STATE COUNCIL OF HIGHER EDUCATION FOR VIRGINIA
PROGRAM PROPOSAL COVER SHEET

1. Institution Old Dominion University	2. Academic Program (Check one): New program proposal ___X__ Spin-off proposal _____ Certificate document _____
3. Name/title of proposed program Data Science	4. CIP code 30.7001
5. Degree/certificate designation Doctor of Philosophy	6. Term and year of initiation Fall 2025
7a. For a proposed spin-off, title and degree designation of existing degree program 7b. CIP code (existing program)	
8. Term and year of first graduates Fall 2028	9. Date approved by Board of Visitors XXXXX
10. For community colleges: date approved by local board date approved by State Board for Community Colleges	
11. If collaborative or joint program, identify collaborating institution(s) and attach letter(s) of intent/support from corresponding chief academic officers(s)	
12. Location of program within institution (complete for every level, as appropriate and specify the unit from the choices). Departments(s) or division of _____ School(s) or college(s) of School of Data Science Campus(es) or off-campus site(s) Main Campus, Norfolk; Institute of Data Science, Virginia Beach. Mode(s) of delivery: face-to-face __X___ distance (51% or more web-based)__X__ hybrid (both face-to-face and distance) ___X_	
13. Name, title, telephone number, and e-mail address of person(s) other than the institution's chief academic officer who may be contacted by or may be expected to contact Council staff regarding this program proposal. Sierra Croker, scroker@odu.edu, 757-683-3154	

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Description of the Proposed Program

Program Background

Old Dominion University (ODU) seeks approval to initiate a Doctor of Philosophy in Data Science, scheduled to begin Fall 2025 in Norfolk, Virginia. This proposed program will be housed in the Interdisciplinary School of Data Science.

The proposed PhD in Data Science is designed to educate students to become data science scholars capable of teaching about and studying complex topics related to the domain of data science. Graduates of the program will be prepared to educate future data science professionals, so those professionals are able to develop proficiencies in the fields of computational data analytics in various sectors of industry, military, and government. The program will prepare individuals who have a strong understanding of data science topics and the ability to translate the subject matter to students seeking knowledge in areas such as machine learning, artificial intelligence and data visualization. In addition, graduates will have the skills to enter research careers where they will be able to study the theory, technologies, skills, and practices necessary to address the daily challenges of analyzing data and integrating the outcomes with business processes to make them more productive. The graduates will have enhanced oral and written communication skills to articulate data science problems and decisions in a cohesive and well-structured way. Finally, graduates will clearly understand ethical standards and rules for data science scholars, allowing them to promote social responsibility in coursework, research, and innovations.

The graduates from this program will have the skills and competencies that will make them successful in today's competitive, data-driven world, especially for senior positions. Around the world, data science is transforming business, health care, banking, agriculture and many other fields. Data scientists use analytical tools and techniques to extract meaningful insights from digital information. The graduates from this program will be prepared to use state-of-the-art programming languages, tools, and software packages to perform analytics on complex data, develop statistical and machine-learning/artificial intelligence (AI) models, and organize, manage, and clean data for its maximum effectiveness in analysis and visualization. It will also address the need for a larger workforce in data analytics and artificial intelligence (AI).

This program is also designed to help prepare data science professors and researchers. Graduates will develop skills and competencies in technical aspects of data science in current and emerging technologies and will be prepared to conduct empirical research. Data science is a multidisciplinary and inter-professional field that combines computer science, business analytics, mathematics, and statistics to understand and leverage data to make advances and decisions that were not possible within previous organizational tools. The program will prepare graduates to teach in higher education programs and conduct research in public and private sectors aiming to build scientific understanding about data science.

Rationale for the Program at Old Dominion University

ODU has a history of educating future data scientists. As part of Old Dominion University's strategic plan (2014-2019), the university committed to an investment in data science. The College of Sciences, Engineering and Business all built capability in data analytics and data-intensive research and developed several data science educational programs.

ODU initiated an interdisciplinary Master of Data Science and Analytics degree in 2020. This program represents an interdisciplinary effort bringing together faculty members with a wide range of expertise in computer science, information technology, engineering, and mathematics. As such, students completing this program choose a concentration from the following choices: Artificial Intelligence and Machine Learning, Business Intelligence and Analytics, Engineering and Big Data Analysis, Geospatial Analytics, and Physics.

ODU's School of Data Science was launched in February 2023 and has become the central home for coordinating data science academic programming that had previously been spread across the University's colleges.[1] Teaching and research faculty within the new school are creating interdisciplinary courses and conduct state-of-the-art research. The School of Data Science includes over fifty faculty teaching or conducting research in data science related fields including but not limited to computer science, mathematics, statistics, engineering, psychology, criminal justice, education, business, information technology, history, and philosophy. The School of Data Science will offer interdisciplinary academic programming for undergraduate, graduate, and non-degree students.

To support the new school, ODU opened the Virginia Beach Institute of Data Science in November 2003.[2] The 17,617-square-foot facility is the central home for academic programming in data science and research. The facility will provide an environment where industry-research partnerships can take place, facilitating the exchange of ideas, resources and expertise between academia and the business community. The School of Data Science will particularly focus on enhancing research partnerships with federal research laboratories located in the region. The new facility is designed to be a hub for data-driven research and exploration, including collaboration areas where students and industry leaders can discuss and test new research models and cutting-edge research labs for data driven exploration. ODU has a unique opportunity to develop a regionally specific data science emphasis that also can become nationally known, due both to regional employers that require a large number of operational data analytics employees and nearby national labs with research thrust areas that can magnify ODU's investments in specific data science niches[3].

Institutional Mission

The mission of the institution states: "Old Dominion University, located in the City of Norfolk in the metropolitan Hampton Roads region of coastal Virginia, is a dynamic public research

[1] Simpson, D. (2023). ODU Establishes School of Data Science. Old Dominion University. https://www.odu.edu/article/odu-establishes-school-of-data-science

[2] Godette, K. (2023) Virginia Beach Data Science Institute Offers Cutting-Edge Space for Collaboration. Old Dominion University. https://www.odu.edu/article/virginia-beach-data-science-institute-offers-cutting-edge-space-for-collaboration

[3] Simpson, D. (2023). ODU Establishes School of Data Science. Old Dominion University. https://www.odu.edu/article/odu-establishes-school-of-data-science

institution that serves its students and enriches the Commonwealth of Virginia, the nation and the world through rigorous academic programs, strategic partnerships, and active civic engagement."

The proposed PhD in Data Science aligns with this mission by (1) providing a rigorous academic program that trains individuals in the field of data science, (2) enhances research on data science and its interdisciplinary components, and (3) strengthening ODU's commitment to contributing to the economy and workforce of the Hampton Roads region and the Commonwealth of Virginia through applications of data driven decision making.

Delivery Format

The PhD in Data Science will be available on-campus and through a fully online format, with students accessing course materials through Canvas, the University's course management system. All assignment submissions and other course management actions will take place in Canvas. Further, faculty-student interaction is available via email, phone, in-person meetings, and Zoom.

Faculty members who teach in the web-based format are trained in course development and delivery through ODUGlobal. There, instructional designers and technologists work individually with each faculty member to convert course content, assignments, testing, and other course work to a web-based platform. Faculty work closely with the designers to ensure web-based content is the same as content taught in face-to-face settings.

Beyond the usual online offerings at ODU, data science is a field that requires extensive hands-on experience, which has been shown to be an important factor in stimulating students' interest and sharpening their scientific reasoning and problem-solving skills. ODU has made significant investments in the creation of a state-of-the-art Institute of Data Science facility in downtown Virginia Beach, approximately 13 miles from the ODU main campus. The new 17,617-square-foot facility is designed to be a hub for data-driven research and exploration housing dedicated laboratory and computer simulations space as well as teaching and collaboration areas.

Admission Criteria

Students entering the Doctor of Philosophy in Data Science should meet the minimum university graduate admission requirements. Additionally, requirements include the following:

- Online graduate application and application fee
- Students may be admitted with a bachelor's or master's degree.
    - For students entering with a bachelor's, the degree should be from a regionally accredited university in the U.S. or an equivalent foreign institution. If the degree is not in Data Science or a related field, students will need to provide competency in topics related to basic statistics and computer science.
    - For students entering with a master's, the degree should be from a regionally accredited university in the U.S. or an equivalent foreign institution. If the degree is not in Data Science or a related field, students will need to provide competency in topics related to basic statistics and computer science.
- Official copies of transcripts of all regionally accredited colleges and universities

attended.

- Two letters of recommendation from individuals familiar with the applicant's professional and/or academic background
- A current resume
- A statement of purpose
- GRE scores (there is no cutoff for considering the application; Waivers may be requested)
- Applicants must have a minimum cumulative GPA of 3.0 (scale is 4.00 = "A") in the last 60 hours of their first bachelor's degree program, or applicants must have a minimum cumulative GPA of 3.25 (scale is 4.00 = "A") in an applicable master's degree program.
- Current scores on the Test of English as a Foreign Language (TOEFL) with a minimum of 230 on the computer based TOEFL or 80 on the TOEFL iBT, if the applicant's native language is not English.

Applicants for admission to graduate study must have an earned degree in data science or a related field, i.e., computer science, electrical and/or computer engineering, mathematics, statistics, information system and technology, from an accredited institution or an equivalent degree from a foreign institution. Students with other degrees will need to provide competency in topics related to basic statistics and computer science such as: differentiation and integration, vectors and matrices, determinants and matrix inverse, elementary statistics and probability, basic programming, software development and testing, and C++/java concepts.

Both B.A and B.S. degrees are acceptable for this interdisciplinary major. For degrees in non-STEM subject areas, the admission team will review the applicants' transcripts to evaluate specific course work. On the recommendation of the graduate program advisors, these students may need to complete additional leveling coursework.

Students with previously completed work at a regionally accredited institution may submit a request for a maximum of 12 elective graduate credit hours to be transferred into the program. If approved by the admission committee, it will be added to the transcript.

Target Population

Three sets of students will be targeted for the proposed program. The first will be Old Dominion University students who are currently enrolled in the Data Science Master's program at ODU. For many, it will represent a natural progression, particularly if they are currently working in, or have plans to work higher education or research. Students in closely related disciplines, such as computer science, mathematics, statistics, information technology, and engineering will also be targeted.

The second target group includes data science students enrolled in bachelor's and master's degree programs across the Commonwealth of Virginia and nation. In particular, those with interest in teaching about and researching data science will be the target group. The availability of the online option will allow us to target students from across the Commonwealth of Virginia who otherwise may not be able to move.

The third target group includes current data science instructors and practitioners who have a master's degree but no doctoral degree and are teaching at community colleges across the Commonwealth and nation. This group also includes those in the military and individuals working for federal, state, or local government, for government contractors, for hospital and educational institutions, among others, who wish to gain advanced expertise in data science and analytics. Other doctoral programs at ODU have successfully provided doctoral training to this segment of the higher education community by offering online degree programs in their disciplinary areas.

Curriculum

The Doctor of Philosophy in Data Science is a 78-credit hour degree program. A dissertation is required. Students who begin the PhD program after having earned a Master's degree will complete a 48-credit hour degree program.

The proposed program will establish a solid educational foundation and prepare graduates for careers as higher education researchers, industry researchers, and data science leaders. Those entering the program straight from an undergraduate program will take four core courses that focus on the fundamental knowledge of data science, foundational data science concepts, data analytics, big data, data visualization, and statistical models for data science and analytics. These students will then choose five restricted electives to learn about different aspects of data science, e.g., in data visualization, big data applications, machine learning, data analytics and artificial intelligence. Courses are also offered to address such important data science topics in specific domain areas such as geographic information systems, information science, business intelligence and computational physics. Students will learn how to identify problems, gather information, analyze data, define hypotheses, develop solutions, establish contingencies, and effectively articulate and communicate results. DASC 690 Capstone Project provides the opportunity to synthesize knowledge from previous coursework and apply it to solve real-world data science problems.

After students have completed the foundational data science coursework and the master's project, they will begin to take advanced core requirements and advanced electives. Those who enter with a master's degree, will begin their curriculum with the advanced courses. The advanced core courses focus on topics such as ethical issues from emerging technologies, approaching data science through an interdisciplinary lens, using multi-method strategies to study data science, and applied experiences in the areas of teaching and studying data science.

Students must successfully complete a dissertation (DASC 899). While working on the dissertation, students will enroll in dissertation research coursework (DASC 898).

Program Requirements for Students Entering Straight from BS/BA
*Indicates New Course

Core requirements: 30 credit hours
DASC/CS 620 Introduction to Data Science and Analytics (3 credits)

CS 624 Data Analytics and Big Data (3 credits)
CS 625 Data Visualization (3 credits)
STAT 603 Statistical/Probability Models for Data Science and Analytics (3 credits)
DASC 690 Capstone Project/Thesis (3 credits)
DASC 800 Interdisciplinary Studies Proseminar* (3 credits)
PHIL 703/803 Moral Reasoning for Emerging Technologies* (3 credits)
DASC/CS 720/820 Advanced Data Science and Analytics* (3 credits)
DASC 768/868 Data Science Applications in the Professions* (3 credits)
DASC 771/871 Fundamentals of Interpretable Machine Learning and Explainable AI (3 credits)

Restricted Foundational Electives: 15 credit hours
Select 15 credits from two different disciplines from the following:
BNAL 503 Data Visualization and Exploration (3 credits)
BNAL 515 Advanced Business Analytics/Big Data Applications (3 credits)
CS 522 Machine Learning I (3 credits)
CS 532 Web Science (3 credits)
CS 550 Database Concepts (3 credits)
CS 569 Data Analytics for Cybersecurity (3 credits)
CS 580 Introduction to Artificial Intelligence (3 credits)
CYSE 520 Applied Machine Learning in Cybersecurity (3 credits)
CYSE 635 AI Security and Privacy (3 credits)
ECE 651 Statistical Analysis and Simulation (3 credits)
ECE 607 Machine Learning 1 (3 credits)
ENMA 646 Information Science for Systems and Engineering Management (3 credits)
GEOG 525 Internet Geographic Information Systems (3 credits)
GEOG 532 Advanced GIS (3 credits)
GEOG 562 Advanced Spatial Analysis (3 credits)
GEOG 590 Applied Cartography/GIS (3 credits)
GEOG 519 Spatial Analysis of Coastal Environments (3 credits)
GEOG 520 Marine Geography (3 credits)
GEOG 563 GIS Programming (3 credits)
GEOG 573 Geographic Information Systems for Emergency Management (3 credits)
GEOG 600 Geospatial Data Analysis (3 credits)
GEOG 601 Spatial Statistics and Modeling (3 credits)
IT 650 Database Management Systems (3 credits)
IT 651 Business Intelligence (3 credits)
IT 652 Information and Communications Technology for Big Data (3 credits)
PHYS 520 Intro to Computational Physics (3 credits)
STAT 604 Statistical Tools for Data Science and Analytics (3 credits)

