in the course syllabus. While criteria differ across disciplines and faculty, and while the ultimate responsibility for setting standards and evaluating performance rests with departments and individual faculty, submitted grades are final and not subject to negotiation. Exceptions are limited to correcting clerical and calculation errors, and correcting deviations from stated criteria. Students have the right to know the basis of a grade, and faculty should be open to that post-semester conversation. Following such conversation, students who believe that an error or deviation remains may appeal to the department chair and, if necessary, subsequently to the graduate dean.

Health Service Requirements

Prior to initial registration, all graduate students must complete an online medical history and provide proof of required immunizations before July 1. Those with missing or incomplete health reports will have an immunization hold placed on their account and will not be allowed to register for classes until the requirements are completed. For more information about the requirements, you can visit our Resources for New Students website. Please send your questions to Immunization Reviewer via the Patient Portal.

Graduate Co-op Program

Tufts University's School of Engineering (SOE) offers a Cooperative (Co-op) Education Program for full time MS students. The objective of this program is to offer Tufts SOE MS students opportunities to pursue real-world work experience, form professional relationships, and to enhance their resumes. The program's main goal is to introduce students to professional experiences that will assist them in their career path. This program helps students get a feel for a company's culture and work environment, and learn to interact with other colleagues in their field.

Benefits of a Co-Op Program

- Provide students with the skills and frameworks to clarify short- and long-term personal, educational, and career goals and to consistently make prudent, informed decisions throughout one's career.
- Help students explore and experience professional employment in areas related to the student's academic program as well as professional interests and personal aspirations.
- Guide students through the development of a modern personal brand including brand statements, marketing documents curation, and effective network cultivation and strategic management.
- Understanding, practicing, and employing best practices around key career competencies in the modern world of work including, but not limited to: interviews, negotiations, workplace professionalism and etiquette, communication with leaders, managers, and colleagues.
- Receive direct and dedicated support from the Assistant Director, Graduate Co-op Advisor and the Tufts Career Center for the entirety of your co-op preparation and employment experience.

How Co-Op Works

Tufts Graduate School of Engineering's co-op program offers students a unique opportunity to integrate their academic knowledge with industry and subject matter expertise to help employers address and solve practical, real-world problems. Participating students may gain up to eight months of full-time paid work experience that is valuable for building and showcasing distinct, technical, professional, and social competencies employers covet and very often offer co-op alumni with a competitive edge for post-graduation employment opportunities.

Eligible MS students may complete one co-op over the course of their degree program. **Students must apply to join the co-op program at the end of their first semester as an enrolled master's student.** After starting their MS program and completing 18 credits, exclusive of seminar credits, that count toward their degree, students may then look for co-op opportunities.

The Graduate Co-op Program follows a cohort model, where admitted students are grouped based on the semester they intend to begin their co-op positions. During the preceding semester, students will engage in intentional, independent, and cohort-shared experiences across all aspects of the Tufts Career Center Career Planning and Management Process, including self-assessment and discovery, strategic opportunity identification and targeting, custom marketing document creation and co-op search, relationship building practice and management, and modern interview and negotiation practice and preparation. Consistent participation in curated professional development offerings, collaborative and supportive cohort working groups, and regularly scheduled meetings with the Graduate Co-op Advisor is expected, and often mandatory. The Career Center and the SOE Graduate School are sincerely invested in our admitted co-op program students' development and execution plan and have built a system of impactful tools, resources, coaching expertise, and insights that are fundamental to not only securing a co-op but also managing all aspects of a career.

In preparation for a co-op search, students must participate in the required career development sessions offered by Tufts Career Center, which provide valuable skills needed to be successful in securing a co-op position that simultaneously aligns with individual needs and preference while also adhering to Tufts standards and ethical guidelines and employer expectation.

As part of the co-op program, eligible MS students are only allowed to accept one position during their time in the program. *There is no guarantee that students who enter the co-op program will secure employment.*

Cost Of Co-Op Program

There is no additional charge for a student to be enrolled in the co-op program.

Graduate Co-op Program Eligibility

Prerequisites that the student must meet to be considered for the program:

1. Must be enrolled in a program that offers the Graduate Co-op Program (see the list of departments below). This program is not available to part time programs, online programs, certificate programs, Ph.D. programs, or Post Baccalaureate programs. Students enrolled in a combined Post-Bacc/MS program or Fifth-Year MS programs are eligible to participate as long as they meet program requirements.
2. Must complete at least 2 full-time semesters as a fully-matriculated and enrolled Master's student. Students must complete a minimum of 9 credits in their first semester to be considered for the program and must complete at least 18 credits towards their MS programs before beginning their co-op. Newly matriculated stu-

dents can only apply for the program and attend the required info session before the end of their first semester as a full-time student.
    a. Post-Bacc/MS students: No bachelor-level classes for at least 2 full-time semesters before beginning their co-op.
    a. Fifth-Year MS students: Must be fully matriculated with a completed BS degree.
3. Must be in good academic standing (See requirements below), enrolled full-time, have had no previous extensions of time or reduced course load accommodations, and have not enrolled in any undergraduate course as an MS student.
4. Must have at least one semester remaining in their MS programs after co-op opportunity .

Academics and the Co-op Program

Students must meet all requirements of the SOE Graduate Handbook and any departmental specific requirements to be eligible and to participate in the program. All students must meet the following criteria:

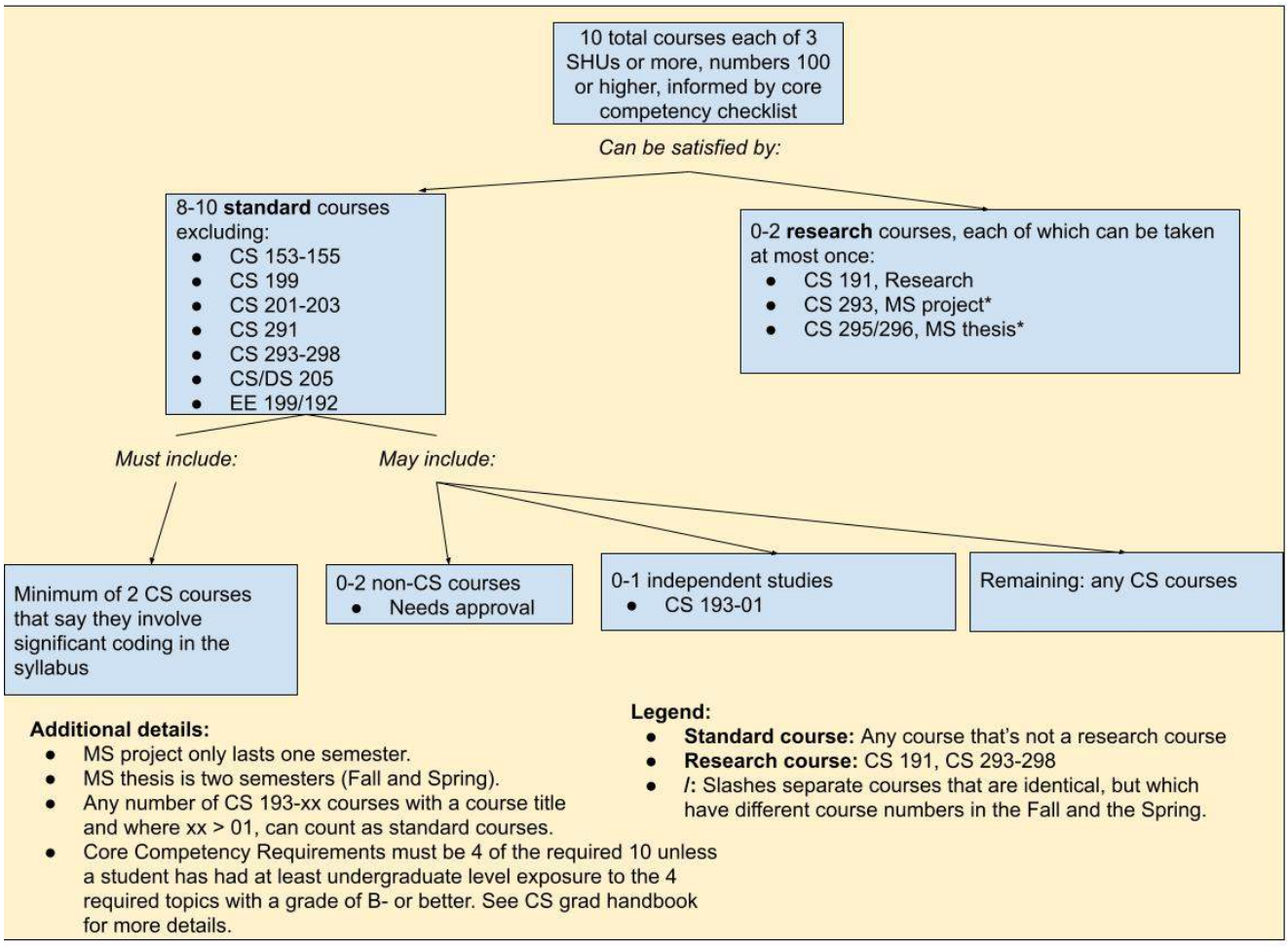
1. Good Academic Standing requirement: Students need to be in good academic standing, enrolled full-time, have had no previous extensions of time or reduced course load accommodations, and have not enrolled in any undergraduate courses as an MS student. Students must be in good academic standing at all times. Failure to remain in good academic standing at all times will result in a student being removed from the co-op program and the MS time to degree will be reduced to the non-co-op time to degree limits for MS programs.
2. Course completion requirement: Fully matriculated students must complete two full-time semesters before working at a co-op, with at least 9 credits total completed in their first semester and at least 18 total credits in the second semester. Courses must be taken at Tufts while matriculated and enrolled as an SOE graduate student. The SOE will be checking to see if an applicant is on track for meeting these requirements in the application process.
3. The student's academic record must demonstrate a high level of success, including:
    a. No missing grades.
    b. No incomplete grades (grade of I).
    c. No grade of W in the most recent spring/fall semester completed or in progress.
    d. No more than one repeated/substituted course.
    e. No academic probation or disciplinary issues.
    f. No semesters on a reduced course load or degree extensions of time.

