



(2004-) Winter 2012 Computer Science Program – LSA

Electrical Engineering & Computer Science Department
Undergraduate Advising Office - CSE
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This brochure applies to students who entered the College of LS&A during or after Fall 2004.

Thank you for your interest in the EECS Department's Computer Science program! The fast rate of innovation in computer technology has created many new and exciting opportunities for students with Computer Science undergraduate degrees. Employment opportunities include positions in: game design, medicine, computer graphics, security, business management, consulting, software engineering, computer systems analysis, data communications administration, robotics, artificial intelligence, knowledge engineering, hardware development, and many others. Major employers of recent graduates include many prominent U.S. corporations and research laboratories, such as Amazon, Apple, AT&T, Cisco, Deutsche Bank, Electronic Arts (EA), Google, IBM, Intel, Microsoft, NASA, and PricewaterhouseCoopers (to name a few). In addition, an undergraduate degree in Computer Science provides opportunities for masters, doctoral, and professional studies in various fields.

Computer science is an exceptional field. Computers have been around for only 60 years while most other scientific disciplines have been around for centuries. Progress in computer science has been extraordinarily rapid during this period, and computers have had a profound impact on society. (Can you envision life without text messaging, cell phones, and Wii?) Computer science research has provided much of the intellectual foundation and creative energy that fueled that transformation, and it continues to be an extremely exciting field.

Getting Advice and Information

- The CS program advisors based in the EECS department do not provide any advice or guidance on meeting LSA requirements. Please review these periodically with an LSA advisor. Call 734-764-0332 to make an appointment with the LS&A Advising Office. (While general degree requirements should be reviewed with an LSA advisor, we recommend that you direct all questions about the CS program requirements to the CS advisors in the EECS Undergraduate Advising Office at 2808 CSE whenever possible.)
- It's a good idea to stop in and see an advisor each term even if you know what you want to take. Careful planning and frequent review of requirements will help ensure that you will have no problems at graduation time. We have faculty advisors who will be happy to help you--just make an appointment online at <https://www.eecs.umich.edu/eecs/undergraduate/index.html>.
- A lot of important information can be found on the EECS Web Pages; this should be your first stop if you have questions about registration procedures, course offerings, book lists, time schedules, advising hours, basic requirements, etc.
- When you declare, you will be automatically added to an email list of our majors. We send out announcements not only about courses and other academic matters, but also about job openings. Declared CS majors also have access to the Engineering Career Resource Center, for finding internships, co-ops, and post-graduation jobs!
- Because declaring the CS concentration can impact a LSA student's tuition charges, some students avoid declaring as long as possible, and at times purposely avoid the Advisors. This is a bad idea! Some of these students end up making mistakes in pursuing requirements that cost them an extra semester or two. And tuition has been known to be charged retroactively in some cases. It is in your best interest to seek advice early (and often), to use your time, energy, and tuition most expediently.
- Don't hesitate to stop in and ask for assistance anytime you need it. You can call 734-763-6563 or e-mail us: Kristi MacKenzie, Undergraduate Advising Office, CSE Advising Coordinator: ugadmin@eecs.umich.edu
Professor Edmund Durfee, Chief Program Advisor, CS-LSA: cslsaadvisor@umich.edu

THIS DOCUMENT DESCRIBES THE COMPUTER SCIENCE PROGRAM REQUIREMENTS FOR STUDENTS IN THE COLLEGE OF LITERATURE, SCIENCE, AND THE ARTS (LSA)

EECS offers two paths to the Computer Science undergraduate degree: one for students with the LSA College (CS-LSA) and another for students in the College of Engineering (CSE). For more information, please see: http://www.eecs.umich.edu/undergraduate/cs_vs_cslsa.html or contact the EECS Undergraduate Advising Office.

2004 (- Winter 2012) Computer Science - LSA

Program Information

Pre-Concentration Requirements.

To enroll in the LSA Computer Science (CS-LSA) program a student must first complete 5 pre-concentration courses. These are: MATH 115, MATH 116, MATH 215 (or 214 or 216*), EECS 203 (or MATH 465), and EECS 280. Performance in these classes is indicative of student aptitude for the Computer Science program, and students who do not perform well are discouraged from continuing. Students must achieve a 2.5 GPA over the 5 pre-concentration courses and have at least a C in each course. Students may repeat a pre-concentration course once, for a maximum of two attempts at each course, and only the final grade for the course will be used to compute the pre-concentration GPA. Only courses with grades of C+ or below can be repeated for this purpose.

*Note that MATH 215 is listed as a prerequisite for STATS 412

Concentration Program. Grades of C or better must be achieved in all courses taken to satisfy the concentration requirements.

1. Core Courses.

- a. *Computer Science:* EECS 281, EECS 370, EECS 376, EECS 496.
- b. *Probability and Statistics:* STATS 412 or STATS 426 or STATS 265/IOE 265 (see Note 1).
- c. *Major Design Experience (MDE):* A course approved as satisfying the MDE requirement (check with the department for current list of approved MDE courses). This is normally one of Upper-Level CS Technical Electives (see below).

2. Technical Communications. Three credits, including TCHNCLCM 300 (1 credit) and TCHNCLCM 497 (2 credits). [TCHNCLCM 497 must be taken concurrently with EECS 496 and a Major Design Experience (MDE) elective (see Note 2)].

