COMPUTER SCIENCE, MS

Banner Code: EC-MS-CS

Academic Advising

Phone: 703-993-1530
Email: csgrad@gmu.edu
Website: http://cs.gmu.edu/prospective-students/ms-programs/ms-in-cs/

The Computer Science graduate program prepares students for research and professional practice in computer science and related technologies. The program includes both fundamentals and advanced work in the areas of artificial intelligence and databases, programming languages and software engineering, systems and networks, theoretical computer science, and visual computing. Graduate classes are divided into basic classes, which have no graduate course prerequisite, and advanced classes, which have a graduate class as a prerequisite. Graduate classes are generally offered in the late afternoon and evening. Financial aid in the form of graduate assistantships may be available for full-time degree-seeking students.

Admissions & Policies

Admissions

In addition to fulfilling Mason's admission requirements for graduate study, applicants must hold a four-year (120-credit minimum) baccalaureate degree in an appropriate discipline from an accredited institution and have earned a GPA of 3.00 or better in the last 60 credits of undergraduate study.

Applicants must also submit the following:

- Transcripts of all post secondary education
- A one-page statement of educational and career goals
- A current resume
- Two letters of recommendation, preferably from instructors
- Internationally-educated applicants must submit an English Proficiency Exam Score (https://www2.gmu.edu/admissions-aid/how-apply/graduate/standardized-test-information/), if applicable
- The baccalaureate degree must include the following subjects:
  - Calculus I and II (equivalent to MATH 113 Analytic Geometry and Calculus I (Mason Core) (http://catalog.gmu.edu/mason-core/) and MATH 114 Analytic Geometry and Calculus II)
  - Introductory and Object-Oriented Programming (equivalent to CS 112 Introduction to Computer Programming (Mason Core) (http://catalog.gmu.edu/mason-core/) and CS 211 Object-Oriented Programming)
  - Discrete Mathematics (equivalent to MATH 125 Discrete Mathematics I (Mason Core) (http://catalog.gmu.edu/mason-core/)
  - Computer Architecture including Assembly Language (equivalent to CS 367 Computer Systems and Programming)
  - Data Structures and Algorithms (equivalent to CS 310 Data Structures)

- Automata Theory and Formal Languages (equivalent to CS 330 Formal Methods and Models)

Alternatively, students may take equivalent courses after their undergraduate program and before applying to the MSCS program, and submit appropriate transcripts. George Mason's School of Computing offers the following foundation courses, which students can use to bridge into the MS CS program:

- Introductory and Object-Oriented Programming: COMP 501 Computer Programming Foundations I
- Discrete Mathematics: COMP 502 Mathematical Foundations of Computing I
- Computer Architecture: COMP 503 Computer Systems Foundations I
- Data Structures and Algorithms: COMP 511 Computer Programming Foundations II
- Automata Theory and Formal Languages: COMP 512 Mathematical Foundations of Computing II

The COMP bridge courses can be taken in non-degree status, provisional status, while enrolled in the Foundations of Computing (bridge) program, or while enrolled in a different MS program. Students who earn a B or better in all the foundation courses they did not have in their undergraduate degree can then apply for full admission into the MSCS program. Eligible domestic students who lack one or more foundation courses may be admitted provisionally and may be required to take the appropriate foundation courses before converting to full degree status.

Requirements

Degree Requirements

Total credits: 30

Required Courses and Plan of Study

In addition to general university requirements, students must complete 30 approved graduate credits (10 courses), divided into five core (required) basic courses, four advanced constrained elective courses, and one constrained elective.

Students must take the two core courses of CS 530 Mathematical Foundations of Computer Science and CS 531 Computer Systems and Fundamentals of Systems Programming as early as possible, preferably as their first two courses in the program.

Students with a strong academic background in computer science may have CS 530 and CS 531 substituted for other elective courses at the discretion of the program director. Students enrolled in PhD CS or the Bachelor's-Accelerated Master's program cannot take CS 530 or CS 531 for credit. Students may also demonstrate that they have the requisite knowledge corresponding to CS 530 or CS 531 by passing an exam. The exams are given before classes begin in January and August, and can only be taken once. Students who fail either one of the exams must take the course in their first semester. Students who successfully test out of CS 530 or CS 531 will be required to fulfill the credit requirement with other coursework chosen under advisement.

Courses are grouped into five areas: Artificial Intelligence and Databases, Programming Languages and Software Engineering, Systems and

Networks, Theoretical Computer Science, and Visual Computing. These areas apply at both the basic and the advanced level.