Tufts course requirements for a Master's and Ph.D. in Computer Science

This document lists important information about course requirements for Master's and Ph.D. Students. The term "courses" refers to lecture-based classes, independent studies, and research. The first two are denoted by "standard courses" and the latter by "research courses. Both Master's and Ph.D. course requirements can be satisfied via a varying combination of standard and research courses depending on your interests.

We recommend that Master's students interested in completing a thesis and Ph.D. students bias their course selection toward research courses.

M.S. in Computer Science (10 total courses, each of 3 SHUs or more)



The flow chart above illustrates the course requirements to get a master's degree. A box that indicates a range in required courses (e.g., 8-10 standard courses) indicates that some of the required courses can be obtained from a box in a sibling branch (e.g., 0-2 research courses).

Core Competencies: By your last semester at Tufts, you must have completed at least one class in each of the four areas listed in Appendix E of the handbook and reproduced below. Designated faculty will hold core competency certification sessions during the first seven days of each semester and can approve and/or advise you on the completion of this requirement.

The competencies can be filled by equivalent classes you may have taken at other universities, and that appear on that university's transcript. Alternatively, you can fill them at Tufts by the courses listed in the sub-bullets below. You must have earned at least a B- in a course, whether at Tufts or elsewhere, to satisfy the relevant course-competency requirement. You will not receive graduate course credit for any course numbered less than 100.

Core Competency areas include:

- Computer Architecture and Assembly Language (CA&AL)
  - CS 40, Machine Structure. *No graduate credit*.
  - CS 111, Operating Systems
  - CS 112, Networks
  - CS 114, Network Security
  - CS 116, Introduction to Security
  - CS 118, Cloud Computing
  - CS 146, (also EE 126) Computer Engineering
  - CS 107 (Formerly COMP/CS 181), Compilers; offered infrequently
  - CS 140, Advanced Topics in Computer Architecture
- Programming Languages (PL)
  - CS 105, Programming Languages
  - CS 21, Concurrent Programming. *No graduate credit.*
  - CS 86, Object-Oriented Programming for GUIs. *No graduate credit.*
  - CS 121 (Formerly COMP/CS 180), Software Engineering
  - CS 107 (Formerly COMP/CS 181), Compilers; offered infrequently
- Data structures and Analysis of Algorithms (DS&AA)
  - CS 160: Intro to Algorithms (we highly recommend taking this class!)
- Theory of Computation (ToC)
  - CS 170, Computation theory
  - If you have little math background, try to take Discrete Math (COMP/CS 61) first.

CS 191: This course is a vehicle for doing research. It has similar requirements to the M.S. project (see below). This course can be taken at most once.

CS 199 (Internship in Computer Science): This course is a vehicle for international students to complete an internship. It does not count towards the 10 course requirement. Reach out to Professor Ming Chow for more information on this course.

M.S. Thesis: The thesis requires a commitment of two semesters total, recorded by enrolling in CS 295 and CS 296 in either order; the M.S. thesis is completely optional. Acceptance to the thesis track occurs after matriculation into the program and only with the support of a faculty advisor who is interested in supervising thesis work. After finding a faculty member who is willing to work with you on a MS Thesis, the faculty member can write to the CS Graduate coordinator to request your change to the thesis track. Some reasons for deciding to do a M.S. thesis may include: 1) you are a M.S. student who wants significant research experience; 2) You want to leave the Ph.D. program with a master's and retain some official record of your research activity; 3) You want to complete a substantial and polished preliminary research project on the way to a Ph.D. You need to submit a thesis prospectus at the end of the first semester and the thesis document just after the end of classes during the semester in which you defend. The deadline can be confirmed here. The defense should be scheduled two weeks earlier than the deadline.

The student and advisor will jointly select a thesis committee subject to approval by the CS Graduate Committee. This committee must include at least three faculty members, including one member from outside the department. You will defend the research via a 45-minute presentation, which the committee will attend.

The defense is also open to the public. You will receive a grade for CS 295 and CS 296 only after you finish both semesters.

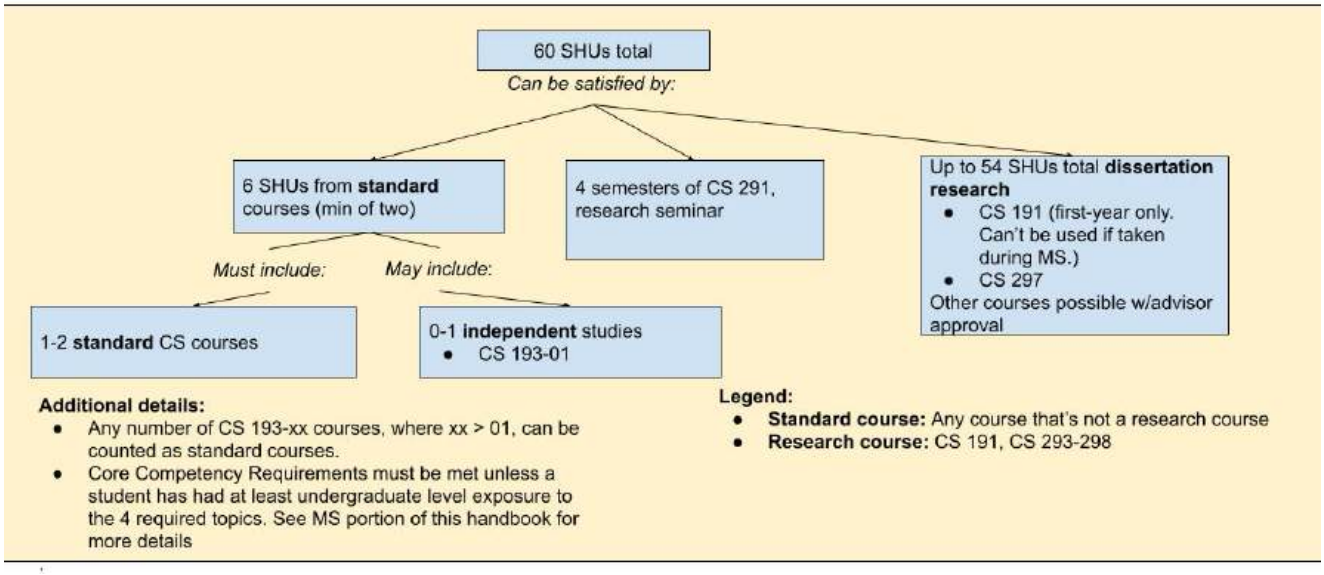
M.S. Project: An M.S. Project consists of research conducted with a faculty advisor and is a commitment of one semester recorded by registering for CS 293, usually for 3 SHUs. You may choose to take this option because: 1) you are a M.S. student who wants to complete a research project without the overhead of writing a thesis, or 2) you are a Ph.D. student who doesn't want to write a separate master's thesis. If you do not have an advisor for the project, you need to find one. If your advisor for the project is not your academic advisor, they need to agree to become your advisor. You and your advisor need to agree on the project and any write-up requirements. (Advisors approve the write-up and keep a copy). This course can be taken at most once.

