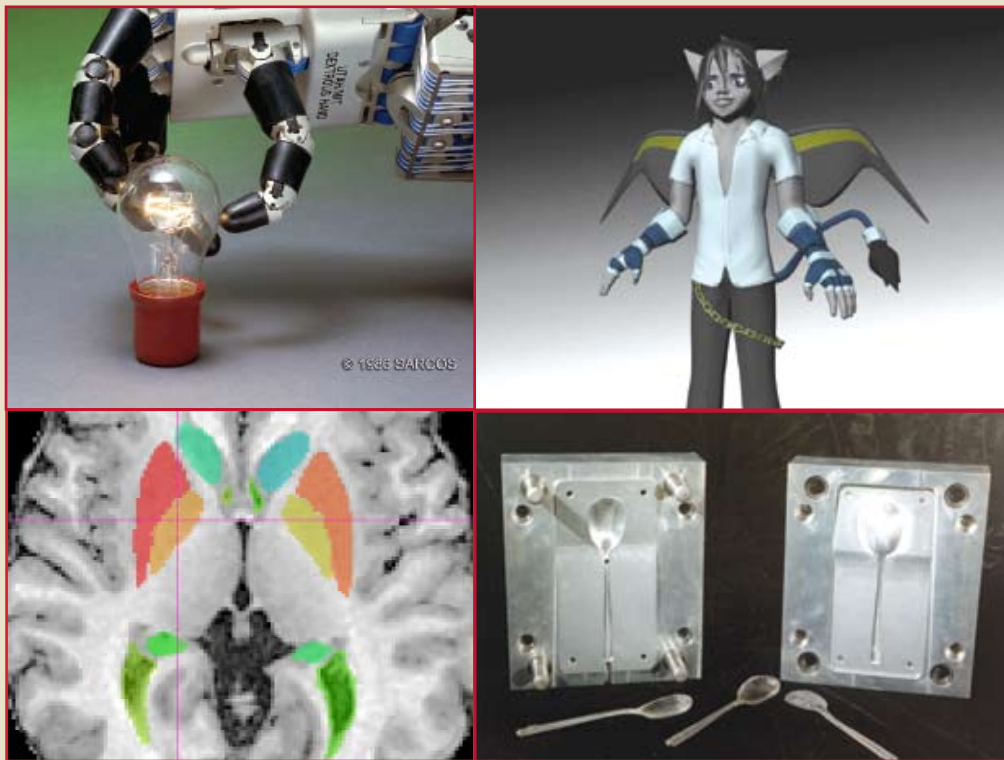


Computer Science

Undergraduate Student Handbook 2009-2010



School of Computing
THE UNIVERSITY OF UTAH

50 S. Central Campus Drive, Merrill Engineering Building (MEB) 3190, Salt Lake City, UT 84112

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Welcome to the School of Computing



“Almost every influential person in the modern computer-graphics community either passed through the University of Utah or came into contact with it in some way.”

-The Algorithmic Image:
Graphic Visions of the Computer Age
by Robert Rivlin

The School of Computing was originally founded as the Computer Science Department at the University of Utah in 1965 by three electrical engineering faculty members (In 2000, the department officially became the School of Computing). In 1985, the department reached 10 full-time faculty members. By 1996, it had doubled to 20. Today the School of Computing boasts 35 regular faculty members, two research faculty, and nine adjunct faculty, with more than 300 CS undergraduate students, 110 CE undergrads, 65 enrolled in the M.S. program and 100 enrolled in the CS Ph.D. program.

Our Research Areas Include:

- Computer Graphics and Visualization
- Computer Systems
- Information Management
- Natural Language Processing and Machine Learning
- Program Analysis, Algorithms and Formal Methods
- Robotics
- Scientific Computing
- Computer Architecture

The School of Computing at the University of Utah has a long history of distinguished faculty and alumni who have made substantial contributions to research and industry. SoC Ph.D. graduate John Warnock (1969) developed the Warnock recursive subdivision algorithm for hidden surface elimination, and later founded Adobe Systems, which developed the Postscript language for desktop publishing. Alan Ashton, 1970 Ph.D. graduate went on to teach at Brigham Young University and founded WordPerfect. Computer animation pioneer Ed Catmull, received both his B.S. and Ph.D. degrees in computer science from the University of Utah. Today he is the co-founder and president of Walt Disney and Pixar Anima-

tion Studios. He received a technical Academy Award in 1996 from the Academy of Motion Picture Arts and Sciences for “pioneering inventions in Digital Image Compositing”.

Today’s School of Computing faculty and students continue to carry the tradition of innovative research and technological advancements at the University of Utah.

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Administration

Undergraduate Program

Director, School of Computing



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Adaptive numerical methods,
parallel algorithms, com-
putational fluid and solid
mechanics applications

Associate Director, School of Computing



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Systems software and
software engineering

Associate Director, School of Computing



Charles Hansen
WEB 4692
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Visualization, computer
graphics, parallel computa-
tion, computer vision

Associate Director, School of Computing Director, Robotics MS Track



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Robotics, teleoperation,
virtual reality, and human
motor control

Director, Undergraduate Studies



Jim de St. Germain
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Artificial Intelligence,
parallel computing,
autonomous agents

Director, Educational Programs



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Application of computers
to education

Industrial Liaison



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Programming languages
and systems

Undergraduate Advisor



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Administration

Graduate Programs

Director, Graduate Studies



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Algorithms, computational
geometry and data mining

Director, Graduate Admissions



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Natural language processing,
information retrieval, and
artificial intelligence

Director, MSIT

Director, Data Management & Analysis



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Databases, web systems

Director, Computer Engineering



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Computer architecture
and VLSI systems

Director, Combined BS/MS Program



Hal Daume III
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Natural Language Processing
and Machine Learning

Director, Graphics/ Visualization MS Track



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Scientific visualization,
computer graphics,
computational geometry

Director, Scientific Computing

Director, Computational Engineering & Science



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Scientific computing
and visualization

Graduate Advisor



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Faculty

Assistant Professor



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Computer architecture: clustered processors, memory hierarchy bottlenecks

Assistant Professor



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Computer graphics and animation

Professor & Dean, College of Engineering



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Microprocessor design, circuits to minimize leakage, solid-state chemical sensors.

Professor



Elaine Cohen
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Computer graphics, scientific visualization, geometric modeling, mechanical design

Professor



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Embedded/multi-core architecture, auto. domain specific architecture synthesis, VLSI, asynchronous circuits

Research Associate Professor



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Integrated process planning and computer aided manufacturing, design, industrial robotics

Assistant Professor



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Shape analysis, computer vision/image analysis, diffusion tensor image processing

Professor



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Medical image analysis

Faculty

Professor



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Dynamic formal verification
of message passing (MPI),
thread programs.

Associate Professor



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Optimization, parallel-
ization and compilers

Professor



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Computer vision, mobile
robotics

Professor



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Digital intellectual
property law

Assistant Professor, Clinical



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Distinguished Professor



Chris Johnson
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Scientific computing, visual-
ization, imaging, and prob-
lem solving environments

Assistant Professor



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Computer networks/systems,
mobile systems and wireless
networks, network security

Assistant Professor



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Security, parallelism, verifi-
cation and optimization

Faculty

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Programming languages,
Computer memory systems
and performance

Professor



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Computer graphics, geometric
modeling, design

Associate Professor



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Computer graphics, compu-
tational geometry, geometric
programming, solid modeling

Professor



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Parallel scientific computa-
tion and computational
complexity

Research Assistant Professor



Marcel Prastawa
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Image analysis, computer
vision and machine learning
(pattern recognition)

Professor



William Thompson
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Computer vision, visual
perception

Assistant Professor



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Embedded, real-time & operat-
ing systems, sensor networks,
static analysis

Associate Professor



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Computer vision, visualiza-
tion, and image processing

Office Staff

Manager/ Senior Accountant



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Accountant



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Accountant



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Front Desk



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School of Computing Degrees

The School of Computing offers a Bachelor of Science degree in computer science. The undergraduate program begins with a set of four courses that give students a solid background in object-oriented programming while exposing them to the breadth of issues that arise in computer science. Students then take seven core courses in discrete mathematics, software engineering, computer organization, algorithms and data structures, software systems, and theory. They build on this background by choosing seven electives from the breadth of the School's course offerings (which includes advanced courses in theoretical computer science, scientific computing, artificial intelligence, databases, operating systems, computer networks, programming languages, graphics, computer architecture, and digital design). Each student's undergraduate program is capped with a senior project. Along with an in-depth study of computing, the curriculum encompasses a general education in mathematics, science, and the humanities.

