

# MASTER OF DATA SCIENCE

## Collaborative program with the Department of Applied Mathematics

This professional master's degree program consists of 33 credit hours of coursework including a six credit hour practicum project. The program is designed primarily for those with previous degrees or experience in computer science, statistics, mathematics, the natural or social sciences, or business, and who are interested in preparing for a career as a data science professional in business and industry. Full-time students may complete the program in one year, including one summer term.

## Admission Requirements

Applicants should have a bachelor's degree from an accredited university with a minimum cumulative GPA of 3.0/4.0. A combined verbal and quantitative GRE examination score of at least 304 and an analytical writing score of at least 3.0 are required. The GRE requirement may be waived for students with a bachelor's degree from an accredited college or university in the United States with a cumulative GPA of at least 3.0/4.0.

Prerequisites include knowledge of a high level programming language at the level of CS 201 (object-oriented programming is required), a data structures and algorithms course at the level of CS 331, multivariate calculus at the level of MATH 251, linear algebra at the level of MATH 332, and probability and statistics at the level of MATH 474. Information on these courses is available in this catalog. Proficiency and placement exams are also available.

Students with an insufficient background in computer science and/or mathematics will be required to take the relevant prerequisite courses and earn at least a "B" grade in each. These prerequisite courses do not count toward the 33 credit hour requirement.

## Curriculum

Coursework includes 15 credit hours of required core courses, 12 credit hours of elective courses, and six credit hours of Data Science Capstone (see below). At least nine credit hours must be taken of 400- or 500-level CS or CSP courses and nine credit hours of 400- or 500-level MATH courses, not including the Data Science Capstone.

Up to six credit hours of 400-level undergraduate coursework may be used toward degree requirements.

The Data Science Capstone comprises three options:

- Practicum track: Students take CSP 572 Data Science Practicum, working in small teams on real-world data science problems for external clients, advised by faculty.
- Research track: Students work on a research project with a faculty advisor, taking 6 credits of CS 597 or MATH 594 over two semesters. A project proposal needs to be approved in advance by the director of the Master of Data Science program.
- Coursework track: Students take 6 credits of Application Courses or Data Science Electives.

| Code   | Title                            | Credit Hours |
|--|----------------------------------|--------------|
| <b>Data Science Core Courses</b>                   |                                  | <b>(15)</b>  |
| MATH 563   | Mathematical Statistics          | 3            |
| or MATH 564  | Regression                       |              |
| CS 584   | Machine Learning                 | 3            |
| or MATH 569  | Statistical Learning             |              |
| SCI 522  | Public Engagement for Scientists | 3            |
| CSP 571  | Data Preparation and Analysis    | 3            |
| Select a minimum of one course from the following: |                                  | 3            |
| CS 525   | Advanced Database Organization   | 3            |
| CS 554   | Data-Intensive Computing         | 3            |
| CSP 554  | Big Data Technologies            | 3            |

|  |             |
|--|-------------|
| <b>Data Science Capstone</b>                   | <b>(6)</b>  |
| 6 credit hours of capstone, depending on track | 6           |
| <b>Data Science Electives</b>                  | <b>(12)</b> |
| 12 credit hours of Data Science Electives      | 12          |
| <b>Total Credit Hours</b>                      | <b>33</b>   |

## Data Science Capstone

| Code  | Title                         | Credit Hours |
|---|-------------------------------|--------------|
| <b>Practicum Track</b>                                      |                               | <b>(6)</b>   |
| CSP 572   | Data Science Practicum        | 6            |
| <b>Research Track</b>                                       |                               | <b>(6)</b>   |
| CS 597  | Reading and Special Problems  | 6            |
| or MATH 594   | Professional Master's Project |              |
| <b>Coursework Track</b>                                     |                               | <b>(6)</b>   |
| 6 credits of Applications Courses or Data Science Electives |                               | 6            |

## Data Science Electives

| Code                       | Title   | Credit Hours |
|----------------------------|---|--------------|
| Computational Fundamentals |   |              |
| CS 425                     | Database Organization                         | 3            |
| CS 430                     | Introduction to Algorithms                    | 3            |
| CS 450                     | Operating Systems                             | 3            |
| CS 520                     | Data Integration, Warehousing, and Provenance | 3            |
| CS 525                     | Advanced Database Organization                | 3            |
| CS 528                     | Data Privacy and Security                     | 3            |
| CS 535                     | Design and Analysis of Algorithms             | 3            |
| CS 538                     | Combinatorial Optimization                    | 3            |
| CS 546                     | Parallel and Distributed Processing           | 3            |
| CS 553                     | Cloud Computing                               | 3            |

