Computer Science Program – LSA

Fall 2012 – Summer 2019 Guide
Applies to students who enter the College of LSA <u>during or after Fall 2012</u>.

Thank you for your interest in the UM Computer Science – LSA program!

The fast rate of innovation in computer technology has created many new, 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, machine learning, 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), Facebook, Google, IBM, Intel, Microsoft, NASA, and PricewaterhouseCoopers (to name a few). Some students also join (or even found) start-ups! In addition, an undergraduate degree in CS 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 Wifi?) Computer science research has provided much of the intellectual foundation and creative energy that has fueled that transformation, and it continues to be an extremely exciting field.

Getting Advice and Information

▪ Students considering a CS major should schedule an appointment with a CS Faculty Advisor. While general LSA advisors can help point you in the right direction, you should seek the details of declaration requirements and course planning from a CS Faculty Advisor for the most up-to-date information. Declared students and future CS students should schedule an appointment at least once per 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 declaration or graduation time. The appointment scheduler is online at eecs.umich.edu/eecs/undergraduate/index.html. This page also hosts the most recent program and policy information, and should be your first resource for enrollment and requirement questions.

▪ The CS Faculty 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 LSA Newnan Advising Office. However, all questions about the CS program requirements should be directed to the CS Faculty Advisors here in the CSE Undergraduate Advising Office.

▪ When you declare, you will be added automatically to a CS-LSA email list. Announcements are sent weekly and include information about courses and academic matters, as well as extracurricular opportunities. Declared CS-LSA majors also have access to the Engineering Career Resource Center, ECRC, for finding internships, co-ops, and jobs.

▪ Because declaring the CS-LSA major will impact a LSA student's U-M tuition, some students avoid declaring as long as possible, and at times purposely avoid the CS Faculty Advisors. This is a bad idea! Some students end up making mistakes in pursuing requirements that cost them an extra term (or more), and in some cases, tuition has been retroactively charged. Always seek advice early and often to use your time, energy, and tuition most expediently.

Further Questions About the CS-LSA Major?
Contact: Bill Arthur, Lecturer III, Chief Program Advisor (cslsaadvisor@umich.edu)
EECS-CSE Undergraduate Advising Office Staff (ugadmin@eecs.umich.edu)
2808 Beyster Bldg. (North Campus) | Phone: (734) 763-6563

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

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

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Program Information

Pre-Declaration Requirements

To declare the Computer Science Major (CS-LSA), a student must first complete 4 pre-declaration requirements with a final letter grade posted on their transcript.

- • Math 115 or 120*   • Math 116 or 121*   • EECS 203 (or Math 465/Math 565**)   • EECS 280
- • Must achieve a 2.5 GPA among the pre-declaration courses and obtain at least a "C" in each course
- • Must be in good academic standing at time of declaration ("Action Pending" and "Probation" do not qualify as good standing for declaration purposes)

*Students who began their U-M math coursework at a higher level should speak to a CS-LSA Advisor for assistance, as higher-level math courses may be substituted in certain circumstances.

**Note that MATH 465/565 require significantly more mathematical background than EECS 203. Seek advising before choosing.

Performance in these courses is indicative of aptitude for the CS program, and students who do not perform well should reconsider continuing. Students may repeat each pre-declaration requirement once, for a maximum of two attempts in each requirement, and only the final grade will be used to compute the pre-declaration GPA. Only requirements with grades of "C+" or below can be repeated for this purpose. If you are having trouble achieving the pre-declaration GPA, it is vital to meet with a CS advisor without delay. If all pre-declaration requirements are satisfied by transfer credit, a student must receive a final letter grade of a "B-" or better in a CS Core course at U-M Ann Arbor before declaring.

Core Courses

1. *Computer Science (all three of the following):* EECS 281, EECS 370, and EECS 376.
2. *Probability & Statistics (one of the following):* STATS 250, STATS 280, STATS 412, STATS 426, EECS 301, EECS 401, ECON 451, IOE 265, or TO 301.

Upper Level CS Technical Electives (ULCS)

16 credits must be in approved Upper Level CS (ULCS) Electives, which are challenging and substantial courses covering a variety of topics in computing. ULCS electives must be selected from the following list of EECS courses. No transfer course will be granted ULCS elective credit. See pg. 7 for assistance in selecting your ULCS with CS-LSA Tracks. Some special topics courses are designated ULCS in certain terms (see eecs.umich.edu/eecs/academics/special_topics.html).