The School also offers a combination B.S./ M.S. degree for students who wish to complete both the Bachelor and Master of Science degrees in a total of five years. Students who want to use computers in another field may opt for a minor in computer science to supplement another degree at the University of Utah.

A Bachelor of Science in computer engineering is jointly offered by the School of Computing and the Department of Electrical and Computer Engineering. Information about that program is available in a separate handbook or from www.ce.utah.edu.

The School of Computing offers a computer science bachelor's degree with an emphasis on Entertainment Arts and Engineering. The focus of this track is to provide interested students with the necessary skills and knowledge to enter the arena of computer gaming and animation.

Undergraduate Degrees

Bachelor's of Science in Computer Science
Bachelor's of Science in Computer Engineering

Combined Degrees

Bachelor's/ Master's Degree

Graduate Degrees

Master's in Computer Science
Non-Thesis Master's in Computer Science
Master's in Computing

- Computer Engineering
- Information Technology
- Graphics and Visualization
- Robotics
- Data Management and Analysis

Ph.D. in Computer Science
Ph.D. in Computing

- Computer Engineering
- Graphics and Visualization
- Robotics
- Scientific Computing
- Data Management and Analysis

School of Computing Degrees

BACHELOR OF SCIENCE DEGREE

The standard Bachelor of Science in computer science track is a software-oriented degree which includes 19 computer science courses, including required core, theory and elective courses. A student must be admitted as a computer science major by the School in order to take upper-division courses and pursue the computer science degree. Computer science pre-majors take six beginning math and computer science courses before applying to the major.



ENTERTAINMENT ARTS EMPHASIS

Interested students are encouraged to explore the new Entertainment Arts and Engineering (EAE) emphasis through the computer science degree. This track requires courses which are relevant to computer game designers and computer animators, including drawing courses and film courses. The EAE curriculum results in a computer science degree, with an emphasis on the entertainment arts.

COMBINED B.S./ M.S. DEGREE

The combined Bachelor of Science/ Master of Science degree in computer science allows students to earn a B.S. and M.S. in approximately five academic years. The B.S./ M.S. can combine a B.S. in either computer science or computer engineering with an M.S. in either computer science or computing. Undergrads will start to take graduate-level courses during the senior year in order to complete the master's degree in just one additional year.



CS Undergraduate Major



PRE-MAJOR STATUS

Any student can become a computer science pre-major by informing the University Registrar or the School of Computing academic advisor. It is advisable to do this early to ensure receiving information about the major and staying advised of any changes that may be made in degree requirements. Declaration as a pre-major will also enable participation in activities associated with the degree program such as the Undergraduate Student Advisory Committee.

Pre-majors are required to take the following courses and must achieve a C- or better and a 2.8 GPA in order to be admitted to full major status. Students should also hold a 2.8 cumulative GPA in all classes.

PRE-MAJOR REQUIREMENTS

All six courses are required in order to obtain full major status. You must earn a C- or better in each course, and a 2.8 average GPA among the following courses:

CS 1010	Intro to Unix ¹	0.5 credits
CS 1060	Explorations in CS ²	3 credits
CS 1410	Computer Science I	4 credits
CS 2420	Computer Science II	4 credits
Math 1210	Calculus I	4 credits
Math 1220	Calculus II	4 credits

¹ CS1010 must be passed with a CR grade. This is a credit/ no credit, Internet-based course.

² CS 1060 may be waived by advanced students. Talk to the Director of Undergraduate Studies for the School of Computing for more information.

CS Undergraduate Major

FULL MAJOR STATUS

In order to become a full major, a student must first complete the courses required of pre-majors and then apply for full major status. An application should be obtained from the School of Computing web page or office during the semester when the student expects to complete these requirements. One may not pre-register for any upper division classes in computer science without first being admitted as a full major or a minor.

Applications for admission are reviewed at the end of spring and summer semesters. New majors are only allowed into the major during fall semesters. Transfer students should be advised that they will only be allowed to start into full major status during the fall and should plan their transfer accordingly. Meeting with the academic advisor early to plan pre-major courses is the best way to ensure these requirements will be met in time for a fall start.

SECOND DEGREE AND DOUBLE MAJORS

Some students may wish to earn a degree in computer science as their second Bachelor of Science degree. This is possible as long as the requirements for both degrees are met. In some cases, fewer additional class hours are needed because of overlaps in the two degrees. This is especially true of students whose other degree is in computer engineering, electrical engineering, or mathematics, where upper level classes may serve as computer science or math electives. General education and bachelor degree requirements for the University will only need to be completed once and will be applied to both degrees. Students pursuing a double major must notify the academic advisor in both majors to become registered with the University and ensure they are meeting both sets of major requirements.



ADDING A MINOR

Students are encouraged to enhance their computer science education by adding a minor to their degree. A minor is not required, but may allow a CS student to explore other areas of interest at the University of Utah. Students may add a minor by contacting the departmental advisor for the minor for which they plan to pursue.

CS Undergraduate Major

UNIVERSITY OF UTAH GRADUATION REQUIREMENTS

Regardless of what major students choose, everyone must complete a set of University-wide graduation requirements before receiving their bachelor's degree. The Office of Undergraduate Studies is responsible for overseeing this program. Although there are very specific requirements to meet, students can choose from a wide variety of courses to complete them.

GENERAL EDUCATION REQUIREMENTS

The General Education requirements are described in the University of Utah General Catalog. The requirements for computer science majors are more specific.

- a. The University writing requirement is satisfied by either Wrtg 2010 or ESL 1060 (for students who speak English as a second language).
- b. The quantitative reasoning requirement is satisfied by Math 1210 or 1250 which is required for computer science pre-majors.
- c. The two-course requirement in physical and life sciences is satisfied by classes required for the major.
- d. Students must take two intellectual explorations courses in each of fine arts, humanities, and social sciences . Two of these six courses must be upper division. One should meet the University diversity requirement, and one should meet the University international requirement. Students should consult with the CS academic advisor to be sure they select appropriate classes to satisfy these requirements with a minimum number of credit hours .
- e. The American institutions requirement can be satisfied by taking one of Econ 1740, Hist 1700, PolS 1100, or Honors 2212.

CS Undergraduate Major

UNIVERSITY BACHELOR DEGREE REQUIREMENTS

The University graduation requirements for the Bachelor of Science degree are described in the University of Utah General Catalog.

- a. The communication/ writing requirement: Computer science majors must take either Wrtg 3015, Wrtg 3014, Wrtg 3012, or Honors 3200 which may be taken by students participating in the University Honors Program. This class should be taken prior to taking the computer science senior project course.
- b. The quantitative intensive course requirement is satisfied by CS 3810, CS 4150 and CS 4400, which are required for CS majors.
- c. The diversity requirement can be satisfied by taking a course from an approved list as part of the intellectual explorations courses.
- d. The international requirement can be satisfied by taking a course from an approved list as part of the intellectual explorations courses.
- e. Students must complete a minimum of 122 total semester hours of course work. At least 40 of the 122 hours must be upper division classes. Upper division classes are numbered 3000 or above. Credits from two-year colleges will not count toward University upper division hours. At least 30 of the total credit hours and 20 of the last 30 hours must be taken at the University.

Computer science students should also consider CS 1050: Computers in Society, as one of their social/behavioral science general education classes. The course focuses on the social issues that surround the increasingly pervasive roles that computers play in society.

It is possible to take some classes that can satisfy several general education requirements at once. Please ask the computer science academic advisor about such options.

CS Undergraduate Major

MATH, SCIENCE AND ENGINEERING REQUIREMENTS

Seven classes in math, science, and/or engineering are required. Math 1210, Math 1220, and Physics 2210 are required courses. A grade of C- or better must be earned in each of these courses:

Math 1210	Calculus I	4 credits
Math 1220	Calculus II	4 credits
Physics 2210	Physics for Scientists and Engineers I	4 credits
Two required math electives must be selected from the following three options:		
Math 2210	Calculus III	3 credits
Math 2270	Linear Algebra ¹	4 credits
ECE 3530 or CS 3130	Engineering Probability and Statistics Engineering Probability and Statistics	3 credits 3 credits
Two additional math/ science courses, each of which must be at least three semester hours, may be chosen from among the following:		
Any non-CS class from the Colleges of Engineering, Mines, or Science that requires Calculus II as a prerequisite or corequisite ¹ .		
Physics 2220	Physics for Scientists and Engineers II	4 credits

¹ Note that Math 2250 covers the same material as Math 2270 and 2280, although in less depth. Hence, if 2270 is used as one of the required math/science electives, Math 2250 may not be counted. Students should take the prerequisites of computer science electives into consideration when planning how to satisfy this requirement.

