COMPUTER SCIENCE, BS

Computer science is the study and design of computer systems, networks, software, and computing techniques. But more importantly, it is a dynamic field with a growing impact on the world today. A report on Science, Technology, Engineering and Math (STEM) from the Georgetown University Center on Education and the Workforce (http://cew.georgetown.edu/STEM/) foresees 51% of STEM occupations will be computer occupations by 2018.

Concentrations
- Artificial intelligence
- Programming Language Design and Implementation
- Software Engineering
- Computer Networking
- Algorithm Design

Research
Work with faculty (http://uwm.edu/engineering/classification/faculty/computer-science/) engaged in leading-edge research in areas such as:
- Object-oriented programming
- Cryptography
- Computational robotics
- Intelligent dialog systems
- Artificial intelligence
- Extensible languages

Career Paths
Computer Science opens up a multitude of career options with great income potential within both the public and private sectors.
- Software Engineer
- Systems Integration Consultant
- Information Technology Manager
- Game Developer
- Application Developer/Programmer
- Data Analyst

Accreditation
The Computer Science program is accredited by the Computing Accreditation Commission of ABET: https://www.abet.org (https://nam02.safelinks.protection.outlook.com/?url=https%3A%2F%2Fwww.abet.org%2F&data=02%7C01%7Cebilicki%40uwm.edu%7C6ce2c28ec5ad4a0c130408d8696f0413%7C0bca7ac3fcb64efd89eb6de9%2BpzMaI3jOBSze7g%3D&reserved=0). Engaged in leading-edge research in areas such as:

New Freshmen
Admission to the College of Engineering and Applied Science is based on an overall assessment of both academic and non-academic qualifications. The primary review factors for admission are the strength and quality of the high school curriculum, high school class percentile, grade point average, and the result of the ACT or SAT. Well-prepared freshman applicants will have four years of mathematics (including one-and-a-half years of algebra, one year of geometry, and one-half year of trigonometry) and four years of natural science (including biology, chemistry, and physics). The College also will consider non-academic qualifications such as leadership skills, diversity in personal background, work experience, motivation, and maturity.

Freshmen applicants will be considered for admission directly to the major or to intended status (Engineering-Intended or Computer Science-Intended). Admission directly to the major is selective.

Transfer Students
Transfer student admission is based on an overall assessment of both academic and non-academic qualifications. For transfer applicants, the primary factors considered for admission are the grade point average on transferable courses and the level of curriculum completion. The College also will consider non-academic qualifications such as leadership skills, diversity in personal background, work experience, motivation, and maturity.

Transfer applicants will be considered for admission directly to the major or to intended status (Engineering-Intended or Computer Science-Intended).

Admission to the Major
Students admitted to Engineering-Intended or Computer Science-Intended may apply for major status with their academic advisor at the time they believe they meet the requirements. The program may impose major status as a prerequisite for courses numbered 200 or above.

1. Complete first semester calculus with a C or better grade.
2. Complete GER Oral and Written Communication Part A.
3. Engineering majors must complete Chem 100 with a C or better grade (or satisfactory score on the placement test). Computer Science majors must complete CompSci 251 with a C or better grade.
4. Obtain a minimum grade point as set by the major department. A 3.00 GPA guarantees admission to any CEAS major.
5. Courses required by the major may be repeated only once. No more than two courses may be repeated.

Questions on admission to CEAS or choosing a major should be directed to the Office of Student Services, (414) 229-4667.

Computer Science Curriculum
The minimum number of credits required to complete the Bachelor of Science in Computer Science with a major in Computer Science is 120.

