DATA SCIENCE - MASTER OF SCIENCE (MS)

The on-campus Master of Science in Data Science program focuses on developing knowledge and skills in interdisciplinary and collaborative data science competencies including statistical analysis, data structures and algorithms, data mining, machine learning, big data architecture and data visualization.

Data science is a multidisciplinary field that focuses on the extraction of knowledge and insight from large datasets. Data scientists are tasked with using a range of skills in applied mathematics, statistics and computer science, and in domain applications such as information science, geography, business, media and the humanities.

The MS-DS provides learners with a strong foundation in acquiring, cleaning and managing data. Learners will learn to analyze large datasets using data mining and machine learning techniques. Students will also design, conduct and run statistical experiments and models; draw rational conclusions from data using probability theory and statistics; and more.

Graduates of the MS-DS program will be well-prepared to apply data science skills to a specific domain area. Graduates will also be able to clearly communicate the results of data science analysis to a non-technical audience; structure effective meetings and projects using collaboration skills; and act ethically in the role of professional data scientist.

**Topic Areas**

**Applied Mathematics**
The Department of Applied Mathematics in the College of Arts and Sciences offers a range of courses and research opportunities in many areas, including computational mathematics, mathematical biology, nonlinear phenomena, physical applied mathematics, and probability and statistics.

**Computer Science**
Computer science is an exciting and challenging field that impacts many parts of our lives. Computer scientists craft the technologies that enable the digital devices we use every day. They develop the large-scale software that powers business and industry, and they advance the computational techniques and write the software that supports scientists in their study of the world around us. Many new applications of computing technology remain to be discovered. Computing will be at the heart of future revolutions in business, science and society. Students who study computer science will be at the forefront of these important advances.

**General Data Science**
Data science is a multidisciplinary field that uses scientific methods, processes, algorithms and systems to extract knowledge and insights from structured and unstructured data.

**Information Science**
Information science considers the relationships between people, places and technology and the information those interactions yield. The internet is a broad example of a socio-technical system that is comprised of hardware and software, but in daily life is better understood as a constantly changing social infrastructure upon which complex forms of human-human and human-information interaction rest. Scholars and students of information science develop new methods to study these socio-technical phenomena and translate those findings to the design and development of useful and meaningful technology.

**Bachelor’s–Accelerated Master’s Degree Program**
Students may earn this degree as part of the Bachelor’s–Accelerated Master’s (BAM) degree program, which allows currently enrolled CU Boulder undergraduate students the opportunity to earn a bachelor’s and master’s degree in a shorter period of time.

For more information, see the Accelerated Master’s tab for the associated bachelor’s degree(s):

- Computer Science - Bachelor of Arts (BA) ([https://catalog.colorado.edu/undergraduate/colleges-schools/engineering-applied-science/programs-study/computer-science/computer-science-bachelor-arts-ba/](https://catalog.colorado.edu/undergraduate/colleges-schools/engineering-applied-science/programs-study/computer-science/computer-science-bachelor-arts-ba/))
- Computer Science - Bachelor of Science (BSCS) ([https://catalog.colorado.edu/undergraduate/colleges-schools/engineering-applied-science/programs-study/computer-science/computer-science-bachelor-science-bscs/](https://catalog.colorado.edu/undergraduate/colleges-schools/engineering-applied-science/programs-study/computer-science/computer-science-bachelor-science-bscs/))

**Requirements**

**Admission Requirements**
Applicants are eligible to apply to the program if they have earned a bachelor’s degree or its equivalent from a regionally accredited college or university. Applicants must show promise of their ability to pursue advanced study and research, as judged by the student’s scholastic record. Applicants must have a minimum of a 2.75 cumulative GPA in their prior degree program to be considered. International students may have country-specific requirements and/or English proficiency requirements.

Strong applicants will also have an undergraduate GPA of 3.2 or higher on a 4.0 scale (3.0 = B)

**Prerequisite Knowledge**
Applicants with the following prior knowledge or equivalent experience are eligible for admission to the Direct to Data Science Pathway and can complete the degree with 30 total credits:

- Mathematics: Applicants should be familiar with differential calculus (including derivatives), integral calculus, linear algebra, and have some experience with infinite sequences and series. Multivariate calculus is preferred but not required.
- Programming: Applicants should have some programming experience, whether it is formal, informal or on the job. Some advanced knowledge of R is also helpful before starting the program.

Applicants without the specific math and programming experience above are eligible for admission to the Bridge to Data Science Pathway and can complete the degree with 30–34 total credits as
determined by the graduate committee upon a review of the student’s prior experience.

