole.

Globally, there has been an explosion of digital forensic services and subsequent demand for practitioners over the past 20 years<sup>1</sup>. Digital Forensics can be classified as the collection of data from physical devices, while Incident Response is considered the collection and preservation of data from the cloud and servers, along with network security, breach and intrusion detection<sup>2</sup>. Thus, the two areas are separate but integrated into a single forensic specialty. The Virginia Department of Forensic Science came to VCU several years ago to advocate for a digital forensic-focused MS degree program, citing the need for better prepared job candidates for their laboratories. Further, we entertain frequent inquiries from prospective students looking for a forensic program with a digital/computer focus. Due to nationwide demand, the national forensic science educational accrediting body, FEPAC, has added standards<sup>3</sup> for academic programs focusing in this area. Unfortunately, employment and student demand continue to outpace availability of qualified analysts<sup>1</sup>. Last spring, we established a stakeholder group of

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<sup>1</sup> Publicly funded forensic crime laboratories: resources and services, 2014. NCJ 250151; Nov. 2016.

<sup>2</sup> What is DFIR? CyberReason, Accessed September 6, 2023. <https://www.cybereason.com/fundamentals/what-is-dfir>

<sup>3</sup> <https://www.aafs.org/sites/default/files/media/documents/2022%200212%20FEPAC%20Standards.pdf>

Virginia agencies; this group included representatives from FBI Computer Analysis Response Team, VA DFS, US Attorney General’s Computer Forensics Unit, VA State Police’s Computer Evidence Recovery and High-Tech Crimes Division, and two private digital investigative companies from Virginia. The stakeholder group was unanimous about the statewide need for better prepared digital analysts. The group confirmed that natural/forensic science majors were unprepared in the areas of computer science methodology while computer science majors lacked forensic coursework focusing on compromised digital/media evidence. The group agreed that a new degree program was needed to address hiring needs and draft curricula were established. Subsequently, the working group expanded to include VCU Departments of Information Systems and Computer Science.

This is one of the newest disciplines in forensic science. Though accreditation has been in place for about a decade for forensic laboratories (through the American National Standards Institute (ANSI) National Board of Accreditation (ANAB)] and academic programs (through FEPAC)), degree programs in this emerging area are few and far between. In fact, the M.S. degree program will be only the second, degree program in the state and the third accredited digital forensic graduate program in the country. The program aims to provide Virginia and the region with better prepared digital forensic employees, reducing the long training periods currently required (due to lack of specialty academic programs). VCU expects this will result in a significant savings for state, federal, and private forensic service providers. Moreover, this program has been heavily shaped by professional forensic science analysts in this field and will quickly prove to be one of a kind.

### **Institutional Mission**

The mission of Virginia Commonwealth University states:

Virginia Commonwealth University and its academic health sciences center serve as one national urban public research institution dedicated to the success and well-being of our students, patients, faculty, staff and community through:

- Real-world learning that furthers civic engagement, inquiry, discovery and innovation
- Research that expands the boundaries of new knowledge and creative expression and promotes translational applications to improve the quality of human life
- Interdisciplinary collaborations and community partnerships that advance innovation, enhance cultural and economic vitality, and solve society’s most complex challenges
- Health sciences that preserve and restore health for all people, seek the cause and cure of diseases through groundbreaking research and educate those who serve humanity
- Deeply ingrained core values of diversity, inclusion and equity that provide a safe, trusting and supportive environment to explore, create, learn and serve

As the home of a nationally, top-rated accredited Forensic Science Department with deep, historical ties to the Virginia Department of Forensic Science, we believe that the proposed M.S. in Digital Forensics & Incident Response aligns well with the institution’s mission. The proposed degree is interdisciplinary, incorporating a strong core of forensic science advanced coursework and research, all with a digital analysis edge. With a significant number of hands-on, laboratory-based specialized courses, the curriculum will focus on “real-world learning”, teaching students

how to use innovative technology and software to provide investigative information to the criminal and social justice systems. As such, this program will advance VCU's mission of helping "solve society's most complex challenges" and will assist in bringing an objective and scientific eye to a system that is often wrought with social, cultural, and economic biases. Our curriculum will feature full-time faculty experts as well as part-time faculty with digital forensics expertise from across the state to provide our students with unique transdisciplinary *and* "interdisciplinary collaborations and community partnerships". The curriculum proposed will add to a thriving Department of Forensic Science that already has a rich history of research, innovation, and a student-focused culture of care. We have no doubt that we can extend those values, and those of VCU, to this new degree program and its students. Though not explicitly mentioned in VCU's most recent six-year plan, the plan focuses on capital projects to "facilitate innovative transdisciplinary and interdisciplinary achievements", which would include the proposed M.S. degree program. The Department of Forensic Science currently occupies space in both Oliver Hall and Temple Hall, which are being replaced with the planned "Interdisciplinary Classroom & Laboratory Building" in the six-year plan. This new space will provide modern interdisciplinary classrooms and laboratory spaces that will serve as a home base for the proposed M.S. degree.

### **Delivery Format**

This degree program will be offered in a traditional face-to-face format in its entirety, but some courses may have specific sections offered in an online and/or hybrid format. The only required course from the program's core that is consistently offered as hybrid format is FRSC 570 (Forensic Science Seminar). This course is offered solely with synchronous delivery with the class meeting at specified days/times over Zoom and with course materials available to students via Canvas, but with other in-person required days each semester. VCU has an existing partnership with Zoom and Canvas, making these platforms available for use by faculty and students. All faculty will have adequate training and credentials for these platforms and delivery methods, the former of which they will be familiar with due to regular use from other aspects of their jobs. Faculty and students will also have access to Zoom and Canvas help resources.

### **Program Accreditation**

The Department of Forensic Science intends to apply for accreditation as a Digital Evidence degree program through the Forensic Science Education Programs Accreditation Commission (FEPAC; <https://www.aafs.org/FEPAC>). FEPAC's mission is to "maintain and enhance the quality of forensic science education through a formal evaluation and accreditation system for college-level academic programs that lead to a baccalaureate or graduate degree." An application for accreditation may be submitted following the graduation of at least two classes from the proposed MS in Digital Forensics & Incident Response degree. Assuming the program will be available Fall 2024, we anticipate that the first two graduating classes will be in Spring 2026 and Spring 2027, thus we intend to apply for accreditation in January 2027; applications are due by March 1 each year in order to be considered for that accreditation cycle. If accreditation is successful, the degree program would be accredited starting February 2028.

Curricular requirements for FEPAC accreditation of a Master's of Science degree program in the category of Digital Evidence include:

- 5.2.3a: Core Forensic Science Topics including crime scene investigation, law/science evidence, ethics and professional responsibilities, quality assurance, and pattern evidence.
- 5.2.3b: Specialized Topics including hardware forensics, software forensics, network forensics, and mobile device forensics
- 5.2.3c: A formal graduate seminar
- 5.2.3d: An independent research project

See Appendix A for accrediting body (FEPAC) requirements.

### **Admissions**

Admission to the proposed MS in Digital Forensics & Incident Response program will require additional requirements beyond those of the admissions policies of the Graduate School of Virginia Commonwealth University, and meets [accreditation standards by FEPAC \(Standard 5.1\)](#). Applicants will be required to also meet the following requirements. In order to be admitted to the proposed Digital Forensics & Incident Response degree program, students must have:

- Completed a Bachelor's Degree in Forensic or a Natural Science, Computer Science, Electrical Engineering, Business or Information Systems, Information Technology or equivalent coursework (30 upper-level credits in the above majors).
- Completed 16 credits in Information Technology, Computer Science, Business/Systems Security, including 6 credits in a programming language. Relevant employment experience in the digital forensics field may substitute for prerequisite coursework.
- An undergraduate GPA that exceeds 2.9 on a 4.0 scale
- Assessment of prior graduate course work and/or relevant laboratory experience (where applicable) may substitute for prerequisite coursework
- Three letters of recommendation pertaining specifically to the student's potential ability as a graduate student in Digital Forensics & Incident Response
- Personal statement

The Graduate Committee, consisting of the Program Director, three additional faculty members from the Department of Forensic Science including at least one subject matter expert, the Department Coordinator, and an outside Affiliate faculty member from the Virginia Department of Forensic Science, reviews each application and scores students using an evaluation rubric. The committee then discusses each student and makes a consensus decision on admission.

With review and approval by the Graduate Committee, a maximum of 6 credits of graduate-level coursework may be transferred from Virginia Commonwealth University's non-degree status or from another accredited institution. Credits must be less than six years old from the time of admission, and graded B (3.0) or better. Credits applied to a degree previously earned at VCU or at another institution may not be transferred. Depending on the content, transferred credits may be substituted for core and other required courses, or transfer in as elective credit.

## Curriculum

The proposed Master of Science (MS) in Digital Forensics & Incident Response is a 39-credit hour degree program. The program is non-thesis, but a Directed Research project will be required. The curriculum will provide students with the application-based training and relevant certifications necessary for an advanced career in Digital Forensics.

Digital forensic device analysis along with incident response, which includes securing cloud and network security and data, is a combination that is rapidly becoming the industry standard for analyst positions and employment demand. As these two fields are separate but related, specialized training in both areas is important for successful career development in this field. The core coursework will ensure that students are prepared for a career as a forensic scientist in government and private forensic laboratories, or for further graduate and/or professional academic degrees. This hands-on experiential learning curriculum will focus on case analysis, testimony and leadership preparation, along with a practical understanding of the structure and function of a working crime laboratory. Core courses include foundational digital and multimedia forensic analysis and incident response courses that the additional required coursework will build on. Additional required courses will dive deeply into areas of digital and multimedia forensic analysis including mobile and Internet-of-Things (IOT) device recovery, and advanced video and media recovery and analysis along with fundamental forensic science topics such as the legal perspectives and professional practices for forensic science and crime scene investigation.

The Directed Research project (FRSC 793) is a required intensive research project which may be mentored by either full-time faculty or collaborating practitioners in crime laboratories throughout the country and world. This model has been successfully used by the existing biology and chemistry-based MS program in Forensic Science and has resulted in a well-funded, nationally recognized research enterprise within the Department of Forensic Science. The Directed Research project provides students with the opportunity to dive deeply into one area of specialty in Digital Forensics or Incident Response, and with the extensive hands-on experience provided by the Directed Research project, students will leave the program very well-qualified to begin their career as a digital forensic analyst. Because of the possibility of on- or off-campus research and the diversity of committee members (students are encouraged to include at least one working forensic practitioner in their research committee), this project does not fall under a thesis classification, but the writing and oral defense requirements are identical to that of a traditional thesis. Students may register and begin their Directed Research project once they have completed 18 credit hours in the MS program. They must hold a 3.0 GPA and their 3-member committee and topic approved by the graduate program director. The research project requires a minimum of 300 laboratory research hours that can be completed over the course of 2-3 semesters and culminates in a presentation of the project results at a campus seminar, and a written technical report of publishable quality. While rare, students who fail the Directed Research project will not be permitted to graduate with an MS in Digital Forensics & Incident Response until they successfully complete an appropriate Directed Research project.

The curriculum is designed to meet admissions and curricular requirements as a Digital Evidence degree program through the Forensic Science Education Programs Accreditation Commission (FEPAC; <https://www.aafs.org/FEPAC>).

Seven new courses have been developed for the MS in Digital Forensics & Incident Response.

All new courses are denoted with an asterisk.

### **Program Requirements**

#### **Core Courses: 21 credit hours**

FRSC 525 Introduction to Digital Forensics (3 credits) \*

FRSC 530 Advanced Forensic Computer & Storage Device Analysis (3 credits) \*

FRSC 531 Hardware Forensics & Advanced Acquisition (3 credits) \*

FRSC 610 Forensic Video & Multimedia Analysis (3 credits) \*

FRSC 611 Cybersecurity, Networking & Ethical Hacking for Forensic Applications (3 credits) \*

FRSC 570 Forensic Science Seminar (3 credits)

FRSC 793 Directed Research in Forensic Science (3 credits)

#### **Other Required Courses: 18 credit hours**

FRSC 565 Scientific Crime Scene Investigation (3 credits)

FRSC 612 Advanced Forensic Mobile & IoT Device Analysis (3 credits) \*

FRSC 613 Applied Forensic Digital & Multimedia Analysis (3 credits) \*

FRSC 670 Forensic Evidence & Criminal Procedure (3 credits)

FRSC 677 Professional Practices & Expert Testimony (3 credits)

#### **Restricted elective: 3 credits**

Students will meet with a faculty adviser to identify an elective most relevant to their chosen career path. Students must take one (1), 3-credit, 5XX-7XX level graduate course.

#### **Total: 39 credit hours**

See Appendix A for accrediting body (FEPAC) curriculum requirements.

See Appendix B for sample plan of study.

See Appendix C for course descriptions.

See Appendix D for directed research manual.

### **Time to Degree**

This program is designed for full-time students. Full-time students can complete the degree in two years by taking 10-11 credits per semester during the fall and spring semester each year. No summer semesters are necessary, but students often take the opportunity to begin their Directed Research projects during the summer between their first and second year, particularly if they choose to perform the Directed Research at a crime laboratory outside of the greater Richmond area. See the sample plan of study provided in Appendix B.

## Faculty Resources

The Department of Forensic Science at VCU has 11 existing full-time faculty positions (11 FTEs). These faculty will be involved with teaching core and other required forensic science courses in the proposed M.S. degree program; each faculty member holds either a doctoral or master's degree in forensic science, analytical chemistry, molecular biology, or a closely related discipline. Together, they have a combined 162 years of forensic science teaching experience *as well as* nearly 120 years of forensic practitioner/casework and laboratory management experience. Collectively, they have published numerous textbooks and hundreds of peer-reviewed publications in professional forensic science journals (~20 publications per year). Further, these faculty frequently serve as manuscript reviewers for professional forensic science journals, hold multiple leadership positions in national and international forensic science professional organizations, and provide ~100 presentations annually at professional conferences and within the broader criminal justice, public health, and social justice communities. The robust research program within this department includes nearly \$1M of new grants awarded annually, which is used to support very active undergraduate and graduate student research programs. These faculty are supplemented with a healthy, rotating pool of local forensic science practitioners (~17 per academic year), who serve as adjunct instructors for a selection of forensic science graduate and undergraduate courses. This includes two existing adjunct instructors, who each have more than 15 years of high-profile casework in electronic investigation, incident response, and digital forensics. Although they have been teaching the undergraduate and graduate level introductory digital forensic courses for several years, their involvement may expand if the proposed M.S. degree is approved.

The Department of Forensic Science's faculty expertise is broad, and it currently includes expertise in forensic science laboratory management and the technical subdisciplines that incorporate traditional criminalistics (chemical, biological, and pattern evidence applications). Consequently, additional faculty with an M.S. or Ph.D., and at least 3 years of appropriate digital analysis casework expertise will be hired. This will include one new faculty member added immediately (1 FTE). As the program grows and reaches projections, an *additional* full-time faculty member (1 FTE) will be sought. These resources have been pledged by the Dean of the College of Humanities & Sciences (CHS), home to the department of Forensic Science (Appendix E).

Adjunct faculty with the same minimum qualifications will be contracted to cover the additional ~4 sections of new courses needed annually to accommodate the M.S. program. A stakeholder group of digital practitioners from the region worked closely with the department to develop the proposed curriculum; several members of this group have committed to serving as adjuncts for the proposed M.S. degree program.

See Appendix E for abbreviated curriculum vitae of faculty.

## Student Learning Assessment

Students who complete the proposed MS in Digital Forensics and Incident Response will have mastered the skill sets necessary to analyze digital evidence and maximize recovery from



incidents involving electronic data. Students will be assessed in each course through various mechanisms including (1) hands-on and theoretical projects, (2) homework assignments, (3) case file synthesis and reports, and (4) exams.

The capstone course, Professional Practices in Forensic Science, provides the opportunity for assessment of combined learning skills obtained through the program, culminating in a mock trial in which students testify to their analysis of a case that they worked in one of their advanced courses. The Directed Research project prepares students to think critically about data recovery and quantitatively measure their outcomes, as well as become comfortable with scientific inquiry and presentation of their work. Their laboratory work is evaluated by their research mentor, and the outputs of their work in the form of the oral presentation, defense and written reports, are evaluated by a committee of 3 scientists, at least one of which is typically a working forensic practitioner. Every aspect of the project from proposal and committee makeup to final defense and report evaluations is overseen and approved by the graduate program director.

The learning outcomes for the degree program are specific to graduate level knowledge, skills, and abilities that students should acquire in the proposed degree program. Faculty worked with staff members in VCU's Director of Institutional Effectiveness and Planning in order to develop learning outcomes and appropriate measures. The Department of Forensic Science conducts a series of assessments annually in order to track students' academic progress, exit surveys for graduating students for feedback and future improvement, and track employment after graduation. These measures are also in place and required by the Forensic Science Educational Program Accreditation Commission (FEPAC), under which VCU's MS in Forensic Science program (Biology and Chemistry specialties) has been fully accredited since 2005, and through which the Digital Forensics & Incident Response program will also seek accreditation. Employment placement statistics for that program within 6 months of graduation are posted annually online. The data from these assessments are used to improve the curriculum, revise courses where appropriate, and request budgetary allocations for equipment and/or software that will better prepare the students for their future careers in digital forensics and incident response.

### Learning Outcomes

Students will be able to:

- Apply basic principles and laboratory procedures of Digital & Multimedia Sciences to forensic evidence analysis.
- Identify and evaluate the capabilities, use, potential and limitations of digital forensic laboratory theory and techniques.
- Describe and apply an understanding of legal procedure and the rules of evidence.
- Discuss the ethical and professional duties and responsibilities of the forensic scientist.
- Perform independent research, interpret data, report and orally present research findings in the digital specialty of forensic science.

Per FEPAC standards, the first program review for accreditation will occur in late spring of 2027, after two MS classes have graduated from the program.

See Appendix A for FEPAC accreditation standards.

Curriculum map for MS in Digital Forensics & Incident Response.

<b>Learning Outcome</b>	<b>Core and Required Courses</b>	<b>Assessment Measures</b>
Apply scientific principles and laboratory procedures of Digital & Multimedia Sciences to forensic evidence analysis.	FRSC 531: Hardware Forensics & Advanced Acquisition  FRSC 610: Forensic Video and Multimedia Analysis  FRSC 565: Scientific Crime Scene Investigation  FRSC 525: Introduction to Digital Forensics	<u>Formative</u> : hands-on practice, homework assignments, problem solving activities  <u>Summative</u> : Final Exam/Project, Recovery case file/report
Identify and evaluate the capabilities, use, potential and limitations of digital forensic laboratory theory and techniques.	FRSC 611: Cybersecurity, Networking and Ethical Hacking  FRSC 530: Advanced Forensic Computer & Storage Device Analysis  FRSC 612: Advanced Forensic Mobile & IoT Device Analysis  FRSC 613: Applied Forensic Digital & Multimedia Analysis	<u>Formative</u> : hands-on practice, homework assignments, problem solving activities  <u>Summative</u> : Final Exam/Project, Recovery case file/report
Describe and apply an understanding of legal procedure and the rules of evidence to a case study	FRSC 670: Forensic Evidence & Criminal Procedure  FRSC 677: Professional Practices & Expert Testimony	<u>Formative</u> : group discussions, summary papers, homework assignments  <u>Summative</u> : Final Exam, Mock Trial
Discuss the ethical and professional duties and responsibilities of the forensic scientist.	FRSC 670: Forensic Evidence & Criminal Procedure  FRSC 677: Professional Practices & Expert Testimony	<u>Formative</u> : group discussions, summary papers, homework assignments  <u>Summative</u> : Final Exam, Mock Trial
Perform independent research, interpret data, report and orally present research	FRSC 570: Forensic Science Seminar	<u>Formative</u> : summary papers, research proposal

findings in the digital specialty of forensic science.	FRSC 793: Directed Research in Forensic Science	<u>Summative</u> : Oral defense and written report
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### **Employment Skills**

All graduates of the proposed degree program will be prepared for positions as digital forensic examiners/analysts, computer forensic examiners/analysts, cyber forensic analysts/investigators, incident responders, security and threat assessment analysts. Graduates of the proposed MS in Digital Forensics and Incident Response program will be able to:

- Demonstrate the proper workflow for digital forensic casework.
- Illustrate the fundamentals of different Digital & Multimedia Sciences' subdisciplines
- Utilize automated and manual methods for processing and analyzing data from a wide variety of digital devices, as well as verification/authentication of data.
- Compare and contrast image and video evidence utilizing scientific methodologies, standards, and best practices.
- Utilize techniques and tools used in system hacking for forensic purposes
- Implement best practices for the collection and preservation of electronically stored information.
- Develop appropriate interpretations and produce thorough expert reports.
- Articulate digital forensic analysis findings effectively to a lay audience.
- Assess ethical expectations and requirements for the forensic science community for compliance and future direction.
- Assess, defend, and promulgate quality assurance standards and practices
- Assess and explain the implications of scientific measurements, uncertainty and bias in forensic science practice.
- Obtain a recognized Digital Forensic certification such as [Cellebrite Certified Mobile Examiner \(CCME\)](#) and an independent certification such as the [International Society of Forensic Computer Examiners Certified Mobile Device Examiner \(ICMDE\)](#). While this is the current list of relevant certifications for practitioners, we acknowledge that this field evolves swiftly and the specific necessary and relevant certifications will be evaluated biennially to ensure that they are still meeting employers' needs.

### **Relationship to Existing Programs**

The proposed M.S. degree program is not similar to or closely related to any other existing degree program at VCU and will not compromise any other existing degree program. There are 15 shared credits total with the existing Forensic Science M.S. degree program (College of Humanities & Sciences); without a shared core, the new degree area is not able to be established as a concentration within the existing degree program.

## Justification for Proposed Program

### **Response to Current Needs**

Digital forensic analysis has played an increasingly important role in our society, due to the prevalence of digital and computing devices. In fact, “Digital and Multimedia Sciences” was the newest forensic science discipline to be formally recognized by the American Academy of Forensic Sciences<sup>4</sup>. Globally, there has been an explosion of digital forensic services and subsequent demand for practitioners over the past 20 years<sup>5</sup>. In 2019, The International Association of Chiefs of Police’s Digital Task Force released a report citing the “lack of capacity”, including “issues such as lack of specialized training”, as one of the three primary ways that law enforcement’s access to digital crime scenes is currently restricted<sup>6</sup>. Citing the need for better prepared job candidates for their laboratories, the Virginia Department of Forensic Science reached out to VCU several times in recent years advocating for digital forensic-focused bachelor’s and master’s degree programs. Simultaneously, due to international demand<sup>7</sup>, the US forensic science educational accrediting body (FEPAC) added standards for academic programs focusing in the area of digital analysis. Yet despite these steps forward, employment and student demand continue to outpace the availability of qualified digital evidence professionals. This is, in large part, due to the lack of specialized educational and training programs<sup>8</sup>. Authors of one recent peer-reviewed article published in the “*Journal of Forensic Science Education*” further noted the lack of published research on educational programs and their effectiveness specifically for the forensic discipline of digital multimedia, stating “...research in this area would benefit not only the educational programs in content and its delivery, but with the input of the forensic science community, has the potential to help ensure that the future forensic science scientists receive quality education, comprehensive of all forensic science subdisciplines”<sup>9</sup>.

With this in mind, early in 2022, the VCU Department of Forensic Science convened a stakeholder group of Virginia digital practitioners, which included representatives from federal/state/local law enforcement agencies, federal/state crime laboratories, and the local

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<sup>4</sup> Membership in the Forensic Digital & Multimedia Sciences Section, American Academy of Forensic Sciences. Accessed August 19, 2023. <https://www.aafs.org/membership/digital-multimedia-sciences>

<sup>5</sup> Discover how technology helps manage the growth in digital evidence. Microsoft Industry Blog. David Williams. Sept. 20, 2022. Accessed August 23, 2023. <https://www.microsoft.com/en-us/industry/blog/government/2022/09/20/discover-how-technology-helps-manage-the-growth-in-digital-evidence/#:~:text=Digital%20evidence%20appears%20in%20nearly%2090%20percent%20of%20all%20crimes%20committed%20today.&text=This%20is%20a%20massive%20increase,that%20proves%20innocence%20or%20guilt>

<sup>6</sup> Digital Evidence Task Force, Executive Primer, International Association of Chiefs of Police. 2019. Accessed July 30, 2023. [https://www.iacpcenter.org/wp-content/uploads/2019/11/IACP\\_Digital\\_Evidence\\_Task\\_Force\\_2019.pdf](https://www.iacpcenter.org/wp-content/uploads/2019/11/IACP_Digital_Evidence_Task_Force_2019.pdf)

<sup>7</sup> Towards Standards in Digital Forensics Education, Working Group Report, Proceedings of the 2010 Conference of Innovation and Technology in Computer Science Education, Association for Computing Machinery. June, 2010. Accessed August 19, 2023. <https://dl.acm.org/doi/pdf/10.1145/1971681.1971688>

<sup>8</sup> Digital evidence and digital forensic education. Goran Oparnica. *Digital Evidence and Electronic Signature Law Review*, 2016, 13:143-147. Accessed August 1, 2023. <https://journals.sas.ac.uk/deeslr/article/view/2305>

<sup>9</sup> A review of existing forensic laboratory education research and needs assessment. Sabra Jones, Ronald Thrasher, et al. *Journal of Forensic Science Education*, 2021, 3(1). Accessed July 17, 2023. <https://jfse-ojs-tamu.tdl.org/jfse/article/view/43>

corporate community. This group included practitioners from the FBI Computer Analysis Response Team, Virginia Department of Forensic Science (state crime lab), the VA Attorney General’s Computer Forensics Unit, Virginia State Police’s Computer Evidence Recovery and High-Tech Crimes Division, the digital investigations unit of a local sheriff’s office, GE Healthcare, and two private digital investigative companies in central Virginia. The group unanimously confirmed the need for better prepared digital analysts in Virginia – at all levels. Citing that natural/forensic science majors were unprepared in the areas of computer science methodology while computer science majors lacked forensic coursework focusing on compromised digital/media evidence, evidence management, criminal law, and forensic ethics, the group agreed that new degree programs were needed to address the specialized hiring needs. Subsequently, the working group expanded to include faculty from the VCU Departments of Information Systems and Computer Science, both of whom were already offering foundational computer and information systems coursework. Together, the team assembled worked closely to advise the VCU Department of Forensic Science on curriculum development, needs assessment, opportunities for inter- and transdisciplinary collaboration, and employment opportunities.

### Digital Forensic Examinations & Incident Response

At its core, digital forensics includes “the science of identifying, preserving, documenting, examining, and analyzing evidence from computer systems, the results of which may be relied upon in court”<sup>10</sup>. However, as everyday things around us increasingly became more digitized and/or internet-connected, the field of digital forensic examination has evolved from personal computers and server analysis to now an infinite list of items ranging from smart work or home devices to mobile phones and other portable “wearable” devices. Digital investigations commonly include analysis of audio and video files, social media, emails and other communications, website access, geolocation files, motor vehicle files, and even sensor data such as that obtained from medical devices, license plate readers, facial recognition software, and/or gunshot detection technology. While “digital forensics” applies to examination of any device, experts in the field often specialize in one or more subdiscipline; the subdisciplines are broadly categorized as network forensics, memory forensics, data and file carving, mobile devices/IoT (Internet of Things), cloud forensics, and anti-digital forensics (reverse engineering).

With time and technological advances, individuals create larger digital footprints, tracked by an increasing number of devices, which can be analyzed to assist fact-finders. For example, an Arkansas murder case in 2016 was ultimately cracked by data retrieved from an Amazon Echo smart home device<sup>11</sup>; similarly, analysis of data from a pacemaker played a key role in charging a suspect for arson and insurance fraud in 2017<sup>12</sup>. In fact, **at least 90% of crimes committed today include some form of digital evidence**, creating a demand for forensic digital analysis

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<sup>10</sup> All the pieces that matter: Evaluating Digital Forensic Expert Witnesses. Christa Miller, Brandon Epstein, et al. Zero Abuse Project. Grant Report. 2022. Accessed July 17, 2023. <https://ojjdp.ojp.gov/library/publications/all-pieces-matter-evaluating-digital-forensic-expert-witnesses>

<sup>11</sup> An Amazon Echo may be key to solving a murder case. TechCrunch+. Sarah Buhr. December 2016. Accessed July 30, 2023. <https://techcrunch.com/2016/12/27/an-amazon-echo-may-be-the-key-to-solving-a-murder-case/>

<sup>12</sup> How a pacemaker led police to accuse someone with arson. Fortune Magazine. Don Reisinger, February 2017. Accessed July 30, 2023. <https://fortune.com/2017/02/07/pacemaker-arson-charges/>

that continues to rise 11-16% annually<sup>13</sup>. With this data, many believe that modern policing will soon have digital forensics & incident response at the core of its basic investigatory function. With that said, digital forensic analysis is not restricted to criminal cases – today, there is a greater societal need for digital forensic analysis, including that involved in civil and corporate litigation. The rise of data compromises, particularly in the web, finance, and tech industries, has led to increased demand for digital forensic professionals in the private sector. In 2022 alone, 88.3% of companies reported at least one data breach, costing those companies nearly \$6.20M<sup>14</sup>.

It is important to note that digital forensic examination is not a function of an IT professional. While both require basic understanding of how computers work and programming, the forensic techniques used by digital professionals are entirely separate. IT, computer science, or cyber security experience and training alone would not sufficiently prepare one to work with forensic evidence. In fact, one expert in the field recently noted that any individual “touting themselves as an IT expert, and thereby a digital forensics expert, should be evaluated cautiously as they most likely do not understand the distinction and thus lack the basic skills to complete a forensic exam”<sup>15</sup>. Thus, it is critically important that specialized forensic science educational communities work to develop formal degree programs that can provide students with the knowledge and skills needed for digital forensics specialization. Generally, in the field of forensic science, Master’s degree programs can provide that level of forensic specialization needed for individuals who hold B.S. degrees in a relevant basic science area. A recent study in the *Journal of Analytical Toxicology* noted that 221 professional forensic scientists in hiring or leadership roles consistently reported that a B.S. degree in a basic science followed by an M.S. degree in a specialized area of forensic science was the most preferred degree *combination* for forensic science positions, regardless of level<sup>16</sup>. Without a specialized M.S. degree, significant related experience may be required in conjunction with the B.S. degree, even for entry-level positions<sup>17</sup>.

### Digital Forensic Educational Needs

In recent years, it has become increasingly challenging for working digital forensic practitioners to keep pace with rapidly changing technological advancements while also shouldering the burden of training the next generation of practitioners for this emerging profession. The lack of quality educational degree programs leads to long, in-depth training programs (12 months or more) within public law enforcement agencies and private businesses; long training programs only further contribute to long turn-around times for digital forensic casework. With so few formal education and training programs, employers are often forced to hire individuals with

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<sup>13</sup>Meeting the future of digital forensics and evidence management. IBM Storage. 2022. Accessed July 17, 2023. <https://www.ibm.com/downloads/cas/RWL5O1PY>

<sup>14</sup>Rising digital evidence and data breaches boost demand for digital forensics. Stax. January 2023. Accessed July 17, 2023. <https://www.stax.com/insights/rising-digital-evidence-and-data-breaches-boost-demand-for-digital-forensics#:~:text=However%2C%20according%20to%20a%20study,of%20all%20crimes%20committed%20today.&text=Investigations%20for%20crimes%20ranging%20from,evidence%20stored%20in%20electronic%20devices.>

<sup>15</sup> All the pieces that matter: Evaluating Digital Forensic Expert Witnesses. Christa Miller, Brandon Epstein, et al. Zero Abuse Project. Grant Report. 2022. Accessed July 17, 2023. <https://ojjdp.ojp.gov/library/publications/all-pieces-matter-evaluating-digital-forensic-expert-witnesses>

<sup>16</sup> What is the preferred educational background of forensic scientists? Mark Marhol, Grace Jensen, et al. *Journal of Analytical Toxicology*, 2023, 47;299-304.

<sup>17</sup>Security and Investigations Careers at the FBI: Forensics Careers, Qualifications & Eligibility. FBI Jobs, Accessed August 25, 2023.

computer science experience or even sworn police officers – neither of whom have backgrounds appropriate for forensic digital examinations. Meanwhile, prospective employees are left to gain specialized knowledge through training programs offered outside of a university or college setting. However, there is no standardized list of training or certification programs to sufficiently qualify individuals, making this a complex pathway. Further, the vast number of offerings, some provided by software vendors, make them difficult to assess for legitimacy and relevance<sup>18</sup>.

Many forensic science thought leaders hope that, as the number of universities and colleges with forensic science degree programs increase, the educational gap in the digital forensic community will be closed. While a limited number of Ph.D. programs have been developed as the academic interest in forensic science has grown, the Ph.D. is only required for research intensive and/or instructional positions within academia. In fact, the M.S. degree is most often considered the terminal degree in forensic science. In a recent survey of forensic science hiring managers and leaders, 50.5% of the 235 respondents reported having a graduate degree; however, of those with graduate degrees, 71.5% reported the Master’s degree as the highest degree attained<sup>19</sup>. Yet, the more recent explosion of digital evidence in forensic settings means there is a lag in the development of associated specialized digital forensic degree programs. The accrediting body for such programs – Forensic Science Education Programs Accreditation Commission (FEPAC) – currently has only two accredited graduate (M.S.) programs in their system, neither in Virginia.

The proposed VCU M.S. degree program in Digital Forensics & Incident response would be only the second of its kind in the state. The proposed degree program is designed specifically to fill the knowledge gap for: a) individuals who have a B.S. degree in a basic natural science, computer science, or information technology who seek to gain exposure to the specialized forensic application and b) individuals who seek, regardless of degree background, more extensive in-depth, hands-on intensive coursework *and* research in the technical specialty area of digital forensics *along with* advanced training in areas related to forensic quality assurance, laboratory/group management, casework documentation, report writing, and courtroom testimony. Most advanced positions within the forensic science field require or strongly prefer an M.S. degree. In the aforementioned survey, 56.5% of hiring managers and forensic science leaders prefer supervisory or leadership-level hires that have an appropriate M.S. degree in their specialized area<sup>18</sup>. Moreover, 42% of respondents prefer an M.S. degree even for *entry-level* positions<sup>18</sup>. The proposed M.S. degree program will provide its students with the knowledge, skills, and abilities that are required to obtain analyst level and/or supervisory and leadership positions within digital forensic units and agencies. This includes advanced, casework-centered laboratory courses covering hardware forensics, advanced acquisition, advanced mobile & IoT device analysis, forensic video and multimedia analysis, cybersecurity, networking, and ethical hacking, along with consistent exposure to forensic management and leadership concepts, culminating in a publication quality research project, and a moot court experience based on a mock case analyzed by the student. Lab directors often rely on M.S. level hires to lead

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<sup>18</sup> All the pieces that matter: Evaluating Digital Forensic Expert Witnesses. Christa Miller, Brandon Epstein, et al. Zero Abuse Project. Grant Report. 2022. Accessed July 17, 2023. <https://ojjdp.ojp.gov/library/publications/all-pieces-matter-evaluating-digital-forensic-expert-witnesses>

<sup>19</sup> What is the preferred educational background of forensic scientists? Data & Supplementary Material, School of Pharmacy, University of Wisconsin-Madison, MINDS. Accessed August 25, 2023. <https://minds.wisconsin.edu/handle/1793/82902>

validation studies, research, implementation of new technologies, and efforts on more complex casework. The high level, progressive approach to graduate education in forensic science at VCU is unique – the depth and breadth of which simply cannot be delivered at the undergraduate level. Further, the comprehensive exposure to traditional areas of forensic science (criminal law, evidence recovery, ethics and bias, and crime scene investigation) are unique to the proposed VCU M.S. degree program, especially relative to the other digital forensics M.S. degree program in Virginia (GMU). We believe that this approach will provide top-notch M.S.-level graduates who are well qualified to enter the workforce as competent digital forensic examiners, analysts, *or* supervisors, requiring minimal internal training upon hire.

### Why VCU?

Virginia Commonwealth University is well-suited to host the state’s only accreditable M.S. degree that offers specialization in digital forensic examinations. Not only does the proposed M.S. degree program fit well with VCU’s mission, VCU’s location in the heart of central Virginia provides perfect proximity to many potential employers and collaborators. Stakeholders located within a short drive of VCU’s campus include: the digital forensics unit at the Virginia Department of Forensic Science’s Central laboratory, the regional computer crimes divisions of both the VA Office of the Attorney General and the US Attorney General’s office, the digital evidence team at the FBI Richmond field office, the computer crimes division at the FBI Laboratory Headquarters, several local law enforcement agencies (who have their own digital teams), and the digital forensics teams for several large international corporations (i.e. GE Healthcare, Capital One, etc.). Individuals from many of these groups have assisted with the development of the M.S. curriculum; through this process, they have offered opportunities for collaborative research, assistance with instruction, and experiential opportunities for students. Moreover, several have noted their intention to hire graduates of the proposed degree program. VCU has had a long-standing commitment to forensic science as an *academic* venture, serving as home to a nationally prominent Department of Forensic Science for many years and nurturing strong, longstanding relationships with most major forensic laboratories in the mid-Atlantic region of the US. In addition, VCU has 41 years of experience managing a highly successful M.S. degree program (focused in the natural science areas); in a time of low M.S. student enrollment at the university level, the existing M.S. in Forensic Science degree program has actually consistently grown enrollments to what is now one of the largest, most lauded M.S. degree programs on campus. Further, VCU is home to an NSA-designated Center of Academic Excellence in Cyber Research and a DHS Center of Academic Excellence in Cybersecurity Defense; these associations will provide additional opportunity for interdisciplinary collaboration for the proposed M.S. degree program. With all of these characteristics in play, VCU is well prepared to serve as the educational core for the already established digital forensics hub of the mid-Atlantic.

The proposed M.S. degree in Digital Forensics & Incident Response is a natural extension of the VCU Department of Forensic Science’s mission – to advance the field of forensic science through teaching, research, community outreach and stakeholder engagement. Ultimately, the vision of the Department of Forensic Science is to inspire the next generation of students to become global leaders in the forensic science community and beyond through unparalleled competency and innovation. The proposed M.S. proposed degree program would, if approved, allow the Department an opportunity to respond to a critical knowledge gap that exists in our



professional community in ways that align well with student demand and the Department's mission and vision.

The existing forensic science degrees offered at VCU are FEPAC-accredited and are supported by a diverse faculty of scientists who, together, have many years of expertise and practitioner forensic science experience. The Department is a multidisciplinary department with existing expertise in crime scene investigation, evidence acquisition, quality assurance management, criminal law and expert testimony, and advanced forensic laboratory management; all of these serve as critical *required* components to the proposed M.S. degree program. The Department's longstanding relationship with the Virginia Department of Forensic Science (their founders) provides a rich pool of adjunct faculty who add a real-world perspective to our classroom instruction. The Department has a well-established applied research portfolio, which includes nearly \$1M of expenditures annually, and has a history of keeping pace with forensic science technological and pedagogical advances. At the core of the Department's mission is the emphasis on contemporary practices to assure that our students are prepared for entering the modern forensic sciences industry. This includes an emphasis on intensive, experiential hands-on learning modalities for all enrolled students. Digital forensics professionals uniformly cite these characteristics as desired qualities of university degree programs in this area<sup>20,21</sup>.

The proposed M.S. degree program will be positioned to become the second digital forensic graduate program in Virginia and the only one that is eligible for accreditation. The program aims to provide Virginia and the nation with better prepared digital forensic employees, reducing the long training periods currently required (due to lack of specialty academic programs) and providing qualified candidates for advanced analytical and supervisory positions. VCU expects this will result in a significant savings for state, federal, and local forensic service providers as well as private industry.

See Appendix F for letters of support (specific demand)

### **Employment Demand**

Graduates of the proposed M.S. in Digital Forensics & Incident Response degree program will find employment in this field in a wide range of positions such as digital forensic examiners, computer forensic analysts, cyber forensic investigators, cyber incident responders, and security and threat assessment analysts. Successful graduates of the program will be qualified to work for a wide variety of law enforcement agencies, federal government agencies (e.g., Federal Bureau of Investigation, Drug Enforcement Agency, Homeland Security, etc.), private cyber forensic companies, and counterintelligence or counterterrorism incident response that involves any digital media.

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<sup>20</sup>Experiential learning in digital forensics. In: Xiaolu Zhang, Timothy Yuen, et al (eds) *Digital Forensic Education*. Studies in Big Data, vol. 61. Springer, Cham. [https://doi.org/10.1007/978-3-030-23547-5\\_1](https://doi.org/10.1007/978-3-030-23547-5_1)

<sup>21</sup>Developing a standardized and multidisciplinary curriculum for digital forensics education. Masooda Bashir and Roy Campbell, CyLab Usable Privacy and Security Lab, Carnegie Mellon University. <chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://cups.cs.cmu.edu/soups/2015/papers/eduBashir.pdf>

The justification for the proposed M.S. in Digital Forensics and Incident Response program lies in the need for specialized skills and knowledge for advanced positions. For careers in this field of study, graduates will be prepared to meet industry demand by performing forensic examinations and responding to incident threats from a variety of electronic sources, document their findings in detailed reports, and present their findings to investigators and in legal proceedings. Additionally, this advanced degree will afford a greater opportunity to develop more specialized skills which are not covered in most B.S. in digital forensics programs and M.S. in cybersecurity, informational technology, or computer science programs. Furthermore, a graduate-level degree increases the possibility for advancement and higher salaries within the forensic science profession<sup>22</sup>. According to the May 2019 U.S. Bureau of Labor Statistics, forensic science technicians earned a median annual salary of \$59,150, whereas laboratory managers earned \$129,100<sup>23</sup>.

The demand for forensic science degrees beyond the B.S. level in both academic settings and crime laboratories has been on the rise<sup>22</sup>. Employment in colleges and universities requires a more comprehensive understanding of complex concepts, often only obtained at the M.S. level or higher, which enables them to effectively communicate the subject materials to others. As with academia, crime laboratories have become more selective for applicants with M.S. degrees, since an advanced degree tends to give the forensic scientist a higher level of credibility in court and is also a factor typically considered for advancement.

A sharp increase in society's dependence and use of digital technologies, and the emergence of criminal activity surrounding those media, has resulted in the emergence of the digital forensics and cyber incident response disciplines<sup>24</sup>. Digital forensics and incident response professionals possess the skills necessary to collect, preserve, analyze, and present their findings in legal proceedings<sup>23</sup>. According to Cybersecurity Ventures, the cost of cybercrimes is expected to rise from \$8 trillion dollars in 2023 to \$10.5 trillion in 2025 and “represents the greatest transfer of economic wealth in history”<sup>23,25</sup>. During the COVID-19 pandemic, cybercrimes spiked 600% and forced industries to rapidly adjust to increasing threats<sup>23</sup>. Twenty years ago, digital evidence was rarely encountered in criminal cases; however, of the crimes committed today, almost 90% include digital evidence. This has led the court system to rely on, and society to have an expectation for, digital evidence collection and analyses in cases to consider the guilt or innocence of an accused<sup>26</sup>. The increase in demand for digital forensics and incident response in both the private and public sectors has created a need for individuals with very specific technical skills and knowledge<sup>25</sup>.

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<sup>22</sup> What is the preferred educational background of forensic scientists? Data & Supplementary Material, School of Pharmacy, University of Wisconsin-Madison, MINDS. Accessed August 25, 2023.

<sup>23</sup> U.S. Bureau of Labor Statistics. Occupational Outlook Handbook. <https://www.bls.gov/ooh/life-physical-and-social-sciences/forensic-science-technicians.htm#tab-2>

<sup>24</sup> Jang-Jaccard, Julian and Surya Nepal. “A Survey of Emerging Threats in Cybersecurity”, *Journal of Computer and System Sciences*, Volume 80, Issue 5, 2014, Pages 973-993.

<sup>25</sup> Sheward, Mike. Hands-on Incident Response and Digital Forensics. Swindon: BCS Learning & Development Limited, 2018. pp. 40-41, 91.

<sup>26</sup> Jang-Jaccard, Julian and Surya Nepal. “A Survey of Emerging Threats in Cybersecurity”,

Graduates of the proposed degree program will be well-prepared to perform forensic examinations and preserve data obtained from a variety of electronic sources, including computers, servers, cloud data, and mobile devices. Additionally, graduates will be able to assist with incident response, including threat hunting, data recovery, email analysis, and malware analysis across a variety of different types of operating systems and will be able to document their findings in detailed reports. Graduates with a M.S. degree in Digital Forensics & Incident Response will also be able to present their findings to investigators and in legal proceedings. A search for employment projections in the US Bureau of Labor Statistics (BLS) reveals no listing for jobs in the digital forensics or computer incident response fields. This is very likely due to the area of digital forensics and incident response being in its infancy and not a well-established profession. Professions listed on the BLS website that most closely align with the field of digital forensics and incident response include those that combine the skills required for forensic science technicians (collection, preservation, and analysis of evidence, as well as courtroom testimony)<sup>27</sup> and information security analysts (monitor networks for security breaches and investigate when they occur)<sup>26</sup>. Entry-level employment in both fields typically requires at least a B.S. degree in programs that include a combination of science, law, crime scene investigation, and computers and information technology, which are the expected topics for a Digital Forensic & Incident Response program. However, advancement to higher positions and analysis of more complex cases typically requires graduate-level degrees. The data for these two occupations are included in the following chart from the BLS:

**Labor Market Information: Bureau of Labor Statistics, 2021-31 (10-Yr)<sup>26</sup>**

Occupation	Base Year Employment	Projected Employment	Total % Change and #s	Typical Entry Level Education
Forensic Science Technician	17,600	19,600	11% 2,000	Bachelor's Degree
Information Security Analyst	163,000	219,500	35% 56,500	Bachelor's Degree

As can be seen from the information in Table 1, occupational fields closely related to digital forensics and incident response are expected to have an exceptional growth rate, with a range of 11-35% within the next 10 years. According to the BLS site, both forensic science technicians and information security analysts typically need a bachelor's degree to enter the occupation<sup>26</sup>. With the versatility the proposed degree offers, the expectation is that the digital forensics and incident response disciplines will have a similar, if not higher, expected growth rate than most of the above-listed comparison professions.

Information included in the U.S. Bureau of Labor Statistics Occupational Outlook Handbook clarifies the close association between traditional forensic science laboratory analysts and the profession of digital forensics<sup>28</sup>:

<sup>27</sup> U.S. Bureau of Labor Statistics. Occupational Outlook Handbook. <https://www.bls.gov/ooh/life-physical-and-social-science/forensic-science-technicians.htm#tab-2>

<sup>28</sup> U.S. Bureau of Labor Statistics. Occupational Outlook Handbook. <https://www.bls.gov/ooh/life-physical-and-social-science/forensic-science-technicians.htm#tab-2>

“Some forensic science technicians, called *forensic computer examiners* or *digital forensics analysts*, specialize in computer-based crimes. They collect and analyze data to uncover and prosecute electronic fraud, scams, and identity theft. The abundance of digital data helps them solve crimes in the physical world as well. Computer forensics technicians must adhere to the same strict standards of evidence gathering found in general forensic science because legal cases depend on the integrity of evidence.”

Unlike the BLS site, the Virginia Employment Commission (VEC) database does have information on ‘Digital Forensics Analyst’ but does not contain any data on ‘Incident Response’. Information on this profession, as well as Forensic Science Technician and Information Systems Analyst (for comparison to the BLS), from the VEC is included in the chart below.

**Labor Market Information: Virginia Employment Commission, 2021-31 (10-Yr)<sup>29</sup>**

Occupation	SOC Code	Base Year Employment	Projected Employment	Total % Change and #s	Annual Change #	Education
Forensic Science Technician	194092	420	470	11.9% 50	5	Bachelor's Degree
Information Security Analyst	15-1212	16,340	22,360	36.8% 6,020	220	Bachelor's Degree
Digital Forensics Analysts	15-1299.06	17,130	19,620	14.5% 2,490	249	Bachelor's Degree

Data presented by the VEC reinforces the expected growth rate for related digital forensic careers in Virginia. For the period of 2021-2031, the above Labor Market Information data from the VEC projects growth of 14.5% in digital forensic analysts and between 11.9-36.8% in two fields related to digital forensics and incident response<sup>28</sup>. Based upon all the data provided in this section of the document and the market analysis that has been done on the digital forensic and incident response profession, there is a strong case to be made for future job growth in this industry and in the educational system needed to prepare individuals for these professions.

See Appendix G for employment announcements.

See Appendix H for letters of support from prospective employers (Employment Demand).

**Duplication**

One public institution in Virginia offers a similar or related M.S. degree program in the field of Digital Forensics: George Mason University.

The only relevant CIP code for the proposed degree program is 43.0403, for Cyber/Computer Forensics and Counterterrorism. It is worth noting that the designated CIP code is very broad and

<sup>29</sup> Virginia Employment Commission. <https://virginiaworks.com/Occupational-Projections>

encompasses all areas of cyber forensics and counterterrorism, which are not the focus of the proposed program (which is exclusively digital forensics & incident response – formerly “Computer Forensics”).

Virginia Commonwealth University would be the first institution in Virginia to offer an M.S. degree in *Digital Forensics & Incident Response*. In Virginia, there is only one Master’s degree program that shares the same CIP code – George Mason University (GMU).

### **George Mason University (GMU)**

GMU offers a M.S. degree in Digital Forensics, however, the GMU degree is not FEPAC-accredited. The GMU degree program requires a minimum of 30 credit hours, including 21 core and 9 elective credits. Students in this degree program have the option to complete a concentration in “Penetration testing/Reverse Engineering” (PTRE), which replaces the 9 elective credits with required specialized coursework.

### Similarities

George Mason’s core coursework includes some basic foundations courses that are similar to the proposed M.S. degree program. Both George Mason and the proposed degree program core requirements include a basic introductory course in digital forensics and an advanced analysis course, which requires students to apply basic knowledge to casework processing. Additionally, both degree programs require a basic digital multimedia course, and network/cybersecurity course as a part of their core. One additional course requirement is shared between the proposed degree program (as an “other required course”) and George Mason’s (as a core course) – mobile device analysis. Altogether, the two (2) degree programs have five core or required courses that seem to overlap in basic content.

### Differences

Generally, the proposed degree program is quite different than that offered by George Mason. The proposed degree program is more extensive, requiring 36 required credits of each student, which together will meet the program accreditation curricular requirements. When combined with an additional 3 elective credits, the required total for the degree sums to 39 credits. This is 30% more credits to obtain the proposed degree than that offered at George Mason. There are several reasons for these additional credits. First, the forensic science department at VCU believes that all students, regardless of degree, should have some broad cross-discipline forensic science exposure in addition to the opportunity for specialization. The proposed degree program achieves this through the department seminar requirement, a generalized crime scene investigation course, and a professional practice/expert testimony course – all of which will include graduate students from both grad-level forensic science degree programs, exposing students to other forensic specialty areas. Additionally, students of the proposed degree program will be permitted to select from a pool of electives that includes both specialized, advanced digital courses as well as non-digital introductory level elective courses focused on other forensic subdisciplines. Further, the proposed degree program requires every student to complete a directed research experience, which is not a part of the George Mason curriculum. Other basic differences include how each program introduces aspects of incident response into the curriculum – the proposed degree program weaves incident response into each specialized course taught while the George Mason program offers a separate incident response course as a core

course option. Most importantly, the proposed degree program has been developed in conjunction with several central Virginia law enforcement and forensic science agencies, including the state crime laboratory (Virginia Department of Forensic Science). These formal and informal local partnerships will benefit students directly by offering diverse instructional perspectives from all levels of the practitioner community and by offering rich opportunity for collaborative efforts on identified research and development needs.

In addition to the general programmatic differences detailed above, there are several curricular differences between the proposed degree program and that offered by George Mason. First, the proposed degree program requires two advanced specialized digital courses that are not required for students at George Mason; this includes an advanced course in hardware forensics & advanced acquisition as well as an advanced digital and multimedia analysis course. Some aspects of these areas are offered as elective options in the George Mason program, but these are not required of each student. Additionally, the proposed degree program covers network and intrusion detection (“ethical hacking”) within a single required, three-credit core course, whereas the George Mason program offers two separate 3-credit courses to cover these topics. Further, the proposed degree program requires each student to complete a course in basic related law and criminal procedure, whereas this is a core *option* for the George Mason program. At George Mason, students may opt out of the law course in favor of a financial fraud course, which is not currently a part of the proposed degree curriculum. Finally, to modernize the curriculum, the proposed degree program includes “IoT” device analysis as a program requirement, which is not included in the George Mason curriculum.

<b>Enrollment</b>	Fall 2018	Fall 2019	Fall 2020	Fall 2021	Fall 2022
George Mason University (43.0403)	70	66	73	71	61
<b>Degrees Awarded</b>	2017-18	2018-19	2019-20	2020-21	2021-22
George Mason University (43.0403)	27	24	33	28	31

### **Student Demand**

VCU evaluated student demand for the proposed M.S. degree in Digital Forensics and Incident Response from three sources of data: 1) a prospective student survey, and 2) survey of students enrolled in an existing related elective course, and 3) prospective student inquiry emails.

#### Prospective Student Survey

In July of 2023, the Department of Forensic Science sent an online survey to college students at the junior and senior levels are current forensic science, computer science, and information technology majors at VCU. Surveys were deployed through the appropriate home Departments with the help of each Department Chair and assigned academic advisors. The online survey remained open for 7 weeks. A five-point Likert scale was used. There were **41 total responses received**; of those, 19 were seniors, 11 were juniors, and 11 indicated “other” for their current status. Additionally, 23 of the respondents were female, 17 were white/European, and 39 indicated that they are U.S. citizens. The most informative data is summarized below:

- Prompt 1: *If VCU offered a MS in Digital Forensics program, I would enroll.*  
15 respondents strongly agreed  
18 respondents agreed
- Prompt 2: *Please rate how likely you would do each of the following: I am interested in pursuing a degree in Digital Forensics*  
16 respondents strongly agreed  
17 respondents agreed
- Prompt 5: *I would likely enroll in this degree program during the following academic school year:*  
22 respondents indicated 2024-2025  
11 respondents indicated 2025-2026

### Survey of FRSC 391 Students

The Department of Forensic Science began offering an undergraduate elective course, FRSC 391: Introduction to Digital Forensics, in part to field interest in the topic. Although open to any major, all students that have enrolled in this course to-date have been forensic science, criminal justice, computer science, and information systems majors at the sophomore, junior, and senior levels. This course has been offered as an elective three times (spring and fall 2022, and fall 2023 – in progress). Initially the course was capped at 24 students, but there was significantly more interest from the student body than we expected. Thus, future sections were raised to a cap of 40 to accommodate as many students as possible within the computer lab space used. A total of 102 students have enrolled for the course total in its three offerings. At the end of the spring and fall 2022 semesters, the adjunct instructor for the course deployed an online survey to enrolled students. A five-point Likert scale was used for the survey. Of the 34 students enrolled each semester, **12 (spring)** and **28 (fall) responded**. The most informative data is summarized below:

- Spring Prompt 4: *I believe the University and future students would benefit from a Digital Forensic degree program at VCU designed to dive deeper into the topics covered in this class and prepare them for a career in digital forensics.*  
9 respondents strongly agreed  
2 respondents agreed
- Spring Prompt 8: *Because of this class, I now have an increased desire to learn more about the field of digital forensics*  
6 respondents strongly agreed  
5 respondents agreed
- Fall Prompt 8: *Because of this class, I now have an increased desire to learn more about the field of digital forensics*  
4 respondents strongly agreed  
16 respondents agreed

See Appendix I for the original student surveys. Results are included as separate document behind the original surveys.

Prospective Student Inquiries

The Department of Forensic Science has received a number of both informal and more formal inquiries in recent years from prospective students. Often, the prospective students are specifically looking for a M.S.-level degree in digital forensics. In other cases, the students are inquiring more generally about how VCU could accommodate their combined interests in cybersecurity, computers science or IT, and forensic science. Informal inquiries have included phone calls received in the Department’s main office from prospective students, prospective student drop-ins in faculty offices and the main office, and direct inquiries from students enrolled in the FRSC 391: Digital Forensics course. Formal inquiries are primarily received as email inquiries to the Department’s general email box. However, unfortunately, the Department has no formal mechanism in place to archive the specific inquiries received.

See Appendix J for prospective student email inquiries.

***State Council of Higher Education for Virginia***  
**Summary of Projected Enrollments in Proposed Program**

Year 1		Year 2		Year 3		Year 4 Target Year (2-year institutions)			Year 5 Target Year (4-year institutions)		
2024 - 2025		2025 - 2026		2026 - 2027		2027 - 2028			2028 - 2029		
HDCT	FTES	HDCT	FTES	HDCT	FTES	HDCT	FTES	GRAD	HDCT	FTES	GRAD
<u>12</u>	<u>12</u>	<u>24</u>	<u>24</u>	<u>36</u>	<u>36</u>	<u>48</u>	<u>48</u>	<u>17</u>	<u>48</u>	<u>48</u>	<u>21</u>

Assumptions :

- Ramp up enrollment in first three years of program from 12 to target of 24 per entering class
- Retention percentage: 88%
- Full-time students: 100%
- Part-time students: 0%
- Full-time student credit hours per semester: 10
- Full-time student graduate in 2 years



## Projected Resource Needs for the Proposed Program

### **Resource Needs**

Virginia Commonwealth University and the College of Humanities & Sciences have all the resources needed to initiate and sustain the proposed M.S. in Digital Forensics & Incident Response, including faculty, staff, equipment, space, and library resources. The proposed degree program allocates 1 FTE of instructional effort for every 26 FTE of graduate student enrollment. The proposed degree program will therefore require approximately 0.67 FTE of instructional effort to initiate, rising to approximately 1.84 FTE by the target year 2028-2029. The following subsections detail the resources required to operate the program from its initiation in the fall 2024 semester through the target year 2028-2029.

#### **Full-Time Faculty**

A faculty member currently serving in the Department of Forensic Science will serve as program director for the proposed degree program. The program director will devote 0.167 FTE to the proposed degree program and will be responsible for program oversight, curriculum, and assisting with scheduling, marketing, and development of recruitment strategy.

Existing full-time faculty capacity (along with the adjunct faculty detailed below) will be used to cover the initial year of the proposed program (2024-2025), given projected enrollments. However, one new full-time faculty member (1 FTE) with expertise in digital forensics and incident response will be hired to teach core and other required courses in the proposed degree program by the target enrollment year (2028-2029). The new hire is expected to be either a term faculty or tenure-track faculty hired at the rank of Assistant Professor. Salary and benefits are expected to be \$90,000 with fringe of \$36,270 for a total expense of \$126,270

Altogether, 0.167 FTE of full-time faculty effort will be needed to initiate the proposed degree program, rising to 1.167 FTE of full-time faculty effort in the target enrollment year.

#### **Part-Time Faculty**

No part-time faculty are needed to support the instruction effort required for the proposed degree program.

#### **Adjunct Faculty**

For the proposed degree program, 0.5 FTE of adjunct faculty will be required to teach digital forensics and incident response specialized core coursework and other required courses in the initial year of the degree program. This need will increase to 0.668 FTE of adjunct faculty effort by the target enrollment year (2028-2029). This need will be met by the hire of up to 3 new adjunct faculty.

#### **Graduate Assistants**

Although no graduate assistants will be required initially for the proposed degree program, 2 will be required to sustain the program in the target enrollment year (2028-2029). Graduate teaching assistants are provided by the College of Humanities & Sciences; positions include a \$12,500 stipend for the 9-month academic year. No other benefits are provided.

**Classified Positions**

The Department Coordinator and the Fiscal Administrator currently employed by the Department will support the proposed degree program in its initial year. However, by the target enrollment year (2028-2029), an additional 1 FTE of classified support will be needed to sustain the proposed degree program.

An Administrative Assistant position will provide general administrative and graduate admissions support to the proposed program. Salary for the Administrative Assistant position will be \$40,000 along with benefits of \$16,120 for a total of \$56,120.

**Equipment**

For each new hire, existing furniture and computers will be provided by the College of Humanities & Sciences. For the full-time faculty hire, it will be necessary to provide a start-up package of \$50,000 *if* the hire is brought in on a tenure-track faculty line.

**Library**

No additional library resources are required to sustain the proposed degree program. Virginia Commonwealth University's current resources includes journals, magazines, electronic materials and other publications needed to support the proposed degree program.

**Telecommunications**

No additional telecommunications are needed to initiate or sustain the proposed degree program. Existing telecommunication services and devices will be utilized for the new hires.

**Space**

New office spaces will be needed for the new faculty and staff hires. Office space will be provided by the College of Humanities & Sciences.

**Targeted Financial Aid**

No targeted financial aid is available for the students in the proposed degree program.

**Special Tuition or Fee Charges**

No specific tuition or fee charges will be utilized to initiate and sustain the proposed degree program. Students enrolled will be charged program fees consistent with the existing forensic science degree program (Tier 1 – College of Humanities & Sciences).

**Other Resources**

No other resources are needed to initiate and sustain the proposed degree program, including marketing, start-up costs, etc.

**Funds to Initiate and Operate the Degree Program**

*Figures provided in the table below will be compared to SCHEV funding estimates using the current base adequacy model. This comparison will serve as a reference for the estimated costs. If there are large discrepancies, SCHEV may request additional clarification to ensure the institution’s assumptions are correct, or require modifications as a condition of approval.*

**Note:** Institutions must use the recommended student-faculty ratio when estimating FTE enrollments and required faculty FTEs.

<b>Cost and Funding Sources to Initiate and Operate the Program</b>			
<b>Informational Category</b>		<b>Program Initiation Year 2024 - 2025</b>	<b>Program Full Enrollment Year<sup>30</sup> 2027 - 2028</b>
1.	Projected Enrollment (Headcount)	12	48
2.	Projected Enrollment (FTE)	0	0
3.	Projected Enrollment Headcount of In-State Students	5	19
4.	Projected Enrollment Headcount of Out-of-State Students	7	29
5.	Estimated Annual Tuition and E&G Fees for In-state Students in the Proposed Program	\$16,763	\$18,428
6.	Estimated Annual Tuition and E&G Fees for Out-of-State Students in the Proposed Program	\$31,589	\$34,748
7.	Projected Total Revenue from Tuition and E&G Fees Due to the Proposed Program	\$304,888	\$1,357,824
8.	Other Funding Sources Dedicated to the Proposed Program (e.g., grant, business entity, private sources)	\$0	\$0

<sup>30</sup> For the “Full Enrollment Year” use: for associate degrees, initiation year plus 1; for baccalaureate degrees, initiation plus 3; for masters degrees, initiation plus 2; for doctoral degrees, initiation plus 3.

*Part V: Certification Statements*

1. A request of any kind will be submitted to the General Assembly for funds to initiate and/or maintain the proposed degree program.

Yes   
No

If “Yes” is checked, include narrative text to describe: when the request will be made, how much will be requested, what the funds will be used for, and what will be done if the request is not fulfilled.

2. The proposed degree program is included in the institution’s most recent six-year plan.

Yes   
No

If “No” is checked, include narrative text to explain why the program is being advanced at the present time despite not being included in the six-year plan.

3. The institution’s governing board has been provided information regarding duplication (if applicable) and labor market projections as part of its approval action.

Yes   
No

If “No” is checked, include narrative text to explain why the governing board has not been provided the information.

The institution’s Chief Academic Officer attests to the accuracy of the above statements

---

Name (Printed)

---

Signature

---

Date

## Appendices

## **Appendix A Accrediting body (FEPAC) curriculum requirements**

# American Academy of Forensic Sciences



# FEPAC

FORENSIC SCIENCE EDUCATION PROGRAMS  
ACCREDITATION COMMISSION

## ACCREDITATION STANDARDS

Adopted by FEPAC – May 16, 2003  
Approved by the AAFS Board of Directors – August 9, 2003  
Revised by FEPAC – February 12, 2022

## 5.0 GRADUATE PROGRAM STANDARDS

A graduate forensic science program shall provide advanced education in the scientific, technical and/or laboratory problem solving skills necessary for success in a modern forensic laboratory. Such a program shall combine rigorous scientific, technical and/or laboratory training with exposure to the breadth of forensic science disciplines, including forensic science practice, law enforcement, and ethics.

The graduate forensic science program shall include teaching and learning, research, and service.

### 5.1 Graduate Admission Requirements

A bachelor's degree in forensic or natural sciences (or its equivalent coursework in a relevant field) shall be required for entrance into the graduate forensic science program. A process shall be in place to evaluate undergraduate work to determine if the applicant has sufficient scientific background to successfully complete the graduate program.

For forensic science programs with an emphasis in digital evidence, a bachelor's degree shall be required for entrance into the graduate forensic science program. A process shall be in place to evaluate undergraduate work to determine if the applicant has sufficient technical background to successfully complete the graduate program.

An exception to the bachelor's degree requirement may include a bachelor's degree/master's degree linked or contiguous program. These programs are sometimes referred to as a 4+1, 3+2, or 5 year program. The program must have well defined admission requirements and defined policies for dual enrollment. With a linked or contiguous program, a student should be able to complete the bachelor's degree without completing the master's degree.

### 5.2 Curriculum

The graduate program in forensic science shall offer a coherent curriculum that reflects the mission and goals of the program.

#### 5.2.1 General Curricular Requirements

The curriculum shall, at a minimum, ensure that each student:

1. develops an understanding of the areas of knowledge that are essential to forensic science;
2. acquires skills and experience in the application of basic forensic science concepts and of specialty knowledge to problem solving;
3. be oriented in professional values, concepts, and ethics; and,
4. demonstrates integration of knowledge and skills through a capstone experience such as a research thesis or project.

The program shall define clear learning objectives for each discrete component of the curriculum. The program shall have clear procedures for assessing and documenting each student's progress toward the fulfillment of these learning objectives and toward readiness for forensic science practice.

The program shall provide students with the basic knowledge necessary for effective testimony as an expert witness, and each student shall participate in practical experiences where they will render expert testimony (e.g., moot court).

For forensic science programs with an emphasis in biology and/or chemistry, **standard 5.2.2** should be followed. For forensic science programs with an emphasis in digital evidence, **standard 5.2.3** should be followed.



## **5.2.2 Specific Requirements within the Curriculum for Forensic Science Programs with an Emphasis in Biology and/or Chemistry**

The curriculum shall include the following:

### **5.2.2a Core Forensic Science Topics**

The following topics must be part of the curriculum:

1. Crime scene investigation
2. Law/science interface
3. Ethics and professional responsibilities
4. Quality assurance
5. Analytical chemistry and instrumental methods of analysis
6. Drug chemistry/toxicology
7. Microscopy and materials analysis
8. Forensic biology
9. Pattern evidence

The emphasis on each topic should be appropriate in light of the degrees awarded. However, a minimum of nine instructional hours must be spent on each topic.

Normally, a topic will involve multiple class meetings and may involve multiple learning modalities, such as lectures, laboratories, and demonstrations. Evaluation of student mastery of each topic may be conducted through a number of modalities, but the topic material must be specifically addressed in a syllabus and assessed.

### **5.2.2b Courses in Specialized Areas**

The curriculum must include graduate-level science courses appropriate for specialization. For example, courses covering the topics of molecular biology and population genetics, advanced analytical chemistry, toxicology, and materials analysis may be appropriate.

Specialized courses offered may be specific for a track(s) and/or concentration(s) offered by that institution, if applicable.

### **5.2.2c Graduate Seminar**

A formal seminar, presented by a combination of invited experts, faculty, and/or students covering topics such as published work, original research, and other relevant topics must be included within the curriculum of a required course.

### **5.2.2d Forensic Science Research or Capstone**

Each student is required to complete an independent research or capstone project. The research/capstone project shall culminate in a thesis or written report of publishable quality. The academic program must have written guidelines for the format of the thesis/report and for the evaluation of the oral presentation.

Each student is required to have a committee of at least three individuals who are responsible for mentoring the project. One member of the student's research committee must be a full-time faculty member of the program. The other two members can include full- or part-time faculty, forensic practitioners, and others with specialized knowledge. At least one member of the committee must be external to the department sponsoring the research. In addition, each student must present the results of the work orally, in a public forum, before the committee.

Presentations at professional meetings do not meet this requirement.

The research shall be conducted in an environment conducive to research and scholarly inquiry and shall provide the opportunity for faculty and students to contribute to the knowledge base of forensic science, including research directed at improving the practice of forensic science.

### **5.2.3 Specific Requirements within the Curriculum for Forensic Science Programs with an Emphasis in Digital Evidence**

The curriculum shall include the following:

#### **5.2.3a Core Forensic Science Topics**

The following topics must be part of the curriculum:

1. Crime scene investigation
2. Law/science evidence
3. Ethics and professional responsibilities
4. Quality assurance
5. Pattern evidence

The emphasis on each topic should be appropriate in light of the degrees awarded. However, a minimum of nine instructional hours must be spent on each topic.

Normally, a topic will involve multiple class meetings and may involve multiple learning modalities, such as lectures, laboratories, and demonstrations. Evaluation of student mastery of each topic may be conducted through a number of modalities, but the topic material must be specifically addressed in a syllabus and assessed.

#### **5.2.3b Courses in Specialized Areas**

The curriculum must include graduate-level courses appropriate to digital forensics and should contain the following concepts or topics:

1. Hardware forensics
2. Software forensics
3. Network forensics
4. Mobile device forensics

In addition, specialized courses may be offered, if applicable, in topics to include embedded device forensics, incident response, reverse engineering, multimedia forensics, information security, and/or operational management.

An advanced digital forensics course that requires a graduate course as a prerequisite must be completed.

#### **5.2.3c Graduate Seminar**

A formal seminar, presented by a combination of invited experts, faculty, and/or students covering topics such as published work, original research, and other relevant topics must be included within the curriculum as a required course.

#### **5.2.3d Digital Evidence Research or Capstone**

Each student is required to complete an independent research or capstone project. The research/capstone project shall culminate in a thesis or written report of publishable quality. The academic program must have written guidelines for the format of the report and for the evaluation of the oral presentation.

Each student is required to have a committee of at least three individuals who are responsible for mentoring the project. One member of the student's research committee must be a full-time faculty member of the program. The other two members can include full- or part-time faculty, forensic practitioners, and others with specialized knowledge. At least one member of the committee must be external to the department sponsoring the research. In addition, each student must present the results of the work orally, in a public forum, before the committee. Presentations at professional meetings do not meet this requirement.

The research/capstone project shall be conducted in an environment conducive to scholarly inquiry and shall provide the opportunity for faculty and students to contribute to the knowledge base of forensic science, including research/capstone projects directed at improving the practice of forensic science.

### **5.3 Program Director**

The program director shall be a full-time faculty member at the academic institution appropriately qualified by academic experience, research qualifications, and background in program administration to meet the program's stated mission, goals, and objectives, and to provide leadership in forensic science education, research, and other scholarly activities so students are adequately prepared for forensic science practice. The program director shall meet the following requirements:

1. a minimum of an earned Doctorate degree appropriate for a forensic science program;
2. at least five years relevant experience as an academic forensic scientist that includes appropriate educational, research, and service contributions to forensic science; OR at least five years relevant experience as a forensic science practitioner, not including any training time in an operational forensic science laboratory setting;
3. documented research experience in a forensic science discipline or in methods and techniques adapted, validated, and implemented by the forensic science community; and
4. documented management experience appropriate to the duties assigned to the position.

## Appendix B - Sample Plan of Study

### Full Time Student

#### First Year

<u>Fall Semester</u>	<u>credits</u>	<u>Spring Semester</u>	<u>credits</u>
FRSC 570 – Forensic Science Seminar	1	FRSC 570 – Forensic Science Seminar	1
FRSC 525 – Introduction to Digital Forensics	3	FRSC 565 – Scientific Crime Scene Investigation	3
FRSC 611 – Cybersecurity, Networking & Ethical Hacking for Forensic Applications	3	FRSC 530 – Advanced Forensic Computer & Storage Device Analysis	3
FRSC 670 – Forensic Evidence & Criminal Procedure	3	FRSC 612 – Advanced Forensic Mobile & IoT Device Analysis	3

**Total First Year: 20 credit hours**

#### Second Year

<u>Fall Semester</u>	<u>credits</u>	<u>Spring Semester</u>	<u>credits</u>
FRSC 570 – Forensic Science Seminar	1	FRSC 677 - Prof Practices	3
FRSC 793 – Directed Research in Forensic Science	2	FRSC 793 - Directed Research in Forensic Science	1
FRSC 531 – Hardware Forensics & Advanced Acquisition	3	FRSC 613 – Applied Forensic Digital & Multimedia Analysis	3
FRSC 610 – Forensic Video & Multimedia Analysis	3	Electives	3

**Total Second Year: 19 credit hours**

**Total Degree Program: 39 credit hours**

## Appendix C - Course Descriptions

New courses are denoted with an asterisk

### Core Courses

#### **\*FRSC 525 Introduction to Digital Forensics (3 credits)**

Semester course; 3 lecture hours. 3 credits. An in-depth study of digital forensics. Covers foundational concepts, evidentiary procedures, tools and software, current challenges, analysis techniques and report production, the legal system and expert testimony, standards and ethical considerations, as well as the vast community of practitioners and resources/opportunities in the field. The different disciplines within the field of digital forensics and the various modalities in which it is practiced will be reviewed.

#### **\*FRSC 530 Advanced Forensic Computer & Storage Device Analysis (3 credits)**

Semester course; 2 lecture hours and 3 laboratory hours. 3 credits. The course is an advanced study of the application of digital forensic methods and tools for the analysis of computer and storage devices. Covers operating and file system artifacts found on modern computer and storage devices, as well as the analytical techniques used in examinations (i.e., collection, acquisition, data structure interpretation, analysis, data recovery). Both theoretical and practical aspects will be covered. There is a significant hands-on laboratory component, including comprehensive working knowledge and extensive practical applications with mock crime scenes. Pre/Co-requisite: FRSC 525.

#### **\*FRSC 531 Hardware Forensics & Advanced Acquisition (3 credits)**

Semester course; 2 lecture and 3 laboratory hours. 3 credits. Establishes a strategy of approach for dealing with damaged, difficult, or uncommon devices. Provides comprehensive working knowledge and hands-on experience with the hardware of digital devices, including research and troubleshooting practices, teardown skills, repair and soldering techniques, and the application of advanced acquisition methods.

#### **FRSC 570. Forensic Science Seminar (1 credit)**

Semester course; 1 lecture hour. 1 credit. May be repeated for a maximum of 3 credits. A seminar course featuring presentations by faculty, crime laboratory staff, students and visiting lecturers. Instruction includes discussions of research and developments and current topics in various forensic science disciplines and related fields. Graded as S/U.

#### **\*FRSC 610 Forensic Video & Multimedia Analysis (3 credits)**

Semester course; 2 lecture and 3 laboratory hours. 3 credits. An advanced study of the core principles of forensic video and multimedia analysis. Students will learn the proper methodology for obtaining video evidence from digital devices, techniques for clarification of digital images, proper workflow for comparison and authentication analysis, and how to perform redactions and produce annotated video presentations for the courtroom through practical exercises. Prerequisite: FRSC 525.

**\*FRSC 611 Cybersecurity, Networking & Ethical Hacking for Forensic Applications (3 credits)**

Semester course; 2 lecture hours and 3 laboratory hours. 3 credits. This course is an introduction to computer network forensics, incident response, and penetration testing. Covers cyber security infrastructures, hardware, terminology, and methodology. Networking protocols and models will be introduced and examined for vulnerabilities and exploitation vectors. Legal considerations will be discussed. Theoretical and practical aspects of security architectures and ethical hacking will be covered. There is a significant hands-on laboratory component. Pre-/Co-requisite: FRSC 525.

**FRSC 793. Directed Research in Forensic Science (1-3 credits)**

Semester course; 1-3 practicum hours. 1-3 credits. May be repeated for credit with up to 6 credits counted toward the degree requirements. Enrollment restricted to students in the forensic science master's degree program with permission of the instructor. A capstone course in which students will conduct independent, original laboratory research in a forensic specialization area of interest, while also gaining practical experience in crime laboratory practices and methods. A minimum of 300 hours of laboratory research and a minimum of three credits are required for graduation.

Other Required Courses

**FRSC 565. Scientific Crime Scene Investigation (3 credits)**

Semester course; 3 lecture and/or laboratory hours. 3 credits. Presents the theory and techniques of scientific crime scene investigation including: recognition, documentation, collection and enhancement of physical evidence. A comprehensive introduction to the use of physical evidence for crime scene reconstruction is presented.

**\*FRSC 612 Advanced Forensic Mobile & IoT Device Analysis (3 credits)**

Semester course; 2 lecture hours and 3 laboratory hours. 3 credits. This course is an advanced study of the application of digital forensic methods and tools for the analysis of mobile and Internet-of-Things (IoT) devices. Covers proper evidence handling, detailed device acquisition techniques, and in-depth examination of digital artifacts for the Android, Apple, and other operating systems. Native and third-party application structures are examined along with the underlying data structures that enable them. Both theoretical and practical aspects will be covered. There is a significant hands-on laboratory component, including comprehensive working knowledge and extensive practical applications with mock crime scenes. Prerequisite: FRSC 525. Pre/Co-requisite: FRSC 530.

**\*FRSC 613 Applied Forensic Digital & Multimedia Analysis (3 credits)**

Semester course; 2 lecture hours and 3 laboratory hours. 3 credits. An advanced study of the methods and techniques of digital forensics, covering topics in computer, mobile, video/image, and audio examination and analysis as applied to forensic casework. Both theoretical and practical aspects will be covered. There is a significant hands-on laboratory component, including comprehensive working knowledge and extensive practical applications with mock crime scenes. Prerequisites: FRSC 610 & FRSC 612.

**FRSC 670. Forensic Evidence and Criminal Procedure (3 credits)**

Semester course; 3 lecture hours. 3 credits. Presents the law of criminal procedure and rules of evidence as applied to forensic science. Explores issues of scientific versus legal burdens of proof, legal terminology and trial procedure.

**FRSC 677. Professional Practices and Expert Testimony (3 credits)**

Semester course; 3 lecture hours. 3 credits. Prerequisite: must have successfully completed a minimum of 18 credit hours in the forensic science master's degree program. Topics related to professional practices in the forensic science field will be covered, including ethics, bias, quality assurance, laboratory management and professional development. Individual and group activities relating to these topics will be completed. Additionally, this course will examine forensic expert testimony in the courtroom, communication of scientific findings to a general audience, trial preparation and cross-examination in moot court format.

**FRSC 5XX-7XX Electives (3 credits)**

## **Appendix D Directed Research Manual**



***FRSC 793: Directed Research in Forensic Science***

***Policies & Procedures***

# **Virginia Commonwealth University**

DEPARTMENT OF FORENSIC SCIENCE



**VCU** *Department of Forensic Science*

**FRSC 793:**

Directed Research in Forensic Science

Policies & Procedures Manual

# ***FRSC 793: Directed Research in Forensic Science***

## ***Policies & Procedures***

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# ***FRSC 793: Directed Research in Forensic Science***

## ***Policies & Procedures***

### **I. Course Description**

Semester course; variable laboratory hours. 1-3 credits.

**Prerequisite:** must have successfully completed a minimum of 18 credit hours in the forensic science master's degree program or have permission of the Program Director and Research Mentor. Students must apply to the Program Director for this directed research experience one semester in advance of enrollment.

A capstone course in which students will conduct independent, original laboratory research in a forensic specialization area of interest, while also gaining practical experience in crime laboratory practices and methods. This laboratory research experience will culminate in a presentation of the project results at a campus seminar and/or professional conference, and a written technical report of publishable quality. A minimum of 300 hours of laboratory research and a minimum of 3 credits are required for graduation.

### **II. General Information**

**Note:** This manual will serve as the course syllabus for FRSC 793. These policies are subject to updates and changes. Students are obligated to meet all requirements as described in the manual effective for the semester of enrollment.

Completion of a Forensic Science Directed Research is required for completion of the MS Degree in Forensic Science at Virginia Commonwealth University. Students should begin planning this experience by the end of the first semester of enrollment in the program.

Students are encouraged to seek research opportunities either on-campus with faculty members or off-campus in accredited forensic laboratories. The Graduate Director and faculty advisers will assist the students with identification of appropriate laboratories and/or research mentors. However, the student is responsible for making initial contact with appropriate laboratory personnel in order to establish the directed research experience.

As a part of the directed research experience, group meetings will be held each semester with the Graduate Director. The purpose of the meetings will be to assist the students with directed research planning, execution, and finalization of the process. In addition, general expectations will be reviewed. Meetings will be announced well in advance and attendance will be mandatory.

**Note:** The requirements described in this manual are the minimal requirements needed to satisfactorily complete this class (FRSC 793). Additional requirements & expectations may be required by the host lab, the research mentor, and/or the DR adviser.

# ***FRSC 793: Directed Research in Forensic Science***

## ***Policies & Procedures***

**Note:** The procedures and policies described in this document shall be followed closely by all enrolled students. Failing to follow all policies or meet all requirements specified in this document, including deadlines, will result in the lowering of the final grade by one letter grade. Enforcement of this policy will be at the discretion of the Graduate Program Director after consultation with the Research Mentor.

Questions regarding these policies should be directed to the Forensic Science Graduate Program Director and/or the VCU Forensic Science Department administrative office. Current contact information can be found on the Department's website at <http://forensicscience.vcu.edu/>.

### **Credits:**

A minimum of three credits of FRSC 793 Directed Research are required; a maximum of 6 credits will be accepted toward the 42 required credits for graduation. Students must achieve an overall GPA of 3.0 ("B") in his/her graduate study at VCU in order to enroll in FRSC 793.

- Transfer credits from other institutions will not be applied towards the required directed research.
- Students may complete FRSC 793 research credits over multiple semesters by enrolling in 1, 1.5, 2, or 3 credits each semester. An initial plan of action should be outlined on the initial paperwork (Request Form).
- Students may register for the number of credits that is deemed appropriate for the work involved during the given semester. Students are encouraged to split FRSC 793 research credits over a minimum of 2 semesters. Students who have completed all associated lab work and are left with only the technical report and oral defense to complete must register for a minimum of 1 credits during the semester of the oral defense.
- If additional credits are desired (beyond what was approved on the initial paperwork), a "[FRSC 793 Request for Additional Credits](#)" form must be submitted and approved.
- Selected FRSC 793 research projects must involve a minimum of 300 hours of supervised laboratory work for 3 credits. This work should encompass an independent research project. If additional credits are requested, another 100 hours of supervised laboratory work is required for each additional credit.

Students must be registered for FRSC 793 credit during the semester in which they are completing the directed research (including lab work, oral defense, and technical report). Further, unless the student is a paid staff member of the host laboratory, all laboratory work must be completed during the semester of enrollment, i.e. laboratory work can begin no sooner than the first day of classes of the semester of enrollment and laboratory work must end by the last day of the exam period for the semester of enrollment.

# ***FRSC 793: Directed Research in Forensic Science***

## ***Policies & Procedures***

### **Liability & Background Checks:**

Directed research completed at forensic laboratories and/or agencies outside of VCU may require extensive application processes, confidentiality agreements, and/or background checks before students can begin working in the laboratory. Drug use policies & policies regarding personal and criminal history vary by agency and may be applied to incoming students. Background investigations for students can be lengthy, often requiring several months to 1 year to complete. Students are responsible for inquiring about these policies, planning ahead appropriately, and following all agency guidelines regarding these issues.

For the FRSC 793 directed research program, pay is not required and is provided entirely at the discretion of the laboratory. Given this, laboratories may consider liability or other legal issues when accepting either paid or unpaid students. All students who are placed in an off- campus non-VCU laboratory for credit (as a degree program requirement) are covered for acts of negligence and general liability under the Commonwealth of Virginia Risk Management Self-Insured coverage. Further, according to US labor laws, laboratories are not required to pay students as long as they are enrolled in a bona fide trainee program such as a university directed research program. For the entire VCU Department of Forensic Science Legal Statement regarding off-campus student research, see **Appendix 2**.

### **III. Enrollment Procedures**

Students are encouraged to begin the directed research search process by the end of their first semester of enrollment in the MS program. The Graduate Director and faculty advisers will assist the student in obtaining contact information for working professionals in laboratories of interest or regions of interest to the student. Students may select current VCU Forensic Science faculty or faculty from another unit as research mentors for on- campus research, or they may contact professionals in operational forensic laboratories to conduct their research off-campus. For off-campus projects, students are encouraged to seek opportunities in accredited forensic laboratories or universities.

Once a directed research opportunity has been established, students should work with prospective mentors to discuss available projects and timelines. The students are encouraged to select the directed research which will best meet their geographical restrictions, timing needs, and the one which will most properly prepare them for a career in their selected specialty area. Projects can include basic or applied research, but all must have a forensic application and must serve to broaden the knowledge base of the specialty area. Once a directed research opportunity has been selected, students can register for credit (during appropriate pre-registration period) and begin the enrollment process outlined below.

After a research mentor and laboratory has been identified, the involved parties should agree on a general topic for the directed research project to be conducted. This should be completed in the semester prior to enrollment in FRSC 793.

# ***FRSC 793: Directed Research in Forensic Science***

## ***Policies & Procedures***

**Note:** Projects selected must have a valid original research component with potential for publication in a peer-reviewed journal. Products of the work should be of publishable quality.

### **On-Campus Research:**

Any VCU faculty member can serve as a research mentor for on-campus research; generally, if the faculty member is in the Forensic Science Department, that faculty member will serve as the Directed Research (DR) adviser as well.

- Research mentors are responsible for supplying laboratory space, supplies, and reagents for the proposed research.
- If the appointment of the Research mentor is in a unit other than Forensic Science, a Forensic Science faculty member must be selected to serve as the DR adviser.

### **Off-Campus Research:**

For off-campus projects, once a research project is established, students should identify and consult with a VCU Forensic Science Department faculty member who can serve as their DR adviser.

- When possible, the faculty member selected as the DR adviser should have an area of expertise that is related to the project.

### **Directed Research (DR) Advisers:**

DR advisers will be responsible for assuring that students follow all University and Department policies and procedures for completing their research through the course of the project.

- DR advisers will assure that the project contains a novel component and has a sound experimental design that follows the scientific method and includes appropriate controls.
- Upon final review and approval of the proposal, DR advisers are responsible for assuring that all content requirements have been met.
- DR advisers will be responsible for assisting the student to develop appropriate timelines for completion of research and development of the technical report and seminar. DR advisers will also facilitate discussions, as needed, with the research mentor and other committee members – this includes planning and leading the final committee meeting.
- DR advisers will be responsible for reporting any committee problems or student issues to the Graduate Director, as necessary.

# ***FRSC 793: Directed Research in Forensic Science***

## ***Policies & Procedures***

### **Committee Selection:**

After selection of host laboratory, research mentor, and DR adviser, students should select additional members for their research committee.

- The committee will be chaired by the DR adviser.
- The committee must include a minimum of three members. The committee must include:
  1. A VCU Forensic Science faculty member.
  2. One additional forensic science professional familiar with the discipline of interest.
  3. The research mentor from the host laboratory.
- At least one of the committee members must be external to the VCU Department of Forensic Science. Full-time faculty, current adjuncts, and affiliate faculty members do not fill this requirement.
- Students may select an optional fourth committee member of their choosing.
- Ph.D. students may serve on the research committee as the fourth committee member.
- Committee members should follow the deadlines given in this document unless alternate deadlines are agreed upon by the full committee, in advance.
- Committee should be approved by the research mentor and DR adviser prior to submission of the request to the Graduate Director.

### **Request Form:**

Students should electronically complete “[FRSC 793: Directed Research in Forensic Science Request Form](#)”. The request form must be completed electronically and be on file with the Graduate Director on the last day of classes in the semester preceding desired enrollment.

- All projects and Request Forms must meet the requirements detailed herein and be approved by the Graduate Director.
- Directed Research Request Forms for students wishing to enroll in summer or fall FRSC 793 are due one week prior to the end of classes in the preceding spring semester.
- Directed Research Request Forms for students wishing to enroll in spring FRSC 793 are due one week prior to the end of classes in the preceding fall semester.
- Directed Research requests not submitted by the stated deadlines will be denied and the student will be administratively dropped from the course the following Monday.
- Directed Research projects completed at VA-DFS laboratories must be approved by the VA-DFS Director of Technical Services.

**Note:** Research to be completed at off-campus agencies outside of VCU may require lengthy application processes and/or background checks before students can begin working in the laboratory. Students are responsible for inquiring about these policies, planning accordingly, and following all agency guidelines regarding these issues.

# ***FRSC 793: Directed Research in Forensic Science***

## ***Policies & Procedures***

### **Proposal:**

By the end of the third week of the semester in which the student is initially enrolled for the FRSC 793 Directed research (fall, summer, or spring), a proposal must be submitted to the Graduate Director for approval.

- Students should work with the Research mentor, DR adviser, and other committee members to obtain their signature approval of the proposal prior to submitting it to the Graduate Director.
- Students who fail to meet this deadline will be administratively dropped from the course the following Monday, or have their grade administratively adjusted by the Graduate Director.

The proposal should be of appropriate length to justify number of credits to be earned and to adequately reflect the depth and nature of the project. The proposal must be in text format with numbered pages, using 12 point font and 1" margins, and free of spelling and grammatical errors. Proposals should detail the work in which the student will be engaged.

Proposals should include each of the following components (section headers should be used for #2-7 below):

1. A proposal title page that includes the students name, semester of enrollment, title of the proposed project, date of submission, host laboratory, and signature lines alongside the names & titles of the research mentor, DR adviser, and other committee member(s).
2. An introduction, providing overview and relevant background information. Historical and other original work relevant to the project should be appropriately cited.
3. Specific goals and objectives of the proposed work
4. A description of the experimental design for the proposed project, including (at minimum): number and origin of samples, number of replicates, general methodology and instrumentation to be used, experiment design and experimental measures to be used, and data analysis approach. Note: This section should be in paragraph formatted text. Bulleted lists are not appropriate and will not be accepted.
5. A short paragraph describing the impact of this work. This should include the significance of the research and/or how your work could impact or advance the field as well as the laboratory hosting the directed research.
6. A week-by-week time table for the conduct and completion of the work. This time table can be in bulleted or table format and should encompass a minimum of 15 weeks for a fall or spring semesters or 12 weeks for a summer session. The time table should reflect the proposed plan of action submitted/approved in the request form.
7. Appropriate references should be used throughout the proposal and all citations should be indexed at the end of the proposal.



# ***FRSC 793: Directed Research in Forensic Science***

## ***Policies & Procedures***

### **Proposal submission:**

- Committee members should review the proposal and sign the proposal (indicating they have received and reviewed) prior to submission to the Graduate Director. Signature lines should be on the title page and should also include the date and printed name of the individual signing.
- DR advisers must thoroughly review the proposal to assure that the format and contents meet all requirements outlined above, including the details listed above in components 1-7.
- Students are responsible for electronically submitting the signed copy of the proposal to the Graduate Director for final approval. Students may either obtain physical signatures or use DocuSign for obtaining signatures. Proposals not meeting the stated minimum requirements will be returned to the student for revisions which must be submitted within one week from notification; research project proposals will not be formally approved until all requirements are met.
- Students who do not meet the proposal requirements within the given deadline will be retroactively dropped from the course.

### **Degree Candidacy:**

The VCU Degree Candidacy form is required by the Graduate school. All students who have completed 21 credits and have moved beyond the proposal stage of the final research project must submit this form to the Graduate School to be eligible for graduation. Once this form has been submitted, the student becomes a “Candidate” for the MS degree in Forensic Science.

- The [instructions and document can be found here](#). Students should use the ‘DocuSign’ version of the Degree Candidacy Form.
- If using animal or human subjects, the student must include the approval number.
- For this form, the student should add the points of contact as follows:
  - Major Adviser – DR adviser
  - Graduate Director
  - Dean: [chsgraddean@vcu.edu](mailto:chsgraddean@vcu.edu)
- The form will be signed electronically by all parties and be returned to the student when complete.

# ***FRSC 793: Directed Research in Forensic Science***

## ***Policies & Procedures***

### **IV. DIRECTED RESEARCH REQUIREMENTS**

The following items will be required of each student to successfully complete the FRSC 793 Directed Research in Forensic Science.

**Note:** Some off-campus host laboratory agencies and private companies require a lengthy review and formal approval of presentations and reports that are based on data acquired at that agency or laboratory. In those agencies/companies, this is generally required prior to that data being discussed or presented. Students should inquire about and carefully follow all agency/company guidelines regarding these issues.

#### **Committee Meeting**

Students are required to meet (as a group) with their committee members at least once during the period of enrollment.

- This committee meeting should be held at or around the halfway point of the proposed laboratory work.
- The purpose of this meeting will be to update the committee on progress of proposed project, ask questions, seek advice, address concerns, and provide a time table for completion of project, technical report, and oral defense.
- Planning, organization, and conduct of this meeting shall be the burden of the student.
- Individual meetings with committee members are encouraged but will not suffice for this required group, committee meeting. Video- and/or teleconferencing may be used when face-to-face meetings are not possible.
- This meeting should be documented on the "[FRSC 793 Committee Meeting](#)" form, to be initiated by the student and signed by their DR Adviser.

#### **Laboratory Performance Evaluation**

At the conclusion of **EACH** semester of enrollment that includes laboratory work, the in-lab research mentor must complete a "[FRSC 793 Directed Research Laboratory Performance Evaluation](#)". This form must be completed by the last day of classes for each semester that the student is working in the laboratory. If laboratory work is divided over multiple semesters, a separate laboratory performance evaluation form will be submitted for each. The Graduate Director sends this form out to research mentors and manages submissions.

# ***FRSC 793: Directed Research in Forensic Science***

## ***Policies & Procedures***

### **Written Technical Report (Thesis)**

The Directed Research project will culminate in a final, written technical report, or thesis. Students will be strongly encouraged to publish the results of their research.

Unless otherwise agreed upon by the committee, a complete, near final draft of the written report must be submitted to all committee members no later than four calendar weeks prior to the scheduled student oral defense.

- During this four week period, the student is required to work with the committee members to make recommended changes/edits to the paper.
- The format and contents of the written report should follow the style of a journal manuscript. The committee should be informed which journal format is being followed.

The final report (with edits completed) must be submitted to the committee no later than 48 hours prior to defense date. Failure to submit on time will result in rescheduling of the oral defense. The final report submitted at that time will be used to assess a final grade for this portion of the students directed research experience.

- Students should also distribute the “[FRSC 793 Written Technical Report Evaluation Form](#)” with the final report to each committee member.
- Students will collect and compile all evaluation forms and submit electronically (along with the thesis and slides from the oral defense) to the Graduate Director through the [Google file upload form](#), no later than the last day of classes in the final semester of enrollment.
- The student will also upload the report to VCU Scholar’s Compass [to this linked location](#) (not through the ETD process).

The report should be of appropriate length to justify number of credits earned and to adequately reflect the depth and nature of the project. Note: Assessment of the final report will be based on the quality of its contents and not its length. The report should be in text format with numbered pages, double-spaced (except where noted below), using 12 point font and 1” margins, free of spelling and grammatical errors, and should detail the work performed, resulting data, and relevant conclusions.

At minimum, the written technical report should include each of the following components:

1. Copyright statement
2. A title page that includes only the student name, semester(s) of enrollment, title of the proposed project, date of submission, host laboratory, and name of the research mentor.
3. Acknowledgements recognizing those individuals who participated in the work, helped guide the student, or those who otherwise impacted the student during the course of the project.
4. Abstract not exceeding 400 words. Abstracts should be single-spaced and submitted on a separate page, just after the title page. Proper abstracts include a summary of the entire paper, including all of its components.

## ***FRSC 793: Directed Research in Forensic Science***

### ***Policies & Procedures***

5. Introduction providing overview and relevant background information. Historical and other original work relevant to the project should be appropriately cited.
6. Research materials & methods section describing in detail the procedures and techniques used, including: number and origin of samples, number of replicates, exact methodology and instrumentation used for each analytical procedure, experimental measures recorded, procedures for data/statistical analysis, and study design. Note: This section should be in paragraph formatted text. Bulleted lists are not appropriate and will not be accepted.
7. Research results & discussion section detailing the results of the work. This should include reference to data that is displayed in the form of figures, charts, and tables. Results sections should describe overall results and/or trends observed with discussion, where appropriate. Detail on individual sample data collected should generally be avoided. Note: Data that includes quantitative measures should be accompanied by appropriate statistical analyses.
8. Conclusion section detailing the conclusions of the research, how the work will impact the field, and future directions of the research.
9. References (literature cited). Appropriate references should be used throughout the proposal and all citations should be indexed at the end of the proposal. The majority of references for a scientific technical report should be primary references (i.e. Citations should cite journal articles that contain original work). Websites, manuals, and text book references are acceptable, but their use should be limited and should not supplant a primary reference.
10. Critical data should be displayed in figures, charts, or tables. Each should be displayed on a separate page and attached at the end sequentially (in the order of reference) at the end of the paper. Figures and charts should include figure legends.
11. Vita - a brief biographical sketch of the student, giving education (institutions attended), degrees and honors, accomplishments, the titles of publications, teaching or professional experiences and any other relevant data.
12. Appendices (if necessary and in consultation with your research mentor)

#### **Oral Defense**

In addition to the final written report, each student must present their research findings at a campus seminar. This seminar will be in the style of a traditional “defense” and will include an open Q&A session as well as a closed Q&A session with the committee, followed by a final assessment by the committee.

General requirements for the oral defense will include:

- The seminar presentation should be a minimum of 45 minutes in length. A minimum of an additional 10-15 minutes should be allowed for the open question period.
  - Students are encouraged to review and practice their presentation with their research mentor, DR adviser, and/or peers prior to the date of the seminar.

## ***FRSC 793: Directed Research in Forensic Science***

### ***Policies & Procedures***

- Students are encouraged to present their research at a professional meeting whenever possible. However, committee evaluations must be based on the campus seminar/oral defense.
- Students should meet with and/or communicate directly with each committee member for an update on the project prior to scheduling a Defense date. This can be done as a group, or individually. All committee members should agree that a satisfactory amount of progress has been made prior to scheduling the defense.
- This seminar may be completed in the FRSC 570 Forensic Science Seminar Series depending upon scheduling and availability. If no FRSC 570 slots are available, students are to make arrangements for a seminar through the Departmental administrative assistant, the FRSC 570 Instructor and/or their DR adviser.
  - All students registered for FRSC 793 will be contacted by the FRSC 570 Instructor to schedule seminars. Students planning to complete their oral defense in the upcoming semester should respond promptly to requests for information. Delays in this response may result in the failure to secure a date in the Department's seminar series or removal from the schedule.
  - The Forensic Science Department runs the seminar series during only fall and spring semesters. Thus, oral defenses should not be planned for summer sessions. Exceptions to this will be rare and only granted upon approval by the Graduate Director.
- All seminars should be open to the public and university community. Announcements of all student seminars should be broadly distributed to all Forensic Science faculty, graduate students, staff, VA-DFS staff, and to external forensic science professionals in the local or regional community.
- All committee members must be present for evaluation of the seminar or available via videoconferencing. Every attempt should be made to select a date, time, and location for the defense that works for ALL committee members. If this scenario is not possible, the seminar may be recorded for viewing/evaluation of the seminar at a later date. The video is a last resort. Only defense presentations that are missing a committee member should be recorded. If a student needs their defense recorded, it is the student's responsibility to clear this with their DR adviser, the Seminar Instructor and the Graduate Director. A TA should be contacted to conduct the recording.
- Students should distribute the "[FRSC 793 Oral Defense Evaluation](#)" form as well as a hardcopy of the seminar slides to all committee members at the beginning of the seminar.
- Completed evaluations can be submitted directly to the DR adviser at the conclusion of the oral defense. DR advisers should compile all evaluation forms and submit electronically to the Graduate Director, cc-ing the student, no later than the last day of classes in the final semester of enrollment
- Students should assure that a final copy of the seminar slides (6/page) are submitted electronically (pdf format) to the Graduate Director no later than the last day of classes in the final semester of enrollment.

# ***FRSC 793: Directed Research in Forensic Science***

## ***Policies & Procedures***

- Defense presentations are formal and should be approached in that manner. As such, speaker introductions should include the following:
  - Name and hometown of the speaker
  - Academic background (prior degrees and current degree/ track in- progress)
  - Highlights of appropriate prior experiences and/ or credentials relevant to science
  - (Optional) ONE interesting fact – note this is optional and is secondary to the appropriate formal introductions. This should not constitute the bulk of the introduction.

### **Final Committee Meeting**

A final research committee meeting will be required for completion of the FRSC 793 directed research experience. Each committee will be strongly encouraged to meet immediately following the student's seminar to complete the requirements of the oral defense (see below). Alternatively, this meeting can be scheduled for another date soon after the seminar. Individual meetings with committee members will not suffice for this required final group committee meeting. If a face-to-face meeting is not possible, the meeting can be facilitated using videoconferencing and/or phone conferencing. This meeting should be led by the DR adviser.

This meeting should be documented on the [FRSC 793 Final Committee Meeting & Grade](#) form. This form must be initiated by the student and should be signed by the DR adviser by the last day of classes in which the student defended their work.

The following tasks should be addressed during the final committee meeting:

- Private question & answer period. Any additional questions that were not addressed at the seminar can be presented directly to the student. This can include both detailed questions about the project as well theoretical questions covering a broader range of related topics within the discipline.
- Closed-door discussion of student's overall performance. During this portion of the meeting, the student should be asked to leave the meeting. At this time, the committee should discuss any information pertinent to the evaluation of the student including their overall laboratory performance, writing skills, and/or presentation skills. Committee members should work to finalize the oral defense evaluation forms. Report and oral defense forms can be immediately submitted to the DR adviser. The committee may choose to discuss the final grade at this time.
- Review of evaluations with student. Led by the mentor, committee members should discuss candidly with the student both positive and negative feedback regarding their performance through the course of the directed research experience.
- Development of timetable (if necessary). If all report and oral defense evaluations are not completed by this meeting, the committee members should agree upon the date by which those forms will be due to the DR adviser. All forms will be needed for review by the DR adviser before a final grade can be documented.

# ***FRSC 793: Directed Research in Forensic Science***

## ***Policies & Procedures***

Graduate research mentors and DR advisers will be encouraged to report any student discrepancies to the Graduate Director.

### **V. FINALIZATION OF DIRECTED RESEARCH**

#### **Documents**

Laboratory performance evaluation forms must be completed by the research mentor (only) for each semester of enrollment that includes laboratory work, no later than the last day of classes during each semester of enrollment.

Additionally, the following items must be submitted to the Graduate Director by the last day of classes in the final semester of enrollment:

- [Mid-semester committee meeting documentation](#)
- [Final committee meeting and grade documentation](#)
- [Thesis Approval & Upload verification](#)

Through the FRSC 793 Document [Google Upload Form](#) (Only electronic PDF copies will be accepted):

- Final technical report (to Google Upload Form AND uploaded to [Scholar's Compass](#))
- Oral defense presentation, 6 slides/page
- All technical report & oral defense evaluation forms (one from each committee member)

It is the responsibility of the student to collate, upload and meet the stated deadlines, distribute appropriate materials to the committee members, obtain appropriate signatures, and to assure that all materials have been received by the Graduate Director by the stated deadlines.

#### **Grading**

The Graduate Director will confer all final grades for FRSC 793 Directed Research in Forensic Science credits. The Graduate Director will determine a final grade based on: the grade recommended by the in-lab research mentor (for semesters that include laboratory work), the grade recommended by the DR adviser, and an independent review of the evaluations and students internal FRSC 793 Directed Research file.

Grades (A/B/C/D/F) will be weighted as follows:

- If the enrolled semester includes only laboratory work, the grade for that semester will be determined by an evaluation of the laboratory performance. Students must be enrolled for 1-3 credits.
- If the enrolled semester includes only completion of the technical written report and the oral defense, the grade for that semester will be determined by evaluations of the written technical report and oral defense (equal consideration). Students must be enrolled for at least 1 credit.

## ***FRSC 793: Directed Research in Forensic Science***

### ***Policies & Procedures***

- If the enrolled semester includes both laboratory work and completion of the technical written report and oral defense, the grade for that semester will be determined by an evaluation of the laboratory performance and by evaluations of the report and oral defense. Students should be registered for more than 1.5 credits; evaluations will be weighted to assure that the report and oral defense evaluations constitute the grade for 1.5 credits of the total registered credits.

After all final documents are submitted, the Graduate Director will review the entire student FRSC 793 Directed Research file, including a careful review of the evaluation forms and DR adviser grade recommendations. Materials that do not meet the minimum requirements outlined in this manual will be returned to the student for revisions. When all documents are received and determined to meet all associated requirements, a final grade for the last semester of enrollment will be issued.

As described in the policy stated on page 3, the Graduate Director retains the right to lower the final grade assigned by the research mentor and/or DR adviser for students who do not follow the policies detailed in this document.



# ***FRSC 793: Directed Research in Forensic Science***

## ***Policies & Procedures***

### **Appendix 1: Required Document Links & Locations**

#### **FRSC 792: Research Techniques**

[Performance Evaluation Form](#) (Your Research Mentor will fill out - Google Survey)

#### **FRSC 793: Directed Research**

##### **Initial Semester:**

[Directed Research Request Form](#) (DocuSign)

##### **Every Semester:**

[Semester Lab Performance Evaluation](#) (Your Research Mentor will fill out - Google Survey)

##### **Mid-Research:**

[Committee Meeting Documentation](#) (Google Form)

[Request for Additional Credits](#) (Google Form)

##### **Final Semester:**

[Final committee meeting and grade documentation](#) (DocuSign)

[Oral Defense Evaluation Form](#) (PDF)

[Technical Report Evaluation Form](#) (PDF)

[Thesis Approval and Upload Verification](#) (DocuSign)

[Thesis Upload to Scholar's Compass](#)

[Document Submission Form](#) (Google Form - only upload when you have all documents (thesis, oral defense, and oral/technical report evaluation forms) ready for upload)

# **FRSC 793: Directed Research in Forensic Science**

## **Policies & Procedures**

### **APPENDIX 2: VCU Department of Forensic Science**

#### **Statement of Legal Policy: Student Internships/Directed Research & Independent Studies**

Virginia Commonwealth University sends many students out each year to perform "field" work for academic credit. Many academics feel that these experiences are critical to the learning process, providing engaging, real-life, hands-on experience for the students. In Forensic Science, this type of immersion experience also provides networking opportunities and contacts for students, which are often crucial for future career development. The VCU Forensic Science Graduate Program Directed Research program is a required, 300 hour, 3 credit (minimum) experience. Additionally, Graduate students have the option of enrolling in independent studies as elective credit. At the Undergraduate level, internships and independent studies are both elective opportunities, with varying credits and associated hourly obligations. For either program, student pay is not required and is provided entirely at the discretion of the laboratory.

There are two legitimate legal issues for laboratories to consider when accepting either paid or unpaid students: liability and pay (Fair Labor laws).

#### Liability

Students who are placed in an off-campus NON-VCU laboratory pursuant to a course and/or a degree program requirement are covered for acts of negligence and general liability under the Commonwealth of Virginia Risk Management Self-Insured coverage. If there is an incident where liability is at-issue, the affected laboratory should immediately contact either the Program Director or the Department Chairperson so that the process can be initiated with the VCU Real Estate and Insurance Services Department.

#### Pay

Students participating in **unpaid** field work are required to earn academic credit due to federal employment laws and liability issues. The U.S. Department of Labor's Fair Labor Standards Act states that all workers must earn a minimum wage for work performed **OR** be enrolled in a bona fide trainee program such as a university Internship or research program. As a general rule, only non-profit public service, charitable, religious, and/or humanitarian organizations are eligible to accept "volunteers".

Both of these aspects (liability and pay) require that the student be registered for credit in a course that is required or otherwise fulfilling a degree requirement.

We (the Department of Forensic Science) do not support or approve **unpaid** student field work unless students are actually fulfilling a requirement and enrolled *for credit*. In order to assure all parties that registration is required and that the experience is fulfilling a degree requirement, we have both the laboratory representative (research mentor), the student, and the Program Director sign a form indicating when and how much credit will be earned. Further, we actively caution laboratories against accepting unpaid student volunteers that are not receiving academic credit for their work.

All of this information has been generated with the assistance of the VCU Office of General Counsel.

Inquiries regarding this policy can be addressed to:

Virginia Commonwealth University  
Department of Forensic Science 1015 Floyd Ave.  
Box 843079  
Richmond VA 23284  
[fos@vcu.edu](mailto:fos@vcu.edu)

**Appendix E for Abbreviated Curriculum Vitae of Faculty**

## Appendix F - Abbreviated CVs for Faculty

### Department of Forensic Science

#### *Existing*

Mason L. Byrd, J.D., 2002, University of Richmond, Master's in Public Administration, 2002, Virginia Commonwealth University, Adjunct Instructor, Area of expertise: Expert testimony & criminal law procedures

Victoria Parks, M.S. in Forensic Science, 2008, Virginia Commonwealth University, Adjunct Instructor, Area of expertise: Forensic molecular biology & seminar development

Michelle Peace, Ph.D. in Pathology, 2005, Virginia Commonwealth University, Professor, Area of expertise: Forensic laboratory management & analytical toxicology

Maureen Riordan, J.D., 1985, St. Mary's University, Adjunct Instructor, Area of expertise: Public interest and criminal law

Karen Lynne Shafer, M.S. in Forensic Studies (concentration in Computer Forensics), 2014, Stevenson University, Adjunct Instructor, Area of expertise: File systems & data structure forensics

Patrick Siewert, B.S. in Criminal Justice, 1999, Virginia Commonwealth University, Adjunct Instructor, Area of expertise: Digital & multimedia forensics and eDiscovery

Steve Stockman, Master's in Public Administration, 1998, Troy University, Assistant Professor, Area of expertise: Crime scene investigation & law enforcement training

#### *Potential Hires*

Nelson Eby, M.A. in Computer Fraud Investigation, 2003, The George Washington University, Position TBD, Area of expertise: Computer crimes investigation & digital mobile device analysis

Patrick Eller, M.S. in Digital Forensics/Cyber Investigations, 2015, University of Maryland, Position TBD, Area of expertise: Computer crimes investigation & digital mobile device analysis

John B. Hirt, B.S. in Science, 2011, Florida State University, Position TBD, Area of expertise: Digital evidence methodology & programming

Jesse M. Lindmar, B.S. in Computer Science, 1999, Fairleigh Dickinson University, Position TBD, Area of expertise: Mobile & IoT device forensic analysis, computer & storage device forensics

Patricia Mullaney, B.S. in Biology, 2002, Texas A&M University, Position TBD, Area of expertise: General digital evidence analysis & video examinations

Nicole R. Odum, M.S. in Forensic Science (concentration in Digital Forensics), 2019, Marshall University, Position TBD, Area of expertise: Digital & multimedia hardware forensics and advanced acquisition, cloud forensics

## **Appendix F Letters of Support (Specific Demand)**



August 9, 2023

Tracey Dawson Green, Ph.D  
Professor and Chair  
Dept. of Forensic Science  
1015 Floyd Avenue  
PO Box 843079  
Richmond, VA 23284

RE: Digital Forensic Degree (M.S.)

Dear Dr. Green:

The Federal Bureau of Investigation has offices in all 50 states, U.S. territories and Legats around the world. Digital evidence plays a role in 99% of all law enforcement investigations, as well as counterintelligence. Due to the prevalence of digital evidence, the FBI has approximately 500 Digital Forensic Examiners located directly in each primary office, as well as in Regional Computer Forensic Laboratories (RCFLs). The FBI has other digital forensic personnel including Computer Scientists, Digital Forensic Specialists and Special Agents who have been trained in digital forensics. In Virginia, the FBI has digital forensic personnel spread throughout the commonwealth in Richmond, Bristol, Charlottesville, Roanoke, Winchester, Chesapeake, Quantico, Manassas, and Norfolk. These personnel provide incident response and laboratory examinations of digital evidence not just to FBI investigations, but in support of other federal, state, and local law enforcement and regularly work with the Virginia State Police and the Virginia Department of Forensic Science.

Currently, there is no M.S. program in digital forensics offered at any VA university and few options at any U.S. universities. While many offer masters in cyber security, digital forensics is a separate and distinct specialty and requires a distinct curriculum, which many current DFEs are looking for to meet the requirements of an FBI Senior and/or Master DFE certifications, which are requirements for higher grades. The master's curriculum also offers an education that would meet the requirements to be hired as an FBI DFE and enable current DFEs to pursue a higher level degree in their field. I personally had to go to a Maryland university to complete my masters and would have preferred a Virginia school close to home.

Sincerely,

Karen Lynne Shafer

*Master Digital Forensic Examiner - Training Program Coordinator*  
CFCE / GCFE  
**Digital Evidence Staffing, Education and Development Unit**  
FBI - OTD (Richmond, VA)  
Mobile: 804-543-7908  
Desk: 804-627-4748  
[klshafer@fbi.gov](mailto:klshafer@fbi.gov)





# COMMONWEALTH of VIRGINIA

## DEPARTMENT OF FORENSIC SCIENCE

OFFICE OF THE DIRECTOR  
A Nationally Accredited Laboratory

700 NORTH 5TH ST.  
RICHMOND, VIRGINIA 23219  
(804) 786-2281 FAX (804) 786-6857

August 15, 2023

Tracey Dawson Green, Ph.D.  
Dept. of Forensic Science  
Harris Hall, 2nd Floor, Rm. 2013  
1015 Floyd Avenue  
PO Box 843079  
Richmond, VA 23284

Dr. Dawson Green,

I am writing this letter in support of the creation of a Master of Science degree in Digital Forensics & Incidence Response (DFIR) at Virginia Commonwealth University.

The Department of Forensic Science (DFS) is a nationally accredited forensic laboratory system that employs six Forensic Scientists in its Digital & Multimedia Evidence (DME) Section.

The mission of DFS is to provide laboratory services in criminal matters in the Commonwealth of Virginia, support the criminal justice system with quality and timely services, and advance the understanding of forensic science in order to promote public safety. DFS supports law enforcement and the criminal justice system by performing impartial forensic analyses of crime scene evidence and by presenting the results of those analyses through reports, consultations, and expert witness testimony in courts of law.

DME examiners analyze electronic information stored on computer, mobile and digital storage devices to identify and/or recover existing, deleted and/or fragmented data, electronic communications, and user activity or usage patterns. Analog or digital video recordings are examined, repaired and clarified to improve appearance.

The minimum qualifications for DME examiners at DFS include a Baccalaureate degree in a computer science, forensic science, natural science, information technology, or closely related field and experience working in a laboratory, using basic laboratory equipment and scientific instrumentation. Certification by an international digital/multimedia association is preferred.

Forensic laboratories across the country hire graduates from universities and train them in-house to meet their internal requirements and ensure that they have the necessary expertise to work independently and provide expert testimony in courts of law. The training program at DFS is typical, generally requires 12 months for completion, and culminates in a three-part competency test, including a practical test, oral technical examination, and formal mock trial.

**Based on a review of the curriculum for the proposed DFIR MS degree, graduates should be very competitive in the hiring process for trainees in the DFS DME section, if the courses focus on practical knowledge and hand-on experiences.** Having graduates with these knowledge, skills, and abilities should shorten the training period once hired, which would be extremely beneficial. In addition, our laboratory uses a salary plan that rewards Forensic Scientists for credentials and activities that broaden their experience and professional stature, which includes earning an advanced degree.

Two of the most important features of this new degree program are the hand-on experience that will be gained through courses with a computer lab component, coupled with the forensic science and law courses that will clarify the environment in which the work will be performed.

A practical DFIR MS degree will allow for students with varied undergraduate backgrounds to focus on Digital Evidence examination as a career with coursework focused on the application of computer science to Digital Evidence investigations within the criminal justice system.

With six Forensic Scientists, our laboratory system only has a small DME section. However, most law enforcement agencies across the Commonwealth perform these functions in-house, which will significantly broaden the scope of opportunities for future graduates of the MS DFIR program at VCU.

Please let me know if you have any further questions.

Sincerely,



Linda C. Jackson  
Director





# *Culpeper County Sheriff's Office*

Scott H. Jenkins, Sheriff



14023 PUBLIC SAFETY COURT CULPEPER, VA 22701  
OFFICE: 540-727-7520 FAX: 540-727-3466 JAIL: 540-727-3434 RECORDS: 540-727-3400

11 August 2023

Tracey Dawson Green, Ph.D.  
Professor & Chair, Department of Forensic Science  
Virginia Commonwealth University  
PO Box 843079  
Richmond, Virginia 23284

Dr. Green,

Culpeper County Sheriff's Office (CCSO) provides law enforcement services - including patrol, investigations, jail, court security, records, civil process, and school resource services - to a community of about 53,000 residents. CCSO's mission is to protect and serve the citizens of Culpeper County while upholding the United States Constitution and the laws of the Commonwealth of Virginia. We discharge our duties while maintaining professional standards and integrity in public service.

The Criminal Investigations Division (CID) is responsible for investigating violent and serious felonies and serious misdemeanor cases. CID has 15 personnel assigned to the Division, including General, Narcotics, and Cold Case Detectives and Crime Analysts, and digital and multimedia evidence (DME) plays a primary or secondary role in most of the cases assigned to them. CCSO's membership in Northern Virginia - Washington, DC Internet Crimes Against Children Task Force, Blue Ridge Narcotics and Gang Task Force, and Drug Enforcement Agency Task Force Program generates additional DME. As of 8 August 2023, the average case turnaround time for DME submitted to Virginia's Department of Forensic Science was 98 days - too long for victims of child pornography and human trafficking, to name but two. CCSO has a digital forensics laboratory, where certified Detectives examine and analyze digital evidence, thereby decreasing the Commonwealth's caseload and wait times for other agencies.

As the lead digital forensics examiner-analyst here who selects applicants for the specialty, I can say from experience that an applicant who obtains VCU's proposed two-year Master of Science (MS) degree in Digital Forensics and Incident Response (DFIR) demonstrates a vested interest in the work that one cannot predict before selecting a Deputy to send to a short course to obtain the certification and then putting him/her/them to work. Furthermore, VCU's proposed MS DFIR curriculum will prepare its graduates to be experts in their field: problem-solvers capable of modifying extraction methods presented broadly in their coursework to individual devices and ever-changing technology who can explain advanced concepts to mentees, judges, and juries.

As the nature of law-breaking has changed, not only in Culpeper County but around the country, Sheriff Jenkins has made decisions designed to stay ahead of such change. We think an MS in DFIR degree program is needed at this time, and we believe the proposed MS degree in DFIR will produce prepared, well-educated graduates who will be capable of addressing the needs of the field.

Very Respectfully,

A handwritten signature in cursive script that reads "Angela Deavers".

Detective Angela D. Deavers, CCO, CCPA, VSIC

## **Appendix G Employment Demand (Job Announcements)**



## Sr. Cybersecurity Analyst - Digital Forensics

Ashburn, VA

Full-time

### Company Description

Visa is a world leader in digital payments, facilitating more than 215 billion payments transactions between consumers, merchants, financial institutions and government entities across more than 200 countries and territories each year. Our mission is to connect the world through the most innovative, convenient, reliable and secure payments network, enabling individuals, businesses and economies to thrive.

When you join Visa, you join a culture of purpose and belonging – where your growth is priority, your identity is embraced, and the work you do matters. We believe that economies that include everyone everywhere, uplift everyone everywhere. Your work will have a direct impact on billions of people around the world – helping unlock financial access to enable the future of money movement.

**Join Visa: A Network Working for Everyone.**

### Job Description

Visa is looking for a Digital Forensic Analyst to join our team. The role of Digital Forensic Analyst is a key role in the Cyber Defense team. You will be working as part of a small team supporting the DFIR & eDiscovery Manager and the wider organization across a number of different areas including internal investigations and litigation support. You will be responsible for reporting to key internal stakeholders, including Legal and Human Resources on a diverse range of issues.

In order to be successful in this role you will be naturally inquisitive with a proven investigative background. You will be a committed problem solver and able to work independently to achieve the desired goals in an agreed time frame.

The successful candidate will be able to carry a large caseload and be able to prioritize tasks to ensure that critical deadlines are met in order to minimize reputational damage to the organization. You will also present a professional, capable and approachable demeanor to others to ensure that all engagements with both internal and external stakeholders reflect positively on yourself, the Cyber Defense team and Visa.

