
School of
Computer Science

School of Computer Science

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Carnegie Mellon founded one of the first Computer Science departments in the world in 1965. Today, the Computer Science Department forms the centerpiece of the School of Computer Science, and is joined by the Entertainment Technology Center, the Human-Computer Interaction Institute, the Institute for Software Research International, the Language Technologies Institute, the Machine Learning Department, and the Robotics Institute. Together, these units make the School of Computer Science a world leader in research and education.

The B.S. program in Computer Science combines a solid core of Computer Science courses with the ability to gain substantial depth in another area through a required minor in a second subject. In addition, the curriculum provides numerous choices for science and humanities courses. As computing is a discipline with strong links to many fields, this provides students with unparalleled flexibility to pursue allied (or non-allied) interests. The curriculum's mathematics and probability component ensures that students have the formal tools to remain current as technologies and systems change, rather than be limited by a narrow focus on programming alone. At the same time, students gain insight into the practical issues of building and maintaining systems by participating in intensive project-oriented courses. Due to the tremendous number of ongoing research projects within the School, many students obtain part-time or summer jobs, or receive independent study credit, working on research while pursuing their undergraduate degree. Students seeking a research/graduate school career may pursue an intensive course of research, equivalent to four classroom courses, culminating in the preparation of a senior research honors thesis.

Students apply to, and are directly admitted into, the undergraduate program in Computer Science and, upon successful completion, are awarded a Bachelor of Science in Computer Science. Suitably prepared students from other Carnegie Mellon colleges are eligible to apply for internal transfer to the School of Computer Science and will be considered for transfer if space is available. Computation-oriented programs are also available within the Departments of Biology, Chemistry, Physics, Electrical and Computer Engineering, Information Systems, Philosophy, Psychology, and Design. Also, a double major in Human-Computer Interaction is available jointly with the College of Humanities & Social Sciences.

Curriculum — B.S. in Computer Science

Computer Science

15-111	Intermediate/Advanced Programming (students with no prior programming experience take 15-100 & 15-111)
15-123	Effective Programming in C and UNIX
15-128	Freshman Immigration Course
15-211	Fundamental Data Structures and Algorithms
15-212	Principles of Programming
15-213	Introduction to Computer Systems
15-251	Great Theoretical Ideas in Computer Science
15-451	Algorithm Design and Analysis

One Communications course:

15-221	Technical Communication for Computer Scientists
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One Applications elective:

15-323	Music Systems and Information Processing
15-381	Artificial Intelligence: Representation & Problem Solving
15-384	Robotic Manipulation
15-385	Computer Vision
15-413	Software Engineering
15-415	Database Applications
15-421	Web Commerce, Security and Privacy
15-437	Web Application Development
15-462	Computer Graphics
15-463	Computational Photography

15-482	Human Language Technologies
15-490	Computational Neuroscience
10-601	Machine Learning
16-362	Mobile Robot Programming Laboratory
xx-xxx	others as appropriate

One Programming elective:

15-312	Foundations of Programming Languages
15-317	Constructive Logic
17-651	Models of Software Systems
21-300	Basic Logic
80-311	Computability and Incompleteness
xx-xxx	others as appropriate

One Systems elective:

15-410	Operating System Design and Implementation
15-418	Parallel Computer Architecture and Programming
15-441	Computer Networks
18-447	Introduction to Computer Architecture
xx-xxx	others as appropriate

One Theory elective:

15-354	Computational Discrete Mathematics
15-355	Modern Computer Algebra
15-414	Bug Catching: Automated Program Verification and Testing
15-453	Formal Languages and Automata
21-301	Combinatorics
21-484	Graph Theory
xx-xxx	others as appropriate

Two Computer Science electives

Mathematics/Probability

21-120	Differential & Integral Calculus
21-122	Integration, Differential Equations, and Approximation
21-127	Concepts of Mathematics
21-241	Matrix Algebra (or 21-341, Linear Algebra)

One of the following Probability courses:

15-359	Probability and Computing
21-325	Probability
36-217	Probability Theory and Random Processes
36-225	Introduction to Probability and Statistics I
36-625	Probability and Mathematical Statistics I

Engineering and Natural Sciences

Four engineering or science courses are required, of which at least one must have a laboratory component and at least two must be from the same department. At present, courses meeting the lab requirement are:

09-101	Introduction to Experimental Chemistry (this 3 unit lab <u>together with</u> 09-105, Introduction to Modern Chemistry, satisfies the lab requirement)
15-321	Research Methods for Experimental Computer Science
27-100	Engineering the Materials of the Future
33-104	Experimental Physics
85-310	Research Methods in Cognitive Psychology

The following MCS and CIT courses cannot be used to satisfy the Engineering and Natural Sciences requirement:

09-103	Atoms, Molecules, and Chemical Change
09-104	Fundamental Aspects of Organic Chemistry and Biochemistry
12-090	Technology and the Environment
18-202	Mathematical Foundations of Electrical Engineering
33-100	Basic Experimental Physics
33-115	Energy and Environmental Issues
33-124	Introduction to Astronomy
39-100	What is Engineering?

Computing @ Carnegie Mellon

The following course is required of all students to familiarize them with the campus computing environment:
99-10x Computing @ Carnegie Mellon

Required Minor

A sequence of courses proscribed by the requirements of the particular department. Completion of a second major (or double degree) also satisfies this requirement. If permitted by the minor or second major department, courses taken in satisfaction of the minor or second major may also count toward any category other than Computer Science.

Humanities and Arts Requirements

All candidates for the bachelor's degree must complete a minimum of 63 units offered by the College of Humanities & Social Sciences and/or the College of Fine Arts. Carnegie Mellon is currently engaged in a university-wide examination of general education under the rubric of Integrative Liberal Studies. The School of Computer Science fully supports this examination and expects that, when this university-wide examination concludes, that our general education requirements will be different than they are in this catalog. For now, though, the general education courses for SCS students are to meet the following distribution requirements:

A. Writing Requirement (9 units)

Complete the following course:
76-101 Interpretation and Argument

B. Breadth Requirement (27 units)

Complete three courses, one each from Category 1, Category 2, and Category 3:

Category 1: Cognition, Choice and Behavior

- 70-311 Organizational Behavior
- 80-130 Introduction to Ethics
- 80-150 Nature of Reason
- 80-180 The Nature of Language
- 80-221 Philosophy of Social Science
- 80-230 Ethical Theory
- 80-241 Ethical Judgments in Professional Life
- 80-242 Conflict, Dispute Resolution
- 80-270 Philosophy of Mind
- 80-271 Philosophy and Psychology
- 80-281 Language and Thought
- 85-100 Introduction to Intelligence in Humans, Animals, and Machines
- 85-102 Introduction to Psychology
- 85-211 Cognitive Psychology
- 85-221 Principles of Child Development
- 85-241 Social Psychology
- 85-251 Personality
- 85-261 Abnormal Psychology
- 88-120 Reason, Passion and Cognition
- 88-260 Organizations

Category 2: Economic, Political and Social Institutions

- 36-303 Sampling, Survey and Society
- 70-332 Business, Society and Ethics
- 73-100 Principles of Economics
- 73-150 Principles of Economics with Calculus
- 79-223 Protest and Dissent in American History
- 79-331 Crime and Punishment
- 79-335 Drug Use and Drug Policy
- 79-345 American Environmental History: Critical Issues
- 79-350/
- 88-326 Theories of International Relations
- 80-135 Introduction to Political Philosophy
- 80-136 Social Structure, Public Policy and Ethical Dilemmas
- 80-235 Political Philosophy
- 80-236 Philosophy and the Law
- 80-243 Environment Management and Ethics
- 80-341 Computers, Society, and Ethics
- 88-104 Decision Processes in American Political Institutions
- 88-110 Experiments with Economic Principles
- 88-205 Comparative Politics
- 88-220 Policy Analysis I

