Mathematics and Computer Science

Arkady Vaintrob and Christopher B. Wilson, Advisors

The undergraduate major in mathematics and computer science leads to a bachelor of arts or bachelor of science degree. The major combines elements of the mathematics and computer and information science curricula into a four-year program that offers an alternative to the undergraduate degree programs in either field. It serves students who want knowledge in both fields but are not ready to specialize in either. The courses selected for the program provide a solid foundation for professional work or for advanced study.

The program is designed to develop team players for information-based occupations. Its graduates have the tools to analyze complex problems and compute the answers to them. Consistent with its emphasis on teamwork and communication, the program requires college-level exposure to an additional scientific field and an upper-division writing course.

Students with strong mathematics backgrounds in high school are frequently advised to major in computer science at the university, often without a clear idea of what the field of study is actually like. The joint major program offers such students the chance to experiment with computer science while retaining the anchor to mathematics. It also allows students the possibility of changing easily to the single-major program in either mathematics or CIS with no loss of credit and, at least through the junior year, without jeopardizing degree completion in four years.

Careers

Graduates with this major can enter industrial positions that require computer science skills and mathematical problem-solving ability. They are particularly well suited for positions in the high-performance computing industry, developing the software tools for large-scale scientific computation. The combination of mathematics and computer science forms an excellent professional background for secondary-school mathematics teachers, and the major program also provides a solid foundation for actuarial, financial, and related professions. Graduates are also prepared to enter advanced programs of study in either mathematics or computer science, or in applied areas such as biological computational science.

Preparation

A high school student planning to major in mathematics and computer science should pursue a strong academic program with four years of mathematics. Courses in algebra, geometry, trigonometry, and more advanced topics should be included. Experience preparing substantial written reports is highly desirable.

Transfer Students

College transfer students who have completed a year of calculus should be able to fit the remaining mathematics courses for the degree into just two years, provided that they have already completed the bulk of their general-education requirements before they transfer.

Transfer students should call or write to the Department of Computer and Information Science to determine whether computer courses they have taken can be counted toward the joint major requirements. Sequential subjects such as mathematics and computer science typically require several years to progress from introductory to senior-level courses. The joint program lets students move forward in both fields at once with limited prerequisites, making it relatively accessible to transfer students and to students who change from other major programs. Students who want to pursue the material in greater depth need to consider prerequisite paths carefully.

Students attending community college in Oregon are encouraged to obtain the Associate of Arts Oregon Transfer degree before entering the University of Oregon. While earning this degree, community college transfer students should take as much discrete mathematics, calculus, and computer science as possible, and also try to complete the science requirement for the major. The associate degree does not automatically satisfy the science requirement for this major.

Faculties and Facilities

The faculties and facilities in both the mathematics and the computer and information science departments are available to students in the combined major program. For detailed descriptions, see those sections of this catalog. Information is also available online.

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.

Preparation for Kindergarten through Secondary School Teaching Careers

The College of Education offers a fifth-year program for middle-secondary licensure in mathematics and for elementary teaching. More information is available from the mathematics department’s education advisor, Shlomo Libeskind; see also the College of Education section of this catalog.

Minor

Minors are offered by the Department of Mathematics and the Department of Computer and Information Science. There is no joint minor in mathematics and computer science.

- Bachelor of Arts
- Bachelor of Science

Undergraduate Studies

Bachelor of Arts Degree Requirements

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>CIS 210–212</td>
<td>Computer Science I-III</td>
<td>12</td>
</tr>
<tr>
<td>MATH 231–232</td>
<td>Elements of Discrete Mathematics I-II</td>
<td>8</td>
</tr>
<tr>
<td>MATH 251–253</td>
<td>Calculus I-III</td>
<td>12</td>
</tr>
<tr>
<td>or MATH 261–263</td>
<td>Calculus with Theory I-III</td>
<td></td>
</tr>
</tbody>
</table>

