

# CS 5800 - Algorithms

Fall 2024

Syllabus

## Just the Facts

**Course Number:** CS 5800

**Title:** Algorithms

**Semester:** Fall 2024

**Meeting Time:** M 1-4:20pm

**Locale:** Miami Campus Room 513

**Instructor:** Dr. Alan Jamieson (please call me Alan!)

**Email:** a.jamieson@northeastern.edu

**Textbooks:** *Dasgupta et al., Algorithms, 1st Edition, McGraw-Hill, 2006*

*Skiena, The Algorithm Design Manual, 3rd Edition, Springer, 2020*

*Goddard, Algorithms, e-text (link available on Canvas)*

**TA Info and Office Hours:** The latest and greatest version of the TA list, along with office hour information (including mine) will be posted prominently to Canvas and updated as needed.

**Course Description:** Presents the mathematical techniques used for the design and analysis of computer algorithms. Focuses on algorithmic design paradigms and techniques for analyzing the correctness, time, and space complexity of algorithms. Topics may include asymptotic notation, recurrences, loop invariants, Hoare triples, sorting and searching, advanced data structures, lower bounds, hashing, greedy algorithms, dynamic programming, graph algorithms, and NP-completeness.

**Pre-course Expectations:** Students taking this course are expected to have a basic background in discrete mathematics, including (but not limited to) proof structures, logic, and graph structures, familiarity with basic algorithmic techniques and problems (sorting, searching, recursion), and a basic programming background (no specific language required). And finally, and most importantly, an expectation that you come to this class without fear of making mistakes and that you have a willingness to make the learning environment comfortable for all.

### Grade Distribution:

Homework - 35%

Syntheses Assignments (3) - 45%

Final Project - 20%

**Exams:** There will not be a traditional exam in this course. Instead, comprehensive assessment of your knowledge will use a synthesis approach (see below).

**Homework:** Every week except for when other assignments are due (syntheses, final) there will be a homework problem set, assigned during class, and then due at 11:59pm ET the following Monday. These are designed to be extensive problem solving exercises. They will take time, but I also don't expect that you will attempt these problems alone. I encourage you to talk with me, the TAs, and, maybe especially, your peers. If you work significantly with a peer, you are required to cite that in your turnin AND you must make sure that your work is your own. Discussions are good! Copying is bad and will be considered plagiarism and will result in severe penalties. All homework will be turned in on Gradescope.

For the linear programming segment of the course, I will be experimenting with a different way of approaching this course. We will tackle the topic as if the course was set up as a graduate-level seminar course. This means that you will be assigned a handful of important academic papers to read through on the topic, and we will, as a class, discuss the topics and algorithms presented in those papers. I will be giving you some guidelines on how to read the papers, and what tasks you will need to complete before the class session (these tasks will count as your homework for that week).

**Syntheses Assignments:** Three times during the semester you will be required to create a special synthesis assignment. These assignments are long, and meant to completely replace the traditional exam. For these individual assignments, you are tasked with creating a mini-textbook of all of the concepts listed in for the synthesis assignment. This includes not only your individual explanation of all of the topics, but original problem sets (with solutions)!

**Final Project:** In lieu of a traditional final, you and your group will select an algorithm from a curated list provided near the end of the semester. Your group will create an implementation of this algorithm, a written report, and also deliver a presentation during the final period. The final will occur Monday, December 9th during our normal class period. Attendance at that session is mandatory.

**Getting Help:** For many of you, parts of the course will feel unfamiliar and, at times, intimidating. Folks around you may seem like they are getting the material faster than you are, that they are somehow smarter, or better than you. This is not true! If you feel like you are missing something about a topic, I must insist that you stop me! Ask questions, challenge assumptions, and help not only you, but others in the class that may feel like you do!

This course, and the other courses that you will take as part of your journey in computer science, will be challenging and frustrating at times. If you feel yourself getting so frustrated that you lose focus and start thinking that you can't do it, STOP. Go for a walk. Play with a pet. Eat something. Chat with your best friend. Do anything but think about this course for a while. Then, come back, and ask a question. Send me an email, or one of the TAs, or, even better, ask your question in class! We are here to help you - that goes for me, the TAs, and your classmates. My classes always work better when we all are working together.

**The 30-Minute Rule:** If you have been stuck on a problem for more than 30 minutes and have made no progress despite your best effort, press pause and get some help. Send a TA an email, ask a question in Piazza, consult with a peer in the class, or set up a meeting with me. There's no sense in bashing your head against the wall, when a simple question may help you move on to the next thing!

