

# COMPUTER SCIENCES, BA

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

### HOW TO GET IN DECLARATION REQUIREMENTS

To declare the computer sciences major, students must meet the following requirements<sup>1</sup>:

- Completion of COMP SCI 300 and MATH 222
- 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 MATH 222

<sup>1</sup> For purposes of computer sciences major declaration requirements, GPA is calculated with UW-Madison courses only and does include the first attempt of all eligible major declaration coursework completed at time of submitting major declaration request. Repeated coursework is not included.

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.

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

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/#requirementsforundergraduatetext>) 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> |
|-------------------|--|

\* 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 (BA)

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>Language</b> | <ul style="list-style-type: none"> <li>• Complete the fourth unit of a language other than English; OR</li> <li>• Complete the third unit of a language and the second unit of an additional language other than English.</li> </ul> |
|-----------------|--|

|             |  |
|-------------|--|
| L&S Breadth | <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.   |
| Major                               | Declare and complete at least one major.  |
| Total Credits                       | Complete at least 120 credits.  |
| UW-Madison Experience               | <ul style="list-style-type: none"><li>• 30 credits in residence, overall; and</li><li>• 30 credits in residence after the 86th credit.</li></ul>                |
| Quality of Work                     | <ul style="list-style-type: none"><li>• 2.000 in all coursework at UW-Madison</li><li>• 2.000 in Intermediate/Advanced level coursework at UW-Madison</li></ul> |

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

Students must complete a minimum of 48 total credits as detailed below.

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       |
| Total Credits       |                                      | 15      |

BASIC CALCULUS

| Code                             | Title   | Credits |
|----------------------------------|---|---------|
| Complete one of these sequences: |   | 9-14    |
| MATH 221 & MATH 222              | Calculus and Analytic Geometry I 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 |
|--------------------------------|---|

|               |      |
|---------------|------|
| Total Credits | 9-14 |
|---------------|------|

ADDITIONAL MATHEMATICS

| Code          | Title  | Credits |
|---------------|--|---------|
| Complete one: |  |         |
| MATH 320      | Linear Algebra and Differential Equations            | 3       |
| MATH 340      | Elementary Matrix and Linear Algebra                 | 3       |
| MATH 341      | Linear Algebra                                       | 3       |
| MATH 375      | Topics in Multi-Variable Calculus and Linear Algebra | 5       |

Probability or Statistics

| Code          | Title   | Credits |
|---------------|---|---------|
| Complete one: |   |         |
| STAT/MATH 309 | Introduction to Probability and Mathematical Statistics I       | 3       |
| STAT 311      | Introduction to Theory and Methods of Mathematical Statistics I | 3       |
| STAT 324      | Introductory Applied Statistics for Engineers                   | 3       |
| MATH 331      | Introductory Probability  | 3       |
| STAT 333      | Applied Regression Analysis                                     | 3       |
| STAT 340      | Data Science Modeling II  | 4       |
| STAT 371      | Introductory Applied Statistics for the Life Sciences           | 3       |
| STAT/MATH 431 | Introduction to the Theory of Probability                       | 3       |
| MATH 531      | Probability Theory  | 3       |

ADVANCED COMPUTER SCIENCE COURSES<sup>1</sup>

Theory of Computer Science

| Code          | Title                               | Credits |
|---------------|-------------------------------------|---------|
| Complete one: |                                     | 3       |
| COMP SCI 577  | Introduction to Algorithms          |         |
| COMP SCI 520  | Introduction to Theory of Computing |         |

Software & Hardware

| Code                | Title  | Credits |
|---------------------|--|---------|
| Complete two:       |  | 6-8     |
| 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 53Introduction to the Theory and Design of Programming Languages |         |

|                        |  |
|------------------------|--|
| COMP SCI 537           | Introduction to Operating Systems                      |
| COMP SCI 542           | Introduction to Software Security                      |
| COMP SCI 544           | Introduction to Big Data Systems                       |
| COMP SCI/<br>E C E 552 | Introduction to Computer Architecture                  |
| COMP SCI 564           | Database Management Systems: Design and Implementation |
| COMP SCI 620           |  |
| 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          |
| COMP SCI/I SY E/<br>MATH 425      | Introduction to Combinatorial Optimization |
| COMP SCI/<br>MATH 513             | Numerical Linear Algebra                   |
| COMP SCI/<br>MATH 514             | Numerical Analysis                         |
| COMP SCI/E C E/<br>I SY E 524     | Introduction to Optimization               |
| COMP SCI/I SY E/<br>MATH/STAT 525 | Linear Optimization                        |
| COMP SCI 534                      | Computational Photography                  |
| COMP SCI 540                      | Introduction to Artificial Intelligence    |
| COMP SCI 559                      | Computer Graphics                          |
| COMP SCI 565                      | Introduction to Data Visualization         |
| COMP SCI 566                      | Introduction to Computer Vision            |
| COMP SCI 570                      | Introduction to Human-Computer Interaction |
| COMP SCI 571                      | Building User Interfaces                   |

