rented/borrowed are also fine. But it must be the 2nd edition.)

You will also need a laptop or desktop computer at home that you can either install database software on, or run a virtual machine that has the database software on it. Windows, Mac, and Linux systems are all acceptable, and all required software is freely available online.

Class Times & Location

This class will be held *in-person* for fall 2021. (Keep an eye on your email for announcements form the university or AS&E schools about COVID-19 precautions, and for announcements from the course instructor.)

- Tuesdays & Thursdays, 6:00 – 7:15 PM
- Joyce Cummings Center, room 160

The first class will be Tuesday, Sept. 6, 2022. The last day of class will be Thursday, Dec. 8, 2022. The final exam will be **Friday, Dec. 16, 2022, at 7:00 pm**.

Instructor & TAs

Dave Lillethun is the instructor. TAs are Tomislav Zabcic-Matic and Mona Ma.

Office hours and contact information will be posted in Canvas.

Assessments

Take-Home Tests

There will be several tests (every other week, 6 in total), which you will

tests. They will not be proctored and will not be strictly timed, but will be released at a certain time and due at a certain later time. You may work on the test any time before the deadline and take as long as you like, up to the deadline. Materials you are allowed to use when working on tests are:

- While taking the test, you may refer to the textbook, your notes (including previous tests, quizzes, class exercises, etc.), the Internet, and generally any other pre-written/recorded sources.
- You *may* ***not*** *collaborate or discuss* test questions or answers with anyone else (whether they are a student in this class or not). This also means that you may not post online (e.g., Stack Overflow, Reddit, etc.) to ask questions pertaining to the test; you may only use information online that already existed before you looked at the test.
- **You must write all answers in your own words.** Even though you may refer to other materials to help you figure out the answers, you may not plagiarize those materials on your answers. Even making minor modifications after copying is forbidden. You must *completely rewrite/rephrase it* ***using your own words***.
- If ever in doubt, ask the instructor *before* you do something. It is better to ask for permission than forgiveness, in this case.

In-Class Quizzes

There will be several quizzes (every 2-3 weeks, 5 in total), which you will take in class. You will be given **30 minutes** to complete the quiz at the beginning of class on days when quizzes are given, and normal class will be held for the rest of the period following the test. **Quizzes are *cumulative***, and you may be asked about any material covered in any lecture or required reading assignment from the textbook.

Quizzes will be proctored, and you *may **not** use any calculators, other electronic devices, books, or notes **except*** for a **one-page note sheet**. You will be allowed to prepare a single letter size (8.5″x11″) sheet of paper with notes that you may use during the exam. You may write on both sides, and there are no rules about text size or margins, but it *must be **hand written*** (unless a disability accommodation allows otherwise). However, you will not be allowed to use any magnification devices (except for routine corrective eyewear, such as glasses), so you must write it such that you will be able to read it. While you are welcome to discuss what to put on the note sheet with other students, **each student must hand write their own copy of the note sheet**. *Photocopies, and other kinds of copies, will **not** be permitted*.

You will be required to turn in your note sheet with your quiz. Among other reasons, the will force you to rewrite a new one for each quiz, which is beneficial for several reasons:

- **The act of writing things down will help you to remember.** Therefore, rewriting the things you need help remembering several times will help you remember them better than just writing them once. (Also, hand writing it will help you remember better than typing would.)
- There will be **new material on each quiz** that you'll want to add to your notes sheet.
- You should also remove old material from the notes sheet. If you find that you were able to remember something without the notes sheet, you may decide to remove it. More importantly, **you'll want to make room for the new material** that you're adding.

Final Exam

The final exam will take place at **7:00 pm on Friday, Dec. 16** in the usual classroom. It will have the same rules, format, and types of questions as the quizzes (including the notes sheet), with the same types and formats of questions, except that it will be fully cumulative. All material from the entire class will be eligible for exam questions. The length of the exam will be approximately twice that of a quiz. (So in essence, it's a longer, more fully cumulative quiz.)

Late Work Policy

In this class, each students starts the semester with **5 "late tokens"** that are each worth an extra day (24 hours) on a take home test assignment. (With the exception that you will get Saturday and Sunday as a bundle for 1 token. Since tests will be due on Fridays, that means 1 token gives you until Sunday, 2 tokens until Monday, and an additional token for every day past then that you need.) There are no penalties for lateness as long as you use a sufficient number of late tokens. If you will not have work completed by the deadline, then **email the instructor** (contact information is in Canvas) ***before* the deadline** and tell him how many extra days you need. A corresponding number of late tokens will be deducted. You don't need to provide any excuses, just the new date when you will submit the work. As long as you send that email before the assignment deadline, your late submission will be graded for full credit. (However, if there is an emergency situation that makes it impossible or unreasonable to contact us before the deadline, then just send the email as soon after the deadline as is reasonable.)

Note that the quizzes and final exam are scheduled to occur in specific class periods, and therefore the deadline cannot be extended. However, make up quizzes and exams can be provided if you miss it due to a miss any of these.

Course Grades

Each test, quiz, or exam will *not* be given a percentage score or letter grade, but rather each individual question will be rated as "Exceeds Expectations", "Meets Expectations", "Needs Improvement", or "Not Assessable" ("N/A" for short). These mean the following:

- **Exceeds Expectations** – This assessment shows that you have significant proficiency in the relevant topic, beyond the minimum expected by the course learning expectations.
- **Meets Expectations** – This assessment shows that you have some proficiency in the relevant topic, in line with the course learning expectations.
- **Needs Improvement** – This assessment shows some knowledge but does not yet demonstrate full proficiency in the topic.
- **Not Assessable** – This assessment is too incomplete to accurately assess whether you have met expectations or not, or it shows little evidence of knowledge or skills. This could be, for example, a question in which not all parts were attempted fully, was left blank, or was partially answered but too much was missing to really be able to assess the student's knowledge/skills.

Here is what you need to do to earn each letter grade. You must meet *all* of the criteria for a letter grade in order to get that grade.

- A
    - Meets Expectations (or higher) on a total of **at least 90.0%** of test questions, and
    - Exceeds Expectations on **at least 30.0%** of test questions, and

    - Exceeds Expectations on **at least 30.0%** of quiz & exam questions
- B
    - Meets Expectations (or higher) on a total of **at least 70.0%** of test questions, and
    - Exceeds Expectations on **at least 10.0%** of test questions, and
    - Meets Expectations (or higher) on a total of **at least 70.0%** of quiz & exam questions, and
    - Exceeds Expectations on **at least 10.0%** of quiz & exam questions
- C
    - Meets Expectations (or higher) on a total of **at least 55.0%** of test questions, and
    - Meets Expectations (or higher) on a total of **at least 55.0%** of quiz & exam questions
- D
    - Meets Expectations (or higher) on a total of **at least 50.0%** of test questions, and
    - Meets Expectations (or higher) on a total of **at least 50.0%** of quiz & exam questions

Students who meet all the criteria for a letter grade, **plus at least 10.0%** (percentage points) more than required Exceed Expectations on *each* of the test questions category and the quiz & exam questions category, **will receive a plus (+)** on their grade. (e.g., B+ for 30% of test questions and 40% of quiz & exam question, or C+ for 10% of test questions and 10% of quiz & exam questions Exceed Expectations.)