Advanced Electives: 15 hours
Select 15 hours from three different disciplines:
BDA 821 High-Dimensional Statistics (3 credits)
BDA 831 Applied Functional Data Analysis (3 credits)
BDA 845 Transform Methods for Data Science (3 credits)
BNAL 821 Simulation Modeling for Business and Supply Chain Systems (3 credits)

CS 833 Natural Language Processing (3 credits)
CS 828 Deep Learning (3 credits)
CS 825 Information Visualization (3 credits)
CS 812 Stochastic Modeling (3 credits)
CS 832 Human Computer Interaction (3 credits)
ECE 884 Computer Vision (3 credits)
ECE 882 Digital Signal Processing II (3 credits)
MSIM 851 Advanced Analysis for Modeling and Simulation (3 credits)
MSIM 8XX Big Data Systems (3 credits)
ENMA 801 Digital Systems Engineering (3 credits)
IT 891 Seminar in Business Intelligence (3 credits)
IT 892 Seminar in Knowledge Management (3 credits)
MAE 740/840 Autonomous and Robotics Systems (3 credits)
CEE 874 Transportation Network Flow Models (3 credits)
PHYS 811 Computational Physics (3 credits)
DASC/CS 895 Fundamentals and Applications of Deep Learning (3 credits)
DASC 8XX Advanced Generative AI: Theory, Applications, and Ethics (3 credits)
DASC 8XX Causality Analysis for Data Science (3 credits)
DASC 8XX Advanced Representation Learning (3 credits)
DASC 8XX Markov Decision Process and Reinforcement Learning (3 credits)
DASC 8XX Advanced Scientific Machine Learning: from theory to practice (3 credits)
DASC 8XX Foundation Models for Data Science (3 credits)
DASC 8XX/BDA 8XX Random Process and Sequence Learning (3 credits)
MATH 618 Applied Functional Analysis (3 credits)
MATH 820 Advanced Applied Functional Analysis (3 credits)
OEAS 805 Advanced Environmental Data Science (3 credits)
STAT 825 Linear Statistical Models (3 credits)
STAT 830 Multivariate Statistics (3 credits)
Other Approved Electives.

Dissertation Research:
DASC 898 Research (15+ credits)
DASC 899 Dissertation (3+ credits)

Program Requirements for Students Entering Straight from MS/MA
*Indicates New Course

Core requirements: 15 credit hours
DASC 800 Interdisciplinary Studies Proseminar* (3 credits)
PHIL 703/803 Moral Reasoning for Emerging Technologies* (3 credits)
DASC/CS 720/820 Advanced Data Science and Analytics* (3 credits)
DASC 768/868 Data Science Applications in the Professions* (3 credits)
DASC 771/871 Fundamentals of Interpretable Machine Learning and Explainable AI (3 credits)

Advanced Electives: 15 hours
Select 15 hours from three different disciplines:

BDA 821 High-Dimensional Statistics (3 credits)
BDA 831 Applied Functional Data Analysis (3 credits)
BDA 845 Transform Methods for Data Science (3 credits)
BNAL 821 Simulation Modeling for Business and Supply Chain Systems (3 credits)
CS 833 Natural Language Processing (3 credits)
CS 828 Deep Learning (3 credits)
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ENMA 801 Digital Systems Engineering (3 credits)
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IT 892 Seminar in Knowledge Management (3 credits)
MAE 740/840 Autonomous and Robotics Systems (3 credits)
CEE 874 Transportation Network Flow Models (3 credits)
PHYS 811 Computational Physics (3 credits)
DASC/CS 895 Fundamentals and Applications of Deep Learning (3 credits)
DASC 8XX Advanced Generative AI: Theory, Applications, and Ethics (3 credits)
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MATH 820 Advanced Applied Functional Analysis (3 credits)
OEAS 805 Advanced Environmental Data Science (3 credits)
STAT 825 Linear Statistical Models (3 credits)
STAT 830 Multivariate Statistics (3 credits)
Other Approved Electives.

Dissertation Research:
DASC 898 Research (15+ credits)
DASC 899 Dissertation (3+ credits)

Candidacy Examination

Students in the PhD in Data Science will be required to pass written and oral examinations to qualify for candidacy for the degree of Doctor of Philosophy. These examinations will access the student's ability to coherently relate information taken from the core and research skills courses in a critical and scholarly manner. The student's advisor must recommend the student for the candidacy exam during the semester in which he/she is scheduled to complete all coursework (except for dissertation hours) required for the degree. The graduate program director (GPD) is

responsible for coordinating the administration of the written and oral candidacy examinations and will appoint a committee to administer the exams. The examination committee will be made up of at least three (3) faculty members, all of whom must be graduate certified and two of whom must be affiliated with the School of Data Science. The procedure for candidacy exams will follow guidelines in the Old Dominion University Graduate Catalog.

After successful completion of the written examination, an oral examination, which must be taken prior to the end of the next semester, is given addressing topics discussed in the written examination and possible additional materials. All students must pass both the written and oral candidacy examinations. Any student not passing an examination will be allowed to take it a second time. If a student does not pass an exam on the second attempt, that student will be suspended from the program.

Dissertation Research

Once the written and oral candidacy examinations have been passed, a dissertation committee will be formed to supervise dissertation research. This committee will be formed by the student, in consultation with his or her advisor and approved by the GPD. After approval of the dissertation proposal, the chair of the dissertation committee shall recommend the student's admission to candidacy to the GPD and the Dean. Each student will complete at least 15 credit hours of dissertation research (DASC 898: Research) during which major work will result in development of a doctoral dissertation that represents original research efforts by the student.

The dissertation (DASC 899: Dissertation) may take the form of one major project or three related research projects prepared for journal publication. Upon completion of the dissertation, the student's dissertation committee will conduct a public examination and defense of the dissertation. Final approval is the responsibility of the dissertation chair, the GPD, and ultimately the Dean of the Interdisciplinary Studies, who together certify the candidate for graduation.

Appendix A provides sample schedules for full-time and part-time students. Course descriptions may be found in Appendix B.

Student Retention and Continuation Plan

Pre-emptive approaches will be adopted to ensure students succeed in the proposed program. Specific plans for student retention and continuation include:

- Requiring an online orientation session for all new students, aimed at introducing the program, curriculum, requirements, expectations, faculty, facility, and other relevant resources that are online or remotely accessible through the myODU portal.
- Providing an up-to-date curriculum and a long-range course schedule to help students plan their enrollment and time to completion.
- Requiring a minimum of one advising session per semester (online or face-to-face) and providing personalized advising throughout students' program of study.
- Holding special advising sessions for nontraditional students.
- Assigning each student a faculty mentor.

Continuation within the program is contingent upon maintaining a 3.0 average in all academic coursework. When individual student performance demonstrates a lack of success, faculty will explore ways to encourage success. These include:

- Individualized advising and mentoring to help the student pass course(s).
- Connecting students to other PhD students who are willing to provide peer mentoring.
- Assigning additional faculty mentors.
- Involvement in state-of-the-art data science projects to stimulate student's interest to become motivated and excited to study data science; and
- Creating a cohort to increase interactions and peer learning.

Time to Degree

Full-time students who enter directly from a bachelor's degree program will be able to complete the program in five years while part-time students will be able to finish the program in eight years. Full-time students who enter from a master's degree program will be able to complete the program in three years while part-time students will be able to finish the program in six years.

Faculty

The School of Data Science has six (6) faculty with credentials to teach in a Doctor of Philosophy in Data Science Program; four (4) additional tenure track faculty are currently being hired. An additional four (4) faculty are affiliated with the school through joint appointments with academic departments and have the subject matter expertise to teach in a data science doctoral program. All faculty are credentialed and hold PhDs in fields related to data science such as computer science, computer engineering, information technology, philosophy, mathematics, and statistics and are tenured or tenure-track faculty members.

Among the faculty members, six will teach the core coursework, including two professors, one of whom serves as the director of the School of Data Science, two associate professors, one of whom serves as the graduate program director, and two assistant professors.

The faculty have breadth and depth in areas of data science including machine learning, big data analysis, artificial intelligence, web science, and more. They are active in research, publications, and teaching in areas related to data science and analytics. Combined, they have an extensive record of scholarship with over 120 recent publications (during the past three years) in peer-reviewed journals and conferences. Over the same time period they received 35 research grants worth 10M from prestigious organizations such as the National Science Foundation, Department of Defense, Department of Education, Commonwealth Cyber Initiative, Alfred P. Sloan Foundation, National Academy of Medicine, Virginia Space Grant Consortium.

Faculty curriculum vitae (abbreviated) are included in Appendix C.

Program Administration

This proposed program will be administered by the School of Data Science. The School of Data Science was established to combine distinct threads of programmatic and facility resources to create a strong education and research program focusing on data science. The School represents an interdisciplinary effort related to faculty, degree programs, certificates, and research initiatives from five colleges, eight academic departments, the Office of Research, Information Technology Services, and the Virginia Modeling, Analysis and Simulation Center.

A tenured data science faculty will be appointed as the graduate program director (GPD). They will assume responsibility for setting class schedules, coordinating student meetings and activities, gathering student input, handling students' concerns, providing admission and enrollment information to the Graduate School, and meeting with the faculty, the School director, and vice provost of academic affairs to discuss programmatic matters.

A graduate committee, to include the graduate program director and other faculty members affiliated with the School of Data Science, will be formed to review applicants for admission, evaluate curriculum in meeting student and employer needs, and conduct regular program assessments.

An administrative assistant in the School of Data Science will support faculty and students in this program; approximately 20% of this individual's time will be devoted to the proposed program. The assistant will help with the processing of applications, scheduling of courses, handling registration issues, updating the catalog, and website management.

Student Assessment

Students will be evaluated throughout the program using formative assessments such as case studies, papers, research projects, and presentations. Student learning outcomes cover many of the professional and empirical competencies required of higher education professors and researchers Specifically, graduates will be able to:

1. Analyze ethical and social issues in the area of data science and communication the underlying implications of those issues to multiple audiences.
2. Conduct independent research on data science using multiple research methods.
3. Communicate in writing the results of their research for both scholarly and non-scholarly audiences.
4. Integrate principles and methods from a variety of disciplines to study data science.
5. Apply their interdisciplinary expertise through course instruction and scholarly research.
6. Orally communicate their understanding of data science and explain decisions in cohesive and well-structured presentations to both technical and non-technical audience.

These student learning outcomes are provided in the following assessment map.

Curriculum Map of Data Science Program Core Courses

Student Learning Objectives	Courses that Develop Competency Course Number and Title	Courses and Activities that Demonstrate Mastery Course Number and Title
1. Ethics Analyze ethical and social issues in the area of data science and communication the underlying implications of those issues to multiple audiences;	DASC/CS 620 - Introduction to Data Science and Analytics CS 624 - Data Analytics and Big Data PHIL 703/803 - Moral Reasoning for Emerging Technologies	DASC/CS 620 Measure: Exam. Target: 80% of students will score 80% or higher on the final exam. CS 624 Measure: Presentation. Target: Students will score an average of 3.5 (out of 5) on ethics portion of presentation. PHIL 703/803 Measure: Research Paper Target: 85% of students will score 80% or higher on the research paper.
2. **Independent Research** Conduct independent research on data science using multiple research methods.	CS 625 - Data Visualization STAT 603 - Statistical/ Probability Models for Data Science and Analytics DASC 771/871 – Fundamentals of Interpretable Machine Learning and Explainable AI	CS 625 Measure: Research Project Target: 85% of students will score 80% or higher on the research project. STAT 603 Measure: Research Project Target: 85% of students will score 80% or higher on the research project. DASC 771/871 Measure: Research Project Target: 85% of students will score 80% or higher on the research project.
3. Written Research Communicate in writing the results of their research for both scholarly and non-scholarly audiences;	DASC 898/899 - Dissertation	DASC 898/899 Measure: Study or 3 Journal Articles Target: 80% of students will score 4 or higher on the "Written Communication" portion of the rubric for the project.
4. Integrated Perspective Integrate principles and methods from a variety of disciplines to study data science;	DASC 800 Interdisciplinary Studies Proseminar DASC/CS 720/820 Advanced Data Science and Analysis	DASC 800 Measure: Research Proposal Target: 90% of students will score 85% or higher. DASC/CS 720/820 Measure: Research Project Target: 85% of students will score 80% or higher.

5. Instruction and Research Apply interdisciplinary expertise through course instruction and scholarly research;	DASC 800 Interdisciplinary Studies Proseminar DASC 768/868 Data Science Applications in the Professions	DASC 800 Measure: Presentation Target: Students will score an average of 3.5 (out of 5) on "Instruction and Research" portion of presentation. DASC 768/868 Measure: Practicum Lesson Observation Target: Students will score 85% or higher on the lesson observation assignment.
6. Oral Communication Orally communicate data science research through well-structured presentations to both technical and non-technical audience.	DASC 800 Interdisciplinary Studies Proseminar DASC 899 Dissertation	DASC 800 Measure: Presentation Target: Students will score an average of 4 (out of 5) on "Oral Communication" portion of presentation. DASC 899 Measure: Dissertation Defense Target: Students will score an average of 3.75 (out of 5) on "Oral Communication" portion of defense.

Employment Skills

Graduates of the proposed Doctor of Philosophy program in Data Science will have the skills and abilities needed for employment and workplace competencies to work in higher education and in industry.

As faculty members, graduates will be able to:

1. Develop and deliver effective data science instruction in an undergraduate or graduate college or university program.
2. Conduct data science research studies independently and in collaboration with other scholars.
3. Advise and mentor data science students.
4. Serve as professional consultants and advisors to government and industry bodies seeking guidance.
5. Expand scientific knowledge about data science through multiple disciplinary frameworks.

As a data science researcher working in industry or government settings, graduates will be able to:

1. Develop original research projects focused on data science.
2. Secure funding for data science research projects.
3. Translate data science research findings into practice.

4. Effectively communicate with various audiences about data science research findings.
5. Provide technical leadership in data science settings.

Program Assessment

The program will be assessed by faculty and administrators in the School of Data Science and the provost's office. The review will be completed annually in the fall starting from the second year after the program is approved, and will consist of:

- Analyzing retention and attrition rates in order to maximize the positive influences and improve the negative ones that affect program completion.
- Analyzing the results of the Old Dominion University Graduate Student Satisfaction Survey for areas where additional student support is needed.
- Analyzing graduate job placement to assess if the program is preparing students with the knowledge, skills, and abilities for jobs in data science and evaluate the program's ability to meet market demands (following initial graduates' completion).

