Northeastern University
Khoury College of Computer Sciences

CS5800: Algorithms
Syllabus

General Information

Instructor	Jonathan Mwaura
Office	Online (Via Zoom – Links on Canvas)
Email	j.mwaura@northeastern.edu
Class Time/ Location	ONLINE
TA/Grader	Katelyn Caldwell: caldwell.ka@northeastern.edu
	Sameer Singh: singh.same@northeastern.edu
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	Ayush K Sahai: sahai.a@northeastern.edu

Table 1: General Information

Contact the Instructor

- Office hours: the best way to contact the professor is to visit the professor's office hours.
- Canvas Discussion board: please post questions related to assignments and class on the Discussion Page on Canvas whenever possible, so others can benefit too. Read the rules further below.
- Email: If you need to send an email to discuss private issues (e.g., your grades), please keep the message brief and put "[CS5800]" in the email title. Otherwise, your email may not be read and replied in a timely manner. Please don't expect the emails will be read as soon as you send them out (leave at least 24 hours before re-emailing).

Required Textbook

- *Introduction to Algorithms* by T.H. Cormen, C.E. Leiserson, R.L. Rivest, MIT Press, 3rd edition, 2009. ISBN 978-0-262-03384-8.

Course Description

This is a graduate-level course that emphasizes the design and analysis of efficient algorithms used in software engineering. The course focuses on the algorithmic design paradigms and techniques for analyzing the correctness, time and space complexity of algorithms. The topics covered include: elementary techniques for analysis (Asymptotic analysis, recursion equations, estimation methods etc), Analysis of Sorting Algorithms (Heap Sort, Quick Sort, Selection, Bucket/Radix etc), Analysis of various Abstract Data structures (Stacks, Queues, Linked Lists, Trees including Binary Search Trees and self-balancing trees) and Hash maps. In addition, Analysis of Graph Algorithms (Breadth First Search, Depth First Search and Topological Sort). Finally, a discussion revolving around NP Completeness and

reducibility will be covered.

Course Category

This is a required course for students pursuing an MSC in Computer Science. It builds on the introduction to data structures and algorithms that students receive in both Data Structures and Algorithms (CS 5004/ CS3000) class and the discrete structures class (CS1800/CS5002) or their equivalents.

Course Core Learning Outcomes

- This course meets the Essential Learning Outcome of Exploring Creative Expression and Innovation as defined under the NU's Core Curriculum requirements. As such, it will reinforce the students' ability to identify, analyze, interpret, and evaluate arguments, data, evidence, problems, and conclusions as part of formulating an opinion or conclusion. Then use that information to design, evaluate and implement a strategy to achieve a desired outcome.
- This course meets the Essential Learning Outcome of Conducting Formal and Quantitative Reasoning as defined under the NU's Core Curriculum requirements. As such, the course will strengthen the students' competency and comfort in working with numerical data.
- This course meets the Essential Learning Outcome of Analyzing and Using Data as defined under the NU's Core Curriculum requirements. As such, it provides students with the opportunity to practice the skills needed to successfully locate, evaluate, and use data, a fundamental ability for scholars and citizens operating in a complex, global information landscape.

Course Prerequisites

The course assumes that students have taken introductory CS mathematics courses (Discrete, Probability and Statistics and Calculus). In addition, students are expected to have taken a Data Structures and Algorithms class (CS5004 /CS3000).

Additional Course Information

Class Website – on Canvas. All class materials (including lecture notes, supplemental materials, etc.) and assignments are posted on Canvas. Assignments should be submitted through Canvas.

Class Discussion Website – (via Canvas)

This online discussion board may be used to clarify your question about assignments and discuss general questions. When possible, students should ask related questions through this portal instead of sending individual emails to the instructor. Please do NOT post your programming code or solutions there. If you have a specific question about your solution, please ask help from the instructor, TA, or approved tutors in their offices.

Discord Server: The professor also encourages the use of discord server:

https://discord.gg/JEMWR8Cvyr for discussions.