3. Technical Electives. A minimum of 21 additional credits of technical electives are required, selected as follows:

- a. At least 16 of the 21 credits must be in approved *Upper Level CS Technical Electives* (this should include the MDE option you choose). An up-to-date list of approved Upper Level CS elective courses can be found later in this document. All 21 elective credits can be Upper Level electives, and students are encouraged to take more than the minimum of 16.
- b. A maximum of 5 of the required 21 technical elective credits may be chosen from the approved *Flexible Technical Electives*. These are courses in engineering, mathematics, or science that are approved as appropriate for CS students. A list of approved Flexible Technical Electives can be found later in this document. EECS 499 (Directed Study) taken with a CS faculty member is accepted as a Flexible Technical elective, but is limited to a maximum of 4 credits; any additional 499 credits count towards free electives.
- c. At least 18 of the 21 elective credits must be in CS courses listed (or the department CS elective lists) at 200-level and above. This means that if the student takes the minimum number of Upper Level CS Technical Electives, at least 2 credits of the Flexible electives must be in CS courses.

Note 1. Students entering the University prior to Fall 2005 may meet this requirement with MATH/STATS 425, but it is not recommended.

Note 2. Students entering the University prior to Fall 2005 may meet this requirement with TCHNCLCM 281 and 496, but it is not recommended.

ABET (Accreditation Board for Engineering and Technology) Laboratory Science Requirement. In order to meet accreditation standards for CS degree programs, all students seeking a CS degree must complete a minimum of 12 credits of NS (natural science) and this must include two courses with laboratories (typically totaling 10 credits). Credits used to meet this requirement may be counted toward LSA distribution requirements, but cannot be used towards Flexible Technical Electives in the concentration program. Meeting this requirement is mandatory for the CS degree.

2004 (- 2012) Computer Science - LSA

General Advice

Pay particular attention to...

1. **The rules stated in the Program Requirements, and the prerequisite chains for EECS courses.** Our program has a very full schedule, so mistakes in understanding the requirements or overlooking course sequencing can cost you additional semesters. The Laboratory Science requirement is especially important to take into account in your planning; if you do not meet this requirement, you will not be granted a CS degree. In case of doubt, please come in for advice at the EECS Undergraduate Advising office.
2. **The C grade rule for Concentration courses.** Required Pre-concentration or concentration courses with grades of C- or below must be retaken; concentration electives with grades of C- or below must either be retaken or replaced with a different acceptable elective. Don't let this surprise you when you think you are ready to graduate!
3. **Getting official information.** Many students get into serious trouble because they rely on information about requirements from the "grapevine" or their friends. Sometimes this information is timely and correct, but often it is confused and garbled rumors - we have multiple programs, old and new sets of rules, and sometimes grant individual exceptions to requirements when it makes sense for an individual student's plan of study. So, if you hear something of interest, don't assume it is right – contact us for the correct version.

Majoring, Step-by-Step

1. If you are a **transfer student** or are seeking course equivalency, see the page on this topic in this brochure.
2. Your first goal is to **meet the pre-concentration requirements**. Taking EECS 203 (Discrete Structures) [note: MATH 465 is an approved substitute] and EECS 280 (Programming) simultaneously often works well, and these are the two prerequisites for the "gateway" course, EECS 281 (Data Structures and Algorithms). Try to have the Math courses done by the time you complete 203 and 280. If you are having trouble meeting the pre-concentration GPA requirement, it is vital to meet with a CS advisor without delay.
3. **Take EECS 281 as soon as you can**, and declare the Computer Science concentration during that semester. Because the Upper Level CS Electives are open only to declared CS majors, declaring will allow you to register for the Upper Level Electives the next semester, which will help you get the choices you want as you finish the program.
4. **The Laboratory Science requirement is required to get the CS degree**, and must be completed by graduation. But you can take these courses at any convenient time; none of them are prerequisites for any required CS courses or Upper Level CS electives.
5. If you are interested in **Operating Systems and Networks (482/489)**, taking EECS 370 (Computer Organization) at the same time as EECS 281 will enable you to register the next semester for EECS 482 (Operating Systems) which is the prerequisite for EECS 489 (Networks). (Note: Historically EECS 281 & EECS 370 assign projects that are due the same week, sometimes the same day. If you tend to procrastinate, you may not want to take these two courses together. If you are organized and manage time well, there should be no problem taking both in the same term.)
6. We often advise students to avoid taking more than two courses at the same time that involve a lot of programming work. The advisors can help you make the best selection; peer advisors also have good insight into course workloads. Saving some of your LSA requirements for later semesters can help spread out the workload. **Here is a current student assessment of the programming load in our EECS courses:**
 - Extremely heavy load: EECS 381, 470
 - Heavy load: EECS 281, 482, 483, 487, 489, 494
 - Moderate load: EECS 270, 280, 370, 475, 477, 478, 481, 484, 485, 492, 493, 497
 - Light load: EECS 203, 285, 376

Rule of thumb: Extreme = 4 points, Heavy = 3 points, Moderate = 2 points, Light = 1 point. Don't take more than 5 points of programming unless you LOVE to burn the midnight oil every night! For details on how students ranked all EECS classes, visit: <http://www.eecs.umich.edu/eecs/undergraduate/survey>