Results of these assessments will be used to evaluate the quality of the program, to stimulate program development, and to assess the role of the program in fulfilling Old Dominion University's institutional mission. The program review may (a) result in strategic decisions about the program, (b) identify areas of improvement, (c) make resource recommendations, (d) articulate considerations for expansion or consolidation, and/or (e) consider other aspects of programmatic quality with respect to policies and practices relative to:

- Student recruitment, admissions, advising, and retention,
- Enrollment projections including consideration of the context of the SCHEV 5-year benchmark and other on-going enrollment targets,
- Course descriptions and implementation,
- Approved curricular changes and development,
- Faculty development and research activities,
- Facilities,
- Internal and external funding; and
- Description of strengths and weaknesses with attention to action items for the future.

The dean and associate dean in the Graduate School will read the program review each year to ensure that benchmarks are met, and excellence is maintained. The Graduate School's annual evaluation of the program will be sent each year to the vice provost for review. The vice provost will offer guidance, as needed, for improvement, and will provide updates about the review to the provost.

Benchmarks of Success

Benchmarks of success for the Doctor of Philosophy in Data Science include the following student enrollment and graduate goals:

- 10-12 new students will be admitted each year.

- The program will graduate a minimum of eight students annually by the completion of the program's target year.
- 80% of the students who begin the program will successfully complete the program within five years of matriculation.
- 80% of graduates will be employed in data science positions using knowledge acquired in their graduate studies within six months of completion.
- 80% of students will be satisfied with the program as determined by the university's Graduate Student Satisfaction Survey.
- 80% of alumni will be satisfied with the program as determined by the university's Graduate Alumni Survey, administered within one year of completion;

After the first year and subsequent years, periodic evaluations of the success of the program in meeting these benchmarks will be undertaken. If program benchmarks are not achieved, the graduate program director and the program faculty will examine the program's admissions policies, curriculum, instructional methods, advising practices, and course evaluations to determine where changes need to be made.

Expansion of an Existing Program

This program is not an expansion of an existing certificate, concentration, emphasis, focus, major, minor, or track at ODU.

Relationship to Existing ODU Degree Programs

Old Dominion University offers a degree program that is related to the proposed PhD in Data Science: Doctor of Philosophy Computational and Applied Mathematics with a Concentration in Mathematics of Data Science (PhD). This degree is offered by the Department of Mathematics and Statistics in the College of Sciences.

Both the existing degree program and the proposed degree program share related interests in general aspects of data science, such as machine learning and data analytics. Both programs emphasize doctoral research as an integral part of the degree. However, there are distinct differences in the purposes of the degree programs and in the knowledge and skills of graduates of the degree programs.

The PhD in Computational and Applied Mathematics with a concentration in Mathematics of Data Science is to provides course work in the mathematical and statistical analysis of computational data science; this includes topics such as advanced machine learning, linear models, multivariate statistics, high dimensional statistics and applied functional data analytics. Students in this program develop research competencies in mathematics, statistics, or biostatistics.

Students in the proposed program do not take the courses offered in the mathematics degree program. Instead, the proposed program has less focus on mathematics and provides a broader emphasis across all data science competency areas. Graduates will possess the knowledge and

skills in computer science, information technology, and data science that will allow them to conduct data science research across multiple application areas.

Compromising Existing Programs

The proposed PhD in Data Science will not impact existing degree programs at Old Dominion University. The proposed degree program has a different scope from other degree programs and will attract students specifically interested learning interdisciplinary concepts in data science. The degree program will not affect the resources of other degree programs in the School of Data Science or the university. No degree programs will be negatively impacted or close as the result of the initiation and operation of the proposed degree program.

Justification for the Proposed Program

Response to Current Needs (Specific Demand)

The magnitude of data being generated and stored every day is overwhelming. Data science makes it possible to uncover important information that would otherwise remain hidden.[4] The term "data scientist" is a relatively recent invention, coined by D. J. Patil and Jeff Hammerbacher in 2008 to describe a high-level professional who makes discoveries from copious amounts of messy data, using and building data products along the way.[5] "Not only has the field seen a boom as big as any other in the past decade as data-driven decision-making became the norm across every industry, but it is only expected to get bigger in the years to come.[6] In 2020, the number of jobs posted by tech companies for analysis skills — including machine learning, data science, data engineering, and visualization — surpassed traditional skills such as engineering for the second time in the last four years.[7] Data science jobs ranked No.3 on Glassdoor's list of best jobs in America 2020 as well as ranked No.3 in LinkedIn's Emerging Jobs Report 2020.[8]

In the broadest sense, data science is about using quantitative tools — statistical, mathematical, computational — to extract knowledge from data. "Every major company today, including Forbes, uses as much data as it can to enhance its business." [9] In response to the high demand for

[4] Knopp, B., Beaghley, S., Frank, A., Orrie, R., & Watson, M. (2016). Defining the roles, responsibilities, and functions for data science within the Defense Intelligence Agency. RAND Corporation. https://www.rand.org/pubs/research_reports/RR1582.html.

[5]Davenport, T. & Patil. (2022). Is Data Scientist 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

[6] The Chronicle of Higher Education (n.d.), The Data Boom Spurs New Demand For Data Scientists, Content Paid for and Created by New Jersey Institute of Technology,p.1., https://sponsored.chronicle.com/the-data-boom-spurs-new-demand-for-data-scientists/index.html

[7] Ramachandran, K. & Watson, J. (2021). Tech looks to analytics skills to bolster its workforce. Deloitte Insights. https://www2.deloitte.com/us/en/insights/industry/technology/data-analytics-skills-shortage.html

[8] Pradhan, R. (2020). Data Science Jobs Continue to be In-demand. Udacity. https://www.udacity.com/blog/2020/05/are-data-science-jobs-really-hot.html

[9] The Chronicle of Higher Education (n.d.), The Data Boom Spurs New Demand For Data Scientists, Content Paid for and Created by New Jersey Institute of Technology, p.1.https://sponsored.chronicle.com/the-data-boom-spurs-new-demand-for-data-scientists/index.html

data science talent, many universities continue to launch new data science degree programs. At the graduate level, nearly 200 analytics and data science master's programs have sprung up over the past decade; those students anticipate earnings similar to graduates of related master's program in computational science and engineering." [10] However, even as universities launch undergraduate and masters' programs to bridge the supply-demand gap, there is still an unmet need for specialized data experts within the rapidly expanding field. Companies are now seeking people with specialized skill sets for their data science units, including advanced computing skills in graduates, along with mathematics and analytical modeling.[11]

A committee of data scientists was commissioned by the National Academy of Sciences, Engineering, and Medicine to review the state of data science education. One of the recommendations of the committee in the 2018 report was: "Academic institutions should embrace data science as a vital new field that requires specifically tailored instruction delivered through majors and minors in data science as well as the development of a cadre of faculty equipped to teach in this new field."[12] As the demand for data scientists grows, there is growing concern that the supply of data scientist's is lagging dangerously behind demand.[13] The Networking and Information Technology Research and Development program (NITRD), for example, argues that we must "improve the national landscape for Big Data education and training to fulfill increasing demand for both deep analytical talent and analytical capacity for the broader workforce."[14]

Compounding this pipeline problem are the heightened education requirements for some roles, especially Data Scientists and Advanced Analysts. Over 79% of data scientists that list their education have earned a graduate degree, and 38% have earned a PhD.[15] In particular, it was noted that individuals with PhD's had the ability to unlock the potential of data, wading through complex, messy data sets and building recommendation algorithms.[16] Higher education needs to be responsive and offer programs responsive to the workforce needs.

<u>Data Science PhD Programs</u>

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[10] Parry, M. (2018). Data Scientists in Demand. The Chronicle of Higher Education. https://www.chronicle.com/article/data-scientists-in-demand/

[11] The Chronicle of Higher Education (n.d.), The Data Boom Spurs New Demand For Data Scientists, Content Paid for and Created by New Jersey Institute of Technology, https://sponsored.chronicle.com/the-data-boom-spurs-new-demand-for-data-scientists/index.html

[12] National Academies of Sciences, Engineering, and Medicine. (2018). Data science for undergraduates: Opportunities and options. National Academies Press, Summary p. 2 https://nap.nationalacademies.org/read/25104/chapter/2#2

[13] Markow, W., Braganza, S. & Taska, B. (2017). The quant crunch. How the demand for data science skills is disrupting the job market. Burning Glass Technologies. https://www.burning-glass.com/wp-content/uploads/The_Quant_Crunch.pdf

[14] Markow, W., Braganza, S. & Taska, B. (2017). The quant crunch. How the demand for data science skills is disrupting the job market. Burning Glass Technologies, p.4. https://www.burning-glass.com/wp-content/uploads/The_Quant_Crunch.pdf

[15] Stich (n.d.) The State of Data Science. https://www.stitchdata.com/resources/the-state-of-data-science/?thanks=true

[16] Davenport, T. & Patil. (2022). Is Data Scientist 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

While there has been much reported on careers in data science from a private sector perspective, there has also been increasing attention on academic career paths in data science. Regarding the development of curricula to help address workforce demand, conversations typically focus on how academic programs are needed to develop the talent pipeline for the hundreds of job vacancies. Often missing from these conversations is the fact that higher education also has a workforce gap when it comes to data science professors: both Zip Recruiter and Indeed job sites identified 261 unfilled Data Science Professor Jobs.[17,18] At the doctorate level, many institutions offer a PhD in related fields, such as computer science or mathematics, including only "concentrations" in data science.[19]

A report based on a 2016 survey of members and affiliates of major U.S. research universities focused on career paths for data scientists within academia. The report provides recommendations about how universities can better support an emerging set of roles and responsibilities around data within and across academic fields. Their findings include:

> "Academic data science involves a variety of new topics, roles, and activities (as well as novel combinations of established and new topics, roles, and activities), which are often not fully supported by traditional academic career paths. As there is no single model of what an academic data scientist does, universities should define and support a broad and diverse range of positions and career paths for data scientists, both within and across disciplines."[20]

These findings support the need for dedicated PhD in Data Science and responds to the demand for such from both higher education and industry.[21] Research shows that PhD students who have a strong preference for freedom to choose research projects and the ability to publish as well as the desire to conduct basic research—strongly prefer academic careers over careers in industry; individuals with more publications are more likely to prefer academic employment.[22] This type of academic pedigree can only be built through PhD programs focused on data science research and mentored by data science faculty. As an example, the National Institutes of Health (NIH) Big Data to Knowledge (BD2K) initiative was created to narrow the gap between needed and existing biomedical data science skills through support to PhD programs. Through mentored training, postdocs and junior faculty can start down a career path that holds much promise, supported by BD2K career development. [23]

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[17] ZipRecruiter (2024) Data science professor jobs
https://www.ziprecruiter.com/Jobs/Data-Science-Professor
[18] Indeed. (2024). Professor Data Science Jobs.
https://www.indeed.com/jobs?q=professor+data+science&l=&vjk=85bb4756b9c5128c
[19] Dunn M. & Bourne P (2017). Building the biomedical data science workforce. PLoS Biol 15(7): e2003082.
https://doi.org/10.1371/journal.pbio.2003082
[20] Geiger, R., Mazel-Cabasse, C., Cullens, C. Y., Norén, L., Fiore-Gartland, B., Das, D., & Brady, H. (2018, June 6). Career Paths and Prospects in Academic Data Science: Report of the Moore-Sloan Data Science Environments Survey. https://doi.org/10.31235/osf.io/xe823
[21] Burtch Works (2022) Industry Insights, Data Science & Analytics Salaries are on the Rise.
https://www.burtchworks.com/industry-insights/data-science-analytics-salaries-are-on-the-rise
[22] Roach, M. & Sauermann, H. (2010). A taste for science? PhD scientists' academic orientation and self-selection into research careers in industry, Research Policy, 39(3) 99 433-434.
https://doi.org/10.1016/j.respol.2010.01.004
[23] Dunn, M. & Bourne P. (2017). Building the biomedical data science workforce. PLoS Biol 15(7): e2003082.
https://doi.org/10.1371/journal.pbio.2003082

As a newer discipline, many data science courses are taught by practitioner instructors. While the benefits of learning from practitioners includes up-to-date knowledge on the latest tools in the field and interaction with direct members of the community of practice, these instructors often lack formal theoretical founding in their subject matter and pedagogical training.[24] Graduates of PhD programs in Data Science can provide faculty to support and grow future programs. Additionally, these graduates also become the data science researchers of the future. The Harvard Data Science Review identified ten challenge areas within the data science research community.[25] These topics range from scientific understanding of deep learning algorithms to trustworthy AI to computing systems for data-intensive applications. It also includes social responsibility topics such as privacy and ethics. In order to stay at the forefront of data science research, graduates from dedicated data science doctoral programs are required.

Interdisciplinary Focus

Data science utilizes ideas from computer science, statistics, mathematics, engineering, and physics, among others, and is deeply embedded in an application domain. It is viewed as an umbrella term that covers a range of generalizable tools and techniques for extracting insight from data.[26] Many academics have argued that data science is unique in that it is not just about methods but also about the use of those methods in the context of a domain—the domain of the data being collected and analyzed is where a question is to be answered from this data.[27] Since data science is broad, these challenge areas speak to the breadth of issues spanning science, technology, and society.[28] In order to address these challenges the proposed PhD in Data Science will be homed in ODU's School of Data Science, part of the ODU Interdisciplinary Schools.

Interdisciplinary academic and research programming brings significant benefits to students, faculty, departments, and the institution. For students, interdisciplinary curricula provide exposure to a wide range of topics within a systematic framework. This broader orientation has great potential to bring together various perspectives. For example, the PhD in Data Science at ODU will include interdisciplinary coursework from philosophy, computer science, information technology, computer engineering, as well as others. Potential PhD students will benefit through forming connections with students and faculty from other departments and colleges with similar interests, providing the opportunity to expand their scientific pursuits.

[24] Kross, S. & Guo, P. (2019). Practitioners Teaching Data Science in Industry and Academia: Expectations, Workflows, and Challenges. In Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems (CHI '19). Association for Computing Machinery, New York, NY, USA, Paper 263, 1–14. https://doi.org/10.1145/3290605.3300493

[25] Wing, J. M. (2020). Ten Research Challenge Areas in Data Science. Harvard Data Science Review, 2(3). https://doi.org/10.1162/99608f92.c6577b1f

[26] Dhar. V. (2013). Data science and prediction. Communication. ACM 56, 12 (December 2013), 64–73. https://doi.org/10.1145/2500499

[27] Wing, J. M., Janeia, V. P., Kloefkorn, T., & Erickson, L. C. (2018). Data Science Leadership Summit. Workshop Report. National Science Foundation, USA. https://dl.acm.org/citation.cfm?id=3293458

[28] Wing, J. M. (2020). Ten Research Challenge Areas in Data Science. Harvard Data Science Review, 2(3). https://doi.org/10.1162/99608f92.c6577b1f

Additionally, many of the large and crosscutting programs applicable to data science, such as NSF INCLUDES, have limits on proposals per institution and require the central coordination and planning that the interdisciplinary School of Data Science can provide. These types of grants provide opportunities for graduate research assistantships and allow PhD students to grow their curricula vitae – an indicator of a future career in academia. The graduates produced by our interdisciplinary programs and research conducted by our interdisciplinary scholars will help to shape the future of data science.

