COMP 6901: Applied Algorithms

Fall 2022

Instructor: Noah Fleming

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Office: EN-2018

Lectures: MWF 12:00 – 12:50

Lecture Room: EN-1052

Office Hours: 1:00 – 3:00 Mondays (or by email appointment)

Course Description

The aim of this course is to familiarize you with both classical and advanced algorithm design techniques, with an emphasis on applications. Topics which we will cover include: graph algorithms, greedy algorithms, dynamic programming, network flows, and linear programming. At the end of the course (time permitting) we will cover some fun topics related to my research including practical SAT algorithms and a brief introduction to complexity theory.

Tentative Marking Scheme

- Midterms (2): 20% each (for a total of 40%).
- Final Exam: 30%. You must pass the exam to pass to the course.
- Drills: 15%. Drills are short, repeatable, and auto-graded exercises that will be available through Brightspace quizzes. Each drill may be repeated an unlimited number of times and the mark will be the average of all attempts.
- Writing Drills: 15%. You will be asked to write your own drills on an algorithm or concept of your choice that was covered in this course. A template will be provided and you may work in groups of up to 3. Drills will be posted to Brightspace, and will be assigned. The bug bounty will be applicable to drills; the first person to find a bug in someone else's drill will receive extra marks and the drill authors' mark will be decreased; they will have to fix the bug and repost the drill.
- Bug Bounty: There will be a bounty (free marks!) on finding errors in slides, assignments, etc. If you found an error in marking your assignment (e.g., an incorrect solution marked as correct) then you can get additional credit for it.
  Eligible bugs: Are conceptual/theoretical errors, not typos (e.g., a missing non-trivial case in an algorithm or proof, an incorrect step, or an unsolvable or trivial solution to a problem).
  Getting Marks: For bugs in course material, please post the bug on the discussion forum on

Brightspace: the first person to find and post the bug will get its bounty. For bugs in marking, please email me directly.

This course will not have graded assignments; practice problems will be provided in place, which will not be graded. However, feedback can be provided during office hours.

Prerequisites

This course assumes proficiency with the basics of computer science: algorithm analysis and asymptotic notation, pseudocode, discrete math, and basic data structures. See the undergraduate courses COMP 1002 and COMP 2002 which contain most of the prerequisites that you will need.

Tentative Course Outline

- Basic Concepts
- Graph Algorithms
  - Depth-First Search
  - Strongly Connected Components
  - Topological Sorting
  - Breadth-First Search
  - Djikstra's Algorithm
  - Shortest Paths and Bellman-Ford
  - Minimum Spanning Trees
- Dynamic Programming
  - Divide and Conquer
  - Longest Common Subsequence
  - All Pairs Shortest Paths
- Network Flows
  - Ford Fulkerson
  - Min Flow/Max Cut
- Linear Programming
  - Network Flows
  - Bipartite Matching

  - Vertex Cover Approximation
  - The Simplex Algorithm
- Practical SAT Solving
  - Satisfiability
  - The DPLL Algorithm
  - Conflict-Driven Clause Learning (CDCL)
  - Resolution
- Complexity Theory
  - Reductions
  - NP-Completeness

Textbooks and Reference Materials

No textbook will be required for this course, however below are some reference materials that may be helpful.

- *Algorithms* by Christos Papadimitriou, Sanjoy Dasgupta, and Umesh Vazirani.
- *Introduction to Algorithms* by Thomas Cormen, Charles Leiserson, Ronald Rivest, and Clifford Stein.

Collaboration and Plagiarism

First of all, the work you submit *must be your own*. You are encouraged to work together on *assignments* and ask questions about them on the discussion forum. However, you must work out all of the answers that you submit on *drills* and *exams by yourself*. If you come across an answer to a similar problem while researching a question online or in a textbook, you must reference the source and restate the solution in your own words in order to receive full marks.

Plagiarism is a serious academic offence and will be dealt with accordingly. Posting any course content (assignments, drills, exams, practice problems) on the internet, with or without solutions, or using services such as Chegg is a *serious academic misconduct* which will be reported.