

Computer Science, Additional Major

Additional Major in Computer Science

Overview

Students interested in pursuing an additional major in Computer Science should first consult with the Program Coordinator in the CS Undergraduate Office. Students are expected to complete the requirements for the CS minor first before continuing to the additional major. Completion of the CS additional major requires 12 computer science courses (not including 15-110 and 15-112 if needed), 5 mathematics courses, and 1 technical communication course.

Declaration for the additional major is allowed only after all math requirements are completed or in progress, and at least 9 of the 12 CS requirements (core and electives) are completed or in progress with an average QPA of 3.0 or higher. Due to high demand, seats in upper-level CS courses are not guaranteed for additional majors; students should plan to be flexible when selecting constrained and general electives. Acceptance to complete a Computer Science additional major is not guaranteed and depends on student performance and seat availability.

Curriculum

The following courses are required for the Additional Major in Computer Science:

Computer Science requirements (12 courses):

Core courses (all are required):		Units
15-122	Principles of Imperative Computation	12
15-150	Principles of Functional Programming	12
15-210	Parallel and Sequential Data Structures and Algorithms	12
15-213	Introduction to Computer Systems	12
15-251	Great Ideas in Theoretical Computer Science	12
15-451	Algorithm Design and Analysis	12
One Artificial Intelligence elective (minimum 9 units). Students will be able to tackle complex, real-world problems using techniques from Artificial Intelligence, including symbolic and probabilistic reasoning, machine learning, optimization, and perception.		Units
07-280	Artificial Intelligence and Machine Learning I	12
10-301	Introduction to Machine Learning	12
11-411	Natural Language Processing	12
11-485	Introduction to Deep Learning	12
15-382	Collective Intelligence (Note: 15-382 is ONLY offered at Carnegie Mellon in Qatar.)	9
15-386	Neural Computation	9
16-280	Intelligent Robot Systems	12
16-384	Robot Kinematics and Dynamics	12
16-385	Computer Vision	12
One Domains elective (minimum 9 units). Students will gain expertise in fundamental principles from a larger domain of computer science not already represented by other constrained categories, currently logic and languages, systems, and artificial intelligence (which includes machine learning, language technologies, and robotics). Students will be able to apply theoretical and computational techniques from the Computer Science core to an introductory study of another major subarea of Computer Science.		Units
02-251	Great Ideas in Computational Biology or 02-180 & 02-181	12
05-391	Designing Human Centered Software or 05-180 & 05-431	12
11-324	Human Language for Artificial Intelligence	12
15-322	Introduction to Computer Music	9
15-330	Introduction to Computer Security	12
15-362	Computer Graphics	12

15-455	Undergraduate Complexity Theory	9
17-313	Foundations of Software Engineering	12
One Logic & Languages elective (minimum 9 units). Students will master techniques for rigorous, formal reasoning about programs or systems, rooted in their logical foundations.		Units
15-311	Logic and Mechanized Reasoning	9
15-312	Foundations of Programming Languages	12
15-316	Software Foundations of Security and Privacy	9
15-317	Constructive Logic	9
15-414	Bug Catching: Automated Program Verification	9
17-355	Program Analysis	12
17-363	Programming Language Pragmatics	12
80-413	Category Theory	9

One Systems elective (minimum 12 units). Students will 1. be able to describe how the properties of modern hardware (e.g., processor architecture, networks, storage) influence the design and implementation of software systems, such as through reasoning about concurrency and performance. 2. be able to analyze failures and / or resource limitations of physical systems and plan for their mitigation or management. 3. be able to develop abstractions based on lower-level primitives to manage the failures or other difficulties inherent in working with hardware. 4. demonstrate their learning through significant project / system implementations, requiring both course-specific knowledge as well as general system-building skills (i.e., not just programming, but also design, debugging, testing, etc.). The programming tasks together constitute a significant fraction of the course grade (e.g., 40% or more).		Units
15-410	Operating System Design and Implementation	15
15-411	Compiler Design	15
15-418	Parallel Computer Architecture and Programming	12
15-440	Distributed Systems	12
15-441	Networking and the Internet	12
15-445	Database Systems	12

