Program Description

Computer Science is a constantly evolving discipline. To quote the Association for Computing Machinery, "Computer Science is not simply concerned with the design of computing devices nor is it just the art of numerical calculation. Computer Science is concerned with information in much the same sense that Physics is concerned with energy; it is devoted to the representation, storage, manipulation, and presentation of information in an environment permitting automatic information systems."

The Computer Science major at CSUB has three pathways that lead to a B.S. in Computer Science. The traditional Computer Science program follows the guidelines recommended by the Association for Computing Machinery (ACM). The Computer Information Systems concentration is intended for training application programmers or for those who wish to apply computer science in another discipline. The Information Security program follows the guidelines of the Association for Computing Machinery (ACM). Students in this program will take advanced courses of their choice.

Program Requirements

This program follows the guidelines of the Association for Computing Machinery (ACM). Students in this program will take advanced courses of their choice.

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>General Education Requirements</td>
<td></td>
<td></td>
</tr>
<tr>
<td>First-Year Seminar (FYS)</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Lower Division Area A: Foundational Skills</td>
<td>3, 4</td>
<td></td>
</tr>
<tr>
<td>Lower Division Area B: Natural Sciences</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Lower Division Area C: Arts and Humanities</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>Lower Division Area D: Social and Behavioral Sciences</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Lower Division Area E: Student Enrichment and Lifelong Learning (SELF)</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Lower Division Area F: Ethnic Studies</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>American Institutions: Government and History</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>Junior Year Diversity &amp; Reflection (JYDR)</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Graduation Writing Assessment Requirement (GWAR)</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Upper Division Thematic Area C and D</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>General Education Capstone</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>General Education Subtotal</td>
<td>26-29</td>
<td></td>
</tr>
</tbody>
</table>

Major Requirements

Lower Division

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>CMPS 2010</td>
<td>Programming I: Programming Fundamentals</td>
<td>4</td>
</tr>
<tr>
<td>CMPS 2020</td>
<td>Programming II: Data Structures and Algorithms</td>
<td>4</td>
</tr>
<tr>
<td>CMPS 2120</td>
<td>Discrete Structures</td>
<td>4</td>
</tr>
<tr>
<td>CMPS 2240</td>
<td>Computer Architecture I: Assembly Language</td>
<td>4</td>
</tr>
</tbody>
</table>

Upper Division

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>CMPS 3120</td>
<td>Algorithm Analysis</td>
<td>3</td>
</tr>
<tr>
<td>CMPS 3140</td>
<td>Theory of Computation</td>
<td>3</td>
</tr>
<tr>
<td>CMPS 3240</td>
<td>Computer Architecture II: Organization</td>
<td>4</td>
</tr>
<tr>
<td>CMPS 3350</td>
<td>Software Engineering</td>
<td>4</td>
</tr>
<tr>
<td>CMPS 3420</td>
<td>Database Systems</td>
<td>4</td>
</tr>
<tr>
<td>CMPS 3500</td>
<td>Programming Languages</td>
<td>3</td>
</tr>
<tr>
<td>CMPS 3560</td>
<td>Artificial Intelligence</td>
<td>3</td>
</tr>
<tr>
<td>CMPS 3600</td>
<td>Operating Systems</td>
<td>4</td>
</tr>
<tr>
<td>CMPS 3620</td>
<td>Computer Networks</td>
<td>4</td>
</tr>
<tr>
<td>CMPS 3640</td>
<td>Distributed and Parallel Computation</td>
<td>3</td>
</tr>
<tr>
<td>CMPS 4910</td>
<td>Senior Project I</td>
<td>2</td>
</tr>
<tr>
<td>CMPS 4928</td>
<td>Senior Project II</td>
<td>2</td>
</tr>
</tbody>
</table>

Upper Division Elective Courses

Select 8 units from the following: 1

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATH/CMPS 3300</td>
<td>Numerical Analysis</td>
</tr>
<tr>
<td>MATH 3310</td>
<td>Discrete Mathematical Modeling</td>
</tr>
<tr>
<td>CMPS 4210</td>
<td>Advanced Computer Architecture</td>
</tr>
</tbody>
</table>

Academic Regulation

A grade of C- is the minimal grade acceptable for progression in the CMPS 2010 Programming I: Programming Fundamentals and CMPS 2020 Programming II: Data Structures and Algorithms sequence.
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>ECE 3200</td>
<td>Digital Circuits</td>
</tr>
<tr>
<td>ECE 4240</td>
<td>Microprocessor System Design</td>
</tr>
<tr>
<td>CMPS 3390</td>
<td>Application Development</td>
</tr>
<tr>
<td>CMPS 3480</td>
<td>Computer Graphics</td>
</tr>
<tr>
<td>CMPS 4350</td>
<td>Advanced Software Engineering</td>
</tr>
<tr>
<td>CMPS 4480</td>
<td>Computer Animation</td>
</tr>
<tr>
<td>CMPS 4490</td>
<td>Game Development</td>
</tr>
<tr>
<td>ECE 4460</td>
<td>Image Processing</td>
</tr>
<tr>
<td>ECE 4470</td>
<td>Computer Vision</td>
</tr>
</tbody>
</table>

**Software Engineering and Visual Computing:**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>CMPS 4200</td>
<td>Advanced Database Systems</td>
</tr>
<tr>
<td>CMPS 4430</td>
<td>Introduction to Data Science</td>
</tr>
<tr>
<td>CMPS 4450</td>
<td>Data Mining and Visualization</td>
</tr>
<tr>
<td>CMPS 4560</td>
<td>Advanced Artificial Intelligence</td>
</tr>
<tr>
<td>CMPS/ECE 4550</td>
<td>Applied Machine Learning</td>
</tr>
<tr>
<td>ECE 4570</td>
<td>Robotics</td>
</tr>
</tbody>
</table>

**Operating Systems, Networking, and Security:**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>CMPS 4510</td>
<td>Vulnerability Analysis</td>
</tr>
<tr>
<td>CMPS 4620</td>
<td>Network and Computer Security</td>
</tr>
<tr>
<td>MATH/CMPs 4300</td>
<td>Applied Cryptography</td>
</tr>
</tbody>
</table>

**Special Topics and Independent Study in Computer Science:**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>CMPS 3770</td>
<td>Special Topics</td>
</tr>
<tr>
<td>CMPS 3771</td>
<td>Special Topics Laboratory</td>
</tr>
<tr>
<td>CMPS 4770</td>
<td>Special Topics</td>
</tr>
<tr>
<td>CMPS 4771</td>
<td>Special Topics Laboratory</td>
</tr>
<tr>
<td>CMPS 4800</td>
<td>Undergraduate Research</td>
</tr>
<tr>
<td>CMPS 4860</td>
<td>Internship in Computer Science</td>
</tr>
<tr>
<td>CMPS 4870</td>
<td>Cooperative Education</td>
</tr>
<tr>
<td>CMPS 4890</td>
<td>Experiential Prior Learning</td>
</tr>
</tbody>
</table>

**Required Cognate Courses**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATH 2510</td>
<td>Single Variable Calculus I</td>
</tr>
<tr>
<td>MATH 2310</td>
<td>Single Variable Calculus I for Engineers</td>
</tr>
<tr>
<td>MATH 2520</td>
<td>Single Variable Calculus II</td>
</tr>
<tr>
<td>MATH 2320</td>
<td>Single Variable Calculus II for Engineers</td>
</tr>
<tr>
<td>MATH 3200</td>
<td>Probability Theory</td>
</tr>
<tr>
<td>PHYS 2210</td>
<td>Physics for Scientists and Engineers I</td>
</tr>
<tr>
<td>PHYS 2220</td>
<td>Physics for Scientists and Engineers II</td>
</tr>
<tr>
<td>PHIL 3318</td>
<td>Professional Ethics</td>
</tr>
</tbody>
</table>

Select one of the following: 3-4

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOL 1009</td>
<td>Perspectives in Biology</td>
</tr>
<tr>
<td>BIOL 1039</td>
<td>Principles of Ecology</td>
</tr>
<tr>
<td>BIOL 2010</td>
<td>Introductory Biology - Cells</td>
</tr>
<tr>
<td>CHEM 1000</td>
<td>Foundations of Chemistry</td>
</tr>
<tr>
<td>GEOL 2010</td>
<td>Physical Geology</td>
</tr>
<tr>
<td>MATH 2200</td>
<td>Introduction to Statistical Concepts and Methods</td>
</tr>
<tr>
<td>MATH 2533</td>
<td>Multivariable and Vector Calculus</td>
</tr>
<tr>
<td>MATH 2540</td>
<td>Ordinary Differential Equations</td>
</tr>
<tr>
<td>MATH 2610</td>
<td>Linear Algebra I</td>
</tr>
<tr>
<td>MATH 3500</td>
<td>Complex Variables</td>
</tr>
</tbody>
</table>

**ECE 4460** Image Processing

**ECE 4470** Computer Vision

**Database Systems and Intelligent Systems:**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>CMPS 4420</td>
<td>Advanced Database Systems</td>
</tr>
<tr>
<td>CMPS 4430</td>
<td>Introduction to Data Science</td>
</tr>
<tr>
<td>CMPS 4450</td>
<td>Data Mining and Visualization</td>
</tr>
<tr>
<td>CMPS 4560</td>
<td>Advanced Artificial Intelligence</td>
</tr>
<tr>
<td>CMPS/ECE 4550</td>
<td>Applied Machine Learning</td>
</tr>
</tbody>
</table>

**ECE 4570** Robotics

**Operating Systems, Networking, and Security:**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>CMPS 4510</td>
<td>Vulnerability Analysis</td>
</tr>
<tr>
<td>CMPS 4620</td>
<td>Network and Computer Security</td>
</tr>
<tr>
<td>MATH/CMPs 4300</td>
<td>Applied Cryptography</td>
</tr>
</tbody>
</table>

**Special Topics and Independent Study in Computer Science:**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>CMPS 3770</td>
<td>Special Topics</td>
</tr>
<tr>
<td>CMPS 3771</td>
<td>Special Topics Laboratory</td>
</tr>
<tr>
<td>CMPS 4770</td>
<td>Special Topics</td>
</tr>
<tr>
<td>CMPS 4771</td>
<td>Special Topics Laboratory</td>
</tr>
<tr>
<td>CMPS 4800</td>
<td>Undergraduate Research</td>
</tr>
<tr>
<td>CMPS 4860</td>
<td>Internship in Computer Science</td>
</tr>
<tr>
<td>CMPS 4870</td>
<td>Cooperative Education</td>
</tr>
<tr>
<td>CMPS 4890</td>
<td>Experiential Prior Learning</td>
</tr>
</tbody>
</table>

**Required Cognate Courses**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATH 2510</td>
<td>Single Variable Calculus I</td>
</tr>
<tr>
<td>MATH 2310</td>
<td>Single Variable Calculus I for Engineers</td>
</tr>
<tr>
<td>MATH 2520</td>
<td>Single Variable Calculus II</td>
</tr>
<tr>
<td>MATH 2320</td>
<td>Single Variable Calculus II for Engineers</td>
</tr>
<tr>
<td>MATH 3200</td>
<td>Probability Theory</td>
</tr>
<tr>
<td>PHYS 2210</td>
<td>Physics for Scientists and Engineers I</td>
</tr>
<tr>
<td>PHYS 2220</td>
<td>Physics for Scientists and Engineers II</td>
</tr>
<tr>
<td>PHIL 3318</td>
<td>Professional Ethics</td>
</tr>
</tbody>
</table>

Select one of the following: 3-4

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOL 1009</td>
<td>Perspectives in Biology</td>
</tr>
<tr>
<td>BIOL 1039</td>
<td>Principles of Ecology</td>
</tr>
<tr>
<td>BIOL 2010</td>
<td>Introductory Biology - Cells</td>
</tr>
<tr>
<td>CHEM 1000</td>
<td>Foundations of Chemistry</td>
</tr>
<tr>
<td>GEOL 2010</td>
<td>Physical Geology</td>
</tr>
<tr>
<td>MATH 2200</td>
<td>Introduction to Statistical Concepts and Methods</td>
</tr>
<tr>
<td>MATH 2533</td>
<td>Multivariable and Vector Calculus</td>
</tr>
<tr>
<td>MATH 2540</td>
<td>Ordinary Differential Equations</td>
</tr>
<tr>
<td>MATH 2610</td>
<td>Linear Algebra I</td>
</tr>
<tr>
<td>MATH 3500</td>
<td>Complex Variables</td>
</tr>
</tbody>
</table>

**MATH 1019** Introduction to Scientific Thinking

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>CMPS 4928</td>
<td>Senior Project II</td>
</tr>
<tr>
<td>PHIL 3318</td>
<td>Professional Ethics</td>
</tr>
<tr>
<td>PHYS 2210</td>
<td>Physics for Scientists and Engineers I</td>
</tr>
<tr>
<td>MATH 2510</td>
<td>Single Variable Calculus I for Engineers</td>
</tr>
<tr>
<td>PHIL 3318</td>
<td>Professional Ethics</td>
</tr>
</tbody>
</table>

**Total Units**: 116-124

1. At least one course must be at the 4000-level.
2. Only a combined total of 4 units of CMPS 377x, 477x, and 48xx may be used for elective credit.
3. MATH 1019 Introduction to Scientific Thinking (A3) is recommended but NOT required.
4. Some of the courses required for the Computer Science major also satisfy General Education requirements. Students who complete each of these courses with the appropriate grade also satisfy the GE requirement, even if they were to change majors:
   - CMPS 4928 Senior Project II satisfies the Capstone requirement.
   - PHIL 3318 Professional Ethics satisfies UD Thematic Area C and the Computer Science Ethics requirement.
   - PHYS 2210 Physics for Scientists and Engineers I satisfies LD Area B1.
   - MATH 2510 Single Variable Calculus I or MATH 2310 Single Variable Calculus I for Engineers with a grade of C- or better satisfies Foundational Skills B4.
   - PHIL 3318 Professional Ethics satisfies GWA

Computer Science majors have the following General Education Modifications (GEMs), which means they do not have to take courses to satisfy these GE requirements. These GEMs are specific to the Computer Science major and students who change to another major will not keep the modifications:

- LD Area B2 is embedded throughout the curriculum.
- 3 units of LD Area D is met through Computer Science outcomes 2 and 4.
- UD Thematic Area D is met through Computer Science outcomes 2 and 4.

Students may choose to take MATH 1019 Introduction to Scientific Thinking as their Mathematics Science elective. Completion of MATH 1019 Introduction to Scientific Thinking with a grade of C- or better satisfies Foundational Skill A3.

The SELF requirement may be met by selecting another General Education course with a SELF overlay or by taking a stand-alone course. The GWAR may be satisfied by taking the GWAR exam, by taking another General Education course with a GWAR overlay, or by taking a stand-alone course. If a student opts to take a stand-alone course for either or both of these requirements, the course(s) will add additional units to that student's general education pathway.

Additional Units are required to meet the 120-unit requirement for graduation. Any accepted university units may be used to meet this requirement, including stand-alone courses for SELF.