Computer Science

College of Engineering, Design and Computing
University of Colorado Denver

These degree requirements are in effect starting from 2023-2024 Admission.

The Department of Computer Science and Engineering (CSE) offers a Master of Science degree in Computer Science as part of the Computer Science and Engineering Graduate Program. The CSE department also offers several graduate certificates, doctorate and undergraduate degrees. For a complete list of degrees, please visit the [CSE website](link) at cse.ucdenver.edu

Research areas of emphasis include: algorithms, automata theory, artificial intelligence, big data management and mining, bio-informatics, cloud computing, communication networks, combinatorial geometry, computational geometry, computer graphics, computer security, computer systems, cyber physical systems, cyber security, database, distributed computing, graph theory, high performance computing, information theory, internet, mobile computing, mobile health systems, machine learning, parallel processing, simulation, and software engineering.

MS in Computer Science Degree Requirements

For students interested in our master's degree program, please see the [College of Engineering, Design and Computing Graduate Admissions website](link) for admission requirements and deadlines.

Applicants for graduate study in computer science must hold a B.S. or B.A. degree or equivalent, have considerable computing experience, sufficient mathematical background and show promise of the ability to pursue advanced study and research.

For students that satisfy the admissions criteria but are lacking some CS foundational courses: A specific plan of study is devised in your admission plan specifying the CS foundational courses to be completed with a minimum grade of B. To register for foundational courses, you will need to submit a [course permissions request](link). In addition to these courses, you will need to complete a minimum of 30 credit hours to satisfy the program requirements. **Foundational courses cannot be waived and must be completed before beginning graduate coursework**.

Master's degree candidates are required to complete a program of study consisting of a minimum of 30 semester hours of graduate level computer science courses while maintaining a cumulative grade point average of at least 3.0. Graduate courses with grades below B- cannot be applied towards the completion of the graduate degree. **If a student receives lower than a B- they cannot retake the same course; they must take a different course in order to fill the Category requirements.**

Students are responsible for completing all requirements towards graduation. Regular visits with a CSE advisor are expected and will help to verify satisfactory progress towards a degree in computer science. Students should start their MS Plan of Study during their first semester of study and update it consistently. It is recommended that students get to know CSE faculty well enough that they can serve as future references.

Students who do not enroll for any course work for three consecutive semesters (including summer) will be discontinued and need to reapply to the program. Students are expected to finish the MS degree program within 5 years. Students who wish to receive credit for a course taken longer than five years before their graduation date will require evaluation and CSE graduate committee approval.

In their final semester, students must **apply for graduation through UCD Access before the census date, complete an application for candidacy and** meet with their advisor for a **graduation check.**

MSCS Graduate Course Categories

MS courses are divided into 3 categories: A, B and C. The number of credit hours required in each category depend on the student's plan (thesis, project or course only). Students must consult with their advisor to develop a MS Plan of Study during their first semester. Students should consult with their faculty advisor for course selection and update their plan of study as needed. Each semester a MS Course List with the A, B and C courses being offered is posted on the [CSE Student Resources website](#).

Category A (Core Courses)
Category A courses are offered on a rotation with two taught each semester. Students will need to complete at least 3 Category A courses as part of their degree.

- CSCI 5446 Theory of Automata (fall)
- CSCI 5451 Algorithms (fall)
- CSCI 5593 Advanced Computer Architectures (spring)
- CSCI 5573 Operating Systems (spring)

Category B (Breadth Courses)
Breadth courses are taught by full-time faculty in the CSE Department. Category B courses offered vary from semester to semester.

Category C
Category C courses include CSCI 5010, CSCI 5011 and courses taught by part time or non-computer science faculty. Students must choose a MS Plan (Plan I, II or III) before taking Category C courses.

Students may take courses from Mathematics and other Engineering departments as Category C courses with prior approval of the CSE Graduate Committee. In order to get approval, the student must meet with their advisor and supply a syllabus for the course. If their advisor

supports the request, they will then forward it to the CSE Graduate Committee. The decision of the CSE Graduate Committee will be communicated via email and is final.

Transfer of Credit:
A maximum of nine semester hours of graduate course work may be transferred into the program based on department approval. Transfer credits must be requested before beginning their CU Denver coursework. These courses are individually evaluated by the CSE Graduate Committee. Core courses must be taken from the CSE department at CU Denver.