Tentative class schedule

Week	Week Dates	Discussion Topic	Associated Work (Tuesday 11.30pm)	% of Grade
1	19th Jan	Introduction/Growth of Functions	Problem Set 1	2%
2	26th Jan	Complexity	Problem Set 2	4%
3	2nd Feb	Divide and Conquer 1	Problem Set 3	5%

4	9th Feb	Divide and Conquer 2	Problem Set 4	5%
5	16th Feb	Data Structures and Graph Algorithms	Problem Set 5	5%
6	23rd Feb	Greedy Algorithms 1	Problem Set 6	5%
7	2nd Mar	Greedy Algorithms 2	Problem Set 7	5%
8	9th Mar	Dynamic Programming 1	Problem Set 8	5%
9	16th Mar	Spring Break	Course Synthesis 1	10%
10	23rd Mar	Dynamic Programming 2	Problem Set 9	5%
11	30th Mar	Network Flows 1	Problem Set 10	5%
12	6th Apr	Network Flows 2	Problem Set 11	5%
13	13th Apr	NP Completeness	Problem Set 12	5%
14	20th Apr	Approximating Algorithms		
15	27th April	Final project presentations	Final Project Report	10 %
16th	May 4th	Exam week	Course Synthesis 2	10%

Table 2:Tentative class schedule

Methodology

Teaching methods:

This course will make use of lectures (videos), examples, and question and answer sessions. Class discussions conducted via the online platform (either in small group or with whole class), in addition to active reading, experimenting with sample programs, and problem solving, will be used during the semester. Independent homework assignments are used to evaluate the learning outcomes.

This is primarily a "paper-and-pencil" course whose homework and quizzes involve writing algorithms using "pseudo-code", establishing their correctness and analyzing their efficiency. Although programming will not be required, programs will be provided whenever possible to illustrate and reinforce concepts. In addition, some of the assignments will involve programming. Students are also encouraged to implement their algorithms throughout the learning period.

Assessment:

There will be regular weekly exercises, problem sets, and quizzes as described below.

- **12 Problem Sets (56%)** – These are weekly homework assignments that are to be carried out individual. The professor will have weekly problem solving week (on Monday and Wed) if you need help
- **12 timed online Quizzes (12%)** - These are timed quizzes (30 - 45 minutes) released either via Canvas or Grade scope. Quizzes will be available all week with a deadline at 11.30pm on Tuesdays. Students are required to allocate 45-60 minutes to work on the quiz.
- **2 Course Syntheses (20%)** consist of short answer questions, as well as several multi-part problems connecting different areas of the course, allowing you to synthesize what you have learned. Think of the Course Synthesis as a week-long individual take-home exam where you may consult your class notes but not your classmates or any online resources other than the ones that are explicitly permitted by the course instructor.
- **4 SAIL Reflections (2%)** are your personal reflections on your journey of self-authored integrated learning (SAIL) in this course. You will reflect on your growth across five learning dimensions: Intellectual Agility, Global Mindset, Social Consciousness and Commitment,

Professional and Personal Effectiveness, and Well-Being. For more details, check out https://sail.northeastern.edu/about/.

- **1 Final Project (10%)** work occurs during the last two weeks of the course, in lieu of a final examination. You are required to work within a group with other learners to create a project. Each group will select any topic relating to the design and/or analysis of Algorithms. Your group will submit a project proposal, a written report, and send in videos where you are presenting your work.

Final Grades:

A	93.00 – 100.00 %
A -	90.00 – 92.99%
B+	86.00 – 89.99%
B	83.00 – 85.99%
B-	80.00 – 82. 9%
C+	76.00 – 79.99%
C	73.00 – 75.99%
C-	70.00 – 72.99%
F	Less that 70%

Table 3: Final grading

Re-grading Assignments:

Requests for re-grading may be made up to one week after the assignment is returned. Please contact the TA first if you have any questions about the grading. If you still have questions, the request must be made in person with the instructor or be submitted in writing and include a short paragraph outlining the rationale for the re-grade. Acceptable requests include correcting errors in calculating a score, marking a correct answer incorrect, etc.

PLEASE: do not debate your grades with me, I find it rather tiresome. Read my and TA's feedback first and come for revision before you request for regrades.

Course Policies

Accommodations:

The goal is for every student to succeed in this course. If you require any accommodations (e.g. child care during class hours, extra time to complete assignments, support for a disability), let me know immediately so that we can work out appropriate arrangements. Speak to me at the end of class or contact me by email, and we will set up a time to meet during the first week of the course. I look forward to learning how I can be of service to you.

