

COMPUTER SCIENCE, BS

for the degree of Bachelor of Science in Computer Science

department website: <https://cs.illinois.edu>
department faculty: Computer Science Faculty (<https://cs.illinois.edu/people/faculty>)
overview of college admissions & requirements: Engineering (<https://engineering.illinois.edu/admissions>)
college website: <https://engineering.illinois.edu/>

The computer science curriculum provides both a broad and deep knowledge of the theory, design, and application of computer systems, with an emphasis on software systems. Because computing is ubiquitous, application areas involve virtually any field imaginable - from developing gene sequencing algorithms via techniques in computational biology, to designing user interfaces for mobile applications; from designing methods for high frequency trading, to creating computer generated graphics and special effects in the gaming industry; and from creating embedded real time systems to be deployed in medical devices, to analyzing social data from internet communication patterns. During the first two years the curriculum provides a strong foundation in mathematics, science, and computation. Advanced coursework in areas of the student's choosing follows in the second two years, which include either a senior thesis or a senior project. Graduates may go on to graduate study or leading positions in industry.

A combined B.S.-M.S. Computer Science degree program is available. Its admission and course requirements are described in the on the Computer Science website (<https://cs.illinois.edu/academics/graduate/fifth-year-masters-programs/5-year-bs-ms-program>).

A Software Engineering Certificate (<https://wiki.cites.illinois.edu/wiki/display/undergradProg/Degree+Requirements/#DegreeRequirements-softengcert>) is also available to all students in the computer science curriculum interested in a career in software engineering. It provides the depth and breadth necessary for satisfying possible future software engineering accreditation requirements.

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Overview of Curricular Requirements

The curriculum requires 128 hours for graduation and is organized as shown below.

Orientation and Professional Development

These courses introduce the opportunities and resources your college, department, and curriculum can offer you as you work to achieve your career goals. They also provide the skills to work effectively and successfully in the engineering profession.

Code	Title	Hours
CS 100	Freshman Orientation ^{1,2}	1
CS 210	Ethical & Professional Issues	2
ENG 100	Engineering Orientation ²	0
Total Hours		3

¹ This optional course is highly recommended and may be used to help meet free elective requirements.

² External transfer students take ENG 300 instead.

Foundational Mathematics and Science

These courses stress the basic mathematical and scientific principles upon which the engineering discipline is based.

Code	Title	Hours
MATH 221	Calculus I ¹	4
MATH 231	Calculus II	3
MATH 241	Calculus III	4
MATH 415	Applied Linear Algebra	3
PHYS 211	University Physics: Mechanics	4
PHYS 212	University Physics: Elec & Mag	4
Science elective, from departmentally approved list below:		3
AE 202	Aerospace Flight Mechanics	3
ANTH 249	Evolution and Human Disease	3
ASTR 210	Introduction to Astrophysics	3
ASTR 350	The Big Bang, Black Holes, and the End of the Universe	3
ATMS 100	Introduction to Meteorology	3
ATMS 120	Severe and Hazardous Weather	3
ATMS 140	Climate and Global Change	3
ATMS 201	General Physical Meteorology	3
BIOE 205	Signals & Systems in Bioengr	3
BIOE 206	Cellular Bioengineering	3
CEE 201	Systems Engrg & Economics	3
CEE 202	Engineering Risk & Uncertainty	3
CHEM 102	General Chemistry I	3
CHEM 103	General Chemistry Lab I	1
CPSC 112	Introduction to Crop Sciences	4
CPSC 265	Genetic Engineering Lab	3
CPSC 270	Applied Entomology	3
DANC 345	Dance Anatomy and Kinesiology	3
FSHN 101	Intro Food Science & Nutrition	3
FSHN 120	Contemporary Nutrition	3
GEOL 107	Physical Geology	4
GEOL 111	Emergence of Life	3
GEOL 117	The Oceans	3
GEOL 118	Natural Disasters	3
GEOL 143	History of Life	3
GEOL 208	History of the Earth System	4
IB 103	Introduction to Plant Biology	4
IB 104	Animal Biology	4
IB 150	Organismal & Evolutionary Biol	4
KIN 150	Bioscience of Human Movement	3
MCB 150	Molec & Cellular Basis of Life	4
MCB 244	Human Anatomy & Physiology I	3
NPRES 247	Modeling Nuclear Energy System	3
NRES 100	Fundamentals of Env Sci	3
NRES 102	Introduction to NRES	3
PLPA 204	Introductory Plant Pathology	3

PSYC 204	Intro to Brain and Cognition	3
PSYC 224	Cognitive Psych	3
PSYC 248	Learning and Memory	3
SHS 240	Intro Sound & Hearing Science	3
SHS 280	Communication Neuroscience	3

¹ *MATH 220 may be substituted, with four of the five credit hours applying toward the degree. MATH 220 is appropriate for students with no background in calculus.*

Computer Science Technical Core

These courses stress fundamental concepts and basic laboratory techniques that comprise the common intellectual understanding of computer science.

Code	Title	Hours
CS 125	Intro to Computer Science	4
CS 126	Software Design Studio	3
CS 173	Discrete Structures	3
CS 225	Data Structures	4
CS 233	Computer Architecture	4
CS 241	System Programming	4
CS 361	Probability & Statistics for Computer Science	3
CS 357	Numerical Methods I	3
CS 374	Introduction to Algorithms & Models of Computation	4
CS 421	Programming Languages & Compilers	3
Total Hours		35

Technical Electives

These courses stress the rigorous analysis and design principles practiced in major subdisciplines of computer science. Students select eight courses, at least six of which must be advanced CS courses. Three courses must be selected from one area of CS and at least one course should satisfy the *team project requirement*.

Code	Title	Hours
Technical electives to be chosen from departmentally approved list below. One of the six CS courses must satisfy the team project requirement using any of the following courses below:		24
CS 427	Software Engineering I	3 or 4
CS 428	Software Engineering II	3 or 4
CS 429	Software Engineering II, ACP	3
CS 445	Computational Photography (Until Spring 2018)	3 or 4
CS 465	User Interface Design	3 or 4
CS 467	Social Visualization	3 or 4
CS 493	Senior Project II, ACP	3
CS 494	Senior Project II	3
CS 497	CS Team Project	1 to 3
CS 498	Special Topics (Virtual Reality (Spring 2018 and later))	1 to 4

Three of the CS courses must be chosen from a single focus area, from among the areas below:

Software Foundations:

CS 422	Programming Language Design	3 or 4
CS 426	Compiler Construction	3 or 4
CS 427	Software Engineering I	3 or 4
CS 428	Software Engineering II	3 or 4
CS 429	Software Engineering II, ACP	3
CS 476	Program Verification	3 or 4
CS 477	Formal Software Devel Methods	3 or 4
CS 492	Senior Project I	3
CS 498	Special Topics (Art and Science of Web Programming; Logic)	1 to 4
CS 522	Programming Language Semantics	4
CS 524	Concurrent Progrmg Languages	4
CS 426	Compiler Construction	3 or 4
CS 527	Topics in Software Engineering	4
CS 528	Obj-Oriented Progrmg & Design	4
CS 576	Topics in Automated Deduction	2 to 4
CS 598	Special Topics (Verification; Languages)	2 to 4
Algorithms and Models of Computation:		
CS 413	Intro to Combinatorics	3 or 4
CS 473	Algorithms	4
CS 475	Formal Models of Computation	3 or 4
CS 476	Program Verification	3 or 4
CS 477	Formal Software Devel Methods	3 or 4
CS 481	Advanced Topics in Stochastic Processes & Applications	3 or 4
CS 482	Simulation	3 or 4
CS 498	Special Topics (Logic; Parallel Algorithms)	1 to 4
CS 571	Combinatorial Mathematics	4
CS 572	Extremal Graph Theory	4
CS 573	Algorithms	4
CS 574	Randomized Algorithms	4
CS 575	Methods of Combinatorics	4
CS 576	Topics in Automated Deduction	2 to 4
CS 579	Computational Complexity	4
CS 583	Approximation Algorithms	4
CS 584	Embedded System Verification	4
CS 598	Special Topics (Crypto)	2 to 4
Intelligence and Big Data:		
CS 410	Text Information Systems	3 or 4
CS 411	Database Systems	3 or 4
CS 412	Introduction to Data Mining	3 or 4
CS 414	Multimedia Systems	3 or 4
CS 440	Artificial Intelligence	3 or 4
CS 445	Computational Photography	3 or 4
ECE 470	Introduction to Robotics	4
CS 446	Machine Learning	3 or 4
CS 447	Natural Language Processing	3 or 4
CS 466	Introduction to Bioinformatics	3 or 4
CS 467	Social Visualization	3 or 4
CS 498	Special Topics (Data Visualzation; Deep Learning; Applied Machine Learning; Social and Info Networks)	1 to 4
CS 510	Advanced Information Retrieval	4

CS 511	Advanced Data Management	4	CS 424	Real-Time Systems	3 or 4
CS 512	Data Mining Principles	4	CS 425	Distributed Systems	3 or 4
CS 543	Computer Vision	4	CS 431	Embedded Systems	3 or 4
CS 544	Optimiz in Computer Vision	4	CS 436	Computer Networking Laboratory	3 or 4
CS 546	Machine Learning in NLP	4	CS 438	Communication Networks	3 or 4
CS 548	Models of Cognitive Processes	4	CS 439	Wireless Networks	3 or 4
CS 576	Topics in Automated Deduction	2 to 4	CS 460	Security Laboratory	3 or 4
CS 598	Special Topics (Machine Learning and Signal Processing)	2 to 4	CS 461	Computer Security I	4
Human and Social Impact:					
CS 460	Security Laboratory	3 or 4	CS 463	Computer Security II	3 or 4
CS 461	Computer Security I	4	CS 483	Applied Parallel Programming	4
CS 463	Computer Security II	3 or 4	CS 484	Parallel Programming	3 or 4
CS 465	User Interface Design	3 or 4	CS 498	Special Topics (Wireless Network Labs)	1 to 4
CS 467	Social Visualization	3 or 4	CS 523	Advanced Operating Systems	4
CS 468	Tech and Advertising Campaigns	3	CS 524	Concurrent Progrmg Languages	4
CS 498	Special Topics (Art and Science of Web Prog; Computational Advertising; Data Visualization; Applied Machine Learning; HCI; Social and Information Networks; Virtual Reality)	1 to 4	CS 525	Advanced Distributed Systems	4
CS 563	Advanced Computer Security	4	CS 538	Advanced Computer Networks	4
CS 565	Human-Computer Interaction	4	CS 563	Advanced Computer Security	4
Media:					
CS 414	Multimedia Systems	3 or 4	Machines:		
CS 418	Interactive Computer Graphics	3 or 4	CS 423	Operating Systems Design	3 or 4
CS 419	Production Computer Graphics	3 or 4	CS 424	Real-Time Systems	3 or 4
CS 445	Computational Photography	3 or 4	CS 426	Compiler Construction	3 or 4
CS 465	User Interface Design	3 or 4	CS 431	Embedded Systems	3 or 4
CS 467	Social Visualization	3 or 4	CS 433	Computer System Organization	3 or 4
CS 468	Tech and Advertising Campaigns	3	CS 484	Parallel Programming	3 or 4
CS 498	Special Topics (Art and Science of Web Prog; Computational Advertising; Virtual Reality; Data Visualization)	1 to 4	CS 523	Advanced Operating Systems	4
CS 519	Scientific Visualization	4	CS 526	Advanced Compiler Construction	4
CS 565	Human-Computer Interaction	4	CS 533	Parallel Computer Architecture	4
CS 598	Special Topics (Machine Learning and Signal Proc.)	2 to 4	CS 536	Fault-Tolerant Dig Syst Design	4
Scientific, Parallel, and High Performance Computing:					
CS 419	Production Computer Graphics	3 or 4	CS 541	Computer Systems Analysis	4
CS 450	Numerical Analysis	3 or 4	CS 584	Embedded System Verification	4
CS 457	Numerical Methods II	3	CS 598	Special Topics (Parallel)	2 to 4
CS 466	Introduction to Bioinformatics	3 or 4	Computer Science Advanced Electives		
CS 482	Simulation	3 or 4	Students must take at least two courses comprising at least 6 hours of 400-level coursework in ANY area offered at the University (including independent study - CS 397 may also be used to count towards these two additional advanced courses). These might be CS courses but don't have to be. Courses must be taken for a letter grade (CS 491 and other seminar courses do not count). It is expected that students will select these additional advanced courses in a way that best augments their program of study. Consultation with faculty mentor is highly encouraged.		
CS 483	Applied Parallel Programming	4	Code	Title	Hours
CS 484	Parallel Programming	3 or 4	At least two courses comprising at least 6 hours of 400-level coursework in any area offered at the University.		
CS 498	Special Topics (Parallel Algorithms)	1 to 4	<hr/>		
CS 519	Scientific Visualization	4	Total Hours		6
CS 554	Parallel Numerical Algorithms	4	Liberal Education		
CS 555	Numerical Methods for PDEs	4	The liberal education courses (https://wiki.illinois.edu/wiki/display/ugadvise/Degree+Requirements/#DegreeRequirements-LiberalEducationElectives) develop students' understanding of human culture and society, build skills of inquiry and critical thinking, and lay a foundation for civic engagement and lifelong learning.		
CS 556	Iterative & Multigrid Methods	4			
CS 558	Topics in Numerical Analysis	4			
Distributed Systems, Networking, and Security:					
CS 423	Operating Systems Design	3 or 4			

Code	Title	Hours	
	Electives from the campus General Education Social and Behavioral Sciences list.	6	RHET 105 Writing and Research (or Liberal education elective) ^{3,4}
	Electives from the campus General Education Humanities and the Arts list.	6	
	Electives either from a list approved by the college, or from the campus General Education lists for Social and Behavioral Sciences or Humanities and the Arts.	6	
Total Hours		18	

Students must also complete the campus cultural studies requirement by completing (i) one western/comparative culture(s) course, (ii) one non-western culture(s) course, and (iii) one U.S. Minority Culture(s) course from the General Education cultural studies lists. Most students select liberal education courses that simultaneously satisfy these cultural studies requirements. Courses from the western, non-western, and U.S. Minority lists that fall into free electives or other categories may also be used satisfy the cultural studies requirements.

Composition

These courses teach fundamentals of expository writing.

Code	Title	Hours
RHET 105	Writing and Research	4
Advanced Composition. May be satisfied by taking any course in either the liberal education or free elective categories which has the Advanced Composition designation.		
Total Hours		4

Free Electives

These unrestricted electives, subject to certain exceptions as noted at the College of Engineering Advising Website (<https://wiki.illinois.edu/wiki/display/ugadvise/Degree+Requirements/#DegreeRequirements-FreeElectives>), give the student the opportunity to explore any intellectual area of unique interest. This freedom plays a critical role in helping students to define research specialties or to complete minors.

Code	Title	Hours
	Free electives.	19

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Suggested Sequence

The schedule that follows is illustrative, showing the typical sequence in which courses would be taken by a student with no college course credit already earned and who intends to graduate in four years. Each individual's case may vary, but the position of required named courses is generally indicative of the order in which they should be taken.

First Year

First Semester	Hours
Science elective	3
CS 100 ¹ Freshman Orientation	1
CS 125 Intro to Computer Science	4
ENG 100 Engineering Orientation	0
MATH 221 ² Calculus I	4

		3-4
Semester Hours		15-16

Second Semester

CS 126	Software Design Studio	3
CS 173	Discrete Structures	3
MATH 231	Calculus II	3
PHYS 211	University Physics: Mechanics	4
RHET 105	Writing and Research (or Liberal education elective) ^{3,4}	4-3
Semester Hours		17-16

Second Year

First Semester

CS 225	Data Structures	4
CS 233	Computer Architecture	4
MATH 241	Calculus III	4
PHYS 212	University Physics: Elec Mag	4
Semester Hours		16

Second Semester

CS 241	System Programming	4
CS 361	Probability Statistics for Computer Science	3
MATH 415	Applied Linear Algebra	3
Liberal education electives ⁴		6
Semester Hours		16

Third Year

First Semester

CS 357	Numerical Methods I	3
CS 374	Introduction to Algorithms Models of Computation	4
CS Technical elective ⁵		3
Liberal education elective ⁴		3
Free elective		3
Semester Hours		16

Second Semester

CS Technical electives ⁵		9
CS 210	Ethical Professional Issues	2
Liberal education elective ⁴		3
Free elective		3
Semester Hours		17

Fourth Year

First Semester

CS 421	Programming Languages Compilers	3
CS Technical electives ⁵		6
Liberal education elective ⁴		3
Free electives		4
Semester Hours		16

Second Semester

CS Technical electives ⁵		6
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Free electives	9
Semester Hours	15
Total Hours:	128

- ¹ *This optional course is highly recommended for freshmen, who may use it to help meet free elective requirements.*
- ² *MATH 220 may be substituted, with four of the five credit hours applying toward the degree. MATH 220 is appropriate for students with no background in calculus.*
- ³ *RHET 105 should be taken in the first or second semester of the first year as authorized. The alternative is a social sciences or humanities elective.*
- ⁴ *Liberal education electives (<https://wiki.illinois.edu/wiki/display/ugadvise/Degree+Requirements/#DegreeRequirements-LiberalEducationElectives>) must include 6 hours of social & behavioral sciences and 6 hours of humanities & the arts course work from the campus General Education lists. The remaining 6 hours may be selected from a list maintained by the college, or additional course work from the campus General Education lists for social & behavioral sciences or humanities & the arts. Students must also complete the campus cultural studies requirement by completing (i) one western/comparative culture(s) course, (ii) one non-western culture(s) course, and (iii) one U.S. Minority Culture(s) course from the General Education cultural studies lists. Most students select liberal education courses that simultaneously satisfy these cultural studies requirements. Courses from the western, non-western, and U.S. Minority lists that fall into free electives or other categories may also be used satisfy the cultural studies requirements.*
- ⁵ *To be chosen from a departmentally approved list (<https://cs.illinois.edu/academics/undergraduate/degree-program-options/bs-computer-science-engineering/#technical-electives>), and to include at least three courses from a single focus area.*