

COMPUTER SCIENCE

Looking at technology today, it is hard to believe that the first computers were developed only half a century ago. Computers are everywhere, and much of modern engineering involves the application of computer technology. The undergraduate major in computer science offers a broad and rigorous training for students interested in the science of computing. The track structure of the CS program also allows you to pursue the area(s) of CS you find most interesting while giving you a solid overall foundation in the field.

Many students obtaining a BS in CS will go on to work in industry or do graduate work in a branch of CS such as artificial intelligence, robotics, software design, graphics, theory, or hardware design. But CS is not just for future computer scientists. There is an increasing demand for people trained in CS and some other field. If you are interested in working as a manager of a high-tech company, a BS in CS along with an MBA is a great combination. If you want to work on court cases involving software piracy, you will be well served by a BS in CS combined with a JD. Similar opportunities exist for those who combine a BS in CS with an MD or other graduate degree.

The minimum major in computer science consists of 96 units, including 26 units of math, 11 units of science, 13 units of engineering fundamentals, one course in TIS (Technology in Society), and 43 units of core depth. After learning essential programming techniques in CS106 (via the CS106A/B/X courses) and the mathematical foundations of computer science in CS103, the computer science major offers coursework in areas such as artificial intelligence, biocomputation, graphics, human-computer interaction, information, systems, and theory.

The Computer Science Department also participates in three interdisciplinary majors: Computer Systems Engineering, Mathematical and Computational Sciences, and Symbolic Systems.

UNDERGRADUATE RESEARCH OPPORTUNITIES

In addition to the honors program in CS (discussed later in this handbook), there are many opportunities for undergraduates to get involved in research. Here is a partial list:

CURIS (Undergraduate Research in Computer Science)

Each summer undergraduates work with CS faculty through the summer research college. Interested students apply for positions during the winter quarter, and CURIS decisions are then made and offers sent out before spring quarter begins. These positions are fully-funded and provide invaluable experience in cutting-edge research. All CS and CSE students are notified via email of CURIS opportunities and the application process.

Research Opportunities for Computer Science Undergraduates

At the beginning of each academic year CS faculty are asked to provide a list of ongoing research projects that are appropriate for undergraduate involvement. Descriptions of the projects are listed at <http://curis.stanford.edu/research.html> (don't let the 'curis' fool you; this is not the web site for the summer CURIS program).

Research Tour/Lunch Series

Each year the CS department offers research lab tours and luncheons specifically geared toward undergraduates. These tours allow students to experience first-hand what goes on in a lab, and the luncheons provide an opportunity for students to discuss interests with research faculty. Past tours included the AI Robotics Lab, the IRoom and the Graphics Lab.

Research Seminars and Talks

At various times throughout the year the CS department hosts talks and presentations on various research and technology topics. In addition to these one-time events, there are regularly scheduled seminars which are open to undergraduates. Many of these seminars are available as a 1 unit, 500-level courses, but enrollment is not required for attendance.

For students interested in Pursuing a Research-Oriented Undergraduate Program:

Freshman and Sophomore Year

Students interested in pursuing research should plan to finish the majority of the CS core (CS 103, 106, 107, 109, 110, and 161) by the end of the sophomore year. If you already have an idea of the area in CS you'd like to pursue, you may find these course suggestions useful:

If you're considering...	...make sure to take these freshman/sophomore year
Possible AI courses	CS 109
Possible graphics courses	Math 51 and/or Math 104
Possible theory courses	CS 109, CS 154, or CS 161

Students doing summer research through CURIS should expect to take a course or two spring quarter to prepare them for their research project.

Junior Year

During the junior year students considering research can take one of the following sequences:

Field of Interest	Fall	Winter	Spring
Artificial Intelligence	221	Any 22x	Coursework suggested by CURIS advisor
Databases	145	245	
Graphics	248*	448	
Human-Computer Interaction	147	247	
Systems	144	140	
Theory	157 and 161	256 or 259	

* Students should take Math 51 or Math 103 before taking CS 248.

Students doing summer research through CURIS should expect to take a course or two spring quarter to prepare them for their research project.

Senior Year

At the end of the junior year students who qualify are encouraged to apply for the CS honors program (see the Computer Science ‘honors’ section later in this handbook). Students who are accepted spend the senior year exploring a research topic in depth and writing an honors thesis. Alternatively, students may choose to take CS 294 if they do not have a specific project in mind but wish to contribute to active research.