## Essential Functions

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- Independently and while operating in a geographically and culturally diverse peer group
- Privately Collaboratively Identify the needs of the referrer and design a strategy to meet those needs
- Identify, seize, and preserve data from existing systems in a forensically sound manner
  - Analyze seized data to meet the strategic needs of the investigation whilst maintaining an open mind as to the eventual outcome
  - Report findings both verbally and in writing in a manner appropriate to the knowledge and experience of the audience
  - Advise, where appropriate, in order to ensure that normal business processes comply with current best practice
  - Coordinate investigation and mitigation strategies with other internal teams within Visa globally such as Legal, HR, Compliance, and Enterprise Risk
  - Contribute to tool optimization and automation initiatives to streamline analysis and response workflows and processes
  - Document playbooks and standard operating procedures to improve processes and information sharing across teams
  - Ensure metrics are complete and accurate and findings are documented in case management system
  - Respond to request for ad-hoc reporting and research topics from management as required
  - Maintain confidentiality, always using discretion and sound judgment

*This is a hybrid position. Hybrid employees can alternate time between both remote and office. Employees in hybrid roles are expected to work from the office 2-3 set days a week (determined by leadership/site), with a general guidepost of being in the office 50% or more of the time based on business needs.*

## Qualifications

### Basic Qualifications

- 5+ years of relevant work experience with a Bachelor's Degree or at least 2 years of work experience with an Advanced degree (e.g. Masters, MBA, JD, MD) or 0 years of work experience with a PhD, OR 8+ years of relevant work experience.

### Preferred Qualifications:

- Possess a degree in Forensic Computing, Computer Science or similar discipline or be able to evidence equivalent industry training
- Be experienced in the use of industry standard forensic software tools.
- Be able to demonstrate a thorough understanding of Forensic principles, particularly in relation to data integrity
- Be an experienced investigator with a background in either law enforcement or a large corporate entity
- Be an excellent communicator able to deal effectively with both internal and external stakeholders and capable of presenting technical information to a non-technical audience
- Be organized and able to manage time and prioritize tasks effectively
- Be able to work as part of a small team supporting other team members as required and capable of working with minimal supervision
- Be a problem solver
- Have a recognized Digital Forensic certification: ENCE, CFCE, ACE etc.

- Have experience of the legal system, either Criminal or Civil, and have given evidence before a Court or Tribunal
- Have experience of using EnCase or a similar forensic tool deployed across an Enterprise environment
- Have some scripting, coding or programming knowledge relevant to the role: PERL, Python, VBA, SQL etc.
- Have some experience of e-Discovery including knowledge of industry standard e-Discovery tools and the EDRM
- Have experience of working with PCI DSS
- Candidate will exhibit a history of reliability and strong decision-making skills
- Ability to react with appropriate urgency to situations and requests

### **Additional Information**

**Work Hours:** Varies upon the needs of the department.

**Travel Requirements:** This position requires travel 5-10% of the time.

**Mental/Physical Requirements:** This position will be performed in an office setting. The position will require the incumbent to sit and stand at a desk, communicate in person and by telephone, frequently operate standard office equipment, such as telephones and computers.

Visa is an EEO Employer. Qualified applicants will receive consideration for employment without regard to race, color, religion, sex, national origin, sexual orientation, gender identity, disability or protected veteran status. Visa will also consider for employment qualified applicants with criminal histories in a manner consistent with EEOC guidelines and applicable local law.

Visa will consider for employment qualified applicants with criminal histories in a manner consistent with applicable local law, including the requirements of Article 49 of the San Francisco Police Code.

**U.S. APPLICANTS ONLY: The estimated salary range for a new hire into this position is 117,700.00 to 153,000.00 USD, which may include potential sales incentive payments (if applicable). Salary may vary depending on job-related factors which may include knowledge, skills, experience, and location. In addition, this position may be eligible for bonus and equity. Visa has a comprehensive benefits package for which this position may be eligible that includes Medical, Dental, Vision, 401 (k), FSA/HSA, Life Insurance, Paid Time Off, and Wellness Program.**

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# Digital Forensic Analyst

 Deloitte

**Location:** Quantico, Virginia

**Type:** Full-Time, Non-Remote

Posted on: April 11, 2023

This job is no longer available from the source.

Digital Forensic Analyst

Deloitte

11,518 reviews

Quantico, VA

Full-time

Deloitte

11,518 reviews

Read what people are saying about working here.

Job details

Job Type

Full-time

Indeed's salary guide • Not provided by employer

• \$71.5K - \$90.6K a year is Indeed's estimated salary for this role in Quantico, VA.

**Full Job Description** In today's environment our clients' abilities to respond to requests for information are more important than ever - and through people, processes, tools, and technology, we help them do so. Are you excited about exploring innovative ways to visualize data, use analytics, and help clients find relevant information in an ever-growing sea of emails and electronic documents? Do you have a legal or technology background and want to continue to grow your skills and abilities? We are a practice that brings together teams focusing on thought diversity, collaborative problem solving, and development of our professionals to enable our Government and Public Services (GPS) Discovery & Data Management Practice clients face litigation and

other regulatory requirements with the resources to efficiently and effectively assist the government and respond to information requests. If you want to help clients make sense of their data and are passionate about keeping up with the latest data trends and technology sources, then our team would be a great fit for you!

### Work you'll do

The candidate shall perform digital forensic analysis and research and development in support of laboratory requirements. In situations where laboratory requirements are not clearly specified, the contractor shall research current industry solutions and provide comprehensive analysis of potential solutions to address analytical gaps.

Exemplar responsibilities include but are not limited to:

- Assisting with seizure of digital evidence from on-site search locations while minimizing possible data loss.
- Preserving and archiving digital evidence using forensic best practices.
- Utilizing authorized forensic tools to perform forensic imaging and extraction from digital media.
- Providing guidance and training on emerging technology and new techniques to forensic personnel as needed.
- Assisting with forensic analytical efforts, to include, but not limited to recovering deleted files and other system artifacts; decrypting password protected data files and devices; performing forensic keyword searches and producing results; analyzing and interpreting various data to provide technically accurate forensic results and reports.
- Identifying potential analytical or technical gaps in current technical procedures or methodologies.
- Developing hardware and software solutions in support of laboratory operations.
- Drafting technical documentation and white papers on relevant technical topics as needed and,
- Researching current industry trends to identify potential sources of forensic information and techniques.

### The team

Deloitte's Government and Public Services (GPS) practice - our people, ideas, technology and outcomes-is designed for impact. Serving federal, state, & local government clients as well as public higher education institutions, our team of over 15,000+ professionals brings fresh perspective to help clients anticipate disruption, reimagine the possible, and fulfill their mission promise.

Discovery is constantly evolving and changing as data volumes and sources continue to grow exponentially. We aim to help our clients solve their most pressing data management challenges by bringing key stakeholders together and helping them to navigate challenges such as cloud migration, implications of new technologies,

evolving data sources, and pressure due to time constraints or regulatory requirements. Our practice has established itself as a leader in delivering the full spectrum of Discovery services to government agencies. Our teams apply eDiscovery leading practices and leverage analytics technology, as well as traditional legal research and writing, to assist government attorneys and agency staff through the litigation or information request process.

Our teams work with government attorneys on litigation readiness; to collect, process, analyze, review, and produce data; and to support discovery requests, depositions, hearings, and trials. Our team applies decades of experience and knowledge gleaned from thousands of cases to each stage of a litigation or dispute engagement, from case theory development and discovery to witness testimony. We use proprietary tools, methodologies, and technology-including data mining and mapping, electronic discovery, and computer forensic capabilities-to address our clients' needs.

## Qualifications

### Required:

- Bachelor's degree required
- Must be legally authorized to work in the United States without the need for employer sponsorship, now or at any time in the future
- Must be able to obtain and maintain the required clearance for this role
- 3+ years of research and development experience required
- Experience working with Python and Microsoft SharePoint
- Familiarity with low-level firmware and/or OS security
- Familiarity writing device drivers that interact directly with hardware
- Familiarity with vulnerability discovery and exploitation
- Areas of principal research and tool development will include process automation, forensic triage, validation mechanisms, ETL techniques, data fusion, emerging technology analysis and more

### Preferred:

- Master's Degree in related subject
- A strong intellectual curiosity with an interest in learning brand-new sets of information
- Track record of innovation and some technology
- Strong critical thinking skills
- Ability to think outside the box, innovate, and help team and client improve workflows to achieve greater



efficiencies

#RLSFY23

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## OPR Cyber Forensics Analyst

Ashburn,, VA

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SSi has principals that are an integral part of the organizations characteristic and are fundamentally essential to the shaping of everyday activities that connect to our broader mission and vision. As an organization SSi is committed to:

### Foster a culture of innovative and out of the box thinking:

We fundamentally understand that each employee has something unique to offer to the organization. We foster a culture that nourishes innovation by empowering staff, leverages their passions, and encompasses a circle of trust where it's all about thinking of new ideas and getting good feedback.

### Invest in our Resources

Employees are essential, their physical and mental well-being are pivotal to the growth of our organization. Our company culture, productivity, and overall employee happiness stem directly from how much training, responsibility, and empowerment they have within our organization. Our focus is on improving the growth of individual through education, allowing them to play central roles, so they can grow and add value to the company.

### Provide solutions that are in the best interest of the customer and improve their strategic posture

We are in business to serve our customers and do what is in their best interest. Our philosophy is to offer services that are complete. We strive to provide services that do more to help the customer improve in all areas including areas that they may not have considered.

### Give thoughtful considerations to our actions and their affects

We give thoughtful consideration to each other's differences and opinions. We must give our individual best to get the job done right. Everyone is accountable for their behaviors, exercising rational judgment, and giving thoughtful consideration to their professional activities and decisions.

### JOB DESCRIPTION

#### Required Education/Experience

Requires BS degree and 3 or more years of relevant experience or Masters Degree with less than 3 years of relevant experience. Four years of related experience may be considered in lieu of a BS degree, with applicable cyber experience and certifications.

#### Primary Responsibilities

The contractor shall support CBP/OPR/CI in a wide range of systems engineering, administration, and Cyber security & regulatory compliance services necessary to maintain and secure OPR

### More Openings

#### [IT Governance Lead -DHS -CBP](#)

Washington, DC

#### [IT Portfolio \(SME and Senior\) -DHS -CBP](#)

Washington, DC

#### [IT Portfolio -Mid level Analyst-DHS -CBP](#)

Washington, DC

#### [IT Portfolio Communications -Jr-level Analyst-DHS -CBP](#)

Washington, DC

#### [Sr. Systems Developer \(REMOTE-USA\) USGS](#)

USA, USA

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information technology networks used in the detection and investigations of cybercrimes and CBP policy violations.

#### Primary Responsibilities:

The candidate shall provide support to CI in conjunction with OIT's Cyber Defense Forensic (CDF) team in support of insider threat and security operations according to established policies, handbooks, and CBP CDF Standard Operating Procedures (SOPs). This support includes monitoring activities, conducting threat analysis, investigating policy violations, identifying mitigation and/or remediation courses of action, and assessing risk posed by trusted insiders. The main focus of this task is to process CBP email misuse "egress" cases assigned to OPR in the CBP OPR Joint Intake Case Management System (JICMS), work with the OIT Data Loss Prevention (DLP) tools to process incidents and assist with SOC Incidents / OPR investigations as needed.

- Provide recommendations for Information Spillage Incident Response efforts on handling and sanitization methods pursuant to industry best practices, NIST 800-88 recommendations, and Federal guidelines.
- Conduct enterprise and individual system(s) endpoint (e.g., Windows, Linux, Mac, and Cloud systems) and network based digital forensic analysis
- Conduct formal digital forensic investigations and document findings in formal investigation reports.
- Perform Email hygiene activities in support of CBP investigations
- Support enterprise recovery efforts as necessary to ensure that security events and incidents are properly remediated prior to reconstitution
- Utilize state of the art forensics tools(FTK/Encase,etc) to perform computer, mobile phone forensics and memory analysis (volatility, rekall) in support of incident response.
- Conduct reverse engineering of suspicious files utilizing dynamic, automated and static analysis
- Properly preserve evidence, maintain chain of custody and write malware analysis or forensic reports.
- Recognize attacker and APT activity, tactics, and procedures as indicators of compromise (IOCs) that can be used to improve monitoring, analysis and incident response.
- Install, secure, maintain and recommend forensic software and hardware within a Forensic Lab environment while following established configuration management processes.
- Develop and build security content, scripts, tools, or methods to enhance forensic processes.
- Effectively investigate and identify root cause findings then communicate findings to stakeholders including technical staff, and leadership.
- Develop and maintain Standard Operating Procedures

#### Requirement Certifications

GREM – Reverse Engineering Malware

GCIH – Incident Handler

GCFA – Forensic Analyst

GCFE – Forensic Examiner

GXPN – Exploit Researcher and Advanced Penetration Tester

OSCP (Certified Professional)

OSCE (Certified Expert)

OSWP (Wireless Professional)

OSEE (Exploitation Expert)

CISSP – Certified Information Systems Security

CHFI – Computer Hacking Forensic Investigator

LPT – Licensed Penetration Tester

ECSA – EC-Council Certified Security Analyst

EnCE

#### Basic Qualifications

Clearance: All CBP SOC employees are required to successfully complete a CBP Background Investigation to support this program

#### Basic Qualifications:

- Requires BS degree and 3 or more years of relevant experience or Masters Degree with less than 3 years of relevant experience. Four years of related experience may be considered in

lieu of a BS degree, with applicable cyber experience and certifications.

- Bachelor Degree in Computer Science, IT, Information/Cyber Security field from an accredited college or university
- Flexible and adaptable self-starter with strong relationship-building skills
- Strong problem solving abilities with an analytic and qualitative eye for reasoning under pressure
- Ability to independently prioritize and complete multiple tasks with little to no supervision

ONSITE REQUIREMENTS: 5 days/week for 90 days then 2 day/week (May be < 90 days if known)

#### **Preferred Qualifications**

- SANS GREM certification
- Experience performing computer forensics in Federal Government, DOD or Law Enforcement
- Ability to script in one more of the following computer languages Python, Bash, Visual Basic or Powershell
- Cyber Kill Chain Knowledge
- Advanced understanding of multiple Operating Systems, monitoring and detection techniques and methods, and Incident Response Lifecycle
- Prior experience with CBP/DHS
- Between 1-2 years of experience in two or more of these specialized areas:
  - Insider Threat
  - Digital media forensic
  - Monitoring and detection
  - Incident Response

---

SSi is an equal opportunity employer regardless of race, color, religion, creed, sex, marital status, national origin, disability, age, veteran status, on-the-job injury, sexual orientation, political affiliation or belief. Employment decisions are made without consideration of these or any other factors that employers are prohibited by law from considering. Any discriminatory action can be a cause for disciplinary action. SSi also prohibits discrimination against individuals with disabilities and will reasonably accommodate applicants with a disability, upon request, and will also ensure reasonable accommodation for employees with a disability. VETS are encouraged to apply.

Powered by

## Accessibility Note:

If you are a job seeker with a disability and require a reasonable accommodation to apply for one of our jobs, you will find the contact information to request the appropriate accommodation by visiting the following page:

[Accessibility Accommodation for Applicants](#)

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# Digital Forensics and Incident Response Instructor - Adjunct

**Job Category:** ACADEMICS

**Requisition Number:** DIGIT003088

[Apply now](#)

Posted: April 6, 2023

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Part-Time

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Keiser University - Online Division  
1900 West Commercial Blvd  
Fort Lauderdale, FL 33309, USA

## Job Details

### Description

#### DESCRIPTION

- Instructors are responsible for leveraging their expertise to deliver education services to students through:
- Preparing course plans and materials
- Delivering courses
- Monitoring progress/attendance
- Advising students
- Recording grades and submitting reports

Must have 18 hours of advanced level courses in the field

## Qualifications

## Education

### Required

Masters or better.

## Experience

### Required

**2 years:** 2 years minimum

Annual Security Report [🔗](#)



# Forensic Analyst - Multimedia/Digital/Audio /Video

**Job Tracking ID:** 512788-855855  
**Job Location:** Houston, TX  
**Job Level:** Entry Level (less than 2 years)  
**Level of Education:** BA/BS

**Job Type:** Full-Time/Regular  
**Date Updated:** May 24, 2023  
**Years of Experience:** Up to 2 Years  
**Starting Date:** ASAP

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## Job Description:

The successful candidate will be responsible for forensic examinations of computer and cell phone evidence and/or forensic examination of audio and video evidence. The basic responsibilities of the analyst include but are not limited to:

- Preserve and analyze data from electronic data sources, including computers, servers, and mobile devices, ensuring that the evidential integrity of the data is not compromised.
- Specialized technical work in the clarification/enhancement, conversion, repair, and reconstruction of audio and video evidence.
- Retrieval of evidence from analog and digital CCTV systems, both in lab and at off-site locations.
- Report detailed findings in preparation for review by investigators, prosecutors, or legal counsel, explaining complex technical concepts to nontechnical people.
- Conduct validation testing and performance verifications of various hardware/software tools.
- Assess and troubleshoot a variety of technical issues.
- Form and articulate expert opinions based on analysis and report findings.
- Provide expert testimony in depositions, trials, and other proceedings.
- Must be willing to be on-call to respond to calls after hours/weekends/holidays.

## Experience and Skills:

### MINIMUM EDUCATIONAL REQUIREMENTS

Bachelor's degree in Digital Forensics, Computer Science, or closely related field is required. A graduate degree in Digital Forensics is strongly preferred. Relevant experience as a multimedia or digital forensic analyst may be considered in lieu of a degree.

### MINIMUM EXPERIENCE REQUIREMENTS

A minimum of two years' experience working with analysis of digital evidence is required. Demonstration expertise with clarification tools is also required. Demonstrated proficiency in the examination and enhancement of digital evidence. An advanced degree may be considered as meeting partial experience requirements. CFCE or GFCE certification is strongly preferred. CCO, CCPA, GSAF, EnCE, or CCME or the ability to quickly gain certification is also strongly preferred.

### KNOWLEDGE AND SKILL REQUIREMENTS

- Knowledge of ISO/IEC 17025 accreditation standards.
- Demonstrated skill in oral and written communication.
- Demonstrated skills in handling multiple tasks and prioritizing work assignments.
- Demonstrated ability to effectively handle conflict and uncertain situations.
- Demonstrated ability to work with frequent interruptions and changing priorities.
- Demonstrated ability to establish and maintain effective communications and working relationships with fellow employees, internal customers, and external customers.
- Ability to lift computers that can weigh up to 50 lbs.

Apply Now

If you are having difficulties with the application process, please [click here](#)



APPLY

# Police Digital Investigative Analyst

CITY OF ONTARIO, CA ONTARIO, CALIFORNIA

POLICE DIGITAL ANALYST DIGITAL POLICE COMMUNITY FORENSICS DEVICES ANALYSIS EMAIL SUPPLEMENTAL CHILDREN SOFTWARE

🕒 July 14, 2023

🏢 City of Ontario, CA

📍 Ontario, California

## 3 Foods That Fight Memory Loss

Forgetful? Eat these foods once daily and w...

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### The Position

**NOTE: This position involves exposure to the exploitation of children and Child Sexual Assault Material (CSAM).**

Are you a **cybersecurity professional** searching for your next opportunity but don t want to work for just any agency? If so, the **Ontario Police Department (OPD)** has the perfect opportunity for you! OPD is looking for an experienced and motivated **Digital Investigative Analyst** to join our Internet Crimes Against Children (ICAC) Task Force. Join our team and work for one of the fastest growing cities in California.

In this role, you ll use your technical expertise and highly specialized software to forensically analyze computers and other digital/data storage devices such as smart phones, tablets, storage devices/drives, and cloud computing systems and applications. This position conducts thorough examinations involving Internet and other technologies, specifically incidents involving exploitation of children, and possession/distribution of Child Sexual Assault Material (CSAM).

The **ideal candidate** for this position will possess:

- Experience in examining digital media evidence in a law enforcement environment.
- Possession of one of the following industry certifications: Certified Computer Examiner (CCE), Certified Forensic Computer Examiner (CFCE), GIAC Certified Forensics Examiner (GCFE), Magnet Forensics Certified Examiner (MFCE).
- Outstanding analytical skills and an innovative mindset.
- The embodiment for the City's Approach to Public Service- Commitment to the Community, Achieving Excellence Through Teamwork, and Doing the Right Thing the Right Way.
- The qualities of a **5 Tool Player** Leader, Thinker, Operator, Communicator, and Public Servant.

**Applications will be accepted on a continuous basis until a sufficient number of qualified applications have been received. The deadline for the first review of applications is 11:59 PM on Friday, February 17, 2023. Applicants are encouraged to submit applications early. Applicants that submit applications after the first review deadline are not guaranteed to be considered for this recruitment. This recruitment may close at any time without notice after the first review deadline.**





## Background Check Process

All appointments to this position are subject to the successful completion of an in-depth background investigation conducted by the Ontario Police Department as well as a physical examination including a drug screening. The background investigation is a rigorous process, which often takes several months to complete. A typical background investigation includes but is not limited to: background interviews with individuals designated by the Ontario Police Department (this may include current and former co-workers, friends, relatives, neighbors, or any other relevant individual), criminal background check, credit check, polygraph examination, and psychological evaluation. Candidates may be disqualified from further consideration during the background investigation for a variety of reasons including if they have: an excessive number of traffic citations and/or collisions; arrests and/or convictions; a history of illegal substance abuse; poor credit history (factors include bankruptcy, foreclosures, liens, repossessions, and recency); or thefts from a previous employer. For clarification of any of the above disqualifying reasons, please call Police Department Background Unit at (909) 408-1820. The following list describes some areas that are covered in the background investigation:

- Your relatives, references, and acquaintances are asked to comment on your suitability for this position.
- The information supplied regarding your educational history is examined and verified.
- You must list a history of your residences.
- Your work history and experience are examined with regard to your dependability, relationships with fellow workers, trustworthiness, and general job performance.
- Military service records are subject to verification.
- The background investigation considers your management of personal finances (however, being in debt does not automatically disqualify you).
- Your criminal, driving, and insurance records are evaluated.

## The Ontario Police Department

The mission of the Ontario Police Department is to protect life and property, build and maintain authentic relationships, and enhance the quality of life in our community.

- **TEAMWORK:** Fulfilling community partnerships that instill pride, passion and commitment through communication and performance. Learn from the past and embrace the future through empowerment, respect, and cooperation.
- **PROFESSIONALISM:** It is not the job we do; it is how we do our job. We are engaging and considerate with our actions, image, and conduct.
- **INTEGRITY:** We hold honesty as our guiding principle. When faced with difficult decisions, we do the right thing, even in the face of adversity.
- **ACCOUNTABILITY:** We openly identify and address problems and willingly accept responsibility for our own actions.
- **DEDICATION:** We are committed to our craft and to the residents, businesses, and visitors of the City of Ontario.

Ontario is an economic leader in the Inland Empire, making it an excellent choice for a law enforcement career. We offer the opportunities and resources of a large department with the teamwork of a small one. Police Officers protect life and property through the enforcement of laws/ordinances and the provision of non-criminal services. Police Officers patrol an assigned beat to identify circumstances that indicate a threat to life or property and to take action to mitigate such threats.

## The City of Ontario

The City of Ontario is a dynamic leading community in the Inland Empire with a variety of full-time and part-time employment and volunteer opportunities. Ontario enjoys the reputation of being a progressive City which provides solid leadership to its citizens and to the business community. The City provides a full range of services to the community including: Police, Fire, Management Services, Economic Development, Community Life & Culture, Community Development, Public Works, Financial Services and the Ontario Municipal Utilities Company. The City's team is staffed with approximately 1,200 full-time and 300 part-time diverse and talented employees who work to support a common goal of providing excellent service to the community.

We invite you to learn more about the City of Ontario by reviewing the City's website. A few useful links are also listed below:

**Approach to Public Service (Download PDF reader)** (Core values for City of Ontario employees)

**Ontario City Employees** (Information about City of Ontario benefit plans)

**The Ontario Plan** (The City's Comprehensive Business Plan for Development)

### Examples of Essential Functions

The essential functions typically performed by the Police Digital Investigative Analyst include the following:

- Conducts investigative analysis of computer hard drives and other digital storage media including smart phones, tablets, flash drives, external hard drives, cloud systems, networks and applications to extract, preserve and present evidence for use in criminal investigations.
- Troubleshoots, repairs, assembles, and disassembles computers, laptops, hard drives and other digital devices, to produce images for analysis purposes.
- Designs and builds computers and peripheral devices as needed to meet internal technological demands related to digital forensics; maintains the functionality of assigned computers and peripheral equipment.
- Assists in preparation of search and seizure warrants, court orders, and subpoenas; determines and recommends appropriate items to be seized based on search warrant details and relevant case law.
- Provides technical guidance and assistance in field investigations to ensure data and equipment are preserved; transports, stores, and maintains evidence according to established protocols.
- Prepares investigative reports documenting the findings of the digital evidence analysis; provides expert testimony in court related to computer/digital analysis.
- Researches and prepares policy and procedure manuals related to digital evidence collection from computers and digital storage devices.
- Provides instructional assistance and training on proper procedures for seizure and collection of evidence from computers and other electronic devices, storage of digital evidence, use of digital forensic software, recent case studies, and any other training as needed.
- Determines the most appropriate method of protecting original evidence and recovering deleted, erased, hidden and encrypted digital evidence; identifies and recommends computer systems hardware and software necessary for investigation use.
- Prepares and maintains statistical and operational logs, records, and reports; maintains computerized databases related to the assigned investigative activities.
- Performs other duties as necessary.

### Qualification Guidelines

#### Education

A Bachelor's degree or its equivalent from an accredited college or university in Computer Science, Information Technology, or a closely related field. Additional related experience may be substituted for the required education on a year for year basis.

#### Experience

Two (2) years work experience in digital forensics and computer systems analysis, including the operation, maintenance and repair of computer systems.

#### Certificates

Possession of one of the following industry certifications, Certified Computer Examiner (CCE), Certified Forensic Computer Examiner (CFCE), GIAC Certified Forensics Examiner (GCFE), Magnet Forensics Certified Examiner (MFCE) or similar, **may be substituted for one year of work experience.**

### Desirable

Master s Degree in Digital Forensics Computer Forensics, Digital Forensic Science, Computer Science/Engineering, Computer Information Systems, or a similarly related field. Prior experience working in a law enforcement environment.

**Note: Proof of successful completion of educational requirements including but not limited to Associate's Degree and/or Bachelors Degree** must be provided by way of attachment to your online application or as an email attachment sent to the Hiring Agency Representative at, or before, time of the reference check process. Acceptable forms of proof include Unofficial Transcripts, Official Transcripts, Photos and/or Photocopies of Institutional Degree/Certifications.

### Supplemental Information

#### How to Apply

Apply online by clicking on the "Apply" link at the top of this announcement. If this is the first time applying for a position using governmentjobs.com, you will be prompted to create a new user account, otherwise log in with your user name and password. Your application and responses to any supplemental questions will be used to evaluate your qualifications for this position. It is suggested that your application include the following:

- List any relevant experience and education demonstrating your qualifications for the position.
- List all periods of employment for at least the past 10 years, beginning with your most recent or present employer (including if applicable, all employment with the City of Ontario).
- Separately list each position held, including different positions with the same employer.

A resume may be attached to your application, however will not substitute for the proper completion of your application. Applications that are not properly completed may be rejected.

### Supplemental Questions

To complete your application for this position, you will be prompted to respond to supplemental questions. This information will be used as part of the application screening and selection process and is designed to help you present your qualifications for this position. This may include a selection step in which your application and supplemental questions are reviewed and scored by a panel of raters familiar with this position.

Incomplete responses, false statements, omission, or partial information may result in disqualification from the selection process. Your responses should be consistent with the information provided on your application.

Please provide succinct, concise, descriptive, and detailed information for each question. If you have no experience, write "no experience" for the appropriate question.

### Email Notices

Email is the primary way that the Human Resources or Hiring Department will communicate with you. Please check your email account (including the SPAM folder) on a regular basis for any emails related to the application or selection process. Emails from the City of Ontario will come from "@ontarioca.gov" or "governmentjobs.com." If you change your email address after submitting your application, please visit governmentjobs.com and update your profile.

### Frequently Asked Questions

If you have any additional questions regarding the application process, please refer to our Frequently Asked Questions page.

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# Senior Digital Forensic Examiner

Ashburn, VA, United States

## JOB DESCRIPTION

### ***Bring your ideas. Make history.***

BNY Mellon offers an exciting array of future-forward careers at the intersection of business, finance, and technology. We are one of the world's top asset management and banking firms that manages trillions of dollars in assets, custody and/or administration. Known as the "bank of banks" - 97% of the world's top banks work with us as we lead and serve our customers into the new era of digital.

With over 238 years of rich history and industry firsts, BNY Mellon has been built upon our proven ability to evolve, lead, and drive new ideas at every turn. Today, we're approximately 50,000 employees across 35 countries with a culture that empowers you to grow, take risks, experiment and be yourself. This is what **#LifeAtBNYMellon** is all about.

We're seeking a future team member for the role of Senior Digital Forensic Examiner to join our global Digital Forensics team. This role is located in Ashburn, VA or Pittsburgh, PA - HYBRID.

In this role, you'll make an impact in the following ways:

- Perform expert level digital forensic investigations across multiple platforms throughout the global organization utilizing commercial and open source forensic tools.
- Assist in the design, implementation, and maintenance of the digital forensic infrastructure.
- Point of contact and subject matter expert for forensic investigations across all business and business partners, specifically in the APAC region.
- Participate in oversight and monitoring functions to ensure compliance with all internal and external audits and reviews for the digital forensics program.
- Provide expert witness testimony in court proceedings as required and/or review detailed and comprehensive

investigative reports that may be utilized for criminal/civil litigation, if necessary.

- Follow industry best practices for evidence collection, handling, digital forensic analysis, and reporting.
- Proactively research and recommend technology solutions and process improvements for digital forensics tools and processes.
- Document newly developed processes, procedures, or research for distribution within the digital forensics team, or appropriate stakeholders when necessary. Produce processes, policies, or procedures in official format when necessary.
- Take ownership of projects and tasks with minimal supervision, providing updates to team management and appropriate stakeholders as necessary.
- Perform forensic analysis on various operating systems
- Perform acquisition and analysis of cloud based platforms.
- Participate in cyber hunt activities for advanced persistent threats
- Assist with insider threat investigations and analysis

To be successful in this role, we're seeking the following:

- Have solid MS Office skills along with strong verbal and written communication skills.
- Experience various commercial and open source forensic tools.
- Proficient in the examination and analysis of various operating systems, both server and user based.
- Understanding and working knowledge of industry best practices in forensic examinations (i.e., NIST, ISO, CoBIT, OWASP, ITIL) is required.
- Possess an excellent knowledge of cyber intrusion incident response procedures and related forensic response tactics to enable quick response, analysis, and incident mitigation.
- Possess solid judgment along with excellent analytical, communication and problem-solving skills as well as advanced technical skills with the ability to apply subject matter expertise to address information risk vulnerabilities.
- Bachelor's degree in computer science or a related discipline (Cybersecurity or Forensics preferred), or equivalent work experience required. 10-12 years of experience in information security or related technology experience required. Experience in the securities or financial services industry is a plus.

## Preferred Qualifications

- Masters degree or above in Cybersecurity or Forensics preferred
- Industry recognized certifications (CISSP, GCFA, GCFE, GREM, CHFI, GCIH, GCIA, GDSA, etc)
- Related incident response or forensics experience in SOC environments.
- Knowledge and understanding of Advance Persistent Threats methodologies and cyber hunt activities
- Knowledge and understanding of Insider Threat methodologies, investigative, and analysis techniques
- Knowledge of forensic procedures for cloud based platforms

At BNY Mellon, our inclusive culture speaks for itself. Here's a few of our awards:

- Fortune World's Most Admired Companies & Top 20 for Diversity and Inclusion
- Bloomberg's Gender Equality Index (GEI)
- [Best Places to Work for Disability Inclusion](#), Disability: IN – 100% score
- 100 Best Workplaces for Innovators, Fast Company
- Human Rights Campaign Foundation, 100% score Corporate Equality Index
- CDP's Climate Change 'A List'

## Our Benefits:

BNY Mellon offers highly competitive compensation, benefits, and wellbeing programs rooted in a strong culture of excellence and our pay-for-performance philosophy. We provide access to flexible global resources and tools for your life's journey. Focus on your health, foster your personal resilience, and reach your financial goals as a valued member of our team, along with generous paid leaves that can support you and your family through moments that matter.

BNY Mellon is an Equal Employment Opportunity/Affirmative Action Employer - Underrepresented racial and ethnic groups/Females/Individuals with Disabilities/Protected Veterans.

Consults with other IT areas and the businesses and provides professional support for major components of the

company's information security infrastructure. Contributes to the development and implementation of security architecture, standards, procedures and guidelines for multiple platforms. Consults with the business and operational infrastructure personnel regarding new and existing technologies. Recommends new security tools to management and reports and provides guidance and expertise in their implementation. Reviews and analyzes complex data and information to provide insights, conclusions and actionable recommendations provides direction and guidance on reports and analyses and ensures recommendations are aligned with customer/business needs and capabilities. Ensures that all significant security concerns are addressed. Recommends course of action to mitigate risk and ensures that appropriate standards are established and published. Contributes to the achievement of area objectives. Bachelor's degree in computer science or a related discipline, or equivalent work experience required, advanced degree preferred, 8-10 years of experience in information security or related technology experience required, experience in the securities or financial services industry is a plus.. BNY Mellon is an Equal Employment Opportunity/Affirmative Action Employer. Minorities/Females/Individuals with Disabilities/Protected Veterans. Our ambition is to build the best global team – one that is representative and inclusive of the diverse talent, clients and communities we work with and serve – and to empower our team to do their best work. We support wellbeing and a balanced life, and offer a range of family-friendly, inclusive employment policies and employee forums.


**APPLY NOW**

**JOB INFO**

Job Identification	41730
Job Category	Information Security
Posting Date	06/14/2023, 01:37 PM
Job Schedule	Full time
Job Shift	Day



Locations

 43777 Central Station  
Drive, Ashburn, VA, 20147,  
US



# Senior Cybersecurity Analyst - Digital Forensics

 Visa

**Location:** Ashburn, Virginia

**Type:** Full-Time, Non-Remote

Posted on: June 12, 2023

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Sr. Cybersecurity Analyst - Digital Forensics

Visa Ashburn, VA (Onsite) Full-Time

CB Est Salary: \$140K - \$140K/Year

[Apply on company site](#)

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[Company Description](#)

Visa is a world leader in digital payments, facilitating more than 215 billion payments transactions between consumers, merchants, financial institutions and government entities across more than 200 countries and territories each year. Our mission is to connect the world through the most innovative, convenient, reliable and secure payments network, enabling individuals, businesses and economies to thrive.

When you join Visa, you join a culture of purpose and belonging - where your growth is priority, your identity is embraced, and the work you do matters. We believe that economies that include everyone everywhere, uplift everyone everywhere. Your work will have a direct impact on billions of people around the world - helping unlock financial access to enable the future of money movement.

Join Visa: A Network Working for Everyone.

[Job Description](#)

Visa is looking for a Digital Forensic Analyst to join our team. The role of Digital Forensic Analyst is a key role in

the Cyber Defense team. You will be working as part of a small team supporting the DFIR & eDiscovery Manager and the wider organization across a number of different areas including internal investigations and litigation support. You will be responsible for reporting to key internal stakeholders, including Legal and Human Resources on a diverse range of issues.

In order to be successful in this role you will be naturally inquisitive with a proven investigative background. You will be a committed problem solver and able to work independently to achieve the desired goals in an agreed time frame.

The successful candidate will be able to carry a large caseload and be able to prioritize tasks to ensure that critical deadlines are met in order to minimize reputational damage to the organization. You will also present a professional, capable and approachable demeanor to others to ensure that all engagements with both internal and external stakeholders reflect positively on yourself, the Cyber Defense team and Visa.

### Essential Functions

- Work both independently and while operating in a geographically and culturally diverse peer group
- Collaboratively identify the needs of the referrer and design a strategy to meet those needs
- Identify, seize, and preserve data from existing systems in a forensically sound manner
- Analyze seized data to meet the strategic needs of the investigation whilst maintaining an open mind as to the eventual outcome
- Report findings both verbally and in writing in a manner appropriate to the knowledge and experience of the audience
- Advise, where appropriate, in order to ensure that normal business processes comply with current best practice
- Coordinate investigation and mitigation strategies with other internal teams within Visa globally such as Legal, HR, Compliance, and Enterprise Risk
- Contribute to tool optimization and automation initiatives to streamline analysis and response workflows and processes
- Document playbooks and standard operating procedures to improve processes and information sharing across teams
- Ensure metrics are complete and accurate and findings are documented in case management system
- Respond to request for ad-hoc reporting and research topics from management as required
- Maintain confidentiality, always using discretion and sound judgment

This is a hybrid position. Hybrid employees can alternate time between both remote and office. Employees in hybrid roles are expected to work from the office 2-3 set days a week (determined by leadership/site), with a general guidepost of being in the office 50% or more of the time based on business needs.

#### QualificationsBasic Qualifications

\* 5+ years of relevant work experience with a Bachelor's Degree or at least 2 years of work experience with an Advanced degree (. Masters, MBA, JD, MD) or 0 years of work experience with a PhD, OR 8+ years of relevant work experience.

#### Preferred Qualifications:

- \* Possess a degree in Forensic Computing, Computer Science or similar discipline or be able to evidence equivalent industry training
- \* Be experienced in the use of industry standard forensic software tools.
- \* Be able to demonstrate a thorough understanding of Forensic principles, particularly in relation to data integrity
- \* Be an experienced investigator with a background in either law enforcement or a large corporate entity
- \* Be an excellent communicator able to deal effectively with both internal and external stakeholders and capable of presenting technical information to a non-technical audience
- \* Be organized and able to manage time and prioritize tasks effectively
- \* Be able to work as part of a small team supporting other team members as required and capable of working with minimal supervision
- \* Be a problem solver
- \* Have a recognized Digital Forensic certification: ENCE, CFCE, ACE etc.
- \* Have experience of the legal system, either Criminal or Civil, and have given evidence before a Court or Tribunal
- \* Have experience of using EnCase or a similar forensic tool deployed across an Enterprise environment
- \* Have some scripting, coding or programming knowledge relevant to the role: PERL, Python, VBA, SQL etc.
- \* Have some experience of e-Discovery including knowledge of industry standard e-Discovery tools and the EDRM
- \* Have experience of working with PCI DSS
- \* Candidate will exhibit a history of reliability and strong decision-making skills
- \* Ability to react with appropriate urgency to situations and requests

#### Additional Information

**Work Hours:** Varies upon the needs of the department.

**Travel Requirements:** This position requires travel 5-10% of the time.

**Mental/Physical Requirements:** This position will be performed in an office setting. The position will require the incumbent to sit and stand at a desk, communicate in person and by telephone, frequently operate standard office equipment, such as telephones and computers.

Visa is an EEO Employer. Qualified applicants will receive consideration for employment without regard to race, color, religion, sex, national origin, sexual orientation, gender identity, disability or protected veteran status.

Visa will also consider for employment qualified applicants with criminal histories in a manner consistent with EEOC guidelines and applicable local law.

Visa will consider for employment qualified applicants with criminal histories in a manner consistent with applicable local law, including the requirements of Article 49 of the San Francisco Police Code.

**. APPLICANTS ONLY:** The estimated salary range for a new hire into this position is 117, to 153, USD, which may include potential sales incentive payments (if applicable). Salary may vary depending on job-related factors which may include knowledge, skills, experience, and location. In addition, this position may be eligible for bonus and equity.

Visa has a comprehensive benefits package for which this position may be eligible that includes Medical, Dental, Vision, 401 (k), FSA/HSA, Life Insurance, Paid Time Off, and Wellness Program.

#### Recommended Skills

- Audio Equipments
- Automation
- Business Processes
- Business Requirements
- Case Management Systems
- Communication

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# Digital Forensic Analyst

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## Position Summary

In today's environment our clients' abilities to respond to requests for information are more important than ever – and through people, processes, tools, and technology, we help them do so. Are you excited about exploring innovative ways to visualize data, use analytics, and help clients find relevant information in an ever-growing sea of emails and electronic documents? Do you have a legal or technology background and want to continue to grow your skills and abilities? We are a practice that brings together teams focusing on thought diversity, collaborative problem solving, and development of our professionals to enable our Government and Public Services (GPS) Discovery & Data Management Practice clients face litigation and other regulatory requirements with the resources to efficiently and effectively assist the government and respond to information requests. If you want to help clients make sense of their data and are passionate about keeping up with the latest data trends and technology sources, then our team would be a great fit for you!

## Work you'll do

The candidate shall perform digital forensic analysis and research and development in support of laboratory requirements. In situations where laboratory requirements are not clearly specified, the contractor shall research current industry solutions and provide comprehensive analysis of potential solutions to address analytical gaps.

Exemplar responsibilities include but are not limited to:

- Assisting with seizure of digital evidence from on-site search locations while minimizing possible data loss.



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Providing guidance and training on emerging technology and new techniques to forensic personnel as needed.

- Assisting with forensic analytical efforts, to include, but not limited to recovering deleted files and other system artifacts; decrypting password protected data files and devices; performing forensic keyword searches and producing results; analyzing and interpreting various data to provide technically accurate forensic results and reports.
- Identifying potential analytical or technical gaps in current technical procedures or methodologies.
- Developing hardware and software solutions in support of laboratory operations.
- Drafting technical documentation and white papers on relevant technical topics as needed and,
- Researching current industry trends to identify potential sources of forensic information and techniques.

### The team

Deloitte's Government and Public Services (GPS) practice – our people, ideas, technology and outcomes —is designed for impact. Serving federal, state, & local government clients as well as public higher education institutions, our team of over 15,000+ professionals brings fresh perspective to help clients anticipate disruption, reimagine the possible, and fulfill their mission promise.

Discovery is constantly evolving and changing as data volumes and sources continue to grow exponentially. We aim to help our clients solve their most pressing data management challenges by bringing key stakeholders together and helping them to navigate challenges such as cloud migration, implications of new technologies, evolving data sources, and pressure due to time constraints or regulatory requirements. Our practice has established itself as a leader in delivering the full spectrum of Discovery services to government agencies. Our teams apply eDiscovery leading practices and leverage analytics technology, as well as traditional legal research and writing, to assist government attorneys and agency staff through the litigation or information request process.

Our teams work with government attorneys on litigation readiness; to collect, process, analyze, review, and produce data; and to support discovery requests, depositions, hearings, and trials. Our team applies decades of experience and knowledge gleaned from thousands of cases to each stage of a litigation or dispute engagement, from case theory development and discovery to witness testimony. We use proprietary tools, methodologies, and technology—including data mining and mapping, electronic discovery, and computer forensic capabilities—to address our clients' needs.

### Qualifications

#### Required:

- Bachelor's degree required
- Must be legally authorized to work in the United States without the need for employer sponsorship, now or at any time in the future





Experience working with python and microsoft sharepoint

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- Familiarity with low-level firmware and/or OS security
- Familiarity writing device drivers that interact directly with hardware
- Familiarity with vulnerability discovery and exploitation
- Areas of principal research and tool development will include process automation, forensic triage, validation mechanisms, ETL techniques, data fusion, emerging technology analysis and more

Preferred:

- Master's Degree in related subject
- A strong intellectual curiosity with an interest in learning brand-new sets of information
- Track record of innovation and some technology
- Strong critical thinking skills
- Ability to think outside the box, innovate, and help team and client improve workflows to achieve greater efficiencies

#RLSFY23

### Recruiting tips

From developing a stand out resume to putting your best foot forward in the interview, we want you to feel prepared and confident as you explore opportunities at Deloitte. [Check out recruiting tips from Deloitte recruiters.](#)

### Benefits

At Deloitte, we know that great people make a great organization. We value our people and offer employees a broad range of benefits. [Learn more about what working at Deloitte can mean for you.](#)

### Our people and culture

Our diverse, equitable, and inclusive culture empowers our people to be who they are, contribute their unique perspectives, and make a difference individually and collectively. It enables us to leverage different ideas and perspectives, and bring more creativity and innovation to help solve our client most complex challenges. This makes Deloitte one of the most rewarding places to work. [Learn more about our inclusive culture.](#)

### Our purpose

Deloitte's purpose is to make an impact that matters for our clients, our people, and in our communities. We are creating trust and confidence in a more equitable society. At Deloitte, purpose is



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## Professional development

From entry-level employees to senior leaders, we believe there's always room to learn. We offer opportunities to build new skills, take on leadership opportunities and connect and grow through mentorship. From on-the-job learning experiences to formal development programs, our professionals have a variety of opportunities to continue to grow throughout their career.

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As used in this posting, "Deloitte Advisory" means Deloitte & Touche LLP, which provides audit and enterprise risk services; Deloitte Financial Advisory Services LLP, which provides forensic, dispute, and other consulting services; and its affiliate, Deloitte Transactions and Business Analytics LLP, which provides a wide range of advisory and analytics services. Deloitte Transactions and Business Analytics LLP is not a certified public accounting firm. Please see [www.deloitte.com/us/about](http://www.deloitte.com/us/about) for a detailed description of the legal structure of Deloitte LLP and its subsidiaries. These entities are separate subsidiaries of Deloitte LLP.

All qualified applicants will receive consideration for employment without regard to race, color, religion, sex, sexual orientation, gender identity, national origin, age, disability or protected veteran status, or any other legally protected basis, in accordance with applicable law.

Requisition code: 150642

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# Digital Identity - Senior Solution Delivery Lead - Access Management (AM) - Deloitte | Orlando, FL

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## Digital Identity - Senior Solution Delivery Lead - Access Management (AM)

Deloitte - 3.9

Orlando, FL



### Job Details

Full-time

\$ Estimated: \$199K - \$253K a year

### Qualifications

- Microsoft Windows Server
- JBoss
- FTP
- Authentication
- SSO
- Controlling experience
- 7 years
- Azure
- Operating systems
- Oracle
- IIS
- Remedy
- WebSphere
- Software deployment
- DevOps
- CISSP
- Disaster recovery
- Microsoft SQL Server
- Solaris
- Google Cloud Platform
- Windows
- Weblogic
- Master's degree
- Databases
- Administrative experience
- SOAP
- SQL
- PKI
- IT infrastructure
- AWS
- Bachelor's degree
- SSL
- ITIL
- Virtualization
- REST
- LDAP
- Sailpoint
- DNS
- ServiceNow
- IT
- SSH
- Linux
- JSON
- Apache
- HTTPS
- Communication skills
- Active Directory
- MvSQL



## Full Job Description

### Digital Identity - Senior Solution Delivery Lead Access Management (AM)

Advisory Managed Services delivers long term value to clients by providing industry leading risk management solutions to assist clients in managing key risk domains including Cyber, Forensic, Strategic and Financial Risk. Deloitte's solutions enable leading global organizations to focus on their core competencies and mission-critical challenges, while maximizing the power of risk management to protect and grow their businesses. Advisory Managed Services is focused on building, delivering, and managing large scale solutions to establish long term relationships where Deloitte's solutions continue to grow and evolve with the rapidly changing market needs to drive differentiated results and insight to help our clients more cost effectively manage their business.

### Work you will do

The Managed Services **Senior Solution Delivery Lead** will be responsible for monitoring, managing and enhancing the Access Management technology Platform and related processes.

### The key job responsibilities include:

- Serve as Subject Matter Expert for the products, solutions and capabilities related to Access Management (AM)
- Support the team members by providing technical guidance on client delivery as well as assist other on-going engagements for resolving critical issues
- Setup and configure Access Management environment in production and Disaster Recovery (DR) environments on cloud or on premise with the help of infrastructure team
- Lead design and implementation of complex enhancements or On-board / integrate new applications effort for an existing client. Work as per the project plan and ensures that assigned tasks and responsibilities are fulfilled in a timely fashion
- Investigate and troubleshoot complex technical issues independently, perform root-cause analysis for high severity issues and provide permanent resolution
- Work with technology vendor for product issues, technology evaluation and design reviews
- Optimize system configurations for performance improvement
- Emergency support in providing technical resolution on high severity incidents in production environment



- Lead and participate in continuous improvement initiatives, identify ways to improve client delivery by introducing technology innovations or processes re-engineering to increase efficiencies of the team
- Work with product vendors to discuss product roadmap and releases, manage patches / hotfix rollouts and plan for major product upgrades
- Coordinate with client / client teams at onsite / globally, discuss issues and resolutions. Identify the risks and mitigation plan. Timely escalation of issues to avoid business disruption
- Enabling business development by assisting in request for proposal, efforts calculation, cost estimations and pre-sales
- Lead process compliance activities by identifying and driving initiatives that are relevant for the project delivery across the practice development and help factor reusability and related benefits
- Support the practice by delivering access manager training to new hire, take brown bag session to benefit other engagements
- Operate as an advisor for the client, connect with a vendor and help them to elect the best solution for resolving the identified / possible technical issues or security threats in the system / infrastructure
- Work with the team to generate service management metrics and reports, KPI / KRI and reports for audit, governance and service improvements plan as per the business requirement and industry standard

## The Team

The Deloitte Risk and Financial Advisory Digital Identity solution is a cloud- hosted and fully-managed identity platform that brings together market-tested technologies, industry leading practices, and pre-built identity management use cases to accelerate deployment and reduce time to value.

Key Identity and Access management technical capabilities delivered by the team:

§ Identity Governance and Administration

§ Access Manager

§ Privileged access management



## Qualifications and Experience

### Required:

- B.Tech / B.E / M.Tech and other bachelors and masters qualifications in Computer Science (CS) or Information Technology (IT)
- Experience - 7 to 9 years in Access Management and Service management.
- Experience in managing large engagements running common AM solution(s) (CA-SiteMinder/ IBM SAM/ Oracle AM/ PingFed/PingAccess / Okta/ Azure AD/ ForgeRock AM)
- Strong understanding of enterprise access management and multi-factor authentication
- Experience in configuring and deployment of Single Sign-on, attribute-based access control, Proxy based application, strong authentication using access management products
- Hands-on on WAM products and particularly on Ping suite of products (Ping Access, Ping Federate and PingID)
- Knowledge of cloud platforms (AWS, Azure, GCP etc.) experience in deploying and managing AM solutions on cloud platforms. AWS is preferred
- Knowledge and / or experience with Active Directory Domain Admin (Active Directory design & architecture, Group Policy, Windows Server, Security, Active Directory troubleshooting) in production environment
- Strong understanding of LDAP domain including Kerberos, certificate and other authentication mechanisms
- Experience in performing administrative tasks such as configuring rules and policies, email templates, authentication store etc. on AM tools
- Strong experience in federation concepts like SAML 2.0, WS-FED, OpenID OAuth 2.0
- Good knowledge of Web / Application servers (e.g. IIS, WebSphere, WebLogic, JBoss, and Apache etc.)
- Strong technical knowledge of authentication and authorization protocols: OIDC, SAML, XACML, LDAP, OAuth, OpenID
- Experience working on various operating systems such as Windows, Linux, Solaris etc.
- Working knowledge on Databases such as MS SQL, Oracle, MySQL
- Good understanding or hands-on experience on JSON, REST and SOAP
- Experience in integration of AM tools (i.e CA SiteMinder) with IGA tools (i.e. SailPoint)
- Ability to create, plan, and execute advanced any AM product trainings and independently drive proof of concepts around fine/coarse grained access control on



- Well-versed with IT service management (ITIL) processes and experience in managing tasks and operations support
- Understanding of security and privacy and IAM controls
- Experience working in a Maintenance and Support environment
- Experience service delivery, SLA/OLAs, reporting and ITSM tools like ServiceNow, Remedy etc. along with a strong sense of customer satisfaction
- Excellent verbal and written communication skills
- Advanced documentation skills for drafting / designing the content for client presentation, reporting, new opportunities followed by effective presentation skills
- Flexibility to work outside business hours for handling the business critical issues
- Reviews and ensures compliance of technical documents including architecture/design guide, operating instruction manuals, system and configurations documentation, work instructions / run-books, processes, standards and procedures

**Preferred:**

- Understanding of DevOps, Virtualization and IT Infrastructure, Network Protocols (SSL, SSH, FTP, SMTP, HTTP and HTTPS etc.)
- Understanding of various IT / Security technologies- Including DNS, Exchange, Firewalls, VPN Gateways, IPS, Proxy and PKI
- One or more certifications on ITIL, PRINCE2, ISO27001, CISSP, IAM Product certifications - Okta, Ping etc.
- Exposure to other security domains

The wage range for this role takes into account the wide range of factors that are considered in making compensation decisions including but not limited to skill sets; experience and training; licensure and certifications; and other business and organizational needs. The disclosed range estimate has not been adjusted for the applicable geographic differential associated with the location at which the position may be filled. At Deloitte, it is not typical for an individual to be hired at or near the top of the range for their role and compensation decisions are dependent on the facts and circumstances of each case. A reasonable estimate of the current range is \$102,750 - \$190,088 . You may also be eligible to participate in a discretionary annual incentive





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## CYBER-Intelligence Analyst

US-VA-Chantilly

**Requisition ID** 2023-133036 **Position Category** Data Analytics / Intelligence **Clearance** Top Secret/SCI w/Poly **Sector** Space & Intelligence

### Responsibilities

Peraton is seeking an experienced Mid-Level Intelligence Analyst for our client's operational requirements on a mission focused program within a challenging, dynamic setting located in the Virginia area. Successful candidates in this position will be responsible for identifying people, relationships, and organizations with access to information needed to advance U.S. national security interests, such as disrupting cyber threats, counterintelligence threats, drug networks, illegal arms trade, etc. Also responsible for combining specialized training, advanced analytic skills and tools, and in-depth knowledge of and experience in operational trade craft to identify opportunities to initiate or enhance foreign intelligence and counterintelligence.

Responsible for using advanced cyber tools, datasets, and methodologies to analyze all-source information, generate operational leads, drive successful technical operations, disrupt threats, and advance mission priorities. Also responsible for applying investigative, pragmatic, and mission driven aptitude in a fast-paced, collaborative environment to identify individuals, computer networks, emerging threats, cyber vulnerabilities, and collection opportunities to transform intelligence and advance U.S. national security interests in the cyber domain.

Must have personal integrity; exhibit initiative, creativity, and flexibility; apply interpersonal, communications, and problem-solving skills; and demonstrate ability to collaborate, build a network of IC relationships, and continually learn.

### Qualifications

- Bachelors of Arts or Bachelors of Science from an accredited college or university, with 5-7 years of experience
- Bachelor's degree from an accredited institution in a relevant field or, a Master's degree from an accredited institution or six years of professional experience in a relevant field may be substituted for a Bachelor's degree not in a relevant field
- Must have a current TS/SCI clearance with Polygraph
- IC experience
- Have strong critical thinking skills; advanced research skills; excellent analytic and investigative curiosities
- Experience in Intelligence Operations / Analysis / direct support to Cyber Network Operations (CNOs) or joint task force focused on Cyber Mission at writ large
- Experience working in at least one of the following technical and/or analytic disciplines: Computer/Digital Forensics; Cyber Security; Data Analytics; Emerging Technologies; Information Science/Systems; Internet/Web Technology; Network Security and Engineering; or Social Network Analysis Experience identifying, analyzing, evaluating targeting leads through the exploitation of disparate, big data databases
- Experience and capability to resolve findings via various targeting methodologies and available tools
- Ability to multi-task to manage time and priorities in a collaborative manner
- Ability to deal effectively, comfortably, and confidently with people at all levels of responsibility, authority, and rank
- Ability to shift focus quickly, work on multiple tasks concurrently, and excel in high-pressure/high-impact situations
- Experience conducting intelligence analysis and reporting
- Understanding of the Intelligence Community, their partners, and supporting/driving intelligence operational activities
- Experience and understanding of research and analysis methodologies in support of the intelligence
- Lifecycle Extensive use of tools specific to the end customer
- Experience of customer's report writing standards and through various reporting methods
- Availability for TDY travel, if necessary

General education Requirements (please also review position specific education requirements) BS 5-7, MS 3-5, PhD 0-2

### Peraton Overview

Peraton drives missions of consequence spanning the globe and extending to the farthest reaches of the galaxy. As the world's leading mission capability integrator and transformative enterprise IT provider, we deliver trusted and highly differentiated national security solutions and technologies that keep people safe and secure. Peraton serves as a valued partner to essential government agencies across the intelligence, space, cyber, defense, civilian, health, and state and local markets. Every day, our employees do the can't be done, solving the most daunting challenges facing our customers.

### Target Salary Range

# Information Security Analyst 3- job post

Virginia Dept of Alcoholic Beverage Control

Hanover, VA

\$70,700 - \$91,900 a year - Full-time

## Job details

### Salary

\$70,700 - \$91,900 a year

### Job Type

Full-time

## Full Job Description

### Information Security Analyst 3

Position #78301

Salary Range: \$70,700.00 – \$91,900.00

### Join Our Team Crafted of Virginia's Top Shelf Talent!

Virginia Alcoholic Beverage Control Authority Information Technology Services Division (ITS) is seeking an Information Security Analyst to help the Information Security Operations (SecOps) Team to assist in the support of the Information Security Program. This member will provide Tier-3 support and act as a backup for the Vulnerability, Identity Management and Monitoring activities, as well as assisting with project initiatives.

This position is a part of Virginia Alcohol Beverage Control Authority Information Security Operations team. The Information Security Analyst will ensure protection of the Authority data and information systems, this position protects authority systems by assisting with managing the vulnerability program, monitoring for incidents and misuse, designing and documenting controls to protect systems, and implementing or directing the implementation of security controls.

### Our Mission

Virginia ABC generates a reliable stream of revenue for Virginia and promotes public safety through the responsible sale and regulation of alcoholic beverages.

### Our Vision

To bring good spirits and excellent service to Virginia.

### Our Values

Accountability – Service – Integrity – Performance Excellence

## **ESSENTIAL FUNCTIONS**

- Identity and Access management and administration.
- Configure and maintain identity and access management systems to include multi factor authentication, Office 365, Windows AD, and Azure administration.
- Review and respond to security monitoring alerts and reported incidents as deemed credible in accordance with Incident handling procedures, providing tasks for remediation, ensure follow through, and provide reports to management.
- Provide notification to technical teams of new vulnerabilities and available patches in systems supported by the agency.
- Maintain program to identify assets, determine vulnerabilities, provide tasking for remediation, ensure follow through, and provide reports to management.
- Provide notification to technical teams of new vulnerabilities and available patches in systems supported by the agency.
- Evaluate effectiveness of controls regularly. Attempt to gain access and bypass controls. Report findings to management and provide improvements to compensate for vulnerabilities.
- Perform penetration testing and create reports for management to address findings.
- Work as key member of project teams to provide ongoing support for projects that require security input and expertise.
- Ensure InfoSec requirements are implemented in key projects where appropriate.
- Review existing and planned ABC policies and other applicable security frameworks, make suggestions for improvements to increase security and ease of business use.
- Coordinate and execute audit actions as requested to evaluate compliance to security assessments, 3rd Party, and industry best practices, etc.

## **Minimum Qualifications**

### **Preferred Qualifications**

- Certifications – Industry certifications in Security, Incident Response, Penetration Testing, **Digital forensics**, etc...
- Education – Masters Degree in Information Technology or related field.

### **Special Requirements**

In support of the Commonwealth's commitment to inclusion, we are encouraging individuals with disabilities to apply through the Commonwealth Alternative Hiring Process. To be considered for this opportunity, applicants will need to provide their Certificate of Disability (COD) provided by a Certified Rehabilitation Counselor within the Department for Aging & Rehabilitative Services (DARS). Veterans are encouraged to answer Veteran status questions and submit their disability documentation, if applicable, to DARS to get their Certificate of Disability. If you need to get a Certificate of Disability, use this link: <https://www.vadars.org/drs/cpid/PWContact.aspx> , or call DARS at 800- 552-5019.

[https://www.abc.virginia.gov/jobs/public/positionOpening\\_list.do](https://www.abc.virginia.gov/jobs/public/positionOpening_list.do)

### **Special Instructions to Applicants**

*For consideration for employment you must complete an online application at **[https://www.abc.virginia.gov/jobs/public/positionOpening\\_list.do](https://www.abc.virginia.gov/jobs/public/positionOpening_list.do)***

*Resumes may accompany but will not substitute for a completed State Application Form. Your completed online application **MUST BE RECEIVED** by Human Resources no later than 11:59 p.m. on the stated closing date.*

*The Virginia Alcoholic Beverage Control Authority does not provide sponsorship. We are an equal opportunity employer without regard to sex, race, color, religion, national origin, age, sexual orientation, political affiliation, veteran status, or disability.*

*AmeriCorps, Peace Corps, and other national service alumni are encouraged to apply.*

*ABC will provide, if requested, reasonable accommodation to applicants in need of accommodation in order to provide access to the application and/or interview process.*

*Criminal history record checks are required prior to employment. All employment offers are contingent upon compliance with Form I-9 completion timeliness and confirmation of employment authorization by E-Verify.*

## **Hiring Insights**

### **Job activity**

- Posted 30+ days ago

## **Appendix H Letters of Support (Employment Demand)**



August 24, 2023

Dr. Tracey Dawson Green, Ph.D

Professor & Chair

Department of Forensic Science

Virginia Commonwealth University

Patrick J. Siewert

Director of Digital Forensics & e-Discovery

ArcherHall Forensics, LLC

Dr. Green:

I'm writing this letter to express my support for the Graduate (MS) Program of Digital Forensic Studies in the Department of Forensic Science at Virginia Commonwealth University (VCU). ArcherHall is a Nationwide provider of litigation support digital forensic services, which assists litigators in both civil and criminal matters with a wide range of forensic data collection, analysis, reporting and expert witness services. As Director of Digital Forensics & e-Discovery at ArcherHall, my responsibilities include oversight of a caseload of dozens of digital forensic projects at any given time, as well as supervision over senior and junior-level examiners to ensure quality control and accurate results for our clients. Accordingly, we conduct digital forensic analysis daily to ensure our clients are well-served and our services add value to their cases.

Advanced education and knowledge are notable commodities in the practice of digital forensic analysis. In reviewing the proposed curriculum for the MS degree in digital forensics at VCU, it seeks to solve the issues that we frequently encounter among those with more basic knowledge in the areas of advanced and specialized application of certain disciplines and effective Expert testimony and presentation in a court of law. These are crucial skills that are generally not addressed at the Undergraduate level and would only serve to make an MS Graduate in this program much more effective as a potential Expert in the field.

Both presently and in the future, ArcherHall looks to hire the most qualified candidates for Digital Forensic Examiner positions, which ideally would include those who possess an MS in Digital Forensic Sciences from VCU. Possessing a graduate-level degree in a burgeoning field such as this would make the candidate much more competitive and only serve to increase the overall value of the team at an organization like ArcherHall.

It is my goal that this letter of support helps bolster the general approval for the Master of Science in Digital Forensics program at VCU. Please don't hesitate to reach out to me if you have any additional questions or needs and I look forward to continued participation in and support for the digital forensic program at VCU.



Regards,

Patrick J. Siewert

Director of Digital Forensics & e-Discovery

ArcherHall Forensics, LLC

Ph: 804-588-9877

Email: [psiewert@archerhall.com](mailto:psiewert@archerhall.com)





**COMMONWEALTH of VIRGINIA**  
*Office of the Attorney General*

**Jason S. Miyares**  
Attorney General

202 North 9th Street  
Richmond, Virginia 23219  
804-786-2071  
FAX 804-786-1991  
Virginia Relay Services  
800-828-1120

To Whom it May Concern,

I am writing this letter in support of Virginia Commonwealth University's (VCU) submission for approval of a new M.S. degree in Digital Forensics & Incident Response (DFIR). As the Director of the Computer Forensics Unit for the Virginia Office of the Attorney General, I oversee the support and casework for digital forensics across the Commonwealth of Virginia that are submitted to our laboratory. Our lab provides government and law enforcement agencies with the ability to process electronic evidence to combat criminal activities such as human trafficking, child exploitation, narcotics offenses, homicide, and various other crimes. Digital forensics is growing in demand and the need for educated examiners and analysts is vital to the continued support of that mission.

A M.S. degree in DFIR would be extremely beneficial to society as it provides education to allow graduates to respond to criminal activity as well as support for the private sector. A significantly hiked workload and case backlog indicates that more personnel are needed in this field to increase efficiency, decrease turnaround time, and handle much more complicated problems that may arise. As someone who went through a Digital Forensic Science M.S. program, I can attest to the benefits of such a program. Upon completion of my degree, my knowledge-base was heightened to be able to successfully identify and deal with much more complex issues that arise during the DFIR process, to the benefit of my agency.

Upon reviewing the curriculum for the proposed M.S. program, I feel confident that the education that students would receive would be able to allow them to succeed in the field. I see many classes and topics that are extremely relevant to today's DFIR field and will benefit the students and the professional market greatly. Our lab here at the OAG is small at the moment but I have hopes to expand it in the coming years. As the hiring manager for my lab as well, I find that a formal education in anything closely related to DFIR is sorely lacking and my hiring pool has suffered because of it. Any graduates from a DFIR program at VCU would be welcome internship and hiring applicants.

Regards,

Erick Paulson  
Director, Computer Forensics Unit  
Computer Crime Section  
Virginia Office of the Attorney General  
epaulson@oag.state.va.us



August 24, 2023

Dr. Tracey Dawson Green, Ph.D

Professor & Chair

Department of Forensic Science

Virginia Commonwealth University

Patrick J. Siewert

Director of Digital Forensics & e-Discovery

ArcherHall Forensics, LLC

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I'm writing this letter to express my support for the Graduate (MS) Program of Digital Forensic Studies in the Department of Forensic Science at Virginia Commonwealth University (VCU). ArcherHall is a Nationwide provider of litigation support digital forensic services, which assists litigators in both civil and criminal matters with a wide range of forensic data collection, analysis, reporting and expert witness services. As Director of Digital Forensics & e-Discovery at ArcherHall, my responsibilities include oversight of a caseload of dozens of digital forensic projects at any given time, as well as supervision over senior and junior-level examiners to ensure quality control and accurate results for our clients. Accordingly, we conduct digital forensic analysis daily to ensure our clients are well-served and our services add value to their cases.

Advanced education and knowledge are notable commodities in the practice of digital forensic analysis. In reviewing the proposed curriculum for the MS degree in digital forensics at VCU, it seeks to solve the issues that we frequently encounter among those with more basic knowledge in the areas of advanced and specialized application of certain disciplines and effective Expert testimony and presentation in a court of law. These are crucial skills that are generally not addressed at the Undergraduate level and would only serve to make an MS Graduate in this program much more effective as a potential Expert in the field.

Both presently and in the future, ArcherHall looks to hire the most qualified candidates for Digital Forensic Examiner positions, which ideally would include those who possess an MS in Digital Forensic Sciences from VCU. Possessing a graduate-level degree in a burgeoning field such as this would make the candidate much more competitive and only serve to increase the overall value of the team at an organization like ArcherHall.

It is my goal that this letter of support helps bolster the general approval for the Master of Science in Digital Forensics program at VCU. Please don't hesitate to reach out to me if you have any additional questions or needs and I look forward to continued participation in and support for the digital forensic program at VCU.



Regards,

A handwritten signature in black ink, appearing to read 'Patrick J. Siewert', written in a cursive style.

Patrick J. Siewert

Director of Digital Forensics & e-Discovery

ArcherHall Forensics, LLC

Ph: 804-588-9877

Email: [psiewert@archerhall.com](mailto:psiewert@archerhall.com)

## **Appendix I Student Demand Surveys**

# M.S. in Digital Forensics Interest Survey

Virginia Commonwealth University is developing a M.S. degree in Digital Forensics for implementation in fall 2024.

This program entails 39 credits and includes a balance of forensic science courses focusing on various areas of the digital forensics discipline (e.g., computer, mobile devices, cloud, hardware, and multimedia forensics), as well as traditional forensic science (e.g., crime scene investigation, forensic evidence, criminal procedure, etc.). Students will perform directed research in digital forensics or incident response and achieve necessary certifications and hands-on training for a career in digital forensics, including acquisition and analysis of digital evidence. Potential jobs include Incident Response Analyst and Digital Forensic/Forensic Science Examiner.

After completing this program, students should be able to:

- Apply basic principles and laboratory procedures of Digital & Multimedia Sciences to forensic evidence analysis.
- Identify and evaluate the capabilities, use, potential and limitations of digital forensic laboratory theory and techniques.
- Describe and apply an understanding of legal procedure and the rules of evidence.
- Discuss the ethical and professional duties and responsibilities of the forensic scientist.
- Perform independent research, interpret data, report and orally present research findings in the digital specialty of forensic science.

We have prepared the survey below to gauge student interest in the program. Your answers to the following questions will be used in summary form only. No personally identifiable information will be released. Please feel free to contact us at [fos@vcu.edu](mailto:fos@vcu.edu) if you would like more information about the proposed program.

1. If VCU offered a MS in Digital Forensics, I would enroll.

*Mark only one oval.*

- Strongly agree
- Agree
- Neutral
- Disagree
- Strongly Disagree

2. Please rate how likely you would do each of the following. Selections range from Strongly Agree to Strongly Disagree.

Mark only one oval per row.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
<b>I am interested in pursuing a degree in Digital Forensics</b>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<b>In addition to face to face, this program should be offered fully online</b>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<b>There should be a hybrid degree program, where some courses are online and some are face to face</b>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

3. I would likely enroll in this degree program during the following academic school year:

*Mark only one oval.*

- 2024-2025
- 2025-2026
- 2026-2027
- 2027-2028
- 2028-2029

4. Please rate how likely you would do each of the following. Selections range from Strongly Agree to Strongly Disagree.

*Mark only one oval per row.*

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
<b>I would likely enroll in this program as a full-time student</b>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<b>I would likely enroll in this program as a part-time student</b>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

5. My current student classification is:

*Mark only one oval.*

- Junior (third year)
- Senior (fourth year)
- Grad Student
- Other

6. What is your current employment status?

*Mark only one oval.*

- Full-time
- Part-time
- Other

7. IF CURRENTLY EMPLOYED, in which field are you working?

*Mark only one oval.*

- Digital Forensics
- Cybersecurity
- Computer Science
- Other

8. I was born in the following year:

---



9. I am:

*Mark only one oval.*

- Female
- Male
- Transgender
- Other
- Prefer not to answer

10. My race or ethnicity is (choose one)

*Mark only one oval.*

- American Indian/Alaskan Native
- Asian
- Black/African American
- White/European American
- Hispanic
- Native Hawaiian/Pacific Islander
- Two or more
- Unknown
- Prefer not to answer

11. The highest degree I have earned is

*Mark only one oval.*

- Bachelor's Degree
- Master's Degree
- Other: \_\_\_\_\_

12. My U.S. citizen status is

*Mark only one oval.*

- U.S. Citizen
- Naturalized U.S. Citizen
- Citizen of another Nation
- Dual Citizenship
- I'd rather not say

---

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Google Forms



Timestamp	If VCU offered a MS in Digital Forensics, I would enroll.	Please rate how likely you would do each of the following. Selections range from Strongly Agree to Strongly Disagree. [I am interested in pursuing a degree in Digital Forensics]	Please rate how likely you would do each of the following. Selections range from Strongly Agree to Strongly Disagree. [In addition to face to face, this program should be offered fully online]	Please rate how likely you would do each of the following. Selections range from Strongly Agree to Strongly Disagree. [There should be a hybrid degree program, where some courses are online and some are face to face]	I would likely enroll in this degree program during the following academic school year:	Please rate how likely you would do each of the following. Selections range from Strongly Agree to Strongly Disagree. [I would likely enroll in this program as a full-time student]	Please rate how likely you would do each of the following. Selections range from Strongly Agree to Strongly Disagree. [I would likely enroll in this program as a part-time student]	My current student classification is:	What is your current employment status?	IF CURRENTLY EMPLOYED, in which field are you working?	I was born in the following year:	I am:	My race or ethnicity is (choose one)	The highest degree I have earned is	My U.S. citizen status is
7/17/2023 10:53:55	Agree	Agree	Disagree	Neutral	2024-2025	Agree	Agree	Senior (fourth year)	Part-time	Other	1996	Male	White/European American	Na	U.S. Citizen
8/29/2023 11:34:31	Agree	Agree	Strongly Agree	Strongly Disagree	2024-2025	Strongly Agree	Agree	Senior (fourth year)	Part-time	Other	1989	Male	White/European American	Bachelor's Degree	U.S. Citizen
8/25/2023 15:35:41	Agree	Strongly Agree	Disagree	Neutral	2025-2026	Agree	Agree	Junior (third year)	Part-time	Other	2001	Male	White/European American	Bachelor's Degree	U.S. Citizen
7/13/2023 10:40:30	Agree	Agree	Agree	Strongly Agree	2024-2025	Strongly Agree	Strongly Disagree	Senior (fourth year)	Other	Other	2002	Female	White/European American	Some college	U.S. Citizen
8/25/2023 16:34:09	Agree	Agree	Neutral	Agree	2025-2026	Agree	Neutral	Junior (third year)	Other	Other	2003	Female	White/European American	Associates degree	U.S. Citizen
7/20/2023 11:37:51	Agree	Neutral	Disagree	Agree	2024-2025	Agree	Disagree	Senior (fourth year)	Full-time	Other	2001	Female	Two or more	Associate's Degree	U.S. Citizen
8/11/2023 18:01:31	Agree	Agree	Agree	Strongly Agree	2026-2027	Agree	Agree	Junior (third year)	Full-time	Computer Science		Female	Prefer not to answer	Bachelor's Degree	U.S. Citizen
7/13/2023 9:49:30	Agree	Agree	Neutral	Strongly Agree	2024-2025	Agree	Strongly Disagree	Other	Part-time	Other	2004	Male	Hispanic	Advanced Studies Diplom	U.S. Citizen
8/25/2023 20:20:06	Agree	Agree	Agree	Agree	2024-2025	Neutral	Agree	Senior (fourth year)	Part-time	Other	2001	Male	Black/African American	Associates	U.S. Citizen
8/25/2023 12:01:29	Agree	Agree	Agree	Agree	2026-2027	Strongly Agree	Strongly Agree	Other	Full-time	Other		Male	Black/African American	Master's Degree	U.S. Citizen
8/30/2023 14:15:48	Agree	Agree	Strongly Disagree	Strongly Agree	2025-2026	Agree	Strongly Disagree	Junior (third year)	Part-time	Cybersecurity	2000	Male	Black/African American	Bachelor's Degree	U.S. Citizen
8/29/2023 15:47:21	Agree	Agree	Strongly Agree	Strongly Agree	2025-2026	Agree	Strongly Agree	Junior (third year)	Full-time	Other	1994	Female	Black/African American	Associates	U.S. Citizen
8/25/2023 13:13:39	Agree	Agree	Neutral	Agree	2024-2025	Neutral	Agree	Senior (fourth year)	Part-time	Cybersecurity	2002	Male	Asian	High School	U.S. Citizen
8/7/2023 11:28:31	Agree	Neutral	Agree	Agree	2025-2026	Agree	Agree	Junior (third year)	Other	Other	2002	Male	Asian	Associates	U.S. Citizen
8/30/2023 16:21:20	Agree	Agree	Neutral	Neutral	2025-2026	Agree	Agree	Junior (third year)	Part-time	Other	2002	Male	Asian	Diploma	U.S. Citizen
8/25/2023 11:48:21	Agree	Agree	Strongly Agree	Strongly Agree	2024-2025	Neutral	Agree	Senior (fourth year)	Part-time	Cybersecurity	2000	Female	Asian	B.S in Computer Science	U.S. Citizen
8/30/2023 11:04:53	Agree	Agree	Strongly Agree	Neutral	2024-2025	Neutral	Agree	Senior (fourth year)	Other	Other		Female	Prefer not to answer	Bachelor's Degree	Naturalized U.S. Citizen
7/9/2023 18:08:19	Agree	Agree	Strongly Agree	Strongly Agree	2024-2025	Neutral	Neutral	Senior (fourth year)	Full-time	Other		Female	Prefer not to answer	Bachelor's Degree	Naturalized U.S. Citizen
7/13/2023 10:12:32	Disagree	Disagree	Neutral	Neutral			Disagree	Senior (fourth year)	Other	Other	2001	Female	White/European American		U.S. Citizen
7/13/2023 10:07:32	Disagree	Disagree	Neutral	Agree			Disagree	Other	Part-time	Other	2004	Female	White/European American	High School Diploma	U.S. Citizen
7/28/2023 17:10:41	Neutral	Neutral	Neutral	Agree	2025-2026	Neutral	Neutral	Other	Part-time	Other	2004	Female	White/European American		U.S. Citizen
8/29/2023 9:29:16	Neutral	Neutral	Strongly Agree	Neutral	2026-2027	Disagree	Agree	Senior (fourth year)	Part-time	Cybersecurity	2002	Female	Two or more	High School Diploma	U.S. Citizen
8/25/2023 9:59:16	Neutral	Neutral	Agree	Agree			Agree	Junior (third year)	Part-time	Other	2003	Female	Hispanic	HS diploma	U.S. Citizen
8/25/2023 13:52:53	Neutral	Strongly Agree	Disagree	Neutral	2024-2025		Disagree	Grad Student	Other	Digital Forensics	1998	Male	Asian	Master's Degree	Citizen of another Nation
8/25/2023 20:48:16	Strongly agree	Strongly Agree	Agree	Strongly Agree	2024-2025	Strongly Agree	Strongly Agree	Other	Other	Other	2004	Male	White/European American	High school	U.S. Citizen
8/25/2023 10:10:23	Strongly agree	Strongly Agree	Agree	Strongly Agree	2025-2026	Strongly Agree	Strongly Disagree	Senior (fourth year)	Other	Other	2002	Female	White/European American	Some college	U.S. Citizen
8/25/2023 12:18:55	Strongly agree	Strongly Agree	Disagree	Neutral	2024-2025	Strongly Agree	Neutral	Senior (fourth year)	Part-time	Other	2003	Female	White/European American	Highschool	U.S. Citizen
7/13/2023 10:30:54	Strongly agree	Strongly Agree	Strongly Agree	Strongly Agree	2024-2025	Strongly Agree	Neutral	Other	Full-time	Other	1993	Female	White/European American	Master's Degree	U.S. Citizen
7/13/2023 11:17:49	Strongly agree	Strongly Agree	Neutral	Neutral	2024-2025	Strongly Agree	Disagree	Other	Other	Other	2004	Female	White/European American	Bachelor's Degree	U.S. Citizen
8/26/2023 22:04:41	Strongly agree	Strongly Agree	Strongly Disagree	Strongly Agree	2024-2025	Strongly Agree	Other	Other	Full-time	Other	1993	Female	White/European American	Master's Degree	U.S. Citizen
8/27/2023 23:24:08	Strongly agree	Strongly Agree	Strongly Agree	Neutral	2024-2025	Strongly Agree	Other	Senior (fourth year)	Part-time	Other	2005	Female	White/European American	High School Advanced D	U.S. Citizen
7/15/2023 21:03:34	Strongly agree	Agree	Neutral	Neutral	2024-2025	Agree	Strongly Agree	Junior (third year)	Part-time	Other	2003	Female	White/European American	Associates of Science	U.S. Citizen
7/31/2023 18:32:40	Strongly agree	Strongly Agree	Strongly Agree	Strongly Agree	2024-2025	Strongly Agree	Strongly Agree	Senior (fourth year)	Other	Other	2001	Prefer not to answer	Unknown	Bachelor's Degree	U.S. Citizen
8/25/2023 11:49:46	Strongly agree	Strongly Agree	Strongly Agree	Neutral	2025-2026	Strongly Agree	Strongly Agree	Senior (fourth year)	Other	Other	2000	Male	Two or more	Working towards a back	U.S. Citizen
7/13/2023 12:32:54	Strongly agree	Strongly Agree	Strongly Agree	Strongly Agree	2024-2025	Strongly Agree	Strongly Agree	Junior (third year)	Full-time	Other	2002	Female	Hispanic		U.S. Citizen
8/25/2023 10:25:37	Strongly agree	Strongly Agree	Agree	Agree	2025-2026	Strongly Agree	Strongly Agree	Junior (third year)	Other	Other	2002	Female	Hispanic		U.S. Citizen
7/13/2023 13:31:18	Strongly agree	Strongly Agree	Strongly Agree	Strongly Agree	2024-2025	Strongly Agree	Strongly Disagree	Senior (fourth year)	Other	Other	2001	Female	Black/African American		U.S. Citizen
7/13/2023 11:32:18	Strongly agree	Strongly Agree	Strongly Agree	Strongly Disagree	2024-2025	Strongly Agree	Strongly Agree	Senior (fourth year)	Other	Other	2002	Male	Asian	Bachelor's Degree	U.S. Citizen
8/25/2023 10:49:07	Strongly agree	Strongly Agree	Strongly Agree	Strongly Agree	2025-2026	Agree	Agree	Senior (fourth year)	Part-time	Other	2002	Male	Asian	High School Diploma	U.S. Citizen
8/25/2023 14:08:32	Strongly Disagree	Strongly Disagree	Agree	Agree				Other	Other	Other	2005	Male	White/European American		U.S. Citizen
7/13/2023 9:48:03	Strongly Disagree	Strongly Disagree	Agree	Agree				Senior (fourth year)	Part-time	Other	2003	Female	White/European American		U.S. Citizen

Timestamp	Overall, the course held my interest [Please choose your response]	The tests were a reasonable assessment of material presented in the class [Please choose your response]	I felt Professor Siewert was a good presenter [Please choose your response]	I believe the university and future students would benefit from a Digital Forensic degree program at VCU designed to dive deeper into the topics covered in this class and prepare them for a career in digital forensics. [Please choose your response]	Future students taking this class would benefit from MORE _____ in the class	Future students taking this class would benefit from LESS _____ in the class	On a scale of 1 (awful) to 10 (da bomb) I would rate this class as a _____ compared to my other electives or major/minor course work (i.e., not core course work).	Because of this class, I now have an increased desire to learn more about the field of digital forensics [Please choose your response]	I felt the assignments in this class were appropriate to the lessons for which they were assigned [Please choose your response]	I would recommend other students interested in and/or majoring/minoring in Forensics take this course [Please choose your response]
2022/05/03 5:09:07 PM AST	Agree	Strongly Agree	Strongly Agree	Agree	hands on practice within the presentations to hold students attention!!	long presentations	8	Agree	Agree	Agree
2022/05/03 5:11:50 PM AST	Agree	Strongly Agree	Agree	Agree	I honestly have no opinions on how you could better the class. I think classes were well presented and I enjoyed learning about this subject.	^	8	Agree	Strongly Agree	Strongly Agree
2022/05/03 5:26:19 PM AST	Agree	Agree	Agree	Neither agree nor disagree	Case studies and why it is important to them	nothing really, it was pretty educational	9	Agree	Agree	Agree
2022/05/03 5:08:09 PM AST	Strongly Agree	Agree	Strongly Agree	Strongly Agree	real life examples	slides	9	Agree	Agree	Agree
2022/05/03 5:08:42 PM AST	Agree	Strongly Agree	Agree	Strongly Agree	class discussion	straight lecture	9	Agree	Strongly Agree	Strongly Agree
2022/05/03 7:40:31 PM AST	Agree	Strongly Agree	Strongly Agree	Strongly Agree	exams	n/a	10	Neither agree nor disagree	Agree	Agree
2022/05/03 5:06:45 PM AST	Agree	Agree	Strongly Agree	Strongly Agree	diversity in how the material is presented and case studies!	"death by powerpoint", reading a textbook, or lengthy essays (this is a great class for hands-on activities!)	10	Strongly Agree	Strongly Agree	Strongly Agree
2022/05/03 5:10:34 PM AST	Strongly Agree	Strongly Agree	Strongly Agree	Strongly Agree	Using real cases to explain certain things and show examples	maybe less code lol but tbh it was pretty interesting	10	Strongly Agree	Strongly Agree	Strongly Agree
2022/05/03 5:10:36 PM AST	Agree	Agree	Agree	Strongly Agree	Air conditioning, the room was hot--but with a more serious suggestion, it might be fun to do a quizlet or kahoot thing in class as an interactive element	Hotness--but I liked the balance of questions/lecturing/practice	10	Strongly Agree	Strongly Agree	Agree
2022/05/03 5:10:59 PM AST	Strongly Agree	Agree	Strongly Agree	Strongly Agree	From more real-life examples that gear more towards everyday things since we use tech everyday.	I don't think that there is anything that needs to be removed from this class.	9	Strongly Agree	Agree	Strongly Agree
2022/05/03 5:15:28 PM AST	Strongly Agree	Strongly Agree	Strongly Agree	Strongly Agree	Maybe more group assignments? Good team building I guess	Maybe shorter sessions Class length (the class is a few hours at a single time, but the breaks Professor Siewert gives are really helpful for stretching legs, refocusing, etc and are much appreciated)	10	Strongly Agree	Strongly Agree	Strongly Agree
2022/05/04 8:53:15 PM AST	Strongly Agree	Strongly Agree	Strongly Agree	Strongly Agree	in-class lab exercises		10	Strongly Agree	Strongly Agree	Strongly Agree

Timestamp	Username	Overall, the course held my interest [Please choose your response]	The tests were a reasonable assessment of material presented in the class [Please choose your response]	I felt Professor Siewert was a good presenter [Please choose your response]	I believe active practitioners in the field of digital forensics should be regularly involved in the instruction of future digital forensic courses at VCU. [Please choose your response]	Future students taking this class would benefit from MORE _____ in the class	Future students taking this class would benefit from LESS _____ in the class	On a scale of 1 (awful) to 10 (da bomb), I would rate this class is a _____ compared to my other electives or major/minor course work	Because of this class, I now have an increased desire to learn more about the field of digital forensics [Please choose your response]	I felt the assignments in this class were appropriate to the lessons for which they were assigned [Please choose your response]	I would recommend other students interested in and/or majoring/minoring in Forensics take this course [Please choose your response]
2022/12/01 4:19	jonesca10@vcu.edu	Strongly Agree	Agree	Strongly Agree	Strongly Agree	guest speakers maybe.	multiple selection questions were	9	Agree	Strongly Agree	Strongly Agree
2022/12/01 4:24	yuanwe@vcu.edu	Strongly Agree	Neither agree nor disagree	Agree	Neither agree nor disagree (meh)	Reminders of information. It is None	I don't think the course needs n/a	7	Agree	Strongly Agree	Strongly Agree
2022/12/01 4:30	wolffg@vcu.edu	Strongly Agree	Strongly Agree	Strongly Agree	Strongly Agree	I don't think the course needs n/a. But, please don't let them cor	more recorded lectures	9	Agree	Strongly Agree	Strongly Agree
2022/12/01 4:36	novifd@vcu.edu	Strongly Agree	Agree	Agree	Strongly Agree	partial credit on questions with n/a	lecture time and more lab work so	8	Agree	Strongly Agree	Strongly Agree
2022/12/01 4:47	melendzic@vcu.edu	Strongly Agree	Agree	Strongly Agree	Strongly Agree	at home exploration of topics	in person lecture	7	Agree	Strongly Agree	Neither agree nor disagree (meh)
2022/12/01 4:16	huser@vcu.edu	Agree	Strongly Agree	Agree	Strongly Agree	More practicals/ case studies	N/A	7	Agree	Strongly Agree	Neither agree nor disagree (meh)
2022/12/01 4:17	crustoresg@vcu.edu	Agree	Agree	Agree	Strongly Agree	labs	lecture	7	Agree	Agree	Agree
2022/12/01 4:21	hernandezj17@vcu.edu	Agree	Agree	Agree	Strongly Agree	study time	harder test	7	Agree	Agree	Agree
2022/12/01 4:26	brownad@vcu.edu	Agree	Neither agree nor disagree	Strongly Agree	Strongly Agree	Discussions	Computer problems	8	Agree	Agree	Strongly Agree
2022/12/01 4:26	bouyboudmp@vcu.edu	Agree	Disagree	Strongly Agree	Strongly Agree	Hands on exercise	Having to look over slides	7	Agree	Agree	Agree
2022/12/01 4:31	garciacz@vcu.edu	Agree	Agree	Strongly Agree	Agree	Real life examples of producers	While Taking this class I didn't com	9	Agree	Strongly Agree	Agree
2022/12/01 4:41	hamiltonp3@vcu.edu	Agree	Agree	Agree	Agree	demonstrations of digital foren	presentation of slideshows	8	Agree	Agree	Agree
2022/12/01 4:45	hernandezrt@vcu.edu	Agree	Neither agree nor disagree	Agree	Agree	real life examples that the prof	slides and more on visual examples	6	Agree	Agree	Agree
2022/12/01 4:49	manciaa@vcu.edu	Agree	Agree	Agree	Strongly Agree	Engagement	Less slides. I know every student le	7	Agree	Agree	Strongly Agree
2022/12/01 4:47	chungb@vcu.edu	Agree	Agree	Strongly Agree	Agree	Q/A, presenting themselves on	from simple lecture	8	Agree	Strongly Agree	Strongly Agree
2022/12/01 4:29	othims@vcu.edu	Strongly Agree	Strongly disagree	Neither agree nor disagree	Agree	If the professor, took the time	Students benefit less from no guid	3	Disagree	Agree	Neither agree nor disagree (meh)
2022/12/01 4:26	sajjadb@vcu.edu	Neither agree nor disagree (meh)	Disagree	Strongly Agree	Strongly Agree	Real life Cases made the class v	I don't think there should be less of	9	Neither agree nor disagree (me)	Strongly Agree	Strongly Agree
2022/12/01 4:26	saajerrk@vcu.edu	Agree	Agree	Agree	Neither agree nor disagree (meh)	with activity	lecture	6	Neither agree nor disagree (me)	Agree	Neither agree nor disagree (meh)
2022/12/01 4:27	chinka@vcu.edu	Agree	Strongly Agree	Strongly Agree	Neither agree nor disagree (meh)	videos and case examples	N/A	7	Neither agree nor disagree (me)	Strongly Agree	Agree
2022/12/01 4:29	smithjs@vcu.edu	Agree	Agree	Agree	Strongly Agree	clips of Prof. Seiwart on the coo	of an info dump for class	7	Neither agree nor disagree (me)	Agree	Agree
2022/12/01 4:36	osafoda@vcu.edu	Agree	Agree	Strongly Agree	Agree	Interactive learning	Long periods of power point infor	8	Neither agree nor disagree (me)	Strongly Agree	Strongly Agree
2022/12/01 4:27	pajjevic@vcu.edu	Strongly Agree	Agree	Strongly Agree	Strongly Agree	If they attend class, and take n	Don't attend class	8	Neither agree nor disagree (me)	Strongly Agree	Strongly Agree
2022/12/01 4:29	bellamyvm@vcu.edu	Strongly Agree	Strongly Agree	Strongly Agree	Strongly Agree	the cyber range worked more	I would just lightly recommend 2 b	10	Strongly Agree	Strongly Agree	Strongly Agree
2022/12/01 4:31	connre@vcu.edu	Strongly Agree	Agree	Strongly Agree	Strongly Agree	Cyber Lab	Written Home Work	10	Strongly Agree	Strongly Agree	Strongly Agree
2022/12/01 4:57	ojon2@vcu.edu	Strongly Agree	Strongly Agree	Strongly Agree	Strongly Agree	short assignments and test rev	material covered per test; maybe h	8	Strongly Agree	Strongly Agree	Strongly Agree
2022/12/01 4:24	salasmr@vcu.edu	Strongly disagree	Strongly disagree	Strongly disagree	Strongly disagree	notes	lecture	10	Strongly Agree	Strongly Agree	Strongly Agree
						group assignments	information per test	7	Strongly disagree	Strongly disagree	Strongly disagree

## **Appendix J Prospective Student Support**

# Leaving the BS/MS program and Digital Forensics at VCU

Inbox

L

██████████  
to me

3:30 PM (3 minutes ago)

Good afternoon Jo!

I was honored to accept a spot in the accelerated BS/MS in forensic science program right before my senior year at VCU. At that time I was interested in a career in forensic medicine and the program was perfect for my educational journey. My plan was to do research and further my forensic education via the MS program and to use the extra semester that the accelerated program granted to prepare for my applications for medical school and to take my MCAT. I loved the classes that I took during my senior year that were a part of the accelerated track, and overall they're some of my favorite classes from VCU overall as well.

At the end of the first semester of my senior year and as the time to start thinking about my formal application to the graduate program drew closer, I was thinking about if the forensic medicine track was right for me and if there were other careers that I hadn't fully considered during my time in college. After talking with some professionals in the fields of cybersecurity and digital forensics, I decided to make a shift in my plans and instead try to pursue a career in digital forensics. I had become disenchanted with the idea of staying in school for so long on the medical track and I've been interested in the ever developing technological fields for a while, and I officially made the switch at the end of that semester. In order to pursue this new track I would have to apply for MS programs in either cybersecurity or in digital forensics, which meant that I had to leave the accelerated BS/MS in forensic science program that I was a part of.

Since then, I've been accepted into NYU's Tandon Bridge program which is an accelerated program with the intention of preparing non-engineering or technical students for masters in technical fields. I am currently working on my applications for graduate schools, and am applying to programs in digital forensics and cybersecurity. There are not many schools with digital forensic specific programs, so I am applying for the cybersecurity programs with the intention of specializing later on if needed. I would have loved to see a digital forensics program at VCU and would have had no hesitation in applying if there was one when I was a student. I was so excited to hear that there may be a program starting for digital forensics, and if I have not already joined a masters program I would absolutely apply to VCU's when it becomes available. I had a great college experience at VCU and am so happy that more pathways within the forensics field are becoming available for students like me!

██████████  
Class of 2023





Tracey Dawson Green <tcdawson@vcu.edu>

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## Fwd: Masters in Forensic Science

1 message

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**VCU Forensic Science** <fos@vcu.edu>  
To: Tracey Dawson Green <tcdawson@vcu.edu>

Tue, Aug 29, 2023 at 1:33 PM

----- Forwarded message -----

From: [REDACTED]  
Date: Fri, Nov 20, 2015 at 2:35 PM  
Subject: RE: Masters in Forensic Science  
To: VCU Forensic Science <fos@vcu.edu>

Hi Jo Murphy,

I am sorry I was not able to make the open house. I had to work.

I am 4 weeks away from officially finishing my bachelor's degree in criminal justice.

I have been thinking, where do I go from here? I am currently an Account Manager at a trucking company which has nothing to do with criminal justice so I feel like I am starting over.

I know a few things, I do not want to be a police officer but I would love to be a homicide detective. I know you have to be one before the other so this is not an option for me.

I have looked up several different careers within the criminal justice world and it looks like all of them involve science or computers.

I would love a career in cyber crime or forensic science so I wanted to see if you could give me some direction as to where I go from here.

Do I get a Masters in criminal justice? Will a Masters in Forensic Science be an option? What about a Masters in Cyber Crime/IT?

I do appreciate your help and I look forward to hearing from you soon.

Have a great weekend! 😊

Thank you,

[REDACTED]

[REDACTED]

[REDACTED]



Tracey Dawson Green &lt;tcdawson@vcu.edu&gt;

---

**Fwd: Prospective Graduate Student**

1 message

Tue, Aug 29, 2023 at 12:43 PM

----- Forwarded message -----

Date: Thu, Feb 9, 2023 at 10:26 PM

Subject: Prospective Graduate Student

To: [cmconnan@vcu.edu](mailto:cmconnan@vcu.edu) <[cmconnan@vcu.edu](mailto:cmconnan@vcu.edu)>, [fos@vcu.edu](mailto:fos@vcu.edu) <[fos@vcu.edu](mailto:fos@vcu.edu)>, [wsadvisor@vcu.edu](mailto:wsadvisor@vcu.edu) <[wsadvisor@vcu.edu](mailto:wsadvisor@vcu.edu)>

Good evening All,

My name is [REDACTED] and I am looking to continue my education at VCU for my Master's in Criminal Justice. I am currently working on an application for the Wilder School and have submitted a request to tour the school. I received my Bachelor's of Science from Old Dominion University with a minor/concentration in Cybersecurity.

I am hoping to earn a minor and/or certificate in forensic science in either a two year or four year program.

I would like to schedule an appointment with an academic advisor. I am able to attend either a virtual or in-person meeting. Is there a graduate academic advisor available, and if so, may I have an advisor's contact information?

Thank you,  
[REDACTED]

Sent from my Verizon, Samsung Galaxy smartphone  
Get [Outlook for Android](#)

--

Jo S Murphy, MSW  
Department & Community Engagement Coordinator  
Department of Forensic Science  
Virginia Commonwealth University  
[804.828.8420](tel:804.828.8420)



Tracey Dawson Green &lt;tcdawson@vcu.edu&gt;

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**Fwd: Seeking Admission for Masters in Forensic Science**

1 message

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**VCU Forensic Science** <fos@vcu.edu>  
To: Tracey Dawson Green <tcdawson@vcu.edu>

Tue, Aug 29, 2023 at 1:31 PM

----- Forwarded message -----

From: [REDACTED]  
Date: Wed, Aug 4, 2021 at 4:38 AM  
Subject: Re: Seeking Admission for Masters in Forensic Science  
To: VCU Forensic Science <fos@vcu.edu>

Hi Jo

I am also interested in cybersecurity and did an undergraduate masters in computer science. Hence wanted to understand if the university offers a double masters in cyber security as well as forensic science?

Best Regards

Sent with [ProtonMail](#) Secure Email.

----- Original Message -----

On Wednesday, July 21st, 2021 at 10:40 PM, VCU Forensic Science &lt;fos@vcu.edu&gt; wrote:

Hi [REDACTED],  
Thanks for your interest in the VCU Department of Forensic Science MS program. All of our students matriculate in the fall so a spring 2022 admission is not an option. Without seeing your evaluated transcript, I'm not sure whether you've completed the necessary coursework. Successful applicants must have completed an eight -credit course sequence (with laboratories) in both general biology and organic chemistry. Further, students wishing to be considered for the forensic biology track will be required to have an additional 9 semester credits (or equivalent) of upper-level biology coursework. Students that desire to be considered for either of the chemistry tracks will be required to have an additional 9 credits of upper level chemistry coursework. Students that desire to be considered for the Physical Analysis track will be required to have an additional 9 credits of either upper level chemistry or biology coursework. If you haven't completed the necessary courses, you may take the courses at any accredited college or university, Lab or research experience will also enhance your chance for admission.

For additional information, please see our [graduate admissions page](#) with our most recent Graduate Open House video.

Please let me know if you have other questions or if there's anything else I can do to help,

Kind wishes & stay safe,  
Jo

On Fri, Jul 16, 2021 at 12:22 PM [REDACTED] &gt; wrote:

Dear Jo ,

I am [REDACTED] and I have just completed a BTech in Biotechnology with a minor in Computer Science ( 4 year undergrad degree) from PES University, Bangalore, India . I chose forensic science as one of my electives and I am very keen on working in the area of forensic sciences and criminal investigation and hence need your guidance on how I can seek admission at VCU for the term starting Jan 2022. Also please advise on any additional online courses I could do in the interim that would enhance my chances of securing admission for the course.

## Appendix K Cited Works

# What is the Preferred Educational Background of Forensic Scientists?

Mark Marohl<sup>1</sup>, Grace Jensen<sup>2</sup> and Heather Barkholtz<sup>3,4,\*</sup>

<sup>1</sup>Molecular and Environmental Toxicology Program, University of Wisconsin-Madison, 1300 University Avenue, Madison, WI 53706, USA

<sup>2</sup>Endocrinology and Reproductive Physiology Program, University of Wisconsin-Madison, 1300 University Avenue, Madison, WI 53706, USA

<sup>3</sup>Pharmaceutical Sciences Division, School of Pharmacy, University of Wisconsin-Madison, 777 Highland Avenue, Madison, WI 53705, USA

<sup>4</sup>Forensic Toxicology Section, Wisconsin State Laboratory of Hygiene, 2601 Agriculture Drive, Madison, WI 53718, USA

\*Author to whom correspondence should be addressed. Email: [hbarkholtz@wisc.edu](mailto:hbarkholtz@wisc.edu)

## Abstract

Forensic science is a broad and rapidly developing field where fundamental scientific principles and techniques are used to investigate crimes. As the field evolves, universities offering forensic science degrees are increasing in both number and diversity of curricula. Paramount to any discussion around forensic science education is an assessment of what educational degrees are preferred by those hiring both entry- and supervisory-level forensic scientists. Quantification of degree preference through surveys of hiring officials occurred in 1986 and 1996. Since then, the Forensic Science Education Programs Accreditation Commission was established and has flourished, potentially enhancing the desirability of forensic science degrees. An updated survey was conducted to identify current educational background preferences within the field. The survey was distributed to members of the American Society of Crime Laboratory Directors and members of the Society of Forensic Toxicologists in hiring or leadership roles, yielding 221 responses. Results indicated a continued preference for a degree combination of master's in forensic science and a bachelor's degree in physical or biological sciences for both entry- and supervisory-level candidates. Holding only a bachelor's in the physical or biological sciences was also preferred for entry-level candidates whereas the preference for supervisory-level candidates was strongly influenced by the respondents' terminal degree.

## Introduction

Forensic scientists straddle the realms of basic and applied science, applying fundamental principles of biology, chemistry, mathematics and physics while aiding in investigations of crimes. Most practitioners receive an undergraduate education in a science, technology, engineering or mathematics (STEM) discipline and learn how to apply this knowledge on-the-job through lengthy apprenticeship-style training programs. In the past three decades, several groups have published data and recommendations on improving forensic science education. Practitioners were queried about hiring practices and desired education and skill sets of candidates in 1986 (1), 1988 (2), 1994 (3), 1996 (4) and 2019 (5). Several other works explored variability and trends in academic programs (6–9), educational pathways to forensic science careers (10) and effectiveness of forensic education pedagogy (11). However, only studies from 1986 (1) and 1996 (4) asked hiring managers what degrees were preferred and required, respectively.

In 1986, Siegel (1) surveyed American Society of Crime Laboratory Directors (ASCLD) members (240 surveyed, unknown response rate), asking preferred educational backgrounds for entry-level forensic scientists. The most preferred educational backgrounds were (#1) a 5-year program leading to a Master of Science (MS) in forensic science (26.7%) followed by (#2) a Bachelor of Science (BS) + MS in forensic science (25.4%). Siegel did not specify BS degree subject

matter and offered a write-in “other” category. Seizing this opportunity, respondents chose “other” and indicated that a BS in chemistry followed by an MS in forensic science was ideal, garnering the third most preferred (16.3%) degree combination. Overall, nearly 66% of respondents preferred that entry-level candidates have an MS degree. Furthermore, Siegel's work found that crime laboratory directors preferred candidates with a strong chemistry or other “hard” science background.

In 1988, Higgins et al. (2) reported results from a survey of American Academy of Forensic Sciences members who were forensic science laboratory managers (156 surveyed, 15% response rate) on the status and appropriateness of graduate-level forensic science education in the USA. Respondents were asked to compare their preference for hiring a candidate with a forensic science graduate degree versus those with “traditional academic backgrounds.” Responses were divided, with 10 preferring candidates with a graduate degree in forensic science, 9 preferring those with “traditional academic backgrounds,” and 2 were ambivalent.

In 1994, Lindquist et al. (3) reported results from a survey of ASCLD members (342 surveyed, 51.8% response rate) on a proposed graduate education model for conventional criminalists (i.e., analysis of firearms, toolmarks, fingerprints, glass, hair and fibers). This proposal was a clinical training model emphasizing an apprenticeship under experienced criminalists. Respondents generally supported the proposed

criminalist graduate program, and authors reported that they were considering implementing it.

In 1996, Furton et al. (4) surveyed ASCLD members (350 surveyed, 15% response rate) for their educational and experience background preferences in candidates for various forensic science specialty positions and found that crime lab directors continued to prefer candidates with BS degrees specializing in (rank = 1) chemistry or biochemistry (2), biology and (3) forensic science.

The National Institute of Justice published a forensic science status update in 1999 and identified needs (12). This report described changes to the field of forensic science resulting from implementation of forensic DNA analysis. These changes resulted in increased demand for forensic science services and a corresponding growth in educational programs. The report identified concerns around the quality of new forensic science education programs, recommending that national consensus standards for forensic science education be developed. In response, the Forensic Education Programs Accreditation Commission (FEPAC) was established in 2002 and awarded its first accreditation in 2004. Accreditation requires that programs meet minimum core curriculum and infrastructure standards (13). As forensic science is a broad and diverse field, FEPAC accreditation allows for programmatic specialization as long as core requirements are met. At the time of this publication, FEPAC lists 26 accredited bachelors and 21 masters programs (14).

In 2009, the National Research Council published "Strengthening Forensic Science in the United States: A Path Forward," wherein an entire chapter was devoted to the topic of forensic science education (15). This report applauded FEPAC's establishment and listed accredited programs. It concluded by calling for continued work assessing and improving the quality and relevance of existing forensic science educational programs.

In 2018, Brown et al. (5) surveyed ASCLD members (number surveyed and response rate not reported) asking what educational qualifications and skill sets they preferred in entry-level candidates across several disciplines. Respondents indicated that relevant coursework and laboratory experience were the most important factors. The next most important considerations were the candidate's interview performance and maturity or character. Respondents identified professional skills, hands-on experience with instrumentation and testimony training as areas where applicants were least prepared. Respondents were also asked to provide detailed information on credits per subject area for applicants seeking entry-level positions in specialty areas. Results indicated that generally, candidates with more credits in STEM courses were preferred, particularly those with subject-relevant electives (e.g., forensic biology, pattern analysis, etc.).

FEPAC continues to accredit educational BS and MS programs and contribute to an overall increase in the quality of available forensic science education. Increasing the availability of high-quality forensic science educational programs is beneficial to both the forensic science community and the public; however, since FEPAC's inception, no studies have re-surveyed crime lab directors regarding their preferences for candidate educational degrees. Furton et al. (4) concluded their 1999 publication:

'It is important to complete educational surveys such as the one summarized here on a regular basis in order to ascertain current trends in desired educational requirements by potential employers. Such information is invaluable in the future development of forensic science educational programs.'

In this work, we sought to re-examine the preferred degrees held for both entry-level and supervisory forensic science candidates. Data were gathered through an electronic survey distributed to crime laboratory directors, members of leadership, and hiring managers.

## Methods

Research was performed as an electronic survey distributed through Qualtrics XM, for which the University of Wisconsin-Madison holds a contract. The survey was distributed via anonymous link, and responses were only accessible to those with survey administrator log-in credentials. Survey questions paralleled those used by Siegel (1) and asked what educational background respondents prefer in entry- and supervisory-level candidates and how often the selected candidate has that educational background. Respondents were asked to rank from 1 (most preferred) to 7 (least preferred) various hypothetical educational backgrounds of entry-level and supervisory-level candidates. After each question about preferred candidate background, respondents were asked how often hired candidates had their preferred educational background. Respondents were given the following options: all the time (90–100% of new hires), often (75–89% of new hires), sometimes (50–74% of new hires), rarely (less than 50% of new hires), and I do not know or not applicable (N/A).

Demographics such as respondent educational background, area of expertise, number of direct reports and length of time in current role were also collected. Areas of expertise or specialty were collected as open text. Responses were coalesced with the aggregation measures defined in Table I. If respondents listed more than one specialty area, all were included. The respondents' supervisory status was probed by asking them to select the statement which best described their role from the following options: I do not have any direct reports, I have at least one direct report, I have at least one direct report that supervises others or I have many direct reports that supervise others.

The survey asked about any research being conducted within the laboratory. If research was conducted, respondents

**Table I.** Respondent Area of Expertise or Specialization Aggregation Measures

Recorded response	Possible open text responses
Chemistry	Analytical chemistry, organic chemistry and biochemistry
DNA	Serology, biology and molecular biology
Toxicology	Forensic toxicology, analytical toxicology, clinical toxicology, chemical toxicology and alcohol toxicology
Seized drugs	Drug chemistry
Pattern analysis	Print analysis, firearm analysis and toolmark analysis

were asked about the category of forensic science, if students participate and the student's educational level. If laboratories were not engaging in research, respondents were asked about barriers. Survey questions and results are available in Supplemental Materials.

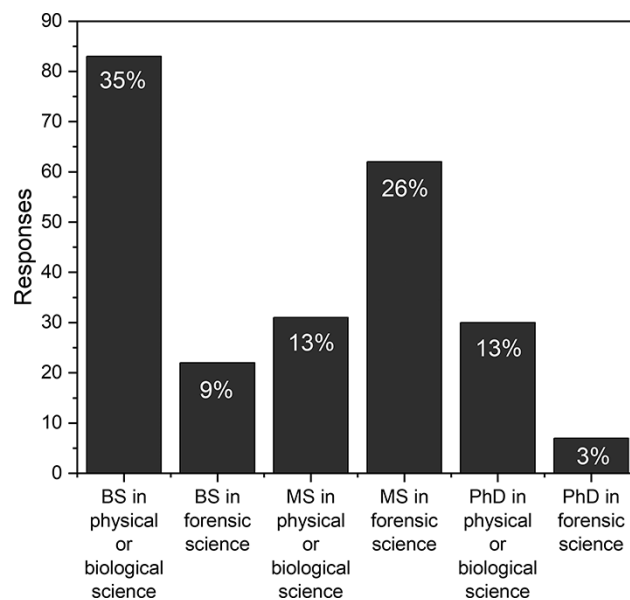
To effectively reach potential respondents, the authors worked with the leadership of two large forensic science professional societies: ASCLD and the Society of Forensic Toxicologists (SOFT). Society presidents were informed about the project and used their listservs for survey distribution. ASCLD members ( $n \sim 700$ ) were sent a link to the survey through the weekly Crime Lab Minute newsletter, on 6 September 2021, with a reminder on 11 October 2021. SOFT members in leadership or hiring roles ( $n = 128$ ) were emailed a link to the survey on 10 November 2021 and sent a reminder on 17 November 2021. The survey was closed on 5 December 2021.

This work has several limitations. The use of an electronic survey has inherent limitations in response bias and self-reporting bias. Survey distribution through the ASCLD newsletter was relatively uncontrolled, and those other than forensic science practitioners could have submitted responses. Considering respondents' self-reported area of expertise, the fields of criminalistics ( $n = 2$ ) and digital analysis ( $n = 1$ ) may be underrepresented in this work whereas toxicology ( $n = 71$ ) and DNA ( $n = 52$ ) may be overrepresented; however, that does not necessarily indicate which expertise they oversee and/or recruit. Furthermore, not all educational background degree combinations were captured in survey options. Also, no attempt was made to quantify preference for specific curriculum elements or relevant work experiences as Brown et al. (5) covered this in 2019. Additionally, no survey questions asked if the respondent was familiar with FEPAC or what value they placed on FEPAC.

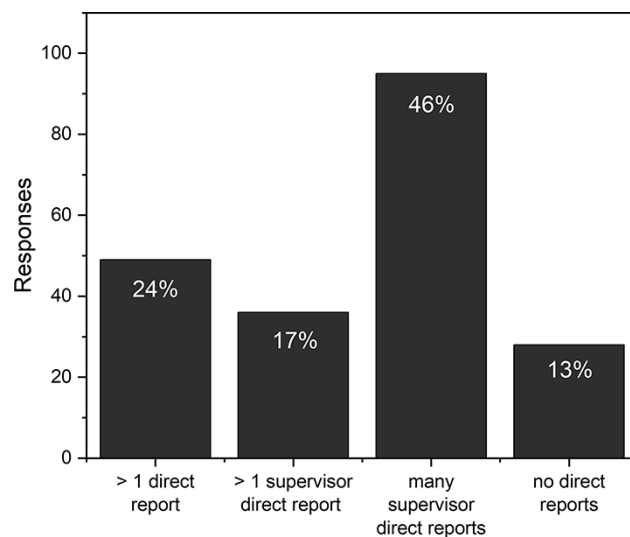
## Results

Of the potential 828 responses, 221 (27% overall response rate) were received. Responses were received from 163 (23% response rate) ASCLD and 58 (45% response rate) SOFT members. Responses from ASCLD and SOFT members were coalesced for analysis, with ASCLD members representing 74% of responses. Information about the respondent was collected to understand the population surveyed and contextualize survey results. Respondents' terminal degrees (Figure 1) were primarily a BS in a physical or biological science (35%), MS in forensic science (26%) and MS in a physical or biological science (13%). Of note, very few respondents held a PhD in forensic science (3%) or BS in forensic science (9%). Respondents' areas of expertise or specialty were primarily toxicology (71), DNA (52), pattern analysis (36) and seized drugs (30). Most (95, 45%) had many direct reports that supervise others, 49 (24%) had at least one direct report, 36 (17%) had at least one direct report that supervises others and 28 (13%) had no direct reports (Figure 2). Over half (56%) of respondents had been in their current role for <10 years, and 31 (15%) respondents for 20 or more years (Figure 3).

Results for the most preferred educational background of entry-level candidates included 61 (36%) BS in physical or biological science and 46 (27%) MS in forensic science with a BS in physical or biological science (Table IIA). Respondents indicated that the selected candidate had their preferred educational background (Figure 4A), often (49, 28%), rarely



**Figure 1.** Self-reported educational background of survey respondents ( $n = 235$ ).

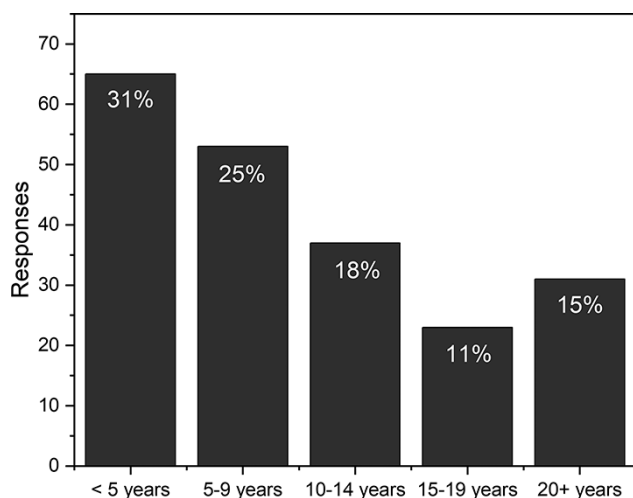


**Figure 2.** Self-reported description of respondents' current supervisory role ( $n = 208$ ).

(43, 24%), all the time (41, 23%), and sometimes (40, 23%); only three (2%) stated that they did not know.

Results for the most preferred educational background for supervisory- or leadership-level candidates (Table IIB) included 49 (29%) MS in forensic science with BS in physical or biological science. Rates in which selected candidates had the preferred educational background were reported as often (50, 29%), rarely (45, 26%), sometimes (33, 19%) and all the time (27, 16%). For leadership-level positions, 19 (11%) responded that they did not know if the selected candidate had the preferred educational background.

Results for the most preferred educational background for both entry-level and supervisory-level candidates was also explored as a function of respondent-reported terminal degree (Table III). The most preferred educational background for candidates were separated by respondent educational



**Figure 3.** Self-reported length of time respondents have been in their current role ( $n = 209$ ).

background. For the evaluation of the preferred educational backgrounds, respondents held the following terminal degrees: BS (77, 46%), MS (54, 32%) and PhD (32, 19%), with six not responding. The degree combination of a MS in forensic science with BS in physical or biological sciences was consistently preferred despite the respondents' terminal degree. Deviations were identified in the preferred educational background for supervisory-level candidates where the reported preference overlapped with the respondents' terminal degree. Similarly, although to a lesser extent, preference for entry-level candidates with a BS in physical or biological sciences was more preferred by respondents with a terminal BS degree.

Respondents were asked if they required candidates to graduate from FEPAC-accredited programs, preferred it, or

did not pay attention to the accreditation status of the candidate's educational program. Most respondents (115, 66%) did not pay attention to accreditation status. When attention was paid, 51 (29%) responded that FEPAC accreditation was preferred and 9 (5%) required it. Comparing responses from ASCLD versus SOFT members revealed similar preferences. ASCLD respondents required (8, 2%), preferred (36, 29%) and did not pay attention (79, 64%) to FEPAC accreditation status; SOFT respondents required (1, 2%), preferred (15, 29%) and did not pay attention (36, 69%). No respondent selected "prefer candidates without FEPAC-accredited degrees—please explain."

Participation in research projects was explored. Respondents were split: 52% were not engaged in research project(s) and 44% were. Those not engaged cited lack of people (30%), time (24%) and money (10%), as well as prioritizing caseload or backlog (26%) as primary reasons. Many cited more than one reason. Of those who do participate in research project(s), topics included 40 (24%) biology/DNA, 39 (23%) toxicology, 26 (16%) physics/pattern interpretation and 23 (14%) seized drugs. Students are often (58%) engaged in these projects including BS (24%), MS (22%) and PhD (14%) candidates.

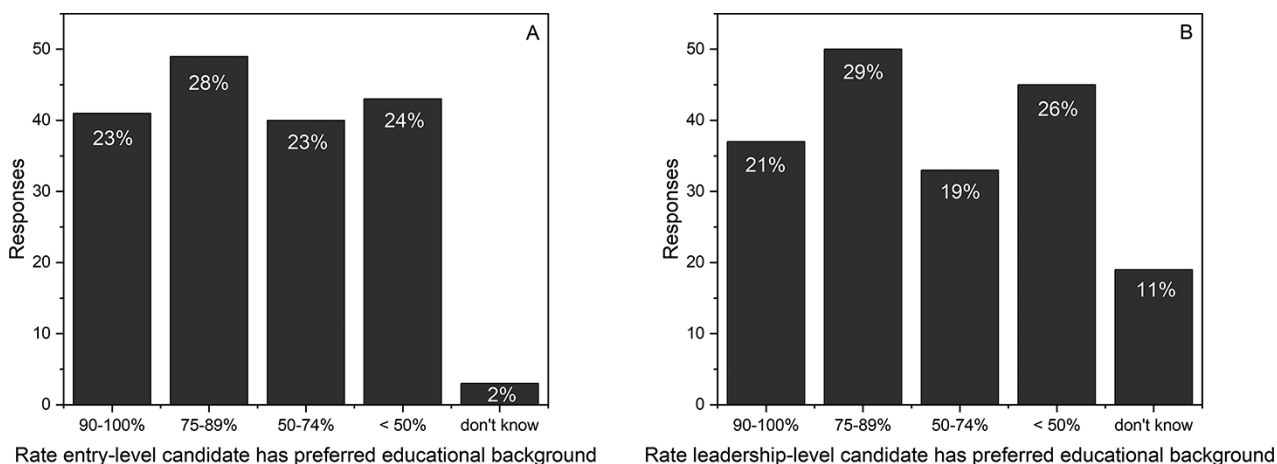
## Discussion

Data gathered by this survey provide a valuable update on the education preferences of forensic science practitioners. An overwhelming majority of respondents (86.5%) have at least one direct report, meaning that they are likely aware of the educational backgrounds most associated with successful forensic scientists. More than half (56.6%) of respondents have been in their roles for <10 years, implying that responses come with a knowledge of available educational offerings. We therefore assume that respondents are aware of FEPAC accreditation and its value. There was also a wide array of

**Table II.** Preferred Educational Levels for Candidates ("1" Indicates Most Preferred). To Aid in Reading the Table, the Most Preferred Educational Backgrounds are Highlighted with Bold Font and Gray Cell

Degree preference level:	1	2	3	4	5	6	7
<b>Entry-level positions (<math>n = 169</math>)</b>							
BS in forensic science	16.57%	17.75%	9.47%	13.61%	22.49%	7.69%	12.43%
BS in physical or biological science	<b>36.09%</b>	<b>22.49%</b>	13.02%	13.02%	4.73%	5.92%	4.73%
MS in forensic science (with BS in forensic science)	4.73%	10.06%	27.81%	26.63%	21.89%	7.69%	1.18%
MS in forensic science (with BS in physical or biological science)	<b>27.22%</b>	<b>23.08%</b>	18.93%	29.59%	0.59%	0.59%	0.00%
MS in physical or biological sciences (with BS in physical or biological science)	10.06%	<b>22.49%</b>	26.63%	5.92%	31.36%	2.96%	0.59%
PhD in forensic science	2.37%	1.78%	2.37%	4.73%	6.51%	51.48%	30.77%
PhD in physical or biological science	2.96%	2.37%	1.78%	6.51%	12.43%	23.67%	50.30%
<b>Supervisory-level positions (<math>n = 168</math>)</b>							
BS in forensic science	5.95%	10.12%	7.74%	14.29%	17.86%	16.67%	27.38%
BS in physical or biological science	15.48%	8.93%	13.69%	11.31%	10.71%	23.21%	16.67%
MS in forensic science (with BS in forensic science)	14.29%	14.29%	23.81%	19.64%	20.24%	5.95%	1.79%
MS in forensic science (with BS in physical or biological science)	<b>29.17%</b>	<b>25.00%</b>	20.83%	21.43%	2.98%	0.60%	0.00%
MS in physical or biological science (with BS in physical or biological science)	13.10%	<b>22.02%</b>	25.00%	9.52%	25.60%	4.17%	0.60%
PhD in forensic science	11.90%	7.14%	5.36%	11.31%	10.71%	35.71%	17.86%
PhD in physical or biological science	10.12%	12.50%	3.57%	12.50%	11.90%	13.69%	35.71%





**Figure 4.** Frequency that the selected candidate has the preferred educational background for (A) entry-level positions ( $n = 176$ ) and (B) leadership-level positions ( $n = 174$ ).