Students who are **within 5.0%** (percentage points) of the required number of questions Meeting or Exceeding Expectations, on *each* of the test

Expectations on *each* of the test questions category and the quiz & exam questions category, **will receive that letter with a minus (-)**, rather than the next lower letter. (e.g., Exceeding Expectations on 10% of test questions and 20% of quiz questions, while Meeting (or Exceeding) Expectations on 80% of test questions and 80% of quiz & exam questions is a B-. However, if you instead Exceed Expectations on only 10% of quiz questions, then that's a C+, and if you Meet (or Exceed) Expectations on only 79% of test questions, then that's a C no matter how many questions you Exceeded Expectations on.)

Students who do not meet the criteria for at least a D- will receive an F.

Course Policies

Students in this class are responsible for reading, understanding, and following all of the course policies listed here. For fall 2021, there are also additional COVID-19 policies for the course. By continuing to take this course, you indicate your agreement to follow all the policies. If there is any policy that you do not understand, please ask. Ignorance will not be accepted as an excuse for violating any policies.

Changes

This syllabus and any policies for this course are subject to change during the semester in response to changing conditions. Such changes are at the sole discretion of the course instructor. If any changes are made, the appropriate documents will be updated and the change will be announced to the entire class in a timely fashion.

This document has a version number at the beginning to help you tell when

example, so you don't need to re-read the entire document just to find a small change.)

Change Log

v1.0: Initial version.

v1.1: Updated course grade calculations after mid-semester evaluation

v1.2: Updated course grade calculations for the final curve (end of semester)

v1.2.1: Added ".0" to percentage values in course grade information, to clarify that these are exact decimal values (not integers) so there will not be any rounding.

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CS 116: Introduction to Security

Tufts University Department of Computer Science, Spring 2025

Course Description

A holistic and broad perspective on cyber security. Attacking and defending networks, cryptography, vulnerabilities, reverse engineering, web security, static and dynamic analysis, malware, forensics. Principles illustrated through hands-on labs and projects, including Capture The Flag (CTF) games.

Sections

1. In-person, undergrads and grads: Tuesdays, 4:30 - 5:45 PM EST in Cummings Center Room 270; Thursdays on Twitch, 4:30 - 5:45 PM EST
2. Online Master's in Computer Science: live sessions on Wednesdays, 5:30 - 7:00 PM EST (via Zoom)

Instructor

- Ming Chow, ming.chow@tufts.edu
- Office Hours: Tuesdays, 3:00 - 4:15 PM EST in JCC, fourth floor --by the kitchen area

Prerequisites

- CS 15 or Data Structures equivalent course. Recommended (not required) that you have taken CS 30 or 40. Please disregard prerequisite that CS 40 is required as listed in the University's bulletin as they are incorrect!

Hardware and Software for This Class (on your personal computer)

Absolute Requirements

- A modern web browser (e.g., Firefox, Google Chrome, Chromium, Safari, Microsoft Edge)

- A command line interface to run Unix/Linux commands (e.g., macOS, Windows with Linux Subsystem, a Linux-based virtual machine, a Docker container)

List of Security Tools That Will Be Used in Course

The following is a list of security tools that will be used in the course. All of these tools are platform-independent.

- Wireshark
- Nmap
- Netcat
- Python
- Scapy
- John the Ripper
- Burp Suite
- apktool and Java as apktool requires Java

Assessment

- Labs (80%)
- Quizzes (20%; there will be two)

Course Infrastructure

- Lab submissions: Canvas (Tufts UTLN required)
- Quizzes: Canvas (Tufts UTLN required)
- Announcements: Piazza
- Discussions: Piazza

Syllabus

Important note: always follow Canvas for due date on labs!

Topic 1, starting week of January 15th	• Course Introduction - By the end of this week, students will learn many of the fundamental Linux commands, an important skill for any good security practitioner, by playing	• Lab 1: Working with the Command Line ◦ Publicly accessible version of Lab 1

	Capture The Flags via OverTheWire. Students will remember the three principles of the CIA triad, critical to any organization's security infrastructure. • Readings and Videos • Video on YouTube with Closed Captioning: The Command Line Interface	

Topic 2, starting Tuesday, January 21st	• Networking and Packets - By the end of this week, students will be able to dissect packet captures (PCAPs), network traffic.
	• Readings and Videos
	• Thursday, January 23rd: Packet Analysis Using Wireshark
	  ◦ On Twitch
	  ◦ On YouTube with Closed Captioning
		• Lab 2: Packet Sleuth
		  ◦ Publicly accessible version of Lab 2

Topic 3, starting Tuesday, January 28th	• Attacking Networks - By the end of this week, students will perform network reconnaissance and port scanning, and build a rudimentary Security Information and Event Management (SIEM) / intrusion detection system (IDS).
	• Readings and Videos
		• Lab 3: Scanning and Reconnaissance
		  ◦ Publicly accessible version of Lab 3
		• Lab 4: Snake Oil, The Incident Alarm
		  ◦ Publicly accessible version of Lab 4

	• Thursday, January 30th: Reconnaissance using Ping, Netcat, and Nmap
	  ◦ On Twitch
	  ◦ On YouTube with Closed Captioning
	• Thursday, February 6th: Distributed Denial of Service (DDoS) Attacks and Scapy feat John Hammond
	  ◦ On Twitch
	  ◦ On YouTube with Closed Captioning	

Topic 4, starting Tuesday, February 11th	• Cryptography - By the end of this week, students will be able to crack passwords on a Linux or Windows system, use one-way hash functions, and briefly describe how Transport Layer Security works.
	• Readings and Videos
	• Thursday, February 13th: Passwords and Password Cracking with John the Ripper
	  ◦ On Twitch
	  ◦ On YouTube with Closed Captioning
		• Lab 5: Password Cracking Contest opens, due on Friday, March 7th at 11:59 PM PST

Topic 5, starting Tuesday, February 18th	• Vulnerabilities - By the end of this week, students will know the difference between CVE and CWE. • Readings and Videos	• Quiz 1 open on Monday, February 17th; due Sunday, February 23rd at 11:59 PDT

Topic 6, starting Tuesday, February 25th	• Web Security - By the end of this week, students will able to perform and defend against the following attacks: Cross-Site Scripting (XSS), SQL injection, Cross-Site Request Forgery (CSRF), session hijacking, cookie tampering, directory traversal, command injection, remote and local file inclusion.
	• Readings and Videos
	• Thursday, February 27th: SQL Injection and Web Proxies
	  ◦ On Twitch
	  ◦ On YouTube with Closed Captioning
	• Thursday, March 6th: Vulnerability Scanning, Exploitation, Badness-O-Meter
	  ◦ On Twitch
	  ◦ On YouTube with Closed Captioning
	• Thursday, March 13th: The Mistakes You Can't Make
	  ◦ On Twitch
	  ◦ On YouTube with Closed Captioning
		• Lab 6: The XSS Game
		  ◦ Publicly accessible version of Lab 6
		• Lab 7: Gain Access to Website
		  ◦ Publicly accessible version of Lab 7

Topic 7, starting Monday, March 24th	• The Capture The Flags (CTF) Game Played Online - By the end of this week,	• Lab 8: The CTF Write Up ◦ Publicly accessible

	students will be able to find and take advantage of a number of vulnerabilities on a live web application. • Readings and Videos	version of Lab 8

Topic 8, starting Tuesday, April 1st	• Static and Dynamic Analysis - By the end of this week, students will be able to perform static analysis and dynamic analysis scans on software, write a technical risk analysis that is communicated to upper management.
	• Readings and Videos
	• Thursday, April 3rd: Really, Really Bad Code and Static Analysis
	  ◦ On Twitch
	  ◦ On YouTube with Closed Captioning
		• Lab 9: Technical Risk Analysis