All the following requirements should be satisfied for the MS in CS degree:

- **Core**: Students must take CS 583 Analysis of Algorithms (from the Theoretical Computer Science area) and two additional core courses from two other areas. Core courses must be successfully completed with a grade of B- or higher. Students receiving lower than a B- must retake the course, or choose a different core course and use the B- grade as an elective.
- **Advanced**: At least four courses (12 credits) must be chosen from the advanced courses in the list given below. These four courses must come from at least two different areas.
- **CS designation**: At least six courses, two of which must be advanced, must be designated CS.
- **Alternative electives**: Up to two courses that are not on the list of pre-approved courses may be taken with prior approval of the program director.

Plan of Study

Before the end of the first semester, students must have a plan of study approved by their academic advisor.

Core Courses by Area

Code	Title	Credits
Artificial Intelligence and Databases		
CS 550	Database Systems	
CS 580	Introduction to Artificial Intelligence	
CS 584	Theory and Applications of Data Mining	
Programming Languages and Software Engineering		
CS 540	Language Processors	
SWE 619	Object-Oriented Software Specification and Construction	
SWE 621	Software Design and Architecture	
Systems and Networks		
CS 555	Computer Communications and Networking	
CS 571	Operating Systems	
ISA 562	Information Security Theory and Practice	
Theoretical Computer Science		
CS 583	Analysis of Algorithms [1]	
Visual Computing		
CS 551	Computer Graphics	

[1] Must be successfully completed with a grade of B- or better

Basic and Advanced MS CS Electives by Area

Code	Title	Credits
Artificial Intelligence and Databases		
Basic Courses:		
CS 550	Database Systems	
CS 580	Introduction to Artificial Intelligence	
CS 584	Theory and Applications of Data Mining	
INFS 623	Web Search Engines and Recommender Systems	
Advanced Courses:		
CS 650	Advanced Database Management	
CS 657	Mining Massive Datasets with MapReduce	
CS 667	Biometrics and Identity Management	
CS 678	Advanced Natural Language Processing	
CS 681	Instructable Cognitive Agents	
CS 685	Autonomous Robotics	
CS 687	Advanced Artificial Intelligence	
CS 688	Machine Learning	
CS 689	Planning Motions of Robots and Molecules	
CS 690	Special Topics in Artificial Intelligence and Databases	
CS 747	Deep Learning	
CS 782	Advanced Machine Learning	
CS 787	Decision Guidance Systems	
INFS 740	Database Programming for the World Wide Web	
INFS 760	Advanced Database Management	
INFS 772	Intelligent Agents and the Semantic Web	
INFS 774	Enterprise Architecture	
Programming Languages and Software Engineering		
Basic Courses:		
CS 540	Language Processors	
SWE 619	Object-Oriented Software Specification and Construction	
SWE 620	Software Requirements Analysis and Specification	
SWE 621	Software Design and Architecture	
SWE 622	Distributed Software Engineering	
SWE 625	Software Project Management	
Advanced Courses:		
CS 640	Advanced Compilers	
CS 691	Special Topics in Programming Languages and Software Engineering	
SWE 631	Software Design Patterns	
SWE 632	User Interface Design and Development	
SWE 637	Software Testing	
SWE 642	Software Engineering for the World Wide Web	
SWE 645	Component-Based Software Development	
SWE 681	Secure Software Design and Programming	
or ISA 681	Secure Software Design and Programming	
SWE 699	Special Topics in Software Engineering	
SWE 721	Reusable Software Architectures	
SWE 737	Advanced Software Testing	
SWE 760	Software Analysis and Design of Real-Time Systems	
SWE 795	Advanced Topics in Software Engineering	
SWE 796	Directed Readings in Software Engineering	
Systems and Networks		

Basic Courses:

CS 531	Computer Systems and Fundamentals of Systems Programming
CS 555	Computer Communications and Networking
CS 571	Operating Systems
CS 587	Introduction to Cryptography
ISA 562	Information Security Theory and Practice
ISA 564	Security Laboratory

Advanced Courses:

CS 635	Foundations of Parallel Computation
CS 655	Wireless and Mobile Computing
CS 658	Networked Virtual Environments
CS 672	Computer System Performance Evaluation
CS 673	Multimedia Computing and Systems
CS 675	Distributed Systems
CS 692	Special Topics in Systems and Networks
CS 706	Concurrent Software Systems
CS 719	Scalable Internet Services
CS 756	Performance Analysis of Computer Networks
CS 773	Real-Time Systems Design and Development
CS 779	Topics in Resilient and Secure Computer Systems
CS 788	Autonomic Computing
ISA 656	Network Security
ISA 673	Operating Systems Security
ISA 674	Intrusion Detection
ISA 697	Topics in Information Security
ISA 763	Security Protocol Analysis
ISA 764	Security Experimentation
ISA 785	Research in Digital Forensics
SWE 660	Software Engineering for Real-Time Embedded Systems

Theoretical Computer Science

Basic Courses:

CS 530	Mathematical Foundations of Computer Science
CS 583	Analysis of Algorithms

