## Computer Sciences, Ph.D.

### Requirements

#### Minimum Graduate School Requirements

Review the Graduate School minimum academic progress and degree requirements ([http://guide.wisc.edu/graduate/#policiesandrequirementstext](http://guide.wisc.edu/graduate/#policiesandrequirementstext)), in addition to the program requirements listed below.

#### Major Requirements

##### Mode of Instruction

<table>
<thead>
<tr>
<th>Mode of Instruction Definitions</th>
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<tbody>
<tr>
<td><strong>Accelerated:</strong> Accelerated programs are offered at a fast pace that condenses the time to completion. Students are able to complete a program with minimal disruptions to careers and other commitments.</td>
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<tr>
<td><strong>Evening/Weekend:</strong> Courses meet on the UW–Madison campus only in evenings and/or on weekends to accommodate typical business schedules. Students have the advantages of face-to-face courses with the flexibility to keep work and other life commitments.</td>
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<tr>
<td><strong>Face-to-Face:</strong> Courses typically meet during weekdays on the UW-Madison Campus.</td>
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<tr>
<td><strong>Hybrid:</strong> These programs combine face-to-face and online learning formats. Contact the program for more specific information.</td>
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<tr>
<td><strong>Online:</strong> These programs are offered 100% online. Some programs may require an on-campus orientation or residency experience, but the courses will be facilitated in an online format.</td>
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#### Curricular Requirements

<table>
<thead>
<tr>
<th>Requirements Detail</th>
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<tbody>
<tr>
<td>Minimum Credit Requirement</td>
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<tr>
<td>Minimum Residence Credit Requirement</td>
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<tr>
<td>Minimum Graduate Coursework Requirement</td>
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<tr>
<td>Overall Graduate GPA Requirement</td>
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<tr>
<td>Other Grade Requirements</td>
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</table>

#### Required Courses

**Additional Breadth Requirement**

Ph.D. students must take at least one course from each of the bands 1, 2 and 3 listed below; the courses must be distinct from the research area of the student’s qualifying exam activity. This requirement can be satisfied with 3 700-level courses, or 2 700-level and 2 500-level courses. Grades in all courses used for breadth must be at least AB. Details on which courses may be used for breadth are in the Graduate Program Handbook.

<table>
<thead>
<tr>
<th>Band 1</th>
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<tbody>
<tr>
<td><strong>Code</strong></td>
</tr>
<tr>
<td>COMP SCI/E C E 552</td>
</tr>
<tr>
<td>COMP SCI/E C E 752</td>
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<tr>
<td>COMP SCI/E C E 755</td>
</tr>
<tr>
<td>COMP SCI/E C E 757</td>
</tr>
<tr>
<td>COMP SCI 758</td>
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**Computer Networks:**

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>COMP SCI 640</td>
<td>Introduction to Computer Networks</td>
<td>3</td>
</tr>
<tr>
<td>COMP SCI/E C E 707</td>
<td>Mobile and Wireless Networking</td>
<td>3</td>
</tr>
<tr>
<td>COMP SCI 740</td>
<td>Advanced Computer Networks</td>
<td>3</td>
</tr>
</tbody>
</table>

**Computer Security:**

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>COMP SCI 642</td>
<td>Introduction to Information Security</td>
<td>3</td>
</tr>
</tbody>
</table>

**Operating Systems:**

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>COMP SCI 537</td>
<td>Introduction to Operating Systems</td>
<td>4</td>
</tr>
<tr>
<td>COMP SCI 736</td>
<td>Advanced Operating Systems</td>
<td>3</td>
</tr>
<tr>
<td>COMP SCI 739</td>
<td>Distributed Systems</td>
<td>3</td>
</tr>
<tr>
<td>COMP SCI 744</td>
<td>Big Data Systems</td>
<td>3</td>
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</tbody>
</table>

**Programming Languages and Compilers:**

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>COMP SCI/E C E 506</td>
<td>Software Engineering</td>
<td>3</td>
</tr>
<tr>
<td>COMP SCI 536</td>
<td>Introduction to Programming Languages and Compilers</td>
<td>3</td>
</tr>
<tr>
<td>COMP SCI 538</td>
<td>Introduction to the Theory and Design of Programming Languages</td>
<td>3</td>
</tr>
</tbody>
</table>
COMP SCI 701 Construction of Compilers 3
COMP SCI 703 Program Verification and Synthesis 3
COMP SCI 704 Principles of Programming Languages 3
COMP SCI 706 Analysis of Software Artifacts 3

**Band 2**

*Artificial Intelligence:*
COMP SCI 534 Computational Photography 3
COMP SCI 540 Introduction to Artificial Intelligence 3
COMP SCI 545 Natural Language and Computing 3
COMP SCI 760 Machine Learning 3
COMP SCI/E C E 761 Mathematical Foundations of Machine Learning 3
COMP SCI 766 Computer Vision 3
COMP SCI 769 Advanced Natural Language Processing 3

*Bioinformatics:*
COMP SCI/B M I 576 Introduction to Bioinformatics 3
COMP SCI/B M I 776 Advanced Bioinformatics 3

*Computer Graphics:*
COMP SCI 559 Computer Graphics 3
COMP SCI 679 Computer Game Technology 3
COMP SCI 765 Data Visualization 3
COMP SCI 777 Computer Animation 3

*Database Systems:*
COMP SCI 564 Database Management Systems: Design and Implementation 4
COMP SCI 764 Topics in Database Management Systems 3
COMP SCI 784 Foundations of Data Management 3

*Human-Computer Interaction:*
COMP SCI 570 Introduction to Human-Computer Interaction 4
COMP SCI/ ED PSYCH/ PSYCH 770 Human-Computer Interaction 3

**Band 3**

*Numerical Analysis:*
COMP SCI/ MATH 513 Numerical Linear Algebra 3
COMP SCI/ MATH 514 Numerical Analysis 3

*Optimization:*
COMP SCI/E C E/ I SY E 524 Introduction to Optimization 3
COMP SCI/I SY E/ MATH/STAT 525 Linear Optimization 3
COMP SCI/I SY E 635 Tools and Environments for Optimization 3
COMP SCI/I SY E 719 Stochastic Programming 3
COMP SCI/I SY E/ MATH/STAT 726 Nonlinear Optimization I 3
COMP SCI/I SY E/ MATH 728 Integer Optimization 3

COMP SCI/I SY E/ MATH 730 Nonlinear Optimization II 3

*Theory of Computing:*
COMP SCI 520 Introduction to Theory of Computing 3
COMP SCI 577 Introduction to Algorithms 4
COMP SCI 710 Computational Complexity 3
COMP SCI 787 Advanced Algorithms 3
COMP SCI 880 Topics in Theoretical Computer Science 3

In addition, some offerings of COMP SCI 838 (http://www.cs.wisc.edu/courses/838/) count towards the breadth requirement. Before each term, it is announced which sections do and what area/band they are in.

One course taken as a graduate student elsewhere may be counted for breadth. A request for this must be made in writing to the GAC Chair. The request should indicate the corresponding UW–Madison course, include a transcript showing a grade of AB or better, and suggest a faculty member who can evaluate the course. GAC will ask this faculty member to evaluate the outside course’s syllabus and other course materials and vouch for the choice of UW–Madison course.