The Professional Master of Science (MSCPS) is a degree program that offers possibilities for a wide range of students. Whether the student is a working engineer or an undergraduate considering a career in industry, there are program options to meet their needs. The department offers seven degree tracks, each of which result in a Professional Master of Science in Computer Science:

1. General
2. Algorithms, Network and Optimization
3. Data Science and Engineering
4. Human-Centered Computing
5. Intelligent Systems
6. Numerical Computation
7. Robotics
8. Software Systems and Cloud Computing

The Department of Computer Science has embraced this degree as an ideal opportunity to expand the high quality courses in the fields above into a wide array of courses leading to a full master’s degree. The goal of the MSCPS program is to produce creative, workforce-ready graduates equipped with versatile specialized skills and technical leadership.

Adding several new subplan courses to the program now enables greater options for earning professional MS degree with a these subplans, while also offering plenty of courses to complete a full master’s degree, principally with a subplan focus. Students pursuing this degree will also have access to many excellent graduate-level courses offered by the department's highly reputed faculty.

**Subplans**

**General Track**

Students opting for this track have the option to select classes from an approved list for the degree. The jobs these students get are also similar to other subplans. However, specializing in a subplan is more beneficial.

**Algorithms, Network and Optimization**

The subplan enables students to employ powerful mathematical tools and techniques from algorithms, graph theory, computational complexity theory and mathematical optimization to solve problems that may arise in research and development of cutting edge computing systems. Skills include: design and analysis of algorithms, understanding inherent problem complexity and deploying optimization-based tools and techniques. We expect graduates to fill software development roles with an emphasis on algorithms design, data analysis and solution design.

Potential job titles include: graph theorist, optimization analyst, software developer on algorithms design and data analysts on algorithms design. Potential employers include Twitter, Google, Facebook, Amazon, Oracle, Uber, Microsoft and Apple.

**Data Science and Engineering**

This subplan provides the skills to develop computer solutions that require expertise in data science and engineering. Students who complete the program receive both a master’s degree in computer science and a specialization within data science and engineering. This combination is very attractive as technology companies are looking for developers that have experience in data science. Students complete both a set of core courses for the degree in addition to a set of data science courses.

Potential job titles include: Hadoop developer, BI developer, quantitative data engineer, search engineer, technical architect, big data analyst, solutions architect, data warehouse engineer, data science software engineer and ETL developer. Potential employers include Twitter, Google, Facebook, Amazon, Oracle, Uber, Microsoft and Apple.

**Human-Centered Computing**

In this track, students learn how to design, implement and evaluate user interfaces for a range of computing technology, and gain skills related to designing technologies to support the needs of real people. Topics covered include user-centered design, information visualization, universally accessible design and computer-supported cooperative work. Students will gain experience with the entire user-centered design process, from requirements gathering, prototyping, and qualitative and quantitative user evaluation. Many courses in this concentration are project-based and will involve user-centered research in the lab and in the field.

Potential job titles for graduates of this program include user experience researcher, user interface engineer, data scientist, interaction designer, front-end developer, accessibility specialist, mobile application developer. Potential employers include Facebook, Google, Microsoft, Twitter, Adobe, Autodesk, Sphero, Snap and Oculus.

**Intelligent Systems and Robotics**

The subplans in intelligent systems and robotics build expertise in algorithms and methods for developing autonomous systems, including robotics and cyber-physical systems. As part of this program, students will design and analyze systems which leverage computation to interact with the world around them through sensors and actuators. Machine learning, signal processing and control theory are all components to this program, where students become experts in creating the software for devices ranging from climate control systems to automobiles.

Potential job titles for graduates of this program focusing on intelligent systems include: software engineer, perception engineer, data scientist and research engineer. Potential employers include Lockheed-Martin, Amazon, Microsoft, Google and Facebook.

Potential job titles for graduates of this program focusing on robotics include: robotics engineer, perception engineer, control engineer and robotics scientist. Potential employers include: Amazon Robotics, Uber, Google, iRobot and DJI.

