Computer Science, B.S.

Learning Outcomes
- Students understand the mathematical, logical, statistical, and theoretical foundations of computing.
- Students can analyze and compare the relative merits of alternative software designs and develop high-quality software systems.
- Students understand the fundamental principles of computer organization, system software, networks, and security.
- Students can apply computer science principles to a variety of problems, such as databases, data mining, graphics, and various fields of artificial intelligence (AI).
- Students understand social, professional, and ethical issues related to computing.

Overview
The major in computer science provides students with the necessary training for employment in careers such as software development and information management. It provides good preparation for graduate study in a variety of disciplines.

Students may declare a major in computer science when they are admitted to the University or afterward. All students begin as Bachelor of Arts majors but may switch to the Bachelor of Science programs at any time.

Undergraduates majoring in computer science develop competence in programming principles and methodologies, problem-solving techniques, mathematics, and computer systems. Computer science training is critical for many careers in science, engineering, business, and health care.

Computer science majors are advised at the Academic Advising Center until they have completed 24 s.h., at which point they are assigned a departmental advisor. Students being advised at the Academic Advising Center also can consult with a computer science faculty advisor.

Transfer students who have taken a course approved as equivalent to a required computer science or informatics course are exempt from that course. Transfer course grades are included in the computer science grade-point average.

Students should consult the Department of Computer Science website or visit the department's office for information about general policies, elective areas, and internships, scholarships, and student groups, such as the University's chapter of the Association for Computing Machinery (ACM) and Women in Computing Sciences (WICS).

Advanced Placement
The Computer Science Advanced Placement Program test may be used to satisfy requirements. See Advanced Placement Credit Policy on the Department of Computer Science website.

Requirements
The Bachelor of Science with a major in computer science requires a minimum of 120 s.h., including at least 63 s.h. of work for the major. Students must maintain a g.p.a. of at least 2.00 in all courses for the major and in all UI courses for the major. A cumulative g.p.a. of at least 2.00 is required for graduation. Students also must complete the College of Liberal Arts and Sciences GE CLAS Core.

The Bachelor of Science program is more rigorous than that of the Bachelor of Arts program; it is designed to provide in-depth training for students who would like to acquire strength in math and science in order to enhance their skills and job prospects. It also is appropriate for those who plan to pursue graduate work in computer science, although it is not required for graduate study at most universities.

Course work for the major includes computer science courses as well as courses in mathematics, statistics, and other supporting disciplines. Work for the major may not be taken pass/nonpass.

Bachelor of Science students with a computer science major should choose their GE CLAS Core Natural Sciences courses carefully since they may be able to use the same courses to satisfy the computer science major natural science sequences requirement; see "Natural Science Sequences" below.

Students majoring in computer science may not earn a second major or minor in business analytics and information systems, computer science and engineering, data science, or informatics.

Departmental Residency Requirement
Students who earn a B.S. in computer science must complete at least seven courses (minimum of 21 s.h.) at the University of Iowa from the following: CS:2630 Computer Organization or ECE:3350 Computer Architecture and Organization, CS:2820 Object-Oriented Software Development, CS:3330 Algorithms, and at least four computer science courses numbered CS:3620-CS:5899, but excluding CS:3910 Informatics Project and CS:3980 Topics in Computer Science I; these courses are requirements for the B.S. in computer science as listed below.

Program Requirements
The B.S. with a major in computer science requires the following course work.

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>CS:1210</td>
<td>Computer Science I: Fundamentals</td>
<td>4</td>
</tr>
<tr>
<td>CS:2210</td>
<td>Discrete Structures</td>
<td>3</td>
</tr>
<tr>
<td>CS:2230</td>
<td>Computer Science II: Data Structures</td>
<td>4</td>
</tr>
<tr>
<td>CS:2820</td>
<td>Object-Oriented Software Development</td>
<td>4</td>
</tr>
<tr>
<td>CS:3330</td>
<td>Algorithms</td>
<td>3</td>
</tr>
<tr>
<td>CS:3820</td>
<td>Programming Language Concepts</td>
<td>3</td>
</tr>
</tbody>
</table>

