School of Computer Science

Martial Hebert, Dean
Thomas Cortina, Associate Dean for Undergraduate Programs
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Location: GHC 4115
www.cs.cmu.edu/undergraduate-programs (http://www.cs.cmu.edu/undergraduate-programs/)

Carnegie Mellon founded one of the first Computer Science departments in the world in 1965. As research and teaching in computing grew at a tremendous pace at Carnegie Mellon, the university formed the School of Computer Science (SCS) at the end of 1968. Carnegie Mellon was one of the first universities to elevate Computer Science into its own academic college at the same level as the Mellon College of Science and the College of Engineering. Today, SCS consists of seven departments and institutes, including the Computer Science Department that started it all, along with the Computational Biology Department, the Human-Computer Interaction Institute, the Language Technologies Institute, the Machine Learning Department, the Robotics Institute and the Software and Societal Systems Department (formerly the Institute for Software Research). Together, these units make SCS a world leader in research and education. Over the last six years, SCS has launched four new primary undergraduate majors in Computational Biology, Artificial Intelligence (the first of its kind in the United States), Human-Computer Interaction, and Robotics. This year, we will launch a new primary major in Robotics. These new majors, along with the highly-ranked Computer Science major, give students in SCS distinct paths in the field of computing with ample opportunities in industry and advanced research.

The School of Computer Science offers the following majors and minors:

- B.S. in Artificial Intelligence
- B.S. in Computational Biology
- B.S. in Computer Science
- B.S. in Human-Computer Interaction
- B.S. in Robotics
- Bachelor's in Computer Science and Art (joint with the College of Fine Arts)
- Additional major in Artificial Intelligence
- Additional major in Computational Biology
- Additional major in Computer Science
- Additional major in Human-Computer Interaction (Interdisciplinary)
- Additional major in Robotics
- Minor in Artificial Intelligence
- Minor in Computational Biology
- Minor in Computer Science
- Minor in Human-Computer Interaction
- Minor in Information Security, Privacy and Policy
- Minor in Language Technologies
- Minor in Machine Learning
- Minor in Neural Computation
- Minor in Robotics
- Minor in Software Engineering

Information for these majors and minors can be found through the navigation menu or through the links below:

- Artificial Intelligence (http://coursecatalog.web.cmu.edu/schools-colleges/schoolofcomputerscience/artificialintelligence/) (B.S. degree, additional major, minor)
- Computational Biology (http://coursecatalog.web.cmu.edu/schools-colleges/schoolofcomputerscience/undergraduatecomputationalbiology/) (B.S. degree, additional major, minor)
- Computer Science (http://coursecatalog.web.cmu.edu/schools-colleges/schoolofcomputerscience/undergraduatecomputerscience/) (B.S. degree, additional major, minor)
- Human-Computer Interaction (http://coursecatalog.web.cmu.edu/schools-colleges/schoolofcomputerscience/humancomputerinteractionprogram/) (B.S. degree, additional interdisciplinary major, minor)
- Robotics (http://coursecatalog.web.cmu.edu/schools-colleges/schoolofcomputerscience/robotics/) (B.S. degree, additional major, minor)
- SCS additional majors and minors (http://coursecatalog.web.cmu.edu/schools-colleges/schoolofcomputerscience/addmajorsminors/)

Students who apply to, and are directly admitted into, the School of Computer Science can choose between five primary majors: Artificial Intelligence, Computational Biology, Computer Science, Human-Computer Interaction and Robotics. Students with artistic and computing interests may be given the option to pursue a major in Computer Science and Art. 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 grades in specific requirements are sufficiently high and space is available. Consult the program websites for specific requirements for transfer requests. Computation-oriented programs are also available within the Mellon College of Science, the Dietrich College of Humanities and Social Sciences, the College of Engineering and the College of Fine Arts.

Policies & Procedures

Academic Standards and Actions

Grading Practices
Grades given to record academic performance in SCS are detailed under Grading Practices at Undergraduate Academic Regulations (http://coursecatalog.web.cmu.edu/aboutcmu/undergraduatedegreeandcertifications/).

Dean’s List WITH HIGH HONORS
SCS recognizes each semester those undergraduates who have earned outstanding academic records by naming them to the Dean’s List with High Honors. The criterion for such recognition is a semester 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 based on GPA:
1. One semester of the first year is below 1.75 GPA;
2. The semester GPA 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 GPA and the cumulative GPA 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 GPA and cumulative GPA (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 may be continued on probation, based on advisor recommendation. This action is normally taken only when a student's semester GPA is above 2.0 but their cumulative GPA is not yet above 2.0.

Suspension: A student who does not meet minimum standards based on GPA at the end of one semester of probation can be suspended:

- A first year student will be suspended if the GPA 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 GPA is below 2.00.