Note: The above are meant to be taken only as suggestions. If you have questions, contact the CS course advisor at advisor@cs.stanford.edu.

REQUIREMENTS

Course	Title	Units	Quarter	Year
Mathematics (26 units minimum)				
MATH 41	Calculus ¹	5	A	Fr
MATH 42	Calculus ¹	5	AW	Fr
CS 103	Mathematical Foundations of Computing ²	5	W	Fr
CS 109	Introduction to Probability for Computer Scientists ³	5	S	So
Mathematics electives ⁴		6		
Science (11 units minimum)				
PHYSICS 41	Mechanics	4	W	Fr
PHYSICS 43	Electricity and Magnetism	4	S	Fr
Science Elective ⁵		3		So/Jr
Engineering Fundamentals (13 units minimum)				
ENGR 40	Introductory Electronics	5	AS	So
CS 106B <i>or</i>	Programming Abstractions	5	WS	Fr/So
CS 106X	Programming Abstractions (Accelerated)	5	AS	Fr/So
Fundamentals Elective (see list of approved courses in Fig. 3-4; may not be 106A, B or X)				
Technology in Society (One course, 3-5 units)				
<i>See list of approved courses in Figure 3-3.</i>				
Writing in the Major (One course)				
<i>CS 181, CS 191W, CS 194 and CS 294W fulfill the "Writing in the Major" requirement.</i>				
Core (14 units)				
CS 107	Computer Organization and Systems ⁶	5	AS	So
CS 110	Principles of Computer Systems ⁷	5	S	So/Jr
CS 161	Design and Analysis of Algorithms	4	AW	So/Jr
Senior Project: CS 191, 191W, 194, 294, or 294W ⁸		3		Sr
Depth: Choose one of the following tracks: minimum of 7 courses (26 units minimum required)				
Artificial Intelligence Track:				
a) CS 221				
b) Any two of: CS 223A, 223B, 224M, 224N, 226, 227, 228, 229				
c) One additional course from category (b) or the following: CS 205A, 222, 224S, 224U, 225A, 225B, 227B, 262, 276, 277, 279, 321, 326A, 327A, 329 (with advisor approval), 374, 379 (with advisor approval); EE 263, 376A; Eng 205, 209A; Ling 180; MS&E 251, 339, 351; Stat 315A, 315B				
d) Track Electives: At least three additional courses selected from (b), (c), the general CS electives list ⁹ , or the following: CS 275, 278; EE 364A, 364B; Econ 286; MS&E 252, 352, 355; Phil 152; Psych 202, 204A, 204B; Stat 200, 202, 205				
Biocomputation Track: (see Biocomputation Track program sheet; Mathematics, Science, and Engineering Fundamentals requirements are non-standard)				
Graphics Track:				
a) CS 248				
b) Any one of ¹⁰ : CS 205A; CME 104, 108; Math 52, 113				
c) Any two of: CS 164, 178, 205B, 223B, 268, 348A, 348B, 448				
d) Track Electives: At least three additional courses selected from (b), (c), the general CS electives list ⁹ , or the following: ArtStudio 60, 70, 179; CS 48N, 326A; CME 302, 306, 324; EE 262, 264, 278, 368; ME 101; Psych 30, 221; STS 144				
CS tracks continues on next page				