**Table III.** Responses to Most Preferred (“1”) Educational Levels for Candidates as a Function of Respondent Terminal Degree. To Aid in Reading the Table, the Most Preferred Educational Backgrounds are Highlighted with Bold Font and Gray Cell

Most preferred (“1”) entry-level candidate degree	Respondent has PhD	Respondent has MS	Respondent has BS	Aggregate of all
<b>Entry-level positions (<math>n = 163</math>)</b>				
BS in forensic science	21.88%	9.26%	14.29%	16.07%
BS in physical or biological science	<b>25.00%</b>	<b>33.33%</b>	<b>45.45%</b>	<b>36.09%</b>
MS in forensic science (with BS in forensic science)	6.25%	5.56%	3.90%	4.73%
MS in forensic science (with BS in physical or biological science)	<b>28.13%</b>	<b>31.48%</b>	<b>25.97%</b>	<b>27.22%</b>
MS in physical or biological sciences (with BS in physical or biological science)	3.13%	18.52%	7.79%	10.06%
PhD in forensic science	6.25%	0.00%	1.30%	2.37%
PhD in physical or biological science	9.38%	1.85%	1.30%	2.96%
<b>Supervisory-level positions (<math>n = 168</math>)</b>				
BS in forensic science	9.38%	3.70%	5.13%	5.95%
BS in physical or biological science	3.13%	7.41%	<b>26.92%</b>	15.48%
MS in forensic science (with BS in forensic science)	18.75%	7.41%	15.38%	14.29%
MS in forensic science (with BS in physical or biological science)	<b>21.88%</b>	<b>37.04%</b>	<b>28.21%</b>	<b>29.17%</b>
MS in physical or biological science (with BS in physical or biological science)	6.25%	<b>22.22%</b>	10.26%	13.10%
PhD in forensic science	15.63%	14.81%	7.69%	11.90%
PhD in physical or biological science	<b>25.00%</b>	7.41%	6.41%	10.12%

specializations represented, which lends credence that results are generalizable across the forensic sciences.

Results from this survey are consistent with works from 1986 (1) and 1996 (4), despite the emergence of FEPAC-accredited forensic science BS and MS programs. Over half of respondents undertook their current role after FEPAC was established, which underscores the stability of hiring preferences over time. In this work, a BS in physical or biological science followed by an MS in forensic science was the most consistently preferred degree combination for both entry-level and supervisory-level candidates. This remained true when looking at candidate degree preference as a function of the respondents’ terminal degree. There was a significant overlap between the respondents’ own educational background and supervisory-level candidate preferences, Table III.

An impetus for this work was identifying what impacts the emergence of FEPAC accreditation has had on the desirability of certain educational degrees. We found that the

majority (95%) of respondents did not require candidates graduate from FEPAC-accredited programs. Most (66%) did not pay attention to whether or not candidate degrees were conferred from FEPAC-accredited programs. This work did not explore possible reasons for this. Future surveys should include relevant questions or explore the topic on their own.

### Acknowledgments

The authors wish to thank members of the American Society of Crime Laboratory Directors (ASCLD) and the Society of Forensic Toxicologists (SOFT) for taking the time to submit thoughtful responses to our survey. Without your responses, this work would not be possible! The authors also wish to acknowledge the critical role Jennifer Naugle (ASCLD president-elect), Laura Sudkamp (ASCLD president) and Amy Miles (SOFT president) played in acquiring survey responses.

Thank you for believing in this project and encouraging responses from your members.

## Data availability

The data underlying this article are available in MINDS@UW at <http://digital.library.wisc.edu/1793/82902>.

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## Description of the Proposed Program

### **Program Background**

Virginia Commonwealth University seeks approval for a Master of Science (MS) degree program in Data Science. The proposed degree program will be jointly administered by the Department of Computer Science in the College of Engineering and the Department of Statistical Sciences & Operations Research in the College of Humanities & Sciences. The target date of the program's initiation is fall 2024.

The purpose of the proposed MS in Data Science degree program is to educate students with the advanced knowledge, skills, and tools necessary to analyze and interpret complex data and help solve real-world problems. Data science is an interdisciplinary field that combines expertise in statistics, computer science, and domain-specific knowledge to extract valuable insights and knowledge from data. The proposed degree program will prepare students to excel using data to drive data-driven decision-making in various industries and domains. An MS in Data Science prepares students to work as data analysts, data scientists, machine learning engineers, data engineers, business analysts, research scientists, data consultants, etc. They may also specialize in specific domains like healthcare or biomedical data analysis and can find opportunities in government, startups, academia, and industry research.

The proposed program will expose students to data manipulation, machine learning algorithms, data visualization, big data technologies, database management, and programming languages (e.g., SQL, Python, R) through coursework that centers on the collection, storage, retrieval, and analysis of data. Ethical considerations, real-world projects, and domain-specific knowledge are emphasized, along with effective data communication through a capstone experience. The program will address various specific needs and issues in today's data-driven world. It tackles a growing demand for data experts and by combining interdisciplinary education, the proposed program will create well-rounded professionals capable of solving real-world data challenges.

Data Science has emerged as a distinct discipline only in the past two decades, and its growth is projected to persist, driving an escalating demand for extensively trained data scientists with graduate-level education.<sup>1</sup> The surge in demand for data science experts with this level of training is attributed to the combination of a proliferation of data, technological advancements, and a recognition of data-driven decision-making as a strategic asset.<sup>2</sup> The Virginia Economic Development Partnership notes that Virginia has a significant increasing need for qualified data scientists. Virginia currently has one of the highest concentrations of data scientist employment. The recruitment platform Zippia ranked Virginia in 2020 as one of the top 12 locations companies were actively looking for data scientists.<sup>3</sup> Additionally, the U.S. Bureau of Labor

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<sup>1</sup> *Is a master's degree in data science worth it?* (n.d.). Fortune. <https://fortune.com/education/articles/is-a-masters-degree-in-data-science-worth-it/>

<sup>2</sup> Resources, H., & America, N. (n.d.). *What's Driving the Demand for Data Scientists?* Knowledge@Wharton. <https://knowledge.wharton.upenn.edu/article/whats-driving-demand-data-scientist/>

<sup>3</sup> *Virginia Universities Prepare to Meet Tomorrow's Data Science Needs | Virginia Economic Development Partnership.* (n.d.). www.vedp.org. [vedp.org/news/virginia-universities-prepare-meet-tomorrows-data-science-needs](http://vedp.org/news/virginia-universities-prepare-meet-tomorrows-data-science-needs)

Statistics predicts employment in data science will grow by 36 percent in the coming decade.<sup>4</sup> In fact, it is predicted that data science will see more growth than almost any other field between now and 2029.<sup>5</sup> The proposed MS in Data Science will help meet the growing demand and offers an opportunity for real-world experiential learning that promotes critical thinking, problem solving, and innovation.

Data science skills can drive translational applications across multiple sectors of society, necessitating interdisciplinary collaborations and cross-disciplinary communication to address future societal challenges, including areas such as health-care, education, and economics. The landscape of data science is continuously evolving, with new tools, algorithms, and techniques introduced at a rapid pace. Advanced training at the master's degree level not only equips students with cutting-edge knowledge but also fosters the adaptability and versatility essential to stay ahead of these transformations.

### **Institutional Mission**

Virginia Commonwealth University and its academic health sciences center serve as one national urban public research institution dedicated to the success and well-being of our students, patients, faculty, staff, and community through:

- Real-world learning that furthers civic engagement, inquiry, discovery, and innovation
- Research that expands the boundaries of new knowledge and creative expression and promotes translational applications to improve the quality of human life
- Interdisciplinary collaborations and community partnerships that advance innovation, enhance cultural and economic vitality, and solve society's most complex challenges
- Health sciences that preserve and restore health for all people, seek the cause and cure of diseases through groundbreaking research and educate those who serve humanity
- Deeply engrained core values of diversity, inclusion, and equity that provide a safe, trusting, and supportive environment to explore, create, learn, and serve.

The proposed MS in Data Science program directly serves to fulfill the mission of Virginia Commonwealth University. The program's emphasis on “real-world learning” ensures that students actively engage with practical applications, fostering civic engagement, inquiry, discovery, and innovation. The “interdisciplinary” nature of data science enables students to collaborate with diverse fields, forging community partnerships that drive innovation, cultural and economic vitality, and solutions to “society's most complex challenges”. The underrepresentation of minority populations in the field of Data Science is notable, but VCU's status as a minority-serving institution offers a pathway to enhance diversity among Data Science professionals and cultivate an inclusive environment.

The proposed MS in Data Science is included in the VCU 2028 Six-Year Plan.

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<sup>4</sup> U.S. Bureau of Labor Statistics. (2022, September 8). *Data Scientists: Occupational Outlook Handbook: U.S. Bureau of Labor Statistics*. [www.bls.gov. https://www.bls.gov/ooh/math/data-scientists.htm](https://www.bls.gov/ooh/math/data-scientists.htm)

<sup>5</sup> *Job Forecast for Data Scientists Still Bright*. (n.d.). School of Data Science. <https://datascience.virginia.edu/news/job-forecast-data-scientists-still-bright>

## **Admission Criteria**

Admissions to the proposed MS program in Data Science will follow the general admission requirements outlined in the 2023-2024 Graduate Bulletin. In addition, applicants will be required to fulfill the following requirement. Applicants must:

- Have earned a bachelor's degree in computer science, statistics, operations research, analytics, engineering, physics, or a closely related quantitative discipline from an accredited institution of higher education.

With program advisor approval, a maximum of 6 credits of graduate-level coursework may be transferred from VCU's non-degree status or from another accredited institution. Credits must be less than 6 years old from the time of admission, and graded B (3.0) or better. Credits applied to a degree previously earned at VCU or at another institution may not be transferred.

## **Curriculum**

The proposed MS in Data Science is a 30-credit hour (non-thesis) degree program. A capstone course sequence (two semesters) is required. The focus of the core curriculum is centered on the foundations of data science and its application. Emphasis will be placed on the two components that shape data science into a unique discipline: applied statistical analysis and data management/manipulation.

The core curriculum equips students with the necessary knowledge and skills to grasp the fundamental concepts behind collection, storage, retrieval, processing, and analysis of data. These courses introduce essential principles from database management, applied statistics, and both machine and statistical learning. Students will learn how to acquire, store, and preprocess data, analyze/model data, and communicate results. Furthermore, the core curriculum places a strong emphasis on programming skills. Students will develop proficiency in popular and versatile programming languages like SQL, Python and R, encompassing both general-purpose and statistical programming. Restricted electives provide students with additional breadth and the ability to personalize the program to align with individual interests and goals.

As part of the core curriculum, students are required to take two capstone project courses. The purpose of the capstone courses is to provide hands-on experience with real-world data drawn from a diverse range of disciplines (e.g., business, medicine, biology, environmental science). The capstone provides an important opportunity to gain practical experience throughout every stage of the data lifecycle, which includes the collection and manipulation of data to insightful analysis and effective communication of results. The culmination of the capstone experience will be a written and oral deliverable to an external client. Students that receive a letter grade lower than C (unsatisfactory) in a capstone course will be required to retake the course. A second unsatisfactory grade will result in dismissal from the degree program.

Four new courses will be developed for the program and are indicated below with an asterisk.

## **Program Requirements**

### **Core Courses: 18 credits**

CMSC 535: Introduction to Data Science (3 credits) \*  
CMSC 608: Advanced Database (3 credits)  
STAT 534: Statistical Data Science I (3 credits)  
STAT 641: Applied Data Analysis (3 credits)

### **Capstone**

CMSC/SSOR 681: Data Science Capstone Project I (3 credits) \*  
CMSC/SSOR 682: Data Science Capstone Project II (3 credits) \*

### **Restricted Electives: 12 credits**

The restricted electives component allows the students to expand their education in areas related to data science (e.g., artificial intelligence, Bayesian statistics, operations research). This consists of 12 credit hours where 6 credits must come from Computer Science courses and 6 credits must come from Statistics or Operations Research courses.

#### Computer Science courses:

CMSC 502: Parallel Algorithms (3 credits)  
CMSC 510: Regularization Methods for Machine Learning (3 credits)  
CMSC 516: Advanced Natural Language Processing (3 credits)  
CMSC 603: High Performance Distributed Systems (3 credits)  
CMSC 606: Introduction to Machine Learning (3 credits) \*  
CMSC 630: Image Analysis (3 credits)  
CMSC 635: Knowledge Discovery and Data Mining (3 credits)  
CMSC 636: Artificial Neural Networks and Deep Learning (3 credits)  
CMSC 691: Special Topics in Computer Science (3 credits)

#### Statistics or Operations Research courses:

OPER 528: Stochastic Simulation (3 credits)  
STAT 545: Applied Bayesian Statistics (3 credits)  
STAT 621: Nonparametric Statistical Methods (3 credits)  
STAT 625: Applied Multivariate Analysis (3 credits)  
STAT/OPER 636: Machine Learning Algorithms (3 credits)  
STAT 642: Design and Analysis of Experiments I (3 credits)  
STAT 643: Applied Linear Regression (3 credits)  
STAT 675: Time Series Analysis I (3 credits)  
STAT 691: Special Topics in Statistics (3 credits)

**Total: 30 credit hours**

### **Field-Based Learning/Capstone Requirements**

The Capstone sequence is the culmination of the students' data science education providing the opportunity to apply their skills to solve a real-world problem in an experiential learning and team environment. The course instructor and program directors will be responsible for placing

students with external clients. Students will work in small (two to three person) teams and will be paired with a faculty mentor and external client by the course instructor in consultation with the program directors. Each group will be required to meet with representatives from the external client to determine the specific data science problem to be solved, discuss the questions to be answered, and outline possible strategies that will be used to address the problem. The proposal will be approved by the course instructor and the external client representative.

Students will experience the entire data lifecycle (data acquisition, storage, preprocessing, visualization, analysis, and effective communication of results to clients) through interim and final written and oral presentations. Regular meetings with the client and faculty mentor will allow students to share progress and receive feedback. Grades (on an A-F scale) will be based on team progress and performance in written/oral presentation. Individual student grades will reflect the grade assigned to their team. Students that receive a letter grade lower than C (unsatisfactory) in a capstone course will be required to retake the course. A second unsatisfactory grade will result in dismissal from the degree program.

See Appendix A for sample plans of study.

See Appendix B for course descriptions.

### **Faculty Resources**

The proposed program will be jointly administered by the Departments of Computer Science and Statistical Sciences & Operations Research.

The Department of Computer Science has 18 full-time tenure-track or tenured faculty members (5 Full Professors, 11 Associate Professors, and 1 Assistant Professor). Of the 18 faculty members, 7 are involved in developing and teaching core and required courses for the proposed MS in Data Science. The faculty members have terminal degrees in computer science or a related field. All have published in peer-reviewed journals such as the *Machine Learning*, *Neurocomputing*, *IEEE Transactions*, *BMC Bioinformatics*, *Journal of Biomedical Informatics*, and conferences such as *Conference on Knowledge Discovery and Data Mining*, *Conference on Neural Networks*, *IEEE Conference on Data Science and Advanced Analytics*. Many serve as leaders in national organizations. One faculty member is an IEEE Fellow, and one faculty member is a Fellow of the American Institute for Medical and Biomedical Engineering.

The Department of Statistical Sciences and Operations Research has 13 full-time tenure-track or tenured faculty members (3 Full Professors, 4 Associate Professors, and 6 Assistant Professors). Of the 13 faculty members, 10 are involved in developing and teaching core and required courses for the proposed MS in Data Science. The faculty members have terminal degrees in statistics or a related discipline and over 150 years of combined teaching and research experience in the field. All have published in peer-reviewed journals such as *Journal of the American Statistical Association*, *Annals of Statistics*, *Technometrics*, *Environmetrics*, and *Journal of Quality Technology* and many serve as leaders in national organizations. One faculty member is an elected fellow of the American Statistical Association.

No new faculty will be hired to support the proposed program.



No adjunct faculty will be utilized to initiate the proposed degree program.

See Appendix C for abbreviated curriculum vitae of faculty.

### **Student Learning Assessment**

Students who complete the proposed MS degree program in Data Science will have mastered a set of skills that are needed to serve as a data science professional. Students will be assessed in their coursework through various mechanisms that include, but not limited to 1) applied projects, 2) case studies, 3) problem solving/programming activities, 4) written and oral reports of analyses, and 5) exams.

The capstone course sequence will provide an opportunity for assessment of the combined learned skills obtained throughout the program. The capstone will require students, under the supervision of a faculty mentor, to work with diverse and complex data sourced from various domains. They will engage in the complete data lifecycle, starting from data acquisition and preprocessing to model development and communication. Students will be assessed on their writing, the depth and breadth of their analyses, and the clarity and effectiveness of their presentation materials.

At Virginia Commonwealth University, each degree program assesses program level student learning outcomes annually. Assessment findings and summaries of faculty discussions about the implications of the findings are maintained in VCU's assessment data management system, Taskstream. This system will be utilized for annual assessment of the MS in Data Science as well as tracking the progress the students are making toward achieving the learning outcomes. The program assessment data related to benchmarking metrics would be collected annually by the Graduate Program Directors and entered into the Taskstream system. Data collection will start once the first students are recruited into the program. Taskstream data will be further analyzed at the meeting of all Department's faculty.

Data from annual assessment at the program level will be reported to the VCU Director of Assessment within the Office of Academic Affairs. The Office of Academic Affairs and Senior Vice Provost for Academic Affairs ensures the integrity, quality, and transparency of academic programs and oversees policies and procedures governing the undergraduate and graduate curriculum. The Office conducts Academic Program Review (APR) on a six-year cycle. The APR will use data from annual program assessments to evaluate a program's contribution to the university missions and towards meeting the needs of the Commonwealth of Virginia, and analyze the productivity and quality of the program.

The learning outcomes for the degree program are specific to graduate level knowledge, skills, and abilities that students should acquire in the proposed degree program. Faculty worked with staff members in VCU's Director of Institutional Effectiveness and Planning to develop outcomes and appropriate measures.

Learning Outcomes

Students will be able to:

- Apply data science tools and techniques, including data cleaning and preprocessing, data presentation/visualization, mathematical modeling, statistical learning, machine learning, and big data technologies, to solve complex problems and generate novel insights in real-world scenarios.
- Apply statistical concepts and data analysis techniques by testing hypotheses, designing experiments, and collecting data in real-world applications.
- Utilize data structures and algorithms to interpret and analyze large-scale data.
- Develop data science applications (e.g., SQL, R, Python) to obtain proficiency in programming.
- Create clear and effective visualizations of data and communicate results both in writing and oral presentation.
- Apply data management skills and ethical considerations in data science to real-world applications.
- Develop collaboration and communication in a data science team environment.

Assessment of student learning includes mapping the expected learning outcomes to the curriculum. The assessments for the MS in Data Science program are embedded in the curriculum and program requirements as illustrated in the table below. All assessments will be assessed with a program level rubric that specifies the expected traits of a successful demonstration of the expected learning.

Curriculum Map for MS in Data Science.

<b>Learning Outcomes</b>	<b>Core or Required Courses</b>	<b>Assessment Measures</b>
Apply data science tools and techniques, including data cleaning and preprocessing, data representation / visualization, mathematical modeling, statistical learning, machine learning, and big data technologies, to solve complex problems and generate novel insights in real-world scenarios.	CMSC 535: Introduction to Data Science  STAT 534: Statistical Data Science I  CMSC/SSOR 681-682: Data Science Capstone I-II	<u>Formative:</u> Class discussions; problem solving / programming assignments; case studies; applied projects  <u>Summative:</u> Final Exam/Project; Written/Oral Report
Apply statistical concepts and data analysis techniques by testing hypotheses, designing experiments, and collecting data in real-world applications.	STAT 641: Applied Data Analysis  CMSC/SSOR 681-682: Data Science Capstone I-II	<u>Formative:</u> Class discussions; problem solving / programming assignments; applied projects  <u>Summative:</u> Final

		Exam/Project; Written/Oral Report
Utilize data structures and algorithms to interpret and analyze large-scale data.	CMSC 535: Introduction to Data Science CMSC/SSOR 681-682: Data Science Capstone I-II	<u>Formative:</u> Class discussions; problem solving / programming assignments; applied projects  <u>Summative:</u> Final Exam/Project; Written/Oral Report
Develop data science applications (e.g., SQL, R, Python) to obtain proficiency in programming.	CMSC 535: Introduction to Data Science STAT 534: Statistical Data Science I CMSC 608: Advanced Database CMSC/SSOR 681-682: Data Science Capstone I-II	<u>Formative:</u> Class discussions; problem solving / programming assignments; case studies; applied projects  <u>Summative:</u> Final Exam/Project; Written/Oral Report
Create clear and effective visualizations of data and communicate results both in writing and oral presentation.	CMSC/SSOR 681-682: Data Science Capstone I-II	<u>Formative:</u> Class discussions; team meetings; case studies; applied projects  <u>Summative:</u> Written/Oral Report
Apply data management skills and ethical considerations in data science to real-world applications.	CMSC 608: Advanced Database CMSC/SSOR 681-682: Data Science Capstone I-II	<u>Formative:</u> Class discussions; problem solving / programming assignments; case studies; applied projects  <u>Summative:</u> Final Exam/Project; Written/Oral Report
Develop collaboration and communication in a data science team environment.	CMSC/SSOR 681-682: Data Science Capstone I-II	<u>Formative:</u> Class discussions; team meetings; case studies; applied projects  <u>Summative:</u> Written/Oral Report

## **Employment Skills**

All graduates of the proposed MS in Data Science program will be able to:

- Exhibit proficiency in programming languages such as Python or R, data analysis tools, and database management (including SQL)
- Understand statistics, machine learning algorithms, and mathematical modeling for effective analysis and interpretation of data
- Create clear and concise visual representations of data for effectively communicating insights to stakeholders
- Using various modes of communication, adapt technical concepts and complex analytical results to suit the needs of differentiated stakeholders
- Gather data and generate models that champion long-term solutions to stakeholder needs
- Integrate the ideas and needs of cross-functional teams in developing feasible strategies to achieve data research project goals
- Develop best practices for coding and data standards to ensure consistency in models

## **Relationship to Existing Programs**

Virginia Commonwealth University offers two (2) degree programs that are related to the proposed degree program: 1) the Master of Decision Analytics (MDA) and 2) the Master of Science (MS) in Information Systems with a concentration in data science in business. Both the MDA and MS in Information Systems are housed in the School of Business. Both of the existing degree programs and the proposed degree program share related interests in data and analysis. However, there are important distinctions.

The Master of Decision Analytics provides students with knowledge of the statistical, mathematical and scientific skills and experience necessary to utilize advanced methods of data analysis for business decision-making. Graduates of this program will be able to examine a situation/problem to determine a relevant data-driven analysis to provide valuable information for decision makers and apply advanced analytical and quantitative skills to the decision problems of businesses, organizations and society. Students will be able to communicate analysis information and recommended decisions in a clear, ethical and transparent manner. Students will be able to leverage unstructured data in support of business decision making. However, while there is some overlap with the proposed degree program, the MDA focuses on applying data-driven insights in a strictly business context. In contrast, the proposed MS in Data Science is broader in scope and application, and more technical in focus. Graduates of the proposed MS in Data Science are prepared to develop computational methods and advanced algorithms for any sector that generates data for decision-making.

The Master of Science in Information Systems with a concentration in data science in business is designed to prepare students for specialized roles using information systems to support organizations. The program is intended to provide a graduate-level, business-technology-oriented curriculum that focuses on the design and development of information systems to solve real-world problems. Graduates of the program are expected to be able to take significant roles in planning, organizing, managing, designing, configuring and implementing systems using state-

of-the-art technologies within organizations. The data science in business concentration of the master's program has an information systems orientation to data science. It is designed to prepare students for specialized roles that involve using information systems concepts, methodologies to effectively and efficiently support knowledge discovery and associated data management activities in modern organizations. Graduates of the proposed MS in Data Science will focus on the more technical aspects of data science and are prepared to develop algorithms and implement them for data-driven decision making.

Thus, while similarities exist, the proposed MS in Data Science will not compromise either of the existing programs in the School of Business. The focus in the School of Business is the utilization of analytics tools and processes for specific business applications whereas the proposed MS in Data Science provides students a broader and more technical understanding of the underlying statistical and machine learning models so as to advance the development of new algorithms. No degree programs will close as a result of the intuition and operation of the proposed degree program.

### Justification of the Proposed Program

#### **Response to Current Needs (Specific Demand)**

With the widespread adoption of digital technologies, there has been an exponential increase in the amount of data generated by individuals, businesses, and organizations. “The field of data science has gained prominence because it enables organizations to efficiently process and interpret data. Leaders, in turn, use this data to make informed business decisions, drive growth, optimize spending, and push performance.”<sup>6</sup>

The proposed MS in Data Science responds to current needs in the Commonwealth of Virginia and the nation and prepares students to work in environments that need professionals with advanced training in data science. The current needs include: 1) a market demand for highly trained data professionals that can extract meaningful insights from the proliferation of generated data and 2) fostering interdisciplinary collaboration to address societal challenges and opportunities (e.g., in healthcare, technology, financial services, public policy, etc.).

#### **Market Demand for Data Professionals**

Data science has rapidly emerged as a discipline within the past 20 years, driven by the exponential growth of data and the need to extract meaningful insights from it. The demand for data scientists is expected to continue growing significantly in the coming years. The U.S. Bureau of Labor Statistics predicts that employment in data science will experience a remarkable 36% growth between now and 2031, which is much faster than the average growth rate for all occupations<sup>7</sup>. However, Virginia currently only has two M.S. programs specifically in data science (Old Dominion University and the University of Virginia).

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<sup>6</sup> Ramakrishnan, M. (2022, July 22). *What Is Data Science? Why Is It in Demand? Find out Now!* Emeritus Online Courses. <https://emeritus.org/blog/what-is-data-science-career-path/>

<sup>7</sup> Bureau of Labor Statistics, US Department of Labor, Occupational Outlook Handbook, <https://www.bls.gov>

In general, the field of data science combines elements of computer science, statistics, and domain knowledge to analyze such large datasets and derive actionable insights. In 2012, the Harvard Business Review published the article “Data Scientist: The Sexiest Job of the 21st Century”. “A decade later, the job is more in demand than ever with employers and recruiters.”<sup>8</sup> “[D]ata science demand is growing because it represents the future of commercial decision-making.”<sup>9</sup> In today's data-driven world, businesses and organizations across various sectors recognize the value of data in driving informed decision-making. Data science degree programs are needed to produce professionals who possess the skills and knowledge to collect, analyze, and interpret large volumes of data to extract valuable insights. These insights enable organizations to make data-driven decisions, optimize processes, identify trends, and gain a competitive advantage.

The increasing importance of data science is also evident in Virginia, which has experienced a growing demand for data scientists. In fact, Virginia hosts the largest data center market in the world.<sup>10</sup> The Virginia Economic Development Partnership (VEDP) has indicated that Virginia has one of the highest concentrations of data scientist employment in the country<sup>11</sup>. The state has attracted numerous companies seeking to harness the power of data to drive innovation, make informed decisions, and gain a competitive edge in their respective industries. Specifically, Virginia ranks among the top 12 locations where companies are actively looking for data scientists, indicating a strong demand for data science expertise in the region<sup>12</sup>. VEDP is focused on growing the pool of data science to ensure that existing and new companies have access to the necessary workforce. VEDP maintains a focus on expanding the reservoir of data science and related talent, aiming to guarantee that both existing and emerging enterprises can readily tap into the essential workforce<sup>13</sup>. The organization's attention has been directed towards the observation that the output of talent in data science and its allied fields from the university system is currently insufficient. This potential shortfall is perceived as a potential impediment to the broader economic growth and advancement across various professions that intersect with data science. To proactively tackle this challenge, VEDP organized a meeting of university partners within Virginia, on October 29, 2021, which VCU participated in to engage in a collective discussion on this issue.

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<sup>8</sup> Davenport, T.H. and Patil, D.J. (2022). “Is Data Science Still the Sexiest Job of the 21st Century?” *Harvard Business Review*. <https://hbr.org/2022/07/is-data-scientist-still-the-sexiest-job-of-the-21st-century>

<sup>9</sup> *Demand For Data Science: Jobs, Data Scientists Future*. (n.d.). [www.knowledgehut.com](http://www.knowledgehut.com). <https://www.knowledgehut.com/blog/data-science/data-science-is-in-demand>

<sup>10</sup> *Data Centers | Virginia Economic Development Partnership*. (n.d.). [www.vedp.org](http://www.vedp.org). <https://www.vedp.org/industry/data-centers>

<sup>11</sup> *Virginia Universities Prepare to Meet Tomorrow's Data Science Needs | Virginia Economic Development Partnership*. (n.d.). [www.vedp.org](http://www.vedp.org). Retrieved July 10, 2023, from <https://www.vedp.org/news/virginia-universities-prepare-meet-tomorrows-data-science-needs>

<sup>12</sup> *Virginia Universities Prepare to Meet Tomorrow's Data Science Needs | Virginia Economic Development Partnership*. (n.d.). [www.vedp.org](http://www.vedp.org). Retrieved July 10, 2023, from <https://www.vedp.org/news/virginia-universities-prepare-meet-tomorrows-data-science-needs>

<sup>13</sup> *On Target for Tech Talent | Virginia Economic Development Partnership*. (n.d.). Retrieved August 15, 2023, from <https://www.vedp.org/news/target-tech-talent>

In addition, the Commonwealth Research and Technology Strategic Roadmap<sup>14</sup> describes research areas worthy of economic development in Virginia. The areas of focus identified as exhibiting the greatest potential for economic growth are life and health sciences, autonomous systems, space and satellites, agricultural and environmental technologies, cybersecurity and data science and analytics. Data science and analytics was one of the two research focus areas, and machine learning, a subcomponent of data science, was identified as one of the technology pillars. Creating cutting-edge, innovative solutions in data science requires deep knowledge of data science foundations. At the Master's level, where ability to innovate is of primary importance, those that choose to specialize in data science need to be immersed in a discipline-specific data science degree program that provides depth and breadth of training in the core methodologies and techniques that are found across multiple disciplines.

Although the minimum education for entry-level data scientist jobs is a bachelor's degree, the leading website on data science and machine learning, KD Nuggets, noted in 2018 that at least 88% of data scientists have a Master's degree.<sup>15</sup> Students are typically attracted to data science M.S. programs because of potential for career growth, advanced specialization, and development of advanced data science concepts to meet required job qualifications. In 2022, Fortune magazine published an article noting that "There is a very recent trend to create many undergraduate degree programs in data science to satisfy the demand for data scientists... But since data science is such a fast-evolving field with many new experimental methods proposed every year, many industries will still seek the maturity and deeper skills that come with a graduate degree."<sup>16</sup> The proposed curriculum offers coursework covering collection, storage, retrieval, and analysis of numerical, textual, and image data, and synergistically introduces machine and statistical learning techniques. Graduates will be well-positioned for careers as data scientists in any workforce sector and thus help satisfy the growing demand for data professionals in Virginia and the nation.

### **Fostering Interdisciplinary Collaboration**

Data scientists empower innovation by bridging gaps across fields and helping experts in a variety of disciplines gain critical insights from data.<sup>17</sup> Data science plays a crucial role in addressing societal challenges by leveraging data-driven insights and interdisciplinary collaborations. For example, data science can improve healthcare outcomes by analyzing large volumes of medical data to help identify disease patterns, predict outbreaks<sup>18</sup>, optimize treatment

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<sup>14</sup> Commonwealth Research and Technology Strategic Roadmap. (2019).

<https://www.schev.edu/home/showpublisheddocument/1700/637826197221300000>

<sup>15</sup> (2018). *9 Must-have skills you need to become a Data Scientist, updated*. KD Nuggets. Retrieved June 6, 2023, from <https://www.kdnuggets.com/2018/05/simplilearn-9-must-have-skills-data-scientist.html>

<sup>16</sup> Malas, M. (2022). "Is a master's degree in data science worth it?" *Fortune*.

<https://fortune.com/education/articles/is-a-masters-degree-in-data-science-worth-it/>

<sup>17</sup> Alzen, J. L., Trumble, I. M., Cho, K. J., & Vance, E. A. (2023). Training Interdisciplinary Data Science Collaborators: A Comparative Case Study. *Journal of Statistics and Data Science Education*, 1-10.

<sup>18</sup> Zhang Q. (2022). Data science approaches to infectious disease surveillance. *Philosophical transactions. Series A, Mathematical, physical, and engineering sciences*, 380(2214), 20210115. <https://doi.org/10.1098/rsta.2021.0115>

plans<sup>19</sup>, and inform personalized medicine<sup>20</sup>. “With about 30% of the world’s data storage residing in the healthcare sector alone, from patient information and insurance claims to government agency records, there is a growing need for data scientists who can manage, analyze and act on the treasure trove of information to find efficiencies across the board.”<sup>21</sup>

As another example, data science can provide valuable insights into environmental issues such as climate change<sup>22</sup> and natural disasters<sup>23</sup> through the analysis of satellite imagery, weather data, and sensor readings to model and predict environmental patterns. “[I]n the next years there will be a major push towards research in the Energy Sector, and Data Science is going to play a big role in this huge battle.”<sup>24</sup> “Data scientists will be critical to building a clean energy economy and ensuring a consistent power supply from renewables like solar and wind.”<sup>25</sup>

The proposed MS in Data Science is, in and of itself, interdisciplinary between Computer Science in the College of Engineering and Statistics/Operations Research in the College of Humanities and Sciences and offers an opportunity for real-world experiential learning that promotes critical thinking, problem solving, and innovation. It aims to produce experts with rigorous training in data science foundations and is necessary to address growing workforce needs. Skills learned will drive translational applications across multiple sectors. Through the capstone experience, it requires interdisciplinary collaborations and cross-discipline communication to address future societal challenges.

### **Why VCU**

As a minority-serving institution, VCU is dedicated to promoting diversity, inclusion, and equity in data science. By offering the proposed M.S. degree program, VCU aims to increase representation and provide opportunities for students from underrepresented backgrounds to excel in the field. This commitment to diversity will not only benefit the individual students but also contribute to a more inclusive and equitable data science community in Virginia. According to research by Zippia, Black/African Americans represent 4.2% of all data scientists<sup>26</sup>. This lack of diversity is a disservice to the field of data science and industries reliant

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<sup>19</sup> Subrahmanya, S. V. G., Shetty, D. K., Patil, V., Hameed, B. M. Z., Paul, R., Smriti, K., Naik, N., & Somani, B. K. (2022). The role of data science in healthcare advancements: applications, benefits, and future prospects. *Irish journal of medical science*, 191(4), 1473–1483. <https://doi.org/10.1007/s11845-021-02730-z>

<sup>20</sup> Capobianco, E., & Dominietto, M. (2020). From Medical Imaging to Radiomics: Role of Data Science for Advancing Precision Health. *Journal of personalized medicine*, 10(1), 15. <https://doi.org/10.3390/jpm10010015>

<sup>21</sup> Koteswarreddy. (2021, July 20). *How data science is transforming in the healthcare sector*. Medium. <https://koteswarreddy284.medium.com/how-data-science-is-transforming-in-the-healthcare-sector-50de9835571a>

<sup>22</sup> <https://www.informationweek.com/author/joao-pierre-s-ruth>. (2023, February 6). *Virginia Beach Using Sensor Data to Respond to Extreme Weather*. InformationWeek. <https://www.informationweek.com/sustainability/virginia-beach-using-sensor-data-to-respond-to-extreme-weather/>

<sup>23</sup> Smith, M. B. (2023, May 24). *Property Peril: Using Data Science to Examine Riskiest US Areas to Live Amid Climate Change*. CoreLogic®. <https://www.corelogic.com/intelligence/using-data-science-to-examine-riskiest-us-areas-to-live-amid-climate-change/>

<sup>24</sup> Pasini, M. (2019, August 21). *How Data Science can help solve Climate Change*. Medium. <https://towardsdatascience.com/how-data-science-can-help-solve-climate-change-12b28768e77b>

<sup>25</sup> *Commentary: A new generation of data scientists could be our best weapon against climate change*. (n.d.). Fortune. <https://fortune.com/2022/07/22/new-generation-data-scientists-heat-wave-climate-change-environment-weiwei-pan/>

<sup>26</sup> Data Science Demographics and Statistics in the US. <https://www.zippia.com/data-scientist-jobs/demographics/>



on using data science to create solutions to human problems that naturally are of a diverse nature. VCU's relationships with the four HBCU four-year colleges and universities in Central Virginia suggest that VCU's M.S. in Data Science program will be able to recruit students from diverse backgrounds.

As evident by its "Bronze Award"<sup>27</sup> from the American Society for Engineering Education (ASEE) Diversity Recognition Program<sup>28</sup> VCU is committed to sustaining an environment that promotes diversity, equity and inclusiveness. The Bronze award, the highest level awarded in 2019, acknowledges VCU commitment to bringing women and underrepresented minorities into the field and places the university among the nation's leaders in inclusive excellence. Specifically, in VCU's College of Engineering, the percentages of female and underrepresented minority undergraduates have each increased 33 percent since 2012, and it has the highest percentage of Hispanic/Latin graduates in Virginia. The university's faculty and students demonstrate an unwavering commitment to the values of diversity, equity and inclusiveness. VCU employs a comprehensive outreach campaign for recruiting prospective graduate students. To increase diversity in our graduate student population, the VCU College of Engineering and the College of Humanities & Sciences works with the VCU Graduate School to recruit diverse applicants through the Southern Regional Education Board (SREB)<sup>29</sup> Scholars Program and the Graduate Education for Minorities (GEM)<sup>30</sup> program.

See Appendix D for letters of support.

## **Employment Demand**

Graduates of the proposed MS in Data Science program will be qualified to serve as data scientists, data analysts, machine learning engineers, statisticians, business intelligence analysts, data consultants, as well as other positions in the data field. Graduates will have the ability to interact with stakeholders and communicate data-driven solutions throughout the multiple sectors that are generating large amounts of data. The field of data science is rapidly evolving, and there are continually emerging roles and opportunities in industries ranging from healthcare and finance to marketing and technology.

Employment projections in the U.S. Bureau of Labor Statistics' (BLS) Occupational Outlook Handbook show the viability of employment for graduates of the proposed M.S. in Data Science. According to the BLS, employment of data scientists is expected to grow 36%, or "much faster than the average for all occupations."<sup>31</sup> The BLS goes on to note that "Employment growth for data scientists is expected to stem from an increased demand for data-driven decisions. The volume of data available and the potential uses for that data will increase over the projected decade. As a result, organizations will likely need more data scientists to mine and analyze the

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<sup>27</sup> VCU Engineering's diversity and inclusion efforts recognized by the American Society for Engineering Education, <https://egr.vcu.edu/news-events/news/asee-bronze-award-announcement.html>

<sup>28</sup> <https://diversityrecognition.asee.org/>

<sup>29</sup> <https://www.sreb.org/doctoral-scholars-program>

<sup>30</sup> <http://www.gemfellowship.org/>

<sup>31</sup> The U.S. Bureau of Labor Statistics. <https://www.bls.gov/ooh/math/data-scientists.htm#tab-6>

large amounts of information and data collected.”<sup>32</sup> With regards to degree requirements, “Data scientists typically need at least a bachelor’s degree...However, some employers require or prefer that candidates have a master’s or doctoral degree.”<sup>33</sup> Furthermore, given the interdisciplinary nature of the field of data science, common degree fields for data scientists can “include mathematics, statistics, computer science, business, and engineering.”

Employment of statisticians is expected to grow 33%, or “much faster than the average for all occupations.”<sup>34</sup> The BLS goes on to note that “Employment growth for statisticians is expected to result from more widespread use of statistical analysis to inform business, healthcare, and policy decisions. The amount of digitally stored data will increase over the projections decade as people and companies continue to conduct business online and use social media, smartphones, and other mobile devices. As a result, businesses will increasingly need statisticians to analyze the large amount of information and data collected. Statistical analyses will help companies improve their business processes, design and develop new products, and advertise products to potential customers.”<sup>35</sup> “Statisticians typically need a master’s degree, but some entry-level positions may accept candidates with a bachelor’s degree.”<sup>36</sup>

Employment of computer and information research scientists is expected to grow 21% or “much faster than the average for all occupations”.<sup>37</sup> “Rapid growth in data collection by businesses will lead to an increased need for data-mining services. Computer and information research scientists will be needed to write algorithms that help businesses make sense of very large amounts of data.”<sup>38</sup> “Computer and information research scientists typically need a master’s or higher degree”<sup>39</sup>.

Data for Virginia also shows strong demand for data scientists and statisticians. The Virginia Employment Commission, Labor Market Information data projects 27% growth between 2020 and 2030 for mathematical science occupations (which includes data scientists) and 37% for statisticians.

**Labor Market Information: Bureau of Labor Statistics, 2021 -2031 (10-Yr)**

<b>Occupation</b>	<b>Base Year Employment</b>	<b>Projected Employment</b>	<b>Total % Change and #s</b>	<b>Typical Entry Level Education</b>
Data Scientists (includes	113,300	153,900	36% 40,500	Bachelor’s degree

<sup>32</sup> The U.S. Bureau of Labor Statistics. <https://www.bls.gov/ooh/math/data-scientists.htm#tab-6>

<sup>33</sup> The U.S. Bureau of Labor Statistics. <https://www.bls.gov/ooh/math/data-scientists.htm#tab-4>

<sup>34</sup> The U.S. Bureau of Labor Statistics. <https://www.bls.gov/ooh/math/mathematicians-and-statisticians.htm#tab-6>

<sup>35</sup> The U.S. Bureau of Labor Statistics. <https://www.bls.gov/ooh/math/mathematicians-and-statisticians.htm#tab-6>

<sup>36</sup> The U.S. Bureau of Labor Statistics. <https://www.bls.gov/ooh/math/mathematicians-and-statisticians.htm#tab-4>

<sup>37</sup> The U.S. Bureau of Labor Statistics. <https://www.bls.gov/ooh/computer-and-information-technology/computer-and-information-research-scientists.htm#tab-6>

<sup>38</sup> The U.S. Bureau of Labor Statistics. <https://www.bls.gov/ooh/computer-and-information-technology/computer-and-information-research-scientists.htm#tab-6>

<sup>39</sup> The U.S. Bureau of Labor Statistics. <https://www.bls.gov/ooh/computer-and-information-technology/computer-and-information-research-scientists.htm#tab-4>

Business Intelligence Analysts, Clinical Data Managers) <sup>40</sup>				
Statisticians (includes Biostatisticians) <sup>41</sup>	34,200	45,300	33% 11,200	Master's degree
Computer and Information Research Scientists <sup>42</sup>	33,500	40,600	21% 7,100	Master's degree

**Labor Market Information: Virginia Employment Commission, 2020 -2030 (10-Yr)**

Occupation	Base Year Employment	Projected Employment	Total % Change and #s	Annual Change #	Education
Mathematical Science Occupations <sup>43</sup>	12,356	15,658	27% 3,302	330	N/A
Statisticians (includes Biostatisticians) <sup>44</sup>	1,276	1,744	37% 468	47	Master's degree

See Appendix E for employment announcements.

See Appendix F for letters of support indicating the potential to hire graduates.

**Duplication**

Four public universities offer a similar or related degree program. The following universities offer graduate degree programs in the area of data science: George Mason University, Old Dominion University, Radford University, and the University of Virginia.

<sup>40</sup> The U.S. Bureau of Labor Statistics. <https://www.bls.gov/ooh/math/data-scientists.htm#tab-6>

<sup>41</sup> The U.S. Bureau of Labor Statistics. <https://www.bls.gov/ooh/math/mathematicians-and-statisticians.htm#tab-6>

<sup>42</sup> The U.S. Bureau of Labor Statistics. <https://www.bls.gov/ooh/computer-and-information-technology/computer-and-information-research-scientists.htm#tab-6>

<sup>43</sup> Virginia Employment Commission, Labor Market Information. <https://virginiaworks.com/occupational-projections>

<sup>44</sup> Virginia Employment Commission, Labor Market Information. <https://virginiaworks.com/occupational-projections>

## **George Mason University**

George Mason University (GMU) offers a Master of Science (MS) in Data Analytics Engineering that is related to the proposed degree program. The degree program is designed to provide students with an understanding of the technologies and methodologies necessary for data-driven decision making. The program requires 30 credit hours. The core requires 15 credit hours. The program requires 15 credits of coursework in a concentration. Thirteen areas of concentration are offered. A capstone course is required.

### Similarities

GMU's program requires core coursework in data science/big data tools, applied statistics, database management, and statistical/machine learning. VCU's proposed program will require the same courses. Both GMU's program and the proposed VCU degree program will require a capstone experience.

### Differences

GMU's program requires 15 credit hours in a concentration area. VCU's proposed program does not have concentrations but requires 12 additional hours in restricted electives (6 hours from computer science and 6 hours from statistics).

GMU's program requires a 3-credit hour capstone course. VCU's proposed capstone experience requires 6 credit hours (two semesters).

GMU's program is offered both in-person and online. VCU's proposed program is only an in-person program.

## **Old Dominion University**

Old Dominion University (ODU) offers a Master of Science (MS) in Data Science and Analytics that is related to the proposed degree program. The degree program focuses on providing students with a foundation to use various programming tools and software packages to develop statistical models. The program requires 30 credit hours. The core requires 15 hours. The program requires 12 credits of coursework in a concentration. Four areas of concentration are offered. A capstone course is required.

### Similarities

ODU's program requires core coursework in data science/big data tools, applied statistics, and statistical/machine learning. VCU's proposed program will require similar courses. Both ODU's program and the proposed VCU degree program will require a capstone experience.

### Differences

ODU's program requires 12 credit hours in a concentration area. VCU's proposed program does not have concentrations but requires 12 additional hours in restricted electives (6 hours from computer science and 6 hours from statistics).

ODU's program requires a 3-credit hour capstone course. VCU's proposed capstone experience requires 6 credit hours (two semesters).

The proposed program requires a course in database management. ODU's program does not require a database course in its core.

ODU's program is offered both in-person and online. VCU's proposed program is only an in-person program.

### **Radford University**

Radford University (Radford) offers a Master of Science (MS) in Data and Information Management that is related to the proposed degree program. The program's focus is to teach students how to manage data systems. The degree program requires 30 credit hours with 15 credits of core coursework. Six credit hours of capstone project is required.

#### Similarities

Radford's program is similar to VCU's proposed program in that both programs include core coursework in databases, and both programs have a 6-credit hour capstone requirement.

#### Differences

Radford's program is quite different in focus and curriculum from the proposed program. Radford's coursework is focused on providing students with the tools and techniques necessary to manage and process traditional and big data, and develop and maintain high performance computing systems. All of the five required core courses are focused on database management, warehousing, performance, security, and distributed systems. VCU's does not require this coursework.

VCU's program is focused on the analysis of data that would be housed in database systems. VCU's program requires core coursework in applied statistics and statistical/machine learning. Radford's program does not require such courses.

### **University of Virginia**

The University of Virginia (UVA) offers a Master of Science (MS) in Data Science that is related to the proposed degree program. The degree program focuses on the technologies and methodologies of data science to solve complex problems. The program requires 32 credit hours, which include 26 credit hours in core courses and 6 credit hours in elective courses. A 2-4 credit hour capstone experience is required.

#### Similarities

UVA's program requires coursework in applied statistics, statistical/machine learning, and data science/big data tools as does VCU's proposed degree program. Both programs require a capstone experience.

#### Differences

UVA's program requires coursework in programming fundamentals, foundations of computer science, Bayesian machine learning, and deep learning. VCU's program does not require these courses, however it includes them as restricted electives. UVA's program's core is 26 credit hours. VCU's proposed core is 18 credit hours.

VCU’s proposed program requires a course in databases. UVA’s program does not require this course.

UVA’s program requires a 2-4 credit hour capstone experience. VCU’s proposed capstone experience requires 6 credit hours.

UVA’s program is offered both in-person and online. VCU’s proposed program is only an in-person program.

**Enrollments and Degrees Awarded at Comparable Programs in Virginia.**

<b>Enrollments<sup>45</sup></b>	<b>Fall 2018</b>	<b>Fall 2019</b>	<b>Fall 2020</b>	<b>Fall 2021</b>	<b>Fall 2022</b>
George Mason University	383	476	527	602	727
Old Dominion University			6	13	29
Radford University	7	4	6	4	4
University of Virginia	69	99	231	258	206
<b>Degrees Awarded<sup>46</sup></b>	<b>2017-18</b>	<b>2018-19</b>	<b>2019-20</b>	<b>2020-21</b>	<b>2021-22</b>
George Mason University	119	152	198	222	153
Old Dominion University					4
Radford University	4	5	1	5	3
University of Virginia	32	57	54	101	139

**Student Demand**

Evidence of student demand comes from two sources: 1) a survey of demand among current VCU undergraduate and graduate students and 2) a survey of demand among VCU alumni.

Current Student Survey

In the summer of 2023, student demand for the proposed M.S. in Data Science was evaluated using an online survey of the target population of the proposed program. The survey was available to target students from June 15-July 31, 2023. Given the interdisciplinary nature of the field of data science, we surveyed current VCU undergraduate and graduate students from a variety of target quantitative degree programs.

<sup>45</sup> C01A2: Completion, Program Detail, <https://research.schev.edu/info/reports.guide-to-the-degrees-awarded-reports>

<sup>46</sup> E16: Fall Headcount Enrollment by Race/Ethnicity, Gender, and Program Detail, [https://research.schev.edu/enrollment/E16\\_Report.asp](https://research.schev.edu/enrollment/E16_Report.asp)

A total of 157 students responded to the survey (43 juniors, 61 seniors, and 53 graduate students). Using a five-point Likert scale (strongly disagree, disagree, neutral, agree, strongly agree), students were asked to respond to the following statement: “If VCU offered an M.S. in Data Science, I would enroll.” Of the 43 juniors that responded, 12 responded “strongly agree” and 21 responded “agree”. Of the 61 seniors, 24 responded “strongly agree” and 23 responded “agree”. Of the 53 graduate students, 11 responded “strongly agree” and 25 responded “agree”. Of all 157 students, 121 “strongly agreed” or “agreed” that they are interested in pursuing a degree in Data Science. 63 students responded that they would enroll in a degree program as early as 2024-2025.

### Alumni Survey

The online survey was also distributed to VCU alumni of the same programs in Appendix H over the same timeframe in summer 2023. A total of 140 alumni responded. When asked to respond to the following statement: “If VCU offered an M.S. in Data Science, I would enroll”, 39 responded “strongly agree” and 54 responded “agree”.

Of all 140 alumni, 102 “strongly agreed” or “agreed” that they are interested in pursuing a degree in Data Science. 58 alumni responded that they would enroll in a degree program as early as 2024-2025. 44 alumni responded that they are already working in the field of data science. Of these 44 alumni, 28 “strongly agreed” or “agreed” that they would enroll in a MS in Data Science if offered by VCU and 31 “strongly agreed” or “agreed” that they are interested in pursuing a degree in data science.

See Appendix G for the original survey.

See Appendix H for a list of degree programs surveyed.

See Appendix I for prospective student emails.

**State Council of Higher Education for Virginia  
Summary of Projected Enrollments in Proposed Program**

Year 1		Year 2		Year 3		Year 4 Target Year (2-year institutions)			Year 5 Target Year (4-year institutions)		
2024 - 2025		2025 - 2026		2026 - 2027		2027 - 2028			2028 - 2029		
HDCT	FTES	HDCT	FTES	HDCT	FTES	HDCT	FTES	GRAD	HDCT	FTES	GRAD
<u>15</u>	<u>12</u>	<u>27</u>	<u>21.5</u>	<u>32</u>	<u>24</u>	<u>32</u>	<u>24</u>		<u>32</u>	<u>24</u>	<u>12</u>

Assumptions:

Retention percentage: 80%

Percentage of full-time students: 60% / Percentage of part-time students: 40%

Full-time students average credit hours per semester: 7.5

Part-time students average credit hours per semester: 5

Full-time students graduate in 2 years

Part-time students graduate in 3 years

Projected Resource Needs for the Proposed Program

**Resource Needs**

Virginia Commonwealth University, the College of Engineering, and the College of Humanities & Sciences have the resources needed to initiate and sustain the proposed MS degree program in Data Science. The departments of Computer Science and Statistical Sciences & Operations Research will have the faculty, staff, equipment, space, and library resources to initiate and sustain the proposed degree program. The proposed degree program allocates 1 FTE of instructional effort for every 8 FTE of enrollment. The proposed degree program will therefore require approximately 1.875 FTE of instructional effort to initiate, rising to approximately 4 FTE by the target year of 2029-2030.

**Full-Time Faculty**

There is no faculty with full-time effort (50% or more effort) devoted to the proposed M.S. program. All Computer Science and Statistical Sciences & Operations Research faculty members have responsibilities for both graduate and undergraduate academic programs, and thus have only part-time responsibility for the proposed program.

**Part-Time Faculty**

Currently the Computer Science Department employs 18 full time tenure-track or tenured faculty members. Of the 18 full time tenure-track or tenured faculty, 7 would be teaching courses for the M.S. in Data Science. It is anticipated that each of these faculty members will devote a minimum of 0.5 FTE to teach core and restricted elective courses for the proposed program. Thus, the FTE



number of faculty resources in the proposed program from the Computer Science department is thus 3.5 in the initial year and through the target enrollment year.

Currently the Statistical Sciences and Operations Research department employs 13 full time tenure-track or tenured faculty members. Of the 13 full time tenure-track or tenured faculty, 10 would be teaching courses for the M.S. in Data Science. It is anticipated that each of these faculty members will devote 0.5 FTE to teach core and restricted elective courses for the proposed program. Thus, the FTE number of faculty resources in the proposed program from the Statistical Sciences & Operations Research department is thus 5 in the initial year and through the target enrollment year.

**Adjunct Faculty**

No adjunct faculty will be involved with the proposed M.S. Data Science program.

**Graduate Assistants**

No graduate assistants will be involved with the proposed M.S. Data Science program.

**Classified Positions**

No classified positions will be involved with the proposed M.S. Data Science program.

**Equipment (including computers)**

No new equipment (including computers) is required to initiate or sustain the proposed degree program.

**Library**

Current library, telecommunication, and other resources are sufficient to support the program. The library has sufficient resources to support the new M.S. in Data Science. The library system at VCU has a total journal collection of above 60,000, including medical, arts & humanities, sciences, social sciences etc. The resources described are sufficient to initiate and sustain the program.

**Space**

No additional space is required to initiate or sustain the proposed degree program.

**Targeted Financial Aid**

No targeted financial aid is projected to initiate or sustain the proposed degree program.

**Special Tuition or Fee Charges**

There are no specific tuition or fees related to the program.

**Other Resources (specify)**

No additional resources are needed to initiate and sustain the program.

**Funds to Initiate and Operate the Degree Program**

*Figures provided in the table below will be compared to SCHEV funding estimates using the current base adequacy model. This comparison will serve as a reference for the estimated costs. If there are large discrepancies, SCHEV may request additional clarification to ensure the institution’s assumptions are correct, or require modifications as a condition of approval.*

**Note:** Institutions must use the recommended student-faculty ratio when estimating FTE enrollments and required faculty FTEs.

<b>Cost and Funding Sources to Initiate and Operate the Program</b>			
<b>Informational Category</b>		<b>Program Initiation Year 2024 - 2025</b>	<b>Program Full Enrollment Year<sup>47</sup> 2026 - 2027</b>
1.	Projected Enrollment (Headcount)	15	32
2.	Projected Enrollment (FTE)	12	24
3.	Projected Enrollment Headcount of In-State Students	13	28
4.	Projected Enrollment Headcount of Out-of-State Students	2	4
5.	Estimated Annual Tuition and E&G Fees for In-state Students in the Proposed Program	\$83,770	\$167,540
6.	Estimated Annual Tuition and E&G Fees for Out-of-State Students in the Proposed Program	\$31,590	\$230,720
7.	Projected Total Revenue from Tuition and E&G Fees Due to the Proposed Program	\$115,360	\$230,720
8.	Other Funding Sources Dedicated to the Proposed Program (e.g., grant, business entity, private sources)	\$0	\$0

<sup>47</sup> For the “Full Enrollment Year” use: for associate degrees, initiation year plus 1; for baccalaureate degrees, initiation plus 3; for masters degrees, initiation plus 2; for doctoral degrees, initiation plus 3.

*Part V: Certification Statements*

1. A request of any kind will be submitted to the General Assembly for funds to initiate and/or maintain the proposed degree program.

Yes   
No

If “Yes” is checked, include narrative text to describe: when the request will be made, how much will be requested, what the funds will be used for, and what will be done if the request is not fulfilled.

2. The proposed degree program is included in the institution’s most recent six-year plan.

Yes   
No

If “No” is checked, include narrative text to explain why the program is being advanced at the present time despite not being included in the six-year plan.

3. The institution’s governing board has been provided information regarding duplication (if applicable) and labor market projections as part of its approval action.

Yes   
No

If “No” is checked, include narrative text to explain why the governing board has not been provided the information.

The institution’s Chief Academic Officer attests to the accuracy of the above statements

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Name (Printed)

---

Signature

---

Date

## Appendices

## Appendix A - Sample Plan of Study

### Full-time Student First Year

Fall semester	credit s	Spring semester	credit s
CMSC 535: Introduction to Data Science	3	CMSC 608: Advanced Database	3
STAT 534: Statistical Data Science I	3	STAT/OPER Elective	3
STAT 541: Applied Data Analysis	3	CMSC Elective	3
<b>Subtotal</b>	<b>9</b>	<b>Subtotal</b>	<b>9</b>

**Total First Year: 18 credit hours**

### Second Year

Fall semester	credit s	Spring semester	credit s
CMSC/SSOR 681: Data Science Capstone Project I	3	CMSC/SSOR 682: Data Science Capstone Project II	3
STAT/OPER Elective	3	CMSC Elective	3
<b>Subtotal</b>	<b>6</b>	<b>Subtotal</b>	<b>6</b>

**Total Second Year: 12 credit hours**

**Total Degree Credits: 30 hours**

## Sample Plan of Study

### Part-time Student

#### First Year

<b>Fall semester</b>	<b>credit s</b>	<b>Spring semester</b>	<b>credit s</b>
CMSC 535: Introduction to Data Science	3	CMSC 608: Advanced Database	3
STAT 534: Statistical Data Science I	3	STAT/OPER Elective	3
<b>Subtotal</b>	<b>6</b>	<b>Subtotal</b>	<b>6</b>

**Total First Year: 12 credit hours**

#### Second Year

<b>Fall semester</b>	<b>credit s</b>	<b>Spring semester</b>	<b>credit s</b>
STAT 641: Applied Data Analysis	3	STAT/OPER Elective	3
CMSC Elective	3	CMSC Elective	3
<b>Subtotal</b>	<b>6</b>	<b>Subtotal</b>	<b>6</b>

**Total Second Year: 12 credit hours**

#### Third Year

<b>Fall semester</b>	<b>credit s</b>	<b>Spring semester</b>	<b>credit s</b>
CMSC/SSOR 681: Data Science Capstone Project I	3	CMSC/SSOR 682: Data Science Capstone Project II	3
<b>Subtotal</b>	<b>3</b>	<b>Subtotal</b>	<b>3</b>

**Total Third Year: 6 credit hours**

**Total Degree Credits: 30 hours**

## Appendix B - Course Descriptions

New courses are denoted with an asterisk.

### Core courses

CMSC 535 Introduction to Data Science – 3 credit hours \*

This course covers understanding, representation, storage, retrieval, preprocessing and analysis of data. Specific topics include data quality and preprocessing, database management systems, data warehouses, selected methods for scalable unsupervised and supervised data analysis, and assessment of results generated by these methods. Students will be engaged in analysis of real-life data from data preprocessing, through data analysis, to the assessment of a knowledge product

CMSC 608 Advanced Databases – 3 credit hours

Topics discussed include: handling of missing information; the relationship between relational calculus, relational algebra and SQL; logic databases; distributed databases; outer joins; and transaction processing. Emphasis is placed on theoretical issues involved in these topics. In addition, students will work in teams to develop a working database application.

STAT 534 Statistical Data Science I – 3 credit hours

Familiarity with computer programming is strongly recommended. Topics include processing data from multiple sources and of different types; presentation of complex data; programming statistical and machine learning algorithms, such as maximum likelihood, least squares, etc.; design, implementation and analysis of simulation studies. Other topics will be covered that reflect the current needs of data scientists.

STAT 641 Applied Data Analysis – 3 credit hours

Topics include the fundamental ideas of descriptive statistics, elementary probability theory, statistical inference including tests of hypotheses and confidence intervals, ANOVA, principles of experimental design, correlation and linear regression analysis, categorical data analysis, and quality control. Focus is on the practical side of implementing these techniques using statistical software packages.

CMSC/SSOR 681 Data Science Capstone Project I - 3 credit hours \*

Enrollment is restricted to students enrolled in the MS in Data Science program. This course will allow students to apply the concepts, theories, and skills learned in other courses to a real data science problem. Student teams, in collaboration with a faculty mentor, will formulate a problem, query databases for appropriate data, perform appropriate analyses, discuss ethical considerations, and present results in both written and oral presentations.

CMSC/SSOR 682 Data Science Capstone Project II - 3 credit hours \*

Continuation of project from CMSC/SSOR 681.

### Restricted Computer Science elective courses

### CMSC 502 Parallel Algorithms (3 credits)

Software and hardware mechanisms for providing mutual exclusion in uniprocessor and multiprocessor environments. Architectural issues including pipeline design, superscalar computers, multiprocessors, memory systems, peripherals, interfacing techniques, networks, performance and software issues. Design and uses of parallel algorithms to solve concurrency problems in a distributed environment including message passing and remote procedure calls. Students will work in teams (as well as on individual projects) to design and implement parallel algorithms.

### CMSC 510 Regularization Methods for Machine Learning (3 credits)

Upon successful completion of this course, the student will be able to understand recent advances in machine learning and apply machine-learning tools that go beyond learning from data, as well as have the ability to incorporate additional knowledge about the learning problem. Topics covered will include optimization-based view of supervised machine learning; classical regularization approaches including weight decay and Lasso; regularization terms incorporating additional knowledge about structures in the feature space, including group lasso and graph-based regularization terms; semi-supervised learning using graphs linking unlabeled and labeled samples.

### CMSC 516 Advanced Natural Language Processing (3 credits)

Upon successful completion of this course, the student will be able to understand recent advances in natural language processing and apply NLP algorithms and techniques for processing unstructured text. Word-level, syntactic and semantic processing will be considered. Specific topics include rule-based and statistical methods for creating computer programs that analyze, generate and understand human language. Regular expressions and automata, context-free grammars, probabilistic classifiers and machine learning. Applications to real-world problems such as spell-checking, Web search, automatic question answering, authorship identification and developing conversational interfaces.

### CMSC 603 High Performance Distributed Systems (3 credits)

The course will assume undergraduate-level background in algorithms, data structures and parallel programming. Upon successful completion of this course, the student will be able to understand the concepts underlying distributed systems; analyze problems to identify performance bottlenecks, parallelization opportunities and concurrency issues in a distributed environment; create distributed and scalable implementations using multiple hosts/GPUs; design and implement algorithms using Hadoop, Spark and CUDA.

### CMSC 606 Introduction to Machine Learning (3 credits) \*

The course will assume undergraduate-level background in calculus, linear algebra, and probability. Upon successful completion of this course, the student will be able to understand foundations of machine learning, as well as recent advances in modern machine learning approaches such as deep learning. Topics covered will include automated differentiation for machine learning; linear models based on maximum likelihood; feedforward deep models and techniques for improving effectiveness and efficiency of training them. The course will also cover specialized deep architectures such as convolutional networks, generative models, and large language models.



### CMSC 630 Image Analysis (3 credits)

Introduces theoretical and practical aspects of computer vision for image processing and understanding. It provides a comprehensive walkthrough from basics of image preparation to using computational intelligence tools for knowledge discovery from images. The course will cover basics of image processing and computer vision, including image sampling and quantization, color, pixel-based operations, image filtering, morphological image processing, and image transforms; information extraction including segmentation and feature extraction; pattern recognition for computer vision: classification, novelty and object detection, image understanding, learning from video streams, and tensor-based methods. Examples will include medical image analysis, object recognition in ground and aerial photographs and hyperspectral imaging.

### CMSC 635 Knowledge Discovery and Data Mining (3 credits)

Covers knowledge discovery and data mining concepts, tools and methods; provides hands-on experience based on a project involving analysis of large real-life data. Topics include the knowledge discovery process, data storage and representation, preprocessing algorithms for missing data imputation, feature selection and discretization; unsupervised learning algorithms for clustering and association mining; supervised learning algorithms including decision trees, Bayesian models and introduction to support vector machines and neural networks; ensemble learning; protocols and measures for validation of predictive models; and data security and privacy issues.

### CMSC 636 Artificial Neural Networks and Deep Learning (3 credits)

The course will assume undergraduate-level background in programming, algorithms, linear algebra, calculus, statistics and probability. Topics ranging from fundamental learning rules, functional, cascade correlational, recurrent and gradient descent networks, to neocognitron, softmax, deep convolutional networks, autoencoders and pretrained deep learning (restricted Boltzmann machines). Students will be required to work in teams on a class paper.

### CMSC 691 Special Topics in Computer Science (3 credits)

Prerequisites: at least one graduate-level computer science course pertaining to the topic area and permission of instructor. An advanced study of selected topic(s) in computer science at the graduate level.

### **Restricted Statistics and Operations Research elective courses**

#### OPER 528 Stochastic Simulation (3 credits)

An introduction to stochastic discrete-event simulation. The course covers simulation modeling and programming in general-purpose languages (e.g., VBA for Excel) and (briefly) in specialized simulation environments (e.g., Arena, @Risk). The probability foundations of stochastic simulation of stochastic processes, random number and variate generation, variance reduction techniques, and proper design and analysis of the simulation experiment are emphasized. Applications are drawn from manufacturing, finance, logistics and service systems.

#### STAT 545 Applied Bayesian Statistics (3 credits)

Students should be familiar with statistical techniques such as multiple linear regression and multi-way ANOVA. Basic probability theory, prior distributions, prior distribution elicitation, likelihood principle, conjugate prior distributions, posterior probability distributions, Bayesian

inference. Analysis of typical types of experiments such as single sample experiments, two sample experiments, regression analysis, ANOVA, hierarchical models, structural equation modeling and other topics. Software such as R, Python, JAGS or STAN will be used to perform computations.

#### STAT 621 Nonparametric Statistical Methods (3 credits)

Estimation and hypothesis testing when the form of the underlying distribution is unknown. One-, two- and k-sample problems. Tests of randomness, Kolmogorov-Smirnov tests, analysis of contingency tables and coefficients of association.

#### STAT 625 Applied Multivariate Analysis (3 credits)

Multivariate statistics is a study of dependent random variables. This course covers methods for analyzing continuous multivariate data, such as numerical and graphical summary of multivariate observations, principal component analysis, factor analysis, classification and discrimination, canonical correlation analysis, and cluster analysis. Students will learn the motivation behind these methods, how to implement them in statistical software packages and how to interpret the results.

#### STAT/OPER 636 Machine Learning Algorithms (3 credits)

Includes an in-depth analysis of machine learning algorithms for data mining, equipping students with skills necessary for the design of new algorithms. Analyses will include framing algorithms as optimization problems and a probabilistic analysis of algorithms. Students will be exposed to current areas of research in the construction of data mining algorithms.

#### STAT 642 Design and Analysis of Experiments I (3 credits)

An introduction to the design and analysis of experiments. Topics include the design and analysis of completely randomized designs, one variable block designs, the family of Latin square designs and split-plot designs. Introductions are also given to multiple comparison procedures and contrasts, analysis of covariance and factorial experiments. Applications involve the use of a statistical software package.

#### STAT 643 Applied Linear Regression (3 credits)

An introduction to the concepts and methods of linear regression analysis. Topics include simple linear regression, multiple linear regression, the impact of model misspecification, model selection criteria, residual analysis, influence diagnostics, diagnostic plots, multicollinearity, transformations and response surface methodology. Applications involve the use of a statistical software package.

#### STAT 675 Time Series Analysis I (3 credits)

Analysis of data when observations are not mutually independent, stationary and nonstationary time series, ARIMA modeling, trend elimination, seasonal models, intervention analysis, transfer function analysis, prediction and applications in economics and engineering.

#### STAT 691 Special Topics in Statistics (1-3 credits)

A detailed study of selected topics in statistics.

## Appendix C – Abbreviated Curriculum Vitae of Faculty

### Computer Science Faculty

Arodz, Tomasz, PhD in Computer Science, 2007, AGH University of Science and Technology, Associate Professor of Computer Science, Specialization Area: Machine Learning and Bioinformatics.

Cano, Alberto, PhD in Computer Science, 2014, University of Granada, Associate Professor of Computer Science, Specialization Area: Machine Learning and High-Performance Computing.

Ghosh, Preetam, Professor, PhD in Computer Science and Engineering, 2007, University of Texas at Arlington, Associate Professor of Computer Science, Specialization Area: Systems Modeling and Optimization.

Kurgan, Lukasz, Professor, PhD in Computer Science, 2003, University of Colorado at Boulder, Professor of Computer Science, Specialization Area: Data Mining and Big Data Analysis.

Leonard, John, Professor, PhD in Engineering, 1991, University of California, Irvine, Professor of Computer Science, Specialization Area: Data Science and Modeling.

Manic, Millos, Professor, PhD in Computer Science, 2003, University of Idaho, Professor of Computer Science, Specialization Area: Artificial Intelligence.

McInnes, Bridget, PhD in Computer Science, 2009, University of Minnesota, Associate Professor of Computer Science, Specialization Area: Natural Language Processing

### Statistical Sciences & Operations Research Faculty

Boone, Edward, PhD in Statistics, 2003, Virginia Tech, Professor of Statistics. Specialization Area: Bayesian Statistical Methods.

Bui, Anh, PhD in Industrial Engineering and Management Sciences, 2019, Northwestern University, Assistant Professor of Statistics. Specialization Area: Statistical Process Control and Statistical Learning.

Chen, Ye, PhD in Mathematical Statistics, 2018, University of Maryland, Assistant Professor of Operations Research. Specialization Area: Stochastic Optimization and Statistical Learning.

Edwards, David, PhD in Statistics, 2008, University of Tennessee, Chair and Professor of Statistics. Specialization Area: Design and Analysis of Experiments.

Ke, Chenlu, PhD in Statistics, 2019, University of Kentucky, Assistant Professor of Statistics. Specialization Area: Dimension Reduction and High Dimensional Data Analysis.

Lu, QiQi, PhD in Statistics, 2004, University of Georgia, Associate Professor of Statistics. Specialization Area: Time Series Analysis.

Mays, James, PhD in Statistics, 1995, Virginia Tech, Associate Professor of Statistics.  
Specialization Area: Exploratory Data Analysis and Regression Analysis.

Qian, Yanjun, PhD in Industrial and Systems Engineering, 2018, Texas A&M University,  
Assistant Professor of Statistics. Specialization Area: Machine Learning and Signal/Image  
Processing.

Sahoo, Indranil, PhD in Statistics, 2018, North Carolina State University, Assistant Professor of  
Statistics. Specialization Area: Spatial-Temporal Statistics.

Su, Ya, PhD in Statistics, 2016, Texas A&M University, Assistant Professor of Statistics.  
Specialization Area: Nonparametric/Semiparametric Modeling and Machine Learning.

## **Appendix D - Letters of Support (Specific Demand)**



Ken Ratliff

9/6/2023

Potential Energy llc

4916 Evelyn Byrd Rd,

Richmond, VA

23225

Dear Drs. McInnes and Edwards,

I am writing to express my support for the proposed Master's program in Data Science at Virginia Commonwealth University. As an independent business owner in Richmond who is reliant upon STEM talent, I see the value in young professionals skilled in the combination of data analysis and data management. The proposed Mater's program, which integrates conceptual aspects of Statistics and Computer Science, seems well-positioned to address the complexities of the modern data environment now and as we move toward an AI and system of systems-based future.

The increasing volume of data generated today necessitates professionals who can effectively manage and analyze real world information as well as understand its limitations. The curriculum of VCU's proposed program, which aims to emphasize the entire data lifecycle, would prepare students for these types of tasks.

Furthermore, I like the program's decision to place less emphasis on deep derivation of mathematical theories in favor of a broader understanding of data processes. Practical application, especially in areas like data preprocessing and machine learning, is becoming critical in most industries.

In addition to my firm's needs, Richmond's business landscape, which includes sectors such as healthcare, finance, manufacturing, and retail, will also benefit from young professionals proficient in the skills taught in this program. Having access to individuals versed in comprehensive data management and analysis can contribute to improved operations and decision-making without the need for extensive in-house training.

In conclusion, I support the introduction of the MS in Data Science program at Virginia Commonwealth University. I believe the program will contribute positively to our local businesses and community.

Kind regards,

Ken Ratliff

Founder

Potential Energy llc

(804) 852-9434

Ken.Ratliff@PEfunds.com

## **Appendix E - Employment Demand (Job Announcements)**

# AI/ML/Data Scientist - Beth Israel Deaconess Medical Center | Boston, MA



The job you are trying to view has expired. Please perform a new search to find current jobs.



## AI/ML/Data Scientist

 Beth Israel Deaconess Medical Center - 3.9 

 Boston, MA



### Job Details

 Full-time

\$ Estimated: \$87.9K - \$111K a year

### Qualifications

TensorFlow

Doctoral degree

Customer service



NumPy      R      UNIX      English  
Master of Engineering      Master's degree      Bash  
Pandas      Analysis skills      C      Machine learning  
Doctor of Philosophy      Perl      SciPy  
Computer skills      Linux      Data science      Keras  
AI      Python      Shell Scripting      Computer graphics  
Under 1 year      Data Science

## Full Job Description

**When you join the growing BILH team, you're not just taking a job, you're making a difference in people's lives.**

### Job Type:

Regular

### Scheduled Hours:

40

### Work Shift:

Day (United States of America)

AI/ML/Data Scientist

## **Job Description:**

**Job Summary:** The Data Scientist will be an MEng, PhD, or someone with similar educational or work experience who has both conceptual/theoretical and practical/hands-on expertise in data science, artificial intelligence, machine learning (including deep learning), and related areas and is highly motivated to contribute to scientific and engineering advances in a fast paced, high caliber, and entrepreneurial academic setting.

## **Essential Responsibilities:**

1. Devise, test, and implement algorithms for high-throughput data.
2. Contribute to the generation of standard protocols and intellectual property.
3. Design and implement computer algorithms, potentially including supervised and unsupervised machine learning methods, deep learning (autoencoders, transformers, geometric deep learning, dynamical systems, model decomposition), etc.

## **Required Qualifications:**

Master's degree in AI, Machine Learning, Data Science, Math, Eng, Phys or related field required. Doctoral degree in AI,

Machine Learning, Data Science, Engineering, Physics, Math or related field preferred.

0-1 years related work experience required.

Expertise with Python libraries like Tensorflow/Theano/Keras, Numpy, Scipy, Pandas, Matplotlib, and Seaborn.

Fluency in Unix/Linux environments, Python and ideally other standard bioinformatics tools (e.g. R, Perl, C, bash/csh/zsh, CUDA, OpenGL), ideally including hands-on experience with parallel processing.

Demonstrated expertise in computational analysis of large data sets, ideally in imaging.

Advanced technical computer skills as required for technical support specific to functional area and related systems.

### **Preferred Qualifications:**

Hands-on expertise with statistical descriptions of complex systems (e.g. energy, entropy, moments, etc.) and their theoretical underpinnings.

Prior experience with/training in medical imaging.

Experience building web applications/portals (e.g. Shiny Server or Python analogs).

## Competencies:

**Decision Making:** Ability to make decisions that are guided by general instructions and practices requiring some interpretation. May make recommendations for solving problems of moderate complexity and importance.

**Problem Solving:** Ability to address problems that are varied, requiring analysis or interpretation of the situation using direct observation, knowledge and skills based on general precedents.

**Independence of Action:** Ability to set goals and determines how to accomplish defined results with some guidelines. Manager/Director provides broad guidance and overall direction.

**Written Communications:** Ability to summarize and communicate in English moderately complex information in varied written formats to internal and external customers.

**Oral Communications:** Ability to comprehend and converse in English to communicate effectively with medical center staff, patients, families and external customers.

**Knowledge:** Ability to demonstrate in-depth knowledge of concepts, practices and policies with the ability to use them in complex varied situations.

**Team Work:** Ability to act as a team leader for small projects or work groups, creating a collaborative and respectful team environment and improving workflows. Results may impact the operations of one or more departments.

**Customer Service:** Ability to provide a high level of customer service to patients, visitors, staff and external customers in a professional, service-oriented, respectful manner using skills in active listening and problem solving. Ability to remain calm in stressful situations.

### **Physical Nature of the Job:**

Sedentary work: Exerting up to 10 pounds of force occasionally in carrying, lifting, pushing, pulling objects. Sitting most of the time, with walking and standing required only occasionally

### **FLSA Status:**

Exempt

**As a health care organization, we have a responsibility to do everything in our power to care for and protect our patients, our colleagues and our communities. Beth Israel Lahey Health requires that all staff be vaccinated against influenza (flu) and COVID-19 as a condition of employment. Learn more about this requirement.**

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# Associate Research Analyst (Associate Data Scientist)

CNA

Arlington, VA 22201

Full-time

## CNA



★★★★☆ 9 reviews

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## Profile insights

Here's how your [profile](#) aligns with the job description

### Licenses

Secret Clearance ?

CNA ?

Do you have a valid **Secret Clearance** license?

Yes

No

### Skills

Microsoft Access ?

Marketing ?

Computer science ?

Analysis skills ?

Do you have experience in **Microsoft Access**?

Yes

No

### Education

Master's degree ?

Do you have a **Master's degree**?

Yes

No

## Job details

No matching [job preferences](#) 

### Job Type

Full-time

Are you looking for **Full-time** work?

Yes

No

### PRIMARY PURPOSE

CNA is looking for Data Scientists/Analysts to join our Data Science Division (DSD). We are a collaborative team who provide data science expertise and support to the Department of the Navy and Department of Defense. We develop models and analytics to solve problems across all Navy domains, including aviation, surface warfare, undersea warfare, cyber, logistics, readiness, force generation, sustainment, acquisition, and cost modeling.

Our Data Scientists/Analysts work on projects involving large datasets and complex questions that demand advanced coding skills as well as statistical and modelling techniques. We are passionate about using our skills to help the Navy achieve its goals and stay ahead of adversaries. We are a team that enjoys working together to solve complex problems. Our work leverages agile project management techniques to support faster cycle times to insights and to develop analytic minimum viable products.

At CNA, we foster an inclusive culture that values diverse backgrounds and perspectives. Our flexible and engaging work environment encourages iterative and creative collaboration at every stage of the problem-solving process. We are committed to helping clients develop effective solutions to better manage their programs through scientific, data-driven approaches. We offer competitive salaries and benefits packages, including health insurance, retirement plans, and paid time off. We also offer opportunities for professional development and growth, including training and mentorship programs.

### JOB DESCRIPTION AND/OR DUTIES

1. Under close supervision, conducts research and analysis that meets CNA's quality standards on focused, structured questions. Can effectively apply standard, routine, and well-established analytic methodologies. With minimal direction and supervision, routinely produces analysis that is logical and traceable as well as objective and unbiased. Shows some analytic creativity.
2. Develops rudimentary institutional knowledge of primary clients/sponsors; their culture, organization, and issues.
3. Contributes productively and harmoniously to the work of others; treats everyone respectfully, professionally and fairly. Keeps others informed. Actively engages with colleagues and works with manager to identify opportunities for collaborations within team and division. Seeks out others working on similar topics.
4. Supports business development efforts and/or marketing activities by conducting background research and helping prepare materials under the direction of more experienced staff.
5. Limited interaction with sponsors/clients and their study POCs under the supervision of an experienced colleague.



6. Impact largely confined to individual project work.
7. Demonstrates basic, effective communication skills, both written and oral. Can effectively present work to colleagues and CNA managers.
8. Works under close supervision on focused, well-structured pieces of projects.
9. Exhibits a positive attitude in interactions with colleagues and clients/sponsors. Serves as an effective member of project or research team by supporting leadership as needed.
10. Performs other duties as assigned.

#### JOB REQUIREMENTS

**1. Education:** Minimum Master's degree in a statistics, data science, computer science or equivalent experience.

**2. Experience:** Typical minimum requirements Master's & 0+ years of experience in research and analysis.

**3. Skills:** Facility with Microsoft Office applications (Excel, Word, Access, Powerpoint); Ability to manage databases; Ability to gather and organize information on policies, systems, problems, or procedures; Strong critical thinking and organizational skills; Basic knowledge of research techniques; Ability to plan and organize tasks effectively, both as an individual contributor and as a team member; Basic, effective communication skills.

**4. Other:** Ability to obtain and maintain an Active Secret Security Clearance.

- Please include a cover letter and your transcripts with your application.

#### \*\*\*Voluntary (but highly desired) document\*\*\*

Please include a personal statement as part of your application. A personal statement is a chance for us to get to know you. The statement is your opportunity to share your goals, interests, influences and show us that you will be a valuable asset to our organization. Please click here for personal statement guidelines – [Click here](#)

Personal statements will not be used as an elimination criteria for this position. They will only be used to enhance a candidate's application

CNA is committed to providing equal employment opportunities (EEO) to all employees and applicants for employment without regard to race, religion, color, sex (including pregnancy, gender identity, and sexual orientation), parental status, national origin, age, disability, family medical history or genetic information, political affiliation, military service and protected veterans, or other non-merit based factors. In addition to federal legal requirements, CNA complies with applicable state and local laws governing nondiscrimination in employment in every location in which the company has facilities. These protections extend to all terms and conditions of employment, including recruiting and hiring practices, promotion, termination, layoff, recall, transfer, leaves of absence, compensation, and training and career development programs. For more information about EEO protections, please view the EEO is the law posters here: "EEO is the Law" Poster; "EEO is the Law" Poster Supplement. The pay transparency policy is available here: Pay Transparency Nondiscrimination Poster. To be considered for hire, all individuals applying for positions with CNA are subject to a background investigation. For positions requiring access to classified information, U.S. citizenship is required. Individuals will also be subject to an additional government background investigation, and continued employment eligibility is contingent upon the ability to obtain and maintain an active security clearance.

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# Biostatistician

The University of Pittsburgh

Pittsburgh, PA

Full-time

## The University of Pittsburgh



★★★★☆ [1,234 reviews](#)

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## Job details

*No matching [job preferences](#)*

### Job Type

Full-time

Are you looking for **Full-time** work?

Yes

No

### Shift and Schedule

Monday to Friday

Are you willing to work **Monday to Friday**?

Yes

No

## Full Job Description

### Biostatistician

Med-Orthopedic Surgery - Pennsylvania-Pittsburgh - (23003400)

Applies scientific methodology to conceptualize, propose, and implement appropriate methodologies for statistical analyses.

Maintains and updates centralized research awards database. Assists with grant preparations and clinical trial budgets. Develops and validates reporting data, validates data subsets of funding data, and facilitates quality control procedures to ensure data accuracy.

The Department of Orthopedics at the University of Pittsburgh is seeking a highly motivated Master's Level Biostatistician to join a multidisciplinary team of physicians dedicated to treating musculoskeletal conditions. This position will collaborate and advise faculty on the appropriate statistical methods and ultimately apply them to research design and outcomes analysis. The analyst will have opportunities for authorship on publications stemming from their work and will play a key role in producing and sharing the results the broader scientific community. Education/Experience • Master's Degree in related field of biostatistics, data science, or epidemiology. • 0 years required (1-3 years preferred) of biostatistical consulting experience. Competencies • Strong knowledge of statistical software such as SAS, R, or STATA. • Excellent written and verbal communication skills. • Intermediate proficiency in data preparation, descriptive analyses, comparative statistics, and advanced statistical modeling. • Possess ability to interpret technical medical data and generate sound recommendations to support clinical research efforts.

- Ability to work independently and as part of a team.
- Demonstrate good organization skills, effective time management, and the ability to manage several concurrent tasks.
- Maintain a team-oriented approach and possesses the ability to cultivate a positive and collegial workplace relationships – demonstrating integrity and ethics at all times. This job will start as hybrid with the potential of full remote.

*The University of Pittsburgh is committed to championing all aspects of diversity, equity, inclusion, and accessibility within our community. This commitment is a fundamental value of the University and is crucial in helping us advance our mission, which includes attracting and retaining diverse workforces. We will continue to create and maintain an environment that allows individuals to discover, belong, contribute, and grow, while honoring the experiences, perspectives, and unique identities of all.*

*The University of Pittsburgh is an Affirmative Action/Equal Opportunity Employer and values equality of opportunity, human dignity and diversity. EOE, including disability/vets.*

*The University of Pittsburgh requires all Pitt constituents (employees and students) on all campuses to be vaccinated against COVID-19 or have an approved exemption. Visit [coronavirus.pitt.edu](https://coronavirus.pitt.edu) to learn more about this requirement.*

**Assignment Category** Full-time regular

**Job Classification** Staff.Medical Data Scientist I

**Job Family** Research

**Job Sub-Family** Data Science

**Campus** Pittsburgh

**Minimum Education Level Required** Master's Degree

**Minimum Years of Experience Required** No experience required

**Will this position accept substitution in lieu of education or experience?** Combination of education and relevant experience will be considered in lieu of education and/ or experience requirement.

**Work Schedule** M-F 8-4

**Work Arrangement** Hybrid: Combination of On-Campus and Remote work as determined by the department.

**Hiring Range** TBD Based Upon Qualifications

**Relocation Offered** No

**Visa Sponsorship Provided** No

**Background Check** For position finalists, employment with the University will require successful completion of a background check

**Child Protection Clearances** Not Applicable

**Required Documents** Resume, Cover Letter

**Optional Documents** Not Applicable

**Essential Functions** • Assist in protocol development by implementing proper study design methodology, performing sample size and power calculations, and generating randomization schedules. • Make recommendations for appropriate statistical analyses and design to investigators and study team. • Collaborate on grants, presentations and manuscripts submitted for publication, including writing methods sections and analysis plans for incorporation into protocol and grant submissions. • Contribute to teaching biostatistical methodology to medical students, residents, and fellows. • Stay informed of statistical techniques as applied to musculoskeletal research issues by reading journals and/or attending courses/programming meetings.

**Physical Effort** N/A

---

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## Data Scientist

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Penn State University Park  
Off Campus - Other

Full time

Posted 15 Days Ago

REQ\_0000001591

### APPLICATION INSTRUCTIONS:

- CURRENT PENN STATE EMPLOYEE (faculty, staff, technical service, or student), please [login to Workday](#) to complete the [internal application process](#). Please do not apply here, apply internally through Workday.
- CURRENT PENN STATE STUDENT (not employed previously at the university) and seeking employment with Penn State, please [login to Workday](#) to complete the [student application process](#). Please do not apply here, apply internally through Workday.
- If you are NOT a current employee or student, please click "Apply" and complete [the application process for external applicants](#).

### JOB DESCRIPTION AND POSITION REQUIREMENTS:

The Algorithms, Prototyping and Integration Department within the Communications, Information and Navigation Office (CINO) at the Applied Research Laboratory (ARL) is looking for two talented, experienced and a highly motivated Data Scientist's to assist in providing its customers with state-of-the-art visualization and decision support. The primary focus will be researching and developing feasible algorithmic solutions to our sponsor's complex problems given large sets of multivariate data. Specifically, you will be engaged in:

- Applying data mining and enhancement techniques
- Performing statistical analysis in support of pattern of life and anomaly detection
- Performing data fusion and correlation

# Data Scientist

Apply

(with regular travel to the State College, PA).

ARL is an authorized DoD SkillBridge partner and welcomes all transitioning military members to apply.

This job will be filled as a level 2, level 3, or level 4, depending upon the successful candidate's competencies, education, and experience. Minimally requires a Bachelor's degree in an Engineering or Science discipline plus two years of related experience, or an equivalent combination of education and experience for a level 2. Additional experience and/or education are required for higher level jobs. A Master's degree in Data Science, Computer Science or Statistics is highly desired.

Experience in the following is required:

- Data science/algorithm development

Experience in the following is preferred:

- Computer programming
- Statistics
- Machine learning
- Multivariable calculus and linear algebra
- Data wrangling/enhancement
- Data visualization and communication
- Software engineering

Candidates selected will be subject to a government security investigation. You must be a U.S. Citizen to apply. Employment with the Applied Research Laboratory will require successful completion of a pre-employment drug screen.

The Applied Research Laboratory (ARL) at Penn State University is committed to diversity, equity, and inclusion; we believe this is central to our success as a Department of Defense designated University Affiliated Research Center (UARC). We are at our best when we draw on the talents of all parts of society, and our greatest accomplishments are achieved when diverse perspectives are part of our workforce.

## CAMPUS SECURITY CRIME STATISTICS:

Pursuant to the Jeanne Clery Disclosure of Campus Security Policy and Campus Crime Statistics Act and the Pennsylvania Act of 1988, Penn State publishes a combined Annual Security and Annual Fire Safety Report (ASR). The ASR includes crime statistics and institutional policies concerning campus security, such as those concerning alcohol and drug use, crime prevention, the reporting of crimes, sexual assault, and other matters. The ASR is available for review [here](#).

# Data Scientist

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# Data Analyst

NovaGigs


McLean, VA

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## Indeed's salary guide

- Not provided by employer
- \$89.7K - \$114K a year is Indeed's estimated salary for this role in McLean, VA. 

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ID: 5345-da

Title: Data Analyst

Job Location: McLean, VA

Posted Date: 6/15/2022

### Job Duties:

- Analyze both business requirements and translate into technical requirements.
- Create data dictionary, solution documents, implementation guides, architecture diagrams and design documents.

- Implement planned and ad-hoc data analysis on raw data to provide insight on data migration, data reconciliation.
- Work on code development based on planned requirements and insight of data analysis.
- Design and develop automation tool using Python with parallel processing.
- Migrate on-premises database project into AWS cloud environment. Convert the SQL into Hive SQL to be compatible with Apache Hadoop ecosystem and achieve the full functionalities.
- Design and implement database management system with Apache Hive, AWS Glue catalog.
- Apply big data technologies to implement data validation process with AWS services such as Elastic Map Reduce (EMR), S3, Lambda function, Step function, etc. Implement the functions with Spark, PySpark, Scala.
- Develop and maintain scalable data pipelines for the AWS projects to upload files from on-premises servers to AWS environment.
- Identify measures, indicators of system performance, and the actions needed to improve or correct performance to achieve desired outcome.
- Manipulate, process and extract value from large datasets. Build infrastructures required to process data from a variety of data sources using Structured Query Language.

## Qualifications

- Master's degree in Statistics, Business Analytics, Information Systems Management, Data Science, Computer Science, or other related quantitative science.

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# Data Scientist

TechWish • Merrifield, VA

Depends on Experience

 Contract: W2

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# Skills

Azure

Azure Data Factory

Azure DevOps

Data Engineering

Data Management

Data Governance

data visualization

data transformation

data mining

DevOps

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# Job Description

Techwish is an Information Technology and Business Consulting firm providing professional staffing services.

Techwish is looking for **Data Scientist** in **Merrifield, VA**

- Master's degree in Data Science, Statistics, Mathematics, Computer Science, Engineering or another quantitative field, or related field, or the equivalent combination of education, training and experience
- Ability to understand complex business problems and determine what aspects require optimization and articulate those aspects in a clear and concise manner
- Advanced skill in communicating actionable insights using data to technical and non-technical audiences
- Significant experience working in a dynamic, research-oriented groups with several ongoing concurrent projects
- Demonstrates advanced functional knowledge of data visualization libraries such as matplotlib or ggplot2; knowledge of other visualization tools such as Microsoft Power BI and Tableau
- Ability to manipulate raw data within visualization tools to create effective dashboards that communicate end-to-end data outcomes visually
- Advanced storytelling with data skills

- Exceptional technical writing skills

## **Advanced Analytics Focused**

- Advanced skill in descriptive, predictive, and prescriptive analytics and modeling; demonstrated success in building models that are deployed and have made measurable business impact
- Significant experience in using two or more of the following modeling types to solve business problems: classification, regression, time series, clustering, text analytics, survival, association, optimization, reinforcement learning
- Advanced knowledge of advanced techniques such as: dimension reduction techniques, natural language processing, sentiment analysis, anomaly detection, geospatial analytics, etc.
- Demonstrates a deep understanding of the modeling lifecycle
- Advanced skill data mining, data wrangling, and data transformation with both structured and unstructured data; deep understanding of data models
- Advanced skill interpreting, extrapolating, and interpolating data for statistical research and modeling

- Advanced skill in Data Interpretation, Qualitative and Quantitative Analysis
- Advanced skill in Python and R
- Advanced skill in SQL and querying (able to pull/transform your own data)
- Advanced knowledge of cloud computing technologies such as: Apache Spark, Azure Data Factory, Azure DevOps, Azure ML (Machine Learning), Hadoop, Microsoft Azure, Databricks, AWS, Google Cloud
- Understanding of data models, large datasets, business/technical requirements, BI tools, statistical programming languages and libraries
- Familiar with Data Engineering concepts
- Familiar with the use of standard ETL tools and techniques
- Familiar with the concepts and application of data mapping and building requirements
- Demonstrates a deep understanding of multiple data related concepts
- Familiar with Data Integration, Data Governance and Data Warehousing
- Advanced skill in Data Management, Data Validation & Cleansing and Information Analysis

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Dice Id: 10432128

Position Id: SB051923

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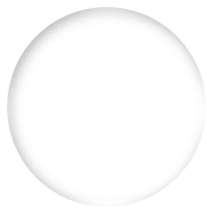
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Headquartered in Tysons Corner, Virginia, TechWish ( formerly BlueAlly Services ) has been serving as a prime source of contingent workforce and consulting solutions for many Fortune 100 companies, including two of the top five media companies, the world s top network infrastructure company and the world s largest credit union. With over 700 global engagements successfullv delivered TechWish ( formerly

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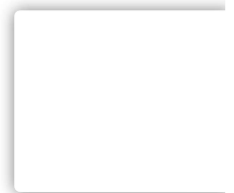
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Where Virginia

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# Data Scientist

Axle Informatics

Bethesda, MD

## Axle Informatics



★★★★☆ 9 reviews

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## Profile insights

Here's how your [profile](#) aligns with the job description

### Skills

Statistical software ? Software troubleshooting ? Natural language processing ?

Do you have experience in **Statistical software**?

Yes No

### Education

Master's degree ?

Do you have a **Master's degree**?

Yes No

### Overview:

**Axle Informatics** is a bioscience and information technology company that offers advancements in translational research, biomedical informatics, and data science applications to research centers and healthcare organizations nationally and abroad. With experts in biomedical science, software engineering, and program management, we focus on developing and applying research tools and techniques to empower decision-making and accelerate research discoveries. We work with some of the top research organizations and facilities in the country including multiple institutes at the National Institutes of Health (NIH).

**Axle** is seeking a highly ambitious, adaptable, structured, and detail-oriented **Data Scientist** to join our

vibrant team at the National Institutes of Health (NIH) supporting the Office of the Director (OD) located in Bethesda, MD.

### Overall Position Summary and Objectives

The All of Us, Office of Data Analytics, Data Scientist focus on the business analytics, metrics collection, and analysis efforts in All of Us. Designing and implementing advanced configurations for complex data sets. Compiling data analysis and conducting sophisticated analysis using tools and natural language processing. Producing ad hoc reports to answer questions Processing data holdings to extract topics that could be parsed to further illuminate areas of customer interest and collection priorities

### Work Details:

- Provides programming and troubleshooting support to the Federal Government in the dissemination of research data.
- Generate and optimize programs and scripts for the analysis of data; create programs and algorithms and develop computational infrastructure resources for organizing and parsing data from large and complex data.
- Serve as bioinformatics expert and coordinate with teams of biologists to conduct experimental queries and/or perform portions of studies using complex procedures and techniques common to modern bioinformatics.
- Coordinate building bioinformatics infrastructure to ensure easy and meaningful scientific analysis and interpretation of data.
- Provide broad-based programming and analytic support for a wide variety of bioinformatic and research projects.
- Install, troubleshoot and run open-source and commercial scientific software on platforms
- Performs computations on research data analysis.
- Perform computational analysis of, and interpret results.
- Provide reports based on analysis of scientific data.
- Perform sequencing and alignment of raw data, and interpret new data using larger public access datasets.
- Provide interpretive analyses of data derived from different experimental platforms to generate biological meaning.
- Write custom programs and algorithms to support data analyses and discovery.
- Works with staff on scientific programming and experimental design.
- Collaborate with scientists to design, analyze, manage and interpret all types of data. **1**
- Design and execute computational experiments. **2**
- Work with staff on planning of experiments, and data analysis for internal and collaborative projects; use bioinformatics expertise to advise and help bench scientists on experimental design and troubleshooting. **3**
- Work with staff to develop specifications for new analysis; design, test and implement solutions. **4**
- Make recommendations to investigators about the correct computational tools for testing scientific hypotheses and reaching valid conclusions. **5**
- Records observations and report results at weekly laboratory meetings.
- Prepare scientific reports and progress reports; assemble data to prepare tables, graphs and slides; conduct scientific and program related information searches and report results.
- Provides statistical support / analysis on research data.
- Utilize and adapt existing bioinformatics techniques to check for trends and patterns in the data.
- Provides research / service goals in the context of the laboratory's overall mission.
- Participate in research design with investigators for determining best practices pertaining to the bioinformatics analysis in new and ongoing projects.

- Evaluates new types of experimental approaches to protocols based on knowledge of scientific literature, available facilities and research needs.
  - Analyze and evaluate data cleaning and harmonization needs in the using a variety of descriptive statistics and analytic methods.
  - Independently coordinates the training of personnel in the use of scientific software applications, statistical software applications and programmatic software applications.
  - Provide training in and technical support (including product updates and version control) for programs, algorithms, archives, and pipelines generated during the course of this work.
  - Initiates interdisciplinary collaborations with other research centers.
  - Work with staff, collaborate with outside researchers, and contribute to positive overall teamwork; teach Bioinformatics principles and methodologies.
  - Deliver at least one presentation per year to audiences outside the Government.
  - Present analysis results at research conferences and meetings.
- 1, 2, 3, 4, 5** represents priority rankings, where 1 is highest priority and 5 is lowest priority of those ranked

### Minimum Education

Master's

### Additional Qualifications:

### Field of Study

- Genetics

### Software

- Powerpoint
- Outlook

### Skills

- Clinical and/or translational research
- Genome-wide association studies
- Work with large data sets

### Benefits

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The diversity of Axle's employees is a tremendous asset. We are firmly committed to providing equal opportunity in all aspects of employment and will not tolerate any illegal discrimination or harassment based

on age, race, gender, religion, national origin, disability, marital status, covered veteran status, sexual orientation, status with respect to public assistance, and other characteristics protected under state, federal, or local law and to deter those who aid, abet, or induce discrimination or coerce others to discriminate.

Accessibility: If you need an accommodation as part of the employment process please contact: [careers@axleinfo.com](mailto:careers@axleinfo.com)

**Disclaimer:** The above description is meant to illustrate the general nature of work and level of effort being performed by individual's assigned to this position or job description. This is not restricted as a complete list of all skills, responsibilities, duties, and/or assignments required. Individuals may be required to perform duties outside of their position, job description or responsibilities as needed.

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## Data Scientist (2023-0136)

Acclaim Technical Services

Reston, VA 20190

Full-time

Apply on company site

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### Job details

Here's how the job details align with your job preferences. Manage job preferences anytime in your [profile](#).

#### Job Type

Full-time ▾

**Acclaim Technical Services**, founded in 2000, is a leading language, operations, and technology services company supporting a wide range of U.S. Federal agencies. We are an Employee Stock Ownership Plan (ESOP) company, which is uncommon within our business sector. We see this as a significant strength, and it shows: ATS is consistently ranked as a top workplace among DC area firms and continues to grow. We are actively hiring a **Data Scientist** to support the U.S. Government working **on-site** in the Washington Metropolitan Area.

#### Education:

Bachelor's degree in one of the following fields or related studies with emphasis on statistical analysis:

- Applied Math, Economics, Physics, Statistics, Data Science, Chemistry, Computer Science, Data Analytics, Electrical or Computer Engineering, Quantitative Science (e.g. Bioinformatics, Computational Social Science)

#### Required Qualifications:

- Entry Level: Demonstrate aptitude in at least two abilities:
  - Natural Language Processing (NLP) - Candidate should understand concepts including working with Unicode, tokenization, lemmatization, term frequencies, stop words, and topic modeling



- Simulation and Modeling — Candidate should demonstrate an understanding of statistics and knowledge such as Bayesian modeling, causal inference, agent-based modeling or physics-based simulations
- Intermediate: Demonstrate substantial experience in at least two abilities:
  - Computer vision — Candidate should understand topics like object detection, segmentation and classification and identify a range of applications
  - Computational skills or Software Engineering — Candidate can describe complex, reusable software they built, the development process they can articulate the role of computational methods in the application of data science.
- Full Performance: Demonstrate mastery in at least one ability and substantial experience with at least one other ability
  - Statistics — Candidate should demonstrate understanding of statistical concepts including hypothesis testing, statistical learning (regression, decision trees, and classification), descriptive statistics, time series analysis, and Bayesian analysis
  - Data or Systems Engineering — Candidate can describe a variety of database types, data workflow tools, explain relational/non-relational databases, data models and ETL design
- Artificial Intelligence and Machine Learning
  - Graph Analytics — Candidate should understand basic data structures (directed, undirected, nodes, edges). They should understand basic graph algorithms, like centrality and shortest path, and application of graph databases
  - Exploratory Data Analysis and Visualization — Candidates should display an ability to explore and ask questions of data through descriptive statistics and visualization

### **Desired Qualifications:**

- Advanced Degree in a data science or data science equivalent
  - Experience with cloud computing like AWS or Google Cloud
  - Experience working with data rich problems through research or programs
  - Experience with visualization or User interface (UI)
  - Experience with computer programming, especially Python
  - Firm understanding of mathematics and/or statistics
  - Experience with parallelization and multiprocessing techniques

### **Minimum Qualifications:**

- Ability to meet the minimum requirements for joining the U.S. Government, including US Citizenship and a background investigation
- Willingness to travel

### **Equal Employment Opportunity / Affirmative Action**

ATS is committed to a program of equal employment opportunity without regard to race, color, ethnicity, national origin, ancestry, citizenship, sex, pregnancy, marital status, sexual orientation, gender identity, age, religion/creed, hairstyles and hair textures, handicap/disability, genetic information/history, military/veteran status, or any other characteristic or condition protected by federal, state or local law. It is the policy of ATS not merely to refrain from employment discrimination as required by the various federal, state, and local enactments, but to take positive affirmative action to realize for women, people of color, individuals with disabilities and protected veterans full equal employment opportunity. We support the employment and advancement in employment of individuals with disabilities and of protected veterans, and we treat qualified individuals without discrimination on the basis of their physical or mental disability or veteran status.

J2vIITrAab

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# Data Scientist I

The University of Pittsburgh

Pittsburgh, PA

Full-time

## The University of Pittsburgh



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## Job details

*No matching [job preferences](#)*

### Job Type

Full-time

Are you looking for **Full-time** work?

Yes

No

### Shift and Schedule

Monday to Friday

Are you willing to work **Monday to Friday**?

Yes

No

## Full Job Description

### Data Scientist I

GSPH-Epidemiology - Pennsylvania-Pittsburgh - (23003885)

Assists in the execution of research objectives, data collection, and data management. Performs routine procedures, statistical analysis, scientific analysis, and reporting. Integrates data and data sets, performs descriptive and exploratory analysis, and creates routine reports and analysis reporting tools. Utilizes statistical software and adheres to all protocols.

*The University of Pittsburgh is committed to championing all aspects of diversity, equity, inclusion, and accessibility within our community. This commitment is a fundamental value of the University and is crucial in helping us advance our mission, which includes attracting and retaining diverse workforces. We will continue to create and maintain an environment that allows individuals to discover, belong, contribute, and grow, while honoring the experiences, perspectives, and unique identities of all.*

*The University of Pittsburgh is an Affirmative Action/Equal Opportunity Employer and values equality of opportunity, human dignity and diversity. EOE, including disability/vets.*

*The University of Pittsburgh requires all Pitt constituents (employees and students) on all campuses to be vaccinated against COVID-19 or have an approved exemption. Visit [coronavirus.pitt.edu](https://coronavirus.pitt.edu) to learn more about this requirement.*

**Assignment Category** Full-time regular

**Job Classification** Staff.Data Scientist I

**Job Family** Research

**Job Sub-Family** Data Science

**Campus** Pittsburgh

**Minimum Education Level Required** Master's Degree

**Minimum Years of Experience Required** No experience required

**Will this position accept substitution in lieu of education or experience?** Combination of education and relevant experience will be considered in lieu of education and/ or experience requirement.

**Work Schedule** 8:30-5:00 M-F

**Work Arrangement** Remote: Teams working from different locations (off-campus).

**Hiring Range** TBD Based Upon Qualifications

**Relocation Offered** No

**Visa Sponsorship Provided** No

**Background Check** For position finalists, employment with the University will require successful completion of a background check

**Child Protection Clearances** Not Applicable

**Required Documents** Resume, Cover Letter

**Optional Documents** Not Applicable

**Essential Functions** The candidate will work with a team of researchers in the areas of maternal health and health equity to develop and design analytic strategies, collect primary data and conduct qualitative and quantitative analyses. They will also participate in communications and dissemination of data

**Physical Effort** Generally Sedentary

---

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# Data Scientist

**Employer**

University of Virginia

**Location**

Charlottesville, VA

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The School of Data Science at the University of Virginia is seeking a full-time **Data Scientist** to support the development and execution of a new Bachelor of Science in Data Science (BSDS). The position will have a broad cross-section of responsibilities and play a significant role in framing student experience and tracking student success using innovative methods that align with the goals of the new School of Data Science. This includes supporting faculty in the development of code-centered course content, creating and maintaining a robust system for tracking student success both while enrolled and post-graduation, providing ad-hoc and regular tutoring and/or training sessions for students and serving as a mentor for students considering or already enrolled in the undergraduate program. This position will also play a significant role in the teaching and development of the support structures for the Foundations of Data Science course that will be required for all students considering the Bachelor of Data Science degree. The goals of the BSDS are dependent on students engaging with real-world data as much as possible. Having dedicated Data Scientists to support the broad curriculum and student experience will be

critical to achieving this goal. In addition to the above the role will have the opportunity to pursue ad hoc data-driven projects or research efforts in support of the larger goals of the School

### **Responsibilities:**

- Understand all phases of the analytic process including data collection, preparation, modeling, evaluation, and deployment.
- Explore and examine data from multiple disparate sources in order to identify, provide reporting on, and analyze trends in the data as well as regular reporting for assigned departments.
- Establish links across existing data sources and find new, interesting data correlations.
- Develop statistical, mathematical, and predictive models using strategic business understanding to build the algorithms necessary to ask the right questions and find the right answers.

- Stay appraised of all assigned initiatives, providing reporting and analytics that will allow the group to make informed, data-driven decisions to meet business objectives.
- Visualize and report data findings creatively in a variety of visual formats that appropriately provides insights to the stakeholders.
- Understands all phases of the analytic process including data collection, preparation, modeling, evaluation, and deployment.
- Under general supervision, formulates and defines analytic scope and objectives through research and fact-finding.
- Competent to work on most phases of data analysis and associated programming activities.
- Analyze and interpret the results of experiments to create cost effective and process-efficient alternatives, enhancements, or modification.

- In addition to the above job responsibilities, other duties may be assigned.

## **Qualifications**

- Master's Degree in Data Science (or similar field) and 3 years of experience (experience gained while a student may be considered).
- Excellent collaborator and communicator.
- Proficient with Python, GitHub, SQL and some familiarity with R.
- Preference will be given to applicants that have an educational background or are familiar with best practices in STEM oriented pedagogy.

## **About the School:**

The University of Virginia School of Data Science—the first of its kind in the nation—is guided by common goals: to further discovery, share knowledge, and make a positive impact on society through collaborative, open, and responsible data science research and education. Founded in fall 2019 through the largest gift in UVA history, the

School positions the university and our community to play a national and international leadership role in the global digital future. The School of Data Science is the newest and 12th School to be formed in the University's 200-year history.

The School of Data Science is driven by a vision to meet the challenges of an increasingly data-driven world through excellence in collaborative, open, interdisciplinary research; education that produces responsible, diverse leaders; and service that leads to products and outcomes which provide societal benefit.

**Anticipated hiring range : \$80,000 – \$95,000**

The selected applicant will be required to complete a background check and health assessment per university policy.

**TO APPLY:**

Please visit UVA job board:

<https://uva.wd1.myworkdayjobs.com/UVAJobs> and search for "R0045258"

Complete an application online and attach:

1. Cover letter to include your interest in the position and your knowledge, skills, abilities, and experiences
2. Resume or CV
3. A diversity statement that summarizes your experience with fostering diversity, equity, and inclusion goals (please provide examples of past activities where possible).

PROCESS FOR INTERNAL UVA APPLICANTS: Please apply through your Workday Home page, search “Find Jobs”, and search for “R0045258”.

Review of applicants will begin March 3, 2023 and the position will remain open until filled.

\*\*\*Please note that you MUST upload ALL documents into the CV/Resume box. Applications that do not contain all of the required documents will not receive full consideration.

\*\*\*

For questions about the application process, please contact Rhiannon O’Coin, Senior Academic Recruiter,  
[rmo2r@virginia.edu](mailto:rmo2r@virginia.edu)

For more information about UVA and the Charlottesville community please see [www.virginia.edu/life/charlottesville](http://www.virginia.edu/life/charlottesville) and <https://embarkcva.com/>

## **COVID Vaccination Requirement and Guidelines**

Please visit the [UVA COVID-19 Job Requirements and Guidelines](#) webpage prior to applying for current information regarding vaccination requirements and guidelines for employment at UVA.

*The University of Virginia, including the UVA Health System which represents the UVA Medical Center, Schools of Medicine and Nursing, UVA Physician's Group and the Claude Moore Health Sciences Library, are fundamentally committed to the diversity of our faculty and staff. We believe diversity is excellence expressing itself through every person's perspectives and lived experiences. We are equal opportunity and affirmative action employers. All qualified applicants will receive consideration for employment without regard to age, color, disability, gender identity or expression, marital status, national or ethnic origin, political affiliation, race, religion, sex (including*

*pregnancy), sexual orientation, veteran status, and family medical or genetic information.*

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## Data Scientist


### SAIC

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 Today

 Top Secret/SCI 

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 IT - Data Science

 Chantilly, VA (ON-SITE/OFFICE)

### Description

SAIC is seeking a **Jr Data Scientist** to fill a critical position on SAIC's Prime Program, Landmark AOS located in Chantilly, VA. Landmark AOS supports the NRO's Ground Enterprise Directorate (GED), which is responsible for the acquisition of systems over the complete end-to-end life cycle.

#### Responsibilities:

- Perform data processing and analysis tasks, working with test designers, statisticians, other data scientists to build datasets and create analytic products.
- Work with senior team members to perform statistical analyses to identify significant effects in novel experimental and operational datasets, including exploratory analyses.
- Implement data visualizations to facilitate a visual understanding of identified effects and differences for both technical and lay audiences.
- Contribute to writing customer reports and technical whitepapers.

### Qualifications

#### Required Education and Experience

- Bachelor's in Computer Science, Data Science, or a Quantitative Science, or similar degree, and two (2) years or more experience; Masters and 0 years related experience.
- **Active Top Secret/SCI with the ability to get a Poly with the NRO**
- **Experience using Python or R for data manipulation, analysis, and visualization.**

- Excellent analytical and problem-solving skills, with the ability to translate complex data into actionable insights.
- Strong writing skills, with the ability to convey findings to both technical and non-technical audiences in whitepapers or presentations.
- Strong understanding of parametric and non-parametric statistical methods.

**GROUP ID:** 10111346

**R** Recruiter (</network/profiles/1390907>)

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### CLEARANCE LEVEL

[Top Secret/SCL \(/jobs/top-secret-sci\)](/jobs/top-secret-sci).

### EMPLOYER

[SAIC \(/jobs/saic\)](/jobs/saic).

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# Manager, Data Science

Fidelity Investments

Boston, MA 02210

## Fidelity Investments



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## Indeed's salary guide

- Not provided by employer

- \$107K - \$135K a year is Indeed's estimated salary for this role in Boston, MA. 

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## Job Description:

### Position Description:

*\*\*\*Applicants are permitted to work remotely from an at-home work site anywhere in the United States\*\*\**

Designs, develops, and implements algorithms and models for Artificial Intelligence/Machine Learning (AI/ML) using open source technologies and methodologies. Supports firm-wide data science initiatives using AI/ML mathematical techniques. Advises senior business stakeholders and leadership on advanced algorithms, data, and data analytics pertaining to AI. Cleanses and processes large data sets using Python, R, and related languages. Visualizes and communicates key business insights using d3.js, Plotly, Seaborn, Tableau, and Qlik. Sources and preprocess data from warehouses using Hadoop, Spark, SQL, and scripting tools.

### Primary Responsibilities:

- Designs, develops, and implements AI/ML mathematical models for production business use cases.
- Assesses and evaluates AI models for fairness, bias and exploitability.

- Identifies and ingests new data sources and performs feature engineering for integration into AI models.
- Structures work, plans new analyses, and translates business questions into analytical projects and AI-powered capabilities.
- Manages and delivers complex/critical AI/ML projects and discovers and verifies new opportunities to identify risk, grow business, and scale and optimize operations.
- Works across technologies and business functions to develop solutions at all levels of a data science stack, from data engineering and sources to production.
- Develops and applies mathematical or statistical theory and methods to collect, organize, collect, and analyze data and develop decision support software, service, and products.
- Formulates mathematical and simulation models of problems, relating constants and variables, restrictions, alternatives, conflicting objectives, and their numerical parameters.
- Performs validation and testing of models to ensure adequacy and reformulate models as necessary.
- Defines data requirements and gathers and validates information, applies judgment and statistical tests.

### Education and Experience:

Master's degree (or foreign education equivalent) in Computer Science, Engineering, Mathematics, Computational Statistics, Operations Research, or a closely related field and no experience.



## Skills and Knowledge:

### Candidate must also possess:

- Demonstrated Expertise (“DE”) designing, testing, and implementing Artificial Intelligence (AI), Machine Learning (ML), and Deep Learning (DL) models, using advanced modeling approaches (BERT, RoBERTA, and auto-encoders/decoders), and Natural Language Understanding and Generation (NLU/NLG); and building computer vision algorithms, using advanced technologies requiring high performance computer environment (PyTorch and TensorFlow).
- DE serving ML and DL models in low-latency production systems, using REST API endpoints; performing source code management and version control, using Git; and integrating DevOps tools for automated deployments to build and promote Continuous Integration and Continuous Deployment (CI/CD) practices.
- DE building and maintaining data pipelines to deploy and run AI and ML models to generate personalized Next Best Actions and Next Best Contents recommendations, using Amazon Web Services (AWS) Sagemaker.
- DE researching and creating algorithms, software, and web applications to visualize and surface AI and ML models into production.

[Expertise may be gained during graduate degree program]

**Please see below for the salary range for work locations in Colorado only:**

N/A

**Please see below for the salary range for work locations in New York City, Westchester County, NY and Jersey City, NJ only:**

N/A

**Please see below for the salary range for work locations in California only:**

N/A

**Please see below for the salary range for work locations in Washington only:**

N/A

**Certifications:**

## **Company Overview**

Fidelity Investments is a privately held company with a mission *to strengthen the financial well-being of our clients*. We help people invest and plan for their future. We assist companies and non-profit organizations in delivering benefits to their employees. And we provide institutions and independent advisors with investment and technology solutions to help invest their own clients' money.

## **Join Us**

At Fidelity, you'll find endless opportunities to build a meaningful career that positively impacts peoples' lives, including yours. You can

take advantage of flexible benefits that support you through every stage of your career, empowering you to thrive at work and at home. Honored with a Glassdoor Employees' Choice Award, we have been recognized by our employees as a Best Place to Work in 2023. And you don't need a finance background to succeed at Fidelity—we offer a range of opportunities for learning so you can build the career you've always imagined.

At Fidelity, our goal is for most people to work flexibly in a way that balances both personal and business needs with time onsite and offsite through what we're calling “Dynamic Working”. Most associates will have a hybrid schedule with a requirement to work onsite at a Fidelity work location for at least one week, 5 consecutive days, every four weeks. These requirements are subject to change.

We invite you to **Find Your Fidelity** at [fidelitycareers.com](https://fidelitycareers.com).

Fidelity Investments is an equal opportunity employer. We believe that the most effective way to attract, develop and retain a diverse workforce is to build an enduring culture of inclusion and belonging.

Fidelity will reasonably accommodate applicants with disabilities who need adjustments to participate in the application or interview process. To initiate a request for an accommodation, contact the HR Accommodation Team by sending an email to [accommodations@fmr.com](mailto:accommodations@fmr.com), or by calling 800-835-5099, prompt 2, option 3.

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# Quantitative Analytics Professional - Data Scientist

Freddie Mac

McLean, VA 22102

Hybrid remote

\$92,000 - \$138,000 a year - Full-time

**Freddie Mac**



★★★★☆ [947 reviews](#)

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## Job details

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**Salary**

\$92,000 - \$138,000 a year

Are you looking for jobs paying at least **\$92,000 a year**?

## Job Type

Are you looking for **Full-time** work?

---

## Full Job Description

At Freddie Mac, you will do important work to build a better housing finance system and you'll be part of a team helping to make homeownership and rental housing more accessible and affordable across the nation.

***Employees, contingent workers and visitors are no longer required to show proof of vaccination to be on-site. Effective January 2023, Freddie Mac's hybrid work arrangement is 3 days in the office (specifically Tuesday, Wednesday & Thursday).***

### Position Overview:

The Data Science & Analytics under Freddie Mac's Multifamily Division is currently seeking a Quantitative Analytics Professional to build data repository to facilitate modeling and analysis of risk evaluation.

### Our Impact:

- We perform data analytics, develop ML models and build data applications that support research, modeling, and business groups of the Multifamily division.

- Our partners span across all parts of Multifamily business groups including, Business Leadership, Product Owners, Data Owners, and IT Partners.
- We play a critical role in several major business/technology initiatives and constantly strive to bring better customer experience with every engagement.
- Our team is responsible for providing a 360 view of various Multifamily data and thereby help our business partners perform better Analytics and reporting.

### **Your Impact:**

You will be able to apply advanced Data Analytics and Engineering skills to solve real world challenges in building data pipelines that help the company build better models and do advanced reporting.

- Develop programs using Python, R, Java, SAS, and PySpark scripts
- Profile and analyze large data sets (Structured, Semi-Structured and Unstructured data)
- Validate data between source and target.
- Design data models, develop data dictionaries, metadata spreadsheets interpreting business needs and data (both structured, semi-structured and unstructured) flowing from and to the variety of the data sources.
- Coordinate with the business and Data Governance team to drive direction and technical solutions to ensure data quality.



- Derive meaningful results and create visualization reports for executive level outputs.
- Engage with internal teams, project teams and business areas to solicit business and data requirements.
- Assists the various collaborators with their requests for analysis/reporting to make business decisions.
- Working under limited direction, independently resolving and developing approach to solutions.