367	Introduction to Autonomous Robotics	482	Introduction to Operating Systems
373	Design of Microprocessor Based Systems	483	Compiler Construction
381	Object-Oriented and Advanced Programming	484	Database Management Systems
388	Introduction to Computer Security	485	Web Systems
427	VLSI Design I	486	Information Retrieval & Web Search
442	Computer Vision	487	Interactive Computer Graphics
445	Introduction to Machine Learning	489	Computer Networks
470	Computer Architecture	490	Programming Languages
475	Introduction to Cryptography	491	Introduction to Distributed Systems
477	Introduction to Algorithms	492	Introduction to Artificial Intelligence
478	Logic Circuit Synthesis and Optimization	493	User Interface Development
481	Software Engineering (taken FA17 or after)		*(*467 may be used as ULCS through Fall 2019)*

Note: An EECS course may only count toward one requirement—either ULCS **or** Capstone, not both.

Capstone Course

Students must take an approved EECS CS course listed below to fulfill the Capstone. A Capstone is often taken during the final year in order to take the best advantage of technical knowledge gained in all previous courses. Students considering pursuit of an Honors thesis (EECS 443) should schedule an appointment to speak with a CS-LSA advisor. Some special topics courses are designated as Capstone in certain terms (see eecs.umich.edu/eecs/academics/special_topics.html).

441	Mobile App Development for Entrepreneurs	473	Advanced Embedded Systems
443	CS Honors Thesis Course	494	Computer Game Design and Development
467	Autonomous Robotics	495	Software for Access
470	Computer Architecture	497	Major Design Projects

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Program Information & Sample Schedule

SAMPLE SCHEDULE FOR COMPUTER SCIENCE – LSA	Credits	Term 1	T2	T3	T4	T5	T6	T7	T8
Programming Prerequisite Course (must be taken before EECS 280)									
EECS 183 Elementary Programming Concepts	4	4	-	-	-	-	-	-	-
Pre-Declaration Reqs. – must have final letter grade posted and 2.5 GPA among these 4 courses to declare (16 hrs.)									
Mathematics 115 Calculus I (or MATH 120 AP)	4	4	-	-	-	-	-	-	-
Mathematics 116 Calculus II (or MATH 121 AP)	4	-	4	-	-	-	-	-	-
EECS 203 or MATH 465 or MATH 565	4	-	-	4	-	-	-	-	-
EECS 280 Programming and Elementary Data Structures	4	-	-	4	-	-	-	-	-
Program Core (16 hours)									
EECS 281 Data Structures and Algorithms	4	-	-	-	4	-	-	-	-
EECS 370 Introduction to Computer Architecture	4	-	-	-	-	4	-	-	-
EECS 376 Foundations of Computer Science	4	-	-	-	-	-	4	-	-
STATS 250, STATS 280, STATS 412, STATS 426, EECS 301, EECS 401, IOE 265, or TO 301	4	-	-	-	4	-	-	-	-
Upper Level CS Electives (16 hours)									
Upper Level CS Technical Electives*	16	-	-	-	-	-	4	4	8
Capstone Course (4 hours)									
Approved Capstone	4	-	-	-	-	-	-	4	-
Total CS-LSA (56 hours)	55-56	8	4	8	8	4	8	8	8
LSA Requirements: *See an LSA Advisor in the Newnan Academic Advising Center to discuss these College requirements.*									
*ULCS: Approved Computer Science courses at the 300-level or higher; see page 2 for a list of approved courses. Students completing interdisciplinary tracks must still have at least 12 credits of ULCS. See "CS-LSA Tracks" (page 7).									
Note: Credits from a course may only be used to fulfill a single CS degree requirement (no double counting).									