Biol 1210: Principles of Biology or Chem 1210: General Chemistry I will also be accepted as a math/ science elective (labs not required).

CS Undergraduate Major

COMPUTER SCIENCE MAJOR REQUIREMENTS

A minimum of 19 computer science classes must be taken. Page 16 gives an example four-year degree program leading to a bachelor's degree in computer science. Page 28 summarizes the prerequisites for computer science courses.

CS 1010	Intro to Unix	0.5 credits
CS 1060	Explorations in CS ³	3 credits
CS 1410	Computer Science I	4 credits
CS 2420	Computer Science II	4 credits
CS 2100	Discrete Structures	3 credits
CS 3500	Software Practice I	4 credits
CS 3505	Software Practice II	3 credits
CS 3810	Computer Organization	4 credits
CS 4150	Algorithms	4 credits
CS 4400	Computer Systems	4 credits
Theory restricted elective. One of the following must be completed ⁴		
CS 3100	Models of Computation	3 credits
CS 3200	Scientific Computing	3 credits
Electives		
Seven additional computer science classes numbered 3000 or higher must be taken. CS 5010/20 and seminars may not be counted. Only one independent study class and one internship (3 credit hours or more) may be counted with special permission. Only courses taken for a letter grade will count toward CS electives.		
Capstone requirement. One of the following must be completed:		
CS 4500	Software Engineering Lab	3 credits
CS 4970	Bachelor's Thesis ⁵	3 credits

CS Undergraduate Major

EXAMPLE COMPUTER SCIENCE DEGREE FOUR-YEAR PROGRAM OF STUDY

The computer science degree can be completed in four full-time years of study if the student is capable of completing the computer science and calculus pre-major sequences during the freshman year. If a student must instead take preparatory classes as a freshman, more than four years may be required to earn a degree.

	Fall Semester			Spring Semester		
Freshman	CS1010	Unix	.5	CS2420	CSII	4
	CS1060	Explorations	3	Math1220	Calc II	4
	CS1410	CS I	4	Phys2210	Physics I	4
	Math1210	Calc I	4	General Education course		3
	Wrtg2010	Writing	3			
Sophomore	CS2100	Discrete	3	CS3505	Software Prac. II	3
	CS3500	Software Prac. I	4	CS elective		3
	CS3810	Comp. Org.	3	Math required elective 1		3
	Wrtg3015	Pro. Writing	3	General Education course		3
				American Institutions course		3
Junior	CS4400	Comp. Systems	4	CS4150	Algorithms	3
	CS3100	Theory elective 1	3	CS elective		3
	Math required elective 2		4	CS elective		3
	General Education course		3	Math/ Science elective		4
	General Education course		3	General Education course		3
Senior	CS elective		3	CS4500	Capstone 2	3
	CS elective		3	CS elective		3
	CS elective		3	Math/ Science elective		4
	General Education course		3	Free elective		4
	Free elective		3			

¹ If both CS 3100 and CS 3200 are taken, the second will be counted as a CS elective. Note that CS 3200 is offered in the spring. If selected, a CS elective should be taken in the fall instead of CS 3100.

² Students choosing the thesis option must get special permission from the faculty. This option is intended for students who are considering graduate school. The bachelors thesis can also be used toward a portion of the thesis requirement for the B.S./ M.S. program.

CS Undergraduate Major

COMPUTER SCIENCE B.S. DEGREE REQUIREMENTS: 2009-10

Pre-Major Requirements:

Required in order to apply for full major status: C- or better in each course, and a 2.8 average GPA among the following:

1. CS 1010, Intro. to Unix (3)
2. CS 1060, Explorations in CS (3)
3. CS 1410, Computer Science I (4)
4. CS 2420, Computer Science II (4)
5. Math 1210, Calculus I (4)
6. Math 1220, Calculus II (4)

General Education Requirements:

1. Wrtg 2010, Intermediate Writing
2. Wrtg 3012 or 3014 or 3015
3. American Institutions [AI]

*Choose one: Econ 1740, Hist 1700, Pols 1100, Hon 2212

A total of six courses must be taken in the following three areas (with two from each): Fine Arts, Humanities, Behavioral/Social Science. TWO of those six must be upper division (3000+), one must satisfy the Diversity requirement and one must satisfy the International requirement.

4. Fine Arts [FF]
5. Fine Arts [FF]
6. Humanities [HF]
7. Humanities [HF]
8. Social/ Behavioral Science [BF]
9. Social/ Behavioral Science [BF]

*Upper Division 1

*Upper Division 2

*Diversity [DV]

*International [IR]

Math/Science Electives:

Physics 2210 is required, plus two of the three required electives: Math 2210, Math 2270, or ECE 3530/ CS 3130. Two additional electives are required; each must be at least 3 credits. Choose any non-CS class that has Math 1220 (Calculus II) as a prerequisite or co-requisite. Math 2250 will not be allowed if Math 2270 is taken. We will also accept Physics 2220, ECE 1270, Biol 1210, or Chem 1210.

1. Physics 2210, Physics for Sci. & Eng. I
2. Required Elective 1 _____
3. Required Elective 2 _____
4. _____
5. _____

Major Requirements:

The following requirements are restricted to FULL majors:

1. CS 2100, Discrete Structures (3)
2. CS 3500, Software Practice I (4)
3. CS 3505, Software Practice II (3)
4. CS 3810, Computer Organization (4)
5. CS 4150, Algorithms (4)
6. CS 4400, Computer Systems (4)

Computer Science Electives:

Choose seven (7) CS courses, 3000-level or above, each must be at least 3 credits.

Seminars may not be counted. Only one Independent Study class and one Internship class (at least 3 credits each) can count as an elective. Any combination of Industry Forum, Research Forum, TA Training, or Programming Challenges can be combined to fulfill one of these required courses.

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____

Theory Restricted Elective:

Choose ONE: (If both classes are taken, one will count as a CS elective above)

1. CS 3100, Models of Computation (3)
2. CS 3200, Scientific Computing (3)

Capstone Requirement:

Choose ONE: (Permission required from Undergraduate Director for thesis option)

1. CS 4500, Software Engineering Lab (3)
2. CS 4970, Bachelor's Thesis (3)

CS Undergraduate Major: EAE



ENTERTAINMENT ARTS AND ENGINEERING EMPHASIS

The School of Computing provides a specialty track through the computer science program with an emphasis on Entertainment Arts and Engineering (EAE). The EAE emphasis is a joint program between the School of Computing and the College of Fine Arts Division of Film Studies.

The purpose of this program is to provide an undergraduate, interdisciplinary academic path for those students that wish to have careers in the digital entertainment industry (video games, digital animation, computer generated special effects, etc.). There are

currently two specified tracks: video games and animation, differing by the junior year game/ animation series of classes.

The key feature of this program is its interdisciplinary nature. Students from both computer science and fine arts take common classes throughout their undergraduate years, culminating in a year-long senior studio project where students build a video game or animation from the ground up. Students in the program choose either a bachelor's degree in film studies or computer science. The requirements listed below are for the computer science Bachelor of Science degree, with an emphasis in EAE.

All requirements of the general computer science degree must be met. The specifics of the track are listed below where they extend the requirements of the traditional computer science bachelor's degree:

EAE GENERAL EDUCATION REQUIREMENTS

Same as the regular CS track (page 12). Fine arts (FF) Requirement: Art 1020 (Drawing for non majors) replaces one fine arts elective.

EAE UNIVERSITY GRADUATION REQUIREMENTS

Same as the regular CS track (page 13). Writing requirement: FA3600 (Writing for New Media) replaces the upper division writing.

