

COMPUTER SCIENCE, BS

Degree: Bachelor of Science (BS)

Major: Computer Science

Program Overview

These programs provide students with a strong background in the fundamentals of mathematics and science. Students can use their technical and open electives to pursue concentrations in software engineering, algorithms, artificial intelligence, databases, data mining, bioinformatics, security, computer systems, and computer networks. In addition to an excellent technical education, all students in the department are exposed to societal issues, ethics, professionalism, and have the opportunity to develop leadership and creativity skills.

The Bachelor of Science degree program in computer science is designed to give a student a strong background in the fundamentals of mathematics and computer science. The curriculum is designed according to the latest ACM/IEEE computer science curriculum guidelines. A graduate of this program should be able to use these fundamentals to analyze and evaluate software systems and the underlying abstractions upon which they are based. A graduate should also be able to design and implement software systems that are state-of-the-art solutions to a variety of computing problems; this includes problems that are sufficiently complex to require the evaluation of design alternatives and engineering trade-offs. In addition to these program-specific objectives, all students in the Case School of Engineering are exposed to societal issues, professionalism, and are provided opportunities to develop leadership skills.

The Bachelor of Science degree program in computer science is accredited by the Computing Accreditation Commission of ABET, <http://www.abet.org/>.

Mission

The mission of the Bachelor of Science degree program in computer science is to graduate students who have fundamental technical knowledge of their profession and the requisite technical breadth and communications skills to become leaders in creating the new techniques and technologies which will advance the field of computer science and its application to other disciplines.

Program Educational Objectives

- To educate and train students in the fundamentals of computer science and mathematics
- To educate students with an understanding of real-world computing needs
- To train students to work effectively, professionally and ethically in computing-related professions

Learning Outcomes

As preparation for achieving the above educational objectives, the Bachelor of Science degree program in computer science is designed so that students attain the ability to:

- Analyze a complex computing problem and to apply principles of computing and other relevant disciplines to identify solutions.

- Design, implement, and evaluate a computing-based solution to meet a given set of computing requirements in the context of the program's discipline.
- Communicate effectively in a variety of professional contexts.
- Recognize professional responsibilities and make informed judgments in computing practice based on legal and ethical principles.
- Function effectively as a member or leader of a team engaged in activities appropriate to the program's discipline.
- Apply computer science theory and software development fundamentals to produce computing-based solutions.

Core and breadth courses provide our students with the flexibility to work across many disciplines and prepare them for a variety of professions. Our curriculum is designed to teach fundamental skills and knowledge needed by all CS graduates while providing the greatest flexibility in selecting topics. Students are also required to develop depth in at least one of the following technical areas: software engineering; algorithms and theory; computer systems, networks, and security; databases and data mining; bioinformatics; or artificial intelligence.

Co-op and Internship Programs

Opportunities are available for students to alternate studies with work in industry or government as a co-op student, which involves paid full-time employment over seven months (one semester and one summer). Students may work in one or two co-ops, beginning in the third year of study. Co-ops provide students the opportunity to gain valuable hands-on experience in their field by completing a significant engineering project while receiving professional mentoring. During a co-op placement, students do not pay tuition but maintain their full-time student status while earning a salary. Learn more at engineering.case.edu/coop. Alternatively or additionally, students may obtain employment as summer interns.

Undergraduate Policies

For undergraduate policies and procedures, please review the Office of Undergraduate Studies section of the General Bulletin.

Accelerated Master's Programs

Undergraduate students may participate in accelerated programs toward graduate or professional degrees. For more information and details of the policies and procedures related to accelerated studies, please visit the Office of Undergraduate Studies section of the General Bulletin.

Program Requirements

Students seeking to complete this major and degree program must meet the general requirements for bachelor's degrees and the general requirements of the Case School of Engineering. Students completing this program as a secondary major while completing another undergraduate degree program do not need to satisfy the latter set of requirements.

Each student is required to complete a total of 20 computer science and computer science related courses, totaling at least 63 credits.

