

COMPUTER SCIENCE

Overview

<http://www.cs.iastate.edu>

The department of Computer Science offers Bachelor of Science and Bachelor of Arts (effective Spring 2023) degrees in Computer Science in the College of Liberal Arts and Sciences.

The undergraduate curriculum in Computer Science leading to the Bachelor of Science degree is accredited by the Computing Accreditation Commission of ABET, <http://www.abet.org>. This degree equips students with a sound knowledge of the foundations of Computer Science as well as problem-solving and system design skills necessary to create robust, efficient, reliable, scalable, and flexible software systems. The B.S. degree in Computer Science prepares students for graduate study in Computer Science and for various business, industry, and government positions including computer scientists, information technologists, and software developers. The main educational objectives of the Computer Science program at Iowa State University are that its graduates demonstrate expertise, engagement, and learning within two to five years after graduation.

•**Expertise:** Graduated students should have the ability to establish peer-recognized expertise in the discipline. They should have the ability to articulate this expertise by formulating and solving problems of interest, by creating or deriving value through the application of technology, and by using mathematical foundations, algorithmic principles, and computer science theory in designing, implementing and evaluating computer-based systems and processes which meet the desired needs of their employers.

•**Engagement:** Graduated students should have the ability to be engaged in the profession through the practice of computer science in industry, academia, or the public sector. They should demonstrate effective teaming and commitment to working with others by applying communications skills and professional knowledge.

•**Learning:** Graduated students should have the ability to engage in sustained learning through graduate work, professional improvement opportunities, and self-study so that they can adapt to the role played by information processing in ever-changing areas of science, technology, and society.

The purpose of the Bachelor of Arts degree in Computer Science is to accommodate students who wish to pursue a major in Computer Science while taking more courses outside of the major than a Bachelor of Science degree program permits. This will include students pursuing double majors, students pursuing one or more strong minors, and students pursuing broader liberal educations. The B.A. program retains

the rigor of our B.S. program while allowing students to spread the breadth of their education over other disciplines in addition to Computer Science.

Student Learning Outcomes

Upon graduation, students should have:

1. An ability to analyze a complex computing problem, and to apply principles of computing and other relevant disciplines to identify solutions.
2. An ability to 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. An ability to communicate effectively in a variety of professional contexts.
4. An ability to recognize professional responsibilities and make informed judgments in computing practice based on legal and ethical principles.
5. An ability to function effectively as a member or leader of a team engaged in activities appropriate to the program's discipline.
6. An ability to apply computer science theory and software development fundamentals to produce computing-based solutions.

Undergraduate Curriculum in Software Engineering

The Department of Computer Science, together with the Department of Electrical and Computer Engineering, also offer a curriculum leading to an undergraduate degree in Software Engineering (<http://catalog.iastate.edu/previouscatalogs/2022-2023/collegeofliberalartsandsciences/softwareengineering/>). The Software Engineering curriculum offers emphasis areas in Software Engineering principles, process, and practice. Students may also take elective courses in Computer Engineering and Computer Science.

Degree Requirements

In addition to satisfying all the University and Liberal Arts and Sciences College requirements for all bachelor's degrees, students pursuing both the B.A. (effective Spring 2023) and the B.S. in Computer Science will complete the following coursework, as outlined below.

Degree Requirements for the B.S. in Computer Science:

The departmental requirements consist of a minimum of 50 credits in Computer Science and satisfaction of written and oral requirements.

The following courses are required:

COM S 101	Orientation	R
COM S 127	Introduction to Computer Programming	4
COM S 227	Object-oriented Programming	4
COM S 228	Introduction to Data Structures	3

COM S 309	Software Development Practices	3
COM S 311	Introduction to the Design and Analysis of Algorithms	3
COM S 321	Introduction to Computer Architecture and Machine-Level Programming	3
COM S 327	Advanced Programming Techniques	3
COM S 331	Theory of Computing	3
COM S 342	Principles of Programming Languages	3
COM S 352	Introduction to Operating Systems	3
COM S 402	Computer Science Senior Project	3

At least 15 credits, including at least 6 credits of 400-level courses, all 15 with a grade of C- or better, from the following:

COM S 319	Construction of User Interfaces	
COM S 336	Introduction to Computer Graphics	
COM S 362	Object-Oriented Analysis and Design	
COM S 363	Introduction to Database Management Systems	
COM S 407	Applied Formal Methods	
COM S 409	Software Requirements Engineering	
COM S 410	Distributed Development of Software	
COM S 412	Formal Methods in Software Engineering	
COM S 413	Foundations and Applications of Program Analysis	
COM S 415	Software System Safety	
COM S 417	Software Testing	
COM S 418	Introduction to Computational Geometry	
COM S 421	Logic for Mathematics and Computer Science	
COM S 424	Introduction to High Performance Computing	
COM S 425	High Performance Computing for Scientific and Engineering Applications	
COM S 426	Introduction to Parallel Algorithms and Programming	
COM S 430	Concurrent Programming in Practice	
COM S 433	Molecular Programming of Nanoscale Devices and Processes	
COM S 435	Algorithms for Large Data Sets: Theory and Practice	
COM S 437	Computer Game and Media Programming	
COM S 440	Principles and Practice of Compiling	
COM S 441	Programming Languages	
COM S 453	Privacy Preserving Algorithms and Data Security	
COM S 454	Distributed Systems	
COM S 455	Simulation: Algorithms and Implementation	
COM S 461	Principles and Internals of Database Systems	
COM S 472	Principles of Artificial Intelligence	

COM S 474	Introduction to Machine Learning	
COM S 476	Motion Strategy Algorithms and Applications	
COM S 477	Foundations of Robotics and Computer Vision	
COM S 481	Numerical Methods for Differential Equations	
COM S 486	Fundamental Concepts in Computer Networking	
COM S 487	Network Programming, Applications, and Research Issues	
CPR E 416	Software Evolution and Maintenance	
CPR E 430	Network Protocols and Security	
CPR E 431	Basics of Information System Security	
CPR E 458	Real Time Systems	
CPR E 489	Computer Networking and Data Communications	

Total Credits **50**

Com S 414 **may not** be applied towards fulfilling the 400-level electives.

Toward satisfying the requirements of the College of Liberal Arts and Sciences, the following courses should be included:

PHIL 343	Philosophy of Technology	3
SP CM 212	Fundamentals of Public Speaking	3

At least 17 credits of Math and Statistics 17

MATH 165	Calculus I	4
MATH 166	Calculus II	4
COM S 230	Discrete Computational Structures	3

One Statistics course from:

STAT 305	Engineering Statistics	3
STAT 330	Probability and Statistics for Computer Science	3
STAT 341	Introduction to the Theory of Probability and Statistics I	4

At least one Math course from:

MATH 207	Matrices and Linear Algebra	3
MATH 265	Calculus III	4
MATH 266	Elementary Differential Equations	3
MATH 267	Elementary Differential Equations and Laplace Transforms	4
MATH 304	Combinatorics	3
MATH 314	Graph Theory	3
MATH 317	Theory of Linear Algebra	4

One of the following 2-course Natural Science sequences (with labs):

BIOL 211 & 211L	Principles of Biology I and Principles of Biology Laboratory I	8
& BIOL 212	and Principles of Biology II	
& BIOL 212L	and Principles of Biology Laboratory II	

Or

BIOL 255 & 255L & BIOL 256 & BIOL 256L	Fundamentals of Human Anatomy and Fundamentals of Human Anatomy Laboratory and Fundamentals of Human Physiology and Fundamentals of Human Physiology Laboratory	8
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Or

CHEM 177 & 177L & CHEM 178 & CHEM 178L	General Chemistry I and Laboratory in General Chemistry I and General Chemistry II and Laboratory in College Chemistry II	9
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Or

GEOL 100 & 100L & GEOL 102 & GEOL 102L	How the Earth Works and How the Earth Works: Laboratory and History of the Earth and History of the Earth: Laboratory	8
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Or

PHYS 231 & 231L & PHYS 232 & PHYS 232L	Introduction to Classical Physics I and Introduction to Classical Physics I Laboratory and Introduction to Classical Physics II and Introduction to Classical Physics II Laboratory	10
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The following courses meet the communication proficiency requirement:

LIB 160	Introduction to College Level Research	1
ENGL 150	Critical Thinking and Communication	3
ENGL 250	Written, Oral, Visual, and Electronic Composition	3

One of the following

ENGL 302	Business Communication	3
ENGL 305	Creative Writing: Nonfiction	3
ENGL 309	Proposal and Report Writing	3
ENGL 314	Technical Communication	3

Degree Requirements for the B.A. in Computer Science:

The B.A. departmental requirements consist of a minimum of 31 credits in Computer Science and satisfaction of written and oral requirements.

The following courses are required:

Computer Science core:

COM S 101	Orientation	R
COM S 127	Introduction to Computer Programming	4
COM S 227	Object-oriented Programming	4
COM S 228	Introduction to Data Structures	3
COM S 309	Software Development Practices	3
COM S 311	Introduction to the Design and Analysis of Algorithms	3

Advanced Computer Science, five 300/400-level courses chosen from 15 lists (a) and (b) below, with at least one at the 400-level and at least two chosen from list (a). COM S 414 may not be applied towards fulfilling the 400-level electives.