CS Undergraduate Major: EAE

EAE MATH, SCIENCE AND ENGINEERING REQUIREMENTS

Seven classes in math, science, and/or engineering are required. The following are required courses. A grade of C- or better must be earned in each of these courses:

Math 1210	Calculus I	4 credits
Math 1220	Calculus II	4 credits
Math 2210	Calculus III	3 credits
Physics 2210	Physics for Scientists and Engineers I	4 credits
Physics 2220	Physics for Scientists and Engineers II	4 credits
One required math elective must be selected from the following three options:		
Math 2270	Linear Algebra ¹	4 credits
ECE 3530 or CS 3130	Engineering Probability and Statistics	3 credits
	Engineering Probability and Statistics	3 credits
One additional course, at least three semester hours, may be chosen from among the following:		
Any non-CS class from the Colleges of Engineering, Mines, or Science that requires Calculus II as a prerequisite or corequisite		
Math 3070	Applied Statistics I (suggested)	4 credits

¹ Math 2250 covers the same material as Math 2270 and 2280, although in less depth. Hence, if 2270 is used as a math/science elective, Math 2250 may not be counted.

Students should take the prerequisites of computer science electives into consideration when planning how to satisfy this requirement. Biol 1210 or Chem 1210 will also be accepted as a math/ science elective.

CS Undergraduate Major: EAE

COMPUTER SCIENCE EAE MAJOR REQUIREMENTS

A minimum of 19 computer science classes must be taken. Page 22 gives an example four-year degree program leading to a bachelor's degree in computer science. Page 28 summarizes the prerequisites for computer science EAE courses.

CS 1010	Intro to Unix	0.5 credits
CS 1060	Explorations in CS ₃	3 credits
CS 1410	Computer Science I (EAE section)	4 credits
CS 2420	Computer Science II (EAE section)	4 credits
CS 2100	Discrete Structures	3 credits
CS 3500	Software Practice I	4 credits
CS 3505	Software Practice I I	3 credits
CS 3810	Computer Organization	4 credits
CS 4150	Algorithms	4 credits
CS 4400	Computer Systems	4 credits
EAE required CS courses		
CS 3650	3D Modeling	3 credits
CS 3660	Machinima	3 credits
CS 5460	Operating Systems	3 credits
CS 5530	Databases	3 credits
CS 5300	Artificial Intelligence	3 credits
Theory restricted elective. Students must take the following course:		
CS 3200	Scientific Computing	3 credits

CS Undergraduate Major: EAE

EAE Requirement. The following class is required:		
FILM 3710	Film Production I	4 credits
Series requirement. One of the following series must be taken (junior year):		
COMPUTER ANIMATION SERIES:		
FILM 4700	Computer Animation I	4 credits
FILM 4710	Computer Animation II	4 credits
GAME DEVELOPMENT SERIES:		
FILM 4750	Game Develop: Historical, Traditional	4 credits
FILM 4760	Game Develop: Contemporary	4 credits
EAE computer science elective. One of the following classes must be taken:		
CS 5350	Machine Learning	3 credits
CS 5600	Intro to Graphics	3 credits
CS 5610	Interactive Graphics	3 credits
CS 4540	Web Software Architecture	3 credits
CS 6620	Intro to Ray Tracing	3 credits
Additional suggested electives (not required):		
FA 3350	Intro to 3D Computer Graphics	3 credits
FILM 2300	Survey of Videogame Theory	3 credits
Capstone requirement. Both of the following courses are required:		
CS 4510	Senior Project I	3 credits
CS 4515	Senior Project II	3 credits

CS Undergraduate Major: EAE

EXAMPLE COMPUTER SCIENCE EAE DEGREE FOUR-YEAR PROGRAM OF STUDY

The computer science degree can be completed in four full-time years of study if the student is capable of completing the computer science and calculus pre-major sequences during the freshman year. If a student must instead take preparatory classes as a freshman, more than four years may be required to earn a degree.

This table gives an eight-semester example program leading to computer science B.S. with an emphasis in Engineering Arts and Entertainment. It is meant only as a guide, since the scheduling of electives and general education classes depends upon which ones are selected. All requirements for a general degree in computer science must be met. It is possible to take certain general education requirements during summer sessions to ease the load.

	Fall Semester			Spring Semester		
Freshman	CS1010	Unix	.5	CS2420	CSII	4
	CS1060	Explorations	3	Math1220	Calc II	4
	CS1410	CS I	4	Wrtg2010	Writing	4
	Math1210	Calc I	4	Phys2210	Physics I	4
	Art1020	Basic Drawing	3	General Education course		3
Sophomore	CS3500	Software Prac. I	4	CS3505	Software Prac. II	3
	CS3810	Comp. Org.	3	CS3660	Machinima	3
	CS3650	3D Modeling	3	FILM3710	Film Production	3
	Phys2220	Physics II	4	Math required elective I		4
				FA3600	Wrtg New Media	3
Junior	CS2100	Discrete	4	CS4150	Algorithms	3
	CS4400	Comp. Systems	3	CS3200	Scientific Comp.	3
	Math2210	Calculus III	3	CS5300	A.I.	3
	EAE Series: Animation/Game I		4	EAE Series: Animation/Game II		4
				General Education course		3
Senior	CS4510	Senior Project I	3	CS4515	Senior Project II	3
	CS5530	Databases	3	EAE CS elective		3
	CS5460	Operating Syst.	3	Math/ Science elective		4
	American Institutions course		3	General Education course		3
	General Education course		3	General Education course		3

CS Undergraduate Major: EAE

COMPUTER SCIENCE B.S. DEGREE REQUIREMENTS, EAE TRACK: 2009-10

Pre-Major Requirements:

Required in order to apply for full major status: C- or better in each course, and a 2.8 average GPA among the following:

1. CS 1010, Intro. to Unix (3)
2. CS 1060, Explorations in CS (3)
3. CS 1410, Computer Science I (4)
4. CS 2420, Computer Science II (4)
5. Math 1210, Calculus I (4)
6. Math 1220, Calculus II (4)

General Education Requirements:

1. Wrtg 2010, Intermediate Writing
2. FA 3600, Writing for New Media
3. American Institutions [AI]

*Choose one: Econ 1740, Hist 1700, Pols 1100, Hon 2212

A total of six courses must be taken in the following three areas (with two from each): Fine Arts, Humanities, Behavioral/Social Science. TWO of those six must be upper division (3000+), one must satisfy the University Diversity requirement and one must satisfy the University International requirement.

4. Art 1020, Drawing for Non-Majors [FF]
5. Fine Arts [FF]
6. Humanities [HF]
7. Humanities [HF]
8. Social/ Behavioral Science [BF]
9. Social/ Behavioral Science [BF]

- *Upper Division 1
- *Upper Division 2
- *Diversity [DV]
- *International [IR]

Math/Science Electives:

Physics 2210, 2220, and Math 2210 are required, plus one of the two required electives: Math 2270 or ECE 3530/ CS 3130. One additional elective is required (at least 3 credits). Choose any non-CS class that has Math 1220 (Calculus II) as a prerequisite or co-requisite. Math 2250 will not be allowed if Math 2270 is taken. We will also accept ECE 1270, Biol 1210, or Chem 1210.

1. Physics 2210, Physics for Sci. & Eng. I
2. Physics 2220, Physics for Sci. & Eng. II
3. Math 2210, ODEs & Linear Algebra
4. Required Elective 1 _____
5. _____

Major Requirements:

The following requirements are restricted to FULL majors:

1. CS 2100, Discrete Structures (3)
2. CS 3500, Software Practice I (4)
3. CS 3505, Software Practice II (3)
4. CS 3810, Computer Organization (4)
5. CS 4150, Algorithms (4)
6. CS 4400, Computer Systems (4)

Film Requirement:

1. FILM 3710, Film Production (3)

EAE CS Requirements:

1. CS 3650, 3D Modeling for VG&M (3)
2. CS 3660, Machinima (3)
3. CS 5460, Operating Systems (4)
4. CS 5300, Artificial Intelligence (3)
5. CS 5530, Databases (3)

EAE CS Elective:

Choose one course, 3000-level+ from approved list (pg 21)

1. _____

Series Requirement:

Choose one

1. FILM 4700, Computer Animation I (4)
2. FILM 4700, Computer Animation II (4)

OR

1. FILM 4750, Game Design I (4)
2. FILM 4760, Game Design II (4)

Theory Restricted Elective:

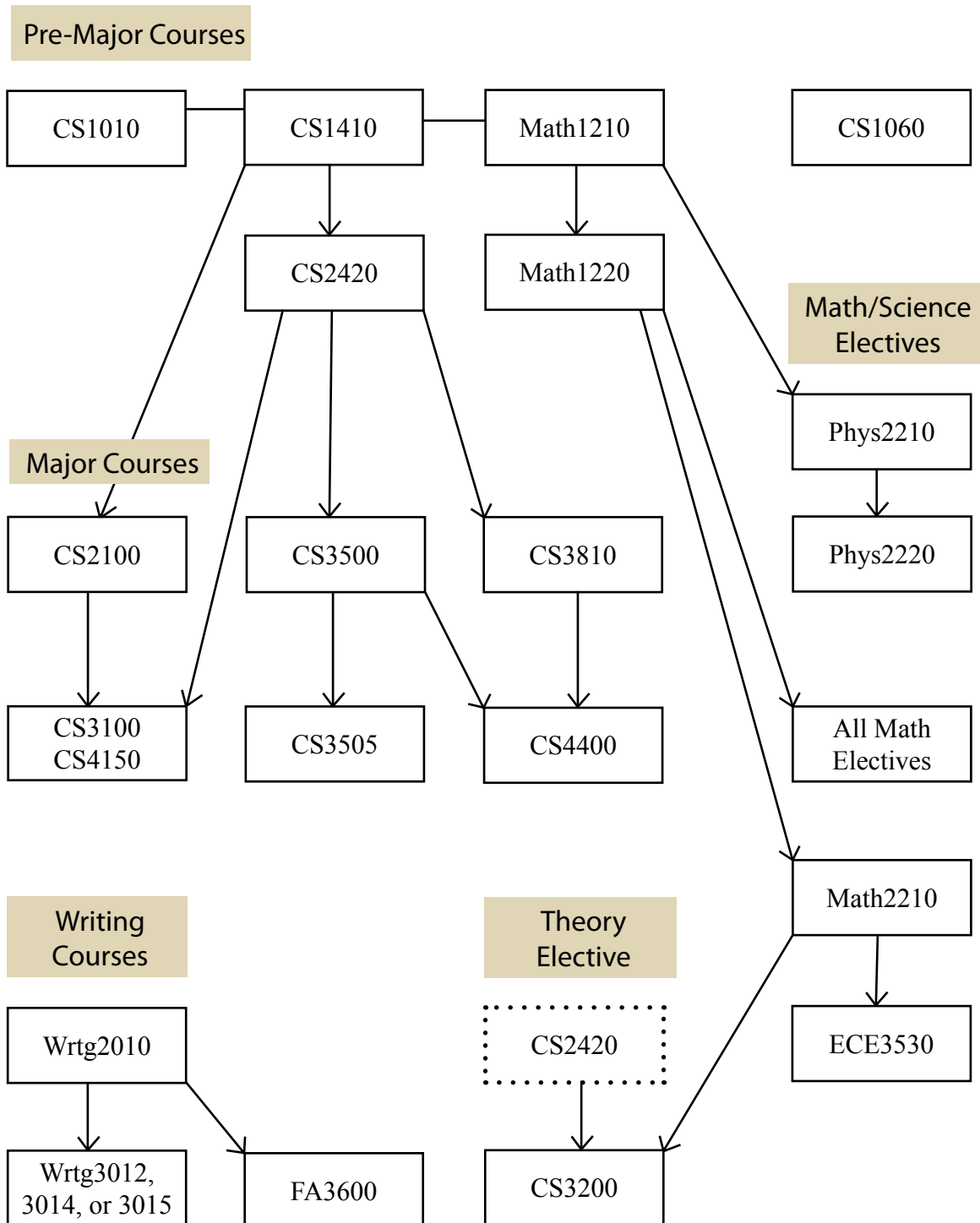
1. CS 3200, Scientific Computing (3)

Capstone Requirement:

1. CS 4510, Senior Project I (3)
2. CS 4515, Senior Project II (3)

Prerequisite Course Requirements

PREREQUISITE FLOW SHEET



Continuing Performance

CONTINUING PERFORMANCE REQUIREMENTS

All computer science, mathematics, science, engineering, and writing courses taken to satisfy the major requirements must be taken for a grade and must be passed with a C- or better (except for CS 1010, in which a grade of CR is required). A student may repeat courses necessary for the major only one time (pre-major courses may be taken as many times as necessary to gain full-major status).

To remain in good standing and graduate, a student must maintain a cumulative grade point average at the University of 2.3 or higher, and also maintain a grade point average (GPA) of 2.3 in computer science classes taken at the University. Students whose GPA in either of these categories falls below 2.3 are notified that they are on probation and will be given conditions to return to good standing. Normally, these conditions must be satisfied during the next two semesters, excluding summers. Students failing to meet their probationary conditions are dropped from the rolls of the major.

All students admitted as full majors are placed on probationary status. If a student's GPA in either of the above categories is below 2.3 after the first year during which they take upper level computer science classes, the student is dropped from the rolls of the major.

Students are expected to complete all requirements for their degree within four years of acceptance to full major status. Students not making satisfactory progress toward their degrees may be dropped from the rolls and declared inactive. The determination that a student is not making satisfactory progress is made in one of two ways. Either (1) the student has not completed a computer science course for a period of one year, or (2) there is no reasonable way in which the student can complete all degree requirements by the end of the required period of time.

In order to be reinstated from inactive status or from being dropped due to low GPA, students must petition the Computer Science Undergraduate Committee. Reinstated students proceed under the latest graduation requirements.

If personal circumstances prevent completion of all degree requirements within four years of acceptance as a full major, a student may request an extension of a specific duration and submit a revised schedule of completion.



Advanced Placement

ADVANCED PLACEMENT EXAM CREDIT

Credit for Advanced Placement tests is given through the University and counts toward the total hours needed to graduate. Specific courses in the Computer Science major are waived based on high AP exam scores, independent of these credit hours. The grades listed on the following page for the purpose of determining the pre-major GPA which is used to determine acceptance into the major. For example, a student who receives a 5 on the CS AB test and a 5 on the Calculus BC test would have CS 1410, CS 2420, Math 1210, and Math 1220 waived, with a pre-major GPA of 3.5 (4.0 + 4.0 + 3.3 + 2.7 divided by 4 classes) and would be allowed directly into the major as a freshman.

The scores on the following page are necessary for the School of Computing to waive a requirement. While lower scores may result in University of Utah credit, they will not satisfy School of Computing requirements. The grade equivalencies will only be used to determine acceptance into the computer science major. They are not part of your University GPA. The School of Computing will not accept AP scores of 3 in some areas. Students should submit a "request for evaluation" to the Admissions Office to have their AP credits officially recorded toward University graduation requirements.

The following graph shows some of the general education courses that are cleared by AP scores. For a more detailed list and information about AP credits and required scores, please visit: www.sa.utah.edu/admiss/AP.html.

ADVANCED PLACEMENT EXAM COURSE EQUIVALENTS FOR THE UNIVERSITY OF UTAH

AP Exam	General Education Course Waived	University Required Score	Semester Hours Awarded
American History	American Institutions	3	6
English	Wrtg 2010	4	6
European History	1 Humanities IE	3	6
Psychology	1 Social Science IE	3	3
World History	1 Humanities IE	3	6

Advanced Placement

ADVANCED PLACEMENT EXAM COURSE EQUIVALENTS FOR COMPUTER SCIENCE

AP Exam	U. Class Equivalent	CS Required Score	Equivalent Grade
Biology	1 Science IE	3	
Chemistry	Chem 1210	4 or 5	
Computer Science A	CS 1410	5	A
Computer Science AB	CS 1410/ 2420	5	A/ A
		4	B+/ B-
		3	B- / *
Physics C: Mech	Phys 2210	4 or 5	
Physics C: E&M	Phys 2210/ 2220	4 or 5	
Calculus AB	Math 1210	5	A
		4	B-
Calculus BC	Math 1210/ 1220	5	A/ A
		4	B+/ B-
		3	B- / *

* Course not waived and must be taken at the University of Utah. Grades are only used for major application. IE=Intellectual Exploration. The AP Biology exam will NOT waive Biol 1210 as a math/science elective for CS.

Computer Science Minor

COMPUTER SCIENCE MINOR

The School of Computing offers a minor for students who desire to gain sufficient background to use and program computers in another field.