<p>Human-Computer Interaction Track:</p> <p>a) CS 147, 247</p> <p>b) Any one of: CS 148, 248, 376, 377, 378</p> <p>c) Any one of: CS 108, 140, 221, 223B, 229, 249A</p> <p>d) Any one of: PSYCH 55, 252; MS&E 184; ME 101, 115</p> <p>e) Track Electives-At least two additional courses selected from (b) [only one of CS 148 or 248 may be counted], (c), (d), the general CS electives list⁹, or the following: ARTSTUD 60; COMM 269; CME 340; CS 447 (with permission of undergraduate advisor), 448B (with permission of undergraduate advisor); LING 180; ME 118; MS&E 216A; PSYCH 205, 221</p>
<p>Information Track:</p> <p>a) CS 124, 145</p> <p>b) Two courses, which must be from different areas below:</p> <p>i. Information-based AI applications: CS 224N, 224S, 229</p> <p>ii. Database and Information Systems: CS 140, 240D, 245, 345, 346, 347</p> <p>iii. Information Systems in Biology: CS262, 270, 274</p> <p>iv. Information Systems on the Web: CS 276, 364B</p> <p>c) At least three additional courses selected from (b) or the general CS electives list⁹</p>
<p>Systems Track:</p> <p>a) CS 140</p> <p>b) One of: CS 143 or EE 108B</p> <p>c) Two additional courses from category (b) or the following: CS 144, 145, 155, 240, 240C, 240D, 242, 243, 244, 245; EE 271, 282</p> <p>d) Track Electives: At least three additional courses selected from (c), the general CS electives list⁹, or the following: CS 240E, 240X, 244C, 244E, 315A, 315B, 343, 344, 344E, 345, 346, 347, 349 (with permission of undergraduate advisor), 448; EE 382A, 382C, 384A, 384B, 384C, 384S, 384X, 384Y</p>
<p>Theory Track:</p> <p>a) CS 154</p> <p>b) Any one of: CS 164, 255, 258, 261, 268, 361A, 361B, 365</p> <p>c) Two additional courses from category (b) or the following: CS 143, 155, 156, 157 or Phil 151, 205A, 228, 242, 256, 259, 262, 354, 355, 357, 358, 359 (with permission of undergraduate advisor), 364A, 364B, 369 (with permission of undergraduate advisor), 374; MS&E 310</p> <p>d) Track Electives: At least three additional courses selected from (b), (c), the general CS electives list⁹, or the following: CME 302, 305; Phil 152</p>
<p>Unspecialized Track:</p> <p>a) CS 154</p> <p>b) Any one of: CS 140, 143</p> <p>c) One additional course from (b) or the following: CS 144, 155, 240D, 242, 244; EE 108B</p> <p>d) Any one of: CS 121 or 221, 223A, 223B, 228, 229</p> <p>e) Any one of: CS 145, 147, 148 or 248, 262</p> <p>f) At least two courses from the general CS electives list⁹</p>
<p>Individually Designed Track: Students may propose an individually designed track. Proposals should include a minimum of seven courses, at least four of which must be CS courses numbered 100 or above</p>

Notes:

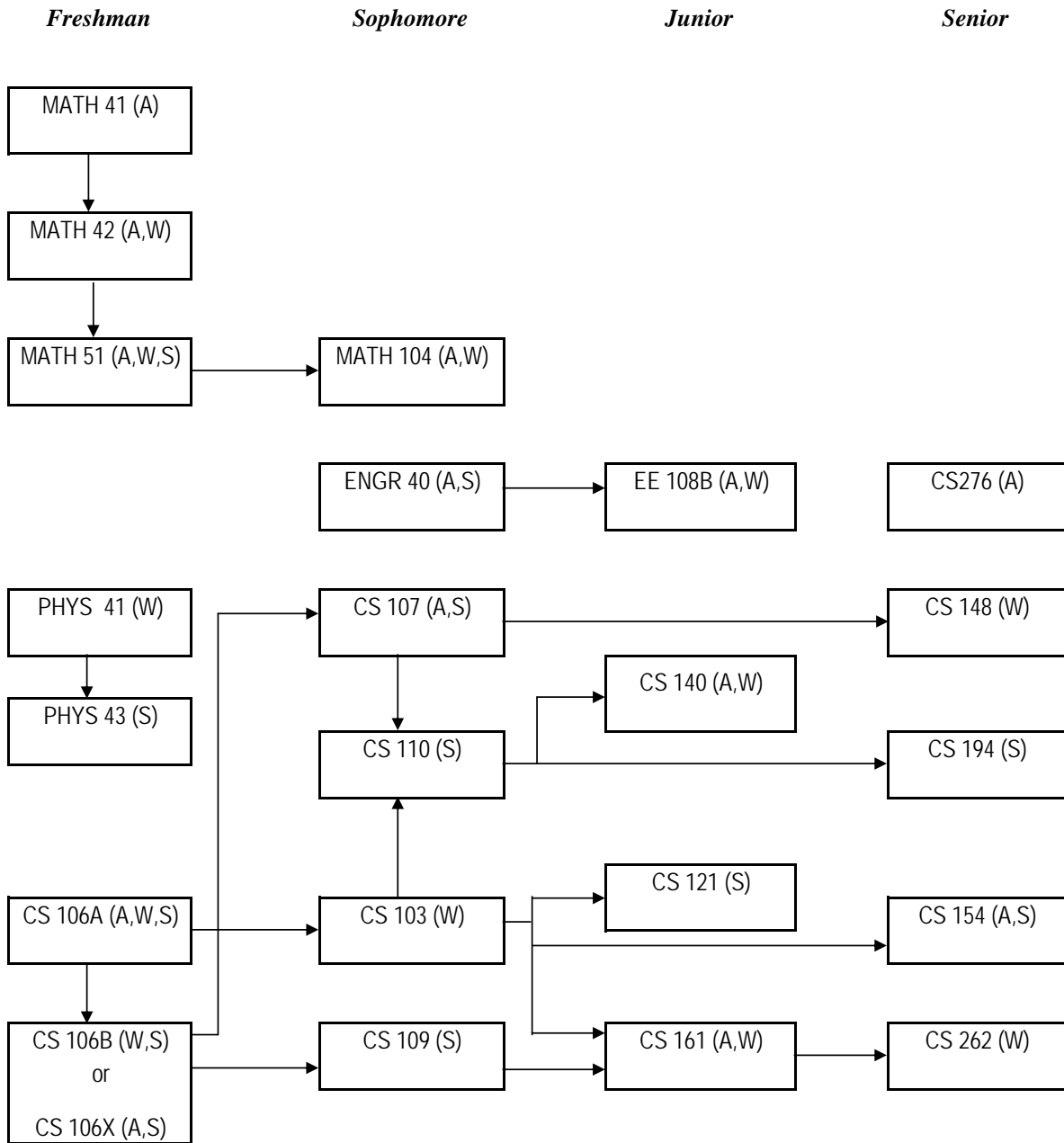
1. MATH 19, 20 and 21 may be taken instead of MATH 41 and 42, as long as at least 26 math units are taken.
2. Students who have taken either CS 103X or CS 103A, B are considered to have satisfied the CS 103 requirement. Students who took CS 103X are required to complete one additional unit in their track or elective courses (i.e., 27 total units for track and elective courses).
3. Students who complete STATS 116, MS&E 120, or CME 106 in *Winter 2008-09 or earlier* may count that course as satisfying the CS 109 requirement. These same courses taken in *Spring 2008-09 or later* cannot be used to satisfy the CS 109 requirement.