The 20 courses must include:

- all 6 core courses;
- at least 5 computer science breadth courses;

- c. at least 4 courses in one of the listed computer science depth areas, including all starred courses in that area;
- d. and a course from the secure computing requirement list.

The remaining courses needed to fulfill the 20 course requirement may come from the computer science breadth courses, courses of any computer science depth area, and up to 6 of the 20 courses may come from the list of approved technical electives with at most two Group 2 courses.

Other computer science related courses not listed here may be used with prior permission from the student's academic advisor. Some courses appear in more than one list. The same course may be used to satisfy multiple requirements of the core, computer science breadth and depth requirements, but courses may not be double counted for the purpose of achieving 20 separate computer science courses and 63 credits.

Computer Science Core Requirement

All computer science majors are required to complete the following 6 courses.

Code	Title	Hours
CSDS 132	Programming in Java	3
CSDS 233	Introduction to Data Structures	4
CSDS 281	Logic Design and Computer Organization	4
CSDS 302	Discrete Mathematics	3
CSDS 310	Algorithms	3
CSDS 395	Senior Project in Computer Science	4

Computer Science Breadth Requirement

BS students are required to complete at least 5 of the 7 following computer science breadth courses.

Code	Title	Hours
CSDS 314	Computer Architecture	3
CSDS 325	Computer Networks I	3
CSDS 338	Intro to Operating Systems and Concurrent Programming	4
CSDS 341	Introduction to Database Systems	3
CSDS 345	Programming Language Concepts	3
CSDS 391	Introduction to Artificial Intelligence	3
CSDS 393	Software Engineering	3

Statistics Requirement

Computer science BS students are required to complete a statistics elective.

One Statistics elective may be chosen from:

Code	Title	Hours
MATH 380	Introduction to Probability	3
STAT 312	Basic Statistics for Engineering and Science	3
STAT 313	Statistics for Experimenters	3
STAT 332	Statistics for Signal Processing	3
STAT 333	Uncertainty in Engineering and Science	3

Computer Science Secure Computing Requirement

Students pursuing the BS degree must demonstrate competence in the principles and practices of secure computing by completing one of

the following courses as part of their 20 computer science or computer science related courses.

Code	Title	Hours
CSDS 344	Computer Security	3
CSDS 356	Data Privacy	3
CSDS 427	Internet Security and Privacy	3
CSDS 444	Computer Security	3
CSDS 448	Smartphone Security	3
MATH 408	Introduction to Cryptology	3

This course may be double counted as a computer science depth course, as appropriate. There is no secure computing requirement for students pursuing the BA degree.

List of Approved Technical Electives

This list of approved technical electives is divided into groups according to how closely a course is related to the core knowledge areas as defined in the ACM/IEEE computer science curriculum guidelines. For Computer Science BS students, up to 6 of the 20 computer science and computer science related courses may come from this list with up to two courses from group 2. Computer science related courses not listed below may be used as a technical elective but require prior permission from the student's academic advisor.

Group 1

Code	Title	Hours
Any CSDS course.		
ECSE 301	Digital Logic Laboratory	2
ECSE 303	Embedded Systems Design and Laboratory	3
ECSE 315	Digital Systems Design	4
ECSE 317	Computer Design - FPGAs	3
ECSE 419	Computer System Architecture	3
ECSE 485	VLSI Systems	3
ECSE 488	Embedded Systems Design	3
MATH 330	Introduction to Scientific Computing	3
MATH 431	Introduction to Numerical Analysis I	3

Group 2

Code	Title	Hours
DSCI 351	Exploratory Data Science	3
DSCI 352	Applied Data Science Research	3
DSCI 353	Data Science: Statistical Learning, Modeling and Prediction	3
ECON 380	Computational Economics	3
ECSE 245	Electronic Circuits	4
ECSE 246	Signals and Systems	4
ECSE 304	Control Engineering I with Laboratory	3
ECSE 305	Control Engineering I Laboratory	1
ECSE 309	Electromagnetic Fields I	3
ECSE 313	Signal Processing	3
ECSE 318	VLSI/CAD	4
ECSE 319	Applied Probability and Stochastic Processes for Biology	3
ECSE 324	Modeling and Simulation of Continuous Dynamical Systems	3
ECSE 346	Engineering Optimization	3

