COMPUTER SCIENCE, BS

for the degree of Bachelor of Science in Computer Science

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 both in more technical core areas and in areas of the student's choosing follows in the second two years. Graduates regularly go on to graduate study or leading positions in industry.

Both a combined B.S.-M.S. degree program and a B.S-M.C.S. degree program are available. The admission and course requirements are described on the Siebel School of Computing and Data Science website (https://siebelschool.illinois.edu/).

Current Program Educational Objectives (https://cs.illinois.edu/about/accreditation/)

for the degree of Bachelor of Science in Computer Science

Graduation Requirements

Minimum hours required for graduation: 128 hours.

M (https://go.grainger.illinois.edu/TechnicalGPA/)inimum Technical GPA (https://go.grainger.illinois.edu/TechnicalGPA/): 2.0

TGPA is required for CS and Math courses. See **Technical GPA (https://go.grainger.illinois.edu/TechnicalGPA/)** to clarify requirements.

University Requirements

Minimum of 40 hours of upper-division coursework, generally at the 300- or 400-level. These hours can be drawn from all elements of the degree. Students should consult their academic advisor for additional guidance in fulfilling this requirement.

The university and residency requirements can be found in the Student Code (https://studentcode.illinois.edu/article3/part8/3-801/) (§ 3-801) and in the Academic Catalog (http://catalog.illinois.edu/general-information/degree-general-education-requirements/).

General Education Requirements

Follows the campus General Education (Gen Ed) requirements (https://courses.illinois.edu/gened/DEFAULT/DEFAULT/). Some Gen Ed requirements may be met by courses required and/or electives in the program.

Code	Title	Hours
Composition I		4-6
Advanced Composition		3
Humanities & the Arts (6 hours)		6
Natural Sciences & Technology (6 hours)		6
fulfilled by PHYS 211 and PHYS 212		
Social & Behavioral Sciences (6 hours)		6
Cultural Studies: Non-Western Cultures (1 course)		3
Cultural Studies: US Minority Cultures (1 course)		3
Cultural Studies: Western/Comparative Cultures (1 course)		3
Quantitative Reasoning (2 courses, at least one course must be Quantitative Reasoning I)		6-10
fulfilled by MATH 220 or MATH 221; and MATH 231, MATH 241, PHYS 211, PHYS 212, CS 124, CS 128, CS 225		
Language Requirement (Completion of the third semester or equivalent of a language other than English is required)		0-15

Orientation and Professional Development

Code	Title	Hours
ENG 100	Grainger Engineering Orientation Seminar (External transfer students take ENG 300.)	1
Highly recommended, optional 1 credit hour course, CS 100 Computer Science Orientation. Credit hour counts toward free electives.		
CS 210	Ethical & Professional Issues	2 or 3
or CS 211	Ethical and Professional Conduct	
Total Hours		**3-4**

Foundational Mathematics and Science

Code	Title	Hours
MATH 221	Calculus I (MATH 220 may be substituted. MATH 220 is appropriate for students with no background in calculus. 4 of 5 credit hours count towards degree.)	4
MATH 231	Calculus II	3
MATH 241	Calculus III	4
MATH 257	Linear Algebra with Computational Applications	3
or MATH 415	Applied Linear Algebra	
or MATH 416	Abstract Linear Algebra	
PHYS 211	University Physics: Mechanics	4
PHYS 212	University Physics: Elec & Mag	4
One Science elective course:		**3**
Students must take one course from the Natural Science & Technology (NST) list, in addition to those taken as part of the General Education requirements. The course must be a course that is allowed for credit by the Grainger College of Engineering.		

Exceptions to the list are: ASTR 100, PHYS 101 and PHYS 102, and CHEM 101.

Students who select either ASTR 121, ASTR 122, or ASTR 150 to satisfy the Science Elective requirement will not receive credit for any other 100-level ASTR course as a free elective (maximum of 4 credit hours of ASTR 100-level can count towards graduation requirements for all Grainger College of Engineering Undergraduates).	
Total Hours	**25**

Computer Science Technical Core

Code	Title	Hours
CS 124	Introduction to Computer Science I	3
CS 128	Introduction to Computer Science II	3
CS 173	Discrete Structures	3
CS 222	Software Design Lab	1
CS 225	Data Structures	4
CS 233	Computer Architecture	4
CS 341	System Programming	4
CS 357	Numerical Methods I	3
CS 361	Probability & Statistics for Computer Science	3
CS 374	Introduction to Algorithms & Models of Computation	4
CS 421	Programming Languages & Compilers	3
Total Hours		**35**