**Numerical Computation**

Ongoing improvements in computational capability and memory performance have increased the importance of high-fidelity simulations, optimization and data-driven science and engineering applications. Students in this subplan develop the skills to design robust and high-performance numerical methods for addressing real-world problems and develop production-grade implementations using state of the art software tools to target modern architectures and large-scale parallel computers.

Potential job titles: Computational scientist/engineer, numerical/data analyst, research scientist, software engineer, HPC developer and
quantitative software engineer. Potential employers include national labs, universities, engineering ISVs (ANSYS, MSC, CD-adapco), aerospace (NASA, Boeing, ULA, SpaceX, Lockheed), exploration (Shell, Schlumberger, CMG), manufacturing (P&G, GE), technology (Amazon, Google, IBM, Motorola) and finance (HFT, mutual funds, credit card).

**Software Systems and Cloud Computing**

In this subplan, students learn about software systems and how they are applied to real world problems. They'll also discover how emerging cloud computing technologies can be used to implement some of the world's most popular services and applications.

For more information, visit the department's Professional MS Degree Program Requirements (http://www.colorado.edu/cs/current-students/graduate-students/ms-degree/professional-ms-degree-requirements/) webpage.

**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):

- Applied Computer Science - Post-Baccalaureate Bachelor of Science (BSACS) (https://catalog.colorado.edu/undergraduate/colleges-schools/engineering-applied-science/programs-study/computer-science/applied-computer-science-post-baccalaureate-bachelor-science-bsacs/)
- 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/)
- 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/)

**Distance Education Option**

Students can take individual courses toward a master's degree or graduate certificate through distance education (online). For more information, connect with the individual graduate program directly.

**Requirements**

**Admission Requirements**

Applicants for graduate study in computer science must hold at least a bachelor's degree or its equivalent from an accredited institution. They should have programming experience, a number of computer science courses and sufficient mathematical maturity to understand pure mathematics courses at the upper division (junior/senior) level. A minimum undergraduate GPA of 3.0 (on a scale of 4.0) is required for admission to the master's program.

Applicants are not required to submit GRE scores.

**Mathematics Courses**

A student's academic background should include at least three semesters of mathematics at the level of sophistication of calculus or above. Examples of such courses include calculus, differential equations, linear algebra, probability, statistics and abstract algebra. The courses should indicate that the student has achieved the mathematical maturity expected of an upper-level science, engineering or mathematics undergraduate.

**Computer Science Courses**

At least three one-semester courses in computer science that are beyond the introductory level are required for admissions. These are intended to demonstrate breadth of basic computer science knowledge in the areas of computer hardware, software and theory. The courses should include the equivalent of the following CU Boulder offerings:

- Hardware requirement: CSCI 2400 Computer Systems (Computer Systems)
- Software requirement: Either CSCI 3155 Principles of Programming Languages or CSCI 3753 Design and Analysis of Operating Systems
- Theory requirement: CSCI 2270 Computer Science 2: Data Structures and either CSCI 3104 Algorithms or CSCI 3434 Theory of Computation

**Required Courses and Credits**

The following requirements are subject to change; for the most current information, visit the department's Professional MS Degree Program Requirements (http://www.colorado.edu/cs/current-students/graduate-students/ms-degree/professional-ms-degree-requirements/) webpage.

**Degree Requirements**

Students must complete a total of 30 credit hours of approved graduate level course work with a grade of C or better and a cumulative GPA of at least 3.00. Students are allowed to take two non-CS courses and the rest must be CSCI courses. Students under this option are not allowed to take research hours or thesis option.

