Computer Science

Computer science is now a critical tool for pursuing an ever-broadening range of topics, from outer space to the workings of the human mind. In most areas of science and in many liberal arts fields, cutting-edge work depends increasingly on computational approaches. The undergraduate program at Brown is designed to combine breadth in practical and theoretical computer science with depth in specialized areas. These areas range from traditional topics, such as analysis of algorithms, artificial intelligence, databases, distributed systems, graphics, mobile computing, networks, operating systems, programming languages, robotics and security, to novel areas including games and scientific visualization.

Our requirements are built on a collection of pathways, each representing a well-defined area within computer science. Concentrators interested in particular areas can choose the courses included in particular pathways. Conversely, concentrators who are unsure of their area of interest but who have particularly enjoyed certain courses can choose pathways that include these concentrations. Students may not use more than two CSCI 1970 courses to complete the requirements for the Sc.B. and one CSCI 1970 course for the A.B. requirements.

For up-to-date information on our concentration requirements please see https://cs.brown.edu/degrees/undergrad/concentrating-in-cs/concentration-handbook/ for further discussion requirements. Please see https://cs.brown.edu/degrees/undergrad/in-cs/concentration-requirements-2020/new-ab-requirements/ for AB requirements and https://cs.brown.edu/degrees/undergrad/concentrating-in-cs/concentration-handbook/ for further discussion regarding our concentration requirements.

Requirements for the Standard Track of the Sc.B. degree

Prerequisites (0-3 courses)

Calculus prerequisite: students must complete or place out of second semester calculus.

| MATH 0100 | Single Variable Calculus, Part II |
| or MATH 0170 | Single Variable Calculus, Part II (Accelerated) |
| or MATH 0190 | Single Variable Calculus, Part II (Physics/Engineering) |

Concentration Requirements

Core-Computer Science:

Select one of the following introductory course Series:

**Series A**

- CSCI 0150 & CSCI 0200: Introduction to Object-Oriented Programming and Computer Science and Program Design with Data Structures and Algorithms

**Series B**

- CSCI 0170 & CSCI 0200: Computer Science: An Integrated Introduction and Program Design with Data Structures and Algorithms

**Series C**

- CSCI 0190: Accelerated Introduction to Computer Science (and an additional CS course not otherwise used to satisfy a concentration requirement; this course may be CSCI 0200, an intermediate-level course, or an advanced course)

**Series D**


Intermediate Courses

ScB students must take at least one course from each intermediate course category to ensure they span all areas. In addition, they must take whatever intermediate courses they haven’t yet taken that are required for their pathways.

Foundations

- CSCI 0220: Introduction to Discrete Structures and Probability
- or MATH 1001: The Art of Writing Mathematics
- or MATH 1530: Abstract Algebra

Mathematics

- CSCI 1010: Theory of Computation
- CSCI 0530: Coding the Matrix: An Introduction to Linear Algebra for Computer Science
- or MATH 0520: Linear Algebra
- or MATH 0540: Linear Algebra With Theory
- CSCI 1450: Advanced Introduction to Probability for Computing and Data Science
- or APMA 1650: Statistical Inference I
- or APMA 1655: Honors Statistical Inference I

Systems

- MATH 0180: Multivariable Calculus
- or MATH 0200: Multivariable Calculus (Physics/Engineering)
- or MATH 0350: Multivariable Calculus With Theory

Core Courses

- CSCI 1380: Distributed Computer Systems
- or CSCI 1670: Operating Systems
- or CSCI 1680: Computer Networks

Related Courses

- CSCI 1260: Compilers and Program Analysis
- CSCI 1270: Database Management Systems

Pathways

Completing a pathway entails taking two courses in the pathway of which at least one is a core course for the pathway. One must also take the intermediate courses specified as part of the pathway. Certain graduate courses can also satisfy pathway requirements, see the CS Pathway page for more info: http://cs.brown.edu/degrees/undergrad/concentrating-in-cs/concentration-handbook/

SYSTEMS: studies the design, construction, and analysis of modern, multi-faceted computing systems

Core Courses

- CSCI 1380: Distributed Computer Systems
- or CSCI 1670: Operating Systems
- or CSCI 1680: Computer Networks

Related Courses

- CSCI 1260: Compilers and Program Analysis
- CSCI 1270: Database Management Systems
DATA: Studies the management and use of large data collections

Core Courses
CSCI 1270 Database Management Systems
or CSCI 1420 Machine Learning
or CSCI 1951A Data Science

Related Courses
CSCI 1550 Probabilistic Methods in Computer Science

Intermediate Courses
CSCI 0320 Introduction to Software Engineering
or CSCI 0330 Introduction to Computer Systems
or CSCI 0300 Fundamentals of Computer Systems

MATH 0520 Linear Algebra
or MATH 0540 Linear Algebra With Theory
or CSCI 0530 Coding the Matrix: An Introduction to Linear Algebra for Computer Science

CSCI 1450 Advanced Introduction to Probability for Computing and Data Science
or APMA 1650 Statistical Inference I
or APMA 1655 Honors Statistical Inference I