Topic 9, starting Tuesday, April 8th	• Malware - By the end of this week, students will be able to describe types of malware, see certain malware behaviors, scan and analyze malware, reverse engineer Android apps to determine if they are malicious.
	• Readings and Videos
	• Thursday, April 10th: Malware and Malware Analysis
	  ◦ On Twitch
		• Lab 10: Android Malware Analysis
		  ◦ Publicly accessible version of Lab 10

	◦ On YouTube with Closed Captioning	
Topic 10, starts Tuesday, April 15th	• Forensics and Incident Handling - By the end of this week, students will be able to acquire data from a disk (e.g., USB drive) using **dd**, analyze image of disk from `dd` using forensics tools, and recover deleted files off a disk. • Readings and Videos • Thursday, April 17th: Forensics ◦ On Twitch ◦ On YouTube with Closed Captioning	• Quiz 2 open on Monday, April 14th; due Tuesday, April 22nd at 11:59 PM PDT
Topic 11, starts Tuesday, April 22nd	• ~~The Future: Nihilism or Hope? - By the end of this week, students shall debate and ponder the hard questions in security, and be able to argue multiple viewpoints.~~ Lessons Not Learned: We Can't Even Get the Basics Right • Readings and Videos • Thursday, April 24th: Opportunities, Where Do You Go From Here ◦ On Twitch ◦ On YouTube with Closed Captioning	

Topics That Will Not Be Covered In This Course

- Social Engineering
- Privacy

Frequently Asked Questions

Q: Is there a textbook for this course?

A: No

Q: Are there teaching assistants (TAs) for this course?

A: No

Q: What is the workload of this course?

A: Here is a list of all the labs with expected length and difficulty:

- Lab 1: Working with the Command Line, Short (1 hour max) to Long (3+ hours) --you can put in as much time as you want on this lab
- Lab 2: Packet Sleuth, Medium (1 - 3 hours)
- Lab 3: Scanning and Reconnaissance, ~~Very short (30 minutes)~~ Your mileage may vary on this lab, could be 30 minutes, could be 2 hours or more. **NOTE: This lab cannot be made publicly available because an actual target is used.**
- Lab 4: Python and the Incident Alarm, Long (over 3 hours) to Impossible
- Lab 5: The Password Cracking Contest, If you crack all the password hashes (read: good luck with that), you will receive an automatic "A" in the course
- Lab 6: The XSS Game, Medium
- Lab 7: Gain Access to Website, Very short. **NOTE: This lab cannot be made publicly available because an actual target is used.**
- Lab 8: The CTF Game, One week --team based. **NOTE: This lab cannot be made publicly available because an actual target is used.**
- Lab 9: Technical Risk Analysis, Short to Medium.
- Lab 10: Android Malware Analysis, Short to Medium

Q: Does this course count towards the M.S. in Cybersecurity and Public Policy?

A: Yes

Q: Does this course count towards the M.S. in Software Systems Development?

A: Yes. In fact, this is one of the four required courses for the M.S.

Q: Did you remove information on using Kali virtual machine for this class? If so, why?

A: Yes. After all these years, it was more trouble than it was worth. Further reasons:

1. Accessibility. For students who are visually impaired, using a virtual machine can be very difficult.
2. Not all students have a capable laptop. Sometimes due to financial reasons, some students use Chromebooks. The tools required for this course can be installed natively on macOS, Windows, and Linux.
3. Performance. Sometimes, using a VM can be very slow. A VM also do not use native drivers (e.g., for networking).
4. Hard disk space requirement: at least 10 GB necessary.
5. Apple M1 Macs cannot run most Intel x86 virtual machines.

Q: Is Piazza used in this course?

Yes, quite a lot

Q: Why is there a course website and a course Canvas? If you say "it is a nuisance for students to use multiple websites and services for one course", what gives?

This course website serves a few critical purposes. Years ago, I made a decision to make all the readings, slide decks, and most of the labs publicly available. The reasons: (1) to show that Tufts is serious and is working on Cyber Security matters, (2) to provide learning material to the public on Cyber Security as the Cyber Security education problem is very dire, (3) for recordkeeping on what is taught and not taught in this Security class --this comes up often when we speak to industry and organizations who want to work with Tufts on Cyber Security-related matters. The Canvas site for this course isn't made publicly available. Even if Canvas site was made publicly available, content is behind a walled garden, and (4) for redundancy if Canvas goes down.

Q: I have not taken a course on Networks (CS 112), Operating Systems (CS 111), or Computer Architecture (CS 40) yet. Is that a problem?

No. Cyber Security is a very broad field and it is impossible for anyone, even professionals, to know everything. What is important for you is to start thinking about Security.

Q: Will videos be recorded in case I miss class?

If you miss the in-person Tuesday classes due to illness or personal matters, you can always watch the recorded Wednesday sessions for online Master's students (Wednesday sessions are always recorded). Tuesday and Wednesday sessions are practically identical. Thursdays are on Twitch which are recorded and also exported to YouTube.

Q: If I am taking this course for professional purpose, can I have a tuition reimbursement letter or certificate?

A: Absolutely! It's a nice tuition reimbursement letter, hand signed!

If you have read this far, send me an email (ming.chow AT tufts DOT edu) with the subject "¯_(ツ)_/¯" to earn a reward.

Course Policies

Labs

- With the exception of the password cracking lab and CTF writeup, all labs for a given topic, are due on a Sunday at 11:59 PM PDT (that is, Pacific Time).
- With the exception of password cracking lab, the CTF game, and quizzes, you are granted an automatic extension of 24 hours at no cost (i.e., grace period). A lab or quiz submitted after the grace period will not be accepted.
- No extension tokens.

Accessibility Statement

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 accommodations, please contact the StAAR Center (formerly SAS) staarcenter@tufts.edu or 617-627-4539 to make an appointment to determine appropriate accommodations. Please be aware that accommodations cannot be enacted retroactively, making timeliness a critical aspect for their provision. You can learn more about the StAAR Center at https://students.tufts.edu/student-accessibility-services.

Expectations and Structure of This Course

This course will be a fun one for sure. A few notes on the expectations and structure of this course:

1. You are responsible for your own learning.

A very important point: if you want everything gone over in lecture or in notes, then this is not the course for you. More importantly, that's not how things work in real life.

2. You will learn by doing.

Each week, there will be at most three labs to hone your skills and to aim at the crux of the matter for the week. Here's an analogy: you don't learn how to cook simply by just reading cookbooks and watching YouTube videos. You learn by making, using your hands, and making mistakes.

3. You will learn by asking questions.

It is your responsibility to ask questions early and to ask for help...

4. ...and I expect discussions online to be very active and civil.

Share thoughts and respond to other people's questions. I will be online constantly. It is no secret that I respond very quickly unless I need to be away.

CS 160-01: Introduction to Algorithms (Spring 2025)

Go to CS 160 schedule

General Information

- **Instructor:** Karen Edwards
- **Lectures:** MW 9:00-10:15 (R+ block) in Barnum LL08
- **Attendance:** There will be a lecture feedback sheet approximately once a week in lecture to measure understanding and participation.
- **Office Hours:** See Piazza.
- **Exams:** Dates can also be found on the schedule page.
  - Exam 1 and Exam 2: 75 minutes during regular class. Dates: Wed Feb 19 and Wed Mar 26.
  - Final Exam: CONFIRMED FOR Wed, May 7, from 7-9 PM, location TBD
- **Homework:** The homework, typically covering the Tuesday and Thursday lecture and the Thursday-Friday recitation is due by 11:59pm on the following Tuesday.
- **Canvas:** Canvas is being used **only** to share video recordings of lectures. There are no guarantees about these videos. If you have to miss a class, a better approach is to rely upon friends with good note-taking skills.