Major Grading & Repeat Policies
Grades of "C" or better must be achieved in all courses used to satisfy the pre-declaration and other major requirements. A grade of "C-" or below is considered a failing grade and the course must be repeated or substituted with another class. **Students are limited to attempting each of the three 200-level courses (EECS 203, EECS 280, EECS 281) at most twice.** An attempt includes, but is not limited to, a notation of any letter grade ("A-F"), withdraw ("W"), Pass/Fail ("P"/"F"), Transfer ("T"), or Incomplete ("I") posted on your U-M transcript. Exceptions to this rule can be granted by the CS-LSA Chief Program Advisor *only in extraordinary circumstances.*

CS Honors Program
The Honors Program in Computer Science is open to LSA students completing the Computer Science B.S. degree program. Students can earn an Honors degree in Computer Science without having been enrolled in the LSA Honors Program in the first and second years at U-M. Students are responsible for finding a faculty mentor whose research area aligns with their interest(s) and who is willing to oversee the thesis project. A summary of requirements is below; see the CS Honors Program handout for more detailed information:
- 3.2 or higher GPA in Math 115, Math 116, EECS 203, and EECS 280
- 3.5 GPA in the CS major (see page 7)
- Must complete a CS Honors thesis course (EECS 443), write an original thesis that is evaluated and deemed worthy of honors, and give an oral presentation of the thesis
- 3.4 overall UM GPA at time of graduation

Pursuing Additional Major(s): Students pursuing CS-LSA in addition to one or more other majors must ensure they have devoted significant, independent work toward each major. To that end, students should consult with a Faculty Advisor to ensure compliance.

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Prerequisite Chain and Transfer Courses
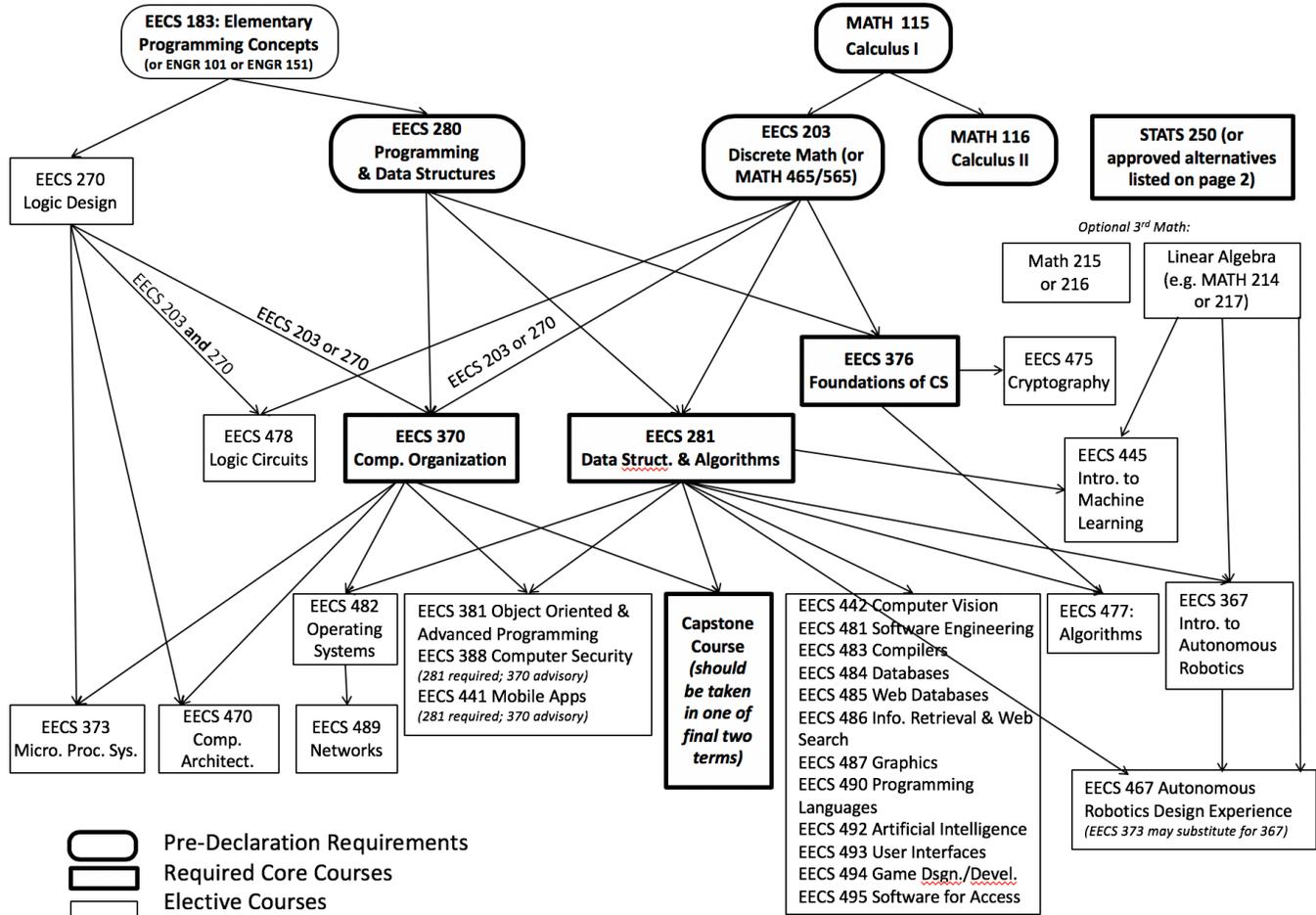
Please note: Students must be declared CS-LSA before they can register for ULCS courses.

