

# COMPUTER SCIENCES, B.A.

Our graduates discover that **computer science (CS)** opens up a world of possibilities.

Computer scientists enjoy **exceptional career opportunities**, in settings ranging from large, established companies to adventurous new start-ups. They are also well qualified to pursue graduate study in a number of fields.

Our students are **creative, analytical problem-solvers**. This is a rich, collaborative and varied field that you will find challenging, no matter where your individual interests lie.

And there is more to CS than programming. While **software engineering** is an important skill, computer scientists also **work with robots** and other physical devices, **design hardware that runs faster** and more efficiently, and **apply machine learning techniques** to gain insight from large data sets—to name just a few examples.

Because CS has become highly **interconnected with medicine, business and many other fields**, it is a great fit with other interests you may have. You will enjoy a strong career outlook while having an **impact on society**.

## HOW TO GET IN

### DECLARATION REQUIREMENTS

To declare the computer sciences major, students must meet the following requirements:

- Completion of COMP SCI 300 and either MATH 222 or MATH 276
- Grade of BC or higher in one of these introductory programming courses, taken at UW-Madison: COMP SCI 300, COMP SCI/E C E 354 or COMP SCI 400
- 2.250 GPA or higher among the first completed attempts of these courses: COMP SCI 300 and either MATH 222 or MATH 276

<sup>1</sup> For purposes of computer sciences major declaration requirements, GPA is calculated with UW-Madison courses only, and does not include repeated coursework.

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If a student needs additional coursework to meet the 2.250 GPA requirement, COMP SCI/MATH 240, COMP SCI/E C E 354, and/or COMP SCI 400 Programming III may also be used.

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Students having difficulties meeting the above requirements should schedule a meeting with a computer sciences advisor to discuss alternatives.

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For instructions on declaring the major, see the Department of Computer Sciences website (<https://www.cs.wisc.edu/undergraduate/ba-bs-in-compsci/>).

## REQUIREMENTS

### UNIVERSITY GENERAL EDUCATION REQUIREMENTS

All undergraduate students at the University of Wisconsin–Madison are required to fulfill a minimum set of common university general education requirements to ensure that every graduate acquires the essential core of an undergraduate education. This core establishes a foundation for living a productive life, being a citizen of the world, appreciating aesthetic values, and engaging in lifelong learning in a continually changing world. Various schools and colleges will have requirements in addition to the requirements listed below. Consult your advisor for assistance, as needed. For additional information, see the university Undergraduate General Education Requirements (<http://guide.wisc.edu/undergraduate/#requirementsforundergraduestudytext>) section of the *Guide*.

General Education	<ul style="list-style-type: none"> <li>• Breadth—Humanities/Literature/Arts: 6 credits</li> <li>• Breadth—Natural Science: 4 to 6 credits, consisting of one 4- or 5-credit course with a laboratory component; or two courses providing a total of 6 credits</li> <li>• Breadth—Social Studies: 3 credits</li> <li>• Communication Part A &amp; Part B *</li> <li>• Ethnic Studies *</li> <li>• Quantitative Reasoning Part A &amp; Part B *</li> </ul>
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\* The mortarboard symbol appears before the title of any course that fulfills one of the Communication Part A or Part B, Ethnic Studies, or Quantitative Reasoning Part A or Part B requirements.

### COLLEGE OF LETTERS & SCIENCE DEGREE REQUIREMENTS: BACHELOR OF ARTS (B.A.)

Students pursuing a bachelor of arts degree in the College of Letters & Science must complete all of the requirements below. The College of Letters & Science allows this major to be paired with either a bachelor of arts or a bachelor of science curriculum.

#### BACHELOR OF ARTS DEGREE REQUIREMENTS

**Mathematics** Complete the University General Education Requirements for Quantitative Reasoning A (QR-A) and Quantitative Reasoning B (QR-B) coursework.