**Technology Use:** I will be utilizing Canvas for your grades, and for course materials. Please check there often as I will be updating grades as material gets evaluated. Gradescope will be used for submissions of problem sets. We will also be using Discord for asynchronous communication. All class sessions and my office hours will be held via Zoom. The TA list contains their preferred method for holding office hours.

The class will be run fairly informally. While there will be some (small) amount of a traditional lecture involved with each class period, I expect there will be a less traditional discussion in each class period involving questions and concepts being batted back and forth amongst you, your peers and myself. Please participate in these discussions, I can almost guarantee that you'll get more out of the class in general if you do.

## Policies

**Classroom Conduct:** To create and preserve a classroom atmosphere that optimizes teaching and learning, all participants share a responsibility in creating a civil and non-disruptive forum for the discussion of ideas. Students are expected to conduct themselves at all times in a manner that does not disrupt teaching or learning.

Your comments to others must be constructive and free from harassing statements. You are encouraged to disagree with other students and the instructor, but such disagreements need to be respectful and be based upon facts and documentation, rather than prejudices and personalities. The instructor reserves the right to interrupt conversations that deviate from these expectations.

Repeated unprofessional or disrespectful conduct may result in a lower grade or more severe consequences.

**Attendance and Tardiness:** Synchronous attendance is highly recommended. Missing a class not only causes you to miss the information disseminated in that lecture, but can cause you to miss important information in regards to assignments. If you miss class, it is your responsibility to catch up on the material you missed including obtaining notes from a classmate and reviewing posted materials. I start class promptly on the hour and expect the students to be in class at that time. If you have circumstances that can prevent you from being in class on time, please let me know. Classes will be held on campus in Miami each week. Any deviation in the delivery of the lecture will be announced through Canvas.

It is my preference to see you all on campus, but your circumstance (even on a week-to-week basis) may prevent you from physically being present *and that's totally fine!*

**Late Policy:** You are allowed 5 “slip-days” throughout the semester. This means that you may turn in an assignment late, where each day it is late will reduce your number of slip-days by 1 (note that for group projects, if the project is turned in one day late, every group member loses a slip-day). So, you could turn in a homework 5 days late, but then you wouldn't have any further slip-days left for the rest of the semester. Once you are out of slip-days, if you turn in the assignment late, you will earn a 0 for that assignment. Group projects are limited by the least number of slip days remaining for a group member. You may not use slip-days on any element of the final project. You may not re-allocate slip-days; once they are used, they are gone.

**Grading Re-Considerations:** If you have concerns about how I or one of the TAs graded your problem sets, please use the regrade request functionality in Gradescope. If you have concerns about any other grades please email your request to me directly (a.jamieson@northeastern.edu). Any request for grading re-considerations must be emailed within a week of grades being posted.

**Communication:** The simplest way to get in touch with me is by making an appointment for my virtual office hours or contacting me via email. The easiest way to get in touch with me “after hours” is to send me an email. I habitually check my Northeastern email account, however, please note that if you send me a message or email “after hours” or on the weekend, that I may not respond until the next business day. If you come by campus and see me there not in an office with the door closed, feel free to stop by to chat. The open door/desk indicates that I'm not working on anything that has to keep my undivided attention at that time so do not feel that you are interrupting me. I do make appointments if you have a certain time that you'd like to meet with me. If it fits in my schedule (meaning I'm not teaching class during that time and otherwise available) I will be happy to meet with you. I also maintain an appointment calendar for student meetings that can be accessed here: <https://calendly.com/acjamieson>. Feel free to use that to schedule appointments when you need to!

**Academic Honesty:** As with all other courses at Northeastern, you are expected to adhere to the university's academic integrity policy (<http://www.northeastern.edu/osccr/academic-integrity>).

With that being said, computer science has long left the idea of the “lone programmer” behind. Computer science is a collaborative discipline, and all of the work we assign in this class is meant to be worked on with others, whether with a peer in the class, or through getting help from me or a TA. However, there are still some ground rules to ensure the integrity of your submissions:

- I reserve the right to request you to verbally explain an answer or snippet of code that you have turned in and to modify your grade on the assignment based on your answers.
- You may not copy someone else's code or answer under any circumstances. This includes from online sources.
- You may not post a potential answer to a problem (including any code) to Piazza or other public forum.
- You may discuss and work through problems with others, and, in fact, I encourage you to do so. However, ultimately, your solution that you turn in must be your original work.

- If you use an online source to help you get to a solution, you must cite that source.
- You may not look at someone else's code, nor should you let someone else look at yours. If you need help debugging something, please reach out to me or a TA.