7. It is a good idea to **save some of the Flexible Technical Elective credits for doing an EECS 499** (Directed Study) course in which you work with a professor on a project of mutual interest. A 499 is especially valuable if you are interested in graduate school. If one of your professors is doing work that is interesting to you, approach him or her to discuss this possibility. It is usually most valuable to do a 499 late in your program, when you have acquired knowledge and skills that contribute to the work, and have a clearer picture of what areas you are most interested in (you must be of senior standing to take 499, sophomores and juniors can take EECS 399 which will not count for flex. tech. credit, but may provide valuable research experience earlier on in your career).
8. All of our Upper Level Electives are challenging and substantial courses, and cover a wide variety of topics in computing. **The best way to choose your electives is have an idea about the kind of work or career path you want to pursue after getting your degree, and then choose the electives that will help you do it.** The best advice will often be from EECS faculty in your area of interest. We encourage you to discuss your elective choices with them, or the CS advisors. Some useful groups of electives are given later in this document.

(2004-) 2012 Computer Science Programs Research & Involvement Opportunities

Majoring in Computer Science at UM provides many exciting opportunities. These include:

Research: Participate in an Independent Study.

A great deal of leading-edge academic research is carried out at UM. If you show that you can do the work, you can get involved in this type of research as an undergraduate, which will provide you with extraordinarily valuable training for future work in the field. EECS 499 (independent study) counts as a Flexible Technical Elective (4 cr. max.). It is a great way to get a letter of reference for grad school. If one of your professors is doing work that is interesting to you, approach him or her to discuss this possibility. It is usually most valuable to do a 499 relatively late in your program, when you have acquired knowledge and skills that contribute to the work, and have a clearer picture of what areas you are most interested in. (But keep in mind that most grad school applications are due late December.)

Teaching: Become an Instructional Aid.

The discussion sections for EECS 182, EECS 183, EECS 280, and ENGR 100 (CSE-based) are led primarily by undergraduates. As a section leader, you will have the chance to teach the next generation of CSE majors and get them excited about computing. If you have done well in your CS courses and have an aptitude for and interest in teaching, you should contact the faculty covering the course.

Mentoring: Become a Peer Advisor.

Share your experiences with other undergraduates. If you are interested, check in with the Undergraduate Advising Office. There are opportunities at the department and college level as well as through numerous student organizations.

Getting Involved: Join an EECS Student Group

CSE Scholars: CSE Scholars at the University of Michigan is a student society for computer science and engineering students (CS-Eng, CS-LSA, and CE). CSE Scholars seeks to build a challenging and supportive diverse community of scholars. The group is organized into "Working Groups" which perform different functions for the group. The different groups are Program Development, Outreach, Recruiting and Retention, and Peer Advising. More information can be found at <http://www.eecs.umich.edu/~cseschol>

Getting Experience: Internships, Co-ops, and Job Opportunities

Many companies hire students for internships upon completion of EECS 280. Since CSE graduates are in great demand, many companies believe in getting potential hires into their company very early.

When looking for that perfect internship, co-op, or permanent job, your first step should always be to check in with the Engineering Career Resource Center (ECRC) to review their list of opportunities. The department forwards all job and internship postings to this office (see: <http://career.engin.umich.edu>). Note that CS-LSA students have full access to the ECRC *once they are declared*.

The EECS department has excellent connections to multiple local and national companies (many of which were founded by people connected with UM-EECS). Meet with your Faculty Career Mentor to discuss your options! For additional advice and more information about the department's Faculty Career Mentor program, see: <http://www.eecs.umich.edu/eecs/undergraduate/employment.html>

The **January Job Fair** is a great place to interview for internships. Again – make sure you register with the **Engineering Career Resource Center (ECRC)** and see: <http://career.engin.umich.edu> for more information.

2004 (-2012) Computer Science Program - LSA

Equivalency and Transfer Students

Below is information about getting CS course equivalency for courses taken elsewhere, and information more generally for students who have or plan to take CS courses elsewhere.

Process for seeking coursework equivalency:

1. If you have taken a CS course at another institution that you want counted toward satisfying a requirement for the CS concentration, your first step is to work with LSA to have the course and its credits appear on your transcript. Normally, if LSA grants credit, your transcript will reflect this as "Departmental Credit" with a course number ending in "X" such as "EECS 201X". *You cannot request course equivalency for a course that does not appear on your transcript, so make sure that this has occurred before continuing on to the next step.*
2. After the course is on your transcript, then you can come to CS advising to request that the "Departmental Credit" be changed to the EECS course that you believe is equivalent. The process involves filling out a form, and providing detailed material about the course that you took, including syllabus, book, handouts, *and especially the assignments and exams that you submitted and received back with grades.* These materials will be evaluated to determine whether the course you took covers similar material at sufficient depth to be considered equivalent.
3. It is important to realize that EECS courses are generally considered "intensive" compared to courses with similar names and topics at most other institutions. Therefore, unless the material supplied clearly demonstrates that the student took a similarly demanding course, it is unlikely that equivalency will be granted. Because of the heavy costs to a student if he or she is placed into a course for which he or she is underprepared, the advisors are very conservative in granting equivalency. Transfer credit is therefore only infrequently granted for pre-concentration and core CS courses. It is very rarely granted for upper-level CS electives, and a student cannot receive transfer credit for more than one upper-level CS elective.
4. Decisions about equivalency for courses in other subjects (math, science, etc.) are up to those departments. We cannot evaluate a course in another subject even if the course is part of our requirements.