(a) Software and Hardware Systems:

COM S 321	Introduction to Computer Architecture and Machine-Level Programming
COM S 327	Advanced Programming Techniques
COM S 342	Principles of Programming Languages
COM S 352	Introduction to Operating Systems
COM S 362	Object-Oriented Analysis and Design
COM S 363	Introduction to Database Management Systems
COM S 409	Software Requirements Engineering
COM S 410	Distributed Development of Software
COM S 412	Formal Methods in Software Engineering
COM S 413	Foundations and Applications of Program Analysis
COM S 415	Software System Safety
COM S 417	Software Testing
COM S 440	Principles and Practice of Compiling
COM S 441	Programming Languages
COM S 454	Distributed Systems
COM S 487	Network Programming, Applications, and Research Issues
COM S 488X	Computer Networks

(b) Other Advanced Computer Science:

COM S 331	Theory of Computing
COM S 336	Introduction to Computer Graphics
COM S 418	Introduction to Computational Geometry
COM S 421	Logic for Mathematics and Computer Science
COM S 433	Molecular Programming of Nanoscale Devices and Processes
COM S 435	Algorithms for Large Data Sets: Theory and Practice
COM S 437	Computer Game and Media Programming
COM S 455	Simulation: Algorithms and Implementation
COM S 472	Principles of Artificial Intelligence
COM S 474	Introduction to Machine Learning
COM S 476	Motion Strategy Algorithms and Applications
COM S 477	Foundations of Robotics and Computer Vision

Total Credits **32**

Toward satisfying the requirements of the College of Liberal Arts and Sciences, the following courses should be included:

Mathematics Core (3 courses):

MATH 165	Calculus I
MATH 166	Calculus II
COM S 230	Discrete Computational Structures

Additional Mathematics (1 course from the following):

COM S 331	Theory of Computing
MATH 207	Matrices and Linear Algebra
MATH 265	Calculus III
MATH 266	Elementary Differential Equations
MATH 267	Elementary Differential Equations and Laplace Transforms
MATH 304	Combinatorics
MATH 314	Graph Theory
MATH 317	Theory of Linear Algebra

Statistics (1 course from the following):

STAT 305	Engineering Statistics	
STAT 330	Probability and Statistics for Computer Science	
STAT 341	Introduction to the Theory of Probability and Statistics I	
STAT 347	Probability and Statistical Theory for Data Science	
SP CM 212	Fundamentals of Public Speaking	3

Natural Sciences: minimum 8 credits from approved College list

The following courses meet the communication proficiency requirement:

LIB 160	Introduction to College Level Research	1
ENGL 150	Critical Thinking and Communication	3
ENGL 250	Written, Oral, Visual, and Electronic Composition	3
One of the following		
ENGL 302	Business Communication	3
ENGL 305	Creative Writing: Nonfiction	3
ENGL 309	Proposal and Report Writing	3
ENGL 314	Technical Communication	3

The following pertains to both the B.S. and the B.S. in Computer Science:

Students must earn at least a C- in Math 165, Math 166, and each Computer Science course taken to fulfill the Degree Program. The LAS College requires the major must contain at least 8 credits in courses taken at Iowa State University that are numbered 300 or above and in which the student's grade is C or higher.

According to the university-wide Communication Proficiency Grade Requirement, students must demonstrate their communication proficiency by earning a grade of C or better in ENGL 250. The

Department requires a C or higher in the upper-level ENGL course (302, 305, 309, 314).

To obtain a bachelor's degree from the College of Liberal Arts and Sciences, curriculum in liberal arts and sciences, a student must earn at least 45 credits at the 300 level or above taken at a four-year college. All such credits, including courses taken on a pass/not pass basis, may be used to meet this requirement.

Students must take at least 15 credits of Computer Science courses at the 300 level or higher at Iowa State University while resident here. Computer Science transfer courses need to be a minimum grade of C or higher to be considered for course substitution.

Four Year Plan Computer Science, B.S.