Employment Demand

National Focus

The demand for data science professors is growing across the nation. Universities play an indispensable role in developing data science talent, but mounting evidence suggests that departments, especially computer science, across the United States do not have enough faculty to meet the growing demand for data science, and especially Artificial Intelligence (AI) education. While it is difficult to measure the potential mismatch between the supply of instructors and the demand, available evidence suggests there is indeed a gap. Over the last decade, the increase in computer science enrollments has far outpaced the growth in computer science faculty, who are responsible for much of the AI instruction at U.S. universities. Universities have started restricting access to specific courses, and academic leaders have publicly lamented the difficulty of recruiting and retaining qualified faculty[29].

Additionally, there is some evidence of shortfalls in data science professors and researchers hindering the expansion of educational programs, limiting the number of qualified candidates entering the job market. This gap between academia and industry is a critical issue that needs to be addressed to ensure a steady supply of skilled professionals[30]. For example, AI experts remain interested in academic careers, but university hiring of AI faculty has not kept pace with student demand. Historically, academia has delivered a steady stream of developers, engineers and entrepreneurs that has fueled an AI innovation ecosystem. This stream has been directly correlated with data science faculty teaching capacity. But while student enrollment in computer science programs has skyrocketed in the past decade, universities have not hired enough faculty to meet that demand[31].

Data science is included in the nation's goal to increase STEM education and support for graduate education is available for these students, such as the National Science Foundation Graduate Research Fellowship program. "The purpose of the NSF Graduate Research Fellowship Program (GRFP) is to help ensure the quality, vitality, and diversity of the scientific and engineering workforce of the United States" [32]. A goal of the program is to broaden participation of the full spectrum of diverse talents in STEM. Applicants must be pursuing full-time research-

[29]Zwetsloot, R. & Corrigan, J. (July 2022). AI Faculty Shortages: Are U.S. Universities Meeting the Growing Demand for AI Skills? Center for Security and Emerging Technology. https://doi.org/10.51593/20190049
[30] Collingwood, D. (October 2023). The Challenges of recruiting for AI and ML Talent. LinkedIn. https://www.linkedin.com/pulse/challenges-recruiting-ai-ml-talent-dave-collingwood/
[31] Zwetsloot, R. & Corrigan, J. (July 2022). *AI Faculty Shortages: Are U.S. Universities Meeting the Growing Demand for AI Skills?* Center for Security and Emerging Technology. https://doi.org/10.51593/20190049
[32] US National Science Foundation (n.d.) Graduate Research Fellowship Program (GRFP). https://www.nsfgrfp.org/

based master's and doctoral degrees in science, technology, engineering, and mathematics (STEM) or in STEM education at accredited US institutions. Data Science is one of the STEM eligible fields.[33]

Additionally, the Department of Defense Scholarship to Service Program includes Science, Mathematics, and Research for Transformation (SMART).The SMART Program is a combined educational and workforce development opportunity for STEM students. SMART offers scholarships for undergraduate, master's, and doctoral students pursuing a STEM degree. Scholarship recipients receive full tuition, annual stipends, internships, and guaranteed employment with the Department of Defense after graduation. The SMART Scholarship builds future leaders in 24 STEM disciplines and is the largest education and workforce development initiative under the Department of Defense STEM Program.[34]

Additionally, PhD graduates in data science are qualified to enter the big data industry at a high level from the outset, often eligible for advanced positions within companies, holding greater responsibilities, keeping more direct communication with leadership, and having more influence on important data-driven decisions.[35] The more advanced a degree one has, the more in-demand they will be for employers, especially for positions at the highest levels of data management and consulting. Since a PhD asserts the highest level of training and education, those who hold them are in the very highest demand for top data science jobs.[36]

Labor Market Information: Bureau of Labor Statistics, 2022 -2032 (10-Yr)

Occupation	Base Year Employment	Projected Employment	Total % Change and #s	Typical Entry Level Education
Data Scientists[37]	168,900	228,200	35% (59,400)	BS
Computer and Information Research Scientists[38]	36,500	44,800	23% (8,300)	MS

Virginia Focus

[33] US National Science Foundation (July 2023) NSF 23-605: Graduate Research Fellowship Program (GRFP). https://new.nsf.gov/funding/opportunities/nsf-graduate-research-fellowship-program-grfp/nsf23-605/solicitation#elig

[34] Department of Defense (DoD) (n.d.) Scholarship-for-Service Program. Scholarship. Stipend. Internship. Career. Build Your Future With SMART. https://www.smartscholarship.org/smart/en

[35] Discover Data Science (n.d.) PhD in Data Science – Your Guide to Choosing a Doctorate Degree Program. https://www.discoverdatascience.org/programs/data-science-phd/

[36] Discover Data Science (n.d.) Do You Need a PhD to Become a Data Scientist? https://www.discoverdatascience.org/articles/do-you-need-a-phd-to-become-a-data-scientist/#:~:text=Indeed%2C%20the%20numbers%20are%20enticing,a%20stunning%2036%25%20by%202031

[37] Bureau of Labor Statistics, (n.d.) U.S. Department of Labor, occupational outlook handbook, data scientists. https://www.bls.gov/ooh/math/data-scientists.htm

[38] Bureau of Labor Statistics, (n.d.) U.S. Department of Labor, *occupational outlook handbook*, Computer and Information Research Scientists. https://www.bls.gov/ooh/computer-and-information-technology/computer-and-information-research-scientists.htm

The proposed PhD in Data Science responds to the urgent need for data science professionals in the Commonwealth of Virginia – it is among the top states with the highest concentration of jobs and location quotients for this occupation.[39] As an example, the Department of Defense has listed Data Science (Code 1560) as one of its In Demand Jobs, with over ten different locations hiring across the state.[40]

The Virginia LMI website provides long term (2020-2030) projected employment information about occupations. The total percent change for Operations Research Analysts, the occupation that includes data scientists, from 2020-2026 is 26% as compared to 9% change for all occupations.[41]

Labor Market Information: Virginia Employment Commission, 2020_ -2030 (10-Yr)

Occupation	Base Year Employment	Projected Employment	Total % Change and #s	Annual Change #	Education
Operations Research Analysts	7,513	9,465	26% (1952)	195	BS

According to the BLS Geographic Profile for Computer and Information Research Scientists, the Commonwealth of Virginia has the third highest employment level in this occupation:[42]

State	Employment	Employment per thousand jobs	Location quotient	Hourly mean wage	Annual mean wage
California	7,510	0.43	1.86	$ 111.64	$ 232,210
Florida	3,100	0.34	1.47	$ 63.42	$ 131,920
Virginia	2,550	0.66	2.88	$ 68.02	$ 141,490
Texas	2,280	0.18	0.77	$ 68.62	$ 142,740

The Commonwealth of Virginia is among the top states with the highest concentration of jobs and location quotients for this occupation. The location quotient is the ratio of the area concentration of occupational employment to the national average concentration. A location quotient greater than one indicates the occupation has a higher share of employment than average, and a location quotient less than one indicates the occupation is less prevalent in the area than average.

[39] Bureau of Labor Statistics (May 2022) U.S. Department of Labor, Geographic profile for Computer and Information Research Scientists 15-1221 https://www.bls.gov/oes/current/oes151221.htm
[40] DoD Civilian Careers (n.d.) Current Opportunities. https://www.dodciviliancareers.com/cyberinformationtechnology
[41] Virginia Works (n.d.), Commonwealth of Virigina, Long and Short Term Occupational Projections. https://virginiaworks.com/occupational-projections
[42] Bureau of Labor Statistics (May 2022) U.S. Department of Labor, Geographic profile for Computer and Information Research Scientists 15-1221 https://www.bls.gov/oes/current/oes151221.htm

In Virginia, five undergraduate, two Master's and only one Doctoral degree programs have been developed in Data Science.[43] There is some evidence of shortfalls in of data science professors and researchers hindering the expansion of educational programs, limiting the number of qualified candidates entering the job market.[44] The proposed degree program will prepare faculty and researchers to educate future professionals and study complex topics.

Tables 1 shows enrollment in master's degree programs in 2020 – 2023; 2020 is the earliest years that indicates program enrollments.[45] The number of students enrolled in Master's degree programs has maintained its high level since initiation.

Table 1. Enrollment in Data Science Master's Degree Programs in Virginia, 2020- 2023

	Fall 2020	Fall 2021	Fall 2022	Fall 2023
Data Science, General. (30.7001)	-	258	228	216
Data Analytics, General. (30.7101)	-	-	89	84
Total	-	258	317	300

Job announcements are included in Appendix D.

Duplication

One public institution in the Commonwealth of Virginia offers a PhD in Data Science, the University of Virginia.

University of Virginia
The University of Virginia offers a PhD in Data Science that is related to the proposed degree program. Doctoral candidates will master the computational and mathematical foundations of data science, and develop competencies in data engineering, software development, data policy and ethics. Graduates of the Ph.D. in Data Science will have contributed novel methodological research to the field of data science, demonstrated their work has impactful interdisciplinary applications and defended their methods in an open forum. As per the UVA Catalog, the program requires: completion of core courses, successful completion of the qualifying exam, successful dissertation proposal, successful defense of dissertation research.

Similarities

[43] State Council of Higher Education for Virigina (n.d.), Commonwealth of Virigina, Search Degree Inventory CIP= 30.7001.
https://research.schev.edu/rdPage.aspx?rdReport=degreeinventory.DegreeInventory_SCHEV&Tab=CIP_Search
[44] Collingwood, D. (October 2023). *The Challenges of recruiting for AI and ML Talent.* LinkedIn.
https://www.linkedin.com/pulse/challenges-recruiting-ai-ml-talent-dave-collingwood/
[45] State Council of Higher Education for Virigina (n.d.), Commonwealth of Virigina, *Higher Ed Data for Virigina*.
https://research.schev.edu/

Both programs provide an interdisciplinary approach to data science.

Differences
The proposed ODU program focuses on doctoral research while the UVA program boasts robust applied training.

The proposed ODU program follows a traditional advisor – student approach while the UVA program uses an apprentice approach to learn data science methods.

The proposed ODU program develops graduate student competencies through research assistant position, while the UVA program emphases teaching assistantships.

Additionally, one public universities offer a degree program with sub areas in the same area as the proposed degree program, William and Mary.

William and Mary
William and Mary (W&M) offers a PhD in Applied Science with a Specialization in Data Science. This PhD is offered as a specialization within Applied Science, with the core mission of training students in the use of exceptionally large, heterogeneous datasets to drive decision making across a wide range of fields. It is a rigorous program that emphasizes the analysis of large datasets in applied domains using machine learning techniques. Students take courses in both the underlying mathematical foundations and computational techniques used to define, implement, and validate models across a range of disciplines. Graduate students complete a core sequence of coursework as a cohort, and then work closely with an advisory committee to complete the degree program.

This concentration is not a standalone degree programs; it is very math intensive and does not provide students with the breadth of data science coursework in the proposed ODU program.

Student Demand

Student demand for a PhD level program in Data Science is strong, as evidenced by two sets of data, as follows.

1. Enrollments in Data Science undergraduate and graduate programs, providing a pool of prospective graduate students in this program.

2. Results of a survey sent to undergraduate and graduate students at ODU.

The student survey and results may be found in Appendix E.

SUMMARY OF PROJECTED ENROLLMENTS IN PROPOSED PROGRAM

Projected enrollment:

Year 1		Year 2		Year 3		Year 4 **Target Year (2-year institutions)**			Year 5 **Target Year (4-year institutions)**		
2025 - 2026		2026 - 2027		2027 - 2028		2028 - 2029			2029 - 2030		
HDCT	FTES	HDCT	FTES	HDCT	FTES	HDCT	FTES	GRAD	HDCT	FTES	GRAD
15	10	25	15	34	28	45	34		50	35	12

Assumptions
Retention: 90%
Part-time students: 60% / Full-time students: 40%
Full-time students credit hours per semester: 12
Part-time students credit hours per semester: 6
Full-time students graduate in 1 year.
Part-time students graduate in 2.5 years.

Projected Resource Needs for the Proposed Program

Resource Needs

Old Dominion University and the School of Data Science have sufficient resources to launch and sustain the proposed program. Specifically, faculty, staff, equipment, space, and library resources are available to launch and maintain the proposed program. The proposed program will allocate 1.0 FTE of instructional effort for every 9.0 FTE of enrollment. During the 2025-2026 academic year when the program is launched, a total of 2.0 FTE of instructional effort will be required, and it will rise to 4.0 FTE by the target year, 2029-2030.

Full-Time Faculty
The Director of the Center for Data Science will teach in the program, in addition to serving as the program director. His instructional efforts will be 50% of his teaching load throughout the initial years; thus, he is considered full time, at .5 FTE.

Part-Time Faculty
Nine additional faculty members at the university, who are affiliated with the School of Data Science, will teach part-time loads in the proposed program. Combined, they will account for 1.5 FTE faculty when the program is launched. By the target year, the combined part-time faculty members will account for 3.5 FTE faculty.

Adjunct Faculty
No adjunct faculty members are required to launch and sustain the proposed program.

Graduate Assistants
No graduate assistants are required to launch and sustain the proposed program.

Classified Positions
A classified person—administrative assistant—who supports the School of Data Science will assist with this proposed program. This person will devote approximately .20 FTE to the program, or $7,500 in salary and $2,783 in fringe benefits.

Targeted Financial Aid
No targeted financial aid is required to launch and sustain the proposed program.

Library
No new library resources are required to launch and sustain the proposed program. The University Libraries have adequate resources to support this program, including all IEEE through the online IEEExplore database. The library also provides access to other highly recognized journals through ScienceDirect open access content, which are easily accessible through the LibKey tool.

Telecommunications
No new telecommunication equipment or software is needed to launch or sustain the proposed program.

Equipment (including computers)
No new equipment or related resources are needed to initiate and sustain this proposed program.

Space
No additional space is needed to initiate and sustain this proposed program.

Other Resources (specify)
No new resources will be required to launch or operate the proposed Doctor of Philosophy in Data Science.

Resource Needs: Parts A - D

Part A: Answer the following questions about general budget information.