**Potential Additional Curriculum**

The graduate committee may require students in this pathway to complete one or more of the following courses (up to 7 credits). Courses should be taken in the first year and are subject to Graduate School grade and cumulative GPA standards. Up to 3 hours of bridge courses which meet applicable standards can count toward the degree in the electives category.

- INFO 5651 Fundamental Concepts in Data Science (3)
- INFO 5652 Statistical Programming in R (3)
- DTSC 5003 Programming for Data Science - Python for Data Science (1)

**Application Requirements**

To apply, applicants must submit the following:

- A completed graduate admission application
- An application fee
- Unofficial undergraduate transcripts and, if applicable, any graduate transcripts
- A statement of purpose that briefly describes the applicant's background, academic goals, and professional goals
- Two to three letters of recommendation
- A current curriculum vitae or resume

An applicant whose native language is not English must provide proof of English proficiency by submitting documents. A TOEFL score of at least 80, IELTS score of at least 6, or Duolingo score of at least 100 is required. To report TOEFL and IELTS scores, students should request that the testing agency submit scores directly to the Office of Admissions. They can also ask the agency to automatically submit TOEFL scores to CU Boulder using institution code 4841. To report official Duolingo scores, click Send Results from inside the application, then choose to report officially to CU Boulder using institution code 4841. To report official Duolingo scores, click Send Results from inside the application, then choose to report officially to CU Boulder using institution code 4841.

See the Data Science website for details about application deadlines.

For information about application deadlines, please see the Graduate School’s Admissions Deadlines (https://www.colorado.edu/graduateschool/admissions/prepare-apply/program-information-deadlines/).

**Program Requirements**

The on-campus data science master’s degree seeks to shape tomorrow’s leaders by providing learners with the skills, competencies and knowledge necessary to fuel creative problem-solving, adaptability, and the capability to communicate effectively across diverse organizations.

The MS degree is a non-thesis degree, though students may have the opportunity to complete a capstone or project as part of the 30 required credit hours. Students in the Bridge to Data Science Pathway may be required to complete up to 4 additional credits as determined by the graduate committee upon a review of the student’s prior experience.

All students must complete 21 credits of core coursework in statistics, computer science and general core concepts as well as 9 credits of elective coursework. The degree does not require a master’s final/comprehensive examination.