### **Qualifications:**

- Master's degree in statistics, data science or a related quantitative field.
- Coursework or work experience applying predictive modeling techniques from data science, statistics, machine learning, and econometrics to large data sets. Qualifying coursework may include—but is not limited to—data science, statistics, machine learning, optimization, numerical analysis, scientific programming, computational methods, supervised learning, unsupervised learning, text mining, and image analysis.
- Coursework or work experience writing computer programs to implement data science pipelines and predictive algorithms. Programming languages may include—but are not limited to—Python, R, SQL, Java, SAS, and MATLAB.
- Coursework or work experience using technologies for manipulating structured and unstructured big data. Big data technologies may include—but are not limited to—Hadoop, Hive, Pig, Spark, relational databases, and NoSQL.

## **Keys to Success in this Role:**

The candidate should be very analytical minded, have a good grasp of data architectures and keen in problem solving. We are looking for someone with good data science skills along with good exploratory data analysis experience used to build ML models. ML skills are highly desirable.

- Ability to think critically and logically.
- Strong predictive data modeling experience and solid skills.
- Solid communications skills – verbal and written.
- Detail oriented and excellent organization skills.
- Strong quantitative, data analytics, analytical, and problem-solving skills.
- Ability to transition easily to using newer Cloud technologies (such as, but not limited to, Snowflake and AWS) in Big Data and Machine Learning

**Current Freddie Mac employees please apply through the internal career site.**

Today, Freddie Mac makes home possible for one in four home borrowers and is one of the largest sources of financing for multifamily housing. Join our smart, creative and dedicated team and you'll do important work for the housing finance system and make a difference in the lives of others.

We are an equal opportunity employer and value diversity and inclusion at our company. We do not discriminate on the basis of race, religion, color, national origin, gender, sexual orientation, age, marital

status, veteran status, disability status or any other characteristic protected by applicable law. We will ensure that individuals with differing abilities are provided reasonable accommodation to participate in the job application or interview process, to perform essential job functions, and to receive other benefits and privileges of employment. Please contact us to request accommodation.

Notice to External Search Firms: Freddie Mac partners with BountyJobs for contingency search business through outside firms. Resumes received outside the BountyJobs system will be considered unsolicited and Freddie Mac will not be obligated to pay a placement fee. If interested in learning more, please visit [www.BountyJobs.com](http://www.BountyJobs.com) and register with our referral code: MAC.

Time-type:Full time

Job Category:Research & Modeling

FLSA Status:Exempt

The anticipated annualized base salary range for this position is \$92,000 to \$138,000 and is eligible to participate in the annual incentive program.

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## Hiring Insights

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# Research Analyst (North America)

IPA

Ashburn, VA

Full-time

Apply on company site

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## Profile insights

Here's how your [profile](#) aligns with the job description

### Skills

Systems engineering ?

Statistics ?

Stata ?

[+ show more](#)

Do you have experience in **Systems engineering**?

Yes

No

### Education

Master's degree ?

Bachelor's degree ?

Do you have a **Master's degree**?

Yes

No

## Job details

No matching [job preferences](#)

### Job Type

Full-time

Are you looking for **Full-time** work?

Yes

No

Ashburn, Virginia, United States

Position type:

Full-time

Department:

Project Research Division

Reports to:

Research Team Lead

Date posted:

May 1, 2023

Closing date:

Open until filled

## JOB SUMMARY

Are you passionate about applying an interest in the energy and renewables area to real-world applications where you can see the benefit? Are you interested in learning about what makes capital projects really tick? Are you curious how companies and teams organize themselves to develop, plan, and execute projects? Do you love **making connections and solving puzzles** or problems? Are you that rare combination of detailed and focused, yet you have broad interests and ideas? Do you enjoy analytical research work while also **being comfortable in a client-facing role**?

## ABOUT THE ROLE

The Research Analyst focuses on developing analytical products that support our benchmarking business as well as targeted research to help clients in the energy, renewables, mining and minerals, and other major commodity areas. They are also tasked with creating new products that drive the company forward and help our clients navigate a changing world. Independent Project Analysis, Inc. (IPA) is a company that values innovation, and the Research Analyst has a lead role this innovation effort.

IPA is a leading capital projects think tank with offices in the United States, the United Kingdom, Australia, Brazil and Singapore. We have openings in our US office in Ashburn, VA, for Research Analysts. This role is within an exciting and established area of the company in which we leverage our expertise and unmatched data to advise our clients on the effect of project practices on capital project performance and work collaboratively with them to support them as they work to improve. The successful candidate will have the potential to **become a consultant and trusted advisor in your specialization** in Industry.

IPA's has expertise and offerings across a wide range of industry sectors and product areas. Research Analysts have the opportunity to specialize in the following areas:

- Industry sector specialization (Energy, Chemicals and Life Sciences, Mining, etc.)
- Carbon Management
- Site and Sustaining Capital
- Project Cost Analysis
- Organization & Teams

IPA's client portfolio includes world-leading companies in both heavy and light industries around the world. Major industry leaders globally rely on us to assess the health of their capital project systems and provide recommendations to improve their performance. The **IPA project databases are unique** and the most comprehensive sources of capital project experience in existence. IPA also takes a leading role in empirical research into the drivers of better projects and project systems using our extensive databases of past project performance.

IPA seeks candidates for the Research Analyst position with strong analytical skills and intellectual curiosity who are looking to contribute as a thought leader. The candidate's interest in studying project practices that affect project outcomes is critical. Aptitude for and demonstrated skills to be a successful analyst and consultant include your ability to connect real life with the data and vice versa, to know when to ask more questions and when to just listen, and to back yourself as you learn and thrive.

## EDUCATION, SKILLS, AND ABILITIES

Analysts must have excellent written and oral communication skills, display the interpersonal skills needed to develop and maintain relationships at senior levels with client companies, and have a demonstrated aptitude for learning new concepts and applying them quickly. The position requires solid analytical skills, a proven ability to relate data and statistical analysis to real-world application, a track record of finding creative solutions to complex problems, comfort with ambiguity, and flexibility in thought and/or approach. The successful candidate will work well in teams, but also be capable of managing multiple projects independently and have experience in applied research or consulting.

We are interested in multiple perspectives and therefore are seeking a range of backgrounds and experience to contribute to the team, but the following are essential:

- A Master's degree in a STEM, behavioral science, or related field OR a Bachelor's degree equivalent and 1 to 2 years of experience. We're looking for backgrounds in economics, statistics, data science, applied research, psychology, political science, energy, renewables, petroleum or chemical engineering, operations research, systems engineering, or allied fields
- Experience using statistical programming languages (e.g., Stata, R, Python, SQL)
- Solid understanding of basic statistics and Best Practices
- Able to translate data and analytics into meaningful stories and insights
- Excellent listening, presentation, and report writing skills, with strong attention to detail
- Able to demonstrate intellectual curiosity and ability to conduct research independently
- Working directly with capital project teams to improve business competitiveness

You'll stand out from the crowd with any of the following:

- Experience working with and creating data architectures
- Applied background in machine learning algorithms (e.g., regression, trees, artificial neural networks)
- Knowledge of state-of-the-art data visualizations
- Applied experience in people analytics
- Expertise in survey design and psychometrics

## TRAVEL REQUIREMENTS

This position will involve approximately 10 to 15 percent travel.

## WHY IPA?

IPA is the preeminent global benchmarking and consultancy for capital projects. IPA guides capital-intensive organizations to **establish the right combination of people, work process, and governance** to maximize cost, schedule, safety, and operability performance. We have a dataset of nearly 21,000 capital projects as the basis of our work. Our clients are leading companies in the process, extractive, and technology sectors who conduct capital projects in the petroleum, minerals, infrastructure, chemicals, and renewables industries. IPA is committed to social and ethical responsibility and all global offices initiate or participate in **local charity initiatives to support those in need.**

We offer competitive salaries, excellent benefits (including the opportunity for a 4-month *paid* sabbatical after 6 years of service), stable employment and a long-term career path for professional growth and



development. IPA is an Equal Employment Opportunity employer.

### REQUIRED APPLICANT DOCUMENTS

Applicants should complete the form below and include a cover letter, resume, and salary requirement. IPA is an Equal Employment Opportunity employer.

- Cover letter
- Resume
- Salary requirement

### Careers

Interested in joining the IPA team? Apply now!

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# Research Analyst (Postsecondary Education Access and Success)

National Student Clearinghouse

2300 Dulles Station Blvd # 300, Herndon, VA 20171

Remote

\$53,700 - \$77,000 a year - Full-time

## National Student Clearinghouse



★★★★☆ 28 reviews

[Read what people are saying about working here.](#)

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## Profile insights

Here's how your [profile](#) aligns with the job description

### Skills

Stata  SAS  Research  [+ show more](#)

Do you have experience in Stata?

Yes

No

Skip

### Education

Master's degree   Bachelor's degree

Do you have a Master's degree?

Yes

No

Skip

## Job details

Here's how the job details align with your job preferences.

Manage job preferences anytime in your [profile](#).

### Pay

\$53,700 - \$77,000 a year ▾

### Job Type

Full-time ▾

## Full job description

*Are you looking for more than just a job and want to make difference? If so, then join the National Student Clearinghouse talent community and discover your impact today!*

*We are a nonprofit, nongovernmental organization and the leading provider of educational reporting, data exchange, verification, and research services. Serving the education, workforce and learner communities has been at the heart of our mission for over 25 years. Our work — performed in a trusted, secure, and private environment — provides numerous time- and cost-saving benefits to students, schools, administrators, and requestors.*

About the Role:

**This position is grant funded for 2 years from the start date, with the potential to extend depending if additional funding is secured/approved.**

Do you believe in changing lives through research? Is data-driven storytelling your talent? Are you someone who thrives in a team environment?

As a member of the National Student Clearinghouse Research Center, this role will support the development of research publications to advance the postsecondary educational opportunity and attainment, by engaging a variety of audience of schools and colleges, policymakers, and students and families in evidence-based research.

Currently, this position is 100% telework, however, as our company starts to return to our new normal, a hybrid work pattern, this position may be required to periodically work on-site at our office and the frequency would depend on the department/division's requirements. Therefore, candidates must either reside within a reasonable distance to commute to our office, or be willing to travel to our office in Herndon, when required.

How You Contribute:

- Demonstrate NSC's core competencies - Customer Focus, Optimizes Work Processes, Collaboration, Communicates Effectively, and Be Open and Authentic - which align with our corporate values. Manager will provide more details to candidates as needed.

**Customer Focus:**

- Support the development and refinement of the Research Center's quantitative research publications by manipulating large-scale data, conducting analysis, and creating data-driven storytelling with data visualizations.
- Develop and communicate data insights and research findings appropriately to diverse audiences.
- Triangulate and validate research results with relevant external sources of data.
- Use data visualization tools including dashboards and presentation formats to help others understand and utilize Clearinghouse data.

**Optimizes Work Processes:**

- Effectively manage multiple research projects simultaneously in a fast-paced, highly collaborative environment.
- Perform and manage quality control checks to ensure tasks are completed in an accurate and timely manner.
- Optimize data visualization tools including data dashboards and publication formats.

**Collaborates:**

- Provide timely communication, coordination, and collaboration on overlapping projects and deadlines and across departments, especially with the communications and marketing units.
- Make recommendations and assist teams to identify issues that require further study and analysis.

**Communicates Effectively:**

- Analyze key postsecondary student outcomes using the Clearinghouse data and effectively communicate the insights from data through objective and impactful narrative and data visualization.

**Be Open and Authentic:**

- Demonstrate openness to new perspectives and ideas.
- Build trust with internal and external stakeholders by demonstrating consistency between words and actions.

Position may be required to perform other duties as required. These essential functions are representative of those that must be met by an employee to successfully perform the job. Reasonable accommodations will be made to enable individuals with disabilities to perform these essential functions.

**What You Bring to the Table:**

- Master's degree in Education, Information/Data Science, Social Sciences, Statistics, or related field; Or a Bachelor's degree with a minimum of two years of relevant research experience.
- Proficiency with a combination of some of the following (typically acquired by 2-3 years of directly related work experience and experience working on relevant school projects):
  - Conducting quantitative research projects,
  - Manipulating and analyzing large-scale data,
  - Administering quality assurance control checks,
  - Writing research findings.
- Experience with SAS programming or other command line driven programming (Python, R, STATA, SPLUS, or SPSS Syntax).
- Familiarity with Tableau or other data visualization software, or the ability and willingness to learn it.
- Excellent interpersonal and communication skills, and the demonstrated ability to communicate technical terms to a diverse audience.
- Excellent attention to detail, time management and analytical skills.

- Team player and the demonstrated ability to work both independently and collaboratively on a team.
- Demonstrates the Clearinghouse's core competencies: customer focus, optimizes work processes, communicates effectively, collaborates, and is open and authentic.
- Proficiency with Microsoft Office Suite and other collaboration tools.
- Must live within a commutable distance to Herndon, VA, or in one of the Clearinghouse's approved States for hiring purposes. Refer to our HR Policies Page, located on our Careers site at <https://www.studentclearinghouse.org/careers/human-resource-policies/>, for more details

#### **Additional Desired Requirements:**

- Professional experience in conducting quantitative research that focus on postsecondary education access and success.
- Experience with large database, data warehouse and working with large SAS databases.
- Familiarity with national and state data sources in secondary and postsecondary education.
- Strong research planning and project management skills with the demonstrated ability to conceptualize research ideas and develop implementation plans to complete work timely.

#### **Physical Demands:**

- Use of a computer for 8 or more hours a day.
- Use of a copy machine and telephone.
- Frequently required to sit for 7 or more hours per day in close proximity to others in an open office environment.
- Occasionally required to use hands and fingers to operate, handle, and reach.
- Vision abilities include close vision and the ability to adjust focus.
- Travel via car, train, or airplane, when needed for training or professional development (up to 10%).

#### **Benefits and Related Information**

*The National Student Clearinghouse provides a robust benefit program designed to help meet the needs of each employee and their family, both now and in the future. We offer comprehensive medical, dental, and vision insurance, as well as life and disability insurance benefits, for employees and their qualified dependents. Health care, dependent care, and limited purpose flexible spending accounts, as well as a health savings account, are options available for employees to set aside pre-taxed dollars for certain qualifying expenses. We offer a very generous 401k matching contribution program with the opportunity to defer pre-tax and Roth contributions, as well as catch-up contributions for those who are eligible! We are proud to offer a competitive paid leave program consisting of vacation, sick, and personal time, as well as paid holidays. Vacation time will accrue based on length of service, and new full-time hires can accrue up to 13 days of vacation and up to 10 days of sick time per year. On an annual basis, new employees may use up to 32 hours of accrued sick time as personal time. Additionally, the Clearinghouse observes at least 11 paid holidays per year.*

*Another perk is that employees have the option to get reimbursed for basic wholesale company and roadside assistance memberships (e.g., Costco and AAA) and to request a buy back on portions of unused accrued vacation based on tenure and certain other qualifications. Employees can further their education and professional development by using our Employee Education Assistance Program, which establishes reimbursement for qualified education expenses upon successful completion of the program, and leveraging the enterprise-wide LinkedIn Learning subscription. There are additional employee benefits, to find out more, please request a copy of our complete benefit package!*

*We reasonably believe that the salary range for this position is between \$53,700-\$77,000.*

**Please submit a cover letter and resume when completing the application.**

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# Research Assistant I, Social Sciences

Eastern Virginia Medical School

Norfolk, VA 23510

Full-time

## Eastern Virginia Medical School



★★★★☆ 218 reviews

[Read what people are saying about working here.](#)

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## Profile insights

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### Skills

Statistics ?

Project management ?

Do you have experience in **Statistics**?

Yes

No

### Education

Master's degree ?

Bachelor's degree ?

Do you have a **Master's degree**?

Yes

No

## Job details

No matching [job preferences](#)

### Job Type

**Full-time**Are you looking for **Full-time** work?**Yes****No****Overview:**

The primary focus of this role is to manage the day-to-day activities of the study, including report development and ensuring the team stays organized. The incumbent will have a background in healthcare research, experience with basic statistics, and exceptional organizational skills. The research project aims to develop a platform that predicts hospitalization costs for Black and Hispanic populations in Hampton Roads with cardiovascular disease, leveraging the power of Artificial Intelligence (AI) and Machine Learning (ML).

**Responsibilities:**

- Perform administrative tasks related to the research study
- Work with PI and data manager II on developing deliverables for this grant
- Keep the team organized and meeting deadlines for deliverables as they come up
- Schedule and maintain contact with collaborators
- Generate reports for internal and external audiences
- Performs other duties as assigned

**Qualifications:**

- Bachelor's degree in public health, health sciences, epidemiology, data science, or a related field (Master's degree preferred)
- Preferred experience in healthcare research or project management

**Preferred Skills**

- Knowledge of healthcare disparities and their impact on minority populations
- Strong organizational skills and ability to prioritize and complete work on schedule
- Familiarity with organizing and managing large databases, planning analytical approaches, and performing appropriate and informative analyses
- Ability to collaborate with a diverse team of researchers and experts
- Proficiency in Microsoft 365

Location : Location: US-VA-Norfolk

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## **Appendix F - Letters of Support (Employment Demand)**

## **Appendix G - Student Demand Survey**

## Master's Degree in Data Science Interest Survey

Data Science has emerged as a discipline only within the last 20 years. Data scientists use analytical tools and techniques to extract meaningful insights from data.

The Virginia Economic Development Partnership notes Virginia has an increasing need for data scientists. Virginia currently has one of the highest concentrations of data scientist employment and is in the top 12 locations companies are actively looking for data scientists. The U.S. Bureau of Labor Statistics predicts employment in data science will grow by 36% in the coming decade and will see more growth than almost any other field between now and 2029.

VCU is proposing a new 30 credit hour Master of Science in Data Science. The proposed program is interdisciplinary between Computer Science and Statistics and offers an opportunity for real-world experiential learning that promotes critical thinking, problem solving, and innovation.

The proposed curriculum offers coursework covering collection, storage, retrieval and analysis of numerical, textual and image data, and synergistically introduces machine and statistical learning techniques. Graduates will be well-poised for careers as data scientists in any workforce sector.

We have prepared the survey below to gauge student interest in the program. Your answers to the following questions will be used in summary form only. No personally identifiable information will be released. Please feel free to contact us at [dedwards7@vcu.edu](mailto:dedwards7@vcu.edu) if you would like more information about the proposed program.

1. If VCU offered a master's degree in Data Science, I would enroll.  
Strongly Disagree \_\_ Disagree \_\_ Neutral \_\_ Agree \_\_ Strongly Agree \_\_
2. I am interested in pursuing a degree in Data Science.  
Strongly Disagree \_\_ Disagree \_\_ Neutral \_\_ Agree \_\_ Strongly Agree \_\_
3. In addition to face-to-face, this program should be offered fully online.  
Strongly Disagree \_\_ Disagree \_\_ Neutral \_\_ Agree \_\_ Strongly Agree \_\_
4. There should be a hybrid degree program, where some courses are online and some are face-to-face.  
Strongly Disagree \_\_ Disagree \_\_ Neutral \_\_ Agree \_\_ Strongly Agree \_\_
5. I would likely enroll in this degree program during the following academic school year.  
2024-2025 \_\_ 2025-2026 \_\_ 2026-2027 \_\_ 2027-2028 \_\_ 2028-2029 \_\_
6. I would likely enroll in this program as a full-time student.  
Strongly Disagree \_\_ Disagree \_\_ Neutral \_\_ Agree \_\_ Strongly Agree \_\_
7. I would likely enroll in this program as a part-time student.  
Strongly Disagree \_\_ Disagree \_\_ Neutral \_\_ Agree \_\_ Strongly Agree \_\_

8. I would sign up for an evening/weekend program for this degree, if given the choice.  
Strongly Disagree\_\_ Disagree\_\_ Neutral\_\_ Agree\_\_ Strongly Agree\_\_

9. My current student classification is:  
Junior\_\_ Senior\_\_ Graduate Student\_\_ Alumni\_\_ Other: \_\_\_\_\_

10. Please specify your degree program (and minor, if applicable). If multiple, please separate with a comma.

11. What is your current employment status?  
Full-time\_\_ Part-time\_\_ Other: \_\_\_\_\_

12. IF CURRENTLY EMPLOYED: Are you working in the field of data science?  
Yes\_\_ No\_\_

13. I am (choose one):  
Female\_\_ Male\_\_ Transgender\_\_ Other\_\_ Prefer not to answer\_\_

14. My race or ethnicity is (choose one):  
American Indian / Alaskan Native\_\_ Asian\_\_ Black / African American\_\_  
White / European American\_\_ Hispanic\_\_ Native Hawaiian / Pacific Islander\_\_  
Two or more\_\_ Unknown\_\_ Prefer not to answer\_\_

15. The highest degree I have earned is:  
High School Diploma or Equivalency\_\_ Associate's Degree\_\_ Bachelor's Degree\_\_  
Master's Degree\_\_ Doctoral Degree\_\_

16. My U.S. citizen status is:  
U.S. Citizen\_\_ Naturalized U.S. Citizen\_\_ Citizen of another nation\_\_  
Dual Citizenship\_\_ I'd rather not say\_\_

Timestamp	Response	In addition to face-to-face, this program should be offered online.	There should be a hybrid degree program, where some courses are online and some are face-to-face.	I would likely enroll in this program during the following academic year.	I would likely enroll in this program as a full-time student.	I would likely enroll in this program as a part-time student.	I would sign up for an evening/weekend program for this degree, if given the choice.	My current student classification is:	Please specify your degree program (and minor, if applicable). If multiple, please separate with a comma.	IF CURRENTLY EMPLOYED: Are you working in the field of science?	I am (choose one):	My race or ethnicity is:	The highest degree I have earned My U.S. citizen status is:	
6/15/2021	Strongly A	Strongly A	Strongly A	Strongly A	2024-2021	Agree	Strongly A	Strongly A	Alumni	Mathema	Unemployed	Male	White / E	Bachelor's U.S. Citizen
6/15/2021	Agree	Agree	Strongly A	Strongly C	2024-2021	Disagree	Agree	Agree	Alumni	Computer	Full-time	Yes	Male	White / E Bachelor's U.S. Citizen
6/15/2021	Neutral	Agree	Strongly A	Agree	2024-2021	Neutral	Strongly A	Agree	Alumni	Computer	Part-time	No	Female	Black / Afi Bachelor's U.S. Citizen
6/15/2021	Strongly A	Strongly A	Strongly A	Disagree	2025-2021	Disagree	Agree	Agree	Alumni	Computer	Full-time	No	Male	Asian Bachelor's U.S. Citizen
6/15/2021	Neutral	Strongly A	Strongly A	Neutral	2024-2021	Neutral	Agree	Agree	Alumni	Bachelors	Full-time	No	Female	Asian Bachelor's Citizen of another nation
6/15/2021	Neutral	Agree	Strongly A	Agree	2025-2021	Neutral	Agree	Agree	Alumni	Computer	Full-time	No	Female	White / E Bachelor's U.S. Citizen
6/15/2021	Agree	Strongly A	Strongly A	Agree	24-25 OR	Strongly A	Neutral	Agree	Alumni	n/a	Unemployed	Female	Asian	Bachelor's U.S. Citizen
6/15/2021	Strongly A	Strongly A	Strongly A	Agree	2024-2021	Neutral	Strongly A	Strongly A	Alumni	Informatic	Part-time	No	Male	Black / Afi Bachelor's Naturalized U.S. Citizen
6/15/2021	Agree	Agree	Strongly A	Strongly A	2025-2021	Disagree	Strongly A	Strongly A	Alumni	Informatic	Full-time	No	Male	White / E Bachelor's U.S. Citizen
6/15/2021	Agree	Agree	Neutral	Neutral	Have already	Agree	Disagree	Neutral	Alumni	Ph.D in Bi	Full-time	Yes	Male	White / E Doctoral U.S. Citizen
6/15/2021	Strongly A	Strongly A	Strongly A	Strongly A	2024-2021	Strongly A	Strongly A	Strongly A	Alumni	Informatic	Part-time	No	Male	Black / Afi Bachelor's U.S. Citizen
6/15/2021	Strongly A	Strongly A	Strongly A	Agree	2024-2021	Agree	Neutral	Strongly A	Alumni	Mathema	Full-time	No	Female	Black / Afi Bachelor's U.S. Citizen
6/15/2021	Neutral	Neutral	Strongly C	Strongly C	2028-2021	Neutral	Strongly A	Strongly A	Alumni	M.S. Decis	Full-time	Yes	Male	White / E Master's U.S. Citizen
6/15/2021	Agree	Strongly A	Agree	Agree	2024-2021	Neutral	Agree	Agree	Alumni	Computer	Full-time	No	Female	Black / Afi Bachelor's U.S. Citizen
6/15/2021	Strongly A	Strongly A	Strongly A	Strongly A	2024-2021	Agree	Strongly A	Strongly A	Alumni	Computer	Full-time	Yes	Female	Prefer not Bachelor's U.S. Citizen
6/15/2021	Strongly A	Strongly A	Strongly A	Agree	2024-2021	Disagree	Strongly A	Strongly A	Alumni	computer	Full-time	No	Male	Black / Afi Bachelor's U.S. Citizen
6/15/2021	Strongly A	Strongly A	Agree	Strongly A	2025-2021	Disagree	Agree	Agree	Alumni	Political Sc	Full-time	Yes	Male	White / E Bachelor's U.S. Citizen
6/15/2021	Agree	Agree	Strongly A	Agree	2024-2021	Disagree	Agree	Agree	Alumni	Mathema	Full-time	No	Female	White / E Bachelor's U.S. Citizen
6/15/2021	Strongly A	Agree	Strongly A	Strongly A	2025-2021	Neutral	Neutral	Agree	Alumni	Art histor	Full-time	Yes	Female	White / E Bachelor's U.S. Citizen
6/15/2021	Strongly A	Neutral	Neutral	Neutral	Complete	Strongly A	Strongly A	Strongly A	Alumni	Finance, a	Full-time	Yes	Male	White / E Master's U.S. Citizen
6/15/2021	Disagree	Neutral	Strongly A	Strongly A	2024-2021	Disagree	Agree	Agree	Alumni	Bachelor's	Full-time	No	Prefer not	Two or mo Bachelor's U.S. Citizen
6/15/2021	Neutral	Neutral	Agree	Agree	2025-2021	Strongly C	Agree	Agree	Alumni	M.S. in Inf	Full-time	Yes	Male	Prefer not Master's U.S. Citizen
6/15/2021	Strongly A	Strongly A	Agree	Strongly A	2024-2021	Disagree	Agree	Strongly A	Alumni	Computer	Full-time	No	Male	Asian Bachelor's U.S. Citizen
6/15/2021	Agree	Agree	Strongly A	Strongly A	2025-2021	Disagree	Agree	Agree	Alumni	Applied m	Full-time	No	Female	White / E Bachelor's U.S. Citizen
6/15/2021	Disagree	Disagree	Disagree	Strongly A	2028-2021	Agree	Strongly C	Strongly A	Alumni	MS Decisi	Full-time	No	Male	White / E Master's U.S. Citizen
6/15/2021	Strongly A	Strongly A	Strongly A	Neutral	2024-2021	Strongly C	Strongly A	Disagree	Alumni	Computer	Full-time	Yes	Female	White / E Bachelor's U.S. Citizen
6/15/2021	Neutral	Neutral	Neutral	Agree	I already f	Neutral	Neutral	Agree	Alumni	MSW, MD	Full-time	Yes	Female	White / E Master's U.S. Citizen
6/15/2021	Agree	Strongly A	Strongly A	Strongly A	2025-2021	Strongly A	Neutral	Strongly C	Alumni	Biomedic	Full-time	Yes	Male	Asian Bachelor's U.S. Citizen
6/15/2021	Agree	Agree	Strongly A	Neutral	2024-2021	Agree	Agree	Strongly A	Alumni	Computer	Full-time	No	Female	White / E Bachelor's U.S. Citizen
6/15/2021	Agree	Neutral	Strongly A	Agree	2025-2021	Disagree	Strongly A	Strongly A	Alumni	Informatic	Full-time	No	Female	Black / Afi Master's U.S. Citizen
6/15/2021	Neutral	Neutral	Agree	Agree	2026-2021	Neutral	Agree	Agree	Alumni	B.s. in Cor	Full-time	Yes	Male	White / E Bachelor's U.S. Citizen

6/15/2021	Neutral	Agree	Strongly A	Agree	2025-2021	Agree	Agree	Agree	Alumni	Chemical E	Full-time	No	Female	Black / Afri	Bachelor's	U.S. Citizen
6/15/2021	Strongly A	Neutral	Strongly A	Strongly A	2027-2021	Disagree	Strongly A	Agree	Alumni	Master of Sci	Full-time	No	Female	Black / Afri	Master's [	U.S. Citizen
6/15/2021	Strongly C	Strongly D	Strongly A	Neutral	Na	Strongly C	Strongly D	Strongly C	Alumni	I have a m	Full-time	Yes	Male	Black / Afri	Master's [	U.S. Citizen
6/15/2021	Neutral	Agree	Strongly A	Agree	2026-2021	Disagree	Agree	Strongly A	Alumni	Computer Sci	Full-time	Yes	Male	White / E	Bachelor's	U.S. Citizen
6/15/2021	Neutral	Neutral	Strongly A	Agree	2024-2021	Disagree	Agree	Strongly A	Alumni	Computer Sci	Full-time	No	Male	Black / Afri	Bachelor's	I'd rather not say
6/15/2021	Strongly A	Strongly A	Strongly A	Strongly A	2024-2021	Strongly A	Agree	Strongly A	Alumni	Nursing & H	Full-time	No	Female	Prefer not	Master's [	U.S. Citizen
6/15/2021	Disagree	Strongly D	Agree	Agree	N/A	Agree	Agree	Agree	Alumni	Physics, Chem	Part-time	No	Male	Asian	Bachelor's	U.S. Citizen
6/15/2021	Agree	Agree	Strongly A	Neutral	Not sure	Neutral	Agree	Strongly A	Alumni	Bachelor of Sci	Full-time	No	Female	White / E	Bachelor's	U.S. Citizen
6/15/2021	Strongly A	Strongly A	Strongly A	Neutral	2024-2021	Agree	Agree	Agree	Alumni	BS in Computer	Full-time	Yes	Male	Hispanic	Bachelor's	Citizen of another nation
6/15/2021	Neutral	Strongly A	Strongly A	Neutral	2024-2021	Disagree	Agree	Strongly A	Alumni	Informatic Sci	Full-time	Yes	Male	Asian	Bachelor's	U.S. Citizen
6/15/2021	Strongly A	Strongly A	Strongly A	Strongly A	2025-2021	Disagree	Agree	Strongly A	Alumni	IT	Full-time	No	Male	White / E	Bachelor's	U.S. Citizen
6/15/2021	Neutral	Agree	Strongly A	Agree	2024-2021	Strongly C	Strongly A	Strongly A	Alumni	Applied Math	Full-time	No	Female	Asian	Bachelor's	U.S. Citizen
6/15/2021	Strongly A	Strongly A	Strongly A	Strongly A	2024-2021	Neutral	Strongly A	Strongly A	Alumni	Bioinformatic	Full-time	No	Female	Asian	Bachelor's	I'd rather not say
6/15/2021	Strongly C	Strongly D	Strongly C	Agree	Never	Strongly C	Strongly D	Strongly C	Alumni	Environmental	Full-time	No	Male	White / E	Master's [	U.S. Citizen
6/15/2021	Strongly A	Strongly A	Strongly A	Agree	2025-2021	Disagree	Strongly A	Agree	Alumni	Informatic Sci	Full-time	No	Male	Hispanic	Bachelor's	U.S. Citizen
6/15/2021	Agree	Neutral	Agree	Agree	2028-2021	Agree	Disagree	Agree	Alumni	M.S in Inform	Contracto	No	Male	Asian	Master's [	Citizen of another nation
6/15/2021	Agree	Strongly A	Neutral	Agree	2024-2021	Agree	Disagree	Neutral	Alumni	Mechanic	Freelance	No	Prefer not	Prefer not	Bachelor's	U.S. Citizen
6/15/2021	Agree	Agree	Strongly A	Strongly A	2024-2021	Agree	Neutral	Agree	Alumni	Physics, Chem	Freelance	No	Prefer not	White / E	Bachelor's	U.S. Citizen
6/15/2021	Strongly A	Strongly A	Neutral	Agree	2024-2021	Strongly A	Disagree	Agree	Alumni	Statistics, Part	Time	No	Male	White / E	Bachelor's	U.S. Citizen
6/15/2021	Neutral	Strongly A	Strongly A	Strongly A	2024-2021	Strongly C	Neutral	Neutral	Alumni	Master of Sci	Full-time	No	Female	Prefer not	Master's [	U.S. Citizen
6/15/2021	Neutral	Agree	Disagree	Strongly A	2025-2021	Disagree	Agree	Strongly A	Alumni	Master in Chem	Full-time	No	Male	Hispanic	Master's [	Citizen of another nation
6/15/2021	Neutral	Neutral	Agree	Strongly A	2024-2021	Agree	Disagree	Strongly A	Alumni	Applied Math	Employed	No	Female	Hispanic	Bachelor's	U.S. Citizen
6/15/2021	Strongly A	Strongly A	Strongly A	Neutral	2024-2021	Strongly C	Strongly A	Strongly A	Alumni	Chemical E	Full-time	No	Prefer not	Prefer not	Bachelor's	U.S. Citizen
6/15/2021	Strongly A	Strongly A	Disagree	Neutral	2026-2021	Strongly C	Strongly A	Strongly A	Alumni	Masters in Chem	Full-time	Yes	Female	Asian	Master's [	Citizen of another nation
6/15/2021	Agree	Neutral	Disagree	Neutral	2024-2021	Agree	Disagree	Disagree	Alumni	MS in Inform	Looking for full time	Male	Asian	Master's [	Citizen of another nation	
6/15/2021	Agree	Strongly A	Strongly A	Strongly A	2024-2021	Strongly C	Strongly A	Strongly A	Alumni	B.S in Mat	Full-time	Yes	Female	Asian	Bachelor's	U.S. Citizen
6/15/2021	Agree	Agree	Agree	Strongly A	2025-2021	Strongly A	Neutral	Disagree	Alumni	Computer Sci	Full-time	No	Male	White / E	Bachelor's	U.S. Citizen
6/15/2021	Agree	Neutral	Strongly A	Disagree	2028-2021	Disagree	Agree	Agree	Alumni	Informatic Sci	Full-time	Yes	Male	Hispanic	Bachelor's	U.S. Citizen
6/15/2021	Strongly A	Strongly A	Agree	Agree	2025-2021	Disagree	Strongly A	Strongly A	Alumni	Statistics	Full-time	No	Female	Asian	Master's [	Citizen of another nation
6/15/2021	Agree	Agree	Strongly A	Strongly A	2025-2021	Strongly A	Neutral	Strongly A	Alumni	Financial	Full-time	Yes	Male	Black / Afri	Bachelor's	U.S. Citizen
6/15/2021	Agree	Strongly A	Neutral	Neutral	2025-2021	Neutral	Neutral	Strongly A	Alumni	Applied Math	Part-time	No	Male	White / E	Bachelor's	U.S. Citizen
6/15/2021	Strongly A	Strongly A	Agree	Disagree	2025-2021	Disagree	Agree	Agree	Alumni	Informatic Sci	Full-time	No	Male	Black / Afri	Bachelor's	U.S. Citizen
6/15/2021	Agree	Strongly A	Disagree	Agree	2024-2021	Disagree	Agree	Agree	Alumni	Statistics	Part-time		Male	White / E	Bachelor's	U.S. Citizen
6/15/2021	Strongly A	Strongly A	Strongly A	Strongly A	2024-2021	Neutral	Strongly A	Strongly A	Alumni	Computer Sci	Full-time	Yes	Female	Asian	Bachelor's	U.S. Citizen
6/15/2021	Agree	Disagree	Neutral	Strongly A	2024-2021	Agree	Disagree	Disagree	Alumni	Biology, Bio	Part-time	No	Male	Asian	Bachelor's	U.S. Citizen
6/15/2021	Strongly A	Strongly A	Neutral	Agree	2024-2021	Disagree	Agree	Agree	Alumni	BS in Mat	Full-time	Yes	Female	Hispanic	Bachelor's	U.S. Citizen
6/15/2021	Neutral	Neutral	Strongly A	Agree	2024-2021	Strongly C	Strongly A	Neutral	Alumni	Master De	Full-time	No	Male	White / E	Master's [	U.S. Citizen
6/15/2021	Agree	Agree	Strongly A	Agree	2026-2021	Disagree	Strongly A	Strongly A	Alumni	Biomedical	Full-time	No	Male	Two or mo	Bachelor's	U.S. Citizen
6/15/2021	Strongly A	Agree	Neutral	Agree	2027-2021	Neutral	Agree	Strongly A	Alumni	Chem eng	Part-time	No	Male	Asian	Bachelor's	Naturalized U.S. Citizen
6/15/2021	Strongly C	Neutral	Strongly A	Neutral	N/A	Disagree	Strongly A	Strongly A	Alumni	I was in th	Full-time	Yes	Female	White / E	Bachelor's	U.S. Citizen
6/15/2021	Agree	Strongly A	Agree	Agree	2026-2021	Neutral	Strongly A	Strongly A	Alumni	Mathema	Full-time	No	Female	White / E	Bachelor's	U.S. Citizen
6/15/2021	Strongly A	Strongly A	Strongly A	Strongly A	2025-2021	Strongly A	Strongly A	Strongly A	Alumni	bscs	Full-time	No	Male	Asian	Bachelor's	U.S. Citizen
6/15/2021	Agree	Agree	Strongly A	Agree	2025-2021	Agree	Disagree	Agree	Alumni	Informatic Sci	Full-time	No	Female	Two or mo	Bachelor's	Dual Citizenship
6/15/2021	Agree	Agree	Strongly A	Agree	2025-2021	Agree	Agree	Disagree	Alumni	Psycholog	Unemploy	No	Female	Black / Afri	Bachelor's	U.S. Citizen
6/15/2021	Agree	Neutral	Agree	Agree	2025-2021	Disagree	Agree	Neutral	Alumni	NA	Full-time	No	Male	White / E	Bachelor's	U.S. Citizen

6/15/2021	Strongly A	Strongly A	Disagree	Agree	2024-2021	Agree	Strongly A	Strongly A	Alumni	Bioinform	Full-time	No	Male	Black / Af	Bachelor's	U.S. Citizen
6/15/2021	Agree	Agree	Strongly A	Neutral	2025-2021	Disagree	Agree	Agree	Alumni	Applied IV	Full-time	No	Male	White / Et	Bachelor's	U.S. Citizen
6/15/2021	Agree	Strongly A	Strongly A	Disagree	2025-2021	Disagree	Agree	Agree	Alumni	Biomedica	Unemployed		Male	White / Et	Master's [	U.S. Citizen
6/15/2021	Agree	Agree	Strongly A	Strongly A	2025-2021	Disagree	Agree	Neutral	Alumni	Informatic	Full-time	No	Female	Black / Af	Bachelor's	U.S. Citizen
6/15/2021	Agree	Strongly A	Strongly A	Neutral	2024-2021	Disagree	Strongly A	Agree	Alumni	Computer	Full-time	Yes	Male	White / Et	Bachelor's	U.S. Citizen
6/15/2021	Neutral	Agree	Strongly A	Agree	2024-2021	Disagree	Strongly A	Strongly A	Alumni	Bioinform	Full-time	No	Female	Asian	Bachelor's	U.S. Citizen
6/15/2021	Neutral	Neutral	Strongly A	Strongly A	2024-2021	Neutral	Neutral	Strongly A	Alumni	Informatic	Full-time	No	Male	Two or mo	Bachelor's	U.S. Citizen
6/15/2021	Neutral	Agree	Strongly A	Strongly A	I am alrea	Neutral	Strongly A	Strongly A	Alumni	Computer	Full-time	No	Male	White / Et	Bachelor's	U.S. Citizen
6/15/2021	Strongly D	Strongly D	Agree	Agree	2025-2021	Agree	Agree	Strongly A	Alumni	Decision /	Full-time	Yes	Male	Two or mo	Master's [	U.S. Citizen
6/15/2021	Strongly A	Strongly A	Strongly A	Strongly A	I'm ahead	Strongly A	Strongly A	Strongly A	Alumni	Double m.	Full time	ξ No	Male	Asian	Bachelor's	U.S. Citizen
6/15/2021	Agree	Neutral	Strongly A	Strongly A	2024-2021	Disagree	Strongly A	Strongly A	Alumni	BS in Infor	Non employed		Prefer not	Prefer not	Master's [	U.S. Citizen
6/15/2021	Agree	Strongly A	Agree	Agree	2024-2021	Neutral	Neutral	Agree	Alumni	Mechanic	Full-time	Yes	Male	Black / Af	Bachelor's	U.S. Citizen
6/15/2021	Agree	Agree	Strongly A	Disagree	2025-2021	Disagree	Strongly A	Agree	Alumni	Bachelor	Full-time	Yes	Male	White / Et	Bachelor's	U.S. Citizen
6/15/2021	Disagree	Agree	Strongly A	Agree	no thanks	Strongly D	Strongly D	Strongly D	Alumni	bioinform	Part-time	No	Female	White / Et	Bachelor's	U.S. Citizen
6/15/2021	Agree	Agree	Neutral	Agree	2024-2021	Neutral	Agree	Agree	Alumni	Bachelors	Full-time	Yes	Male	White / Et	Master's [	U.S. Citizen
6/15/2021	Agree	Agree	Strongly C	Strongly C	2027-2021	Disagree	Strongly A	Strongly A	Alumni	M.S. Decis	Full-time	Yes	Prefer not	Prefer not	Master's [	U.S. Citizen
6/15/2021	Agree	Agree	Strongly A	Neutral	2024-2021	Disagree	Strongly A	Strongly A	Alumni	Computer	Unemploy	No	Transgenc	Hispanic	Bachelor's	U.S. Citizen
6/15/2021	Agree	Strongly A	Neutral	Neutral	2025-2021	Agree	Agree	Strongly A	Alumni	Computer	Full-time	Yes	Male	White / Et	Bachelor's	U.S. Citizen
6/15/2021	Strongly A	Strongly A	Strongly A	Strongly A	2025-2021	Neutral	Agree	Neutral	Alumni	Mechanic	Full-time	No	Male	White / Et	Bachelor's	U.S. Citizen
6/15/2021	Strongly A	Strongly A	Agree	Strongly A	2024-2021	Agree	Agree	Strongly A	Alumni	B.S. Mech	Full-time	Yes	Male	American	Bachelor's	U.S. Citizen
6/15/2021	Neutral	Neutral	Disagree	Agree	Already h:	Neutral	Disagree	Agree	Alumni	MDA-DAP	Full-time	Yes	Male	White / Et	Master's [	U.S. Citizen
6/15/2021	Neutral	Neutral	Disagree	Disagree	Haven't th	Strongly D	Strongly A	Strongly A	Alumni	PhD Syste	Full-time	No	Male	White / Et	Doctoral [	U.S. Citizen
6/15/2021	Agree	Agree	Strongly A	Strongly A	2026-2021	Disagree	Agree	Strongly A	Alumni	Informatic	Part-time	No	Male	White / Et	Bachelor's	U.S. Citizen
6/15/2021	Strongly A	Strongly A	Agree	Agree	2024-2021	Disagree	Agree	Strongly A	Alumni	Computer	Full-time	No	Male	White / Et	Bachelor's	U.S. Citizen
6/15/2021	Disagree	Disagree	Disagree	Disagree	Na	Disagree	Disagree	Disagree	Alumni	Decision /	Full-time	No	Male	White / Et	Master's [	U.S. Citizen
6/15/2021	Strongly D	Strongly D	Disagree	Disagree	Never	Strongly C	Strongly D	Strongly D	Alumni	CLSE	Full-time	No	Other	Prefer not	Bachelor's	U.S. Citizen
6/15/2021	Agree	Agree	Strongly A	Neutral	2024-2021	Disagree	Agree	Disagree	Alumni	bioinform	Full-time	Yes	Female	Asian	Bachelor's	U.S. Citizen
6/15/2021	Agree	Disagree	Strongly C	Neutral	2025-2021	Agree	Agree	Strongly A	Alumni	Bioinform	Full-time	No	Transgenc	White / Et	Bachelor's	U.S. Citizen
6/15/2021	Strongly D	Strongly D	Neutral	Agree	I may purs	Strongly D	Strongly D	Strongly C	Alumni	Master in	Full-time	Yes	Male	Asian	Master's [	I'd rather not say
6/15/2021	Strongly A	Strongly A	Strongly A	Strongly A	Already gr	Strongly A	Strongly A	Strongly A	Alumni	Double e	Alumni	No	Male	Hispanic	Bachelor's	U.S. Citizen
6/15/2021	Neutral	Agree	Strongly C	Strongly C	2027-2021	Neutral	Neutral	Agree	Alumni	Informatic	Full-time	No	Male	Black / Af	Bachelor's	U.S. Citizen
6/15/2021	Agree	Agree	Neutral	Agree	2024-2021	Neutral	Strongly A	Strongly A	Alumni	Electrical	Full-time	No	Male	White / Et	Bachelor's	U.S. Citizen
6/15/2021	Neutral	Strongly A	Neutral	Neutral	2025-2021	Neutral	Agree	Strongly A	Alumni	Computer	Full-time	No	Male	Asian	Bachelor's	U.S. Citizen
6/15/2021	Strongly D	Disagree	Neutral	Agree	N/A	Neutral	Agree	Agree	Alumni	Statistics	Unemployed		Male	Prefer not	Bachelor's	U.S. Citizen
6/15/2021	Strongly A	Strongly A	Strongly A	Strongly C	Now if po:	Strongly A	Neutral	Strongly A	Alumni	Bachelors	Full-time	Yes	Female	Black / Af	Bachelor's	I'd rather not say
6/16/2021	Agree	Strongly A	Neutral	Strongly A	2025-2021	Neutral	Neutral	Neutral	Alumni	Informatic	Full-time	No	Female	Asian	Bachelor's	U.S. Citizen
6/16/2021	Neutral	Neutral	Strongly A	Agree	N/A	Neutral	Agree	Neutral	Alumni	ECE/Com	Full-time	No	Male	Black / Af	Bachelor's	U.S. Citizen
6/16/2021	Neutral	Neutral	Agree	Strongly A	2027-2021	Disagree	Agree	Strongly A	Alumni	Degrees: (	Full-time	Yes	Female	Asian	Bachelor's	U.S. Citizen
6/16/2021	Agree	Agree	Neutral	Disagree	2025-2021	Disagree	Agree	Agree	Alumni	Informatic	Full-time	Yes	Female	White / Et	Bachelor's	U.S. Citizen
6/16/2021	Strongly A	Strongly A	Strongly A	Strongly A	2025-2021	Strongly A	Strongly A	Strongly A	Alumni	Computer	Full-time	No	Male	Asian	Bachelor's	U.S. Citizen
6/16/2021	Agree	Agree	Strongly A	Neutral	2025-2021	Disagree	Strongly A	Strongly A	Alumni	Bioinform	Full-time	No	Female	Asian	Bachelor's	U.S. Citizen
6/16/2021	Strongly C	Strongly D	Strongly C	Neutral	2024-2021	Neutral	Strongly D	Agree	Alumni	Mathema	Full-time	Yes	Male	Black / Af	Bachelor's	U.S. Citizen
6/16/2021	Strongly A	Strongly A	Agree	Neutral	2028-2021	Disagree	Agree	Agree	Alumni	Masters ir	Full-time	No	Female	Asian	Master's [	Citizen of another nation
6/17/2021	Neutral	Neutral	Agree	Agree	Not pursu	Neutral	Neutral	Neutral	Alumni	Decision /	Full-time	No	Female	Black / Af	Master's [	U.S. Citizen
6/17/2021	Strongly D	Strongly A	Agree	Disagree	2024-2021	Neutral	Agree	Neutral	Alumni	MBA, MD.	Full-time	Yes	Male	Asian	Master's [	Citizen of another nation



6/17/2023	Agree	Strongly A	Strongly A	Neutral	2024-2025	Strongly A	Agree	Strongly A	Alumni	B.S. Math	Full-time	Yes	Male	White / E	Bachelor's	U.S. Citizen
6/18/2023	Agree	Neutral	Strongly C	Strongly C	I obtained	Strongly C	Strongly D	Strongly A	Alumni	Masters, I	Full-time	No	Female	Black / Af	Master's	U.S. Citizen
6/18/2023	Agree	Agree	Strongly A	Strongly A	2026-2027	Disagree	Strongly A	Agree	Alumni	N/A	Full-time	Yes	Male	Asian	Master's	U.S. Citizen
6/18/2023	Agree	Strongly A	Neutral	Agree	Future	Disagree	Agree	Agree	Alumni	Exercise s	Graduate student		Female	Asian	Bachelor's	U.S. Citizen
6/19/2023	Strongly A	Strongly A	Strongly A	Strongly C	2024-2025	Strongly C	Agree	Strongly A	Alumni	MS Comp	Full-time	No	Male	Prefer not	Master's	U.S. Citizen
6/19/2023	Agree	Neutral	Strongly A	Strongly A	2025-2026	Neutral	Agree	Strongly A	Alumni	Computer	Unemployed		Male	Black / Af	Bachelor's	Citizen of another nation
6/19/2023	Neutral	Strongly A	Strongly A	Strongly A	2025-2026	Disagree	Strongly A	Strongly A	Alumni	Bioinform	Full-time	No	Male	White / E	Bachelor's	U.S. Citizen
6/20/2023	Neutral	Neutral	Strongly A	Strongly C	2025-2026	Strongly C	Strongly A	Agree	Alumni	IDS in Pro	Full-time	No	Male	Black / Af	Bachelor's	U.S. Citizen
6/20/2023	Neutral	Agree	Agree	Agree	2024-2025	Disagree	Agree	Strongly A	Alumni	Statistics	Full-time	No	Female	White / E	Bachelor's	U.S. Citizen
6/20/2023	Agree	Agree	Strongly A	Agree	2024-2025	Agree	Agree	Neutral	Alumni	B.S. in Bio	Full-time	No	Male	White / E	Master's	U.S. Citizen
6/20/2023	Neutral	Agree	Agree	Agree	2024-2025	Disagree	Agree	Agree	Alumni	Electrical	Full-time	Yes	Female	Asian	Bachelor's	U.S. Citizen
6/20/2023	Agree	Agree	Strongly A	Neutral	2024-2025	Neutral	Neutral	Agree	Alumni	B.S. in Bus	Full-time	No	Female	Asian	Bachelor's	U.S. Citizen
6/23/2023	Strongly A	Agree	Agree	Neutral	2024-2025	Disagree	Agree	Strongly A	Alumni	Computer	Full-time	No	Male	White / E	Bachelor's	U.S. Citizen
6/26/2023	Agree	Agree	Strongly A	Agree	2024-2025	Neutral	Strongly A	Agree	Alumni	Comp Sci	Full-time	No	Male	White / E	Bachelor's	U.S. Citizen
6/30/2023	Strongly A	Agree	Agree	Strongly A	2024-2025	Neutral	Agree	Agree	Alumni	Master's C	Full-time	Yes	Female	White / E	Master's	U.S. Citizen
7/2/2023	Neutral	Agree	Strongly A	Strongly A	2026-2027	Disagree	Agree	Strongly A	Alumni	Bioinform	Full-time	No	Female	White / E	Bachelor's	U.S. Citizen
7/4/2023	Disagree	Agree	Agree	Agree	2025-2026	Disagree	Agree	Agree	Alumni	GIS Certifi	Full-time	Yes	Male	White / E	Bachelor's	U.S. Citizen
7/10/2023	Agree	Agree	Agree	Agree	2025-2026	Agree	Neutral	Agree	Alumni	MS in Con	Full-time	No	Male	Asian	Master's	U.S. Citizen
7/29/2023	Neutral	Agree	Agree	Neutral	2024-2025	Agree	Disagree	Agree	Alumni	Mathema	Part-time	No	Female	Two or mo	Doctoral	U.S. Citizen

Timestamp	Response	Interest	Program	Face-to-face	Online	Academic	Student	Choice	Classification	Current	Separate	Employment	Field	I am	My race	The highest	My U.S. citizen status is:
6/15/2023	Strongly A	Strongly A	Agree	Neutral	2024-2025	Agree	Agree	Strongly A	Graduate	Masters d	Full-time	No	Female	Black / Afi	Bachelor's	U.S. Citizen	
6/15/2023	Agree	Agree	Strongly A	Agree	2023-2024	Strongly A	Neutral	Agree	Graduate	Masters o	Part-time	No	Male	White / Et	Bachelor's	U.S. Citizen	
6/15/2023	Strongly A	Strongly A	Strongly A	Strongly A	2027-2028	Agree	Agree	Agree	Junior	Bioinform	Part-time	No	Female	Two or mo	High Scho	U.S. Citizen	
6/15/2023	Agree	Agree	Strongly A	Strongly A	2025-2026	Strongly A	Disagree	Disagree	Junior	Computer	Full-time	Yes	Transgenc	Black / Afi	High Scho	U.S. Citizen	
6/15/2023	Agree	Agree	Strongly A	Disagree	2027-2028	Disagree	Strongly A	Agree	Graduate	Masters C	Full-time	No	Female	American	Bachelor's	U.S. Citizen	
6/15/2023	Strongly A	Strongly A	Strongly A	Neutral	2024-2025	Neutral	Strongly A	Strongly A	Senior	Computer	Part-time	No	Male	Asian	High Scho	U.S. Citizen	
6/15/2023	Neutral	Agree	Neutral	Agree	2025-2026	Disagree	Agree	Agree	Senior	Informatic	Part-time	No	Male	White / Et	Associate'	U.S. Citizen	
6/15/2023	Agree	Strongly A	Neutral	Neutral	2024-2025	Agree	Agree	Disagree	Senior	statistics,	Full-time	Yes	Transgenc	Two or mo	High Scho	Dual Citizenship	
6/15/2023	Agree	Agree	Strongly A	Disagree	2024-2025	Neutral	Agree	Strongly A	Graduate	Geograph	Full-time	Yes	Female	White / Et	Bachelor's	U.S. Citizen	
6/15/2023	Agree	Strongly A	Neutral	Agree	2025-2026	Agree	Disagree	Disagree	Junior	Bioinform	Student	No	Female	Asian	High Scho	U.S. Citizen	
6/15/2023	Agree	Agree	Strongly A	Neutral	2025-2026	Disagree	Strongly A	Strongly A	Graduate	MS in Stat	Full-time	No	Female	White / Et	Bachelor's	U.S. Citizen	
6/15/2023	Neutral	Agree	Strongly A	Strongly A	2028-2029	Neutral	Agree	Agree	Junior	Chemical	Full-time	No	Female	Two or mo	High Scho	U.S. Citizen	
6/15/2023	Agree	Neutral	Agree	Agree	2024-2025	Strongly A	Strongly A	Strongly A	Junior	Computer	Not applic	Yes	Male	Unknown	High Scho	U.S. Citizen	
6/15/2023	Neutral	Agree	Agree	Agree	2025-2026	Strongly A	Neutral	Strongly C	Junior	Biology &	Full-time		Female	Black / Afi	High Scho	U.S. Citizen	
6/15/2023	Agree	Neutral	Agree	Strongly A	2024-2025	Neutral	Agree	Neutral	Senior	Chemical	Part-time	No	Female	Black / Afi	Associate'	U.S. Citizen	
6/15/2023	Strongly A	Strongly A	Strongly A	Strongly A	2024-2025	Strongly A	Strongly A	Strongly A	Graduate	Phd	Full-time	No	Male	Prefer not	Master's [	Citizen of another nation	
6/15/2023	Agree	Agree	Agree	Neutral	2025-2026	Agree	Neutral	Strongly A	Senior	Bioinform	Part-time	No	Female	Hispanic	Bachelor's	U.S. Citizen	
6/15/2023	Strongly A	Strongly A	Strongly A	Strongly A	2025-2026	Strongly A	Neutral	Neutral	Junior	Bioinform	Part-time		Female	Asian	High Scho	U.S. Citizen	
6/15/2023	Agree	Strongly A	Strongly A	Strongly A	2025-2026	Disagree	Agree	Neutral	Junior	Informatic	Full-time	Yes	Female	Hispanic	High Scho	U.S. Citizen	
6/15/2023	Agree	Strongly A	Neutral	Neutral	2024-2025	Strongly C	Strongly A	Strongly A	Graduate	Masters ir	Full-time	Yes	Female	White / Et	Bachelor's	U.S. Citizen	
6/15/2023	Strongly A	Strongly A	Neutral	Strongly A	2026-2027	Neutral	Strongly A	Neutral	Junior	Biomedic	Part-time	No	Male	Asian	High Scho	U.S. Citizen	
6/15/2023	Agree	Neutral	Strongly A	Strongly A	N/A	Neutral	Neutral	Strongly A	Junior	Biomedic	Part-time	No	Female	Black / Afi	High Scho	U.S. Citizen	
6/15/2023	Agree	Strongly A	Agree	Neutral	2024-2025	Neutral	Agree	Strongly A	Senior	BS in Info	Full-time	No	Female	White / Et	Associate'	U.S. Citizen	
6/15/2023	Agree	Agree	Disagree	Disagree	2024-2025	Disagree	Agree	Strongly A	Graduate	Masters o	Full-time	Yes	Female	White / Et	Bachelor's	U.S. Citizen	
6/15/2023	Agree	Strongly A	Neutral	Agree	2025-2026	Neutral	Disagree	Disagree	Junior	Computer	Full-time	Yes	Female	White / Et	High Scho	U.S. Citizen	
6/15/2023	Agree	Strongly A	Strongly A	Agree	2025-2026	Agree	Strongly A	Strongly C	Junior	informatic	Part-time	No	Female	Black / Afi	High Scho	U.S. Citizen	
6/15/2023	Strongly A	Strongly A	Neutral	Neutral	2024-2025	Disagree	Strongly A	Agree	Graduate	MS decisi	Full-time	Yes	Male	White / Et	Bachelor's	U.S. Citizen	
6/15/2023	Strongly A	Agree	Neutral	Agree	2025-2026	Agree	Agree	Neutral	Senior	Informatic	Part-time	No	Female	Black / Afi	High Scho	U.S. Citizen	
6/15/2023	Neutral	Neutral	Strongly A	Neutral	2027-2028	Neutral	Neutral	Disagree	Junior	Electrical	Full-time	No	Male	White / Et	High Scho	U.S. Citizen	
6/15/2023	Neutral	Neutral	Agree	Agree	Not sure	Neutral	Neutral	Neutral	Junior	Mechanic	Part-time	No	Prefer not	Black / Afi	Associate'	U.S. Citizen	
6/15/2023	Strongly A	Strongly A	Agree	Agree	2024-2025	Strongly A	Agree	Disagree	Senior	Computer	Part-time	Yes	Transgenc	White / Et	High Scho	U.S. Citizen	

6/15/2021	Neutral	Neutral	Agree	Neutral	2027-2021	Disagree	Agree	Agree	Graduate	informatic	Part-time	Yes	Female	Black / Af	Bachelor's	U.S. Citizen
6/15/2021	Agree	Agree	Strongly A	Strongly A	2027-2021	Neutral	Agree	Neutral	Senior	Informatic	Full-time	Yes	Female	Asian	High Scho	U.S. Citizen
6/15/2021	Agree	Strongly A	Strongly A	Disagree	2025-2021	Neutral	Neutral	Strongly A	Graduate	BS Inform.	Full-time	Yes	Male	Prefer not	Bachelor's	U.S. Citizen
6/15/2021	Agree	Agree	Neutral	Neutral	2024-2021	Neutral	Neutral	Agree	Graduate	Phd in Hu	Full-time	Yes	Female	Asian	Master's [	Citizen of another nation
6/15/2021	Agree	Agree	Strongly A	Strongly A	2024-2021	Strongly A	Strongly A	Strongly A	Graduate	lls	Full-time	No	Female	White / E	Master's [	Naturalized U.S. Citizen
6/15/2021	Strongly A	Agree	Strongly A	Agree	2024-2021	Agree	Neutral	Agree	Senior	Mechanic	Full-time	No	Male	Black / Af	High Scho	U.S. Citizen
6/15/2021	Strongly A	Strongly A	Strongly A	Neutral	2025-2021	Agree	Neutral	Strongly A	Senior	Bioinform	Part-time	No	Female	Hispanic	Bachelor's	U.S. Citizen
6/15/2021	Neutral	Strongly D	Strongly A	Strongly A	2025-2021	Neutral	Agree	Disagree	Senior	Informatic	Part-time	Yes	Female	Black / Af	High Scho	U.S. Citizen
6/15/2021	Agree	Strongly A	Agree	Agree	2023-2021	Strongly A	Strongly D	Neutral	Senior	Bioinform	Part-time	Yes	Female	White / E	High Scho	Dual Citizenship
6/15/2021	Strongly D	Strongly A	Strongly A	Neutral	None	Strongly D	Agree	Agree	Graduate	Applied M	Part-time	No	Male	White / E	Bachelor's	U.S. Citizen
6/15/2021	Strongly A	Strongly A	Agree	Strongly A	As soon as	Agree	Agree	Agree	Senior	Physics	Part-time	No	Other	White / E	High Scho	U.S. Citizen
6/15/2021	Agree	Agree	Agree	Disagree	2024-2021	Disagree	Agree	Strongly A	Graduate	Informatic	Full-time	No	Male	Black / Af	Bachelor's	U.S. Citizen
6/15/2021	Strongly A	Strongly A	Strongly A	Strongly A	2024-2021	Strongly A	Strongly D	Strongly A	Senior	Business:	Full-time	No	Male	Asian	Associate'	U.S. Citizen
6/15/2021	Strongly A	Strongly A	Disagree	Agree	2025-2021	Disagree	Strongly A	Strongly A	Graduate	Decision A	Full-time	Yes	Female	Asian	Master's [	U.S. Citizen
6/15/2021	Neutral	Neutral	Agree	Agree	2026-2021	Neutral	Agree	Neutral	Senior	Psycholog	Part-time	No	Female	Asian	Bachelor's	U.S. Citizen
6/15/2021	Disagree	Agree	Agree	Agree	Not lookir	Agree	Neutral	Neutral	Graduate	Ph.D Integ	Student	No	Female	Asian	Master's [	Citizen of another nation
6/15/2021	Strongly D	Strongly D	Neutral	Neutral	No interes	Strongly D	Strongly D	Strongly D	Senior	Mechanic	Full-time	No	Male	Two or mo	Associate'	U.S. Citizen
6/15/2021	Agree	Agree	Strongly A	Strongly A	2025-2021	Strongly A	Neutral	Neutral	Senior	Bioinform	Part-time	Yes	Male	White / E	Associate'	U.S. Citizen
6/15/2021	Agree	Agree	Agree	Agree	2028-2021	Neutral	Neutral	Agree	Junior	Financial	Full-time	No	Male	Asian	High Scho	U.S. Citizen
6/15/2021	Disagree	Strongly D	Agree	Neutral	Never	Strongly D	Disagree	Disagree	Graduate	Pharmacy	Full-time		Female	Hispanic	Bachelor's	U.S. Citizen
6/15/2021	Agree	Agree	Disagree	Agree	2025-2021	Agree	Agree	Disagree	Junior	math	Full-time		Female	Asian	High Scho	U.S. Citizen
6/15/2021	Agree	Agree	Agree	Agree	2026-2021	Strongly D	Strongly A	Agree	Senior	Computer	Full-time	No	Male	White / E	Associate'	U.S. Citizen
6/15/2021	Strongly A	Strongly A	Agree	Agree	2024-2021	Agree	Neutral	Strongly A	Graduate	PhD in Qu	Full-time	Yes	Male	White / E	Master's [	Citizen of another nation
6/15/2021	Agree	Strongly A	Strongly A	Strongly A	2025-2021	Neutral	Strongly A	Strongly A	Senior	Informatic	Full-time	No	Female	White / E	Associate'	U.S. Citizen
6/15/2021	Strongly D	Strongly D	Agree	Agree	Never	Strongly D	Strongly D	Strongly D	Senior	Financial	Full-time	No	Male	White / E	High Scho	U.S. Citizen
6/15/2021	Strongly A	Strongly A	Neutral	Neutral	2024-2021	Neutral	Agree	Agree	Graduate	epidemiol	Full-time		Prefer not	Asian	Master's [	Citizen of another nation
6/15/2021	Agree	Strongly A	Agree	Agree	2024-2021	Agree	Disagree	Disagree	Senior	Major: M	Full-time s	No	Female	Black / Af	High Scho	U.S. Citizen
6/15/2021	Strongly A	Agree	Strongly A	Agree	2025-2021	Strongly A	Neutral	Strongly A	Junior	Major: sta	Part-time s	No	Male	White / E	Associate'	U.S. Citizen
6/15/2021	Disagree	Strongly D	Neutral	Neutral	NA	Neutral	Neutral	Neutral	Graduate	PhD Integ	Full-time	No	Female	White / E	Bachelor's	U.S. Citizen
6/15/2021	Agree	Agree	Strongly A	Neutral	2025-2021	Neutral	Agree	Agree	Junior	business i	Part-time	No	Female	Asian	High Scho	Naturalized U.S. Citizen
6/15/2021	Strongly A	Strongly A	Strongly A	Disagree	2024-2021	Strongly A	Neutral	Strongly A	Senior	Business I	Full-time	Yes	Female	White / E	Bachelor's	U.S. Citizen
6/15/2021	Agree	Agree	Agree	Agree	2024-2021	Agree	Neutral	Strongly A	Senior	Math, Cor	Part-time	No	Female	Asian	High Scho	U.S. Citizen
6/15/2021	Neutral	Agree	Agree	Agree	2024-2021	Neutral	Neutral	Neutral	Graduate	Bme	Full-time	No	Male	White / E	Master's [	U.S. Citizen
6/15/2021	Strongly A	Strongly A	Strongly A	Strongly A	2024-2021	Strongly A	Neutral	Agree	Junior	Computer	Full-time	No	Female	Hispanic	High Scho	U.S. Citizen
6/15/2021	Disagree	Disagree	Agree	Disagree	2024-2021	Disagree	Disagree	Disagree	Graduate	Doctorate	Full-time	Yes	Male	Hispanic	Master's [	Citizen of another nation
6/15/2021	Strongly A	Strongly A	Strongly A	Strongly A	2024-2021	Strongly A	Neutral	Strongly D	Senior	Informatic	Full-time	Yes	Male	White / E	Bachelor's	U.S. Citizen
6/15/2021	Agree	Agree	Neutral	Neutral	If this had	Agree	Agree	Neutral	Graduate	MS Applie	Full-time	No	Female	Two or mo	Bachelor's	U.S. Citizen
6/15/2021	Agree	Neutral	Disagree	Agree	Currently	Agree	Agree	Agree	Graduate	DAPT	Full-time	No	Female	White / E	Bachelor's	U.S. Citizen
6/15/2021	Neutral	Disagree	Strongly C	Agree	2027-2021	Disagree	Agree	Agree	Senior	Computer	Full-time	No	Female	White / E	High Scho	U.S. Citizen
6/15/2021	Agree	Neutral	Strongly A	Strongly A	2025-2021	Strongly D	Agree	Strongly A	Graduate	Masters o	Part-time	No	Male	Asian	Bachelor's	Citizen of another nation
6/15/2021	Agree	Agree	Strongly A	Agree	2025-2021	Agree	Disagree	Agree	Graduate	Bioinform	Full-time	No	Female	Black / Af	Bachelor's	U.S. Citizen
6/15/2021	Agree	Agree	Strongly A	Neutral	2024-2021	Strongly A	Neutral	Agree	Graduate	MS in Info	Full-time	No	Female	Black / Af	Bachelor's	U.S. Citizen
6/15/2021	Strongly A	Agree	Strongly A	Strongly A	2024-2021	Neutral	Strongly A	Neutral	Senior	Current: ir	Part-time	No	Female	Asian	High Scho	U.S. Citizen
6/15/2021	Strongly A	Strongly A	Strongly A	Strongly A	2024-2021	Strongly A	Neutral	Agree	Senior	Bioinform	None	No	Female	Hispanic	Associate'	U.S. Citizen
6/15/2021	Disagree	Disagree	Strongly C	Disagree	2025-2021	Agree	Neutral	Strongly A	Junior	Biomedica	Full-time	Yes	Male	White / E	High Scho	U.S. Citizen

6/15/2021	Neutral	Neutral	Strongly A	Strongly A	2024-2021	Neutral	Agree	Agree	Junior	Biomedical	Full-time	No	Male	Asian	High Scho	U.S. Citizen
6/15/2021	Agree	Agree	Strongly A	Agree	2024-2021	Neutral	Agree	Strongly A	Graduate	Computer	Full-time	No	Male	White / Et	Bachelor's	U.S. Citizen
6/15/2021	Agree	Agree	Neutral	Agree	2026-2021	Agree	Neutral	Neutral	Junior	Computer	Part-time	No	Transgenc	White / Et	High Scho	U.S. Citizen
6/15/2021	Agree	Agree	Strongly A	Strongly A	2026-2021	Neutral	Agree	Neutral	Junior	Bioinform	internship	No	Female	Asian	High Scho	U.S. Citizen
6/15/2021	Strongly A	Strongly A	Agree	Agree	2026-2021	Agree	Agree	Agree	Junior	Bachelors	Full-time		Female	White / Et	High Scho	U.S. Citizen
6/15/2021	Strongly A	Strongly A	Strongly A	Strongly A	2024-2021	Strongly A	Neutral	Strongly A	Senior	Applied m	Full-time	No	Female	Prefer not	Associate'	Dual Citizenship
6/15/2021	Neutral	Agree	Disagree	Neutral	2027-2021	Agree	Disagree	Agree	Junior	Mechanic	Part-time	No	Prefer not	Prefer not	High Scho	U.S. Citizen
6/15/2021	Agree	Agree	Agree	Strongly A	2025-2021	Agree	Agree	Neutral	Junior	Computer	Part-time	No	Female	Two or m	Associate'	Dual Citizenship
6/15/2021	Agree	Agree	Strongly A	Neutral	2024-2021	Agree	Agree	Neutral	Senior	Informatic	Part-time	Yes	Male	Hispanic	Associate'	U.S. Citizen
6/15/2021	Agree	Strongly A	Neutral	Strongly A	2025-2021	Disagree	Strongly A	Strongly A	Senior	Operation	Full-time	Yes	Female	Hispanic	High Scho	U.S. Citizen
6/15/2021	Strongly A	Strongly A	Strongly A	Strongly A	2026-2021	Strongly A	Strongly A	Strongly A	Junior	Electrical	Part-time	Yes	Male	White / Et	High Scho	U.S. Citizen
6/15/2021	Agree	Strongly A	Agree	Strongly A	2025-2021	Neutral	Agree	Strongly A	Graduate	Accountin	Full-time	No	Male	Black / Af	Bachelor's	Dual Citizenship
6/15/2021	Strongly C	Strongly D	Strongly C	Strongly C	2025-2021	Strongly C	Neutral	Strongly C	Junior	Bioinform	None	No	Male	Asian	High Scho	U.S. Citizen
6/15/2021	Agree	Agree	Agree	Agree	2025-2021	Disagree	Agree	Agree	Senior	informatic	Part-time	No	Female	Asian	High Scho	U.S. Citizen
6/15/2021	Strongly A	Strongly A	Strongly A	Strongly C	2025-2021	Disagree	Strongly A	Agree	Senior	Informatic	Full-time	No	Male	White / Et	Associate'	U.S. Citizen
6/15/2021	Neutral	Strongly A	Disagree	Agree	I am alrea	Neutral	Neutral	Neutral	Graduate	Ms. Comp	Full-time	Yes	Female	White / Et	Master's [	Citizen of another nation
6/15/2021	Neutral	Neutral	Agree	Strongly A	2026-2021	Disagree	Agree	Strongly A	Graduate	PhD, Syste	Full-time	Yes	Female	White / Et	Master's [	Citizen of another nation
6/15/2021	Neutral	Neutral	Disagree	Strongly A	2025-2021	Agree	Disagree	Agree	Junior	Informatic	Part-time	No	Male	White / Et	Associate'	U.S. Citizen
6/15/2021	Strongly A	Strongly A	Strongly A	Neutral	2025-2021	Agree	Agree	Agree	Junior	Computer	Full-time	Yes	Male	Asian	Associate'	U.S. Citizen
6/15/2021	Strongly A	Strongly A	Strongly A	Strongly A	2024-2021	Strongly A	Neutral	Agree	Graduate	English	job seeking		Female	Two or m	Bachelor's	U.S. Citizen
6/15/2021	Neutral	Agree	Disagree	Neutral	2024-2021	Neutral	Neutral	Neutral	Senior	Financial	Full-time	No	Male	White / Et	High Scho	U.S. Citizen
6/15/2021	Strongly A	Strongly A	Strongly A	Neutral	2024-2021	Strongly A	Agree	Strongly A	Senior	Mathema	Full-time	No	Female	Black / Af	Bachelor's	U.S. Citizen
6/15/2021	Agree	Strongly A	Agree	Strongly A	unsure	Disagree	Neutral	Strongly A	Graduate	Master of	Full-time	Yes	Male	Black / Af	Bachelor's	U.S. Citizen
6/15/2021	Neutral	Neutral	Strongly C	Agree	2027-2021	Strongly A	Strongly D	Agree	Graduate	Master's i	Internatio	No	Male	White / Et	Doctoral [	Citizen of another nation
6/15/2021	Strongly A	Strongly A	Strongly A	Strongly A	2024-2021	Strongly A	Disagree	Neutral	Senior	CMDA	Internship	Yes	Male	Asian	High Scho	U.S. Citizen
6/15/2021	Strongly A	Strongly A	Strongly A	Strongly A	2024-2021	Agree	Agree	Strongly A	Senior	Chemical	intern	Yes	Male	Black / Af	Bachelor's	U.S. Citizen
6/15/2021	Neutral	Agree	Agree	Strongly A	2027-2021	Strongly A	Disagree	Agree	Senior	Computer	Part-time	No	Female	White / Et	High Scho	U.S. Citizen
6/15/2021	Strongly A	Agree	Neutral	Agree	2024-2021	Agree	Strongly C	Agree	Senior	Computer	Part-time	No	Male	Asian	High Scho	U.S. Citizen
6/15/2021	Strongly A	Agree	Strongly A	Strongly A	2027-2021	Neutral	Agree	Agree	Senior	Informatic	Currently not employ		Female	Asian	Associate'	U.S. Citizen
6/15/2021	Strongly A	Strongly A	Strongly A	Strongly A	2024-2021	Agree	Strongly A	Strongly A	Senior	Computer	Full time s	No	Female	White / Et	Associate'	U.S. Citizen
6/15/2021	Disagree	Disagree	Agree	Neutral	n/a	Disagree	Disagree	Disagree	Senior	Computer	Part-time	No	Female	White / Et	High Scho	U.S. Citizen
6/15/2021	Disagree	Neutral	Strongly A	Strongly A	I wish the	Disagree	Disagree	Disagree	Graduate	MDA	Full-time	Yes	Female	White / Et	Bachelor's	U.S. Citizen
6/15/2021	Strongly C	Strongly D	Strongly A	Neutral	I wouldn't	Strongly C	Strongly D	Neutral	Graduate	Informatic	Part-time	No	Male	White / Et	Bachelor's	U.S. Citizen
6/15/2021	Strongly A	Strongly A	Agree	Agree	2025-2021	Neutral	Agree	Strongly A	Junior	Computer	Full-time	No	Male	Black / Af	Associate'	U.S. Citizen
6/15/2021	Strongly A	Strongly A	Strongly A	Strongly A	2024-2021	Agree	Agree	Strongly A	Senior	B.S. Infor	Full-time	Yes	Male	Hispanic	Associate'	U.S. Citizen
6/15/2021	Agree	Agree	Disagree	Disagree	2025-2021	Agree	Disagree	Neutral	Junior	B.S. Math	None		Male	White / Et	Associate'	U.S. Citizen
6/15/2021	Agree	Agree	Strongly C	Disagree	2026-2021	Disagree	Agree	Strongly A	Junior	Financial	Part-time	No	Female	White / Et	High Scho	Naturalized U.S. Citizen
6/15/2021	Strongly A	Strongly A	Agree	Strongly C	ASAP	Strongly A	Strongly D	Strongly C	Graduate	Master of Student			Male	White / Et	Bachelor's	U.S. Citizen
6/15/2021	Neutral	Strongly A	Strongly A	Agree	2025-2021	Disagree	Agree	Neutral	Senior	Major: Co	Part-time	No	Male	Asian	High Scho	U.S. Citizen
6/15/2021	Neutral	Strongly A	Neutral	Strongly A	None. Fini	Strongly C	Agree	Neutral	Graduate	Master's c	Full-time	No	Male	White / Et	Bachelor's	U.S. Citizen
6/15/2021	Agree	Agree	Neutral	Strongly A	2024-2021	Strongly C	Strongly A	Strongly A	Graduate	Graduate	Full-time	Yes	Female	White / Et	Bachelor's	U.S. Citizen
6/15/2021	Agree	Agree	Strongly A	Neutral	2024-2021	Agree	Neutral	Agree	Senior	Accountin	Full-time	No	Male	Black / Af	High Scho	U.S. Citizen
6/15/2021	Neutral	Disagree	Strongly A	Strongly A	2028-2021	Neutral	Neutral	Neutral	Senior	Mechanic	Full-time	No	Male	White / Et	Associate'	U.S. Citizen
6/15/2021	Neutral	Neutral	Strongly A	Strongly A	No true in	Neutral	Neutral	Neutral	Senior	Physics an	Student	No	Male	White / Et	Bachelor's	U.S. Citizen
6/15/2021	Strongly A	Strongly A	Strongly A	Strongly A	2024-2021	Strongly A	Neutral	Disagree	Junior	Bioinform	Unemploy	No	Female	Black / Af	High Scho	U.S. Citizen

6/15/2023	Neutral	Agree	Agree	Strongly A	2024-2023	Agree	Neutral	Neutral	Senior	Business I	Self-empl	No	Male	Prefer not	High Scho	U.S. Citizen
6/15/2023	Strongly A	Strongly A	Strongly A	Disagree	2024-2023	Strongly C	Disagree	Strongly A	Senior	Computer	Intern	Yes	Female	Prefer not	Associate'	U.S. Citizen
6/15/2023	Strongly A	Strongly A	Disagree	Neutral	2026-2023	Strongly A	Neutral	Neutral	Junior	Computer	Part-time	No	Male	White / Et	Associate'	U.S. Citizen
6/15/2023	Neutral	Neutral	Strongly A	Strongly A	2025-2023	Neutral	Agree	Neutral	Junior	Bioinform	Full-time	No	Female	Asian	Associate'	U.S. Citizen
6/15/2023	Strongly A	Strongly A	Strongly A	Neutral	2024-2023	Neutral	Neutral	Strongly A	Senior	Informatic	Full-time	No	Female	Asian	Bachelor's	U.S. Citizen
6/16/2023	Agree	Neutral	Strongly A	Strongly A	2025-2023	Neutral	Agree	Strongly A	Junior	Mechanic	Part-time	No	Male	Black / Afi	High Scho	U.S. Citizen
6/16/2023	Strongly A	Agree	Agree	Agree	2024-2023	Agree	Neutral	Agree	Senior	BS in phys	Part-time	No	Male	Asian	Bachelor's	Citizen of another nation
6/16/2023	Agree	Strongly A	Agree	Agree	2025-2023	Disagree	Agree	Strongly A	Senior	Chemical	Full-time	No	Prefer not	Prefer not	High Scho	U.S. Citizen
6/16/2023	Agree	Agree	Neutral	Agree	2025-2023	Agree	Agree	Agree	Junior	Math	Part-time	No	Male	Black / Afi	High Scho	U.S. Citizen
6/16/2023	Agree	Agree	Strongly A	Neutral	2024-2023	Disagree	Agree	Neutral	Senior	Informatic	Full-time	No	Female	White / Et	Associate'	U.S. Citizen
6/16/2023	Agree	Strongly A	Disagree	Agree	TBD	Neutral	Agree	Neutral	Senior	Informatic	Full-time	No	Male	White / Et	Associate'	U.S. Citizen
6/16/2023	Agree	Agree	Strongly A	Strongly A	2027-2023	Neutral	Agree	Strongly A	Graduate	Human ar	Full-time	No	Female	Hispanic	Bachelor's	Citizen of another nation
6/16/2023	Strongly A	Strongly A	Strongly A	Strongly A	2024-2023	Neutral	Neutral	Agree	Junior	Software I	Full-time	Yes	Male	Unknown	High Scho	I'd rather not say
6/16/2023	Strongly A	Strongly A	Strongly A	Neutral	2024-2023	Strongly A	Strongly A	Strongly A	Senior	Informatic	Full-time	No	Female	Black / Afi	Associate'	U.S. Citizen
6/17/2023	Agree	Agree	Agree	Strongly A	2025-2023	Agree	Neutral	Agree	Senior	Applied m	Full-time	No	Other	White / Et	High Scho	U.S. Citizen
6/17/2023	Agree	Agree	Agree	Strongly A	2024-2023	Neutral	Agree	Agree	Senior	Computer	Internship		Male	Asian	Bachelor's	U.S. Citizen
6/17/2023	Agree	Agree	Strongly A	Strongly A	2024-2023	Strongly A	Strongly A	Strongly A	Graduate	MBA, MSI	Part-time	No	Male	White / Et	Bachelor's	U.S. Citizen
6/18/2023	Agree	Agree	Neutral	Agree	2026-2023	Agree	Disagree	Agree	Junior	Mathema	Part-time	No	Male	Asian	High Scho	U.S. Citizen
6/18/2023	Strongly C	Strongly D	Strongly C	Strongly C	2024-2023	Strongly C	Agree	Strongly C	Graduate	MS in Bioi	Part-time	No	Male	Asian	Bachelor's	U.S. Citizen
6/19/2023	Disagree	Neutral	Agree	Strongly A	2024-2023	Disagree	Neutral	Agree	Senior	Computer	Part-time	No	Other	Two or mo	Associate'	U.S. Citizen
6/19/2023	Agree	Disagree	Agree	Agree	2025-2023	Agree	Disagree	Agree	Graduate	Bioinform	Full-time	No	Male	White / Et	Master's I	Citizen of another nation
6/19/2023	Agree	Agree	Neutral	Neutral	2025-2023	Neutral	Neutral	Agree	Junior	Biomathe	Part-time	No	Female	White / Et	Associate'	U.S. Citizen
6/19/2023	Strongly A	Strongly A	Agree	Strongly A	2024-2023	Strongly A	Agree	Strongly A	Graduate	Decision A	Full-time	No	Male	White / Et	Bachelor's	U.S. Citizen
6/19/2023	Agree	Agree	Disagree	Neutral	2025-2023	Neutral	Agree	Agree	Junior	Bioinform	Part-time	No	Female	Asian	High Scho	I'd rather not say
6/19/2023	Agree	Neutral	Disagree	Neutral	2025-2023	Disagree	Strongly A	Strongly A	Graduate	Masters o	Full-time	No	Male	Hispanic	Bachelor's	U.S. Citizen
6/19/2023	Agree	Agree	Disagree	Disagree	2026-2023	Agree	Agree	Neutral	Senior	Mathema	Full-time	Yes	Male	Prefer not	High Scho	U.S. Citizen
6/20/2023	Agree	Agree	Neutral	Strongly A	2026-2023	Neutral	Neutral	Agree	Graduate	Decision a	Full-time	No	Prefer not	Prefer not	Bachelor's	U.S. Citizen
6/20/2023	Strongly A	Strongly A	Neutral	Strongly A	2024-2023	Disagree	Agree	Agree	Graduate	DAPT	Full-time		Male	White / Et	Bachelor's	U.S. Citizen
6/20/2023	Strongly A	Strongly A	Agree	Strongly A	2024-2023	Disagree	Agree	Agree	Graduate	MS Comp	Part-time	Yes	Male	White / Et	Bachelor's	U.S. Citizen
6/21/2023	Neutral	Agree	Strongly A	Disagree	2024-2023	Disagree	Agree	Strongly A	Graduate	Graduate	Full-time	Yes	Male	White / Et	Master's I	U.S. Citizen
6/27/2023	Agree	Agree	Agree	Agree	2024-2023	Agree	Neutral	Neutral	Junior	Bioinform	Part-time	No	Male	Asian	High Scho	Naturalized U.S. Citizen
6/30/2023	Neutral	Neutral	Strongly A	Strongly C	2024-2023	Disagree	Strongly A	Agree	Graduate	MSIS	Full-time	No	Male	Two or mo	Bachelor's	U.S. Citizen
6/30/2023	Neutral	Neutral	Strongly C	Strongly A	N/A	Disagree	Agree	Agree	Graduate	Informatic	Full-time	No	Female	Asian	Bachelor's	Citizen of another nation
7/1/2023	Agree	Disagree	Neutral	Neutral	2025-2023	Disagree	Strongly A	Neutral	Senior	Computer	Full-time	No	Male	Black / Afi	High Scho	U.S. Citizen
7/6/2023	Agree	Strongly A	Strongly A	Strongly A	2024-2023	Disagree	Strongly A	Strongly A	Graduate	MDA-DCA	Full-time	No	Female	White / Et	Bachelor's	U.S. Citizen
7/8/2023	Agree	Strongly A	Strongly A	Strongly A	2024-2023	Strongly A	Agree	Agree	Senior	Informatic	Full-time	Yes	Male	White / Et	High Scho	U.S. Citizen

## Appendix H - Survey Target Population

### Degree Programs of Target Population in Demand Survey

<i>Level</i>	<i>Major</i>	<i>Concentration</i>
Undergraduate, Baccalaureate	Bioinformatics	All
	Biomedical Engineering	All
	Chemical and Life Science Engineering	All
	Computer Engineering	All
	Computer Science	All
	Electrical Engineering	All
	Financial Technology	All
	Information Systems	All
	Mathematical Sciences	All
	Mechanical Engineering	All
	Physics	All
Undeclared	Engineering	
Undergraduate, Minors	Actuarial Science	All
	Biomedical Engineering	All
	Chemical and Life Science Engineering	All
	Computer Engineering	All
	Computer Science	All
	Electrical Engineering	All
	Mathematics	All
	Mechanical Engineering	All
	Physics	All
	Statistics	All
Undergraduate, Certificate	Fundamentals of Computing	All
Post-Baccalaureate, Certificate	Computer Science	All
	Data Science	All
	Information Systems	All
	Statistics	All

Graduate, Certificate	Applied Statistics	All
	Decision Analytics	All
	Genomics Data Science	All
	Geographic Information Systems	All
Graduate, Master and Doctoral	Biomedical Engineering	All
	Biostatistics	Genomic Biostatistics
	Chemical and Life Science Engineering	All
	Computer Science	All
	Decision Analytics (M.D.A.)	All
	Economics	All
	Electrical Engineering	All
	Epidemiology	All
	Human Genetics (Ph.D.)	Quantitative Human Genetics
	Information Systems	All
	Integrative Life Sciences (Ph.D.)	Behavioral and Statistical Genetics
		Bioinformatics and Genome Sciences
	Mathematical Sciences	All
	Mechanical Engineering	All
Physics	All	
Systems Modeling and Analysis (Ph.D.)	All	

## **Appendix I - Student Demand (Inquiries from Prospective Students)**





David Edwards <dedwards7@vcu.edu>

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## Interests in the Data Science Program

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Thu, Jun 15, 2023 at 2:02 PM

[REDACTED]  
To: David Edwards <dedwards7@vcu.edu>

Good Afternoon Mr. Edwards,

I received the email about the upcoming Master's data science program, and I am interested in learning more about it! My future plan was to become a data scientist, and I think this a great opportunity that I should seize! I am currently a junior at VCU and I would love to hear more about my future career job! Please reach out to me when you get the chance!

[REDACTED]



Bridget Thomson-McInnes <btmcinnes@vcu.edu>

---

## Expressed Interested in Data Science Master's

1 message

---

Sun, Aug 6, 2023 at 9:51 PM

[REDACTED]  
To: Bridget Thomson-McInnes <btmcinnes@vcu.edu>

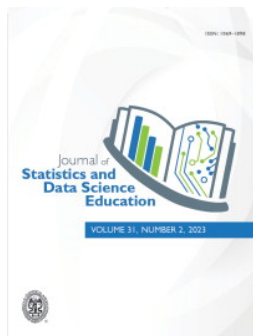
Hi Dr McInne ,

As mentioned previously in person I'm interested in taking the Data Science Master's program that VCU is looking to offer (hopefully next year). My current job is focused in the data science space and I believe this program will be a good avenue to refine my skill and learn new technique

Looking forward to hearing more.

Thank ,  
[REDACTED]

## Appendix J – Cited Documents



## Training Interdisciplinary Data Science Collaborators: A Comparative Case Study

Jessica L. Alzen, Ilana M. Trumble, Kimberly J. Cho & Eric A. Vance

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# Training Interdisciplinary Data Science Collaborators: A Comparative Case Study

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## ABSTRACT

Data science is inherently collaborative as individuals across fields and sectors use quantitative data to answer relevant questions. As a result, there is a growing body of research regarding how to teach interdisciplinary collaboration skills. However, much of the work evaluating methods of teaching statistics and data science collaboration relies primarily on self-reflection data. Additionally, prior research lacks detailed methods for assessing the quality of collaboration skills. In this case study, we present a method for teaching statistics and data science collaboration, a framework for identifying elements of effective collaboration, and a comparative case study to evaluate the collaboration skills of both a team of students and an experienced collaborator on two components of effective data science collaboration: structuring a collaboration meeting and communicating with a domain expert. Results show that the students could facilitate meetings and communicate comparably well to the experienced collaborator, but that the experienced collaborator was better able to facilitate meetings and communicate to develop strong relationships, an important element for high-quality and long-term collaboration. Further work is needed to generalize these findings to a larger population, but these results begin to inform the field regarding effective ways to teach specific data science collaboration skills.

## ARTICLE HISTORY

Received October 2022  
Accepted March 2023

## KEYWORDS

Case study; Data science collaboration; Data science education; Statistical consulting; statistical practice

## 1. Introduction

Statisticians and data scientists empower innovation by bridging gaps across fields and helping experts in a variety of disciplines gain critical insights from data. To appropriately equip data scientists for this complex work, it is necessary to understand effective ways of teaching collaboration. There is burgeoning research regarding how to teach interdisciplinary collaboration skills (Davidson, Dewey, and Fleming 2019; Kolaczyk, Wright, and Yajima 2020; Thabane et al. 2008; Vance 2021), but these studies most often use data such as student reflections and surveys or survey responses from the domain-specific collaborators as evidence of effectiveness (Bangdiwala et al. 2002; Davidson, Dewey, and Fleming 2019; Jersky 2002; Kolaczyk, Wright, and Yajima 2020). While this is promising data, more is needed to understand the effectiveness of these approaches to teaching statistics and data science collaboration. In this study, we present a method for teaching collaboration, a framework for identifying elements of effective collaboration, and provide a comparative case study (Yin 2017) of two collaboration meetings. The purpose of this case study is to model a way to evaluate collaboration on data science projects, provide emergent evidence of the effectiveness of one approach to teaching interdisciplinary collaboration, and contribute to the literature regarding assessing elements of effective interdisciplinary collaboration more generally.

## 2. Literature Review

Extant literature on teaching and learning about statistics and data science collaboration indicate that this type of learning typically occurs in one of three contexts: (a) traditional courses with collaborative project assignments, (b) on-campus consulting centers or statistics labs where students collaborate with a faculty supervisor (Vance and Pruitt 2022), and (c) direct consulting projects on which students collaborate with a faculty mentor and an outside client (Belli 2001). Much of the work around the effectiveness of these programs relies on informal documentation as opposed to empirical research with rigorous methodology (Bangdiwala et al. 2002; Jersky 2002; Mackisack and Petocz 2002; Roseth, Garfield, and Ben-Zvi 2008). Other work focuses on providing descriptions of teaching statistical collaboration in order to grow exposure to the different approaches (Davidson, Dewey, and Fleming 2019; Kolaczyk, Wright, and Yajima 2020; Sima et al. 2020; Thabane et al. 2008; Vance 2021). This work provides beginning evidence of effective training in statistics and data science collaboration, but additional research must be done to build a more robust research base.

In the balance of this article, we begin by presenting an approach to teaching statistics and data science collaboration in Section 3 and then providing a definition of effective collaboration in Section 4. Next, we describe the context and data for the current study before explaining the methodology in Sections 5

and 6. Following in Section 7, we present results from comparing two different data science collaboration meetings, one facilitated by data science students and another by an experienced data science collaborator. We then provide discussion of the implications of our findings and conclude with thoughts regarding the contribution of this work to the field at large in Section 8.

### 3. Teaching Statistics and Data Science Collaboration

Students in this study learn statistical collaboration at University of Colorado Boulder through participation in the Laboratory for Interdisciplinary Statistical Analysis (LISA) housed in the Applied Mathematics Department. LISA has a 3-fold mission:

1. Train statisticians and data scientists to become interdisciplinary collaborators,
2. Provide research infrastructure to enable and accelerate quantitative research around the campus community, and
3. Engage with the community to improve statistical skills and literacy.

Initiation into LISA begins when students take Statistical Collaboration, which is cross-listed as both an undergraduate and graduate course. The pre-requisite for this class is successful completion of an advanced statistical modeling or methods course to ensure students have sufficient technical skills to draw upon while they focus more on collaboration skills through the course. Students who take this course help LISA accomplish each area of its mission. During Statistical Collaboration, students work to master the following learning objectives:

1. Managing effective data science collaboration meetings with domain experts;
2. Communicating statistical concepts, analyses, and results to nonstatistical audiences;
3. Using peer feedback, self-reflection, and video analysis as a process for improving statistical collaboration skills;
4. Effectively collaborating with team members; and
5. Creating reproducible data science workflows and working ethically.

The course is comprised of three parts: theoretical preparation, working on actual data science collaboration projects, and reflections on the collaboration projects. In preparation for engaging in actual collaboration projects, students read several papers throughout the course. They complete in-class and homework exercises to apply the main concepts of the readings.

The bulk of the work to master the learning objectives occurs as students work on the three data science collaboration projects during the semester with individual researchers or decision makers across campus and in the community. On these projects, members of LISA are referred to as collaborators and the individuals who bring projects to LISA are referred to as domain experts. These labels work to recognize both the data science collaborator and the research collaborator as equal partners on the projects and to emphasize the importance of both roles.

In addition to working on data science projects, students collectively discuss and reflect on projects during class meetings. The model is for each LISA collaborator to be comfortable asking for and giving advice regarding technical issues of statistics

and data science along with any nontechnical issues encountered during any given project. In addition to time where students can simply ask questions about how to approach a project, dedicated activities facilitate collaboration skill development for students. In particular, students participate in role playing activities regarding specific collaboration skills and video coaching and feedback sessions.

Role playing activities include practice with opening a meeting, talking about time allocations for meetings, asking great questions about a new project (Vance et al. 2022b), and summarizing action steps at the end of a meeting. During video feedback coaching sessions, collaborators watch three video clips (~1–5 min each) from a data science collaboration meeting, typically from the opening, middle, and end of the meeting. Following viewing of each clip, the faculty member along with other students in the class give feedback to the students whose collaboration meeting was recorded. Feedback may be given on topics such as if there are other questions students could have asked to gain better understanding, how the time could be spent better to ensure shared understanding about the project, and problem-solving when collaborators struggled to run the meeting in the way they hoped. At the end of the session, everyone in class shares at least one thing they learned to improve their own collaboration skills from the video feedback coaching session.

After completion of Statistical Collaboration, students have the opportunity to remain involved in LISA either on a volunteer basis or through taking Advanced Statistical Collaboration. In this course, students often continue collaborating on projects that were not completed in their previous semester or that need to be extended to a second semester. Students also continue their development of collaboration skills through additional readings, role-playing activities, engaging in more advanced collaboration skills, and mentoring junior students. One key skill in the advanced class is that of reflection. Students are first introduced to personal reflection on projects in Statistical Collaboration as modeled in class discussion and the video feedback coaching session activities. In Advanced Collaboration students extend this skill to work on reflecting with domain experts regarding what works best in collaboration meetings. In addition, advanced students work on five collaboration projects and specifically mentor novice students on those projects.

### 4. Defining Effective Interdisciplinary Collaboration

Our conceptual framework for identifying effective data science collaboration relies on the ASCCR frame for collaboration skills (Vance and Smith 2019). Under ASCCR, an effective collaboration is based on five components: Attitude, Structure, Content, Communication, and Relationship. We provide a high-level summary of ASCCR as a guide for evaluating an effective collaboration (Vance, Alzen, and Şeref 2020); details are provided in Vance and Smith (2019).

#### 4.1. Attitude

Interdisciplinary collaboration relies on the data scientist having a positive attitude toward themselves, the domain expert, and the collaboration team. Three attitudes that we believe enable

effective collaboration are that the data science collaborator has the willingness and ability to learn new data science skills as necessary to help the domain expert, the domain expert should be regarded as an expert in their field or for their project and should be treated as such, and that the data scientist and domain expert can accomplish more together than either could accomplish alone. It is key for the data science collaborator to consider both themselves and the domain expert as equally important in the shared work of making a meaningful contribution to the field.

#### 4.2. Structure

To maximize the effectiveness of collaborations, meetings should be structured to enable both the domain expert and the data scientist to accomplish their goals while fostering a positive relationship. The POWER process for organizing meetings (Zahn 2019) is a way to effectively structure meetings. The data scientist **P**repares for the meeting, **O**pens the meeting to make sure all attendees have the same expectations for the meeting, ensures that the **W**ork time is targeted and effective for accomplishing their shared goals, and devotes time at the **E**nd of the meeting to summarize what was accomplished and identify next steps. More advanced collaborators also take time to **R**eflect on the meeting with the domain expert to ensure that meeting time is used even more effectively and efficiently in the future.

#### 4.3. Content

The content of collaboration meetings should consist of both qualitative and quantitative stages. In the ASCCR frame, effective collaboration follows the  $Q_1Q_2Q_3$  method of addressing statistical content (Leman, House, and Hoegh 2015; Trumble et al. 2022). Under this approach, the data science collaborator first focuses on the qualitative ( $Q_1$ ) aspects of the project before completing the quantitative ( $Q_2$ ) analyses. Then the collaborator works to complete the content-specific contribution to the project by qualitatively ( $Q_3$ ) conveying the analysis, results, conclusions, and recommendations to the domain expert for further action (Olubusoye, Akintande, and Vance 2021; Vance and Love 2021).

#### 4.4. Communication

Effective communication is essential for successful collaboration. Key skills for effective communication include questioning (Vance et al. 2022b); listening, paraphrasing, summarizing (Vance et al. 2022a); and explaining. Statistical collaborators should use these skills to guarantee that both themselves and the domain expert understand one another at each step of the project. These communication skills should be used to elicit information and gain shared understanding (Vance, Alzen, and Smith 2022a). Shared understanding occurs when both the collaborator and the domain expert have common knowledge about project goals, project information, and the relevance of the information to the project goals. Clear communication also strengthens the relationship between the collaborator and the domain expert (Vance et al. 2022b).

#### 4.5. Relationship

The final component of the ASCCR frame is that of relationship. Vance (2020) makes the case that, in addition to completing the project tasks, building a strong relationship with the domain expert should be a goal for every statistics and data science collaboration. Stronger relationships lead to better contributions to the field and sustained working relationships between domain experts and data scientists. As relationships grow stronger in statistics and data science collaborations, interdisciplinary fields are subsequently improved as well.

In the LISA model, students specifically learn about the ASCCR frame by reading papers explicating the five components (Azad 2015; Kimball 1957; Trumble et al. 2022; Vance et al. 2022a; Vance and Smith 2019) and conducting in-class and homework exercises. For example, early in the semester students discuss an inventory of attitudes they may or may not have regarding collaboration and which ones they believe promote or detract from collaboration. Near the end of the semester, students are presented four models for thinking about relationships, reflect on the strength of their relationships with the domain experts with whom they have collaborated, and discuss barriers and facilitators for creating strong relationships in collaborations. Additionally, the components of ASCCR are discussed during each video coaching feedback session. Students provide constructive feedback to one another regarding the ways that relevant elements of the ASCCR frame are addressed in the specific video clips.

We present this summary of the ASCCR frame to help the reader understand the overall ethos of effective collaborations. For the current study, we focus on two specific components, structure and communication, because they are the most easily observable in a single meeting out of several in a full project. We specifically seek to answer two questions. First, how do student collaborators trained in ASCCR compare to an experienced data scientist in the structure and communication components when conducting a collaboration meeting? Second, to what extent does this case study provide evidence of the effectiveness of ASCCR for interdisciplinary collaboration?

### 5. Data

Data for this study come from one data science collaboration project from Fall 2021 in which all individuals involved in the project completed informed consent forms approved by the University of Colorado Boulder's Institutional Review Board (Protocol 18-0554). Participants agreed to have their project documents, survey data, and video observation data used for research purposes. We use data from two Zoom recordings of the initial collaboration meeting between a Ph.D. candidate in geological sciences (the domain expert) and statistical collaborators. The domain expert first met with two student collaborators and then attended another "initial" meeting for the collaboration project with a LISA post-doctoral researcher (referred to as the experienced collaborator).<sup>1</sup>

<sup>1</sup>We purposefully chose the ordering of the meetings to favor the more experienced collaborator. Since the domain expert met with the students first, by the time she met with the experienced collaborator, she had a better idea of how to explain her project to someone in another field and

**Table 1.** Rubric Scores for Structure and Communication in Collaboration Meetings Scored from 1 (low) – 4 (high).

Element	Definition	Student Collaborator Scores	Experienced Collaborator Scores
Structure			
Prepare	The collaborator has clearly prepared for the meeting as evidenced by some knowledge of the project and/or domain expert as well as practical preparation such as a shared notes document.	2	3
Opening	Meeting is opened with a friendly tone. Time is spent discussing everyone's wants for the meeting.	4	4
Work	Collaborator shapes the meeting in a way that specifically responds to the wants agreed upon during the opening conversation.	4	4
Ending	Time is reserved at the end of the meeting for summarizing outcomes and next steps.	3	3
Reflection	Collaborator allows space for and invites reflection regarding the meeting with the domain expert.	2	4
Communication <sup>a</sup>			
Questioning	Collaborator effectively uses questioning throughout the meeting to provide clarity for both self and the domain expert Asks "great" questions that both elicit useful information and strengthen the relationship.	3	3
Listening	The collaborator listens attentively throughout the meeting. When the collaborator speaks, it is in direct response to the previous comment by the domain expert.	4	4
Paraphrasing	Collaborator paraphrases regularly throughout the meeting to clarify both their own language and the language of the domain expert.	3	4
Summarizing	Collaborator summarizes regularly throughout the meeting to solidify discussion topics and decisions made.	3	4

<sup>a</sup>Note that since this was an initial meeting during which we typically expect for the domain expert to do the majority of the talking to describe the project, we did not expect to observe or code for collaborators to explain statistical concepts as is defined under Communication in the ASCCR frame.

When student teams meet with a domain expert, one student leads the meeting. In this instance, the student leading the meeting was a senior undergraduate double-majoring in computer science and statistics/data science. This meeting was the first he led after observing and supporting in two other meetings. The second student was a Ph.D. student in aerospace engineering, and this was her second collaborative project. The experienced collaborator was a recent biostatistics Ph.D. graduate. At the time of the meeting, she had 3 years of experience working on approximately 15 collaborative projects at statistical centers in two research universities. The purpose of this meeting was for the domain expert to explain the project, give a general orientation to the statistics or data science need, and then for the collaborators to ensure they understood the project before conducting statistical analyses or providing advice regarding quantitative analysis. Meetings occurred at the end of September during Fall 2021, when the students were enrolled in Statistical Collaboration and learned about the ASCCR frame.

We selected this project for a case study because we had complete data for the project, and it is representative of a common project context for LISA. In the particular semester from which we selected this case study, LISA participated in 36 collaboration projects. Thirty-two of the projects came from the campus community. Of those 32 campus projects, 18 came from the College of Arts and Sciences, which includes geological sciences, the department in which this domain expert works. Further, 19 of the 32 campus domain experts during this semester were graduate students.

In addition to data from the meeting Zoom recordings, we also use data from a survey the domain expert completed about the students and the experienced collaborator separately after the close of the project. The survey consisted of 21 Likert-scale items and 4 open response items. We use these data sources to answer our second research question regarding the effectiveness of ASCCR for teaching collaboration from the viewpoint of a domain expert.

## 6. Methods

We present a comparative case study (Yin 2017) for collaboration meetings. The purpose of this case study is to provide a rich description of the different enactments of two elements of the ASCCR frame. These rich descriptions allow for a holistic understanding of the difference in these two meetings and provide insight into the varying skill levels among the collaborators and the implication of that variation on project outcomes (Stake 2013; Yin 2017).

First, two authors used the element codes in Table 1 to independently code Zoom recording transcripts<sup>2</sup> for evidence of each element of effective structure and communication. Following the qualitative coding process of Miles, Huberman, and Saldaña (2014), the two coders then met to reach consensus and validate codes. Next, each coder independently scored elements for overall quality using a four-point rubric<sup>3</sup> (see Appendix

could anticipate questions or points of confusion. To this end, we expect the data to be biased in favor of the experienced collaborator and that evidence suggesting success for the students to minimize the extent of that effectiveness.

<sup>2</sup>Due to the ways the collaborators explained the multiple collaboration meetings, we were unable to blind the transcripts regarding student or experienced collaborator status and still code for all elements in Table 1.

<sup>3</sup>Authors from a research and evaluation center on campus, who are not affiliated with LISA, developed the rubric based on the ASCCR frame and piloted it with five coders across four disciplines outside of LISA and four



and met a second time to reach consensus on scores (Miles, Huberman, and Saldaña 2014). The rubric scores provide evidence of success in interdisciplinary collaboration as defined by adherence to the structure and communication components of ASCCR. These data<sup>4</sup> allow us to answer our research question about if the student team could perform comparably well to an experienced data science collaborator.

After identifying elements of effective meeting structure and communication, we used the data from the domain expert surveys as a second data source for successful collaboration. These data provide some initial insight into the effectiveness of the collaboration meetings overall.

## 7. Results

Table 1 shows that for each element of the rubric, the experienced collaborator scored as well or higher than the students. Of the four elements where scores differed, the students received scores one level lower than the experienced collaborator on three elements and two levels lower on the relationship element.

To better understand the evidence for these scores and to answer our first research question regarding how well students compare to an experienced collaborator, we present contrasting descriptions of the ways each collaborator engaged with structure and communication within the meetings. We examine key excerpts to identify patterns in the differences between the facilitation of each collaboration meeting. We then provide emerging descriptive evidence of the effectiveness of this approach for teaching interdisciplinary collaboration from the lens of a domain expert.

### 7.1. Structure in Collaboration Meetings

By organizing meetings with Zahn's (2019) POWER structure, the statistical collaborator can lessen the cognitive load of the meeting for themselves and the domain expert and help themselves focus on providing domain-specific statistics and data science advice (Vance and Smith 2019). Both the students and the experienced collaborator attend well to each element of the POWER structure in their meetings, as evidenced by the scores in Table 1. Although differences in scores do illustrate some variability in the quality of meeting structure between students and an experienced collaborator, our evidence also shows that the students learned how to follow the POWER structure well by this point in the semester.

#### 7.1.1. Prepare

There is one clear way the experienced collaborator is more advanced in preparing for the meeting than the students. Near the beginning of the meeting, the experienced collaborator tells the domain expert that she read the domain expert's initial

request for a collaboration meeting and knew some basic information about the domain expert herself.

*Experienced Collaborator: Why don't we just start with you giving me kind of the big picture? I have read your collaboration request, so I know you're a student. You're doing geological sciences. There were a lot of words that I didn't know. {Laughs}*

The experienced collaborator shows she thought about the content of this collaboration prior to the meeting. She knows something about the domain expert and recognizes from the beginning how she will learn from the domain expert. While the students are clearly prepared to facilitate the meeting, they do not show evidence of having thought about the content of the study prior to the meeting. The lack of demonstrated preparation, however, does not seem to detract from the meeting.

#### 7.1.2. Opening

Both the students and the experienced collaborator received the highest score possible for the meeting openings. The leading student starts the meeting with smiles and cordial introductions and then states:

Okay. Thank you so much for meeting with us. I'm looking forward to collaborating on this project. First of all, I'd like to have a time conversation. Right now we're scheduled from 10:00 to 11:00 a.m. Does that still work for everybody? [...] Okay. Great. And then the next thing that I'd like to discuss is what are your wants from this collaboration both today in this meeting and also longer term? What are you looking to get out of this collaboration? [...] It sounds like you would like help with analyzing your data using statistical tools. [...] Okay. Great. So if you want to tell us a little bit about your overall research goals, that would be helpful.

This student demonstrates all elements of the opening of the conversation discussed during class. The students are friendly and make sure everyone is on the same page regarding meeting timing. The student leading the meeting also provides the domain expert an opportunity to define objectives for the meeting and asks about the overall research project. This is very similar to the way the experienced collaborator begins her meeting:

Usually how we start is to have a time discussion. I have an hour blocked out for this meeting until 10:00 a.m. Does that work for you? [...] If we're being productive, can you go a little over 10:00 a.m. like ten or 15 minutes? [...] Cool. And then the next thing we usually like to go through is what we each want to get out of the meeting. I've listed some generic things that I usually try to get out of my initial meeting: an overview of your research, the big picture of what you're doing and the real-world implications that it has, what exactly your hypothesis question is, if you know that, what does your data look like, and why you've come to us for collaboration. And then the last thing is what your deadlines are. Is there anything else you want to put on the agenda for today?

The experienced collaborator includes the same elements of the opening to a meeting as the student collaborators with just a bit more detail. Both openings ensure everyone is on

collaboration videos. Raters independently scored videos in teams of two and then met to discuss necessary changes to the rubric to appropriately identify differences in quality across score levels as well as to clarify language in the rubric.

<sup>4</sup>Full transcripts are available on the Open Science Framework (OSF; <https://osf.io/c95jd/>) for readers to use with the included rubrics and paper text to better understand the coding, reproduce the results, and repeat the evaluation process in other contexts.

the same page regarding the time available for the meeting and identifying and paraphrasing the domain expert's objectives for the meeting. The experienced collaborator provides a bit more in her opening by naming specific objectives she typically has for an initial collaboration meeting. Although a bit less direct, the students solicit similar information about the project by inviting the domain expert to share her overall research goals.

### 7.1.3. Work

Effective collaborators shape meetings in a way that specifically responds to the wants or objectives agreed upon during the opening conversation. The overall goal for this meeting was for the domain expert to give the collaborators a general sense of her project and to identify the statistical problem about which she came to LISA for help. The bulk of this section of the meeting includes the domain expert sharing details about her project and onboarding the collaborators to her content. Throughout this process, both the students and the experienced collaborator show evidence of attending to the stated objectives of understanding the research project and helping the domain expert think about the research analysis. The students regularly make statements like the following:

To check my understanding...  
Really quickly before we go [on], I want to understand [...] better.  
What does that comparison look like?

Similarly, the experienced collaborator made comments such as these:

Hold on. I'm trying to understand this...  
We're focusing on this first bullet point?  
What is this called on the x-axis?

In addition to pausing the domain expert to ask questions and make sure they understand details, the collaborators also ask the domain expert to check their understanding. In both quotations below, the collaborators summarize the details of what they identify as the main task of the collaboration. The domain expert is interested in using statistical analysis to show that there are significant differences in facies, or rock types, about which she had collected data.

*Student 1: You're looking for the significant differences in your measurements between facie at the same stratigraphic height or between stratigraphic heights or both? [...] What you're looking for from us right now. It's more of just the analysis between stratigraphic heights. [...] You want to show that the facies are in fact facies.*

*Experienced Collaborator: You want to look at carbon and oxygen composition between the facies and then you also want to look at temperature between the facies. [...] And in order for you to classify something as different, you would be looking at if the delta 180 thing that you have is different. You want to tell between the different [facie]?*

In response, the domain expert affirms that the collaborators all understand her goals for the project. The use of domain-specific vocabulary by all collaborators helps ensure that they have a deep understanding of the domain expert's problem and

research questions and strengthens the relationship by demonstrating an effort to use the domain expert's language, thus, making for a more effective collaboration.

### 7.1.4. Ending and Reflection

During the end of the meeting, the students and the experienced collaborator make similar moves. Both reserve time at the end of the meeting for a closing conversation, summarize what was discussed, and make plans for next steps.

Student1: Okay. We only have about ten minutes left in our initial planned meeting time. [...] I think we can summarize.  
Experienced Collaborator: Okay. I'm just looking at the wants, goals again. So I think I've gotten through everything.

Both also have some element of reflection in the meeting, but the experienced collaborator is more explicit about it and provides more space for the domain expert to give direct feedback.

The students exchange multiple generally positive and reflective comments with the domain expert toward the end of the meeting such as the following:

Student1: This was super helpful.  
Student2: I think we made a lot of progress today. And it helps us to understand your greater goals first before we jump into the analysis just so we understand what's going on.  
Domain Expert: Super  
Student2: Thanks for being patient with us [as we understand your project]  
Domain Expert: No. This is fun for me.  
Student1: I think I have a few ideas for potential analyses, but I have some things I want to look in to first.  
Domain Expert: Totally  
Student2: I have some ideas, but I would want to look into them more before I would give a recommendation as well.  
Domain Expert: That sounds great.

The domain expert responds positively to the collaborators throughout the meeting and has a general tenor of excitement moving forward at the end of the meeting. This is all evidence to suggest that the students developed a positive connection with the domain expert, and they are all eager to continue working together.

The experienced collaborator and the domain expert exchange similarly positive comments throughout their meeting.

Experienced Collaborator: I didn't quite catch the last thing you said.

Domain Expert: Oh, I was just being stoked about my own science.

Experienced Collaborator: It's really cool.

—

Domain Expert: I appreciate you letting me take a lot – so much time to be like, “This is a rock.”

Experienced Collaborator: {Laughs} I'm so glad you did. It's so interesting.

Domain Expert: Yes, yes. It's fun.

These two exchanges are not unlike the example showed above from the student collaborators. However, the experienced

collaborator makes one additional move the students did not that elevates her reflection during the meeting and resulted in the higher rubric scores in [Table 1](#).

Experienced Collaborator: Another thing we like to do at the end of the meetings is to reflect with the domain expert and say, “How did this meeting go for you? In the future, is there anything that we could do differently to make the meeting easier or anything that for you?”

In response to this question the domain expert first comments on how the process of onboarding multiple collaborators to her project was a good experience for her and helped her think about how she explains her research to others. She also gives some feedback regarding how there were some vocabulary words (e.g., independent) that seemed to operate differently in her field of geology compared to statistics. The domain expert points out that making sure everyone understood vocabulary in the same way would help to avoid misconceptions.

By and large, the students and the experienced collaborator facilitate their initial meetings with this domain expert in very similar ways. The meetings are well-organized, cover all aspects of the POWER structure (e.g., preparation, open, work, ending, and reflection), and achieve the goals of the collaborators understanding the overall project research goals. There are some small ways in which the experienced collaborator added additional levels of expertise to the structure of the meeting that not only led to greater shared understanding about the project but also worked to build a stronger relationship between herself and the domain expert.

## 7.2. Communication in Collaboration Meetings

Both the student and experienced collaborators demonstrate evidence of every element of communication in their respective meetings. All collaborators clearly listen intently to the domain expert as she explains her project. Each collaborator also responds to the domain expert input with thoughtful comments and intelligent questions such as the following:

Student1: Would this whole stratigraphic section be considered one type, then, in your analysis or in your data the way that you’ve been recording it? Do you designate it based on what it is right now? How do you designate type?

Experienced Collaborator: In the geological sciences, is there a certain number of categories of facies, or is it kind of like a continuous scale? Or what is it? How does it work?

Both the students and the experienced collaborator also make sure to paraphrase regularly to ensure they understand the new domain-specific information. Finally, both meetings have regular moments where the collaborators summarize the thoughts just shared or next steps in the project. There are few differences in the skills shown in these elements of communication throughout both meetings.

The student collaborators received lower scores on paraphrasing and summarizing because the experienced collaborator more frequently made connections to the overall project rather than focusing on specific details, likely resulting in better comprehension of the domain expert’s research. The

experienced collaborator also more frequently uses the domain expert’s domain-specific vocabulary.

Student1: I think what you were saying is you think that it might be different at these different stratigraphic heights, but you’re not sure yet.

Experienced Collaborator: The Jacob’s staff allows you to be able to tell the height or how deep these things are, what kind of rock it is, and then, also, you can look at sort of – is it the CaCO<sub>3</sub> nodules that tell you what kind of environment it was?

The ASCCR frame suggests that while statistical collaborators work to understand and to be understood in a project, they also use communication to build a relationship with the domain expert. As seen in the structure results above, this is where we see nuanced differences between the students and experienced collaborator. Although the students certainly have moments where we observe a positive relationship being built with the domain expert, we see deeper moments with the experienced collaborator.

Experienced Collaborator: In the geological sciences, is there a certain number of categories of facies, or is it kind of like a continuous scale? Or what is it? How does it work?

Domain Expert: [...It’s like] “Okay. I have this rock in my hand, so it had to have formed somehow.” So now I have to figure out what setting and sequence of conditions provided the right moment for this rock to form.

Experienced Collaborator: Kind of like playing detective.

Domain Expert: It’s totally like playing a detective with rocks {Laughter}

Experienced Collaborator: You’re a professional rock detective.

Domain Expert: Yes, exactly. It’s very fun.

—

Domain Expert: I ran a couple of ANOVAs on my data and was like, “I don’t know how to do this prudently.” And I know that there is a lot of ways that one could just get the right – or get an answer you want out of stats, and I just really felt like a kid using a power tool that I wasn’t supposed to be doing without supervision. I was like, “I probably should go get some handrails to make sure I use those correctly.” {laughs}

Experienced Collaborator: Well, I appreciate that. Yay, I’m so excited that you’re here. So as part of what you maybe want in addition to us helping with this particular analysis is maybe kind of – it’s a learning experience for you too, and you want to be able to understand what we’re doing. And then maybe you came across a similar problem in the future, like you would have enough understanding to kind of do it on your own. Is that what your goal is?

In both exchanges the experienced collaborator and the domain expert share moments of connection around the work. The experienced collaborator not only speaks with the goal of understanding the project, but she includes an element of interpersonal relationship. These excerpts show how the experienced collaborator used communication to accomplish the tasks of the meeting and develop a relationship with the domain expert, the two end goals of a collaboration under ASCCR.

### 7.3. Domain Expert Evaluation

Our qualitative data show that both the student and experienced collaborators include all the expected elements of structure and communication from the ASCCR frame in their collaboration meetings with this domain expert. More than that, our data show that the quality of the structure and communication are similar between the students and the experienced collaborator. We see some evidence of the experienced collaborator adding a subtle level of improved collaboration skills, but the data suggest that both collaboration meetings were successful.

In addition to coding transcripts, we also asked the domain expert to complete a survey<sup>5</sup> at the end of the project in which she evaluated her experiences with both collaboration teams. A limitation to this data source is that the domain expert completed these surveys after six meetings with the student collaborators over the course of the semester and after only the initial meeting with the experienced collaborator. The repeated initial meetings allowed us to study how student collaborators compared to an experienced collaborator during the initial meeting, but the experienced collaborator only served as a consultant for the student team following the double initial meeting. While this survey data is problematic for direct comparisons between the experienced collaborator and the student collaborators in projects overall, it does still serve as a useful tool for understanding the domain expert's experience with the student collaborators as well as some nascent information regarding effectiveness of collaboration in general.

When asked if her collaboration with LISA was helpful and if she was satisfied with her experience, the domain expert gave the students and the experienced collaborator scores of 6 (strongly agree) and 4 (somewhat agree; on a 6-point scale), respectively. This makes sense as the students were the ones who helped the domain expert through the full project. In another item about feeling welcomed during collaboration meetings that used the same scale, the domain expert rated both the students and the experienced collaborator a 5 (agree). These scores represent the general pattern in scoring across all items. For each, the domain expert either gave both the students and the experienced collaborator equally high scores, or she gave the experienced collaborator a slightly lower score than the students. However, all ratings were on the positive end of the scales. The domain expert reported that all collaborators made her feel welcomed both during and outside of meetings and that she would recommend the statistical lab to colleagues after her experiences with this collaboration. Finally, the domain expert indicated an equally high level of relationship between herself and all collaborators.