4. The Mathematics electives list consists of: Math 51, 103, 104, 108, 109, 110, 113; CS 156, 157, 205A; Phil 151; CME 100, 102, 104. Completion of Math 52 and 53 will (together) count as one Math elective.
Restrictions: Math 51 and Math 103, or Math 51 and CME 100, or Math 103 and Math 113, or CS 157 and Phil 151, may not be used in combination to satisfy the Math electives requirement.
5. Any course of 3 or more units from the School of Engineering list of “Courses Approved for the Science Requirement” (Figure 3-2); PSYCH 30; PSYCH 55, or AP Chemistry credit may also be used. Either of the physics sequences 61/63 or 21/23 may be substituted for 41/43 as long as at least 11 science units are taken.
6. The name of CS 107 has changed. The previous CS 107 course titled *Programming Paradigms* also fulfills this requirement.
7. Students who complete CS 108 and either CS 140 or CS 143 by Winter Quarter 2008-09 or earlier may choose to count CS 108 as satisfying the CS 110 requirement. In such a case CS 108 may not also be counted as an elective and the student will be required to complete one additional unit in their track or elective courses (i.e., 27 total units for track and elective courses).
8. CS 191 and 191W independent study projects require faculty sponsorship and must be approved, in advance, by the advisor, faculty sponsor, and the CS senior project advisor (Robert Plummer or Patrick Young). A form bearing these signatures, along with a brief description of the project, should be filed with the department representative in Gates 182 the quarter before work on the project is begun.
9. General CS Electives: CS 108, 121 or 221, 124, 140, 142, 143, 144, 145, 147, 148 or 248, 154, 155, 156, 157 or Phil 151, 164, 205A, 205B, 222, 223A, 223B, 224M, 224N, 224S, 224U, 225A, 225B, 226, 227, 228, 228T, 229, 240, 242, 243, 244, 244B, 245, 247, 249A, 249B, 255, 256, 257, 258, 261, 262, 270, 271, 272, 273A, 274, 276, 277, 295; CME 108; EE 108B, 282
10. Of the category (b) options for the Graphics track, CS 205A is strongly recommended as a preferred choice. Note that students taking CME 104 are also required to take its prerequisite course CME 102.