MINOR REQUIREMENTS		
The minor consists of a minimum of 18.5 semester hours of required computer science classes. The following classes must be taken:		
CS 1010	Intro to Unix	0.5 credits
CS 1410	Computer Science I	4 credits
CS 2420	Computer Science II	4 credits
MATH 1210	Calculus I	4 credits
CS 2100	Discrete Structures	4 credits
CS 3500	Software Practice I	4 credits
CS Elective: Students must take at least one additional CS class (3-4 credits) at the 3000 level. CS 3505 is recommended.		

In order to be admitted as a computer science minor, a student must have a declared major in another department and be making progress in that major. An application should be obtained from the School of Computing web page or office during the semester when the student expects to complete these requirements. One may not pre-register for any upper division classes in computer science without first being admitted as a minor. Applications for admission are reviewed at the end of spring and summer semesters.

Students are admitted to the minor if their average grade in Math 1210, CS 1410, and CS 2420 is 2.8 or higher. They must also achieve a letter grade of C- or better in these courses. CS minors should submit an application to the minor to the academic advisor in MEB 3190.

B.S./ M.S. Program

COMPUTER SCIENCE B.S./ M.S. DEGREE

The B.S./ M.S. degree program allows students to complete both a bachelor's and master's degree in computer science in five years. Degree requirements are the same as those for earning a B.S. and M.S. separately (122 undergraduate hours + 30 graduate hours), but there are several advantages:

- The synchronization barrier between the degrees is broken. Hence, students may take graduate classes during their senior year, and undergrad classes during their fifth year.
- B.S./ M.S. students may take up to 12 graduate-level credits for the undergraduate fee.
- B.S./ M.S. students are not required to take the Graduation Record Examination (GRE) as part of their graduate school admittance.



The M.S. Degree may be in any of our programs:

- *Master of Computer Science
- *Master of Computing with a computer engineering specialization
- *Master of Computing with a graphics and visualization specialization
- *Master of Computing with a information technology specialization
- *Master of Computing with a robotics specialization

Each of the degrees has two options: course-based and thesis-based. Students wishing to pursue the thesis option for their M.S. degree must also choose the thesis option for their B.S. degree. The bachelor's thesis will normally constitute a portion of the master's thesis.

Students must be a junior in the CS or CE department in order to apply. International students on a visa are not eligible for B.S./ M.S. programs. Applications for the B.S./ M.S. program are due mid-May to the graduate advisor and must include a copy of the student's University of Utah transcript and the B.S./ M.S. application form. For more information about the B.S./ M.S. program, graduate tracks, and how to apply, please visit: www.cs.utah.edu/bsms.

Scholarships

UNDERGRADUATE SCHOLARSHIPS

The School of Computing awards several scholarships each year. Recipients are selected based upon academic performance, rather than financial need. Most are awarded to computer science and computer engineering full majors, or to those students who will become full majors during the following academic year. Applications for these scholarships are available on the Web at www.cs.utah.edu/info/scholarships/ or from the School of Computing office. They must be submitted to the School's office by March 1 of the preceding year.

Tuition Waiver Scholarships: These awards are available to students majoring in computer science or computer engineering who are residents of the state of Utah. They cover up to 18 credit hours of resident tuition for two semesters. To be eligible, students must take at least 12 credit hours per semester, be U.S. citizens and have a cumulative GPA of 3.5 or higher.

School of Computing Scholarships: These are awards available to all computer science and computer engineering majors. They range in value from \$500 to \$4,000, and are made possible by generous donations from the School of Computing faculty, the Eccles Foundation, Kiri Wagstaff, Dave Hanscom, Joan de St. Germain, and others. To be eligible, students must take at least nine credit hours per semester.

College of Engineering Scholarships: The College of Engineering also awards several scholarships (Kennecott, Ariel Berrier, Simon Ramo, and others) to the top students in the college. Students may also apply for financial aid from the College, which each year awards a number of Josephine Beam Educational Scholarships. These are worth approximately \$500 and are based on need. Information and applications are available on the web at www.coe.utah.edu/current-undergrad/scholarships, or from the Office of the Dean of Engineering (WEB 1650).

Transfer students and entering freshmen are not eligible to apply for the School of Computing Scholarships or Tuition Waivers until they have been admitted to the University of Utah and declared as a full or pre-major in computer science or computer engineering. These students should consider applying for University of Utah or College of Engineering Scholarships.

B.S./ M.S. students are eligible to apply for School of Computing Scholarships, but are only eligible to receive undergraduate scholarship funding while they are finishing their undergraduate career.

Student Involvement

STUDENT PARTICIPATION IN SCHOOL AFFAIRS

The School of Computing and the University of Utah both offer clubs, courses, and academic support to students which can enhance their undergraduate degree. The following offers a list of many, but not all, opportunities which computer science students are encouraged to explore. For a thorough list of clubs, groups, and activities at the University of Utah, please visit the Associated Students of the University of Utah student group (ASUU) at www.asuu.utah.edu.

Industry Forum

Students are encouraged to take CS 3011: Industry Forum in their junior or senior year. This course meets once weekly for one credit hour. Students will engage in presentations from local and national business leaders discussing issues in computing from industry perspectives, trends in computer science, professionalism, ethics, career readiness, lifelong learning, and contemporary issues. CS 3011 may be repeated up to three times for credit.

Research Forum

Research forum is encouraged for students who are planning to take the thesis senior project course or plan to go on to graduate school. Students attend weekly presentations from speakers discussing different research opportunities within the School of Computing, as well as problems that remain unsolved in computer science. This one-credit course may be taken along with industry forum, programming challenges, and/or TA training to take place of one three-credit CS elective. Research forum is encouraged for sophomore or junior year.

Internships

Qualified students may count an internship experience as a CS elective course during their junior or senior year. The benefits of such experience include exposure to ideas which could help with career decisions, making contacts which may be useful sometime in the future, and valuable experience in an area that is pertinent to current studies. School of Computing students have received internships with notable companies such as IBM, Hewlett Packard, L-3 Communications Systems, Intel, and Micron. Many of our majors take advantage of this valuable opportunity. All internships must be pre-approved by the Director of Undergraduate Studies.

Student Involvement

STUDENT PARTICIPATION IN SCHOOL AFFAIRS

Independent Study

Students may enroll in one independent study course (three credits or more) as one of the seven required CS electives. Independent study must be approved by the supporting faculty member and must be taken for a grade. Students who are interested in assisting with undergraduate research may consider working with a School of Computing faculty member in an independent study course.

Research Opportunities

There are a number of ways to become involved in research as an undergraduate student. The most basic way is to be proactive and discuss research options and opportunities with College of Engineering faculty. There are two formal research avenues undergraduate students can investigate: The Merrill Engineering Scholars Fellowship and The Undergraduate Research Opportunities Program. Visit www.coe.utah.edu/current-undergrad/research for more information.

School of Computing UgSAC

Opportunities for students to develop their organizational and leadership abilities are available through participation in the Undergraduate Student Advisory Committee (UgSAC), which plays an active role in the School by coordinating the following:

1. Course and faculty teaching evaluations.
2. Representation (one student) at faculty meetings.
3. Announcements to all declared pre-majors and majors.
4. Representation on the College Student Advisory Committee.
5. Representation on the end-of-year awards committee.
6. Organization of lunch meetings for pre-majors and majors.
7. Organization of university and high school programming contests.
8. Feedback on issues affecting students, such as scheduling, curriculum changes, and graduation requirements.

Anyone interested in joining this organization should contact UgSAC at ugsac@cs.utah.edu. Participation, suggestions, and criticisms are solicited.

Student Involvement

STUDENT PARTICIPATION IN SCHOOL AFFAIRS

Society of Women Engineers

The Society of Women Engineers (SWE), founded in 1950, is a not-for-profit educational and service organization. SWE is the driving force that establishes engineering as a highly desirable career aspiration for women. SWE empowers women to succeed and advance in those aspirations and be recognized for their life-changing contributions and achievements as engineers and leaders. For more information, please visit: web.utah.edu/swe.



Honors Programs

The College of Engineering offers an honors bachelor's degree. For information on this program, see the college web page: www.coe.utah.edu/current_undergrad/hie. Students may also participate in the University's honor program through Honors College. For more information, please visit: www.honors.utah.edu.