Transfer Credit
The College of Engineering maintains a list of approved EECS transfer courses from many other institutions at http://www.engin.umich.edu/transferdatabase. Courses that do not appear on this list may still transfer, but will need review. Directions for LSA students to request a course evaluation can be found at the bottom of the tcaf.engin.umich.edu webpage. Note that we rarely grant equivalence for EECS 280, and never for EECS 281 or above.

Course Planning & Workload
Student feedback about workload in CS courses can be found online: www.eecs.umich.edu/eecs/undergraduate/survey/. Note that there is considerable variance for courses because different students find different aspects of courses challenging (writing complicated programs, understanding math concepts, etc.) Below is a summary guide that synthesizes workload survey data with other relevant course information to estimate workload in each course:

> Extremely heavy workload: 281, 373, 381, 467, 470, 473, 482, 494
> Heavy workload: 445, 477, 483, 485, 487
> Moderate workload: 203, 280, 285, 370, 376, 388, 442, 475, 478, 481, 484, 489, 490, 492
> Light workload: 183, 441, 486, 493, 496, 497

CS courses can be more demanding relative to many courses at the University, so we advise students to avoid overloading themselves. For most CS students, a load of 2 CS courses in the same semester is normal, but that can vary based on the combination of CS courses chosen (e.g., a CS course with an extremely heavy load should only be paired with one with a moderate load or less), as well as what non-CS courses are being taken at the same time. We encourage students to talk with faculty advisors and peer advisors if they have questions about the course load they are considering.

GENERAL ADVICE

Mental health. Take care of your brain. If you are feeling stressed, depressed, or just need someone to talk to, there are many places to find support on campus. For more information, see: https://www.uhs.umich.edu/stressresources

Information from friends. Your friends can be a good source of information on some topics, like the workload in courses they have taken. Sometimes this information is timely and correct, but often it is confused and garbled rumors. We have some complicated requirement structures, and sometimes grant individual exceptions to requirements when it makes sense for an individual student's plan of study. Thus if you hear something of interest, don't assume it is right—contact the CSE Advising Office to find a definitive answer.

Prerequisite chains and sequencing. Our program has a full schedule, so mistakes in understanding requirements or course sequencing can cost you additional semesters.

EECS 203 & EECS 280. Taking EECS 203 (Discrete Structures) [note: MATH 465 or 565 are acceptable alternatives] and EECS 280 (Programming) simultaneously often works well, and these are the two prerequisites for the "gateway" course, EECS 281 (Data Structures and Algorithms). However, note that EECS 183 is a prerequisite for EECS 280.

EECS 281 timing. Take 281 as soon as you can, and declare the Computer Science major during that semester if you plan to take ULCS courses the next term. Because ULCS electives are open only to declared CS majors, declaring will allow enrollment in ULCS electives the next semester, which increase your chances of enrolling in desired courses.

ULCS electives. ULCS courses are challenging and substantial, and cover a wide variety of topics in computing. The best way to choose your electives is to consider 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 (see "CS-LSA Tracks" on page 7). Course selection advice can also be sought from IAs in courses you are taking; reach out to these fellow students for their suggestions.