When given the chance to provide some qualitative feedback regarding the collaboration, the domain expert indicated that the student collaborators “were very respectful and clearly were taking time to understand aspects of my research most relevant to the statistical goals. [Student1] was really excellent. [He was] very professional and thoughtful in the questions he asked regarding the research.” In the qualitative items regarding the experienced collaborator, the domain expert noted:

Meeting with [the experienced collaborator] was pleasant and a positive experience, but I have to admit that I was confused as to why I met with her separately to the other student collaborators and then had no further contact with her. I thought we were going to all meet together (me, student collaborators, and her) after we had had separate onboarding meetings, but I guess I misunderstood that aspect of the process. With that in mind, giving detailed feedback on how effective the collaboration was with [the experienced collaborator] is difficult because I didn't work with her besides our one meeting during which I explained my research.

In this instance, the experienced collaborator did not communicate to the domain expert how the project would progress, resulting in a lack of shared understanding. The domain expert had the impression that the experienced collaborator would be involved in all subsequent meetings, but she only provided support to the students when needed. This resulted in the experienced collaborator receiving lower scores than the students, which is evidence for the need to create shared understanding for a successful collaboration.

## 8. Discussion

This comparative case study provides illustrative examples of the structure and communication elements of ASCCR in two collaboration meetings. Further, this study provides some emerging tools for evaluating collaboration meetings grounded in collaboration theory (Vance and Smith 2019). This study differs from previous research regarding the effectiveness of teaching interdisciplinary statistical collaboration in that it explicitly defines specific elements of statistics and data science collaboration, uses pre-defined criteria to evaluate particular elements of collaboration meetings, and provides data from student collaborators alongside an experienced collaborator (Bangdiwala et al. 2002; Jersky 2002; Mackisack and Petocz 2002; Roseth, Garfield, and Ben-Zvi 2008). The case study method allows for the comparative inspection of detailed elements of the collaboration meetings. It also provides real world examples of structure and communication skills in action. By aligning evidence from collaboration meeting transcripts with the theoretical framing of effective collaboration and feedback from the domain expert, this study expands the body of evidence regarding the effectiveness of teaching interdisciplinary collaboration.

A limitation of this approach is the small sample size. While an in-depth look at two meetings allows for careful scrutiny of individual collaboration skills within meetings, there is limited ability to generalize the results to comparisons between student and experienced collaborators at large. Future work will involve expanding the datasets by comparing more student and experienced data science collaboration meetings in order to bolster these claims. Such research will provide more information regarding the most effective ways to teach data science students to become successful interdisciplinary collaborators.

Practice is essential for developing collaboration skills. For example, using the domain expert's vocabulary and making clear connections between specific points in the project and the overall project goals are ways in which novice collaborative

<sup>5</sup>Full survey available at (<https://osf.io/c95jd/>)

data scientists may build their craft through practice. Additionally, building relationships throughout collaboration projects is something that may come more naturally through practice as inexperienced collaborators become more comfortable with asking questions and learning about new domains in ways that not only build their understanding of new fields but also develop strong relationships with new colleagues.

We believe that statistics and data science educators should consider the ASCCR frame for teaching collaboration skills to their students. It provides a straightforward and clear way to implement successful interdisciplinary collaboration and names discrete skills to model and practice. Teaching collaboration with ASCCR can advance the field in training data scientists and push our thinking regarding successful interdisciplinary collaboration. Professional data scientists can also benefit from implementing ASCCR in their future collaborations.

Most statisticians and data scientists will inevitably find themselves working on interdisciplinary teams at some point in their careers. To equip future data scientists to contribute most effectively to their own field as well as others, we must understand the best ways to support them in developing collaboration skills. The emerging evidence provided here suggests that training data scientists in the ASCCR frame can help improve collaboration skills. We encourage statistics and data science educators and practitioners to consider implementing aspects of the ASCCR frame and the related rubric to expand the data from this study to continue to build the body of evidence of effectively teaching interdisciplinary collaboration. We believe that the ASCCR frame can improve the quality of collaborations and ultimately improve collaborative data scientists' ability to transform evidence into action.

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## Data Availability Statement

The data that support the findings of this study are openly available in the Open Science Framework at <https://osf.io/c95jd/>.

## Disclosure Statement

The authors report there are no competing interests to declare.

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## Appendix

**Table A1.** Rubric for structure and communication.

		Structure			
		4 Mastery	3 Competent	2 Developing	1 Minimal
Preparation	The collaborator has clearly prepared for the meeting as evidenced by general knowledge about the project as well as some thoughts about the project beyond what the domain expert shared in the project request.	It is clear that the collaborator has reviewed the collaboration request and has done some preparation for the meeting. They appear generally familiar with the project but have perhaps not done any other preparation for the meeting.	Collaborator does not do anything that specifically reveals they have spent time thinking about the project ahead of time. However, this does not appear to detract from the meeting's success.	No evidence of preparing for the meeting evident. Collaborator appears to have no prior knowledge of the project. Collaborator is ill-prepared to engage in the project.	
Open	Meeting is opened with a friendly tone. Time is spent discussing everyone's wants for the meeting.	Meeting is opened with a friendly tone. Time is spent discussing everyone's wants for the meeting, but may be hurried, rushed, or incomplete.	Collaborator may or may not take time for friendly interaction at the beginning of the meeting. If goals/an agenda are shared, the collaborator tells the domain expert rather than including them in the process.	Collaborator doesn't take time for friendly interaction at the beginning of the meeting. Goals and/or an agenda are not shared at the beginning of the meeting.	
Work	Collaborator shapes the bulk of the meeting in a way that specifically responds to the wants agreed upon during the opening conversation.	Collaborator attempts to address the wants agreed upon during the opening conversation but is sometimes unsuccessful.	Collaborator does little to address domain expert wants and focuses more on own ideas for addressing the project goals.	Collaborator ignores domain expert wants and jumps into project statistics with no consideration for project context of domain expert wants.	
End	10%–20% of meeting time is reserved for the closing conversation. All applicable elements of “end” are present.	Time is reserved for the closing conversation, but it may be insufficient. Some elements of “end” are missed.	Collaborator attempts to cover some elements of ending a meeting via the POWER structure, but time was not reserved. The conversation is rushed and incomplete.	No time is reserved for meeting closure activities. Collaborator does not attempt to cover elements of ending a meeting via POWER structure.	
Reflection	Collaborator allows space for and invites reflection with the domain expert.	Collaborators reflect on the meeting after the domain expert leaves.	Collaborator asks for or provides space for reflection but does not reserve sufficient time for the conversation.	Collaborator does not provide space for meeting reflection.	
		Communication			
Questioning	Collaborator effectively uses questioning throughout to provide clarity for both self and the domain expert. Asks “great” questions that elicit useful information and strengthen the relationship.	Questioning is attempted frequently during the meeting but is sometimes insufficient for gaining clarity for collaborator or domain expert.	Collaborator asks questions to help clarify for self or the domain expert but not both regularly throughout the meeting.	Questioning is not evident in the meeting.	
Listening	The collaborator listens attentively throughout the meeting. When the collaborator speaks, it is in direct response to the previous comment by the domain expert.	The collaborator listens attentively throughout the meeting. When the collaborator speaks, it is in direct response to the domain expert. However, sometimes the collaborator does not fully respond to domain expert comments.	The collaborator occasionally jumps ahead of the domain expert to talk about their own desired topics. Responses sometimes do not make sense after domain expert comments.	The collaborator regularly jumps ahead of the domain expert to talk about their own desired topics. Responses do not make sense after domain expert comments.	
Paraphrasing	Collaborator paraphrases regularly throughout the meeting to clarify both their own language and the language of the domain expert.	Collaborator paraphrases regularly throughout the meeting for clarity but may only do this for the domain expert or themselves.	Collaborator occasionally paraphrases during the meeting to add clarity for either themselves or the domain expert.	Collaborator rarely, if ever, paraphrases during the meeting.	
Summarizing	Collaborator summarizes regularly throughout the meeting to solidify discussion topics and decisions made.	Collaborator summarizes regularly throughout the meeting but may miss some key moments that would have benefited from summarizing.	Collaborator occasionally summarizes, but individuals will leave with lack of clear understanding of the discussions and decisions.	Collaborator rarely, if ever, summarizes during the meeting.	

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## Description of the Proposed Program

### **Program Background**

Virginia Commonwealth University (VCU) seeks approval for a Bachelor of Arts (B.A.) degree program in Computer Science. The degree program would be located in the Department of Computer Science located in the College of Engineering. The initiation date is fall 2024.

The purpose of the proposed B.A. degree program in Computer Science is to educate a broader population of students to identify, build, and support computer systems in all industries within Virginia by proposing a multidisciplinary approach to computer science. The program will provide students with the fundamental knowledge and skills in programming and software development necessary to become entry-level software designers, software developers, software engineers, and systems engineers. The students will be able to determine client computing needs, develop computing systems designs and prototypes, code computing solutions, test code, and develop system documentation. Students will learn the latest software development processes, such as agile programming. Students will work in project teams to develop their teamwork skills and ability to solve real-world computing problems. The program's multidisciplinary nature will allow students to apply computing knowledge to the specialized interest areas they choose. Graduates of the proposed degree program will be prepared to work in all industries in the public and private sectors that seek candidates who can seamlessly integrate computing skills to address business needs.

The proposed degree program responds to current needs in Virginia and the nation. "The role of computers in daily life and the economy grows yearly, and that trend is only expected to continue for the foreseeable future."<sup>1</sup> Computing skills are needed in most industries, thus resulting in a great need in Virginia for graduates with these skills. Virginia is ranked #3 in the nation for the highest concentration of tech workers<sup>2</sup>. However, a student found that most Computer Science graduates from Virginia leave the state by five years post-graduation<sup>3</sup>. There is a need to recruit more Computer Science graduates that will stay in Virginia. Multidisciplinary programs are attractive to many potential computer science majors who desire a more liberal arts-focused major. A study of high school students found that the number one reason students chose computer science is that they saw the ability to combine it with another field of interest<sup>4</sup>. In 2005, Computer Magazine offered suggestions for Computer Science departments to prepare their graduates for tomorrow's Information Technology World. The top recommendation was to provide multidisciplinary and cross-disciplinary programs<sup>5</sup>. Other suggestions included offering

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<sup>1</sup> Hansen, M. & Zerbino, N. (2022, April 11). Exploring the state of computer science education amid rapid policy expansion. *Brookings Research*. <https://www.brookings.edu/articles/exploring-the-state-of-computer-science-education-amid-rapid-policy-expansion/>

<sup>2</sup> Matzelle, E. (2023, June 2). Where Are Tech Jobs Thriving in the U.S.? (2023 Refresh). *CompTIA Blog*. <https://www.comptia.org/blog/where-are-tech-jobs-thriving-in-the-u-s->

<sup>3</sup> Yancey, D. (2022, December 20). In some high-demand fields, most Virginia graduates leave the state. *Cardinal News*. <https://cardinalnews.org/2022/12/20/in-some-high-demand-fields-most-virginia-graduates-leave-the-state/>

<sup>4</sup> Carter, L. (2006, March). Why students with an apparent aptitude for computer science don't choose to major in computer science. *ACM SIGCSE Bulletin*, 38(1), 27–31. <https://doi.org/10.1145/1124706.1121352>

<sup>5</sup> Mahmoud, Q. (2005, June). Revitalizing Computing Science Education. *Computer*, 38(5), 100–98. <https://ieeexplore.ieee.org/stamp/stamp.jsp?arnumber=1430645>



a B.A. in Computer Science to allow for more options in computer education<sup>6</sup>. The proposed B.A. in Computer Science degree program at VCU is well-positioned to help fulfill the need for computing professionals in Virginia.

### **Institutional Mission**

Virginia Commonwealth University and its academic health center serve as one national urban public research institution dedicated to the success and well-being of our students, patients, faculty, staff, and community through:

- Real-world learning that furthers civic engagement, inquiry, discovery, and innovation
- Research that expands the boundaries of new knowledge and creative expression and promotes translational applications to improve the quality of human life
- Interdisciplinary collaborations and community partnerships that advance innovation, enhance culture and economic vitality, and solve society's most complex problems
- Health sciences that preserve and restore health for all people, seek the cause and cure of diseases through groundbreaking research, and educate those who serve humanity
- Deeply engrained core values of diversity, inclusion, and equity that provide a safe, trusting and supportive environment to explore, create, learn and serve

The proposed B.A. in Computer Science program directly serves to fulfill the mission of Virginia Commonwealth University. The proposed program will educate students with “real-world learning that furthers inquiry, discovery and innovation” in computer systems and programming. Students will form “interdisciplinary collaborations” to “solve society’s most complex problems” by applying their computing skills in all areas of society. The proposed program will allow for “diversity, inclusion, and equity” by providing additional pathways for students to attain a degree in Computer Science. The proposed program will attract non-traditional Computer Science students, who want more diversity of course offerings and choices in their learning paths.

The proposed B.A. in Computer Science is included in the Virginia Commonwealth University’s 2022 Six-Year Plan. In response to Section G: Programs and Instructional Sites, VCU committed that “each of VCU’s schools and colleges is planning to strengthen existing and/or to advance new programs in critical domains and fields that will benefit the Commonwealth of Virginia.” One of the areas mentioned was computing.

### **Delivery Format**

Virginia Commonwealth University has VCU Online, “a global leader in providing quality higher education using a number of delivery methods, including fully-online and hybrid. Each year we help thousands of students further their goals on their own schedules with our flexible degree and certificate options.”<sup>7</sup>

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<sup>6</sup> Ibid.

<sup>7</sup> VCU Online. <https://online.vcu.edu/>

The proposed program will deliver the following core courses in both online and in-person options:

- CMSC 235 – Asynchronous Fall 2024
- CMSC 255 - Asynchronous Fall 2024
- CMSC 256 - Synchronous Fall 2024
- CMSC 302 - Asynchronous Fall 2024
- CMSC 311 - Asynchronous Fall 2024
- CMSC 355 - Asynchronous Fall 2025
- CMSC 401 - Asynchronous Fall 2024

CMSC 254 and most restricted elective courses will remain as in-person only courses at this time. The online courses will use the Canvas platform for course delivery. This instructional tool allows for many tool add-ons which include online, interactive textbooks and tools to assist student learning.

Two faculty and one adjunct in the Computer Science department have been formally trained in online education curriculum development. Each course being developed will be reviewed and approved to be an online course by those faculty and VCU Online. Faculty teaching online courses will be required to complete the applicable online teaching training modules provided by VCU Online before they can teach the online courses.

### **Admission Criteria**

The admission requirements for Virginia Commonwealth University are that an applicant is a graduate of an accredited secondary school or its equivalent or hold a GED or have taken a State Department of Education approved High School Equivalency examination. The college preparatory curriculum is highly preferred, and a minimum of 20 units is required for admission to all programs with the following minimum distribution of subjects: four (4) units in English; three (3) units in mathematics, one of which must be algebra I and one of which must be geometry or algebra II; three (3) units in science, one of which must be a laboratory science; and three (3) units in history or social sciences or government.

Admission to the proposed B.A. in Computer Science program will require additional requirements beyond those of the admissions policies of Virginia Commonwealth University. The additional requirements applicants must meet in order to be admitted to the proposed Computer Science degree program are:

- A minimum overall high school GPA of 3.5
- Completion of Algebra II with at least a C.
- Engineering, science, computer science, or other technical coursework.
- No grades of D or F in the last two years of courses taken.

## Curriculum

The proposed Bachelor of Arts in Computer Science will require 120 credit hours.

The curriculum will provide students with a foundation in programming and software development. Core coursework will educate students about determining client computing needs, developing computing systems designs and prototypes, coding computing solutions, and developing system documentation. Coursework will educate them on the ethical and legal issues involved in computing and data management. Students will gain a strong understanding of how the computer works and the tools and processes that computer professionals use to solve problems and develop software for large organizations, including the design, development, and testing of software systems. This degree offers the students the opportunity to acquire additional knowledge in cybersecurity, data science, machine learning, and software development. The proposed degree program provides flexibility for students to major or minor in an additional content area to broaden and integrate their computer skills into the content areas of their interest.

There are no new courses needed for this degree.

### **Program Requirements**

#### **General Education Requirements: 30 credit hours**

The General Education curriculum is a requirement for all VCU undergraduate students and therefore does not focus on those skills, techniques or procedures specific to a particular occupation or profession. The general education curriculum which follows consists of 30 credit hours divided into three sections: 1) foundations, 2) breadth of knowledge, and 3) areas of inquiry.

UNIV 111. Focused Inquiry I (3 credits) – required by all VCU students

UNIV 112. Focused Inquiry II (3 credits) – required by all VCU students

UNIV 200. Inquiry and the Craft of the Argument (3 credits) – required by all VCU students

Quantitative Foundations (3-4 credits)

Breadth of Knowledge (9 credits)

Areas of Inquiry (8-9 credits)

#### **Core Courses: 27 credit hours**

CMSC 235 Computing and Data Ethics (3 credits)

CMSC 254 Introduction to Problems-solving (4 credits)

CMSC 255 Introduction to Programming (4 credits)

CMSC 256 Data Structures and Object-oriented Programming (4 credits)

CMSC 302 Introduction to Discrete Structures (3 credits)

CMSC 311 Computer Organization (3 credits)

CMSC 355 Fundamentals of Software Engineering (3 credits)

CMSC 401 Algorithm Analysis with Advanced Data Structures (3 credits)

#### **Additional Required Courses: 13 credit hours**

MATH 151 Precalculus Mathematics (4 credits)

MATH 211 Mathematical Structures (3 credits)

MATH 310 Linear Algebra (3 credits)  
STAT 212 Concepts of Statistics (3 credits)

**Restricted Electives: 12-13 credit hours**

Students will be required to select four courses from the following list of courses.

CMSC 257 Computer Systems (4 credits)  
CMSC 303 Introduction to the Theory of Computation (3 credits)  
CMSC 304 Programming Languages (3 credits)  
CMSC 312 Introduction to Operating Systems (3 credits)  
CMSC 404 Compiler Construction (3 credits)  
CMSC 408 Database Theory (3 credits)  
CMSC 410 Introduction to Quantum Computing (3 credits)  
CMSC 411 Computer Graphics (3 credits)  
CMSC 412 Social Network Analysis and Cybersecurity Risks (3 credits)  
CMSC 413 Introduction to Cybersecurity (3 credits)  
CMSC 414 Computer and Network Security (3 credits)  
CMSC 415 Introduction to Cryptography (3 credits)  
CMSC 420 Software Project Management  
CMSC 425 Introduction to Software Analysis and Testing (3 credits)  
CMSC 426 Software as a Service (3 credits)  
CMSC 427 Design and Implementation of User Interfaces (3 credits)  
CMSC 428 Mobile Programming: iOS (3 credits)  
CMSC 435 Introduction to Data Science (3 credits)  
CMSC 436 Artificial Intelligence (3 credits)  
CMSC 437 Introduction to Natural Language Processing (3 credits)  
CMSC 438 Machine Learning (3 credits)  
CMSC 440 Data Communication and Networking (3 credits)

**Open Electives: 37-38 credit hours**

Students may select 37-38 credits of open electives.

**Total Credit Hours: 120**

See Appendix A for a sample plan of study.

See Appendix B for course descriptions.

**Faculty Resources**

The Department of Computer Science has 20 full-time faculty members who will deliver the core and restrictive elective courses for the proposed B.A. in Computer Science degree program. The faculty members have master's or terminal degrees in computer science or a related discipline and over 100 years of combined teaching and research experience in the field. Most faculty have published in peer-reviewed journals. The research and teaching interests of the faculty cover all major areas of computer science.

Five (5) faculty from the Department of Mathematics and the Department of Statistics will teach required courses in the proposed program. All faculty will hold master's or doctoral level degrees in the discipline area in which they teach.

Five (5) adjunct faculty members with at least a master's in Computer Science or related field will teach the core courses. The adjunct faculty members will have at least two years of teaching experience.

One new adjunct will be hired for the proposed program. The position will require a master's degree in computer science.

See Appendix C for abbreviated curriculum vitae of faculty.

### **Student Learning Assessment**

Students who complete the proposed B.A. in Computer Science degree will possess the appropriate knowledge, skills, and ability needed to analyze, design, and build computer solutions for any business or organization. Students will be assessed in each course through various mechanisms that include (1) projects, (2) homework assignments, (3) quizzes, and (4) exams. Laboratory and project-based experiences are provided where students will be expected to demonstrate knowledge and skills in a practical, "real world" sense and assessment measures will include peer and faculty reviews.

The student learning outcomes for the program are based on national professional guidelines. Faculty elected not to develop additional, specific, or different student learning outcomes for the proposed program as this program shares many of the same core courses as the current Bachelor of Science (B.S.) in Computer Science at VCU, which follows these guidelines. The program learning outcomes are derived from ABET, a world-wide accreditation agency for computing programs<sup>8</sup>. Program faculty will maintain awareness of the standards of this organization through professional development activities such as conference attendance, workshop training, and keeping abreast of the professional literature.

At Virginia Commonwealth University, each degree program assesses program level student learning outcomes annually. Assessment findings and summaries of faculty discussions about the implications of the findings are maintained in VCU's assessment data management system, Taskstream.

#### Learning Outcomes

All students will be able to:

- Analyze a complex computing problem and apply principles of computing and other relevant disciplines to identify solutions
- Design, implement, and evaluate a computing-based solution to meet a given set of computing requirements in the context of the program's discipline

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<sup>8</sup> ABET. <https://www.abet.org/accreditation/>

- Function effectively as a member or leader of a team engaged in activities appropriate to the program's discipline
- Apply computer science theory and software development fundamentals to produce computing-based solutions

Curriculum Map for B.A. in Computer Science.

<b>Learning Outcomes</b>	<b>Core and Required Courses</b>	<b>Assessment Methods</b>
Analyze a complex computing problem	CMSC 254 Introduction to Problem-Solving CMSC 255 Introduction to Programming CMSC 256 Data Structures and Object-Oriented Programming CMSC 311 Computer Organization CMSC 401 Algorithm Analysis with Advanced Data Structures	<u>Formative:</u> Problem sets, quizzes, class discussions, individual and collaborative projects, laboratory exercises  <u>Summative:</u> Midterm and final exams, final projects
Design, implement and evaluate a computing-based solution	CMSC 254 Introduction to Problem-Solving CMSC 255 Introduction to Programming CMSC 256 Data Structures and Object-Oriented Programming CMSC 302 Discrete Structures CMSC 311 Computer Organization CMSC 401 Algorithm Analysis with Advanced Data Structures	<u>Formative:</u> Problem sets, quizzes, class discussions, individual and collaborative projects, laboratory exercises  <u>Summative:</u> Midterm and final exams, final projects
Function effectively on a team	CMSC 254 Introduction to Problem-Solving CMSC 255 Introduction to Programming CMSC 256 Data Structures and Object-Oriented Programming CMSC 355 Fundamentals of Software Engineering	<u>Formative:</u> Class discussions, individual and collaborative projects, laboratory exercises  <u>Summative:</u> Instructor and peer-reviews, final projects
Apply computer science theory	CMSC 256 Data Structures and Object-Oriented Programming	<u>Formative:</u> Problem sets, quizzes, class discussions, individual and

	CMSC 355 Fundamentals of Software Engineering CMSC 401 Algorithm Analysis with Advanced Data Structures	collaborative projects, laboratory exercises  <u>Summative:</u> Midterm and final exams, final projects
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### **Employment Skills**

Graduates of the proposed B.A. in Computer Science degree program will be able to:

- Write computer code in a variety of different coding languages to generate computer solutions
- Employ standard and cutting-edge industry procedures for analyzing, designing, testing, and building software solutions to meet stakeholder needs
- Analyze and modify existing code for optimization
- Analyze business processes for optimization
- Collaborate effectively on a team to effectively implement computing solutions
- Communicate complex information and findings clearly and logically to colleagues and stakeholders

### **Relationship to Existing Programs**

Virginia Commonwealth University offers a B.S. in Computer Science that is related to the proposed degree program. The B.S. in Computer Science is housed in the College of Engineering Computer Science Department.

The B.S. in Computer Science and the proposed B.A. in Computer Science degree programs share related learning outcomes. However, there are distinct differences in the purposes and program objectives. There are also distinct differences in the knowledge and skills of the graduates.

The B.S. in Computer Science is an ABET accredited program whose purpose is to provide in-depth coverage of computer science topics and skills. The B.S. in Computer Science program requires a comprehensive curriculum in computer science encompassing 54 credit hours of coursework with focused coverage of all major topic areas including a year-long capstone project. The proposed B.A. degree program will require 39 credit hours of coursework. Core topics that are similar between the two programs include courses in programming, software engineering, data structures, algorithm analysis, discrete structures, and computer organization. The B.S. in Computer Science also requires courses in databases, operating systems, computer systems, and the theory of computation. Both programs require additional technical electives. In the B.S. degree program, students have three technical electives. They can decide to concentrate all three electives in one of the following areas: software engineering, data science, and cybersecurity. These concentrations are indicated on their transcript. Students in the proposed degree program will have four technical electives and will not receive any concentrations.

Students in the proposed degree program are computer science generalists. The program allows for 38 open credit hours where they will be encouraged to get a second major or several minors in order to integrate computing science skills into other topic areas.

### Justification of the Proposed Program

#### **Response to Current Needs (Specific Demand)**

Computer Science is a broad field of study encompassing many different computing professions. These professionals are found “in every kind of business, every kind of science, in government, analyzing data, websites, and scientific data”<sup>9</sup>. Since computing and software are vital to all professions, there is a significant need to develop computing professionals who can apply their computing skills to all employment sectors and various contexts. The proposed B.A. degree program will respond to the current needs by preparing individuals who can develop, test, and maintain the code and computer systems used in all industry and government areas.

The proposed program responds to the current need in Virginia and the nation for individuals trained with robust computing skills. The current needs include: 1) a market demand for professionals with skills in computing, critical thinking, and communication skills, and 2) increasing diversity in the computing workforce to promote a more diverse, multi-disciplined workforce that better aligns with computing careers in all areas.

#### **Market Demand**

In 2016, Burning Glass Technologies examined 26 million online job postings to determine “the specific jobs and skills that employers were seeking”<sup>10</sup>. They documented several key findings: 1) coding skills are in high demand, 2) coding skills are not just for programmers, 3) coding jobs pay more, 4) coding skills provide an avenue to high income jobs, and 5) coding jobs are growing faster than the job market<sup>11</sup>. This trend has only increased. “[O]n an intellectual level, computer science has become fundamental to almost every aspect of society.”<sup>12</sup> Companies are looking for new ways to use technology. They will require a larger workforce of computer scientists to develop processes and programs to handle these new opportunities<sup>13</sup>. “[E]mployers want college graduates with multidisciplinary savvy. They want innovators, lifelong learners, communicators who can reflect, analyze and interpret a text, no matter what the medium.”<sup>14</sup> Multidisciplinary computer science programs prepare students to be versatile, innovative, and

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<sup>9</sup> Kowarski, I & Wood, S. (2023, May 9). What can you do with a computer science degree. *U.S. News & World Report*. <https://www.usnews.com/education/best-graduate-schools/articles/what-can-you-do-with-a-computer-science-degree#:~:text=Salaries%20and%20Career%20Outlook%20for%20Computer%20Science%20Graduates&text=U.S.%20employment%20within%20computer%20and,expected%20growth%20among%20all%20occupations>.

<sup>10</sup> Burning Glass Technologies. (2016). *Beyond Point and Click: The Expanding Demand for Coding Skills*. [https://www.burning-glass.com/wp-content/uploads/Beyond\\_Point\\_Click\\_final.pdf](https://www.burning-glass.com/wp-content/uploads/Beyond_Point_Click_final.pdf)

<sup>11</sup> Ibid.

<sup>12</sup> Kafka, A. (2020, April 15). The discipline that is transforming higher ed. *The Chronicle of Higher Education*, 66(28). <https://www.chronicle.com/article/the-discipline-that-is-transforming-higher-ed/>

<sup>13</sup> Khandelwal, A. (2023, March 9). Job outlook for computer science roles (plus salaries). *Indeed Career Guide*. <https://www.indeed.com/career-advice/finding-a-job/job-outlook-for-computer-science>

<sup>14</sup> Anderson, N. (2023, May 20). College is remade as tech majors surge and humanities dwindle. *Washington Post*. <https://www.washingtonpost.com/education/2023/05/19/college-majors-computer-science-humanities/>



adaptable problem solvers who can address the complex challenges in all sectors of the economy. They promote collaboration, ethical awareness, and a deeper understanding of how technology intersects with various aspects of society. “Individuals who develop expertise in computer and technology fields enjoy higher wages and employment. Even those who do not pursue technical occupations still reap these benefits, as computing and data analysis skills have been broadly integrated into many industries and occupations. ... [E]conomies overall fare better when individuals are more technologically competent. Studies show a positive relationship between economic growth, technology, and human-capital investments in related skills. Many states and countries view computing and technology jobs as engines of economic growth.”<sup>15</sup> Professionals in all industry areas will need advanced computer science skills as the technology trend grows. Providing a pathway where employees in all industries can gain a solid foundation in computer science will assist in closing the knowledge gap among all professionals in their computing skills. The proposed B.A. degree program will follow this model and provide graduates who can utilize their computing skills in many diverse industries throughout Virginia and the nation.

### The Greater Washington Partnership

In 2016, the Greater Washington Partnership, a civic alliance of the DC, Virginia, and Maryland's leading employers was formed. One of their focus areas is to promote skills, talent, and infrastructure in the region. The Greater Washington Partnership identified that by 2025, a 50% gap in tech talent will exist in the area, equaling 17,000 strictly computing-related jobs. Additionally, computing jobs in non-tech companies will see a 67% gap in talent or about 52,000 jobs<sup>16</sup>. VCU actively participates in this partnership and is working to fill this talent gap. The proposed B.A. degree program will expand VCU's offerings to meet the market demand. Currently, VCU offers a B.S. degree in Computer Science for students whose focus and interest are in companies and industries in the technology sector. Additionally, VCU offers a Fundamentals in Computing Certificate Program for non-technical majors seeking exposure to computer basics, data science, and cybersecurity. The proposed B.A. in Computer Science degree program would cater to students aiming to acquire significant computing skills and apply them in the non-tech job sectors, which are experiencing the most growth.

### Tech Talent Pipeline

In 2019, Governor Ralph Northam launched the Tech Talent Pipeline initiative, partnering with 11 universities, including VCU, to produce an additional 32,000 technology graduates over the next 20 years. This strategic emphasis on technology has elevated Virginia's status as a prime destination for hiring computing professionals. It was pivotal in Amazon's decision to establish a second headquarters in the state. Virginia's reputation as a technology hub attracted Amazon and continues to fuel economic growth across various industries<sup>17</sup>.

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<sup>15</sup> Hansen, M. & Zerbino, N. (2022, April 11). Exploring the state of computer science education amid rapid policy expansion. *Brookings Research*. <https://www.brookings.edu/articles/exploring-the-state-of-computer-science-education-amid-rapid-policy-expansion/>

<sup>16</sup> Greater Washington Partnership. (2020, July). *The capital region faces a huge tech talent shortage*. <https://greaterwashingtonpartnership.com/publications/the-capital-region-faces-a-huge-tech-talent-shortage/>

<sup>17</sup> Simmons, L. (2023, July 26). Top careers in computer science. *Computer Science.org*. <https://www.computerscience.org/careers/>

In alignment with this vision, VCU has committed to producing an additional 722 Computer Science graduates over the next two decades. Our existing B.S. in Computer Science degree program has experienced steady growth. The proposed B.A. degree program will further bolster this expansion by creating additional avenues for students to earn computing degrees.

### **Increasing diversity in the computing workforce**

Nationally, in 2020, about 25% of the employees in computer fields were women<sup>18</sup>, and about 11.6% were underrepresented minorities<sup>19</sup>. These statistics are well under the demographic representation of our country. Companies perform better with a diverse workforce. “[C]ompanies in the top quartile for gender diversity on executive teams were 25 percent more likely to have above-average profitability than companies in the fourth quartile”<sup>20</sup>. Diverse teams make better decisions in 87% of situations and deliver 60% better results<sup>21</sup>. In Virginia, in 2022, 21% of the graduates in Computer Science were women, and 19% of the graduates were from underrepresented minorities<sup>22</sup>. These graduation statistics will not lead to more company diversity and growth. The proposed degree program will offer a new, more inclusive pathway for diverse students to become computer science professionals. The three traditional barriers to diversity growth in computer science have been 1) a heavy mathematics focus, 2) lack of prior exposure to computer science, and 3) lack of choice or integration with other programs.

### Mathematics Focus

Many universities are looking to move away from traditional calculus courses as a requirement for computer science programs. It is widely recognized that this heavy math/science focus is not the only pathway to success in the computing field and can be a barrier to success for some students<sup>23</sup>. “[M]athematics does not provide the most appropriate conceptual foundations for computer science, but, rather, that these foundations are a primary source of unnecessary complexity and confusion”<sup>24</sup>. Instead, the proposed degree program will teach students the mathematical concepts that will directly aid their understanding of the computing discipline without the added complexity. Studies have shown that math/science self-efficacy has a

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<sup>18</sup> McCain, A. (2022, October 31). 40 telling women in technology statistics [2023]: Computer science gender ratio. *Zippia*. <https://www.zippia.com/advice/women-in-technology-statistics/#:~:text=The%20percentage%20of%20bachelor's%20in.%2C%20to%2018%25%20in%202021.>

<sup>19</sup> Zippia. (2023, July 21). *Computer scientist demographics and statistics in the US*.

<https://www.zippia.com/computer-scientist-jobs/demographics/>

<sup>20</sup> Dixon-Fyle, S., Dolan, K., Hunt, D.V., & Prince, S. (2020, May 19). Diversity wins: How inclusion matters. *McKinsey & Company*. <https://www.mckinsey.com/featured-insights/diversity-and-inclusion/diversity-wins-how-inclusion-matters>

<sup>21</sup> Larson, E. (2017, September 21). New research: Diversity + inclusion = better decision making at work. *Forbes*. <https://www.forbes.com/sites/eriklarson/2017/09/21/new-research-diversity-inclusion-better-decision-making-at-work/?sh=66d5c2524cbf>

<sup>22</sup> State Council of Higher Education for Virginia (SCHEV). (2023). Completions, race/ethnicity, program detail. *Higher Education Data*. [https://research.schev.edu/rdPage.aspx?rdReport=Completions.C6\\_Report&inpGENDER=1&inpPROGONE=110101&inpREPYEAR=2122&inpUNITID=234030&rdRnd=59483](https://research.schev.edu/rdPage.aspx?rdReport=Completions.C6_Report&inpGENDER=1&inpPROGONE=110101&inpREPYEAR=2122&inpUNITID=234030&rdRnd=59483)

<sup>23</sup> Chen, X. & Soldner, M. (2013). STEM attrition: College students' paths into and out of STEM fields. *National Center for Education Statistics, Institute of Education Sciences, US Department of Education*. <https://files.eric.ed.gov/fulltext/ED544470.pdf>

<sup>24</sup> Fant, Karl M. (2007). Computer Science Reconsidered: The Invocation Model of Process Expression. *John Wiley & Sons*. Located at <https://www.chronicle.com/blognetwork/castingoutnines/does-computer-science-need-math>

statistically significant effect on STEM career aspirations. Eliminating this boundary will help ease students' transition into a CS major<sup>25</sup>.

### Prior Exposure

“Prior research indicates low access to CS educational opportunities and resources being critical drivers of STEM participation gaps, which tend to mirror larger socioeconomic inequalities based on race, income, or locale”<sup>26</sup>. These inequities still exist in Virginia even after adopting the Computer Science Standards of Learning (SOL) for grades K – 12 in 2017. About 53% of high schools nationally teach a computer science course<sup>27</sup>. In Virginia, the percentage is 75%<sup>28</sup>. However, one course in most high schools does not provide sufficient access to computer science for all students. Additionally, there is no formal testing of the Virginia Computer Science SOLs as in the other Virginia SOLs, so they are not enforced. Many students come to VCU without any background in Computer Science. Students who are not exposed to computer science courses in high school will not select computer science as a major in college. At VCU, we have several courses designed to introduce computer science to non-major students. The proposed degree program would provide a pathway to a computer science degree for students who discover an interest after their first few semesters. Studies have found that over a third of students switch majors during their time in college, and most students do not declare a degree until their sophomore year.<sup>29</sup> The proposed degree program will allow these students the flexibility to complete the proposed degree on time, without extending their college career. This flexibility would not be possible with the very structured existing B.S. in Computer Science degree program.

### Lack of Choices

The number one reason women choose to major in computer science is their desire to use it in another field<sup>30</sup>. This proposed degree program will give students the flexibility to major or minor in other degree areas, which our survey of high school students stated that they most liked about the proposed degree program. 69% of the respondents indicated that the proposed B.A. degree program would provide them with the ability to broaden their skill sets and job prospects, and 67% of the respondents were looking to have the ability to double major. The proposed program will produce graduates with a solid foundation in computing skills and a cross-section of skills and tools to navigate complex societal issues. Graduates will be well-positioned to hold computing jobs in all employment sectors.

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<sup>25</sup> Mau, Wei-Cheng J. & Li, J. (2018, September). Factors influencing STEM career aspirations of underrepresented high school students. *The Career Development Quarterly* 66(3). 246-258.

[https://soar.wichita.edu/bitstream/10057/16274/1/Mau\\_Li\\_2018.pdf](https://soar.wichita.edu/bitstream/10057/16274/1/Mau_Li_2018.pdf)

<sup>26</sup> Hansen, M. & Zerbino, N. (2022, April 11). Exploring the state of computer science education amid rapid policy expansion. *Brookings Research*. <https://www.brookings.edu/articles/exploring-the-state-of-computer-science-education-amid-rapid-policy-expansion/>

<sup>27</sup> Code.org (2023). <https://code.org/promote/va>

<sup>28</sup> Ibid.

<sup>29</sup> Chen, X. & Soldner, M. (2013). STEM attrition: College students' paths into and out of STEM fields. *National Center for Education Statistics, Institute of Education Sciences, US Department of Education*.

<https://files.eric.ed.gov/fulltext/ED544470.pdf>

<sup>30</sup> Carter, L. (2006, March). Why students with an apparent aptitude for computer science don't choose to major in computer science. *ACM SIGCSE Bulletin*, 38(1), 27–31, <https://doi.org/10.1145/1124706.1121352>

## Why VCU

As evidenced by its “Bronze Award” from the American Society for Engineering Education (ASEE) Diversity Recognition Program, VCU is committed to sustaining an environment that promotes diversity, equity, and inclusiveness. The Bronze Award, the highest level awarded in 2019, acknowledges VCU’s commitment to bringing women and underrepresented minorities into the field and places the university among the nation’s leaders in inclusive excellence<sup>31</sup>. Specifically, in VCU’s College of Engineering, the percentages of female and underrepresented minority undergraduates have each increased by 33% since 2012, and it has the highest rate of Hispanic/Latin graduates in Virginia. The university’s faculty and students demonstrate an unwavering commitment to diversity, equity, and inclusiveness. VCU employs a comprehensive outreach campaign for recruiting prospective students. VCU’s Spring 2023 Computer Science graduates were 30% female and 28% underrepresented minorities. We are already on a great path, and the proposed B.A. in Computer Science degree program can significantly further this endeavor.

As discussed previously, most Computer Science graduates leave the state within ten years of graduation. In the case of VCU, our percentages were much better. Of the 227 graduates in a computing field from VCU in the 2004 – 2006 cohort, 189, or 83%, were still employed in the state ten years after graduation<sup>32</sup>. At UVA, the percentage was 41%, and, at Virginia Tech, the rate was 49%<sup>33</sup>. Since VCU’s in-state admissions is 91.2%<sup>34</sup>, the proposed program is well positioned to educate and retain a strong computing workforce in Virginia.

## **Employment Demand**

Graduates of the proposed B.A. in Computer Science degree program will be qualified to become entry-level software developers, software engineers, software quality assurance analysts and testers, computer programmers and computer systems analysts. Graduates will be prepared to work in all industries and public sector jobs requiring computing or software engineering skills.

According to the U.S. Bureau of Labor Statistics (BLS), between 2021 and 2031 employment for many computer professionals will grow at 15%, “much faster than other occupations”<sup>35</sup>. The BLS goes on to say, “[T]his increase is expected to result in about 682,800 new jobs over the decade. In addition to new jobs from growth, opportunities arise from the need to replace workers who leave their occupations permanently. About 418,500 openings each year, on average, are projected to come from growth and replacement needs.”<sup>36</sup>

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<sup>31</sup> ASEE Diversity Recognition Program (ADRP) (2023). <https://diversityrecognition.asee.org/recognized-institutions/>

<sup>32</sup> State Council of Higher Education for Virginia (SCHEV). [https://research.schev.edu/rdPage.aspx?rdReport=EOM.CENSUS\\_CIP2\\_EARNINGS\\_REPORT&rdRequestForwarding=Form](https://research.schev.edu/rdPage.aspx?rdReport=EOM.CENSUS_CIP2_EARNINGS_REPORT&rdRequestForwarding=Form)

<sup>33</sup> Ibid.

<sup>34</sup> State Council of Higher Education for Virginia (SCHEV). (2022). [https://research.schev.edu/enrollment/e19\\_report.asp](https://research.schev.edu/enrollment/e19_report.asp)

<sup>35</sup> The U.S. Bureau of Labor Statistics. Occupational Outlook Handbook. <https://www.bls.gov/ooh/computer-and-information-technology/home.htm>

<sup>36</sup> Ibid.

The data for software developers, software quality assurance analysts and testers show that from 2021 to 2031 employment will grow at 25%, “much faster than other occupations”<sup>37</sup>. The BLS indicates that this demand “will stem from the continued expansion of software development for artificial intelligence (AI), Internet of Things (IoT), robotics, and other automation applications.”<sup>38</sup>

For computer systems analysts, the BLS project that between 2021 and 2031 employment is projected to grow 9%, “faster than the average for all occupations”<sup>39</sup>. The BLS indicates that “[a]s organizations across the economy continue to rely on information technology (IT), computer systems analysts will be hired to design and install new computer systems.”<sup>40</sup>

The data for computer programmers shows that from 2021 to 2031 employment will decline 10%<sup>41</sup>. The BLS indicates that “about 9,600 openings for computer programmers are projected each year, on average, over the decade. All of those openings are expected to result from the need to replace workers who transfer to other occupations or exit the labor force, such as to retire.”<sup>42</sup>

For web developers, the BLS projects that between 2021 and 2031 employment is projected to grow 23%, “much faster than the average for all occupations”<sup>43</sup>. The BLS indicates that “[E]mployment of web developers and digital designers is projected to grow as e-commerce continues to expand.”<sup>44</sup>

The data for all other computer occupations shows that from 2021 to 2031 employment is projected to grow 10%<sup>45</sup>. The BLS indicates that these are jobs that require a bachelor’s degree with minimal work experience<sup>46</sup>.

The Virginia Economic Development Partnership (VEDP) listed information technology, specifically listing software as one of the key industries for Virginia<sup>47</sup>. “Over the last few decades, the Commonwealth of Virginia has become one of North America’s premier locations for the tech sector. Thousands of tech firms and tech industry leaders have been attracted to

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<sup>37</sup> The U.S. Bureau of Labor Statistics. Occupational Outlook Handbook. <https://www.bls.gov/ooh/computer-and-information-technology/software-developers.htm#tab-6>

<sup>38</sup> Ibid.

<sup>39</sup> The U.S. Bureau of Labor Statistics. Occupational Outlook Handbook. <https://www.bls.gov/ooh/computer-and-information-technology/computer-systems-analysts.htm#tab-6>

<sup>40</sup> Ibid.

<sup>41</sup> The U.S. Bureau of Labor Statistics. Occupational Outlook Handbook. <https://www.bls.gov/ooh/computer-and-information-technology/computer-programmers.htm#tab-6>

<sup>42</sup> Ibid.

<sup>43</sup> The U.S. Bureau of Labor Statistics. Occupational Outlook Handbook. <https://www.bls.gov/ooh/computer-and-information-technology/web-developers.htm#tab-6>

<sup>44</sup> Ibid.

<sup>45</sup> The U.S. Bureau of Labor Statistics. Occupational Outlook Handbook. <https://www.bls.gov/ooh/about/data-for-occupations-not-covered-in-detail.htm#151299>

<sup>46</sup> Ibid.

<sup>47</sup> Virginia Economic Development Partnership. Key Industries. <https://www.vedp.org/industry/software>

Virginia by its combination of diverse, world-class talent, exceptional quality of life, attractive business climate, and competitive costs.”<sup>48</sup>

**Labor Market Information: Bureau of Labor and Statistics, 2021 – 2031 (10-Yr)**

<b>Occupational Title</b>	<b>Base Year Employment</b>	<b>Projected Employment</b>	<b>Total % Change</b>	<b>Typical Entry Level Education</b>
Software Developers and Software Quality Assurance Analysts and Testers <sup>49</sup>	1,622,200	2,033,600	25%	Bachelor’s degree
Computer Systems Analysts <sup>50</sup>	538,800	589,700	9%	Bachelor’s degree
Computer Programmers <sup>51</sup>	174,400	156,600	-10%	Bachelor’s degree
Web Developers and Digital Interface Designers (includes Video Game Designers) <sup>52</sup>	197,100	242,500	23%	Bachelor’s degree
Computer Occupations, All Other (includes Web Administrators, Geographic Information Systems Technologists and Technicians, Document Management Specialists, Penetration Testers, Information Security Engineers, Digital Forensics Analysts, Blockchain Engineers, Computer Systems Engineers/ Architects, Information Technology Project Managers) <sup>53</sup>	408,200	449,200	10%	Bachelor’s degree

<sup>48</sup> Ibid.

<sup>49</sup> The U.S. Bureau of Labor Statistics. Occupational Outlook Handbook. <https://www.bls.gov/ooh/computer-and-information-technology/software-developers.htm#tab-6>

<sup>50</sup> The U.S. Bureau of Labor Statistics. Occupational Outlook Handbook. <https://www.bls.gov/ooh/computer-and-information-technology/computer-systems-analysts.htm#tab-6>

<sup>51</sup> The U.S. Bureau of Labor Statistics. Occupational Outlook Handbook. <https://www.bls.gov/ooh/computer-and-information-technology/computer-programmers.htm#tab-6>

<sup>52</sup> The U.S. Bureau of Labor Statistics. Occupational Outlook Handbook. <https://www.bls.gov/ooh/computer-and-information-technology/web-developers.htm#tab-6>

<sup>53</sup> The U.S. Bureau of Labor Statistics. Occupational Outlook Handbook. <https://www.bls.gov/ooh/about/data-for-occupations-not-covered-in-detail.htm#151299>

**Virginia Employment Commission, Labor Market Information 2020 – 2030 (10-Yr)**

<b>Occupation</b>	<b>Base Year Employment</b>	<b>Projected Employment</b>	<b>Total Projected Difference</b>	<b>Total Percent Change</b>	<b>Annual Change</b>	<b>Education</b>
Software Developers and Software Quality Assurance Analysts <sup>54</sup>	95,930	116,960	21,030	22%	9,790	Bachelor's degree
Computer Systems Analysts <sup>55</sup>	24,010	26,210	2,200	9%	1,950	Bachelor's degree
Computer Programmers <sup>56</sup>	6,970	6,220	-750	-11%	360	Bachelor's degree
Web Developers and Digital Interface Designers <sup>57</sup>	6,680	7,410	730	11%	73	Bachelor's degree
Computer and Mathematical Occupations, All Other (includes, Web Administrator, Geographic Information Systems Technologists and Technicians, Document Management Specialists, Penetration Testers, Information Security Engineers, Digital Forensics Analysts, Blockchain Engineers, Computer Systems Engineers/Architects, Information Technology Project Managers) <sup>58</sup>	17,130	19,620	2,490	15%	249	Bachelor's degree

Appendix D provides employment announcements.

<sup>54</sup> O\*net Online. Virginia Employment Trends. <https://www.onetonline.org/link/localtrends/15-1253.00?st=VA>

<sup>55</sup> O\*net Online. Virginia Employment Trends. <https://www.onetonline.org/link/localtrends/15-1211.00?st=VA>

<sup>56</sup> O\*net Online. Virginia Employment Trends. <https://www.onetonline.org/link/localtrends/15-1251.00?st=VA>

<sup>57</sup> O\*net Online. Virginia Employment Trends. <https://www.onetonline.org/link/localtrends/15-1254.00?st=VA>

<sup>58</sup> Virginia Employment Commission. Long and Short-Term Occupational Projections. <https://virginiaworks.com/Occupational-Projections>

## Duplication

Three (3) public institutions in Virginia offer a degree program similar or related to the proposed B.A. in Computer Science: Longwood University, the College of William and Mary and the University of Virginia.

### **Longwood University (Longwood)**

Longwood offers a B.A. in Computer Science. The degree program requires 120 credit hours. Based on information in the university's 2023-2024 catalog, there are 29 core requirement credits, 2 mathematical foundation credits, 12 technical elective credits, and 3 additional credit hours for a total of 46 required credit hours.

### **Similarities**

Longwood requires 16 core credit hours that are similar to 17 of the 27 core credit hours in VCU's proposed degree program. Coursework covers programming, data structures, discrete structures, algorithm analysis, and computer organization.

### **Differences**

VCU's proposed program requires 11 more credit hours in mathematics compared to Longwood's degree program. Nine of the 29 core courses required by Longwood are elective requirements at VCU and 6 credits are not required at all.

### **The College of William and Mary in Virginia (William and Mary)**

William and Mary offers a B.A. in Computer Science. The degree program requires 120 credit hours. Based on information in the university's 2023-2024 catalog, there are 22 core requirement credits and 15 technical elective credits for a total of 36 – 37 required credit hours.

### **Similarities**

William and Mary requires 22 core credit hours that are similar to 19 of the 27 core credit hours in VCU's proposed degree program. Coursework covers programming, data structures, discrete structures, software engineering, algorithm analysis, and computer organization.

### **Differences**

The proposed program at VCU requires a total of 39 credit hours in computer science where William and Mary requires 28 since only six of the 15 technical electives need to be computer science courses. In addition, VCU's proposed degree program requires an additional 13 credits in mathematics and statistics, which are not listed as requirements for the William and Mary program.

### **University of Virginia (UVA)**

UVA offers a B.A. in Computer Science. The degree program requires 120 credit hours. Based on information in the university's 2023-2024 catalog, there are 20 core requirement credits, 9 technical elective credits, and 12 integration elective credit hours for a total of 41 required credit hours. In addition, there are 7 prerequisite credit hours needed before starting this degree.



### Similarities

UVA requires 13 core and 7 prerequisite credit hours that are similar to 20 of the 27 core credit hours in VCU’s proposed degree program. Coursework covers programming, data structures, discrete structures, algorithm analysis, software engineering and computer organization.

### Differences

UVA requires 12 integration credit hours where students explore applications of computing to arts and science fields in significant ways, VCU’s proposed degree program does not. The proposed degree program requires 13 credit hours in mathematics and statistics, which the UVA degree program does not.

### Enrollment and graduation for comparable degree programs in Virginia

<b>Enrollment<sup>59</sup></b>	<b>Fall 2018</b>	<b>Fall 2019</b>	<b>Fall 2020</b>	<b>Fall 2021</b>	<b>Fall 2022</b>
Longwood University (Note: B.A./BS Combined)	104	99	85	82	84
William and Mary (Note: B.A./BS Combined)	198	202	209	251	224
University of Virginia (No data exists)					
<b>Degrees Awarded<sup>60</sup></b>	<b>2017-18</b>	<b>2018-19</b>	<b>2019-20</b>	<b>2020-21</b>	<b>2021-22</b>
Longwood University (Note: B.A./BS Combined)	20	17	20	12	12
William and Mary (Note: B.A./BS Combined)	81	60	73	78	93
University of Virginia (No data exists)					

### Student Demand

Evidence of student demand comes from two sources: 1) a survey of high school students and 2) a survey of current VCU students who are either minoring in Computer Science or are pre-engineering with undeclared majors.

#### High School Survey

In May 2023, the Office of Admissions sent an online survey to high school students in the Commonwealth of Virginia with names drawn from VCU’s database of students who had expressed an interest in VCU. The online survey remained open for two months. There were 129 responses from rising seniors and 15 responses from rising juniors. Three of the prompts are most relevant to students’ interest in a B.A. in Computer Science degree. The first two of these prompts are listed below, followed by the number of rising seniors who answered either “strongly agree” or “agree” to the prompt.

- **Prompt 1:** *If VCU offered this Bachelor of Arts in CS program, I would enroll.*  
Rising Seniors: 23 respondents strongly agreed, 49 agreed

<sup>59</sup> SCHEV. <https://research.schev.edu/>

<sup>60</sup> Ibid.

Rising Juniors: 3 respondents strongly agreed, 7 agreed

- Prompt 2: *I am interested in pursuing a degree in Computer Science.*  
Rising Seniors: 58 respondents strongly agreed, 30 agreed  
Rising Juniors: 8 respondents strongly agreed, 1 agreed

The last prompt asks prospective students “If you are interested in this Bachelor of Arts Program, please let us know what makes it attractive to you.” The highest three responses are:

- *Ability to broaden my skill sets and job prospects*, 95 responses (69.9%)
- *Ability to get a double major*, 92 responses (67.6%)
- *Ability to pursue interests in other subject areas*, 85 responses (61%)

#### Computer Science Minors and Undeclared Pre-engineering Students Survey

In June 2023, the Office of Admissions sent an online survey to current VCU students who either were minoring in Computer Science or were undeclared pre-engineering students. The online survey remained open for two months. There were 32 responses. Three of the prompts are most relevant to students’ interest in a B.A. in Computer Science degree. Two of these prompts are listed below, followed by the number of students who answered either “strongly agree” or “agree” to the prompt.

- Prompt 1: *If VCU offered this Bachelor of Arts in CS program, I would enroll.*  
14 respondents strongly agreed, 8 agreed
- Prompt 2: *I am interested in pursuing a degree in Computer Science.*  
24 respondents strongly agreed, 4 agreed

The last prompt asks “If you are interested in this Bachelor of Arts Program, please let us know what makes it attractive to you.” The highest three responses are:

- *Ability to broaden my skill sets and job prospects*, 23 responses (71.9%)
- *Flexibility*, 22 responses (68.8%)
- *Ability to pursue interests in other subject areas*, 21 responses (65.6%)
- *Ability to get a double major*, 20 responses (62.5%)

Appendix E provides a copy of the original student surveys. A summary of the responses for each survey is included after the respective surveys.

**State Council of Higher Education for Virginia  
Summary of Projected Enrollments in Proposed Program**

Year 1		Year 2		Year 3		Year 4 Target Year (2-year institutions)			Year 5 Target Year (4-year institutions)		
2024 - 2025		2025 - 2026		2026 - 2027		2027 - 2028			2028 - 2029		
HDCT	FTES	HDCT	FTES	HDCT	FTES	HDCT	FTES	GRAD	HDCT	FTES	GRAD
<u>20</u>	<u>20</u>	<u>40</u>	<u>40</u>	<u>60</u>	<u>60</u>	<u>80</u>	<u>80</u>	—	<u>84</u>	<u>84</u>	<u>16</u>

Assumptions:

Retention percentage: 80%

Full-time students: 100% Part-time students: 0%

Full-time students credit hours per semester: 15

Full-time students graduate in 4 years

Projected Resource Needs for the Proposed Program

**Resource Needs**

Virginia Commonwealth University and the Department of Computer Science have the resources needed to initiate and sustain the proposed B.A. degree in Computer Science. The following subsections detail the resources required to operate the program from its initiation in the fall 2024 semester through the target year 2028-29. Assessments of need for full-time, part-time, and adjunct faculty are based on a ratio of 1.0 FTE of instructional effort for every 28.0 FTE of enrollment. The proposed program will require a total of 0.7 FTE of instructional effort in 2024-25, rising to 2.9 FTE by the target year 2028-29.

**Full-Time Faculty**

There are no faculty with full-time effort (50% or more effort) devoted to the proposed B.A. program. All Computer Science faculty members have responsibilities for all academic programs, and thus have only part-time responsibility for the proposed program.

**Part-Time Faculty**

Faculty from the Computer Science Department will teach the core and restricted elective courses for the proposed B.A. in Computer Science program. It is anticipated that 20 faculty members will teach required courses. The program will require 1.0 FTE of part-time faculty to initiate and will rise to 3.0 FTE of part-time faculty in the target year.

The dean of the College of Engineering has committed resources for another faculty member who will be available to teach in the proposed BA in Computer Science degree program beginning in Fall 2025. The new faculty member will be hired at the rank of Assistant Professor with an estimated salary of \$105,302 and benefits of \$41,805 for a total of \$147,107. The new

hire will contribute .50 FTE in the initial year and remain constant through the target enrollment year.

Faculty from the Department of Mathematics will teach required courses in the proposed degree program. It is anticipated that 4 faculty members will teach required courses. The program will require 0.2 FTE of part-time faculty to initiate and will rise to 1.0 FTE of part-time faculty by the target year.

Faculty from the Department of Statistics will teach required courses in the proposed degree program. It is anticipated that 1 faculty member will teach the required course. The program will require 0.1 FTE of part-time faculty to initiate and will rise to 0.50 FTE of part-time faculty by the target year.

#### **Adjunct Faculty**

No additional adjunct faculty will be involved with the proposed B.A. in Computer Science program.

#### **Graduate Assistants**

No graduate assistants will be involved with the proposed B.A. in Computer Science program.

#### **Classified Positions**

An administrative assistant currently employed by the Department will support the proposed degree program. The program will require 0.50 FTE of classified support to initiate and this level of effort will remain constant through the target year 2028-29. The estimated salary for the administrative assistant will be \$50,559 and fringe benefits \$20,072 for a total of \$70,631. Two advisors currently employed by the Department will support the proposed degree program. The program will require no FTE of classified support to initiate but will grow to 0.50 FTE in the target year. The estimated salary for the administrative assistant will be \$50,559 and fringe benefits \$20,072 for a total of \$70,631.

#### **Equipment (including computers)**

No new equipment (including computers) is required to initiate or sustain the proposed degree program.

#### **Library**

No new resources are needed to initiate and sustain the proposed degree program. The library has an adequate collection of resources to support the proposed B.A. in Computer Science degree program. Resources include books, journals, publications for computer science and engineering and all are sufficient to support courses in the proposed program.

#### **Telecommunications**

No new telecommunications resources are needed to initiate and sustain this program.

**Space**

No new space is needed to initiate and sustain the proposed degree program. There is adequate space for classrooms, meetings, and offices in the Department of Computer Science and the College of Engineering. Office space is also available for graduate assistants.

**Targeted Financial Aid**

There is no financial aid targeted specifically to initiate and sustain the proposed program.

**Special tuition or fee charges**

There are no special tuition and/or E&G fees specific to the proposed program or academic unit within which the proposed program is housed.

**Other Resources (specify)**

No other resources are needed to initiate and sustain the proposed program.

**Funds to Initiate and Operate the Degree Program**

*Figures provided in the table below will be compared to SCHEV funding estimates using the current base adequacy model. This comparison will serve as a reference for the estimated costs. If there are large discrepancies, SCHEV may request additional clarification to ensure the institution’s assumptions are correct, or require modifications as a condition of approval.*

**Note:** Institutions must use the recommended student-faculty ratio when estimating FTE enrollments and required faculty FTEs.

<b>Cost and Funding Sources to Initiate and Operate the Program</b>			
<b>Informational Category</b>		<b>Program Initiation Year 2024 - 2025</b>	<b>Program Full Enrollment Year<sup>61</sup> 2027 - 2028</b>
1.	Projected Enrollment (Headcount)	20	80
2.	Projected Enrollment (FTE)	20	80
3.	Projected Enrollment Headcount of In-State Students	18	76
4.	Projected Enrollment Headcount of Out-of-State Students	2	4
5.	Estimated Annual Tuition and E&G Fees for In-state Students in the Proposed Program	\$8,881	\$8,881
6.	Estimated Annual Tuition and E&G Fees for Out-of-State Students in the Proposed Program	\$18,244	\$18,244
7.	Projected Total Revenue from Tuition and E&G Fees Due to the Proposed Program	\$196,346	\$747,932
8.	Other Funding Sources Dedicated to the Proposed Program (e.g., grant, business entity, private sources)	\$0	\$0

<sup>61</sup> For the “Full Enrollment Year” use: for associate degrees, initiation year plus 1; for baccalaureate degrees, initiation plus 3; for masters degrees, initiation plus 2; for doctoral degrees, initiation plus 3.

*Part V: Certification Statements*

1. A request of any kind will be submitted to the General Assembly for funds to initiate and/or maintain the proposed degree program.

Yes

No

If “Yes” is checked, include narrative text to describe: when the request will be made, how much will be requested, what the funds will be used for, and what will be done if the request is not fulfilled.

2. The proposed degree program is included in the institution’s most recent six-year plan.

Yes

No

If “No” is checked, include narrative text to explain why the program is being advanced at the present time despite not being included in the six-year plan.

3. The institution’s governing board has been provided information regarding duplication (if applicable) and labor market projections as part of its approval action.

Yes

No

If “No” is checked, include narrative text to explain why the governing board has not been provided the information.

The institution’s Chief Academic Officer attests to the accuracy of the above statements

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Name (Printed)

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Signature

Date

## Appendices



## Appendix A – Sample Plan of Study

### Sample Plan of Study for Full-Time Students

Year	Fall Semester	Spring Semester
<b>Freshman</b>	CMSC 235 Computing and Data Ethics (3)	CMSC 255 Introduction to Programming (4)
	CMSC 254 Introduction to Problem-solving (4)	MATH 211 Mathematical Structures (3)
	MATH 151 Precalculus Mathematics (4)	UNIV 112 Focused Inquiry II (3)
	UNIV 111 Focused Inquiry I (3)	General Education (3)
		General Education (3)
<b>Sophomore</b>	CMSC 256 Data Structures and Object-Oriented Programming (4)	CMSC 311 Computer Organization (3)
	CMSC 302 Introduction to Discrete Structures (3)	STAT 212 Concepts of Statistics (3)
	UNIV 200 Inquiry and the Craft of Argument (3)	General Education (3)
	General Education (3)	General Education (3)
	General Education (3)	Open Electives (3)
<b>Junior</b>	CMSC 355 Fundamentals of Software Engineering (3)	CMSC 401 Algorithm Analysis with Advanced Data Structures (3)
	MATH 310 Linear Algebra (3)	Major Restricted Elective Course (3)
	Major Restricted Elective Course (3)	Open Electives (3)
	Open Electives (3)	Open Electives (3)
	Open Electives (3)	Open Electives (3)
<b>Senior</b>	Major Restricted Elective Course (3)	Major Restricted Elective Course (3)
	Open Electives (3)	Open Electives (3)
	Open Electives (3)	Open Electives (3)
	Open Electives (3)	Open Electives (3)
	Open Electives (3)	Open Electives (2)

Credit Hours – Freshman – Fall Term	___14___
Credit Hours – Freshman – Spring Term	___16___
Credit Hours – Sophomore – Fall Term	___16___
Credit Hours – Sophomore – Spring Term	___15___
Credit Hours – Junior – Fall Term	___15___
Credit Hours – Junior – Spring Term	___15___
Credit Hours – Senior – Fall Term	___15___
Credit Hours – Senior – Spring Term	___14___
<b>TOTAL CREDIT HOURS</b>	<b>___120___</b>

## Appendix B – Course Descriptions

### Core Courses

CMSC 235. Computing and Data Ethics. 3 Hours.

Semester course; 3 lecture hours. 3 credits. Introduction to ethical considerations for computing and working with data, legal implications surrounding data and computational systems, and sociotechnical responsibilities.

CMSC 254. Introduction to Problem-solving. 4 Hours.

Semester course; 3 lecture and 2 laboratory hours. 4 credits. Introduction to problem solving and implementation of solutions using Python. The course introduces students to concepts and practice of structured programming, problem-solving, top-down design of algorithms, a Python language syntax, control structures and arrays. The course content also includes instruction in critical-thinking and problem-solving skills using contemporary tools. Specific topics include flowcharting, pseudocode and program control structures, including sequence, selection, repetition and modularization.

CMSC 255. Introduction to Programming. 4 Hours.

Semester course; 3 lecture and 2 laboratory hours. 4 credits. Prerequisite: calculus-level placement on the VCU Mathematics Placement Test within the one-year period immediately preceding enrollment in the course, or MATH 151 or equivalent. Students are expected to have fundamental computer skills. Introduction to object-oriented programming using Java. Topics include problem-solving, top-down design of algorithms using control structures, methods, arrays, basic I/O, basic concepts of objects and classes in Java, Java classes for manipulating strings, and introduction to program testing, UML notation and integrated development environments. Students may not receive credit for both CMSC 255 and INFO 250.

CMSC 256. Data Structures and Object-Oriented Programming. 4 Hours.

Semester course; 3 lecture and 2 laboratory hours. 4 credits. Prerequisite: CMSC 255 with a minimum grade of C; corequisite: CMSC 302. Advanced programming using Java. Topics include introduction to object-oriented design, inheritance, polymorphism, exceptions, interfaces, linked lists, stacks, queues, binary trees, recursion, and basic searching and sorting techniques. Continued focus on program testing and UML notation. Students may not receive credit for both CMSC 256 and INFO 350.

CMSC 302. Introduction to Discrete Structures. 3 Hours.

Semester course; 3 lecture hours. 3 credits. Prerequisite: CMSC 255 with minimum grade of C. Logic and proofs, sets, functions, sequences and sums, relations, graphs, trees, induction and recursion, advanced counting technique (recurrences).

CMSC 311. Computer Organization. 3 Hours.

Semester course; 3 lecture hours. 3 credits. Prerequisite: CMSC 302 with minimum grade of C; corequisite: CMSC 257. Introduction to the basic organization of computers including elementary digital logic design, processor and arithmetic/logic unit design, data paths, memory hierarchy, I/O devices, instruction set architecture and addressing modes.

CMSC 355. Fundamentals of Software Engineering. 3 Hours.

Semester course; 3 lecture hours. 3 credits. Prerequisite: CMSC 256 or EGRE 246, either with a minimum grade of C. Provides an overview of how to engineer software systems, including all stages of the software development process based on agile principles. Familiarizes students with modern software tooling and the principles of software quality and testing. Students will work in teams to gain experience in software development methodology, write specification and design documents, and develop a prototype.

CMSC 401. Algorithm Analysis with Advanced Data Structures. 3 Hours.

Semester course; 3 lecture hours. 3 credits. Prerequisites: CMSC 256 with a grade of C or better and CMSC 302 with a grade of C or better. Introduction to algorithm analysis and complexity classes. Advanced data structures topics including multiple linked lists, height-balanced trees, B-trees, hashing and graph representation; incorporating data structures into object-oriented design. Analysis of various searching and sorting algorithms. Algorithm design topics include divide-and-conquer, dynamic programming and greedy methods.

### **Additional Required Courses**

UNIV 111. Focused Inquiry I. 3 Hours.

Semester course; 3 lecture hours (delivered online, face-to-face or hybrid). 3 credits. Utilizes contemporary themes to give students opportunities and practice in writing, critical thinking, oral presentation, collaborative learning, information retrieval and evaluation, and social and civic responsibilities. Incorporates common reading materials and course activities across all sections.

UNIV 112. Focused Inquiry II. 3 Hours.

Semester course; 3 lecture hours (delivered online, face-to-face or hybrid). 3 credits. Prerequisite: UNIV 111 or equivalent. Builds on skills introduced in UNIV 111 by providing practice in expository essays, argument and contextual analysis. Focuses on practice in writing in a variety of genres, framing writing according to both purpose and audience and identifying academically valid sources. Students must earn a minimum grade of C to receive credit for this course.

UNIV 200. Inquiry and the Craft of Argument. 3 Hours.

Semester course; 3 lecture hours (delivered online, face-to-face or hybrid). 3 credits. Prerequisite: UNIV 112 or HONR 250 with a minimum grade of C. A research and writing process course that emphasizes critical analysis, elements of argument, inquiry-based research skills, writing conventions of academic argument and the presentation of argument and research into new mediums. Students must earn a minimum grade of C to receive credit for this course.

MATH 151. Precalculus Mathematics. 4 Hours.

Semester course; 3 lecture and 1 mathematics laboratory/recitation hours. 4 credits. Prerequisite: MATH 139 or MATH 141 with a minimum grade of C, or satisfactory score on the VCU Mathematics Placement Test within the one-year period immediately preceding the beginning of the course. An exception to this policy is made in the case where the stated alternative prerequisite course has been completed at VCU. Concepts and applications of algebra and trigonometry. Topics include graphics, transformations and inverses of functions; linear, exponential, logarithmic, power, polynomial, rational and trigonometric functions.

MATH 211. Mathematical Structures. 3 Hours.

Semester course; 3 lecture hours. 3 credits. Prerequisite: MATH 151, MATH 200, MATH 201 or BUSN 212\* with a minimum grade of C, or calculus-level placement on the VCU Mathematics Placement Test within the one-year period immediately preceding enrollment in the course. An alternative prerequisite course may be approved at the discretion of the academic adviser. An introduction to mathematical logic and set theory, including applications in Boolean algebras and graph theory. \*Previously MGMT 212, SCMA 212.

MATH 310. Linear Algebra. 3 Hours.

Semester course; 3 lecture hours. 3 credits. Prerequisite: MATH 201 with a minimum grade of C. Systems of linear equations, vector spaces, linear dependence, bases, dimensions, linear mappings, matrices, determinants, quadratic forms, orthogonal reduction to diagonal form, eigenvalues and geometric applications.

STAT 212. Concepts of Statistics. 3 Hours.

Semester course; 3 lecture hours. 3 credits. Prerequisite: satisfactory score on the VCU Mathematics Placement Test within the one-year period immediately preceding the beginning of the course, or MATH 151, MATH 200 or MATH 201. Introductory statistics course with an emphasis on descriptive statistics, correlation and regression, probability, normal distributions, t distributions, and statistical inference. Graphing calculators will be used extensively. A core course for mathematical sciences. Students may receive credit toward graduation for only one of STAT 206, STAT 208, STAT 210, STAT 212, STAT 312 or SCMA 301.

### **Restricted Elective Courses or Elective Courses**

CMSC 257. Computer Systems. 4 Hours.

Semester course; 3 lecture and 2 laboratory hours. 4 credits. Prerequisite: CMSC 256 with a minimum grade of C. Topics include UNIX essentials; system programming in C; machine-level representation and organization of programs/data, arrays and pointers; types, structs and unions; strings; bit/byte operations; memory management; shell programming; input/output, including file handling; debugging; signals; network programming using sockets; program concurrency using forks and threads; experiments on program performance and optimization techniques.

CMSC 303. Introduction to the Theory of Computation. 3 Hours.

Semester course; 3 lecture hours. 3 credits. Prerequisite: CMSC 302 or the equivalent with a grade of C or better. Complexity classes, grammars, automata, formal languages, Turing machines, computability.

CMSC 304. Programming Languages. 3 Hours.\*

Semester course; 3 lecture hours. 3 credits. Prerequisites: CMSC 256 and CMSC 303, both with a minimum grade of C. Survey of representative modern programming languages. Formal definition of programming languages including specifications of syntax and semantics. Precedence, infix, prefix and postfix notation. Global properties of algorithmic languages. Sub-routines, co-routines and tasks. List processing, string manipulation, data description and simulation languages. Run-time representation of program and data structures.

Note: Was CMSC 403

CMSC 312. Introduction to Operating Systems. 3 Hours.

Semester course; 3 lecture hours. 3 credits. Prerequisite: CMSC 311 or EGRE 364. Computer systems design, I/O processing, secondary memory organization, command languages, memory management and job scheduling. Students will work in teams to design and implement an operating system simulation.

CMSC 404. Compiler Construction. 3 Hours.

Semester course; 3 lecture hours. 3 credits. Prerequisites: CMSC 401 and 403. A first course in compiler theory and construction. Formal description of languages, underlying theory and design techniques for compilers, lexical analysis, syntax analysis, syntax-directed translation, intermediate languages, run-time system management, code generation, code optimization, compiler-building tools.

CMSC 408. Databases. 3 Hours.\*

Semester course; 3 lecture hours. 3 credits. Prerequisite: CMSC 303 with a minimum grade of C. Introduction to databases. Database design and the entity-relationship model. Relational database design, normalization and decomposition. Relational algebra. SQL. Data definition language. Data manipulation language. Data query language. Queries, subqueries, functions, procedures, cursors, views, triggers, indexes and transactions. Security, performance, and scalability of databases. Database installation, configuration and administration. MySQL and the web.

Note: Was CMSC 508

CMSC 410. Introduction to Quantum Computing. 3 Hours.

Semester course; 3 lecture hours. 3 credits. Prerequisites: CMSC 401 and MATH 310, both with a minimum grade of B. Introduction to quantum information processing: state vectors and density operators, tensor product space, unitary evolution, no-go theorems, measurement, qubit, gate model of quantum computing, quantum complexity theory, quantum error correction, quantum algorithms, and quantum machine learning.

CMSC 411. Computer Graphics. 3 Hours.

Semester course; 3 lecture hours. 3 credits. Prerequisites: CMSC 355 and MATH 310. Presents mathematical techniques for graphic development and transformation, curve and surface approximation and projections, graphical languages and data structures and their implementation, graphic modeling.

CMSC 412. Social Network Analysis and Cybersecurity Risks. 3 Hours.

Semester course; 3 lecture hours. 3 credits. Prerequisites: CMSC 401 with a minimum grade of C. Covers network models, link prediction and analysis, centrality measures, random networks, power-laws and preferential attachment, small world phenomenon and decentralized search, community structure, information propagation in networks, and security and privacy issues in OSNs.

CMSC 413. Introduction to Cybersecurity. 3 Hours.

Semester course; 3 lecture hours. 3 credits. Prerequisite: CMSC 401 with a minimum grade of C. This course provides introduction and basic concepts of computer security, cyber attacks, cyber defense, cyber forensics and cyber ethics.

CMSC 414. Computer and Network Security. 3 Hours.

Semester course; 3 lecture hours. 3 credits. Prerequisite: CMSC 401 with a minimum grade of C. Corequisite: CMSC 312. This course covers the best practices of computer systems and network security. Key topics include security architecture, cryptographic systems and security management tools.

CMSC 415. Introduction to Cryptography. 3 Hours.

Semester course; 3 lecture hours. 3 credits. Prerequisite: CMSC 401 with a minimum grade of C. This course provides a rigorous and theoretical introduction to modern cryptography. Key topics include symmetric key encryption and authentication, public key encryption, and digital signatures.

CMSC 420. Software Project Management. 3 Hours.

Semester course; 3 lecture hours. 3 credits. Prerequisite: CMSC 355 with a minimum grade of C. Study of the logistics of team software development. Students work in teams to gain experience in software management and develop the components of a larger software product. Topics include risk management, project planning, quality management, configuration management and software testing.

CMSC 425. Introduction to Software Analysis and Testing. 3 Hours.

Semester course; 3 lecture hours. 3 credits. Prerequisite: CMSC 355 with a minimum grade of C. Enrollment is restricted to majors in the computer science program. A practical introduction to testing complex software applications. An introduction to concepts and techniques used in the analysis of software, including basic and advanced control flow and data flow analyses. Using analytic results to derive test data and validate the correct implementation of programs. Advanced testing strategies including random, structural, mutation and fuzzing.

CMSC 426. Software as a Service. 3 Hours.\*

Semester course; 3 lecture hours. 3 credits. Prerequisite: CMSC 355 with a minimum grade of C. Enrollment is restricted to majors in the computer science program. Students will examine the challenges, opportunities and open problems of software-as-a-service deployed on commodity cloud computing platforms. Covers relevant software architectures and API design principles. Includes concepts of modern software frameworks for software development, cloud computing for software deployment and software operations. Students participate in projects that use modern tooling to develop, deploy and monitor a software application.

Note: Was CMSC 455

CMSC 427. Design and Implementation of User Interfaces. 3 Hours.\*

Semester course; 3 lecture hours. 3 credits. Prerequisite: CMSC 355 with a minimum grade of C. Enrollment is restricted to majors in the computer science program. This course investigates the design and implementation of user interfaces and the evaluation of user experiences. Particular emphasis is placed on creating professional-quality designs and implementations and on

evaluating these implementations with end-users. Students will create their own UIs as well as critique others to develop a deep understanding of what works in practice.

Note: Was CMSC 475

CMSC 428. Mobile Programming: iOS. 3 Hours.

Semester course; 3 lecture hours. 3 credits. Prerequisite: CMSC 355, with a minimum grade of C. This course covers the fundamentals of Swift, Xcode and iOS for programming and design of iOS applications. Background in object-oriented programming and access to a computer with Xcode platform is required.

CMSC 435. Introduction to Data Science. 3 Hours.

Semester course; 3 lecture hours. 3 credits. Prerequisite: CMSC 401 with a minimum grade of C. This course covers understanding, representation, storage, retrieval, preprocessing and analysis of data. Specific topics include data quality and preprocessing, database management systems, data warehouses, selected methods for scalable unsupervised and supervised data analysis, and assessment of results generated by these methods. Students will be engaged in analysis of real-life data from data preprocessing, through data analysis, to the assessment of a knowledge product.

CMSC 436. Artificial Intelligence. 3 Hours.\*

Semester course; 3 lecture hours. 3 credits. Prerequisites: CMSC 401 with a minimum grade of C and MATH 310. Covers problem spaces, problem-solving methods, game playing, knowledge representatives, expert systems, natural language understanding.

Note: Was CMSC 409

CMSC 437. Introduction to Natural Language Processing. 3 Hours.\*

Semester course; 3 lecture hours. 3 credits. Prerequisite: CMSC 401 with a minimum grade of C. Covers rule-based and statistical methods for creating computer programs that analyze, generate and understand human language. Topics include regular expressions and automata, context-free grammars, probabilistic classifiers, and machine learning. Word-level, syntactic and semantic processing are all considered. Application to real-world problems such as spell-checking, Web search, automatic question answering, authorship identification and developing conversational interfaces.

Note: Was CMSC 416

CMSC 438. Machine Learning. 3 Hours.\*

3 Lecture hours. 3 credits. Prerequisites: CMSC 257 and MATH 310 with a grade of C or better. The course will assume undergraduate-level background in algorithms, linear algebra, calculus, statistics and probability. Upon successful completion of this course, the student will be able to understand basic concepts and techniques in machine learning. Topics covered will include: probabilistic and optimization-based view of machine learning, linear models, deep nonlinear models, deep networks for specific domains such as large language models and generative models for images.

CMSC 440. Data Communication and Networking. 3 Hours.

Semester course; 3 lecture hours. 3 credits. Prerequisite: CMSC 257 with a minimum grade of C. Enrollment is restricted to majors in the College of Engineering. This course explores computer networking, focusing on the applications and protocols that run on the Internet. Students will take a top-down approach to the layered network architecture, studying applications first and then proceeding down the network “stack” toward the physical link. Students will examine the operation of applications such as the web, FTP, e-mail and DNS. At the transport layer, students will study both connectionless UDP and connection-oriented TCP, with an in-depth study of TCP operation, specifically flow control and congestion control. Data communications are explored through various data routing protocols. Additional topics include network security and wireless/mobile networking.



## Appendix C – Abbreviated Curriculum Vitae of Faculty

### Abbreviated CVs for Core Faculty

Irfan Ahmed, Ph.D. in Computer Science, 2010, Ajou University, South Korea, Assistant Professor, Area of expertise: Cyber-physical systems security, Industrial Control System (ICS) Security, Cybersecurity Education, System Security, Digital Forensics, Malware Detection and Analysis.

Tomasz Arodz, Ph.D. in Computer Science, 2007, AGH University of Science and Technology, Associate Professor, Area of expertise: Data Science and Bioinformatics.

Caroline Budwell, Ph.D. in Computer Science, 2008, Nova Southeastern University, Associate Professor, Area of expertise: Learning and Engagement Strategies.

Eyuphan Bulut, Ph.D. in Computer Science, 2011, Rensselaer Polytechnic Institute, Associate Professor, Area of expertise: Wireless Networks and Mobile Computing.

Alberto Cano, Ph.D. in Computer Science, 2014, University of Granada, Assistant Professor, Area of expertise: Machine Learning, Data Mining, High Performance Computing.

Vijender Chaitankar, Ph.D. in Engineering (Computer Science), 2012, Virginia Commonwealth University, Adjunct Professor.

Daniel Cranston, Ph.D. in Computer Science, 2007, University of Illinois at Urbana-Champaign, Associate Professor, Area of expertise: Graph Coloring.

Kostadin Damevski, Ph.D. in Computer Science, 2007, University of Utah, Assistant Professor, Area of expertise: Software Engineering, Recommendation Systems.

Debra Duke, M.S. in Computer Science, 2006, Virginia Commonwealth University, Professor of the Practice, Area of expertise: Learning and Engagement Strategies.

Preetam Ghosh, Ph.D. in Computer Science and Engineering, 2007, University of Texas at Arlington, Professor, Area of expertise: Modeling and Simulation, Systems Biology, Networks.

Ralph Grove, Ph.D. in Computer Science and Engineering, 1994, University of Louisville, Adjunct Professor.

Luke Gusukuma, Ph.D. in Computer Science, 2020, Virginia Tech, Associate Professor, Area of expertise: Technology Innovation in the Teaching of Computer Science.

Lukasz Kurgan, Ph.D. in Computer Science, 2003, University of Colorado at Boulder, Professor, Area of expertise: Bioinformatics and Data Science.

John D. Leonard II, Ph.D. in Traffic and Transportation Engineering, 1991, University of California, Irvine, Professor, Area of expertise: Traffic Flow Theory, and Computer Modeling and Simulation

Changqing Luo, Ph.D, in Computer Engineering, 2018, Case Western Reserve University, Assistant Professor, Area of expertise: Security and Privacy, Complex Networks.

Milos Manic, Ph.D. in Computer Science, 2003, University of Idaho, Professor, Area of expertise: Computational Intelligence

Bridget McInnes, Ph.D. in Computer Science, 2009, University of Minnesota, Assistant Professor, Area of expertise: Natural Language Processing

Tamer Nadeem, Ph.D. in Computer Science, 2006, University of Maryland, Associate Professor, Area of expertise: Wireless Networking, Mobile & Edge Computing, Network Security and Privacy, and Internet-of-things & Smart City Systems

Manziba Akanda Nishi, Ph.D. in Computer Science, 2019, Virginia Commonwealth University, Adjunct Professor.

Allison Sands, M.S. in Computer Science, 2015, Virginia Commonwealth University, Adjunct Professor.

Ahmet Sonmez, Ph.D. in Computer Science, 2012, University of Houston, Associate Professor, Area of expertise: Cybersecurity and computer systems.

Claire Sparks, M.S. in Computer Science, 2017, Christopher Newport University, Instructor, Area of expertise: High quality instruction for undergraduate students.

Rodrigo Spinola, Ph.D. in Systems Engineering and Computer Science, 2010, Federal University of Rio de Janeiro, Associate Professor, Area of expertise: Software Engineering, Empirical Software Engineering, and Technical Debt in Software Projects.

Adam Traub, M.S. in Computer Science, 2020, Virginia Commonwealth University, Adjunct Professor.

Hong-Sheng Zhou, Ph.D. in Computer Science, 2010, University of Connecticut, Associate Professor, Area of expertise: Cryptography.

#### Abbreviated CVs for Additional Required Courses Faculty

Moa Apagodu, Ph.D. in Mathematics, 2006, Rutgers University, Associate Professor of Mathematics, Area of Expertise: Computer Algebra, Algorithmic Proof Theory, Combinatorics, and Number Theory.

Aimee Ellington, PhD Mathematics Education, 2000, University of Tennessee-Knoxville, Professor, Area of Expertise: Active learning in general education mathematics courses and K-8 mathematics teacher leadership.

Joseph Flenner, Ph.D. in Mathematics, 2008, University of California, Berkeley, Teaching Assistant Professor, Area of expertise: Logic.

Punit Gandhi, Ph.D. in Physics, 2016, University of California, Berkeley, Assistant Professor, Area of expertise: Applied Dynamical Systems and Bifurcation Theory.

Rebecca Durfee, MS in Mathematical Sciences, 2006, Virginia Commonwealth University, Teaching Assistant Professor of Statistics. Specialization Area: Statistics Education.

**Appendix D – Employment Demand  
Job Announcements**

## **Appendix E – Student Demand Survey**

## VCU Bachelor of Arts in Computer Science Student Demand Survey

Virginia Commonwealth University is developing a Bachelor of Arts degree in Computer Science for implementation in Fall of 2024. This program offers students the flexibility to major in Computer Science while pursuing other interests. The Bachelor of Arts in Computer Science curriculum is a total of 120 credit hours and includes 39 credit hours in the major instead of the 57 hours in the major as the Bachelor of Science requires. It would provide students with about 40 open electives within their course of study. Graduates of this degree will be able to analyze, plan, design, and build software solutions to meet stakeholder needs in a variety of IT related industries. After completing this program, students should be able to:

- Analyze a complex computing problem and apply principles of computing and other relevant disciplines to identify solutions
- Design, implement, and evaluate a computing-based solution to meet a given set of computing requirements in the context of the program's discipline
- Communicate effectively in a variety of professional contexts
- Recognize professional responsibilities and make informed judgments in computing practice based on legal and ethical principles
- Function effectively as a member or leader of a team engaged in activities appropriate to the program's discipline
- Apply computer science theory and software development fundamentals to produce computing-based solutions

We have prepared the survey below to gauge student interest in the program. Your answers to the following questions will be used in summary form only. No personally identifiable information will be released. Please feel free to contact us at [ccbudwell@vcu.edu](mailto:ccbudwell@vcu.edu) if you would like more information about the proposed program.

We greatly appreciate your participation!

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\* Indicates required question

1. If VCU offered this Bachelor of Arts in CS program, I would enroll. \*

Mark only one oval.

Strongly Disagree

1

2

3

4

5

Strongly Agree

2. I am interested in pursuing a degree in Computer Science. \*

Mark only one oval.

Strongly Disagree

1

2

3

4

5

Strongly Agree

3. If you are interested in this Bachelor of Arts Program, please let us know what makes it attractive to you.

Check all that apply.

- Flexibility
- Ability to get a double major
- Ability to pursue interests in other subject areas
- Ability to easily minor in other subject areas
- Ability to broaden my skill sets and job prospects
- Provides a more manageable way to attain my career goals
- Provides me the ability to personalize my degree program
- Other



4. If you listed "Other" above, please elaborate.

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5. In addition to face to face, this program should be offered fully online. \*

*Mark only one oval.*

Strongly Disagree

1

2

3

4

5

Strongly Agree

6. There should be a hybrid degree program, where some courses are online and some are face to face. \*

Mark only one oval.

Strongly Disagree

1

2

3

4

5

Strongly Agree

7. I would likely enroll in this degree program during the following academic school year: \*

Mark only one oval.

2024 - 2025

2025 - 2026

2026 - 2027

2027 - 2028

2028 - 2029

8. I am currently attending: \*

*Mark only one oval.*

- High School
- Community College
- VCU

9. IF COMMUNITY COLLEGE: I would likely apply to this program after completing courses at Community College.

*Mark only one oval.*

Strongly Disagree

1

2

3

4

5

Strongly Agree

10. My anticipated high school graduation year is:

*Mark only one oval.*

- 2024
- 2025
- After 2026

11. I was born in the year: \*

---

12. I am (choose one): \*

*Mark only one oval.*

- Female
- Male
- Transgender
- Other

13. My race or ethnicity is (choose one): \*

*Mark only one oval.*

- American Indian / Alaskan Native
- Asian
- Black / African American
- White / European American
- Native Hawaiian / Pacific Islander
- Two or more
- Unknown
- Prefer not to answer

14. My U.S. Citizen status is: \*

*Mark only one oval.*

- U.S. Citizen
- Naturalized U.S. Citizen
- Citizen of another nation
- Dual Citizenship
- I'd rather not say

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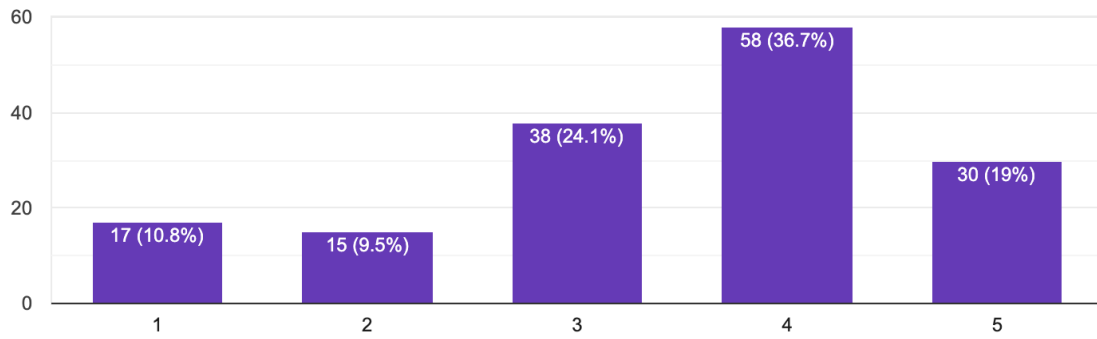
This content is neither created nor endorsed by Google.

Google Forms

If VCU offered this Bachelor of Arts in CS program, I would enroll.

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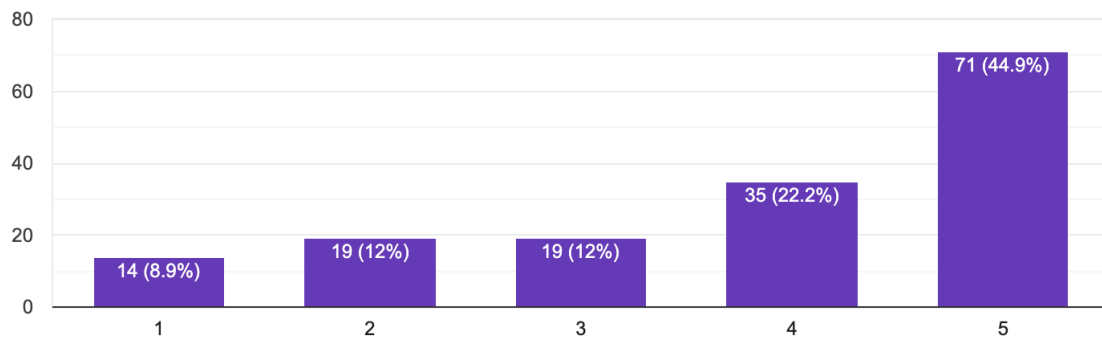
158 responses



I am interested in pursuing a degree in Computer Science.

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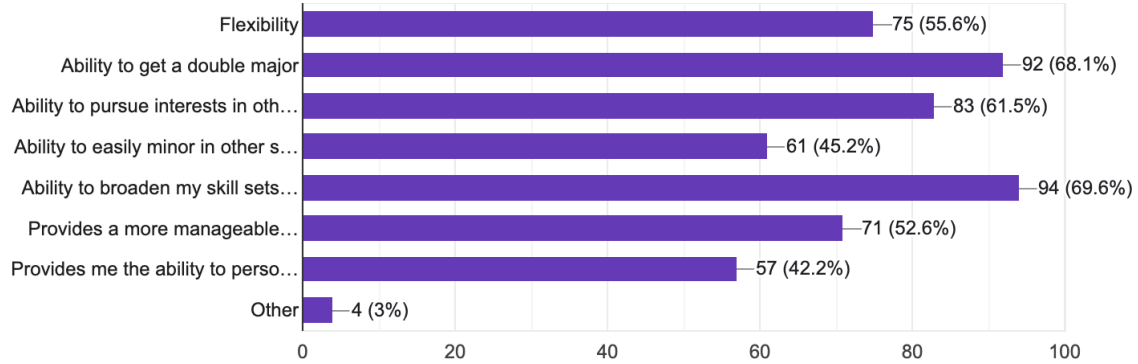
158 responses



If you are interested in this Bachelor of Arts Program, please let us know what makes it attractive to you.

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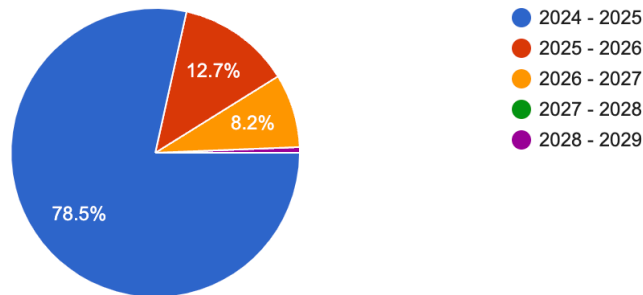
135 responses



I would likely enroll in this degree program during the following academic school year:

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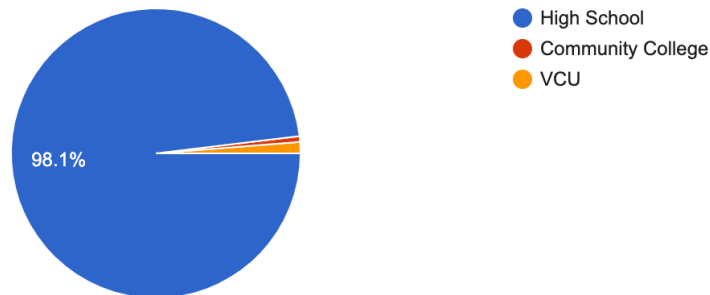
158 responses



I am currently attending:

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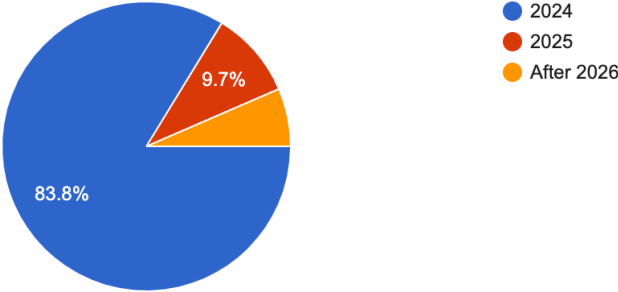
158 responses



My anticipated high school graduation year is:

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154 responses





# Copy of Computer Science Minors and Undeclared Pre-engineering Students Survey

8/10/23, 3:20 PM

VCU Bachelor of Arts in Computer Science Student Demand Survey

## VCU Bachelor of Arts in Computer Science Student Demand Survey

Virginia Commonwealth University is developing a Bachelor of Arts degree in Computer Science for implementation in Fall of 2024. This program offers students the flexibility to major in Computer Science while pursuing other interests. The Bachelor of Arts in Computer Science curriculum is a total of 120 credit hours and includes 39 credit hours in the major instead of the 57 hours in the major as the Bachelor of Science requires. It would provide students with about 40 open electives within their course of study. Graduates of this degree will be able to analyze, plan, design, and build software solutions to meet stakeholder needs in a variety of IT related industries. After completing this program, students should be able to:

- Analyze a complex computing problem and apply principles of computing and other relevant disciplines to identify solutions
- Design, implement, and evaluate a computing-based solution to meet a given set of computing requirements in the context of the program's discipline
- Communicate effectively in a variety of professional contexts
- Recognize professional responsibilities and make informed judgments in computing practice based on legal and ethical principles
- Function effectively as a member or leader of a team engaged in activities appropriate to the program's discipline
- Apply computer science theory and software development fundamentals to produce computing-based solutions

We have prepared the survey below to gauge student interest in the program. Your answers to the following questions will be used in summary form only. No personally identifiable information will be released. Please feel free to contact us at [codbudwell@vcu.edu](mailto:cdbudwell@vcu.edu) if you would like more information about the proposed program.

We greatly appreciate your participation!

\* Indicates required question

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1. Email \*

---

2. If VCU offered this Bachelor of Arts in CS program, I would enroll. \*

Mark only one oval.

Strongly Disagree

1

2

3

4

5

Strongly Agree

3. I am interested in pursuing a degree in Computer Science. \*

Mark only one oval.

Strongly Disagree

1

2

3

4

5

Strongly Agree

4. If you are interested in this Bachelor of Arts Program, please let us know what makes it attractive to you.

Check all that apply.

- Flexibility
- Ability to get a double major
- Ability to pursue interests in other subject areas
- Ability to easily minor in other subject areas
- Ability to broaden my skill sets and job prospects
- Provides a more manageable way to attain my career goals
- Provides me the ability to personalize my degree program
- Other

5. If you listed "Other" above, please elaborate.

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6. In addition to face to face, this program should be offered fully online. \*

*Mark only one oval.*

Strongly Disagree

1

2

3

4

5

Strongly Agree

7. There should be a hybrid degree program, where some courses are online and some are face to face. \*

Mark only one oval.

Strongly Disagree

1

2

3

4

5

Strongly Agree

8. I would likely enroll in this degree program during the following academic school year: \*

Mark only one oval.

2024 - 2025

2025 - 2026

2026 - 2027

2027 - 2028

2028 - 2029

9. I am currently attending: \*

*Mark only one oval.*

- High School
- Community College
- VCU

10. My anticipated college graduation year is:

*Mark only one oval.*

- 2024
- 2025
- 2026
- 2027
- 2028
- After 2028

11. My current year in school is:

*Mark only one oval.*

- Incoming Freshman
- Freshman
- Sophomore
- Junior
- Senior
- Other: \_\_\_\_\_

12. I am (choose one): \*

*Mark only one oval.*

- Female
- Male
- Transgender
- Other

13. My race or ethnicity is (choose one): \*

*Mark only one oval.*

- American Indian / Alaskan Native
- Asian
- Black / African American
- White / European American
- Native Hawaiian / Pacific Islander
- Two or more
- Unknown
- Prefer not to answer

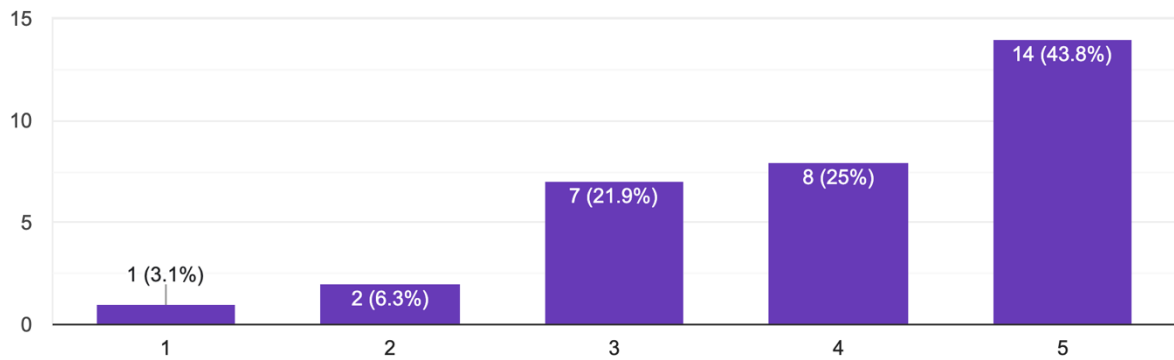
14. My U.S. Citizen status is: \*

*Mark only one oval.*

- U.S. Citizen
- Naturalized U.S. Citizen
- Citizen of another nation
- Dual Citizenship
- I'd rather not say

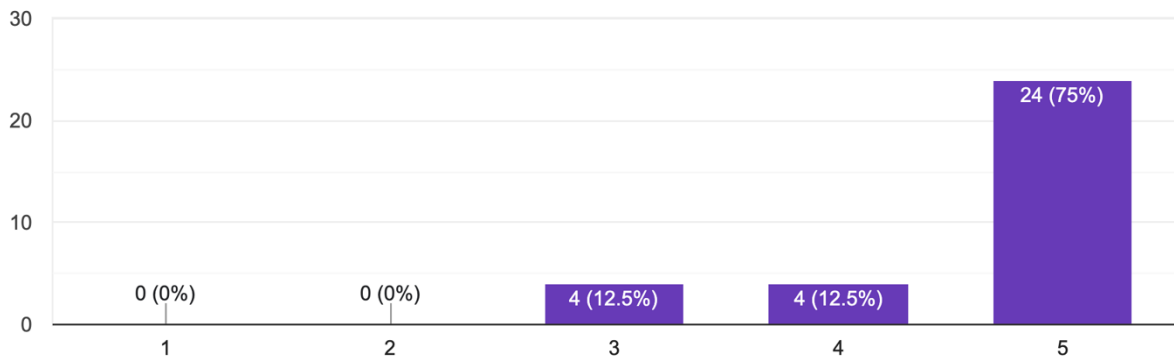
If VCU offered this Bachelor of Arts in CS program, I would enroll.

32 responses



I am interested in pursuing a degree in Computer Science.

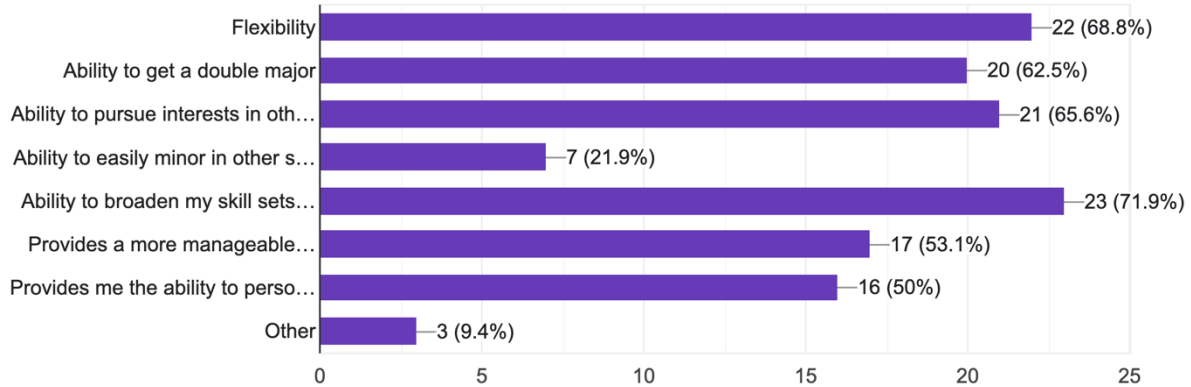
32 responses





If you are interested in this Bachelor of Arts Program, please let us know what makes it attractive to you.

32 responses



If you listed "Other" above, please elaborate.

3 responses

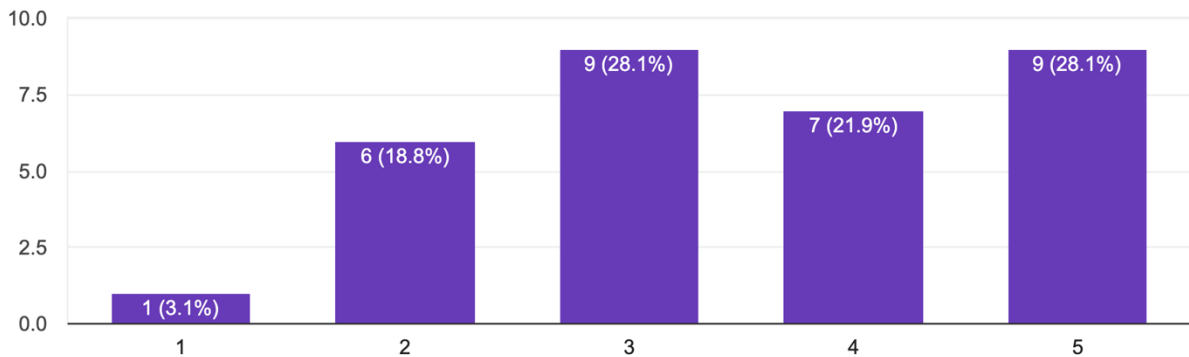
It could provide a pathway not available to me at the moment.

Connection of computer science and arts

It is pretty much flexibility, but I am curious if the same standards apply for transferring into the major. Do I still need a GPA of 3.0 or higher to enter the program?

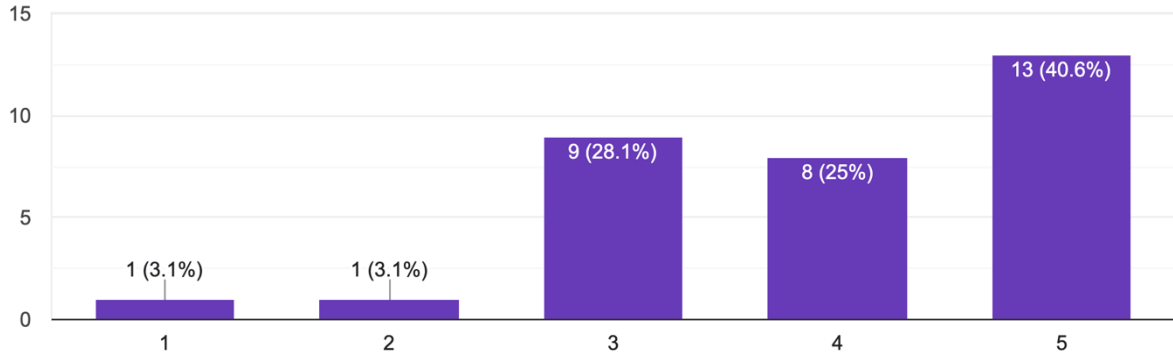
In addition to face to face, this program should be offered fully online.

32 responses



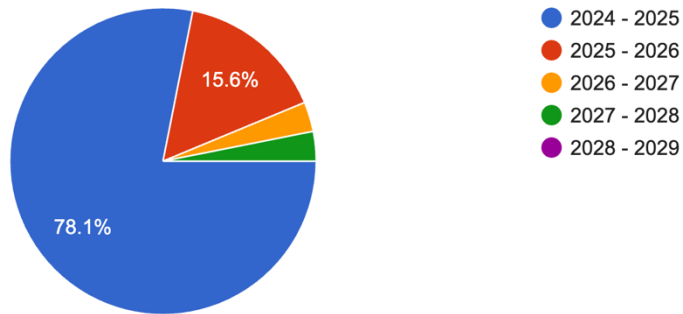
There should be a hybrid degree program, where some courses are online and some are face to face.

32 responses



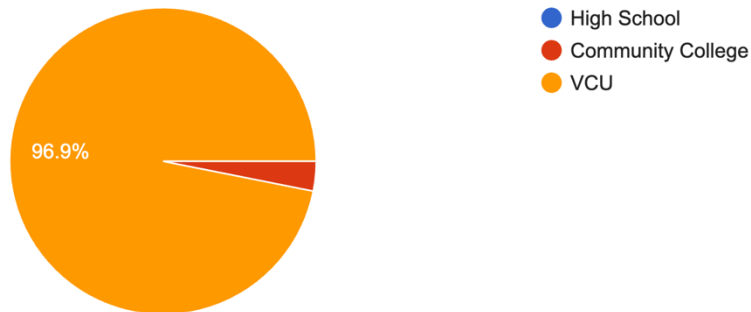
I would likely enroll in this degree program during the following academic school year:

32 responses

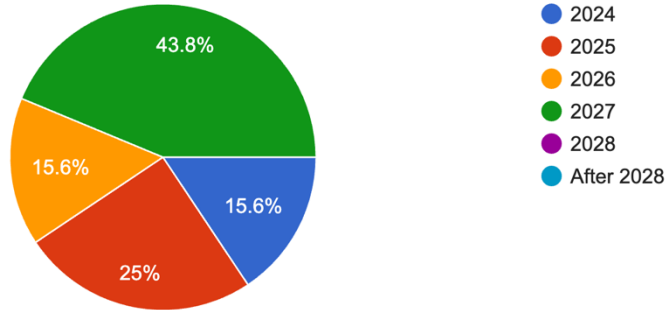


I am currently attending:

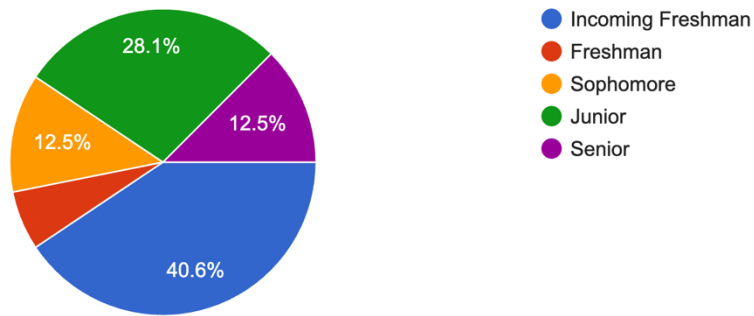
32 responses



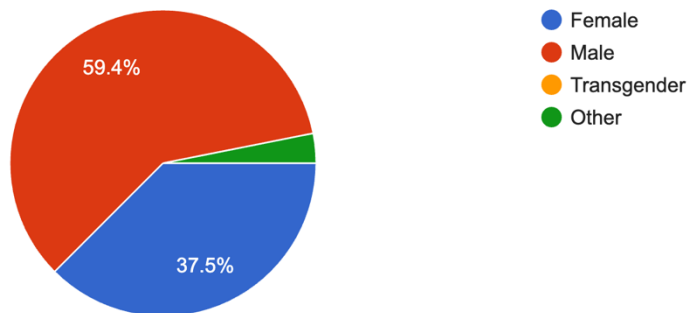
My anticipated college graduation year is:  
32 responses



My current year in school is:  
32 responses

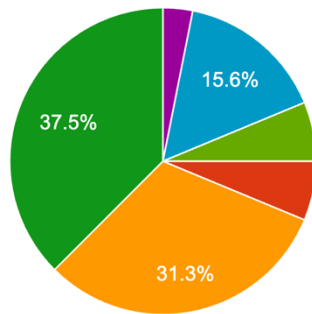


I am (choose one):  
32 responses



My race or ethnicity is (choose one):

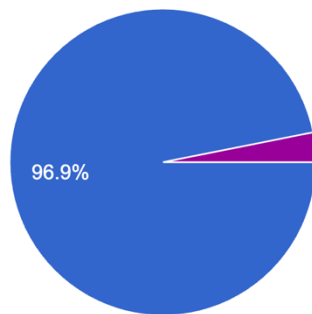
32 responses



- American Indian / Alaskan Native
- Asian
- Black / African American
- White / European American
- Native Hawaiian / Pacific Islander
- Two or more
- Unknown
- Prefer not to answer

My U.S. Citizen status is:

32 responses



- U.S. Citizen
- Naturalized U.S. Citizen
- Citizen of another nation
- Dual Citizenship
- I'd rather not say

## **Appendix F – Cited Documents**

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## Description of the Proposed Program

### **Program Background**

Virginia Commonwealth University (VCU) seeks approval for a Bachelor of Science (B.S.) degree program in Supply Chain Management (SCM) at the Monroe Park campus in Richmond, Virginia. The proposed program will be administered by the Department of Supply Chain Management and Analytics, which resides in VCU's the School of Business. The target date of the program's initiation is the fall semester of 2024.

The purpose of the proposed program is to equip students with the necessary skills to assume roles as supply chain managers within both public and private sector organizations. Through this program, students will gain a comprehensive understanding of the managerial principles and quantitative methods necessary for improving the efficiency and responsiveness of an organization's supply chain. By offering a combination of theoretical knowledge and practical skills, the proposed program will enable students to implement these principles and methods. Students will learn to effectively analyze information and data in order to address the complex challenges presented by modern, global supply chains. Through experiential learning opportunities, students will be exposed to techniques that support sound decision making in areas such as sourcing, logistics and distribution, sustainability, process management, quality management, forecasting, and inventory management. Students of the proposed program will gain an ability to work across diverse populations, navigate cultural differences, and incorporate people from different socioeconomic backgrounds in their roles as supply chain managers. Upon completing the program, graduates will be well-prepared for a wide range of supply chain vocations, including procurement, logistics and distribution planning, sustainability, vendor management, and quality management.

The proposed degree program responds to current needs in Virginia and the nation. Technological progress has led to broad globalization for manufacturing and service operations, linking local and national economies through complex global networks of organizations. Consequently, the significance of proficient supply chain management has steadily increased, assuming a critical role in maintaining both local and national economic stability. The COVID-19 pandemic, for instance, exposed the vulnerabilities and risks inherent in supply chains, manifesting as critical shortages and destabilizing imbalances between supply and demand, affecting even life-sustaining items such as food<sup>1</sup> and medications<sup>2</sup>. Supply chain-related problems have also been a major contributor to contemporary inflationary pressures<sup>3</sup>, national security concerns<sup>4</sup>, and the country's economic prosperity<sup>5</sup>. The need to address these challenges

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<sup>1</sup> Kakaei, H., Nourmoradi, H., Bakhtiyari, S., Jalilian, M., & Mirzaei, A. (2022). Effect of covid-19 on food security, hunger, and food crisis. Retrieved from <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9335023/>

<sup>2</sup> <https://www.whitehouse.gov/cea/written-materials/2021/06/17/why-the-pandemic-has-disrupted-supply-chains/>. Last Updated 17 Jun 21. Accessed 21 Aug 23.

<sup>3</sup> Source: <https://www.usbank.com/investing/financial-perspectives/market-news/supply-chain-issues-contribution-to-inflation.html>. Last Updated 27 Jun 23. Accessed 25 Jul 23.

<sup>4</sup> <https://www.rubio.senate.gov/public/index.cfm/2020/3/rubio-colleagues-introduce-the-strengthening-america-s-supply-chain-and-national-security-act>. Last Updated 19 Mar 20. Accessed 25 Jul 23.

<sup>5</sup> <https://www.whitehouse.gov/briefing-room/statements-releases/2022/02/24/the-biden-harris-plan-to-revitalize-american-manufacturing-and-secure-critical-supply-chains-in-2022/>. Last Updated 24 Feb 22. Accessed 25 Jul 23.

has led to strong demand for professionals with supply chain management skills, from both prospective students and employers. This demand is expected to escalate into the foreseeable future, evidenced by strong job growth projections presented by the Virginia Works<sup>6</sup> and the Bureau of Labor Statistics<sup>7</sup>, as well as industry reports.<sup>8,9</sup>

The proposed degree program addresses a “talent crisis,” marked by a shortage of qualified supply chain professionals<sup>10</sup> that adversely impacts local and national economies. Graduates of the proposed program will acquire the skills needed to manage supply chain risks and disruptions within a global context. The proposed program is designed to develop students’ proficiencies in acquiring, assembling, and analyzing complex datasets to improve an organization’s supply chain operations. Students of the proposed program will gain exposure to a variety of quantitative methodologies and analytics software used in practice. As a result, graduates of the proposed program will be equipped to satisfy contemporary needs for supply chain managers capable of leveraging the abundant data streams generated by supply chains<sup>11</sup>. Virginia Commonwealth University is fully committed to offering the proposed degree program to ensure an adequate supply of professionals who are prepared and trained to meet industry needs.

The proposed B.S. in Supply Chain Management stands to be unique within the Commonwealth of Virginia. Despite strong industry activity and demand for supply chain professionals within Virginia, no public university within the Commonwealth currently offers a B.S. degree in Supply Chain Management (CIP Code 52.0203: Logistics, Materials, and Supply Chain Management)<sup>12</sup>. Because the Commonwealth does not currently maintain a public, undergraduate program under this CIP code, residents seeking an SCM-focused degree may qualify for in-state tuition rates at out-of-state universities offering programs under this CIP code (e.g., the University of Tennessee), vis-à-vis the Commonwealth’s reciprocity agreements through the Southern Regional Education Board’s (SREB) Academic Common Market<sup>13</sup>. This, in turn, incentivizes some of Virginia’s most promising students to emigrate to neighboring states. By being the Commonwealth’s first public university to offer a B.S. in Supply Chain Management degree, VCU would not only position itself as a leader in supplying well-trained professionals prepared to meet industry needs both locally and nationally, but also fulfill the Commonwealth’s overarching objective of retaining its in-state talent.

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<sup>6</sup> <https://viriniaworks.com/Occupational-Projections>. Accessed 29 Aug 23.

<sup>7</sup> <https://www.bls.gov/emp/tables/occupational-projections-and-characteristics.htm>. Accessed 29 Aug 23.

<sup>8</sup> The Responsible Supply Chain: Transparency, Sustainability, and the Case for Business. 2023 MHI Annual Industry Report. MHI and Deloitte.

<sup>9</sup> <https://scmtalent.com/supply-chain-talent-shortage>. Last Updated 2 Mar 23. Accessed 29 Aug 23.

<sup>10</sup> Cottrill, K. 2010. Are you prepared for the supply chain talent crisis? MIT CTL White Paper. Fall 2010. MIT Center for Transportation and Logistics.

<sup>11</sup> The Responsible Supply Chain: Transparency, Sustainability, and the Case for Business. 2023 MHI Annual Industry Report. MHI and Deloitte.

<sup>12</sup> <https://nces.ed.gov/ipeds/cipcode/cipdetail.aspx?y=55&cipid=88873>. Accessed 29 Aug 23.

<sup>13</sup> <https://www.sreb.org/academic-common-market>. Accessed 29 Aug 23.



## **Institutional Mission**

This mission of Virginia Commonwealth University states<sup>14</sup>:

Virginia Commonwealth University and its academic health sciences center serve as one national urban public research institution dedicated to the success and well-being of our students, patients, faculty, staff and community through:

- Real-world learning that furthers civic engagement, inquiry, discovery and innovation
- Research that expands the boundaries of new knowledge and creative expression and promotes translational applications to improve the quality of human life
- Interdisciplinary collaborations and community partnerships that advance innovation, enhance cultural and economic vitality, and solve society's most complex challenges
- Health sciences that preserve and restore health for all people, seek the cause and cure of diseases through groundbreaking research and educate those who serve humanity
- Deeply engrained core values of diversity, inclusion and equity that provide a safe, trusting and supportive environment to explore, create, learn and serve

The proposed program aligns with the institution's mission. The curriculum emphasizes "real-world learning" where actual industry problems related to supply chain management are integrated throughout the coursework. Because supply chain management involves integrating the supply and demand sides of an organization, the proposed program will train students on effectively managing "interdisciplinary collaborations" with other fields such as marketing, finance, and operations management. The proposed program will emphasize the global nature of modern supply chains, teaching students how to incorporate the "diversity, inclusion and equity" of the many cultural, socioeconomic, and ethnic backgrounds found across the globe. Finally, the proposed program will train students on solutions to one of "society's most complex challenges": global supply chain management<sup>15</sup>.

The proposed B.S. in Supply Chain Management stands is included in the VCU 2028 Six-Year Plan.

## **Curriculum**

The proposed B.S. in Supply Chain Management will require a total of 120 credits. The curriculum will offer a single degree option and is designed to be fully on-campus (face-to-face). The focus of the curriculum is to provide students with foundations in the principles necessary to make operating decisions pertaining to an organization's supply chain as well as training on the quantitative methodologies commonly used to inform those decisions.

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<sup>14</sup> <http://bulletin.vcu.edu/about/mission-vision-core-values/>. Last Updated: 23 August 22. Accessed 21 Aug 23.

<sup>15</sup> Why the Pandemic Has Disrupted Supply Chains, The White House. <https://www.whitehouse.gov/cea/written-materials/2021/06/17/why-the-pandemic-has-disrupted-supply-chains/>. 17 Jun 21. Accessed 21 Aug 23.

The program's intent is to offer an integrated coursework that blends theoretical perspectives and quantitative modeling techniques with applied practical approaches in supply chain management. The core courses will provide students with foundational theories and managerial strategies in supply chain management, covering topics such as sourcing, operations management, and logistics. The core courses also introduce students to the fundamental methodologies and technologies utilized by professionals in the field. The electives will offer additional training on specialized topics, advanced quantitative methods, and emerging aspects of the field. The curriculum has been designed with input from industry professionals to ensure it meets the needs of companies seeking to hire individuals in the supply chain domain.

The recent global pandemic prompted a critical re-examination of supply chain functionality, revealing significant shortcomings resulting from a lack of understanding of the tradeoffs associated with supply chain strategies and their execution. The proposed program's curriculum is designed to address these shortcomings by structuring its framework around the fundamental principles of supply chain management, including core components such as risk management, sourcing, operations, and logistics. The curriculum focuses on the application of critical thinking and analytical techniques to address present and future supply chain problems. Specifically, it covers strategic-level decision-making, including considerations such as supply chain structure, outsourcing, network design. Concurrently, it addresses operational-level aspects, encompassing process analysis, capacity analysis, inventory modeling, network analysis. Additionally, the coursework exposes students to computational tools commonly employed by industry professionals, such as Excel, JMP, SimQuick, anyLogistix, and R. Finally, the curriculum equips students with the knowledge necessary to comprehend the influence of supply chains on sustainability initiatives, thereby establishing a foundation in understanding future problems faced on a global scale.