Courses most likely and useful to transfer:

- Because most of our CS courses are very intensive, it is difficult to find equivalent courses elsewhere, so our advice is to plan on taking your CS courses at Michigan.
- More fruitful can be taking courses elsewhere to satisfy your LSA requirements. If you plan on a semester abroad, for example, take courses for LSA requirements that are enriched by being abroad (language, culture, politics).
- The pre-concentration math courses and the ABET science courses are also reasonable candidates. The most useful CS courses to take elsewhere would be a C++ programming course similar to EECS 183 that will help prepare you to take EECS 280, and some schools offer Discrete Math courses similar to EECS 203. Notice that our curriculum is primarily in C and C++, so Java-based courses elsewhere will not be equivalent to our core and upper-level elective courses, although they will be valuable background and may get credit for EECS 285.

If you are a Univ. of Michigan student considering taking some courses elsewhere:

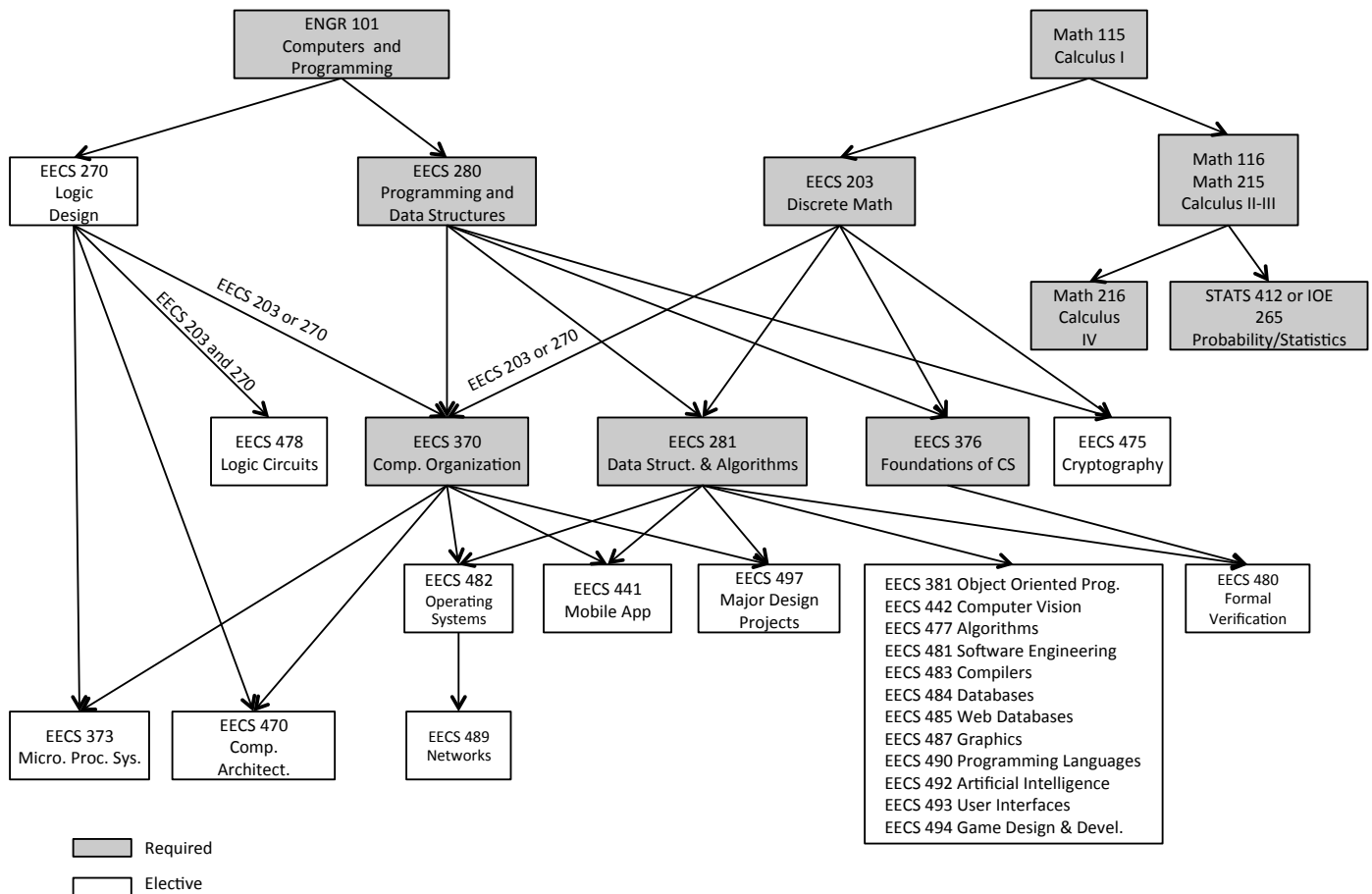
- As indicated above, it is generally hard to find CS courses elsewhere that are likely to be equivalent to Michigan's CS courses. To inquire about specific CS courses offered elsewhere, you can speak with an advisor. Note that we can only give rough likelihoods of course equivalency rather than any guarantees. Whether a course is equivalent will be determined from the materials you supply *after* completing the course, as described above.