If you have had a substantive discussion of any homework or programming solution with a classmate, then be sure to cite them in your report. If you are unsure of what constitutes "substantive", then ask us or err on the side of caution. You will not be penalized for working together. You must not copy answers or code from another student either by hand or electronically. Another way to think about it is that you should be talking English with one another, not Python.

**Participatory Challenges:** If you have any kind of challenge that can affect your performance and participation in this class, I invite you to email me with what supports you need to enable full participation in this class, with no need to identify anything about your challenges.

Northeastern University and the Disability Resource Center (DRC) are committed to providing disability services that enable students who qualify under Section 504 of the Rehabilitation Act and the Americans with Disabilities Act Amendments Act to participate fully in the activities of the university. To receive accommodations through the DRC, students must provide appropriate documentation that substantiates a disability and demonstrates a current significant limitation. Accommodations are provided based on an evaluation of the information provided by students, and their clinicians, on a case-by-case basis. Students should provide documentation to the DRC at their earliest convenience to allow for sufficient time for review. Please reach out to your academic advisor for more information or contact the DRC at [drc@northeastern.edu](mailto:drc@northeastern.edu)

**Title IX and Sexual Misconduct:** Title IX of the Education Amendments of 1972 protects individuals from sex or gender-based discrimination, including discrimination based on gender-identity, in educational programs and activities that receive federal financial assistance.

Northeastern University's Title IX Policy addresses Prohibited Offenses, which are defined as sexual harassment, sexual assault, relationship or domestic violence, and stalking. The Title IX Policy applies to the entire community, including male, female, transgender students, faculty, and staff.

If you or someone you know has been a survivor of a Prohibited Offense, confidential support and guidance can be found through University Health and Counseling Services staff (<http://www.northeastern.edu/uhrs/>) and the Center for Spiritual Dialogue and Service clergy members (<http://www.northeastern.edu/spirituallife/>). By law, those employees are not required to report allegations of sex or gender-based discrimination to the University.

Alleged violations can be reported non-confidentially to the Title IX Coordinator within The Office for Gender Equity and Compliance at: [titleix@northeastern.edu](mailto:titleix@northeastern.edu) and/or through NUPD (Emergency 617.373.3333; Non-Emergency 617.373.2121). Reporting Prohibited Offenses to NUPD does NOT commit the victim/affected party to future legal action.

Faculty members are considered "responsible employees" at Northeastern University, meaning they are required to report all allegations of sex or gender-based discrimination to the Title IX Coordinator.

In case of an emergency, please call campus police.

Please visit <http://www.northeastern.edu/titleix> for a complete list of reporting options and resources both on- and off-campus.

**Closing:** The most important thing in any of my classes is that you are learning and expanding your horizons. If you are having any undue difficulty with your work as it pertains to this class, please contact me as soon as possible. Always remember that professors win when you don't need us any longer. I want you to be bouncing ideas off of each other throughout the class and it is my hope that by the end of the semester that you are driving the class session rather than me. Thank

you for being a part of my class, and trusting me to help you plot your path through computer science.

*Citation: some segments pulled or inspired by Prof. Valcourt's and Prof. Hoshino's 5002 syllabi.*

## Schedule

**Special note:** This schedule is set at the start of the course. Changes inevitably happen, so be sure to check the Canvas site for the latest and greatest information.

| Date         | Topic  | Assignments                              |
|--------------|--|--|
| September 9  | Introduction, Syllabus Review, Asymptotic Analysis | HW 0,<br>Read Ch. 0, 1, 2                |
| September 16 | Divide and Conquer                                 | HW 1,<br>Read Ch. 2                      |
| September 23 | Recurrences and Master Theorem                     | HW 2,<br>Read Ch. 3, 4                   |
| September 30 | Graphs   | Synthesis #1,<br>Read Goddard Part D     |
| October 7    | Graph Algorithms                                   | HW 3,<br>Read Ch. 5                      |
| October 14   | No class, University Holiday                       |  |
| October 21   | Greedy Algorithms                                  | HW 4,<br>Read Ch. 6, Goddard B.2         |
| October 28   | Dynamic Programming                                | Synthesis #2,<br>Read Ch. 6, Goddard B.2 |
| November 4   | Dynamic Programming                                | HW 5.<br>Read Ch. 7                      |
| November 11  | No class, University Holiday                       |  |
| November 18  | Linear Programming                                 | HW 6,<br>Read Goddard Part C             |
| November 25  | Complexity   | HW 8<br>Final Project                    |
| December 2   | Prep for the final                                 | Synthesis #3, The Final Project          |
| December 9   | Final  | The Final Project!                       |