## Electives<sup>1</sup>

| 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/<br>MATH 425 | Introduction to Combinatorial Optimization     |
| COMP SCI/E C E/<br>MATH 435  | Introduction to Cryptography                   |
| COMP SCI/<br>STAT 471        | Introduction to Computational Statistics       |
| COMP SCI/<br>MATH/STAT 475   | Introduction to Combinatorics                  |
| COMP SCI/<br>E C E 506       | Software Engineering                           |
| COMP SCI/<br>MATH 513        | Numerical Linear Algebra                       |
| COMP SCI/<br>MATH 514        | Numerical Analysis                             |
| COMP SCI/DS/<br>I SY E 518   | Wearable Technology                            |

|                                   |  |
|-----------------------------------|--|
| COMP SCI 520                      | Introduction to Theory of Computing                            |
| COMP SCI/E C E/<br>I SY E 524     | Introduction to Optimization                                   |
| COMP SCI/I SY E/<br>MATH/STAT 525 | Linear Optimization  |
| COMP SCI/<br>I SY E 526           | Advanced Linear Programming                                    |
| COMP SCI/E C E/<br>M E 532        | Matrix Methods in Machine Learning                             |
| COMP SCI/<br>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/<br>M E 539        | Introduction to Artificial Neural Networks                     |
| COMP SCI 540                      | Introduction to Artificial Intelligence                        |
| COMP SCI 541                      | Theory & Algorithms for Data Science                           |
| COMP SCI 542                      | Introduction to Software Security                              |
| COMP SCI 544                      | Introduction to Big Data Systems                               |
| COMP SCI/<br>E C E 552            | Introduction to Computer Architecture                          |
| COMP SCI/I SY E/<br>M E 558       | Introduction to Computational Geometry                         |
| COMP SCI 559                      | Computer Graphics  |
| COMP SCI/<br>E C E 561            | Probability and Information Theory in Machine Learning         |
| COMP SCI 564                      | Database Management Systems: Design and Implementation         |
| COMP SCI 565                      | Introduction to Data Visualization                             |
| COMP SCI/<br>B M I 567            | Medical Image Analysis   |
| COMP SCI 570                      | Introduction to Human-Computer Interaction                     |
| COMP SCI 571                      | Building User Interfaces                                       |
| COMP SCI/<br>B M I 576            | Introduction to Bioinformatics                                 |
| COMP SCI 577                      | Introduction to Algorithms                                     |
| COMP SCI/<br>DS 579               | Virtual Reality  |
| COMP SCI 620                      |  |
| COMP SCI/<br>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 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>2</sup>
- 15 credits in COMP SCI, taken on campus

# 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>3</sup>

# FOOTNOTES

<sup>1</sup> COMP SCI courses may only fulfill one COMP SCI major requirement area. For example, if you take a course for the COMP SCI Applications requirement, it cannot also apply to the COMP SCI Elective requirement.

<sup>2</sup> COMP SCI courses numbered 400 through 699 count as Upper Level.

<sup>3</sup> Senior Honors Thesis proposal must be approved by the thesis/project advisor and student must be declared as Honors in the Major before enrollment in COMP SCI 681. A final thesis or project must be completed before a final grade for COMP SCI 682 can be awarded.

# 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

# 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       |
| MATH 221                | 5 MATH 222  | 4       |
| Communications Part A   | 3 Ethnic Studies                                    | 3       |
| First-Semester Language | 4 Second Semester Language                          | 4       |
| 15                      |   | 14      |
| 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       |
| Linear Algebra          | 3 INTER-LS 210 (Optional Career Development Course) | 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       |
| Probability or Statistics                  | 3 COMP SCI Applications        | 3         |
| COMP SCI 368 (Optional Programming Course) | 1 Literature Breadth           | 3         |
| Humanities Breadth                         | 3 Biological Science Breadth   | 3         |
| Social Science Breadth                     | 3 Elective                     | 3         |
| Elective                                   | 3                              |           |
|  | <b>16</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 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 on 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 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**

Every L&S major opens a world of possibilities. SuccessWorks (<https://successworks.wisc.edu/>) at the College of Letters & Science helps students turn the academic skills learned in their major, certificates, and other coursework into fulfilling lives after graduation, whether that means jobs, public service, graduate school or other career pursuits.

In addition to providing basic support like resume reviews and interview practice, SuccessWorks offers ways to explore interests and build career skills from their very first semester/term at UW all the way through graduation and beyond.

Students can explore careers in one-on-one advising, try out different career paths, complete internships, prepare for the job search and/or graduate school applications, and connect with supportive alumni and even employers in the fields that inspire them.

- SuccessWorks (<https://careers.ls.wisc.edu/>)
- Set up a career advising appointment (<https://successworks.wisc.edu/make-an-appointment/>)
- Enroll in a Career Course (<https://successworks.wisc.edu/career-courses/>) – a great idea for first- and second-year students:
  - INTER-LS 210 L&S Career Development: Taking Initiative (1 credit)
  - INTER-LS 215 Communicating About Careers (3 credits, fulfills Comm B General Education Requirement)
- Learn about internships and internship funding (<https://successworks.wisc.edu/finding-a-job-or-internship/>)
  - INTER-LS 260 Internship in the Liberal Arts and Sciences
- Activate your Handshake account (<https://successworks.wisc.edu/handshake/>) to apply for jobs and internships from 200,000+ employers recruiting UW-Madison students
- Learn about the impact SuccessWorks has on students' lives (<https://successworks.wisc.edu/about/mission/>)

## PEOPLE

**PEOPLE**

Visit the CS website to view our department faculty (<https://www.cs.wisc.edu/people/faculty/>) and staff (<https://www.cs.wisc.edu/people/staff/>).

## RESOURCES AND SCHOLARSHIPS

**RESOURCES AND SCHOLARSHIPS**

Visit 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/>) on the Department of Computer Sciences website for a

compendium of opportunities available to students studying computer sciences.