Category 3: Cultural Analysis

- 57-173 Survey of Western Music History
- 70-342 Managing Across Cultures
- 76-227 Comedy
- 76-232 African-American Studies
- 76-239 Introduction to Film Studies

- 76-241 Introduction to Gender Studies
- 79-104 Introduction to World History
- 79-113 Culture and Identity in American Society
- 79-201 Introduction to Anthropology
- 79-206 Development of American Culture
- 79-207 Development of European Culture
- 79-209 Theory and Practice in Anthropology
- 79-218 The Roots of Rock & Roll
- 79-222 Religion in American Society
- 79-226 History and Cultures of East Asia
- 79-241 African-American History I
- 79-242 African-American History II
- 79-259 Introduction to Religion
- 79-270 Chinese Culture and Society
- 79-368 Poverty, Charity, and Welfare
- 79-384 Medicine and Society
- 80-100 What Philosophy Is
- 80-151 God in the West
- 80-250 Ancient Philosophy
- 80-251 Modern Philosophy
- 80-253 Continental Philosophy
- 80-254 Analytic Philosophy
- 80-255 Pragmatism
- 80-261 Aesthetics of Mass Art
- 80-276 Philosophy of Religion
- 82-273 Introduction to Japanese Language and Culture
- 82-294 Topics in Russian Language and Culture
- 82-303 French Culture
- 82-304 Francophone World
- 82-325 Introduction to German Studies
- 82-333 Introduction to Chinese Language and Culture
- 82-342 Spain: Language and Culture
- 82-343 Latin America: Language and Culture
- 82-344 US Latinos: Language and Culture
- 82-345 Hispanic Literary and Cultural Studies

C. Humanities and Arts Electives (27 units)

Complete 3 non-technical courses of at least 9 units each from any of the departments in the College of Humanities & Social Sciences or the College of Fine Arts or from the Department of Business Administration. Some of the courses taught in these units are considered technical courses and may not be used to satisfy this requirement. The complete list of currently acceptable and not acceptable courses can be found at <http://www.csd.cs.cmu.edu/education/bcs/hss.html>.

Free Electives

A free elective is any Carnegie Mellon course. However, a maximum of nine units of physical education and/or military science (ROTC) courses may be used toward fulfilling graduation requirements.

Summary of Degree Requirements:

Area	Courses	Units
Computer Science	14	148
Math/Statistics	5	47
Engineering/Science	4	36
Humanities/Arts	7	63
Minor/Free Electives	7	63
Computing @ Carnegie Mellon	1	3
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		360

Suggested Course Sequence:

Freshman Year

		Units
	Fall	
15-111	Intermediate/Advanced Programming	10
15-128	Freshman Immigration Course	1
21-120	Differential & Integral Calculus	10
21-127	Concepts of Mathematics	9
76-101	Interpretation and Argument	9
99-10x	Computing Skills Workshop	3
xx-xxx	Science/Engineering Course	9
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Spring

15-211	Fundamental Data Structures and Algorithms	12
15-251	Great Theoretical Ideas in Computer Science	12
21-122	Integration, Differential Equations, and Approximation	10
xx-xxx	Science/Engineering Course	9
xx-xxx	Humanities and Arts Elective	9
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Sophomore Year

Fall		Units
15-123	Effective Programming in C and UNIX	9
15-212	Principles of Programming	12
21-241	Matrix Algebra	9
xx-xxx	Science/Engineering Course	9
xx-xxx	Humanities and Arts Elective	9

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Spring

15-213	Introduction to Computer Systems	12
15-221	Technical Communication for Computer Scientists	9
15-xxx	Computer Science Elective	9
xx-xxx	Science/Engineering Course	9
xx-xxx	Minor Requirement / Free Elective	9

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Junior Year

Fall		Units
15-451	Algorithm Design and Analysis	12
15-xxx	Computer Science Elective	9
xx-xxx	Probability Course	9
xx-xxx	Humanities and Arts Elective	9
xx-xxx	Minor Requirement / Free Elective	9