Two School of Computer Science electives (minimum 18 units): These electives can be from any SCS department (Computer Science [15-xxx], Computational Biology [02-xxx], Human-Computer Interaction [05-xxx], SCS Interdisciplinary [07-xxx], Machine Learning [10-xxx], Language Technologies [11-xxx], Robotics [16-xxx], or Software & Societal Systems [17-xxx]). They must be 200-level or above and at least 9 units each, with the following exceptions:

ADDITION: 15-195 and 15-295 can be combined to count as one SCS elective.

DELETIONS: 1) the following courses do NOT count as SCS electives: 02-201, 02-223, 02-250, 02-261, 05-200, 07-300, 07-402, 10-202, 11-423, 15-351, 16-211, 16-223, 16-224, 16-375, 16-376, 16-377, 16-397, 16-480, 16-730, 17-200, 17-333, 17-416, 17-562; 2) some IDEATe courses and some SCS undergraduate and graduate courses might not be allowed based on course content. Always consult with a CS undergraduate advisor before registration to determine eligibility for this requirement.

Math requirements (minimum 5 courses):

All of the following courses:		Units
21-120	Differential and Integral Calculus	10
21-122	Integration and Approximation	10
21-127	Concepts of Mathematics	12
or 21-128	Mathematical Concepts and Proofs	
21-241	Matrices and Linear Transformations	11
or 21-242	Matrix Theory	
21-259	Calculus in Three Dimensions	10
or 21-266	Vector Calculus using Matrix Algebra	
or 21-268	Multidimensional Calculus	
or 21-269	Vector Analysis	
Plus one of the following:		
15-259	Probability and Computing	12

21-325	Probability	9
21-425	Probability and Martingales	9
36-218	Probability Theory for Computer Scientists	9
36-226	Introduction to Statistical Inference (for students already taking 36-219 or 36-225)	9

Technical Communication requirement (1 course)

Learning Objectives:

- Audience: Students will be able to analyze the audience or audiences of a work: who the stakeholders are, what those stakeholders are trying to accomplish, and how persuasive communication can help students achieve their goals.
- Written Mechanics: Students will practice developing their professional writing voice, paying attention to spelling, grammar, style, and the use of visual information.
- Adaptation: Students will be able to adapt expert-level information for a general audience, across textual, graphical, and oral presentation.
- Genres/Templates: Students will practice developing information in a variety of communication contexts, connecting areas of content in their own voice, and leading the reader through a cogent sequence of ideas while working within the constraints of a particular genre or template.
- Peer Review: Students will practice reading and revising the work of themselves and their peers.
- Oral Presentation Mechanics: Students will prepare for the real-time act of presenting to an audience, including delivery, practice, venue setup, and managing presentation support (slides, props, etc.).
- Oral Presentation Development: Students will explore formal and informal modes of communication, selecting, organizing and explaining information for a real-time audience, and increasing clarity with use of structure and style.
- Group Work: Students will practice skills to help them work as a team, stay on track, and produce a group deliverable.

One Technical Communications course:		Units
07-300	Research and Innovation in Computer Science	9
17-200	Ethics and Policy Issues in Computing	9
76-270	Writing for the Professions	9

Double-Counting Restriction

Students pursuing an Additional Major in Computer Science must complete all requirements listed above. In addition, at most 5 of the 12 computer science requirements can be double counted toward all other declared majors and minors. The mathematics and technical communication requirements can be double counted without restriction. Students, especially from interdisciplinary majors or with multiple majors or minors, are urged to consult with the Computer Science Program Director or the Undergraduate Program Coordinator in the CS Undergraduate Office to determine double-counting restrictions specific to their own situations.