Note: The online version of the UGHB is considered the definitive and final version of SoE requirements for each major. Since corrections or updates may have been made after this Handbook went to press in August 2008, download an online CS program sheet from ughb.stanford.edu to ensure you are using an accurate major plan.

Computer Science

Typical Sequence of Courses
Unspecialized Track



CS FOUR-YEAR PLANS —

Plans available at <http://ughb.stanford.edu> for the following CS tracks:

- **Artificial Intelligence**
- **Graphics**
- **Human-Computer Interaction**
- **Information**
- **Systems**
- **Theory**
- **Unspecialized**

INSTRUCTIONS FOR DECLARING MAJOR IN COMPUTER SCIENCE

1. Find an Advisor

For details see <http://csmajor.stanford.edu/ChoosingAdvisor.shtml>
 Find a CS professor or lecturer who verbally agrees to be your advisor. See
<http://csmajor/FacultyList.php> for a list of faculty members. You should meet with
 him or her in person, either in office hours or by appointment. Write your advisor's name
 here.

I have spoken and he/she has agreed
 to _____ to be my advisor.

2. Collect Folder and Declare on Axess

Print out a copy of your unofficial transcript from Axess (Academics → View Unofficial
 Transcript). *Please don't staple it.*

My folder includes an unofficial transcript from this quarter.

While you're on Axess, be sure to declare there. (Academics → Declare a Major/Minor).

I have declared on Axess.

3. Basic Information

Full Name	First	Middle	Last	
Name you go by:		Birth date:	Month:	Day: Year:
SUID #		E-mail _____@stanford.edu		
Major	<input type="radio"/> CS <input type="radio"/> CSE	Expected graduation	<input type="radio"/> 2011 <input type="radio"/> 2010 <input type="radio"/> 2009 <input type="radio"/> 2008 <input type="radio"/> Other:	
Date you came to see the Course Advisor:				

4. See the Course Advisor in Gates 160

Bring this form to the Course Advisor's office hours in **Gates 160**. The current quarter's
 office hours are posted at <http://csmajor.stanford.edu/WhoToSee.shtml>.

NOTE: There are no office hours during finals week, break, or summer quarter. It may take
 up to a week for a declaration to go through, so please plan accordingly! Juniors should do
 this before winter quarter.

**CS PROGRAM SHEETS FOR TRACKS OTHER THAN THE BIOCOMP TRACK ARE AVAILABLE
 ONLINE AT [HTTP://UGHB.STANFORD.EDU](http://ughb.stanford.edu)**

Stanford University ♦ School of Engineering
Computer Science
Biocomputation Track
2008-2009 Program Sheet

Final version of program sheet due to the department one month prior to the last quarter of senior year.

Follow all requirements as stated for the year of the program sheet used.

Name: _____
 Email: _____
 Date: _____

SU ID: _____
 Local Phone: _____
 Date B.S. expected: _____

Mathematics and Science Requirement

Dept	Course	Title	Transfer/AP Approval		Unit	Grade
			✓ if Transfer	Initials		
Mathematics (23 units minimum)						
MATH	41	Calculus (see note 1)			5	
MATH	42	Calculus			5	
CS	103	Mathematical Foundations of Computing (see note 2)			5	
CS	109	Introduction to Probability for Computer Scientists (see note 3)			5	
STAT		One of: Stat 141, 203, 205, 215, 225			3 to 5	
<i>Mathematics Unit Total (23 units minimum)</i>						

Science (22 units minimum)

PHYSICS	41	Mechanics			4	
CHEM	31AB or X	Chemical Principles			4 or 8	
CHEM	33	Structure and Reactivity			4	
BIO	41, 42 or	Principles of Biology or			10	
HUMBIO	2A, 3A	Genetics, Evolution and Ecology/Cell and Dev Biology			10	
<i>Science Unit Total (22 units minimum)</i>						
<i>(35 units min. Math/Sci combined)</i>						

Technology in Society Requirement (1 course required; see UGHB Figure 3-3 for approved list; see note 11)

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Engineering Fundamentals (8 units minimum)

CS	106	Programming Methodology (B or X)			5	
		Elective (see note 4)			3 to 5	
<i>Engineering Fundamentals Total (10 units minimum)</i>						