<b>Foreign Language</b>	<ul style="list-style-type: none"> <li>• Complete the fourth unit of a foreign language; OR</li> <li>• Complete the third unit of a foreign language and the second unit of an additional foreign language.</li> </ul>
<b>L&amp;S Breadth</b>	<ul style="list-style-type: none"> <li>• 12 credits of Humanities, which must include 6 credits of literature; and</li> <li>• 12 credits of Social Science; and</li> <li>• 12 credits of Natural Science, which must include one 3+ credit Biological Science course and one 3+ credit Physical Science course.</li> </ul>

**Liberal Arts and Science Coursework** Complete at least 108 credits.

Depth of Intermediate/Advanced work Complete at least 60 credits at the intermediate or advanced level.

Advanced work

Major Declare and complete at least one major.

Total Credits Complete at least 120 credits.

UW-Madison Experience • 30 credits in residence, overall; and  
• 30 credits in residence after the 86th credit.

Quality of Work • 2.000 in all coursework at UW–Madison  
• 2.000 in Intermediate/Advanced level coursework at UW–Madison

## NON–L&S STUDENTS PURSUING AN L&S MAJOR

Non–L&S students who have permission from their school/college to pursue an additional major within L&S only need to fulfill the major requirements. They do not need to complete the L&S Degree Requirements above.

## REQUIREMENTS FOR THE MAJOR

### BASIC COMPUTER SCIENCES

Code	Title	Credits
COMP SCI/ MATH 240	Introduction to Discrete Mathematics	3
COMP SCI/E C E 252	Introduction to Computer Engineering	3
COMP SCI 300	Programming II	3
COMP SCI/E C E 354	Machine Organization and Programming	3
COMP SCI 400	Programming III	3
<b>Total Credits</b>		<b>15</b>

### BASIC CALCULUS

Code	Title	Credits
<b>Complete one of these sequences:</b>		<b>9-14</b>
MATH 221 & MATH 222	Calculus and Analytic Geometry 1 and Calculus and Analytic Geometry 2	
MATH 171 & MATH 217 & MATH 222	Calculus with Algebra and Trigonometry I and Calculus with Algebra and Trigonometry II and Calculus and Analytic Geometry 2	
MATH 275 & MATH 276	Topics in Calculus I and Topics in Calculus II	
<b>Total Credits</b>		<b>9-14</b>

### ADDITIONAL MATHEMATICS (BEYOND CALCULUS)

Code	Title	Credits
<b>Complete two courses for at least 6 credits:</b>		<b>6-10</b>
MATH 340 or MATH 375	Elementary Matrix and Linear Algebra <sup>1</sup> Topics in Multi-Variable Calculus and Linear Algebra	

STAT 324	Introductory Applied Statistics for Engineers
COMP SCI 412	Introduction to Numerical Methods <sup>2</sup>
COMP SCI/E C E/ MATH 435	Introduction to Cryptography
COMP SCI/ MATH 513	Numerical Linear Algebra
COMP SCI/ MATH 514	Numerical Analysis
COMP SCI/I SY E/ MATH/STAT 525	Linear Optimization
COMP SCI/ I SY E 526	Advanced Linear Programming
E C E 331	Introduction to Random Signal Analysis and Statistics
MATH 234 or MATH 375	Calculus–Functions of Several Variables <sup>1</sup> Topics in Multi-Variable Calculus and Linear Algebra
MATH 319	Techniques in Ordinary Differential Equations
MATH 320 or MATH 375	Linear Algebra and Differential Equations <sup>1</sup> Topics in Multi-Variable Calculus and Linear Algebra
MATH 321	Applied Mathematical Analysis
MATH 322	Applied Mathematical Analysis
MATH 331	An Introduction to Probability and Markov Chain Models
MATH 341	Linear Algebra
MATH 376	Topics in Multi-Variable Calculus and Differential Equations
MATH/STAT 431	Introduction to the Theory of Probability
MATH 443	Applied Linear Algebra
MATH 461	College Geometry I
MATH/COMP SCI/ STAT 475	Introduction to Combinatorics
MATH 521	Analysis I
MATH 541	Modern Algebra
MATH 542	Modern Algebra
MATH 567	Modern Number Theory
MATH/ PHILOS 571	Mathematical Logic
STAT/MATH 309	Introduction to Probability and Mathematical Statistics I
STAT/MATH 310	Introduction to Probability and Mathematical Statistics II
STAT 311	Introduction to Theory and Methods of Mathematical Statistics I
STAT 312	Introduction to Theory and Methods of Mathematical Statistics II