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Spring

15-xxx	Computer Science Elective	12
15-xxx	Computer Science Elective	9
xx-xxx	Humanities and Arts Elective	9
xx-xxx	Minor Requirement / Free Elective	9

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Senior Year

Fall		Units
15-xxx	Computer Science Elective	12
xx-xxx	Humanities and Arts Elective	9
xx-xxx	Minor Requirement / Free Elective	9
xx-xxx	Minor Requirement / Free Elective	9

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Spring

15-xxx	Computer Science Elective	9
xx-xxx	Humanities and Arts Elective	9
xx-xxx	Minor Requirement / Free Elective	9
xx-xxx	Minor Requirement / Free Elective	9

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Minimum number of units required for the degree: 360

Suggested Options

The flexibility in the curriculum allows many different schedules, of which the above is only one possibility. For those students looking for some additional guidance in navigating their elective options, we offer the following recommendations of elective choices that might be made for particular concentrations.

Artificial Intelligence

15-381	Artificial Intelligence: Representation and Problem Solving
15-384/5	Robotic Manipulation / Computer Vision
15-486	Artificial Neural Networks
15-681	Artificial Intelligence: Machine Learning
80-300	Minds, Machines, and Knowledge
80-316	Probability and AI
85-211	Cognitive Psychology
85-213	Human Information Processing and Artificial Intelligence
85-419	Introduction to Parallel Distributed Processing

Cognitive Modeling

05-432	Cognitive Modeling and Intelligent Tutoring Systems
05-811	Cognitive Modeling for HCI
85-211	Cognitive Psychology
85-213	Human Information Processing and Artificial Intelligence
85-392	Human Expertise
85-412	Cognitive Modeling

Computer Systems

15-410	Operating System Design and Implementation
15-411	Compiler Design
15-412	Operating System Practicum
15-441	Computer Networks
15-610	Engineering Complex, Large-Scale Computer Systems
18-240	Fundamentals of Computer Engineering
18-447	Introduction to Computer Architecture

Entrepreneurship

15-390	Entrepreneurship for Computer Science
15-391	Technology Consulting in the Community

Graphics/Virtual Reality

05-331	Building Virtual Worlds
15-462	Computer Graphics
15-463	Computational Photography
15-464	Technical Animation
15-465	Animation Art and Technology
15-466	Computer Game Programming

Human-Computer Interaction

05-410	Introduction to Human-Computer Interaction Methods
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Additionally, students who are interested in Human-Computer Interaction are encouraged to look at the description of the Double Major in Human-Computer Interaction on page 97 of the Undergraduate Catalog.

Language Technologies

11-741	Information Retrieval
11-751	Speech Recognition
15-482	Human Language Technologies
80-180	The Nature of Language

Additionally, students interested in Language Technologies are encouraged to look at the description of the Minor in Language Technologies on page 321 and the Minor in Linguistics on page 222 of the Undergraduate Catalog.

Robotics

16-311	Introduction to Robotics
16-362	Mobile Robot Programming Laboratory
16-363	Advanced Mobile Robot Programming

Additionally, students who are interested in Robotics are encouraged to look at the description of the Minor in Robotics on page 104 of the Undergraduate Catalog.

Scientific Computation

21-259	Calculus in Three Dimensions
21-260	Differential Equations
21-320	Symbolic Programming Methods
21-369	Numerical Methods
36-410	Introduction to Probability Modeling

Additionally, students who are interested in Scientific Computation are encouraged to look at the description of the Minor in Scientific Computing on page 288 in the Undergraduate Catalog as well as the following discipline-specific Computational Science courses:

03-310	Introduction to Computational Biology
09-560	Molecular Modeling and Computational Chemistry
33-241	Introduction to Computational Physics

Software Systems

15-312	Foundations of Programming Languages
15-410	Operating System Design and Implementation
15-411	Compiler Design
15-415	Database Applications
15-441	Computer Networks

Theory

15-312	Foundations of Programming Languages
15-453	Formal Languages and Automata
15-85x	Graduate Theory course
21-301	Combinatorial Analysis
21-341	Linear Algebra
21-355	Principles of Real Analysis I
21-373	Algebraic Structures
21-484	Applied Graph Theory
21-600	Mathematical Logic I

Graduate School Preparation

Students considering going on to graduate school in Computer Science should take a wide variety of Computer Science and Mathematics courses, as well as consider getting involved in independent research. Additionally, graduate CS courses can be taken with permission of the instructor.