While not required, the curriculum is structured to prepare students for potential external certification. A mandatory component of this preparation is the certification as a Lean/Six Sigma White Belt professional, which all students will attain upon program completion. Students will have the opportunity to pursue additional certifications, including Lean/Six Sigma Yellow Belt, certification as a Certified Supply Chain Professional (CSCP) by the Association of Supply Chain Management, SCPro by the Council of Supply Chain Management Professionals, or Associate Professional in Supply Management (APSM) by the Institute for Supply Management<sup>16</sup>.

The curriculum will embed experiential learning throughout its entirety. Students will also be strongly encouraged to earn credit through internships and guided independent studies.

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<sup>16</sup> These certifications are operated externally and not affiliated with VCU.

## **Program Requirements**

### **General Education Requirements: 30 credits hours**

The General Education curriculum is a requirement for all VCU undergraduate students and therefore does not focus on those skills, techniques or procedures specific to a particular occupation or profession. The general education curriculum which follows consists of 30 credit hours divided into three sections: 1) foundations, 2) breadth of knowledge, and 3) areas of inquiry.

#### **Foundations (13 credits)**

UNIV 111. Focused Inquiry I (3 credits) – required by all VCU students

UNIV 112. Focused Inquiry II (3 credits) – required by all VCU students

UNIV 200. Inquiry and the Craft of the Argument (3 credits) – required by all VCU students

Quantitative Foundations (3-4 credits)

- All School of Business students are required to take BUSNL 212: Business Problem Solving and Analysis (4 credits)

#### **Breadth of Knowledge (9 credits)**

- All School of Business students are required to take ECON 210: Principles of Microeconomics (3 credits)

#### **Areas of Inquiry (8-9 credits)**

### **Core Coursework: 24 credits**

SCMA 302: Business Statistics II (3cr)

SCMA 303: Business Analytics (3cr)

SCMA 339: Quantitative Solutions for Supply Chain Management (3cr)

SCMA 350: Introduction to Project Management (3cr)

SCMA 386: Global Supply Chain Management (3cr)

SCMA 410: Logistics and Distribution Strategy (3cr)

SCMA 420: Strategic Sourcing (3cr)

SCMA 439: Process Management and Quality Control (3cr)

### **Restricted Electives: 6 credit hours**

Students must take 6 credits from the following:

ACCT 306 Cost Accounting (3 credits)

BUSN 400 Principles of Consulting *and* BUSN 401 International Consulting Practicum (6 credits)

FIRE 312 Financial Modeling (3 credits)

INFO 320 Business Intelligence and Data Mining (3 credits)

INFO 482 Introduction to Enterprise Resource Planning Systems (3 credits)

MGMT 319 Leadership (3 credits)

MGMT 405 Negotiation, Influence and Conflict Management (3 credits)

MKTG 325 Business-to-business Marketing (3 credits)

MKTG 335 Introduction to Personal Selling (3 credits)

MKTG 340 Retail Management (3 credits)

MKTG 350 Customer and Marketing Analytics (3 credits)

MKTG 435 Selling in the Business Marketplace (3 credits)

MKTG 450 Product Development and Management (3 credits)

SCMA 430 Data Management and Visualization (3 credits)  
SCMA 440 Data Mining and Forecasting (3 credits)  
SCMA 491 Topics in Supply Chain Management and Analytics (1-3 credits)  
SCMA 492 Independent Study in Supply Chain Management and Analytics (1-3 credits)  
SCMA 493 Internship in Supply Chain Management and Analytics (3 credits)

**School of Business Shared Undergraduate Curriculum (43 credits)**

This shared undergraduate curriculum is a requirement for all School of Business students and not specific to any particular major. It consists of:

ACCT 203: Introduction to Accounting I (3 credits)  
ACCT 204: Introduction to Accounting II (3 credits)  
BUSN 201: Foundations of Business  
*Or* BUSN 205: Introduction to World of Business (3 credits)  
BUSN 225: Winning Presentations (3 credits)  
BUSN 301: Career & Professional Development (1 credit)  
BUSN 323: Legal Environment for Business  
*Or* FIRE 325: Real Estate Law  
*Or* FIRE 459: Insurance Law (3 credits)  
BUSN 499: Business Knowledge Exam (0 credit)  
ECON 211: Principles of Microeconomics/Macroeconomics (3 credits)  
FIRE 311: Financial Management (3 credits)  
INFO 360: Business Information Systems (3 credits)  
MGMT 303: Creativity and Ideation (3 credits)  
MGMT 310: Managing People in Organizations (3 credits)  
MGMT 434: Strategic Management (Capstone) (3 credits)  
MKTG 301: Marketing Principles (3 credits)  
SCMA 301: Business Statistics I (3 credits)  
SCMA 320: Production/Operations Management (3 credits)

**Open Electives: 17 credits**

**Total: 120 credit hours**

See Appendix A for a sample plan of study.  
See Appendix B for course descriptions.

**Faculty Resources**

The Supply Chain Management and Analytics (SCMA) department has 10 full-time faculty, six tenured and four non-tenure (term) faculty, that will teach coursework throughout the proposed program. The faculty members teaching courses in the degree program have over 100 years of combined teaching experience in a university setting.

Collectively, faculty that will teach in the proposed program have published textbooks, professional journal articles, served as textbook reviewers and manuscript reviewers for professional journals, and made over 100 presentations at professional conferences. The department's six tenured faculty members have earned PhD's in closely related fields from accredited universities. All of these faculty publish in and serve as editors on leading peer-reviewed journals, routinely present at national conferences, and lead national organizations in the field. The department's four non-tenure track (term) faculty have substantial careers in industry and significant postgraduate academic training. Of the four term faculty members, two hold doctoral degrees in fields related to the program's quantitative methods, which constitute the subject matter of their instructional responsibilities. The other two term faculty members hold Master's degrees in fields related to supply chain management, aligning with the subject matter of the courses they teach.

Students in the proposed program will also take courses with faculty members from other departments in the School of Business. As part of the Business Core Requirement, students will take courses in the Department of Economics, the Department of Information Systems, the Department of Accounting, the Department of Finance, the Department of Marketing, and the Department of Management. All faculty members teaching in the program will have appropriate academic and/or professional qualifications for the courses to which they are assigned.

Beyond the SCMA department's full-time faculty, up to four adjunct faculty will be utilized as needed to accommodate the full-time faculty's labor or scheduling constraints, and/or provide the flexibility needed to accommodate uncertainty in student demand. Adjunct faculty teaching in the proposed program will be required to hold a Master's degree (or higher) in fields related to the proposed degree program, including Operations Management, Supply Chain Management, Operations Research, Statistics, and/or Mathematics, with the additional requirement that the adjunct's academic degree relates directly to the course(s) they teach. Adjunct faculty are also expected to have substantial professional experience and/or certifications in fields related to the course(s) they teach (e.g., Project Management Professional, Six Sigma certification, Certified Supply Chain Professional).

See Appendix C for abbreviated curriculum vitae of faculty.

### **Student Learning Assessment**

Upon successful completion of the proposed program, students will possess the requisite knowledge, critical thinking acumen, and quantitative skills needed for achieving success and efficacy in industry practice. The program will prepare students for diverse career opportunities in supply chain management, encompassing roles such as supply chain analyst, logistician, distribution manager, and operations analyst, among others.

Throughout the program, student learning will be evaluated through an array of summative and formative measures. These assessment methods will include, but are not limited to, assigned papers, quizzes, tests, and applied projects within the classroom environment. Students will also be assessed through activities conducted external to the classroom, including engagement in capstone and independent projects, and feedback/reports stemming from internship

experiences<sup>17</sup>. The array of assessment methods was developed to provide multiple avenues for evaluating and ensuring the effective retention and application of knowledge by students.

The SCMA department will conduct and report annual assessments of student learning outcomes in accordance with the established policies and procedures of Virginia Commonwealth University, the School of Business, and any external accreditations held by the school (e.g., AACSB). The SCMA department will administer and evaluate students' evaluations of courses and instructors, for all of the proposed program's core courses. These assessment data will be used in conjunction with industry feedback, enabling an evaluation of the need for updates in material coverage or adjustments to skills (e.g., technology, software, analytical methods, etc.). Any amendments to learning assessments will be presented for approval to the Dean of the School of Business, in accordance with school policies.

### Learning Outcomes

The proposed program's student learning outcomes are classified into four principal areas: Content knowledge, uncertainty and risk assessment, analytics methodologies, and analytics applications. These assessment categories mirror those presently employed by the School of Business' external accrediting body (AACSB) for the existing concentration in Supply Chain Management. Regarding each of these areas, students of the proposed program will be able to:

#### Content Knowledge

- Demonstrate an understanding of the core responsibilities and measures of performance for supply chain functions, including sourcing, operations, and logistics
- Qualitatively assess the inherent complexities within global supply chains and their impact on supply chain performance
- Identify and apply appropriate managerial strategies to supply chain problems
- Integrate global macroeconomic conditions into managerial decision-making
- Incorporate sustainability factors into the assessment of supply chains strategies

#### Uncertainty and Risk

- Apply appropriate strategies for assessing and managing uncertainty and risk
- Analyze the risk exposure of organizations within a specific supply chain
- Propose solutions to mitigate risk exposure

#### Analytics Methodologies

- Evaluate the requisites and available data pertaining to analytics-based problems
- Determine suitable analytical techniques for problem analysis
- Employ contemporary analytics tools, such as data visualization, predictive analytics, to facilitate understanding and decision-making
- Utilize statistical methods (e.g., hypothesis testing, regression, design of experiments), when appropriate, to conduct analyses and derive insights

#### Analytics Applications

- Employ computational tools (e.g., Excel, R, Python, SimQuick, anyLogistix) to assist in analyzing supply chain problems
- Utilize quantitative techniques (e.g., simulation, optimization, forecasting models, inventory analysis) to improve supply chain performance

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<sup>17</sup> These activities will be used as secondary assessment measures since they are not required for degree completion.

- Demonstrate an understanding of how supply chain systems (e.g., ERP, VMI, EDI) are used for performance measurement and management

Curriculum Map for B.S. in Supply Chain Management.

<b>Learning Outcomes</b>	<b>Courses</b>	<b>Assessment Methods<sup>18</sup></b>
Content Knowledge	SCMA 386: Global SCM SCMA 410: Logistics & Distribution Strategy SCMA 420: Strategic Sourcing SCMA 491: Topics in SCM	<u>Formative:</u> class discussions, written assignments, oral presentations  <u>Summative:</u> Examinations, case- and data-based projects
Uncertainty and Risk	SCMA 350: Intro to Project Mgmt. SCMA 386: Global SCM SCMA 410: Logistics & Distribution Strategy SCMA 420: Strategic Sourcing SCMA 439: Process Mgmt. & Quality Control	<u>Formative:</u> class discussions, written assignments, oral presentations  <u>Summative:</u> Examinations, case- and data-based projects
Analytics Methodologies	SCMA 302: Business Statistics II SCMA 303: Business Analytics SCMA 430: Data Management & Visualization SCMA 440: Data Mining & Forecasting	<u>Formative:</u> class discussions, written assignments  <u>Summative:</u> Examinations, case- and data-based projects
Analytics Applications	SCMA 339: Quant. Solutions for SCM SCMA 439: Process Mgmt. & Quality Control SCMA 440: Data Mining & Forecasting SCMA 492: Independent Study in SCM	<u>Formative:</u> class discussions, written assignments  <u>Summative:</u> Examinations, case- and data-based projects

### Employment Skills

Graduates of the proposed undergraduate degree in supply chain management will be able to:

- Collect, analyze, and interpret data relevant to supply chain operations

<sup>18</sup> The assessment methods and courses listed in this table summarize how the specified learning objectives will be incorporated throughout the proposed B.S. in SCM program, beyond the assessments formally considered by AACSB.

- Utilize spreadsheet (e.g., Excel) and data visualization (e.g., Tableau, Power BI) software to conduct quantitative statistical analyses, construct performance dashboards, and develop mathematical models for supply chain problems
- Assess and quantify risks associated with an organization's supply chain
- Perform supplier qualification and evaluations, encompassing competitive benchmarking, the creation of performance scorecards, and the initiation of competitive bidding processes
- Manage and schedule projects, including the use of Gantt charts, PERT, and CPM techniques
- Evaluate logistics and distribution networks and utilize optimization methods where appropriate
- Manage an organization's inventory and quantitatively compute appropriate ordering and holding policies
- Address and support challenges related to international and multimodal supply chain logistics networks
- Evaluate the capacities of supply chain processes and manage bottlenecks
- Develop forecasts and delivery schedules for both supply- and demand-side products and materials
- Collaborate with other functional areas within an organization (e.g., Finance, Marketing) to make informed decisions regarding the supply chain
- Apply statistical process controls (SPC) concepts to evaluate quality-related data and manage conformance levels

### **Expansion of Existing Program**

The current B.S. in Business Administration degree program offers an elective concentration in Supply Chain Management (SCM). The proposed program is an expansion of the existing concentration in the current B.S. in Business Administration. This expansion to a standalone degree program is needed to: 1) eliminate the curricular restraints of a concentration, 2) respond to the increasing demand for highly specialized supply chain professionals in industry, nonprofits, and governments, and 3) allow students to earn a degree that more clearly matches the coursework, graduates' skills, and employment opportunities in the field.

First, a standalone degree eliminates the shared curriculum restraints of a concentration. Currently, supply chain management is one of five available concentrations (business administration, entrepreneurship, international management, human resource management, and supply chain management). By virtue of "shared curriculum requirements", all concentrations offered under the B.S. in Business degree are limited to a total of 18 credit hours devoted to discipline-specific topics (6 credits of core coursework, plus 12 credits of restricted electives). This restriction has resulted in reduced student opportunity for advanced training in the managerial and quantitative techniques associated with supply chain management. The faculty has determined that a concentration no longer offers enough flexibility in the curriculum to satisfy the industry demands for advanced supply chain management skills. In a stand-alone degree program, the curriculum can be expanded to include advanced coursework and



experiential learning opportunities, thereby ensuring that graduates possess the requisite knowledge and proficiencies essential for securing employment upon graduation, while simultaneously addressing society's contemporary supply chain challenges.

Second, a standalone degree program would respond to the increasing demand for specialized supply chain professionals in industry, nonprofit organizations, and governmental entities. This would be achieved by providing a curriculum that offers advanced training on topics relevant to contemporary supply chain management careers. Employers are increasingly seeking graduates equipped with capabilities in specialized domains and proficiencies in more advanced analytical methodologies, particularly within the realm of quantitative analysis. By expanding the number of credit hours devoted to discipline-specific coursework beyond the foundational offerings currently required by the existing concentration, the proposed program would enable students to pursue more advanced studies in specialized subjects aligned with their personal interests and career aspirations. Concurrently, this would equip graduates with a deeper knowledge and specialization area that better addresses the demands of employers.

Finally, a standalone degree program in Supply Chain Management will provide students with a degree and title that more accurately reflects the coursework and training offered to students. The curriculum for the proposed degree program is not the curriculum for a general business degree program. The department has received consistent feedback from employers and students expressing a desire to have a dedicated B.S. in Supply Chain Management available to them. Relative to the existing concentration, the proposed program would result in improved recognition within the industry and alignment with employment opportunities available to professionals in the field.

If the proposed B.S. in Supply Chain Management is approved, VCU will close the existing Supply Chain Management concentration in the B.S. in Business degree program upon approval by the State Council of Higher Education for Virginia (SCHEV).

### **Relation to Existing VCU Degree Programs**

The proposed B.S. in Supply Chain Management degree program is not directly related to nor similar to any other existing degree program at Virginia Commonwealth University. The proposed B.S. in Supply Chain Management will not compromise any existing degree program at Virginia Commonwealth University. No degree programs will close as a result of the initiation and operation of the proposed degree program.

### **Justification of the Proposed Program**

#### **Response to Current Needs (Specific Demand)**

Supply chain management is an extensive domain of study and a vocation that fundamentally involves overseeing the efficient and effective materials, services, and logistical operations. This discipline encompasses the operational transformation of raw materials into finished products and services, including sourcing, manufacturing, and distributing to end users. Given the

preponderance of evidence emphasizing the importance of robust and efficient supply chain activities in modern society, there is an evident need for skilled individuals to maintain efficient supply chain operations, evaluate potential risks, and develop solutions to rectify disruptions as they occur. The proposed degree program will address these needs by equipping an individual capable of orchestrating and advancing supply chain operations while engaging with diverse stakeholders across various sectors, economies, and capacities.

A need exists for deploying optimized logistical practices within enterprises and across networks of interconnected organizations. The proposed program directly addresses the current needs for the dissemination and advocacy of efficient supply chain management and the promotion of resilient supply chains in the face of disruption risks. The current needs in Virginia and at a national level encompass: 1) industry demand for professionals proficient in the strategic management of supply chain logistics and operations, 2) industry demand for professionals with foundational quantitative skills in assessing and optimizing supply chain activities, and 3) a talent shortage in the field of supply chain management.

### Strategic Management in Supply Chain Management

Well-functioning supply chains significantly contribute to global economic stability. However, disruptions or suboptimal management of supply chains can have significant repercussions on the daily lives of the global populace. Recent events, including halts in production induced by the COVID-19 pandemic<sup>19</sup>, healthcare scarcities<sup>20</sup>, the Russian incursion into Ukraine<sup>21</sup>, extreme weather such as the Texas winter storms of 2021<sup>22</sup>, incidents such as the Suez Canal blockage<sup>23</sup>, and cyber-attacks like the Colonial Pipeline incident<sup>24</sup>, have highlighted the criticality of effective supply chain management to the proper function of international economies.

With the growing complexity and global reach of supply chain networks, the frequency of such disruptions and the subsequent strategic ramifications have correspondingly escalated. As a result, professionals in supply chain management must possess competencies in applying sound strategic principles to anticipate and effectively address events that occur on a global level. The contemporary landscape of effective supply chain management relies on interorganizational collaboration and strategic planning, representing a shift from the erstwhile tactical stance<sup>25</sup>.

Proficiently navigating strategic issues inherent in supply chain operations has become increasingly critical to organizations, consequently impacting state and national economies at a larger scale. This resonance is succinctly articulated by the Gartner Group: “companies are recognizing the importance of the supply chain for their success and, for some, survival”<sup>26</sup>.

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<sup>19</sup> <https://www.whitehouse.gov/cea/written-materials/2021/06/17/why-the-pandemic-has-disrupted-supply-chains/>

<sup>20</sup> <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9014739/>. Accessed 26 June 2023.

<sup>21</sup> <https://www.forbes.com/sites/paulnoble/2022/05/12/the-ukraine-russia-wars-impact-on-the-supply-chain-why-mro-optimization-is-a-top-priority/?sh=1198b8e86d2e>. Accessed 27 June 2023.

<sup>22</sup> <https://www.forbes.com/sites/willyshih/2021/02/19/severe-winter-weather-in-texas-will-impact-many-supply-chains-beyond-chips/?sh=56f852a8358a>. Accessed 25 June 2023

<sup>23</sup> <https://www.bbc.com/news/business-56559073>. Accessed 25 June 2023

<sup>24</sup> <https://www.nytimes.com/2021/05/14/us/politics/pipeline-hack.html>. Accessed 25 June 2023

<sup>25</sup> <https://www.sait.ca/news/2022/01/supply-chain-training>, 12 Jan 22. Accessed 29 Aug 23.

<sup>26</sup> <https://www.supplychainbrain.com/blogs/1-think-tank/post/35243-why-the-supply-chain-talent-shortage-isnt-letting-up>. 5 Jul 22. Accessed 29 Aug 23.

Given an increasing emphasis on strategic thinking and the importance of addressing global risks, supply chain management requires individuals knowledgeable in global challenges, capable of anticipating risks, and versed in managerial tactics to address them.

Being able to successfully navigate the challenges and complexities of modern supply chains therefore requires individuals to possess skills in a variety of managerial practices. The SCM Talent Group recently noted the need for strategic skills in the field: “today the ideal employee (in supply chain management) has both tactical and operational expertise... talent will also need to excel at leadership, strategic thinking, (and) innovation<sup>27</sup>.”

The proposed program aims to provide students with a sound foundation in the managerial principles and critical thinking skills needed to evaluate the strategic risks and vulnerabilities associated with modern supply chain networks. The program will offer coursework that combines theoretical techniques with practical approaches to train students on effectively addressing the risks and challenges within supply chain management. The proposed program will produce graduates trained to assess their organization’s strategic needs, identify the risks associated with its supply chain, and develop innovative strategies which preemptively and effectively address those risks while simultaneously fulfilling their organization’s overarching strategic goals.

#### Quantitative Skills in Supply Chain Management

Technological advancements in recent decades have driven the complex global nature found in modern supply chains. Supply chains have been at the forefront of firms’ digital transformations, with the organizations that comprise supply chain networks now highly interconnected through platforms which integrate digital and physical technologies. These technologies, in turn, have “reshaped how stakeholders communicate and transact with each other, (requiring) more informed decision-making and a more flexible, responsive organization”<sup>28</sup>. The COVID-19 pandemic has accelerated these digital transformations – According to the most recent (2023) report by MHI in collaboration with Deloitte, 74% of those companies surveyed are increasing their supply chain technology investments<sup>29</sup>, up from 49% in 2021<sup>30</sup>. These technological investments into supply chains have created a concomitant demand for supply chain professionals possessing an ability to harness and analyze the vast volumes of data that exist across a supply chain.

Central to the digital transformations within supply chains lies the generation, distribution, and analysis of data. Quantitative skills offer the means to decipher intricate patterns and trends embedded within the data streams that flow through supply chains. From demand forecasting and distribution optimization to risk appraisals and performance assessments, quantitative insights enable supply chain professionals to make informed decisions grounded in evidence.

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<sup>27</sup> <https://scmtalent.com/supply-chain-talent-shortage>. 2 Mar 23. Accessed 29 Aug 23.

<sup>28</sup> <https://www2.deloitte.com/us/en/insights/focus/industry-4-0/challenges-on-path-to-digital-transformation/supply-chain-paradox.html>, 10 Oct 18. Accessed 29 Aug 23.

<sup>29</sup> 2023 MHI Annual Industry Report - The Responsible Supply Chain: Transparency, Sustainability, and the Case for Business. MHI and Deloitte.

<sup>30</sup> The 2021 MHI Annual Industry Report – Innovation Driven Resilience. MHI and Deloitte.

Supply chain disruptions, such as those associated with the COVID-19 pandemic, emphasize the need for proactive risk management and predictive modeling. Quantitative skills equip supply chain professionals to create models for diverse scenarios and simulate potential disruptions, allowing for the development of robust contingency plans. This ability to quantitatively manage supply chain risks bolsters an organization’s resilience in the face of unforeseen challenges.

Supply chain management has also become increasingly interconnected with other facets of business, such as finance and marketing. Supply chain professionals skilled in quantitative analyses possess the ability to bridge these domains by analyzing how supply chain decisions impact the entire organization, optimizing not only operational aspects but also overarching business goals.

The proposed B.S. in Supply Chain Management will educate students on the quantitative methods and associated software-based tools currently employed in practice. Aligned with industry’s increasing emphasis on data analytics, the proposed curriculum places an emphasis on developing students’ proficiencies in data analysis and statistical methodologies, while also training students on the supporting techniques of assembling and structuring large datasets. In addition, the program will train students on the application of mathematical optimization techniques, commonly used throughout the supply chain management discipline, in areas such as logistics, distribution, and risk assessments. Graduates of the proposed program will be able to conduct the analytical assessments requisite for quantifying supply chain performance, evaluating risks, and devising improvement strategies.

#### Talent Shortage in Supply Chain Management

The field of supply chain management struggled with a notable talent shortage for over a decade. For example, a study conducted by the MIT Center for Transportation and Logistics in 2010 – titled *Are You Prepared for the Supply Chain Talent Crisis?* – emphasizes: “supply chain faces a severe shortage of talent at a time when the demands on the profession have never been greater”<sup>31</sup>. Since the publication of that report, the rapid progression of all industries towards complex, global supply chains has amplified the demand for qualified supply chain managers. Most recently, the COVID-19 pandemic has further exacerbated the prevailing shortage of supply chain talent. In 2023, the SCM Talent Group, for instance, notes: “for at least the last decade... there has been a shortage of (supply chain) talent, and it continues to get more severe. This is true across all industries and across the globe. Demand for supply chain talent (in 2023) is at an all-time high as companies have recognized the importance of supply chain for their success”<sup>32</sup>.

Industry’s focus on supply chain management is particularly salient for Virginia, as the Commonwealth occupies a strategic position as a hub for supply chain activity. The Virginia Economic Development Partnership (VEDP) has identified supply chain management as one of the key industrial areas on which the state is currently focusing<sup>33</sup>. Notably, many of the other industries highlighted by VEDP as focal areas – e.g., automotive, aerospace, food/beverage

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<sup>31</sup> Cottrill, K. 2010. Are you prepared for the supply chain talent crisis? MIT CTL White Paper. Fall 2010. MIT Center for Transportation and Logistics.

<sup>32</sup> <https://scmtalent.com/supply-chain-talent-shortage>. 2 Mar 23. Accessed 29 Aug 23.

<sup>33</sup> <https://www.vedp.org/why-virginia>. Accessed 29 June 2023

processing, semiconductors, and wood products – rely heavily on supply chain management throughout their operations. Virginia has also become a preferred destination for major supply chain corporations including Amazon, Walmart, Dollar Tree, Lego, DHL. This preference is reinforced by Virginia’s recognition as “America’s East Coast Logistics Hub”<sup>34</sup>, supported by the Port of Virginia and associated infrastructure. Furthermore, Virginia’s strategic geographical position offers convenient access to a large percentage of the U.S. population. Despite the evident importance of supply chain management to Virginia’s future, no public university within the Commonwealth currently offers a dedicated undergraduate academic program (under CIP 52.0203) designed to produce business specialists in supply chain management. Taken together, these points indicate the perpetual rise in demand for supply chain professionals within Virginia, while Commonwealth’s capacity to produce qualified graduates remains constrained. The proposed program directly addresses this gap.

Beyond Virginia, a B.S. in Supply Chain Management is a central component to many of the top undergraduate business programs across the country, including institutions that are considered peer institutions to VCU. This is evident in the annual rankings published by the Gartner research group, which highlights the top undergraduate programs in supply chain management nationwide<sup>35</sup>. The SCM programs at these universities rank among the offerings with the greatest demand within each institution: At the University of Tennessee, for instance, the B.S. in Supply Chain Management degree program boasts the largest number of students across the entire university, not just the business school<sup>36</sup>. The mainstream attention to supply chain management brought by COVID-19 pandemic has yielded a pronounced surge in student interest for SCM programs<sup>37</sup>. Furthermore, the size and success of the aforementioned SCM programs in competing states clearly indicate strong demand from both students and employers.

Despite this growing interest, there is a nationwide scarcity of accredited programs currently offering a B.S. in SCM. Among AACSB-accredited institutions, only 17% offer undergraduate SCM degrees<sup>38</sup>. In contrast, other business disciplines such as Accounting (66% of all schools have at least one accounting degree program), Finance (59%), and Marketing (58%) are much more saturated<sup>39</sup>. In light of the national gap between the demand for SCM graduates and the supply of reputable institutions providing them, it is unsurprising that SCM programs are among the most successful for the universities that currently offer them.

Reports of the shortage of SCM graduates are reinforced by job market and salary data. The National Association of Colleges and Employers (NACE), a professional association of college career services providers and recruiting professionals, conducts annual surveys to forecast hiring intentions<sup>40</sup>. In their 2022 job survey report, NACE ranks a Bachelor's degree in supply chain

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<sup>34</sup> [https://issuu.com/vedpvirginia/docs/americas\\_east\\_coast\\_logistics\\_hub](https://issuu.com/vedpvirginia/docs/americas_east_coast_logistics_hub). 24 May 21. Accessed 29 Aug 23.

<sup>35</sup> <https://www.gartner.com/en/newsroom/press-releases/2022-06-07-gartner-announces-rankings-of-the-2022-north-american-supply-chain-undergraduate-university-programs>. Last Updated: June 22. Accessed 2 Aug 23.

<sup>36</sup> <https://supplychainmanagement.utk.edu/about/by-the-numbers>. Last Updated: 2022. Accessed 2 Aug 23.

<sup>37</sup> <https://www.marketplace.org/2022/02/07/university-students-flock-to-supply-chain-majors/>. Last Updated: 7 Feb 22. Accessed: 2 Aug 23.

<sup>38</sup> <https://www.aacsb.edu/-/media/publications/research-reports/2021-business-school-data-guide-october-release.pdf>. Oct 2021 Release. Accessed: 2 Aug 23.

<sup>39</sup> Ibid.

<sup>40</sup> <https://www.naceweb.org/about-us/>

management as the fifth most in-demand degree program, with over 50% of employers indicating their intent to hire individuals with a B.S. in SCM<sup>41</sup>. In that same report, NACE identifies SCM occupations as the ninth highest-paid positions at the bachelor's degree level, with engineering, healthcare, and natural science programs predominantly occupying the positions above. Separate studies conducted by Bankrate<sup>42</sup> and Coursera<sup>43</sup> rank SCM as the second-highest paying business discipline. This places SCM just behind finance, a discipline commonly perceived as the highest-paying undergraduate business discipline. To the extent that elevated salaries reflect tightness in the labor market, these research studies affirm that SCM graduates are among the most in-demand majors being offered at the undergraduate level.

In sum, the available evidence strongly indicates that organizations across a wide range of sectors and industries across the nation face a notable constraint: an insufficient flow of adequately qualified graduates in Supply Chain Management. The strength and success of B.S. in SCM programs at competing, out-of-state institutions reflects strong student demand. Simultaneously, the high salaries and industry job reports demonstrate strong demand for SCM graduates in Virginia's and national job markets. The Association to Advance Collegiate Schools of Business (AACSB)<sup>44</sup> attributes the limited supply of qualified SCM students to the relatively small number of reputable institutions across the country that offer a B.S. in SCM. Consequently, there is a clear systemic and infrastructural need to increase the flow of SCM graduates. Through the proposed program, VCU would be favorably positioned to address this prevailing shortage. By developing skilled professionals in the field through the proposed program, VCU would address talent shortages that exist not only within Virginia but also on a national scale.

### **Employment Demand**

Graduates of the proposed Bachelor's in Supply Chain Management degree program will be qualified for a wide range of employment opportunities in the field. In addition to the role of "supply chain manager", they can pursue positions such as logistician, distribution manager, facilities manager, purchasing manager, production manager, management analyst, project management specialist, or operations research analyst<sup>45</sup>. Job growth in these areas is expected both in Virginia and across the nation.

The logisticians career field is particularly relevant to the proposed degree program. Duties outlined by the U.S. Bureau of Labor Statistics (BLS) for logisticians include managing a product's life cycle, overseeing material allocation, developing supplier relationships,

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<sup>41</sup> Source: <https://www.nacweb.org/uploadedfiles/files/2022/publication/executive-summary/nace-2022-winter-salary-survey-executive-summary.pdf>. Updated: Winter 2022. Accessed 2 Aug 23.

<sup>42</sup> Source: <https://www.bankrate.com/loans/student-loans/most-valuable-college-majors/>. 4 Oct 21. Accessed: 2 Aug 23.

<sup>43</sup> Source: <https://www.coursera.org/articles/best-business-majors>. 3 Aug 22. Accessed: 2 Aug 23.

<sup>44</sup> Opatny-Yazell, C., E. Nelson. 2021. The Core Argument for Supply Chain Management. <https://www.aacsb.edu/insights/articles/2021/07/the-core-argument-for-supply-chain-management>. 7 Jul 21. AACSB.

<sup>45</sup> The Bureau of Labor Statistics (BLS) and the Virginia Economic Commission (VEC) do not currently report employment projections under the title of "supply chain manager". Instead, they report projections for various career paths that fall under the broader domain of supply chain management. We have included projections for the relevant fields reported by the BLS and VEC in the accompanying tables; notably, the term "supply chain" frequently appears within the descriptions provided by the BLS for each of these fields.

understanding client needs, reviewing functions to identify areas for improvement, and proposing strategies for cost or time savings. These duties form the core skills taught in the proposed program. According to the BLS, employment of logisticians is expected to grow at 27.7% or “much faster than average for all occupations”. This aligns closely with the data provided by the Virginia Employment Commission (VEC), which projects a growth rate of 29%. The BLS notes that “the growth of e-commerce makes logistics more dynamic and complex ... the increased volume of inventory and the need to manage multiple supply chains have made logisticians’ work critical. In addition, as more goods are purchased online, timeliness of delivery remains a priority for companies, further increasing demand for these workers”<sup>46</sup>.

The job category of transportation, storage, and distribution managers is closely related in terms of roles and responsibilities to logisticians. Transportation, storage, and distribution managers “plan, direct, or coordinate transportation, storage, or distribution activities in accordance with organizational policies and applicable government laws or regulations. (This category) includes logistics managers”<sup>47</sup>. The BLS and VCE project job growth rates of 8.4% - “faster than average across all occupations” - and 13.4%, respectively, for this job category.

The BLS projects employment growth for management analysts to be “much faster than average across all occupations”, at a rate of 11.4%; the VEC projects a higher growth rate at 15.2%. The BLS notes that management analysts are heavily focused on improving organizational efficiency with typical tasks including gathering data, analyzing the information, and making recommendations for improving systems and procedures. These skills are developed throughout the proposed program. The BLS notes that “demand (for management analysts) is expected to increase as organizations seek ways to improve efficiency and control costs. As markets become more competitive, firms will need to use resources more efficiently. ... Government agencies are also expected to seek the services of management analysts as they look for ways to reduce spending and improve efficiency”<sup>48</sup>.

The BLS projects the project management specialist category to grow “about as fast as the average for all occupations” at a rate of 7.2%. The VEC does not provide any information on this specific category. The BLS notes that project managers are responsible for coordination, scheduling, staffing, and other details of a project. Specifically, they note that individuals will typically develop project plans, assign duties to staff, identify and resolve problems, monitor project status and budget, and supervise the project. The proposed program will develop students’ skills in these areas. The BLS notes that “as organization seek ways to maintain and improve productivity, employment of project management specialists is expected to increase. These specialists will be needed to help manage various business operations, ensuring that projects meet their goals and are completed on time and within budget”<sup>49</sup>.

The BLS also projects “much faster than average” growth for operations research analysts (23.2%); the VEC provides a similar projection at 26%. Operations research analysts “identify problems in areas such as business (and) logistics... they may help managers decide how to

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<sup>46</sup> <https://www.bls.gov/ooh/business-and-financial/logisticians.htm#tab-6>. Accessed 29 Aug 23.

<sup>47</sup> <https://www.bls.gov/ooh/about/data-for-occupations-not-covered-in-detail.htm#Management%20occupations>. Accessed 29 Aug 23.

<sup>48</sup> <https://www.bls.gov/ooh/business-and-financial/management-analysts.htm#tab-6>. Accessed 30 Aug 23.

<sup>49</sup> <https://www.bls.gov/ooh/business-and-financial/project-management-specialists.htm#tab-6>. Accessed 30 Aug 23.

allocate resources, develop production schedules, oversee the supply chain, and set prices ... using statistical database software and analytical techniques”<sup>50</sup>. The proposed program will develop students’ skills in these areas. The BLS notes that “as technology advances and companies and government agencies seek efficiency and cost savings, demand for operations research analysis should continue to grow ... Technological advances have made it faster and easier for organizations to get data. Operations research analysts manage and evaluate data to improve business operations, supply chains, pricing models and marketing... More companies are expected to employ operations research analysts to help them turn data into information that managers use to make decisions about all aspects of their business”<sup>51</sup>.

The BLS projects the facilities managers category to grow “about as fast as the average for all occupations” at a rate of 6.8%. The VEC projects that this category will grow at 8.9%. Facilities managers “oversee buildings, grounds, equipment, and supplies. Their responsibilities cover several categories, including operations, maintenance, and planning and managing projects”<sup>52</sup>. The proposed program will develop students’ skills in these areas. The BLS notes that “a continuing focus on the environmental impact and energy efficiency of buildings will keep facilities managers in demand”.

The BLS projects the purchasing managers category to grow at a rate of 3.8%. The BLS notes that purchasing managers are responsible for procuring goods and services for organizations. Typical tasks include supplier identification, supplier selection, supplier evaluation, supplier development, and negotiations and contract execution. The BLS notes that “employment of purchasing managers is projected to increase because these workers will continue to be needed to help procure goods and services for business operations or for resale to customers”<sup>53</sup>. For Virginia, the VEC projects job growth for purchasing managers at a rate of 6.4%, which is “about as fast as the average for all occupations”.

Industrial production managers are projected by the BLS to grow at a rate of 3%. Industrial production managers “oversee the operations of manufacturing and related plants”<sup>54</sup>. Although the BLS job growth for industrial production managers is “slower than average for all occupations”, the BLS notes that the slower growth rate is “due to greater productivity” in manufacturing settings, and that “because industrial production managers are responsible for coordinating work activities with the goal of increasing productivity, they will continue to be needed in this capacity”<sup>55</sup>. Job growth projections within Virginia for industrial production managers are notably stronger than national estimates – the VEC projects a growth rate of 10.8% within Virginia.

All of these career areas require a bachelor’s degree. The roles and responsibilities for each, as defined by the BLS, align with the proposed program. Taken together, the available data indicate

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<sup>50</sup> <https://www.bls.gov/ooh/math/operations-research-analysts.htm#tab-2>. Accessed 30 Aug 23.

<sup>51</sup> <https://www.bls.gov/ooh/math/operations-research-analysts.htm#tab-6>. Accessed 30 Aug 23.

<sup>52</sup> <https://www.bls.gov/ooh/management/administrative-services-managers.htm#tab-2>. Accessed 30 Aug 23.

<sup>53</sup> <https://www.bls.gov/ooh/business-and-financial/purchasing-managers-buyers-and-purchasing-agents.htm#tab-6>. Accessed 30 Aug 23.

<sup>54</sup> <https://www.bls.gov/ooh/management/industrial-production-managers.htm#tab-1>. Accessed 30 Aug 23.

<sup>55</sup> <https://www.bls.gov/ooh/management/industrial-production-managers.htm#tab-6>. Accessed 30 Aug 23.



strong growth for career fields related to the proposed program, and corroborate industry reports of a shortage of qualified supply chain management professionals<sup>56</sup>.

See Appendix D provides letters of support from prospective employers.

See Appendix E provides employment announcements.

**U.S. Bureau of Labor Statistics (BLS), Labor Market Information 2021-2031 (10-Yr)<sup>57</sup>**

<b>Occupation</b>	<b>Base Year Employment</b>	<b>Projected Employment</b>	<b>Total Projected Difference</b>	<b>Total Percent Change</b>	<b>Annual Change</b>	<b>Education</b>
Logisticians	195.0	249.1	54.1	27.7	5.4	Bachelor's Degree
Transportation, Storage and Distribution Managers	150.7	163.4	12.7	8.4	1.3	Bachelor's Degree
Management Analysts	950.6	1059.0	108.4	11.4	10.6	Bachelor's Degree
Project Management Specialists	781.4	837.6	56.2	7.2	5.6	Bachelor's Degree
Operations Research Analysts	104.2	128.3	24.1	23.2	2.4	Bachelor's Degree
Facilities Managers	109.1	116.6	7.5	6.8	0.8	Bachelor's Degree
Purchasing Managers	72.8	75.6	2.8	3.8	0.3	Bachelor's Degree
Industrial Production Managers	203.8	210.9	7.1	3.5	0.7	Bachelor's Degree

**Virginia Employment Commission (VEC), Labor Market Information 2020-2030 (10-Yr)<sup>58</sup>**

<b>Occupation</b>	<b>Base Year Employment</b>	<b>Projected Employment</b>	<b>Total Projected Difference</b>	<b>Total Percent Change</b>	<b>Annual Change</b>	<b>Education</b>
Logisticians	8043	10376	2333	29.0	233	Bachelor's Degree
Transportation, Storage and	2962	3358	396	13.4	40	Bachelor's Degree

<sup>56</sup> <https://scmtalent.com/supply-chain-talent-shortage>. 2 Mar 23. Accessed 29 Aug 23.

<sup>57</sup> <https://www.bls.gov/emp/tables/occupational-projections-and-characteristics.htm>. Accessed 29 Aug 23. All numbers in thousands.

<sup>58</sup> <https://viriniaworks.com/Occupational-Projections>. Accessed 29 Aug 23.

Distribution Managers						
Management Analysts	56801	65437	8636	15.2	864	Bachelor's Degree
Operations Research Analysts	7513	9465	1952	26.0	195	Bachelor's Degree
Facilities Managers	4886	5319	433	8.9	43	Bachelor's Degree
Purchasing Managers	2791	2969	178	6.4	18	Bachelor's Degree
Industrial Production Managers	2458	2724	266	10.8	27	Bachelor's Degree

### Duplication

Through the proposed program, Virginia Commonwealth University would be the first public institution in Virginia to offer a dedicated B.S. degree program in supply chain management. No other public institution in the Commonwealth offers such a program under CIP 52.0203. Six public institutions offer degree programs with sub areas (e.g., concentrations, minors, etc.) that have similar aspects to the proposed degree. The following universities offer programs with sub areas that overlap the VCU proposed degree: George Mason University (GMU), James Madison University (JMU), Longwood University (LU), Old Dominion University (ODU), Virginia Polytechnic and State University (VT), and the College of William & Mary (W&M). None of the aforementioned programs have a declared major in supply chain management; as a result, current Virginia residents may qualify for in-state tuition rates at out-of-state schools offering B.S. degrees in supply chain management (e.g., University of Tennessee, West Virginia University)<sup>59</sup>.

#### George Mason University

George Mason University (GMU) does not offer a stand-alone degree program in supply chain management. They do offer a B.S. in Business Administration (CIP 52.0201) with a concentration in SCM. The concentration focuses on the strategic and tactical planning activities within a company's business operations. The concentration requires three courses (9 credits) and an additional 12 credits of restricted electives. The concentration includes coursework covering supply chain management, quality management, and project management. Elective courses cover data mining, analytics, service operations, process analysis, forecasting, and government contracting and procurement. This concentration is not a stand-alone program and does not offer the full depth and breadth of coursework required in the proposed VCU degree program.

#### James Madison University

James Madison University does not offer a stand-alone degree program in supply chain management. They do offer a Bachelor of Business Administration (B.B.A.) degree (CIP 52.0201) with a minor in global supply chain management. The minor has two required courses

<sup>59</sup> <https://www.sreb.org/academic-common-market> Accessed 30 Aug 23.

and four electives, for a total of 18 required credit hours. The minor includes coursework covering supply chain management and logistics. Elective courses are administered through the Integrated Science and Technology program and include production methods, process analysis, lean manufacturing and six sigma. This minor is not a stand-alone program and does not offer the full depth and breadth of coursework required in the proposed VCU degree program.

### **Longwood University**

Longwood University does not offer a stand-alone degree program in supply chain management. They do offer a B.S. in Business Administration (CIP 52.0201) with an endorsement in supply chain management. The endorsement has two required courses (6 credits) and two elective courses (6 credits), for a total of 12 credit hours. The endorsement includes coursework covering supply chain management and operations management. Elective courses include negotiations and conflict management, project management, and risk management. This endorsement is not a stand-alone program and does not offer the full depth and breadth of coursework required in the proposed VCU degree program.

### **Old Dominion University**

Old Dominion University (ODU) does not offer a stand-alone degree program in supply chain management. They do offer a Bachelor of Science in Business Administration (CIP 52.0201) with two related concentrations: (1) maritime management and (2) supply chain management. The focus of the maritime program is on seafaring aspects of supply chain management, while the supply chain management concentration considers topics for a more general business setting. Each concentration consists of three concentration electives, one free elective, and two business electives. The concentration in maritime management offers coursework in international shipping, supply chain management & logistics, shipping management, port management, and inland waterway and intermodal transportation. The supply chain management concentration includes courses in international shipping, supply chain management and logistics, strategic sourcing & purchasing management, quality management, and distribution center and material handling management. Both concentrations share electives that include maritime security and special topics in supply chain management. Neither concentration is a stand-alone program and does not offer the full depth and breadth of the coursework required in the proposed VCU degree program.

### **Virginia Polytechnic and State University**

Virginia Polytechnic and State University (VT) does not offer a stand-alone degree program in supply chain management. They do offer a Bachelor of Science in Business Information Technology (BIT) (CIP 52.1301) concentration in operations and supply chain management. The concentration requires five courses that cover operations and supply chain management, process improvement, ERP systems, advanced supply chain management, and computer applications in the supply chain arena. The concentration is not a stand-alone program and does not offer the full depth and breadth of the coursework required in the proposed VCU degree program.

### **The College of William and Mary**

The College of William and Mary (WM) does not offer a stand-alone degree program in supply chain management. They do offer a BBA degree (CIP 52.0201) with a minor in supply chain analytics. The minor requires the business analytics core and three supply chain

courses. Courses in the minor include project management, supply chain management, supply chain analytics, and lean six sigma. The minor is not a stand-alone program and does not offer the full depth and breadth of the coursework required in the proposed VCU degree program.

### **Student Demand**

Virginia Commonwealth University assessed student demand for the proposed program through two means: 1) historical enrollment data for the concentration in Supply Chain Management currently offered at VCU, and 2) enrollments in supply chain degree programs at peer universities within the Virginia region.

#### Enrollment in existing concentration

We evaluated student demand by analyzing enrollments in the existing concentration in Supply Chain Management currently being offered within the B.S. in Business program. Data covering the past 7 years of enrollments in the existing concentration (see Table and Figure, below) indicates an upward trajectory in student demand. It is worth noting that the concentration’s growth has been sustained even in the face of demand shocks caused by the recent pandemic.

Enrollment in Existing Concentration, 2016-2022<sup>60</sup>.

<b>Academic Year</b>	<b>2016-17</b>	<b>2017-18</b>	<b>2018-19</b>	<b>2019-20</b>	<b>2020-21</b>	<b>2021-22</b>	<b>2022-23</b>
Enrollment	71	69	101	112	105	128	114

#### Enrollment in regional supply chain programs

We also assessed student demand by analyzing enrollments in SCM programs listed under the same CIP Code as the proposed program (52.0203) at other universities within the region. Enrollment data were obtained from JobsEQ<sup>61</sup>. The available data included schools in New York, New Jersey, Maryland, Pennsylvania, and North Carolina. As mentioned earlier in this proposal, no public institution within Virginia offered a standalone B.S. degree program under the focal CIP code during the period being considered (2010 – 2021) and, as a result, Virginia is absent from these data.

The supplied data for the represented universities can be found in the table below, while the accompanying figure depicts enrollments for the aggregate region. Taken together, these figures reveal a strong and consistent upward trend that spans the 12-year period and institutions captured by the enrollment data received.

External reports covering the national level similarly indicate strong student demand. Encoura, for instance, notes: “Market indicators point to the bachelor’s market as the most favorable opportunity in the supply chain management area. It is the largest and fastest growing credential market of those analyzed and has seen positive efficiency gains in recent years”<sup>62</sup>.

<sup>60</sup> Source: Insights 2.0. VCU Office of Institutional Research and Decision Support.

<sup>61</sup> Data were supplied from a central VCU office and originate from <https://www.chmura.com/software>

<sup>62</sup> <https://encoura.org/program-spotlight-supply-chain-management/>. 11 Jan 22. Accessed 5 Sep 23.

See Appendix F for Supply Chain Management degree program enrollments from comparable, regional universities.

See Appendix G for Supply Chain Management degrees awarded from comparable, regional universities.

**State Council of Higher Education for Virginia  
Summary of Projected Enrollments in Proposed Program**

Year 1		Year 2		Year 3		Year 4 Target Year (2-year institutions)			Year 5 Target Year (4-year institutions)		
2024 - 2025		2025 - 2026		2026 - 2027		2027 - 2028			2028 - 2029		
HDCT	FTES	HDCT	FTES	HDCT	FTES	HDCT	FTES	GRAD	HDCT	FTES	GRAD
145	123	154	131	136	139			—	181	154	92

**Assumptions:**

Retention percentage: 85%

Percentage of full-time students: 75% Percentage of part-time students: 25%

Full-time students credit hours per semester: 15

Part-time students credit hours per semester: 6

Full-time students graduate in 4 years

Part-time students graduate in 6 years

Projected Resource Needs for the Proposed Program

**Resource Needs**

Virginia Commonwealth University, the School of Business, and the SCMA department have the faculty, classified support, equipment, space, library, and other resources necessary to initiate the proposed program. The following subsections detail the resources required to operate the program from its initiation in Fall 2024 through the target year 2028-29. Assessments of need for full-time, part-time, and adjunct faculty are based on a ratio of 1.0 FTE of instructional effort for every 24 FTE students in lower division courses and 18 FTE students in upper division courses. The proposed program will require 5.75 FTE faculty instructional effort in the initiation year, rising to 7.25 FTEs by the target year.

**Full-Time Faculty**

Ten (10) full-time faculty members in VCU’s Supply Chain and Analytics department will teach in the proposed program. These faculty currently teach in the existing Supply Chain Management concentration for the B.S. in Business. One of these faculty members will contribute 1.0 FTE, six will each contribute 0.5 FTE, and three will each contribute 0.25 FTE toward teaching in the proposed program upon initiation, for a total of 4.75 FTE instructional

effort. One additional FTE (for a total of 5.75 FTE) of full-time faculty will be required by the target year, with a salary range of \$100,000 to \$200,000 and benefits of \$40,000 to \$80,000.

### **Part-time Faculty**

No part-time faculty are required from the program's initiation through the target year.

### **Adjunct Faculty**

The proposed program will require 1.0 FTE of adjunct faculty teaching effort upon the program's initiation. By the target year, up to 1.5 adjunct FTE will be required. The average adjunct faculty salary for a three-credit hour course is \$4,000 to \$8,000, plus benefits of \$300 to \$700, depending upon the number of students enrolled in the course being taught.

### **Graduate Assistants**

No graduate assistants are required to initiate or sustain the proposed degree program.

### **Classified Positions**

A Program Manager currently employed by the Supply Chain and Analytics department will support the proposed degree program. The program will require no more than 0.25 FTE of classified support to initiate and sustain the proposed program. The cost associated with the classified position attributable to the proposed program (based upon 25% FTE allocation) is \$15,000 and \$6,000 in benefits for a total of \$21,000.

### **Program Administration**

The proposed B.S. in Supply Chain Management program will be administered by the Chair of the Supply Chain Management and Analytics Department, with the assistance of the department's Program Manager. The Department Chair will teach courses in the proposed program and will have oversight for coordinating the enrollment of students into the program. The Department Chair will also oversee teaching evaluations and share feedback with faculty. Finally, the Department Chair coordinates program assessments as well as curriculum changes.

The Program Manager will provide support for the Department Chair, the faculty, and the students in the proposed program. Approximately 25% of the Program Manager's time will be utilized to support the program. The Program Manager will assist with classroom scheduling, coordinating paperwork for faculty travel and guest speakers, equipment purchasing, and textbook orders. The Program Manager currently spends approximately 25% of their time performing these duties to support the existing concentration in SCM. With the initiation of the proposed program, the existing concentration will be closed, and the Program Manager will be reassigned to support the proposed program. As a result, the proposed program will not require any administrative time or resources beyond what is currently used to support the current concentration. This Program Manager is the same person as described in the previous subsection, titled "classified positions".

### **Targeted Financial Aid**

No targeted financial aid is required to initiate and sustain the proposed degree program.

### **Equipment Resources (including computers)**

No new equipment, including computers, is required to initiate or sustain the proposed degree program. For any new hires, existing furniture and equipment (including computers) will be provided.

**Library Resources**

No additional library resources are required to initiate or sustain the proposed degree program. The VCU Library provides adequate resources for faculty and student research, teaching, and learning to support the proposed program.

**Space Resources**

No additional space is required to initiate or sustain the proposed degree program. There is already adequate classroom and faculty office space. For any new hires, existing office space is available and will be utilized.

**Funds to Initiate and Operate the Degree Program**

*Figures provided in the table below will be compared to SCHEV funding estimates using the current base adequacy model. This comparison will serve as a reference for the estimated costs. If there are large discrepancies, SCHEV may request additional clarification to ensure the institution’s assumptions are correct, or require modifications as a condition of approval.*

**Note:** Institutions must use the recommended student-faculty ratio when estimating FTE enrollments and required faculty FTEs.

<b>Cost and Funding Sources to Initiate and Operate the Program</b>			
<b>Informational Category</b>		<b>Program Initiation Year 2024 – 2025</b>	<b>Program Full Enrollment Year<sup>63</sup> 2027 – 2028</b>
1.	Projected Enrollment (Headcount)	145	172
2.	Projected Enrollment (FTE)	123	147
3.	Projected Enrollment Headcount of In-State Students	130	154
4.	Projected Enrollment Headcount of Out-of-State Students	15	18
5.	Estimated Annual Tuition and E&G Fees for In-state Students in the Proposed Program	\$16,233	\$16,233
6.	Estimated Annual Tuition and E&G Fees for Out-of-State Students in the Proposed Program	\$38,817	\$38,817
7.	Projected Total Revenue from Tuition and E&G Fees Due to the Proposed Program	\$2,692,545	\$3,198,588
8.	Other Funding Sources Dedicated to the Proposed Program (e.g., grant, business entity, private sources)	\$0	\$0

<sup>63</sup> For the “Full Enrollment Year” use: for associate degrees, initiation year plus 1; for baccalaureate degrees, initiation plus 3; for masters degrees, initiation plus 2; for doctoral degrees, initiation plus 3.



*Part V: Certification Statements*

1. A request of any kind will be submitted to the General Assembly for funds to initiate and/or maintain the proposed degree program.

Yes

No

If “Yes” is checked, include narrative text to describe: when the request will be made, how much will be requested, what the funds will be used for, and what will be done if the request is not fulfilled.

2. The proposed degree program is included in the institution’s most recent six-year plan.

Yes

No

If “No” is checked, include narrative text to explain why the program is being advanced at the present time despite not being included in the six-year plan.

3. The institution’s governing board has been provided information regarding duplication (if applicable) and labor market projections as part of its approval action.

Yes

No

If “No” is checked, include narrative text to explain why the governing board has not been provided the information.

The institution’s Chief Academic Officer attests to the accuracy of the above statements

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Name (Printed)

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Signature

Date

## Appendices

## Appendix A - Sample Plan of Study

### Sample Plan of Study for full-time student

Year	Fall Semester	Spring Semester
Freshman	UNIV 111 Focused Inquiry I (3)	BUSN 212 Business Problem Solving and Analysis (4)
	General Education Courses (8)	BUSN 225 Winning Presentations (3)
	Open Elective (4)	UNIV 112 Focused Inquiry II (3)
		General Education Course (3)
		Open Elective (3)
Sophomore	ACCT 203 Intro. to Accounting I (3)	ACCT 204 Intro. to Accounting II (3)
	BUSN 201 Foundations of Business (3)	BUSN 301 Career and Professional Development (1)
	ECON 210 Principles of Microecon. (3)	BUSN 323 Legal Environment of Business (3)
	UNIV 200 Inquiry & the Craft of Argument (3)	ECON 211 Principles of Macroeconomics (3)
	General Education Courses (3)	MKTG 301 Marketing Principles (3)
		SCMA 301 Business Statistics I (3)
Junior	MGMT 303 Creativity and Ideation (3)	INFO 360 Business Information Systems (3)
	MGMT 310 Managing People in Organizations (3)	FIRE 311 Financial Management (3)
	SCMA 302 Business Statistics II (3)	SCMA 303 Business Analytics (3)
	SCMA 320 Production/Operations Management (3)	SCMA 386 Global SCM (3)
	SCMA 350 Intro to Project Management (3)	(SCM) Major Restricted Electives (3)
Senior	SCMA 339 Quant. Solutions for SCM (3)	BUSN 499 Business Knowledge Exam (0)
	SCMA 420 Strategic Sourcing (3)	MGMT 434 Strategic Management (3)
	Open electives (4)	SCMA 410 Logistics and Distribution Strategy (3)
	(SCM) Major Restricted Electives (3)	SCMA 439 Process Management and Quality Control (3)
		Open electives (6)

Credit Hours – Freshman – Fall Term: 15  
 Credit Hours – Freshman – Spring Term: 16  
 Credit Hours – Sophomore – Fall Term: 15  
 Credit Hours – Sophomore – Spring Term: 16  
 Credit Hours – Junior – Fall Term: 15  
 Credit Hours – Junior – Spring Term: 15  
 Credit Hours – Senior – Fall Term: 13  
 Credit Hours – Senior – Spring Term: 15

**TOTAL CREDIT HOURS: 120**

## Appendix B - Course Descriptions

### Virginia Commonwealth University General Education Courses

#### UNIV 111. Focused Inquiry I. 3 Hours.

Semester course; 3 lecture hours (delivered online, face-to-face or hybrid). 3 credits. Utilizes contemporary themes to give students opportunities and practice in writing, critical thinking, oral presentation, collaborative learning, information retrieval and evaluation, and social and civic responsibilities. Incorporates common reading materials and course activities across all sections.

#### UNIV 112. Focused Inquiry II. 3 Hours.

Semester course; 3 lecture hours (delivered online, face-to-face or hybrid). 3 credits.

Prerequisite: UNIV 111 or equivalent. Builds on skills introduced in UNIV 111 by providing practice in expository essays, argument and contextual analysis. Focuses on practice in writing in a variety of genres, framing writing according to both purpose and audience and identifying academically valid sources. Students must earn a minimum grade of C to receive credit for this course.

#### UNIV 200. Inquiry and the Craft of Argument. 3 Hours.

Semester course; 3 lecture hours (delivered online, face-to-face or hybrid). 3 credits.

Prerequisite: UNIV 112 or HONR 250 with a minimum grade of C. A research and writing process course that emphasizes critical analysis, elements of argument, inquiry-based research skills, writing conventions of academic argument and the presentation of argument and research into new mediums. Students must earn a minimum grade of C to receive credit for this course.

### Core Courses

#### SCMA 302. Business Statistics II. 3 Hours.

Semester course; 3 lecture hours (delivered online, face-to-face or hybrid). 3 credits.

Prerequisite: BUSN 212\* or MATH 200; and SCMA 301\*\*, STAT 210 or STAT 212. Statistical methods employed in the collection and analysis of business and economic data. Continuation of statistical inference for means and variable relationships using t-tests, analysis of variance, contingency tables, regression and correlation analysis with emphasis on problem formulation and interpretation of computational results. \*Formerly MGMT 212, SCMA 212; \*\*formerly MGMT 301.

#### SCMA 303. Business Analytics. 3 Hours.

Semester course; 3 lecture hours. 3 credits. Prerequisites: BUSN 212\* or MATH 200; and SCMA 301\*\*, STAT 212 or STAT 210. Descriptive analysis (Excel models and pivot tables, summary statistics, data visualization and regression analysis), predictive analysis (time series and forecasting) and prescriptive analysis (optimization models, decision trees and sensitivity analysis). \*Formerly MGMT 212, SCMA 212; \*\*formerly MGMT 301.

#### SCMA 339. Quantitative Solutions for Supply Chain Management. 3 Hours.

Semester course; 3 lecture hours. 3 credits. Prerequisite: SCMA 301, STAT 210 or STAT 212. Enrollment is restricted to students who have completed at least 54 credit hours (junior standing). Modeling business-related problems using quantitative techniques. Focus is on applications to

problems in the service and manufacturing sectors. Typical problem situations involve management of inventory, scheduling of people and processes and allocation of scarce resources.

SCMA 350. Introduction to Project Management. 3 Hours.

Semester course; 3 lecture hours. 3 credits. Prerequisite: junior standing. Introductory exposure to and practice with the concepts of project management, the activities and skills of project managers, the prevalence of projects in organizations, and the value of project management skills for all managers. Students will employ project management terminology, participate in project work and engage in the appropriate technical and interpersonal processes for managing successful projects.

SCMA 386. Global Supply Chain Management. 3 Hours.

Semester course; 3 lecture hours. 3 credits. Prerequisite: SCMA 320. Enrollment is restricted to students who have completed at least 54 credit hours (junior standing). Introduction to supply chains with emphasis on management, e-commerce and globalization. Topics covered include achievement of strategic fit among members of the chain; managing information system requirements; managing economies of scale, role of cycle inventory, impact of aggregation on risk and inventory; determining the optimal level of product availability, coordination and performance measurement.

SCMA 410. Logistics and Distribution Strategy. 3 Hours.

Semester course; 3 lecture hours. 3 credits. Prerequisite: SCMA 320. This course provides an introduction to the principal analytical tools and methods used in supply chain management, including experience in solving relevant supply chain and logistics problems. The course content includes a heavy emphasis on the use of Microsoft Excel functions to develop modeling skills, including decision analysis, linear programming, heuristics and simulation for supply chain decision-making. Context areas for problem solving include supply chain network design, inventory management, transportation management, purchasing and demand management.

SCMA 420. Strategic Sourcing. 3 Hours.

Semester course; 3 lecture hours. 3 credits. Prerequisite: SCMA 320. Procurement and strategic sourcing address the processes that facilitate the structure, creation and management of value-added transactions and relationships between supplier and customer organizations in a channel, supply chain and integrated value system context.

SCMA 439. Process Management and Quality Control. 3 Hours.

Semester course; 3 lecture hours. 3 credits. Prerequisite: SCMA 320. Enrollment is restricted to students who have completed at least 54 credit hours (junior standing). Critical concepts of process management from quality management and Six Sigma; service quality; systems thinking; process improvement strategy and methods; fact-based decision-making; collection and use of data in improvement projects; introduction to data analysis tools and techniques; statistical process control.

### Restricted Electives

ACCT 306. Cost Accounting. 3 Hours.

Semester course; 3 lecture hours (delivered online, face-to-face or hybrid). 3 credits.

Prerequisite: ACCT 303 with a minimum grade of C. Enrollment is restricted to students who have completed at least 54 credit hours (junior standing) or those in the post-baccalaureate certificate program. Cost accumulation for inventory pricing and income determination. Cost behavior concepts for planning and control. Job order and process cost systems, standard costs, budgets and special topics in relevant costs for managerial decisions.

BUSN 400. Principles of Consulting. 3 Hours.64

Semester course; 3 lecture hours. 3 credits. Prerequisites: junior status and acceptance into International Consulting Program. Corequisite: BUSN 401. Intended to provide students with “formal” training in how to conduct consulting engagements. The course is designed to teach students how to conduct consulting engagements by providing academic background through readings and lectures, real-world perspectives from practicing consultants, and practice application through simulations and cases. The course culminates in a consulting engagement with a real client from the Richmond business community to provide the students with an opportunity to apply the consulting skills they learned in the classroom.

BUSN 401. International Consulting Practicum. 3 Hours.

Semester course; 3 lecture hours. 3 credits. Prerequisites: junior status and acceptance into International Consulting Program. Corequisite: BUSN 400. Intended to provide students with an opportunity to apply the lessons learned about consulting in BUSN 400 to a real business client in a foreign country.

FIRE 312. Financial Modeling. 3 Hours.

Semester course; 3 lecture hours (delivered online, face-to-face or hybrid). 3 credits.

Prerequisites: FIRE 311 with a minimum grade of C; and SCMA 301, STAT 210, STAT 212 or STAT 541. Enrollment is restricted to students with majors or concentrations offered by the Department of Finance, Insurance and Real Estate who have completed at least 54 credit hours (junior standing). This course is designed to introduce students to a wide array of primarily Excel techniques used in financial model building. Students will be introduced to techniques such as data tables, solver, matrix manipulation, array formulas, pivot tables, etc., to create financial models that are common in the areas of finance, risk management and real estate finance.

INFO 320. Business Intelligence and Data Mining. 3 Hours.

Semester course; 3 lecture hours. 3 credits. Prerequisite: SCMA 301\*, STAT 210 or STAT 212.

Enrollment is restricted to students who have completed at least 54 credit hours (junior standing). Modeling business-related problems using information systems tools and quantitative techniques. Focus is on relevant business and external data, quantitative analysis and presentation of findings. Typical problem situations involve suggested productivity improvements, revenue enhancement opportunities and marketing. \*Formerly MGMT 301.

INFO 482. Introduction to Enterprise Resource Planning Systems. 3 Hours.

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64 BUSN 400 and BUSN 401 are corequisite courses; students are therefore required to take both courses (6 credits total) in the same semester, with all 6 credit hours applied towards (SCM) Major Elective curriculum components.

Semester course; 3 lecture hours. 3 credits. Enrollment is restricted to majors in the School of Business who have completed 54 credit hours (junior standing). This course allows students to develop an appreciation of the impact of enterprise resource planning systems on businesses and to understand the issues involved in the design, implementation, and maintenance of these systems. Students also develop practical skills in the use of a commercial enterprise resource planning system.

MGMT 319. Leadership. 3 Hours.

Semester course; 3 lecture hours. 3 credits. Prerequisite: MGMT 310. This course is restricted to students who have completed at least 54 credit hours (junior standing). Coverage of the major approaches to leadership considering individual, team, organizational and cultural perspectives. Emphasis on self-assessment and on historical and contemporary leadership cases.

MGMT 405. Negotiation, Influence and Conflict Management. 3 Hours.

Semester course; 3 lecture hours. 3 credits. Enrollment is restricted to students who have completed a minimum of 54 credit hours (junior standing). Designed to develop negotiation and conflict management skills as well as an understanding of negotiation and influence theories and frameworks. Considerable emphasis is placed on experiential negotiation exercises and role-playing.

MKTG 325. Business-to-business Marketing. 3 Hours.

Semester course; 3 lecture hours. 3 credits. Prerequisites: MKTG 301 and junior standing. This course focuses on strategy development for marketers whose customers include other businesses, the government and/or institutions. It explores the buying behavior of these organizations and highlights how the product development and management processes for such customers differ from the processes used for consumer marketing.

MKTG 335. Introduction to Personal Selling. 3 Hours.

Semester course; 3 lecture hours. 3 credits. Enrollment is restricted to students who have completed at least 26 credit hours (sophomore standing). Examines the fundamental nature of personal selling in the promotion mix, including the sales process and the techniques used in performing the selling function.

MKTG 340. Retail Management. 3 Hours.

Semester course; 3 lecture hours. 3 credits. Prerequisite: MKTG 301. This course is restricted to students who have completed at least 54 credit hours (junior standing). A comprehensive view of retailing and an application of marketing concepts in a practical retail managerial environment. Students learn to evaluate retail firms and to identify their strengths and weaknesses.

MKTG 350. Customer and Marketing Analytics. 3 Hours.

Semester course; 3 lecture hours (delivered online, face-to-face or hybrid). 3 credits. Prerequisite: MKTG 301 with a minimum grade of C. Introduces tools to gain insights into customer interactions with brands, advertising, digital or social media marketing, and shopping or purchase contexts. Reviews data structure, analysis, synthesis and presentation techniques that aid marketing decision-making.

MKTG 435. Selling in the Business Marketplace. 3 Hours.

Semester course; 3 lecture hours. 3 credits. Prerequisites: MKTG 301, MKTG 335 and junior standing. This course focuses on selling strategy and tactics for sales managers and field sales representatives whose customers include other businesses, government and/or institutions. Areas of concentration include preparing for, and conducting, effective business-to-business sales calls, including prospecting, scheduling customer sales meetings, needs identification, presentation and securing new business.

MKTG 450. Product Development and Management. 3 Hours.

Semester course; 3 lecture hours (delivered online, face-to-face or hybrid). 3 credits. Prerequisite: MKTG 301. Enrollment is restricted to students who have completed at least 54 credit hours (junior standing). Study of the role of marketing in developing and managing products. Essential concepts include the use of project teams for product development and the application of a new product development process. Topics include innovation, technology, listening to the voice of the customer, product design, branding, positioning and product life-cycle management.

SCMA 430. Data Management and Visualization. 3 Hours.

Semester course; 3 lecture hours. 3 credits. Prerequisite: SCMA 303. This course is designed with the goal of equipping students with competencies in data management and visualization, with the intended product being an individual capable of developing analytically rigorous decision support tools, catered to specific managerial environments, which can be easily handed off for robust application by a range of intended users in those environments.

SCMA 440. Data Mining and Forecasting. 3 Hours.

Semester course; 3 lecture hours. 3 credits. Prerequisite: SCMA 302 or STAT 314. Enrollment is restricted to students who have completed at least 54 credit hours (junior standing). This course introduces nonmathematical managers to the major quantitative models designed for sound demand, competitive and system forecasting in today's complex and increasingly uncertain business environment. The course is useful for multiple business disciplines, including general management, marketing and finance. Topics include game theory, Markov processes, statistical quality control, exponential smoothing and seasonally adjusted trend analysis. Emphasis is placed on a general understanding of theory, mechanics, application potential, available software packages and templates.

SCMA 491. Topics in Supply Chain Management and Analytics. 1-3 Hours.

Semester course; variable hours. 1-3 credits. Students are restricted to a maximum total of 6 credits for all topics courses. Prerequisite: junior standing. An in-depth study of a selected business topic related to the disciplines in supply chain management and analytics, to be announced in advance.

SCMA 492. Independent Study in Supply Chain Management and Analytics. 1-3 Hours.

Semester course; 1-3 credits. Maximum total of 3 credits. Prerequisites: junior or senior standing as a major in a business curriculum and approval of adviser and department chair prior to course registration. Intensive study under supervision of a faculty member in an area not covered in depth or contained in the regular curriculum.



SCMA 493. Internship in Supply Chain Management and Analytics. 3 Hours.

Semester course; 3 credits. Prerequisites: senior standing in the major offering the internship and permission of the department chair. Intention to enroll must be indicated to the instructor prior to or during advance registration for semester of credit. Involves students in a meaningful experience in a setting appropriate to the major.

School of Business Required Curriculum

ACCT 203. Intro. to Accounting I. 3 Hours.

Semester course; 3 lecture hours (delivered online, face-to-face or hybrid). 3 credits. Theoretical and technical facets of financial and managerial accounting for business. Accumulation, analysis, interpretation and uses of accounting information. Course will focus on financial accounting.

ACCT 204. Intro. to Accounting II. 3 Hours.

Semester course; 3 lecture hours (delivered online, face-to-face or hybrid). 3 credits.

Prerequisite: ACCT 203 with a minimum grade of C. Theoretical and technical facets of financial and managerial accounting for business. Accumulation, analysis, interpretation and uses of accounting information. Course will focus on managerial accounting.

BUSN 201. Foundations of Business. 3 Hours.

Semester course; 3 lecture hours. 3 credits. Prerequisite: UNIV 112, HONR 200 or HONR 250. Introduces students to basic business environments and business functions and practices. Builds awareness of corporate social responsibility and ethical business behavior. Helps students gain an integrated awareness of business and practice analytical skills needed for their advanced business courses and careers.

BUSN 205. Intro. to the World of Business. 3 Hours.

Semester course; 3 lecture hours (delivered online, face-to-face or hybrid). 3 credits.

Prerequisite: UNIV 112, HONR 200 or HONR 250. This course will cover the concepts, principles and operations of private enterprise in the world economy. Students will explore the functions of modern business management, marketing and accounting. They will have a chance to practice making business decisions in a safe environment; learn how to approach ethical dilemmas in business and explore classic international business blunders made due to a lack of cross-cultural awareness; and begin working on their own professional habits, learn how to search for a job or internship and learn professional ways to get a team to work well together.

BUSN 212. Business Problem Solving and Analysis. 4 Hours.

Semester course; 4 lecture hours (delivered online, face-to-face or hybrid). 4 credits.

Prerequisite: BUSN 171\*, MATH 139, MATH 141 or MATH 151 with a minimum grade of C; or satisfactory score on the VCU Mathematics Placement Test within the one-year period immediately preceding the beginning of the course. This course provides an intuitive approach to algebra and introductory calculus, with an emphasis on concepts, applications and problems related to business. Starting with a review of functions, the course will explore the use of algebra to formulate and solve problems. Students will learn how to use of matrices to solve introductory linear programming problems. Additionally, students will be introduced to limits, continuity, techniques of differentiation and integration as it applies to algebraic, exponential and logarithmic functions, and optimization with an emphasis on applications in business. Students

will build their understanding of mathematical models and how to use functions and data to solve real-world problems. Instruction will include the use of spreadsheets as a calculation and graphing tool. Students may not receive degree credit for more than one of BUSN 212, MGMT 212, SCMA 212 or MATH 200. This course was formerly numbered MGMT 212 and SCMA 212. \*Formerly MGMT 171, SCMA 171.

**BUSN 225. Winning Presentations. 3 Hours.**

Semester course; 3 lecture hours. 3 credits. Enrollment is restricted to School of Business freshmen, sophomores and juniors in the foundation or advanced programs. Why are some presenters bad, some good and others great? Why do some people have more “presence” than others? What leadership skills work in a room full of people who are not on the same page? How does one pitch an idea in less than two minutes? Presentation skills involve more than just speaking in public. Good presentation skills require an understanding of yourself, your subject and your audience. This course will explore the skills involved in mastering all of these. Students may receive credit toward graduation for only one of SPCH 121, SPCH 321 or BUSN 225.

**BUSN 301. Career and Professional Development. 1 Hour.**

Semester course; 1 lecture hour (delivered online, face-to-face or hybrid). 1 credit. Prerequisite: HONR 200, HONR 250 or UNIV 200. Enrollment is restricted to majors in the School of Business who have completed at least 24 credit hours (sophomore standing). This course focuses on preparing students to enter and succeed in the world of business today. Students will examine standard practices and expectations across organizations, evaluate and develop an individual professional style, create a career plan, and prepare to successfully market themselves for an internship or job.

**BUSN 323. Legal Environment of Business. 3 Hours.**

Semester course; 3 lecture hours (delivered online, face-to-face or hybrid). 3 credits. Enrollment is restricted to students who have achieved sophomore standing. Basic legal concepts applicable to business, including the legal aspects of operating a business, contracts, employment relationships, sales, and bailments and commercial paper. Also includes ethical considerations and social and political influences. Students may not receive degree credit for both BUSN 323 and ACCT/MGMT 481. This course was formerly numbered MGMT 323 and SCMA 323.

**BUSN 499. Business Knowledge Exam. 0 Hours.**

Semester course; variable hours (delivered online, face-to-face or hybrid). 0 credits. Prerequisites: MGMT 310; MKTG 301; INFO 360, 361 or ACCT 307; FIRE 311; and SCMA 301, STAT 210 or STAT 212. Enrollment is restricted to business majors. This course consists of a capstone exam covering general business knowledge in the subjects of accounting, economics, finance, information systems, management, marketing and statistics. Students may be asked to complete follow-up activities in the areas in which they have weak knowledge in order to earn a passing grade. Students should contact their academic adviser for information on how to take the exam and register for this course. Graded as pass/fail.

**ECON 210. Principles of Microeconomics. 3 Hours.**

Semester course; 3 lecture hours (delivered online, face-to-face or hybrid). 3 credits. A course designed to acquaint the student with a theoretical and practical understanding of the economic

institutions and problems of the American economy with a focus on microeconomics. Students may receive credit toward graduation for only one of the following three courses: ECON 203, ECON 205 or ECON 210.

ECON 211. Principles of Macroeconomics. 3 Hours.

Semester course; 3 lecture hours (delivered online, face-to-face or hybrid). 3 credits.

Prerequisite: ECON 203 with a minimum grade of B, ECON 205 with a minimum grade of B or ECON 210. A course designed to acquaint the student with a theoretical and practical understanding of the economic institutions and problems of the American economy with a focus on macroeconomics.

FIRE 311. Financial Management. 3 Hours.

Semester course; 3 lecture hours (delivered online, face-to-face or hybrid). 3 credits.

Prerequisites: MATH 200 or BUSN 212\*; ACCT 203 or ACCT 202 (for non-business majors); and ECON 210, or ECON 203 or ECON 205 with a minimum grade of B. Enrollment is restricted to students who have completed at least 54 credit hours (junior standing) or 24 credits with minimum cumulative GPA of 2.5. Principles of optimal financial policy in the procurement and management of wealth by profit-seeking enterprises; the application of theory to financial decisions involving cash flow, capital structure and capital budgeting. \*Formerly MGMT 212, SCMA 212.

INFO 360. Business Information Systems. 3 Hours.

Semester course; 3 lecture hours (delivered online, face-to-face or hybrid). 3 credits. Enrollment is restricted to students who have completed at least 54 credit hours (junior standing). Provides an understanding of the importance of computer-based information in the success of the firm. Emphasis is on the role of information systems within each of the functional areas of business. Major concepts include data management, decision support and management information systems.

MGMT 303. Creativity and Ideation. 3 Hours.

Semester course; 3 lecture hours (delivered online, face-to-face or hybrid). 3 credits. Enrollment is restricted to students who have completed a minimum of 54 credits (junior standing). Course explores the individual, social and institutional contexts for creativity and ideation. Students will examine four specific concepts in support of exploration in these areas: knowledge, curiosity, creativity and ideation.

MGMT 310. Managing People in Organizations. 3 Hours.

Semester course; 3 lecture hours (delivered online, face-to-face or hybrid). 3 credits. Enrollment is restricted to students who have completed at least 54 credits (junior standing). Introduces students to the management of people in organizations, focusing on the managerial skills, knowledge and activities needed for a successful business operation. Topics include planning, organizing, staffing and leading; effectively utilizing human capital to achieve an organization's objectives in today's competitive environment.

MGMT 434. Strategic Management. 3 Hours.

Semester course; 3 lecture hours (delivered online, face-to-face or hybrid). 3 credits.  
Prerequisites: MGMT 310; MKTG 301; FIRE 311; and SCMA 301, STAT 210 or STAT 212.  
Enrollment is restricted to business majors with senior standing. Integrative course to analyze policy issues at the overall management-level involving functional areas such as production, finance and marketing, in context with the economic, political and social environment.

MKTG 301. Marketing Principles. 3 Hours.

Semester course; 3 lecture hours (delivered online, face-to-face or hybrid). 3 credits. Enrollment is restricted to students who have completed at least 26 credit hours (sophomore standing). An introduction to the activities, set of institutions and processes for creating, communicating, delivering and exchanging offerings that have value for customers, clients, partners and society at large.

SCMA 301. Business Statistics I. 3 Hours.

Semester course; 3 lecture hours (delivered online, face-to-face or hybrid). 3 credits.  
Prerequisite: BUSN 171\*, MATH 151, BUSN 212\*\*, MATH 200 or higher level mathematics course. Statistical methods for collection, visualization and analysis of business and economic data from populations and processes. Statistical thinking, concepts of variability, sampling, descriptive measures, contingency tables, probability and introduction to regression, correlation, confidence intervals and hypothesis testing, with implementation in spreadsheet software. Students may receive credit toward graduation for only one of STAT 206, STAT 208, STAT 210, STAT 212, STAT 312 or SCMA 301. This course was formerly numbered MGMT 301. \*Formerly MGMT 171, SCMA 171;\*\*formerly MGMT 212, SCMA 212.

SCMA 320. Production/Operations Management. 3 Hours.

Semester course; 3 lecture hours (delivered online, face-to-face or hybrid). 3 credits.  
Prerequisite: SCMA 301, STAT 210 or STAT 212. This course is restricted to students who have completed at least 54 credit hours (junior standing). Discipline of management and the management process within the operations of an organization. Planning and controlling of operations through decision analysis, forecasting, aggregate planning, inventory management and quality management.

## **Appendix C - Abbreviated Curriculum Vitae of Faculty**

David Berdish. MS in Business, Virginia Commonwealth University, 1982. Term Faculty, Executive-in-Residence. Specialization Areas: Decision Sciences, Global Supply Chain Management

Pamela Burch, MS in Operations Research, College of William & Mary, 1993. Term Faculty, Assistant Professor. Specialization Areas: Mathematical & Statistical Analysis.

Paolo Catasti, PhD in Biophysics, UC Davis & University of Genoa (joint program), 1993. Term Faculty, Associate Professor. Specialization Areas: Business Analytics & Statistical Analysis

Steven Custer, PhD in Statistics, Virginia Polytechnic Institute & State University (Virginia Tech), 1969. Term Faculty, Assistant Professor. Specialization Area: Forecasting, Quality Management.

Shannon Harris, PhD in Business Analytics & Operations, University of Pittsburgh, 2016. Tenure-Track Faculty, Associate Professor. Specialization Area: Healthcare Operations.

Xiaojin (Jim) Liu, PhD in Business Administration (w/ concentration in Operations Management), University of Minnesota, 2016. Tenure-Track Faculty, Associate Professor. Specialization Area: Innovation Management.

Brett Massimino, PhD in Operations Management (w/ Minor in Logistics), 2014, The Ohio State University. Department Chair and Tenure-Track Faculty, Associate Professor. Specialization Area: Digital Supply Chains, Process Compliance.

Jason Merrick, PhD in Operations Research, George Washington University, 1997. Tenure-Track Faculty, Professor. Specialization Area: Decision & Risk Analysis, Quantitative Modeling.

Jeff Shockley, PhD in Management (w/ concentration in Operations Management), Clemson University, 2009. Tenure-Track Faculty, Associate Professor. Specialization Area: Retail & Healthcare Supply Chain Management.

Jeff Smith, PhD in Operations Management (w/ minor in Management Information Systems), University of South Carolina, 2007. Tenure-Track Faculty, Professor. Specialization Area: Healthcare Operations.

## **Appendix D - Letters of Support (Specific Demand)**



August 30, 2023

Dr. Jeff Smith  
Department Chair Supply Chain Management and Analytics  
Virginia Commonwealth University  
301 West Main Street  
Richmond, VA 23284

Dear Dr. Smith,

I'm writing in support of Virginia Commonwealth University's effort to initiate a Bachelor of Science (B.S.) degree program in Supply Chain Management and Analytics. In my role as Vice President Supply Chain & Operations of Hamilton Beach Brands and serving on the Industry Advisory Board for Virginia Commonwealth University, I have had the opportunity to work closely with VCU's business department faculty and students. Through those experiences, including serving on the international Board of Directors for the Association of Supply Chain Management and my 31 years of experience in the Supply Chain industry, I can attest to the significance and added value of a degree in this field.

One of the main functions of my role at Hamilton Beach Brands is to lead the solution of complex supply chain problems within a global distribution network. This includes issues with domestic transportation, international logistics, port services and warehousing across the world. The demand for our work is so great, our office here in Glen Allen, VA is trying to grow at an appropriate speed to address the global supply chain challenges, but we struggle to find talent aligned with our needs. Out of our Glen Allen corporate offices, we manage centralized planning, procurement, sourcing, distribution, customer service, and other supply chain areas and do so at both a strategic and tactical level. Some of our recruiting efforts go as far as both coasts as we work to attract the best educated talent to make sure our organization stays relevant into the future. We have roots going back to 1904 and will make sure we maintain relevancy for another 119 years. As we continue to grow and become more strategic in the field of supply chain, we will need the best and brightest the industry has to offer. This is exactly why we started our relationship with VCU a few years ago, and I have come to learn the talent pool at VCU runs deep.

Along with a few members of the faculty and help from our college recruiters here at Hamilton Beach Brands we have developed an onboarding program where we hope to align with VCU for years to come through offering internships and recruitment that optimizes the local talent pool to meet our organization's needs. The future of our company is sitting in class at VCU as we speak, and I am confident that this potential degree program, with the support of our local business leadership and associations like the Association of Supply Chain Management, would become one of the best supply chain programs in the country.

Sincerely,

A handwritten signature in black ink that reads "Michael Bunge".

Michael Bunge  
Vice President, Global Supply Chain & Operations  
<https://www.linkedin.com/in/michaelbunge/>

5000 Dominion Boulevard  
Glen Allen, VA 23060  
DominionEnergy.com



August 25, 2023

Mr. Peter A. Blake, Director  
State Council of Higher Education for Virginia  
James Monroe Building, 101 N 14<sup>th</sup> St. 10<sup>th</sup> floor  
Richmond, VA 23219

Mr. Blake,

I am writing to express my support of VCU's request of the SCHEV to initiate a Bachelor of Science degree program in Supply Chain Management and Analytics.

In my role as Director of Supply Chain Management at Dominion Energy, I have hired several graduates of VCU's SCM concentration and been involved in the undergrad program as a corporate sponsor. I am impressed with the program's rigor and the quality of the candidates it produces. Market conditions and business needs in my industry and others highlight the need for more highly trained supply chain management professionals. Dominion Energy regularly hires college graduates to join our supply chain management program and individuals possessing supply chain management degrees are highly sought after.

Additionally, having a degreed program in the Commonwealth would be advantageous. Dominion Energy Supply Chain recruits from the University of Tennessee because of its robust degreed program. Over 20% of the students enrolled in the UT program are from the state of Virginia. I would have to believe the SCHEV would like to keep those students in Virginia.

Thank you for your consideration and I hope you and the council choose to approve VCU's request.

Sincerely,

A handwritten signature in black ink that reads "Lewis Dawson". The signature is written in a cursive style and is positioned above the printed name.

Lewis Dawson  
Director, Supply Chain Management – Power Generation  
Dominion Energy Services, Inc.





September 5<sup>th</sup>, 2023  
Brett Massimino  
Department Chair  
School of Business  
Box 844000  
Richmond, VA 23284

Dear Mr. Massimino,

One of the main functions of my job at J.B. Hunt is to help solve complex supply chain problems for a variety of Fortune 500 companies and their subsidiaries. This includes domestic transportation, international logistics, port services and warehousing across the country. Our office here in Richmond, VA is growing at an exponential pace and will continue to expand as we attack an \$86 billion dollar flatbed market here in the United States.

The Richmond flatbed branch was built from the ground up starting in 2017 with a few seasoned logistics professionals from a variety of backgrounds. As we continue to grow and become more strategic in the field of supply chain, we will need the best and brightest the industry has to offer. Mark Hoover started our relationship with VCU a few years ago and the talent pool at VCU is deep.

Along with a few members of the faculty and help from our college recruiters here at J.B. Hunt we have developed a J.B. Hunt Scholars Program that we hope to incorporate at VCU for years to come. I would love to wrap my arms around the VCU Supply Chain program and strengthen our pipeline of exceptional students for internships and full-time roles. The future of our company is sitting in class at VCU as we speak, and I want them to know.

Myself, along with the other members of my J.B. Hunt team, are excited to further our relationship with VCU and the School of Supply Chain Management and Analytics. We are here to help develop the curriculum necessary to push the program forward and become one of the best supply chain programs in the country!

Sincerely,

A handwritten signature in black ink, appearing to read "Christian Sed".

Christian Sed  
Senior Manager, Sales

J.B. Hunt Business

Sept. 9, 2023



LEGO Manufacturing Richmond  
1400 Meadowville Road  
Chester, VA 23836

Dear Jeff Smith:

I am writing in support of your pursuit of developing a formal major in Supply Chain Management at Virginia Commonwealth University.

As you are aware, LEGO Group has recently invested in creating a US based production facility here in the greater Richmond VA area. Over the course of the next two years, we will be building up the capability (professionally and operationally) of the people resources in the local area. Specifically, to my responsibilities in this operation, I will be looking to develop and build the capabilities in the areas of Logistics, Manufacturing Control, and Strategic Planning.

Your efforts to develop these capabilities is of great interest to me, and I hope to partner with you to build momentum to set up future generations of leaders to support the ongoing operations of LEGO Manufacturing Richmond. As we enter the area and build out our operations, we will be looking for talent, with formal degrees, to support us. Majors in Supply Chain Management, educated in the newest practices, are of particular interest.

Our organization expects to grow significantly over the next five years, investing \$1 Billion USD into development of our operations here in the Richmond area. We plan to operate with close to 1,700 employees and predict a need for ongoing talent development in Supply Chain Management to support our desire to be a best-in-class manufacturer in the US. We plan to make significant investments in leading-edge technology and have a need to match that with people capabilities that will ultimately help us achieve delivering world class products that "inspire the builders of tomorrow" (one of LEGO Groups long-term ambitions).

As a long-term partner to academia, I look forward to working with you, and your future students focused on building their career in the amazing world of supply chain management.

A handwritten signature in black ink, appearing to read "Bud Wilkes", written in a cursive style.

Bud Wilkes  
Production Planning and Control Director  
LEGO Manufacturing Richmond

## **Appendix E - Employment Demand (Job Announcements)**

← Google

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Jobs Saved 25 Alerts

**Supply Chain Associate Supervisor**  
PepsiCo  
Harrisburg, PA  
via Indeed  
Full-time  
\$ 68K–72K a year  
Health insurance Dental insurance

**Chemical Supply Chain Specialist (Entry Level)**  
Noblis  
Anywhere  
via ZipRecruiter  
18 days ago  
Work from home Full-time  
Health insurance

**Supply Chain Planner**  
Balchem Corporation  
Covington, VA  
via ZipRecruiter  
19 days ago  
Full-time

**Chemonics International Inc.**  
via Www.devox.com  
Expired

**Supply Chain Planning Analyst II**  
Cox Communications  
Chesapeake, VA  
via ZipRecruiter  
10 days ago  
\$ 63.6K–95.4K a year  
Full-time Health insurance

**Supply Chain Analyst, Rail Strategy and Planning**  
Ocean Network Express  
Richmond, VA  
via LinkedIn  
16 days ago  
Full-time

**Sherwin-Williams**  
via Www.ziprecruiter.com  
Expired

**CUSTOMER OPERATIONS AND LOGISTICS ANALYST**  
Century Distribution Systems, Inc  
Richmond, VA  
via Indeed  
Full-time Health insurance  
Dental insurance Paid time off

**Chemical Supply Chain Specialist (Entry Level)**  
Noblis  
Reston, VA  
via LinkedIn  
28 days ago  
\$ 54.8K–95.9K a year  
Full-time Health insurance

**Transportation Analyst**  
Republic National Distributing Company  
Raleigh, NC  
via ForceBrands  
1 day ago  
Full-time

**Ion Storage Systems**  
via Www.applicantpro.com  
Expired

**Supply Chain Planner**  
TekPartners is now INSPYR Solutions  
Winchester, VA  
via LinkedIn  
Full-time

**Associate Commodity Buyer**  
Segula Technologies  
Greensboro, NC  
via SmartRecruiters Job Search  
Full-time Health insurance

**McKesson Corporation**  
via Www.learn4good.com  
Expired

**Defense Logistics Agency**  
via Lensa.com  
Expired

## Supply Chain Planner

Balchem Corporation  
Covington, VA

Apply on ZipRecruiter
Apply directly on Indeed
Apply on LinkedIn

19 days ago Full-time

### Job highlights

Identified by Google from the original job post

#### Qualifications

- Bachelor's degree in supply chain management or related field
- Minimum 1-3 years of supply chain planning or related experience
- Knowledge of planning processes and activities
- Knowledge of ERP/MRP system operation, preferably with Microsoft Dynamics 365
- Strong leadership, interpersonal and communications skills

#### Responsibilities

- This position will be responsible for planning and scheduling all assets at our Covington, VA site
- In addition, they will function as the liaison with customer service, the commercial and sales teams, procurement, production, logistics, and quality to schedule production, purchase raw materials and develop and maintain an optimum schedule to drive service and cost performance
- Complete all tasks in compliance with corporate and ANH at the forefront
- Develop production schedules to ensure strong customer service performance, and optimized manufacturing costs including inventory of raw materials, intermediates, finished goods and packaging supplies
- Partner with manufacturing team to identify production floor capacity issues and implement solutions to capacity pinch points
- Manage supply and demand plans that feed into S&OP process
- Identify excess capacity and implement solutions to reduce cost to serve
- Utilize D365 ERP system and Power BI tool and reports to support day to day operations and S&OP reporting
- Manage production and purchase orders in D365
- Confirm deliveries of raw materials and maintain accurate delivery dates in D365
- Develop and maintain minimum stocking quantities
- Responsible for managing and reporting on inventory levels
- Responsible for coordinating use of rework and distressed inventory
- Manage site-to-site transfers to cover production needs of shared materials
- Manage timely MRO material ordering (creating purchase orders from purchase requests) for Covington site, tracking and ensuring timely delivery
- Perform other duties as needed
- Comply with all policies and procedures of the Corporation

### Job description

Text to Apply! Text JOIN3215 to 845-400-TEAM (8326)

#### COMPANY OVERVIEW

Balchem Corporation develops, manufactures and markets specialty ingredients that improve and enhance the health and well-being of life on the planet, providing state-of-the-art solutions and the finest quality products for a range of industries worldwide. Our corporate headquarters is located in Montvale, New Jersey, and we have a broad network of sales offices, manufacturing sites, and R&D centers, primarily located in the US and Europe. Founded in 1967, Balchem is a publicly traded company (NASDAQ - "BCPC") with annual revenues over \$900 million and a market cap exceeding \$4.0 billion. The company consists of three business segments: Human Nutrition & Health; Animal Nutrition & Health; and Specialty Products. Balchem employs over 1,400 people worldwide who are engaged in diverse activities, committed to developing the company into global market leadership positions. To learn more about our dynamic, stable and growing company, visit [www.balchem.com](http://www.balchem.com)

#### POSITION SUMMARY:

This position will be responsible for planning and scheduling all assets at our Covington, VA site. In addition, they will function as the liaison with customer service, the commercial and sales teams, procurement, production, logistics, and quality to schedule production, purchase raw materials and develop and maintain an optimum schedule to drive service and cost performance.

#### ESSENTIAL FUNCTIONS:

- Complete all tasks in compliance with corporate and ANH at the forefront.
- Develop production schedules to ensure strong customer service performance, and optimized manufacturing costs including inventory of raw materials, intermediates, finished goods and packaging supplies.
- Partner with manufacturing team to identify production floor capacity issues and implement solutions to capacity pinch points.
- Manage supply and demand plans that feed into S&OP process.
- Identify excess capacity and implement solutions to reduce cost to serve.
- Utilize D365 ERP system and Power BI tool and reports to support day to day operations and S&OP reporting.
- Manage production and purchase orders in D365.
- Confirm deliveries of raw materials and maintain accurate delivery dates in D365.
- Develop and maintain minimum stocking quantities.
- Responsible for managing and reporting on inventory levels.
- Responsible for coordinating use of rework and distressed inventory.
- Manage site-to-site transfers to cover production needs of shared materials.
- Manage timely MRO material ordering (creating purchase orders from purchase requests) for Covington site, tracking and ensuring timely delivery.
- Perform other duties as needed.
- Comply with all policies and procedures of the Corporation.

#### REQUIREMENTS:

- Bachelor's degree in supply chain management or related field.
- Minimum 1-3 years of supply chain planning or related experience
- Knowledge of planning processes and activities.
- Knowledge of ERP/MRP system operation, preferably with Microsoft Dynamics 365.
- ASCM Certification a plus.
- Strong leadership, interpersonal and communications skills

#IN

Balchem is committed to a workplace culture that values and promotes diversity, inclusion, equal employment opportunities, and a work environment free of harassment and hostility

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POSTED ON 6/8/2023    AVAILABLE BEFORE 12/7/2023

[Boeing](#)    Ridley Park, PA    Other

## Job Posting for **Entry Level Supply Chain Specialist** at **Boeing**

### Job Description

At Boeing, we innovate and collaborate to make the world a better place. From the seabed to outer space, you can contribute to work that matters with a company where diversity, equity and inclusion are shared values. We're committed to fostering an environment for every teammate that's welcoming, respectful and inclusive, with great opportunity for professional growth. Find your future with us.

**Boeing Global Services (BGS)** is currently looking for an **Entry Level Supply Chain Specialist (Level 1)** to join the team in **Ridley Park, PA**.

In this role the selected candidate will manage the inventory of international defense customers.

## **Position Responsibilities**

Duties will include (but are not limited to):

Create and Manage Spare Parts Orders to satisfy customer requirements when no inventory is available.

Performs or maintains routine inventory procedures. Processes material returned from the customer and makes recommendations concerning disposition.

Enters, tracks and monitors customer requirements/inquiries using various job processes and systems to support our customers. Identifies and responds to customer supply chain management issues of routine scope and complexity using established processes, policies and practices for guidance to understand and meet customer needs.

Processes and tracks supply chain management data from multiple sources, prepares data and inputs into tools and models in order to maintain supply chain effectiveness and efficiency.

Processes and tracks supply chain requirements with internal/external suppliers in order to support demands and ensure best value (e.g., schedule, quality, price, cycle time) for Boeing and the customer.

Prepares for supplier/customer interface requirements or needs by supporting related activities to improve or sustain performance or program status.

Collects customer, supplier, and industry information to support the development, planning, testing, and implementation of process, product, system and program enhancements and revisions.

Collects supplier and/or customer data regarding products or services to include production or repair capabilities, capacity, and performance in order to support product improvement opportunities. Summarizes and communicates findings to appropriate parties.

When the parameters are clearly defined, generates and analyzes supply chain performance and management metrics data and charts for the organization's leadership used to manage business operations. Supports administration of budget plan.

Coordinate the movement of assets and components through the repair cycle. Process documentation associated with the movement of repair articles to ensure traceability of assets and customer visibility.

***This position is hybrid. This means that the selected candidate will be required to perform some work onsite at one of the listed location options. This is at the hiring team's discretion and could potentially change in the future.***

**The position must meet Export Control compliance requirements, therefore a “US Person” as defined by 22 C.F.R. § 120.15 is required. “US Person” includes US Citizen, lawful permanent resident, refugee, or asylee.**

#### **Basic Qualifications (Required Skills / Experience):**

Experience and/or knowledge in Supply Chain/Demand Planning

Experience and/or knowledge in Forecasting and Inventory Management

Experience with Microsoft Office Suite (Word, Excel, PowerPoint)

#### **Preferred Qualifications (Desired Skills / Experience):**

Bachelor of Science Degree with focus on Supply Chain or Planning

Supply Chain Basic Knowledge

MS Office (Excel, PowerPoint, Word)

Oracle or SQL Experience

#### **Typical Education & Experience:**

Education/experience typically acquired through advanced education (e.g. Bachelor) or an equivalent combination of education and experience (e.g. 4 years' related work experience).

**Relocation:**

Relocation assistance is not a negotiable benefit for this position. Candidates must live in the immediate area or relocate at their own expense.

**Drug Free Workplace:**

Boeing is a Drug Free Workplace where post offer applicants and employees are subject to testing for marijuana, cocaine, opioids, amphetamines, PCP, and alcohol when criteria is met as outlined in our policies.

**Shift:**

This position is for 1st shift.

**Salary:**

At Boeing, we strive to deliver a Total Rewards package that will attract, engage and retain the top talent. Elements of the Total Rewards package include competitive base pay and variable compensation opportunities.

The Boeing Company also provides eligible employees with an opportunity to enroll in a variety of benefit programs, generally including health insurance, flexible spending accounts, health savings accounts, retirement savings plans, life and disability insurance programs, and a number of programs that provide for both paid and unpaid time away from work.

The specific programs and options available to any given employee may vary depending on eligibility factors such as geographic location, date of hire, and the applicability of collective bargaining agreements.

Please note that the salary information shown below is a general guideline only. Salaries are based upon candidate experience and qualifications, as well as market and business considerations.

Summary pay range: \$56,950 - \$77,050

**Export Control Requirements:** U.S. Government Export Control Status: This position must meet export control compliance requirements. To meet export control compliance requirements, a "U.S. Person" as



defined by 22 C.F.R. §120.15 is required. "U.S. Person" includes U.S. Citizen, lawful permanent resident, refugee, or asylee.

**Export Control Details:** US based job, US Person required

**Equal Opportunity Employer:**

Boeing is an Equal Opportunity Employer. Employment decisions are made without regard to race, color, religion, national origin, gender, sexual orientation, gender identity, age, physical or mental disability, genetic factors, military/veteran status or other characteristics protected by law.

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Hourly Wage Estimation for **Entry Level Supply Chain Specialist** in Ridley Park, PA

**\$52.08 to \$70.48**

---

Sign up to receive alerts about other jobs with skills like those required for the **Entry Level Supply Chain Specialist**.

Click the checkbox next to the jobs that you are interested in.

### Build To Stock Skill

**Calibration Technician II** ⓘ

Income Estimation: \$59,533 - \$79,619

**Cost Estimation Engineer I** ⓘ

Income Estimation: \$63,594 - \$81,614

### Data Collection Skill

**Financial Assistant (Corporate)** ⓘ

Income Estimation: \$53,726 - \$73,864

**Capacity Planner I** ⓘ

Income Estimation: \$58,405 - \$79,608

[Apply for this job and sign up for alerts](#)

**Employees:** [Get a Salary Increase](#)



## Job openings at **Boeing**

### Associate Procurement Agent

**Boeing**

Huntsville, AL Other

Job Description At Boeing, we innovate and collaborate to make the world a better place. From the seabed to outer space,...

### Associate Manufacturing Engineering Planner (COE)

**Boeing**

Huntsville, AL Other

Job Description At Boeing, we innovate and collaborate to make the world a better place. From the seabed to outer space,...


### Test & Evaluation Lab Technician 5 (contract)



**Boeing**

 Madison, AL  Full Time

Oversees planning, execution and documentation of tests on products, systems, components, materials, and manufacturing p...

### Principal Strategy Analyst

 **Boeing**



 Huntsville, AL  Other

Job Description At Boeing, we innovate and collaborate to make the world a better place. From the seabed to outer space,...

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Not the job you're looking for? Here are some other **Entry Level Supply Chain Specialist** jobs in the **Ridley Park, PA** area that may be a better fit.

#### Sponsored

 [pandionalliance.com](https://www.pandionalliance.com)  
<https://www.pandionalliance.com/healthcare/supply-chain> 

### Pandion Optimization Alliance - Supply Chain Consulting

Providing Cost-Effective Solutions To Help Streamline Operations & Enhance Performance! Our Reach Helps Us Anticipate, Identify & Deliver Cost-Saving Opportunities To You! Maximum cost savings. Local & regional buying. Be a member at no cost. Best-in-class purchasing. Superior customer service. Services: Group Purchasing, Sourcing & Purchasing, Consulting.

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[Why Choose Us](#)      [Who We Are](#)

### Jr. Supply Chain Analyst

Logistics Plus Inc. , Erie, PA

### Supply Chain Specialist

WE-EF LIGHTING USA , Warrendale, PA

### Supply Chain Specialist

**Oxford Solutions** , Pittsburgh, PA

**Supply Chain Specialist**

**Zobility** , Moon Township, PA

**Supply Chain Specialist**

**Zobility** , Moon Township, PA

**Deloitte Consulting, US Delivery Center, Government & Public Services - Solution Analyst (Busines...**

**Deloitte** , Mechanicsburg, PA

**Supply Chain Specialist**

**Boothwyn Pharmacy** , Kennett Square, PA

**Regional Supply Chain Specialist**

**ProducePay** , Philadelphia, PA

**Entry-Level Supply Chain Specialist / Supply Chain Specialist**

**Boeing**, Ridley Park, PA

**Intern - Supply Chain**

**Supply Chain - Energy Transfer Family of Partnerships Careers, NEWTOWN SQUARE, PA**

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We search millions of resumes on Indeed to show candidates that fit your job description. You need Indeed's all-in-one employer hiring platform.. Number 1 Job Site. Post Jobs. Hire Local Talent. Reach 250M Job Seekers. Post a Job in Minutes. Services: Post Jobs, Resume Search, Sponsored Job Postings, Hiring Resources.

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4.7  (1k+)

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## Chemical Supply Chain Specialist (Entry Level)

3 months ago

**Requisition #** 21724    **Security Clearance** None    **FT/PT/On-Call** Full Time    **📍** US-VA-Reston

**Minimum Salary** USD \$54,800.00/Yr.    **Maximum Salary** USD \$95,900.00/Yr.

### Responsibilities

On Noblis' energy and environment team, we are dedicated to addressing our planet's biggest environmental challenges, including chemical supply chain risk management. Increasing global chemical regulations and changing market forces are impacting the ability to reliably source various products. Lack of knowledge regarding the presence of chemicals in the supply chain makes it challenging to assess and mitigate the impacts from product obsolescence or supply chain disruption.

We are seeking a professional who will be a member of our team supporting our Federal government customers. Our team conducts assessments that include different elements of supply chain resilience and sustainability, such as surveys of manufacturers and suppliers to evaluate the health and responsiveness of the industrial base; technical assessment of manufacturing capabilities; economic assessment to better understand market incentives for supply chain resilience; illumination studies to determine location of chemicals and products; and analysis of Foreign Ownership, Control or Influence.

As a **Chemical Supply Chain Specialist** on our team, you will assist with analytical research, data analysis, and stakeholder engagement. You will work to develop an understanding of our Federal customers' priorities and missions, and provide Supply Chain Risk Management (SCRM) solutions.

### Responsibilities:

- Research and analyze chemical supply chain data by performing in-depth online searches, gathering open source and customer data, and utilizing subscription services and tools.
- Contribute to supply chain illumination assessments by mapping companies, people, and products to increase visibility into supply chain
- Contribute to SCRM assessments (e.g., supply chain risks against defense systems, supply chain mapping, assessment of manufacturing capabilities, market assessment)
- Develop, clean, and maintain various datasets
- Identify critical suppliers and evaluate supply chain risk



analysis

- Ensure performance of tasks within scope and direction of project manager

## Qualifications

- U.S. Citizenship is required
- Eligibility to obtain DoD Secret Clearance
- Bachelor's degree in relevant field (e.g., supply chain management, engineering, chemistry, or other field relevant to supply chain analysis)
- Proficient with data analysis and tools such as Excel
- Excellent communication and writing skills
- Presentation skills and experience presenting to technical and nontechnical audiences
- Works well in a geographically diverse team environment

## Desired Qualifications:

- 1-5 years of professional experience related to supply chain analysis
- Master's degree in relevant field (e.g., supply chain management, MBA, engineering, chemistry, or other field relevant to supply chain analysis)
- Knowledge of U.S. Government agencies including, Department of Defense (DoD), Homeland Security, State, Commerce
- Experience with programming languages and data transformation/visualization tools and techniques
- Experience with supply chain risk management research and analysis in accordance with DoD SCRM standards
- Strong preference for candidates located in the Washington, D.C. metro area.

## Client Engagement

- Learn about and support Noblis' client engagement, corporate values, and corporate strategic priorities, including providing input to proposal writers.
- Build a productive relationship with your client and understand their structure and goals.
- Participate in the proposal process by providing input to proposal writers.

## Overview

**At Noblis we recognize and reward your contributions, provide you with growth opportunities, and support your total well-being. Our offerings include health, life, disability, financial, and retirement benefits, as well as paid leave, professional development, tuition assistance, and work-life programs. Our award programs acknowledge employees for exceptional performance and superior demonstration of our service standards. Full-time and part-time employees working at least 20 hours a**



**Salary at Noblis is determined by various factors, including but not limited to, the combination of education, certifications, knowledge, skills, competencies, and experience, internal and external equity, location, and clearance level, as well as contract-specific affordability and organizational requirements and applicable employment laws. The projected compensation range for this position is provided within the posting and are based on full time status. Part time staff receive a prorated salary based on regularly scheduled hours. The estimated minimum and maximum displayed represents the broadest range for this position (inclusive of high geographic and high clearance requirements), and is just one component of Noblis' total compensation package for employees.**

Noblis and our wholly owned subsidiaries, Noblis ESI, and Noblis MSD tackle the nation's toughest problems and apply advanced solutions to our clients' most critical missions. We bring the best of scientific thought, management, and engineering expertise together in an environment of independence and objectivity to deliver enduring impact on federal missions. Noblis works with a wide range of government clients in the defense, intelligence and federal civil sectors. Learn more at [Noblis -About Us](#)

### **Why work at a Noblis company?**

Our employees find greater meaning in their work and balance the other things in life that matter to them. Our people are our greatest asset. They are exceptionally skilled, knowledgeable, team-oriented, and mission-driven individuals who want to do work that matters and benefits the public. Noblis has won numerous workplace awards. Noblis maintains a drug-free workplace.

Noblis is an Equal Opportunity Employer. Employment decisions are made without regard to race (as well as because of or on the basis of traits historically associated with race, including hair texture, hair type, and protective hairstyles such as braids, locks, and twists), color, religion, national origin, gender, sexual orientation, gender identity, age, physical or mental disability, pregnancy, childbirth, lactation and related medical conditions, genetic factors, military/veteran status, or other characteristics protected by law.

Noblis is committed to the full inclusion of all qualified individuals. As part of this commitment, Noblis will ensure that persons with disabilities are provided reasonable accommodations. If reasonable accommodation is needed to participate in the job application or interview process, to perform essential job functions, and/or to receive other benefits and privileges of employment, please contact [\*\*employee-relations@noblis.org\*\*](mailto:employee-relations@noblis.org).



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### CONTACT

Human Resources: [hr@noblis.org](mailto:hr@noblis.org)

Talent Acquisition: [careers@noblis.org](mailto:careers@noblis.org)

General Questions: [answers@noblis.org](mailto:answers@noblis.org)

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**Entry Level Supply Chain Specialist**

Boeing  
Ridley Park, PA  
via Salary.com

🕒 23 days ago 🏢 Full-time 🛡️ Health insurance  
🏠 Dental insurance

C

**Supply Chain Risk Management Analyst - Junior with Security Clearance**

ClearanceJobs  
Washington, DC  
via LinkedIn

🕒 29 days ago 🏢 Full-time 🛡️ Health insurance  
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I

**Strategic Outsourcing Project Manager - Clinical Supply**

ICON Strategic Solutions  
Richmond, VA  
via Learn4Good

🕒 9 days ago 🏢 Full-time

M

**McKesson Corporation**

Richmond, VA  
via [www.careerbuilder.com](http://www.careerbuilder.com)

🕒 Expired

EY

**Business Consulting Senior - Supply Chain & Operations-EAST**

EY  
Richmond, VA  
via Nextt

🏢 Full-time 🛡️ Health insurance 🏠 Dental insurance  
📅 Paid time off

S

**RAW MATERIALS BUYER**

Sauer Brands, Inc.  
Richmond, VA  
via ZipRecruiter

🕒 8 days ago 🏢 Full-time

SINCLAIR

**Strategic Sourcing Agent**

Sinclair Broadcast Group  
Cockeysville, MD  
via ShowbizJobs

🏢 Full-time

IR

**LOGISTICS ANALYST**

Integrated Resources, Inc  
Richmond, VA  
via [Integrated Resources, Inc - Jobs.net](http://IntegratedResources.com)

🕒 30 days ago 🏢 Full-time

C

**Logistics Specialist (NOC 1215)**

CTC Logistics  
Richmond, VA  
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## Entry-level Supply Chain/Procurement Specialist

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**Job highlights**

Identified by Google from the original job post

**Qualifications**

- MUST have a minimum of a Bachelors Degree, in either Supply Chain Management or Procurement

**Responsibilities**

- The Sourcing Specialist, Indirect Goods & Services will report directly to the Head of Indirect Strategic Sourcing Americas
- This person will be responsible for end-to-end (PR to PO) sourcing and contracting of corporate indirect goods and services
- This position will act as a strategic buying function, supporting the execution of competitive bid events, evaluating bids and providing award recommendations, executing PO's, and following up with suppliers in relation to contract compliance
- The scope of this position requires working closely with internal and external cross-functional departments to maximize potential value for transactions

**Benefits**

- We also offer a number of Work/Life Programs such as Flextime and a variety of Training and Development opportunities
- Hitachi Rail STS employees enjoy a comprehensive benefits package including Competitive Pay, Medical, Dental and Vision Insurance, Short & Long Term Disability, Life & Accident Insurance, Flexible Spending Accounts, Savings Plan, and Paid Vacation

**Job description**

Hitachi Rail is looking for an enthusiastic self-motivated entry-level Supply Chain/Procurement Specialist who thrives in a fast-paced environment. The successful candidate is comfortable performing a wide range of tasks from administrative to strategic. The position is based in Pittsburgh, PA.

**Who We Are:**

Hitachi Rail is a fully integrated, global provider of rail solutions across rolling stock signaling, service & maintenance, digital technology and turnkey. With a presence in 38 countries across three continents and over 13,000 employees, our mission is to contribute to society through the continuous development of superior rail transport solutions.

The Sourcing Specialist, Indirect Goods & Services will report directly to the Head of Indirect Strategic Sourcing Americas. This person will be responsible for end-to-end (PR to PO) sourcing and contracting of corporate indirect goods and services. This position will act as a strategic buying function, supporting the execution of competitive bid events, evaluating bids and providing award recommendations, executing PO's, and following up with suppliers in relation to contract compliance. The scope of this position requires working closely with internal and external cross-functional departments to maximize potential value for transactions.

**Knowledge/Skills/Experience**

MUST have a minimum of a Bachelors Degree, in either Supply Chain Management or Procurement

**Language:**

English

**Benefits:**

Hitachi Rail employees enjoy a comprehensive benefits package including Competitive Pay, Medical, Dental and Vision Insurance, Short & Long Term Disability, Life & Accident Insurance, Flexible Spending Accounts, Savings Plan, and Paid Vacation. We also offer a number of Work/Life Programs such as Flextime and a variety of Training and Development opportunities.

We thank all applicants for their interest; however, only those under consideration will be contacted. Join us at [www.HitachiRail-sts.com/en/careers](http://www.HitachiRail-sts.com/en/careers).

It is our commitment at Hitachi Rail to create a diverse environment and we are proud to be an equal opportunity employer. All qualified applicants will receive consideration for employment without regard to race, color, religion, gender, gender identity or expression, sexual orientation, national origin, genetics, disability, age, or veteran status.

**We would be delighted if you would be one of our followers!**

Have a glance at our LinkedIn page <https://www.linkedin.com/company/hitachirail/>

**Benefits:**

Hitachi Rail STS employees enjoy a comprehensive benefits package including Competitive Pay, Medical, Dental and Vision Insurance, Short & Long Term Disability, Life & Accident Insurance, Flexible Spending Accounts, Savings Plan, and Paid Vacation. We also offer a number of Work/Life Programs such as Flextime and a variety of Training and Development opportunities.

We thank all applicants for their interest; however, only those under consideration will be contacted. Join us at [www.ansaldo-sts.com/en/careers](http://www.ansaldo-sts.com/en/careers)

It is our commitment at Hitachi Rail STS USA Inc. to create a diverse environment and we are proud to be an equal opportunity employer. All qualified applicants will receive consideration for employment without regard to race, color, religion, gender, gender identity or expression, sexual orientation, national origin, genetics, disability, age, or veteran status

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# Supply Chain Industrial Readiness Specialist (Entry-level)



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## Job Posting for **Supply Chain Industrial Readiness Specialist (Entry-level)** at **MRA SYSTEMS LLC**

Description

### About Us:

**Middle River Aerostructure Systems** is a world-leading manufacturer of thrust reversers (the braking system on a jet engine), engine nacelle components and specialized aerostructures. It supplies and supports these products for engine makers, airplane manufacturers and aircraft operators. Located on Maryland's Chesapeake Bay near Baltimore, MRAS has a 1.7-million sq. ft. facility situated on 180 acres – where the company and its predecessors have designed, built and equipped civil and military aircraft for over 90 years. In 2019, MRAS was acquired by ST Engineering North America, the U.S. affiliate of Singapore-based ST Engineering – becoming a part of its global network of aerospace facilities and offices. With the ownership change, the company was renamed Middle River Aerostructure Systems.

**Role Summary:**

ST Engineering Aerospace – Middle River Aerostructure Systems, LLC. is looking for a Supply Chain Industrial Readiness Specialist with technical manufacturing interest to interface with the internal sourcing team, suppliers, and customers, to drive adherence to program schedule and support customer reporting requirements.

In this role, you will evaluate suppliers' manufacturing systems, processes and procedures to assess industrial capacity, identify risks, and drive corrective action. This role also involves creating and/or enhancing tools to measure, summarize, and present to both internal and external stakeholders and customers.

**Essential Responsibilities:**

As a Supply Chain Industrial Readiness Specialist, you will:

- Create and/or manage various supplier metrics and scorecards
- Assist in creating supplier recovery tracking tools and supporting supplier recoveries
- Conduct supplier demand analyses
- Monitor and/or manage supplier work transfers
- Participate in cross-functional technical issue resolution
- Create and/or manage various supplier evaluation and reporting tools
- Support supplier on-site evaluations and reviews, occasionally with customers
- Support various supplier risk mitigation activities
- Perform capacity evaluation activities including rate demonstration/ run-at-rate, cycle time analyses, and time studies
- Assist with supplier material nonconformance (MRB) elimination and first-time yield improvement
- Evaluate supplier industrial planning for future rates
- Support regular customer industrial reviews involving PowerPoint slide deck creation and presentation
- Occasionally assist with various sourcing buyer tasks

**Requirements**

Bachelor's degree from an accredited university (supply chain or industrial/technical degree preferred)

- Minimum two years' experience in manufacturing, supply chain, engineering, quality and/or sourcing/procurement strongly preferred
- Strong Microsoft Office skills, particularly Excel and PowerPoint
- Ability to travel
- Experience working within cross functional teams

- Knowledge of aviation manufacturing, supply chain, planning, engineering, and quality concepts; machine, sheet metal, casting, forging, forming, composite, and/or raw material commodities

### Desired Characteristics

- Ability to lead assessments and project workouts
- Ability to comprehend engineering drawings and models
- Ability to work in a fast-paced environment
- Critical self-thinker, strong problem-solving skills, and ability to operate independently
- Familiar with ERP systems (Oracle and/or SAP desired) and SRM
- Strong communication and presentation skills
- Lean manufacturing experience
- Aerospace industry experience

MRAS is an equal opportunity employer and service provider and does not discriminate on the basis of race, age, religion, gender, gender identity, national origin, citizenship status, sexual orientation, disability, political affiliation or belief, or any other protected class. We are committed to the principles of Equal Opportunity Employment and are dedicated to making employment decisions based on merit and value.

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**MRA SYSTEMS LLC**

Baltimore, MD Full Time

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 MRA SYSTEMS LLC Baltimore, MD  Full Time

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### Mechanical Engineer - Systems

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Patuxent Roofing and Contracting, LLC , Laurel, MD

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Advantage Technical , Columbia, MD

**Licensed Multi Trade Specialist**

**University of Maryland Medical System , Baltimore, MD**

**MAINTENANCE ASSISTANT (Entry Level) 1st shift**

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**Supply Planning Manager**

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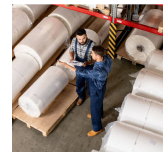
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# Supply Chain Analyst

POSTED ON 8/25/2023    AVAILABLE BEFORE 2/24/2024

[Ferguson Enterprises, LLC](#)    Newport, VA    Full Time

## Job Posting for **Supply Chain Analyst** at **Ferguson Enterprises, LLC**

Job Posting: Ferguson is North America’s leading value-added distributor across residential, non-residential, new construction and repair, maintenance, and improvement (RMI) end markets. Spanning 34,000 suppliers and more than one million customers, we deliver local expertise, value-added solutions, and the industry’s most extensive portfolio of products. From infrastructure, plumbing, and appliances, to HVAC, fire protection, fabrication, and more, we make our customers’ complex projects simple, successful, and sustainable. Ferguson is currently seeking the right individual to fill an immediate need for a Supply Chain Analyst within the Supply Chain Management team. The ideal candidate is an energetic and highly



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Job Openings

recommend specific courses of action based on analysis of special requests for management or internally generated opportunities. Develop the supply chain with partnered vendors to achieve target business results that create and maintain a competitive advantage for the Company. Assist in design, development, and implementation of data gathering and analysis tools and processes. Recommend procedural changes to improve efficiency of Supply Chain operations. Work cross-functionally with Ferguson departments to define standard operational procedures in support of creating a positive vendor partnership Create and deliver training in live, recorded, and written formats Oversee a significant Supply Chain process or function and manage all aspects of executing said process or function. Educate others throughout the organization on Supply Chain management and its impact on roles and collective opportunities. Act as a liaison cross functionally to ensure tasks are completed on time Performs all work in accordance with established safety standards and adheres to all safety policies, rules, regulations, and procedures. Participates in associate meetings and communicates any concerns to management. Performs other related duties as requested by management. Qualifications: Bachelor's degree in supply chain, business, or related field preferred Strong analytical skills with the ability to dissect operational reporting to identify areas of focus Proficient in analysis and reporting Strong intuition for business and critical thinking skills Strong verbal and written communication skills are required Strong organizational skills with attention to detail and accuracy Strong judgment and decision-making ability Possess intermediate MS Excel, Power BI, and PowerPoint skills Able to work both independently and in a team environment Able to manage priorities and get tasks accomplished in a timely and efficient manner Highly motivated and customer service oriented individual Ferguson is dedicated to providing meaningful benefits programs and products to our associates and their families—geared toward benefits, wellness, financial protection, and retirement savings. Ferguson offers a competitive benefits package that includes medical, dental, vision, retirement savings with company match, paid leave (vacation, sick, personal, holiday, and parental), employee assistance programs, associate discounts, community involvement opportunities, and much more! - Pay Range: - \$3,600.00 - \$5,866.30 - Estimated Ranges displayed are Monthly for Salaried roles OR Hourly for all other roles. - This role is Bonus or Incentive Plan eligible. - The Company is an equal opportunity employer as well as a government contractor that shall abide by the requirements of 41 CFR 60-300.5(a), which prohibits discrimination against qualified protected Veterans and the requirements of 41 CFR 60-741.5(A), which prohibits discrimination against qualified individuals on the basis of disability. Ferguson Enterprises, LLC. is an equal employment employer F/M/Disability/Vet/Sexual Orientation/Gender Identity. Equal Employment Opportunity and Reasonable Accommodation Information Ferguson is a project success company providing expertise, solutions and products from infrastructure, plumbing and appliances to HVAC, fire, fabrication and more. As a leading value-added distributor of residential and commercial plumbing supplies and pipe, valves and fittings in the U.S., we exist to make our customers' complex projects simple, successful and sustainable. The professionals we serve help transform the world we live in, and we are their trusted partners with the scale to provide peace of mind. Founded in 1953, Ferguson is part of Ferguson plc, which is listed on the New York Stock Exchange (NYSE: FERG) and London Stock Exchange (LSE: FERG). With approximately 36,000 associates across 1,700 locations, Ferguson plc serves customers in all 50 states, Canada, Puerto Rico, Mexico and the Caribbean.



