**CS3000 - Algorithms & Data**
**Summer 2023**
**Northeastern University**

**Prof. Laney Strange (she/her)**

| | |
|---|---|
| Emails | laneys@northeastern.edu |
| Course web page | http://course.ccs.neu.edu/cs3000 |
| Piazza | https://piazza.com/northeastern/summer2023/cs3000 |
| Gradescope | https://www.gradescope.com/courses/519665<br>access code 4V7V48 |
| Lecture Question Form | https://forms.gle/rAjLvAk6pivCwmLW9 |
| Missed Recitation Form | https://forms.gle/v4gGPY4UYyuyopmK9 |
| Lecture Schedule | MTWR 9:50-11:30am, SH 335 |
| Recitation Schedule (CS3001) | Sec 1. TR 11:40am-12:45pm, WVH 108<br>Sec 2. TR 1:30-2:35pm, DG 119<br>Sec 3. TR 3:20-4:25pm, HA 221 |

# About this Course

This is an introductory undergraduate course in algorithms. Every computer program can be viewed as an implementation of an algorithm for solving a particular computational problem. The focus of this course is on learning algorithm design techniques for solving the underlying computational problems. We will also look at how algorithms translate to programs, but our emphasis will be on the algorithm design and analysis. In this class, we will:

- Work on a range of computational problems that arise in diverse applications
- Learn how to formulate problems precisely from somewhat informal descriptions
- Learn algorithmic design techniques used to solve the problems
- Learn proof techniques critical for reasoning about algorithms
- Learn analysis techniques critical to determine the efficiency of algorithms

Specific topics covered in the course include:

- Basics tools for analysis of algorithms: proof by induction, asymptotic notation
- Divide-and-conquer algorithms
- Dynamic programming
- Basic graph algorithms: BFS, DFS, topological sorting, strongly connected components
- Graph optimization: shortest paths, minimum spanning trees
- Amortized analysis, randomized algorithms

- Greedy algorithms
- Network flow algorithms and applications
- NP-completeness

# Recommended Textbook

There is no required textbook. However, the material is mostly going to be from the following book:

- Introduction to Algorithms by Cormen, Leiserson, Rivest, and Stein
- (The 4th edition has just come out, but it's fine to buy an older/used edition!)

Relevant chapters will be listed alongside lecture topics on the course website. You do not need to read the textbooks ahead of lecture; they are most useful as reference materials or for looking up new examples. Keep them handy when working on the homework or reviewing your lecture notes.

# Evaluation

You will receive the same grade for CS3000 (lecture) and CS3001 (recitation).

| **Factor** | **Number** | **Weight** |
|---|---|---|
| Long Homeworks | 5 | 35% |
| Short Homeworks | 4 | 15% |
| Recitations | 5 | 10% |
| Exams | 2 | 40% |
| | **TOTAL** | **100%** |

Your final grade for CS3000 will use the following breakpoints to convert from letter to number grades. We use natural rounding to get these whole numbers, e.g., 96.5 becomes a 97 but 96.4 becomes 96.

| **Letter** | **Range** |
|---|---|
| A | 94-100 |
| A- | 90-93 |
| B+ | 87-89 |
| B | 83-86 |
| B- | 80-82 |

| | |
|---|---|
| C+ | 77-79 |
| C | 73-76 |
| C- | 70-72 |
| D | 60-69 |
| F | < 60 |

# Office Hours

Office hours are a great place to get clarification on concepts and have conversations with TAs and professors. Instructor and TA office hours are listed on the course website.

It'll be important that you come to office hours having already made an attempt on the homework. We will be happy to help guide you on concepts and provide clarification. We do not provide you with answers to problems, and we do not confirm that your solution is correct.

# Homework

Five homeworks will be "long" -- assigned Thursday and due the following Tuesday. Four homeworks are "short" -- assigned Tuesday and due Thursday.

Homeworks are due at 9pm eastern on the due date, unless otherwise noted. You may submit homeworks up to 48 hours late with no penalty, but ***your submission will not be graded right away if it is submitted late.*** The summer semester goes by quickly, and to ensure we grade homeworks in a timely manner, we will prioritize those submitted by the deadline.

There is also **one second-chance deadline** this semester, which you can use to resubmit TWO previous homeworks (one long and one short).

- Deadline: **June 20th, 2023 at 9pm**. You can use this second-chance homework to resubmit any two previous homeworks (one has to be a Long HW and one a Short HW).

Short HW4 cannot be resubmitted. Homework solutions will not be released because of this policy, but we will go over all relevant homeworks at the recitation meetings preceding the exams.

All homework solutions must be typed (preferably in LaTeX). We will provide the source files for the HW assignments to help you get started. Our first recitation will include a tutorial on LaTeX, and we'll link some resources on the course website.