<sup>1</sup> MATH 375 Topics in Multi-Variable Calculus and Linear Algebra will not meet the requirement if a student already has credit for

MATH 234 Calculus–Functions of Several Variables, MATH 320 Linear Algebra and Differential Equations or MATH 340 Elementary Matrix and Linear Algebra.

if COMP SCI 412 is applied to the ADDITIONAL MATH (BEYOND CALCULUS) requirement, it cannot also apply to the APPLICATIONS requirement.

## ADVANCED COMPUTER SCIENCE COURSES

### THEORY OF COMPUTER SCIENCE

Code	Title	Credits
<b>Complete one:</b>		<b>3</b>
COMP SCI 577	Introduction to Algorithms	
COMP SCI 520	Introduction to Theory of Computing	

### SOFTWARE & HARDWARE

Code	Title	Credits
<b>Complete two:</b>		<b>6-8</b>
COMP SCI 407	Foundations of Mobile Systems and Applications	
COMP SCI/ E C E 506	Software Engineering	
COMP SCI 536	Introduction to Programming Languages and Compilers	
or COMP SCI 531	Introduction to the Theory and Design of Programming Languages	
COMP SCI 537	Introduction to Operating Systems	
COMP SCI 542	Introduction to Software Security	
COMP SCI/ E C E 552	Introduction to Computer Architecture	
COMP SCI 564	Database Management Systems: Design and Implementation	
COMP SCI 640	Introduction to Computer Networks	
COMP SCI 642	Introduction to Information Security	

### APPLICATIONS

Code	Title	Credits
<b>Complete one:</b>		<b>3</b>
COMP SCI 412	Introduction to Numerical Methods <sup>1</sup>	
COMP SCI/ I SY E/ MATH 425	Introduction to Combinatorial Optimization	
COMP SCI/ MATH 513	Numerical Linear Algebra	
COMP SCI/ MATH 514	Numerical Analysis	
COMP SCI/ E C E/ I SY E 524	Introduction to Optimization	
COMP SCI/ I SY E/ MATH/ STAT 525	Linear Optimization	
COMP SCI 534	Computational Photography	
COMP SCI 540	Introduction to Artificial Intelligence	
COMP SCI 545	Natural Language and Computing	
COMP SCI 559	Computer Graphics	
COMP SCI 570	Introduction to Human-Computer Interaction	
COMP SCI 571	Building User Interfaces	