Senior Research Thesis

The goal of the Senior Research Thesis Program is to introduce students to the breadth of tasks involved in independent research, including library work, problem formulation, experimentation, and writing and speaking. In particular, students present a brief midterm progress report each semester, present a public poster session in December, present an oral summary in the year-end university-wide Undergraduate Research Symposium and submit a written thesis in May. Students work closely with faculty advisors to plan and carry out their projects. Projects span the entire senior year, and students receive 18 units of academic credit each semester. Nine of these 18 can be counted toward CS elective requirements, and nine as free elective credits; hence, for most students, the thesis program replaces two courses per semester.

Computer Science as a Secondary Concentration

The School of Computer Science offers a Double Major in Computer Science and Minors in Computer Science, Language Technologies, and Robotics. It also jointly offers a Double Major in Human-Computer Interaction.

Double Major in Computer Science

The following courses are required for the Double Major in Computer Science:

Prerequisites:

15-111	Intermediate/Advanced Programming (students with no prior programming experience take 15-100 & 15-111)
15-123	Effective Programming in C and UNIX
21-120	Differential & Integral Calculus
21-122	Integration, Differential Equations, and Approximation
21-127	Concepts of Mathematics
21-241	Matrix Algebra (or 21-341, Linear Algebra)

Double Major requirements:

15-211	Fundamental Data Structures and Algorithms
15-212	Principles of Programming
15-213	Introduction to Computer Systems
15-251	Great Theoretical Ideas in Computer Science
15-451	Algorithm Design and Analysis

One Communications course:

15-221	Technical Communication for Computer Scientists
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One Applications elective:

15-323	Music Systems and Information Processing
15-381	Artificial Intelligence: Representation and Problem Solving
15-384	Robotic Manipulation
15-385	Computer Vision
15-413	Software Engineering
15-415	Database Applications
15-421	Web Commerce, Security and Privacy
15-437	Web Application Development
15-462	Computer Graphics
15-463	Computational Photography
15-482	Human Language Technologies
15-490	Computational Neuroscience
10-601	Machine Learning
16-362	Mobile Robot Programming Laboratory

One Programming elective:

15-312	Foundations of Programming Languages
15-317	Constructive Logic
17-651	Models of Software Systems
21-300	Basic Logic
80-311	Computability and Incompleteness

One Systems elective:

15-410	Operating System Design and Implementation
15-418	Parallel Computer Architecture and Programming
15-441	Computer Networks
18-447	Introduction to Computer Architecture

One Theory elective:

15-354	Computational Discrete Mathematics
15-355	Modern Computer Algebra
15-414	Bug Catching: Automated Program Verification and Testing
15-453	Formal Languages and Automata
21-301	Combinatorics
21-484	Graph Theory

Two Computer Science electives

One of the following Probability courses:

15-359	Probability and Computing
21-325	Probability
36-217	Probability Theory and Random Processes
36-225	Introduction to Probability and Statistics I
36-625	Probability and Mathematical Statistics I

Minor in Computer Science

The following courses are required for the Minor in Computer Science:

Prerequisites:

15-111	Intermediate/Advanced Programming (students with no prior programming experience take 15-100 & 15-111)
21-127	Concepts of Mathematics

Minor requirements:

15-211	Fundamental Data Structures and Algorithms
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One of the following courses:

15-213	Introduction to Computer Systems (requires 15-123 as a prerequisite)
15-251	Great Theoretical Ideas in Computer Science

Three Computer Science electives

Double-Counting Restriction

In order to avoid excessive double-counting, students pursuing a Double Major or Minor in Computer Science must complete at least 6 courses in their home department, of at least 9 units each, none of which are required by (or are cognates for requirements in) the Computer Science major.

Language Technologies Minor

The following courses are required for the Minor in Language Technologies:

Prerequisites:

15-111	Intermediate/Advanced Programming (students with no prior programming experience take 15-100 & 15-111)
21-127	Concepts of Mathematics
15-211	Fundamental Data Structures and Algorithms
15-212	Principles of Programming
15-251	Great Theoretical Ideas in Computer Science

Minor requirements:

Both of the following courses:

15-482	Human Language Technologies
11-721	Grammars and Lexicons

Two of the following electives:

11-411	Natural Language Processing
11-617	LT in CALL
11-711	Algorithms for NLP
11-731	Machine Translation
11-741	Information Retrieval
11-751	Speech Recognition

11-752	Speech II
11-761	Language and Statistics
15-492	Speech Processing
15-493	Information Retrieval
80-180	The Nature of Language
80-280	Linguistic Analysis

A semester-long directed research project

More information on the required research project, and on the minor, can be found at http://www.lti.cs.cmu.edu/lti_minor.

Double-Counting Restriction

CS majors may use 15-482 as an elective for their CS major and also as a required course for the Language Technologies Minor. Courses in the Language Technologies Minor may not also be counted towards another SCS minor.

Robotics Minor

The following courses are required for the Minor in Robotics:

Prerequisites:

15-111	Intermediate/Advanced Programming (students with no prior programming experience take 15-100 & 15-111)
15-123	Effective Programming in C and UNIX

Minor requirements:

Both of the following courses:

15-384	Robotic Manipulation
16-311	Introduction to Robotics

One of the following courses:

16-299	Introduction to Feedback Control Systems
18-370	Fundamentals of Control
24-452	Feedback Control Systems

Two of the following electives:

15-381	Artificial Intelligence: Representation & Problem Solving
15-385	Computer Vision
15-462	Computer Graphics
15-463	Computational Photography
15-681	Artificial Intelligence: Machine Learning
16-284	Humanoids
16-362	Mobile Robot Programming Laboratory
16-721	Advanced Perception
16-735	Motion Planning
16-778	Mechatronic Design
60-422	Advanced ETB: Robotic Art Studio
85-213	Information Processing and Artificial Intelligence
85-370	Perception

More information on the minor can be found at http://www.ri.cmu.edu/education/ugrad_minor.html.

Double-Counting Restriction

Courses in the Robotics Minor may not also be counted towards another SCS minor.

Software Engineering Minor

The following courses are required for the Minor in Software Engineering:

Prerequisites

15-211	Fundamental Data Structures and Algorithms, <i>plus one of the following:</i>
15-212	Principles of Programming
15-213	Introduction to Computer Systems

Core Course Requirements

15-313	Foundations of Software Engineering
15-413	Software Engineering Practicum

Electives

1. One domain-independent course focused on technical software engineering material, and

15-414	Bug Catching: Automated Program Verification and Testing
17-606	Software Systems Security Engineering

17-619	Introduction to Real-Time Software and Systems
17-651	Models of Software Systems
17-652	Methods: Deciding What to Design
17-653	Managing Software Development (prerequisite: 15-413 or an internship)
17-654	Analysis of Software Artifacts
17-655	Architectures for Software Systems (prerequisite: 15-413 or an internship)

17-690

Seminar in Software Process
Other courses, with **prior** approval from the Director of the Software Engineering Masters Program.

2. One engineering-focused course with a significant software component, and

15-410	Operating System Design and Implementation
15-412	Operating System Practicum
15-437	Web Application Development
15-441	Computer Networks
15-540	Rapid Prototyping of Computer Systems
17-643	Hardware for Software Engineers
18-549	Embedded Systems Design
18-649	Distributed Embedded Systems
18-749	Fault-Tolerant Distributed Systems (not presently offered)

Other courses, with **prior** approval from the Director of the Software Engineering Masters Program.

3. One course that explores computer science problems related to existing and emerging technologies and their associated social, political, legal, business, and organizational contexts

05-801	Computer-Supported Cooperative Work
08-200	Ethical Dilemmas and Policy Issues in Computing
08-300	Constructing Appropriate Technology
08-531	Usable Privacy and Security
08-532	Law of Computer Technology
08-533	Privacy Policy, Law and Technology
08-781	Mobile and Pervasive Computing Services
08-782	Adaptive Trading Technologies
08-801	Dynamic Organizations and Networks
08-810	Computational Modeling of Complex Socio-Technical Systems
15-390	Entrepreneurship for Computer Science
15-391	Technology Consulting in the Community
15-421	Web Commerce, Security and Privacy
15-502	Technology for Global Development
19-402	Telecommunications, Technology Policy & Management
19-403	Policies of Wireless Systems and the Internet
70-311	Organizational Behavior
70-414	Technology Based Entrepreneurship for CIT
70-421	Entrepreneurship for Computer Scientists
70-459	Web Business Engineering
70-471	Logistics and Supply Chain Management
88-260	Organizations
88-341	Organizational Communication
88-343	Economics of Technological Change
88-393	Technology and Economic Growth

Required Internship and Reflection Course

A software engineering internship of a minimum of 8 full-time weeks in an industrial setting is required. The student must be integrated into a team and exposed to industry pressures. The intern may work in development, management, quality assurance, or other relevant positions. The director of the SE minor program has sole discretion in approving an internship experience based on these criteria. Students should confirm that an internship position is appropriate before accepting it, but internships that fulfill the criteria will also be accepted after the fact.

17-413 Internship Reflection (required 6 unit course, number to be determined, to be offered Fall semester):

Each student will write an issue-focused reflection and analysis of some personal software engineering experience, typically (but not always) based on the engineering internship above. This report must be passed by one SCS faculty member and one SE Ph.D. student, for both technical content and effective written communication. Initial course meetings will cover the reflective, writing, and speaking process. In later meetings, each student will present his or her experience through a 30-45 minute talk, which will be evaluated for communication skills and critical reflective content. This course is limited to enrollment of 16, and students who are admitted to the minor program are given first priority.

Double Counting Rule.

At most 2 of the courses used to fulfill the minor requirements may be counted towards any other major or minor program.

For more information, visit <http://www.cs.cmu.edu/~aldrich/se-minor/>

School of Computer Science (SCS)**Academic Standards and Actions****Grading Practices**

Grades given to record academic performance in SCS are detailed under Grading Practices on page 54 of the Undergraduate Catalog.

Dean's List

SCS recognizes each semester those undergraduates who have earned outstanding academic records by naming them to the Dean's List. The criterion for such recognition is a quality point average of at least 3.75 while completing a minimum of 36 factorable units and earning no incomplete grades.

Academic Actions

In the first year, quality point averages below 1.75 in either semester invoke an academic action. For all subsequent semesters an academic action will be taken if the semester quality point average or the cumulative quality point average (excluding the first year) is below 2.00.

Probation: The action of probation will be taken in the following cases:

1. One semester of the first year is below 1.75 QPA;
2. The semester QPA of a student in good standing beyond the first year falls below 2.00.

The term of probation is one semester as a full-time student. First year students are no longer on probation at the end of the second semester if the second semester's QPA is 1.75 or above. Students in the third or subsequent semester of study are no longer on probation at the end of one semester if the semester QPA and cumulative QPA (excluding the first year) are 2.00 or above.

Probation Continued: A student who has had one semester on probation and is not yet meeting minimum requirements but whose record indicates that the standards are likely to be met at the end of the next semester of study is occasionally continued on probation. This action is normally taken only when a student's semester QPA is above 2.0 but their cumulative QPA is not yet above 2.0.

Suspension: A student who does not meet minimum standards at the end of one semester of probation will be suspended.

- A first year student will be suspended if the QPA from each semester is below 1.75.
- A student on probation in the third or subsequent semester of study will be suspended if the semester QPA is below 2.00.