CS 193-xx (where xx > 01): These are directed study courses with official names and with two or more students. Your advisor might create one as a vehicle for reading a set of research papers from a conference or understanding a new research area. Another faculty member might create one that involves a joint implementation project, or as a dry run of a course that will become a CS 150. You can count any number of these as *standard* CS courses.

Maintaining Good Standing: You must maintain a grade average of at least a B, earning no more than one grade below B-, and make continuous progress toward graduation. Courses that do not count toward your degree requirements must still meet the B- grade requirement.

Applying for Graduation: Graduation information for graduate students can be found at this website. The chart at the bottom of the page outlines what needs to be done by when for each possible graduation date. https://students.tufts.edu/registrar/make-request/apply-graduation/graduation-information-graduate-students.

Ph.D. Requirements



The flow chart above shows the course requirements for obtaining a Ph.D. If you don't already have an M.S. degree in computer science or an approved alternative, you must complete these requirements in addition to those for the master's.

Teaching Assistantship: You must TA at least one course during your time as a student at Tufts.

Core Competencies: By the time you take quals (see below), you must certify that you do have background in the areas listed in Appendix E of the handbook. (See comments on core competencies in the M.S. section above.)

- Students without their M.S. must have core competencies finished by the end of their third or fourth semester, and before taking the qualifying exam.
- Students with their M.S. must have core competencies finished by the end of their first or second semester, and before taking the qualifying exam.

Qualifying Exam: This is a sanity check to ensure you are making research progress and have adequate background about your research area. The exam involves giving a presentation about some research you've conducted + an oral exam on 4-7 research papers. The presentation is 30-40 minutes followed by questions. The oral exam is one hour long. You may read more about the process here.

- *Timing:*
  - Students without M.S.: Take it during your third or fourth semester from entry into the program, after satisfying your core competencies. You must pass it by the end of your fifth semester at Tufts.
  - Students with M.S.: Take it by the end of your second semester, after satisfying your core competencies. You must pass it by the end of your third semester at Tufts.
- *Process:*
  - Students, in conjunction with their advisor, select a committee of at least three members. At least two must be insiders of the student's research area, and at least one of these must be a regular faculty member in the computer science department. In addition, there must be at least one member from outside of the student's research area who is a tenured regular member of the computer science faculty. The Grad Committee approves quals committees; they make the final determination of what committees are acceptable.

    - Insider committee members choose 4-7 papers related to the student's research and informs the student of them. These are the papers the student will be evaluated on during the oral exam.
    - Students work with CS Grad Coordinator to schedule both the presentation and the oral exam with the committee. These may be done back-to-back on the same day or on separate days, so long as the research talk occurs first.

Prospectus: You must write a document describing the research you plan to conduct for your dissertation and submit it to the CS graduate committee. The prospectus you submit should be about 2-3 pages long and it must: (1) have a title, (2) describe your intended research direction or open problems to be addressed in the thesis research, (3) cite and briefly describe appropriate related work, (4) identify the dissertation advisor, and (5) identify two additional dissertation committee members within the CS department. Two more members will be added later, (6) include references on any cited work.

- *Process:*
    - Write the prospectus with input from your Ph.D. advisor.
    - Ask two additional Tufts faculty members apart from your advisor who will serve on your committee. List them in the prospectus.
    - Submit the prospectus to the graduate committee six months after your quals. The document should be **signed by your advisor prior to submission**.
    - Your prospectus is a living document and should be updated at least once per year at the time of the grad reviews.

Dissertation Committee: One year after the submission of the prospectus, the student will convene a meeting of the 3 Tufts CS members and the 1 Tufts member outside of CS to review the progress and plans. Six months before the defense, the full committee, including the member external to Tufts, shall meet to map out the expectations for the dissertation.

Dissertation Defense: This is when you are done. During a dissertation defense, you give a public presentation on your research, and then answer private questions from your committee members about both the presentation and the dissertation document that describes your research. The final deadline for submission of the approved dissertation document is just after the end of classes in each of the Spring, Summer, and Fall semesters, and can be confirmed here. The defense occurs two weeks earlier than the university deadline to allow for edits requested by the committee at the defense.

- *Process:*
    - Together with your advisor, propose a committee to the Grad Coordinator. This goes for review to the CS Grad Committee.
    - Convene the committee one year after submitting prospectus and again 6-12 months before defense.
    - Write the dissertation document.
    - Schedule a defense date with your committee.
    - Submit the abstract and title for the dissertation to the CS office at least three weeks before the defense date so that the public portion of the defense can be publicized.
    - Submit the full draft of your dissertation to your committee at least three weeks before the defense date so that they have adequate time to review and to provide you with comments.
        - At the same time, submit a copy to the Graduate Program Coordinator for your student file. It will be made available to faculty or students upon request.
    - Give your defense!
    - Submit final approved document to the university.
- *Committee:*
    - Your committee should have five members.

- CS Faculty Advisor (with or without tenure)
- CS Faculty Member (with tenure)
- CS Faculty Member (with or without tenure)
- Tufts Faculty Member Outside of CS (does not need to be tenured, can have a joint appointment in CS so long as primary appointment is elsewhere)
- Member Outside of Tufts (doctoral-level researcher whether in university or industry)
    - This member does not need to be tenured

Applying for Graduation: Graduation information for graduate students can be found at this website. The chart at the bottom of the page outlines what needs to be done by when for each possible graduation date. https://students.tufts.edu/registrar/make-request/apply-graduation/graduation-information-graduate-students.

FAQs for Ph.D. Registrations

Registration for students on RAships and TAships:

- You should register for at least 9 units of load to be considered full-time. You should not register for more than 13 units of load.
- You should register for CS 405-TA or CS 406-RA to indicate status as a Ph.D. TA or RA. These are special courses that count as 3 units of load, but do not count as credit.
- You need to register for at least 6 more SHUs of courses (standard or research) to be considered full time. You should not register for more than 10 additional SHUs of courses.
- An example full-time course load for a Ph.D. student on RA or TAship could be:
    - CS 405-TA/406-RA (3 units of load)
    - CS 135 Machine Learning (3 SHUs)
    - CS 297 Dissertation Research (3 SHUs)
    - Total: 9 units of load, 6 SHUs towards degree requirements

What research courses do I register for once I have completed the 60 SHUs required for the Ph.D.?

- Once you have accrued 60 SHUs, you switch to "CS 502: Matriculation Continued" rather than registering for more research SHUs.
- An example full-time course load for a Ph.D. student who has met the 60 SHU requirement could be:
    - CS 405-TA (3 units of load)
    - CS 502 Matriculation Continued
    - Total: full-time status met

What is the minimum number of "actual" classes I need to take to get an M.S. + Ph.D.?

- You will need to take 8 "actual" classes. Your M.S. would consist of 7 actual courses, 2 research courses (i.e., CS 191 and 293 or CS 295 and 296), and 1 independent study (CS 193-01).
- Your Ph.D. would consist of 1 actual course, 1 CS 193-01, and the rest would be research credits (191, 297). It is possible this number could be further reduced by taking named CS 193-0x classes (x>1), as these count as "actual" classes.

What should I register for if I'm here over the summer?

- Current students who stay for the summer should register for CS 406-RA/405-TA as well as CS 502 – Doctoral Degree Continued.
- A Ph.D. student who has not yet completed the M.S. degree should register for CS 406-RA/405-TA and CS 401/402 – Master's Degree Continued.
- For incoming Ph.D. students who will be here on a temporary visa, they must have a full-time enrollment of 6 SHUs over the summer. This could include one "standard" course, one "research/independent study" course, plus CS 406-RA/405-TA.

32 Results

Arts, Sciences, and Engineering, Summer 2025, CS

☐ Show Descriptions ☐ Show Sections **Enrollment Status:** open closed waitlist

CS-0011 **Introduction To Computer Science**

The study of computer science centers on two complementary aspects of the discipline. First, computer science is fundamentally concerned with the problem-solving methodologies it derives from its foundational fields: the design principles of engineering, mathematical theory, and scientific empirical study. Second, these methodologies are applied in the complex context of a modern day computing system. In this course we will address both of these important aspects. As a means for developing your design skills, we will discuss the fundamental features of a high level, general purpose programming language — namely C++ — and learn how to use it as a tool for problem solving. We will also consider the performance of solutions, and how to apply both analytical and empirical assessment techniques. Finally, we will explore the Unix operating system as a context for problem solving.