- Has or will the institution submit an addendum budget request to cover one-time costs? Yes _____ No _____
- Has or will the institution submit an addendum budget request to cover operating costs? Yes _____ No _____
- Will there be any operating budget requests for this program that would exceed normal operating budget guidelines (for example, unusual faculty mix, faculty salaries, or resources)? Yes _____ No _____
- Will each type of space for the proposed program be within projected guidelines? Yes _____ No _____
- Will a capital outlay request in support of this program be forthcoming? Yes _____ No _____

Part B:

Part C:

Part D: Certification Statement(s)
The institution will require additional state funding to initiate and sustain this program.

_____ Yes _____
Signature of Chief Academic Officer

__X__ No _____
Signature of Chief Academic Officer

If "no," please complete Items 1, 2, and 3 below.

1. Estimated $$ and funding source to initiate and operate the program.

Funding Source	Program initiation year 2025 – 2026	Target enrollment year 2029 - 2030
Reallocation within the department *(Note below the impact this will have within the department.)*		
Reallocation within the school or college *(Note below the impact this will have within the school or college.)*		
Reallocation within the institution *(Note below the impact this will have within the institution.)*		

Other funding sources *(Specify and note if these are currently available or anticipated.)*		

2. Statement of Impact/Other Funding Sources.

Reallocation within the Institution:
No reallocation of funds will be made to support this program.

3. Secondary Certification.

If resources are reallocated from another unit to support this proposal, the institution will **not** subsequently request additional state funding to restore those resources for their original purpose.

__X__ Agree _____
Signature of Chief Academic Officer

_____ Disagree _____
Signature of Chief Academic Officer

APPENDIX A
PLAN OF STUDY

Sample Plan of Study for Full-Time Students from BS/BA Program

Course	**Credits**	**Category**
Fall I		
DASC/CS 620 Introduction to Data Science and Analytics	3	Core
CS 624 Data Analytics and Big Data	3	Core
Restricted Elective (1/5)	3	Elective
TOTAL 9 credits		
Spring I		
STAT 603 Statistical/ Probability Models	3	Core
CS 625 Data Visualization	3	Core
Restricted Elective (2/5)	3	Elective
TOTAL 9 credits		
Summer I		
DASC 690 Capstone Project	3	Capstone
Restricted Elective (3/5)	3	Elective
TOTAL 6 credits		
Year I TOTAL 24 credits – Program Credits 24		
Course	**Credits**	**Category**
Fall II		
DASC/CS 720/820 Advanced Data Science and Analytics	3	Core
DASC 800 Interdisciplinary Studies Proseminar	3	Core
Restricted Elective (4/5)	3	Elective
TOTAL 9 credits		
Spring II		
CYSE 868 Data Science Applications in the Professions	3	Core
DASC 871 Fundamental of Interpretable Machine Learning	3	Elective
Restricted Elective (5/5)	3	Elective
TOTAL 9 credits		
Summer II		
PHIL 703/803 Moral Reasoning for Emerging Technologies	3	Capstone
Advanced Elective (1/5)	3	Elective
TOTAL 6 credits		
Year II TOTAL 24 credits – Program Credits 48		
Course	**Credits**	**Category**
Fall III		
Advanced Elective (2/5)	3	Elective
Advanced Elective (3/5)	3	Elective
DASC 898 Research (1/5)	3	Research
TOTAL 9 credits		
Spring III		

Advanced Elective (4/5)	3	Elective
Advanced Elective (5/5)	3	Elective
DASC 898 Research (2/5)	3	Research
TOTAL 9 credits		
Summer III		
DASC 898 Research (3/5)	3+	Research
TOTAL 3+ credits		
Year III TOTAL 21+ credits – Program Credits 69+		
Course	**Credits**	**Category**
Fall IV		
DASC 898 Research (3/5)	3+	Research
TOTAL 3+ credits		
Spring IV		
DASC 898 Research (3/5)	3+	Research
TOTAL 3+ credits		
Summer IV		
DASC 899 Research	3+	Capstone
TOTAL 3+ credits		
Year IV TOTAL 9 credits - Program Credits 78+		

Sample Plan of Study for Part-Time Students from BS/BA Program

Course	**Credits**	**Category**
Fall I		
DASC/CS 620 Introduction to Data Science and Analytics	3	Core
CS 624 Data Analytics and Big Data	3	Core
TOTAL 6 credits		
Spring I		
STAT 603 Statistical/ Probability Models	3	Core
Restricted Elective (1/5)	3	Elective
TOTAL 6 credits		
Fall II		
CS 625 Data Visualization	3	Core
Restricted Elective (2/5)	3	Elective
TOTAL 6 credits		
Spring II		
DASC 690 Capstone Project	3	Capstone
Restricted Elective (3/5)	3	Elective
TOTAL 6 credits		
Fall III		
DASC/CS 720/820 Advanced Data Science and Analytics	3	Core
DASC 800 Interdisciplinary Studies Proseminar	3	Core
TOTAL 6 credits		
Spring III		

CYSE 868 Data Science Applications in the Professions	3	Core
Restricted Elective (4/5)	3	Elective
TOTAL 6 credits		
Fall IV		
DASC 871 Fundamental of Interpretable Machine Learning	3	Elective
Restricted Elective (5/5)	3	Elective
TOTAL 6 credits		
Spring IV		
PHIL 703/803 Moral Reasoning for Emerging Technologies	3	Capstone
Advanced Elective (1/5)	3	Elective
TOTAL 6 credits		
Fall V		
Advanced Elective (2/5)	3	Elective
DASC 898 Research (1/5)	3	Research
TOTAL 6 credits		
Spring V		
Advanced Elective (3/5)	3	Elective
DASC 898 Research (2/5)	3	Research
TOTAL 6 credits		
Fall V		
Advanced Elective (4/5)	3	Elective
DASC 898 Research (2/5)	3	Research
TOTAL 6 credits		
Spring V		
Advanced Elective (5/5)	3	Elective
DASC 898 Research (3/5)	3+	Research
TOTAL 6+ credits		
Fall VI		
DASC 898 Research (4/5)	3+	Research
DASC 898 Research (5/5)	3+	Research
TOTAL 6+ credits		
Spring VI		
DASC 899 Research	3+	Capstone
TOTAL 3+ credits		
TOTAL Program Credits 78+		

Sample Plan for Full-Time Students who are Admitted with an MS/MA

Course	Credits	Category
Fall I		
DASC/CS 720/820 Advanced Data Science and Analytics	3	Core
DASC 800 Interdisciplinary Studies Proseminar	3	Core
Advanced Elective (1/5)	3	Elective
TOTAL 9 credits		

Spring I		
CYSE 868 Data Science Applications in the Professions	3	Core
DASC 871 Fundamental of Interpretable Machine Learning	3	Elective
Advanced Elective (2/5)	3	Elective
TOTAL 9 credits		
Summer I		
PHIL 703/803 Moral Reasoning for Emerging Technologies	3	Capstone
Advanced Elective (3/5)	3	Elective
TOTAL 6 credits		
Year II TOTAL 24 credits – Program Credits 24		
Course	**Credits**	**Category**
Fall II		
Advanced Elective (4/5)	3	Elective
DASC 898 Research (1/5)	3+	Research
TOTAL 6+ credits		
Spring II		
Advanced Elective (5/5)	3	Elective
DASC 898 Research (2/5)	3+	Research
TOTAL 6+ credits		
Summer II		
DASC 898 Research (3/5)	3+	Research
TOTAL 3+ credits		
Year II TOTAL 15+ credits – Program Credits 39+		
Course	**Credits**	**Category**
Fall III		
DASC 898 Research (4/5)	3+	Research
TOTAL 3+ credits		
Spring III		
DASC 898 Research (5/5)	3+	Research
TOTAL 3+ credits		
Summer III		
DASC 899 Research	3+	Capstone
TOTAL 3+ credits		
Year III TOTAL 9+ credits - Program Credits 48+		

Sample Plan for Part-Time Students who are Admitted with an MS/MA

Course	**Credits**	**Category**
Fall I		
DASC/CS 720/820 Advanced Data Science and Analytics	3	Core
DASC 800 Interdisciplinary Studies Proseminar	3	Core
TOTAL 6 credits		
Spring I		
CYSE 868 Data Science Applications in the Professions	3	Core

Advanced Elective (1/5)	3	Elective
TOTAL 6 credits		
Fall II		
DASC 871 Fundamental of Interpretable Machine Learning	3	Elective
Advanced Elective (2/5)	3	Elective
TOTAL 6 credits		
Spring II		
PHIL 703/803 Moral Reasoning for Emerging Technologies	3	Capstone
Advanced Elective (3/5)	3	Elective
TOTAL 6 credits		
Fall III		
Advanced Elective (4/5)	3	Elective
DASC 898 Research (1/5)	3+	Research
TOTAL 6+ credits		
Spring III		
Advanced Elective (5/5)	3	Elective
DASC 898 Research (2/5)	3+	Research
TOTAL 6+ credits		
Fall III		
DASC 898 Research (3/5)	3+	Research
DASC 898 Research (4/5)	3+	Research
TOTAL 6+ credits		
Spring III		
DASC 898 Research (5/5)	3+	Research
DASC 899 Research	3+	Capstone
TOTAL 6+ credits		
TOTAL Program Credits 48+		

APPENDIX B
COURSE DESCRIPTIONS

Core Courses

DASC 620 Introduction to Data Science and Analytics (3 Credit Hours)
This course will explore data science as a burgeoning field. Students will learn fundamental principles and techniques that data scientists employ to mine data. They will investigate real life examples where data is used to guide assessments and draw conclusions. This course will introduce software and computing resources available to a data scientist to process, visualize, and model different types of data including big data. Cross-listed with CS 620.

CS 620 Introduction to Data Science and Analytics (3 Credit Hours) This course will explore data science as a burgeoning field. Students will learn fundamental principles and techniques that data scientists employ to mine data. They will investigate real life examples where data is used to guide assessments and draw conclusions. This course will introduce software and computing resources available to a data scientist to process, visualize, and model different types of data including big data. Cross-listed with DASC 620.

CS 624 Data Analytics and Big Data (3 Credit Hours)
This course introduces the essential data science tools to work with different types of data including streaming data and big data, including static and streaming data using Python software packages; modeling and predictive analysis using basic machine learning techniques; work with real sample data sets from different disciplines, e.g., the health sciences and finance industry; and how to work with big data using emerging technology such as Apache Spark.

CS 625 Data Visualization (3 Credit Hours)
This course covers the theory and application of data visualization. This includes issues in data cleaning to prepare data for visualization, theory behind mapping data to appropriate visual representations, introduction to visual analytics, and tools used for data analysis and visualization. Modern visualization software and tools will be used to analyze and visualize real-world datasets to reinforce the concepts covered in the course.

STAT 603 Statistical/Probability Models for Data Science and Analytics (3 Credit Hours)
This course will serve as an introduction for modeling data using probability and statistical methods. Topics include basic concepts of probability, Bayes theorem, frequently-occurring discrete and continuous probability distributions, as well as how to simulate data from these distributions. Basic properties of the probability distributions will be discussed, which will provide an insight into the use of these distributions in data science. The course will also cover bivariate and conditional distributions, linear correlation and statistical inference concepts that include likelihood, parameter estimation, and goodness of fit.
Prerequisites: STAT 330 or equivalent or permission of the instructor

DASC 690 Data Science Capstone Project (3 Credit Hours)

The culminating course in the proposed MS in Data Science and Analytics degree program will bring students together with faculty and external partners. In consultation with a faculty advisor and a business or industry or government representative, students will be required to develop a project that aims to solve a data science/analytics problem in a real-world business, industry, or government setting. Faculty and business/industry/government representatives will serve as external mentors for the students during this experience. Note that an external mentor is not mandatory but encouraged.
Pre- or corequisite: DASC 620/CS 620, CS 624, CS 625, STAT 603, and STAT 604

***DASC 800 Interdisciplinary Studies Proseminar (3 Credit Hours)**
This course provides students with a broad overview of enduring topics and emerging issues in criminology and criminal justice. It also explores the history and role of criminology as an academic discipline and criminal justice as an institutional system in American society.

***PHIL 703/803 Moral Reasoning for Emerging Technologies (3 credits)**

***DASC/CS 720/820 Advanced Data Science and Analytics (3 credits)**

***CYSE 868 Data Science Applications in the Professions (3 credits)**

DASC 871 Fundamentals of Interpretable Machine Learning and Explainable AI (3 credits)
Laws in many countries and states within the U.S. require that predictive models impacting humans be accompanied by an understandable interpretation, yet many such models are based on so called black box models that can't be easily interpreted or explained. This course will enable students to produce explanations and interpretations for advanced ML and AI algorithms. It will review the state of the science methods for interpretable ML and explainable AI, including graphical and contextual approaches as well as model agnostic and model specific methods for generating understandable explanations and interpretations. The course will also introduce the concepts of algorithmic bias and model fairness as they relate to explanation and understanding.
Prerequisites: R, Python, and basic supervised and unsupervised machine learning methods (e.g., BDA 511/ BDA 611, or CS 522 or CS 580).

Restricted Foundational Electives

BNAL 503 Data Visualization and Exploration (3 Credit Hours)
This course introduces students to concepts and processes, technologies, and methodologies that are commonly used in data visualization that an organization may use to enhance its descriptive, predictive, and prescriptive methods for making fact-based decisions.
Prerequisites: A grade of C or better in BNAL 306 or an equivalent course or instructor's permission

BNAL 515 Advanced Business Analytics/Big Data Applications (3 Credit Hours)
This course addresses advanced business analytics techniques and the application of such techniques to large data sets. Some alternative business analytics strategies are introduced. Descriptive, predictive, and prescriptive models are included. Topics covered in this course

include data visualization and exploration, cluster analysis, and developing and calibrating predictive models for big data. Applications of multivariate, logistic, and probit regression to business analytics are discussed. Software packages such as SAS/JMP/SPSS may be used.
Prerequisites: A grade of C or better in BNAL 306 or BNAL 606 or an equivalent course or instructor's permission

CS 522 Introduction to Machine Learning (3 Credit Hours)
Laboratory work required. An introduction to machine learning with a focus on practical aspects of various learning techniques. Topics include supervised learning (linear models, probabilistic models, support vector machine, decision trees, neural networks, etc.), unsupervised learning (scaling, dimension reduction, clustering, etc.), reinforcement learning, and model evaluation. The course will also discuss applications on image analysis, text processing, and biomedical informatics.
Prerequisites: MATH 316 and CS 150 (or equivalent programming experience)

CS 532 Web Science (3 Credit Hours)
An overview of the World Wide Web and associated decentralized information structures, focusing mainly on the computing aspects of the Web: how it works, how it is used, and how it can be analyzed. Students will examine a number of topics including: web architecture, web characterization and analysis, web archiving, Web 2.0, social networks, collective intelligence, search engines, web mining, information diffusion on the web, and the Semantic Web.