The minimum period of suspension is one academic year (two non-summer semesters). Suspension is meant to allow a student to take a pause from their academic studies to address the issues that are causing poor academic performance. At the end of that period a student may return to campus (on probation) by:

1. completing a Return from Leave form from the HUB and submitting this form to their academic advisor, and
2. submitting an additional written statement to their academic advisor and the SCS Associate Dean for Undergraduate Programs, minimum one page, that outlines what the student did while on leave to address the issues that led to the suspension and that would indicate future success on return, and
3. (optional) submitting up to two letters of support from individuals supporting the student's return to the academic advisor and the SCS Associate Dean for Undergraduate Programs.

Upon review by the student's academic advisor and the Associate Dean for Undergraduate Programs, in consultation with the Office of Student Affairs and the Office of International Education as appropriate, the student may be approved to continue their studies.

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. Students who have been suspended and who fail to meet minimum standards in the subsequent semester(s) after they return to school on probation will be dropped from the School of Computer Science. Students who have been dropped and are not admitted to another program at the university are required to absent themselves from the campus (including residence halls and Greek houses) within a maximum of two days after the action.

Appeal: Students may appeal a suspension or drop decision in writing within 10 business days of notification if, under consultation with their academic advisor, they feel that the decision was made in error and they have additional information that would indicate that they can proceed in the next step of their academic status. Instructions on the appeal process are given in the suspension letter that is sent to the student.

Other Actions: In addition to academic actions based on QPA, the Associate Dean for Undergraduate Programs may place students on probation, subsequent suspension or drop, if they do not demonstrate reasonable progress through the core curriculum of their major (e.g., not completing a core class after 3 attempts, not completing the required 100-level core courses by the end of the sophomore year, etc.). Students are encouraged to consult with their academic advisor about any concerns with regard to lack of progress in their chosen SCS major to determine if any course drop or withdrawal will lead to an action.

The relation indicated above between probation, suspension and drop is nominal. In unusual circumstances, SCS College Council may suspend or drop a student without prior probation.

Leave of Absence and Return from Leave of Absence

SCS undergraduate students may elect to take a leave of absence for a variety of reasons, after consultation with their academic advisor. Students who wish to take a leave of absence must do so by the last day of classes before final exams begin and before final grades are posted (in case this is earlier). Students requesting a leave of absence must complete a form from the HUB and have this signed by their academic advisor and SCS Associate Dean for Undergraduate Programs. Students who take a leave of absence up to the last day to drop classes will have all of their classes dropped. Students who take a leave of absence after the last day to drop classes will be assigned a grade of W (withdrawal) for all of their classes.

Students returning from a leave of absence are required to submit a Return from Leave of Absence form to their academic advisor for approval by the student's academic advisor and the SCS Associate Dean for Undergraduate Programs. In addition, for students taking a leave for academic reasons, the student must also supply a letter that explains the reason for the leave, the actions that were performed during the leave to prepare the student for a successful return, and a description of the on-campus resources, if required, that would be used by the student in order to increase the likelihood of success. Students returning from a leave are also encouraged to provide up to two letters of support from people close to the student (e.g. family, friends, clergy, teachers, coaches, others as appropriate). Requests to return are reviewed by the student’s academic advisor, the Associate Dean and the Student Affairs liaison to determine eligibility and any resources that need to be put into place to assist the student upon return. Contact the SCS Undergraduate Office (GHC 4115) for more information.

Internal Transfer within SCS

First year students admitted to SCS are considered undeclared during their first year. These students declare their SCS major in the middle of the second semester of their first year of study. Students who wish to transfer from one SCS major to another SCS major may do so by applying for transfer by mid-semester break during the semester the transfer is desired (or the end of the summer session for summer transfers). These students should consult with their academic advisor and the program director of the intended major for more information about specific course requirements and academic plans. Internal SCS transfers do not have any grade requirements. Transfers are approved based on demonstrated interest, ability, and available space in the intended major. Consult the website for the individual SCS major for more information about expected courses to take to demonstrate interest and ability. The transfer request form is available on the SCS website.

Transfer into SCS / Dual-Degree

Undergraduate students admitted to colleges at CMU other than SCS and wishing to transfer to SCS or pursue a dual degree in SCS should consult with the Director or Program Coordinator of the desired SCS major during their first year. See the individual program pages for the names of the current directors and program coordinators, along with their contact information.

• For the Artificial Intelligence primary major, students must complete 15-222, 15-251, 15-351, 15-352, 15-391, 15-392, and 15-393, with an expected overall QPA of at least 3.0, in order to be considered for transfer or dual degree.

• For the Computational Biology primary major, students must complete 21-127 (or equivalent), 15-122, 15-251, 15-351 (or 15-210), 15-225, 15-250 with an expected overall QPA of at least 3.0, in order to be considered for transfer or dual degree.

• For the Computer Science program primary major, students must complete 21-127 (or equivalent), 15-122, 15-251, 15-210, 15-213, 15-251 with an expected overall QPA of at least 3.0, in order to be considered for transfer or dual degree.

• For the Human-Computer Interaction primary major, students must complete 21-127 (or equivalent), 15-122, 15-251, 15-351, 15-210 and 15-213, and one of 21-325, 21-352, 21-355, 21-356, 21-357, or 21-358, with an expected overall QPA of at least 3.0, in order to be considered for transfer or dual degree.

• For the Robotics primary major, students must complete 21-127 (or equivalent), 15-122, 15-213, 15-251, one of the following robotics courses: 16-211, 16-299, 16-311 (or Robot Building when launched), and one of 21-325, 21-352, 21-356, 21-359, with an expected overall QPA over these six courses of 3.6 or higher and an overall QPA of at least 3.0, in order to be considered for transfer or dual degree.

Students may apply for transfer by the start of the mid-semester break in the semester when the final course(s) of the six required courses will be completed (or the end of the summer session for summer transfer requests). In the case of course(s) in progress, the mid-semester grades will be used in the QPA calculation. The decision to allow transfer or dual degree will be made by committee based on the student's academic performance (in the specified courses and in their courses overall if necessary), academic involvement in SCS and other computing-related activities, and availability of space in the student's class level. Students should consult the SCS Undergraduate Office for complete information concerning minimum requirements, instructions and deadlines.

External Transfer

A student currently enrolled at another university or college who wishes to transfer to SCS should first apply through the Office of Admission. If the Office of Admission believes the applicant meets admission guidelines, the student's record is sent to SCS for evaluation. Admission is based on seat availability, overall academic performance and course rigor from the student's current institution, ability to complete the rigorous SCS program on time, and the application material including recommendations and a letter of recommendation. It is important to note that extremely few external transfers are admitted to the SCS program at Carnegie Mellon University due to space limitations.

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 at CMU. Students who start their undergraduate study at CMU may meet this requirement without the first year of study, if necessary.

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.

A student who does not meet the QPA requirement above must petition SCS College Council for a waiver of the first requirement.

General Education Requirements

All undergraduate degrees in the School of Computer Science include depth in their particular field of study but also breadth through the general education requirements. General education requirements are part of SCS degrees to give students an opportunity to learn more about the world from scientific and humanistic points of view. These additional skills are useful for graduates since computing is often embedded in domains that are not entirely within the bounds of computing. SCS students will need to use their computing skills to solve problems alongside scientists and engineers, artists, social and cognitive scientists, historians, linguists, economists and business experts, and SCS students will need to communicate effectively and
understand the ethical implications of their work. The general education requirements help SCS students gain this broad perspective so they can work well in a wide variety of domains.

Science and Engineering

All candidates for a B.S. degree in the School of Computer Science must complete a minimum of 36 units offered by the Mellon College of Science and/or the College of Engineering (CIT).

Computational Biology majors

For Computational Biology majors, consult the Computational Biology (http://coursescatalog.web.cmu.edu/schools-colleges/schoolofcomputerscience/undergraduatecomputationalbiology/) program page for specific science and engineering requirements. The required science and engineering courses for the Computational Biology major also satisfy the General Education requirement for SCS by default.

Artificial Intelligence, Computer Science and Human-Computer Interaction majors

For Artificial Intelligence, Computer Science and Human-Computer Interaction majors, four courses in science and engineering are required, 9 units or more for each course, at least one course must have a laboratory component and at least two courses must be from the same department. Consult with your SCS undergraduate advisor for possible use of any mini course for this requirement which needs to be reviewed by your advisor and the SCS Associate Dean for Undergraduate Programs.

Non-lab courses that are usually taken by AI, CS and HCI majors to satisfy this requirement are given in the list below. (Consult your academic advisor for additional choices available each semester.)

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>02-223</td>
<td>Personalized Medicine: Understanding Your Own Genome</td>
<td>9</td>
</tr>
<tr>
<td>03-121</td>
<td>Modern Biology</td>
<td>9</td>
</tr>
<tr>
<td>03-125</td>
<td>Evolution</td>
<td>9</td>
</tr>
<tr>
<td>03-132</td>
<td>Basic Science to Modern Medicine</td>
<td>9</td>
</tr>
<tr>
<td>03-133</td>
<td>Neurobiology of Disease</td>
<td>9</td>
</tr>
<tr>
<td>06-100</td>
<td>Introduction to Chemical Engineering</td>
<td>12</td>
</tr>
<tr>
<td>09-105</td>
<td>Introduction to Modern Chemistry I</td>
<td>10</td>
</tr>
<tr>
<td>09-106</td>
<td>Modern Chemistry II</td>
<td>10</td>
</tr>
<tr>
<td>09-217</td>
<td>Organic Chemistry I</td>
<td>9</td>
</tr>
<tr>
<td>09-218</td>
<td>Organic Chemistry II</td>
<td>9</td>
</tr>
<tr>
<td>09-225</td>
<td>Climate Change: Chemistry, Physics and Planetary Science</td>
<td>9</td>
</tr>
<tr>
<td>12-100</td>
<td>Exploring CEE: Infrastructure and Environment in a Changing World</td>
<td>12</td>
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<tr>
<td>12-201</td>
<td>Geology</td>
<td>9</td>
</tr>
<tr>
<td>18-095</td>
<td>Getting Started in Electronics: An Experiential Approach</td>
<td>9</td>
</tr>
<tr>
<td>18-100</td>
<td>Introduction to Electrical and Computer Engineering</td>
<td>12</td>
</tr>
<tr>
<td>18-220</td>
<td>Electronic Devices and Analog Circuits</td>
<td>12</td>
</tr>
<tr>
<td>18-240</td>
<td>Structure and Design of Digital Systems</td>
<td>12</td>
</tr>
<tr>
<td>24-101</td>
<td>Fundamentals of Mechanical Engineering</td>
<td>12</td>
</tr>
<tr>
<td>24-231</td>
<td>Fluid Mechanics</td>
<td>10</td>
</tr>
<tr>
<td>24-261</td>
<td>Mechanics I: 2D Design</td>
<td>10</td>
</tr>
<tr>
<td>24-291-24-381</td>
<td>Environmental Systems on a Changing Planet - Environmental Systems on a Changing Planet: Science Engineering Addendum (must take both courses together)</td>
<td>12</td>
</tr>
<tr>
<td>24-351</td>
<td>Dynamics</td>
<td>10</td>
</tr>
<tr>
<td>24-358</td>
<td>Culinary Mechanics</td>
<td>9</td>
</tr>
<tr>
<td>27-215</td>
<td>Thermodynamics of Materials</td>
<td>12</td>
</tr>
<tr>
<td>33-114</td>
<td>Physics of Musical Sound</td>
<td>9</td>
</tr>
<tr>
<td>33-120</td>
<td>Science and Science Fiction</td>
<td>9</td>
</tr>
<tr>
<td>33-121</td>
<td>Physics I for Science Students</td>
<td>12</td>
</tr>
<tr>
<td>or 33-141</td>
<td>Physics I for Engineering Students</td>
<td>12</td>
</tr>
<tr>
<td>or 33-151</td>
<td>Matter and Interactions I</td>
<td>12</td>
</tr>
<tr>
<td>33-142</td>
<td>Physics II for Engineering and Physics Students</td>
<td>12</td>
</tr>
<tr>
<td>or 33-152</td>
<td>Matter and Interactions II</td>
<td>12</td>
</tr>
<tr>
<td>33-224</td>
<td>Stars, Galaxies and the Universe</td>
<td>9</td>
</tr>
<tr>
<td>33-226</td>
<td>Physics of Energy</td>
<td>9</td>
</tr>
<tr>
<td>42-101</td>
<td>Introduction to Biomedical Engineering</td>
<td>12</td>
</tr>
<tr>
<td>42-202</td>
<td>Physiology</td>
<td>9</td>
</tr>
<tr>
<td>85-219</td>
<td>Foundations of Brain Behavior</td>
<td>9</td>
</tr>
</tbody>
</table>

At present, courses meeting the lab requirement include:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
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</thead>
<tbody>
<tr>
<td>02-261</td>
<td>Quantitative Cell and Molecular Biology Laboratory</td>
<td>9</td>
</tr>
<tr>
<td>02-262</td>
<td>Computation and Biology Integrated Research Lab</td>
<td>Var.</td>
</tr>
<tr>
<td>03-124</td>
<td>Modern Biology Laboratory</td>
<td>9</td>
</tr>
<tr>
<td>09-101</td>
<td>Introduction to Experimental Chemistry</td>
<td>3</td>
</tr>
<tr>
<td>09-221</td>
<td>Laboratory I: Introduction to Chemical Analysis</td>
<td>12</td>
</tr>
<tr>
<td>27-100</td>
<td>Engineering the Materials of the Future</td>
<td>12</td>
</tr>
<tr>
<td>33-104</td>
<td>Experimental Physics</td>
<td>9</td>
</tr>
<tr>
<td>33-228</td>
<td>Electronics I</td>
<td>10</td>
</tr>
<tr>
<td>42-203</td>
<td>Biomedical Engineering Laboratory</td>
<td>9</td>
</tr>
<tr>
<td>85-310</td>
<td>Research Methods in Cognitive Psychology</td>
<td>9</td>
</tr>
<tr>
<td>85-314</td>
<td>Cognitive Neuroscience Research Methods</td>
<td>9</td>
</tr>
</tbody>
</table>

The following MCS and CIT courses cannot be used to satisfy the Science and Engineering requirement (see note below this list for additional exceptions and conditions):