EECS 498/398 Special Topics. This is the generic number for "Special Topics" courses. Individual sections may be approved by the department to count as ULCS or Capstone credit (prerequisites and class information is posted on the website at cse.umich.edu/eecs/academics/special_topics.html), or may count only as general elective credit. **Do not assume these courses will count for any requirement unless explicitly indicated by the department.**

Operating Systems and **Networks (EECS 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).

Linear Algebra. If you are interested in taking more math beyond the requirements, we recommend a linear algebra course like MATH 217, MATH 417, or MATH 214. The content will be helpful for topics like Machine Learning or Robotics.

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

Research: Pursue an Honors Thesis or 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. For students who qualify to pursue a CS Honors Thesis (EECS 443), working with a faculty member in their research lab can give you valuable experience for your future computer science endeavors, and is a great way to get a strong letter of reference for graduate school. If you are taking a course (usually a ULCS) where you are doing really well and you have a strong interest in the area, approach your professor to learn what research opportunities might be available. Students who do not qualify for the CS Honors program can pursue research experiences through independent study courses (EECS 399 and 499); while these courses do not satisfy CS LSA degree requirements, the credits can apply to your total credits toward a degree.

Teaching: Become an Instructional Aid.

Primarily undergraduates lead discussion sections for EECS 183, EECS 203, EECS 280, and ENGR 100 (CSE-based). As a section leader, you will have the chance to teach the next generation of CS 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 may consider pursuing the Instructional Aid opportunity. Start by contacting Karen Liska, HR specialist in CSE, at liska@umich.edu.

Mentoring: Become a Peer Advisor.

Share your experiences with other undergraduates. There are opportunities at the department and college level as well as through numerous student organizations. See the CSE Undergraduate Advising Office.

Getting Involved: Join an EECS Student Group.

Code-M: Code-M at the University of Michigan is a student club for computer science and engineering students (CS-Eng, CS-LSA, and CE). They host corporate events for networking, workshops for skill-building, and social events to help members form relationships in the department. web.eecs.umich.edu/~cseschol/index.php.

HKN (Eta Kappa Nu): HKN strives to help progress the engineering student body through leadership, scholarship, and service. HKN helps members by providing networking and educational opportunities. hkn.eecs.umich.edu/

IEEE (Institute of Electrical and Electronics Engineers): The UM campus branch of IEEE hosts social events, conducts community service events, and brings in technical speakers for meetings and recruiting purposes. ieee.eecs.umich.edu

A handout profiling other CS student groups is available at the Undergraduate Advising Office, 2808 Beyster.

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

Many companies hire students for internships upon completion of EECS 281 (for some, even after 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 **October and January Job Fairs** are great places to interview for internships; make sure you register with **the Engineering Career Resource Center (ECRC) - http://career.engin.umich.edu** for more information.

A good way to choose your ULCS 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 courses that will help you achieve your goals. A student can work with an advisor to identify the combination of electives tailored to his or her needs. For some of the more established and anticipated paths, however, we have predefined the CS-LSA tracks listed below that provide a coherent group of elective courses appropriate for those paths. Note that if you take a 500-level course to satisfy the requirements of a track that you successfully complete, then the course can count towards your ULCS credit requirements.

The CS-LSA Tracks are optional and a student does _not_ have to pursue any track, and instead can select other combinations of approved ULCS courses selected with an advisor's advice. CS-LSA Tracks do not appear on the student's transcript or diploma; however, the CSE Undergraduate Advising Office can provide a letter stating a student has completed a specific track within the CS-LSA major plan. All final grades need to be posted to receive a CS-LSA Track completion letter.

Artificial Intelligence: AI is a broadly based multidisciplinary area comprising theoretical, experimental, and applied investigations of intelligent systems. Required: 1) EECS 492; 2) EECS 445 or 545; 3) one of EECS 442, 467, 543, 545, 595; and 4) a 4th ULCS of student's choice.