### ELECTIVES

Code	Title	Credits
<b>Complete two:</b>		<b>6-8</b>
COMP SCI 407	Foundations of Mobile Systems and Applications	
COMP SCI 412	Introduction to Numerical Methods	
COMP SCI/ I SY E/ MATH 425	Introduction to Combinatorial Optimization	
COMP SCI/ E C E/ MATH 435	Introduction to Cryptography	
COMP SCI/ STAT 471	Introduction to Computational Statistics	
COMP SCI/ MATH/ STAT 475	Introduction to Combinatorics	
COMP SCI/ E C E 506	Software Engineering	
COMP SCI/ MATH 513	Numerical Linear Algebra	
COMP SCI/ MATH 514	Numerical Analysis	
COMP SCI 520	Introduction to Theory of Computing	
COMP SCI/ E C E/ I SY E 524	Introduction to Optimization	
COMP SCI/ I SY E/ MATH/ STAT 525	Linear Optimization	
COMP SCI/ I SY E 526	Advanced Linear Programming	
COMP SCI/ E C E/ M E 532	Matrix Methods in Machine Learning	
COMP SCI/ E C E 533	Image Processing	
COMP SCI 534	Computational Photography	
COMP SCI 536	Introduction to Programming Languages and Compilers	
COMP SCI 537	Introduction to Operating Systems	
COMP SCI 538	Introduction to the Theory and Design of Programming Languages	
COMP SCI/ E C E/ M E 539	Introduction to Artificial Neural Networks	
COMP SCI 540	Introduction to Artificial Intelligence	
COMP SCI 542	Introduction to Software Security	
COMP SCI 545	Natural Language and Computing	
COMP SCI/ E C E 552	Introduction to Computer Architecture	
COMP SCI/ I SY E/ M E 558	Introduction to Computational Geometry	
COMP SCI 559	Computer Graphics	
COMP SCI 564	Database Management Systems: Design and Implementation	
COMP SCI/ B M I 567	Medical Image Analysis	

<sup>2</sup> In every case, a course used toward one requirement may not be used again toward another requirement. For example,

COMP SCI 570	Introduction to Human-Computer Interaction
COMP SCI 571	Building User Interfaces
COMP SCI/ B M I 576	Introduction to Bioinformatics
COMP SCI 577	Introduction to Algorithms
COMP SCI/ DS 579	Virtual Reality
COMP SCI/ I SY E 635	Tools and Environments for Optimization
COMP SCI 640	Introduction to Computer Networks
COMP SCI 642	Introduction to Information Security
COMP SCI 679	Computer Game Technology
COMP SCI 639	Undergraduate Elective Topics in Computing

## RESIDENCE AND QUALITY OF WORK

- 2.000 GPA in all COMP SCI courses and courses counting toward the major
- 2.000 GPA on 15 upper-level credits, taken in residence<sup>3</sup>
- 15 credits in COMP SCI, taken on campus

<sup>3</sup> COMP SCI courses numbered 400 through 699 count as Upper Level.

## HONORS IN THE MAJOR

Students may declare Honors in the Computer Sciences Major in consultation with the Computer Sciences undergraduate coordinator(s). To earn Honors in the Major in Computer Sciences, students must satisfy both the requirements for the major (above) and the following additional requirements:

- Earn a minimum 3.300 University GPA
- Earn a minimum 3.500 GPA for all COMP SCI and major courses
- Complete one COMP SCI course numbered 500 through 699, taken for Honors with a grade of B or higher
- Complete COMP SCI 681 and COMP SCI 682 for a total of 6 credits.<sup>4</sup>

<sup>4</sup> Senior Honors Thesis proposal must be approved by both the thesis/project advisor and the department undergraduate coordinator before enrollment in COMP SCI 681. A final thesis or project must be filed with the Department of Computer Sciences before a final grade for COMP SCI 682 can be awarded.

## DISTINCTION IN THE MAJOR

Distinction will be awarded at graduation to majors who are **not** declared for Honors in the Major, and who meet this criteria:

- Earn a minimum 3.750 GPA or higher in all COMP SCI and major courses, or
- Earn a minimum 3.500 GPA in all COMP SCI and major courses, plus:
- Complete one COMP SCI courses numbered 500 through 699 for Honors credit and at least a "B" grade
- Complete COMP SCI 691 - COMP SCI 692 for at least 6 credits

## UNIVERSITY DEGREE REQUIREMENTS

**Total Degree** To receive a bachelor's degree from UW–Madison, students must earn a minimum of 120 degree credits. The requirements for some programs may exceed 120 degree credits. Students should consult with their college or department advisor for information on specific credit requirements.

**Residency** Degree candidates are required to earn a minimum of 30 credits in residence at UW–Madison. "In residence" means on the UW–Madison campus with an undergraduate degree classification. "In residence" credit also includes UW–Madison courses offered in distance or online formats and credits earned in UW–Madison Study Abroad/Study Away programs.