LECTURE

Section	Class No.	Session	Day, Times and Locations	Faculty	Credit	Status	Select
C1-LEC Details	50421	S12	Time Not Specified Online	STAFF	4		
C2-LEC Details	50456	S12	Time Not Specified Online	STAFF	4		
M1-LEC Details	50490	S12	Time Not Specified Online	STAFF	4		
M2-LEC Details	50476	S12	Time Not Specified Online	STAFF	4		

CS-0015 **Data Structures**

A second course in computer science. Data structures and algorithms are studied through major programming projects. Topics include linked lists, trees, graphs, dynamic storage allocation, and recursion. Enrollment priority given to freshmen or sophomores; computer science majors or minors; or majors or minors that list CS15 as a requirement or elective.

LECTURE

Section	Class No.	Session	Day, Times and Locations	Faculty	Credit	Status	Select
C1-LEC Details	50422	S12	Time Not Specified Online	STAFF	4		
C2-LEC Details	50423	S12	Time Not Specified Online	STAFF	4		
M1-LEC Details	50477	S12	Time Not Specified Online	STAFF	4		
M2-LEC Details	50491	S12	Time Not Specified Online	STAFF	4		

CS-0061 **Discrete Mathematics**

(Cross-listed as MATH 61). Sets, relations and functions, logic and methods of proof, combinatorics, graphs and digraphs. Recommendations: MATH 32 or COMP 11 or permission of instructor.

LECTURE

Section	Class No.	Session	Day, Times and Locations	Faculty	Credit	Status	Select
C1-LEC Details	50424	S12	Time Not Specified Online	STAFF	3		
C2-LEC Details	50457	S12	Time Not Specified Online	STAFF	3		
C3-LEC Details	50460	S12	Time Not Specified TBA Medford/Somerville	STAFF	3		
M1-LEC Details	50478	S12	Time Not Specified Online	STAFF	3		

Section	Class No.	Session	Day, Times and Locations	Faculty	Credit	Status	Select
M2-LEC Details	50479	S12	Time Not Specified Online	STAFF	3		

CS-0099 **Internship Computer Science**

Study of approved topics in Computer Science in concert with an internship in computing or a related field. Prerequisites: Permission of instructor.

INTERNSHIP

Section	Class No.	Session	Day, Times and Locations	Faculty	Credit	Status	Select
CPT-INT Details	50405	S12	Time Not Specified Online	Ming Yan Chow	1		

CS-0111 **Operating Systems**

(Cross-listed as EE 128). Fundamental issues in operating system design. Concurrent processes: synchronization, sharing, deadlock, scheduling. Relevant hardware properties of uniprocessor and multiprocessor computer systems.

LECTURE

Section	Class No.	Session	Day, Times and Locations	Faculty	Credit	Status	Select
C1-LEC Details	50428	S12	Time Not Specified Online	STAFF	3		
M1-LEC Details	50480	S12	Time Not Specified Online	STAFF	3		

CS-0115 **Database Systems**

Fundamental concepts of database systems, including conceptual design, relational and object-oriented data models, query languages (SQL, QBE), and implementation issues (indexing, transaction processing, concurrent control). The concepts and algorithms covered encompass many of those used in commercial and experimental database systems. Other topics include distributed databases and distributed query processing. Recommendations: CS 40

LECTURE

Section	Class No.	Session	Day, Times and Locations	Faculty	Credit	Status	Select
C1-LEC Details	50427	S12	Time Not Specified Online	STAFF	3		
M1-LEC Details	50481	S12	Time Not Specified Online	STAFF	3		

CS-0120 **Web Programming and Engineering**

Web applications as complex systems that deliver functionality to a large number of users, and exhibit unique behaviors and demands in terms of performance, scalability, usability, and security. How the web works, limitations of client-side and server-side technologies including frameworks and APIs, content optimization, and data persistence and storage. Projects will involve search, using the cloud infrastructure, location-based services, mobile web development, and using tools to assess the security and privacy of web applications.

LECTURE

Section	Class No.	Session	Day, Times and Locations	Faculty	Credit	Status	Select
C1-LEC Details	50429	S12	Time Not Specified Online	STAFF	3		
M1-LEC Details	50482	S12	Time Not Specified Online	STAFF	3		

CS-0121 **Software Engineering**

Core principles and ideas that enable development of large-scale software systems, with a focus on programming. Abstraction, modularity, design patterns, specification, testing, verification, and debugging.

LECTURE

Section	Class No.	Session	Day, Times and Locations	Faculty	Credit	Status	Select

Section	Class No.	Session	Day, Times and Locations	Faculty	Credit	Status	Select
C1-LEC Details	50430	S12	Time Not Specified Online	STAFF	3		
M1-LEC Details	50483	S12	Time Not Specified Online	STAFF	3		

CS-0131 **Artificial Intelligence**

History, theory, and computational methods of artificial intelligence. Basic concepts include representation of knowledge and computational methods for reasoning. One or two application areas will be studied, to be selected from expert systems, robotics, computer vision, natural language understanding, and planning.

LECTURE

Section	Class No.	Session	Day, Times and Locations	Faculty	Credit	Status	Select
C1-LEC Details	50431	S12	Time Not Specified Online	STAFF	3		
M1-LEC Details	50484	S12	Time Not Specified Online	STAFF	3		

CS-0135 **Introduction To Machine Learning And Data Mining**

An overview of methods whereby computers can learn from data or experience and make decisions accordingly. Topics include supervised learning, unsupervised learning, reinforcement learning, and knowledge extraction from large databases with applications to science, engineering, and medicine. Recommendations: CS 160 is highly recommended.

LECTURE

Section	Class No.	Session	Day, Times and Locations	Faculty	Credit	Status	Select
C1-LEC Details	50432	S12	Time Not Specified Online	STAFF	3		
M1-LEC Details	50485	S12	Time Not Specified Online	STAFF	3		

CS-0151 **Special Topics in Data Infrastructure and Systems - Cybersecurity Clinic**

A special topics course in data infrastructures and systems, suitable for fulfilling requirements of the Bachelor of Science in Data Science.

LECTURE

Section	Class No.	Session	Day, Times and Locations	Faculty	Credit	Status	Select
C-LEC Details	50461	S12	Time Not Specified TBA Medford/Somerville	STAFF	3		

CS-0160 **Algorithms**

Introduction to the study of algorithms. Strategies such as divide-and-conquer, greedy methods, and dynamic programming. Graph algorithms, sorting, searching, integer arithmetic, hashing, and NP-complete problems. High demand (see "course notes" for signup procedure).

LECTURE

Section	Class No.	Session	Day, Times and Locations	Faculty	Credit	Status	Select
C1-LEC Details	50425	S12	Time Not Specified Online	STAFF	4		
C2-LEC Details	50418	S12	Time Not Specified Online	STAFF	4		
M1-LEC Details	50486	S12	Time Not Specified Online	STAFF	4		
M2-LEC Details	50487	S12	Time Not Specified Online	STAFF	4		

CS-0170 **Computation Theory**

(Cross-listed as MATH 191). Models of computation: Turing machines, pushdown automata, and finite automata. Grammars and formal languages, including context-free languages and regular sets. Important problems, including the halting problem and language equivalence theorems.

LECTURE

Section	Class No.	Session	Day, Times and Locations	Faculty	Credit	Status	Select
C1-LEC Details	50426	S12	Time Not Specified Online	STAFF	3		
M1-LEC Details	50488	S12	Time Not Specified Online	STAFF	3		

CS-0191 **Research**

Research on a topic in Computer Science or a related discipline, culminating in a final paper describing accomplishments, with the goal of advancing the state of the art. Topic is proposed by a faculty sponsor in Computer Science. Faculty consent required. Students sign up for a section that corresponds to a faculty member.

RESEARCH

Section	Class No.	Session	Day, Times and Locations	Faculty	Credit	Status	Select
C-RSC Details	50412	S12	Time Not Specified TBA Medford/Somerville	Abani Patra, Alva Couch, Bert Huang, Daniel Jared Votipka, Dave Lillethun, Deborah Sunter, Diane L Souvaine, Donna Slonim, Elaine Schaertl Short, Ethan E. Danahy, Fahad Rafique Dogar, Jeffrey Foster, Jivko Sinapov, Johannes Peter Albert De Ruiter, Karen A Panetta, Karen Edwards, Lenore J Cowen, Liping Liu, Mark A Sheldon, Marty Allen, Matthias Scheutz, Megan Monroe, Michael C. Hughes, Ming Yan Chow, Noah Mendelsohn, Norman Ramsey, Peter John Love, Raja Raman Sambasivan, Remco K Chang, Richard Townsend, Robert Jacob, Samuel Guyer, Soha Hassoun, Susan Landau	3		

CS-0193 **Directed Study**

Guided study of an approved topic. Please see departmental website for specific details.