Internships:
Internships are available to students who have completed at least **2 category A courses** and have a cumulative GPA of **3.0.** International students must register for CSCI 5939 Internship in order to qualify for CPT. Internship credit will **not** be counted towards MSCS degree requirements.

MS Plans:

Students may choose Plan I (thesis), Plan II (project), or Plan III (course only). Plans I and II require successful defense of thesis or project in the student's graduating semester. Students in Plan I and II are responsible for selecting their committee members (in consultation and approval of their advisor), scheduling their oral exam and submitting their exam request two weeks before the posted deadline. Plan III requires successful completion of a final MS course project.

Plan I – Thesis: Students will write and defend a thesis**.** Students **MUST** be accepted by a research advisor to sponsor their thesis before their second year of study.

Students in the thesis plan have priority in obtaining departmental assistantships.

Students choosing to complete the Data Science and Biomedicine Track must follow the curriculum requirements in that track. Please refer to the section "Data Science in Biomedicine Track on page 5.

Students in Plan I will complete the following:
- A minimum of 9 credits in Category A.
- A minimum of 9 credits in Category B.
- 6 credits of MS thesis.

A maximum of 6 credits of Independent study can be applied with the approval of their faculty research advisor.

*Students can choose to complete all 4 Category A courses, or take an additional Category B to support their research if needed to reach the 30 graduate level credits required.

Plan II – MS Project: Students will write and defend a MS project. **MUST** be accepted by a research advisor to sponsor their project before their second year of study.

> Students in Plan II will complete the following:
- A minimum of 9 credits in Category A.
- A minimum of 12 credits in Category B.
- 3 credits of MS project.

A maximum of 3 credits of Independent study can be applied with the approval of their faculty research advisor.

* Students can choose to complete all 4 Category A courses, or take an additional Category B to support their research if needed to reach the 30 graduate level credits required.

Plan III – Course Only: Students in this plan must complete a MS course project. Students should complete their CSCI 6970 MS Course Project <u>after</u> completing 9 credits in Category A. If a student wishes to enroll in their final Category A course concurrently with CSCI 6970, they must obtain advisor approval and submit this approval to the Graduate Coordinator.

> Students in Plan III will complete the following:
- A minimum of 9 credits in Category A.
- A minimum of 12 credits in Category B.
- Successful completion of CSCI 6970 MS Course Project (0 credit hours)

Independent Study is not allowed.

*Students can satisfy all 30 credits by taking all credits needed in Category A and B or elect to take the final credits in Category C. (For example; students completing their Software Engineering certificate.)

Final MS Course Project:
- The MS course project is an **individually written final report documenting research, implementation, results, analysis, and mastery of the subject.** It must demonstrate scholarly/scientific knowledge acquired over the course of their MS studies
- A list of approved MS courses to complete the course project will be available on the in the CSE department [CSE Student Resources website](#) each semester before registration begins.
- Students must register for CSCI 6970 the semester they complete their MS course project. All work related to the MS course project will be submitted to CSCI 6970 on Canvas.
- The final course project must meet the following requirements:
    1. Must be an individual semester term project.
    2. Must demonstrate mastery of the subject.

3. Must demonstrate scholarly/scientific knowledge acquired over the course of their MS studies.
4. Must require significant research and implementation.
5. Must include documented research, implementation, results, analysis, and a bibliography.

MS Advising

Each student is assigned an academic advisor at the beginning of their studies. Students in Plan III may not change academic advisors.

Students in Plan I and Plan II will need to find a Research Advisor to sponsor their thesis/project before the end of their first year. Their research advisor must be full-time Computer Science and Engineering faculty member with a graduate faculty appointment. Their research advisor will supervise their thesis/project and independent study coursework. Students research advisor will chair their defense committee. Students defense committees must consist of at least three members, two of whom must be CSE graduate faculty members.

Part time CSE faculty, non-tenure track CSE faculty or tenured/tenure-track faculty from outside of the CSE department may co-advise and/or serve on the defense committee with the approval of the research advisor.

Data Science in Biomedicine Track (Plan I)

The Data Science in Biomedicine Track is offered under the Computer Science Master of Science degree program for students who choose Plan I - Thesis. It is best to plan out the track starting the first year to ensure timely graduation and availability of electives.