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>COMPSCI 250</td>
<td>Introductory Computer Programming</td>
<td>3</td>
</tr>
<tr>
<td>COMPSCI 251</td>
<td>Intermediate Computer Programming</td>
<td>3</td>
</tr>
<tr>
<td>COMPSCI 317</td>
<td>Discrete Information Structures</td>
<td>3</td>
</tr>
<tr>
<td>COMPSCI 337</td>
<td>System Programming</td>
<td>3</td>
</tr>
<tr>
<td>COMPSCI 351</td>
<td>Data Structures and Algorithms</td>
<td>3</td>
</tr>
<tr>
<td>COMPSCI 361</td>
<td>Introduction to Software Engineering</td>
<td>3</td>
</tr>
<tr>
<td>COMPSCI 395</td>
<td>Social, Professional, and Ethical Issues</td>
<td>3</td>
</tr>
<tr>
<td>COMPSCI 431</td>
<td>Programming Languages Concepts</td>
<td>3</td>
</tr>
<tr>
<td>COMPSCI 458</td>
<td>Computer Architecture</td>
<td>3</td>
</tr>
<tr>
<td>COMPSCI 535</td>
<td>Algorithm Design and Analysis</td>
<td>3</td>
</tr>
<tr>
<td>COMPSCI 537</td>
<td>Introduction to Operating Systems</td>
<td>3</td>
</tr>
<tr>
<td>COMPSCI 594</td>
<td>Capstone Project Preparation</td>
<td>1</td>
</tr>
<tr>
<td>COMPSCI 595</td>
<td>Capstone Project</td>
<td>3</td>
</tr>
<tr>
<td>EAS 200</td>
<td>Professional Seminar</td>
<td>1</td>
</tr>
</tbody>
</table>
Mathematics Requirement 4
Select one of the following:
MATH 211 Survey in Calculus and Analytic Geometry I
MATH 213 Calculus with Life Sciences Applications
MATH 221 Honors Calculus I
MATH 231 Calculus and Analytic Geometry I

Natural Science Requirement - Complete 6 credits including 1 laboratory credit from approved list.
Technical Electives - Complete 9 credits from approved list.
Applied Mathematics Electives - Complete 9 credits from approved list.
Free Electives 39
GER Distribution Requirement
Arts 3
Humanities 3
Social Science 6
ENGLISH 310 Writing, Speaking, and Technoscience in the 21st Century 3
Cultural Diversity - Arts, Humanities, or Social Science course must also satisfy UWM Cultural Diversity Requirement
Students must also satisfy Oral and Written Communication (OWA) Part A 0-6
Students must also Satisfy the UWM Foreign Language requirements (0-8) 0-8
Total Credits 120

Approved Natural Science Courses

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASTRON 104</td>
<td>Astronomy Laboratory</td>
<td></td>
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<tr>
<td>BIO SCI 150</td>
<td>Foundations of Biological Sciences I</td>
<td></td>
</tr>
<tr>
<td>BIO SCI 152</td>
<td>Foundations of Biological Sciences II</td>
<td></td>
</tr>
<tr>
<td>BIO SCI 201</td>
<td>Human Structure and Function</td>
<td></td>
</tr>
<tr>
<td>BIO SCI 203</td>
<td>Anatomy and Physiology II</td>
<td></td>
</tr>
<tr>
<td>CHEM 102</td>
<td>General Chemistry</td>
<td></td>
</tr>
<tr>
<td>CHEM 104</td>
<td>General Chemistry and Qualitative Analysis</td>
<td></td>
</tr>
<tr>
<td>CHEM 105</td>
<td>General Chemistry for Engineering</td>
<td></td>
</tr>
<tr>
<td>GEO SCI 100</td>
<td>Introduction to the Earth</td>
<td></td>
</tr>
<tr>
<td>GEO SCI 102</td>
<td>Principles of Historical Geology</td>
<td></td>
</tr>
<tr>
<td>GEO SCI 120</td>
<td>Geology of the Planets</td>
<td></td>
</tr>
<tr>
<td>GEO SCI 151</td>
<td>Ocean Sciences Laboratory</td>
<td></td>
</tr>
<tr>
<td>GEO SCI 185</td>
<td>Introductory Earth Science for Teachers</td>
<td></td>
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<tr>
<td>GEO SCI 250</td>
<td>Marine Science at Sea: A Hands-On Laboratory</td>
<td></td>
</tr>
<tr>
<td>GEOG 120</td>
<td>Our Physical Environment</td>
<td></td>
</tr>
<tr>
<td>PHYSICS 121</td>
<td>General Physics Laboratory I (Non-Calculus Treatment)</td>
<td></td>
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<tr>
<td>PHYSICS 123</td>
<td>General Physics Laboratory II (Non-Calculus Treatment)</td>
<td></td>
</tr>
<tr>
<td>PHYSICS 214</td>
<td>Lab Physics I (Calculus Treatment)</td>
<td></td>
</tr>
<tr>
<td>PHYSICS 215</td>
<td>Lab Physics II (Calculus Treatment)</td>
<td></td>
</tr>
<tr>
<td>PHYSICS 219</td>
<td>Physics I: Calculus-Based, Studio Format</td>
<td></td>
</tr>
<tr>
<td>PHYSICS 220</td>
<td>Physics II: Calculus-Based, Studio Format</td>
<td></td>
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</tbody>
</table>