INDEPENDENT STUDY

Section	Class No.	Session	Day, Times and Locations	Faculty	Credit	Status	Select
A-IND Details	50440	SA	Time Not Specified TBA Medford/Somerville	Diane L Souvaine, Elaine Schaertl Short, Jivko Sinapov	0-4		

CS-0193 **Directed Study**

Guided study of an approved topic. Please see departmental website for specific details.

INDEPENDENT STUDY

Section	Class No.	Session	Day, Times and Locations	Faculty	Credit	Status	Select
B-IND Details	50473	SB	Time Not Specified TBA Medford/Somerville	Diane L Souvaine, Elaine Schaertl Short, Jivko Sinapov	0-4		

CS-0193 **Directed Study**

Guided study of an approved topic. Please see departmental website for specific details.

INDEPENDENT STUDY

Section	Class No.	Session	Day, Times and Locations	Faculty	Credit	Status	Select
C-IND Details	50401	S12	Time Not Specified TBA Medford/Somerville	Abani Patra, Alva Couch, Bert Huang, Daniel Jared Votipka, Dave Lillethun, Diane L Souvaine, Donna Slonim, Elaine Schaertl Short, Ethan E. Danahy, Fahad Rafique Dogar, Jeffrey Foster, Jivko Sinapov, Johannes Peter Albert De Ruiter, Karen Edwards, Lenore J Cowen, Liping Liu, Mark A Sheldon, Marty Allen, Matthias Scheutz, Megan Monroe, Megumi Ando, Michael Allan Jahn, Michael C. Hughes, Milod Kazerounian, Ming Yan Chow, Noah Mendelsohn, Norman Ramsey, Raja Raman Sambasivan, Remco K Chang, Richard Townsend, Robert Jacob, Samuel Guyer, Soha Hassoun, Susan Landau	0-4		

CS-0193 **Directed Study - Algorithms Practicum**

Guided study of an approved topic. Please see departmental website for specific details.

INDEPENDENT STUDY

Section	Class No.	Session	Day, Times and Locations	Faculty	Credit	Status	Select
C1-IND Details	50470	S12	Time Not Specified TBA Medford/Somerville	Michael Allan Jahn	0-4		

CS-0193 **Directed Study - Discrete Mathematics**

Guided study of an approved topic. Please see departmental website for specific details.

INDEPENDENT STUDY

Section	Class No.	Session	Day, Times and Locations	Faculty	Credit	Status	Select
C2-IND Details	50469	S12	Tu, Th 1:30PM - 3:00PM No Room Assigned Medford/Somerville	Michael Allan Jahn	0-4		

CS-0288 **Master of Science Capstone Project I**

Part one of a two-course, hands-on, and project-based culmination to the Master of Science in Computer Science Online program. Application of principles, strategies, methods, and tools for requirements analysis and design of a programming project, including project planning, project management, and proof of concept prototyping. Formulation

of a project plan, including estimation of project completion requirements and timeline. To be taken in the second-to-last term of the Master of Science in Computer Science Online degree. Not available to students outside that program. Prerequisites: CS 180 or 121, and enrollment in the Master of Science in Computer Science Online program.

INDEPENDENT STUDY

Section	Class No.	Session	Day, Times and Locations	Faculty	Credit	Status	Select
M1-IND Details	50475	S12	Time Not Specified Online	Marty Allen	3		

CS-0289 **Master of Science Capstone Project II**

Part two of a two-course, hands-on, project-based culmination experience for the Master of Science in Computer Science Online program. Implementation of the project defined in part one, including use of principles, tools, and strategies for implementation, debugging, testing, documentation, maintenance, and release management. Presentation of final project results and documentation. To be taken in the last term of the Master of Science in Computer Science Online degree. Not available to students outside that program. Prerequisites: CS 288, and enrollment in the Master of Science in Computer Science Online program.

INDEPENDENT STUDY

Section	Class No.	Session	Day, Times and Locations	Faculty	Credit	Status	Select
M1-IND Details	50416	S12	Time Not Specified Online	Marty Allen	3		

CS-0293 **Master's Project**

Guided individual study of an approved topic suitable for a master's design project. Please see departmental website for specific details. Faculty consent required. Students sign up for a section that corresponds to a faculty member.

PROJECT

Section	Class No.	Session	Day, Times and Locations	Faculty	Credit	Status	Select
C-PRO Details	50402	S12	Time Not Specified Online	Abani Patra, Alva Couch, Bert Huang, Daniel Jared Votipka, Dave Lillethun, Diane L Souvaine, Elaine Schaertl Short, Fahad Rafique Dogar, Jeffrey Foster, Jivko Sinapov, Johannes Peter Albert De Ruiter, Lenore J Cowen, Liping Liu, Mark A Sheldon, Marty Allen, Matthias Scheutz, Megan Monroe, Michael C. Hughes, Ming Yan Chow, Noah Mendelsohn, Norman Ramsey, Raja Raman Sambasivan, Remco K Chang, Richard Townsend, Robert Jacob, Samuel Guyer, Soha Hassoun, Susan Landau	0-4		

CS-0295 **Masters Thesis**

Guided individual study of an approved topic suitable for a master's design project. Please see departmental website for specific details. Faculty consent required. Students sign up for a section that corresponds to a faculty member.

THESIS

Section	Class No.	Session	Day, Times and Locations	Faculty	Credit	Status	Select
C-THS Details	50409	S12	Time Not Specified Online	Abani Patra, Alva Couch, Bert Huang, Daniel Jared	0-6		

Section	Class No.	Session	Day, Times and Locations	Faculty	Credit	Status	Select
				Votipka, Dave Lillethun, Deborah Sunter, Diane L Souvaine, Donna Slonim, Elaine Schaertl Short, Fahad Rafique Dogar, Jeffrey Foster, Jivko Sinapov, Johannes Peter Albert De Ruiter, Lenore J Cowen, Liping Liu, Mark A Sheldon, Marty Allen, Matthias Scheutz, Megan Monroe, Michael C. Hughes, Milod Kazerounian, Ming Yan Chow, Noah Mendelsohn, Norman Ramsey, Peter John Love, Raja Raman Sambasivan, Remco K Chang, Richard Townsend, Robert Jacob, Samuel Guyer, Soha Hassoun, Susan Landau			

CS-0297 **Dissertation Research**

Guided research on a topic suitable for a doctoral dissertation. Please see departmental website for specific details. Prerequisites: Ph.D. student standing in Computer Science

INDEPENDENT STUDY

Section	Class No.	Session	Day, Times and Locations	Faculty	Credit	Status	Select
C-IND Details	50411	S12	Time Not Specified TBA Medford/Somerville	Abani Patra, Alva Couch, Bert Huang, Daniel Jared Votipka, Dave Lillethun, Diane L Souvaine, Donna Slonim, Elaine Schaertl Short, Fahad Rafique Dogar, Jeffrey Foster, Jivko Sinapov, Johannes Peter Albert De Ruiter, Johes Bater, Karen A Panetta, Kathleen Fisher, Lenore J Cowen, Liping Liu, Mark A Sheldon, Marty Allen, Matthias Scheutz, Megan Monroe, Michael C. Hughes, Ming Yan Chow, Noah Mendelsohn, Peter John Love, Raja Raman Sambasivan, Remco K Chang, Richard Townsend, Samuel Guyer, Shuchin Aeron, Soha Hassoun, Susan Landau	1-9		

CS-0299 **Internship In Computer Science**

Study of approved topics in Computer Science in concert with an internship in computing or a related field outside the University. Prerequisites: Permission of instructor

INTERNSHIP

Section	Class No.	Session	Day, Times and Locations	Faculty	Credit	Status	Select
CPT-INT Details	50406	S12	Time Not Specified Online	Ming Yan Chow	1		

CS-0401 **Masters Degree Continuation**

Part-time.Please see departmental website for specific details.

CONTINUANCE

Section	Class No.	Session	Day, Times and Locations	Faculty	Credit	Status	Select
PT-CON Details	50465	SA	Time Not Specified TBA Medford/Somerville	STAFF	0		

CS-0401 **Masters Degree Continuation**

Part-time.Please see departmental website for specific details.

CONTINUANCE

Section	Class No.	Session	Day, Times and Locations	Faculty	Credit	Status	Select
PT-CON Details	50462	S12	Time Not Specified TBA Medford/Somerville	STAFF	0		

CS-0402 **Masters Degree Continuation**

Full-time.Please see departmental website for specific details.

CONTINUANCE

Section	Class No.	Session	Day, Times and Locations	Faculty	Credit	Status	Select
FTA-CON Details	50463	SA	Time Not Specified TBA Medford/Somerville	Diane L Souvaine	0		

CS-0402 **Masters Degree Continuation**

Full-time.Please see departmental website for specific details.