Track Requirements

- Students must complete 36 credit hours including Plan I requirements.
- Students will complete an additional 9 credits of electives from a list of courses related to Biomedical Computing and Informatics, Bioinformatics, Health Informatics, etc. (meet with an advisor for current course offerings).
- Category B courses must be selected among CS courses focused on data science and engineering and be approved by the program director, Dr. Banaei-Kashani.
- Write a thesis with a focus on Data Science in Biomedicine.

Graduate Certificates

Graduate Certificate in Software Engineering

Students interested in completing a graduate certificate in Software Engineering should

follow Plan III- Course Only option.

Certificate Objectives

To provide working or career-oriented students with knowledge and practice of the applied skills needed to become successful software engineers. The learning outcomes are:

- Learn basic knowledge of software requirements analysis and development.
- Learn advanced skills for various techniques in software requirement analysis.
- Learn how to design large scale complex systems and enterprise data systems
- Master skills for development and management of large complex systems: software planning, estimations, staffing, and scheduling.

Process to Attain Certificate Objectives

Students are required to take the following courses:
- Software Architecture (CSCI 5010)
- Software Project Management (CSCI 5011)
- CSCI 5573 (Operating Systems) or CSCI 5593 (Advanced Computer Architectures

Students must take and pass each course with a grade of B- or better and earn a GPA of at least 3.0 to obtain the Software Engineering Certificate.

Graduate Certificate in Cyber Security and Defense

[The Graduate Certificate in Cyber Security and Defense](#) prepares computer science professionals to identify, analyze and mitigate technical cybersecurity related vulnerabilities, exploits and attacks against network and critical cyber infrastructure. The coursework emphasizes practical technical skills, analysis and research focused on current cybersecurity issues

Certificate Objectives

This certificate program focuses on both the technical and analytical aspects of advanced cyber security and defense. The learning outcomes are:

- Learn how to mitigate known cyber-related attaches against multiple network and infrastructure devices.
- Learn how to design secure solutions and analyze new cyber-attacks.
- Provide solutions that balance risk, security, privacy, cost and operations.

Program Learning Outcomes

1. Demonstrate an in-depth understanding of cybersecurity principles and practices.
2. Identify and analyze various types of cyber and infrastructure threats and apply basic cybersecurity defense concepts to develop and assess defensive solutions against them.
3. Apply cybersecurity knowledge and skills to maintain operations in the presence of risks.

4. Understand the national needs in the area of cybersecurity and learn the necessary skills to advance their careers as practicing cybersecurity professionals.
5. Understand their professional responsibilities and make informed judgments in their cybersecurity practices based on legal and ethical principles.

Process to Attain Certificate Objectives
Students are required to take the following courses:
- CSCI 5742 —3 credits - Cybersecurity Programming and Analysis
- CSCI 5743 —3 credits – Cyber and Infrastructure Defense
- CSCI 5573 —3 credits – Operating Systems
- CSCI 5765 - 3 credits – Computer Networks

Students must take and pass each course with a grade of B- or better and earn a GPA of at least 3.0 to obtain the Cyber Security and Defense Certificate.

Student Responsibilities

Failure to deviate from any of these plans of study may delay your graduation. All students are responsible for adhering to the Academic Calendar, the Computer Science MS Handbook, as well as any specific Graduate student dates and deadlines published each semester.

ALL new MS students must attend the orientation that is held during the week before the start of every semester. This date will be finalized, sent out via email and published on social media sites.

Students must meet with their assigned advisor and prepare a plan of study by the end of their first semester.
- o Changes can be made to the plan of study if needed during the course of study.
- o All changes must be approved by the advisor.

Students in their final semester, must apply for graduation by completing the following items;

1. **Apply for Graduation** through UCD Access before census date the semester they are graduating.
2. **MSCS Application for Candidacy**- This form is available in the department as well as on our student resource page and must be turned in before census date the semester they are graduating.
   a. This **MUST** be completed with advisor approval before submitting it to the department.
   b. Students on the MS Thesis or Project track must submit the request for Examination by the posted deadline

For answers to more frequently asked questions, please refer to our FAQ page on our website; engineering.ucdenver.edu

Contact Information:

Please contact the CSE Department for information, appointments, and inquiries:

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