Technical Electives

Code	Title	Hours
Students must take a minimum of (6) six additional technical electives with at least eighteen (18) cumulative credit hours and chosen from CS 397 and the CS 400-level courses, not including CS 400, CS 401, CS 402, CS 403 or CS 491. CS 500-level courses may be used as technical electives, but only with special permission from the CS Academic Office. CS 397 and CS 499 may be used with a cumulative maximum of six (6) credits from them counting as technical electives. One "CS-like" course in another department (e.g., ECE) may also be counted as a CS 400-level course with permission of the CS Academic Office. Non-CS tech electives will not be considered in focus areas.		**18**
At least one (1) of the CS courses used for technical electives must be chosen from the list below of CS courses satisfying the team project requirement.		
Team Project Course List:		
CS 417	Virtual Reality	3
CS 427	Software Engineering I	3 or 4
CS 428	Software Engineering II	3 or 4
CS 429	Software Engineering II, ACP	3
CS 437	Topics in Internet of Things	3
CS 465	User Interface Design	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
At least three (3) of the CS courses used for technical electives must be chosen from a single focus area, from among the list of focus areas listed below. The team project course may be used as one of them.		
CS 498 Special Topics and CS 598 Special Topics classes may be included in a focus area by department approval.		
Software Foundations:		
CS 407	Cryptography	3 or 4
CS 409	The Art of Web Programming	3
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 474	Logic in Computer Science	3 or 4
CS 476	Program Verification	3 or 4
CS 477	Formal Software Development Methods	3 or 4
CS 492	Senior Project I	3
CS 493	Senior Project II, ACP	3
CS 494	Senior Project II	3
CS 521	Advanced Topics in Programming Systems	4
CS 522	Programming Language Semantics	4
CS 524	Concurrent Progrmg Languages	4
CS 526	Advanced Compiler Construction	4
CS 527	Topics in Software Engineering	4
CS 576	Topics in Automated Deduction	2 to 4
Algorithms and Models of Computation:		
CS 407	Cryptography	3 or 4
CS 413	Intro to Combinatorics	3 or 4
CS 473	Algorithms	4
CS 474	Logic in Computer Science	3 or 4
CS 475	Formal Models of Computation	3 or 4
CS 476	Program Verification	3 or 4
CS 477	Formal Software Development Methods	3 or 4
CS 481	Advanced Topics in Stochastic Processes & Applications	3 or 4
CS 482	Simulation	3 or 4
CS 571	Combinatorial Mathematics	4
CS 572	Extremal Graph Theory	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 580	Topics in Algorithmic Game Theory	4
CS 581	Algorithmic Genomic Biology	4
CS 583	Approximation Algorithms	4
CS 584	Embedded System Verification	4
CS 586	Combinatorial Optimization	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 416	Data Visualization	3 or 4
CS 440	Artificial Intelligence	3 or 4
CS 441	Applied Machine Learning	3 or 4
CS 442	Trustworthy Machine Learning	3 or 4
CS 444	Deep Learning for Computer Vision	3 or 4
CS 445	Computational Photography	3 or 4
CS 446	Machine Learning	3 or 4
CS 447	Natural Language Processing	3 or 4
CS 448	Audio Computing Laboratory	3 or 4
CS 464	Topics in Societal and Ethical Impacts of Computer Technology	3
CS 466	Introduction to Bioinformatics	3 or 4
CS 467	Social Visualization	3 or 4
CS 469	Computational Advertising Infrastructure	3