If you are (or are considering) transferring to Michigan from elsewhere:

- Admissions for transfer students interested in CS are handled by the College of LSA (or Engineering). The College defines the processes and requirements for transferring. You should consult with the appropriate office at the College into which you want to transfer to get detailed information. Unfortunately, the CS advisors are not qualified to discuss these requirements and procedures.
- You are encouraged to meet with a CS advisor if you want to discuss aspects of the CS program (the curriculum, courses, opportunities, etc.). If you are still attending another school, this can include discussing how best to prepare to join the CS program after your transfer. If you have transferred, this can include discussing courses to take given your background.
- If you have transferred and are seeking equivalency for one or more CS courses taken at your previous institution(s), follow the procedure above. Do this as soon as possible (preferably before the beginning of your first semester at Michigan) so that you can start the right courses from the outset of your time here.

(2004-) 2012 Computer Science Programs

Prerequisite Chain and ABET Lab. Information



ABET (Accreditation Board for Engineering and Technology) requires that all students seeking an accredited CS degree must complete a minimum of 12 credits of natural science (NS) and this must include two courses with laboratories. The remainder of the 12-credit requirement can be met with any courses designated as NS. Credits used to meet this requirement may be counted toward LSA distribution requirements, but cannot be used towards Flexible Technical Electives in the Computer Science concentration program.

You must have the requirement completed by the time you graduate. There are no other requirements on when you take the courses. You must earn passing grades in the courses; *the "C or better" rule that applies to other CS Concentration courses does not apply to courses used to meet the Laboratory Science requirement, and they are not included in your Concentration GPA calculation.*

What fulfills the ABET Laboratory Science Course Requirement?

1. There must be two semesters of courses with each semester involving both a lecture course and a lab course. The lab course must be described as a lab course in the course catalog, and taking it at the same time as the lecture course needs to be either required or recommended in the course catalog. One course can be both the lecture course and the lab course if the catalog description says that it includes a lab (or a lab fee is charged), and the number of credits is large enough to be consistent with it being both a lab and regular lecture (i.e. at least 4).
2. There must be some concentration program in science or engineering that accepts the course as meeting the requirements for that degree, either as a required course or elective.

2004 (-2012) Computer Science Programs

Major Design Experience (MDE)

The time to take the Major Design Experience package is as a capstone in one of your final two semesters, in order to take the best advantage of the technical knowledge you have gained in all of your previous courses. Some students prefer the MDE in their final term, to maximize the prior coursework that they can bring to their project, while others prefer it in their next-to-final term so that they can point to this experience during job interviews in their final term.

To prepare for the MDE, be sure to take TCHNCLCM 300 your sophomore or junior year (a rule of thumb is the semester you take 281), and then be sure to take TCHNCLCM 497 and EECS 496 in the same semester as you take your Major Design Experience elective. TCHNCLCM 497 should coordinate with the MDE course to give you the most realistic preparation for real-world design and development work, in which communicating your ideas is critical to success. Similarly, EECS 496 should be taken the same semester as the MDE course.

To satisfy the MDE requirement, the following courses must be taken concurrently in the Senior year:

1. EECS 497 or approved alternative (see below), a capstone design project course.
2. Tech Com 497, a course on writing and oral presentation skills.
3. EECS 496, a lecture and discussion course on computer professionalism issues.

Descriptions:

EECS 497 is a 4-credit team design project course that allows students to work in teams to design and implement their own system or application in software. Teams of four are selected in order to foster diversity in background and training.

TCHNCLCM 497 is a 2-credit course on writing and oral presentation skills. The focus will be on the same documents the students are preparing for their design projects. TCHNCLCM 497 should coordinate with the MDE course to give you the most realistic preparation for real-world design and development work, in which communicating your ideas is critical to success. *Note: TCHNCLCM 300 is a prerequisite for this course, and should be taken in the Sophomore or Junior year.*

EECS 496 is a 2-credit lecture and discussion course that covers team building strategies and project management, ethics, entrepreneurial skills, intellectual property (patents and copyrights), social and environmental awareness, and life-long learning.

Current list of approved alternative 400-level design courses:

EECS 441 Mobile App Development for Entrepreneurs
EECS 470 Computer Architecture
EECS 481 Software Engineering
EECS 494 Computer Game Design and Development

If the MDE project course is listed as an Upper Level CS Technical Elective, then it counts as meeting both the MDE requirement and as an Upper Level CS Technical Elective. In the list above, note that EECS 441 is *not* a ULCS technical elective; however, it can be used to satisfy CS Flexible Technical Elective requirements.

Note:

Engineering 450 Multidisciplinary Design (4 credits) is acceptable for the MDE design project course. However, it will only count as a Flexible Technical Elective.

Students who elect approved MDE options that are not Upper Level CS Technical Electives will need to incorporate another Upper Level CS Technical Elective course into their schedules to meet the 16 credit upper-level CS requirement. Please see your CS Advisor with questions.