E-LEAP

Incoming engineering students should consider the Engineering LEAP (E-LEAP) program organized by the Office of Undergraduate Studies. It is a year-long cohort program set up to allow students to take several classes together during their first year on campus. Two of these classes are seminar courses that satisfy University General Education and Diversity requirements. The program also includes sections of writing, calculus, and physics. For more information on E-LEAP, contact the College of Engineering advisor at 585-7769.

Engineering Ambassadors/ NSF Outreach

Engineering ambassadors represent their department on a college level and help with student recruitment and information sessions. Responsibilities may include presenting during Friday Afternoons in Engineering events or visiting local high schools and junior highs. NSF representatives assist with similar outreach opportunities at college recruiting events and speaking engagements. Contact Cynthia Furse at cfurse@ece.utah.edu for more information about NSF opportunities.

Academic Support



UNDERGRADUATE ADVISING

Academic Advisor
Kelly Olson
MEB 3190
ugrad-help@cs.utah.edu
801-581-8225

Faculty Advisor
H. James de St. Germain
MEB 3190
germain@cs.utah.edu
801-581-8224

University College Advising
SSB 450
uc@sa.utah.edu
801-581-8146

The School of Computing has an undergraduate academic advisor who is available to answer questions regarding schedule plans, registration for computer science classes, degree requirements, recent School of Computing actions, or any problems the student may be experiencing. Students should visit the academic advisor at least once a year to verify that they are on track for graduation.

The University of Utah requires all incoming new and transfer students to meet with an advisor before registering for classes. Additionally, students will need to make mandatory advising appointments once during their freshmen year, their second year, and again in order to apply for graduation. University College advisors are also available to assist students with additional majors or minors, and answer questions about general education and bachelor degree requirements.

The School also has a faculty advisor who can answer questions about any of the above, as well as more technical issues, such as career decisions and equivalence of transfer classes.

The School of Computing receptionist (MEB 3190, 581-8224) will be happy to set up an appointment for you to meet with either the faculty advisor or the academic advisor. Please call University College at 801-581-8146 to set up a general advising appointment.

EMPLOYMENT OPPORTUNITIES

The School of Computing employs a number of junior and senior students as computer operators and as teaching assistants. These jobs involve no more than 20 hours of work per week at an appropriate hourly wage. Appointments are made each semester

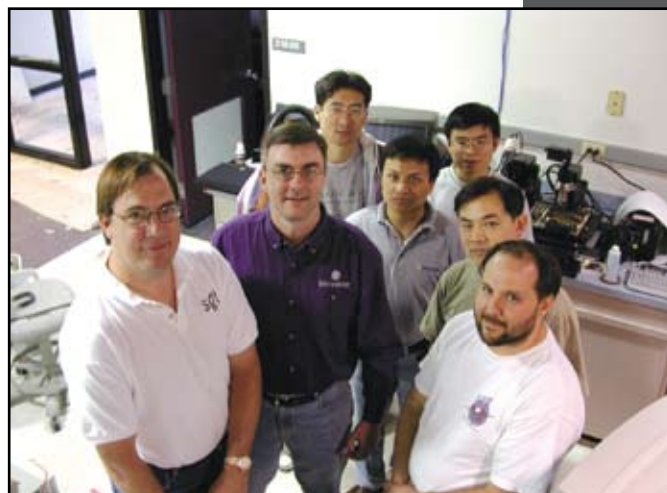
Academic Support

based on student applications, which should be submitted prior to the start of each term. These applications are available on the Web . In addition, general inquiries are received periodically from local industry and from University research groups for students who are interested in working part or full time. These are emailed to all computer science and computer engineering majors. More information may be obtained from the faculty advisor.

Students seeking employment upon graduation should contact the University Office of Career Services in order to be included on a list supplied to employers. Students not planning to work towards an advanced degree should register with Career Services during their junior year, since most companies begin interviewing during the fall semester (www.careers.utah.edu). Each year, Career Services hosts a general career fair during spring and summer semesters, as well as a separate Science and Engineering Fair in the fall. Computer Science students are encouraged to attend both fairs to begin networking and interviewing with potential employers.

ENGINEERING TUTORING CENTER

The College of Engineering recently started an engineering specific tutoring center. First and second year engineering students frequently take a heavy class load of chemistry, physics, and calculus. Even the best students need a little help with these subjects from time to time. The engineering tutoring center is staffed with junior and senior engineering students that offer academic help as well as experience. The engineering tutors are able to help students not only understand the subject, but understand how the information will pertain to their future engineering studies.



Open tutoring labs are available throughout the week in WEB 1622. Schedules are posted weekly on the whiteboard in this room. More information on tutoring hours and availability can be found at www.eng.utah.edu/tutoring.

STUDENT AFFAIRS

Student Affairs at the University houses several other student support resources ranging from health and wellness to counseling services and child care. For more information, please visit www.sa.utah.edu.

Computer Science Courses

The number and title of each course is followed by the number of semester hours it carries, the semester(s) during which it is taught (F=fall, S=spring, U=summer), its pre-requisites, its co-requisites, and any courses with which it is cross-listed.

Where a course has both a 5000-and 6000-level number, the 5000-level version is intended for undergraduates, and the 6000-level version is for honors and graduate students. The two versions of the class will meet together, but extra work will be expected of honors and graduate students. Additional credit toward the bachelor's degree will not be given for taking a 6000-level course after taking the 5000-level version. Courses that have only 6000-level numbers may be taken by graduate and advanced undergraduate students.

Some elective classes are not offered every year. Check the online schedule or talk to the computer science academic advisor to see which classes will be offered in upcoming semesters. For a complete list of courses and course descriptions, visit the School of Computing online at www.cs.utah.edu.

COURSE/ CREDITS/ SEMESTER OFFERED/ PREREQS F=Fall, S=Spring, U=Summer

1000 Engineering Computing/ 3/ FS/ Coreq: CS 1010, MATH 1210
1001 Engineering Computing using MATLAB /1.5/ FS/ Coreq: CS 1010, MATH 1210
1010 Introduction to Unix/ 0.5/ FSU
1020 Introduction to Programming in C++/ 3
1021 Introduction to Programming in Java/ 3
1040 Creating Interactive Web Content/ 3/ FS
1050 Computers in Society/ 3, FS
1060 Explorations in Computer Science/ 3/ FS
1410 Introduction to Computer Science I/ 4/ FS/ Coreq: MATH 1210, CS 1010
2000 Introduction to Programming in C/ 4/ F/ Coreq: MATH 1210, CS 1010
2100 Discrete Structures/ 3/ F/ Prereq: CS 1410
2420 Introduction to Computer Science II/ 4/ SU/ Prereq: CS 1410
3010/3011 Industry Forum/ 1/ F
3100 Models of Computation/ 3/ F/ Prereq: CS 2420, CS 2100
3130 Engineering Probability and Statistics/ 3/ F/ Prereq: Math1220
3200 Scientific Computation/ 3/ S/ Prereq/ CS 2420, MATH 2210
3500 Software Practice I/ 4/ F/ Prereq: CS 2420
3505 Software Practice II/ 3/ S/ Prereq: CS 3500
3650 3D Modeling for Video Games and Machinima/ 3/ F
3660 Interactive Machinima/ 3 / S
3700 Fundamentals of Digital System Design/ 4/ S, Prereq: CS 1410, PHYCS 2220