|  |  |   |
|--|--|---|
| CS 554                                   | Data-Intensive Computing                             | 3 |
| CS 589                                   | Software Testing and Analysis                        | 3 |
| CSP 554                                  | Big Data Technologies                                | 3 |
| Computer Science Applications            |  |   |
| CS 422                                   | Data Mining  | 3 |
| CS 512                                   | Computer Vision                                      | 3 |
| CS 513                                   | Geospatial Vision and Visualization                  | 3 |
| CS 522                                   | Advanced Data Mining                                 | 3 |
| CS 529                                   | Information Retrieval                                | 3 |
| CS 556                                   | Cyber-Physical Systems: Languages and Systems        | 3 |
| CS 557                                   | Cyber-Physical Systems Security and Design           | 3 |
| CS 577                                   | Deep Learning  | 3 |
| CS 578                                   | Interactive and Transparent Machine Learning         | 3 |
| CS 579                                   | Online Social Network Analysis                       | 3 |
| CS 581                                   | Advanced Artificial Intelligence                     | 3 |
| CS 583                                   | Probabilistic Graphical Models                       | 3 |
| CS 584                                   | Machine Learning                                     | 3 |
| CS 585                                   | Natural Language Processing                          | 3 |
| Mathematics, Probability, and Statistics |  |   |
| MATH 454                                 | Graph Theory and Applications                        | 3 |
| MATH 481                                 | Introduction to Stochastic Processes                 | 3 |
| MATH 483                                 | Design and Analysis of Experiments                   | 3 |
| MATH 486                                 | Mathematical Modeling I                              | 3 |
| MATH 487                                 | Mathematical Modeling II                             | 3 |
| MATH 522                                 | Mathematical Modeling                                | 3 |
| MATH 532                                 | Linear Algebra                                       | 3 |
| MATH 535                                 | Optimization I                                       | 3 |
| MATH 540                                 | Probability  | 3 |
| MATH 542                                 | Stochastic Processes                                 | 3 |
| MATH 546                                 | Introduction to Time Series                          | 3 |
| MATH 563                                 | Mathematical Statistics                              | 3 |
| MATH 564                                 | Regression   | 3 |
| MATH 565                                 | Monte Carlo Methods                                  | 3 |
| MATH 566                                 | Multivariate Analysis                                | 3 |
| MATH 567                                 | Advanced Design of Experiments                       | 3 |
| MATH 569                                 | Statistical Learning                                 | 3 |
| MATH 527                                 | Machine Learning in Finance: From Theory to Practice | 3 |
| MATH 574                                 | Bayesian Computational Statistics                    | 3 |
| MATH 584                                 | Mathematical Methods for Algorithmic Trading         | 3 |
| Mathematical and Scientific Computing    |  |   |
| BIOL 550                                 | Bioinformatics                                       | 3 |
| MATH 512                                 | Partial Differential Equations                       | 3 |
| MATH 544                                 | Stochastic Dynamics                                  | 3 |
| MATH 577                                 | Computational Mathematics I                          | 3 |
| MATH 578                                 | Computational Mathematics II                         | 3 |
| MATH 590                                 | Meshfree Methods                                     | 3 |

|                     |   |   |
|---------------------|---|---|
| PHYS 440            | Computational Physics                   | 3 |
| Professional Skills |   |   |
| SCI 511             | Project Management                      | 3 |
| SCI 522             | Public Engagement for Scientists        | 3 |
| ID 420              | Fundamentals of Design                  | 3 |
| COM 525             | User Experience Research and Evaluation | 3 |

## Applications Courses

| Code     | Title   | Credit Hours |
|----------|---|--------------|
| BIOL 440 | Neurobiology  | 3            |
| BIOL 550 | Bioinformatics  | 3            |
| BME 433  | Biomedical Engineering Applications of Statistics                                     | 3            |
| BME 504  | Neurobiology  | 2            |
| BME 506  | Computational Neuroscience II: Vision   | 3            |
| BME 507  | Cognitive Neuroscience  | 2            |
| BME 538  | Neuroimaging  | 3            |
| BME 545  | Quantitative Neural Function  | 3            |
| BUS 510  | Strategic Management  | 3            |
| BUS 550  | Business Statistics   | 3            |
| CAE 576  | Applications of Unmanned Aerial Vehicles (UAVs or "Drones") for Construction Projects | 3            |
| CHE 560  | Statistical Quality and Process Control   | 3            |
| COM 501  | Introduction to Linguistics   | 3            |
| COM 583  | Social Networks   | 3            |
| COM 584  | Humanizing Technology   | 3            |
| ECE 563  | Artificial Intelligence in Smart Grid   | 3            |
| FDSN 401 | Nutrition, Metabolism, and Health   | 3            |
| FDSN 408 | Food Product Development  | 3            |
| FDSN 410 | Food Plant Operations   | 3            |
| FDSN 435 | Performance Management in Food Operations   | 3            |
| MAX 501  | Digital Marketing   | 3            |
| MAX 522  | Predictive Analytics  | 3            |
| MAX 523  | Social Media Marketing Analytics  | 3            |
| MAX 526  | Quantitative Marketing Models   | 3            |
| MMAE 440 | Introduction to Robotics  | 3            |
| MMAE 500 | Data Driven Modeling  | 3            |
| MMAE 540 | Robotics  | 3            |
| MSF 502  | Statistical Analysis in Financial Markets   | 3            |
| MSF 503  | Financial Modeling  | 3            |
| PHIL 551 | Science and Values  | 3            |
| PHIL 574 | Ethics in Computer Science  | 3            |
| PSYC 423 | Learning Theory   | 3            |
| PSYC 426 | Cognitive Science   | 3            |
| PSYC 503 | Cognitive and Affective Bases   | 3            |
| SSCI 422 | Complex Organizations   | 3            |

# Master of Data Science Curriculum

|                               |              |                         |              |            | Year 1       |
|-------------------------------|--------------|-------------------------|--------------|------------|--------------|
| Semester 1                    | Credit Hours | Semester 2              | Credit Hours | Semester 3 | Credit Hours |
| CS 525, 554, or CSP 554       |              | 3 CS 584 or MATH 569    |              | 3 CSP 572  | 6            |
| MATH 563 or 564               |              | 3 CSP 571               |              | 3          |              |
| SCI 522                       |              | 3 Data Science Elective |              | 3          |              |
|                               |              | <b>9</b>                |              |            | <b>6</b>     |
|                               |              |                         |              |            | Year 2       |
| Semester 1                    | Credit Hours |                         |              |            |              |
| SCI 511                       |              | 3                       |              |            |              |
| Data Science Elective         |              | 3                       |              |            |              |
| Data Science Elective         |              | 3                       |              |            |              |
|                               |              | <b>9</b>                |              |            |              |
| <b>Total Credit Hours: 33</b> |              |                         |              |            |              |