The minimum period of suspension is one academic year (two semesters). At the end of that period a student may return to school (on probation) by:

1. Receiving permission in writing from the assistant dean for undergraduate education,
2. Completing a Return from Leave form from the Registrar's Office, and
3. Providing transcripts and clearance forms if the student has been in a degree program at another college or university. Academic credit earned in such circumstances will not transfer back to Carnegie Mellon.

Students who have been suspended or have withdrawn are required to absent themselves from the campus (including residence halls and Greek houses) within a maximum of two days after the action and to remain off the campus for the duration of the time specified. This action includes debarment from part-time or summer courses at the university for the duration of the period of the action.

Although suspended students may not hold student jobs, students on academic suspension may, under certain circumstances, have a non-student job with the university. Students on disciplinary or administrative suspension may not.

Drop: This is a permanent severance. A student who has been suspended and who fails to meet minimum standards after returning to school is dropped.

Students who have been dropped are required to absent themselves from the campus (including residence halls and Greek houses) within a maximum of two days after the action.

The relation indicated above between probation, suspension and drop is normal, not binding. In unusual circumstances, the College Council may suspend or drop a student without prior probation.

Transfer into SCS

Undergraduate students admitted to colleges at CMU other than SCS and wishing to transfer into SCS during their first year should consult with the Assistant Dean for Undergraduate Education. In general, no undergraduate student will be considered for transfer until after having completed 15-211, Fundamental Data Structures and Algorithms. At that time, the decision to allow transfer will be made based on availability of space in the student's class and the student's academic performance.

Procedure for transfer of students from another university into SCS: A student first applies through the Office of Admission. If the Office of Admission believes the applicant is acceptable, the student's record is sent to SCS for evaluation. Extremely few external transfers are admitted.

Graduation Requirements

1. A requirement for graduation is the completion of the program specified for a degree with a cumulative quality point average of 2.00 or higher for all courses taken after the first year.
2. Students must be recommended for a degree by the faculty of SCS.
3. A candidate for the bachelor's degree must complete at the University a minimum of four semesters of full-time study, or the equivalent of part-time study, comprising at least 180 units of course work.
4. Students will be required to have met all financial obligations to the university before being awarded a degree.

Modification of Graduation Requirements: A student may seek permission to modify graduation requirements by petition to the SCS College Council.

Research and Teaching Faculty

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JONATHAN ALDRICH, Assistant Professor — Ph.D., University Of Washington; Carnegie Mellon, 2003—.

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- STEPHEN BROOKES, Professor — Ph.D., University College; Carnegie Mellon, 1981—.
- RALF BROWN, Senior Systems Scientist — Ph.D., Carnegie Mellon University; Carnegie Mellon, 1993—.
- BRETT BROWNING, Systems Scientist — Ph.D., University of Queensland; Carnegie Mellon, 2000—.
- RANDAL BRYANT, University Professor and Dean, School of Computer Science — Ph.D., Massachusetts Institute Of Technology; Carnegie Mellon, 1984—.
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- WILLIAM COHEN, Associate Research Professor — Ph.D., Rutgers University; Carnegie Mellon, 2003—.
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- DAVID ROOT, Associate Teaching Professor — M.P.M., Carnegie Mellon University; Carnegie Mellon, 2002—.
- CAROLYN ROSE, Assistant Professor — Ph.D., Carnegie Mellon University; Carnegie Mellon, 2003—.
- RONALD ROSENFELD, Professor — Ph.D., Carnegie Mellon University; Carnegie Mellon, 1995—.
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- BRADLEY SCHMERL, Senior Systems Scientist — Ph.D., Flinders University of South Australia; Carnegie Mellon, 2000—.
- JEFF SCHNEIDER, Associate Research Professor — Ph.D., University of Rochester; Carnegie Mellon, 1995—.
- TANJA SCHULTZ, Research Scientist — Ph.D., University of Karlsruhe; Carnegie Mellon, 2001—.
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- DANIEL SIEWIOREK, Buhl Professor, Director Human Computer Interaction Institute — Ph.D., Stanford University; Carnegie Mellon, 1972—.
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