Mathematics Requirements

Select one of the following:
MATH 316  Fundamentals of Analysis I
MATH 347  Fundamentals of Number Theory I
MATH 391  Fundamentals of Abstract Algebra I
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

Upper-level mathematics course ¹  4

Computer and Information Science
CIS 313  Intermediate Data Structures  4
CIS 314  Computer Organization  4
CIS 315  Intermediate Algorithms  4
CIS 425  Principles of Programming Languages  4
Select one of the following:  4
CIS 322  Introduction to Software Engineering  4
CIS 330  C/C++ and Unix  4
CIS 420  Automata Theory  4
CIS 422  Software Methodology I  4
Two other upper-division CIS courses ²  8

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

Science Requirements
Select 12 credits from the following:  12
Biology ³
BI 211,213  General Biology I,III  6
or BI 211–212  General Biology I-II  6
Chemistry ³
CH 111  Introduction to Chemical Principles  3
or CH 113  The Chemistry of Sustainability  3
or CH 221  General Chemistry I  3
or CH 224H  Honors General Chemistry  3
CH 221–223  General Chemistry  6
or CH 224H–226H  Honors General Chemistry  6

Geography
GEOG 141  The Natural Environment  3
Select two of the following:
GEOG 321  Climatology  3
GEOG 322  Geomorphology  3
GEOG 323  Biogeography  3

Earth Sciences
GEOL 201  Earth’s Interior Heat and Dynamics  3
GEOL 202  Earth Surface and Environmental Geology  3
GEOL 203  Evolution of the Earth  3

Physics ³
PHYS 201–203  General Physics  6
or PHYS 251–253  Foundations of Physics I  6

Psychology
PSY 201  Mind and Brain  3
PSY 202  Mind and Society  3

Select one of the following:
PSY 304  Biopsychology  3
PSY 348  Music and the Brain  3

Total Credits  100

¹ Excludes Statistical Methods I-II (MATH 425–426)
² Special Studies: [Topic] (CIS 399) and Experimental Course: [Topic] (CIS 410) courses used as electives must have a prerequisite of Intermediate Data Structures (CIS 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.

Bachelor of Science Degree Requirements

Code  Title  Credits
Core Courses
CIS 210–212  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  12

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  8
Upper-level mathematics course ¹  4

Computer and Information Science
CIS 313  Intermediate Data Structures  4
CIS 314  Computer Organization  4
CIS 315  Intermediate Algorithms  4
CIS 425  Principles of Programming Languages  4
Select one of the following:  4
CIS 322  Introduction to Software Engineering  4
CIS 330  C/C++ and Unix  4
CIS 420  Automata Theory  4
CIS 422  Software Methodology I  4
Two other upper-division CIS courses ²  8

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

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Select 12 credits from the following:  12
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BI 211,213  General Biology I,III  6
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Chemistry ³
CH 111  Introduction to Chemical Principles  3
or CH 113  The Chemistry of Sustainability  3
or CH 221  General Chemistry I  3
or CH 224H  Honors General Chemistry  3
CH 221–223  General Chemistry  6
or CH 224H–226H  Honors General Chemistry  6

Geography
GEOG 141  The Natural Environment  3
Select two of the following:
GEOG 321  Climatology  3
GEOG 322  Geomorphology  3
GEOG 323  Biogeography  3

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GEOL 201  Earth’s Interior Heat and Dynamics  3
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PHYS 201–203  General Physics  6
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Advising and Program Planning

Each major is assigned two advisors, one in the Department of Mathematics and one in the Department of Computer and Information Science. One of the two is designated as the advisor of record for the student, but both cooperate in planning the student’s program. Because of the interrelationship between mathematics and computer science courses, it is especially important that a student planning for the combined major consult closely with both advisors. Since both mathematics and computer science are sequential subjects, prerequisite planning should be discussed with the student’s advisors.

Programming Experience

Students who take Computer Science I-III (CIS 210–212) are expected to have programming experience, which may have been acquired in a high school course, through employment, or in a course such as Introduction to Programming and Problem Solving (CIS 122). Students who are unsure about their level of preparation should meet with a CIS advisor.