Bioinformatics: Computation plays an increasingly important role in modern biology. This is an interdisciplinary track. Required: three ULCS courses- 1) at least two of: EECS 445, 477, 484, 485, 492; 2) a 3rd ULCS course of student's choice; 3) BIOINF 527; and 4) BIOLOGY 305 or MCDB 310. **This track is not open to Biology Majors.**

Data and Information: Fast information storage and retrieval are crucial to many computer applications, and manipulating large data collections on servers or networks pose difficult challenges for computer professionals. Required: 1) EECS 445; 2) EECS 484; 3) one of EECS 477, 482, 485, 492; and 4) 4th ULCS of student's choice.

Economics and Computation: As social and market interactions become more computational, computer science has adopted more traditional economic concepts such as decentralized decision-making and allocation of resources. This is an interdisciplinary track. Required: 1) at least one of: EECS 492 or EECS 547; 2) at least two of: EECS 475, 485, 492, 547, 588; 3) ECON 401; and 4) one of: ECON 406, 409, 431, 442. **This track is not open to Economics Majors.**

Robotics and Vision: Until recently most robots were stationary manufacturing devices, but they are rapidly evolving into mobile information gathering and decision making platforms, with vision being perhaps their most important information gathering capability. Required: 1) EECS 467; 2) EECS 442; 3) one of: EECS 492, EECS 445, 542, 543, 567, 568; and 4) a 4th ULCS course of student's choice.

Security: Security for hardware, software, and networked systems is one of the fastest growing areas of computer science. Required: 1) EECS 388; 2) EECS 475 or 575; 3) EECS 482, 484, or 485; and 4) a 4th ULCS of student's choice.

Software Development: Designing and developing large software systems is a formidable engineering challenge and is the primary enterprise of the software industry. Required: 1) EECS 381; 2) EECS 477; 3) EECS 485; and 4) a 4th ULCS of student's choice.

Software Systems: Software systems are the tools and applications we use when we compute. Required: 1) at least three of: EECS 388, 482, 483, 484, 489; and 2) a 4th ULCS of student's choice.

Theory of Computation: Research on mathematical foundations has enormously influenced the development of computer science, yielding advances in data management, communications, security, and may other areas. This is an interdisciplinary track. Required: 1) EECS 477; 2) EECS 445 or 475; 3) one of: EECS 574, 575, 586; and 4) two of the following: Math 412, 465, 425, 475, Stats 426, IOE 510, 512, 518, and EECS 550. **This track is not open to Math Majors.**

* If a course is used as a CS-LSA Major Core Course, it may _not_ also count for a CS-LSA Track course (no double counting).

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Progress Sheet and GPA Calculation

Computer Science–LSA: Progress Sheet

Introductory Programming: 4 credits					Name:				
Course	*Hrs.*	*Term*	*Grade*	*Note*	UMID:				
EECS 183	4				Date:				
Pre-Declaration Requirements: 16 Credits					**Upper Level CS Electives: 16 Credits**				
Course	*Hrs.*	*Term*	*Grade*	*Note*	*Course*	*Hrs.*	*Term*	*Grade*	*Note*
MATH 115	4								
MATH 116	4								
EECS 203*	4								
EECS 280	4								
*or Math 465/565									
Pre-Declaration GPA: (2.5 required):									
					Capstone Course: 3-4 Credits				
CS Program Core: 16 Credits					*Course*	*Hrs.*	*Term*	*Grade*	*Note*
Course	*Hrs.*	*Term*	*Grade*	*Note*					
EECS 281	4								
EECS 370	4				**LSA College Requirements**				
EECS 376	4				**College Requirements**: Students must consult with their LSA Newnan Advisor, 1225 Angell Hall, to discuss LSA College requirements.				
STATS 250*	4								
*STATS 280, STATS 412, STATS 426, EECS 301, EECS 401, ECON 451, IOE 265, or TO 301 can also fulfill this requirement.									
TOTAL CTP:					**CS Major GPA:**				

Calculating Your CS Major GPA: GPA=MHP/MSH
You must include all EECS courses: EECS 183, EECS 203, EECS 280, CS Program Core, ULCS, Capstone course (CS MDE course or CS honors thesis course), and Stats 250/412/approved Stats requirement course. Do not include Math 115/116. **You must have an overall CS Major GPA* of at least 2.0 in order to graduate!**

MHP = Michigan Honors Points
MSH = Michigan Semester Hours
* Can be found on your U-M transcript (official or unofficial).