Quick Links:

Prerequisites

The prerequisites for this class are CS 15 and (CS/MATH 61 or MATH 65). If you have not successfully completed both courses either at Tufts or elsewhere and if you are enrolled in CS 160, please contact your instructor. We will be glad to help with references for you to study, but please understand that learning the prerequisite topics is mainly your responsibility.

This class also assumes familiarity with a few math topics such as logarithms, manipulation of summation notation, and summation of various geometric series. Be prepared to brush up on such topics as needed.

Course Logistics

Syllabus

- This page (and the schedule page) function as the course's syllabus.

Textbook

- The course is heavily based on the following book:
  [CLRS] T. H. Cormen, C. L. Leiserson, R. L. Rivest, and C. Stein. *Introduction to Algorithms (4th edition).* MIT Press, 2022.

    - We will also provide section numbers from the 3rd edition, if the topic is in there. (If there is something covered in the new edition that is not there in the older one, or is presented in a different way, be aware that we will be using that newest edition, and your experience is likely to be better if you can gain access to that one.)
    - More info at MIT press. Many students find they can learn more easily when they have access to a hard copy (even if it is an older edition).
    - You may also use this link to access a digital copy of the 3rd edition from Tufts.
    - Two copies of the 3rd edition have been permanently reserved on reserve in the Tisch library for students to access.
    - **Note:** The book is a comprehensive introduction to algorithms and contains many wonderful topics beyond what will be covered in this course.

- For further reading, any of these additional texts is recommended as an extra reference (all of them should also be available in the Tisch library, please alert us if not).
  Several students in the past have found the Skiena text particularly readable and have enjoyed his particular perspective, and yet each of these supplemental texts has had fans!

    - [KT] J. Kleinberg, E. Tardos. *Algorithm Design,* Addison-Wesley, 2005.
    - [DPV] S. Dasgupta, C.H. Papadimitriou, and U.V. Vazirani. *Algorithms,* McGraw-Hill, 2006.
    - [S] S. Skiena, *The Algorithm Design Manual,* (2nd edition) Springer, 2010.
        - Use this link for an online version from Tufts of the second edition. See here for errata.
    - [BVG] S. Baase and A. Van Gelder, *Computer Algorithms*, 3rd edition, Addison-Wesley, Reading, MA, 2000.

Course Tools

- We will use Piazza for class discussions, announcements, polls, handouts, assignments, and so on.
- Homework will be submitted and graded using Gradescope.
- Video recordings of lectures (if successful, no guarantees) will be available on Canvas.

Instructional Team:

Lead Instructor:

- Karen Edwards

Grad TAs:

- Jacob Boerma
- Jocelyn Garcia

Teaching Fellows:

- Dan Patterson
- Kimaya Wijeratna

CAs:

- Daniel Peng
- Eli Morton
- Johnny Tan
- Kevin Yu
- Lakshita Jain
- Marlon Fagundes Pereira Junior
- Megan Yi
- Meghan Kelly
- Merwan Malakapalli
- Peter Scully
- Rafeed Anwar
- Saška Barancikova
- Shayne Sidman
- Stephen Burchfield

Office Hours:

- Office hours are a great place to hang out and get work done, whether or not you have any questions yet. We have a large pool of motivated and talented TAs. Please don't be afraid to join them in office hours as needed to help you further understand the material.
- List of office hours is available on Piazza. Any cancellations, one-time location changes or additional hours will also be noted there.

Expected Work

Participation: Classes, Recitations, Quizzes/Feedback Forms:

- Students are expected to attend class and complete the related reading assignments.
- Students are expected to attend and participate actively in recitation sessions (attendance will be taken; we will drop two). These sessions provide an invaluable opportunity to practice the material and solidify learning.

- There will be lecture feedback sheets approximately once a week in lecture to measure attendance and understanding. We will drop two. Part of your grade will be based on this participation.

Homework:

- Most weeks, you will be given an assignment to practice the material presented in class and discussed in recitation. Due 11:59pm on Tuesday.
- Individual completion and regular timely submission of the homework with full attribution of sources is a prerequisite for passing this course.
- To obtain full credit, you must justify your answers. When describing an algorithm, do not forget to analyse its running time and justify why the algorithm is correct.

Collaboration and Integrity on Homework Submissions

Although you may discuss these problems in the preliminary stages with others, **submitted work should be done individually** and written in **your own words**. If you have any discussions with others, whether students, friends, TAs or faculty, relative to a homework problem or if you gain information from a written source (e.g., website) other than your own notes from lecture or the textbook for the course, you **must identify your collaborator(s)/source(s)** in writing on your homework submission. Failure to cite your sources constitutes an academic integrity violation and may be reported to the Dean.

How to write proofs:

On Piazza there is a short summary containing the key points on how to write proofs. In addition to our guide, there are various materials on the web to check out. We encourage you to look around for those resources whenever you have time in the beginning of the semester.

How to submit homework

- Homework assignments will be available on Piazza. Homeworks are turned in via Gradescope.
- Homeworks **must be typeset** using your preferred software -- LaTex is one option, and it is highly recommended. It is also required for the first homework. In general, you may handwrite or draw diagrams, trees, and graphs, which you must include/embed in the PDF. Any associated math, analysis, or descriptions of the diagrams should be typeset.

Late homework policy:

- You are allowed ~~**four (4)**~~ **now six (6) "tokens"** to be used at your discretion. Each token accounts for a **24-hour automatic extension** on the homework.
- Up to **two (2) tokens** can be used on the same assignment (for a 48-hour maximum extension). After that, if you want to use more than 2 tokens for a longer extension, you need to ask either in Piazza (to "instructors") or in office hours.
- Tokens will be applied automatically based on the Gradescope timestamp of your last submission. You do not need to notify staff that you are using tokens.
- Make sure to keep track of how many tokens you have used. (You can see late submissions on Gradescope).
- Our calculations have a small grace period (of roughly 10 minutes) to account for last minute changes and/or differences in clocks. This grace period is automatically applied to all submissions.
- If you run out of tokens (or submit homework more than 48 hours late), late homework will be counted as 0. However ....
- At the end of the semester we will calculate how many tokens are used by each student. If a student missed the deadline once by a couple of minutes (even after taking into account the tokens and the

grace period), then we will be lenient. Any other case will count as 0, which will be applied to the lowest late homework(s) to minimize impact. So it is always worth turning in homeworks even if you are late and already used all your tokens.
    - In short, be punctual and you will save all of us from troubles! If you have a valid reason for not submitting homework or need to request a longer extension, you should notify your Dean (and, if applicable, Health Services). Decisions on any extension requests will be made in consultation with your Dean.

Exams:

- The midterm exams and the final exam will include questions similar to those included on homework assignments or recitation problems and will draw on material covered in lecture and/or in the reading.
- Exam dates and times are listed under General Information and on the schedule page.
- **There are no make-up exams, so check the exam schedule before making travel arrangements.**

Grading

Your final grade percentage will be the **maximum** of the following two formulas:

> **Overall grade = 25%(Homework) + 5%(Participation) + 2x20%(per midterm exam) + 30%(Final exam)**
>
> OR
>
> **Overall grade = 25%(Homework) + 5%(Participation) + 2x15%(per midterm exam) + 40%(Final exam)**

Clarifications:

- No homeworks will be dropped.
- Participation is half recitation attendance, half lecture attendance (as measured by turning in class gradescope quizzes.) Two recitations and two class gradescope quizzes will be dropped, i.e., you can miss up to 2 of each for any reason. We do not distinguish between "excused absences" and other absences; all such requests are covered by dropping 2 for everyone. If you have valid reasons for missing 3 or more recitations, or 3 or more class gradescope quizzes, please email the instructors.
- Exam grades will not be curved individually, but the final overall letter grades of the course will be adjusted as needed. In particular, anyone in this class whose overall average is at or above the median will earn at least a B+.

Regrade requests:

If you believe any part of your work on Gradescope was graded incorrectly, we want you to let us know via a regrade request on Gradescope. Regrade requests should be concise, directed, and respectful. You should point out a specific aspect of the assignment that was graded incorrectly, and explain why in your own words. We also reserve the right to deduct points if we notice additional errors during the regrading. The person who regrades your submission will send you a response. If you have further concerns thereafter, you may contact one of the TFs or Graduate TAs at office hours or through a private Piazza post. Regrades must be submitted within **one week** of release of the grades, unless stated otherwise.

Tips on getting the most out of this course:

- Come to every class prepared. At a minimum, you should review the previous lecture, and you may also benefit from looking over the reading beforehand. Simply showing up will not suffice for your learning.
- If the pace of the lecture feels too fast, consider reading some basic material beforehand, perhaps in one of the auxiliary texts.
- When studying, try to re-derive the solutions on your own, rather than verifying what is written. You would like to "own your knowledge".
- Please don't cram. This material needs time to sink in. It cannot be learned in a couple of days.
- Spend regular time on this **core course in computer science**. It will require as much time as other core courses such as CS40 and CS105 where you may spend significant time programming. In CS160, you should spend an equivalent amount of time developing a deep understanding and mastery of the core theoretical concepts and algorithm paradigms being presented.
- After doing the reading and attending class, brainstorm about homework problems, perhaps with a small study group including 2-3 other students, informally gathering ideas and without taking notes. Then remember to go off by yourself and work independently at writing up the solutions. Make sure to cite the other members of your study group.
- Use all of the course resources. Actively participate in recitation. Attend office hours when you have questions. If additional questions arise, post them to Piazza. Solve extra practice problems from the book (these may vary in difficulty). Make your own practice problems (e.g., draw an arbitrary graph and find shortest paths).
- Read all the grading feedback on your homework as well as any published solutions (e.g., recitation). The TAs are devoting many hours to grading and giving useful feedback on your work.
- Avoid memorization. Instead, focus on understanding and then being able to explain a concept or prove a theorem in your own words.
- One of the most helpful strategies is to imagine that you are teaching this material to your parent or to a cousin or to a next-door neighbor. If you don't have the details right and don't fully understand the solution yourself, you will confuse them. (Try and actually practice explaining the concepts!) This is another reason we encourage you to collaborate in small groups, to be active at recitations and to attend office hours, since these are good opportunities to discuss the course materials with other people.

Tufts University Policies

Faculty, students, and staff are jointly responsible for the policies below. Please read carefully and do not hesitate to contact us if you have further questions.

- Academic Misconduct Policy
- The Tufts Non-Discrimination Policy

Equal access

If you have a disability that requires reasonable accommodations, please contact the Office of Accessibility Services at The StAAR Center.
(Note: Academic tutoring is also offered by the StAAR Center for those who need tutoring through Tutor Finder)

Please be aware that accommodations cannot be enacted retroactively, making timeliness a critical aspect for their provision.

Academic Integrity

- It is **not** acceptable to copy solutions from **any** source for **any** work submitted in this course.
- If you cheat on an exam by consulting any source other than the allowed page of notes, the most likely penalty is a grade of F in the course.
- On a homework or project assignment, students may consult a variety of sources at the outset and groups of people may work together, discussing and strategizing how to solve the problems, **subject to the following conditions**: each person must write and submit their solutions in their **OWN** words; **every person and/or text and/or website** consulted in the process of completing the assignment must be **accurately cited** on the homework paper submitted.
- If, for whatever reason, your homework solutions end up matching solutions from any other source in a non-coincidental way, this constitutes cheating and will incur consequences.
- In case of doubt, we encourage you to reach out to the instructor.

Have Questions?

This website is a great source of information for this class. Before inquiring, please check for the answer here (e.g., when is the exam, how do tokens work, etc).
If you still have questions, we can be reached as follows:

- **In class:** Just come and chat with the instructor before/after the lectures.
- **Office hours:** We have a large pool of TAs to cover most work hours. Please keep in mind that the further away you are from a deadline, the less waiting time you will have.
- **Piazza:** The main advantage of posting your question on Piazza is that the TAs and/or your classmates will also see that question and can answer it much faster. Make sure to use the search button before posting because your question might have already been asked! If the question needs to be private, please post to "Instructors" (this will reach Karen and all the TAs).
- **PLEASE NOTE:** Your communication with TAs should be at office hours and over Piazza. **Please do NOT email TAs directly** -- their work for the department as TAs should be conducted at office hours and over Piazza, keeping their personal email addresses for their own use as students.
- **E-mail:** You can contact the course instructor using the syntax first.last@tufts.edu. However, other methods may be better than emailing in order to get the fastest response.

Course Aims and Description

This is a computer science elective aimed at upper level undergraduates and graduate students. Upon the completion of the course, students will be able to:

- Comprehend the biological background, nature, and relevance of computational problems in molecular biology.
- Assess the efficiency of computational methods for handling data-rich problems in the field.
- Understand computational techniques and probabilistic models for working effectively with large data sets.
- Discuss and evaluate tradeoffs involved in choosing how to tackle hard computational problems.
- Develop experience applying theoretical CS material in a practical setting.

Mastery of these aims will be achieved and assessed through readings, discussions, problem sets, algorithm implementation or data analysis assignments, two in-class midterms, and a final exam. About half of the course will focus on molecular sequences and sequence manipulation; the rest will focus on issues of interpretation, which require more complex data and methods. We will talk about scalability and how and when approximate solutions are appropriate. In addition, we will introduce some ongoing areas of research in the fields of bioinformatics and computational biology.

Students will be expected to contribute to class discussion and group activities, to do the assigned reading, and to read supplementary background materials as they find necessary.

Course Staff and office hours:
Professor Donna Slonim (she/her) is the course instructor.

CS PhD student Blessing Kolawole will be our graduate teaching assistant. CS Major Adhvith Reddy is our undergraduate course assistant. TA office hours: Mondays at 7-8:30pm and Thursdays at 12:30-2pm, in JCC 349.

Email addresses are firstname dot lastname at tufts dot edu, but you can reach all the course staff at once via Piazza at all times.

Instructor Office Hours: Tuesdays, 1:30-2:45pm, and Fridays, 2:30-4pm, or by appointment. In-person office hours will be held in JCC 322. Zoom office hours (any day that we have classes online, or by request) and online appointments will be at my personal Zoom room (see private course page for links).

Course Requirements

Prerequisites: CS 15 and at least one 100-level computer science course, or graduate standing in Computer Science, or permission of the instructor.

No biology background required!

Graduate standing in a related field (Biomedical Engineering, Biology, Genetics) may be sufficient providing your computer programming background is strong enough and you know something about algorithm analysis; check with the instructor, and read the following paragraphs first.

Homework assignments will include several implementation projects in Python. We will learn about algorithms in class and in the readings, but you will then be expected to implement them from scratch and apply them, without much formal help in designing the code.

Also essential will be some basic understanding of algorithm analysis, as is typically covered in CS 15. You should be familiar with asymptotic analysis of algorithmic running times and Big O notation, at least at an introductory level. CS 160 (Algorithms) is helpful but not essential as a prerequisite; material used here will help you when you take Algorithms if you have not yet done so.

Readings: The course textbook is *Understanding Bioinformatics* by Marketa Zvelebil and Jeremy O. Baum, published by Garland Science (a subsidiary of Taylor & Francis Group). Copies of the text should be available in the Medford campus bookstore, or you can order or rent a copy online. Online orders are typically available immediately.
Readings from this text will be listed in the schedule where appropriate. Supplementary readings from the literature or from some of the recommended textbooks listed below appear on the schedule as well.

If you have no biology background, you may want to supplement the readings as well by getting a good introductory molecular biology text. (Several online texts are available for looking up occasional details).

We will do two or three collective "journal club" activities to introduce some class material. These dates are announced on the web schedule. Please read the the journal club papers listed in the schedule *before* class on the indicated day. During class, you will be assigned to join a group of students. Each group will be given a slide with questions on it about some aspect of the paper. You group will collaboratively edit the slide with answers to the questions on that slide. We will then have each team present their slide in order, making up a presentation covering the key points of the whole paper.

Other recommended books:

- *Bioinformatics and Functional Genomics* , by Jonathan Pevsner. A readable introduction to the field. Aimed primarily at biologists, provides somewhat less detail than the course text but may be slightly more approachable.
- *The Cartoon Guide to Genetics* by Larry Gonick and Mark Wheelis. A surprisingly good and serious introduction to the biological concepts covered in this course.
- *An Introduction to Bioinformatics Algorithms*, by N. Jones and P. Pevzner. An algorithms text focusing on examples motivated by computational biology. Helpful if you've never taken an algorithms class; provides a more gentle introduction to selected topics than the following book.
- *Introduction to Algorithms*, by T. Cormen, C. Leiserson, R. Rivest, and C. Stein. The canonical algorithms textbook. Has nothing to do with biology, but should be on every computer scientist's bookshelf.
- *Introduction to Computational Molecular Biology*, by J. Setubal and J. Meidanis. A detailed text focused on computational biology algorithms, aimed at computer scientists. From 1997, but covers several complex topics in depth.
- *Biological Sequence Analysis*, by R. Durbin, S. Eddy, A. Krogh, and G. Mitchison. A good computational biology text focusing on sequence analysis, HMMs, and phylogeny. Includes an excellent whirlwind introduction to statistics.
- *Molecular Biology*, by David Freifelder. A general introductory molecular biology text. Easy to read, a gentle introduction to the topic.
- *Molecular Biology of the Gene*, by J. Watson, N. Hopkins, J. Roberts, J. Steitz, and Alan Weiner. A more advanced and detailed molecular biology text. A very thorough index makes this a good reference book.

Computational resources:

- You will need access to a computer with an internet connection, support for coding in Python, and the ability to remotely log into the department's computer systems.

- **CS account**: The computer science department will provide you with an account on the EECS computer systems for this purpose. **Your LDAP authentication credentials for this account will enable you to log in to the private class materials page.** Thus, this account is essential. Such an account will be automatically provided to all students enrolled in SIS who do not already have one.

  If you need help in obtaining computational resources, you need an account but never received email about its creation, or you are a non-traditional student or auditor who may not be enrolled in SIS, please contact the instructor or teaching assistant as soon as possible. If you didn't receive email but did take a CS course in a prior semester, try **resetting your password** first; most of the time the account still exists and this will work.

  Any code you write for your homework will be graded based on its ability to run on the machine homework.cs.tufts.edu. Please be sure to test your code there; just because it works on your laptop does not mean it will work on a different machine or platform!

- **Gradescope:** You will also need a Gradescope account to submit your work and receive feedback on it. The code for signing up is available on the private class materials page.

- **Piazza:** Finally, there is a class Piazza site linked here that you are encouraged to use to ask questions and discuss topics with your classmates and the course staff. Please take advantage of this resource. You will get faster answers to your questions if you ask the entire group of students and staff at once than if you just email one of us individually.

- We will *not* be using Canvas this semester.

Policies

Grading: Grades will be based on homework assignments (45%), including both written and programming components, two in-class midterms (15% each), a final exam (20%), and class participation (5%).

Late policy: Submissions are due by midnight on the indicated date; Gradescope's timestamp is official. For late work, we are going to use a token policy. You will have 10 tokens for the term. You may use up to 2 tokens per assignment; each token gets you an extra day, which is 24 hours as counted by Gradescope. (**Exception:** homework 4 has a hard 2nd-token deadline of 6pm on April 2nd, to allow for midterm review without compromising the homework.) To use a token, you don't need to tell anyone, just submit and we will count the number of late days as the number of tokens used. **It is your job to keep track of your token usage.** Beyond the 10 tokens, we will not accept late submissions; submit what you have by the deadline for partial credit.

Turning work in on time is important for consistency in grading, because it allows us to discuss homework content in class in a timely fashion. Content builds on previous material, so it is important to figure out quickly if you are lost.

As usual, in the case when your studies are interrupted by serious illness or other truly exceptional circumstances (e.g., situations where your Academic Dean is involved), let us know and we will work something out.

Diversity, Inclusion, and Collegiality: Tufts, the Computer Science Department, and the course staff intend to create a welcoming environment in which all students feel supported and believe that their learning needs and perspectives are valued. We intend to present materials in ways that are respectful to students of any background, ethnicity, race, culture, gender, sexual orientation, or age. We welcome your suggestions on how to improve course effectiveness for yourself or others. If you have religious conflicts with class meetings or requirements, please connect with the course staff.

In this class, we will encourage questions, discussions, and some assignments that involve interacting in groups. While disagreements and differing opinions can be an important part of the learning experience, we expect all students to treat each other with collegiality and respect. Please reach out to course staff if there are any issues with inter-student interactions. While we do not expect this will be necessary, please be reminded that we will, if needed, follow the steps outlined in Tufts' sexual misconduct and non-discrimination policies.

Please also be aware that Tufts faculty are "mandated reporters": if we see, hear, or learn about any kind of discrimination or sexual misconduct, we are required to report it to the university. If you would prefer to access *confidential* counseling for an issue, you can find relevant resources here.

Accomodation for Students with Disabilities: Tufts University values the diversity of our students, staff, and faculty, recognizing 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 Student Accessibility and Academic Resources (StAAR) Center or call 617-627-4539 to make an appointment with a StAAR representative to determine appropriate accommodations. Please be aware that accommodations cannot be enacted retroactively, making timeliness a critical aspect for their provision.

In addition to following the standard procedures, if you have a disability and would like to discuss how we can better support your learning, please feel free to set up an appointment with course staff.

Academic Integrity: The Tufts academic integrity policy and code of conduct appears here. In particular, plagiarism will not be tolerated. Submitting as your own any written work or code that you did not write yourself, without the help of any other person or entity, is a violation of the academic integrity process.

Please see our collaboration policy below describing what is and is not acceptable in the context of this course. If you are not certain what constitutes plagiarism, please see the academic integrity resources at the link above or ask the course staff.

Please be aware that if Tufts faculty find evidence of academic misconduct, we are required to report it to the university. Penalties can be truly draconian. The time you save in using someone else's work will be lost ten times over as you work through the academic integrity process. So please, don't put yourself through it. We are eager to help you learn what you need to in order to complete complete the work yourself.

Collaboration Policy: *All written work and code submitted should be your own unless you obtain prior permission to collaborate.* You are free to discuss assignments with others in the class unless specifically asked not to, but you must write up your answers and code yourself.

We reserve the right to use computational tools to identify instances of plagiarism or materials (text or code) first written by someone - or something - else, whether published online or previously or concurrently submitted at Tufts. We may make use of plagiarism or similarity detection tools such as TurnItIn, Moss, GPTZero, or other methods to detect inappropriate conduct. We also reserve the right to ask you to verbally explain, in person, any content you submit under your name.

All sources used should be cited. In other words, if you discuss a homework problem with a classmate, you should list that classmate as one of your references for that problem. Please also be warned that not everything you read online is correct. (This is true of print sources as well, but the risk increases greatly online.) Chatbots notoriously hallucinate. Even data from supposedly reputable sources, such as slides posted by faculty at Tufts or other universities, may not have been reviewed by an editor and might contain crucial mistakes. For this reason, I'd like to discourage you from using Google to tackle the problem sets, but if you choose to do so, you must cite the URL(s) that you used. Directly copying text or code from any source without attribution is plagiarism and will be dealt with accordingly.

Course Materials

For homeworks, slides, and other class information, go to the private course materials page. You will need to log in using your CS department account and password. An account will be created for all students registered for the course in SIS who do not already have one.

Tentative Course Schedule:

Updates will occur during the term: check back frequently. Shaded rows refer to past dates.

DATE	TOPICS	READING	OPTIONAL READING
Thurs., Jan. 16	Class overview and administrivia. Introduction to sequences and sequence comparison.	This course Syllabus. Zvelebil & Baum (ZB): Chapter 1 and Section 4.1	For CS students new to biology: Larry Hunter's article, Molecular Biology for Computer Scientists. For bio or BME students or others with less formal CS background: either Corman, Leiserson, Rivest and Stein Chapters 2 + 3, or Jones and Pevzner, Chapter 2: Bio O notation, NP-completeness.
Tues., Jan. 21	Sequence alignment: Global alignment. Dynamic programming. **Hwk 1 out**	This course syllabus ZB: Sections 4.2, 4.5 (pp. 87-89 only); 5.2 (pp. 127-135 only)	Global alignment: Durbin, pp. 17-22.
Thurs., Jan. 23	Local alignment. Scoring schemes, gaps.	ZB: Sections 4.4, 5.2 (pp. 135-140),	Local alignment: Durbin, pp. 23-24, 29-30
Tues., Jan. 28	Scoring matrices, PAM and BLOSUM. **Hwk 1 due**	ZB: Sections 4.3, 5.1	
Thurs., Jan. 30	Database search: introduction, BLAST **Hwk 2 out**	ZB: 4.6-4.7, 5.4	
Tues., Feb. 4	BLAST scoring, Information content; FASTA		Altschul's tutorial on statistics of sequence similarity scores. Altschul's slides on information theory, scoring matrices, and E-values.
Thurs., Feb. 6	Multiple sequence alignment: introduction, star alignment, scoring, NP-completeness **Hwk 2 part 1 due**	Ron Shamir's MSA notes	ZB: 4.5 (pp. 90-93), 6.4-6.5; Durbin, 6.1--6.4
Tues., Feb. 11	MSA iterative and progressive methods	ZB: 6.1	
Thurs., Feb. 13	DNA motifs, profiles. **Hwk 2 part 2 due**	ZB: 6.6	
Tues., Feb. 18	**Midterm 1**		
Thurs., Feb. 20	**NO CLASS**: Monday schedule		
Tues., Feb. 25	Compressive BLAST **journal club**, sublinear search	Compressive BLAST paper	
Thurs., Feb. 27	Gibbs sampling for motif discovery. **Hwk 3 out**	Original paper on the Gibbs sampler for local multiple alignment	Durbin, 6.1--6.4; Original paper on MEME algorithm
Tues., Mar. 4	Sequence assembly: deBruijn graphs; Eulerian paths	The paper about the SOAPdenovo assembler.	
Thurs., Mar. 6	Overlap graphs, Hamiltonian paths, OLC assembly. **Hwk 3 part 1 due**	ZB: 5.3(pp. 141-3)	ARACHNE paper on overlap-based whole genome assembly.
Tues., Mar. 11	Gene finding; Markov models; HMM intro	ZB: 9.2-9.7	
Thurs., Mar. 13	Hidden Markov Models (HMMs) - Viterbi **Hwk 3 part 2 due**	Rabiner handout, pp. 257-266.	
Tues., Mar. 18	**NO CLASS:** Spring Break		
Thurs., Mar. 20	**NO CLASS:** Spring Break		
Mon., Mar. 24	**Hwk 4 out**		
Tues., Mar. 25	Finish Hidden Markov Models; HMM uses in gene finding.		Durbin: chapter 3
Thurs., Mar. 27	EM algorithm **journal club**	short paper on EM algorithms	
Mon., Mar. 31	**Hwk 4 due**		
Tues., Apr. 1	Gene expression: detecting differential expression, multiple testing	ZB: 15.1, 16.1, 16.4	Slonim review article
Thurs., Apr. 3	**Midterm 2**		
Tues., Apr. 8	Gene expression: RNA sequence alignment; clustering and classification **Hwk 5 out**	ZB: 16.2-16.3, 16.5	Golub and Slonim et al., on leukemia classification
Thurs., Apr. 10	Transcriptomic interpretation; functional enrichment		

Tues., Apr. 15	Bioinformatics ethics discussion I **Hwk 5 part 1 due**		
Thurs., Apr. 17	Gene set enrichment analysis **journal club**	Gene Set Enrichment Analysis	
Tues., Apr. 22	Bioinformatics ethics discussion II **Hwk 5 part 2 due**		
Thurs., Apr. 24	Regulatory network inference methods; class wrap-up		
Tues., Apr. 29	Make-up class if needed		
Tues., May 6, 3:30pm-5:30pm	**Final Exam**		

CS 171: Human Computer Interaction (HCI)

Course Number	CS171
Semester	Fall, 2021
Hours	TR 1:30-2:45
Schedule	H+ Block
Location	Alumnae Lounge, Alumnae Hall
Instructor	Remco Chang
Graduate TA	Ellery Buntel Blessing Kolawole
Email	remco at cs_tufts Ellery.Buntel at tufts, Blessing.Kolawole at tufts
Office	TBD
Office Hours	TBD
TA Hours	TBD

Course Description

Introduction to human-computer interaction, or how computers communicate with people Methodology for designing and testing user interfaces, interaction styles (command line, menus, graphical user interfaces, virtual reality), interaction techniques (including use of voice, gesture, eye movement), design guidelines, and user interface management software system. Students will design a small user interface, program a prototype, and test the result for usability.

Format: This class meets twice a week (Tuesdays and Thursday). Tuesdays are lecture days, and Thursdsays are studio days. On a studio day selected teams will present their assignment from the prior week. The class will give design and critical feedback. Each assignment is handed out on a Tuesday (after the lecture), and is due the following Tuesday before class. All assignments (with the exception of Assignment 1) will be done in groups. Note that there will be no late submissions. If there are special circumstances tha prevent your team from submitting your assignment on time, you will need to contact the TA or the professor beforehand to receive permission.