ECSE 350	Operations and Systems Design	3
ECSE 354	Digital Communications	3
ECSE 375	Applied Control	3
ECSE 408	Introduction to Linear Systems	3
ECSE 413	Nonlinear Systems I	3
ECSE 414	Wireless Communications	3
ECSE 416	Convex Optimization for Engineering	3
ECSE 489	Robotics I	3
ENGR 210	Introduction to Circuits and Instrumentation	4
MATH 224	Elementary Differential Equations	3
MATH 228	Differential Equations	3
MATH 303	Elementary Number Theory	3
MATH 308	Introduction to Abstract Algebra	3
MATH 327	Convexity and Optimization	3
MATH 439	Bayesian Scientific Computing	3
MATH 497	Stochastic Models: Time Series and Markov Chains	3
PHIL 201	Introduction to Logic	3
PHYS 221	Introduction to Modern Physics	3
PHYS 250	Computational Methods in Physics	3
STAT 345	Theoretical Statistics I	3
STAT 346	Theoretical Statistics II	3

Computer Science Depth Requirement

Students pursuing the BS degree must demonstrate a depth of competence in one of the technical areas listed below. To complete the depth requirement, students must complete at least four courses in one of the depth areas, including all starred courses. Recommended general background courses are listed following each area where applicable.

Area 1: Software Engineering

Code	Title	Hours
CSDS 293	Software Craftsmanship	4
CSDS 337	Compiler Design	4
CSDS 344	Computer Security	3
CSDS 345	Programming Language Concepts *	3
CSDS 392	App Development for iOS	3
CSDS 393	Software Engineering *	3
CSDS 427	Internet Security and Privacy	3
CSDS 438	High Performance Data and Computing	3
CSDS 448	Smartphone Security	3

Area 2: Algorithms and Theory

Code	Title	Hours
CSDS 310	Algorithms *	3
CSDS 343	Theoretical Computer Science *	3
CSDS 394	Introduction to Information Theory	3
CSDS 440	Machine Learning	3
CSDS 455	Applied Graph Theory	3
CSDS 477	Advanced Algorithms	3
MATH 406	Mathematical Logic and Model Theory	3
MATH 408	Introduction to Cryptology	3
PHIL 306	Mathematical Logic and Model Theory	3

Recommended preparation: MATH 380

Area 3: Computer Systems, Networks and Security

Code	Title	Hours
CSDS 312	Introduction to Data Science Systems	3
CSDS 325	Computer Networks I *	3
CSDS 337	Compiler Design	4
CSDS 338	Intro to Operating Systems and Concurrent Programming *	4
CSDS 344	Computer Security	3
or CSDS 444	Computer Security	
CSDS 356	Data Privacy	3
CSDS 427	Internet Security and Privacy	3
CSDS 428	Computer Communications Networks II	3
CSDS 438	High Performance Data and Computing	3
CSDS 448	Smartphone Security	3
MATH 408	Introduction to Cryptology	3

Area 4: Databases and Data Mining

Code	Title	Hours
CSDS 234	Structured and Unstructured Data	3
CSDS 313	Introduction to Data Analysis	3
CSDS 341	Introduction to Database Systems *	3
CSDS 405	Data Structures and File Management	3
CSDS 433	Database Systems	3
CSDS 435	Data Mining	3
CSDS 440	Machine Learning	3
MATH 382	High Dimensional Probability	3
MATH 444	Mathematics of Data Mining and Pattern Recognition	3

Area 5: Bioinformatics

Code	Title	Hours
CSDS 310	Algorithms *	3
CSDS 341	Introduction to Database Systems	3
CSDS 435	Data Mining	3
CSDS 440	Machine Learning	3
CSDS 458	Introduction to Bioinformatics *	3
CSDS 459	Bioinformatics for Systems Biology	3

Recommended breadth and preparation: STAT 325 or PQHS 431, SYBB 311A, SYBB 311B, SYBB 311C, SYBB 311CSYBB 311CSYBB 311CSYBB 311CSYBB 311C, BIOL 214.