CONTINUANCE

Section	Class No.	Session	Day, Times and Locations	Faculty	Credit	Status	Select
FT-CON Details	50407	S12	Time Not Specified Online	Diane L Souvaine	0		

CS-0405 **Grad Teaching Assistant**

TEACHING ASSISTANT

Section	Class No.	Session	Day, Times and Locations	Faculty	Credit	Status	Select
TA-TAS Details	50403	S12	Time Not Specified Online	Abdullah Bin Faisal, Andrew Scott Winslow, Diane L Souvaine, Elaine Schaertl Short, Fabrizio Santini, Jivko Sinapov, Marty Allen, Michael Allan Jahn, Milod Kazerounian, Owen A. Morrissey, Patrick Feeney, Sandra Schulenburg, Shivam Goel	0		

CS-0406 **Grad Research Assistant**

RESEARCH

Section	Class No.	Session	Day, Times and Locations	Faculty	Credit	Status	Select
RA-RSC Details	50404	S12	Time Not Specified Online	Daniel Jared Votipka, Elaine Schaertl Short, Fahad Rafique Dogar, Jeffrey Foster, Jivko Sinapov, Lenore J Cowen, Matthias Scheutz, Megumi Ando, Michael C. Hughes, Peter John Love, Raja Raman Sambasivan, Remco K Chang, Robert Jacob, Saeed Mehraban, Sandra Schulenburg, Soha Hassoun, Vasanth Sarathy	0		

CS-0502 **Doctoral Degree Continuation**

Full-time.Please see departmental website for specific details.

CONTINUANCE

Section	Class No.	Session	Day, Times and Locations	Faculty	Credit	Status	Select
CON-CON Details	50408	S12	Time Not Specified Online	Diane L Souvaine	0		

g. Satisfied language assessment and completion of the English for Technical Professionals online course (for international students who were required to submit TOEFL/language scores in their application).

4. Students searching for a co-op position during a fall or spring semester must meet the semester-hour requirements.
5. All students must have their academic advisors sign off on the Co-op Agreement form to ensure a return plan that outlines a feasible pathway for completing the remaining requirements within the degree time limits. The sequence of courses in the program should be considered in addition to possible alternatives to required courses, should a required course not be offered during the semester when the student returns from co-op. A student's degree program cannot be extended because a required course is not offered during the semester that they return.
6. After the co-op, students must return to complete one full semester at Tufts before graduating. There must be degree requirements remaining in their program after the co-op is completed. Students cannot go on a co-op if all degree requirements are already satisfied.

Departments Participating in Co-Op Program

Students enrolled in MS degree programs offered by the following departments are eligible to participate in the co-op program for graduate students. Part-time, online certificate, post-bacc, and Ph.D. students students do not qualify for the co-op.

- Biomedical Engineering
- Chemical and Biological Engineering
- Civil and Environmental Engineering
- Computer Science
- Electrical and Computer Engineering
- Mechanical Engineering
- Tufts Gordon Institute

Questions and Contact Information

Graduate Admissions for new applicants.

Career Center for enrolled MS students.

Co-op Application Process

To be considered for enrollment in the Graduate Co-op Program, students must:

1. **Attend a REQUIRED Graduate Co-op Information Session.** Info sessions are typically held at the end of the semester and are hosted by the Career Center and partnership with SOE. Eligible students will receive an announcement to their

CS-119 Syllabus for Spring, 2025

Teaching Team

Professor	Jitendra Singh
Assistants	TBA

On-Campus Lectures: Mondays and Wednesdays 10:30 am — 11:45 am. Joyce Cummings Center, Room 180, except where noted below[1].
Online Synchronous Meetings: Mondays 5:30 — 7:00 pm, except where noted below[2].

The meeting dates for both sections are shown below[3], (note the exceptions for week of 2/17)

Wk-Of	1/15	1/22	1/27	2/3	2/10	2/17	2/24	3/3	3/10		3/24	3/31	4/7	4/14	4/23	4/28
Day	W	W	M W	M W	M W	W Th	M W	M W	M W		M W	M W	M W	M W	W	M
Campus	✅	✅	✅✅	✅✅	✅✅	✅✅	✅✅	✅✅	✅✅		✅✅	✅✅	✅✅	✅✅	✅	✅
Online	x	✅	✅ x	✅ x	✅ x	x ✅	✅ x	✅ x	✅ x		✅ x	✅ x	✅ x	✅ x	x	✅

[1] Campus lectures on 1/15 and 1/22 will also be available on zoom (requires Tufts ID to access) and recorded for the benefit of students joining before the last day for AS&E students to ADD classes.
[2] Online lectures will begin on 1/22. All online lectures will be recorded.
[3] Per the University calendar.

CS-119 Syllabus for Spring, 2025

Course Description

Big Data deals with emerging applications in science and engineering disciplines that generate and collect data at unprecedented speed, scale, and complexity — and the techniques for these data to be processed and analyzed efficiently.

CS-119 introduces the latest techniques and infrastructures developed for big data including parallel and distributed database systems, map-reduce infrastructures, scalable platforms for complex data types, stream processing systems, and cloud-based computing.

The course content will be a blend of theory, algorithms and practical (hands on) work, involving software design, coding, testing and debugging!

Prerequisites: (1) Linear Algebra and (2) Fluency with Python. There are no other formal requirements but it helps if you enjoy programming, especially debugging code! Familiarity with database internals (CS-115) is helpful but is not required. Most of our work in this class will be Python-based. We'll primarily (but not exclusively) use Google Colab.

Big Data work across the industry involves Python, Java, Scala, shell programming and SQL. Familiarity with the programming languages cited will give you a head start. It is expected that students taking CS-119 know at least some of these and will pick up the rest, as required, on their own.

About the "Alice" Theme: Some of the exercises in this course playfully evoke *Alice in Wonderland* by Lewis Carroll[4].

[4] In addition to authoring Alice in Wonderland, Lewis Carroll was a Mathematician. He is credited with a paper on infinite logic, What the Tortoise said to Achilles, popularized by Douglas Hofstadter's writings.

Hofstadter's *I am a Strange Loop* and its predecessor *Gödel, Escher, Bach (GEB)* are a mixture of his musings on consciousness, intelligence (human and artificial), mathematics and a whole lot more. GEB won the Pulitzer Prize for General Non-Fiction in 1980. The Strange Loop Conferences, sadly, ended in 2023.

CS-119 Syllabus for Spring, 2025

Textbooks on Big Data Theory

The Datacenter as a Computer *Designing Warehouse-Scale Machines*, Third Edition Luiz André Barroso Urs Hölzle Parthasarathy Ranganathan	Springer Cham Copyright: 2019 ISBN: 978-3031006333 Downloadable from Tufts Library with your credentials.
Mining of Massive Datasets, 3rd edition Jure Leskovec Anand Rajaraman Jeff Ullman	Cambridge University Press Copyright: 2014 ISBN: 978-1108476348 Textbook home page
Everybody lies *Big data, new data, and what the internet can tell us about who we really are* Seth Stephens-Davidowitz	Harper Collins Copyright: 2017 ISBN: 9780062390875

Textbooks on Big Data Programming

Hadoop: The Definitive Guide: Storage and Analysis at Internet Scale, 4th Edition Tom White	O'Reilly Media Copyright: 2015 ISBN: 978-1491901632
Spark: The Definitive Guide Bill Chambers Matei Zaharia	O'Reilly Media Copyright: 2018 ISBN: 978-1491912218

Grades for the Course[5]

Item	% score
Class Participation Your class participation score is intended to reflect your effort in maintaining a collaborative learning environment for everyone. ● Thoughtful public postings on Piazza, our class discussion platform, ● Willingness to help peers when they are stuck and being acknowledged for having done so, ● Participation during office hours & lectures and – for the online section – turning on your video camera and keeping it turned on!	**8%**
Exercises The exercises are intended to reflect your effort in staying current with what's happening in class. They are typically due a week after they are assigned, never more than two weeks. Only the best 7 out of 9 of your exercise scores will count towards the final grade. However, not all exercises are equal – two of the 9 exercises are worth more points than the other 7.	**55%**
Assignments Big Data is a continuously evolving field. The ability to consume published, peer-reviewed papers is critical to your ability to stay current with it. We will follow a methodology proposed by S. Keshav to review some of the seminal papers in the field. Small programming assignments may be utilized to prepare for forthcoming exercises.	**17%**
Projekt[6] Writing proposals is an integral part of moving up in the organization where you work, be it academe or industry. The first step for a research project is to apply for funding. The projekt is essentially that: a funding proposal. You will not be doing the actual research just yet — you will be creating a proposal[7] for securing funding for the research. Choosing a topic thoughtfully is part of the project.	**20%**

[5] All Exercises, Assignments and the Projekt are open-book, open-internet, take home. There is no midterm or final exam.
[6] Short for "GedankenProjekt." It is named in honor of "Gedankenexperiment," a term used by Albert Einstein to describe his unique approach of using conceptual rather than actual experiments in creating the theory of relativity.
[7] A research proposal is a detailed plan or 'blueprint' for the intended study, and once it is completed, the research project should flow smoothly. The Projekt will include the technical design of a system but not its implementation.