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Salary.com Estimation for **Supply Chain Analyst** in **Newport, VA**

**\$65,461 to \$85,280**

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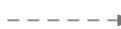
Sign up to receive alerts about other jobs that are on the **Supply Chain Analyst** career path.

Click the checkbox next to the jobs that you are interested in.



**Supply Chain Analyst II** ⓘ

Income Estimation: \$69,140 - \$90,072



**Supply Chain Analyst III** ⓘ

Income Estimation: \$86,392 - \$109,069

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**Supply Chain Optimization Skill**

**Materials Management Manager** ⓘ

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**Supply Chain Manager** ⓘ

Income Estimation: \$116,048 - \$156,318

**Supply Chain Planning Skill**

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Income Estimation: \$116,048 - \$156,318

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**Associate Material Specialist**

MKS2 Technologies , Glen Allen, VA

**Supply Chain Coordinator**

TECHEAD , Richmond, VA

**Senior Supply Chain Analyst (Remote Opportunity)**

**Smithfield Foods** , Suffolk, VA

**Supply Chain Planner**

**ProKatchers LLC** , Front Royal, VA

**Supply Chain OpEx Lean Facilitator**

**J.Crew** , Lynchburg, VA

**Senior IT Business Analyst - Supply Chain Traceability (Hybrid Opportunity)**

**Smithfield Foods** , Smithfield, VA

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# Logistics Specialist (NOC 1215)

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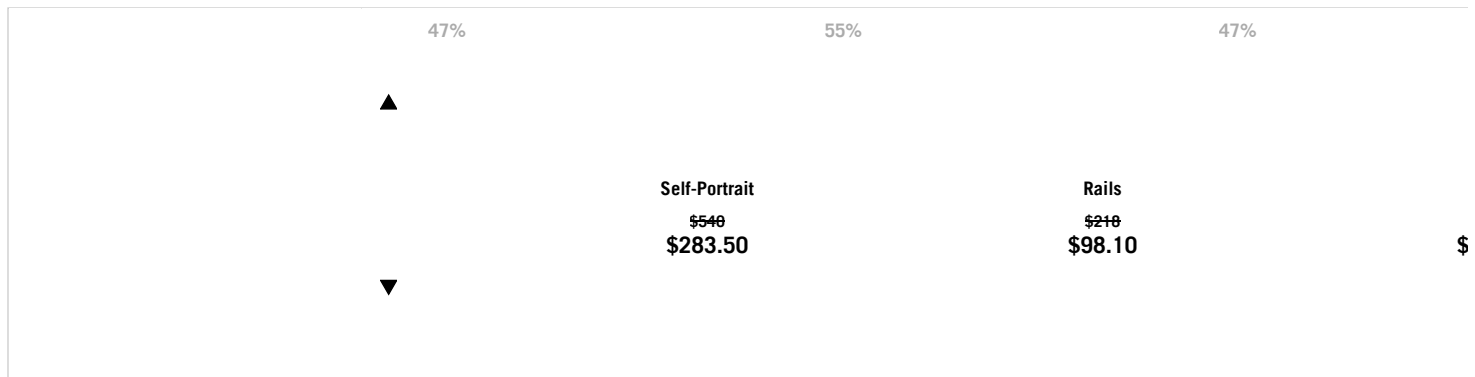
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🕒 August 5, 2023

🏢 CTC LOGISTICS

📍 Richmond, Virginia

📁 OTHER



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### Job Description

- Monitors the quality, quantity, cost and efficiency of the movement and storage of goods.
- Develops methods and procedures for transportation of commodities for designated shippers from local or offshore locations to warehouses, other storage facilities or final consignee locations.
- Liaise and negotiates with customers and suppliers.
- Develops business by gaining new contracts, analysis logistical problems and producing new solutions.
- Analyzes data to monitor performance and plan improvements and demand.
- Schedules the appropriate service line for the situation (across all modes and all trade lanes) to maintain a cost effective balance between customer service and cost of shipment.
- Works closely with client's representative to ensure service satisfaction.
- Develops, analyzes and implements procedures for tracking/tracing shipments. Plans and schedules appropriate modes of transportation based on daily needs.
- Schedules the appropriate service line for the situation (across all modes and all trade lanes) to maintain a cost effective balance between customer service and cost of shipment


### Minimum Requirements

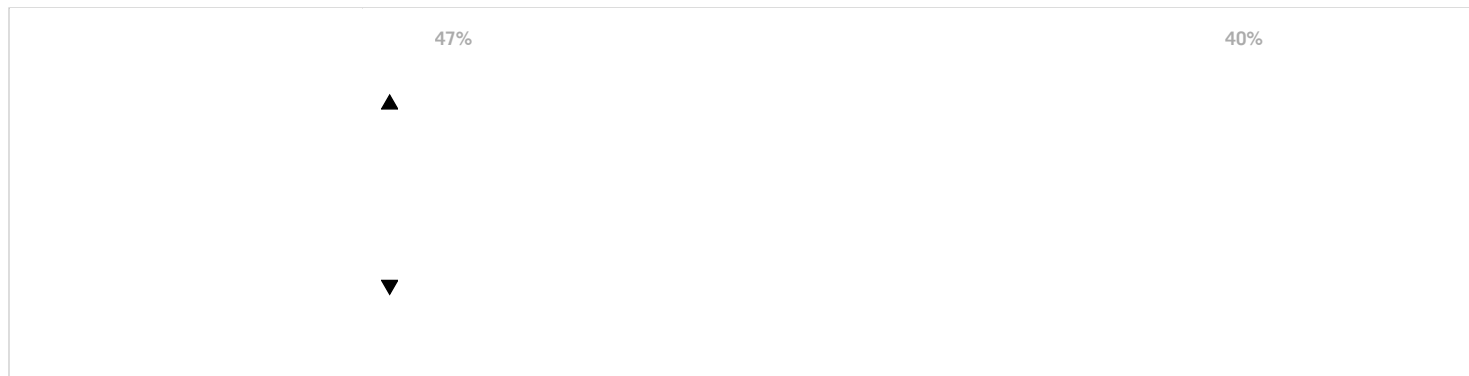
- Bachelor's Degree in Business, Transportation, Logistics or equivalent combination of experience and education.

- Minimum of 1 year experience of logistics management
- Advanced knowledge of computer literacy, including Word, Excel and PowerPoint

**SKILLS AND ABILITIES REQUIRED**

- Must possess the ability to manage multiple tasks from multiple services/locations as well as the mode of transport, costs, warehousing and distribution center management.
- Must have ability to communicate effectively with all levels of operation and staff.
- English-Mandarin Chinese speaking is preferred.

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### Description

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Imagine joining an industry leader to further develop your Logistics and Supply Chain career with a Monday-Friday hybrid work schedule, wide-ranging benefits package, and competitive pay

As a Logistics and Supply Chain Specialist at Century you are responsible for impacting the successful delivery of, both intact and transload/over the road, as well as domestic FTL/LTL and Mexico/Canada cross-border operations. The Specialist actively executes the operational process with minimal supervision, works to identify and address any operational or customer issues to be overcome, and is a primary person responsible for the end-to-end deliverable of this service.

**Monday through Friday, 9:00 am to 5:30 pm. Hybrid work schedule with office located in Innsbrook, Glen Allen, Virginia.**

**This position is hybrid/remote and offers the following benefits:**

- Competitive salaried compensation
- Medical
- Dental
- Vision
- 401(k) with Matching
- Life insurance
- Short-term and long-term disability
- Paid holidays
- Vacation and Sick Time
- Real, achievable advancement opportunities.
- Industry Leader: Enjoy working with a leader in the industry due to superior service, high-quality products, and competitive pricing.

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### ESSENTIAL FUNCTIONS AND DUTIES:

- Coordinating support needs for assigned customers.
- Ability to identify and resolve basic operational problems.
- Ability to identify and resolve problems with minimal supervision.

- Manage correspondence with customer and vendors to resolve operational issue.
- Customer facing requirements including attending customer/vendor meetings when necessary.
- Supply Chain or Logistics Experience a plus
- Bachelors Degree in Logistics, Supply Chain Management or relative field
- Strong written and verbal communication skills
- B2B Customer Service Experience
- Ability to effectively communicate effectively during face to face meetings with customers
- Intermediate Excel skills and ability to learn and master various proprietary software programs
- Highly organized individual with excellent time management skills
- Critical thinking skills and ability to effectively multi-task.

Century Distribution Systems Inc. is an equal opportunity employer and is committed to compliance with all applicable laws prohibiting employment discrimination. All qualified applicants will receive consideration for employment without regard to race, color, religion, sex, sexual orientation, gender identity or expression, pregnancy, age, national origin, disability status, genetic information, protected veteran status, or any other characteristic protected by law.

All applications will be used exclusively for selection purposes and handled confidentially by authorized personnel only. Your application may also be considered for other suitable positions within Century Distribution Systems Inc.

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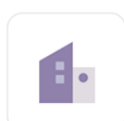
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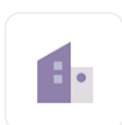
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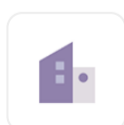
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## Regional Supply Chain Planner, Food

POSTED ON 8/24/2023 AVAILABLE BEFORE 2/23/2024

Gate Gourmet Reston, VA Full Time

### Job Posting for **Regional Supply Chain Planner, Food** at **Gate Gourmet**

We're looking for motivated, engaged people to help make everyone's journeys better.

The Regional Supply Chain Planner is part of the Regional Supply Chain Planning team. This position provides materials planning support to assigned catering units and ensures that they have raw materials required for daily production requirements. Activities include reviewing demand plans, setting inventory policies and placing purchase orders with suppliers to fulfill unit and/or network requirements. The planner must analyze material requirements and plan to meet service objectives while also balancing inventory related financial targets. They must be able to navigate and leverage ERP and MRP systems as well as ad hoc tools to make these daily tactical decisions. The individual must be able to communicate effectively across all levels of the field and headquarters organization.

Main Duties and Responsibilities:

Plans and purchases products designated for use in catering/production, replenishment and sales to customers. Analyzes inventory to ensure consistency with production plan and company inventory policies.

Consolidates and analyzes unit Enterprise Resource Planning (ERP) requirements for use in Material Resource Planning (MRP) process. Sets, monitors and ad

Generates purch

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Monitors menus and meal cycle changes for materials requirements. Checks the accuracy of information received from the responsible unit(s). Manages the cross functional flow of data to support demand and supply planning execution at all stages of the product life cycle (Phase In, Current, Phase Out, Obsolete)

Works closely with vendors, procurement, commercial and field operations to address and resolve issues.

Communicates issues and provides timely solutions for product availability issues. Conducts investigations as needed to determine root cause for issues as well as measuring the financial impact.

Participates in new product introduction / cycle change process to ensure successful launch.

Collaborates with procurement, finance, and operations to suggest, align on, and implement inventory policies that meet the Company's performance objectives.

Works directly with Unit GMs and unit supply chain/operations teams to achieve service objectives, financial targets and to resolve materials issues.

Provides support to unit to troubleshoot stock variance, actual vs. theoretical usage variances and general issue resolution.

Participates in Weekly Materials Management Meetings to review KPIs related unit performance and process compliance.

Monitors units to ensure that an accurate food, beverage and controllable materials inventory is kept.

Other duties as assigned

#### Qualifications

##### Education:

Bachelor's degree in business, supply chain management or related field required

##### Work Experience:

Functional experience with material purchasing, forecasting, supply chain management  
Experience in planning and replenishment flows.  
Knowledge of supply chain management within the airline industry a plus

##### Technical Skills: (Certification, Licenses and Registration)

Advanced capabilities with Microsoft Excel, Word and Access  
Functional knowledge of ERP (Enterprise Resource Planning) systems and MRP planning processes.  
Knowledge of supply chain programs and the ability to manage project execution of these programs.  
Excellent analytical skills and problem-solving skill  
Knowledge of statistical software a plus  
Must be detailed oriented  
Must have the ability to work in a fast paced, deadline driven environment  
Willing to learn and implement new processes and procedures.  
Continuous improvement mindset  
APICS Certification a plus

##### Language / Communication Skills:

Excellent communication skills, both written & oral  
Strong interpersonal skills

##### Job Dimensions

Geographic Responsibility: North America

Type of Employment: Full-time

Travel %: up to 10%

Exemption Classification: Exempt

Internal Relationships: all internal departments

External Relationships: Suppliers and external customers

Work Environment / Requirements of the Job: Regular Office Environment, may spend some time working in food storerooms

### Organization Structure

Direct Line Manager (Title): Regional Supply Chain Planning Manager

Dotted Line Manager (Title, if applicable): na

Number of Direct Reports: 0

Number of Dotted Line Reports: 0

Estimated Total Size of Team: 1

gategroup Competencies Required to be Successful in the Job:

Thinking – Information Search and analysis & problem resolution skills

Engaging – Understanding others, Team Leadership and Developing People

Inspiring – Influencing and building relationships, Motivating and Inspiring, Communicating effectively

Achieving – Delivering business results under pressure, Championing Performance Improvement and Customer Focus

Demonstrated Values to be Successful in the Position

Employees at gategroup are expected to live our Values of Excellence, Integrity, Passion and Accountability. To demonstrate these Values, we expect to observe the following from everyone:

We treat each other with respect and we act with integrity

We communicate and keep each other informed

We put our heads together to problem solve and deliver excellence as a team

We have passion for our work and we pay attention to the little details

We foster an environment of accountability, take responsibility for our actions and learn from our mistakes

We do what we say we will do, when we say we are going to do it

We care about our coworkers, always taking an opportunity to make someone's day better

The above statements are intended to describe the general nature and level of work being performed by the individual(s) assigned to this position. They are not intended to be an exhaustive list of all duties, responsibilities, and skills required. Management reserves the right to modify, add, or remove duties and to assign other duties as necessary. In addition, reasonable accommodations may be made to enable individuals with disabilities to perform the essential functions of this position.

gategroup is an equal opportunity employer committed to workforce diversity. All qualified applicants will receive consideration for employment and will not be discriminated against on the basis of race, color, religion, sex, sexual orientation, gender identity, national origin, veteran status, disability status or other category under applicable law.

For further information regarding Equal Employment Opportunity, copy and paste the following URL into your web browser:

<http://www.dol.gov/ofccp/regs/compliance/posters/pdf/eeopost.pdf>

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Senior Supply Chain Planner

Salary.com Estimation for **Regional Supply Chain Planner, Food** in Reston, VA

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 Gate Gourmet

 Kahului, HI  Full Time

We're looking for motivated, engaged people to help make everyone's journeys better. Job Summary: A Porter is responsibl...

### Materials Manager

 Gate Gourmet

 Schiller Park, IL  Full Time

Title: Materials Control Manager Location: 4347 United Parkway, Shiller Park, IL Salary range: \$72k -\$75k The Materials ...

### Equipment Set Up


 Gate Gourmet

 Newark, NJ  Full Time

We're looking for motivated, engaged people to help make everyone's journeys better. Job Summary: An Equipment Setup emp...

### Customer Service Admin

 Gate Gourmet

 Cincinnati, OH  Full Time

We're looking for motivated, engaged people to help make everyone's journeys better. Position is responsible for FAC, IF...

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Supply Chain Coordinator

TECHEAD , Richmond, VA

Master Scheduling Specialist

BrightFarms Inc , Elkwood, VA

Senior Supply Chain Analyst (Remote Opportunity)

Smithfield Foods , Suffolk, VA

Supply Chain Planner

ProKatchers LLC , Front Royal, VA

Production Planner

FAREVA RICHMOND, INC , Varina, VA

Senior IT Business Analyst - Supply Chain Traceability (Hybrid Opportunity)

Smithfield Foods , Smithfield, VA

Supply Chain Planner



**Senior Supply Chain Planning Manager**

Apothekary , Lorton, VA

**Supply Chain Planner**

Yoh, A Day & Zimmermann Company, Front Royal, VA

**Supply Chain Planner**

US Tech Solutions Private Limited, Front Royal, VA

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<https://www.thyssenkrupp-supply-chain.com/>

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Our Consultants Support You at Every Step -- Strategic, Tactical or Operational. Capture Maximum Supply Chain Value and Reach Business Goals. 130K+ Employees Worldwide. Deep Industry Expertise. Client Focus. Top 10 Global IT Provider. Trusted Global Innovator. Digital-First Portfolio. Preferred Digital Partner. Services: Applications, BPO, Cloud, Consulting, Cybersecurity.





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Supply Chain Analytics Guide - Manufacturer Supply Chain Need

Gartner's insights into what you should expect in a supply chain A&DI technology vendor. See Gartner's list of existing & emerging tech enabling Supply Chain key capabilities. ChatGPT & Knowledge Graph. Conversational AI. LLM Knowledge Graph. Super scalable. Highly performant. Enterprise Compliant. Flexible graph data model.



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New This Year - Supply Chain 360 Summit! Dive Into Solving Retail's Supply Chain Issues. NRF Supply Chain 360 Summit Is A New Day-Long Program At The Big Show - Find Out More. Where Big Ideas Are Born. 1,000+ Exhibitors. Make It Matter. Over 6,200 Brands. Highlights: A Large Retail Trade Association, In Business For Over A Century.



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### **Supply Chain Strategy Toolkit - By ex-McKinsey Consultants**

Trusted by 200,000 executives, consultants & entrepreneurs from small & large companies. Learn how the Fortune 100 Companies define & execute their Supply Chain Strategy. Increase your revenue. Don't reinvent the wheel. Improve your efficiency. Save hours of work. Increase your profit. Types: Toolkits, Frameworks, Tools, Templates.



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## Integrated Planner, Martinsville, VA

Eastman

Fieldale, VA 24089

### Eastman



★★★★☆ 560 reviews

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Founded in 1920, Eastman is a global specialty materials company that produces a broad range of products found in items people use every day. With the purpose of enhancing the quality of life in a material way, Eastman works with customers to deliver innovative products and solutions while maintaining a commitment to safety and sustainability. The company's innovation-driven growth model takes advantage of world-class technology platforms, deep customer engagement, and differentiated application development to grow its leading positions in attractive end-markets such as transportation, building and construction, and consumables. As a globally inclusive and diverse company, Eastman employs approximately 14,500 people around the world and serves customers in more than 100 countries. The company had 2022 revenues of approximately \$10.6 billion and is headquartered in Kingsport, Tennessee, USA. For more information, visit [www.eastman.com](http://www.eastman.com).

### Eastman Performance Films

Performance Films is a world leader in the manufacturing and marketing of window and paint protection films, with a portfolio of industry-leading professional and consumer brands and product lines, including LLumar®, Vista® by LLumar, FormulaOne® by LLumar, SunTek®, V-Kool™, Huper Optik™ and Gila®.

Location: Onsite based at the Eastman Manufacturing Site in Martinsville, VA

### The Role

The Integrated Planner for Performance Film defines and executes short-term production schedules and supply plans by utilizing variety of tools including Excel, SAP, and OMP. The position requires analytical skills, strong influence and communication skills, and the ability to develop and execute complex plans in support of business, customer, and manufacturing strategies. The planner will regularly interface with procurement representatives, demand planners, manufacturing area leaders, engineers, and sales representatives.

### Responsibilities

- Comply with corporate safety requirements and be a role model for safety excellence.
- Monitor execution plans to fulfill manufacturing order deadlines.

- Develop and implement scheduling tools to improve planning and visibility of product availability for the business.
- Perform ad-hoc “what-if” analysis on supply and production plan scenarios.
- Utilize SAP and OMP systems to maintain all planning parameters, review and manage to resolution all exception messages.
- Identify and resolve conflicts with material availability, capacity availability and order promise data integrity.
- Develop and maintain in-depth knowledge of key customers, markets, and products in area of responsibility.

**Qualifications**

- Requires a Bachelor’s or Master’s degree in Industrial Engineering, Supply Chain Management, or related field of study.
- Requires experience with the following skills: MRP II principles and concepts; Supply Chain processes; Statistical Analysis (hypothesis testing, regression, or design of experiments); and Mathematical Modeling (simulation or optimization).
- Ability to formulate good judgments and clear rationale in making decisions, considering all relevant inputs and alternatives.

Eastman Chemical Company is an equal opportunity employer. All qualified applicants will receive consideration for employment without regard to age, race, color, religion, sex, sexual orientation, gender identity, national origin, disability, veteran status or any other characteristics protected by law.

Eastman is committed to creating a powerfully diverse workforce and a broadly inclusive workplace, where everyone can contribute to their fullest potential each day.

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# Associate Planning Analyst, Supply Chain Management

VTG

2505 International Parkway, Virginia Beach, VA 23452

Hybrid remote

Full-time

**VTG**★★★★☆ [200 reviews](#)[Read what people are saying about working here.](#)

## Job details

Here's how the job details align with your job preferences.

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### Job Type

Full-time

## Benefits

Pulled from the full job description

- Flexible schedule

### Overview:

VTG is seeking an Associate Planning Analyst, Supply Chain Management to support our Virginia Beach, VA corporate office. This role is a hybrid role allowing for telework and in office days each week with flexible schedules.

### Responsibilities:

- Defines and develops material strategy.
- Responsible for the assessment of supply chain resources; aggregates and prioritizes demand requirements.
- Develops, coordinates, and executes material forecasting and delivery schedule.
- Participates in make/buy process, long-term capacity and resource planning; product phase-in/phase-out, manufacturing ramp-up, end-of-life management and product-line management.
- Lead affordability, cost savings, and/or process improvement strategies.
- Analyzes purchase material supply/demand position using Material Requirements Planning (MRP) tools.
- Monitors inventory levels based on dependent and independent Bill-of-Materials (BOM) requirements.

- Creates/reduces supply requirements based on inventory adjustments.
- Participates in long-term capacity and resource planning to ensure proper scheduling of new product line phase-ins as well as existing product line phase-outs.
- Interfaces with Source process area regarding inventory levels, working capital and other areas as needed.
- Receives/reviews requirements for non-standard parts.
- Analyzes lead times and identifies critical path procurements.
- Supports manufacturing production line, providing planned and unplanned requirements in an expedited manner.
- Collaborate cross functionally with supplier quality, engineering, quality, production and other support functions.
- Prioritize and communicate impacts of current and potential material shortages.

#### Qualifications:

- Bachelor's degree with 0 years of experience, or 4 years of experience with a HS diploma in lieu of a degree. Experience must be in supply chain, procurement, logistics or another relevant field.
- Proficient with Microsoft Suite with an emphasis on Excel and Power Point.
- Excellent oral and written communication skills.
- Must have developed organizational skills and the ability to handle multi-tasking.
- Self-motivated and able to work as a teammate and independently.
- Must be a US Citizen.

If you require alternative methods of application or screening, you must approach the employer directly to request this as Indeed is not responsible for the employer's application process.

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# Associate Materials Planner (Hybrid Opportunity)

Smithfield Foods

111 Commerce St, Smithfield, VA 23430

\$50,000 - \$72,600 a year - Full-time

## Smithfield Foods

★★★★☆ 2,791 reviews

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Job Company

## Job details

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### Pay

\$50,000 - \$72,600 a year

### Job Type

Full-time

## Benefits

Pulled from the full job description

- Tuition reimbursement

Job Locations: US-VA-Smithfield Your Opportunity:

The Associate Materials Planner will determine optimal internal vs. external raw materials sourcing decisions while meeting and exceeding company defined key performance indicators. Planning production capacity while balancing the cost of inventory capital, capacity constraints, plant production efficiencies, and customer fill rate objectives. Overseeing the planning of inventories at manufacturing facilities and 3rd party distribution centers to support Smithfield Foods. Coordinates and acts as the liaison with business partners regarding supply chain related projects involving raw materials. Communicates with business partners regarding capacity constraints and limitations for internal manufacturing locations, working with manufacturing facilities and/or suppliers in scheduling production to support sales activity at the least landed cost.

Salary Range: \$50,000 - \$72,600 Core Responsibilities:

- Ensure all master scheduling, product replenishment & inventory management metrics are being met through use of planning software & other departmental processes.
- Identify action items & leverage resources to address action items/follow up on all supply planning related issues.
- Accountable for internal vs. external raw materials sourcing decisions.
- Own & manage the stock transport order (STO) lifecycle from creation to closure.
- Work with internal and external suppliers to ensure raw materials are delivered on time and in sufficient quantities to maximize producing plant production schedules.
- Execute freeze/thaw strategy across network to create supply buffering to manage demand fluctuations & seasonality.
- Provide direction regarding capacity availability or limitations for existing or new production.
- Identify possible material shortages against inventory plans, develop action items, and drive resolution.
- Provide resolution to key shortage issues to upper management.
- Actively interact with all upstream & downstream business partners for strengthening of process opportunities and effectiveness across the company.

*The above statements are intended to describe the general nature and level of work being performed by people assigned to this job. They are not intended to be an exhaustive list of all responsibilities, duties, and skills required of personnel so classified. May perform other duties as assigned.*

Qualifications:

*To perform this job successfully, an individual must be able to perform each essential duty satisfactorily. The requirements listed below are representative of the knowledge, skill, and/or ability required. Reasonable accommodations may be made to enable individuals to perform the essential functions.*

- Bachelor's degree from an accredited college or university in Meat Science, Supply Chain, Logistics, Business or related field; or equivalent combination of education and experience.
- Company will consider a currently enrolled college student with an anticipated graduation by end of current school year as qualified.
- Experience in other areas of the supply chain such as purchasing, customer service, demand planning or logistics is desirable.
- APICS certification, CPIM or CSCP is a plus.
- Experience in planning software is desirable.
- Proficient in using PC-base technology (Excel, Power Point, and Word).
- SAP experience is preferred.
- Strong mathematical/statistical abilities.
- Works well under pressure with limited supervision and displays a willingness to make value-based timely decisions.
- Excellent written and verbal communication skills.
- Ability to manage multiple tasks simultaneously and meet deadlines.
- Strong organizational skills with a high level of accuracy and attention to detail.

- Effectively interact with all levels of management.
- Ability to work well with others in fast paced, dynamic environment.
- Ability to be respectful, approachable and team oriented while building strong working relationships and a positive work environment.
- 5% -10% travel is required.

#### Careers and Benefits:

To learn more about Smithfield's benefits, visit [smithfieldfoods.com/careerbenefits](https://smithfieldfoods.com/careerbenefits).

## PEOPLE MATTER

More than 63,000 employees globally drive our success. We strive to create a fair, ethical and rewarding work environment.

## GROWTH & DEVELOPMENT

Working at Smithfield isn't just a job – it's the foundation for a lifelong career with training designed to help you advance professionally.

## BENEFITS

Our people matter. That's why we offer excellent, comprehensive benefits packages to our full-time employees. Also, education benefits available to full and part-time Smithfield team members on their first day of employment

## SUSTAINABILITY PLEDGE

Sustainability is ingrained in our culture and guides how we operate. We believe in innovating for the future.

#### About Smithfield Foods:

Headquartered in Smithfield, Va. since 1936, Smithfield Foods, Inc. is an American food company with agricultural roots and a global reach. With more than 60,000 jobs globally, we are dedicated to producing "Good food. Responsibly™" and serve as one of the world's leading vertically integrated protein companies. We have pioneered sustainability standards for more than two decades, including our industry-leading commitments to become carbon negative in our U.S. company-owned operations and reduce GHG emissions 30 percent across our entire U.S. value chain by 2030. We believe in the power of protein to end food insecurity and have donated hundreds of millions of food servings to our communities. Smithfield boasts a portfolio of high-quality iconic brands, such as Smithfield®, Eckrich® and Nathan's Famous®, among many others. For more information, visit [www.smithfieldfoods.com](https://www.smithfieldfoods.com), and connect with us on Facebook, Twitter, LinkedIn and Instagram.

#### EEO/AA Information:

Smithfield is an equal opportunity employer committed to workplace diversity. All qualified applicants will receive consideration for employment without regard to race, color, religion, sex, sexual orientation, national origin, age, gender identity, protected veterans status, status as a disabled individual or any other protected group status or non-job characteristic as directed by law.

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## Bausch + Lomb Consumer

Bausch + Lomb

Virginia Beach, VA 23452

### **Bausch + Lomb**



★★★★☆ [631 reviews](#)

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### Benefits

Pulled from the full job description

- 401(k)
- Adoption assistance
- Dental insurance
- Employee assistance program
- Employee stock purchase plan
- Flexible spending account
- Health insurance
- Life insurance
- Parental leave
- Tuition reimbursement
- Vision insurance

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Our comprehensive portfolio of over 400 products is fully integrated and built to serve our customers across the full spectrum of their eye health needs throughout their lives. Our iconic brand is built on the deep trust and loyalty of our customers established over our nearly 170-year history. We have a significant global research, development, manufacturing and commercial footprint of approximately 12,500 employees and a presence in approximately 100 countries, extending our reach to billions of potential customers across the globe. We have long been associated with many of the most significant advances in eye health, and we believe we are well positioned to continue leading the advancement of eye health in the future.

## Responsibilities

Maintain existing and new customers in Vendor Managed Inventory (VMI) activities ensuring account service levels, inventory targets, and KPI's are met or exceeded. KPI measurements from customer and internal B&L metrics.

Partner with Sales and Marketing on assigned strategic retail key accounts, ensuring internal communications within the organization and departments are coordinated for full execution of customer needs. This would include base, incremental promotional and display volumes for forecasting.

Coordinate order, item and other specific details relating to the customer and system needs with internal and external supply chains to ensure fulfillments are met with new product launches, revisions to existing, material and component changes.

Provide forecasts monthly for any Private Label products for strategic accounts and any incremental significant increases for brands with lead time for production and horizon view planning.

Monitor, generate and utilize sales reports to ensure targets are being met, identifying voids or opportunities for increased distribution or identify/troubleshoot issues in customer orders, EDI transmissions, and any other issue in the customer and internal system relationships.

Maintain high levels of communication both verbally and in writing to all relevant stakeholders about critical supply interruptions and resolutions to the issue.

Account management skills, high level of creative problem solving and discussion.

Become a SME for internal processes, procedures, and system changes.

Time management with projects and multiple deliverables.

Other ad hoc requests as needed.

## Qualifications

BS degree, preferably in Supply Chain and associated experience.

Must have demonstrated analytical skills with ability to review consumer data, identify trends and present information to leadership.

Strong analytical, interpersonal, and collaborative skills.

Ability to thrive in a fast-paced environment, multi-task, perform well under pressure and effectively manage competing and/or changing priorities.

Must have proficiency with Microsoft suite.

## Experience

Experience within a CPG with large retail accounts and volume understanding the departments and functions within the retailer organization and relation to internal departments

Project management and team leadership with a passion and proven track record of growth.

Knowledge of SAP, BI tools, excel.



## Comprehensive Benefits

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Employee Assistance Plan (EAP)

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**Appendix F - Supply Chain Management Degree Program Enrollment**

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Regional-All Schools	154	248	419	451	619	720	853	892	1,064	1,154	1,255	1,402
Howard University									20	27	16	23
University of Maryland-College Park	39	103	147	141	153	140	153	140	107	146	117	113
Rowan University								8	20	19	40	26
Rutgers University-New Brunswick		14	38	52	98	113	147	216	241	251	245	278
Rutgers University-Newark			3	34	67	75	109	104	115	134	226	291
Clarkson University	32	34	41	44	19	32	43	27	30	42	36	30
Binghamton University					2	7	3	10	15	9	18	11
SUNY College at Plattsburgh									27	29	21	11
Syracuse University			77	62	89	91	90	59	71	43	64	59
Excelsior College									1	5	4	13
Appalachian State University								25	54	47	66	75
East Carolina University												37
Bloomsburg University of Pennsylvania							7	15	27	34	34	41
Duquesne University	33	47	48	44	67	66	81	74	55	67	67	46
Lehigh University	17	19	27	20	37	59	49	15	29	29	26	15
University of Pittsburgh					21	68	109	107	120	121	114	143
Shippensburg University of Pennsylvania	33	30	36	45	55	55	46	58	59	66	46	47
Temple University								12	42	57	70	86
York College of Pennsylvania			1	9	7	11	12	14	16	19	19	14

## **Appendix G - Supply Chain Management Degrees Awarded**

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## Description of the Proposed Program

### **Program Background**

Virginia Commonwealth University seeks approval for a Bachelor of Science (B.S.) degree program in Digital Forensics and Incident Response. The proposed degree program will be located in the Department of Forensic Science in the College of Humanities and Sciences. The target date of the program's initiation is Fall 2024.

The purpose of the proposed B.S. degree program is to equip students with the necessary knowledge and skill set to effectively collect, analyze, and preserve a variety of digital evidence for forensic purposes, as well as identify, combat, and respond to threats and/or attacks. The degree program will prepare students for a wide range of positions, such as digital forensic examiners, computer forensic analysts, cyber forensic investigators, cyber incident responders, and security and threat assessment analysts. Through experiential learning, the program will expose students to a variety of operating systems, platforms, devices, and malware. The proposed program will address other professional responsibilities of a forensic examiner, including ethical concerns, report writing, and expert testimony. Graduates will be prepared to work in law enforcement agencies, federal government agencies (e.g., Federal Bureau of Investigation, Drug Enforcement Agency, Homeland Security, etc.), private cyber forensic companies, and counterintelligence or counterterrorism incident response that involves any digital media. Graduates will be capable of: securing forensic digital evidence and responding to live attacks; analyzing a variety of evidence; and troubleshooting challenging situations based on the needs of the client. The program will address the demand for professionals with Bachelor of Science degrees in digital forensics and incident response.

The proposed degree program responds to current needs in Virginia and the nation as a whole. Digital forensics and incident response is one of the newest disciplines in forensic science and is emerging as a significant area due to repeated technological advancements. Each advancement has resulted in new types, and an abundance, of digital and multimedia evidence.<sup>1, 2</sup> Additionally, cybercrimes attacking sensitive information are so frequent and disruptive that there is an immense need for effective incident response.<sup>3</sup> What began as a rather narrow focus on digital evidence for crimes like child pornography, has expanded exponentially to a plethora of evidence types, such that digital evidence is now the norm and underpins almost all modern crime scenes and investigations.<sup>4</sup>

While still in its infancy, “digital evidence” started earning formal recognition as a laboratory discipline in 1999 as organizations like the American Society of Crime Laboratory Directors-

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<sup>1</sup> Pollitt (2010). Chapter 1: A history of digital forensics. IFIP Open Digital Library. Retrieved 8/4/2023, from <http://opendl.ifip-tc6.org/db/conf/ifip11-9/df2010/Pollitt10.pdf>.

<sup>2</sup> Vincze EA. Challenges in digital forensics. *Police Practice and Research* 2016; 17(2):183-194; <https://doi.org/10.1080/15614263.2015.1128163>

<sup>3</sup> Ahmadi-Assalemi G, Al-Khateeb H, Epiphaniou G, et al. Cyber Resilience and Incident Response in Smart Cities: A Systematic Literature Review. *Smart Cities* 2020; 3:894-927; <https://doi.org/10.3390/smartcities3030046>

<sup>4</sup> Casino F, Dasaklis TK, Spathoulas GP, et al. Research Trends, Challenges, and Emerging Topics in Digital Forensics: A Review of Reviews. *IEEE Access* 2022; 10:25464-25493.

Laboratory Accreditation Board (ASCLD-LAB) and the Scientific Working Group for Digital Evidence (SWGDE) began developing guidelines and standards.<sup>2</sup> ASCLD-LAB first offered forensic laboratories the option of accreditation in digital evidence in 2003.<sup>5</sup> Years later, the Forensic Science Education Programs Accreditation Commission (FEPAC) began to accredit higher education programs in “digital forensics” in 2011.<sup>6</sup> While these regulations were being established, continued technological advancements led to increased opportunities for potential evidentiary sources (including those related to incident response), thereby adding pressure for more guidelines and standards. The development of these guidelines and standards illustrate that the forensic science community recognizes and has a vested interest in digital forensics and incident response. They also drive the specific content that should be included in academic degree programs for this emerging field. Despite these efforts, academic degree programs in this emerging area are sparse. There are currently no programs in this discipline at the B.S. level in the Commonwealth and only one such program that is FEPAC-accredited in the United States.<sup>7</sup>

### **Institutional Mission**

The mission of Virginia Commonwealth University states:

Virginia Commonwealth University and its academic health sciences center serve as one national urban public research institution dedicated to the success and well-being of our students, patients, faculty, staff and community through:

- Real-world learning that furthers civic engagement, inquiry, discovery and innovation.
- Research that expands the boundaries of new knowledge and creative expression and promotes translational applications to improve the quality of human life.
- Interdisciplinary collaborations and community partnerships that advance innovation, enhance cultural and economic vitality, and solve society’s most complex challenges.
- Health sciences that preserve and restore health for all people, seek the cause and cure of diseases through groundbreaking research and educate those who serve humanity.
- Deeply ingrained core values of diversity, inclusion and equity that provide a safe, trusting and supportive environment to explore, create, learn and serve.

As the home of a nationally, top-rated accredited Forensic Science Department with deep, historical ties to the Virginia Department of Forensic Science, we believe that the proposed B.S. in Digital Forensics and Incident Response aligns well with the institution’s mission. The proposed degree is interdisciplinary, incorporating a strong core of computer science coursework, with a forensic science edge. With a significant number of hands-on, laboratory-

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<sup>5</sup> Barbara JJ. Digital evidence accreditation in the corporate and business environment. *Digital Investigation* 2005; 2(2):137-146; <https://doi.org/10.1016/j.diin.2005.04.005>

<sup>6</sup> Forensic Science Education Programs Accreditation Commission. Accreditation Standards, rev 22 July 2011. American Academy of Forensic Sciences.

<sup>7</sup> Forensic Science Education Programs Accreditation Commission (<https://www.aafs.org/fepac/>). Accessed 10 August 2023.

based specialized courses, the curriculum will focus “real-world learning”, teaching students how to use innovative technology and software to provide investigative information to the criminal and social justice systems. As such, this program will advance VCU’s mission of helping “solve society’s most complex challenges” and will assist in bringing an objective and scientific eye to a system that is often wrought with social, cultural, and economic biases. Our curriculum will feature full-time faculty experts as well as part-time faculty with digital forensics expertise from across the state to provide our students with unique transdisciplinary *and* “interdisciplinary collaborations and community partnerships”. The curriculum proposed will add to a thriving Department of Forensic Science that already has a rich history of research, innovation, and a student-focused culture of care. We have no doubt that we can extend those values, and those of VCU, to this new degree program and its students.

Though not explicitly mentioned in VCU’s most recent six-year plan, the plan focuses on capital projects to “facilitate innovative transdisciplinary and interdisciplinary achievements”, which would include the proposed B.S. degree program. The Department of Forensic Science currently occupies space in both Oliver Hall and Temple Hall, which are being replaced with the planned “Interdisciplinary Classroom & Laboratory Building” in the six-year plan. This new space will provide modern interdisciplinary classrooms and laboratory spaces that will serve as a home base for the proposed B.S. degree.

The proposed B.S. in Digital Forensics and Incident Response is included in the Virginia Commonwealth University’s 2024-2030 Six-Year Plan.

### **Program Accreditation**

The Department of Forensic Science intends to apply for accreditation as a Digital Evidence degree program through the Forensic Science Education Programs Accreditation Commission (FEPAC). FEPAC’s mission is to “maintain and enhance the quality of forensic science education through a formal evaluation and accreditation system for college-level academic programs that lead to a baccalaureate or graduate degree.”<sup>8</sup>

FEPAC requires the submission of an application for accreditation following the graduation of at least two classes from the proposed B.S. in Digital Forensics and Incident Response degree. Assuming the program will be available Fall 2024, we anticipate that the first two graduating classes will be in Spring 2027 and Spring 2028, thus we intend to apply for accreditation in January 2028; applications are due by March 1 each year in order to be considered for that accreditation cycle. Once the program’s eligibility is confirmed, a self-study will be conducted, followed by an on-site evaluation. If accreditation is successful, the degree program will be accredited starting 2029.

VCU is proposing the following timeline for the accreditation process:

March 1, 2028	Submit application for accreditation
May 1, 2028	Receive notification of application acceptance or rejection

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<sup>8</sup> The Forensic Science Education Programs Accreditation Commission (FEPAC). <https://www.aafs.org/FEPAC>



May 2 - July 14, 2028	Work on self-study
July 15, 2028	Submit self-study
September 15 - October 15, 2028	On-site evaluation
November 15, 2028	Receive comments from self-study and on-site evaluation
December 15, 2028	Submit responses to comments
February - March, 2029	Receive notification of accreditation decision

See Appendix A for FEPAC curriculum requirements for a B.S. degree program in the area of “Digital Forensics”.

## **Curriculum**

The proposed degree program is the Bachelor of Science in Digital Forensics and Incident Response, which consists of a minimum of 120 credit hours and is a purely face-to-face program; this program will not have concentrations or specialty areas. It is designed to equip students with the necessary knowledge and skill set to effectively collect, analyze, and preserve a variety of digital evidence for forensic purposes, as well as identify, combat, and respond to threats and/or attacks.

This program is especially strong given its interdisciplinary approach and abundance of hands-on laboratory courses in digital forensics and incident response. The core coursework will instill foundational knowledge in computer programming and information systems, as well as forensic evidence handling and legal considerations. Advanced core courses will impart specialized forensic knowledge and skills focusing on recovery and analysis of computers, mobile devices, cloud systems, other related hardware, and incident response to system attacks. Throughout the program, students will engage in classroom discussions and become proficient communicators—both orally and in writing—for scientific and non-scientific audiences. Students will effectively apply what they have learned during hands-on laboratory exercises and think critically to solve problems. They will also learn to be cognizant of how their actions can and will impact later steps, including but not limited to laboratory analyses and/or courtroom testimony. An emphasis on ethics is embedded in the curriculum, ensuring that students are exposed to the ethical professional standards that govern forensic science professionals.

The capstone for this program is the existing course FRSC 490, through which students will strengthen their analytical and oral communication skills related to topics that have been addressed throughout the curriculum in earlier coursework and reiterated here. This course focuses on post-graduation preparation; ethical and professional duties of a forensic scientist/analyst; the role of an expert witness; and forensic science case studies. Deliverables include: resumé and cover letter or curriculum vitae and personal statement; live expert testimony exercise; active participation in classroom discussions; and presentation of a case study group research project. All of these are due at various time points throughout the course. In the event that a student fails to earn a minimum grade of C in this course, they can repeat it.

This program is specifically designed to and will meet FEPAC accreditation standards for a Bachelor of Science degree in the specialty area of “Digital Evidence”.

A total of eight new courses will be developed for this program. New courses are denoted with an asterisk.

### **Program Requirements**

#### **General Education Requirements: 30 credit hours**

The General Education curriculum is a requirement for all VCU undergraduate students and therefore does not focus on those skills, techniques or procedures specific to a particular occupation or profession. The general education curriculum which follows consists of 30 credit hours divided into three sections: 1) foundations, 2) breadth of knowledge, and 3) areas of inquiry.

UNIV 111. Focused Inquiry I (3 credits) – required by all VCU students

UNIV 112. Focused Inquiry II (3 credits) – required by all VCU students

UNIV 200. Inquiry and the Craft of the Argument (3 credits) – required by all VCU students

Quantitative Foundations (3-4 credits)

Breadth of Knowledge (9 credits)

Areas of Inquiry (8-9 credits)

#### **Core Courses: 55 credit hours**

Core requirements provide a strong foundation via an interdisciplinary approach, coupled with specialized coursework in digital and multimedia forensic sciences.

CMSC 255 Introduction to Programming (4 credits)

CMSC 256 Data Structures and Object-Oriented Programming (4 credits)

CMSC 257 Computer Systems (4 credits)

CMSC 302 Introduction to Discrete Structures (3 credits)

CMSC 311 Computer Organization (3 credits)

FRSC 231 Programming for Digital Forensics (2 credits) \*

FRSC 232 Reverse Engineering Malware for Forensic Applications (2 credits) \*

FRSC 300 Survey of Forensic Science (3 credits)

FRSC 309 Scientific Crime Scene Investigation (3 credits)

FRSC 330 Introduction to Digital and Multimedia Forensic Sciences (3 credits) \*

FRSC 331 File System and Data Structure Forensics (3 credits) \*

FRSC 375 Forensic Evidence, Law, and Criminal Procedure (3 credits)

FRSC 431 Computer and Storage Forensics (3 credits) \*

FRSC 432 Mobile and IoT Device Forensics (3 credits) \*

FRSC 433 Cloud Forensics and Incident Response (3 credits) \*

FRSC 531 Hardware Forensics and Advanced Acquisition (3 credits) \*

FRSC 490 Professional Practices in Forensic Science (3 credits)

INFO 300 Information Technology Infrastructure (3 credits)

#### **Restricted Electives: 8 credit hours**

CMSC 200-level or higher (2 credits)

FRSC/FRSZ Forensic Science Electives (300-level or higher) (6 credits)

### **Additional Degree Requirements**

#### **Mathematics/Statistics Courses: 7 credit hours**

Students complete one course from each of the following groups:

BUSN 212 Business Problem Solving and Analysis (4 credits)

*or* MATH 200 Calculus with Analytic Geometry I (4 credits)

STAT 210 Concepts of Statistics (3 credits)

*or* STAT 212 Applications of Statistics (3 credits)

#### **Natural Science Courses: 8-10 credit hours**

Students select two of the following:

BIOL 151/BIOZ 151 Introduction to Biological Science I and Laboratory (4 credits)

BIOL 152/BIOZ 152 Introduction to Biological Science II and Laboratory (4 credits)

CHEM 101/CHEZ 101 General Chemistry I and Laboratory (4 credits)

CHEM 102/CHEZ 102 General Chemistry II and Laboratory (4 credits)

PHYS 201 General Physics I (4 credits)

*or* PHYS 207 University Physics I (5 credits)

PHYS 202 General Physics II (4 credits)

*or* PHYS 208 University Physics II (5 credits)

#### **Other College of Humanities Undergraduate Required Courses: 8-10 credit hours**

Experiential fine art (1-3 credits)

Foreign language (101 & 102 of the same language) (6 credits)

HUMS 202 Choices in a Consumer Society (1 credits)

#### **Open electives: 0-4 credit hours**

Students may select 0-4 credits of open electives.

### **Capstone Requirements**

Students are required to enroll in the capstone course FRSC 490, which is restricted to seniors with at least 85 credit hours toward the degree; students must also have completed FRSC 330 and at least one other forensic science course, both with a minimum grade of C. Students will undertake a forensic case study group project, in which students research a criminal case that had significant forensic evidence, went to trial, and exhibited a combination of quality assurance, forensic examination, and/or ethical violations. The group presents their case study as an oral presentation. Students will engage in an expert testimony exercise; this is a unique component of the course. Students will participate in in-depth discussions regarding ethical and professional duties of a digital forensic analyst/examiner, as well as job-related stressors. To prepare for post-graduation careers, students will: 1) prepare a resumé and cover letter for an appropriate job posting or a curriculum vitae and personal statement for a graduate/professional school admission application; and 2) a practice interview exercise. In the event that a student fails to earn a minimum grade of C in this course, they can repeat it.

See Appendix A for FEPAC accreditation curriculum requirements.

See Appendix B for sample plans of study for students.

See Appendix C for course descriptions.

See Appendix D for an example of a student internship ad.

### **Faculty Resources**

The Department of Forensic Science has 11 full-time faculty (11 FTEs). Five of these faculty will teach core courses for the proposed B.S. in Digital Forensics and Incident Response. Each faculty member holds either a doctoral or master's degree in forensic science, analytical chemistry, or a closely related discipline. Faculty have a combined 162 years of forensic science teaching experience *as well as* nearly 120 years of forensic practitioner/casework and laboratory management experience. Collectively, they have published numerous textbooks and hundreds of peer-reviewed publications in professional forensic science journals (~20 publications per year). Further, these faculty frequently serve as manuscript reviewers for professional forensic science journals, hold multiple leadership positions in national and international forensic science professional organizations, and provide ~100 presentations annually at professional conferences and within the broader criminal justice, public health, and social justice communities.

Five faculty members in the Department of Computer Science (VCU College of Engineering) will teach core computer science courses for the proposed degree program. These faculty have either doctoral or master's degrees in computer science. Faculty members selected to teach each core CMSC course will have appropriate teaching experience to teach their assigned content areas. Similarly, two faculty members in the Department of Information Systems (School of Business) will teach the core information systems course (INFO 300); each has the appropriate doctoral and/or master's degrees to teach this content area. Both supervising Deans, as well as the department faculty and staff, have pledged support for the proposed degree program and are prepared to offer seats and sections of core CMSC and INFO courses, as needed, to accommodate the projected enrollments.

One new faculty member (1 FTE) will be hired immediately upon approval of the proposed B.S. in Digital Forensics and Incident Response program. As the program grows and reaches projections, an additional full-time faculty member (1 FTE) will be sought. The new faculty members will be hired at the rank of Instructor or Assistant Professor. The positions will require at least an MS in digital forensics, incident response, or closely related field. The candidates will have served as digital forensics and/or incident response practitioner for a minimum of five years, as well as teaching experience commensurate with hiring rank.

Thirteen adjunct faculty members will be utilized to initiate and teach core courses of the proposed degree program. All adjunct faculty will have a minimum of three years of experience in digital forensics, incident response, crime scene investigation, criminal proceedings, or other relevant forensic science area of expertise. All faculty will have a minimum of a B.S. in digital forensics, incident response, forensic science, or a closely related discipline.

See Appendix E for abbreviated curriculum vitae of faculty.

## Student Learning Assessment

Students who complete the proposed B.S. in Digital Forensics and Incident Response will have mastered a set of skills that are needed as a digital forensic examiner/analyst/investigator and/or incident responder. Students will be assessed for the Student Learning Outcomes (SLOs) listed below through a variety of methods: 1) an end-of-program Achievement Test, 2) a case study group project and 3) mock cases. These specific learning outcomes and forms of assessment were chosen by the faculty in the Department of Forensic Science per input from subject matter experts in digital forensics and incident response, the department's Undergraduate Curriculum Committee, and the university's director of assessment.

The university uses the TaskStream platform to house assessment data. Results from these assessments will be reviewed carefully on an annual basis by the department's Program Director and Undergraduate Curriculum Committee, as well as the department as a whole, in an effort to improve the program. It is the Program Director's responsibility to identify the SLOs in which the target is not met and to lead efforts to improve those particular aspects of the program's curriculum via the assistance of the Undergraduate Curriculum Committee, faculty members teaching (or having expertise in) the applicable courses, etc. The department has a mechanism in place to make improvements in the form of curriculum reform, program review, and budget reallocations and planning.

### Learning Outcomes

Upon successful completion of this program, students will be able to:

- Articulate an understanding of the laws of criminal procedure and rules of evidence
- Employ proper crime scene investigation and reconstruction
- Recognize appropriate ethical and professional duties and responsibilities of the forensic scientist
- Apply principles, theory, and laboratory procedures of digital and multimedia sciences to forensic science
- Exercise appropriate incident response to contain, stop, and prevent an attack
- Demonstrate knowledge, capabilities, use and limitations of digital forensic laboratory techniques to the extent of acquiring professional certification and workplace competencies

For each, the target will be that 80% of students participating in the assessment will perform satisfactorily on the test (i.e., by scoring a 70% or better) or activity. This assessment plan will be an integral part of the program's FEPAC accreditation application, which is planned for the spring of 2028.

Curriculum map for B.S. in Digital Forensics and Incident Response.

<b>Learning Outcomes</b>	<b>Core and Required Courses</b>	<b>Assessment Methods</b>
Articulate an understanding of the laws of criminal	FRSC 300 Survey of Forensic Science	<u>Formative</u> : class readings, discussions, and assignments

procedure and rules of evidence	FRSC 375 Forensic Evidence, Law, and Criminal Procedure	<u>Summative</u> : Achievement Test
Employ proper crime scene investigation and reconstruction	FRSC 300 Survey of Forensic Science  FRSC 309 Scientific Crime Scene Investigation	<u>Formative</u> : class readings, discussions, assignments, and mock crime scenes  <u>Summative</u> : Achievement Test
Recognize appropriate ethical and professional duties and responsibilities of the forensic scientist	FRSC 300 Survey of Forensic Science  FRSC 490 Professional Practices in Forensic Science	<u>Formative</u> : class readings, discussions, and assignments  <u>Summative</u> : Achievement Test and Case Study presentation experiential learning and capstone experience
Apply principles, theory, and laboratory procedures of digital and multimedia sciences to forensic science	CMSC 255 Introduction to Programming  CMSC 256 Data Structures and Object-Oriented Programming  CMSC 257 Computer Systems  CMSC 302 Introduction to Discrete Structures  CMSC 311 Computer Organization  INFO 300 Information Technology Infrastructure  FRSC 231 Programming for Digital Forensics  FRSC 232 Reverse Engineering Malware for Forensic Applications	<u>Formative</u> : class readings, discussions, laboratory activities, and assignments  <u>Summative</u> : Achievement Test

	<p>FRSC 330 Introduction to Digital and Multimedia Forensic Sciences</p> <p>FRSC 331 File System and Data Structure Forensics</p> <p>FRSC 431 Computer and Storage Forensics</p> <p>FRSC 432 Mobile and IoT Device Forensics</p> <p>FRSC 433 Cloud Forensics and Incident Response</p> <p>FRSC 531 Hardware Forensics and Advanced Acquisition</p>	
<p>Exercise appropriate incident response to detect, combat, and recover from an attack</p>	<p>CMSC 255 Introduction to Programming</p> <p>CMSC 256 Data Structures and Object-Oriented Programming</p> <p>CMSC 257 Computer Systems</p> <p>CMSC 302 Introduction to Discrete Structures</p> <p>CMSC 311 Computer Organization</p> <p>INFO 300 Information Technology Infrastructure</p> <p>FRSC 231 Programming for Digital Forensics</p> <p>FRSC 232 Reverse Engineering Malware for Forensic Applications</p>	<p><u>Formative</u>: class readings, discussions, laboratory activities, and assignments</p> <p><u>Summative</u>: mock cases</p>

	<p>FRSC 330 Introduction to Digital and Multimedia Forensic Sciences</p> <p>FRSC 331 File System and Data Structure Forensics</p> <p>FRSC 431 Computer and Storage Forensics</p> <p>FRSC 432 Mobile and IoT Device Forensics</p> <p>FRSC 433 Cloud Forensics and Incident Response</p>	
<p>Demonstrate knowledge, capabilities, use and limitations of digital forensic laboratory techniques to the extent of acquiring professional certification and workplace competencies</p>	<p>FRSC 231 Programming for Digital Forensics</p> <p>FRSC 232 Reverse Engineering Malware for Forensic Applications</p> <p>FRSC 330 Introduction to Digital and Multimedia Forensic Sciences</p> <p>FRSC 331 File System and Data Structure Forensics</p> <p>FRSC 431 Computer and Storage Forensics</p> <p>FRSC 431 Computer and Storage Forensics</p> <p>FRSC 432 Mobile and IoT Device Forensics</p> <p>FRSC 433 Cloud Forensics and Incident Response</p> <p>FRSC 531 Hardware Forensics and Advanced Acquisition</p>	<p><u>Formative</u>: class readings, discussions, laboratory activities, and assignments</p> <p><u>Summative</u>: mock cases</p>



## **Employment Skills**

All graduates of the proposed B.S. in Digital Forensics and Incident Response degree program will be able to:

- Articulate and demonstrate knowledge of principles of digital and multimedia evidence (DME) acquisition & analysis, including application of laws (e.g., rules of evidence, chain of custody, etc.), regulations, and investigative methods
- Articulate and demonstrate knowledge of network operations
- Conduct examinations of video/image recording, computer, mobile, and/or data storage devices and associated data
- Accurately perform analysis and interpret data to develop conclusions
- Explain technical concepts in a manner that is simple, concise, and accessible to all levels of understanding
- Communicate findings in a written and oral format, consistent with expert testimony in a court of law
- Examine the inner workings of malware and applications from a forensic perspective
- Implement or mitigate security measures to identify vulnerabilities and compromised systems in a networked environment
- Complete relevant digital forensic certifications (e.g., video, mobile, or computer)
- Demonstrate competency in a variety of digital forensic tools, including commercial and open-source digital forensic hardware and software
- Utilize commands and syntax for a variety of operating systems (including Windows, Mac OS, Linux, Android and iOS)
- Automate tasks through use of computer programming languages
- Evaluate emerging technologies

See Appendix F for a summary of where these skills are acquired in the curriculum.

## **Relationship to Existing Programs**

The proposed B.S. degree program is not similar to or closely related to any other existing degree program at VCU and will not compromise any other existing degree program. There are 12 shared credits with the existing Forensic Science B.S. degree program (College of Humanities & Sciences); with only 12, there are not enough shared core courses for this to be a new concentration within that major. There are 19 credits shared with the existing B.S. in Computer Science degree program (College of Engineering); these are primarily foundational computer systems courses required prior to exploration of the forensic application. With only 19 shared credits, the requirements of the computer science minor are met, however, these shared credits are less than the 25% needed for this program to exist as a computer science concentration. Further the core courses of the proposed degree program and expertise needed for the specialized coursework are inherently forensic science, which requires different knowledge, experience, and expertise than computer science.

## Justification of the Proposed Program

### **Response to Current Needs**

Digital forensic analysis and incident response to cybercrimes have played an increasingly important role in our society, due to the prevalence of digital and computing devices. In fact, “Digital and Multimedia Sciences” was the newest forensic science discipline to be formally recognized by the American Academy of Forensic Sciences.<sup>9</sup> Globally, there has been an explosion of digital forensic and incident response services and subsequent demand for practitioners over the past 20 years.<sup>10</sup> In 2019, The International Association of Chiefs of Police’s Digital Task Force released a report citing the “lack of capacity”, including “issues such as lack of specialized training” as one of the three primary ways that law enforcement’s access to digital crime scenes is currently restricted.<sup>11</sup> Citing the need for better prepared job candidates for their laboratories, the Virginia Department of Forensic Science reached out to VCU several times in recent years advocating for digital forensic-focused bachelor’s and master’s degree programs. Simultaneously, due to international demand<sup>12</sup>, the US forensic science educational accrediting body (FEPAC) had added standards for academic programs focusing in the area of digital analysis. Despite these steps forward, employment and student demand continue to outpace the availability of qualified digital evidence professionals. This is, in large part, due to the lack of specialized educational and training programs.<sup>13</sup> Authors of one recent peer-reviewed article published in the *Journal of Forensic Science Education* further noted the lack of published research on educational programs and their effectiveness for the forensic discipline of digital multimedia, stating “...research in this area would benefit not only the educational programs in content and its delivery, but with the input of the forensic science community, has the potential to help ensure that the future forensic science scientists receive quality education, comprehensive of all forensic science subdisciplines”.<sup>14</sup>

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<sup>9</sup> Membership in the Forensic Digital & Multimedia Sciences Section, American Academy of Forensic Sciences. Accessed August 19, 2023. <https://www.aafs.org/membership/digital-multimedia-sciences>

<sup>10</sup> Discover how technology helps manage the growth in digital evidence. Microsoft Industry Blog. David Williams. Sept. 20, 2022. Accessed August 23, 2023. <https://www.microsoft.com/en-us/industry/blog/government/2022/09/20/discover-how-technology-helps-manage-the-growth-in-digital-evidence/#:~:text=Digital%20evidence%20appears%20in%20nearly%2090%20percent%20of%20all%20crimes%20committed%20today.&text=This%20is%20a%20massive%20increase,that%20proves%20innocence%20or%20guilt>

<sup>11</sup> Digital Evidence Task Force, Executive Primer, International Association of Chiefs of Police. 2019. Accessed July 30, 2023. [chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://www.iacp.org/wp-content/uploads/2019/11/IACP\\_Digital\\_Evidence\\_Task\\_Force\\_2019.pdf](chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://www.iacp.org/wp-content/uploads/2019/11/IACP_Digital_Evidence_Task_Force_2019.pdf)

<sup>12</sup> Towards Standards in Digital Forensics Education, Working Group Report, Proceedings of the 2010 Conference of Innovation and Technology in Computer Science Education, Association for Computing Machinery. June, 2010. Accessed August 19, 2023. <chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://dl.acm.org/doi/pdf/10.1145/1971681.1971688>

<sup>13</sup> Digital evidence and digital forensic education. Goran Oparnica. *Digital Evidence and Electronic Signature Law Review*, 2016, 13:143-147. Accessed August 1, 2023. <https://journals.sas.ac.uk/deeslr/article/view/2305>

<sup>14</sup> A review of existing forensic laboratory education research and needs assessment. Sabra Jones, Ronald Thrasher, et al. *Journal of Forensic Science Education*, 2021, 3(1). Accessed July 17, 2023. <https://jfse-ojs-tamu.tdl.org/jfse/article/view/43>

With this in mind, early in 2022, the VCU Department of Forensic Science convened a stakeholder group of Virginia digital practitioners, which included representatives from federal/state/local law enforcement agencies, federal/state crime laboratories, and the local corporate community. This group included practitioners from the FBI Computer Analysis Response Team, Virginia Department of Forensic Science (state crime lab), the VA Attorney General’s Computer Forensics Unit, Virginia State Police’s Computer Evidence Recovery and High-Tech Crimes Division, the digital investigations unit of a local sheriff’s office, GE Healthcare, and two private digital investigative companies in central Virginia. The group unanimously confirmed the need for better prepared digital analysts in Virginia—at all levels. Citing that natural/forensic science majors were unprepared in the areas of computer science methodology while computer science majors lacked forensic coursework focusing on compromised digital/media evidence, evidence management, criminal law, and forensic ethics, the group agreed that new degree programs were needed to address the specialized hiring needs. Subsequently, the working group expanded to include faculty from the VCU Departments of Information Systems and Computer Science, both of whom were already offering foundational computer and information systems coursework. Together, the team assembled worked closely to advise the VCU Department of Forensic Science on curriculum development, needs assessment, opportunities for inter- and transdisciplinary collaboration, and employment opportunities.

#### Digital Forensic Examinations & Incident Response

At its core, digital forensics includes “the science of identifying, preserving, documenting, examining, and analyzing evidence from computer systems, the results of which may be relied upon in court”.<sup>15</sup> However, as everyday things around us increasingly became more digitized and/or internet-connected, the field of digital forensic examination and incident response has evolved from personal computers and server analysis to now an infinite list of items ranging from smart work or home devices to mobile phones and other portable “wearable” devices. Digital investigations commonly include analysis of audio and video files, social media, emails and other communications, website access, geolocation files, motor vehicle files, and even sensor data such as that obtained from medical devices, license plate readers, facial recognition software, and/or gunshot detection technology. While “digital forensics” applies to examination of any device, experts in the field often specialize in one or more subdiscipline; the subdisciplines are broadly categorized as network forensics, memory forensics, data and file carving, mobile devices/IoT (Internet of Things), cloud forensics, and anti-digital forensics (reverse engineering).

With time and technological advances, individuals create larger digital footprints, tracked by an increasing number of devices, which can be analyzed to assist fact-finders. For example, an Arkansas murder case in 2016 was ultimately cracked by data retrieved from an Amazon Echo smart home device<sup>16</sup>; similarly, analysis of data from a pacemaker played a key role in charging

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<sup>15</sup> All the pieces that matter: Evaluating Digital Forensic Expert Witnesses. Christa Miller, Brandon Epstein, et al. Zero Abuse Project. Grant Report. 2022. Accessed July 17, 2023. <https://ojjdp.ojp.gov/library/publications/all-pieces-matter-evaluating-digital-forensic-expert-witnesses>

<sup>16</sup> An Amazon Echo may be key to solving a murder case. TechCrunch+. Sarah Buhr. December 2016. Accessed July 30, 2023. <https://techcrunch.com/2016/12/27/an-amazon-echo-may-be-the-key-to-solving-a-murder-case/>

a suspect for arson and insurance fraud in 2017.<sup>17</sup> In fact, at least 90% of crimes committed today include some form of digital evidence, creating a demand for forensic digital analysis that continues to rise 11-16% annually.<sup>18</sup> With this data, many believe that modern policing will soon have digital forensics and incident response at the core of its basic investigatory function. With that said, digital forensic analysis is not restricted to criminal cases—today, there is a greater societal need for digital forensic analysis, including that involved in civil and corporate litigation. The rise of data compromises, particularly in the web, finance, and tech industries, has led to increased demand for digital forensic and incident response professionals in the private sector. In 2022 alone, 88.3% of companies reported at least one data breach, costing those companies nearly \$6.20M.<sup>19</sup>

It is important to note that digital forensic examination and incident response is not a function of an IT professional. While both require basic understanding of how computers work and programming, the forensic techniques used by digital professionals are entirely separate. IT, computer science, or cyber security experience and training alone would not sufficiently prepare one to work with forensic evidence. In fact, one expert in the field recently noted that any individual “touting themselves as an IT expert, and thereby a digital forensics expert, should be evaluated cautiously as they most likely do not understand the distinction and thus lack the basic skills to complete a forensic exam”.<sup>15</sup> Thus, it is critically important that specialized forensic science educational programs work to develop formal degree programs that can provide students with the knowledge and skills needed for digital forensics specialization.

### Digital Forensic Educational Needs

In recent years, it has become increasingly challenging for working digital forensic practitioners to keep pace with rapidly changing technological advancements while also shouldering the burden of training the next generation of practitioners for this emerging profession. The lack of quality educational degree programs leads to long, in-depth training programs (12 months or more) within public law enforcement agencies and private businesses; long training programs only further contribute to long turn-around times for digital forensic casework. With so few formal education and training programs, employers are often forced to hire individuals with computer science experience or even sworn police officers—neither of whom have backgrounds appropriate for forensic digital examinations. Meanwhile, prospective employees are left to gain specialized knowledge through training programs offered outside of a university or college setting. However, there is no standardized list of training or certification programs to sufficiently qualify individuals, making this a complex pathway. Further, the vast number of offerings, some provided by software vendors, make them difficult to assess for legitimacy and relevance.<sup>15</sup>

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<sup>17</sup> How a pacemaker led police to accuse someone with arson. Fortune Magazine. Don Reisinger, February 2017. Accessed July 30, 2023. <https://fortune.com/2017/02/07/pacemaker-arson-charges/>

<sup>18</sup> Meeting the future of digital forensics and evidence management. IBM Storage. 2022. Accessed July 17, 2023. <chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://www.ibm.com/downloads/cas/RWL5O1PY>

<sup>19</sup> Rising digital evidence and data breaches boost demand for digital forensics. Stax. January 2023. Accessed July 17, 2023. <https://www.stax.com/insights/rising-digital-evidence-and-data-breaches-boost-demand-for-digital-forensics#:~:text=However%2C%20according%20to%20a%20study,of%20all%20crimes%20committed%20today&text=Investigations%20for%20crimes%20ranging%20from,evidence%20stored%20in%20electronic%20devices.>

While the number of universities and colleges with digital forensics degree programs is slowly increasing, there are still relatively few. The proposed VCU B.S. degree program would be the first of its kind in the state. The accrediting body for such programs—Forensic Science Education Programs Accreditation Commission (FEPAC)—currently has only two accredited undergraduate programs in their system, neither in Virginia. The proposed curriculum seeks to provide both the foundational forensic science educational components (including crime scene recovery, evidence acquisition, forensic ethics and bias training, report writing, chain of custody and rules of evidence, and a capstone professional practice course), as well as specialized education and training in digital forensic examinations. Basic computer science and programming courses coupled with those that cover reverse engineering, file system and data structure, computer and storage device forensics, cloud forensics, advanced acquisition, and mobile and IoT device forensics would, together, exceed the minimum curricular requirements needed for accreditation. Further, graduates would be well qualified to enter the workforce as competent digital forensic examiners who require less extensive internal training, making them highly marketable to prospective employers.

### **Why VCU?**

Virginia Commonwealth University is well suited to host the state's only B.S. degree that offers specialization in digital forensic examinations. Not only does the proposed B.S. degree program fit well with VCU's mission, VCU's location in the heart of central Virginia provides perfect proximity to many potential employers and collaborators. Stakeholders located within a short drive of VCU's campus include: the digital forensics unit at the Virginia Department of Forensic Science's Central laboratory, the regional computer crimes divisions of both the VA Office of the Attorney General and the US Attorney General's office, the digital evidence team at the FBI Richmond field office, the computer crimes division at the FBI Laboratory Headquarters, several local law enforcement agencies (who have their own digital teams), and the digital forensics teams for several large international corporations (i.e., GE Healthcare, Capital One, etc.). Individuals from many of these groups have assisted with the development of the B.S. curriculum; through this process, they have offered opportunities for collaborative research, assistance with instruction, and experiential opportunities for students. Moreover, several have noted their intention to hire graduates of the proposed degree program. VCU has had a long-standing commitment to forensic science as an *academic* venture, serving as home to a nationally prominent Department of Forensic Science for many years and nurturing strong longstanding relationships with most major forensic laboratories in the mid-Atlantic region of the US. In addition, VCU offers well-established coursework in both computer science and information systems, which will serve as strong foundational coursework for students of the proposed B.S. degree program. Further, VCU is home to an NSA-designated Center of Academic Excellence in Cyber Research and a DHS Center of Academic Excellence in Cybersecurity Defense; these associations will provide additional opportunity for interdisciplinary collaboration. With all of these characteristics in play, VCU is well prepared to serve as the educational core for the already established digital forensics hub of the mid-Atlantic.

The proposed B.S. in Digital Forensics and Incident Response degree program is a natural extension of the VCU Department of Forensic Science's mission—to advance the field of forensic science through teaching, research, community outreach and stakeholder engagement. Ultimately, the vision of the Department of Forensic Science is to inspire the next generation of

students to become global leaders in the forensic science community and beyond through unparalleled competency and innovation. The proposed degree program would allow the Department to respond to a critical need that exists in our professional community in ways that align well with student demand and the Department's mission and vision.

The existing forensic science degrees offered at VCU are FEPAC-accredited and are supported by a diverse faculty of scientists who, together, have many years of expertise and practitioner forensic science experience. The Department is a multidisciplinary department with existing expertise in crime scene investigation, evidence acquisition, criminal law and expert testimony, ethics and bias in forensic science, and forensic laboratory management; all of these serve as critical *required* components to the proposed B.S. degree program. The Department's longstanding relationship with the Virginia Department of Forensic Science (their founders) provides a rich pool of adjunct faculty who add a real-world perspective to our classroom instruction. The Department has a well-established applied research portfolio, which includes nearly \$1M of expenditures annually, and has a history of keeping pace with forensic science technological and pedagogical advances. At the core of the Department's mission is the emphasis on contemporary practices to assure that our students are prepared for entering the modern forensic sciences industry. This includes an emphasis on intensive, experiential hands-on learning modalities for all majors. Digital forensics professionals uniformly cite these characteristics desired of universities or colleges that plan to offer degree programs in this area.<sup>20,21</sup>

The proposed B.S. in Digital Forensics and Incident Response degree program will be the first and only digital forensic undergraduate program in the state of Virginia; it will also be the first to achieve FEPAC-accreditation. The program aims to provide Virginia and the nation with better prepared digital forensic and incident response employees, reducing the long training periods currently required (due to lack of specialty academic programs). VCU expects this will result in a significant savings for state, federal, and local forensic service providers as well as private industry.

See Appendix G for letters of support (specific demand).

### **Employment Demand**

Graduates of the proposed B.S. in Digital Forensics and Incident Response will find entry-level employment in this field in a wide range of positions, such as digital forensic examiners, computer forensic analysts, cyber forensic investigators, cyber incident responders, and security and threat assessment analysts. Successful graduates of the program will be qualified to work for a wide variety of law enforcement agencies, federal government agencies (e.g., Federal Bureau of Investigation, Drug Enforcement Agency, Homeland Security, etc.), private cyber forensic

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<sup>20</sup> Experiential learning in digital forensics. In: Xiaolu Zhang, Timothy Yuen, et al (eds) *Digital Forensic Education*. Studies in Big Data, vol. 61. Springer, Cham. [https://doi.org/10.1007/978-3-030-23547-5\\_1](https://doi.org/10.1007/978-3-030-23547-5_1)

<sup>21</sup> Developing a standardized and multidisciplinary curriculum for digital forensics education. Masooda Bashir and Roy Campbell, CyLab Usable Privacy and Security Lab, Carnegie Mellon University. <chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://cups.cs.cmu.edu/soups/2015/papers/eduBashir.pdf>

companies, and counterintelligence or counterterrorism incident response that involves any digital media.

A sharp increase in society's dependence and use of digital technologies, and the emergence of criminal activity surrounding those media, has resulted in the emergence of the digital forensics and cyber incident response disciplines.<sup>22</sup> Digital forensics and incident response professionals possess the skills necessary to collect, preserve, analyze, and present their findings in legal proceedings.<sup>23</sup> Due to the scarcity of relevant degree programs, practitioners have historically not been required to have a degree, but have instead relied on practical training (including certifications).<sup>24</sup> However, there remains is a desire to strengthen the academic requirements to require a BS, preferably in science.<sup>24</sup> Additionally, according to Cybersecurity Ventures, the cost of cybercrimes is expected to rise from \$8 trillion dollars in 2023 to \$10.5 trillion in 2025 and “represents the greatest transfer of economic wealth in history”.<sup>25,26</sup> During the COVID-19 pandemic, cybercrimes spiked 600% and forced industries to rapidly adjust to increasing threats.<sup>27</sup> Twenty years ago, digital evidence was rarely encountered in criminal cases, however, of the crimes committed today, almost 90% include digital evidence. This has led the court system to rely on, and society to have an expectation for, digital evidence collection and analyses in cases to consider the guilt or innocence of an accused.<sup>28</sup> The increase in demand for digital forensics and incident response in both the private and public sectors has created a need for individuals with very specific technical skills and knowledge.<sup>29</sup>

Graduates of the proposed degree will be well-prepared to perform forensic examinations and preserve data obtained from a variety of electronic sources, including computers, servers, cloud data, and mobile devices. Additionally, graduates will be able to assist with incident response, including threat hunting, data recovery, email analysis, and malware analysis across a variety of different types of operating systems and will be able to document their findings in detailed reports. Graduates with a B.S. degree in Digital Forensics and Incident Response will also have the ability to present their findings to investigators and in legal proceedings.

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<sup>22</sup> Jang-Jaccard, Julian and Surya Nepal. “A Survey of Emerging Threats in Cybersecurity”, *Journal of Computer and System Sciences*, Volume 80, Issue 5, 2014, Pages 973-993.

<sup>23</sup> Sheward, Mike. *Hands-on Incident Response and Digital Forensics*. Swindon:BCS Learning & Development Limited, 2018. pp. 40-41, 91.

<sup>24</sup> West Virginia University. Technical Working Group for Education and Training in Digital Forensics, 2007. <https://www.ojp.gov/pdffiles1/nij/grants/219380.pdf>

<sup>25</sup> Morgan, Steve. “Cybercrime to Cost the World 8 Trillion Annually in 2023”, *Cybercrime Magazine*, October 17, 2022, <https://cybersecurityventures.com/cybercrime-to-cost-the-world-8-trillion-annually-in-2023/>

<sup>26</sup> Brook, Chuck. “Cybersecurity Trends & Statistics For 2023; What You Need To Know”, *Forbes*, <https://www.forbes.com/sites/chuckbrooks/2023/03/05/cybersecurity-trends--statistics-for-2023-more-treachery-and-risk-ahead-as-attack-surface-and-hacker-capabilities-grow/?sh=2488a70019db>

<sup>27</sup> Mclean, Mike. “2023 Must-Know Cyber Attack Statistics and Trends”, *Embroker*, June 1, 2023, <https://www.embroker.com/blog/cyber-attack-statistics/>

<sup>28</sup> Williams, David. “Discover How Technology Helps Manage the Growth in Digital Evidence”, September 20, 2022 <https://www.microsoft.com/en-us/industry/blog/government/2022/09/20/discover-how-technology-helps-manage-the-growth-in-digital-evidence/>

<sup>29</sup> U.S. Bureau of Labor Statistics. *Occupational Outlook Handbook*. <https://www.bls.gov/ooh/life-physical-and-social-science/forensic-science-technicians.htm#tab-2>

A search for employment projections in the US Bureau of Labor Statistics (BLS) reveals no listing for jobs in the digital forensics or computer incident response fields. This is very likely due to the area of digital forensics and incident response being in its infancy and not a well-established profession. Professions listed on the BLS website that most closely align with the field of digital forensics and incident response include those that combine the skills required for forensic science technicians (collection, preservation, and analysis of evidence, as well as courtroom testimony)<sup>15</sup> and information security analysts (monitor networks for security breaches and investigate when they occur).<sup>30</sup> Entry-level employment in both of these fields typically requires at least a B.S. degree in programs that include a combination of science, law, crime scene investigation, and computers and information technology, which are the expected topics for a Digital Forensic and Incident Response program.<sup>31</sup> The data for these two occupations are included in the following table from the BLS:

**Labor Market Information: Bureau of Labor Statistics, 2021-31 (10-Yr)<sup>31</sup>**

Occupation	Base Year Employment	Projected Employment	Total % Change and #s	Typical Entry Level Education
Forensic Science Technician	17,600	19,600	11% 2,000	Bachelor's Degree
Information Security Analyst	163,000	219,500	35% 56,500	Bachelor's Degree

As can be seen from the information in Table 2, occupational fields closely related to digital forensics and incident response are expected to have an exceptional growth rate, with a range of 11-35% within the next 10 years. According to the BLS site, both forensic science technicians and information security analysts typically need a bachelor's degree to enter the occupation.<sup>9</sup> With the versatility the proposed degree offers, the expectation is that the digital forensics and incident response disciplines will have a similar, if not higher, expected growth rate than most of the above-listed comparison professions.

Information included in the U.S. Bureau of Labor Statistics Occupational Outlook Handbook clarifies the close association between traditional forensic science laboratory analysts and the profession of digital forensics:<sup>32</sup>

“Some forensic science technicians, called *forensic computer examiners* or *digital forensics analysts*, specialize in computer-based crimes. They collect and analyze data to uncover and prosecute electronic fraud, scams, and identity theft. The abundance of digital data helps them solve crimes in the physical world as well. Computer forensics technicians must adhere to the same strict standards of evidence gathering found in general forensic science because legal cases depend on the integrity of evidence.”

<sup>30</sup> U.S. Bureau of Labor Statistics. Occupational Outlook Handbook. <https://www.bls.gov/ooh/computer-and-information-technology/information-security-analysts.htm#tab-2>

<sup>31</sup> U.S. Bureau of Labor Statistics. Occupational Outlook Handbook. <https://data.bls.gov/projections/occupationProj>

<sup>32</sup> Virginia Employment Commission. <https://virginiaworks.com/Occupational-Projections>



Unlike the BLS site, the Virginia Employment Commission (VEC) database does have information on ‘Digital Forensics Analyst’ but does not contain any data on ‘Incident Response’. Information on this profession—as well as Forensic Science Technician and Information Systems Analyst (for comparison to the BLS)—from the VEC is included in the table below.

**Labor Market Information: Virginia Employment Commission, 2020-30 (10-Yr)<sup>32</sup>**

Occupation	SOC Code	Base Year Employment	Projected Employment	Total % Change and #s	Annual Change #	Education
Forensic Science Technician	194092	420	470	11.9% 50	5	Bachelor's Degree
Information Security Analyst	15-1212	16,340	22,360	36.8% 6,020	220	Bachelor's Degree
Digital Forensics Analysts	15-1299.06	17,130	19,620	14.5% 2,490	249	Bachelor's Degree

Data presented by the VEC reinforces the expected growth rate for related digital forensic careers in Virginia. For the period of 2021-2031, the above Labor Market Information data from the VEC projects growth of 14.5% in digital forensic analysts and between 11.9-36.8% in two fields related to digital forensics and incident response.<sup>32</sup> Based upon all the data provided in this section of the document and the market analysis that has been done on the digital forensic and incident response profession, there is a strong case to be made for future job growth in this industry and in the educational system needed to prepare individuals for these professions.

See Appendix H for job announcements.

See Appendix I for letters of support (employment demand).

**Duplication**

The only relevant CIP code for the proposed degree program is 43.0403, for Cyber/Computer Forensics and Counterterrorism. It is worth noting that the designated CIP code is very broad and encompasses all areas of cyber forensics and counterterrorism, which are not the focus of the proposed program (which is exclusively digital forensics and incident response—formerly “Computer Forensics”).

Virginia Commonwealth University would be the first institution in Virginia to offer a B.S. degree in Digital Forensics and Incident Response. In Virginia, there are no other public institutions that offer Bachelor’s degree programs that share the CIP code of the proposed B.S. degree program. Further, there are no other similar degree programs that we know of, regardless of CIP code. Therefore, we believe there is no duplication of the proposed B.S. degree program with any others in Virginia.

**Student Demand**

VCU evaluated student demand for the proposed B.S. degree in Digital Forensics and Incident Response from three sources of data: 1) a prospective student survey, and 2) survey of students enrolled in an existing related elective course, and 3) prospective student inquiry emails.

### Prospective Student Survey

In June of 2023, the Department of Forensic Science sent an online survey to junior and senior high school students at select public and private high schools in the Richmond, VA area. Additionally, to obtain feedback from prospective transfer students, the online survey was also deployed to state community colleges that frequently send students to VCU. Contacts for the high schools were developed through prior existing relationships that the Department has for various community engagement and service-learning relationships. The community college contacts were provided by the VCU Transfer Center. The online survey remained open for 10 weeks. A five-point Likert scale was used. There were 164 responses total; of those, 141 respondents were community college students, prospective transfer students, or recent transfer students who are undeclared, 21 were high school students, and 2 did not indicate their current status. Additionally, 109 of the respondents were female, 75 were white/European, and 149 indicated that they are U.S. citizens. The most informative data is summarized below:

- Prompt 1: *If VCU offered a BS in Digital Forensics program, I would enroll.*  
50 respondents strongly agreed  
45 respondents agreed
- Prompt 2: *Please rate how likely you would do each of the following: I am interested in pursuing a degree in Digital Forensics.*  
26 respondents strongly agreed  
53 respondents agreed
- Prompt 5: *I would likely enroll in this degree program during the following academic school year:*  
78 respondents indicated 2024-2025  
42 respondents indicated 2025-2026

### Survey of FRSC 391 Students

The Department of Forensic Science began offering an undergraduate elective course, FRSC 391: Introduction to Digital Forensics, in part to field interest in the topic. Although open to any major, all students that have enrolled in this course to-date have been forensic science, criminal justice, computer science, and information systems majors at the sophomore, junior, and senior levels. This course has been offered as an elective three times (spring 2022, fall 2022, and fall 2023 – in progress). Initially the course was capped at 24 students, but there was significantly more interest from the student body than we expected. Thus, future sections were raised to a cap of 40 to accommodate as many students as possible within the computer lab space used. A total of 102 students have enrolled for the course total in its three offerings. At the end of the spring and fall 2022 semesters, the adjunct instructor for the course deployed an online survey to enrolled students. A five-point Likert scale was used for the survey. Of the 34 students enrolled each semester, 12 (spring) and 28 (fall) responded. The most informative data is summarized below:

- Spring 2022 Prompt 4: *I believe the University and future students would benefit from a Digital Forensic degree program at VCU designed to dive deeper into the topics covered in this class and prepare them for a career in digital forensics.*  
9 respondents strongly agreed  
2 respondents agreed
- Spring 2022 Prompt 8: *Because of this class, I now have an increased desire to learn more about the field of digital forensics.*  
6 respondents strongly agreed  
5 respondents agreed
- Fall 2022 Prompt 8: *Because of this class, I now have an increased desire to learn more about the field of digital forensics.*  
4 respondents strongly agreed  
16 respondents agreed

#### Prospective Student Inquiries

The Department of Forensic Science has received a number of both informal and more formal inquiries in recent years from prospective students. Often, the prospective students are specifically looking for a B.S.-level degree in digital forensics. In other cases, the students are inquiring more generally about how VCU could accommodate their combined interests in cybersecurity, computer science or IT, and forensic science and want advice about what major to select. Informal inquiries have included phone calls received in the Department's main office from prospective students, prospective student drop-ins in faculty offices and the main office, and direct inquiries from students enrolled in the FRSC 391: Digital Forensics course. Formal inquiries are primarily received as email inquiries to the Department's general email box. However, unfortunately, the Department has no formal mechanism in place to archive the specific inquiries received.

See Appendix J for the student demand surveys, including raw survey data.  
See Appendix K for prospective student support.

**State Council of Higher Education for Virginia**  
**Summary of Projected Enrollments in Proposed Program**

Year 1		Year 2		Year 3		Year 4 Target Year (2-year institutions)			Year 5 Target Year (4-year institutions)		
2024 - 2025		2025 - 2026		2026 - 2027		2027 - 2028			2028 - 2029		
HDCT	FTES	HDCT	FTES	HDCT	FTES	HDCT	FTES	GRAD	HDCT	FTES	GRAD
<u>25</u>	<u>25</u>	<u>100</u>	<u>100</u>	<u>190</u>	<u>190</u>	<u>300</u>	<u>300</u>	—	<u>300</u>	<u>300</u>	<u>19</u>

Assumptions:

Retention percentage: 74.2%

Full-time students: 100%

Part-time students: 0%

Full-time student credit hours per semester: 15

Full-time student graduate in 4 years

Projected Resource Needs for the Proposed Program

**Resource Needs**

Virginia Commonwealth University and the College of Humanities & Sciences have all of the resources necessary to initiate and sustain the proposed B.S. in Digital Forensics & Incident Response, including faculty, staff, equipment, space, and library resources. The proposed degree program allocates 1 FTE of instructional effort for every 75 FTE of undergraduate student enrollment. The proposed degree program will therefore require approximately 1.25 FTE of instructional effort to initiate, rising to approximately 4 FTE by the target year 2028-2029. The following subsections detail the resources required to operate the program from its initiation in the fall 2024 semester through the target year 2028-2029.

**Full-Time Faculty**

A faculty member currently serving in the Department of Forensic Science will serve as program director for the proposed degree program. The program director will devote 0.08 FTE to the proposed degree program and will be responsible for program oversight, curriculum, and assisting with scheduling, marketing, and development of recruitment strategy. Another 2 FTE of full-time faculty are needed to teach core forensic science required courses in the proposed program.

Existing full-time faculty capacity (along with the part-time and adjunct faculty detailed below) will be used to cover the initial year of the proposed program (2024-2025), given projected enrollments. However, one new full-time faculty member (1 FTE) with expertise in digital forensics and incident response will be hired to teach in the proposed degree program by the

second year of the program (2025-2026). The first new hire is expected to be a term faculty member hired at the rank of either Instructor or Assistant Professor. Salary for the new program is expected to be \$90,000 with fringe of \$36,270 for a total expense of \$126,270. A second new hire full-time faculty member (1 FTE) with digital forensics and incident response expertise will be hired by the target enrollment year (2028-2029) to sustain the program. This hire is expected to be either a term faculty or tenure-track faculty hired at the rank of Assistant Professor. Salary and benefits are expected to be the same as the first hire, detailed above.

Altogether, 0.25 FTE of full-time faculty effort will be needed to initiate the proposed degree program, rising to 2.08 FTE of full-time faculty effort in the target enrollment year.

### **Part-Time Faculty**

Existing faculty members in the College of Engineering, Department of Computer Science, will devote a total of 0.334 FTE to teach required core computer science and restricted computer science elective courses in the initial year of the proposed program (2024-2025). This will rise to 1 FTE of instructional effort to teach those courses by the target enrollment year (2028-2029).

Existing faculty members in the School of Business, Department of Information Systems, will devote a total of 0 FTE in the initial year of the proposed degree program (2024-2025). This will rise to 0.167 FTE of instructional support to teach a core information systems course required for the major by the target enrollment year (2028-2029).

### **Adjunct Faculty**

For the proposed degree program, 0.667 FTE of adjunct faculty will be required to teach digital forensics and incident response specialized core coursework and restricted electives required in the initial year of the major. This need will increase to 0.834 FTE of adjunct faculty effort by the target enrollment year (2028-2029). This need will be met by the hire of up to 4 new adjunct faculty.

### **Graduate Assistants**

Although no graduate assistants will be required initially for the proposed degree program, four will be required to sustain the program in the target enrollment year (2028-2029). Graduate teaching assistants are provided by the College of Humanities & Sciences; positions include a \$12,500 stipend for the 9-month academic year. No other benefits are provided.

### **Classified Positions**

The Department Coordinator, Academic Advisor, and the Fiscal Administrator currently employed by the Department will support the proposed degree program in its initial year. However, by the target enrollment year (2028-2029), an additional 3 FTE of classified support will be needed to sustain the proposed degree program. This will include an Administrative Assistant, an Academic Advisor, and a Lab Coordinator position.

The Administrative Assistant position will provide general administrative support to the proposed program. Salary for the Administrative Assistant position will be \$40,000 along with benefits of \$16,120 for a total of \$56,120.

The Laboratory Coordinator position will help provide oversight to the Graduate Assistants, and be responsible for ongoing maintenance of equipment (including computers) and software. Salary for the Lab Coordinator position will be \$55,000 along with benefits of \$20,150 for a total of \$77,165.

The Academic Advisor position will help provide advising support for students regarding matriculation, class registration, and graduation requirements. Salary for the Academic Advisor position will be \$50,000 along with benefits of \$20,150 for a total of \$70,150.

### **Equipment**

For each new hire, existing furniture and computers will be provided by the College of Humanities & Sciences. For the second hire, it will be necessary to provide the hired faculty with a start-up package of \$50,000 *if* the hire is brought in on a tenure-track faculty line.

### **Library**

No additional library resources are required to sustain the proposed degree program. Virginia Commonwealth University's current resources include journals, magazines, electronic materials and other publications needed to support the proposed degree program.

### **Telecommunications**

No additional telecommunications are needed to initiate or sustain the proposed degree program. Existing telecommunication services and devices will be utilized for the new hires.

### **Space**

New office spaces will be needed for new faculty and staff hires. Office space will be provided by the College of Humanities & Sciences.

### **Targeted Financial Aid**

No targeted financial aid is available for the students in the proposed degree program.

### **Special Tuition or Fee Charges**

No specific tuition or fee charges will be utilized to initiate and sustain the proposed degree program. Students enrolled will be charged program fees consistent with the existing forensic science degree program (Tier 1 – College of Humanities & Sciences).

### **Other Resources**

No other resources are needed to initiate and sustain the proposed degree program, including marketing, start-up costs, etc.

**Funds to Initiate and Operate the Degree Program**

*Figures provided in the table below will be compared to SCHEV funding estimates using the current base adequacy model. This comparison will serve as a reference for the estimated costs. If there are large discrepancies, SCHEV may request additional clarification to ensure the institution’s assumptions are correct, or require modifications as a condition of approval.*

**Note:** Institutions must use the recommended student-faculty ratio when estimating FTE enrollments and required faculty FTEs.

<b>Cost and Funding Sources to Initiate and Operate the Program</b>			
<b>Informational Category</b>		<b>Program Initiation Year 2024 - 2025</b>	<b>Program Full Enrollment Year<sup>33</sup> 202_ - 2028</b>
1.	Projected Enrollment (Headcount)	25	300
2.	Projected Enrollment (FTE)	0	0
3.	Projected Enrollment Headcount of In-State Students	21	249
4.	Projected Enrollment Headcount of Out-of-State Students	4	51
5.	Estimated Annual Tuition and E&G Fees for In-state Students in the Proposed Program	\$16,563	\$18,219
6.	Estimated Annual Tuition and E&G Fees for Out-of-State Students in the Proposed Program	\$39,147	\$43,062
7.	Projected Total Revenue from Tuition and E&G Fees Due to the Proposed Program	\$504,411	\$6,732,693
8.	Other Funding Sources Dedicated to the Proposed Program (e.g., grant, business entity, private sources)	\$0	\$0

<sup>33</sup> For the “Full Enrollment Year” use: for associate degrees, initiation year plus 1; for baccalaureate degrees, initiation plus 3; for masters degrees, initiation plus 2; for doctoral degrees, initiation plus 3.

*Part V: Certification Statements*

1. A request of any kind will be submitted to the General Assembly for funds to initiate and/or maintain the proposed degree program.

Yes   
No

If “Yes” is checked, include narrative text to describe: when the request will be made, how much will be requested, what the funds will be used for, and what will be done if the request is not fulfilled.

2. The proposed degree program is included in the institution’s most recent six-year plan.

Yes   
No

If “No” is checked, include narrative text to explain why the program is being advanced at the present time despite not being included in the six-year plan.

3. The institution’s governing board has been provided information regarding duplication (if applicable) and labor market projections as part of its approval action.

Yes   
No

If “No” is checked, include narrative text to explain why the governing board has not been provided the information.

The institution’s Chief Academic Officer attests to the accuracy of the above statements

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Name (Printed)

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Signature

Date



## Appendices

## Appendix A – FEPAC Accreditation Curriculum Requirements

The Forensic Science Education Programs Accreditation Commission (FEPAC) curriculum requirements are provided below for the accreditation of a B.S. degree program in the area of Digital Forensics.<sup>34</sup>

Standard	Course(s) used to fulfill requirement
<b>4.1a</b> – Coverage of the following topics: courtroom testimony, introduction to law, quality assurance, ethics, professional practice, and evidence identification, collection, and processing	FRSC 300 Survey of Forensic Science FRSC 309 Scientific Crime Scene Investigation FRSC 375 Forensic Evidence, Law, and Criminal Procedure FRSC 490 Professional Practices in Forensic Science
<b>4.1b</b> – A survey of forensic science course (≥3 credits)	FRSC 300 Survey of Forensic Science
<b>4.1b</b> – Coursework introducing methods, instrumentation, and concepts that are commonly associated with the professional practice of forensic science (≥6 credits, ≥3 of which contain laboratory training)	FRSC 300 Survey of Forensic Science FRSC 309 Scientific Crime Scene Investigation
<b>4.1c</b> – A forensic science capstone experience	FRSC 490 Professional Practices in Forensic Science
<b>4.2.4a</b> – Natural science courses: two courses in calculus and/or statistics (≥6 credits)	BUSN 212 Business Problem Solving and Analysis <i>Or</i> MATH 200 Calculus with Analytic Geometry I  AND  STAT 210 Concepts of Statistics <i>Or</i> STAT 212 Applications of Statistics
<b>4.2.4a</b> – Natural science courses: two courses in biology, chemistry, and/or physics with the co-requisite laboratory (≥7 credits)	Students must complete the course(s) from two of the following groups:  BIOL 151 Introduction to Biological Sciences I & BIOZ 151 Introduction to Biological Science Laboratory I BIOL 152 Introduction to Biological Sciences II & BIOZ 152 Introduction to Biological Science

<sup>34</sup> The Forensic Science Education Programs Accreditation Commission (FEPAC). <https://www.aafs.org/FEPAC>

Standard	Course(s) used to fulfill requirement
	Laboratory II CHEM 101 General Chemistry I & CHEZ 101 General Chemistry Laboratory I CHEM 102 General Chemistry II & CHEZ 102 General Chemistry Laboratory II PHYS 201 General Physics I <i>Or</i> PHYS 207 University Physics I PHYS 202 General Physics II <i>Or</i> PHYS 208 University Physics II
<b>4.2.4b</b> – A computer programming course ( $\geq 3$ credits)	CMSC 255 Introduction to Programming CMSC 256 Data Structures and Object-Oriented Programming FRSC 231 Programming for Digital Forensics
<b>4.2.4b</b> – Coverage of the following topics: computer organization and structure; file systems and operating systems; computer networking; information assurance/network security; data structures/database design; web or mobile application design and development; and microelectric circuits ( $\geq 6$ credits)	INFO 300 Information Technology Infrastructure CMSC 257 Computer Systems CMSC 311 Computer Organization FRSC 232 Reverse Engineering Malware for Forensic Applications FRSC 330 Introduction to Digital and Multimedia Forensic Sciences FRSC 331 File System and Data Structure Forensics
<b>4.2.4c</b> – Specialized digital forensic courses covering: acquisition of data; network/“live” forensic analysis; and exploitation of mobile devices ( $\geq 6$ credits)	FRSC 431 Computer and Storage Forensics FRSC 432 Mobile and IoT Device Forensics FRSC 433 Cloud Forensics and Incident Response FRSC 531 Hardware Forensics and Advanced Acquisition

## Appendix B – Sample Plan of Study

### Full-time Student

<b>Freshman Year</b>			
<b>Fall semester</b>	<b>credits</b>	<b>Spring semester</b>	<b>credits</b>
CMSC 255 Introduction to Programming	4	CMSC 256 Data Structures and Object-Oriented Programming	4
FRSC 231 Programming for Digital Forensics	2	FRSC 232 Reverse Engineering Malware for Forensic Applications	2
UNIV 111 Focused Inquiry I*	3	FRSC 330 Introduction to Digital and Multimedia Forensic Sciences	3
General education courses	6	HUMS 202 Choices in a Consumer Society	1
		UNIV 112 Focused Inquiry II*	3
		Experiential Fine Art	1-3
<b>Subtotal</b>	<b>15</b>	<b>Subtotal</b>	<b>14-16</b>
<b>Total for year: 29-31 credits</b>			
<b>Sophomore Year</b>			
<b>Fall semester</b>	<b>credits</b>	<b>Spring semester</b>	<b>credits</b>
CMSC 257 Computer Systems	4	CMSC 302 Introduction to Discrete Structures	3
INFO 300 Information Technology Infrastructure	3	FRSC 300 Survey of Forensic and Science	3
FRSC 331 File System and Data Structure Forensics	3	FRSC 375 Forensic Evidence, Law & Criminal Procedure	3
UNIV 200 Inquiry and the Craft of Argument*	3	MATH 200 Calculus with Analytical Geometry I*	4
Open elective	3	General education course	3
<b>Subtotal</b>	<b>16</b>	<b>Subtotal</b>	<b>16</b>
<b>Total for year: 32 credits</b>			
<b>Junior Year</b>			
<b>Fall semester</b>	<b>credits</b>	<b>Spring semester</b>	<b>credits</b>
CMSC 311 Computer Organization	3	FRSC 432 Mobile and IoT Device Analysis	3
FRSC 309 Scientific Crime Scene Investigation	3	General education courses	6
FRSC 431 Computer and Storage Device Analysis	3	Natural science with lab (ex: BIOL/Z 152, CHEM/Z 102, PHYS 202)	4
STAT 212 Concepts of Statistics	3	FRSC elective (300-level or higher)	3
Natural science with lab (ex: BIOL/Z 151, CHEM/Z 101, PHYS 201) *	4		
<b>Subtotal</b>	<b>16</b>	<b>Subtotal</b>	<b>16</b>
<b>Total for year: 32 credits</b>			

<b>Senior Year</b>			
<b>Fall semester</b>	<b>credits</b>	<b>Spring semester</b>	<b>credits</b>
FRSC 490 Professional Practices in Forensic Science	3	FRSC 531 Hardware Forensics and Advanced Acquisition	3
FRSC 433 Cloud Forensics and Incident Response	3	FRSC elective (300-level or higher)	3
Foreign language 101 (or open elective)	3	Foreign language 102 (or open elective)	3
CMSC elective (200-level or higher)	2	Open electives	4
Open elective	3		
<b>Subtotal</b>	<b>14</b>	<b>Subtotal</b>	<b>13</b>
<b>Total for year: 27 credits</b>			
<b>TOTAL for Degree Program: 120-122</b>			

\*Counts as gen ed course

## Sample Plan of Study

### Part-time Student

#### First Year

Fall semester	credits	Spring semester	credits
HUMS 202 Choices in a Consumer Society	1	FRSC 330 Introduction to Digital and Multimedia Forensic Sciences	3
STAT 212 Concepts of Statistics	3	UNIV 112 Focused Inquiry II*	3
UNIV 111 Focused Inquiry I*	3	Experiential Fine Art	1-3
General education course	3	Open elective	2
<b>Subtotal</b>	<b>10</b>	<b>Subtotal</b>	<b>9-11</b>
<b>Total for year: 19-21 credits</b>			

#### Second Year

Fall semester	credits	Spring semester	credits
CMSC 255 Introduction to Programming	4	CMSC 256 Data Structures and Object-Oriented Program	4
FRSC 231 Programming for Digital Forensics	2	FRSC 232 Reverse Engineering Malware for Forensic Applications	2
UNIV 200 Inquiry and the Craft of Argument*	3	MATH 200 Calculus with Analytical Geometry I*	4
Open elective	1		
<b>Subtotal</b>	<b>10</b>	<b>Subtotal</b>	<b>10</b>
<b>Total for year: 20 credits</b>			

#### Third Year

Fall semester	credits	Spring semester	credits
CMSC 257 Computer Systems	4	CMSC 302 Introduction to Discrete Structures	3
INFO 300 Information Technology Infrastructure	3	FRSC 300 Survey of Forensic Science	3
FRSC 331 File System and Data Structure Forensics	3	FRSC 375 Forensic Evidence, Law & Criminal Procedure	3
		CMSC elective (200-level or higher)	2
<b>Subtotal</b>	<b>10</b>	<b>Subtotal</b>	<b>11</b>
<b>Total for year: 21 credits</b>			

#### Fourth Year

Fall semester	credits	Spring semester	credits
CMSC 311 Computer Organization	3	FRSC 309 Scientific Crime Scene Investigation	3
FRSC 431 Computer and Storage Device Analysis	3	General education course	3
Natural science with lab (ex: BIOL/Z 151, CHEM/Z 101, PHYS)	4	Natural science with lab (ex: BIOL/Z 152, CHEM/Z 102, PHYS 202)	4

201) \*

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<b>Subtotal</b>	<b>10</b>	<b>Subtotal</b>	<b>10</b>
<b>Total for year: 20 credits</b>			

**Fifth Year**

<b>Fall semester</b>	<b>credits</b>	<b>Spring semester</b>	<b>credits</b>
FRSC 432 Mobile and IoT Device Analysis	3	FRSC elective (300-level or higher)	3
Foreign language 101 (or open elective)	3	Foreign language 102 (or open elective)	3
General education course	3	General education course	3
Open elective	2	Open elective	1
<b>Subtotal</b>	<b>11</b>	<b>Subtotal</b>	<b>10</b>
<b>Total for year: 21 credits</b>			

**Sixth Year**

<b>Fall semester</b>	<b>credits</b>	<b>Spring semester</b>	<b>credits</b>
FRSC 433 Cloud Forensics and Incident Response	3	FRSC 531 Hardware Forensics and Advanced Acquisition	3
FRSC 490 Professional Practices in Forensic Science	3	FRSC elective (300-level or higher)	3
General education course	3	Open electives	4
<b>Subtotal</b>	<b>9</b>	<b>Subtotal</b>	<b>10</b>
<b>Total for year: 19 credits</b>			

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**TOTAL for Degree Program: 120-122**

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\*Counts as gen ed course

## Appendix C – Course Descriptions

Course descriptions are provided for the core and required courses. New courses are designated with an asterisk (\*).

### Core courses

#### CMSC 255. Introduction to Programming

Semester course; 3 lecture and 2 laboratory hours. 4 credits. Prerequisite: calculus-level placement on the VCU Mathematics Placement Test within the one-year period immediately preceding enrollment in the course, or MATH 151 or equivalent. Students are expected to have fundamental computer skills. Introduction to object-oriented programming using Java. Topics include problem-solving, top-down design of algorithms using control structures, methods, arrays, basic I/O, basic concepts of objects and classes in Java, Java classes for manipulating strings, and introduction to program testing, UML notation and integrated development environments. Students may not receive credit for both CMSC 255 and INFO 250.

#### CMSC 256. Data Structures and Object-Oriented Programming

Semester course; 3 lecture and 2 laboratory hours. 4 credits. Prerequisite: CMSC 255 with a minimum grade of C; corequisite: CMSC 302. Advanced programming using Java. Topics include introduction to object-oriented design, inheritance, polymorphism, exceptions, interfaces, linked lists, stacks, queues, binary trees, recursion, and basic searching and sorting techniques. Continued focus on program testing and UML notation. Students may not receive credit for both CMSC 256 and INFO 350.

#### CMSC 257. Computer Systems

Semester course; 3 lecture and 2 laboratory hours. 4 credits. Prerequisite: CMSC 256 with a minimum grade of C. Topics include UNIX essentials; system programming in C; machine-level representation and organization of programs/data, arrays and pointers; types, structs and unions; strings; bit/byte operations; memory management; shell programming; input/output, including file handling; debugging; signals; network programming using sockets; program concurrency using forks and threads; experiments on program performance and optimization techniques.

#### CMSC 302. Introduction to Discrete Structures

Semester course; 3 lecture hours. 3 credits. Prerequisite: CMSC 255 with minimum grade of C. Logic and proofs, sets, functions, sequences and sums, relations, graphs, trees, induction and recursion, advanced counting technique (recurrences).

#### CMSC 311. Computer Organization.

Semester course; 3 lecture hours. 3 credits. Prerequisite: CMSC 302 with minimum grade of C; corequisite: CMSC 257. Introduction to the basic organization of computers including elementary digital logic design, processor and arithmetic/logic unit design, data paths, memory hierarchy, I/O devices, instruction set architecture and addressing modes.

#### FRSC 231 Programming for Digital Forensics\*.

Semester course; 1 lecture hour and 2 laboratory hours. 2 credits. Pre- or corequisite: CMSC 255. A study of programming applied to digital forensics. The course begins with the command-line interface and concludes with programming for data transcoding and task automation. Students



will gain practical experience interpreting various data structures and learn skills to develop forensic tools of their own.

#### FRSC 232 Reverse Engineering Malware for Forensic Applications\*

Semester course; 1 lecture and 2 laboratory hours. 2 credits. Prerequisite: FRSC 231 with a minimum grade of C. Provides an overview of malicious software and a basic understanding of how to examine the inner workings of both malware and applications to allow for forensic analysis.

#### FRSC 300. Survey of Forensic Science

Semester course; 3 lecture hours. 3 credits. Prerequisites: BIOL 151, BIOZ 151, CHEM 102, CHEZ 102 and UNIV 112, each with a minimum grade of C. Pre- or corequisites: CHEM 301 and CHEZ 301, and UNIV 200 or HONR 200. Enrollment is restricted to forensic science majors or by permission of instructor. Introduces the theory, concepts and practices used in the analysis of physical evidence performed in crime laboratories, and the fundamentals of crime scene investigation. Also introduces ethical and quality assurance issues of crucial importance in modern crime laboratories.

#### FRSC 309 Scientific Crime Scene Investigation

Semester course; 2 lecture and 2 laboratory hours. 3 credits. Prerequisite: FRSC 300 with a minimum grade of C. Enrollment is restricted to forensic science majors or by permission of the instructor. Provides scientific theory of crime scene investigation and crime scene reconstruction and basic knowledge of proper crime scene protocol and evidence processing techniques. Includes the processes for documentation, collecting and preserving physical evidence.

#### FRSC 375 Forensic Evidence, Law, and Criminal Procedure

Semester course; 3 lecture hours. 3 credits. Prerequisites: BIOL 151, BIOZ 151, CHEM 102, CHEZ 102 and UNIV 112, each with a minimum grade of C. Pre- or corequisites: FRSC 300, CHEM 301 and CHEZ 301; and UNIV 200 or HONR 200. Enrollment is restricted to forensic science majors or by permission of the instructor. The law of criminal procedure and rules of evidence as applied to forensic science. Topics will include scientific versus legal burdens of proof, legal terminology and trial procedure.

#### FRSC 330 Introduction to Digital and Multimedia Forensic Sciences\*

Semester course; 2 lecture and 2 laboratory hours. 3 credits. A broad overview of digital forensics. Covers the foundational topics of terminology, methodologies, devices, operating systems and filesystems, tools and software, standards, ethics, and challenges. Provides an introduction to the various areas of focus within the digital and multimedia sciences, including computer, mobile, video, audio, and network forensics, as well as the various modalities in which it is practiced (i.e., public vs. private sector).

#### FRSC 331 File System and Data Structure Forensics\*

Semester course; 2 lecture and 2 laboratory hours. 3 credits. Prerequisites: FRSC 330 with a minimum grade of C, and pre- or corequisite INFO 300. An in-depth analysis of the most commonly seen file systems and data structures in digital forensics including FAT, NTFS and EXFAT, Registry and Plists. Students will use hands-on labs with digital forensic tools to find,

interpret, examine and recover data from disks. Students will practice writing digital forensic reports to a lay audience.

#### FRSC 431 Computer and Storage Forensics\*

Semester course; 2 lecture and 2 lab hours. 3 credits. Prerequisites: FRSC 330 and FRSC 331, each with a minimum grade of C. The course will be an introduction to the digital forensic examination of computer devices and their associated storage devices. Lecture topics include the collection, acquisition and analysis of common (e.g., Windows, MacOS and Linux) systems, recovery of deleted data and interpretation of operating and file system artifacts in order to answer investigative questions. Students will perform forensic processes using commercial-off-the-shelf and/or open-source tools and learn to analyze the artifacts found using realistic data sets. Students will understand the importance of examination documentation, reporting, expert testimony and law in the forensic process.

#### FRSC 432 Mobile and IoT Device Forensics\*

Semester course; 2 lecture and 2 laboratory hours. 3 credits. Prerequisites: FRSC 330 and FRSC 331, each with a minimum grade of C. An in-depth instruction in forensic mobile device examination, including the “Internet of Things” (IoT). Focuses on the forensic process from collection through acquisition and analysis, culminating in report writing and expert testimony. Covers data structures encountered in Android and iOS devices, as well as various less-common operating systems.

#### FRSC 433 Cloud Forensics and Incident Response\*

Semester course; 2 lecture hours and 2 laboratory hours. 3 credits. Prerequisite: FRSC 431 with a minimum grade of C. An in-depth study of incident response investigations and cloud platforms. Provides the skills and tactics necessary to identify vulnerabilities and compromised systems, combat threats in real-time, and recover from an incident. Covers a wide-range of cloud platforms and how they can be leveraged to gather evidence during an incident through use of Security Information and Event Management tools.

#### FRSC 531 Hardware Forensics and Advanced Acquisition\*

Semester course; 2 lecture and 3 laboratory hours. 3 credits. Prerequisites: FRSC 431 and FRSC 432, each with a minimum grade of C; or FRSC 530. Enrollment is restricted to seniors in forensic science with at least 85 credit hours toward the degree or graduate students in forensic science. Establishes a strategy of approach for dealing with damaged, difficult, or uncommon devices. Provides comprehensive working knowledge and hands-on experience with the hardware of digital devices, including research and troubleshooting practices, teardown skills, repair and soldering techniques, and the application of advanced acquisition methods.

#### FRSC 490 Professional Practices in Forensic Science

Semester course; 3 lecture hours. 3 credits. Prerequisites: FRSC 300; and one additional FRSC or FRSZ course, each with a minimum grade of C. Enrollment is restricted to seniors in forensic science with at least 85 credit hours toward the degree. An examination and evaluation of historical and current issues in the scientific analysis of physical evidence in criminal investigations. Individual and group activities relating to professional practices (ethics, quality control and testimony) of forensic scientists.

INFO 300 Information Technology Infrastructure

Semester course; 3 lecture hours. 3 credits. Pre- or corequisite: INFO 202, CMSC 245 or CMSC 255. The course introduces principles of computer hardware and software architecture and organization. The focus is on surveying what is likely to be encountered in the IT legacy today, emerging technologies and introducing data structures and algorithms.

## Appendix D – Student Internship Ad



### Intern-Computer Forensics

Richmond, Virginia

Dominion has an exciting internship opportunity for a student studying Forensics, Criminology, Homeland Security or Computer Science for Summer 2017. We are looking for current juniors and sophomores who are ready to apply their knowledge to practical work while working along with Dominion professionals. The job summary and qualifications are provided below.

This intern position will provide support to the Dominion Corporate Security organization that provides expertise and leadership that ensures a safe and secure environment for the Company, its employees, shareholders and stakeholders by advancing regulatory compliance, preventative strategies, recognizing threats and responding effectively.

This intern position will work with our Security Computer Forensic specialist and will assist with the research and analysis of automated systems to develop pertinent data on investigations. Recovers, examines, maintains and processes data from electronic storage devices for evidentiary purposes. Provides reports and presentations of investigative results, maintains evidence logs, maintains chain of evidence logs.

Job Qualifications include a solid understanding of security concepts and the ability to apply academics to real-life opportunities. General knowledge and understanding of security concepts, and sophisticated security technologies, to support computer forensics. Experience with the following operating systems; DOS, Macintosh, Linux, Android, and MS Windows is preferred. Experience with office products such as Word, Outlook, Power Point, Access, Excel, email is highly preferred. Consistent demonstration of strong, critical thinking and decision making skills, applied in a security environment. Ability to assess security incidents and take appropriate action. Demonstrated ability to manage the flow of sensitive information.

Experience with Encase Forensic Software, Encase, FTK, Autopsy, Magnet is a plus.

Students must be working towards completing a bachelor's degree in a related field; Forensics, Criminology, Criminal Science, Computer Science. Prefer a student with an anticipated graduation date of December 2017 to May 2018 with a cumulative GPA >2.5.

#### Application Process

To apply for this opportunity for the Summer 2017, please visit our website to apply at <https://campusconnection-dominion.icims.com/jobs/9072/intern-computer-forensics-%28criminology-computer-science-students%29/job>



ONE DOMINION | MANY CAREERS



## Appendix E –Abbreviated Curriculum Vitae for Faculty

### Department of Forensic Science

#### *Existing*

Mason L. Byrd, J.D., 2002, University of Richmond, Master's in Public Administration, 2002, Virginia Commonwealth University, Adjunct Instructor, Specialization Area: Expert testimony & criminal law procedures.

Chris Ehrhardt, Ph.D. in Earth & Environmental Sciences, 2007, University of California at Santa Barbara, Professor, Specialization Area: Environment, microbial and trace forensic biochemistry.

Mary MacQuire, J.D., 1991, Georgetown University, Adjunct Instructor, Specialization Area: Federal rules of evidence & federal courts system.

Karen Lynne Shafer, M.S. in Forensic Studies (concentration in Computer Forensics), 2014, Stevenson University, Adjunct Instructor, Specialization Area: File systems & data structure forensics.

Patrick Siewert, B.S. in Criminal Justice, 1999, Virginia Commonwealth University, Adjunct Instructor, Specialization Area: Digital & multimedia forensics and eDiscovery.

Tal Simmons, Ph.D. in Anthropology, 1990, University of Tennessee, Professor, Specialization Area: Forensic anthropology.

Baneshwar Singh, Ph.D. in Biology, 2011, West Virginia University, Associate Professor, Specialization Area: Forensic entomology & forensically relevant microbiomes.

Steve Stockman, Master's in Public Administration, 1998, Troy University, Assistant Professor, Specialization Area: Crime scene investigation & law enforcement training.

Stephanie Walcott, M.S. in Criminal Justice (Concentration in Forensic Science), 2002, Virginia Commonwealth University, Assistant Professor, Specialization Area: Forensic firearms & tool marks analysis.

Nia Vidal, J.D., 2002, Howard University, Adjunct Instructor, Specialization Area: Criminal law & evidence procedures.

#### *Potential Hires*

Nelson Eby, M.A. in Computer Fraud Investigation, 2003, George Washington University, Position *TBD*, Specialization Area: Computer crimes, digital forensics, and digital crime scene management.

Patrick Eller, M.S. in Digital Forensics/Cyber Investigations, 2015, University of Maryland, Position *TBD*, Specialization Area: Computer crimes investigation & digital mobile device analysis.

John B. Hirt, B.S. in Science, 2011, Florida State University, Position *TBD*, Specialization Area: Digital evidence methodology & programming.

Jesse M. Lindmar, B.S. in Computer Science, 1999, Fairleigh Dickinson University, Position *TBD*, Specialization Area: Mobile & IoT device forensic analysis, computer & storage device forensics.

Patricia Mullaney, B.S. in Biology, 2002, Texas A&M University, Position *TBD*, Specialization Area: General digital evidence analysis & video examinations.

Nicole R. Odom, M.S. in Forensic Science (concentration in Digital Forensics), 2019, Marshall University, Position *TBD*, Specialization Area: Digital & multimedia hardware forensics and advanced acquisition, cloud forensics.

#### Department of Computer Science

Caroline Budwell, Ph.D. in Computer Science, 2008, Nova Southeastern University, Associate Professor, Specialization Area: Learning and Engagement Strategies.

Debra Duke, M.S. in Computer Science, 2006, Virginia Commonwealth University, Professor of the Practice, Specialization Area: Learning and Engagement Strategies.

Luke Gusukuma, Ph.D. in Computer Science, 2020, Virginia Tech, Associate Professor, Specialization Area: Technology Innovation in the Teaching of Computer Science.

Ahmet Sonmez, Ph.D. in Computer Science, 2012, University of Houston, Associate Professor, Specialization Area: Cybersecurity and computer systems.

Claire Sparks, M.S. in Computer Science, 2017, Christopher Newport University, Instructor, Specialization Area: High quality instruction for undergraduate students.

#### Department of Information Systems

Dan Han, M.S. in Information Systems, 2011, Virginia Commonwealth University, Master's in Business Administration, 2010 Virginia Commonwealth University, Adjunct Professor, Specialization Area: Information security and information technology governance.

Michael T. McGarry, Ph.D. in Business Administration, Temple University, Master's in Business Administration, 1992, Case Western Reserve University, Instructor, Specialization Area: Information technology strategy, advanced programming, and database management.