Sequence of Courses

Elements of Discrete Mathematics I-II (MATH 231–232) and Computer Science I-III (CIS 210–212) go well together, as do calculus and physics. Students with advanced placement credit in calculus and programming experience may want to take Elements of Discrete Mathematics I-II (MATH 231–232) and Computer Science I-III (CIS 210–212) in the freshman year. Students with little or no programming experience should plan to take Introduction to Programming and Problem Solving (CIS 122), Calculus I-III (MATH 251–253), and the major science requirement in the freshman year. In the sophomore year, students should take whichever of calculus or computer science was not taken freshman year, and continue into the 300 level of the branch that was taken.

Major Progress Review and Major in Good Standing

Each major must meet with a CIS advisor to file a Major Progress Review form after completing 12 credits of the upper-division core, including at least one course from each department. Mathematics and computer science courses and at least 8 credits of upper-division CIS courses used to satisfy upper-division major requirements must be taken for letter grades and passed with grades of C– or better. At least 12 of the upper-division mathematics credits and 12 of the upper-division computer and information science credits applied to the degree must be taken in residence at the university. A student who receives two grades below C– in the upper-division core or three grades below C– in any upper-division courses may be removed from the major.

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

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
<th>Milestones</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>First Year</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Fall</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CIS 122</td>
<td>Introduction to Programming and Problem Solving</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>MATH 112</td>
<td>Elementary Functions</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>WR 121</td>
<td>College Composition I</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>200-level language sequence</td>
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<td>4</td>
<td></td>
</tr>
<tr>
<td><strong>Credits</strong></td>
<td></td>
<td>16</td>
<td></td>
</tr>
<tr>
<td><strong>Winter</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CIS 210</td>
<td>Computer Science I</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>MATH 231</td>
<td>Elements of Discrete Mathematics I</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>WR 122</td>
<td>College Composition II</td>
<td>4</td>
<td></td>
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<tr>
<td>200-level language sequence</td>
<td></td>
<td>4</td>
<td></td>
</tr>
<tr>
<td><strong>Credits</strong></td>
<td></td>
<td>16</td>
<td></td>
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<tr>
<td><strong>Spring</strong></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>CIS 211</td>
<td>Computer Science II</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>MATH 232</td>
<td>Elements of Discrete Mathematics II</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>200-level language sequence</td>
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<td>4</td>
<td></td>
</tr>
<tr>
<td><strong>Credits</strong></td>
<td></td>
<td>16</td>
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</tr>
<tr>
<td><strong>Total Credits</strong></td>
<td></td>
<td>48</td>
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| **Second Year**|                                                      |         |                            |
| **Fall**       |                                                      |         |                            |
| CIS 212        | Computer Science III                                 | 4       |                            |
| MATH 251       | Calculus I                                           | 4       |                            |
| 200-level language sequence |                               | 4       |                            |
| **Credits**    |                                                      | 16      |                            |
| **Winter**     |                                                      |         |                            |
| CIS 313        | Intermediate Data Structures                         | 4       |                            |
| MATH 252       | Calculus II                                          | 4       |                            |
| 200-level language sequence |                               | 4       |                            |
| **Credits**    |                                                      | 16      |                            |
| **Third Year** |                                                      |         |                            |
| **Fall**       |                                                      |         |                            |
| CIS 314        | Computer Organization                                | 4       |                            |
| MATH 316       | Fundamentals of Analysis I                           | 4       |                            |
| 200-level language sequence |                               | 4       |                            |
| **Credits**    |                                                      | 16      |                            |
| **Winter**     |                                                      |         |                            |
| CIS 322        | Introduction to Software Engineering or Automata     | 4       |                            |
| MATH 341       | Elementary Linear Algebra                            | 4       |                            |
| 200-level language sequence |                               | 4       |                            |
| **Credits**    |                                                      | 16      |                            |
| **Spring**     |                                                      |         |                            |
| CIS 322        | Introduction to Software Engineering or Automata     | 4       |                            |
| MATH 341       | Elementary Linear Algebra                            | 4       |                            |
| 200-level language sequence |                               | 4       |                            |
| **Credits**    |                                                      | 16      |                            |