Computer Science Courses

3710 Computer Design Laboratory/ 3/ F/ Prereq: CS/ECE 3700, CS/ECE 3810
3810 Computer Organization/ 4/ F/ Prereq: CS 2420 or CS 2000
3950 Independent Study/ 1–4
3960 Special Topics/ 1–4/
3991 Computer Engineering Junior Seminar/ 0.5/ F/ Prereq: CE major status
3992 CE Pre-Thesis/Pre-Project/ 1/ S/ Prereq: CS/ECE 3710, 3991, CE major status
4005 Honors Research Practice/ 3/ S/ Prereq: CS 3500 and admission to CS Honors track
4010 Teaching Introductory Computer Science/ 1/ FS/ Prereq: Permission of instructor
4150 Algorithms/ 3/ S/ Prereq: CS 2100, CS 3500
4400 Computer Systems/ 4/ F/ Prereq: CS 3500, CS 3810
4500 Software Engineering Laboratory/ 3/ S/ Prereq: CS 3505, senior standing in CS
4540 Web Software Architecture/ 3/ S/ Prereq: CS 3505
4550 Simulation/ 3/ F/ Prereq: CS 3505
4710 Computer Engineering Senior Project/ 3/ F/ Prereq: CS/ECE 3710, 3992, 5780
4950 Independent Study/1–4
4960–4964 Special Topics/1–4
4970 Computer Science Bachelors Thesis/ 3/ Prereq: Senior standing in CS
4991 CE Senior Thesis I/ 2/ F/ Prereq: CS/ECE 3992 and approved senior thesis proposal
4992 Computer Engineering Senior Thesis II/ 2/ S/ Prereq: CS/ECE 4991
5010 Software Practice I/ 4/ F/ Prereq: CS 2420 and permission of instructor
5020 Software Practice II/ 3/ S/ Prereq: CS 5010 and permission of instructor
5100 Foundations of Computer Science/ 3/ S/ Prereq: CS 3100, CS 4150
5150 Advanced Algorithms/ 3/ F/ Prereq: CS 4150, CS 3130, Math 1220
5160 Computational Geometry/ 3/ Prereq: CS 4150 or 5150
5300 Artificial Intelligence/ 3/ S/ Prereq: CS 3505
5310 Robotics/ 3/ F/ Prereq: CS 1000, MATH 2250, PHYCS 2210
5320 Computer Vision/ 3/ F/ Prereq: CS 3505, MATH 2210, MATH 2270
5340 Natural Language Processing/ 3/ F/ Prereq: CS 3505
5350 Machine Learning/ 3/ F/ Prereq: CS 2100, CS 2420; CS 5300 recommended
5460 Operating Systems/ 4/ F/ Prereq: CS 4400
5470 Compiler Principles and Techniques/ 4/ S/ Prereq: CS 3100, CS 4400
5480 Computer Networks/ 3/ F/ Prereq: CS 4150, CS 4400
5510 Programming Language Concepts/ 3/ F/ Prereq: CS 3500
5520 Anatomy of a Modern Programming Language/ 3/ S/ Prereq: CS 5510
5530 Database Systems/ 3/ F/ Prereq: CS 3500
5600 Introduction to Computer Graphics/ 3/ S/ Prereq: CS 3500, MATH 2250 or 2270
5610 Interactive Computer Graphics/ 3/ F/ Prereq: CS 5600
5630 Scientific Visualization/ 3/ F/ Prereq: CS 3505; CS 3200 or CS 6210 or MATH 5600
5710 Digital VLSI Design/ 4/ F/ Prereq: CS 3700, CS 3810 recommended
5720 Analog Integrated Circuit Design/ 3/ S/ Prereq: ECE 3110
5740 Computer-Aided Design of Digital Circuits/ 3/ S/ Prereq: CS/ECE 3700, CS 4150
5745 Testing and Verification of Digital Circuits/ 3/ Prereq: ECE/CS 3700

Computer Science Courses

5750 Synthesis, Verification of Asynchronous VLSI Systems/ 3/ Prereq: CS/ECE 3700, 3505
5780 Embedded System Design/ 4/ S/ Prereq: CS/ECE 3810, CS 2000 or 4400
5785 Advanced Embedded Systems/ 4/ F/ Prereq: CS/ECE 5780
5830 VLSI Architecture/ 3/ S/ Prereq: CS/ECE 3700, CS/ECE 3810
5950 Independent Study/ 1–4
5960–5969 Special Topics/ 1–4
6020 Conducting, Presenting Early-Career Research/ 3/ Prereq: Grad standing in CS
6100 Foundations of Computer Science/ 3/ S/ Prereq: CS 3100, CS 4150
6110 Formal Methods for System Design/ 3/ S/ Prereq: CS 5100/6100
6210 Advanced Scientific Computing I/ 3/ F/ Prereq: CS 3200, CS 3505, MATH 3150
6220 Advanced Scientific Computing II/ 3/ S/ Prereq: CS 6210 or MATH 5600
6230 High Performance Parallel Computing/ 3/ S/ Prereq: Programming in C/C++
6300 Artificial Intelligence/ 3/ S/ Prereq: CS 3505
6310 Robotics/ 3/ F/ Prereq: CS 1000, MATH 2250, PHYCS 2210
6320 Computer Vision/ 3/ S/ Prereq: CS 3505, MATH 2210, MATH 2270
6340 Natural Language Processing/ 3/ F/ Prereq: CS 3505
6350 Machine Learning/ 3/ F/ Prereq: CS 2100, CS 2420; CS 6300 recommended
6360 Virtual Reality/ 3/ S/ Prereq: CS 5310/6310
6370 Geometric Computation for Motion Planning/ 3/ F/ Prereq: CS 1020, MATH 2250
6380 Multiagent Systems/ 3/ S/ Prereq: See instructor
6460 Operating Systems/ 4/ F/ Prereq: CS 4400
6470 Advanced Topics in Compilation/ 3/ F/ Prereq: CS 5470
6480 Computer Networks/ 3/ F/ Prereq: CS 4150, CS 4400
6490 Network Security/ 3/ S/ Prereq: CS 5480/6480
6510 Functional Programming/ 3/ F/ Prereq: CS 3100, CS 5510
6530 Database Systems/ 3/ F/ Prereq: CS 3500
6540 Human/Computer Interaction/ 3/ F/ Prereq: CS 3500
6610 Advanced Computer Graphics I/ 3/ F/ Prereq: CS 5600
6620 Ray Tracing/ 3/ S/ Prereq: CS 5610/6610
6630 Scientific Visualization/ 3/ F/ Prereq: CS 3505; CS 3200 or CS 6210 or MATH 5600
6640 Image Processing/ 3/ S/ Prereq: CS 2420, MATH 2250
6670 Computer-Aided Geometric Design I/ 3/ F/ Prereq: MATH 2210, 2250, CS 3505
6680 Computer-Aided Geometric Design II/ 3/ Prereq: CS 6670
6712 Digital IC Projects Testing/ 1/ F/ Prereq: CS/ECE 6710
6720 Advanced Integrated Circuit Design II/ 3/ S/ Prereq: ECE 3110
6721 Analog Integrated Circuits Lab/ 1/ S/ Coreq: CS 6720
6722 Analog Integrated Circuits Project Testing/ 1/ F/ Prereq: CS/ECE 6720
6740 Computer-Aided Design of Digital Circuits/ 3/ S/ Prereq: CS/ECE 3700, CS 4150
6750 Synthesis, Verification of Asynchronous VLSI Systems/ 3/ F/ Prereq: CS3700, 3505
6760 Modeling, Analysis of Biological Networks/ 3/ F/ Prereq: See instructor
6770 Advanced Digital VLSI Systems Design/ 3/ Prereq: CS6710, instructor permission
6780 Embedded System Design/ 4/ S/ Prereq: CS/ECE 3810, CS 2000 or 4400

Computer Science Courses

6785 Advanced Embedded Systems/ 4/ F/ Prereq: CS/ECE 5780/6780

6810 Computer Architecture/ 3/ F/ Prereq: CS/ECE 3810

6830 VLSI Architecture/ 3/ S/ Prereq: CS/ECE 3700, CS/ECE 3810

6960–6969 Special Topics/ 1–4

7010 Writing Research Proposals/ 2/ S/ Prereq: Graduate standing in Computer Science

7120 Information-Based Complexity/ 3/ Prereq: CS 3200, MATH 2270, MATH 3210

7240 Sinc Methods/ 3/ S/ Prereq: CS 6210 or MATH 5600 or MATH 5610

7250 Advanced Topics in Scientific Computing/ 3/ F/ Prereq: CS 6220

7310 Advanced Manipulation and Locomotion/ 3/ Prereq: CS 6310 or ME 6220

7320 System Identification for Robotics/ 3/ Prereq: CS 5310/6310 or ME EN 5220/6220

7460 Distributed Operating Systems/ 3/ Prereq: CS 5460, CS 5480/6480

7520 Programming Language Semantics/ 3/ S/ Prereq: CS 3100, CS 5510

7650 Realistic Image Synthesis/ 3/ F/ Prereq: CS 6620, CS 6670, MATH 5010

7810 Advanced Computer Architecture/ 3/ S/ Prereq: CS/ECE 6810

7820 Parallel Computer Architecture/ 3/ S/ Prereq: CS/ECE 6810

7960–7969 Special Topics/ 1–4



School of Computing

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