NOTES

- * This form is available as an Excel file at <<http://ughb.stanford.edu/>>. The printed form must be signed by the departmental representative. Changes must be initialed in ink.
 - * All courses listed on this form must be taken for a letter grade if offered by the instructor.
 - * Minimum Grade Point Average (GPA) for all courses in Engineering Fundamentals and Computer Science Depth (combined) is 2.0.
 - * Transfer and AP credits in Math, Science, Fundamentals, & TIS must be approved by the SoE Dean's Office. Transfer credits in Computer Science Depth must be approved by the Computer Science undergraduate program office.
 - * All courses listed on this form may only be included under one category. Delete courses not taken.
- (1) Math 19, 20 and 21 may be taken instead of Math 41 and 42 as long as at least 23 math units are taken.
 - (2) Students who have taken either CS 103X or CS 103A+ B are considered to have satisfied the CS 103 requirement. Students who took CS 103X are required to complete one additional unit in their track or elective courses (i.e., 23 units min. for track and elective courses).
 - (3) Students who complete STATS 116, MS&E 120, or CME 106 in *Winter 2008-09 or earlier* may count that course as satisfying the CS 109 requirement. These same courses taken in *Spring 2008-09 or later* cannot be used to satisfy the CS 109 requirement.
 - (4) One course required; may not be CS 106A, B or X. See Engineering Fundamentals Fig. 3-4 in the UGHB for approved list.

CS Biocomputation Program Sheet cont.

Biocomputation Track Core and Depth (39 units minimum).

Dept	Course	Title	Transfer/AP Approval			Unit	Grade	
			✓ if Transfer	Initials	Date			
Core (14 units minimum)								
CS	107	Computer Organization and Systems (see note 5)				5		
CS	110	Principlets of Computer Systems (see note 6)				5		
CS	161	Design and Analysis of Algorithms				4		
Depth (22 Units minimum)								
CS		One of: CS 121, 221, 223B, 228, 229				3 or 4		
CS		One of: CS 262, 270, 273A, 274, 275, 278, 279				3 or 4		
CS		One of (if not selected above) CS 121, 221, 223B, 228, 229, 262, 270, 273A, 274, 275, 278, 279, 145, 147, 148 or 248				3 to 5		
		Restricted Elective (see note 7)				3 or 4		
		Restricted Elective (see note 8)				3 or 4		
		Restricted Elective (see note 9)				3 to 5		
		Restricted Elective (see note 10)				3 to 5		
Seior Project (1 course required)								
CS		At least 3 units of 191, 191W, 194, 294 or 294W (see note 11)				3		
<i>Computer Science Core and Depth Total 39 units minimum)</i>								

Program Approvals

Departmental

Printed Name: _____

Date: _____

Signature: _____

School of Engineering (signature not required prior to graduation)

Printed Name: _____

Date: _____

Signature: _____

NOTES (continued from page 1)

- * Read all emails from the Office of Student Affairs; this is the SoE's only method of conveying key information to Eng majors.
- (5) The name of CS 107 has changed. The previous CS 107 course titled *Programming Paradigms* also fulfills this requirement.
- (6) Students who complete CS108 and either CS 140 or CS 143 by Winter Quarter 2008-09 or earlier may choose to count CS 108 as satisfying the CS 110 requirement. In such a case CS 108 may not also be counted as an elective and the student will be required to complete one additional unit in their track or elective courses (i.e., 23 units minimum for track and elective courses).
- (7) One course selected from either the Biomedical Computation (BMC) 'Informatics' electives list (go to <http://bmc.stanford.edu> and select 'Informatics' from the elective options), or from the general CS electives list: 108, 121 or 221, 124, 140, 142, 143, 144, 145, 147, 148 or 248, 154, 155, 156, 157 or Phil 151, 164, 205A, 205B, 222, 223A, 223B, 224M, 224N, 224S, 224U, 225A, 225B, 226, 227, 228, 228T, 229, 240, 242, 243, 244, 244B, 245, 247, 249A, 249B, 255, 256, 257, 258, 261, 262, 270, 271, 272, 273A, 274, 276, 277, 295; CME 108; EE108B,282
- (8) One course selected from the BMC 'Informatics' electives list (go to <http://bmc.stanford.edu>).
- (9) One course selected from either the BMC 'Informatics', 'Cellular/Molecular', or 'Organs/Organisms' electives lists.
- (10) One course selected from either the BMC 'Cellular/Molecular' or 'Organs/Organisms' electives lists.
- (11) The WIM requirement for Freshmen and Transfer students entering Fall 96 or later may be met by taking CS 181 as a Technology in Society course or through the Senior Project course (191W, 194, or 294W only).