CS 470	Social and Information Networks	3
CS 510	Advanced Information Retrieval	4
CS 511	Advanced Data Management	4
CS 512	Data Mining Principles	4
CS 514	Advanced Topics in Network Science	4
CS 540	Deep Learning Theory	4
CS 542	Statistical Reinforcement Learning	4
CS 543	Computer Vision	4
CS 544	Optimiz in Computer Vision	4
CS 545	Machine Learning for Signal Processing	4
CS 546	Advanced Topics in Natural Language Processing	4
CS 562	Advanced Topics in Security, Privacy, and Machine Learning	4
CS 567	Social Signals and Social Media	4
CS 576	Topics in Automated Deduction	2 to 4
CS 582	Machine Learning for Bioinformatics	4
Human and Social Impact:		
CS 409	The Art of Web Programming	3 or 4
CS 416	Data Visualization	3 or 4
CS 417	Virtual Reality	3 or 4
CS 441	Applied Machine Learning	3 or 4
CS 442	Trustworthy Machine Learning	3 or 4
CS 460	Security Laboratory	3 or 4
CS 461	Computer Security I	4
CS 463	Computer Security II	3 or 4
CS 464	Topics in Societal and Ethical Impacts of Computer Technology	3
CS 465	User Interface Design	4
CS 467	Social Visualization	3 or 4
CS 468	Tech and Advertising Campaigns	3
CS 469	Computational Advertising Infrastructure	3
CS 470	Social and Information Networks	3
CS 500	Current Topics in Computing Education Research	4
CS 514	Advanced Topics in Network Science	4
CS 562	Advanced Topics in Security, Privacy, and Machine Learning	4
CS 563	Advanced Computer Security	4
CS 565	Human-Computer Interaction	4
CS 567	Social Signals and Social Media	4
Media:		
CS 409	The Art of Web Programming	3 or 4
CS 414	Multimedia Systems	3 or 4
CS 416	Data Visualization	3 or 4
CS 417	Virtual Reality	3 or 4
CS 418	Interactive Computer Graphics	3 or 4
CS 419	Production Computer Graphics	3 or 4
CS 445	Computational Photography	3 or 4
CS 448	Audio Computing Laboratory	3 or 4
CS 465	User Interface Design	4
CS 467	Social Visualization	3 or 4
CS 468	Tech and Advertising Campaigns	3
CS 469	Computational Advertising Infrastructure	3 or 4
CS 519	Scientific Visualization	4
CS 545	Machine Learning for Signal Processing	4
CS 565	Human-Computer Interaction	4
CS 567	Social Signals and Social Media	4
Scientific, Parallel, and High Perfomance Computing:		
CS 419	Production Computer Graphics	3 or 4
CS 435	Cloud Networking	3 or 4
CS 450	Numerical Analysis	3 or 4
CS 466	Introduction to Bioinformatics	3 or 4
CS 482	Simulation	3 or 4
CS 483	Applied Parallel Programming	4
CS 484	Parallel Programming	3 or 4
CS 519	Scientific Visualization	4
CS 554	Parallel Numerical Algorithms	4
CS 555	Numerical Methods for PDEs	4
CS 556	Iterative & Multigrid Methods	4
CS 558	Topics in Numerical Analysis	4
Distributed Systems, Networking, and Security:		
CS 407	Cryptography	3 or 4
CS 423	Operating Systems Design	3 or 4
CS 424	Real-Time Systems	3 or 4
CS 425	Distributed Systems	3 or 4
CS 431	Embedded Systems	3 or 4
CS 435	Cloud Networking	3 or 4
CS 436	Computer Networking Laboratory	3 or 4
CS 437	Topics in Internet of Things	3 or 4
CS 438	Communication Networks	3 or 4
CS 439	Wireless Networks	3 or 4
CS 460	Security Laboratory	3 or 4
CS 461	Computer Security I	4
CS 463	Computer Security II	3 or 4
CS 483	Applied Parallel Programming	4
CS 484	Parallel Programming	3 or 4
CS 523	Advanced Operating Systems	4
CS 524	Concurrent Progrmg Languages	4
CS 525	Advanced Distributed Systems	4
CS 537	Advanced Topics in Internet of Things (IoT)	4