(2004-) 2012 Computer Science Programs

Upper Level CS Technical Electives

At least 16 of the Technical Elective credits must be in approved Upper Level CS Technical Electives. All the technical elective credits can be Upper Level electives, and we encourage students to take more than the minimum of 16.

Our Upper Level Electives cover a wide variety of topics in computing. All are challenging and substantial courses. The best way to choose your electives is to have an idea about the kind of work or career path you want to pursue after getting your degree, and then to choose the electives that will get you closer to your goals. The best advice will often be from EECS faculty in your area of interest. We encourage you to discuss your elective choices with these faculty or with a CS advisor. Some useful groups of electives appear below. Upper Level CS technical electives must be selected from the following list of EECS courses (approved MDE design project courses are highlighted in **bold**). EECS courses not in this list are not accepted as Upper Level CS electives. It is very rare for any course to transfer in as an ULCS.

373	Design of Microprocessor Based Systems	482	Introduction to Operating Systems
381	Object-Oriented and Advanced Programming	483	Compiler Construction
427	VLSI Design I	484	Database Management Systems
442	Computer Vision	485	Web Database and Information Systems
470	Computer Architecture	487	Interactive Computer Graphics
475	Introduction to Cryptography	489	Computer Networks
477	Introduction to Algorithms	490	Programming Languages
478	Logic Circuit Synthesis and Optimization	492	Introduction to Artificial Intelligence
480	Logic and Formal Verification	493	User Interface Development
481	Software Engineering	494	Computer Game Design and Development

Flexible CS Technical Electives

The following courses are approved as Flexible CS Technical Electives (flexible technical electives in other fields are on the next page). This list includes many courses at the graduate level (numbered 500 and above). Students with interests in research, graduate school, or specific areas should discuss graduate course options with the Chief Program Advisor, who *may* approve graduate courses on a per-student basis for use as ULCS (approval must be obtained prior to registering for the course).

270	Introduction to Logic Design	579	Digital System Testing
285	A Programming Language or Computer System	580	Advanced Computer Graphics
382	Internet-Scale Computing	581	Software Engineering Tools
441	Mobile App Development for Entrepreneurs	582	Advanced Operating Systems
497	EECS Major Design Projects*	583	Advanced Compilers
527	Layout Synthesis and Optimization	584	Advanced Database Systems
543	Knowledge-Based Systems	586	Design and Analysis of Algorithms
545	Machine Learning	587	Parallel Computing
547	Electronic Commerce	588	Computer and Network Security
567	Introduction to Robotics	589	Advanced Computer Networks
570	Parallel Computer Architecture	590	Advanced Programming Languages
571	Principles of Real Time Computing	591	Distributed Systems
573	Microarchitecture	592	Advanced Artificial Intelligence
574	Computational Complexity	594	Introduction to Adaptive Systems
575	Advanced Cryptography	595	Natural Language Processing
578	CAD Verification of Digital Systems		

* **EECS 497**: Beginning Fall 2013, this course will no longer count as ULCS. Students who take this course prior to Fall 2013 may count it as a ULCS. This change does not affect the status of EECS 497 as an MDE course; EECS 497 will still count toward the MDE requirement, if EECS 496 and TCHNLCM 497 are taken with it.

Note: EECS 398, 498, and 598 are the generic numbers for "Special Topics" courses. Individual sections may be approved for Upper Level CS elective credit and/or Flexible Technical elective credit. Whether the course is approved for ULCS and/or Flex Tech credit is normally part of the course announcement. See the Undergraduate Advising Office with questions about particular offerings.

Elective Groups

The CS programs have no official specializations, but we often advise students to consider the following groups of electives depending on their career interests. Some courses appear in more than one group; these are good choices if you aren't yet certain what area of computing you are most interested in.

Computer hardware: 270, 373, 470, 478

Computing infrastructure: 482, 483, 484, 489

Intelligent systems: 442, 492, 543

Software development: 381, 481, 482, 484, 493, 494

Theory of computation: 475, 477, 480

Web technology and applications: 285, 382, 475, 484, 485

(2004-) 2012 Computer Science & Computer Engineering Programs

Flexible Technical Electives

Listed below are some courses that meet the Flexible Technical Elective requirement for CS-Eng, CS-LSA, and CE. Other courses (including *special topics courses*, such as EECS 398 and 498) may be approved by the Curriculum Committees on a term-by-term basis. Please see the Undergraduate Advising Office with questions.

Directed/Independent Study Rule: At most 4 credits count toward the Flexible Technical Elective requirement. This applies to all independent/directed study or research courses (including those from other departments). Any additional credits count toward free electives.

Aerospace Engineering

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| 215 | Introduction to Solid Mechanics and Aerospace Structures | Any AEROSP course at the 300-level or higher [AEROSP 390 & 490: see Directed Study Rule above.] |
| 225 | Introduction to Gas Dynamics | |
| 245 | Performance of Aircraft and Spacecraft | |

Atmospheric, Oceanic and Space Sciences

Any AOSS course at the 300-level or higher [AOSS 499: see Directed Study Rule above.]