CS 550 Database Concepts (3 Credit Hours)
Laboratory work required. Three level database architecture. The relational database model and relational algebra. SQL and its use in database procedures and with conventional programming languages. Entity relationship modeling. Functional dependencies and normalization. Transactions, concurrency and recovery.
Prerequisites: Familiarity with elementary set theory, propositional logic, and any two programming languages are expected; a course in finite mathematics or discrete structures is recommended

CS 569 Data Analytics for Cybersecurity (3 Credit Hours)
The course introduces classical and advanced models and techniques in machine learning and deep learning. It applies these techniques in the cybersecurity domain including anomaly detection, network security, and malware detection and classification. Advanced applications such as self-driving cars and IoT systems are also discussed. In addition, cyber-attacks on machine learning techniques and AI systems and the possible consequences are also discussed.
Prerequisites: CS 462/CS 562 or CS 465/CS 565 or experience in cybersecurity

CS 580 Introduction to Artificial Intelligence (3 Credit Hours)
Laboratory work required. Introduction to concepts, principles, challenges, and research in major areas of AI. Areas of discussion include: natural language and vision processing, machine learning, machine logic and reasoning, robotics, expert and mundane systems.

CYSE 520 Applied Machine Learning in Cybersecurity (3 Credit Hours)

This course introduces the concepts and technologies of machine learning with a focus on applications related to cybersecurity. The objectives are to learn fundamental knowledge and practical experience and identify the use case of machine learning techniques in cybersecurity. The course will discuss traditional and advanced machine learning techniques, e.g., neural network, deep convolutional neural network, generative adversarial network, and transfer learning algorithms. Students will engage in oral and written communication by reporting and presenting the materials of the course project.

CYSE 635 AI Security and Privacy (3 Credit Hours)
This course focuses on Machine Learning (ML) security and privacy. Students will understand and explore the vulnerabilities of the ML models, learn how to develop and deploy defenses to mitigate possible attacks, and gain hands-on experience to protect private data during model training and testing.

ECE 651 Statistical Analysis and Simulation (3 Credit Hours)
An introduction to probabilistic and statistical techniques for analysis of signals and systems. This includes a review of probability spaces, random variables, and random processes. Analysis and simulation of systems with random parameters and stochastic inputs are considered.
Prerequisites: MATH 312 and one undergraduate course in probability or statistics or permission of instructor

ECE 607 Machine Learning I (3 Credit Hours)
Course provides a practical treatment of design, analysis, implementation and applications of algorithms. Topics include multiple machine learning models: linear models, neural networks, support vector machines, instance-based learning, Bayesian learning, genetic algorithms, ensemble learning, reinforcement learning, unsupervised learning, etc.
Prerequisites: Graduate standing

ENMA 646 Information Science for Systems and Engineering Management (3 Credit Hours)
This course aims to prepare students with the general knowledge and skills for the on-going digital transformation. The course covers: (1) preliminaries of information and informatics; (2) information and knowledge modeling; (3) fundamental concepts, models, tools, and applications of Big Data; and (4) digital mechanisms of trust and security, including: digital asset access control, digital signature, digital certification, Public Key Infrastructures, and Blockchains.

GEOG 525 Internet Geographic Information Systems (3 Credit Hours)
Theoretical and practical exploration of methods, standards, and policies related to the development and utilization of geographic information systems on the Internet. Students will create and utilize distributed geospatial data and analytical systems using the WWW and the Internet to address geographical problems.
Prerequisites: GEOG 502

GEOG 532 Advanced GIS (3 Credit Hours)

The study of a series of advanced topics in the field of geographic information systems/science. Focus is placed on the development of projects/models and a survey of several advanced techniques. Students will work on a computer based GIS to implement topics from lectures.
Prerequisites: GEOG 502

GEOG 562 Advanced Spatial Analysis (3 Credit Hours)
This course introduces the essential theoretical concepts and analytical tools for analyzing spatial process, spatial autocorrelation, spatial patterns, techniques for spatial interpolation, network connectivity, big data, and landscape patterns. The course culminates with students carrying out their own spatial analysis projects. This course assumes that students understand the basic concepts in GIS with some experience in software operation of ArcGIS.
Prerequisites: GEOG 402 or GEOG 502, or permission of the instructor

GEOG 590 Applied Cartography/GIS (1-3 Credit Hours)
Practical experience in applying the principles of cartography and geographical information systems to the design and construction of maps and other graphics.

GEOG 519 Spatial Analysis of Coastal Environments (3 Credit Hours)
The course integrates remotely sensed and field techniques for scientific investigation and practical management of coastal environmental systems. Spatial modeling of coastal processes and management tools using Geographic Information System (GIS).
Prerequisites: GEOG 300, GEOG 402 or GEOG 502, or permission of instructor

GEOG 520 Marine Geography (3 Credit Hours)
An analysis of the environmental geography and resources of the ocean, with particular emphasis on geospatial analysis of the seafloor, hydrography, climate change, fisheries, ocean pollution, maritime activity spaces and management.

GEOG 563 GIS Programming (3 Credit Hours)
This course develops students' GIS programming skills. Focus is placed on Python programming in ArcGIS and JavaScript in Web GIS development.
Prerequisites: GEOG 402 or GEOG 600

GEOG 573 Geographic Information Systems for Emergency Management (3 Credit Hours)
Students will demonstrate advanced skills and techniques using spatial data to prevent, mitigate, respond to, and recover from intentional, natural, and accidental homeland security threats and emergencies. This course demonstrates the importance of rapidly disseminating spatial information towards the prevention and response of various organizations to homeland security events. This course will provide students with the tools and experience required to collect, prepare and manage spatial data and enable students to be prepared to map and analyze the data to quickly and effectively create a coordinated response to real homeland security events.
Prerequisites: GEOG 100S, GEOG 101S, GEOG 102T, or permission of the instructor

GEOG 600 Geospatial Data Analysis (3 Credit Hours)

Course focuses on the fundamentals of geospatial data science. Students learn the key data models, structures, sources, and application of spatial analysis using GIS software, R, programming, and Earth observations.

GEOG 601 Spatial Statistics and Modeling (3 Credit Hours)
This course covers the foundations of spatial statistics and modeling. Emphasis is placed on point, linear and areal patterns, geostatistics, and model development for a variety of problems using multiple software packages.

IT 650 Database Management Systems (3 Credit Hours)
Introduction to database management systems. The topics addressed include system architecture, data models, database analysis, design and implementation, query processing, business transaction processing, and database security.
Prerequisites: IT 620 or equivalent; or permission of the department

IT 651 Business Intelligence (3 Credit Hours)
Introduction to business intelligence and its three components: data warehouse, data mining, and OLAP. Examines traditional techniques as well as emerging technologies.
Prerequisites: IT 650, or admission to a graduate program at ODU, or permission of the instructor or department

IT 652 Information and Communications Technology for Big Data (3 Credit Hours)
Introduction to emerging ICT techniques for big data analytics and big data science. Topics cover WSN, cloud computing and IoT.
Prerequisites: IT 650, or admission to a graduate program at ODU, or permission of the instructor or department

PHYS 520 Introductory Computational Physics (3 Credit Hours)
Introduction of computational methods and visualization techniques for problem solving in physics.

STAT 604 Statistical Tools for Data Science and Analytics (3 Credit Hours)
This course will cover statistical tools for data exploration. Topics taught include descriptive statistics, correlation, confidence intervals, linear and logistic regressions, t-test for one and two samples, and analysis of variance. For analyzing categorical data, students will study contingency tables, odds ratios for measuring association, and chi-square tests for testing independence. The course will also introduce principal components and clustering methods to analyze multivariate data. R and/or Python software for computing various statistics for real data analysis will be used.
Prerequisites: STAT 603 or equivalent or permission of the instructor

Advanced Electives

BDA 821 High-Dimensional Statistics (3 Credit Hours)
Techniques for obtaining basic tail bounds and concentration inequalities, uniform laws of large numbers, Rademacher complexity of a set, covering and packing in metric spaces, and metric

entropy. Also, high dimensional random matrices described in a non-asymptotic framework, with a focus on the estimation of sparse and structured covariance matrix are studied. The sparse linear regression models and the principal component analysis in the unstructured and sparse setting will be covered.
Prerequisites: STAT 727, STAT 728, MATH 616, and MATH 618

BDA 831 Applied Functional Data Analysis (3 Credit Hours)
An introduction to the statistical analysis of sample curves or functions. Topics include smoothing, registration, functional principal component analysis, scalar-on-function regression, functional response models. All these techniques will be applied using the statistical software R.
Prerequisites: STAT 725 or STAT 825

BDA 845 Transform Methods for Data Science (3 Credit Hours)
Various transform methods from the data domain to coefficients of the data in certain discrete bases are studied. Transforms studied include FFT, DCT, wavelet transforms and framelet transform. Both theory and applications of these transforms are covered.
Prerequisites: MATH 518 and MATH 616

BNAL 821 Simulation Modeling for Business and Supply Chain Systems (3 Credit Hours)
This course covers both the theory and application of simulation modeling and analysis to business, supply chain, and logistics systems. Both discrete-event and continuous simulation modeling approaches are covered, using a major commercial simulation package. Emphasis will be on the use of simulation as a tool to support business, supply chain, and logistics decision making.
Prerequisites: BNAL 606 or STAT 330 or MSIM 601 or BNAL 476 or BNAL 576 or BNAL 722 or BNAL 822, or permission of the instructor or department

CS 833 Natural Language Processing (3 Credit Hours)
Natural language processing (NLP) techniques are the crux of many leading modern technologies. Advances in NLP are also critical in the pursuit of Artificial Intelligence. This course will discuss core problems in NLP and the state-of-the-art tools and techniques as well as advanced NLP research topics. The topics will include language models, part-of-speech tagging, syntactic parsing, word embedding, statistical machine translation, text summarization, question answering, and dialog interaction. At the end of the course, students will be familiar with many language-processing tasks and applications.
Prerequisites: CS 580

***CS 828 Deep Learning**

ECE 884 Computer Vision (3 Credit Hours)
Principles and applications of computer vision, advanced image processing techniques as applied to computer vision problems, shape analysis and object recognition.
Prerequisites: Graduate standing

ENMA 801 Digital Systems Engineering (3 Credit Hours)

Digital systems engineering applies digital technologies to the systems engineering processes and principles. This course provides students with knowledge and skills on necessary digital technologies, such as Artificial Intelligence and Machine Learning, Big Data, Blockchain, and computational modeling. The course covers: (1) preliminaries of digitalization and digital technologies; (2) data and knowledge modeling; (3) logical approach to MBSE (Model-Based Systems Engineering); (4) application of Big Data and Machine Learning in Systems Engineering; and (5) digital mechanisms of trust and security for digital engineering.
Prerequisites: ENMA 646

IT 800 Theoretical Foundation in Supply Chain/Information Technology Research (3 Credit Hours)
A survey of research methodology in supply chain and operations management, data science, and information technology including empirical, behavioral, computational, and interdisciplinary methods and techniques in different types of problem domains.

IT 891 Seminar in Business Intelligence (3 Credit Hours)
The objective of this course is to provide an overview of managerial and technical issues associated with business intelligence. Topics covered include the state-of-the art data warehousing, data mining and OLAP technologies.
Prerequisites: IT 800

IT 892 Seminar in Knowledge Management (3 Credit Hours)
The course examines the latest advances in knowledge management (KM) including identifying, capturing, sharing and evaluating an enterprise's knowledge assets. The course reviews and discusses existing technologies in KM and new emerging KM technologies and practices.
Prerequisites: IT 800

MAE 740 Autonomous and Robotic Systems Analysis and Control (3 Credit Hours)
Kinematics, dynamics and control of complex non-linear electro-mechanical systems, particularly robotic manipulators.

MAE 840 Autonomous and Robotic Systems Analysis and Control (3 Credit Hours)
Kinematics, dynamics and control of complex non-linear electro-mechanical systems, particularly robotic manipulators.

PHYS 811 Computational Physics (3 Credit Hours)
Studies of high level computer languages. Computational techniques used in physics. Numerical techniques for differential and integral problems. Algebraic processing languages. Introduction to scientific visualization techniques.

MATH 618 Applied Functional Analysis (3 Credit Hours)
Topics include orthogonal projections to subspaces, duality, the Hahn-Banach theorem and the Banach-Steinhaus theorem, L-2 spaces and convolution operators, fixed point theory, construction of Hilbert spaces, approximation procedures in Hilbert spaces, and spectral theory.
Prerequisites: MATH 617

MATH 820 Advanced Applied Functional Analysis (3 Credit Hours)
In the first half of this course, several concepts in the classical functional analysis are studied. Topics include Banach Spaces, the dual spaces, the Baire category theorem, the adjoint operator, weak convergence, spectral theory and compact operators. In the second half, at the instructor's discretion, special topics are studied. Possible topics include ill-posed problems, inverse scattering theory, the regular Sturm-Liouville problem and the Dirichlet problem for Laplace's equation.
Prerequisites: MATH 617 and MATH 618

OEAS 805 Advanced Environmental Data Science (3 Credit Hours)
This is an advanced computational analysis course designed to introduce students to data management and analysis methods commonly used in data science applications. The data analysis portion of the course will be primarily based on machine learning methods. The course will also give an overview of a selection of scientific databases which host freely available oceanographic data and output from numerical model simulations. This course is not discipline specific and will be useful for any students who want to work with data efficiently and gain experience in data management, proper techniques in developing analytical pipelines and applying machine learning to their research.
Prerequisites: Permission of instructor

STAT 825 Linear Statistical Models (3 Credit Hours)
Topics include the multivariate normal distribution, distributions of quadratic forms, the general linear model, estimability, the Gauss-Markov theorem and general linear hypotheses, analysis of variance (ANOVA) and covariance (ANCOVA) with special attention to unbalanced data, and analysis of mixed effects and variance components models including repeated measures and split-plot designs.
Prerequisites: STAT 626

STAT 830 Multivariate Statistics (3 Credit Hours)
Topics include the multivariate normal distribution, graphical display of multivariate data and tests for normality, Hotelling's T2, multivariate analysis of variance (MANOVA) and regression, profile analysis, growth curve models, canonical correlation analysis, principal components, factor models, clustering, and discriminant analysis. All methods are implemented using the SAS statistical software.
Prerequisites: STAT 537 or STAT 725/STAT 825

Dissertation Research:

***DASC 898 Doctoral Research (1-9 Credit Hours)**
Independent study at the doctoral level under the direction of an instructor.
Prerequisites: Permission of the instructor

***DASC 899 Doctoral Dissertation (1-9 Credit Hours)**
Research for the doctoral dissertation. Departmental permission required.

APPENDIX C
FACULTY CURRICULUM VITAE (ABBREVIATED)

School of Data Science

Buskirk, Trent, PhD. Statistics, Arizona State University, 1999, Professor. Specialization: Machine learning methods, Social Science design and analysis

Liu, Frank, Ph.D, Electrical and Computer Engineering, Carnegie Mellon University, 1999, Professor. Specialization: Machine Learning, Big Data Analysis.

Jayarathna, Sampath, Ph.D., Computer Science, Texas A&M, 2016, Assistant Professor. Specialization: Data Science, Human Computing Interactions, Digital Library

Qin, Hong, Ph.D., Biochemistry and Molecular Biology, University of Chicago, 2001, Associate Professor. Specialization: Computational Biology, Artificial Intelligence for Biometrics

Padilla, Jose, Ph.D., Engineering Management, Old Dominion University, 2010, Research Associate Professor, Specialization: Modeling and Simulation

Poursadar, Faryaneh, Ph.D., Texas A&M University, 2016, Research Assistant Professor, Specialization: Web Science, Digital Libraries

New Hire: Ph.D. in Computer Science, Assistant Professor. Specialization: Visualization.

New Hire: Ph.D. in Computer Engineering, Assistant Professor. Specialization: Machine Learning.

New Hire: Ph.D. in Mathematics or Statistics, Assistant Professor, Specialization: Big Data.

New Hire: PhD. in Health Informatics, Associate Professor, Specialization: Biostatistics

Department of Computer Science
Nelson, Michael, PhD. Computer Science, Old Dominion University, 2000, Professor, Specialization: Web Science, Open Archives

Department of Engineering Management and Systems Engineering
Handley, Holly, Ph.D., Information Technology and Engineering, George Mason University, 1999, Professor. Specialization: Data Science, Human Systems Engineering

Department of Mathematics and Statistics
Michael Pokojovy, Michael, PhD. Mathematics, University of Konstanz, 2011, Associate Professor. Specialization: Statistics, Machine Learning

Department of Philosophy and Religious Studies
Teresa Kouri Kissel, Ph.D., Philosophy, The Ohio State University, 2016. Associate Professor. Specialization: Data Ethics

APPENDIX D
Job Announcements

Clinical Professor Open-rank – MS in Applied Data Science

Employer
The University of Chicago, Data Science Institute

Location
Chicago, Illinois (US)

Salary
This is a career-track position with competitive salary and benefits.

Date posted
Feb 12, 2024

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Position Title: Clinical Professor Open-rank – MS in Applied Data Science

Position Description

The Data Science Institute in the Physical Sciences Division at the University of Chicago invites applications for Clinical Professor (open-rank) to teach in its MS in Applied Data Science program. Appointments will be made as Assistant Clinical Professor, Associate Clinical Professor, or Full Clinical Professor, depending on qualifications. This full-time, benefits-eligible appointment is for an initial term of up to five years, with possibility of renewal. This is a teaching position with no research responsibilities and some administrative duties. The position is expected to begin in the 2024-2025 academic year.

The person holding this position must be able to teach at least two of the following courses: Statistical Analysis, Advanced Linear Algebra, Python for Data Science, Data Mining Principles, Time Series, Machine Learning, Data Engineering, Linear/Non-Linear Models, Big Data Platforms, Financial Analytics, Marketing Analytics, Health Analytics, or Leadership and Consulting for Data Science. An overview of the MS in Applied Data Science course offerings can be found at datascience.uchicago.edu/masters-programs. Depending on background and interests, the person holding this position may also be asked to teach other classes in the MS in Applied Data Science program.

Qualifications

Minimum Qualifications:

A PhD in Data Science, Applied Math, Statistics, Computer Science, Mathematics, or other closely related field, and at least 5 years of professional experience.

Type: Full-Time
Posted: 10/21/2023
Category: Computer Science

University of Virginia: UVA Provost's Office: Data Science
Location: Charlottesville, VA
Description:
The School of Data Science at the University of Virginia (UVA) seeks applicants for multiple **Open Rank Tenure or Tenure-Track Professors of Data Science**. The school is assembling a diverse and world-class faculty with broad expertise in data science. Candidates with a research focus in artificial intelligence systems, large-langua models, machine learning, and predictive analytics are encouraged to apply.
We are seeking candidates with a pioneering spirit who have methodologic expertise and research experience one or more domains of data science.
The domains of data science include, but are not limited to,

- Data Ethics, Critical Data Studies & Policy (e.g., representativeness, privacy, ethics of algorithmic constructio interpretability)ata Design (e.g., visualization, human-computer interaction, communication)
- Analytics (e.g., predictive modeling, machine learning, imaging, computer vision, algorithm development, statistical methods)
- Data Structures (e.g., data architecture and pipelines, database theory)
- Informatics (e.g., graph theory, information systems, bioinformatics)
- Data Systems (e.g., high performance computing, continuous integration and deployment (CI/CD) of data science tools, cloud architectures, federated learning, data sharing)

Description:
Candidates with backgrounds and experiences that are underrepresented in data science are especially encouraged to apply. A commitment to advancing the University's mission is essential for all candidates (https://provost.virginia.edu/faculty-handbook/mission-statement-university-virginia). Candidates with industry experience are encouraged to apply if they wish to pursue research in an academic setting.
The School of Data Science at UVA was established in 2019 with the largest private gift in the institution's 200-

Open Rank Professor of Data Science, Tenured/Tenure-Track
University of Virginia in Charlottesville, VA

Appointments are made in the School of Data Science with the potential for joint or courtesy appointments in other schools as applicable.
Candidates for senior ranks (Associate and Full with tenure) must have a demonstrated record of excellence in research, teaching, and advising, in data science and/or closely related fields, and must have established a national/international reputation for contribution to the field in methodology, application, and impact.
Candidates for Assistant rank (tenure-track) must demonstrate the potential for excellence in methodological development and scientific impact in data science or a related field and have prior experience in educational related activities.

Type: Full-Time
Posted: 11/02/2023
Category: Computer Science

Assistant/Associate Professor of Data Science

The Department of Quantitative Sciences of Canisius University seeks applicants for a tenure-track faculty position in Data Science at the Assistant/Associate Professor level beginning fall 2024. The department consists of the programs in Computer Science, MS-Cybersecurity, MS-Data Analytics, Data Science, Mathematics/Statistics, and Pre-Engineering. A PhD in Data Science or related field is required. The successful candidate should have a strong commitment to excellence in teaching in both our undergraduate Data Science program and our Master's program in Data Analytics, especially in courses with machine learning and generative AI. Interest in and experience with hybrid and/or online instruction is welcome. The faculty member will establish a successful research program involving undergraduate students and advise our graduate students in their internships and capstone projects. The candidate must be fluent in Python and R, and be familiar with SQL, Tableau, standard statistics packages, and at least one cloud-based platform.

The successful candidate will partner with the Canisius Center for Analytics and Data Ecosystems to build connections with regional partners. Position duties include directing the MS-Data Analytics program

Assistant/Associate Professor of Data Science
Canisius University in Buffalo, NY
Apply on Institution's Website

their approach to diversity, equity, inclusion, justice, and belonging in their role as a college professor. Review of completed applications will begin December 20, 2023. Questions can be directed to Professor Michael Wood, Chair of the Department of Quantitative Science (**wood5@canisius.edu**).

Canisius University, a Catholic and Jesuit institution, is an independent, co-educational, medium-sized institution of higher education located in Buffalo, NY. Canisius University is an Equal Opportunity Employer. Minority candidates are strongly encouraged to apply.

The Office of Human Resources at Canisius University utilizes an online recruitment management system. Individuals who need reasonable accommodations under the ADA in order to participate in the search process should contact the office of human resources at (716) 888-2240. To apply online, go to **http://careers.canisius.edu/cw/en-us/listing/**.

Post Doc Res Assoc

Employer
University of Utah

Location
Utah, United States

Salary
Salary Not specified

Date posted
Feb 9, 2024

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Post Doc Res Assoc

Job Summary

The **College of Social and Behavioral Science** at the **University of Utah** is seeking applicants for a Postdoctoral Research Associate with an interest in applying Artificial Intelligence (AI) to US Census data. AI is having far-reaching effects as it moves into everyday systems, such as healthcare, education, policy, immigration, and criminal justice, often with a focus on individualized outcomes. Interdisciplinary research is critical for developing "responsible" technologies that forward the public interest, recognizing AI as both a technological approach and a social practice (e.g. how humans are classified, how we identify technological problems, how we understand our society). Federal Statistical Research Data Centers, such as the **Wasatch Front Research Data Center (WFRDC)**, located in the Interdisciplinary Exchange for Utah Science (NEXUS), offer a unique resource of census microdata, allowing the exploration of socio-demographic dynamics at an individual level, and there is a significant opportunity to apply AI methodologies to these data. We seek a researcher interested in developing research that integrates AI methods with the type of microdata held in the WFRDC. The successful candidate for this position will have a record of working with socio-demographic data and AI methods, and a commitment to responsible AI applications.

Applicants should articulate a research plan that encompasses their own agenda and work with AI in ways that explicitly consider ethical implications. The research plan should involve analysis of census microdata at the WRFDC and the integration of other datasets (e.g. on redlining, mortgage lending, environmental exposures or health outcomes), and should reflect the specific research interests of the applicant. The selected applicant will join a collaborative team of geographers, sociologists, and other researchers using the WFRDC. Ideally, applicants will demonstrate interest in collaborations within the college and across campus. They will also have the opportunity to provide training for students interested in linking AI with, for example, research methods and ethics, policy applications, and social justice.

Responsibilities

- Carry out independent research
- Engage in research collaborations with University of Utah faculty, postdoctoral researchers, and graduate students
- Utilize resources associated with the Wasatch Front Regional Data Center
- Document research activities and follow applicable data management protocols
- Share research skills and findings with faculty, postdocs, and grad students through research group meetings, seminars, and/or classes

Minimum Qualifications

- A PhD in data science, computer science, demography, geography, GIS, sociology, or other closely-related field with experience related to machine/deep learning algorithms, by the anticipated start date.
- Enthusiasm about applying AI methods to social-environmental problems.
- Extensive experience with data science methods and approaches, including the use of scientific computer programming in languages such as R and Python.
- Familiarity working with large, complex datasets.
- Excellent written and oral presentation skills.
- Strong analytical and critical thinking abilities.
- Ability to work independently, lead project deliverables and meet deadlines.
- Due to data access restrictions in Federal Statistical Data Centers, candidates should be either a U.S. resident or a foreign national who has been in the U.S. 3 of the last 5 years. Some data access requires U.S. citizenship.

Assistant Professor of Data Science

Employer
St. Catherine University

Location
Minnesota, United States

Salary
Salary Not specified

Date posted
Mar 6, 2024

Apply on website

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Assistant Professor of Data Science

Division: Academic Affairs
Department/Office: Data Science

Advertisement:
The **Data Science Program of the School of Arts, Humanities, and Sciences** at **St. Catherine University** invites applications for a full-time, 9-month non-tenure track Assistant Teaching Professor of Data Science position. This position is grant funded.

The undergraduate college at St. Catherine University (St. Kate's) is one of only six US institutions that is both a women's college and a minority serving institution. Based in the Twin Cities of St. Paul and Minneapolis, Minnesota, St. Kate's is home to a diverse group of around 3,500 students in varying disciplines and degree levels. The Data Science Program requires a full-time teaching faculty with a non-tenure track that is experienced in teaching Data Science, Applied Computing for Data Science, Artificial Intelligence (AI), Machine Learning, and Distributed Computing courses as well as Computer Science courses as needed for a diverse population. The primary appointment is for the Data Science Bachelor's of Science (BS) major and minor degrees. This position will support the students pursuing major in Data Science. We seek applicants who are excited about growing the program to reach more students.

Responsibilities Include:

- Collaborates with colleagues to drive the development of course content and student. assessments that reflect best practice in equity-based learning and accreditation objectives.
- Teach undergraduate level data science and/or computer science courses and additional courses (as needed).
- Teach the equivalent of six courses during the academic year (typically three in Fall and three in Spring term) with the option to teach in January and Summer sessions.
- Communicate respectfully and build relationships of trust with people of all cultures and abilities, affirming the worth and preserving the dignity of individuals, families, and communities.
- Independently advises students.
- Communicate frequently with the department leaders and/or coordinators for updates or changing course information.
- Engage in service to the Data Science program, the University and the data science profession by participation/leadership in standing/ad hoc committees, and/or other service opportunities in the University and in the data science practice community.

St. Catherine University in St. Paul, Minnesota, is a comprehensive Catholic university and home to one of the nation's largest colleges for women, with associate and graduate programs for all genders. Founded by the Sisters of St. Joseph of Carondelet in 1905, the University integrates liberal arts and professional education within the Catholic traditions of intellectual inquiry and social teaching. Committed to excellence and opportunity, St. Catherine **enrolls students** in certificate, associate, baccalaureate, master's and doctoral programs in traditional day and evening/weekend/online formats.

Minimum Qualifications:

- Earned Doctorate in Data Science, Computer Science, Computer Engineering or related discipline. All But Dissertation (ABD) applicants will be accepted, but doctorate must be awarded on transcript prior to the start date of the position.
- 1-2 years experience in teaching, student advising, and curriculum development.
- Experience in teaching Data Science or Computer Science courses such as Python Programming, Machine Learning, Data Mining, and other related courses.
- Advanced level experience with Python, R, or other Data Science software tools.

Type: Full-Time
Posted: 01/22/2024
Category: Computer Science; +1

MILITARY

Job ID: 267616

About Us

For more than 50 years, Kennesaw State University has been known for its entrepreneurial spirit and sense of community. A leader in innovative teaching and learning, Kennesaw State is located just north of Atlanta, and combines a suburban setting on two metro-Atlanta campuses in Kennesaw and Marietta. As one of Georgia's largest universities, Kennesaw State offers undergraduate and graduate degrees, including a growing number of doctoral programs. A member of the University System of Georgia, Kennesaw State is a Carnegie-designated doctoral research institution (R2) committed to becoming a world-class academic institution positioned to broaden its academic and research missions and expand its scope on a local, regional and national level. For more information, visit https://kennesaw.edu.

Location

Our Kennesaw campus is located at 1000 Chastain Road NW, Kennesaw, GA 30144. Our Marietta campus is located at 1100 South Marietta Parkway, Marietta, GA 30060.