Attendance:

This is a purely online class. There will be no formal class schedule. The materials will be released weekly, and students are expected to complete the work within the given timelines.

Course readings:

Required readings will be announced and where possible uploaded onto the Canvas platform. It is a student's objective to complete all required reading and the ensuing

assignments. Note that assignments related to the readings will not be extended.

Assignments:

Assignments will be distributed via the canvas platform. Students are responsible for managing due dates and understanding submission procedures to turn in assignments. All assignments are due at 11.30pm on Tuesdays.

Late work:

Late assignments will not be accepted without PRIOR approval. Students must consult the instructor at least two days prior to the scheduled due date to make alternative arrangements; however, the instructor is under no obligation to grant any such request. Any late assignment will be assessed a 50% penalty for up to 2 days of lateness. Work submitted after 2 days (48 hours) will receive zero (0) credit. Note that 1 minute late is considered within the 2 days (48 hours) lateness. Internet or computer issues are NOT valid excuses of late submission.

Note that this late penalty only applies to Problem Sets, Programming Projects, and Course Syntheses. The remaining assessments (In-Class/timed online Quizzes, SAIL Reflections, Group Seminar, Final Project) must be submitted on time; failure to do so will result in an automatic zero.

Exams:

The course will NOT have formal timed exams:

Academic integrity:

The practice of good ethical behavior is essential for maintaining good order in the classroom, providing an enriching learning experience for students, and as training as a practicing computing professional upon graduation. This practice is manifested in the University's Academic Integrity policy. Students are expected to strictly avoid academic dishonesty and adhere to the Academic Integrity policy as outlined in the course catalog. Violations will be dealt with as outlined therein.

As a general rule, all work submitted for grading must be the student's OWN work.

In regard to homework, students may discuss the problems (what is being asked for), appropriate material from class lectures, the textbook or acceptable other sources. Students, however, may not share answers or the specifics of how to answer the question.

Use of material from previous classes, solution manuals, material from the Internet or other sources (e.g., parents, siblings, friends, etc.) that directly bears on the answer is strictly prohibited. Please cite the references if you use any help.

In addition, you are not allowed to post course materials and solutions to problem sets assigned in this class in public places (e.g. Github, courseHero) without the instructor's permission. Solutions include your own solutions as well as solutions that may be provided by the instructor. The University policy on academic integrity states that assisting students in their own acts of academic dishonesty is itself a violation of academic integrity. Doing so will be considered an act of academic dishonesty and you will receive a grade of 0 for the actual assignment or a grade of F for the course.

At the discretion of the instructor, students may be asked to sign a statement that they have abided by the University's Academic Integrity policy and its application to this class. This statement may appear on homework, or tests.

When in doubt, consult the course professor before doing something that may result in violation of the University's Academic Integrity policy (http://www.northeastern.edu/osccr/academic-integrity)

The sanction for the first violation of the Academic Integrity policy or plagiarism policy will result in a minimum failing grade on the relevant assignment and the violation will be reported to the student's department chair. Once the final decision has been rendered and any or all appeals exhausted by any parties involved, the instructor or appropriate parties will carry out the recommended sanction.

Title IX Policy

Title IX of the USA 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. Though our campus is located in Canada, all Northeastern University campuses follow the Title IX Policy.

Northeastern's Title IX Policy prohibits 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 and the Center for Spiritual Dialogue and Service clergy members. 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 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 911. Please visit http://www.northeastern.edu/titleix for a complete list of reporting options and resources, both on-campus and off-campus.

Feedback

Your opinions are very important to me. All students are strongly encouraged to use the Teacher Rating and Course Evaluation (TRACE) system, at https://www.northeastern.edu/trace/, to complete your course evaluations. A reminder about TRACE should arrive via email about two weeks before the end of the course.

In addition, I will be asking for your feedback at least once, about halfway through the semester. However, if you have concerns about the course, do not wait until you are asked. Please schedule a meeting with me, and we will discuss your concerns then.

Thank you for taking this course and entrusting me to shape your education here at Northeastern.