Biology

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| 305 | Genetics | Any BIOLOGY course at the 400-level or higher |
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Biomedical Engineering

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| 221 | Biophysical Chemistry and Thermodynamics | Any BIOMEDE course at the 300-level or higher [BIOMEDE 490: see Directed Study Rule above.] |
| 231 | Introduction to Biomechanics | |

Chemical Engineering

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| 230 | Material and Energy Balances | Any CHE course at the 300-level or higher [CHE 490: see Directed Study Rule above.] |
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Chemistry

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| 210 | Structure and Reactivity I | 241 Introduction to Chemical Analysis |
| 211 | Investigations in Chemistry | 242 Introduction to Chemical Analysis Laboratory |
| 215 | Structure and Reactivity II | 260 Chemical Principles |
| 216 | Synthesis and Characterization of Organic Compounds | Any CHEM course at the 300-level or higher [CHEM 398, 399, 498, & 499: see Directed Study Rule above.] |
| 230 | Physical Chemical Principles and Applications | |

Civil and Environmental Engineering

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|-----|--------------------------------|---|
| 211 | Statics and Dynamics | 260 Environmental and Sustainable Engineering Principles |
| 212 | Solid and Structural Mechanics | Any CEE course at the 300-level or higher [CEE 490: see Directed Study Rule above.] |
| 230 | Energy and Environment | |

Complex Systems

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| 270 | Agent Based Modeling | |
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Economics

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| 401 | Intermediate Microeconomic Theory (last term as a Flex Tech is Fall'13) | 406 Introduction to Econometrics |
| 402 | Intermediate Macroeconomic Theory (last term as a Flex Tech is Fall'13) | 409 Game Theory |

Electrical Engineering and Computer Science

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| 215 | Introduction to Electronic Circuits | Any EECS course at the 300-level or higher (<i>except</i> 398*, 399, 402, 406, 410, and 498*) [EECS 499: see Directed Study Rule above.] *each special topics course is reviewed for possible FTE/ULCS credit for the term/topic offered, see the Advising Office for details |
| 216 | Introduction to Signals and Systems | |
| 230 | Electromagnetics I | |
| 250 | Electronic Sensing Systems | |
| 270 | Introduction to Logic Design | |
| 285 | A Programming Language or Computer System | |

Engineering

- 350 Internat'l Lab Experience for Engineers
- 403 Scientific Visualization

- 450 Multidisciplinary Design
- 455 Multidisciplinary Design II

Industrial and Operations Engineering

- 201 Economic Decision Making (last term as a Flex Tech is Fall'12)
- 202 Operations Modeling

Any IOE course at the 300-level or higher (*except* 373 & 422) [IOE 490: see Directed Study Rule above.]

Linguistics

- 441 Computational Linguistics I (last term as a Flex Tech is Winter'12)

- 442 Computational Linguistics II

Materials Science and Engineering

- 220 Introduction to Materials and Manufacturing
- 242 Physics of Materials
- 250 Principles of Engineering Materials

Any MATSCIE course at the 300-level or higher [MATSCIE 490: see Directed Study Rule above.]

Mathematics

- 214 Linear Algebra and Differential Equations
- 216 Introduction to Differential Equations (CS-LSA only)
- 217 Linear Algebra

Any MATH course at the 300-level or higher (*except* 310, 327, 333, 385, 389, 399, 422, 429, 431, 485, 486, 489, 497)

Mechanical Engineering

- 211 Introduction to Solid Mechanics
- 235 Thermodynamics
- 240 Introduction to Dynamics and Vibrations
- 250 Design and Manufacturing I

Any MECHENG course at the 300-level or higher [MECHENG 490 & 491: see Directed Study Rule above.]

Molecular, Cellular, and Developmental Biology (MCBD)

- 306 Introductory Genetics Laboratory
- 310 Introductory Biochemistry

Naval Architecture and Marine Engineering

- 260 Marine Systems Manufacturing
- 270 Marine Design

Any NAVARCH course at the 300-level or higher [NAVARCH 490: see Directed Study Rule above.]

Nuclear Engineering and Radiological Sciences

- 211 Introduction to Nuclear Engineering and Radiological Sciences (last term as a Flex Tech is Fall'12)

250 Fundamentals of Nuclear Engineering and Radiological Sciences
Any NERS course at the 300-level or higher [NERS 499: see Directed Study Rule above.]

Operations & Management Science

- 605 Manufacturing and Supply Operations

Performing Arts Technology

- 451 & 452 Computer Music Programming I & II. = Total of 3 FTE credits.
- 461 & 462 Digital Sound Synthesis I & II. = Total of 3 FTE credits.

Physics

- 240 General Physics II (CS-LSA only)
- 241 Elementary Laboratory II (CS-LSA only)

Any PHYSICS course at the 300-level or higher (*except* 333, 334, and 420). [PHYS 496, 497, 498, 499: see Directed Study Rule above.]

School of Information

- 301 Models of Social Information Processing

- 422 Evaluation of Systems and Services

Statistics

- 406 Introduction to Statistical Computing
- 415 Data Mining and Statistical Learning
- 425 Introduction to Probability (cross-listed with MATH 425, cannot be double-counted with CE Program Core)

- 426 Introduction to Theoretical Statistics
- 430 Applied Probability
- 470 Introduction to the Design of Experiments
- 531 Analysis of Time Series

2004 (-2012) LSA Computer Science Program GPA Calculation & Honors Information

How to Calculate Your Concentration GPA

LSA requires that your concentration GPA be at least 2.0 in order to graduate. The following is the official procedure for calculating your Concentration GPA in the LSA CS program, following the guidelines supplied by LSA for what courses to include.