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>03-511</td>
<td>Computational Molecular Biology and Genomics</td>
<td>9</td>
</tr>
<tr>
<td>04-330</td>
<td>Fundamentals of Software Development and Problem Solving</td>
<td>12</td>
</tr>
<tr>
<td>06-262</td>
<td>Mathematical Methods of Chemical Engineering</td>
<td>12</td>
</tr>
<tr>
<td>09-103</td>
<td>Atoms, Molecules and Chemical Change</td>
<td>9</td>
</tr>
<tr>
<td>09-108</td>
<td>The Illusion and Magic of Food</td>
<td>6</td>
</tr>
<tr>
<td>09-109</td>
<td>Kitchen Chemistry Sessions</td>
<td>3</td>
</tr>
<tr>
<td>09-110</td>
<td>The Design and Making of Skin and Hair Products</td>
<td>3</td>
</tr>
<tr>
<td>09-114</td>
<td>Basics of Food Science</td>
<td>3</td>
</tr>
<tr>
<td>09-204</td>
<td>Professional Communication Skills in Chemistry</td>
<td>3</td>
</tr>
<tr>
<td>09-209</td>
<td>Kitchen Chemistry Sessions</td>
<td>3</td>
</tr>
<tr>
<td>09-231</td>
<td>Mathematical Methods for Chemists</td>
<td>9</td>
</tr>
<tr>
<td>12-215</td>
<td>Introduction to Professional Writing in CEE</td>
<td>9</td>
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<tr>
<td>12-271</td>
<td>Computation and Data Science for Civil &amp; Environmental Engineering</td>
<td>9</td>
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<tr>
<td>18-090</td>
<td>Twisted Signals: Multimedia Processing for the Arts</td>
<td>10</td>
</tr>
<tr>
<td>18-200</td>
<td>ECE Sophomore Seminar</td>
<td>1</td>
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<tr>
<td>18-202</td>
<td>Mathematical Foundations of Electrical Engineering</td>
<td>12</td>
</tr>
<tr>
<td>18-213</td>
<td>Introduction to Computer Systems</td>
<td>12</td>
</tr>
<tr>
<td>18-330</td>
<td>Introduction to Computer Security</td>
<td>12</td>
</tr>
<tr>
<td>18-334</td>
<td>Network Security</td>
<td>12</td>
</tr>
<tr>
<td>18-335</td>
<td>Secure Software Systems</td>
<td>12</td>
</tr>
<tr>
<td>18-411</td>
<td>Computational Techniques for Data Science and Engineering</td>
<td>12</td>
</tr>
<tr>
<td>18-441</td>
<td>Computer Networks</td>
<td>12</td>
</tr>
<tr>
<td>18-460</td>
<td>Optimization</td>
<td>12</td>
</tr>
<tr>
<td>18-461</td>
<td>Introduction to Machine Learning for Engineers</td>
<td>12</td>
</tr>
<tr>
<td>18-462</td>
<td>Principles and Engineering Applications of AI</td>
<td>12</td>
</tr>
<tr>
<td>18-465</td>
<td>Advanced Probability &amp; Statistics for Engineers</td>
<td>12</td>
</tr>
<tr>
<td>18-482</td>
<td>Telecommunications Technology and Policy for the Internet</td>
<td>12</td>
</tr>
<tr>
<td>18-487</td>
<td>Introduction to Computer Security</td>
<td>12</td>
</tr>
<tr>
<td>18-540</td>
<td>Rapid Prototyping of Computer Systems</td>
<td>12</td>
</tr>
<tr>
<td>19-101</td>
<td>Introduction to Engineering and Public Policy</td>
<td>12</td>
</tr>
<tr>
<td>19-211</td>
<td>Ethics and Policy Issues in Computing</td>
<td>9</td>
</tr>
<tr>
<td>or 17-200</td>
<td></td>
<td></td>
</tr>
<tr>
<td>19-213</td>
<td>The American Railroad: Decline and Renaissance in the Age of Deregulation</td>
<td>6</td>
</tr>
<tr>
<td>19-301</td>
<td>Decision Making Methods for Engineers and Scientists</td>
<td>9</td>
</tr>
<tr>
<td>19-303</td>
<td>Cryptocurrencies, Blockchains and Applications</td>
<td>9</td>
</tr>
<tr>
<td>19-351</td>
<td>Applied Methods for Technology-Policy Analysis</td>
<td>9</td>
</tr>
<tr>
<td>19-402</td>
<td>Telecommunications Technology and Policy for the Internet</td>
<td>12</td>
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<tr>
<td>19-403</td>
<td>Policies of Wireless Systems</td>
<td>12</td>
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<tr>
<td>19-411</td>
<td>Science and Innovation Leadership for the 21st Century: Firms, Nations, and Tech</td>
<td>9</td>
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</table>
19-421  Emerging Energy Policies
19-425  Sustainable Energy for the Developing World
19-433  Data Science for Technology, Innovation and Policy
19-534  Usable Privacy and Security
19-608  Privacy Policy, Law, and Technology
24-281  Introduction to Scientific Computing
24-311  Numerical Methods
27-410  Computational Techniques in Engineering
33-100  Basic Experimental Physics
33-115  Physics for Future Presidents
33-124  Introduction to Astronomy
33-232  Mathematical Methods of Physics
42-201  Professional Issues in Biomedical Engineering
49-300  Integrated Product Conceptualization

All Electrical and Computer Engineering graduate courses [18-6xx, 18-7xx, 18-8xx, 18-9xx] cannot be used for this requirement. Students interested in Engineering & Public Policy (19-xxx) courses that are not excluded above, including special topics courses, must consult with their SCS undergraduate advisor and the SCS Associate Dean for Undergraduate Programs to determine suitability for this requirement. In general, any MCS or CIT courses that are cross-listed with SCS courses or have significant mathematical or computational content cannot be used for this requirement. Students must consult with an SCS undergraduate advisor about any course to be used for the Science and Engineering requirement before registration.