ARTIFICIAL INTELLIGENCE / MACHINE LEARNING:

Core Courses
CSCI 1410 Artificial Intelligence
or CSCI 1420 Machine Learning
or CSCI 1430 Computer Vision
or CSCI 1460 Computational Linguistics
or CSCI 1470 Deep Learning
or CSCI 1850 Deep Learning in Genomics
or CSCI 1951R Introduction to Robotics

Related Courses
CSCI 1440 Algorithmic Game Theory
or CSCI 1550 Probabilistic Methods in Computer Science
or CSCI 1951A Data Science
or CSCI 1951C Designing Humanity Centered Technology
or APMA 1740 Recent Applications of Probability and Statistics
or ENGN 1610 Image Understanding

Intermediate Courses
CSCI 1450 Advanced Introduction to Probability for Computing and Data Science
or APMA 1650 Statistical Inference I
or APMA 1655 Honors Statistical Inference I

MATH 0520 Linear Algebra
or MATH 0540 Linear Algebra With Theory
or CSCI 0530 Coding the Matrix: An Introduction to Linear Algebra for Computer Science

THEORY: students the foundations of models and algorithms for computing in various contexts

Core Courses
CSCI 1510 Introduction to Cryptography and Computer Security
or CSCI 1550 Probabilistic Methods in Computer Science
or CSCI 1570 Design and Analysis of Algorithms
or CSCI 1760 Multiprocessor Synchronization
or CSCI 1951W Sublinear Algorithms for Big Data
or CSCI 1951X Formal Proof and Verification

Related Courses
CSCI 1440 Algorithmic Game Theory
or CSCI 1550 Probabilistic Methods in Computer Science
or CSCI 1760 Multiprocessor Synchronization
or CSCI 1951G Optimization Methods in Finance

CSCI 1590 Introduction to Computational Complexity
or CSCI 1710 Logic for Systems
or CSCI 1810 Computational Molecular Biology
or CSCI 1820 Algorithmic Foundations of Computational Biology
or CSCI 1950H Computational Topology
or CSCI 1951G Optimization Methods in Finance

Intermediate Courses
CSCI 1010 Theory of Computation
CSCI 1450 Advanced Introduction to Probability for Computing and Data Science
or APMA 1650 Statistical Inference I
or APMA 1655 Honors Statistical Inference I

MATH 0520 Linear Algebra
or MATH 0540 Linear Algebra With Theory
Intermediate Courses

CSCI 1320 Creating Modern Web & Mobile Applications
or CSCI 1380 Distributed Computer Systems
or CSCI 1670 Operating Systems
or CSCI 1680 Computer Networks
or CSCI 1710 Logic for Systems
or CSCI 1730 Design and Implementation of Programming Languages
or CSCI 1800 Cybersecurity and International Relations
or CSCI 1805 Computers, Freedom and Privacy
or CSCI 1951L Blockchains and Cryptocurrencies

Related Courses

CSCI 1320 Introduction to Cryptography and Computer Security
or CSCI 1650 Software Security and Exploitation
or CSCI 1660 Introduction to Computer Systems Security

Core Courses

CSCI 1510 Introduction to Cryptography and Computer Security
or CSCI 1650 Software Security and Exploitation
or CSCI 1660 Introduction to Computer Systems Security

Intermediate Courses

CSCI 0330 Introduction to Computer Systems
or CSCI 0300 Fundamentals of Computer Systems
CSCI 0220 Introduction to Discrete Structures and Probability (Or Probability and Statistics (see options below))
or APMA 1650 Advanced Introduction to Probability for Computing and Data Science
or APMA 1650 Statistical Inference I
or APMA 1655 Honors Statistical Inference I

VISUAL COMPUTING: studies the creation, interaction, and analysis of images and visual information, including animation and games

Core Courses

CSCI 1230 Introduction to Computer Graphics
or CSCI 1250 Introduction to Computer Animation
or CSCI 1280 Intermediate 3D Computer Animation
or CSCI 1290 Computational Photography
or CSCI 1300 User Interfaces and User Experience
or CSCI 1370 Virtual Reality Design for Science
or CSCI 1430 Computer Vision
or CSCI 1950T Advanced Animation Production
or CSCI 1951T Surveying VR Data Visualization Software for Research

Related Courses

CSCI 1950N 2D Game Engines
or CSCI 1470 Deep Learning
or CSCI 1950N 2D Game Engines
or CSCI 1950U Topics in 3D Game Engine Development
or CSCI 1951V Hypertext/Hypermedia: The Web Was Not the Beginning and the Web Is Not the End
or CLPS 1520 Computational Vision

Intermediate Courses

CSCI 0320 Introduction to Software Engineering
or CSCI 0330 Introduction to Computer Systems
MATH 0520 Linear Algebra
or MATH 0540 Linear Algebra With Theory
or CSCI 0530 Coding the Matrix: An Introduction to Linear Algebra for Computer Science

COMPUTER ARCHITECTURE: studies the design, construction, and analysis of computer architecture and hardware