It is encouraged that you work with your classmates on the homework problems. If you do collaborate, you must write all solutions by yourself, in your own words; you are also strictly forbidden from sharing

any written solutions. You must list all of your collaborators on your submission.

# Recitations

The recitation for this class, CS3001, has two meetings per week, but **we will use only the Tuesday meeting for a graded recitation section.** You will be assigned a problem set to complete during the Tuesday recitation.

Thursday recitations will be fun algo-practice sessions, led by our TAs! We'll announce on Piazza each week what the theme will be and who your TA lead will be. These Thursday times will be excellent preparation for your co-op and job interviews.

Please check the schedule on the course website; recitation schedules vary week to week and we'll post reminders/announcements on Piazza and in class.

**One problem of each recitation** will be graded for credit. It will be graded on completeness, though -- full credit if you made an honest attempt at the problem. The one graded problem will also be closely linked to an upcoming homework problem, so make sure you read the feedback from your grader!

The ungraded problems in the problem set are for practice and to help you prepare for the upcoming homeworks.

Your attendance is expected in recitation, and your solution is due on gradescope at 9pm. However, you can submit late with no penalty. If you are not in attendance at a Tuesday recitation, or will be submitting late, please use this form:

- https://forms.gle/v4gGPY4UYyuyopmK9

The late submission deadlines for recitations are:

- May 23rd at 9pm eastern (Late deadline for any/all of: Recitations 1-2)
- June 20th at 9pm eastern (Late deadline for any/all of: Recitations 3-5)

# Exams

There are two exams during the semester, and they will be administered in-person, during class. Exam dates are:

- Thursday, May 25th
- Thursday, June 15th

For each exam, you may bring one 8.5x11-inch paper as a cheat sheet, with anything written or typed on it (one side only). You will submit this cheat sheet along with your exam, and you are not permitted to use any other materials or notes during the exams.

Additionally, we will use the last day of class to offer a short, one-problem exam for anyone who wants to take it. Your score on this problem can be used to replace your score on ONE problem from Exam 1 OR Exam 2. No cheat sheets are permitted for this make-up exam problem.

If you have a DRC accommodation for extra time on exams, it is your responsibility to arrange to take the exams in the DRC office. Make sure you set this time up at least a week ahead of the scheduled exams to guarantee the time and space you need.

# Revise/Resubmit Policy

You'll have a few opportunities to re-submit your work this semester. You can review and consider the feedback you receive from us as part of your graded work, and use that to revise and build a better solution.

Because of these resubmission policies, ***we don't make any exceptions to published deadlines***. We also don't publish solutions to homeworks, but we will go over the solutions to all relevant homeworks during the exam-prep recitations.

**Resubmissions - Homework**

- You can submit any/all homeworks up to 48 hours late with no penalty. However, we can't guarantee it will be graded and returned with the other submissions; we'll prioritize solutions that were submitted on time.
- You also have an opportunity to resubmit one long homework and one short one for a new grade.
- Short HW4 is the exception; it cannot be resubmitted.

Resubmission Deadline - Homework

- **June 20th at 9pm eastern** (You may resubmit one long HW and one short one)

**Make-Up Exam Question**

- On the last day of class, we'll have an optional make-up exam question. You'll be able to pick a topic from exam #1 OR exam #2, and then take a mini-exam with a new problem on that topic.
- Your score on the make-up question will replace your score on one problem from one exam.
- No cheat sheets are allowed for the make-up exam question.

Make-up Exam Date

- **Thursday June 22nd**, during lecture

# Late/Attendance Policy

CS3000 is an in-person class, and attendance is expected. However, we don't take attendance and we don't want or expect anyone to come to class when they're sick. We'll post the lecture notes from each day that you can use to catch up on any missed material. If you miss class for any reason, we recommend reading the notes for that day and stopping by Laney's office hours to get caught up.

CS3001 is an in-person recitation, and attendance is expected on Tuesdays (and optional on Thursdays). Please check the website for the course schedule, though, because we don't have a graded Tuesday recitation every week.

For Tuesday recitations, you will be assigned a problem set and expected to submit it at the end of the recitation; one problem will be graded and the rest are for practice. However, we don't take attendance and we don't want or expect anyone to come to recitation when they're sick. Please fill out the missed/late recitation form if you miss your section (link below).

Recitations are due at the end of your section. However, you can submit late (by sending your solution to laneys@northeastern.edu) with no penalty up until:

- Recitations 1-2: late due date May 23rd 9pm eastern
- Recitations 3-5: late due date June 20th 9pm eastern

If you are not in attendance at a Tuesday recitation, or will be submitting late, please use this form:

- https://forms.gle/v4gGPY4UYyuyopmK9

***You must be present in-person for scheduled exams***. Make sure you familiarize yourself with the schedule so that you don't miss the exams.