Humanities and Arts

All candidates for a B.S. degree in the School of Computer Science must complete a minimum of 63 units offered by the College of Humanities & Social Sciences and/or the College of Fine Arts as prescribed below. Students pursuing a Bachelor's in Computer Science and Art (http://coursescatalog.web.cmu.edu/intercollegeprograms/bxaintercollege/#bcsacurriculumtext) should consult the general education requirements for that program.

A. Freshman Writing Requirement (9 units)

Complete one of the following writing options for 9 units:
76-101  Interpretation and Argument 9
76-102  Advanced First Year Writing: Special Topics (by invitation only) 9
or two of these three writing minis for 9 units total:
76-106  Writing about Literature, Art and Culture 4.5
76-107  Writing about Data 4.5
76-108  Writing about Public Problems 4.5

B. Breadth Requirement (minimum 27 units; 9 units each)

Complete three courses, one each from Category 1, Category 2, and Category 3. Students may use two minis totaling 9 units or more to satisfy one of the categories, with permission of the Associate Dean for Undergraduate Education, if the minis meet the goals of the desired category. NOTE: Artificial Intelligence majors replace Category 1 with Category 1A: Cognitive Studies which is a subset of Category 1.

Category 1 (for all SCS majors except Artificial Intelligence):
Cognition, Choice and Behavior - this requirement explores the process of thinking, decision making, and behavior in the context of the individual.
70-311  Organizational Behavior 9
70-318  Managing Effective Work Teams 9
80-101  Dangerous Ideas in Science and Society 9
80-130  Introduction to Ethics 9
80-150  Nature of Reason 9
80-180  Nature of Language 9
80-221  Philosophy of Social Science 9
80-270  Problems of Mind and Body: Meaning and Doing 9
80-271  Mind and Body: The Objective and the Subjective 9
80-275  Metaphysics 9
80-330  Ethical Theory 9
85-102  Introduction to Psychology 9
85-104  Psychopathology 9
85-211  Cognitive Psychology 9
85-213  Human Information Processing and Artificial Intelligence 9
85-221  Principles of Child Development 9
85-241  Social Psychology 9
85-251  Personality 9
85-261  Psychopathology 9
85-370  Perception 9
85-408  Visual Cognition 9
85-421  Language and Thought 9
88-120  Reason, Passion and Cognition 9
88-230  Human Intelligence and Human Stupidity 9

Category 1A (for Artificial Intelligence majors): Cognitive Studies - this requirement explores how the brain and the mind work.
85-211  Cognitive Psychology 9
85-213  Human Information Processing and Artificial Intelligence 9
85-370  Perception 9
85-408  Visual Cognition 9
85-421  Language and Thought 9

Category 2 (all SCS majors): Economic, Political and Social Institutions - this requirement explores the processes by which institutions organize individual preferences and actions into collective outcomes.
19-101  Introduction to Engineering and Public Policy 12
36-503  Sampling, Survey and Society 9
66-221  Topics of Law: Introduction to Intellectual Property Law 9
70-332  Business, Society and Ethics 9
73-102  Principles of Microeconomics 9
73-103  Principles of Macroeconomics 9
73-230  Intermediate Microeconomics 9
73-240  Intermediate Macroeconomics 9
76-425  Rhetoric, Science, and the Public Sphere 9
79-101  Making History: How to Think About the Past (and Present) 9
79-189  Democracy and History: Thinking Beyond the Self 9
79-237  Comparative Slavery 9
79-244  Women in American History 9
79-253  Imperialism and Decolonization in South Asia 9
79-300  History of American Public Policy 9
79-320  Women, Politics, and Protest 9
79-321  Documenting Human Rights 9
79-331  Body Politics: Women and Health in America 9
79-370  Technology in the United States 9
79-383  The History of Capitalism 9
79-391  Nations and Nationalisms in South Asia 9
79-392  Europe and the Islamic World 9
80-135  Introduction to Political Philosophy 9
80-136  Social Structure, Public Policy & Ethics 9
80-244  Environmental Ethics 9
80-245  Medical Ethics 9
80-324  Philosophy of Economics 9
80-335  Social and Political Philosophy 9
80-334  Social and Political Philosophy 9
80-348  Health, Human Rights, and International Development 9
84-104  Decision Processes in American Political Institutions 9
84-110  Foundations of Political Economy 9
84-275  Comparative Politics 9
84-310  International Political Economy 9
84-322  Nonviolent Conflict and Revolution 9
84-324  The Future of Democracy 9
84-352  Representation and Voting Rights 9
84-362  Diplomacy and Statecraft 9
84-365  The Politics of Fake News and Misinformation 9
84-380  US Grand Strategy 9
84-386  The Privatization of Force 9
84-387  Remote Systems and the Cyber Domain in Conflict 9
84-389  Terrorism and Insurgency 9
84-390  Social Media, Technology, and Conflict 9
84-393  Legislative Decision Making: US Congress 9
84-402  Judicial Politics and Behavior 9
84-405  The Future of Warfare 9
88-281  Topics in Law: 1st Amendment 9
88-284  Topics of Law: The Bill of Rights 9
Cultural Analysis - this requirement seeks to recognize cultures that have shaped and continue to shape the human experience; courses in this category are usually either broad in place, time, or cultural diversity.

