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.

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

Prerequisites (0-3 courses)
Calculation prerequisite: students must complete or place out of second semester calculus.

- MATH 0100 Introductory Calculus, Part I
- or MATH 0170 Advanced Placement Calculus
- or MATH 0190 Advanced Placement Calculus (Physics/Engineering)

Concentration Requirements
Core-Computer Science:
Select one of the following introductory course Series:

Series A
- CSCI 0150 Introduction to Object-Oriented Programming and Computer Science
- & CSCI 0160 and Introduction to Algorithms and Data Structures

Series B
- CSCI 0170 Computer Science: An Integrated Introduction
- & CSCI 0180 and Computer Science: An Integrated Introduction

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 0180, an intermediate-level course, or an advanced course)

Thirteen CS courses numbered 0220 or higher.

# Two complete pathways (at least one core course from each)
# Each requires two 1000-level courses as well as one to three intermediate courses
# One of the courses used in one pathway must be a capstone course (defined below)
# The core and related courses used in one pathway may not overlap with those used in another
# Additional intermediate courses so that a total of five are taken, with at least one from each of the three categories
# One additional 1000-level course that is neither a core nor a related course for the pathways used above

Intermediate Courses

Students must complete the intermediate courses defined for the pathway they choose. In addition, ScB students must take at least one course from each intermediate course category to ensure they span all areas. Taking additional courses beyond those listed for the pathway may be required.

Foundations
- CSCI 0220 Introduction to Discrete Structures and Probability
- CSCI 1010 Theory of Computation

Mathematics
- CSCI 0530 Coding the Matrix: An Introduction to Linear Algebra for Computer Science
- or MATH 0520 Linear Algebra
- or MATH 0540 Honors Linear Algebra
- CSCI 1450 Probability and Computing
- or APMA 1650 Statistical Inference I
- or APMA 1655 Statistical Inference I

Systems
- MATH 0180 Intermediate Calculus
- or MATH 0200 Intermediate Calculus (Physics/Engineering)
- or MATH 0350 Honors Calculus

Pathways
Completing a pathway entails taking two courses in the pathway of which at least one is a course course for the pathway. One must also take the intermediate courses specified as part of the pathway.

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 1270 Database Management Systems
- or CSCI 1320 Creating Modern Web Applications
- or CSCI 1600 Real-Time and Embedded Software
- or CSCI 1650 Software Security and Exploitation
- or CSCI 1660 Introduction to Computer Systems Security
- or CSCI 1730 Design and Implementation of Programming Languages
- or CSCI 1760 Multiprocessor Synchronization
- or CSCI 1950Y Logic for Systems
- or ENGN 1640 Design of Computing Systems

Intermediate Courses
- CSCI 0330 Introduction to Computer Systems
- CSCI 0320 Introduction to Software Engineering
- or CSCI 0320 Introduction to Computer Systems

SOFTWARE PRINCIPLES: studies the design, construction, and analysis of modern software systems

Core Courses
- CSCI 1260 Compilers and Program Analysis
- or CSCI 1320 Creating Modern Web Applications
- or CSCI 1600 Real-Time and Embedded Software
- or CSCI 1730 Design and Implementation of Programming Languages
- or CSCI 1950Y Logic for Systems

Related Courses
- CSCI 1270 Database Management Systems
### Computer Science

#### Core Courses

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
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</thead>
<tbody>
<tr>
<td>CSCI 1510</td>
<td>Introduction to Cryptography and Computer Security</td>
</tr>
<tr>
<td>or CSCI 1380</td>
<td>Distributed Computer Systems</td>
</tr>
<tr>
<td>or CSCI 1650</td>
<td>Software Security and Exploitation</td>
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</tbody>
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#### Intermediate Courses

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
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<tbody>
<tr>
<td>CSCI 0220</td>
<td>Introduction to Discrete Structures and Probability</td>
</tr>
<tr>
<td>CSCI 0320</td>
<td>Introduction to Software Engineering</td>
</tr>
<tr>
<td>CSCI 0330</td>
<td>Introduction to Computer Systems (Data)</td>
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**DATA: Studies the management and use of large data collections**

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<thead>
<tr>
<th>Course Code</th>
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<tbody>
<tr>
<td>CSCI 1270</td>
<td>Database Management Systems</td>
</tr>
<tr>
<td>or CSCI 1420</td>
<td>Machine Learning</td>
</tr>
<tr>
<td>or CSCI 1951A</td>
<td>Data Science</td>
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</tbody>
</table>

#### Related Courses

<table>
<thead>
<tr>
<th>Course Code</th>
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<tbody>
<tr>
<td>CSCI 1550</td>
<td>Probabilistic Methods in Computer Science</td>
</tr>
<tr>
<td>or CSCI 1580</td>
<td>Information Retrieval and Web Search</td>
</tr>
<tr>
<td>or ECON 1660</td>
<td>Big Data</td>
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<tbody>
<tr>
<td>MATH 0520</td>
<td>Linear Algebra</td>
</tr>
<tr>
<td>or MATH 0540</td>
<td>Honors Linear Algebra</td>
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<tr>
<td>or CSCI 0530</td>
<td>Coding the Matrix: An Introduction to Linear Algebra for Computer Science</td>
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#### ARTIFICIAL INTELLIGENCE / MACHINE LEARNING: studies the theory and application of algorithms for making decisions and inferences from rules and data