Freshman

Fall	Credits Spring	Credits
COM S 101	R COM S 227	4
COM S 127	4 MATH 166	4
MATH 165	4 ENGL 250	3
ENGL 150	3 LIB 160	1
SOCIAL SCIENCE	3 ARTS & HUMANITIES	3
	14	15

Sophomore

Fall	Credits Spring	Credits
COM S 228	3 COM S 321	3
COM S 230	3 COM S 311	3
SCIENCE SEQUENCE PART 1	4 COM S 300/400 ELECTIVE	3
SOCIAL SCIENCE	3 SCIENCE SEQUENCE PART 2	4
WORLD LANGUAGE 101/ ELECTIVE	3-4 WORLD LANGUAGE 102/ ELECTIVE	3-4
	16-17	16-17

Junior

Fall	Credits Spring	Credits
COM S 309	3 COM S 327	3
COM S 300/400 ELECTIVE	3 COM S 331	3
MATH ELECTIVE	3 STAT 300 ELECTIVE	3
SP CM 212	3 ENGL 300 ELECTIVE	3
ARTS & HUMANITIES	3 PHIL 343	3
	15	15

Senior

Fall	Credits Spring	Credits
COM S 342	3 COM S 402	3
COM S 300/400 ELECTIVE	3 COM S 352	3

COM S 400 ELECTIVE	3	COM S 400 ELECTIVE	3
SOCIAL SCIENCE & USD/IP	3	ARTS & HUMANITIES & USD/IP	3
ELECTIVE	3	ELECTIVE	3
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	15		15

Undergraduate Minor in Computer Science

The Department of Computer Science offers an undergraduate minor in Computer Science. The minor requires at least 16 credits in computer science courses. Com S 414 cannot be used to fulfill minor requirements.

A minimum grade of C- is required in Com S 227 and Com S 228. A minimum grade of C is required in both Com S 311 and the three credits of 300-level Computer Science courses and above. Students must meet all prerequisites for Computer Science courses taken to fulfill the minor. At least 6 credits of the minor must be in courses numbered 300 and above and taken at ISU with a grade of C or higher. The minor must include at least 9 credits that are not used to meet any other department, college, or university requirement.

COM S 227	Object-oriented Programming	4
COM S 228	Introduction to Data Structures	3
COM S 230	Discrete Computational Structures	3
COM S 311	Introduction to the Design and Analysis of Algorithms	3
3 credits in ComS courses at the 300 level or above		3

Certificate in Computing Applications

Students interested in the computing applications, may want to explore the Certificate in Computing Applications (<http://catalog.iastate.edu/previouscatalogs/2022-2023/collegeofliberalartsandsciences/computingapplicationscertificate/>); it is a cross-disciplinary course of study in the Colleges of Liberal Arts and Sciences, Engineering, and Business.

Concurrent Bachelors and Masters Degrees

The concurrent B.S./M.S. degree in Computer Science offers highly motivated and focused students the opportunity for accelerated study. Students will be allowed to double count up to 12 credits. This program will pair undergraduate students in the concurrent program with research teams of graduate students and dedicated faculty members prominent in their fields of expertise. Students that declare concurrent enrollment will be considered graduate-level students, and therefore eligible for graduate research assistantships and scholarships. Click here for application instructions (<https://www.cs.iastate.edu/concurrent-bsms-computer-science/>).

More information can be found here: <https://www.cs.iastate.edu/cs.iastate.edu/concurrent-comajor-transfer> (<https://www.cs.iastate.edu/cs.iastate.edu/concurrent-comajor-transfer/>)

Graduate programs

The department offers graduate programs leading to degrees of Master of Science (MS) and Doctor of Philosophy (PhD) with a major in Computer Science. The Doctor of Philosophy degree may also be earned with computer science as a co-major with some other discipline. Additionally, the department offers a minor for the students majoring in other disciplines. The department also offers a Master of Science (MS) in Artificial Intelligence. This program is for graduate-level students with strong quantitative backgrounds who are interested in learning AI and machine-learning techniques.

Established research areas include algorithms, artificial intelligence, computational complexity, computer architecture, bioinformatics, computational biology, computer networks, database systems, formal methods, information assurance, machine learning and neural networks, multimedia, operating systems, parallel and distributed computing, programming languages, robotics, and software engineering. There are also numerous opportunities for interdisciplinary research.

Typically, students beginning graduate work in the Department of Computer Science have completed a bachelor's degree or equivalent in Computer Science. However, some students with undergraduate majors in other areas, such as Mathematical, physical, or biological science or engineering become successful graduate students in Computer Science.

For the degree Master of Science, 31 - 34 semester credits is required. A thesis or a creative component demonstrating research and the ability to organize and express significant ideas in computer science is required.

The purpose of the doctoral program is to train students to do original research in Computer Science. Each student is also required to attain knowledge and proficiency commensurate with a leadership role in the field. The PhD requirements are governed by the student's program of study committee within established guidelines of the department and the graduate college. They include coursework (demonstrating breadth and depth of knowledge), a research skills requirement, a preliminary examination, and a doctoral dissertation and final oral examination. The department recommends that all graduate students majoring in Computer Science teach as part of their training for an advanced degree.