48-240 History of World Architecture, I 9
48-241 History of Modern Architecture 9
57-173 Survey of Western Music History 9
60-105 Cultural History of the Visual Arts 9
60-106 Cultural History of the Visual Arts - the Modern Period 9
62-371 Photography, The First 100 Years, 1839-1939 9
70-342 Managing Across Cultures 9
70-343 Cross-Cultural Business Communications 9
76-221 Books You Should Have Read By Now 9
76-239 Introduction to Film Studies 9
76-241 Introduction to Gender Studies 9
76-243 Introduction to Television 9
79-145 Genocide and Weapons of Mass Destruction 9
79-201 Introduction to Anthropology 9
79-202 Flesh and Spirit: Early Modern Europe, 1400-1750 9
79-223 Mexico: From the Aztec Empire to the Drug War 9
79-226 African History: Earliest Times to 1780 9
79-229 The Origins of the Palestinian-Israeli Conflict, 1880-1948 9
79-230 The Arab-Israeli Conflict and Peace Process since 1948 9
79-234 Technology and Society 9
79-240 Development of American Culture 9
79-241 African American History: Africa to the Civil War 9
79-242 African American History: Reconstruction to the Present 9
79-245 Capitalism and Individualism in American Culture 9
79-248 U.S. Constitution & the Presidency 9
79-261 The Last Emperors: Chinese History and Society, 1600-1900 9
79-262 Modern China: From the Birth of Mao ... to Now 9
79-265 Russian History: Game of Thrones 9
79-281 Introduction to Religion 9
79-282 Europe and the World Since 1800 9
79-288 Bananas, Baseball, and Borders: Latin America and the United States 9
79-316 Photography, the First 100 Years, 1839-1939 9
79-345 Roots of Rock & Roll 9
79-350 Early Christianity 9
76-386 Language & Culture 9
79-104 Global Histories 9
79-293 Inward Odyssey 9
79-378 Gender in South Asia 9
79-393 Institutions of the Roman Church 9
79-395 The Arts in Pittsburgh 9
79-396 Music, Art, and Society in 19th and 20th Century Europe and the U.S. 9
79-465 The Arts in Qatar 9
80-100 Introduction to Philosophy 9
80-250 Ancient Philosophy 9
80-251 Modern Philosophy 9
80-253 Continental Philosophy 9
80-254 Analytic Philosophy 9
80-255 Pragmatism: Making Ideas Work 9
80-261 Experience, Reason, and Truth 9
80-276 Philosophy of Religion 9
82-267 Beyond the Mafia and Michelangelo 9
82-273 Introduction to Japanese Language and Culture 9
82-279 Anime - Visual Interplay between Japan and the World 9
82-280 Bilingual & Bicultural Experiences in the US 9
82-286 Cultural Complexities 9
82-293 Russian Cinema: From the Bolshevik Revolution to Putin's Russia 9
82-294 19th Century Russian Masterpieces 9
82-303 French & Francophone Cultures 9
82-304 French & Francophone Sociolinguistics 9
82-313 Topics in Modern Arabic Language, Literature and Culture 9
82-314 Literature of the Arabic-speaking World 9
82-327 The Emergence of the German Speaking World 9
82-333 Chinese Language and Culture 9
82-342 Spain: Language and Culture 9
82-343 Latin America Language and Culture 9
82-344 U.S. Latinos: Language and Culture 9
82-345 Introduction to Hispanic Literary and Cultural Studies 9
82-436 Introduction to Classical Chinese 9

C. Humanities and Arts Electives (minimum 27 units)

Complete 3 non-technical courses of at least 9 units each from any of the departments in the Dietrich College of Humanities & Social Sciences or the College of Fine Arts. Some of the courses taught in these units are considered technical courses and may not be used to satisfy this requirement (see Deletions below). Additionally, a select set of courses from Business Administration and from Environmental and Public Policy can also count for this requirement (see Additions below). Students may combine humanities/arts courses with lower units together to form a single course of 9 units or more. Students are encouraged, but not required, to take courses from different departments to gain additional breadth and to create new opportunities for engagement with the university community.