General-education arts and letters or multicultural course

<table>
<thead>
<tr>
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<tr>
<td>CIS 322</td>
<td>Introduction to Software Engineering or Automata</td>
<td>4</td>
<td></td>
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<td>MATH 341</td>
<td>Elementary Linear Algebra</td>
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<td></td>
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<tr>
<td>200-level language sequence</td>
<td></td>
<td>4</td>
<td></td>
</tr>
<tr>
<td><strong>Credits</strong></td>
<td></td>
<td>16</td>
<td></td>
</tr>
</tbody>
</table>
MATH 342  Elementary Linear Algebra  4
General education course in social science  4
Elective course  4

Credits  16
Total Credits  48

Course Title Credits Milestones
Fourth Year
Fall
Elective course with CIS subject code  4
MATH 351 or MATH 461 Elementary Numerical Analysis I
or Introduction to Mathematical Methods of Statistics I  4
Elective course  4

Credits  12
Winter
Elective course with CIS subject code  4
MATH 352 or MATH 462 Elementary Numerical Analysis II
or Introduction to Mathematical Methods of Statistics II  4
Elective course  4

Credits  12
Spring
WR 320 or WR 321 Scientific and Technical Writing
or Business Communications  4
Elective course with MATH subject code  4
Elective course  4
Elective course  4

Credits  16
Total Credits  40

Bachelor of Science in Mathematics and Computer Science

Course Title Credits Milestones
First Year
Fall
MATH 112 Elementary Functions  4

Credits  12
Winter
CIS 122 Introduction to Programming and Problem Solving  4
WR 121 College Composition I  4
General education course in arts and letters  4

Credits  16
Second Year
Fall
MATH 251 Calculus I  4
CIS 212 Computer Science III  4
General education course in arts and letters also satisfies a multicultural requirement  4
Mathematics and computer science requirement  4

Credits  16
Winter
CIS 313 Intermediate Data Structures  4
MATH 247 or MATH 252 or MATH 262 Calculus for the Biological Sciences II
or Calculus II or Calculus with Theory II  4
Mathematics and computer science requirement  4
General education course in social science also satisfies a multicultural requirement

<table>
<thead>
<tr>
<th>Course</th>
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<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spring</td>
<td>CIS 315</td>
<td>Intermediate Algorithms</td>
</tr>
<tr>
<td></td>
<td>MATH 253 or MATH 263</td>
<td>Calculus III or Calculus with Theory III</td>
</tr>
<tr>
<td></td>
<td>Mathematics and computer science requirement</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>General education course in social science</td>
<td>4</td>
</tr>
</tbody>
</table>

| Credits | 16 |

**Total Credits**: 48

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<thead>
<tr>
<th>Course</th>
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<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Third Year</td>
<td>CIS 314</td>
<td>Computer Organization</td>
</tr>
<tr>
<td></td>
<td>MATH 316 or MATH 347 or MATH 391</td>
<td>Fundamentals of Analysis I or Fundamentals of Number Theory I or Fundamentals of Abstract Algebra I</td>
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<td>General education course in arts and letters</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>CIS 322 or CIS 420</td>
<td>Introduction to Software Engineering or Automata Theory</td>
</tr>
</tbody>
</table>

| Credits | 16 |

**Fourth Year**

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

| Credits | 12 |

| Winter | Elective course with a CIS subject code | 4 |
|        | MATH 352 or MATH 462 | Elementary Numerical Analysis II or Introduction to Mathematical Methods of Statistics II | 4 |
|        | Elective course | 4 |

| Credits | 12 |

| Spring | Elective course with MATH subject code | 4 |
|        | WR 320 or WR 321 | Scientific and Technical Writing or Business Communicator | 4 |
|        | Elective course | 4 |

| Credits | 12 |

| Total Credits | 36 |