Advanced Courses:

CS 600	Theory of Computation
CS 630	Advanced Algorithms
CS 633	Computational Geometry
CS 683	Parallel Algorithms
CS 684	Graph Algorithms
CS 693	Special Topics in Theoretical Computer Science

Visual Computing

Basic Courses:

CS 551	Computer Graphics

Advanced Courses:

CS 662	Computer Graphics Game Technologies
CS 663	Computational Design
CS 664	Virtual Reality
CS 667	Biometrics and Identity Management
CS 682	Computer Vision
CS 686	Image Processing and Applications
CS 694	Special Topics in Visual Computing
CS 752	Interactive Graphics Software
CS 774	Computational Vision
CS 777	Human-Computer Intelligent Interaction

Elective courses not classified by area [1]

Basic Courses

CS 595	Basic Topics in Computer Science

Advanced Courses

CS 695	Special Topics in Computer Science
CS 697	Independent Reading and Research
CS 795	Advanced Topics in CS
CS 798	Research Project
CS 799	MS Thesis
CS 895	Research Topics in CS

[1]   Unclassified courses can be classified into an area with approval from the Program Director or Associate Chair.

Project or Thesis

With approval from a faculty advisor and the Program Director or Associate Chair, six credit hours of the advanced classes may be replaced by a thesis. A thesis must be advised by a member of the Graduate Faculty who is a full-time or affiliate member of the CS Department. A thesis committee must be formed, consisting of the thesis advisor and two members of the Graduate Faculty, at least one of whom must be in the CS Department. An MS thesis must have a research component and must result in a written document, and may include software. An MS thesis usually spans two semesters and the student takes three credits of CS 799 in each semester.

Three credits of the advanced classes may be replaced by a project. A project must be advised by a member of the Graduate Faculty who is a full-time or affiliate member of the CS Department. An MS project must result in a written document, and may include software.

Requests for either a project or a thesis must be initiated by the thesis advisor, and approved by the CS Department Chair or delegate.

Code	Title	Credits
Select one from the following:		
CS 798	Research Project (3 credits)	
CS 799	MS Thesis (6 credits)	

Concentration in Cyber Security (CYSC)

Students must take 5 courses from the following categories:

Code	Title	Credits
Required:		
ISA 656	Network Security	3
ISA 562	Information Security Theory and Practice	3
Choose 2-3 elective courses:		6-9
CS 587	Introduction to Cryptography	

ISA 564	Security Laboratory	
ISA 673	Operating Systems Security	
ISA 674	Intrusion Detection	
SWE 637	Software Testing	
SWE 681	Secure Software Design and Programming	
or ISA 681	Secure Software Design and Programming	
ISA 763	Security Protocol Analysis	
ISA 764	Security Experimentation	
Choose 0-1 related course:		0-3
CS 540	Language Processors	
CS 555	Computer Communications and Networking	
CS 571	Operating Systems	
CS 600	Theory of Computation	
CS 655	Wireless and Mobile Computing	

Thesis (optional):

If a student in a concentration choose a thesis option, the 6 credits of CS 799 MS Thesis can replace two electives or related courses in the concentration.

Concentration in Machine Learning (ML)

Students must take 5 courses from the following categories:

Code	Title	Credits
Required:		
CS 584	Theory and Applications of Data Mining	3
CS 688	Machine Learning	3
Choose 2-3 elective courses:		6-9
CS 657	Mining Massive Datasets with MapReduce	
CS 678	Advanced Natural Language Processing	
CS 681	Instructable Cognitive Agents	
CS 747	Deep Learning	
CS 782	Advanced Machine Learning	
Choose 0-1 related course:		0-3
CS 580	Introduction to Artificial Intelligence	
CS 687	Advanced Artificial Intelligence	
CS 685	Autonomous Robotics	
CS 682	Computer Vision	

Thesis (optional):

If a student in a concentration choose a thesis option, the 6 credits of CS 799 MS Thesis can replace two elective or related courses in the concentration.

Accelerated Master's

Applied Computer Science, BS/Computer Science, Accelerated MS

Overview

Highly-qualified students in the Applied Computer Science, BS (http://catalog.gmu.edu/colleges-schools/engineering/computer-science/applied-computer-science-bs/) can complete both a BS-ACS and a Computer Science, MS (http://catalog.gmu.edu/colleges-schools/engineering/computer-science/computer-science-ms/) in five years through the BS-MS accelerated (BAM) program.

General BAM policies are in the catalog under AP.6.7 Bachelor's/Accelerated Master's Degrees (http://catalog.gmu.edu/policies/academic/graduate-policies/#ap-6-7). Policies governing all graduate degrees are in the catalog under AP.6 Graduate Policies (http://catalog.gmu.edu/policies/academic/graduate-policies/).

Admission Requirements

Students in the Applied Computer Science, BS (http://catalog.gmu.edu/colleges-schools/engineering/computer-science/applied-computer-science-bs/) program are encouraged to apply to the BAM program after earning 60 undergraduate credits with an overall GPA of at least 3.30. Students must have successfully completed CS 310 Data Structures and CS 330 Formal Methods and Models.

Accelerated Option Requirements

Students accepted to the BAM program may earn up to 12 credits of graduate coursework that count towards both the BS and MS degrees. They may begin taking graduate courses after completing 75 undergraduate credits and successfully completing CS 367 Computer Systems and Programming.

The following graduate courses can replace the corresponding undergraduate courses.

Code	Title	Credits
CS 540	Language Processors (to replace CS 440)	3
CS 550	Database Systems (to replace CS 450)	3
CS 551	Computer Graphics (to replace CS 451)	3
CS 555	Computer Communications and Networking (to replace CS 455)	3
CS 571	Operating Systems (to replace CS 471)	3
CS 580	Introduction to Artificial Intelligence (to replace CS 480)	3
CS 584	Theory and Applications of Data Mining (to replace CS 484)	3
CS 583	Analysis of Algorithms (to replace CS 483)	3
CS 587	Introduction to Cryptography (to replace CS 487)	3
SWE 619	Object-Oriented Software Specification and Construction (to replace SWE 419)	3
SWE 637	Software Testing (to replace SWE 437)	3
SWE 642	Software Engineering for the World Wide Web (to replace SWE 432)	3

Notes:

- Students may not use both the graduate course and the undergraduate alternative for their BS degree.
- Students must satisfy all recommended and required prerequisites for the graduate courses they take.
- Students also have the option to take up to 6 additional credits of graduate coursework *on reserve*, which can be used for the MS degree only.

Degree Conferral

Students must apply for degree conferral the semester before they expect to complete their BS requirements. At the beginning of their final undergraduate semester, students must submit a completed Bachelor's-Accelerated Master's Transition form to the CS department office. The master's degree will be conferred after the student completes the MS requirements.

Computer Science, BS/Computer Science, Accelerated MS

Overview

Highly-qualified students in the Computer Science, BS (http://catalog.gmu.edu/colleges-schools/engineering-computing/school-computing/computer-science/computer-science-bs/) can complete both a BS-CS and a Computer Science, MS in five years through the BS-CS accelerated (BAM) program.

General BAM policies are in the catalog under AP.6.7 Bachelor's/Accelerated Master's Degrees (http://catalog.gmu.edu/policies/academic/graduate-policies/#ap-6-7). Policies governing all graduate degrees are in the catalog under AP.6 Graduate Policies (http://catalog.gmu.edu/policies/academic/graduate-policies/).

Admission Requirements

Students in the Computer Science, BS (http://catalog.gmu.edu/colleges-schools/engineering-computing/school-computing/computer-science/computer-science-bs/) program are encouraged to apply to the BAM program after earning 60 undergraduate credits with an overall GPA of at least 3.30. Students must also have successfully completed CS 310 Data Structures and CS 330 Formal Methods and Models.

Accelerated Option Requirements

Students accepted to the BAM program may earn up to 12 credits of graduate coursework that count towards both the BS and MS degrees. They may begin taking graduate courses after completing 75 undergraduate credits and successfully completing CS 367 Computer Systems and Programming.

The following graduate courses can replace the corresponding undergraduate courses.

Code	Title	Credits
CS 540	Language Processors (to replace CS 440)	3
CS 550	Database Systems (to replace CS 450)	3
CS 551	Computer Graphics (to replace CS 451)	3
CS 555	Computer Communications and Networking (to replace CS 455)	3
CS 571	Operating Systems (to replace CS 471)	3
CS 580	Introduction to Artificial Intelligence (to replace CS 480)	3
CS 583	Analysis of Algorithms (to replace CS 483)	3
CS 584	Theory and Applications of Data Mining (to replace CS 484)	3
CS 587	Introduction to Cryptography (to replace CS 487)	3
SWE 619	Object-Oriented Software Specification and Construction (to replace SWE 419)	3
SWE 637	Software Testing (to replace SWE 437)	3
SWE 642	Software Engineering for the World Wide Web (to replace SWE 432)	3

Notes:

- Students may not use both the graduate course and the undergraduate alternative for their BS degree.
- Students must satisfy all recommended and required prerequisites for the graduate courses they take.
- Students also have the option to take up to 6 additional credits of graduate coursework, on reserve, which can be used for the MS degree only.

Degree Conferral

Students must apply for degree conferral the semester before they expect to complete their BS requirements. At the beginning of their final undergraduate semester, students must submit a completed Bachelor's-Accelerated Master's Transition form to the CS department office. The master's degree will be conferred after the student completes the MS requirements.