Deletions

Some courses from the Dietrich College or the College of Fine Arts may not count toward the unconstrained electives in Humanities and Arts in SCS due to the technical (computing and/or mathematical) nature of the courses. Courses from the following departments do not count toward the unconstrained Humanities and Arts electives:

• Statistics and Data Science (36), except 36-303 Sampling, Survey and Society
• Information Systems (67)
• Economics (73), except 73-102 Principles of Microeconomics and 73-103 Principles of Macroeconomics

Additionally, the following courses do NOT count toward the unconstrained Humanities and Arts electives:

51-257 Introduction to Computing for Creative Practices 10
51-327 Design Center: Introduction to Web Design 9
51-328 Design Center: Design for Digital Systems 9
76-388 Coding for Humansists 9
76-481 Introduction to Multimedia Design 12
76-487 Web Design 12
80-210 Logic and Proofs 9
80-211 Logic and Mathematical Inquiry 9
80-212 Arguments and Logical Analysis 9
80-305 Game Theory 9
80-310 Formal Logic 9
80-311 Undecidability and Incompleteness 9
80-315 Modal Logic 9
80-316 Logic and AI 9
80-325 Foundations of Causation and Machine Learning 9
80-405 Game Theory 9
80-411 Proof Theory 9
80-413 Category Theory 9
80-419 Interactive Theorem Proving 9
80-514 Categorical Logic 9
80-521 Seminar on Formal Epistemology: Belief and Evidence Var.
85-219 Foundations of Brain and Behavior 9
85-310 Research Methods in Cognitive Psychology 9
85-314 Cognitive Neuroscience Research Methods 9
85-414 Cognitive Neuropsychology 9
85-426 Learning in Humans and Machines 9
88-251 Empirical Research Methods 9
88-372 Social and Emotional Brain 9

Additions

The following courses outside of Dietrich College and the College of Fine Arts may count toward the unconstrained Humanities and Arts electives:

16-161 ROB Freshman Seminar: Artificial Intelligence and Humanity 9
16-397 Art, Conflict and Technology 12
Honors Research Thesis

Students considering going on to graduate school in Computer Science or related disciplines should take a wide variety of Computer Science and Mathematics courses, as well as consider getting involved in independent research as early as possible. This would be no later than the junior year and can begin even earlier. Students interested in graduate school in computer science or its related areas are strongly encouraged to participate in the SCS Honors Undergraduate Research Thesis program. Additionally, graduate CS courses can be taken with permission of the instructor and in consultation with an academic advisor.

The goal of the SCS Honors Undergraduate Research Thesis Program is to introduce students to the breadth of tasks involved in independent research, including library work, problem formulation, experimentation, analysis, technical writing and public speaking. In particular, students write a short paper summarizing prior results and current progress in their desired area of research, present a poster session in December of their senior year describing their current progress, present their final results with a poster and an oral presentation in the year-end university-wide Undergraduate Research Symposium (Meeting of the Minds) and submit a written thesis at the end of their senior year. Students work closely with faculty research advisors to plan and carry out their research. The 07-599 SCS Honors Undergraduate Research Thesis typically begins in the fall of the senior year, and spans the entire senior year. Students receive a total of 36 units of academic credit for the thesis work, 18 units per semester. Students should prepare their research prospectus (i.e. proposal of work) during the spring semester of their junior year, and students in this program are advised to plan their schedules carefully to ensure there is ample time to perform the required research for the thesis during the senior year.

Students interested in research are urged to consult with their undergraduate advisor and the SCS Associate Dean for Undergraduate Programs no later than the end of their sophomore year in order to plan their workload effectively. Although there is no specific GPA requirement to participate, students are expected to have at least a 3.5 GPA in the core SCS topics relevant to their proposed research to be successful in their work. For those students with no background in research, they may consider using 07-300 Research and Innovation in Computer Science (9 units) as an introduction to the research process in their junior year since this course will introduce students to various research projects going on in the School of Computer Science and important skills that are needed to be an effective researcher. This course leads to a subsequent research practicum, 07-400 Research Practicum in Computer Science (12 units), that allows students to complete a small-scale research study or experiment and present a research poster. Students who use this practicum to start their senior thesis can use the units toward the required 36 units. Students should consult with their academic advisor concerning how the units earned toward the senior thesis can be used toward elective requirements for their major.

Interested juniors should submit a project prospectus of 3-4 pages by the end of their junior year, although submissions over the summer prior to the senior year will also be considered for review. A prospectus must include:

• The name of the research advisor (an SCS faculty member)
• A short abstract (two paragraphs, max)
• A description of the problem to be worked on and its significance

• A tactical description of the proposed research plan, including:
  • a description of the background reading to be carried out,
  • a description of the research contribution,
  • a description of the expected results of the research, and
  • a reasonably detailed timeline for the thesis work
• A bibliography of related work (all references belong here)

The signature of the research advisor, signifying endorsement of the project and willingness to supervise and evaluate it (or an email confirmation from the research advisor)

Students who need help finding potential advisors should get in touch with their academic advisor or the Associate Dean for Undergraduate Programs. Applications to the program are due by the start of the senior year, although submission of applications in the junior year is encouraged.

Global students completing an outstanding senior thesis based on the judgement of the SCS Undergraduate Review Committee will earn SCS College Honors and can compete for various SCS research awards given out during commencement.

Faculty

UMUT ACAR, Associate Professor, Computer Science Department – Ph.D., Carnegie Mellon University; Carnegie Mellon, 2012–

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