Area 6: Artificial Intelligence

Code	Title	Hours
CSDS 391	Introduction to Artificial Intelligence *	3
CSDS 394	Introduction to Information Theory	3
CSDS 440	Machine Learning	3
CSDS 442	Causal Learning from Data	3
CSDS 465	Computer Vision	3
CSDS 491	Artificial Intelligence: Probabilistic Graphical Models	3
CSDS 496	Artificial Intelligence: Sequential Decision Making	3
CSDS 497	Artificial Intelligence: Statistical Natural Language Processing	3

CSDS 499	Algorithmic Robotics	3
ECSE 484	Computational Intelligence I: Basic Principles	3
MATH 382	High Dimensional Probability	3

Recommended breadth and preparation: MATH 380, and either ECSE 416 or CSDS 477.

Sample Plan of Study

First Year

Fall		Hours
SAGES First Year Seminar *		4
CHEM 111	Principles of Chemistry for Engineers	4
MATH 121	Calculus for Science and Engineering I	4
CSDS 132	Programming in Java	3
PHED (2 half semester courses) *		0
Open elective		3
Hours		18

Spring		Hours
SAGES University Seminar *		3
PHYS 121	General Physics I - Mechanics	4
MATH 122 or MATH 124	Calculus for Science and Engineering II or Calculus II	4
CSDS 233	Introduction to Data Structures	4
PHED (2 half semester courses) *		0
Hours		15

Second Year

Fall		Hours
SAGES University Seminar *		3
PHYS 122	General Physics II - Electricity and Magnetism	4
MATH 223 or MATH 227	Calculus for Science and Engineering III or Calculus III	3
CSDS 302	Discrete Mathematics	3
CSDS 281	Logic Design and Computer Organization	4
Hours		17

Spring		Hours
MATH 201 or MATH 307	Introduction to Linear Algebra for Applications or Linear Algebra	3
Statistics elective ^a		3
Computer science breadth course ^b		3
Breadth elective ^{**}		3
Technical Elective ^d		3
Hours		15

Third Year

Fall		Hours
CSDS 310	Algorithms	3
Computer science breadth course ^b		3
Computer science breadth course ^b		3
Technical elective ^d		3
Breadth elective ^{**}		3
Hours		15

Spring		Hours
ENGL 398	Professional Communication for Engineers	2
ENGR 398	Professional Communication for Engineers	1
Computer science breadth course ^b		3
Computer science breadth course ^b		3
Computer science depth course ^c		3
Breadth elective ^{**}		3
Hours		15

Fourth Year

Fall		Hours
Breadth elective ^{**}		3
Computer science depth course ^c		3
Technical elective ^d		3
Technical elective ^d		3
Open elective		3
Hours		15

Spring		Hours
CSDS 395	Senior Project in Computer Science	4
Computer science depth course ^c		3
Technical elective ^d		3
Technical elective ^d		3
Open elective		3
Hours		16

Total Hours **126**

* University general education requirement.

** Engineering general education requirement.

a Chosen from: MATH 380, STAT 312, STAT 313, STAT 332, STAT 333.

b Each student must complete 5 of the 7 following courses: CSDS 314, CSDS 325, CSDS 338, CSDS 341, CSDS 345, CSDS 391, CSDS 393. CSDS 338 is a 4 unit course.

c Each student must complete 4 courses in one of the computer science depth areas listed above, including all starred courses.

d Chosen from additional computer science breadth courses, depth courses, or the list of approved technical electives. Any other course used as a technical elective must be approved by the student's advisor.