**Quality of Work** Undergraduate students must maintain the minimum grade point average specified by the school, college, or academic program to remain in good academic standing. Students whose academic performance drops below these minimum thresholds will be placed on academic probation.

## LEARNING OUTCOMES

1. Recognize and apply the core principles of Computing (abstractions and algorithms) to solve real-world problems.
2. Describe and apply the theoretical foundations of Computer Science (e.g., complexity analysis) in practical settings.
3. Demonstrate knowledge of key elements of computer systems, e.g., hardware, operating systems, networks.
4. Use fundamental and detailed knowledge, skills, and tools (e.g., specific algorithms, techniques methods, etc.) of computer science and develop the ability to acquire new knowledge, skills, and tools.
5. Design, implement, and evaluate software in multiple programming paradigms and languages.
6. Develop a substantial piece of software, and recognize the challenges of designing and developing software.
7. Exhibit technical (designing, implementing, and testing) and teamwork (communication, collaboration, and professional practice) skills in order to develop solutions as a computer science practitioner.
8. Can solve problems by applying a broad toolbox of knowledge and techniques.

## FOUR-YEAR PLAN

### SAMPLE FOUR-YEAR PLAN

This Sample Four-Year Plan is a tool to assist students and their advisor(s). Students should use it—along with their DARS report, the Degree Planner, and Course Search & Enroll tools—to make their own four-year plan based on their placement scores, credit for transferred courses and approved examinations, and individual interests. As students become involved in athletics, honors, research, student organizations, study abroad, volunteer experiences, and/or work, they might adjust the order of their courses to accommodate these experiences. Students will likely revise their own four-year plan several times during college.

**First Year**

Fall	Credits	Spring	Credits
COMP SCI 200		3 COMP SCI 300	3
COMP SCI 304 (optional companion course)		1 MATH 222	4
MATH 221		5 Ethnic Studies	3
Communications Part A		3 Second Semester Language	4
First-Semester Language		4	
	<b>16</b>		<b>14</b>

**Second Year**

Fall	Credits	Spring	Credits
COMP SCI 400		3 COMP SCI/E C E 354	3
COMP SCI/E C E 252		3 COMP SCI/MATH 240	3
Additional Math Beyond Calculus (MATH 340 recommended)		3 INTER-LS 210	1
Third Semester Language		4 Communication Part B	3
Social Science Breadth		3 Fourth Semester Language	4
	<b>16</b>		<b>14</b>

**Third Year**

Fall	Credits	Spring	Credits
COMP SCI Theory (COMP SCI 577 recommended)		3-4 COMP SCI Software/Hardware	3-4
Additional Math (STAT 324 recommended)		3 COMP SCI Applications	3
Humanities Breadth		3 Literature Breadth	3
Social Science Breadth		3 Biological Science Breadth	3
Elective		3 Elective	3
	<b>15</b>		<b>15</b>

**Fourth Year**

Fall	Credits	Spring	Credits
COMP SCI Software/Hardware		3-4 COMP SCI Elective	3
COMP SCI Elective		3 Physical Science Breadth	3
Humanities Breadth		3 Literature Breadth	3
Social Science Breadth		3 Social Science Breadth	3
Elective		3 Elective	3
	<b>15</b>		<b>15</b>

**Total Credits 120****ADVISING AND CAREERS****ADVISING**

The undergraduate coordinators in the Department of Computer Sciences are ready to help students with questions about the major, L&S degree requirements and policy, and course selection. Information on academic advising for students interested or declared in the computer sciences

major is posted to the Computer Sciences advising page (<https://www.cs.wisc.edu/undergraduate/undergraduate-advisors/>).

**CAREERS**

Demand for those with a computer sciences education is exceptionally strong. According to figures from the U.S. Bureau of Labor Statistics, the vast majority of growth in STEM (science, technology, engineering, and math) occupations through 2020 will occur within computing fields.