Core Courses

ENGN 1630 Digital Electronics Systems Design
or ENGN 1640 Design of Computing Systems
or ENGN 1650 Embedded Microprocessor Design

Related Courses

CSCI 1600 Real-Time and Embedded Software
or CSCI 1760 Multiprocessor Synchronization
or ENGN 1600 Design and Implementation of Digital Integrated Circuits

Intermediate Course

CSCI 0330 Introduction to Computer Systems

COMPUTATIONAL BIOLOGY: studies the foundations and applications of algorithms for analyzing biological data and processes

Core Courses

CSCI 1810 Computational Molecular Biology
or CSCI 1820 Algorithmic Foundations of Computational Biology
or CSCI 1850 Deep Learning in Genomics

Related Courses

CSCI 1420 Machine Learning
or CSCI 1430 Computer Vision
or CSCI 1470 Deep Learning
or CSCI 1951A Data Science
or CLPS 1520 Computational Vision

Intermediate Courses

CSCI 0220 Introduction to Discrete Structures and Probability
CSCI 1010 Theory of Computation
CSCI 1450 Advanced Introduction to Probability for Computing and Data Science
or APMA 1650 Statistical Inference I
or APMA 1655 Honors Statistical Inference I

DESIGN: studies the design, construction, and analysis of processes at the interface between humans and systems

Core Courses

CSCI 1300 User Interfaces and User Experience
or CSCI 1370 Virtual Reality Design for Science
or CSCI 1951C Designing Humanity Centered Technology

Related Courses

CSCI 1230 Introduction to Computer Graphics
or CSCI 1320 Creating Modern Web & Mobile Applications
or CSCI 1360 Human Factors in Cybersecurity
or CSCI 1600 Real-Time and Embedded Software
or CSCI 1951A Data Science
or CSCI 1951L CS for Social Change
or CSCI 1951T Surveying VR Data Visualization Software for Research
or CSCI 1951V Hypertext/Hypermedia: The Web Was Not the Beginning and the Web Is Not the End
or CSCI 1952B Responsible Computer Science in Practice
or ENGN 1931I Design of Robotic Systems
or VISA 1720 Physical Computing

Intermediate Courses

CSCI 0330 Introduction to Computer Systems
or CSCI 0320 Introduction to Software Engineering
or CSCI 0300 Fundamentals of Computer Systems

Requirements for the Standard Track of the A.B. degree

Prerequisites (0-3 courses) 0-3
Students must complete or place out of second semester calculus.

- MATH 0100 or MATH 0170 or MATH 0190
  - Single Variable Calculus, Part II
  - Single Variable Calculus, Part II (Accelerated)
  - Single Variable Calculus, Part II (Physics/Engineering)

Concentration Requirements (9 courses)

- Core Computer Science:
  - Select one of the following series:
    - Series A
      - CSCI 0150 & CSCI 0200
        - Introduction to Object-Oriented Programming and Computer Science and Program Design with Data Structures and Algorithms
    - Series B
      - CSCI 0170 & CSCI 0200
        - Computer Science: An Integrated Introduction and Program Design with Data Structures and Algorithms
    - Series C
      - CSCI 0190
        - Accelerated Introduction to Computer Science (and an additional CS course not otherwise used to satisfy a concentration requirement; this course may be CSCI 0200, an intermediate-level course, or an advanced course)
    - Series D
      - CSCI 0111 & CSCI 0112 & CSCI 0200
        - Computing Foundations: Data Organization and Program Design with Data Structures and Algorithms

- Seven more advanced courses.

- One complete pathway (see ScB for pathways)

Requirements for the Professional Track of the both the Sc. B. and A.B. degrees.

The requirements for the professional track include all those of the standard track, as well as the following:

Students must complete full-time professional experiences doing work that is related to their concentration programs, totaling 2-6 months, whereby each internship must be at least one month in duration in cases where students choose to do more than one internship experience. Such work is normally done at a company, but may also be at a university under the supervision of a faculty member. Internships that take place between the end of the fall and the start of the spring semesters cannot be used to fulfill this requirement.

On completion of each professional experience, the student must write and upload to ASK a reflective essay about the experience addressing the following prompts, to be approved by the student's concentration advisor:

- Which courses were put to use in your summer's work? Which topics, in particular, were important?
- In retrospect, which courses should you have taken before embarking on your summer experience? What are the topics from these courses that would have helped you over the summer if you had been more familiar with them?
- Are there topics you should have been familiar with in preparation for your summer experience, but are not taught at Brown? What are these topics?
- What did you learn from the experience that probably could not have been picked up from course work?
- Is the sort of work you did over the summer something you would like to continue doing once you graduate? Explain.
- Would you recommend your summer experience to other Brown students? Explain.

Honors

Honors candidates must have earned A's or S-with-distinction in 2/3 (rounding up) of the courses used towards the concentration, excluding introductory-sequence courses (CS courses numbered 0200 or below) and the calculus prerequisite (unless that course is also used as an intermediate math course in CS requirements).