Natural Science courses without laboratory (NS)
ASTRON 103 Survey of Astronomy
ATM SCI 194 First-Year Seminar:
ATM SCI 297 Study Abroad:
ATM SCI 381 Honors Seminar:
ATM SCI 497 Study Abroad:
BIO SCI 194 First-Year Seminar:
BIO SCI 206 Biology of Women
BIO SCI 380 Honors Seminar:
CES 210 Introduction to Conservation and Environmental Science

CHEM 100 Chemical Science
GEOG 125 Introduction to Environmental Geography
GEO SCI 150 Introduction to Ocean Sciences
GEO SCI 194 First-Year Seminar:
GEO SCI 208 Geology of Wisconsin
GEO SCI 381 Honors Seminar:
PHYSICS 120 General Physics I (Non-Calculus Treatment)
PHYSICS 122 General Physics II (Non-Calculus Treatment)
PHYSICS 209 Physics I (Calculus Treatment)
PHYSICS 210 Physics II (Calculus Treatment)

Technical Electives

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>COMPSCI 315</td>
<td>Introduction to Computer Organization and Assembly Language Programming</td>
<td></td>
</tr>
<tr>
<td>COMPSCI 417</td>
<td>Introduction to the Theory of Computation</td>
<td></td>
</tr>
<tr>
<td>COMPSCI 422</td>
<td>Introduction to Artificial Intelligence</td>
<td></td>
</tr>
<tr>
<td>COMPSCI 423</td>
<td>Introduction to Natural Language Processing</td>
<td></td>
</tr>
<tr>
<td>COMPSCI 425</td>
<td>Introduction to Data Mining</td>
<td></td>
</tr>
<tr>
<td>COMPSCI 443</td>
<td>Intelligent User Interfaces and Usability Assessment</td>
<td></td>
</tr>
<tr>
<td>COMPSCI 444</td>
<td>Introduction to Text Retrieval and Its Applications in Biomedicine</td>
<td></td>
</tr>
<tr>
<td>COMPSCI 459</td>
<td>Fundamentals of Computer Graphics</td>
<td></td>
</tr>
<tr>
<td>COMPSCI 469</td>
<td>Introduction to Computer Security</td>
<td></td>
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<tr>
<td>COMPSCI 481</td>
<td>Server-side Internet Programming</td>
<td></td>
</tr>
<tr>
<td>COMPSCI 482</td>
<td>Rich Internet Applications</td>
<td></td>
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<tr>
<td>COMPSCI 511</td>
<td>Symbolic Logic</td>
<td></td>
</tr>
<tr>
<td>COMPSCI 520</td>
<td>Computer Networks</td>
<td></td>
</tr>
<tr>
<td>COMPSCI 530</td>
<td>Computer Networks Laboratory</td>
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</tr>
</tbody>
</table>
Minimum Requirements

Students must maintain an average GPA of at least 2.00 on all work attempted at the University and in all courses offered by the College. Students majoring in biomedical engineering, computer engineering, computer science, industrial engineering, and materials engineering must maintain an average GPA of at least 2.00 in all 300-level and above courses in the student’s major department. Students majoring in civil engineering, electrical engineering, and mechanical engineering must maintain an average GPA of at least 2.50 in all 300-level and above courses in the major department. Transferable courses will be included as appropriate. Advancement to major status is required for graduation.

In order to provide maximum flexibility while preserving the institutional identity of a UWM degree, the College requires residence:

1. during the last 30 credits, or
2. during 45 of the last 60 credits, or
3. during any 90 credits of a student’s undergraduate career.

At least 15 credits of advanced work in the major must be completed in residence at UWM.

A student who does not maintain continuous registration during the academic year and is re-admitted to the College must meet the program and graduation requirements in effect at the time of re-entry.

Degree and major requirements must be completed within 10 years of initial enrollment at UW-Milwaukee. Should students not complete the major within the 10-year time frame, the students will switch to the most current degree and major requirements. A new 10-year time frame would then begin.

Dual Majors

Students wishing to major in more than one field can do so in two ways:

1. Complete the requirements for more than one major before receiving a degree from the College. In this case, the degree will list both majors.
2. Be admitted to the College as a second degree candidate (after earning a bachelor’s degree in any field), providing University and College entrance requirements are met. Such a student must meet all undergraduate degree requirements in the College and present a minimum of 30 credits beyond the previous bachelor’s degree.

Concurrent Registration at Other Institutions

CEAS students wishing to establish concurrent enrollment at another institution must obtain prior permission from their academic advisor.

Student Academic Appeals

Students may appeal an academic action to the Office of Student Services. An appeal is a request for an exception to an established policy or rule. The content of each appeal is carefully reviewed in order to reach a decision. Appeals should be submitted in writing to the Office of Student Services. The appeals committee considers individual cases concerning the degree requirements and other academic rules and regulations established by the College of Engineering and Applied Science faculty.
The College of Engineering and Applied Science has established written procedures for undergraduate student academic grievances. Copies of the grievance procedure are available in the Office of Student Services. As a first step, students must discuss the grievance with the faculty member or administrator as soon as possible to attempt to resolve the issue, but not later than 30 days after the action that prompted the grievance/appeal.

### Computer Science and Engineering Programs

Detailed descriptions of the CEAS undergraduate programs are provided in this catalog. All courses are not offered every semester. A few technical elective courses may be offered only once every three to four semesters. In addition, since computer science and engineering curricula are continually evolving to keep current, students are encouraged to consult with their advisors to plan each semester’s list of classes. Part-time students should always maintain a plan that looks ahead two to three semesters to avoid scheduling difficulties.

The curricula outlined in the pages are applicable to new students entering CEAS in fall 2016 or later. Students who enrolled in computer science or engineering programs prior to that date should consult with the appropriate previous editions of this catalog for information about their program requirements. As a general rule, when program changes occur, continuing students have the choice of continuing in their existing program or following the new requirements. Occasionally, a program change will be required of all students regardless of their date of matriculation, so long as it does not increase the total credits needed for graduation.

These program descriptions represent the minimum requirements for graduation from UWM in computer science or engineering. In all cases, it is important that students consult with their advisor before making course selections to avoid errors in programming.

### Academic Advising

The Office of Student Services in the College of Engineering and Applied Science, located in Room E386 of the Engineering and Mathematical Sciences Building, offers undergraduate students academic advising from professional advisors who are familiar with the curriculum, College requirements, and the special needs of engineering and computer science students. These advisors provide services such as freshman orientation, course selection, program planning, and credit transfer evaluation. Students are assigned to a permanent professional advisor as soon as they are accepted into the College, and are urged to confer with their advisor at least once each semester. Students also are assigned to a faculty advisor who provides technical expertise specific to the student’s area of study.

We understand that it can be a delicate balance managing school, work, family, and active social lives. The College of Engineering and Applied Science advisors are here to help you achieve that balance.

You will be assigned a professional academic advisor upon being admitted to the College of Engineering & Applied Science. Your advisor will work with you throughout your undergraduate experience, providing guidance on:

- course registration,
- graduation planning,
- career preparation,
- and serving as a liaison to the many other resources available on our campus.

Advisors are also a great source of information on student organizations, tutoring and scholarship opportunities.

In addition to professional academic advisors, you will also have access to faculty advisors. These advisors can provide insights into the technical aspects of the engineering and computer science curricula while mentoring you as you define your professional goals.

### Honors in the Major

Students in Computer Science who meet all of the following criteria can be awarded honors in the major upon graduation:

1. A 3.000 cumulative GPA in all UWM graded credits;
2. A 3.500 GPA over all upper-division (300 level and higher) Computer Science courses; and
3. At least one of the following:
   a. Successful completion of 3 credits of research experience via senior thesis (COMPSCI 599) and/or an approved independent study (COMPSCI 699).
   b. Participation in the Accelerated MS program with successful completion of 6 credits in approved courses for the Master of Science in Computer Science program.
   c. Successful completion of 4 credit team-based, faculty supervised, research experience via a capstone via (COMPSCI 594) and (COMPSCI 595), subject to approval by supervising faculty.

Students who believe they may qualify for honors in Computer Science should apply to the College of Engineering & Applied Science during their last semester of study.

### Honors in the College of Engineering and Applied Science

#### Dean’s Honor List

GPA of 3.500 or above, earned on a full-time student’s GPA on 12 or more graded credits in a given semester.

#### Honors College Degree and Honors College Degree with Distinction

Granted to graduating seniors who complete Honors College requirements, as listed in the Honors College (http://catalog.uwm.edu/opportunities-resources/honors-college/) section of this site.

#### Commencement Honors

Students with a cumulative GPA of 3.500 or above, based on a minimum of 40 graded UWM credits earned prior to the final semester, will receive all-university commencement honors and be awarded the traditional gold cord at the December or May Honors Convocation. Please note that for honors calculation, the GPA is not rounded and is truncated at the third decimal (e.g., 3.499).

#### Final Honors

Earned on a minimum of 60 graded UWM credits: Cum Laude - 3.500 or above; magna Cum Laude - 3.650 or above; Summa Cum Laude - 3.800 or above.
Joint Programs with Other Campuses

Pre-engineering
Qualified students may enroll in coordinated pre-engineering programs at UW-Green Bay, UW-Parkside, and UW-Waukesha for two years of pre-engineering coursework. These coordinated programs ensure equivalent coursework, appropriate advising, and early access to the Cooperative Education Program at UWM.

Dual Degree Programs
Qualified students may enroll in coordinated dual degree programs at Alverno College, Carroll University, UW-Eau Claire, UW-Green Bay, UW-La Crosse, UW-Oshkosh, UW-Stevens Point, UW-Whitewater and Wisconsin Lutheran College. Students in these programs will earn a bachelor’s degree at both universities in five years. Students transfer to UWM after three years at the partner university. For more information, contact the Office of Student Services at (414) 229-4667.

Joint Programs with Wisconsin Technical Colleges

Gateway Technical College
An agreement with GTC allows those students having associate degrees in the Electrical Engineering - Technology the opportunity to be given credit for courses required in the UWM bachelor of science in engineering program. For more information, contact the Office of Student Services at (414) 229-4667.

Milwaukee Area Technical College
An agreement with MATC allows joint admission and enrollment at MATC and CEAS. Qualified students may take English, mathematics, chemistry, and general education courses at MATC. The program ensures equivalent coursework and appropriate advising. Students complete a bachelor of science degree in engineering or computer science at UWM.

Waukesha County Technical College
An agreement with WCTC allows those students having associate degrees in the Industrial Occupations Division at WCTC the opportunity to be given credit for courses required in the UWM bachelor of science in engineering or bachelor of science in computer science program. For more information, contact the Office of Student Services at (414) 229-4667.