Department Information

The School of Data Science and Analytics offers a wide range of educational courses and programs focused on applied statistics, analytics, and data science including general education courses, an undergraduate minor, an undergraduate major, a master's degree, and a PhD in Data Science and Analytics. Faculty in the School currently conduct collaborative, interdisciplinary research in biostatistics, process improvement, survey methodology, sports analytics, psychometrics, education, and various areas of applied data science. Industry, government, and organizations partner with us to find solutions to their data-centric problems through the Center for Data Science and Analytics (CDSA) and the Human Studies Lab, two of the most successful and dynamic research units at the university. There are opportunities to support the School services and programs through CDSA.

Job Summary

Kennesaw State University is now accepting applications for a full-time, twelve-month, administrative faculty position as a tenured Professor and Director of the School of Data Science and Analytics in the College of Computing and Software Engineering with a preferred start date of July 1, 2024.

This role is a unique opportunity for a visionary leader with a passion for educational excellence and innovation in the rapidly evolving field of data science.

Responsibilities

- Provide dynamic, effective leadership to the School of Data Science and Analytics (SDSA)
- Boost the school's reputation and visibility, locally and nationally
- Promote academic excellence, foster a strong research environment, and the procurement of external funding
- Mentor and advise faculty and students, enhancing research activities and academic achievements
- Play a pivotal role in the management and growth of the Center for Data Science and Analytics (CDSA)
- Strategically manage enrollment growth and program development in the SDSA
- Advocate for the SDSA faculty and programs, ensuring their needs and goals are effectively represented
- Ensure the effective and efficient offering of general education courses

Director of the School of Data Science and Analytics
Kennesaw State University in Marietta, GA

Apply on Institution's Website

- An earned doctoral degree, or its foreign equivalent, in Data Science, Data Engineering, Analytics, Statistics, Biostatistics, Computing or a related discipline with an academic background and appropriate credentials to be a tenured Professor in the School of Data Science and Analytics in the College of Computing and Software Engineering at KSU
- Demonstrated strong commitment to the Computing disciplines and a substantive record of scholarship and Data Science and Analytics research leading to the procurement of external funding
- Evidence of effective leadership experience
- Exceptional communication and interpersonal skills
- Demonstrated ability to work productively with faculty and students
- Experience mentoring and advising early career faculty, undergraduate and graduate students in research activities

Type: Full-Time
Posted: 10/21/2023
Category: Computer Science

University of Virginia: UVA Provost's Office: Data Science
Location: Charlottesville, VA
Description:
The School of Data Science at the University of Virginia (UVA) seeks applicants for multiple **Open Rank Academic General Faculty (Teaching Track) Professors of Data Science**. The school is assembling a diverse and world-class faculty with broad expertise in data science. We are seeking candidates with a pioneering spirit who have expertise in pedagogy, instruction, and advising in data science. Exceptional candidates will demonstrate experience with, or the potential for, sustained scholarship in data science education in an academic or industry setting. Candidates should also explain their methodologic expertise as it pertains to the domains of data science.
The domains of data science include, but are not limited to,

- Data Ethics, Critical Data Studies & Policy (e.g., representativeness, privacy, ethics of algorithmic construction, interpretability)
- Data Design (e.g., visualization, human-computer interaction, communication)
- Analytics (e.g., predictive modeling, machine learning, imaging, computer vision, algorithm development, statistical methods)
- Data Structures (e.g., data architecture and pipelines, database theory)
- Informatics (e.g., graph theory, information systems, bioinformatics)
- Data Systems (e.g., high performance computing, continuous integration and deployment (CI/CD) of data science tools, cloud architectures, federated learning, data sharing).

Candidates with backgrounds and experiences that are underrepresented in data science are especially encouraged to apply. A commitment to advancing the University's mission is essential for all candidates (https://provost.virginia.edu/faculty-handbook/mission-statement-university-virginia).
The School of Data Science at UVA was established in 2019 with the largest private gift in the institution's 200-year history. Faculty duties include teaching (in-person and online), mentoring, advising students, research and service to the university and the discipline. Faculty will have the opportunity to help shape the culture of a new

engaged in educational activities with underserved populations, or candidates who have worked to broaden student access to data science careers. *Ideal candidates for Academic General Faculty positions will demonstrate commitment to, or potential for, excellence in data science education, advancing classroom paradigms for modern environments, and making these advancements accessible to all students.*
Rank will be commensurate with academic and industry experience. Appointments will be available on 9-month contracts.

Type: Full-Time
Salary: $92,800-$105,000
Posted: 12/20/2023
Application Due: 01/31/2024
Category: Computer Engineering; +1

Salary/Position Classification

- $92,800+ commensurate with experience, 9-month Contract, Tenure Track, Exempt
- 40 hours per week
- 100% Remote Work Availability: No
- Hybrid Work Availability: No

Purpose of Position

The School of Electrical Engineering and Computer Science at the University of North Dakota seeks to fill two assistant professor positions in areas related to Data Science. This will be a 9-month tenure-track position. Successful candidates will support the University's Computational and Data Research Initiative to grow our portfolio of research and education programs related to Data Science, Computer Science, Cyber Security, and Electrical Engineering. Successful candidates will be appointed to a faculty position in the School of Electrical Engineering and Computer Science.

The School of Electrical Engineering and Computer Science in the College of Engineering & Mines supports degree programs and cutting-edge research in areas related to Electrical Engineering, Computer Science, Data Science, and Cyber Security. Undergraduate and graduate degree programs are offered in the areas of Electrical Engineering, Computer Science, Data Science, and Cyber Security. Our academic programs serve a total of approximately 700 students, approximately 550 at the undergraduate level and 150 at the graduate level. Our programs and research activities provide a balance of theoretical and practical, hands-on experiences that prepare students for academic careers, further study, and employment in a variety of sectors.For more information about SEECS, please visit:https://engineering.und.edu/academics/electrical-and-computer-science/index.html

Successful candidates will be expected to:• Develop and execute an externally funded research program• Work individually and collaboratively• Demonstrate leadership potential

The dates of initial contract are August 16, 2024 to May 15, 2025. Summer salary may be obtained through externally funded research grants.

Duties & Responsibilities

- Expected to establish a nationally recognized research program with significant external funding in data science. Alignment of research interests with UND goals is expected.
- Receive a contract with an approximate effort distribution of 20% teaching; 70% research; 10% service for the initial 2–3 years. Teaching responsibilities include graduate and/or undergraduate courses in Data Science, Computer Science, or Electrical Engineering with an anticipated load of two courses per academic year and supervision of graduate and undergraduate research.
- All faculty are expected to contribute service within the department, college, university, and community. UND and the College of Engineering & Mines value diverse perspectives and seek applicants who are committed to helping students from underrepresented backgrounds succeed.

Required Competencies

- Excellent written and oral communication skills, including evidence of the ability to teach, inspire, and mentor students.
- Effective interpersonal skills, including the ability to collaborate effectively with faculty, staff, and students.
- Ability to work with and engage diverse students and colleagues within and outside the School of Electrical Engineering and Computer Science.
- Ability to adapt to current methods of teaching, including online delivery.

Minimum Requirements

- Earned PhD in Data Science, Computer Science, Electrical Engineering, or a closely related field with a research focus in the broad area of Data Science
- Successful completion of a Standard Criminal History Background Check

In compliance with federal law, all persons hired will be required to verify identity and eligibility to work in the US and to complete the required employment eligibility verification form upon hire.

Assistant Professor, Tenure Track, Data Science

University of North Dakota Grand Forks, ND

- Record of involvement in seeking and administering extramural research funding, especially at the federal level
- Experience working on individual and collaborative multi-disciplinary research teams
- Experience in a postdoctoral research position or industry experience after completion of the bachelor's degree
- A strong record of high-quality peer-reviewed publications related to data science
- Teaching experience at the undergraduate and/or graduate level
- Knowledge to be able to contribute to multiple UND Grand Challenges including Big Data, National Security/Space, Autonomous Systems, Energy Sustainability, and Human Health

Type: Full-Time
Posted: 09/20/2023
Category: Computer Science

UNT | SYSTEM

UNT System Overview

Welcome to the **University of North Texas System**. The UNT System includes the **University of North Texas in Denton** and **Frisco**, the **University of North Texas at Dallas** and UNT Dallas **College of Law**, and the **University of North Texas Health Science Center at Fort Worth**. We are the only university system based exclusively in the robust Dallas-Fort Worth region. We are growing with the North Texas region, employing more than 14,000 employees, educating a record 49,000+ students across our system, and awarding nearly 12,000 degrees each year.

We are one team comprised of individuals who are committed to excellence, curiosity and innovation. We are transforming lives and creating economic opportunity through education. We champion a people-first values-based culture where **We Care** about each other and those we serve. We believe that we are **Better Together** because we foster an inclusive environment of respect, belonging, and access for all. We demonstrate **Courageous Integrity** through setting exceptional standards and acting in the best interest of our communities. We are encouraged to **Be Curious** about opportunities for learning, creating, discovering, and innovating, and are encouraged to learn from failure. **Show Your Fire** by joining our team and exhibiting your passion and pride in your work as part of our UNT System team.

Learn more about the UNT System and how we live our values at www.UNTSystem.edu.

Posting Title
Assistant / Associate Professor - Data Science

Department: UNT-Information Science-133310

College/School
College of Information

Job Location: Denton

Full Time/Part Time: Full-Time

Retirement Eligibility
ORP Eligible

Additional Retirement Information

For more information on retirement plan options, please visit **https://hr.untsystem.edu/benefits/retirement-plans/index.php**.

Department Summary

The Department of Information Science is part of the **College of Information** and is a member of the **iSchools** and a member of the **iCaucus**. The Department of Information Science promotes the understanding of access to and use of data and information through teaching, research and service activities. The department prepares data and information professionals of the highest quality to serve in dynamic roles locally, nationally and globally. Faculty members of the department measure their success by the success of their students and the quality of intellectual contributions to the profession and society. The department offers programs in Data Science, Library Science and Information Science at the undergraduate, graduate and doctoral levels. The department has an established Master of Science in Data Science (MS-DS) program, the Bachelor of Science in Data Science program (BS-DS), Grad-Track in Data Science (BS-DS and MS-DS) program, and a PhD in Information Science with concentration in Data Science. Detailed information about the department can be found at **https://informationscience.unt.edu/**.

UNT has a highly diverse campus with a wide range of languages spoken in addition to English. We welcome candidates who have experience with HSI/MSIs and/or who speak Spanish, Vietnamese, American Sign Language, Chinese (Cantonese, Mandarin and other variations), Arabic, Tagalog, Farsi, French, or/and Yoruba.

Position Summary

The Department of Information Science at the University of North Texas (UNT) invites applications for a tenure-track Assistant/Associate Professor position. Position will begin Fall 2024. We are seeking exceptional candidates with interests in a wide range of topics within the theoretical, machine learning, data visualization, and computational foundations of data science. The candidate will teach, conduct research, and provide service in an academic position with emphasis in Data Science. The candidate must demonstrate a record of research accomplishments and have the ability to design and deliver courses in a variety of formats, including online and hybrid modalities in Data Science. The candidate is expected to teach Data Science undergraduate, graduate

Assistant / Associate Professor - Data Science
University of North Texas in Denton, TX
Apply on Institution's Website

leadership in research and teaching, who can leverage the strengths of the department's dynamic faculty and programs, and who will build collaborative relationships in the University and profession.

Minimum Qualifications

The minimum requirement for appointment is an earned doctorate in Data Science, Computer Science, Computer Engineering or other related fields at the time of appointment.

Preferred Qualifications

Candidates will demonstrate evidence of effective teaching, research, and scholarship with experience/expertise in the broad areas of Data Science, Information Science, and Computer Science. Preference will be given to candidates who have been active in publication and have a demonstrated record of funded scholarly research and publication.

Type: Full-Time
Posted: 12/05/2023
Category: Statistics; +2

Job Summary:
The College of Science (COS) at the University of Texas at Arlington is welcoming applications for two non-tenure track faculty positions in Statistics or Data Science at the levels of Assistant or Associate Professor of Instruction. Additionally, there is an opening for a lab coordinator position. These positions place a strong emphasis on teaching or overseeing labs. They are dedicated to statistics, data science, computational methods, and programming courses for both the Bachelor of Science in Data Science (BS DS) and the Master of Science in Applied Statistics and Data Science (MS ASDS) programs within the College of Science at UTA.

Essential Duties:
As full-time, 9-month non-tenure track (NTT) faculty members, their duties will include teaching eight courses within the BS DS and MS ASDS programs during academic semesters. Additionally, during the summer, faculty members may be requested to teach and oversee capstone research projects and will be compensated for their summer teaching assignments. The specific teaching assignments will be determined by the program director, who will consider program requirements and student enrollment. In cases where courses within the MS ASDS or BS Data Science programs do not meet minimum enrollment requirements, faculty members may be reassigned to other responsibilities that support administration, student recruitment, and curriculum development. The lab coordinator is responsible for leading all lab discussions included as part of the course projects for the MS ASDS program.

Required Qualifications:
Candidates for Assistant or Associate Professor of Instruction positions must possess a doctoral degree in Data Science, Statistics, Applied Mathematics, Computer Science, or a data-intensive scientific field. The minimum educational qualification for a lab coordinator is a master's degree in data science, Statistics, Applied Mathematics, Computer Science, or a data-intensive scientific field and exhibits a high level of proficiency in programming skills in SAS, Python, or other programming languages relevant to Data Science.

Preferred Qualifications:
The Assistant or Associate Professor of Instruction should show proficiency in techniques, programming languages, and software stack employed in contemporary Data Science. Candidates must demonstrate a solid commitment to teaching excellence. They should share the university's core values of fostering an open and inclusive environment that promotes diversity and participation of groups that are currently underrepresented in the fields of Applied Statistics and Data Science.

Special Instructions:
To apply, applicants should go to **https://uta.peopleadmin.com/postings/26434**

Assistant or Associate Professor of Instruction
University of Texas at Arlington in Arlington, TX
Apply on Institution's Website

- Unofficial Transcripts (required ***only*** for candidates for whom their degree is not in the same discipline as the one in which they will teach)
- Teaching Statement
- Names and Contact information for 3 references

APPENDIX E

Q1 - What is your level of interest in pursuing a Doctor of Philosophy in Data Science degree?

Field	Extremely interested		Very interested		Interested		Not interested		Extremely uninterested		Total
Undergrad	17%	4	29%	7	25%	6	25%	6	4%	1	24
Grad	60%	6	0%	0	30%	3	10%	1	0%	0	10
Total	29%	10	21%	7	26%	9	21%	7	3%	1	34

Q2 - If ODU were to offer a Doctor of Philosophy in Data Science, would you enroll?

Field	Definitely		Very likely		Likely		Somewhat likely		Not at all likely		Total
Undergrad	17%	4	21%	5	17%	4	25%	6	21%	5	24
Grad	10%	1	50%	5	10%	1	30%	3	0%	0	10
Total	15%	5	29%	10	15%	5	26%	9	15%	5	34