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<tbody>
<tr>
<td>CSCI 1410</td>
<td>Artificial Intelligence</td>
</tr>
<tr>
<td>or CSCI 1420</td>
<td>Machine Learning</td>
</tr>
<tr>
<td>or CSCI 1430</td>
<td>Computer Vision</td>
</tr>
<tr>
<td>or CSCI 1460</td>
<td>Computational Linguistics</td>
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<td>or CSCI 1951A</td>
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<tbody>
<tr>
<td>MATH 1050</td>
<td>Linear Algebra</td>
</tr>
<tr>
<td>or MATH 1052</td>
<td>Honors Linear Algebra</td>
</tr>
<tr>
<td>or CSCI 1950Y</td>
<td>Statistical Inference I</td>
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<tr>
<td>or CSCI 1950G</td>
<td>Statistical Inference I</td>
</tr>
<tr>
<td>or APMA 1650</td>
<td>Linear Algebra</td>
</tr>
<tr>
<td>or APMA 1655</td>
<td>Honors Linear Algebra</td>
</tr>
<tr>
<td>or CSCI 0530</td>
<td>Coding the Matrix: An Introduction to Linear Algebra for Computer Science</td>
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**SECURITY: studies the design, construction, analysis, and defense of techniques to protect systems, data, and communications**

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<td>Introduction to Cryptography and Computer Security</td>
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<tr>
<td>or CSCI 1660</td>
<td>Introduction to Computer Systems Security</td>
</tr>
<tr>
<td>or CSCI 1650</td>
<td>Software Security and Exploitation</td>
</tr>
</tbody>
</table>

### Visual Computing: studies the creation, interaction, and analysis of images and visual information, including animation and games

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<tbody>
<tr>
<td>CSCI 1230</td>
<td>Introduction to Computer Graphics</td>
</tr>
<tr>
<td>or CSCI 1250</td>
<td>Introduction to Computer Animation</td>
</tr>
<tr>
<td>or CSCI 1280</td>
<td>Intermediate 3D Computer Animation</td>
</tr>
<tr>
<td>or CSCI 1300</td>
<td>User Interfaces and User Experience</td>
</tr>
<tr>
<td>or CSCI 1370</td>
<td>Virtual Reality Design for Science</td>
</tr>
<tr>
<td>or CSCI 1430</td>
<td>Computer Vision</td>
</tr>
<tr>
<td>or CSCI 1950T</td>
<td>Advanced Animation Production</td>
</tr>
<tr>
<td>or CSCI 2240</td>
<td>Interactive Computer Graphics</td>
</tr>
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#### Core Courses

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<td>CSCI 1510</td>
<td>Introduction to Cryptography and Computer Security</td>
</tr>
<tr>
<td>or CSCI 1950N</td>
<td>2D Game Engines</td>
</tr>
<tr>
<td>or CSCI 1950U</td>
<td>Topics in 3D Game Engine Development</td>
</tr>
</tbody>
</table>
Intermediate Courses
CSCI 0320  Introduction to Software Engineering
or CSCI 0330  Introduction to Computer Systems
MATH 0520  Linear Algebra
or MATH 0540  Honors Linear Algebra
or CSCI 0530  Introduction to Computer Systems

Related Courses
CSCI 1600  Real-Time and Embedded Software
or CSCI 1760  Multiprocessor Synchronization
or ENGN 1600  Design and Implementation of VLSI Systems

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
CSCI 1820  Algorithmic Foundations of Computational Biology

Related Courses
CSCI 1420  Machine 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  Probability and Computing
or APMA 1650  Statistical Inference I
or APMA 1655  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 Human-Centered Robots

Related Courses
CSCI 1230  Introduction to Computer Graphics
or CSCI 1320  Creating Modern Web Applications
or CSCI 1600  Real-Time and Embedded Software
or CSCI 1951A  Data Science
or CSCI 1900  csciStartup
or VISA 1720  Physical Computing

Intermediate Courses
CSCI 0320  Introduction to Software Engineering
or CSCI 0330  Introduction to Computer Systems
CSCI 1450  Probability and Computing
or APMA 1650  Statistical Inference I
or APMA 1655  Statistical Inference I

Requirements for the Professional Track of the Sc.B. degree.
The requirements for the professional track include all those of the standard track, as well as the following:
Students must complete two two-to-four-month full-time professional experiences, doing work that is related to their concentration programs. Such work is normally done within an industrial organization, but may also be at a university under the supervision of a faculty member.
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.

Requirements for the Standard Track of the A.B. degree.
Prerequisites (0-3 courses)
Students must complete or place out of second semester calculus.
MATH 0100  Introductory Calculus, Part II
or MATH 0170  Advanced Placement Calculus
or MATH 0190  Advanced Placement Calculus (Physics/Engineering)

Concentration Requirements (9 courses)
Core Computer Science:
Select one of the following series:

Series A
CSCI 0150  Introduction to Object-Oriented Programming and Computer Science

Series B
### Requirements for the Professional Track of the A.B. degree.

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

Students must complete two two-to-four-month full-time professional experiences, doing work that is related to their concentration programs. Such work is normally done within an industrial organization, but may also be at a university under the supervision of a faculty member.

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:

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- 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.
Font Notice

This document should contain certain fonts with restrictive licenses. For this draft, substitutions were made using less legally restrictive fonts. Specifically:

Helvetica was used instead of Arial.

The editor may contact Leepfrog for a draft with the correct fonts in place.