## Appendix F – Mapping of Employment Skills within the Curriculum

Employment Skill	Course(s) in which skill(s) is acquired
Articulate and demonstrate knowledge of principles of digital and multimedia evidence (DME) acquisition & analysis, including application of laws (e.g., rules of evidence, chain of custody, etc.), regulations, and investigative methods	FRSC 300 Survey of Forensic Science FRSC 309 Scientific Crime Scene Investigation FRSC 375 Forensic Evidence, Law, and Criminal Procedure FRSC 330 Introduction to Digital and Multimedia Forensic Sciences FRSC 431 Computer and Storage Forensics FRSC 432 Mobile and IoT Device Forensics FRSC 531 Hardware Forensics and Advanced Acquisition
Articulate and demonstrate knowledge of network operations	INFO 300 Information Technology Infrastructure CMSC 257 Computer Systems FRSC 330 Introduction to Digital and Multimedia Forensic Sciences FRSC 432 Mobile and IoT Device Forensics FRSC 433 Cloud Forensics and Incident Response
Conduct examinations of video/image recording, computer, mobile, and/or data storage devices and associated data	FRSC 231 Programming for Digital Forensics FRSC 232 Reverse Engineering Malware for Forensic Applications FRSC 330 Introduction to Digital and Multimedia Forensic Sciences FRSC 331 File System and Data Structure Forensics FRSC 431 Computer and Storage Forensics FRSC 432 Mobile and IoT Device Forensics FRSC 433 Cloud Forensics and Incident Response FRSC 531 Hardware Forensics and Advanced Acquisition
Accurately perform analysis and interpret data to develop conclusions	FRSC 231 Programming for Digital Forensics FRSC 232 Reverse Engineering Malware for Forensic Applications FRSC 330 Introduction to Digital and Multimedia Forensic Sciences FRSC 331 File System and Data Structure Forensics

Employment Skill	Course(s) in which skill(s) is acquired
	FRSC 431 Computer and Storage Forensics FRSC 432 Mobile and IoT Device Forensics FRSC 433 Cloud Forensics and Incident Response FRSC 531 Hardware Forensics and Advanced Acquisition
Explain technical concepts in a manner that is simple, concise, and accessible to all levels of understanding	FRSC 330 Introduction to Digital and Multimedia Forensic Sciences FRSC 331 File System and Data Structure Forensics FRSC 490 Professional Practices in Forensic Science
Communicate findings in a written and oral format, consistent with expert testimony in a court of law	FRSC 331 File System and Data Structure Forensics FRSC 431 Computer and Storage Forensics FRSC 432 Mobile and IoT Device Forensics
Examine the inner workings of malware and applications from a forensic perspective	FRSC 232 Reverse Engineering Malware for Forensic Applications
Implement or mitigate security measures to identify vulnerabilities and compromised systems in a networked environment	FRSC 232 Reverse Engineering Malware for Forensic Applications FRSC 433 Cloud Forensics and Incident Response
Complete relevant digital forensic certifications (e.g., video, mobile, or computer)	FRSC 231 Programming for Digital Forensics FRSC 232 Reverse Engineering Malware for Forensic Applications FRSC 330 Introduction to Digital and Multimedia Forensic Sciences FRSC 331 File System and Data Structure Forensics FRSC 431 Computer and Storage Forensics FRSC 432 Mobile and IoT Device Forensics FRSC 433 Cloud Forensics and Incident Response FRSC 531 Hardware Forensics and Advanced Acquisition
Demonstrate competency in a variety of digital forensic tools, including commercial and open-source digital forensic hardware and software	FRSC 330 Introduction to Digital and Multimedia Forensic Sciences FRSC 331 File System and Data Structure Forensics



Employment Skill	Course(s) in which skill(s) is acquired
	FRSC 431 Computer and Storage Forensics FRSC 432 Mobile and IoT Device Forensics FRSC 433 Cloud Forensics and Incident Response FRSC 531 Hardware Forensics and Advanced Acquisition
Utilize commands and syntax for a variety of operating systems (including Windows, Mac OS, Linux, Android and iOS)	FRSC 231 Programming for Digital Forensics FRSC 330 Introduction to Digital and Multimedia Forensic Sciences FRSC 331 File System and Data Structure Forensics FRSC 431 Computer and Storage Forensics FRSC 432 Mobile and IoT Device Forensics
Automate tasks through use of computer programming languages	CMSC 255 Introduction to Programming CSC 256 Data Structures and Object-Oriented Programming FRSC 231 Programming for Digital Forensics
Evaluate emerging technologies	INFO 300 Information Technology Infrastructure FRSC 231 Programming for Digital Forensics FRSC 232 Reverse Engineering Malware for Forensic Applications FRSC 330 Introduction to Digital and Multimedia Forensic Sciences FRSC 331 File System and Data Structure Forensics FRSC 431 Computer and Storage Forensics FRSC 432 Mobile and IoT Device Forensics FRSC 433 Cloud Forensics and Incident Response FRSC 531 Hardware Forensics and Advanced Acquisition

## **Appendix G – Letters of Support (Specific Demand)**



August 9, 2023

Tracey Dawson Green, Ph.D  
Professor and Chair  
Dept. of Forensic Science  
1015 Floyd Avenue  
PO Box 843079  
Richmond, VA 23284

RE: Digital Forensic Degree (B.S.)

Dear Dr. Green:

The Federal Bureau of Investigation has offices in all 50 states, U.S. territories and Legats around the world. Digital evidence plays a role in 99% of all law enforcement investigations, as well as counterintelligence. Due to the prevalence of digital evidence, the FBI has approximately 500 Digital Forensic Examiners located directly in each primary office, as well as in Regional Computer Forensic Laboratories (RCFLs). The FBI has other digital forensic personnel including Computer Scientists, Digital Forensic Specialists and Special Agents who have been trained in digital forensics. In Virginia, the FBI has digital forensic personnel spread throughout the commonwealth in Richmond, Bristol, Charlottesville, Roanoke, Winchester, Chesapeake, Quantico, Manassas, and Norfolk. These personnel provide incident response and laboratory examinations of digital evidence not just to FBI investigations, but in support of other federal, state, and local law enforcement and regularly work with the Virginia State Police and the Virginia Department of Forensic Science.

Currently, there is no B.S. program in digital forensics offered at any VA university. While several offer classes in cyber security, digital forensics is a separate and distinct specialty and requires a distinct curriculum which I believe the new VCU Digital Forensics and Incident Response program would provide. The FBI regularly has multiple openings for digital forensic examiners and has difficulty finding candidates with a digital forensics background. The FBI digital forensic training program must provide substantial training in digital forensics to bring new trainees to the level needed to become certified digital forensic examiners. The proposed curriculum does match the requirements of the posting for FBI digital forensic examiner, which would make the VCU graduates competitive for any openings.

Sincerely,

Karen Lynne Shafer

*Master Digital Forensic Examiner - Training Program Coordinator*  
CFCE / GCFE  
**Digital Evidence Staffing, Education and Development Unit**  
FBI - OTD (Richmond, VA)  
Mobile: 804-543-7908  
Desk: 804-627-4748  
[kshafer@fbi.gov](mailto:kshafer@fbi.gov)





# COMMONWEALTH of VIRGINIA

## DEPARTMENT OF FORENSIC SCIENCE

OFFICE OF THE DIRECTOR  
A Nationally Accredited Laboratory

700 NORTH 5TH ST.  
RICHMOND, VIRGINIA 23219  
(804) 786-2281 FAX (804) 786-6857

August 15, 2023

Tracey Dawson Green, Ph.D.  
Dept. of Forensic Science  
Harris Hall, 2nd Floor, Rm. 2013  
1015 Floyd Avenue  
PO Box 843079  
Richmond, VA 23284

Dr. Dawson Green,

I am writing this letter in support of the creation of a Bachelor of Science degree in Digital Forensics & Incidence Response (DFIR) at Virginia Commonwealth University.

The Department of Forensic Science (DFS) is a nationally accredited forensic laboratory system that employs six Forensic Scientists in its Digital & Multimedia Evidence (DME) Section.

The mission of DFS is to provide laboratory services in criminal matters in the Commonwealth of Virginia, support the criminal justice system with quality and timely services, and advance the understanding of forensic science in order to promote public safety. DFS supports law enforcement and the criminal justice system by performing impartial forensic analyses of crime scene evidence and by presenting the results of those analyses through reports, consultations, and expert witness testimony in courts of law.

DME examiners analyze electronic information stored on computer, mobile and digital storage devices to identify and/or recover existing, deleted and/or fragmented data, electronic communications, and user activity or usage patterns. Analog or digital video recordings are examined, repaired and clarified to improve appearance.

The minimum qualifications for DME examiners include a Baccalaureate degree in a computer science, forensic science, natural science, information technology, or closely related field and experience working in a laboratory, using basic laboratory equipment and scientific instrumentation. Certification by an international digital/multimedia association is preferred.

Forensic laboratories across the country hire graduates from universities and train them in-house to meet their internal requirements and ensure that they have the necessary expertise to work independently and provide expert testimony in courts of law. The training program at DFS is typical, generally requires 12 months for completion, and culminates in a three-part competency test, including a practical test, oral technical examination, and formal mock trial.

**Based on a review of the curriculum for the proposed DFIR BS degree, graduates should be very competitive in the hiring process for trainees in the DFS DME section.** Having graduates with these knowledge, skills, and abilities should shorten the training period once hired, which would be extremely beneficial.

Two of the most important features of this new degree program are the hand-on experience that will be gained through courses with a computer lab component, coupled with the forensic science and law courses that will clarify the environment in which the work will be performed.

With six Forensic Scientists, our laboratory system only has a small DME section. However, most law enforcement agencies across the Commonwealth perform these functions in-house, which will significantly broaden the scope of opportunities for future graduates of the BS DFIR program at VCU.

Please let me know if you have any further questions.

Sincerely,

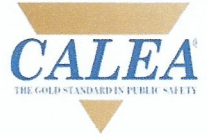


Linda C. Jackson  
Director



# Culpeper County Sheriff's Office

Scott H. Jenkins, Sheriff



14023 PUBLIC SAFETY COURT CULPEPER, VA 22701  
OFFICE: 540-727-7520 FAX: 540-727-3466 JAIL: 540-727-3434 RECORDS: 540-727-3400

11 August 2023

Tracey Dawson Green, Ph.D.  
Professor & Chair, Department of Forensic Science  
Virginia Commonwealth University  
PO Box 843079  
Richmond, Virginia 23284

Dr. Green,

Culpeper County Sheriff's Office (CCSO) provides law enforcement services - including patrol, investigations, jail, court security, records, civil process, and school resource services - to a community of about 53,000 residents. CCSO's mission is to protect and serve the citizens of Culpeper County while upholding the United States Constitution and the laws of the Commonwealth of Virginia. We discharge our duties while maintaining professional standards and integrity in public service.

The Criminal Investigations Division (CID) is responsible for investigating violent and serious felonies and serious misdemeanor cases. CID has 15 personnel assigned to the Division, including General, Narcotics, and Cold Case Detectives and Crime Analysts, and digital and multimedia evidence (DME) plays a primary or secondary role in most of the cases assigned to them. CCSO's membership in Northern Virginia - Washington, DC Internet Crimes Against Children Task Force, Blue Ridge Narcotics and Gang Task Force, and Drug Enforcement Agency Task Force Program generates additional DME. As of 8 August 2023, the average case turnaround time for DME submitted to Virginia's Department of Forensic Science was 98 days - too long for victims of child pornography and human trafficking, to name but two. CCSO has a digital forensics laboratory, where certified Detectives examine and analyze digital evidence, thereby decreasing the Commonwealth's caseload and wait times for other agencies.

As the lead digital forensics examiner-analyst here who selects applicants for the specialty, I can say from experience that an applicant who obtains VCU's proposed four-year Bachelor of Science (BS) degree in Digital Forensics and Incident Response (DFIR) demonstrates a long-standing interest in the work that one cannot predict before selecting a Deputy to send to a short course to obtain the certification and then putting him/her/them to work.

As the nature of law-breaking has changed, not only in Culpeper County but around the country, Sheriff Jenkins has made decisions designed to stay ahead of such change. We think a BS in DFIR degree program is needed at this time, and we believe the proposed BS degree in DFIR will produce prepared, well-educated graduates who will be capable of addressing the needs of the field.

Very Respectfully,

A handwritten signature in cursive script that reads "Angela Deavers".

Detective Angela D. Deavers, CCO, CCPA, VSIC

## **Appendix H – Employment Demand Job Announcements**



## Incident Response Analyst

Apply

Houston, Texas, United States of America

Full time

Posted 4 Days Ago

R000042806

Chevron’s strategy is straight-forward: be a leader in efficient and lower carbon production of traditional energy, in high demand today and for decades to come, while growing lower carbon businesses that will be a bigger part of the future. To achieve these goals, we’ll build on the assets, experience, capabilities, and relationships we’ve developed over 140 years to incubate and grow new business.

Technology will play a crucial role in unlocking ever cleaner and more affordable sources of energy. Chevron is seeking innovative, technology professionals with a desire to thrive in the global digital environment and help us lead the global energy transition. An IT career at Chevron offers you the opportunity to work in a technical environment with a global reach. You’ll find that we make a business of investing in our people and encouraging your professional development through a learning culture and challenging on-the-job opportunities. We differentiate ourselves through the application of cutting-edge technology, and by taking a collaborative approach that includes in-house expertise, proprietary solutions, and strategic partnerships. We also offer flexible work schedules and very competitive benefits.

Join Chevron IT. Lend us your skills and enjoy a great career with Chevron.

### The Role

The Cyber Intelligence Center delivers cyber threat monitoring and incident response.

We leverage threat intelligence that enables early detection and rapid response to protect Chevron global operations.

This role supports 24x7 cyber threat detection and incident response

The function leverages threat intelligence to proactively hunt for and respond to external cyber threats.

The operational scope includes Chevron’s global network infrastructure, industrial control systems and information assets.



**As a Cyber Incident Response Analyst, you will:**

- Carry out appropriate processes to contain and remediate cybersecurity incidents through coordination across the IT Function and Business Representatives
- Perform forensic analysis of compromised hosts and develop an action plan for remediation
- Examine potentially malicious files, with the goal of breaking down programmatic functions and techniques
- Extract indicators of compromise to then feed detection capabilities as a means of continuous improvement
- Participate in an on-call rotation in support of 24x7 escalation activities outside of standard business hours

**Requirements:****Experience**

- Previous experience performing incident response in a security operations center or equivalent cybersecurity organization
- Hands on experience performing host and network digital forensics
- Proven ability to coordinate assignments within a team setting, and communicate findings using both technical and non-technical content

**Skills**

- Adept in incident response, digital forensics, and cyber threat hunting
- Expertise in the identification of cyber attack techniques
- Familiarity with reverse engineering of malicious code, with an understanding of programming languages, scripting and coding techniques

**Education –**

- Bachelor's Degree in related fields
- Professional cybersecurity certifications a plus

**Flexible Working**

Chevron offers a complete package and provides career development opportunities to all employees. We do this through on-boarding, training and development, mentoring, volunteering opportunities and employee networking groups. We advocate work-life balance and offer employees access to various health and wellness programs.

What type of flex work does the position offer?

- We offer alternative work schedules including 9/80 (work 9-hour days, with every other Friday off)
- We offer a hybrid work model - work remotely from home 2-3 days a week

**Relocation & International Considerations**

Relocation not be considered

Expatriate assignments will not be considered.

Chevron regrets that it is unable to sponsor employment Visas or consider individuals on time-limited Visa status for this position.

## Working with us

Chevron is one of the world's leading integrated energy companies. We believe affordable, reliable and ever-cleaner energy is essential to achieving a more prosperous and sustainable world. Chevron produces crude oil and natural gas; manufactures transportation fuels, lubricants, petrochemicals and additives; and develops technologies that enhance our business and the industry. We are focused on lowering the carbon intensity in our operations and seeking to grow lower carbon businesses along with our traditional business lines. More information about Chevron is available at [www.chevron.com](http://www.chevron.com).

### Benefits

Chevron offers competitive compensation and benefits programs which includes, but is not limited to, variable pay, healthcare coverage, retirement plan, insurance, time off programs, training and development opportunities and a range of allowances connected to specific work situations. Details of such benefits and allowances are available at <https://hr2.chevron.com/>.

### Regulatory Disclosure for US Positions:

Chevron is an Equal Opportunity / Affirmative Action employer. Qualified applicants will receive consideration for employment without regard to race, color, religious creed, sex (including pregnancy, childbirth, breast-feeding and related medical conditions), sexual orientation, gender identity, gender expression, national origin or ancestry, age, mental or physical disability (including medical condition), military or veteran status, political preference, marital status, citizenship, genetic information or other status protected by law or regulation.

We are committed to providing reasonable accommodations for qualified individuals with disabilities. If you need assistance or an accommodation, please email us at [emplymnt@chevron.com](mailto:emplymnt@chevron.com).

Chevron participates in E-Verify in certain locations as required by law.

## About Us



Chevron Corporation is one of the world's leading integrated energy companies. Through its subsidiaries that conduct business worldwide, the company is involved in virtually every facet of the energy industry. Chevron explores for, produces and transports crude oil and natural gas; refines, markets and distributes transportation fuels and lubricants; manufactures and sells petrochemicals and additives; generates power; and develops and deploys technologies that enhance business value in every aspect of the company's operations. Chevron is

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[Chevron Privacy Statement](#)



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# Associate Security Incident Response Engineer, Security Response and Engineering (SRE)

Job ID: 2424161 | Amazon Web Services, Inc.

## DESCRIPTION

The Amazon Web Services team is looking for a passionate Associate Security Incident Response Engineer who can respond to security issues across the largest cloud provider in the world. You must thrive in dynamic situations, and think like both an attacker and defender, while working through the entire incident response lifecycle. You'll be working in a global team environment where clear and accurate communication and collaboration on security issues is critical.

In this role you'll be conducting security monitoring and response activities for the Amazon internal network. We value broad and deep technical knowledge, specifically in the fields of operating system security, network security, cryptography, software security, malware analysis, forensics, security operations, incident response, and emergent security intelligence. We don't expect you to be an expert in all of the domains mentioned above, but we do expect you to be excited to learn about them!

You'll apply your creative and critical problem solving skills to quickly design and build tooling that enables programmatic automation at a massive scale. You must have a passion for engineering solutions to complex security challenges, and recognize and fill gaps in capabilities. Above all, you should be passionate about information security, the threat landscape and security automation and tooling.

### About Us

#### Inclusive Team Culture

Here at AWS, we embrace our differences. We are committed to furthering our culture of inclusion. We have ten employee-led affinity groups, reaching 40,000 employees in over 190 chapters globally. We have innovative benefit offerings, and we host annual and ongoing learning experiences, including our Conversations on Race and Ethnicity (CORE) and AmazeCon (gender diversity) conferences. Amazon's culture of inclusion is reinforced within our 16 Leadership Principles, which remind team members to seek diverse perspectives, learn and be curious, and earn trust.

#### Work/Life Balance

Our team puts a high value on work-life balance. Striking a healthy balance between your personal and professional life is crucial to your happiness and success here, which is why we aren't focused on how many hours you spend at work or online. Instead, we're happy to offer a flexible schedule so you can have a more productive and well-balanced life—both in and outside of work.

#### Mentorship & Career Growth

Our team is dedicated to supporting new members. We have a broad mix of experience levels and tenures, and we're building an environment that celebrates knowledge sharing and mentorship. We care about your career growth and strive to assign projects based on what will help each team member develop into a better-rounded engineer and enable them to take on more complex tasks in the future.

We are open to hiring candidates to work out of one of the following locations: Herndon, VA, USA

## BASIC QUALIFICATIONS

- BS degree in Computer Science, Computer Engineering, Electrical Engineering or equivalent related field
- 1+ year or more of demonstrated experience with a focus in areas such as systems, network, and/or application security.
- 1+ year experience on a Security team, especially experience coordinating responses to security incidents
- Proficiency with one high-level programming or scripting language

## PREFERRED QUALIFICATIONS

- Previous experience working in security response, security automation tooling, or threat intelligence
- Familiarity with malware analysis, forensics, SOAR, SIEM platforms, and a variety of Operating Systems (MS Windows, Linux, MacOS)
- Experience with Amazon Web Services
- Meets/exceeds Amazon's leadership principles requirements for this role - Meets/exceeds Amazon's functional/technical depth and complexity for this role.

Amazon is committed to a diverse and inclusive workplace. Amazon is an equal opportunity employer and does not discriminate on the basis of race, national origin, gender, gender identity, sexual orientation, protected veteran status, disability, age, or other legally protected status. For individuals with disabilities who would like to request an accommodation, please visit <https://www.amazon.jobs/en/disability/us>.





# Junior Forensic Analyst

BAE Systems

**Location:** Arlington, VA 22209 (Radnor-Ft Myer Heights area)

**Type:** Full-Time, Non-Remote

Posted on: March 5, 2023

**This job is no longer available from the source.**

Junior Forensic Analyst

BAE Systems

3,426 reviews

1300 17th St N, Arlington, VA 22209

Full-time

BAE Systems

3,426 reviews

Read what people are saying about working here.

Job details

Job Type

Full-time

Full Job Description Job Description

BAE Systems is looking for a Junior Forensic Analyst to provide biometric image comparisons and other forensic analysis support for our Federal Customer. Support required include:

- Perform 1:1 biometric image comparisons (i.e. comparing two separate biometric images to each other), provide/record comparison results and associated case data when applicable.
- Search facial images against a gallery of over several hundred million facial images, analyze resulting candidates and provide/record comparison results/reports and associated case data as needed.
- Perform routine identity maintenance activities to include review of a biometric record(s) and/or comparison of multiple biometric records to resolve/deconflict complex identity management issues.

- Support Help Desk/technical troubleshooting efforts on provided examiner tools.
- Support stakeholder conferences, demonstrations, and training of existing capabilities.
- Research and present on a regular basis on topics including new technologies, issues, SOPs, etc.

#### Required Education, Experience, & Skills

- Bachelor's Degree/equivalent work experience or higher in related field.
- Three months to 3 years' forensic analysis or biometric image comparison experience.

#### About BAE Systems Intelligence & Security

BAE Systems, Inc. is the U.S. subsidiary of BAE Systems plc, an international defense, aerospace and security company which delivers a full range of products and services for air, land and naval forces, as well as advanced electronics, security, information technology solutions and customer support services. Improving the future and protecting lives is an ambitious mission, but it's what we do at BAE Systems. Working here means using your passion and ingenuity where it counts – defending national security with breakthrough technology, superior products, and intelligence solutions. As you develop the latest technology and defend national security, you will continually hone your skills on a team—making a big impact on a global scale. At BAE Systems, you'll find a rewarding career that truly makes a difference.

Intelligence & Security (I&S), based in McLean, Virginia, designs and delivers advanced defense, intelligence, and security solutions that support the important missions of our customers. Our pride and dedication shows in everything we do—from intelligence analysis, cyber operations and IT expertise to systems development, systems integration, and operations and maintenance services. Knowing that our work enables the U.S. military and government to recognize, manage and defeat threats inspires us to push ourselves and our technologies to new levels.

#### Our Commitment to Diversity, Equity, and Inclusion:

At BAE Systems, we work hard every day to nurture an inclusive culture where employees are valued and feel like they belong. We are conscious of the need for all employees to see themselves reflected at every level of the company and know that in order to unlock the full potential of our workforce, everyone must feel confident being their best, most sincere self and be equipped to thrive. We provide impactful professional development experiences to our employees and invest in social impact partnerships to uplift communities and drive purposeful change. Here you will find significant opportunities to do meaningful work in an environment intentionally designed to be one where you will learn, grow and belong.

Hiring Insights Job activity • Posted 1 day ago



Job Posting Data and Labor Data from [JobsEQ®](#) by Chmura.

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Data as of 6/23/2023 2:50:59 PM UTC.

# Special Agent: Cybersecurity/Technology

## Background- job post

[Federal Bureau of Investigation](#)

[836 reviews](#)

Norfolk, VA

\$78,000 - \$153,000 a year - Full-time

### HOW TO APPLY

**STEP 1:** Click on the “Apply” button to be directed to the FBIJobs Careers website.

**STEP 2:** Click the “Start” button to begin. You will be prompted to either Sign In to continue or to register with FBIJobs if you don’t already have an account.

**STEP 3:** Follow the step-by-step process to submit your interest. You will be guided through each step. You must complete all sections of the form AND ALL REQUIRED DOCUMENTS MUST BE ATTACHED to successfully submit your interest.

1. Your resume, specifically noting relevant work experience and associated start and end dates.

2. Other supporting documents:

- College transcripts, if qualifying based on education, or if there is a positive education requirement.
- Veterans: DD 214; Disabled Veterans: DD 214, SF-15 and VA letter dated 1991 or later.

Please see instructions on the site for attaching documents.

### JOB DESCRIPTION

Use your cyber and IT background to become an FBI Special Agent!

FBI Special Agents apply their professional experience and unique skill sets to their work and role every day. Because technology permeates every aspect of what we do, our Agents also come from all IT backgrounds including network information, cybersecurity, computer science, digital forensics and other technical specialties. We need professionals experienced in network security, computer science and software engineering to prevent cybercrimes, data theft, ransomware and other attacks to our national security.

You can expect continued specialized training once onboard and opportunities to work on some of the Bureau's most complex cases. The scope and scale of our investigations provide unique challenges unlike anything you could work on in the private sector.



## **SALARY LEVEL**

- \$78,000.00 – \$153,000.00

Salary is commensurate to experience and location.

## **DUTIES**

- Adhere to strict standards of conduct.
- Undergo a rigorous background investigation, credit checks and a polygraph in order to obtain a Top Secret Sensitive Compartmented Information (SCI) Clearance.
- Pass all physical fitness requirements; must be physically fit to complete training at the FBI Academy at Quantico, VA, and maintain a high level of fitness throughout your career.
- Pass a medical exam, which includes, but is not limited to, meeting visual and hearing standards.
- Successfully complete approximately 19 weeks of employment as a Special Agent trainee, while housed at the FBI Academy at Quantico.
- Upon graduation from the FBI Academy, be available to transfer to one of the FBI's 56 Field Offices, including San Juan, Puerto Rico or remote resident agencies (satellite offices) to meet the needs of the FBI. Special Agents rarely return to their processing office. Applicants should ensure that their families are prepared for and support this move.
- Throughout your career, be available for temporary duty assignments anywhere in the world, on either a temporary or a long-term basis.
- Work a minimum of a 50-hour workweek, which may include irregular hours, and be on-call 24/7, including holidays and weekends.
- Be willing and able to participate in arrests, execute search warrants, raids and similar assignments.

In addition, all Special Agent candidates must successfully complete the Special Agent Selection System (SASS), a mentally and physically challenging process designed to find only the most capable applicants. The selection process typically takes one year or more to complete.

## **KEY REQUIREMENTS**

You must:

- Be a U.S. citizen.
- Be at least 23 years old and not have reached your 37th birthday on appointment.
- Be able to obtain a Top Secret SCI Clearance.
- Have two years of full-time professional work experience (see work experience waiver for exceptions).
- Meet the FBI's Employment Eligibility requirements.

- Possess a valid driver's license with at least six months driving experience.

## **EDUCATION**

- Candidates must have a bachelor's degree or higher (preferably in computer science, engineering, data science, information technology or similar disciplines) from a U.S.-accredited college or university.

**All degrees must be from an accredited college or university and must be verified by submitting college transcripts.**

As the federal agency whose mission is to ensure the fair and impartial administration of justice for all Americans, the Department of Justice is committed to fostering a diverse and inclusive work environment. To build and retain a workforce that reflects the diverse experiences and perspectives of the American people, we welcome applicants from the many communities, identities, races, ethnicities, backgrounds, abilities, religions, and cultures of the United States who share our commitment to public service.

Job Type: Full-time

Pay: \$78,000.00 - \$153,000.00 per year

Benefits:

- 401(k)
- Dental insurance
- Flexible schedule
- Health insurance
- Life insurance
- Paid time off
- Professional development assistance
- Vision insurance

Schedule:

- 8 hour shift
- Holidays
- On call
- Weekend availability

Ability to commute/relocate:

- Norfolk, VA: Reliably commute or planning to relocate before starting work (Required)

Experience:

- Cybersecurity: 1 year (Preferred)

Work Location: In person



# Cybersecurity and Privacy Associate - Summer 2024

Arlington, VA, United States

## JOB DESCRIPTION

With the rise in Cyber breaches across industries, companies are aggressively looking for consultants to help them protect their critical assets and proactively prepare and respond to Cyber breaches. The threat actors have shifted from simple, nuisance based Cyber hacks to criminals, activists, ransom hacks and nation states.

Our Cybersecurity & Privacy practice offers an opportunity for you to leverage your technology background and experience to broaden your business and project management skills in a rewarding and challenging environment. Individuals will work on projects across our portfolio of Cybersecurity & Privacy and will assist in the development of Cyber risk strategies, identity and access management programs, network security, Cyber security analytics, ethical hacking, cloud security, privacy & data protection, artificial intelligence, etc.

Interested candidates should have analytical skills, be strong “thinkers”, with an affinity for learning and innovation. Interested candidates should be self-starters and should demonstrate strength in or a desire to build skills related to Grant Thornton’s core values of: Collaboration, Leadership, Excellence, Agility, Respect, and Responsibility.

### Your day-to-day may include:

- Associates can expect to work closely with the Cybersecurity & Privacy team on all phases of the engagement lifecycle including planning, engagement management, and project wrap up. Some of the typical projects are:
  - Ethical Hacking
  - Cyber Threat Monitoring
  - Cloud Security
  - Identity and Access Management
  - Privacy and Data Protection
  - Cyber Incident Management
  - Cyber War Gaming
  - Cyber Strategy and Program Design
  - Artificial Intelligence (AI) in Cybersecurity
  - Secure Code Design
  - Business Strategy and Cyber strategy Alignment

- In addition, Associates are expected to actively contribute to business growth by identifying business development opportunities, participating in marketing and brand initiatives, and assisting with the development of Grant Thornton thought leadership.

### **You have the following technical skills or qualifications:**

- B.S. in Engineering within Computer, Computer Science, Information Systems
- B.S. in Computer Science
- B.S. program in Data analytics, Informatics, Management with Cybersecurity (minor)
- B.S. program with a specialization in Technology – “Hands on technology experience”
- Strong business and technical aptitude and problem-solving skills
- Likes to learn the business of our clients to help them solve problems
- Ability to bridge the gap between business strategy and Cybersecurity/technology to help deliver sustainable solutions to our clients
- Excellent thinking, analytical, communication (written and verbal) and interpersonal skills
- Effective time management skills for handling multiple priorities and simultaneous projects
- Enthusiasm to learn through a combination of structured, on-the-job, and self-directed training
- Ability to work efficiently and effectively in a team environment
- B.S. in Cybersecurity or Information Security
- Optional – Juris Doctorate (J.D.) degree with interest in Cybersecurity and Data Privacy
- Minimum major and overall GPA of 3.0/4.0 preferred
- Ability to travel as required

## **ABOUT US**

At Grant Thornton, we believe in making business more personal and building trust into every result – for our clients and you. Here, we go beyond your expectations of a career in professional services by offering a career path with more: more opportunity, more flexibility, and more support. It’s what makes us different, and we think being different makes us better.

## **ABOUT THE TEAM**

### **The team you’re about to join is ready to help you thrive. Here’s how:**

- Whether it’s your work location, weekly schedule or unlimited flex time off, we empower you with the options to work in the way that best serves your clients and your life.
- Here, you are supported to prioritize your overall well-being through work-life integration options that work best for you and those in your household.
- We understand that your needs, responsibilities and experiences are different — and we think that’s a good thing. That’s why we support you with personalized and comprehensive benefits that recognize and empower all the identities, roles and aspirations that make you, well, you. See how at [www.gt.com/careers](http://www.gt.com/careers)
- When it comes to inclusion, we are committed to doing more than checking boxes. Explore all the ways we’re taking action for diversity, equity & inclusion at [www.gt.com/careers](http://www.gt.com/careers)

**Here's what you can expect next:**

If you apply and are selected to interview, a Grant Thornton team member will reach out to you to schedule a time to connect. We encourage you to also check out other roles that may be a good fit for you or get to know us a little bit better at [www.gt.com/careers](http://www.gt.com/careers).

**Benefits:**

We understand that your needs, responsibilities and experiences are different, and we think that's a good thing. That's why we support you with personalized and comprehensive benefits that recognize and empower all the identities, roles and aspirations that make you, well, you. For an overview of our benefit offerings, please visit: <https://www.grantthornton.com/careers/rewards-and-benefits>

- Benefits for internship positions: Grant Thornton interns are eligible to participate in the firm's medical, dental and vision insurance programs and the firm's employee assistance program. Interns also receive a minimum of 72 hours of paid sick leave, and are paid for firm holidays that fall within their internship period.
- Benefits for seasonal employee positions: Grant Thornton seasonal employees are eligible to participate in the firm's medical, dental and vision insurance programs and the firm's employee assistance program. Seasonal employees may also be eligible to participate in the firm's 401(k) savings plan and employee retirement plan in accordance with applicable plan terms and eligibility requirements. Seasonal employees receive a minimum of 72 hours of paid sick leave.

Grant Thornton employees may be eligible for a discretionary, annual bonus based on individual and firm performance, subject to the terms, conditions and eligibility criteria of the applicable bonus plan or program. Interns and seasonal employees are not eligible for bonus compensation.

**Additional Details:**


It is the policy of Grant Thornton to promote equal employment opportunities. All personnel decisions (including, but not limited to, recruiting, hiring, training, working conditions, promotion, transfer, compensation, benefits, evaluations, and termination) are made without regard to race, color, religion, national origin, sex, age, marital or civil union status, pregnancy or pregnancy-related condition, sexual orientation, gender identity or expression, citizenship status, veteran status, disability, handicap, genetic predisposition or any other characteristic protected by applicable federal, state, or local law.

Consistent with the Americans with Disabilities Act (ADA) and applicable state and local laws, it is the policy of Grant Thornton LLP to provide reasonable accommodation when requested by a qualified applicant or employee with a disability, unless such accommodation would cause an undue hardship. The policy regarding requests for reasonable accommodation applies to all aspects of employment, including the application process. To make an accommodation request, please contact [ColleagueSupportSpecialists@us.gt.com](mailto:ColleagueSupportSpecialists@us.gt.com).

For Los Angeles Applicants only: We will consider for employment all qualified Applicants, including those with Criminal Histories, in a manner consistent with the requirements of applicable state and local laws, including the City of Los Angeles' Fair Chance Initiative for Hiring Ordinance.

**APPLY NOW**

## JOB INFO

Job Identification	109441
Job Category	Security & Privacy Risk Management
Posting Date	08/24/2023, 04:56 PM
Degree Level	Bachelor's Degree
Job Schedule	Full time
Locations	 Arlington, VA, United States

### Similar Jobs

Cybersecurity and Privacy Associate - Summer 2024  
Philadelphia, PA, United States • Posted on 08/17/2023



Cybersecurity and Privacy Associate - Summer 2024  
Dallas, TX, United States • Posted on 08/24/2023



Cybersecurity and Privacy Associate - Summer 2024

San Francisco, CA, United States • Posted on 08/24/2023



Cybersecurity and Privacy Associate - Summer 2024

New York, NY, United States • Posted on 08/24/2023



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# Computer Forensics Analyst

**Job Category:** Intelligence

**Requisition Number:** COMPU003951

[Apply now](#)

Posted: August 4, 2023

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Full-Time

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Marine Corps Base Quantico  
Quantico, VA 22134, USA

## Job Details

### Description

**Requisition #:** COMPU003951

**Job Title:** Computer Forensics Analyst

**Location:** 27130 Telegraph Road Stafford, Virginia 22554

**Clearance Level:** Active DoD - Top Secret SCI

**Required Certification(s):**

- DoD forensic certification standard as a Forensic Analyst is Defense Cyber Investigations Training Academy (DCITA) Computer Crime Investigator certification, which are four courses: Introduction to Networks and Computer Hardware (INCH), Computer Incident Responders Course (CIRC), Windows Forensic Examinations-EnCase (WFE-E) and Forensics and Intrusions in a Windows Environment (FIWE).
- Civilian equivalent course examples are: International Association of Computer Investigative Specialists (IACIS), Certified Forensic Computer Examiner (CFCE); or SANS.org Global Information Assurance Certification (GIAC) Certified Forensic Analyst (GCFA).
- EnCE certification desirable.

### SUMMARY

Agile Defense is seeking a Digital Forensics Examiner to support the Army Criminal Investigation Division. The primary purpose of this position is to conduct computer forensic investigations, data recovery, and electronic discovery. The candidate will be expected to have a solid foundation of technical experience and expertise, possess strong communication skills, and exceed our clients expectations. The successful candidate will work with a senior level forensic analyst, a project manager, and management personnel, as well as with corporate clients. A strong background in forensic lab practices and procedures, evidence handling, and testifying as an expert witness is required. Experience in law enforcement, basic investigations or with a professional services firm is preferred.

### JOB DUTIES AND RESPONSIBILITIES

- Conduct R&D (including password decryption) on forensic software and hardware to determine best practices and tools for inclusion in MEDEX procedures downrange.
- Deploy downrange as necessary to perform media exploitation.
- Use computer forensic software, hardware and best practices to image and analyze various types of electronic media including hard disk drives (HDD), thumb drives, cell phones, multi-media cards (MMC), CDs/DVDs, and video.
- Follow chain of custody rules and evidence handling procedures.
- Document findings for military intelligence purposes and to assist federal agents in criminal prosecution.
- Monitor and perform day-to-day IT security tasks including: information assurance, risk management, risk examination and assessment; vulnerability monitoring and analysis; website policy management, access control and monitoring; network traffic monitoring and incident investigation.
- Recovery information from partially damaged or whole disks, memory cards and other electronic devices
- Innovate new techniques for recovering information
- Analyze new technologies and products for security flaws and technical specifications
- Produce reports for field operatives and agency directors
- Use forensic tools and investigative methods to find specific electronic data, including Internet use history, word processing documents, images and other files.
- Provide cyber forensic and analytic support to criminal investigations involving digital media, devices and networks.
- Perform digital media evidence seizure support, cyber forensic analysis, and data recovery services for law enforcement customers.
- Research and maintain proficiency in cyber investigative tools, forensic techniques, and trends in computer network vulnerabilities, forensic analysis and data recovery.
- Tests/validates digital forensic analysis tools.
- Assists in identifying, monitoring, investigating and analyzing computer network intrusions.
- Act as subject matter expert in digital forensics and testifies as expert witness as needed in criminal prosecutions.

## QUALIFICATIONS

### Required Certifications

- DoD forensic certification standard as a Forensic Analyst is Defense Cyber Investigations Training Academy (DCITA) Computer Crime Investigator certification, which are four courses: Introduction to Networks and Computer Hardware (INCH), Computer Incident Responders Course (CIRC), Windows Forensic Examinations-EnCase (WFE-E) and Forensics and Intrusions in a Windows Environment (FIWE).
- Civilian equivalent course examples are: International Association of Computer Investigative Specialists (IACIS), Certified Forensic Computer Examiner (CFCE); or SANS.org Global Information Assurance Certification (GIAC) Certified Forensic Analyst (GCFA).
- EnCE certification desirable.

### Education, Background, and Years of Experience

- Bachelor's Degree in Computer Information Systems or related.

## ADDITIONAL SKILLS & QUALIFICATIONS

### Required Skills

- Experience with EnCase, X-Ways, AXIOM, Cellebrite, and other forensic tools.
- Competency in computer forensics, electronic discovery, and information security.

## WORKING CONDITIONS

### Environmental Conditions

- Typical office environment.

### Strength Demands

- Sedentary – 10 lbs. Maximum lifting, occasional lift/carry of small articles. Some occasional walking or standing may be required. Jobs are sedentary if walking and standing are required only occasionally, and all other sedentary criteria are met.

### Physical Requirements

- Stand or Sit; Walk; Repetitive Motion; Use Hands / Fingers to Handle or Feel; Stoop, Kneel, Crouch, or Crawl; See; Push or Pull; Climb (stairs, ladders) or Balance (ascend / descend, work atop, traverse).

### About Us!

*Agile Defense provides leading-edge Digital Transformation solutions to support and advance our customers' mission. We deliver innovative and high-quality services to our customers worldwide through an empowered and engaged workforce.*

*Employees of Agile Defense are our number one priority, and the importance we place on our culture here is fundamental. Our culture is alive and evolving, but it always stays true to its roots. Here, you are valued as a family member, and we believe that we can accomplish great things together. Agile Defense has been highly successful in the past few years due to our employees and the culture we create together. We believe several attributes are the root of our very best employees and extraordinary culture. We have named these attributes "The 6 H's" – Happy, Helpful, Honest, Humble, Hungry, and Hustle.*

- **Happy:** We exhibit a positive outlook in order to create a positive environment.
- **Helpful:** We assist each other and pull together as teammates to deliver.
- **Honest:** We conduct our business with integrity.
- **Humble:** We recognize that success is not achieved alone, that there is always more to learn, and that no task is below us.
- **Hungry:** We desire to consistently improve.
- **Hustle:** We work hard and get after it.

*These Core Values are present in all our employees and our organization's aspects. Learn more about us and our culture by visiting us here.*

### COVID-19 Vaccination Requirements

*Agile Defense is subject to federal vaccine mandates or other customer/facility vaccination requirements as a federal contractor. As such, to protect its employees' health and safety and comply with customer requirements, Agile Defense may require employees in certain positions to be fully vaccinated against COVID-19. Vaccination requirements will depend on the status of the federal contractor mandate and customer site requirements.*

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### Equal Opportunity Employer/Protected Veterans/Individuals with Disabilities

The contractor will not discharge or in any other manner discriminate against employees or applicants because they have inquired about, discussed, or disclosed their own pay or the pay of another employee or applicant. However, employees who have access to the compensation information of other employees or applicants as a part of their essential job functions cannot disclose the pay of other employees or applicants to individuals who do not otherwise have access to compensation information, unless the disclosure is (a) in response to a formal complaint or charge, (b) in furtherance of an investigation, proceeding, hearing, or action, including an investigation conducted by the employer, or (c) consistent with the contractor's legal duty to furnish information. 41 CFR 60-1.35(c)

"Listen. Think. Innovate" 

## Forensic Scientist - Digital & Multimedia Evidence - Central Laboratory - CF802

- 497184
- Richmond, Virginia, United States
- Department of Forensic Science
- Applied Sciences and Natural Resources
- Full-Time (Salaried)
- Closing at: Feb 27 2023 at 23:55 EST
- Department of Forensic Science

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**Title:** Forensic Scientist - Digital & Multimedia Evidence - Central Laboratory - CF802

**Hiring Range:** \$52,676 - \$88,123

**Pay Band:** 5

**Agency:** Department of Forensic Science

**Location:** Dept of Forensic Science

**Agency Website:** [www.dfs.virginia.gov](http://www.dfs.virginia.gov)

**Recruitment Type:** General Public - G

### Job Duties

The Virginia Department of Forensic Science is seeking a qualified candidate to perform Digital & Multimedia evidence analyses, with a focus on video & image analysis, and mobile device analysis, at the Central Regional Laboratory, located in Richmond, Virginia.

The successful candidate will receive and process forensic evidence; independently perform analyses; use knowledge of methodologies, techniques and instrumentation related to electronic information stored on a variety of video/image recording devices, data storage devices, and

mobile devices; interpret results and prepare reports of findings for use by the Criminal Justice System; prepare court exhibits and testify in court as an expert witness. Forensic Scientists working in this position will encounter data containing sensitive or explicit content. Occasional overnight travel is required and employee will provide own transportation as required.

To be considered qualified, candidates must have completed a documented training program and/or demonstration of competency in at least one of the Digital & Multimedia sub-disciplines:

1. Video & Image Analysis or
2. Mobile Device Analysis

The documented training program and/or demonstration of competency, which can include relevant academic coursework, internal or external training courses, and competency tests, must meet the Virginia Department of Forensic Science's training requirements for the candidate to be considered qualified. Records documenting the successfully completed coursework, training and testing will be requested.

Candidates who are considered qualified in one sub-discipline, will be required to successfully complete an in-house training program in the additional sub-discipline.

### **Minimum Qualifications**

- Bachelor's degree from an accredited four-year college/university
- Successful completion of a documented training program and/or demonstration of competency in video & image analysis and/or mobile device analysis
- Knowledge of the basic principles of digital & multimedia evidence acquisition and analysis
- Professional work experience conducting digital forensic examinations of video/image recording devices and video recordings and still images, and/or mobile devices and their associated electronically stored information
- Knowledge, skills and ability to testify in court through experience and/or training
- Ability to work independently, set priorities, work efficiently, keep accurate records, and to communicate effectively, both verbally and in writing in a clear and concise manner
- Ability to accurately perform analysis and interpret data and develop conclusions.
- Valid driver's license and/or other means of reliable transportation

### **Preferred Qualifications:**

- Experience examining current D/NVR and/or mobile device operating and file systems
- Experience in the repair, reconstruction, decoding, identification, capture, and/or clarification of video recordings and still images
- Knowledge of file formats, encoding standards, and compression algorithms used in digital video and images
- Experience parsing encoded data, SQLite databases, [Binary] Property List ([B]Plist) files, and application and system logs
- Experience with the use of Amped Five, FFmpeg, DVR Examiner, Adobe Photoshop and/or Premiere, VideoFOCUS Pro, Cellebrite Premium | UFED 4PC and Physical Analyzer, GrayKey, and/or X-Ways Forensics
- Digital forensic certification (e.g., video, mobile, or computer) by an international association

- Experience examining data storage media including hard disk drives (HDD), solid-state drives (SSD), RAID arrays, optical discs, and flash memory
- Knowledge of multimedia (i.e. pictures, and audio and video recordings) data structures and attributes
- Experience implementing or mitigating information security measures (i.e. encryption and password-protection)
- Experience distinguishing between user-generated and system-generated data
- Experience searching raw, hexadecimal data for known or unknown data structures and file content
- Knowledge of and experience with mobile device repair and current data acquisition methods including automated hardware/software, custom recovery, JTAG, In-System Programming (ISP), and chip-off
- Ability to explain technical concepts in a manner that is simple, concise and accessible to all levels of technical understanding
- Experience working in an accredited forensic science laboratory and/or familiarity with ANAB and ISO/IEC 17025:2017 accreditation criteria

**Trainee:**

If a fully qualified Forensic Scientist candidate does not meet all of the required qualifications, a trainee position may be offered to the most suited candidate with a salary of \$44,472. The candidate will be expected to successfully complete the digital & multimedia evidence analysis training program. The Trainee must meet the degree requirements stated in the qualifications.

**Special Instructions:**

You will be provided a confirmation of receipt when your application and/or résumé is submitted successfully. Please refer to “Your Application” in your account to check the status of your application for this position.

**Probationary Period:** If you are a current Commonwealth of Virginia employee, this position requires a new probationary period be served.

**Background Investigation:** Selected candidate(s) must successfully pass a background investigation to include a fingerprint-based criminal history check. Selected candidate(s) must provide a DNA sample via a buccal swab (saliva sample) and successfully pass a drug test. Reference checks will be conducted to include contact with current/previous supervisors.

**Employment Eligibility Verification:** DFS will record information from each new employee’s Form I-9 (Employment Eligibility Verification) into the Federal E-Verify system to confirm identity and work authorization.

The Department of Forensic Science is an Equal Opportunity Employer and is V3 Virginia Values Veterans certified. The Department strictly prohibits discrimination on the basis of race, sex, color, national origin, religion, sexual orientation, gender identity, age, veteran status, political affiliation, genetics, or disability in the recruitment, selection, and hiring of its workforce. Veterans, AmeriCorps, Peace Corps and other national service alumni are encouraged to apply.

<https://dfs.virginia.gov/job/forensic-scientist-digital-multimedia-central-laboratory-cf802/>

Applications for this position must be submitted electronically, through this website, no later than the position's closing date stated in the announcement. Mailed, emailed, faxed, or hand delivered applications and resumes will not be accepted. Consideration for an interview is based solely on the information within the application and/or resume and required transcripts (if applicable).

Applicants needing accommodations during the application and/or interview process may contact the Human Resource office at 804-786-0150 or [dfshumanresource@dfs.virginia.gov](mailto:dfshumanresource@dfs.virginia.gov) for additional information. Auxiliary Aids and Services are available upon request to individuals with disabilities.

DFS does not provide sponsorship; therefore, applicants must be legally authorized to work in the United States at the time of employment.

**Contact Information:**

Name: Tracey Kazelskis

Phone: 804-588-4000

Email: [tracey.kazelskis@dfs.virginia.gov](mailto:tracey.kazelskis@dfs.virginia.gov)

In support of the Commonwealth's commitment to inclusion, we are encouraging individuals with disabilities to apply through the Commonwealth Alternative Hiring Process. To be considered for this opportunity, applicants will need to provide their Certificate of Disability (COD) provided by a Vocational Rehabilitation Counselor within the Department for Aging & Rehabilitative Services (DARS), or the Department for the Blind & Vision Impaired (DBVI). Veterans are encouraged to answer Veteran status questions and submit their disability documentation, if applicable, to DARS/DBVI to get their Certificate of Disability. If you need to get a Certificate of Disability, use this link: [Career Pathways](#) for Individuals with Disabilities, or call DARS at 800-552-5019, or DBVI at 800-622-2155.

Each agency within the Commonwealth of Virginia is dedicated to recruiting, supporting, and maintaining a competent and diverse work force. **Equal Opportunity Employer**

# Computer Forensics Examiner I



(<https://www.governmentjobs.com/careers/balting>)



APPLY

<b>Salary</b>	\$54,683.42 - \$62,555.09 Annually	<b>Location</b> ⓘ	Towson, MD
<b>Job Type</b>	MERIT	<b>Job Number</b>	10.532 7-19
<b>Department</b>	POLICE	<b>Opening Date</b>	07/29/2019
<b>Closing Date</b>	Continuous		

## DESCRIPTION

## BENEFITS

## QUESTIONS

Pay Schedule I, Grade 29, Regular Schedule: 35 hours per week

A vacancy exists in the Police Department, Bureau of Administrative and Technical Services.

A list of eligible applicants will be established based on the examination as outlined below.

Current and future vacancies occurring within this class may be filled from the list of eligible applicants.

All interested **transfer** and **promotional** candidates must apply at this time.

List all **promotions** and changes in job duties due to **reclassification** as separate work experiences on your application. You must include the dates of the promotions and reclassification.

**NOTE:** Failure to complete all fields of the "Work Experience" section of the application will result in your application not being considered. A resume will not be considered in determining your qualifications for a position. Applicants selected for an interview may provide a resume at that time.

You can attach your transcript(s) or license(s) to your application.

Failure to submit proof of **Licenses, Certifications and Education** will result in your application not being considered. Proof of licenses, certifications, and/or education must be submitted with



each application.

### **Examples of Duties**

Under general supervision, processes, examines and analyzes computer hardware, software, electronically stored data and other computer-related evidentiary materials pertaining to law enforcement investigations.

- Prepares and presents reports of findings, provides expert testimony, and performs a variety of crime laboratory duties.
- Conducts thorough examinations of computer hard disk drives, and other electronic data storage media.
- Preserves and copies the original media.
- Prevents the transference of viruses, destructive programs, and inadvertent writes to and from the original media.
- Restores recoverable deleted files.
- Accesses password-protected and secured files.
- Uses forensic software applications to analyze electronic media.
- Examines the contents of a computer's CMOS.
- Examines boot record data, system configuration, and operation command files.
- Verifies the correctness of the computer's internal clock.
- Physically disassembles and examines computers and related hardware components.
- Identifies evidence of computer crimes such as the theft and sabotage of data; unlawful access of data and systems; fraudulent use of bank, credit, and telecommunications accounts; and the trafficking of pornography.
- Examines and analyzes text, graphics, multimedia, and digital images.
- Labels and secures evidence.
- Prepares and presents reports of examinations and findings.
- Works with prosecutors and others to prepare cases for trial.
- Provides expert opinion testimony in courts.
- Trains and instructs other employees.
- Provides advice and guidance regarding computer crimes.
- Gives presentations to community groups.

### **Examples of Other Duties**

Attends and participates in seminars and conferences. Performs other related duties as required.

(NOTE: The duties and responsibilities listed above are for the purpose of determining a common set of minimum qualifications for all positions in this class. They may not include all of the essential job functions of each position in the class. Each position may not be required to perform all of the essential job functions listed.)

### **Qualifications**

Possession of a bachelor's degree in computer science, information technology, or a related field

### **PLUS**

at least two years of experience in computer forensics, computer systems analysis, and/or the operation, maintenance and repair of computer systems.

Additional experience may be substituted on a year-for-year basis for the required education.

Education beyond a bachelor's degree may be substituted on a year-for-year basis for the required experience.

### **Licenses and Certificates**

Possession of a valid driver's license equivalent to a non-commercial, class C Maryland driver's license is required at the time of appointment. All licenses and certifications must be maintained throughout employment.

### **Character Requirements**

All applicants must be of good moral character and emotionally stable, as determined by a comprehensive background investigation, polygraph examination, and drug test. Employees are subject to periodic drug testing.

### **Proof of Education, Licenses and Certificates**

Applicants are required to submit proof of education beyond high school to meet the required qualifications for this job. Diplomas or transcripts must show the applicant's major field of study. Copies and unofficial transcripts are acceptable. Proof of licenses, certifications, and/or education **must** be submitted with each application.

### **Proof of Degree Equivalency**

Applicants who have obtained a degree outside the United States of America are required to submit degree equivalency documentation from the World Education Services, Inc. ([www.wes.org](http://www.wes.org))

Mail or deliver documents to:  
ATTN: Computer Forensic Examiner I  
Office of Human Resources  
308 Allegheny Avenue  
Towson, MD 21204

You can attach your transcript(s) or license(s) to your application.

### **Preferred Qualifications**

**At least two years of work experience in computer forensics or computer systems analysis. Forensic experience using the following techniques and tools - write blockers, Encase, FTK, X-Ways, Cellebrite, XRY.**

### **EXAMINATION PROCEDURE**

Applicants will be qualified based on an evaluation of their training and experience, as stated on their application, which includes answers to the supplemental questions. Applicants must state the dates and duties of past and present experience clearly and completely for evaluation.

**Conditions of Employment**

Employees hired after July 1, 2022 are required to participate in the Baltimore County Employees' Retirement System, with very limited exceptions.

Employees in this classification may be assigned to a work shift which includes nights, evenings, weekend, and/or holidays. Employees in this classification are subject to call to duty in emergencies, and may be required to work overtime as needed.

Applicants appointed to this position are required to provide a DNA sample.

**Physical and Environmental Conditions**

The duties of this classification requires walking and standing, moderate lifting and carrying of equipment and evidence, and travel between work sites.

**Medical Examination and Employment Background Investigation**

Applicants selected for an appointment to a position in Baltimore County must successfully complete a physical examination and drug screen and an employment background investigation, including, but not limited to a criminal background, and fingerprint check.

---

**Agency**

Baltimore County

**Address**

308 Allegheny Avenue

Towson, Maryland, 21204

**Phone**

410-887-3135

**Website**

<http://www.baltimorecountymd.gov> (<http://www.baltimorecountymd.gov>)

# Job Title: Cyber Forensics Analyst

Requisition ID **11355** - Posted - **Technology** - (Professional Level (More than 2 Years Work Experience)) - **Travel - 30% or less** - (Amarillo, TX)

**Location:** Amarillo, TX

**Job Title:** Cyber Forensics Analyst

**Career Level From:** Senior Associate

**Career Level To:** Senior Specialist

**Organization:** Chief Information Security Off (50003144)

**Job Specialty:** Cyber Security

## Location

This position is a hybrid role at the Pantex plant in Amarillo, TX. Some on-site work is required in this position. If offered the role, relocation assistance will be available.

## What You'll Do

The Cyber Forensics Analyst is responsible for analyzing digital evidence to investigate internal and external computer security incidents and derive useful information in support of system/network vulnerability mitigation. This role also may include performing digital forensics activities in support of ethics and internal audit investigations.

- Conduct analysis of log files, evidence, and other information to determine best methods for identifying the perpetrator(s) of a network intrusion
- Create a forensically sound duplicate of the evidence (i.e., forensic image) that ensures the original evidence is not unintentionally modified, to use for data recovery and analysis processes
- Decrypt seized data using technical means
- Provide technical summary of findings in accordance with established reporting procedures
- Ensure that chain of custody is followed for all digital media acquired in accordance with the Federal Rules of Evidence
- Perform file signature, static media, and malware analysis
- Extract data using data carving techniques
- Use specialized equipment and techniques to catalog, document, extract, collect, package, and preserve digital evidence
- Perform Windows registry analysis
- Collect and analyze intrusion artifacts (e.g., source code, malware, and system configuration) and use discovered data to enable mitigation of potential cyber defense incidents within the enterprise
- Additional responsibilities as necessary

## What You Can Expect

- Meaningful work and unique opportunities to support missions vital to national and global security
- Top-notch, dedicated colleagues
- Generous pay and benefits with a stable organization
- Career advancement and professional development programs
- Work-life balance fostered through flexible work options and wellness initiatives

## Minimum Job Requirements

Bachelor's degree in Computer Science, Information Security, Information Systems or a related field with a minimum of 2 years of relevant experience.

Ten or more years of relevant education, training, and/or progressive experience may be considered to satisfy educational and years-of-experience requirements for this posting.

- Knowledge of cyber threats and vulnerabilities
- Knowledge of operating systems and file system implementations
- Knowledge of physical computer components and architectures, including the functions of various components and peripherals
- Knowledge of incident response and handling methodologies

## Preferred Job Requirements

- Ability to conduct forensic analyses in both Windows and Unix/Linux environments
- Knowledge of processes for seizing and preserving digital evidence, including legal governance related to admissibility (e.g. Rules of Evidence)
- Knowledge of hacking methodologies
- Knowledge in analyzing memory dumps to extract information
- Knowledge of encryption algorithms
- Experience using forensic tool suites (e.g., EnCase, and FTK)
- Ability to perform both bit-level analysis and packet-level analysis
- Experience with analyzing malware and identifying anomalous code as malicious or benign
- Experience with reverse engineering concepts
- Knowledge of system administration concepts for operating systems such as but not limited to Unix/Linux, IOS, Android, and Windows operating systems
- Ability to identifying obfuscation techniques
- Ability to perform Windows registry analysis
- Ability to use virtual machines and decrypt digital data collections
- Strong problem solving and communication skills (both orally and in writing)

## Notes

The minimum education and experience for the lowest career level in the job posting range are listed under Minimum Job Requirements. Successful candidates hired into a higher career level than the minimum in the range must meet the requirements listed in the job leveling charts for the career level into which they are being hired.

If a range of Career Levels is posted, i.e., Senior Associate to Senior Specialist, internal applicants already in one of the Career Levels would come across at their current Career Level. Internal applicants currently in a lower level Career Level would move to the lowest posted Career Level, and internal applicants in higher Career Levels may be considered, on an exception basis, to come across laterally based on the applicant's education and experience, and the scope of work being performed in the role.

Requires a Q clearance; however all qualified candidates will be considered regardless of their current clearance status. The ability to obtain and maintain a Department of Energy Q clearance is required.

Position may require entry into Materials Access Areas (MAA) and participation in the Human Reliability Program (HRP). If HRP is required, candidate must complete a counterintelligence-scope polygraph, pursuant to 10CFR 709. Medical requirements may apply.

CNS is a drug-free workplace. Candidates accepting a job offer will be required to pass a pre-placement physical, drug screening and background investigation. As an employee, you may be required to receive and maintain a security clearance from the United States Department of Energy in order to meet eligibility requirements for access to sensitive information or matter. U.S. citizenship is a requirement for security clearance applicants. All employees are subject to being randomly selected for drug testing without advance notification.

CNS is an equal opportunity employer. All qualified applicants will receive consideration for employment without regard to race, color, gender, sexual orientation, gender identity, age, religion, national origin, ancestry, genetic information, disability or veteran status.



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# Cyber Host Forensic Analyst II

Raytheon

Arlington, VA 22201

Full-time

## Raytheon



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## Profile insights

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### Licenses

TS/SCI ?

Do you have a valid **TS/SCI** license?

Yes No

### Certifications

GCFA ? CISSP ?

Do you have a valid **GCFA** certification?

Yes No

### Skills

Systems engineering ? Computer networking ? Splunk ?

[+ show more](#)

Do you have experience in **Systems engineering**?

Yes No

### Education

Bachelor's degree ?

Do you have a **Bachelor's degree**?

Yes

No

## Job details

*No matching job preferences* [🔗](#)



### Job Type

Full-time

Are you looking for **Full-time** work?

Yes

No

### Date Posted:

2023-04-26

### Country:

United States of America

### Location:

VA149: 1110 N Glebe Road Arlington 1110 North Glebe Road Suite 630, Arlington, VA, 22201 USA

### Position Role Type:

Hybrid

The DHS's Hunt and Incident Response Team (HIRT) secures the Nation's cyber and communications infrastructure. HIRT provides DHS's front line response for cyber incidents and proactively hunting for malicious cyber activity. Raytheon (RTX), as a prime contractor to DHS, performs HIRT investigations to develop a preliminary diagnosis of the severity of breaches. RTX provides HIRT remote and onsite advanced technical assistance, proactive hunting, rapid onsite incident response, and immediate investigation and resolution using host-based and network-based cybersecurity analysis capabilities.

Raytheon is supporting a U.S. Government customer to provide support for onsite incident response to civilian Government agencies and critical asset owners who experience cyber-attacks, providing immediate investigation and resolution. Contract personnel provide front line response for digital forensics/incident response (DFIR) and proactively hunting for malicious cyber activity. Raytheon is seeking a Cyber Forensic Analyst to support this critical customer mission.

### Responsibilities:

- Acquiring/collecting computer artifacts (e.g., malware, user activity, link files, etc.) from systems in support of onsite engagements
- Assessing evidentiary value by triaging electronic devices
- Correlating forensic findings with network events to further develop an intrusion narrative
- When available, collecting and documenting system state information (running processes, network connections, etc.) prior to imaging
- Performing incident triage from a forensic perspective to include determining scope, urgency and potential impact
- Tracking and documenting forensic analysis from initial involvement through final resolution
- Collecting, processing, preserving, analyzing and presenting computer related evidence



- Coordinating with others within the Government and with customer personnel to validate/investigate alerts or other preliminary findings
- Conducting analysis of forensic images and other available evidence and drafting forensic write-ups for inclusion in reports and other written products
- Assisting in documenting and publishing Computer Network Defense guidance and reports on incident findings to appropriate constituencies
- Assisting in preliminary analysis by tracing an activity to its source and documenting findings for input into a forensic report
- Documenting original condition of digital and/or associated evidence by taking photographs and collecting hash information
- Assisting team members in imaging digital media
- Assisting in gathering, accessing and assessing evidence from electronic devices using forensic tools and knowledge of operating systems
- Using hashing algorithms to validate forensic images
- Working with mentor to identify and understand adversary TTPs
- Assisting team members in analyzing the behaviors of malicious software
- Under direct guidance and coaching if needed, locating critical items in various file systems to aid more senior personnel in their analysis
- Performing analysis of log files from a variety of sources to identify possible threats to computer security
- Using leading edge technology and industry standard forensic tools and procedures to provide insight into the cause and effect of suspected cyber intrusions
- Following proper evidence handling procedures and chain of custody protocols
- Producing written reports documenting digital forensic findings
- Determining programs that have been executed, finding files that have been changed on disk and in memory
- Using timestamps and logs (host and network) to develop authoritative timelines of activity
- Finding evidence of deleted files and hidden data
- Identifying and documenting case relevant file-system artifacts (browser histories, account usage and USB histories, etc.)
- Creating forensically sound duplicates of evidence (forensic image) to use for data recovery and analysis
- Performing all-source research for similar or related network events or incidents.

### Required Skills:

- U.S. Citizenship
- Must have an active TS/SCI clearance
- Must be able to obtain DHS Suitability
- 2+ years of directly relevant experience in cyber forensic investigations using leading edge technologies and industry standard forensic tools
- Ability to create forensically sound duplicates of evidence (forensic images)
- Able to write cyber investigative reports documenting digital forensics findings
- Experience with the analysis and characterization of cyber attacks
- Experience with proper evidence handling procedures and chain of custody protocols
- Skilled in identifying different classes of attacks and attack stages
- Knowledge of system and application security threats and vulnerabilities
- Knowledgeable in proactive analysis of systems and networks, to include creating trust levels of critical resources
- Must be able to work collaboratively across physical locations

### Desired Skills:

- Experience with two or more of the following tools:

- EnCase
  - FTK
  - SIFT
  - X-Ways
  - Volatility
  - WireShark
  - Sleuth Kit/Autopsy
  - Splunk
  - Snort
  - Other EDR Tools (CrowdStrike, Carbon Black, etc)
- Experience with conducting all-source research.

**Required Education:**

BS Computer Science, Computer Engineering, Computer Information Systems, Computer Systems Engineering or related degree. Two years of related work experience may be substituted for each year of degree level education.

**Desired Certifications:**

- GCFA, GCFE, EnCE, CCE, CFCE, CISSP

This requisition is eligible for an employee referral award. ALL eligibility requirements must be met to receive the referral award.

Arlington, VA

#RTXCyber

#RTXCPS

#RTXHIRT

***Raytheon Technologies is An Equal Opportunity/Affirmative Action Employer. All qualified applicants will receive consideration for employment without regard to race, color, religion, sex, sexual orientation, gender identity, national origin, disability or veteran status, age or any other federally protected class.***


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# Job Description


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**SPECIAL AGENT - GS 1811-10 (EXTERNAL - All U.S. Citizens)**
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**ID** 22187

**Regular/Tem...** Regular

**Location** NATIONWIDE

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### WHO MAY APPLY

This Special Agent (SA) posting is open to all qualified candidates within the United States (U.S.) and its territories. The FBI will use this to fill multiple vacancies around the country.

### JOB SUMMARY

The mission of the Federal Bureau of Investigation (FBI) is to protect the American people and uphold the Constitution of the United States.

### About Us

We're looking for people with unique skills, experiences, and backgrounds to become Special Agents. The one thing every SA shares is a belief in the mission of the FBI. They have the drive to help keep our nation safe, become part of something bigger than themselves, and take pride in making a difference in the communities they serve.

Special Agents are:

- Driven to find solutions to all types of problems.
- Compassionate and respectful to everyone they meet.
- Adaptable to a variety of situations, and able to keep a calm demeanor in the face of challenges.
- Well-spoken, well-written, and enjoy meeting, speaking and collaborating with people from different backgrounds.
- Physically fit and able to pass the physical fitness test (PFT).

### KEY REQUIREMENTS

You must meet the following requirements at the time of application:

Please click on the link and go to the listed page number, if applicable, for further explanation.

- Be a U.S. citizen.
- Be between 23 and 36 years of age ([Exceptions](#)) [see page 16].
- Have a [bachelor's degree or master's degree](#) [see page 17] from a U.S.-accredited college or university. You should not apply if you have not received your bachelor's degree.
- Have at least two years of [full-time professional work experience](#) [see page 17] or one year if you have an advanced degree (master's degree, doctorate degree).
- Possess a valid driver's license and have six months of driving experience.
- Meet the [physical requirements](#).
- Meet all [FBI employment eligibility requirements](#).
- Be able to obtain a Top Secret Sensitive Compartmented Information (SCI) Clearance.

- If you are currently active duty in the military, you must be within 15 months of completing your service before submitting your application.
- Be available for [assignment](#) [see page 13] to any of the FBI's 56 Field Offices.

### **Major Duties**

The SA position requires significant commitment and dedication. SAs must:

- Adhere to the highest standards of conduct, especially in maintaining honesty and integrity.
- Work a minimum of 50 hours per week, which may include irregular hours, and be on-call 24/7, including holidays and weekends.
- Maintain a level of fitness necessary to effectively respond to life-threatening situations on the job.
- Carry a firearm and be willing to use deadly force, if necessary.
- Be willing and able to participate in arrests, execution of search warrants, and other dangerous assignments.

### **BEFORE YOU APPLY**

- You should review the [Special Agent Selection Process, All You Need to Know to Apply](#) guide before you begin the application process. This guide provides helpful information about processing for the Special Agent position.

### **ABOUT THE APPLICATION PROCESS**

The application process consists of the below-listed steps and you must successfully complete each step of the process. Those who meet the screening qualifications will be invited to complete the Phase I exam via an email notification.

- Step 1: Application and Screening [see page 7]
- Step 2: Phase I Test
- Step 3: Meet and Greet Session/Review Process [see page 7]
- Step 4 Official Physical Fitness Test (PFT) [see page 7]
- Step 5: Phase II Test
- Step 6: [Conditional Appointment Offer](#) [see page 8]
- Step 7: [Background Investigation](#) [see page 8]
- Step 8: Pre -Quantico Physical Fitness Test (PFT) (see page 8)
- Step 9: [Basic Field Training Course \(BFTC\)](#)
- Finish: Career Placement [see page 9]

### **Required Documentation for your Application**

Please review and submit all required documents below with your application. **If you do not submit all required documents, your application will not be processed and will be discontinued.**

#### **All Special Agent applicants:**

- Official or unofficial college transcript(s)
- A resume formatted in the Federal Resume Template that meets all guidelines outlined in the Federal Resume Guide

#### **Current or former federal employees:**

- SF-50, Notification of Personnel Action

#### **Current or former members of the armed forces:**

- DD-214, Member 4 copy or Service 2 copy
- Statement of Service (if not yet separated)

#### **Disabled veterans:**

- DD-214, Member 4 copy or Service 2 copy

- VA letter dated within one year
- SF-15, Veterans' Preference form (optional)

Please Note:

- DO NOT attach a cover letter
- When scanning and uploading your document(s), please make sure that all pages are readable and facing upright in the same direction.
- DO NOT upload any picture files (JPEG, TIFF, PNG, BMP).

## ADDITIONAL INFORMATION

**Salary and Compensation:** New Special Agents, called New Agent Trainees or NATs, are paid on the [GL schedule for Federal Law Enforcement Officers](#) (LEO), beginning as a GL-10, step 1, while in training at Quantico. In addition to the base salary, NATs will also get locality pay for the Washington, D.C. area plus availability pay, which is 25% of the base and locality pay (the calculation is 25% x [base + locality]).

Upon graduation from training, your salary will be adjusted according to your field office assignment and [Law Enforcement Officers' availability pay](#). Check the OPM Pay Calculator to see locality pay for a specific geographic area. Upon completion of a two-year probationary period, Special Agents will transition to the General Schedule (GS) pay scale. Most Special Agents are able to achieve a GS-13 level within five (5) years.

As the federal agency whose mission is to ensure the fair and impartial administration of justice for all Americans, the Department of Justice is committed to fostering a diverse and inclusive work environment. To build and retain a workforce that reflects the diverse experiences and perspectives of the American people, we welcome applicants from the many communities, identities, races, ethnicities, backgrounds, abilities, religions, and cultures of the United States who share our commitment to public service

**Reasonable Accommodations:** The FBI provides Reasonable Accommodations to qualified individuals with disabilities. If you believe you have a disability that will require special arrangements during the hiring process, you may request a reasonable accommodation at any time by notifying your applicant coordinator. Each test in the hiring process is evaluated differently. Therefore, you must submit a reasonable accommodation request for each test, if needed. The decision to grant the requested accommodation will be made on a case-by-case basis.

### Reasonable Accommodation (RA) Request:

The FBI provides legally entitled reasonable accommodations to qualified applicants. If you need a reasonable accommodation pursuant to a sincerely held religious belief or medical disability for any part of the application and/or hiring process, please notify the OEEOA RA Program by either e-mail [REASONABLE\\_ACCOMMODA@fbi.gov](mailto:REASONABLE_ACCOMMODA@fbi.gov), telephone at 202-324-2158, or fax at 202-324-3976. Your request will receive an individualized assessment.

**Equal Employment Opportunity:** The FBI is an Equal Opportunity Employer, and all qualified applicants will receive consideration for this vacancy. Except where otherwise provided by law, selection will be made without regard to, and there will be no discrimination because of color, race, religion, national origin, political affiliation, marital status, parental status, physical or mental disability, genetic information, age, sex, sexual orientation, membership or non-membership in an employee organization, or on the basis of personal favoritism, or any other non-merit factors.

**Nepotism:** Nepotism is the act of favoring relatives in the hiring process and is prohibited by law. Public officials are prohibited from hiring or promoting relatives or relatives of officials in their chain of command, as well as actively or indirectly endorsing a relative's appointment or promotion. During the hiring process, all selected candidates and FBI hiring managers will be required to certify they are not related to anyone involved in the hiring process.

### IF YOU HAVE QUESTIONS ON THE APPLICATION:

- Check out our FAQs [here](#)
- Visit our website <https://fbijobs.gov/special-agents>
- Email [SAINFO@fbi.gov](mailto:SAINFO@fbi.gov)

## **Appendix I – Letters of Support (Employment Demand)**



August 24, 2023

Dr. Tracey Dawson Green, Ph.D

Professor & Chair

Department of Forensic Science

Virginia Commonwealth University

Patrick J. Siewert

Director of Digital Forensics & e-Discovery

ArcherHall Forensics, LLC

Dr. Green:

I'm writing this letter to express my support for the Undergraduate Program of Digital Forensic Studies in the Department of Forensic Science at Virginia Commonwealth University (VCU). ArcherHall is a Nationwide provider of litigation support digital forensic services, which assists litigators in both civil and criminal matters with a wide range of forensic data collection, analysis, reporting and expert witness services. As Director of Digital Forensics & e-Discovery at ArcherHall, my responsibilities include oversight of a caseload of dozens of digital forensic projects at any given time, as well as supervision over senior and junior-level examiners to ensure quality control and accurate results for our clients. Accordingly, we conduct digital forensic analysis daily to ensure our clients are well-served and our services add value to their cases.

Some of the challenges we encounter with newer examiners breaking in the field of work include a lack of practical application knowledge, specifically with newer graduates from B.S. programs obtained from other institutions. This can include a lack of general computer or mobile device knowledge & operation (i.e., hardware), a lack of basic file system and/or operating system knowledge, a lack of practical certification in the basic practices in the field of digital forensics and a general lack of understanding about the differences between litigation support and incident response and the examiner's role within those two disciplines.

Based upon the proposed curriculum, with which I've had some involvement in helping to develop, I feel that these are all areas with which a modernized undergraduate BS in Digital Forensics program at VCU can and will address in the future. While it's true that we can't prepare new entries into the work force for every possible contingency, the approach taken by the Planning Committee has been overwhelmingly to set up the BS candidates for success for a career in digital forensics by taking input from multiple sources working in the field, and from both private and public sector practitioners.



Both presently and in the future, ArcherHall looks to hire the most qualified candidates for Digital Forensic Examiner positions, which often includes those who possess recent undergraduate degrees in Digital Forensic Sciences. While our staffing is currently full, we frequently have openings for digital forensic examiner positions and, being not only a VCU Alum, but an active member of the Planning Committee for this program, I would feel confident in the competitive nature of a successful BS Graduate in the proposed Digital Forensic program at VCU.

It is my goal that this letter of support helps bolster the general approval for the Bachelor of Science in Digital Forensics program at VCU. Please don't hesitate to reach out to me if you have any additional questions or needs and I look forward to continued participation in and support for the digital forensic program at VCU.

Regards,

Patrick J. Siewert

Director of Digital Forensics & e-Discovery

ArcherHall Forensics, LLC

Ph: 804-588-9877

Email: [psiewert@archerhall.com](mailto:psiewert@archerhall.com)





**COMMONWEALTH of VIRGINIA**  
*Office of the Attorney General*

**Jason S. Miyares**  
Attorney General

202 North 9th Street  
Richmond, Virginia 23219  
804-786-2071  
FAX 804-786-1991  
Virginia Relay Services  
800-828-1120

To Whom it May Concern,

I am writing this letter in support of Virginia Commonwealth University's (VCU) submission for approval of a new B.S. degree in Digital Forensics & Incident Response (DFIR). As the Director of the Computer Forensics Unit for the Virginia Office of the Attorney General, I oversee the support and casework for digital forensics across the Commonwealth of Virginia that are submitted to our laboratory. Our lab provides government and law enforcement agencies with the ability to process electronic evidence to combat criminal activities such as human trafficking, child exploitation, narcotics offenses, homicide, and various other crimes. Digital forensics is growing in demand and the need for educated examiners and analysts is vital to the continued support of that mission.

A B.S. degree in DFIR would be extremely beneficial to society as it provides education to allow graduates to respond to criminal activity as well as support for the private sector. A significantly hiked workload and case backlog indicates that more personnel are needed in this field to increase efficiency and decrease turn around time. As someone who went through a Digital Forensics B.S. program, I can attest to the benefits of such a program. Upon completion of my degree, I was able to enter the workforce with little to no downtime, and I found my knowledge-base was equal if not greater than those that had been in the field with no formal education.

Upon reviewing the curriculum for the proposed B.S. program, I feel confident that the education that students would receive would be able to allow them to succeed in the field. I see many classes and topics that are extremely relevant to today's DFIR field and will benefit the students and the professional market greatly. Our lab here at the OAG is small at the moment but I have hopes to expand it in the coming years. As the hiring manager for my lab as well, I find that a formal education in anything closely related to DFIR is sorely lacking and my hiring pool has suffered because of it. Any graduates from a DFIR program at VCU would be welcome internship and hiring applicants.

Regards,

Erick Paulson  
Director, Computer Forensics Unit  
Computer Crime Section  
Virginia Office of the Attorney General  
epaulson@oag.state.va.us

August 25, 2023

Nelson L. Eby  
Director, Enterprise Forensics and eDiscovery  
GE Healthcare  
(804) 346-7426  
[Nelson.Eby@ge.com](mailto:Nelson.Eby@ge.com)

VCU Department of Forensic Science

Response to proposed BS Digital Forensic & Incident Response Curriculum

Dear faculty,

I have served in several capacities over the last 20+ years in the field of digital forensics including as a federal law enforcement practitioner, trainer, and corporate investigator. In those years one issue was a consistent problem; the limited number of qualified candidates to fill roles in this critical field of science.

Over 90% of all crimes committed involve digital evidence. The challenges are and always have been the rapid changes in technology coupled with the determination of the criminal element to take advantage of them to enact higher yield criminal acts with lower amounts of effort and visibility.

This does not change in the Corporate environment where billions of dollars of research and development are at the fingertips of employees seeking personal gain. The forensics and eDiscovery team are charged, in part, with investigating acts by employees that are alleged to have engaged in theft of intellectual property, a crime heavily dependent on digital evidence.

These agencies and corporate teams need trained and educated employees who have been exposed to real-world scenarios. Quite often employees begin their digital forensics careers in law enforcement and move into a corporate investigative role where an advanced degree is a logical "next step" towards advancement.

As an employer with a team of digital forensics investigators and incident response professionals, I look for education and certifications from universities. As part of that review of qualifications, I evaluate the specific program offerings to ensure the courses align with real-world exposure. I am confident in Virginia Commonwealth University's bachelor's degree in digital forensics and incident response proposed curriculum providing a solid foundation of core knowledge and specialized, practical use skills needed to fill the gaps we see as employers. I would seek employees from this program in the future.

Respectfully submitted,

*Nelson L. Eby*

Nelson L. Eby

## **Appendix J – Student Demand Survey**

## B.S. in Digital Forensics Interest Survey (Summer 2023)

Virginia Commonwealth University is developing a B.S. degree in Digital Forensics for implementation in fall 2024.

This program entails 120 credits and includes a balance of forensic science courses focusing on various areas of the digital forensics discipline (e.g., computer, mobile devices, cloud, hardware, and multimedia forensics), as well as traditional forensic science (e.g., crime scene investigation, forensic evidence, criminal procedure, etc.), coupled with accompanying computer science and information systems courses. Students will be thoroughly prepared for a career in digital forensics, including acquisition and analysis of digital evidence. Potential jobs include Incident Response Analyst and Digital Forensic Analyst.

After completing this program, students should be able to:

- Articulate an understanding of the laws of criminal procedure and rules of evidence
- Employ proper crime scene investigation and reconstruction
- Practice appropriate ethical and professional duties and responsibilities of the forensic scientist
- Demonstrate capabilities, use and limitations of digital forensic laboratory theory and techniques
- Apply principles and laboratory procedures of digital & multimedia sciences to forensic science to the extent of acquiring professional certification and workplace competencies

We have prepared the survey below to gauge student interest in the program. Your answers to the following questions will be used in summary form only. No personally identifiable information will be released. Please feel free to contact us at [fos@vcu.edu](mailto:fos@vcu.edu) if you would like more information about the proposed program.

1. If VCU offered a BS in Digital Forensics program, I would enroll.

*Mark only one oval.*

- Strongly Agree
- Agree
- Neutral
- Disagree
- Strongly Disagree

2. Please rate how likely you would do each of the following. Selections range from Strongly Agree to Strongly Disagree.

*Mark only one oval per row.*

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
I am interested in pursuing a	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

---

degree in Digital Forensics

---

In addition to face to face, this program should be offered fully online

---

There should be a hybrid degree program, where some courses are online and some are face to face

---

3. I would likely enroll in this degree program during the following academic school year:  
*Mark only one oval.*

- 2024-2025
- 2025-2026
- 2026-2027
- 2027-2028
- 2028-2029

4. I am currently attending:  
*Mark only one oval.*

- High School
- Community College
- VCU (undeclared major)
- Other: \_\_\_\_\_

5. My current classification is:  
*Mark only one oval.*

- High School Junior
- High School Senior
- College Freshman (first year)
- College Sophomore (second year)
- Other

6. My anticipated high school graduation year  
*Mark only one oval.*

- 2024
- 2025
- After 2025

- Already graduated

7. I was born in the following year

---

8. I am:

*Mark only one oval.*

- Female
- Male
- Transgender
- Other
- Prefer not to answer

9. My race or ethnicity is (choose one)

*Mark only one oval.*

- American Indian/Alaskan Native
- Asian
- Black/African American
- White/European American
- Hispanic
- Native Hawaiian/Pacific Islander
- Two or more
- Unknown
- Prefer not to answer

10. My U.S. citizen status is

*Mark only one oval.*

- U.S. Citizen
- Naturalized U.S. Citizen
- Citizen of another Nation
- Dual Citizenship
- Prefer not to answer

**B.S. in Digital Forensics Interest Survey (Summer 2023) - Raw data**

<b>Timestamp</b>	<b>If VCU offered a BS in Digital Forensics program, I would enroll.</b>	<b>I am interested in pursuing a degree in Digital Forensics</b>	<b>In addition to face to face, this program should be offered fully online</b>	<b>There should be a hybrid degree program, where some courses are online and some are face to face</b>	<b>I would likely enroll in this degree program during the following academic school year:</b>	<b>I am currently attending:</b>	<b>My current student classification is:</b>	<b>My anticipated high school graduation year</b>	<b>I was born in the following year</b>	<b>I am:</b>
6/17/2023 20:50:47	Strongly Agree	Agree	Agree	Agree	2024-2025	High School	High School Senior	2024	2006	Female
6/23/2023 10:24:38	Strongly Agree	Agree	Strongly Agree	Agree	2024-2025	Community College	College Sophomore (second year)	2024	1989	Female
6/23/2023 10:50:32	Strongly Agree	Strongly Agree	Strongly Agree	Disagree	2025-2026	Community College	College Sophomore (second year)	2025	1986	Male
6/23/2023 10:51:07	Strongly Agree	Strongly Agree	Agree	Agree	2024-2025	Community College	College Sophomore (second year)	Already graduated	1997	Female
6/23/2023 10:53:25	Strongly Agree	Strongly Agree	Strongly Agree	Strongly Agree	2024-2025	Community College	College Sophomore (second year)	Already graduated	1995	Female
6/24/2023 5:21:25	Strongly Agree	Strongly Agree	Strongly Agree	Strongly Agree	2025-2026	Community College	Other	2024	2003	Male

6/24/2023 18:01:22	Strongly Agree	Agree	Strongly Disagree	Strongly Disagree	2025-2026	Community College	College Sophomore (second year)	Already graduated	1996	Female
6/24/2023 23:27:39	Strongly Agree	Strongly Agree	Disagree	Disagree	2025-2026	Community College	College Sophomore (second year)	2025	1981	Female
6/25/2023 18:43:57	Strongly Agree	Strongly Disagree	Strongly Disagree	Strongly Disagree	2024-2025	Community College	College Sophomore (second year)	Already graduated	1988	Male
6/25/2023 20:15:05	Strongly Agree	Agree	Strongly Agree	Agree	2024-2025	Community College	College Sophomore (second year)	Already graduated	1980	Female
6/26/2023 20:10:07	Strongly Agree	Strongly Agree	Strongly Agree	Disagree	2024-2025	Community College	College Sophomore (second year)	Already graduated	1970	Female
6/26/2023 20:57:27	Strongly Agree	Agree	Neutral	Neutral	2024-2025	Community College	College Sophomore (second year)		1986	Female
6/27/2023 15:09:06	Strongly Agree	Strongly Disagree	Strongly Disagree	Strongly Disagree	2024-2025	Community College	College Freshman (first year)	2024	2003	Female
6/27/2023 15:12:26	Strongly Agree	Strongly Agree	Strongly Agree	Strongly Agree	2024-2025	Community College	Other	Already graduated	1980	Male
6/27/2023 15:30:59	Strongly Agree	Strongly Agree	Strongly Agree	Strongly Agree	2024-2025	Community College	College Freshman (first year)	Already graduated	1998	Female
6/27/2023 15:34:18	Strongly Agree	Neutral	Neutral	Agree	2024-2025	Community College	College Sophomore (second year)	2024	2004	Female



6/27/2023 15:35:07	Strongly Agree	Agree	Neutral	Agree	2025-2026	Communit y College	College Sophomore (second year)	Already graduated	1988	Male
6/27/2023 15:45:04	Strongly Agree	Agree	Strongly Agree	Strongly Agree	2024-2025	Communit y College	College Sophomore (second year)	Already graduated	2002	Female
6/27/2023 15:53:26	Strongly Agree	Agree	Agree	Strongly Agree	2024-2025	Communit y College	Other	2024		Male
6/27/2023 16:11:54	Strongly Agree	Agree	Neutral	Neutral	2024-2025	High School	High School Senior	2024	2006	Male
6/27/2023 17:41:15	Strongly Agree	Strongly Agree	Strongly Agree	Strongly Agree	2025-2026	VCU SOB - Accountin g	Other	Already graduated	1993	Female
6/27/2023 18:55:10	Strongly Agree	Agree	Agree	Agree	2024-2025	Communit y College	Other	Already graduated		Female
6/27/2023 19:34:32	Strongly Agree	Agree	Strongly Disagree	Disagree	2025-2026	VCU (undeclare d major)	Other	Already graduated	1970	Male
6/27/2023 19:35:26	Strongly Agree	Strongly Agree	Disagree	Agree	2025-2026	Communit y College	Other	Already graduated	1986	Female
6/27/2023 19:54:44	Strongly Agree	Strongly Agree	Disagree	Strongly Agree	2024-2025	Communit y College	College Sophomore (second year)	2024	1965	Male
6/27/2023 21:26:30	Strongly Agree	Neutral	Strongly Agree	Neutral	2025-2026	Communit y College	College Sophomore (second year)	2024	1980	Female

6/28/2023 6:04:36	Strongly Agree	Strongly Agree	Strongly Agree	Strongly Agree	2025-2026	Community College	College Sophomore (second year)	Already graduated	1983	Male
6/28/2023 8:56:57	Strongly Agree	Strongly Disagree	Strongly Disagree	Disagree	2025-2026	Community College	Other	Already graduated	1974	Female
6/28/2023 9:34:58	Strongly Agree	Strongly Agree	Neutral	Strongly Agree	2025-2026	Community College	Other	Already graduated	1977	Female
6/28/2023 10:47:34	Strongly Agree	Agree	Agree	Neutral	2025-2026		College Sophomore (second year)	Already graduated	2001	Female
6/28/2023 12:37:35	Strongly Agree	Agree	Strongly Agree	Strongly Agree	2025-2026	Community College	College Sophomore (second year)	Already graduated	1999	Female
6/28/2023 23:11:58	Strongly Agree	Strongly Agree	Strongly Disagree	Neutral	2025-2026	Community College	College Freshman (first year)	Already graduated	1992	Female
6/29/2023 0:33:03	Strongly Agree	Neutral	Neutral	Strongly Agree	2025-2026	Community College	Other	Already graduated	2004	Female
6/29/2023 9:02:21	Strongly Agree	Strongly Agree	Strongly Agree	Strongly Agree	2025-2026	Community College	Other	After 2025	1993	Female
6/29/2023 10:10:04	Strongly Agree	Agree	Neutral	Strongly Agree	2024-2025	Community College	College Freshman (first year)	Already graduated	2005	Female
6/30/2023 10:12:02	Strongly Agree	Strongly Disagree	Strongly Disagree	Strongly Disagree	2024-2025	Community College	Other	2024	1994	Female
6/30/2023 13:13:04	Strongly Agree	Strongly Agree	Agree	Strongly Agree	2024-2025	Community College	Other	2024	1975	Female

6/30/2023 19:52:25	Strongly Agree	Strongly Agree	Strongly Agree	Strongly Agree	2025-2026	Community College	College Sophomore (second year)	Already graduated		Male
6/30/2023 22:05:16	Strongly Agree	Agree	Agree	Agree	2026-2027	Community College	College Sophomore (second year)	Already graduated	2003	Female
7/2/2023 18:10:33	Strongly Agree	Strongly Agree	Strongly Agree	Agree	2025-2026	Community College	College Sophomore (second year)	Already graduated	2000	Female
7/2/2023 19:59:02	Strongly Agree	Strongly Agree	Strongly Agree	Strongly Disagree	2024-2025	Community College	College Freshman (first year)	Already graduated	1972	Female
7/4/2023 2:24:03	Strongly Agree	Strongly Agree	Strongly Agree	Strongly Agree	2024-2025	VCU (undeclared major)	Other	2025	2002	Male
7/4/2023 22:08:58	Strongly Agree	Agree	Strongly Agree	Agree	2025-2026	Community College	College Freshman (first year)	Already graduated	2004	Female
7/6/2023 0:39:29	Strongly Agree	Agree	Strongly Agree	Strongly Agree	2024-2025	Community College	College Sophomore (second year)	Already graduated	2001	Female
7/8/2023 22:23:55	Strongly Agree	Strongly Agree	Strongly Agree	Strongly Agree	2024-2025	Community College	Other	Already graduated	1965	Male
7/11/2023 13:53:54	Strongly Agree	Neutral	Strongly Disagree	Strongly Disagree	2024-2025	High School	High School Senior	2024	2006	Male
7/17/2023 20:37:00	Strongly Agree	Neutral	Disagree	Agree	2025-2026	High School	High School Junior	2025	2006	Female

7/19/2023 13:15:05	Strongly Agree	Strongly Agree	Strongly Agree	Neutral	2024-2025	Community College	College Freshman (first year)	2025	1996	Female
7/27/2023 20:40:41	Strongly Agree	Strongly Agree	Neutral	Neutral	2024-2025	VCU (undeclared major)	Other	Already graduated		Female
8/2/2023 14:49:54	Strongly Agree	Strongly Agree	Strongly Agree	Strongly Agree	2024-2025	Community College	College Sophomore (second year)	2025	2004	Female
8/3/2023 5:51:52	Strongly Agree	Agree	Strongly Agree	Strongly Agree	2025-2026	Community College	College Freshman (first year)	Already graduated	2001	Female
6/22/2023 9:12:24	Agree	Neutral	Strongly Agree	Neutral	2025-2026	High School	High School Junior	2025	2006	Male
6/22/2023 10:00:21	Agree	Agree	Disagree	Neutral	2024-2025	High School	High School Senior	2024	2005	Male
6/22/2023 11:54:04	Agree	Disagree	Neutral	Agree	2024-2025	High School	High School Junior	2025	2007	Male
6/23/2023 10:25:23	Agree	Agree	Neutral	Agree	2024-2025	Community College	College Sophomore (second year)	Already graduated	1986	Male
6/23/2023 10:30:02	Agree	Strongly Disagree	Strongly Disagree	Neutral	2024-2025	Community College	Other	Already graduated	1979	Female
6/23/2023 10:36:49	Agree	Agree	Agree	Agree	2024-2025	Community College	College Sophomore (second year)	Already graduated		Female
6/23/2023 10:53:09	Agree	Agree	Agree	Agree	2025-2026	Community College	College Sophomore (second year)	Already graduated	2001	Female

6/23/2023 12:54:46	Agree	Agree	Neutral	Neutral	2026-2027	Community College	College Freshman (first year)	After 2025	2003	Male
6/24/2023 20:00:02	Agree	Agree	Strongly Agree	Neutral	2024-2025	Community College	Other	Already graduated	1980	Female
6/26/2023 11:54:56	Agree	Strongly Agree	Strongly Agree	Strongly Agree	2026-2027	Community College	College Freshman (first year)	After 2025	2004	Female
6/26/2023 21:23:26	Agree	Agree	Neutral	Agree	2025-2026	High School	High School Junior	2025	2006	Female
6/27/2023 15:06:59	Agree	Agree	Strongly Agree	Neutral	2024-2025	Community College	College Freshman (first year)	Already graduated	2004	Female
6/27/2023 15:07:08	Agree	Neutral	Strongly Agree	Strongly Agree	2024-2025	Community College	College Freshman (first year)	Already graduated		Female
6/27/2023 15:10:11	Agree	Agree	Agree	Agree	2024-2025	Just graduated from bright point community college	Other	Already graduated	1980	Female
6/27/2023 15:17:08	Agree	Disagree	Agree	Agree	2024-2025	Community College	College Sophomore (second year)	2025	2003	Female
6/27/2023 15:20:42	Agree	Agree	Strongly Agree	Strongly Agree	2024-2025	Community College	College Sophomore (second year)	Already graduated	2003	Male

6/27/2023 15:52:30	Agree	Neutral	Strongly Disagree	Strongly Disagree		Communit y College	College Sophomore (second year)	Already graduated	2004	Female
6/27/2023 16:14:36	Agree	Neutral	Agree	Agree	2024-2025	Communit y College	College Sophomore (second year)	Already graduated	1984	Female
6/27/2023 16:16:33	Agree	Neutral	Strongly Agree	Strongly Agree	2024-2025	Communit y College	College Freshman (first year)	Already graduated	1999	Male
6/27/2023 16:20:47	Agree	Agree	Agree	Agree	2025-2026	Just graduated from community college	Other	Already graduated	1987	Female
6/27/2023 16:31:39	Agree	Neutral	Agree	Strongly Agree	2025-2026	Communit y College	College Freshman (first year)	Already graduated	2005	Female
6/27/2023 16:37:57	Agree	Agree	Disagree	Agree	2025-2026	Communit y College	College Sophomore (second year)	Already graduated	1968	Female
6/27/2023 18:25:13	Agree	Agree	Disagree	Disagree	2026-2027	Communit y College	College Freshman (first year)	Already graduated	2004	Male
6/27/2023 18:27:38	Agree	Agree	Strongly Agree	Agree	2024-2025	VCU (undeclare d major)	College Sophomore (second year)	Already graduated	2005	Female
6/27/2023 20:28:38	Agree	Agree	Strongly Agree	Strongly Agree	2024-2025	Communit y College	Other	Already graduated	2004	Female

6/27/2023 21:22:28	Agree	Agree	Disagree	Agree	2025-2026	Community College	College Freshman (first year)	2025	1995	Female
6/27/2023 23:11:21	Agree	Agree	Strongly Agree	Strongly Agree	2024-2025	Community College	College Freshman (first year)	Already graduated	1999	Female
6/28/2023 2:35:40	Agree	Neutral	Neutral	Agree		Community College	College Sophomore (second year)	Already graduated	1993	Female
6/28/2023 11:54:37	Agree	Strongly Agree	Disagree	Strongly Agree	2025-2026	Community College	College Freshman (first year)	After 2025	1978	Female
6/28/2023 20:48:08	Agree	Neutral	Neutral	Strongly Agree	2026-2027	Community College	College Freshman (first year)	Already graduated	1994	Female
6/29/2023 8:20:01	Agree	Agree	Strongly Agree	Neutral	2024-2025	Community College	College Freshman (first year)	Already graduated	1979	Female
6/29/2023 23:23:19	Agree	Agree	Strongly Agree	Strongly Agree	2025-2026	Community College	College Freshman (first year)	Already graduated	2001	Male
6/30/2023 0:27:31	Agree	Agree	Neutral	Strongly Agree	2024-2025	Community College	College Sophomore (second year)	Already graduated	2000	Female
7/1/2023 13:39:33	Agree	Agree	Agree	Strongly Agree	2028-2029	Postgraduate University	Other	Already graduated		Other
7/1/2023 19:22:48	Agree	Agree	Strongly Agree	Disagree	2024-2025	Community College	Other	Already graduated	1993	Male

7/5/2023 8:59:05	Agree	Disagree	Strongly Disagree	Disagree		Communit y College	Other	Already graduated		Female
7/5/2023 20:02:51	Agree		Strongly Agree		2024-2025	Communit y College	College Sophomore (second year)	2024	1984	Female
7/9/2023 17:06:31	Agree	Agree	Agree	Agree	2024-2025	Communit y College	College Sophomore (second year)	Already graduated	1974	Female
7/11/2023 10:15:00	Agree	Agree	Disagree	Strongly Agree	2024-2025	High School	High School Senior	2024	2005	Male
7/11/2023 11:18:40	Agree	Neutral	Agree	Strongly Agree	2026-2027	Communit y College	College Freshman (first year)	Already graduated	1997	Female
7/12/2023 14:57:40	Agree	Neutral	Neutral	Agree	2025-2026	Communit y College	Other	After 2025	1954	Male
7/12/2023 21:52:50	Agree	Agree	Agree	Agree	2024-2025	High School	High School Junior	2025	2007	Female
7/17/2023 20:19:42	Agree	Agree	Strongly Agree	Agree	2025-2026	Communit y College	College Freshman (first year)	Already graduated	2000	Male
8/1/2023 20:50:06	Agree	Neutral	Strongly Disagree	Agree	2024-2025	Communit y College	College Sophomore (second year)	Already graduated	1984	Female
8/8/2023 13:50:44	Agree	Agree	Strongly Agree	Agree	2024-2025	Communit y College	College Sophomore (second year)	Already graduated	1998	Male
6/22/2023 9:18:51	Neutral	Disagree	Disagree	Agree	2025-2026	High School	High School Junior	2025		Female



6/22/2023 11:55:01	Neutral	Disagree	Agree	Agree	2026-2027	High School	Other	After 2025	2008	Female
6/23/2023 17:57:59	Neutral	Neutral	Strongly Agree	Neutral		Community College	College Sophomore (second year)	Already graduated	1969	Male
6/25/2023 22:06:52	Neutral	Neutral	Strongly Agree	Strongly Agree	2025-2026	Community College	Other	Already graduated	1992	Female
6/26/2023 11:36:11	Neutral	Agree	Strongly Agree	Strongly Agree	2024-2025	Community College	College Sophomore (second year)	Already graduated	2002	Female
6/27/2023 15:06:37	Neutral	Agree	Disagree	Agree	2024-2025	Community College	College Freshman (first year)	Already graduated	2004	Male
6/27/2023 15:06:53	Neutral	Strongly Disagree	Neutral	Strongly Disagree	2024-2025	Community College	College Sophomore (second year)	Already graduated	1996	Female
6/27/2023 15:07:21	Neutral	Neutral	Disagree	Strongly Agree		Community College	College Sophomore (second year)	Already graduated	2000	Female
6/27/2023 15:07:27	Neutral	Neutral	Disagree	Agree	2025-2026	Community College	College Sophomore (second year)	Already graduated	2002	Female
6/27/2023 15:10:04	Neutral	Neutral	Disagree	Agree	2024-2025	Community College	College Sophomore (second year)	Already graduated	2004	Female
6/27/2023 15:31:44	Neutral	Neutral	Strongly Agree	Neutral	2024-2025	Community College	College Freshman (first year)	Already graduated	1990	Female

6/27/2023 15:33:05	Neutral	Neutral	Strongly Agree	Strongly Agree	2026-2027	Community College	College Freshman (first year)	2025	2003	Female
6/27/2023 15:37:46	Neutral	Neutral	Neutral	Agree	2025-2026	High School	High School Junior	2025	2007	Female
6/27/2023 15:53:50	Neutral	Agree	Strongly Agree	Agree	2028-2029	Community College	Other	Already graduated	1982	Female
6/27/2023 15:57:13	Neutral	Disagree	Neutral	Neutral		Community College	College Sophomore (second year)	Already graduated	1983	Prefer not to answer
6/27/2023 16:02:38	Neutral	Neutral	Disagree	Disagree	2024-2025	Community College	High School Junior	2024	2005	Male
6/27/2023 16:39:00	Neutral	Strongly Agree	Strongly Agree	Agree	2025-2026	Community College	Other	2024	199X	Female
6/27/2023 16:47:41	Neutral	Neutral	Agree	Strongly Agree	2024-2025	Community College	College Sophomore (second year)	Already graduated	2004	Male
6/27/2023 16:52:31	Neutral	Neutral	Agree	Strongly Agree	2024-2025	Virginia Tech	Other	Already graduated	2003	Female
6/27/2023 17:39:01	Neutral	Neutral	Strongly Agree	Strongly Agree	2025-2026	Community College	College Sophomore (second year)	Already graduated	1987	Female
6/27/2023 17:48:47	Neutral	Agree	Strongly Agree	Strongly Agree	2028-2029	Community College	Other	Already graduated	2003	Male
6/27/2023 18:43:46	Neutral	Disagree	Strongly Disagree	Agree	2026-2027	VCU (undeclared major)	Other	2025	2002	Female

6/27/2023 19:08:04	Neutral	Agree	Disagree	Agree	2024-2025	Community College	College Freshman (first year)	Already graduated	1978	Female
6/27/2023 22:32:54	Neutral	Neutral	Strongly Agree	Strongly Agree	2026-2027	Community College	College Sophomore (second year)	Already graduated	1999	Other
6/28/2023 1:56:08	Neutral	Strongly Disagree	Strongly Agree	Strongly Disagree	2024-2025	Community College	College Sophomore (second year)	2024	05/12/1999	Male
6/28/2023 8:28:35	Neutral	Neutral	Strongly Agree	Neutral	2024-2025	Community College	Other	Already graduated	1983	Male
6/28/2023 8:31:25	Neutral	Agree	Strongly Agree	Neutral	2025-2026	Community College	College Sophomore (second year)	2024	1986	Female
6/28/2023 15:49:49	Neutral	Neutral	Strongly Agree	Strongly Agree		Community College	Other	Already graduated	1995	Female
6/28/2023 16:19:34	Neutral	Neutral	Strongly Agree	Neutral	2025-2026	Community College	College Freshman (first year)	Already graduated	1966	Female
6/29/2023 8:56:24	Neutral	Neutral	Neutral	Neutral	2028-2029	Community College	Other	After 2025	2001	Female
6/29/2023 11:27:01	Neutral	Strongly Disagree	Neutral	Neutral		Community College	Other	Already graduated	1977	Female
6/29/2023 12:55:11	Neutral	Neutral	Disagree	Agree	2024-2025	High School	High School Senior	2024	2006	Female
6/29/2023 20:36:29	Neutral	Neutral	Neutral	Agree	2028-2029	Community College	Other	2025	1982	Female
6/30/2023 5:33:04	Neutral	Neutral	Strongly Disagree	Neutral	2024-2025	Community College	Other	Already graduated	1978	Male

6/30/2023 15:52:27	Neutral	Disagree	Neutral	Neutral		Community College	College Freshman (first year)	Already graduated	09/08/2004	Female
7/1/2023 8:43:12	Neutral	Neutral	Strongly Disagree	Agree	2024-2025	Community College	College Sophomore (second year)	2025	2004	Female
7/1/2023 13:22:06	Neutral	Neutral	Neutral	Agree	2024-2025	Community College	High School Senior	Already graduated	2005	Male
7/3/2023 14:59:28	Neutral	Disagree	Strongly Agree	Strongly Agree	2025-2026	Community College	College Freshman (first year)	Already graduated	2005	Female
7/5/2023 15:17:41	Neutral	Neutral	Strongly Agree	Strongly Agree	2024-2025	Community College	College Sophomore (second year)	2024	2000	Male
7/12/2023 8:33:26	Neutral	Neutral	Strongly Agree	Strongly Agree	2024-2025	High School	High School Senior	2024	2006	Male
7/16/2023 7:37:02	Neutral	Neutral	Agree	Agree	2025-2026	Community College	Other	Already graduated	1971	Male
7/17/2023 13:26:12	Neutral	Agree	Strongly Agree	Agree	2024-2025	Community College	College Sophomore (second year)	After 2025	1990	Female
8/9/2023 11:03:09	Neutral	Agree	Strongly Agree	Strongly Agree	2024-2025	Community College	College Sophomore (second year)	Already graduated	1990	Male
8/13/2023 14:21:09	Neutral	Neutral	Disagree	Strongly Agree	2026-2027	Community College	College Freshman (first year)	Already graduated	1998	Female
6/23/2023 20:26:26	Disagree	Disagree	Neutral	Strongly Agree	2024-2025	High School	High School Junior	2025	2006	Female

6/27/2023 15:08:28	Disagree	Disagree	Strongly Disagree	Strongly Agree		Community College	College Freshman (first year)	Already graduated	1999	Male
6/27/2023 15:41:54	Disagree	Disagree	Strongly Agree	Agree	2024-2025	Community College	College Freshman (first year)	2025	1993	Female
6/28/2023 8:25:59	Disagree	Disagree	Neutral	Agree	2024-2025	Dual enrolled middle school student	College Sophomore (second year)	2024	2008	Female
6/28/2023 20:54:36	Disagree	Disagree	Agree	Agree		Community College	Other	Already graduated	1973	Female
6/30/2023 10:38:49	Disagree	Strongly Disagree	Neutral	Agree		VCU (undeclared major)	Other	2025	2002	Male
7/3/2023 21:43:28	Disagree	Disagree	Disagree	Agree	2024-2025	Community College	College Freshman (first year)	Already graduated	2005	Female
7/10/2023 0:43:16	Disagree	Neutral	Strongly Agree	Strongly Agree	2024-2025	Community College	Other	Already graduated	2001	Female
7/10/2023 22:18:16	Disagree	Disagree	Strongly Agree	Strongly Agree	2028-2029	Community College	College Sophomore (second year)	Already graduated	1999	Other
6/22/2023 11:53:33	Strongly Disagree	Disagree	Agree	Agree		High School	High School Junior	2025	2006	Male
6/22/2023 13:23:50	Strongly Disagree	Strongly Disagree	Strongly Agree	Strongly Agree	2028-2029	High School	High School Senior	2024	2006	Male

6/22/2023 13:45:30	Strongly Disagree									
6/22/2023 13:46:33	Strongly Disagree	Strongly Disagree	Strongly Disagree	Neutral	2026-2027	High School	Other	After 2025	2008	Male
6/24/2023 14:24:24	Strongly Disagree	Strongly Disagree	Strongly Disagree	Strongly Disagree	2026-2027	High School	Other	After 2025	2008	Male
6/27/2023 15:06:37	Strongly Disagree	Neutral	Strongly Disagree	Agree		Communit y College	Other	Already graduated		Female
6/27/2023 15:13:24	Strongly Disagree	Strongly Disagree	Neutral	Neutral		Communit y College	College Freshman (first year)	Already graduated	1992	Female
6/27/2023 16:14:32	Strongly Disagree	Strongly Disagree	Strongly Agree	Agree		Communit y College	College Freshman (first year)	Already graduated	1999	Female
6/27/2023 19:05:12	Strongly Disagree	Strongly Disagree	Strongly Disagree	Strongly Disagree		Communit y College	Other	Already graduated	2003	Male
6/27/2023 22:39:29	Strongly Disagree	Strongly Disagree	Strongly Agree	Strongly Agree		Mba	Other	Already graduated	1985	Female
6/28/2023 12:52:53	Strongly Disagree	Strongly Disagree	Agree	Agree	2024-2025	Communit y College	College Sophomore (second year)	Already graduated	2001	Male
6/28/2023 14:05:24	Strongly Disagree	Strongly Disagree	Strongly Agree	Strongly Agree		Communit y College	College Sophomore (second year)	2025	1969	Male
6/28/2023 20:17:07	Strongly Disagree	Strongly Disagree	Strongly Disagree	Agree		VCU transfer student	Other	Already graduated	9/21/2001	Male

6/30/2023 20:53:00	Strongly Disagree	Strongly Disagree	Strongly Agree	Strongly Agree		Communit y College	College Freshman (first year)	Already graduated	2004	Female
7/5/2023 18:53:20	Strongly Disagree	Strongly Disagree	Neutral	Neutral		Communit y College	College Sophomore (second year)	Already graduated	2004	Female

**FRSC 391: Introduction to Digital Forensics Survey (Spring & Fall 2022) - Raw data**

Timestamp	Overall, the course held my interest	The tests were a reasonable assessment of material presented in the class	I felt Professor Siewert was a good presenter	I believe active practitioners in the field of digital forensics should be regularly involved in the instruction of future digital forensic courses at VCU.	Future students taking this class would benefit from MORE _____ in the class	Future students taking this class would benefit from LESS _____ in the class	On a scale of 1 (awful) to 10 (dabomb), I would rate this class is a _____ compared to my other electives or major/minor course work (i.e., not core course work).	Because of this class, I now have an increased desire to learn more about the field of digital forensics	I felt the assignments in this class were appropriate to the lessons for which they were assigned	I would recommend other students interested in and/or majoring/minoring in Forensics take this course
2022/05/03 5:09:07 PM AST	Agree	Strongly Agree	Strongly Agree	Agree	hands on practice within the presentations to hold students attention!!	long presentations	8	Agree	Agree	Agree



2022/05/03 5:11:50 PM AST	Agree	Strongly Agree	Agree	Agree	I honestly have no opinions on how you could better the class. I think classes were well presented and I enjoyed learning about this subject.	^	8	Agree	Strongly Agree	Strongly Agree
2022/05/03 5:26:19 PM AST	Agree	Agree	Agree	Neither agree nor disagree	Case studies and why it is important to them	nothing really, it was pretty educational	9	Agree	Agree	Agree
2022/05/03 5:08:09 PM AST	Strongly Agree	Agree	Strongly Agree	Strongly Agree	real life examples	slides	9	Agree	Agree	Agree
2022/05/03 5:08:42 PM AST	Agree	Strongly Agree	Agree	Strongly Agree	class discussion	straight lecture	9	Agree	Strongly Agree	Strongly Agree
2022/05/03 7:40:31 PM AST	Agree	Strongly Agree	Strongly Agree	Strongly Agree	exams	n/a	10	Neither agree nor disagree	Agree	Agree

2022/05/03 5:06:45 PM AST	Agree	Agree	Strongly Agree	Strongly Agree	diversity in how the material is presented and case studies!	"death by powerpoint", reading a textbook, or lengthy essays (this is a great class for hands-on activities!)	10	Strongly Agree	Strongly Agree	Strongly Agree
2022/05/03 5:10:34 PM AST	Strongly Agree	Strongly Agree	Strongly Agree	Strongly Agree	Using real cases to explain certain things and show examples	maybe less code lol but tbh it was pretty interesting	10	Strongly Agree	Strongly Agree	Strongly Agree
2022/05/03 5:10:36 PM AST	Agree	Agree	Agree	Strongly Agree	Air conditioning, the room was hot--but with a more serious suggestion, it might be fun to do a quizlet or kahoot thing in class as an interactive element	Hotness--but I liked the balance of questions/lecturing/practice	10	Strongly Agree	Strongly Agree	Agree

2022/05/03 5:10:59 PM AST	Strongly Agree	Agree	Strongly Agree	Strongly Agree	From more real-life examples that gear more towards everyday things since we use tech everyday.	I don't think that there is anything that needs to be removed from this class.	9	Strongly Agree	Agree	Strongly Agree
2022/05/03 5:15:28 PM AST	Strongly Agree	Strongly Agree	Strongly Agree	Strongly Agree	Maybe more group assignments? Good team building I guess	Maybe shorter sessions	10	Strongly Agree	Strongly Agree	Strongly Agree
2022/05/04 8:53:15 PM AST	Strongly Agree	Strongly Agree	Strongly Agree	Strongly Agree	in-class lab exercises	Class length (the class is a few hours at a single time, but the breaks Professor Siewert gives are really helpful for stretching legs, refocusing, etc and are much appreciated)	10	Strongly Agree	Strongly Agree	Strongly Agree

2022/12/01 4:19:20 PM EST	Strongly Agree	Agree	Strongly Agree	Strongly Agree	guest speakers maybe.	multiple selection questions where when you get one wrong, you get no points.	9	Agree	Strongly Agree	Strongly Agree
2022/12/01 4:24:16 PM EST	Strongly Agree	Neither agree nor disagree (meh)	Agree	Neither agree nor disagree (meh)	Reminders of information. It is sometimes a lot of information in class to remember a week later and for exams. Maybe have study guides?	None	7	Agree	Strongly Agree	Strongly Agree

2022/12/01 4:30:54 PM EST	Strongly Agree	Strongly Agree	Strongly Agree	Strongly Agree	I don't think the course needs more or less of anything. The lectures and practical exercises are well balanced. The tests were fair and the assignments were relevant to what we did in class.	N/A. But, please don't let them convince you to do study guides or review sessions anymore because it's really unnecessary since all of the information is there in your presentations and a waste of your time.	9	Agree	Strongly Agree	Strongly Agree
2022/12/01 4:36:14 PM EST	Strongly Agree	Agree	Agree	Strongly Agree	more recorded lectures	lecture time and more lab work so they can work on actual situations	9	Agree	Strongly Agree	Strongly Agree
2022/12/01 4:47:49 PM EST	Strongly Agree	Agree	Strongly Agree	Strongly Agree	partial credit on questions with multiple answers and a grace day for one assignment	n/a	8	Agree	Strongly Agree	Strongly Agree

2022/12/01 4:16:27 PM EST	Agree	Agree	Agree	Agree	at home exploration of topics	in person lecture	7	Agree	Strongly Agree	Neither agree nor disagree (meh)
2022/12/01 4:17:40 PM EST	Agree	Strongly Agree	Agree	Strongly Agree	More practicals/ case studies	N/A	7	Agree	Strongly Agree	Neither agree nor disagree (meh)
2022/12/01 4:21:21 PM EST	Agree	Agree	Agree	Strongly Agree	labs	lecture	7	Agree	Agree	Agree
2022/12/01 4:26:40 PM EST	Agree	Neither agree nor disagree (meh)	Strongly Agree	Strongly Agree	study time	harder test	7	Agree	Agree	Agree
2022/12/01 4:26:50 PM EST	Agree	Agree	Strongly Agree	Strongly Agree	Discussions	Computer problems	8	Agree	Agree	Strongly Agree
2022/12/01 4:28:28 PM EST	Agree	Disagree	Agree	Agree	Hands on exercise	Having to look over slides	7	Agree	Agree	Agree

2022/12/01 4:31:05 PM EST	Agree	Agree	Strongly Agree	Agree	Real life examples of producers and or methods (real cases). More extra credit opportunities.	While Taking this class I didn't come across anything that didn't help me in the class it self.	9	Agree	Strongly Agree	Agree
2022/12/01 4:41:41 PM EST	Agree	Agree	Agree	Agree	demonstrations of digital forensics tools	presentation of slideshows	8	Agree	Agree	Agree
2022/12/01 4:45:23 PM EST	Agree	Neither agree nor disagree (meh)	Agree	Agree	real life examples that the professor has experienced	slide and more on visual examples	6	Agree	Agree	Agree
2022/12/01 4:49:12 PM EST	Agree	Agree	Agree	Strongly Agree	Engagement	Less slides. I know every student learns differently but I find it difficult to sit through presentations every session. Maybe include more activities the class can work	7	Agree	Agree	Strongly Agree

						on together that get the students more involved.				
2022/12/01 4:49:14 PM EST	Agree	Agree	Strongly Agree	Agree	Q/A, presenting themselves on digital forensics	from simple lecture	8	Agree	Strongly Agree	Strongly Agree



2022/12/01 4:47:09 PM EST	Agree	Strongly Disagree	Neither agree nor disagree (meh)	Agree	If the professor, took the time to take off all the noise in his presentations. Created review guides for students to follow and specifically attend towards. I believe that students concerns for getting better grades are often overlooked because professors are "too busy" or "doesn't have time" catering towards students needs. I believe that professors passive aggressive emails proves no success as well as not motivating students at ALL. If the professor took the time to cut down all the excessive words in his presentation and instead replace with few more concise points and speak more, the students will be able to stay more engaged to the professor. It's like what everyone who attended a school is taught. To NOT READ off the slides and to give more information spoken. I believe students can be more successful if the professor RECORDS his class so students have something to fall back to, because often the Exams/ tests the professor provide have too much	Students benefit less from no guidance, vague responses like "review all presentation slides" and trigger words like "in the real world." Being lenient helps push students to be more vocal in class as well as more motivated to show up and stay till the end of class. There are outcomes to these actions and if anything nothing really goes into the students favor when the professor doesn't really listen to what the students	3	Disagree	Agree	Neither agree nor disagree (meh)
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2022/12/01 4:29:03 PM EST	Strongly Agree	Disagree	Strongly Agree	Strongly Agree	Real life Cases made the class very interesting.	I don't think there should be less of anything taught currently in the course. I do believe that the select all that apply questions on the test are difficult.	9	Neither agree nor disagree (meh)	Strongly Agree	Strongly Agree
2022/12/01 4:26:40 PM EST	Neither agree nor disagree (meh)	Agree	Agree	Neither agree nor disagree (meh)	with activity	lecture	6	Neither agree nor disagree (meh)	Agree	Neither agree nor disagree (meh)
2022/12/01 4:24:29 PM EST	Agree	Strongly Agree	Strongly Agree	Neither agree nor disagree (meh)	videos and case examples	N/A	7	Neither agree nor disagree (meh)	Strongly Agree	Agree
2022/12/01 4:27:43 PM EST	Agree	Agree	Agree	Strongly Agree	clips of Prof. Seiwart on the court show, and case studies	of an info dump for class	7	Neither agree nor disagree (meh)	Agree	Agree

2022/12/01 4:29:46 PM EST	Agree	Agree	Strongly Agree	Agree	Interactive learning	Long periods of power point information	8	Neither agree nor disagree (meh)	Agree	Strongly Agree
2022/12/01 4:36:58 PM EST	Agree	Agree	Strongly Agree	Agree	If they attend class, and take notes on key terms.	Don't attend class	8	Neither agree nor disagree (meh)	Strongly Agree	Strongly Agree
2022/12/01 4:27:58 PM EST	Strongly Agree	Strongly Agree	Strongly Agree	Strongly Agree	If the cyber range worked more often and wasn't so buggy.	I would just lightly recommend 2 breaks during the lecture cause it is hard to hold someone's attention for that long.	10	Strongly Agree	Strongly Agree	Strongly Agree
2022/12/01 4:29:18 PM EST	Strongly Agree	Strongly Agree	Strongly Agree	Strongly Agree	Cyber Lab	Written Home Work	10	Strongly Agree	Strongly Agree	Strongly Agree
2022/12/01 4:31:27 PM EST	Strongly Agree	Agree	Strongly Agree	Strongly Agree	short assignments and test review	material covered per test; maybe have 4 tests instead of 3	8	Strongly Agree	Strongly Agree	Strongly Agree

2022/12/01 4:57:02 PM EST	Strongly Agree	Strongly Agree	Strongly Agree	Strongly Agree	notes	lecture	10	Strongly Agree	Strongly Agree	Strongly Agree
2022/12/01 4:24:33 PM EST	Strongly Disagree	Strongly Disagree	Strongly Disagree	Strongly Disagree	group assignments	information per test	7	Strongly Disagree	Strongly Disagree	Strongly Disagree

## **Appendix K – Prospective Student Support**



Tracey Dawson Green <tcdawson@vcu.edu>

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**Fwd: forensic computer analysis**

1 message

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**VCU Forensic Science** <fos@vcu.edu>  
To: Tracey Dawson Green <tcdawson@vcu.edu>

Tue, Aug 29, 2023 at 12:41 PM

----- Forwarded message -----

From: **Sanaa Wooden** <woodens2@vcu.edu>  
Date: Fri, May 5, 2023 at 11:20 AM  
Subject: forensic computer analysis  
To: <fos@vcu.edu>

Hello, I will be a incoming freshman for Fall 2023 and would like to know what should I major in if I would like to be a forensic computer analysis ?

Thanks, Sanaa Wooden

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Jo S Murphy, MSW  
Department & Community Engagement Coordinator  
Department of Forensic Science  
Virginia Commonwealth University  
[804.828.8420](tel:804.828.8420)



Tracey Dawson Green <tcdawson@vcu.edu>

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**Fwd: Interest in Digital Forensics Program**

1 message

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**VCU Forensic Science** <fos@vcu.edu>  
To: Tracey Dawson Green <tcdawson@vcu.edu>

Mon, Aug 28, 2023 at 12:45 PM

----- Forwarded message -----

From: **Makayla Stover** <stoverml@vcu.edu>  
Date: Sun, Aug 27, 2023 at 11:27 PM  
Subject: Interest in Digital Forensics Program  
To: <fos@vcu.edu>

Hello,

I was just reaching out to get more information on the upcoming Digital Forensics program. I am a first year student at VCU and I did a 4 year program in high school called STAT IT. One of my mentors actually teaches here at VCU, James Liston and he has been telling me that you guys plan to start the program in 2024? I would join the program guaranteed. Ever since I was in the STAT IT program in high school, I knew I wanted to do mobile forensics as a career field. If you guys have any additional information, that would be greatly appreciated! If you guys need anything at all, feel free to ask!

Thank you,  
Makayla Stover

--

Jo S Murphy, MSW  
Department & Community Engagement Coordinator  
Department of Forensic Science  
Virginia Commonwealth University  
[804.828.8420](tel:804.828.8420)

## Appendix L – Cited Works