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credit Hours</th>
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</thead>
<tbody>
<tr>
<td>CSCI 5229</td>
<td>Computer Graphics</td>
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<tr>
<td>CSCI 5254</td>
<td>Convex Optimization and Its Applications</td>
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<tr>
<td>CSCI 5434</td>
<td>Probability for Computer Science</td>
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<tr>
<td>CSCI 5444</td>
<td>Introduction to Theory of Computation</td>
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<tr>
<td>CSCI 5446</td>
<td>Chaotic Dynamics</td>
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<tr>
<td>CSCI 5454</td>
<td>Design and Analysis of Algorithms</td>
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<tr>
<td>CSCI 5576</td>
<td>High-Performance Scientific Computing</td>
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<tr>
<td>CSCI 5606</td>
<td>Principles of Numerical Computation</td>
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<tr>
<td>CSCI 5636</td>
<td>Numerical Solution of Partial Differential Equations</td>
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<tr>
<td>CSCI 5646</td>
<td>Numerical Linear Algebra</td>
<td></td>
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<tr>
<td>CSCI 5654</td>
<td>Linear Programming</td>
<td></td>
</tr>
<tr>
<td>CSCI 5676</td>
<td>Numerical Optimization</td>
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</tr>
</tbody>
</table>

**Breadth Courses**

Students must complete one breadth course from each of the three bins listed below, for a total of 9 credits of breadth courses. Students must earn a grade of B or better in each of the three breadth courses.

**Bin One**

Choose one:

- CSCI 5229 Computer Graphics
- CSCI 5254 Convex Optimization and Its Applications
- CSCI 5434 Probability for Computer Science
- CSCI 5444 Introduction to Theory of Computation
- CSCI 5446 Chaotic Dynamics
- CSCI 5454 Design and Analysis of Algorithms
- CSCI 5576 High-Performance Scientific Computing
- CSCI 5606 Principles of Numerical Computation
- CSCI 5636 Numerical Solution of Partial Differential Equations
- CSCI 5646 Numerical Linear Algebra
- CSCI 5654 Linear Programming
- CSCI 5676 Numerical Optimization
Bin Two
Choose one: 3
- CSCI 5302  Advanced Robotics
- CSCI 5322  Algorithmic Human-Robot Interaction
- CSCI 5352  Network Analysis and Modeling
- CSCI 5402  Research Methods in Human-Robot Interaction
- CSCI 5502  Data Mining
- CSCI 5616  Introduction to Virtual Reality
- CSCI 5622  Machine Learning
- CSCI 5722  Computer Vision
- CSCI 5822  Probabilistic Models of Human and Machine Learning
- CSCI 5832  Natural Language Processing
- CSCI 5839  User-Centered Design and Development
- CSCI 5849  Input, Interaction, and Accessibility
- CSCI 5922  Neural Networks and Deep Learning

Bin Three:
Choose one: 3
- CSCI 5135  Computer-Aided Verification
- CSCI 5253  Datacenter Scale Computing - Methods, Systems and Techniques
- CSCI 5273  Network Systems
- CSCI 5403  Cybersecurity
- CSCI 5413  Computer Security and Ethical Hacking
- CSCI 5448  Object-Oriented Analysis and Design
- CSCI 5525  Compiler Construction
- CSCI 5535  Fundamental Concepts of Programming Languages
- CSCI 5573  Advanced Operating Systems
- CSCI 5673  Distributed Systems
- CSCI 5753  Computer Performance Modeling
- CSCI 5854  Theoretical Foundations of Autonomous Systems

Project Courses
Complete six credits of projects class from either of the following two options: 6
- CSCI 5340 & CSCI 5350  Startup Essentials: Entrepreneurial Projects in Computing and Entrepreneurial Projects II
- CSCI 5040 & CSCI 5050  Professional Masters Project 1 and Professional Masters Project 2

Additional Coursework
An additional 15 credits are required to complete the degree, with restrictions. 1, 2 15

Total Credit Hours 30

1 Additional coursework may consist of no more than two non-CS classes, except for classes under subplans. (Classes listed under required sub-plans will not be considered against the two non-CS.)

2 Students must seek approval for any non-CS classes outside the College of Engineering and Applied Science or the following pre-approved departments: Applied Mathematics, Business, Geography, Information Science, Mathematics, Linguistics or Physics.

Time Limit
All degree requirements must be completed within four years of the date of commencing coursework. Most students complete the degree in two years.

Subplan Tracks
In addition to the above mentioned required courses, students enrolled in any of the following subplans must also complete the required subplan courses as listed below.

Data Science and Engineering (DSE) (https://www.colorado.edu/cs/data-science-engineering-sub-plan-requirements/)

Core Courses
Choose four:
- CSCI 5253  Datacenter Scale Computing - Methods, Systems and Techniques
- CSCI 5502  Data Mining
- CSCI 5622  Machine Learning
- CSCI 5654  Linear Programming
- ATLS 5214  Big Data Architecture
- CSCI 5254  Convex Optimization and Its Applications
- CSCI 5352  Network Analysis and Modeling
- CSCI 5576  High-Performance Scientific Computing
- CSCI 5676  Numerical Optimization
- CSCI 5722  Computer Vision
- CSCI 5832  Natural Language Processing
- CSCI 5922  Neural Networks and Deep Learning
- CSCI 6502  Big Data Analytics: Systems, Algorithms, and Applications

Human-Centered Computing (HCC) (https://www.colorado.edu/cs/human-centered-computing-sub-plan-requirements/)

Core Courses
Choose five:
- CSCI 5229  Computer Graphics
- CSCI 5239  Advanced Computer Graphics
- CSCI 5402  Research Methods in Human-Robot Interaction
- CSCI 5616  Introduction to Virtual Reality
- CSCI 5809  Computer Animation
- INFO 5501  Open Collaboration
- INFO 5601  Ethical and Policy Dimensions of Information and Technology
- INFO 5602  Information Visualization
- INFO 5603  Survey Research Design
### Core Courses

#### Intelligent Systems (IST)

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<tbody>
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<td>INFO 5611</td>
<td>Ubiquitous Computing Experience Design</td>
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<tr>
<td>CSCI 5839</td>
<td>User-Centered Design and Development</td>
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<td>CSCI 5849</td>
<td>Input, Interaction, and Accessibility</td>
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<tr>
<td>CSCI 5919</td>
<td>HCC Survey and Synthesis: Foundations and Trajectories</td>
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<tr>
<td>CSCI 5929</td>
<td>HCC Survey and Synthesis: New Disciplinary Directions</td>
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<tr>
<td>CSCI 6402</td>
<td>Issues and Methods in Cognitive Science</td>
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<tr>
<td>CSCI 7772</td>
<td>Topics in Cognitive Science</td>
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Intelligent Systems (IST) ([link](https://www.colorado.edu/cs/current-students/graduate-students/ms-degree/professional-ms-degree-requirements/intelligent-systems/))

#### Numerical Computation (NUM)

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<td>Neural Networks and Deep Learning</td>
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<tr>
<td>APPM 8500</td>
<td>Statistics, Optimization and Machine Learning Seminar</td>
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<td>CSCI 5502</td>
<td>Data Mining</td>
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Numerical Computation (NUM) ([link](https://www.colorado.edu/cs/current-students/graduate-students/ms-degree/professional-ms-degree-requirements/numerical/))

#### Robotics (RBT)

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<td>ASEN 6020</td>
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<td>ASEN 6412</td>
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<td>ECEN 5358</td>
<td>Optimization and Optimal Control</td>
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Robotics (RBT) ([link](https://www.colorado.edu/cs/current-students/graduate-students/ms-degree/professional-ms-degree-requirements/robotics-sub-plan/))

#### Software Systems and Cloud Computing (SSC)

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Software Systems and Cloud Computing (SSC) ([link](https://www.colorado.edu/cs/current-students/graduate-students/ms-degree/professional-ms-degree-requirements/software-systems/))

### Dual Degree

**MSCPS/EMEN in Computer Science and Engineering Management**

Computer Science and Engineering Management ([link](https://www.colorado.edu/emp/)) have teamed up to offer an exciting dual degree ([link](https://www.colorado.edu/cs/current-students/graduate-students/ms-degree/dual-professional-ms-engineering-management/)) for MSCPS students. Student complete a total of 45 credits of graduate-level coursework. Of those, 24 credits are in CS courses and 21 credits are in EMEN courses. All degree requirements must be completed within four years of the date of commencing coursework.