CS-119 Syllabus for Spring, 2025

Course Administration and Policies

Lab Environment

Each student will have an allowance for use of a Cloud Platform to be used for some of the earlier exercises. Google has been generous in making this resource available to us through their "Google Cloud Platform credits" program (GCP credits program), please be thoughtful in using it. Some things to consider:

- *Shut off your VM or cluster when you are done using it, otherwise they will continue to accrue charges.*
- *Don't confuse Google's "Free Trial" program with the GCP credits program* and be aware of the risk of signing up for the Free Trial. It is deceptively easy to change to billing that credit card when the $300/90 days of the Free Trial is used up.
- *If your credit card is charged at the end of the Free Trial program, GCP credits admins cannot help.* Please see this warning from the GCP credits program.

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Seeking Help

Please keep in mind the following as regards to approaching the instructor for help.

- For technical questions, please utilize Piazza — plus other students could likely benefit from the Q & A. Some students may answer your questions even faster! *Public questions will receive a higher weighting because they apply to everyone.*
- For questions that have specifics of your solution that you don't want others to see, it's OK to post private questions.
- To get in touch with the instructor for a matter unrelated to course content, please use email. Please keep the use of email to confidential matters, not for general class discussion
- If there is no response from the above within 24 hrs, or in case of an emergency, please call the instructor.

Illness-related policies

Please do not come to class when exhibiting even mild Covid-19 symptoms. If you are ill or symptomatic, please alert the teaching team via Piazza. This guideline applies to everyone: the students, TAs and the instructor.

Zoom recordings will be available to those who are unable to attend due to illness, anxiety, grief or trauma. On-campus students must inform the instructor via email at least 2 hours prior to class.

To make zoom recordings available to everyone for unexpected absences, please be aware that you are consenting to being recorded, even if we don't record on a particular day..

Academic Integrity

You are expected to be familiar with the Student Guide to Academic Integrity at Tufts and follow those guidelines.

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Accommodations for Students with Disabilities

Tufts University values the diversity of our students, staff, and faculty and recognizes the important contribution each student makes to our unique community. Tufts is committed to providing equal access and support to all qualified students through the provision of reasonable accommodations so that each student may fully participate in the Tufts experience. If you have a disability that requires reasonable accommodations, please contact the StAAR Center (formerly Student Accessibility Services) at StaarCenter@tufts.edu or 617-627-4539 to make an appointment with an accessibility representative to determine appropriate accommodations. Please be aware that *accommodations cannot be enacted retroactively*, making timeliness a critical aspect for their provision.

Academic Support at the StAAR Center

The StAAR Center (formerly the Academic Resource Center and Student Accessibility Services) offers a variety of resources to all students (both undergraduate and graduate) in the Schools of Arts and Science, Engineering, the SMFA and Fletcher; services are free to all enrolled students. Students may make an appointment to work on any writing-related project or assignment, attend subject tutoring in a variety of disciplines, or meet with an academic coach to hone fundamental academic skills like time management or overcoming procrastination. Students can make an appointment for any of these services by visiting the StAAR Center website.

Mental Health Support

As a student, there may be times when personal stressors or emotional difficulties interfere with your academic performance or well-being. The Counseling and Mental Health Service (CMHS) provides confidential consultation, brief counseling, and urgent care at no cost for all Tufts undergraduates as well as for graduate students who have paid the student health fee. To make an appointment, call 617-627-3360. Please visit the CMHS website to learn more about their services and resources.

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About the Instructor

I received my M.S. in Electrical Engineering with a thesis on handwriting recognition – a topic for which we now use neural networks. My Ph.D. in Electrical Engineering was on solving large-scale matrix problems in Electromagnetics. A significant part of my career was in industry, mostly in Systems Architect roles, Computer-Aided Design at first and later in Finance.

I have been a member of the faculty at WPI in the past, and more recently at Tufts. I've taught Big Data for 10+ years. I have worked in Cloud Computing, Big Data and Python since 2008. Python has been my programming language of choice ever since!

Please call me Jitendra or J or Prof. J, whichever you prefer. (No period after the J)

ARTIFICIAL INTELLIGENCE

Prof. Fabrizio Santini - Fabrizio.Santini@tufts.edu

This course is an introductory survey of Artificial Intelligence (AI). It will cover AI's history, theory, and computational methods. Basic concepts include the representation of knowledge and computational methods for reasoning.

TUFTS: http://www.cs.tufts.edu/comp/131/

CANVAS: https://canvas.tufts.edu/courses/63214

- **Text**: Artificial Intelligence: A Modern Approach (4th edition). Stuart Russell and Peter Norvig, Prentice Hall (2021) ISBN: 0-13-461099-7
- **Hours:** Monday – Wednesday, 6 PM – 7:15 PM, Joyce Cummings Center 160
- **Block:** M+
- **Recorded classes:** Classes are not recorded.
- **Prerequisites:** Algorithms and data structures, basic Linear Algebra, basic Probability Theory.
- **Office hours:** After every class or by appointment.

COURSE GOALS

By the end of the semester, students should be able to:

1. Identify the major classical and modern AI paradigms and explain how they relate to each other.
2. Analyze the structure of a given problem such that they can choose an appropriate paradigm in which to frame that problem.
3. Implement a wide variety of both classical and modern AI algorithms.

TENTATIVE LIST OF TOPICS

The following is a tentative list of topics covered in this course. The list will be subject to changes that depend on the time and pace of the class:

01/15 **Wed**	Introduction to AI
01/20 **Mon**	**NO CLASS**
01/22 **Wed**	Rational agents
01/27 **Mon**	Behavior Trees
01/29 **Wed**	Uninformed search
02/03 **Mon**	Informed search 1
02/05 **Wed**	Informed search 2
02/10 **Mon**	Constraint Satisfaction Problems
02/12 **Wed**	Local search
02/17 **Mon**	**NO CLASS**
02/19 **Wed**	**Test 1** (6:00 PM – 7:15 PM, Joyce Cummings Center 160)
02/20 **Thu**	Propositional Logic 1
02/24 **Mon**	Propositional Logic 2
02/26 **Wed**	First-order Logic 1
03/03 **Mon**	First-order Logic 2
03/05 **Wed**	Probability Theory 1
03/10 **Mon**	Probability Theory 2
03/12 **Wed**	**Test 2** (6:00 PM – 7:15 PM, Joyce Cummings Center 160)
03/17 **Mon**	**NO CLASS**
03/19 **Wed**	**NO CLASS**
03/24 **Mon**	Bayes networks 1
03/26 **Wed**	Bayes networks 2
03/31 **Mon**	Markov models 1
04/02 **Wed**	Markov models 2
04/07 **Mon**	Learning by examples
04/09 **Wed**	Artificial Neural Networks 1
04/14 **Mon**	Artificial Neural Networks 2
04/16 **Wed**	Clustering
04/21 **Mon**	**NO CLASS**
04/23 **Wed**	Cognitive architectures
04/28 **Mon**	Ethics in AI
05/08 **Thu**	**Test 3** (12:00 PM – 2:00 PM, Joyce Cummings Center 160)

HOMEWORK AND TESTS

Assignments

Six (6) assignments (roughly matching the major course sections) will be given during the class.

Python is the official implementation language for assignments. C++ or other languages can be used **ONLY** after negotiating with the teaching staff before submitting.

You can submit a ZIP file with all the files needed to run your solution on Canvas. There is no auto-grader. All assignments are manually executed and graded. For Python, provide a plain PY file (**DO NOT** use `Jupyter` notebooks). If you are writing in C++, please include a `CMakeLists.txt` file and other compilation instructions.
Your solutions may make use of any numerical libraries for pre-processing and visualization. However, the core portion of your solutions **MUST** be implemented from scratch.
Any material regarding the solution will be submitted electronically. Homework is due at midnight of the deadline (check the COMP 131 website calendar for more details). Late assignments are penalized at 10% for each 24-hour delay. No homework will be accepted after one week.

You have three (3) 4-day extensions available to you. Multiple extensions cannot be combined on a single assignment. If you decide to use them, please alert the teaching staff **before the assignment's deadline**.