Piazza: We'll be using Piazza for class discussions and Canvas for design critique and for submitting assignments.

COVID and Masking Policy: We will follow the university's masking policy strictly. Students (including those who are vacinnated) are required to wear a mask properly during (indoor) class. Failure to comply will result in: (1) the student being marked as disruptive, (2) the lecture ending immediately, and (3) the student being disenrolled from the course.

Schedule

Date	Week	Topic	Due	Out	Notes
9/9/2021	Thursday	Intro: What is HCI (How to submit assignments)		Assignment 1 Out	
9/14/2021	Tuesday	Needfinding and Problem Discovery			(Empathy), (Workarou
9/16/2021	Thursday	Studio 1 -- Practice interviewing skills	Assignment 1 (good/bad design) Due	Assignment 2 Out	
9/21/2021	Tuesday	Studio 2 -- Finding groups			
9/23/2021	Thursday	Problem definition (Intro to WordPress)		Assignment 3 Out	
9/28/2021	Tuesday	Studio 3 -- Practice empthay mapping	Assignment 2 (interview) Due		
9/30/2021	Thursday	Studio 4 -- present interviews			
10/5/2021	Tuesday	Ideate	Assignment 3 (empathy map + POV) Due	Assignment 4 Out	
10/7/2021	Thursday	Solution + Experience Prototypes			
10/12/2021	Tuesday	Video	Assignment 4 (ideation + solution) Due	Assignment 5 and 6 Out	
10/14/2021	Thursday	Studio 5 -- present ideation+solution			

10/19/2021	Tuesday	Design exploration	Assignment 5 (storyboard) Due		
10/21/2021	Thursday	Studio 6 -- present storyboard		Assignment 7 Out	
10/26/2021	Tuesday	Studio 7a -- present videos	Assignment 6 (videos) Due		VIS conferene
10/28/2021	Thursday	Studio 7b -- present videos			VIS conferene
11/2/2021	Tuesday	Visualization and colors			
11/4/2021	Thursday	Studio 8 -- Figma tutorial			
11/9/2021	Tuesday	Design patterns	Assignment 7 (sketches) Due;	Assignments 8 Out	
11/11/2021	Thursday	NO CLASS (Veteran's day)			
11/16/2021	Tuesday	Heuristic evaluation			
11/18/2021	Thursday	Studio 9 -- Run heuristic studies	Assignments 8 (interactive prototype) Due	Assignments 9 Out	Remco at NSF
11/23/2021	Tuesday	NO CLASS			
11/25/2021	Thursday	NO CLASS (Thanksgiving)			
11/30/2021	Tuesday	NO CLASS			Remco out sick
12/2/2021	Thursday	Studio 10 -- share evaluation results	Assignment 9 (evaluation) Due	Assignment 10 Out	
12/7/2021	Tuesday	Human abilities			
12/9/2021	Thursday	Studio 11 -- final project feedback			
12/14/2021	Tuesday	Research and topics in HCI			
12/20/2021	Monday	Final Project Presentation	Assignment 10 (final prototype and presentation) Due		Final exam (H+ Block, 3:30-5:30)

Recommended Reading

- Designing The User Interface: Strategies for Effective Human-Computer Interaction, 6th edition, Shneiderman et al.
- Design of Everyday Things, Don Norman

Grading

Assignments	55%
Studio Work	15%
Website	10%
Critiques	10%
Final Presentation	10%
Total	100%

Assignments:
There are 11 assignments in this class. Each assignment is worth 5% of your final grade. For assignment 1 you will work individually. All other assignments are done in a group (the same group throughout the semester).

Late Policy:
All the assignments due on the designated dates before class. Assignments that are turned in late will not receive credit. Because each of the assignments ties into the next, one late assignment will downstream effects. If you have an extraordinary circumstance, you must contact the instructor or the TA to obtain written approval.

Studio Work:
You will have studio work throughout the semester, including presentations of your work. We will announce the names of the teams when we hand out each assignment. Together, all of your studio work counts for 15% of your final grade.

Website:
You are required to maintain a website for your semester-long project. When you submit your assignment each week, you are also required to update your website with your new work. Updating your website for each of the assignments is worth 1% of your final grade.

Critiques:
In addition to your assignments, each team will be asked to give feedback to another team's work from the week before. As there are 10 assignments, each of your feedback will be worth 1% of your final grade.

Final Project:
You will be asked to present your project at the end of the semester. Your presentation of your final project is worth 10% of your final grade.

Accommodation

Tufts is committed to providing support services and reasonable accommodations to all students with documented disabilities. To request an accommodation, you must register with the Student Accessibility Services at the beginning of the semester.

Acknowledgement

Course lecture and material are based on the HCI course at Stanford by Professor James Landay.

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CS 11 - Spring 2025

ow you will find our **proposed** schedule for the semester. Topics and assignments are subject to change, and may dated as the semester progresses.

eek 1: 1/12/2025

Wednesday	**Lab 0:** Linux or Bust
Thursday	**Lecture:** Welcome - Introduction (pre-recorded lecture videos) Read: CS11 Syllabus encrypt.cpp **HW0 Out:** Holy Shift

eek 2: 1/19/2025

Monday	No School - MLK Day
Tuesday	**Lecture:** Variables, Data Types, and Arrays (pre-recorded lecture videos) Read: Sec. 1.3, 2.1-2.3, 7.1 temperature.cpp temp_float.cpp phone_number.cpp
Wednesday	No Lab - Fake Monday
Thursday	**Lecture:** Conditionals and Boolean Expressions (pre-recorded lecture videos) Read: Sec. 2.4 scope.cpp

eek 3: 1/26/2025

Tuesday	**Lecture:** Loops (pre-recorded lecture videos) Read: pp. 84-91, Sec. 3.3-3.4 **HW0 Due** by midnight
Wednesday	**Lab 1:** What the Diff? **HW1 Out:** Lock and Load
Thursday	**Lecture:** Functions (pre-recorded lecture videos) Read: Sec. 4.1-4.4, 7.2 arg_test.cpp functions.cpp

eek 4: 2/2/2025

Tuesday	**Lecture:** File I/O (pre-recorded lecture videos) Read: Sec. 6.1, pp. 355-356 file_basics.cpp numbers.txt pitfalls.cpp words.txt eof.cpp integers.txt **HW1 Due** by midnight
Wednesday	**Lab 2:** Crash Test **HW2 Out:** Snow Crash
Thursday	**Lecture:** Strategy and Debugging (pre-recorded lecture videos) bowling.cpp bowling_test.in

eek 5: 2/9/2025

Tuesday	**Lecture:** Memory Part 1: Pointers (pre-recorded lecture videos) Read: pp. 510-514 (i.e., Ch. 9.1 until they start talking about 'new') **HW2 Due** by midnight
Wednesday	**Lab 3:** Baby G **HW3 Out:** Tradecraft
Thursday	**Lecture:** Memory Part 2: Heap Allocations (pre-recorded lecture videos) Read: The rest of Ch 9.1, Ch. 9.2 grade_bot.cpp

eek 6: 2/16/2025

Monday	No School - Presidents' Day
Tuesday	**Lecture:** Structs (pre-recorded lecture videos) Read: Sec. 10.1 celebs_complete.cpp celebs_start.cpp celebs.txt **HW3 Due** by midnight
Wednesday	**Lab 4:** Ye Olde Strings **HW4 Out:** Word Play
Thursday	No Class - Fake Monday

eek 7: 2/23/2025