Computer Science Core

Total Hours 63-67

Natural Sciences Sequences Courses 3-5

Object-Oriented Software Development 3-4

Computer Science Core Courses 12-13

Mathematics Core Courses 15-16

Computation Theory Course 3

Advanced Technical Electives 12

Natural Sciences Sequences Courses 6-8

Total Hours 63-67

Computer Science Core

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>All of these:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CS:1210</td>
<td>Computer Science I: Fundamentals</td>
<td>4</td>
</tr>
<tr>
<td>CS:2210</td>
<td>Discrete Structures</td>
<td>3</td>
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<td>4</td>
</tr>
<tr>
<td>CS:3330</td>
<td>Algorithms</td>
<td>3</td>
</tr>
<tr>
<td>CS:3820</td>
<td>Programming Language Concepts</td>
<td>3</td>
</tr>
</tbody>
</table>
One of these:

CS:2630  Computer Organization  4
ECE:3350  Computer Architecture and Organization  3

One of these:

CS:3620  Operating Systems  3
CS:3640  Introduction to Networks and Their Applications  3

**Mathematics Core**

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATH:1550</td>
<td>Engineering Mathematics I: Single Variable Calculus</td>
<td>4</td>
</tr>
<tr>
<td>MATH:1850</td>
<td>Calculus I</td>
<td>4</td>
</tr>
</tbody>
</table>

**Calculus II**

One of these:

MATH:1560  Engineering Mathematics II: Multivariable Calculus  4
MATH:1860  Calculus II  4

**Linear Algebra**

This course:

MATH:2700  Introduction to Linear Algebra  4

**Probability and Statistics**

One of these:

STAT:2020  Probability and Statistics for the Engineering and Physical Sciences  3

Other probability and statistics courses (prefix STAT) with a calculus prerequisite approved by the department

Students who take MATH:2550 Engineering Mathematics III: Matrix Algebra and MATH:2560 Engineering Mathematics IV: Differential Equations can use these courses together to satisfy the linear algebra requirement.

**Computation Theory**

Students must complete one of the following.

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>CS:4330</td>
<td>Theory of Computation</td>
<td>3</td>
</tr>
<tr>
<td>CS:4350</td>
<td>Logic in Computer Science</td>
<td>3</td>
</tr>
</tbody>
</table>

**Advanced Technical Electives**

Students must earn at least 12 s.h. (four courses) in advanced technical electives, as follows.

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>At least 6 s.h. from these:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A computer science course (prefix CS) numbered 3620-5899, except CS:3910 and CS:3980</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A computer science course (prefix CS) numbered 5900 or above, with department approval</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Remaining courses may be chosen from advanced technical elective courses in computer science (prefix CS) or in other disciplines with department approval

An approved list of courses in other departments that satisfy this requirement can be found on the Department of Computer Science website; see the CS Requirements web page.

Students may count a maximum of 3 s.h. earned in CS:3990 Honors in Computer Science or Informatics toward the advanced technical elective requirement.

**Natural Science Sequences**

Students take two or more courses in a sequence (totaling at least 6 s.h.) in a cognate area of natural science. The natural science sequence is intended to enhance a student's perspective by providing a deeper understanding of the scientific method. Typically, it consists of a sequence of courses taken in the same science department. Students often choose courses that also fulfill the GE CLAS Core Natural Sciences requirement. Some possible choices are listed below; the department chair may approve others.

CLEP/APP credit may be used to satisfy part or all of the natural science requirement only if the appropriate science department at the University of Iowa accepts the credit as equivalent to one or more of the specific courses listed below.

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASTR:1771</td>
<td>Introductory Astronomy I: Basic Astrophysics and Planetary Astronomy</td>
<td>4</td>
</tr>
<tr>
<td>ASTR:1772</td>
<td>Introductory Astronomy II: Stellar, Galactic, and Extragalactic Astronomy</td>
<td>4</td>
</tr>
</tbody>
</table>

**Astronomy**

**Biology**

BIOL:1411  Foundations of Biology  4
BIOL:1412  Diversity of Form and Function  4

**Chemistry**

CHEM:1110  Principles of Chemistry I  4
CHEM:1120  Principles of Chemistry II  4

**Earth and Environmental Sciences**

EES:1030  Introduction to Earth Science  3-4
or EES:1050  Introduction to Geology  3-4
EES:1080  Introduction to Environmental Science  3-4

**Geographical and Sustainability Sciences**

GEOG:1020  The Global Environment  3
GEOG:1050  Foundations of GIS  4

**Physics**

One of these sequences:

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHYS:1611-1612</td>
<td>Introductory Physics I-II</td>
<td>8</td>
</tr>
<tr>
<td>PHYS:1701-1702</td>
<td>Physics I-II</td>
<td>8</td>
</tr>
</tbody>
</table>
Early Admission to the Graduate College

Undergraduate computer science students who have 6 s.h. or less to earn toward graduation may apply for early admission to the Graduate College. Early admission allows students in their final undergraduate semester to take courses for graduate credit in addition to the courses they need to complete their bachelor's degrees.

Combined Programs

B.S./M.C.S.

Qualified computer science undergraduate students who plan to earn the Master of Computer Science degree may apply for the combined Bachelor of Science/Master of Computer Science program. The combined B.S./M.C.S. program allows students to earn both degrees in five years. The program requires a total of 140 s.h. Students are granted a B.S. when they complete all requirements for the undergraduate degree.

Students in the combined program must complete all requirements for each degree, but may count a maximum of 12 s.h. (four courses) toward both degrees. The four courses must be taken during the fourth year of undergraduate study, after admission to the combined program, and must satisfy degree requirements of both the B.S. and the M.C.S.

If students withdraw from the combined program before completing their bachelor's degree, credit earned in the four courses is counted only toward the undergraduate degree.

Students apply for admission to the combined program during their third year as an undergraduate and enter the program at the beginning of their fourth year. They typically complete the combined program comfortably in one year after completing the B.S. requirements.

Applicants to the combined program must:

- be enrolled as a B.S. student majoring in computer science at the University of Iowa;
- have completed a minimum of 80 s.h. at the time of admission to the combined program, with at least 30 s.h. earned at the University of Iowa; and
- have a cumulative University of Iowa g.p.a. of at least 3.25 and a g.p.a. of at least 3.25 in the computer science major (computed on math prerequisites and core computer science course work taken at the University of Iowa).

Applicants must meet the admission requirements of the Graduate College; see the Manual of Rules and Regulations of the Graduate College on the Graduate College website.

Students must submit an application for admission to the program, a statement of purpose, three letters of recommendation, and transcripts from all colleges attended; they also must apply to the Graduate College. Graduate Record Examination (GRE) scores are not required. For more detailed information, see Prospective Students on the Department of Computer Science website.

B.S./M.S. in Business Analytics (Career Subprogram)

Students majoring in computer science who are interested in earning a master's degree in business analytics with a career subprogram may apply to the combined B.S./M.S. program offered by the College of Liberal Arts and Sciences and the Tippie College of Business. The program enables students to begin the study of business analytics before they complete their bachelor's degree. Students are able to complete both degrees in five years rather than six.

Separate application to each degree program is required. Applicants must be admitted to both programs before they may be admitted to the combined degree program. For information about the business analytics program, see the M.S. in business analytics (career) in the Tippie College of Business section of the Catalog.

B.S./M.S. in Finance

Students majoring in computer science who are interested in earning a master's degree in finance may apply to the combined B.S./M.S. program offered by the College of Liberal Arts and Sciences and the Tippie College of Business. The program enables students to begin the study of finance before they complete their bachelor's degree. Students are able to complete both degrees in five years rather than six.

Separate application to each degree program is required. Applicants must be admitted to both programs before they may be admitted to the combined degree program. For information about the finance program, see the M.S. in finance (Tippie College of Business) in the Catalog.

Honors

Honors in the Major

Students majoring in computer science have the opportunity to graduate with honors in the major. They must maintain a minimum UI cumulative g.p.a. of 3.33 and complete 4-6 s.h. of CS:3990 Honors in Computer Science or Informatics which requires the submission of an acceptable honors thesis.

Students are responsible for finding a faculty member willing to supervise their honors project. They can register for CS:3990 with the project supervisor's name once the faculty member approves the proposed project and a timetable for the work. An honors project usually takes two semesters to complete. For more details, see Honors on the Department of Computer Science website.

Students interested in pursuing honors in the major should communicate their intention to do so to their academic advisor or the department honors project coordinator. In order to receive honors in the major at graduation, students must have their honors status verified by the department prior to completing their degree application.

Honors students may count a maximum of 3 s.h. of CS:3990 Honors in Computer Science or Informatics toward the B.S. degree's advanced technical elective requirement. Students in the combined B.S./M.C.S. program may register for 4-6 s.h. of CS:5990 Individualized Research or Programming Project instead of CS:3990; this will allow them to receive graduate credit for the course while satisfying the course requirements to graduate with honors.

University of Iowa Honors Program

In addition to honors in the major, students can pursue honors study and activities through membership in the University of Iowa Honors Program. Visit Honors at Iowa to learn about the University's honors program.
Membership in the UI Honors Program is not required to earn honors in the computer science major. However, the semester hours earned in CS:3990 Honors in Computer Science or Informatics or CS:5990 Individualized Research or Programming Project can be used to partially satisfy the UI Honors requirement of 12 s.h. of experiential learning course work.

For more information, contact the Department of Computer Science honors project coordinator.

Academic Plans

Four-Year Graduation Plan

The Four-Year Graduation Plan is not available to B.S. students majoring in computer science. Students work with their advisors on individual graduation plans.

Sample Plan of Study

Sample plans represent one way to complete a program of study. Actual course selection and sequence will vary and should be discussed with an academic advisor. For additional sample plans, see MyUI.

Computer Science, B.S.

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>First Year</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fall</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CS:1210</td>
<td>Computer Science I: Fundamentals</td>
<td>4</td>
</tr>
<tr>
<td>MATH:1850</td>
<td>Calculus I</td>
<td>4</td>
</tr>
<tr>
<td>RHET:1030 or ENGL:1200</td>
<td>Rhetoric or The Interpretation of Literature</td>
<td>3 - 4</td>
</tr>
<tr>
<td>CS:1600</td>
<td>Success at Iowa</td>
<td>2</td>
</tr>
<tr>
<td>Elective course</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Hours</td>
<td>14-15</td>
</tr>
<tr>
<td>Spring</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CS:2210</td>
<td>Discrete Structures</td>
<td>3</td>
</tr>
<tr>
<td>CS:2230</td>
<td>Computer Science II: Data Structures</td>
<td>4</td>
</tr>
<tr>
<td>MATH:1860</td>
<td>Calculus II</td>
<td>4</td>
</tr>
<tr>
<td>RHET:1030 or ENGL:1200</td>
<td>Rhetoric or The Interpretation of Literature</td>
<td>3 - 4</td>
</tr>
<tr>
<td>Elective course</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Hours</td>
<td>15-16</td>
</tr>
<tr>
<td>Second Year</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fall</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CS:2630</td>
<td>Computer Organization</td>
<td>3</td>
</tr>
<tr>
<td>Major: Math elective</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>GE CLAS Core: World Languages First Level Proficiency or elective course</td>
<td>4 - 5</td>
<td></td>
</tr>
<tr>
<td>GE CLAS Core: Diversity and Inclusion</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>Elective course</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Hours</td>
<td>16-17</td>
</tr>
<tr>
<td>Spring</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CS:2820</td>
<td>Object-Oriented Software Development</td>
<td>4</td>
</tr>
<tr>
<td>Major: Math elective</td>
<td></td>
<td>3 - 4</td>
</tr>
<tr>
<td>GE CLAS Core: World Languages Second Level Proficiency or elective course</td>
<td>4 - 5</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Hours</td>
<td>15</td>
</tr>
</tbody>
</table>

GE CLAS Core: Literary, Visual, and Performing Arts

Elective course

Hours 16-18

Third Year

Fall

Major: Computer Science core course

CS:3330 Algorithms

GE CLAS Core: World Languages Second Level Proficiency or elective course

GE CLAS Core: Natural Sciences with Lab

Elective course

Hours 16-17

Spring

Major: Computer Science core course

Major: Computer Science advanced elective

GE CLAS Core: World Languages Fourth Level Proficiency or elective course

GE CLAS Core: Natural Sciences without Lab

Elective course

Hours 16-17

Fourth Year

Fall

Major: Computer Science computational theory or logic course

Major: Computer Science advanced elective

GE CLAS Core: Historical Perspectives

GE CLAS Core: International and Global Issues

Elective course

Hours 15

Spring

Major: Computer Science advanced or technical elective course

Major: Computer Science advanced or technical elective course

GE CLAS Core: Social Sciences

GE CLAS Core: Values and Culture

Elective course

Degree Application: apply on MyUI before deadline (typically in February for spring, September for fall)

Hours 15

Total Hours 123-130

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a Enrollment in math courses requires completion of a placement exam.

b Students may use elective courses to earn credit towards the total s.h. required for graduation or to complete a double major, minors, or certificates.

c Students may take CS:2630, CS:2820 and CS:3330 in any order after completing CS:1210, CS:2210, and CS:2230.

d Required math electives include (1) MATH:2700 and (2) STAT:2020 or STAT:3120.

e Students who have completed four years of a single language in high school have satisfied the GE CLAS Core World Languages requirement. Enrollment in world languages courses requires a placement exam, unless enrolling in a first-semester-level course.

f GE CLAS Core courses may be completed in any order unless used as a prerequisite for another course. Students should consult with an advisor about the best sequencing of courses.

g Possible courses include (1) CS:3620 or CS:3640 or CS:4640 for systems requirement or (2) CS:3820.
h. The Computer Science B.S. degree requires a 6-8 s.h., two-semester sequence science cognate. Select courses approved to meet the major requirement may also be used to meet the GE CLAS Core Natural Science requirement. See your academic advisor for additional information.

i. Systems course must be taken after CS:2630.

j. Students may choose a computer science course (prefix CS) numbered 3620-5890, except CS:3910 and CS:3980, or a CS course numbered 5900 or above with department approval. A course used to satisfy a core requirement cannot also be used as an advanced major elective.

k. Students may choose CS:4330 or CS:4350. Check with your advisor to see if these courses are offered in the semester you plan to take them.

l. Students may choose a computer science course (prefix CS) numbered 3620-5890, except CS:3910 and CS:3980, or a CS course numbered 5900 or above with department approval. A course used to satisfy a core requirement cannot also be used as an advanced major elective. Alternatively, students may take a course in other disciplines with department approval. See academic advisor for additional information.

m. Please see Academic Calendar, Office of the Registrar website for current degree application deadlines. Students should apply for a degree for the session in which all requirements will be met. For any questions on appropriate timing, contact your academic advisor. For more information visit http://commencement.uiowa.edu/. If applicable search for "Early and Late Participation" to find this page (e.g. walk in graduation ceremony in May, degree conferral in August).

**Career Advancement**

Computer science graduates work primarily in two market sectors. One includes the software and computer industry, from small start-ups to giants such as Amazon, Google, Intel, Yahoo, and Microsoft. These offer job opportunities in software design, including UIX, mobile, and web development. Another sector is made up of organizations whose primary business is not computing, such as banks, insurance, and other financial groups; health care organizations; consulting, media and legal firms; entertainment companies; and the military.

As many as one-third of computer science graduates go into research or elect to pursue graduate studies in computer science, including the University of Iowa B.S./M.C.S. program, or pursue other areas where computer science provides a strong foundation.

A recent job placement survey indicates that more than 97 percent of computer science graduates were placed or no longer seeking employment within six months of graduation.

The Pomerantz Career Center offers multiple resources to help students find internships and jobs.