CS 538	Advanced Computer Networks	4
CS 562	Advanced Topics in Security, Privacy, and Machine Learning	4
CS 563	Advanced Computer Security	4
Machines:		
CS 423	Operating Systems Design	3 or 4
CS 424	Real-Time Systems	3 or 4
CS 426	Compiler Construction	3 or 4
CS 431	Embedded Systems	3 or 4
CS 433	Computer System Organization	3 or 4
CS 437	Topics in Internet of Things	3 or 4
CS 484	Parallel Programming	3 or 4
CS 523	Advanced Operating Systems	4
CS 526	Advanced Compiler Construction	4
CS 533	Parallel Computer Architecture	4
CS 534	Advanced Topics in Computer Architecture	4
CS 536	Fault-Tolerant Dig Syst Design	4
CS 541	Computer Systems Analysis	4
CS 584	Embedded System Verification	4
CS 588	Autonomous Vehicle System Engineering	4

Computer Science Advanced Electives

Code	Title	Hours
Students must take for a letter grade a minimum of two (2) advanced elective courses comprising at least six (6) credit hours. These advanced elective courses must be distinct from courses used to satisfy the technical electives. They may be chosen from CS 397 Individual Study and the 400-level coursework offered for letter grade in ANY area offered at the University of Illinois at Urbana-Champaign. It is expected that students will select these additional advanced courses in a way that best augments their program of study. Consultation with a faculty mentors is highly encouraged. A maximum of six (6) credit hours of CS 397 may be used in the combination of technical electives and advanced electives.		6
Total Hours		**6**

Free Electives

Code	Title	Hours
Additional course work,subject to the Grainger College of Engineering restrictions to Free Electives,so that there are at least 128 credit hours earned toward the degree. (https://go.grainger.illinois.edu/FreeElectives/)		**24-25**
Total Hours of Curriculum to Graduate		**128**

for the degree of Bachelor of Science in Computer Science

Sample Sequence

This sample sequence is intended to be used only as a guide for degree completion. All students should work individually with their academic advisors to decide the actual course selection and sequence that works best for them based on their academic preparation and goals. Enrichment programming such as study abroad, minors, internships, and so on may impact the structure of this four-year plan. Course availability is not guaranteed during the semester indicated in the sample sequence. The curriculum sequence can also be viewed via dynamic and static curricular maps *(*https://grainger.illinois.edu/academics/undergraduate/majors-and-minors/cs-map/*), which include prerequisite sequencing.*

Students must fulfill their Language Other Than English requirement by successfully completing a third level of a language other than English. See the corresponding section on the Degree and General Education Requirements *(*http://catalog.illinois.edu/general-information/degree-general-education-requirements/*). If the option of* CS 211 *is chosen, it will satisfy a core course requirement and the Campus General Education Advanced Composition requirement.*

Free Electives: Additional course work, subject to the Grainger College of Engineering restrictions to Free Electives *(*https://go.grainger.illinois.edu/FreeElectives/*), so that there are at least 128 credit hours earned toward the degree.*

First Year

First Semester	Hours	Second Semester	Hours
CS 100 (Optional course, highly recommended, free elective)	1	CS 128	3
CS 124	3	CS 173	3
MATH 221 (MATH 220 may be substituted)	4	MATH 231	3
ENG 100	1	General Education course (Choose a Humanities or Social/Behavioral Science course with Cultural Studies designation)	3
Science elective course	3	General Education (Choose a Humanities or Social/Behavioral Science course) or Composition I course	3-4
Composition I or General Education (Choose a Humanities or Social/Behavioral Science course)	4-3		
	16		**15**

Second Year

First Semester	Hours	Second Semester	Hours
CS 222	1	CS 233	4
CS 225	4	CS 361	3
MATH 241	4	MATH 257	3
PHYS 211	4	PHYS 212	4

General Education course (choose a Humanities or Social/Behavioral Science course with Cultural Studies designation)	3	Free elective course	3
	16		**17**

Third Year

First Semester	Hours	Second Semester	Hours
CS 210 (CS 211 may be substituted)	2	CS 374	4
CS 341	4	CS Technical elective course	3
CS 357	3	CS Technical elective course	3
CS Technical elective course	3	General Education course (choose a Humanities or Social/Behavioral Science course with Cultural Studies designation)	3
Language Other Than English (3rd level) course	4	Free elective course	3
	16		**16**

Fourth Year

First Semester	Hours	Second Semester	Hours
CS 421	3	CS Technical elective course	3
CS Advanced elective course	3	CS Technical elective course	3
CS Advanced elective course	3	CS Technical elective course	3
Free elective course	3	Free elective course	4
Free elective course	4	Free elective course	3
	16		**16**

Total Hours 128

for the degree of Bachelor of Science Major in Computer Science

By the time of graduation, students will have the ability to:

1. Analyze a complex computing problem and apply principles of computing and other relevant disciplines to identify solutions.
2. Design, implement, and evaluate a computing-based solution to meet a given set of computing requirements in the context of the program's discipline.
3. Communicate effectively in a variety of professional contexts.
4. Recognize professional responsibilities and make informed judgments in computing practice based on legal and ethical principles.
5. Function effectively as a member or leader of a team engaged in activities appropriate to the program's discipline.
6. Apply computer science theory and software development fundamentals to produce computing-based solutions.

for the degree of Bachelor of Science in Computer Science

Siebel School of Computing and Data Science (https://siebelschool.illinois.edu/)
Siebel School of Computing and Data Science Faculty (https://siebelschool.illinois.edu/about/people/all-faculty/)

The Grainger College of Engineering Admissions (https://grainger.illinois.edu/)
The Grainger College of Engineering