Include the following courses in the GPA calculation:

- All EECS courses that you have taken – regardless of how they were used to meet requirements.
- All non-EECS courses taken to complete a program requirement except for the three Pre-Concentration Math courses (e.g. Math 115, 116, 215) and the ABET Laboratory Science Requirement courses. That is, include the Tech Com courses, the statistics course (e.g. Stat 412), and all courses used to meet the elective requirements. A copy of the progress sheet in your EECS department file will help identify these.
- *Important:* If you repeated an included course, you must include *all* of the attempts in the GPA calculation. In what follows, “course” means each attempt at a course.

Do not include:

- The three Pre-Concentration Math courses (e.g. Math 115, 116, 215)
- Courses taken to meet the ABET Laboratory Science Requirement
- Any non-EECS courses not required by the CS program, such as LSA-only requirements
- Courses for which your transcript shows that you got AP or Transfer credit, or course attempts that show with a W (withdraw) grade - these have no grade to average in

Doing the calculation:

1. For each course to be included, determine from your transcript the number of credit hours the course was worth (e.g. 3 or 4). If your transcript shows "NFC" or no credit hours for a repeated course, use the credit hours shown for the first attempt.
2. For each course to be included, take the grade from the transcript, determine the point value of the grade (see table), and multiply the point value by the credit hours for the course. Sum these products. Include all attempts at a repeated course.
3. Calculate the total number of credit hours for the included courses, including all attempts at repeated courses.
4. Divide the sum of the products by the total number of credit hours. This is your Concentration GPA.

Grade Point Chart	
Grade	Grade Points
A+	4.0
A	4.0
A-	3.7
B+	3.3
B	3.0
B-	2.7
C+	2.3
C	2.0
C-	1.7
D+	1.3
D	1.0
D-	0.7
E	0.0

Honors Requirements

The Honors Program in Computer Science is open to LSA students completing the Computer Science B.S. degree program. You can earn an Honors degree in Computer Science without having been enrolled in the LSA Honors Program in your freshman or sophomore years.

Students wishing to complete an Honors degree in Computer Science must have: 3.2 or higher GPA in the five required pre-concentration courses (MATH 115, 116, 215, EECS 203/MATH 465 and 280), an overall GPA of 3.4 or higher (as required by LSA for Honors), and a final concentration GPA in Computer Science of 3.5 or higher. In addition, the required minimum of 18 credits of electives in Computer Science must be satisfied by Upper Level CS electives; no Flexible electives can be used to meet this requirement.

Prior to graduation, an Honors version of the Concentration Release form must be completed by a CS program advisor. After your final grades are in, the Chief Advisor will verify to LSA that your final concentration GPA meets the Honors Requirements.

Note: LSA Honors Advising

A student who joins the CS Honors Program and was not previously an LS&A Honors student will have his or her LS&A academic file moved to the LS&A Honors Office at 1228 Angell Hall. Thereafter, when making an appointment to meet with an LS&A Advisor, these students must specify that they are in the LS&A Honors Program so that the file will be available for the appointment.

COMPUTER SCIENCE LSA: 2004 (-2012) Concentration Progress Sheet

Last Name:	First Name:
UMID:	Unique Name / Email:
Trans. Inst.:	Date:

Pre-Concentration Requirements:						ABET Laboratory Science Req.: 12 cr.					
Subj.	Nbr.	Hr s.	Term	Grade	Note:	Students must complete two Natural Science courses with labs. Remaining credits must be fulfilled with any Natural Science course (to total 12 credits).					
MATH	115	4									
MATH	116	4									
MATH	215*	4									
EECS	203**	4									
EECS	280	4									
*or MATH 214, 216 or 217; NOTE: MATH 215 is a prerequisite for STATS 412 (see CS Program Core) **or MATH 465						Subj.	Nbr	Hrs	Term	Grade	Note:
Preconc. GPA (2.5 required):											

CS Program Core:						A number of course selections may fulfill the requirement: See a CS-LSA Program Advisor with questions. Note: ABET Lab. Sciences may be used to meet LSA Distribution requirements, but cannot be used as Flexible Technical Electives.					
Subj.	Nbr	Hrs	Term	Grade	Note:						
EECS	281	4									
EECS	370	4									
EECS	376	4									
STATS	412 ¹	3									
TCOM	300 ²	1									
TCOM	497 ²	2									
EECS	496	2									
Note 1: IOE 265 will fulfill this requirement; students entering prior to Fall 2005 may use MATH/STATS 425, but it is not recommended Note 2: Students entering prior to Fall 2005 may use TC 281/496, but it is not recommended											

Upper Level CS Electives: 16 cr. min. <input type="checkbox"/> MDE						LSA College Requirements					
Subj.	Nbr	Hrs	Term	Grade	Note:						

Flex. Tech. Elective: 5 cr. max. <input type="checkbox"/> 2 cr. CS req.						<i>LSA students must consult with their LSA college advisor in Angell Hall to discuss college requirements.</i>					
Subj.	Nbr	Hrs	Term	Grad	Note:						

Note: FTEs cannot be used for LSA Distribution Req.	
Total CTP:	Concentration GPA: