Mathematics and Computer Science (BA/BS)

Arkady Vaintrob and Christopher B. Wilson, Advisors

Students who want training in both mathematics and computer science can declare a joint mathematics and computer science major. This allows them to develop skills and knowledge in both fields. The program develops team players prepared for information-based jobs. MACS students graduate with the tools to analyze complex problems and to compute the answers to them.

Program Learning Outcomes

Upon successful completion of this program, students will be able to:

- Demonstrate proficiency in the main areas of computer science, including data structures and algorithms, computer systems, programming languages, and software development.
- Draw on broad knowledge of computer science to design, implement, and test software solutions to problems in a variety of areas.
- Demonstrate in-depth understanding of some area of computer science (theoretical foundations, computer systems, software development).
- Demonstrate proficiency with the calculational techniques and applications of calculus and linear algebra.
- Read and write mathematical proofs, producing arguments that are logically and syntactically correct.
- Demonstrate an in-depth understanding of some area of mathematics.
- Communicate and collaborate with others and express ideas orally and in writing.

Mathematics and Computer Science Major Requirements

The requirements for the mathematics and computer science (MACS) major fall into four categories: mathematics, computer science, writing, and science, with 44 credits taken in mathematics, 40 credits in computer science, and 16 credits (science and writing) in other departments.

Computer Science I (CS 210), Computer Science II (CS 211), Computer Science III (CS 212), Elements of Discrete Mathematics I (MATH 231), and Elements of Discrete Mathematics II (MATH 232) must be passed with grades of B– or better before students can take the upper-division core courses. Courses required for the major must be taken for a letter grade. Upper-division courses must be passed with a grade of C– or better.

Code | Title | Credits
--- | --- | ---
Core Courses
CS 210–212 & CS 211–212 | Computer Science I-III | 12
MATH 231–232 | Elements of Discrete Mathematics I-II | 8
MATH 251–253 | Calculus I-III | 12
or MATH 261–263 | Calculus with Theory I-III | 26

Mathematics Requirements

Select one of the following:

- MATH 316 | Fundamentals of Analysis I | 4
- MATH 347 | Fundamentals of Number Theory I | 4
- MATH 391 | Fundamentals of Abstract Algebra I | 4
- MATH 341–342 | Elementary Linear Algebra | 8
- MATH 351–352 | Elementary Numerical Analysis I-II | 8
  or MATH 461–462 | Introduction to Mathematical Methods of Statistics I-II | 462

Upper-level mathematics course

Computer Science

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>CS 313</td>
<td>Intermediate Data Structures</td>
<td>4</td>
</tr>
<tr>
<td>CS 314</td>
<td>Computer Organization</td>
<td>4</td>
</tr>
<tr>
<td>CS 315</td>
<td>Intermediate Algorithms</td>
<td>4</td>
</tr>
<tr>
<td>CS 425</td>
<td>Principles of Programming Languages</td>
<td>4</td>
</tr>
</tbody>
</table>

Select one of the following:

- CS 322 | Introduction to Software Engineering | 4 |
- CS 330 | C/C++ and Unix | 4 |
- CS 420 | Automata Theory | 4 |
- CS 422 | Software Methodology I | 4 |

Two other upper-division CS courses

Writing Requirements

WR 320 | Scientific and Technical Writing | 4 |
  or WR 321 | Business Communications | 4 |

Science Requirements

Select 12 credits from the following:

Biology

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>BI 211 &amp; BI 213</td>
<td>General Biology I: Cells and General Biology III: Ecology and Evolution</td>
<td>6</td>
</tr>
</tbody>
</table>
  or BI 211–212 | General Biology I-II | 8 |

Chemistry

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>CH 111</td>
<td>Introduction to Chemical Principles</td>
<td>4</td>
</tr>
</tbody>
</table>
  or CH 113 | The Chemistry of Sustainability | 4 |
  or CH 221 | General Chemistry I | 4 |
  or CH 224H | Advanced General Chemistry I | 4 |
  or CH 221–223 | General Chemistry | 8 |
  or CH 224H-Honors General Chemistry 226H | 8 |

Geography

GEOG 141 | The Natural Environment | 4 |

Select two of the following:

GEOG 321 | Climatology | 4 |
GEOG 322 | Geomorphology | 4 |
GEOG 323 | Biogeography | 4 |

Earth Sciences

ERTH 201 | Dynamic Planet Earth | 4 |
ERTH 202 | Earth's Surface and Environment | 4 |
ERTH 203 | History of Life | 4 |

Physics

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHYS 201–203</td>
<td>General Physics</td>
<td>8</td>
</tr>
</tbody>
</table>
Mathematics and Computer Science (BA/BS)

Psychology
PSY 201  Mind and Brain
Select two of the following:
PSY 301  Scientific Thinking in Psychology
PSY 304  Biopsychology
PSY 305  Cognition
PSY 348  Music and the Brain

Total Credits 96

1  Excludes Statistical Methods I (MATH 425)
2  Special Studies: [Topic] (CS 399) and Experimental Course: [Topic] (CS 410) courses used as electives must have a prerequisite of Intermediate Data Structures (CS 313) and have regular class meetings and homework assignments. At least one course must be numbered 410 or above.
3  Students are encouraged to complete the accompanying lab courses.

Honors Program
Both of the cooperating departments offer departmental honors programs to their undergraduate majors. After obtaining advance approval from both of their advisors, students in the joint degree program are eligible to attain honors in mathematics and computer science by meeting the honors requirements of either department, including writing a thesis.

Four-Year Degree Plan
The degree plan shown is only a sample of how students may complete their degrees in four years. There are alternative ways. Students should consult their advisor to determine the best path for them.

Bachelor of Arts in Mathematics and Computer Science

Code  Title  Credits
MATH 316  Fundamentals of Analysis I 4
MATH 341  Elementary Linear Algebra 4
MATH 342  Elementary Linear Algebra 4
CS 313  Intermediate Data Structures 4
CS 314  Computer Organization 4
CS 315  Intermediate Algorithms 4
CS 425  Principles of Programming Languages 4
One of the following:
CS 330  C/C++ and Unix 4
CS 420  Automata Theory 4
CS 422  Software Methodology I 4

Honors Program
Both of the cooperating departments offer departmental honors programs to their undergraduate majors. After obtaining advance approval from both of their advisors, students in the joint degree program are eligible to attain honors in mathematics and computer science by meeting the honors requirements of either department, including writing a thesis.

Four-Year Degree Plan
The degree plan shown is only a sample of how students may complete their degrees in four years. There are alternative ways. Students should consult their advisor to determine the best path for them.

Bachelor of Arts in Mathematics and Computer Science

Code  Title  Credits
CS 122  Introduction to Programming and Problem Solving 4
MATH 112Z  Precalculus II: Trigonometry 4
WR 121Z  Composition I 4
First term of second-year second-language sequence 4

Credits 16

Winter
CS 210  Computer Science I 4
MATH 231  Elements of Discrete Mathematics I 4
WR 122Z  Composition II or College Composition III 4
Second term of second-year second-language sequence 4

Credits 16

Spring
CS 211  Computer Science II 4
MATH 232  Elements of Discrete Mathematics II 4
Core-education course in arts and letters 4
Third term of second-year second-language sequence 4

Credits 16

Total Credits 48

Course  Title  Credits
Fall
CS 212  Computer Science III 4
MATH 251  Calculus I or Calculus for the Biological Sciences I or Calculus with Theory I 4
MATH 261  Calculus I or Calculus for the Biological Sciences I or Calculus with Theory I 4
First course of additional science sequence 4
Core-education course in social science 4

Credits 16

Winter
CS 313  Intermediate Data Structures 4
Bachelor of Science in Mathematics and Computer Science

Course Title Credits Milestones

First Year
Fall
MATH 112Z Precalculus II: Trigonometry 4
CS 122 Introduction to Programming and Problem Solving 4
WR 121Z Composition I 4
Core-education course in arts and letters 4