### Courses by Topic Area

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credit Hours</th>
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<tbody>
<tr>
<td><strong>Applied Mathematics</strong></td>
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<tr>
<td>STAT 5000</td>
<td>Statistical Methods and Application I</td>
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<tr>
<td>STAT 5010</td>
<td>Statistical Methods and Applications II</td>
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<td>STAT 5600</td>
<td>Methods in Statistical Learning</td>
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<td><strong>Computer Science</strong></td>
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<tr>
<td>DTSC 5501</td>
<td>Data Structures and Algorithms</td>
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<tr>
<td>CSCI 5502</td>
<td>Data Mining</td>
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<tr>
<td>CSCI 5622</td>
<td>Machine Learning</td>
<td>3</td>
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<tr>
<td><strong>General Data Science</strong></td>
<td></td>
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<tr>
<td>DTSC 5301</td>
<td>Data Science as a Field</td>
<td>1</td>
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<tr>
<td>DTSC 5302</td>
<td>Ethical Issues in Data Science</td>
<td>1</td>
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<tr>
<td>DTSC 5303</td>
<td>Cybersecurity for Data Science</td>
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<tr>
<td><strong>Data Science Electives</strong></td>
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<tr>
<td>CSCI 5253</td>
<td>Datacenter Scale Computing - Methods, Systems and Techniques</td>
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<tr>
<td>CSCI 5302</td>
<td>Advanced Robotics</td>
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<td>CSCI 5314</td>
<td>Dynamic Models in Biology</td>
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<td>CSCI 5322</td>
<td>Algorithmic Human-Robot Interaction</td>
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<td>CSCI 5352</td>
<td>Network Analysis and Modeling</td>
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<tr>
<td>CSCI 5402</td>
<td>Research Methods in Human-Robot Interaction</td>
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<tr>
<td>CSCI 5403</td>
<td>Cybersecurity</td>
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<tr>
<td>CSCI 5423</td>
<td>Biologically-inspired Multi-Agent Systems</td>
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<tr>
<td>CSCI 5454</td>
<td>Design and Analysis of Algorithms</td>
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<td>CSCI 5576</td>
<td>High-Performance Scientific Computing</td>
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<tr>
<td>CSCI 5722</td>
<td>Computer Vision</td>
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<tr>
<td>CSCI 5822</td>
<td>Probabilistic and Causal Modeling in Computer Science</td>
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<tr>
<td>CSCI 5832</td>
<td>Natural Language Processing</td>
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<td>CSCI 5880</td>
<td>Interactive Machine Learning for Customizable and Expressive Interfaces</td>
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<td>CSCI 5922</td>
<td>Neural Networks and Deep Learning</td>
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<td>CSCI 6502</td>
<td>Big Data Analytics: Systems, Algorithms, and Applications</td>
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<td>CSCI 7000</td>
<td>Current Topics in Computer Science</td>
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<td>DTSC 5810</td>
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<td>DTSC 5840</td>
<td>Independent Study</td>
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<tr>
<td>DTSC 5900</td>
<td>Special Topics</td>
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<td>DTSC 5930</td>
<td>Professional Internship</td>
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<tr>
<td>GEOG 4303/5303</td>
<td>Geographic Information Science: Spatial Programming</td>
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<tr>
<td>GEOG 5103</td>
<td>Geographic Information Science: Spatial Analytics</td>
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<tr>
<td>GEOG 5203</td>
<td>Geographic Information Science: Spatial Modeling</td>
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<tr>
<td>GEOG 5563</td>
<td>Earth Analytics</td>
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<tr>
<td>IPHY 5262</td>
<td>Application of Bioinformatics and Genomics</td>
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<tr>
<td>IPHY 5800</td>
<td>Advanced Statistics and Research Methods in Integrative Physiology</td>
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</table>
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IPHY 6010 Seminar 1-3
INFO 5507 Data and the Humanities 3
INFO 5601 Ethical and Policy Dimensions of Information and Technology 3
INFO 5602 Information Visualization 3
INFO 5612 Recommender Systems 3
INFO 5613 Network Science 3
MATH 5440 Mathematics of Coding and Cryptography 3
MBAX 6330 Market Intelligence 3
MBAX 6410 Process Analytics 3
MSBC 5070 Survey of Business Analytics 3
MSBC 5680 Optimization Modeling 3
MSBX 5310 Customer Analytics 2-3
MSBX 5405 Structured Data Modeling and Analysis 3
MSBX 5420 Unstructured and Distributed Data Modeling and Analysis 3
STAT 5680 Statistical Collaboration 3

1 Option: Methods in Statistical Learning (STAT 5600); Datacenter Scale Computing - Methods, Systems and Techniques (CSCI 5253) or Big Data Architecture (ATLS 5214); Information Visualization (INFO 5602); Design and Analysis of Algorithms (CSCI 5454).

Time Limit
All degree requirements must be completed within four years of the date of commencing coursework. Most students complete the degree in one-and-a-half to two years.

Plans of Study
Data Structures and Algorithms Option

Year One
Fall Semester
DTSC 5301 Data Science as a Field 1
DTSC 5302 Ethical Issues in Data Science 1
DTSC 5303 Cybersecurity for Data Science 1
DTSC 5501 3
STAT 5000 Statistical Methods and Application I 3
Credit Hours 9

Spring Semester
STAT 5010 Statistical Methods and Applications II 3
CSCI 5622 Machine Learning 3
Option 1 3
Credit Hours 9

Year Two
Fall Semester
CSCI 5622 Machine Learning 3
Option 1 3
Credit Hours 6

Spring Semester
Electives 6
Credit Hours 6
Total Credit Hours 30

1 Intro to Statistical Learning (STAT 5600); Datacenter Scale Computing (CSCI 5253) or Big Data Architecture (ATLS 5214); Information Visualization (INFO 5602); Design and Analysis of Algorithms (CSCI 5454).

Non-Data Structures and Algorithms Option

Year One
Fall Semester
DTSC 5301 Data Science as a Field 1
DTSC 5302 Ethical Issues in Data Science 1
DTSC 5303 Cybersecurity for Data Science 1
STAT 5000 Statistical Methods and Application I 3
CSCI 5502 Data Mining 3
Credit Hours 9

Spring Semester
STAT 5010 Statistical Methods and Applications II 3
CSCI 5622 Machine Learning 3
Option 1 3
Credit Hours 9

Year Two
Fall Semester
CSCI 5622 Machine Learning 3
Option 1 3
Credit Hours 6

Spring Semester
Electives 6
Credit Hours 6
Total Credit Hours 30

1 Intro to Statistical Learning (STAT 5600); Datacenter Scale Computing (CSCI 5253) or Big Data Architecture (ATLS 5214); Information Visualization (INFO 5602); Design and Analysis of Algorithms (CSCI 5454).