Homework

For reading assignments, students will be asked to read a section from the textbook. Occasionally, an exercise or two will be given in class to be solved at home. The results of the homework will be discussed upon request from the students.

Attendance

For some lectures, I will provide a short questionnaire that must be returned at the end to promote engagement and obtain feedback on the class's understanding of the topics. The questionnaire is based on best effort, so there is no actual grade. However, it will impact the attendance portion of your grade. You can miss at most two questionnaires without any impact on the grade.

Tests

Three (3) tests will be administered over the semester (see the tentative schedule below). The tests will combine single-choice, multiple-choice, calculations, and open-ended answers. Books must be closed, and electronic devices are not allowed.
If you need to miss any of the tests for any reason, you must inform me **before the scheduled day** so that a make-up session can be arranged.

Please Note: If you wish to dispute a grade, you must do so **within one week** of receiving the grade. After such a term, the grade will be considered final.

Do NOT bring unauthorized materials, information, or any electronic equipment with you to a room where an exam is being administered. **DO NOT** engage in behavior that looks like cheating, such as passing a note to a friend, whispering to another student while the exam is in progress, or looking toward another student's work. **DO NOT** bring your cell phone, tablet, music device, programmable calculator, or any other electronic device to an exam room. If an exam proctor sees you handling an electronic device, even silencing a phone if it rings or vibrates in the middle of the exam, the Judicial Affairs Administrator will treat it as an academic integrity violation. **DO** turn off your cell phone and put it out of reach, out of sight, or as instructed before the exam begins.

Final grades

You must show proficiency in all grading areas to pass the class. A failing average (below 70 or "C-") in *any* of the grading areas (assignments or tests) will result in a failing grade in the class. Your final grade will be determined using the following percentage breakdown: 45% coding assignments, 50% tests, and 5% attendance.

The following standard grading scale will be applied without any grading on the curve:

70 – 72.99	C-
73 – 76.99	C
77 – 79.99	C+
80 – 82.99	B-
83 – 86.99	B
87 – 89.99	B+
90 – 94.99	A-
95 – 98.99	A
99 – 100	A+

COMMUNICATIONS

Canvas will be our primary means of communication. The website will also be the venue for all course announcements and class discussions.

Rather than emailing questions to the teaching staff, we encourage you to post your questions as a public discussion. You are also encouraged to help each other, as long as the question does not contain any code or portion of a problem set answer. In such a case, the question must be made private (please refer to the section Academic Honesty below).

To schedule office hours outside the posted times, please email any teaching staff or post a private email or a message on Canvas.

BEHAVIOR IN CLASS

Please respect your classmates' right to learn without unwanted distractions by silencing your cell phones and other electronic devices before class begins. The teaching staff will be doing the same. **No text messaging**, **instant messaging**, **gaming**, or **web surfing** will occur during class. You may use laptops to take notes during lectures, but a single violation of this policy will result in losing that privilege.
An exception will be made in the case of a disability if the student approaches the instructor beforehand and an arrangement is agreed to.

If you are disruptive in class, the teaching staff will ask you not to be. If you continue to be disruptive, we will ask you to leave.

ACADEMIC HONESTY

Science is, at its core, a collaborative effort. The advantages of coming together for examination or comparison, sometimes even to explain the problem, are well known. I strongly encourage students to discuss course material, problems, and applications outside the classroom with the teaching staff and other students. You are also encouraged to form study groups for the tests.

Integrity and honesty, however, are equally important qualities of any future academic, scientist, or engineer. We take plagiarism very seriously. You must do your homework and the final projects independently and without the help of any AI-enabled tools. If you need help, the teaching staff will be more than happy to help you!

The Faculty of the School of Arts and Sciences and the School of Engineering must report suspected academic integrity violations to the Dean of Student Affairs Office. If I suspect you cheated or plagiarized in this class, I must report the situation to the dean. If students do not understand these terms or those outlined in the Academic Code of Conduct, they must talk to the instructor.

STUDENTS WITH DISABILITIES

To maximize each student's participation in the Tuft experience, Tufts and the teaching staff are committed to providing equal access and support to all qualified students through reasonable accommodations.

If you need reasonable accommodations for a disability, don't hesitate to contact the Student Accessibility Services office at mailto:accessibility@tufts.edu or 617-627-4539 to determine appropriate actions.

Please be aware that accommodations cannot be enacted retroactively, making timeliness a critical aspect of this provision. If you need special accommodations for exams, please do not wait until just before the exam to contact SAS. Please give us sufficient time to arrange the necessary accommodations.

MENTAL HEALTH SUPPORT

As a student, there may be times when personal stressors or emotional difficulties interfere with your academic performance or well-being. The Counseling and Mental Health Service (CMHS) provides confidential consultation, brief counseling, and urgent care at no cost for all Tufts undergraduates and graduate students who have paid the student health fee. To make an appointment, call 617-627-3360. Please visit the CMHS website: http://go.tufts.edu/Counseling to learn more about their services and resources.

FEEDBACK

Tufts and the Artificial Intelligence teaching staff strive to create a learning environment welcoming students of all backgrounds. Your thoughts and concerns are important. You are encouraged to give feedback to the instructor throughout the term. If you feel uncomfortable talking to teaching staff members, consider contacting your academic advisor, department chair, or dean.

COMP 23: Introduction to Game Development

Tufts University Department of Computer Science, Fall 2015

Instructor

- Ming Chow, mchow@cs.tufts.edu
- Office Hours: Wednesdays from 1 - 4 PM, or by appointment, "in my usual spot". Hours are good until the last day of classes, December 11th.
- Please send all class questions (e.g., help on assignments and labs) via Piazza. DO NOT E-MAIL ME! Sign up at https://piazza.com/tufts/fall2015/comp23.
- For emergencies or private matters, please e-mail or see me directly.

Teaching Assistant

- Arthur Berman
- Arthur will hold office hours between 11 and 2 on Fridays. Arthur will be showing when and where he is on office hours on http://www.halliganhelper.com.

Class Time and Location

- Tuesdays and Thursdays, 12:00 - 1:15 PM in Halligan 111A

Prerequisites

- COMP 15: Data Structures

Documentation

- Phaser.io: http://phaser.io/docs
- Unity: http://docs.unity3d.com/Manual/index.html

Syllabus

Schedule is subject to change.

Topics:

- Audio, Sound, and Music
- Storytelling
- Artificial Intelligence
- Game Testing
- Ethics, MMORPGs, and Securing Online Games
- Mobile Games
- Networking

Date	Agenda	Deliverables
Tuesday, September 8th	Course Introduction	• Lab 1: Course Roster. PLEASE COMPLETE ASAP! This lab is worth 1 point. • Please sign up for our Piazza group • Semester Personal Engagement Project

		• Sign up for the Fall 2015 Reverse Career Fair (not mandatory)
Thursday, September 10th	• Brief History of Video Games; Game Design Principles • Read: DEF CON: Why Conference Harassment Matters • Read: Sexual Harassment at DefCon (and Other Hacker Cons) by Bruce Schneier • Read: DEF CON Conference Code of Conduct	• The One Button Game Design Document (GDD)
Tuesday, September 15th	• Game Development Methodologies • Working in a Team; Agile; Git • Play: Zork I - The Great Underground Empire (by Infocom) • Read: Down From the Top of Its Game: The Story of Infocom, Inc. (MIT)	• Project 1 Assigned • Teams • Career Panel Hosted by Tufts CS from 7:30 - 9 PM in Cabot Auditorium. You will receive 2 points for attending this event. Attendance will be taken.
Thursday, September 17th	• Working in a Team; Agile; Git • Revision Control with Git (COMP 20 notes) • GitHub's Git Cheat Sheet • Reading: A Successful Git Branching Model	To Do Before Next Class: Complete the Phaser tutorial at http://phaser.io/tutorials/making-your-first-phaser-game/index. Come to the next class with questions to ask. Please complete it in a git repository using the skills we've discussed in class, post this git repository on github, and send us a link via email (arthur.berman@tufts.edu).
Tuesday, September 22nd	• JavaScript • Q: Why Not Python and PyGame and Why Not Unity (for now)? • Phaser.io	
Thursday, September 24th		Lab Due 10/1
Tuesday, September 29th	Work Day	• Tufts Career Fair on Wednesday, September 30th from 11:30 AM - 2:30 PM at Gantcher • Tufts CS Reverse Career Fair on Wednesday, September 30th from 2:45 - 4 PM in Halligan 102
Thursday, October 1st	Sprites, Animation, Physics	
Tuesday, October 6th	Unity	
Thursday, October 8th	Project 1 Demo	
Tuesday, October 13th		