Winter
MATH 251 Calculus I 4
CS 210 Computer Science I 4
WR 122Z Composition II or WR 123 or College Composition III 4
Core-education course in social science 4

Total Credits 48

Second Year
Fall
MATH 252 Calculus II or Calculus for the Biological Sciences II or Calculus with Theory II 4
CS 211 Computer Science II 4
Core-education course in arts and letters 4
Core-education course in social science 4

Winter
MATH 352 Elementary Numerical Analysis II or Introduction to Mathematical Methods of Statistics II 4
Upper-division elective course with CS subject code 4
Elective course 4

Total Credits 12

Third Year
Fall
CS 314 Computer Organization 4
MATH 316 Fundamentals of Analysis I or Fundamentals of Number Theory I or Fundamentals of Abstract Algebra I 4
CS 322 Introduction to Software Engineering 4
Core-education course in arts and letters 4

Winter
CS 322 Introduction to Software Engineering 4
MATH 341 Elementary Linear Algebra 4
Core-education course in social science 4
Core-education course in arts and letters that also satisfies cultural literacy requirement 4

Total Credits 16

Spring
CS 425 Principles of Programming Languages 4
MATH 342 Elementary Linear Algebra 4
Core-education course in social science that also satisfies cultural literacy requirement 4
Elective course 4

Total Credits 16

Fourth Year
Fall
MATH 351 Elementary Numerical Analysis I or Introduction to Mathematical Methods of Statistics I 4
CS 315 Intermediate Algorithms 4
Core-education course in arts and letters also satisfies a cultural literacy requirement 4
First course of additional science sequence 4

Winter
MATH 352 Elementary Numerical Analysis II or Introduction to Mathematical Methods of Statistics II 4
Upper-division elective course with CS subject code 4
Elective course 4

Total Credits 12

Total Credits 48
<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
<th>Milestones</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATH 247</td>
<td>Calculus for the Biological Sciences II</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>or MATH 252</td>
<td>Calculus II</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>or MATH 262</td>
<td>Calculus with Theory II</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Second course of additional science sequence</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Core-education course in social science also satisfies a cultural literacy requirement</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Credits</td>
<td>16</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
<th>Milestones</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATH 253</td>
<td>Calculus III</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>or MATH 263</td>
<td>Calculus with Theory III</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Third course of additional science sequence</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Core-education course in social science</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Credits</td>
<td>16</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Total Credits:** 48

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
<th>Milestones</th>
</tr>
</thead>
<tbody>
<tr>
<td>CS 314</td>
<td>Computer Organization</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>MATH 316</td>
<td>Fundamentals of Analysis I</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>or MATH 347</td>
<td>Fundamentals of Number Theory I</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>or MATH 391</td>
<td>Fundamentals of Abstract Algebra I</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>CS 322</td>
<td>Introduction to Software Engineering</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Core-education course in arts and letters</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Credits</td>
<td>16</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
<th>Milestones</th>
</tr>
</thead>
<tbody>
<tr>
<td>CS 322</td>
<td>Introduction to Software Engineering</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>MATH 341</td>
<td>Elementary Linear Algebra</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Elective courses</td>
<td>8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Credits</td>
<td>16</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
<th>Milestones</th>
</tr>
</thead>
<tbody>
<tr>
<td>CS 425</td>
<td>Principles of Programming Languages</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>MATH 342</td>
<td>Elementary Linear Algebra</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Elective courses</td>
<td>8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Credits</td>
<td>16</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Total Credits:** 48

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
<th>Milestones</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elective course with a CS subject code</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MATH 351</td>
<td>Elementary Numerical Analysis I</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>or MATH 461</td>
<td>or Introduction to Mathematical Methods of Statistics I</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Elective course</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Credits</td>
<td>12</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
<th>Milestones</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elective course with a CS subject code</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MATH 352</td>
<td>Elementary Numerical Analysis II</td>
<td>4</td>
<td></td>
</tr>
</tbody>
</table>