Computer sciences majors are encouraged to begin working on their career exploration and preparation soon after arriving on campus to explore different career paths, participate in co-ops or summer internships, prepare for the job search and/or graduate school applications, and network with professionals in the field.

**Department of Computer Sciences:** the department hosts one major career fair (<https://www.cs.wisc.edu/connect/job-fair/>) per year, in the fall, as well as other opportunities to connect with employers, such as technical talks and information sessions.

**SuccessWorks at the College of Letters & Science:** SuccessWorks offers two major career fairs per year, assists with resume writing and interviewing skills, and offers individual career advising appointments for L&S students.

**Engineering Career Services (ECS):** ECS (<https://ecs.engr.wisc.edu/public/>) offers two major career fairs per year, assists with resume writing and interviewing skills, and hosts workshops on the job search.

**L&S CAREER RESOURCES**

SuccessWorks at the College of Letters & Science helps students leverage the academic skills learned in their major, certificates, and liberal arts degree; explore and try out different career paths; participate in internships; prepare for the job search and/or graduate school applications; and network with professionals in the field (alumni and employers). In short, SuccessWorks helps students in the College of Letters & Science discover themselves, find opportunities, and develop the skills they need for success after graduation.

SuccessWorks can also assist students in career advising, résumé and cover letter writing, networking opportunities, and interview skills, as well as course offerings for undergraduates to begin their career exploration early in their undergraduate career.

Students should set up their profiles in Handshake (<https://careers.ls.wisc.edu/handshake/>) to take care of everything they need to explore career events, manage their campus interviews, and **apply to jobs and internships from 200,000+ employers around the country.**

- SuccessWorks (<https://careers.ls.wisc.edu/>)
- Set up a career advising appointment (<https://careers.ls.wisc.edu/make-an-appointment/>)
- INTER-LS 210 L&S Career Development: Taking Initiative (1 credit, targeted to first- and second-year students)—for more information, see Inter-LS 210: Career Development, Taking Initiative (<https://careers.ls.wisc.edu/inter-ls-210-career-development-taking-initiative/>)
- INTER-LS 215 Communicating About Careers (3 credits, fulfills Com B General Education Requirement)
- Handshake (<https://careers.ls.wisc.edu/handshake/>)
- Learn how we're transforming career preparation: L&S Career Initiative (<http://ls.wisc.edu/lsci/>)

## PEOPLE

Professors A. Arpaci-Dusseau, R. Arpaci-Dusseau, Bach, Barford, Banerjee, Cai, Doan, Dyer, Ferris, Gleicher, Jha, Livny, Miller, Mutlu, Patel, Reps, Ron, Sankaralingam, Sohi, Swift, van Melkebeek, Wright, Zhu

Associate Professors I. Diakonikolas, Lee, Sifakis

Assistant Professors Albarghouthi, Chatterjee, D'Antoni, J. Diakonikolas, Fernandes, Gupta, Hanna, Hsu, Kim, Koutris, Li, Liang, Sala, Sinclair, Tzamos, Venkataraman, Yu, Zhao

Faculty Associates Ayari Ben Hadj Kacem, Captain, Caraza-Harter, Dahl, Deppeler, Doescher, Hasti, Heimerl, Kuemmel, Legault, Lewis-Williams, Renault, Skrentny, Syamkumar, Williams

## RESOURCES AND SCHOLARSHIPS

Visit [Scholarships@UW-Madison](mailto:Scholarships@UW-Madison) (<https://scholarships.wisc.edu/Scholarships/>) to find UW–Madison scholarships and apply online.

Visit the [scholarships page](https://www.cs.wisc.edu/academics/scholarships/) (<https://www.cs.wisc.edu/academics/scholarships/>) on the Department of Computer Sciences website for a compendium of opportunities available to students studying computer sciences.