Lecture 0 - Course Overview

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CS 860 - Graduate Complexity Theory
Fall 2022

Overview

- Introduction
  - What is this course about?
  - What to expect from me?
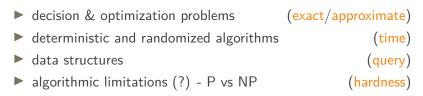 - What do I expect from you?

- Logistics
  - Structure of Lectures
  - Homework
  - Final Project
  - Miscellaneous

What is this course about?

In your algorithms/optimization/complexity courses, you studied:

- ► decision & optimization problems $\qquad$ (exact/approximate)
- ► deterministic and randomized algorithms $\qquad$ (time)
- ► data structures $\qquad$ (query)
- ► algorithmic limitations (?) - P vs NP $\qquad$ (hardness)

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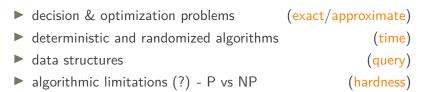- data structures   (query)
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This course aims to use the complexity theoretic lens to:

- explore several models of computation (deterministic, randomized, uniform, non-uniform, interactive)
- expand your "worldview"
  - connections between models above
  - proofs, algorithms and lower bounds
  - cryptography and computation

What to expect from me?

Here is what you can expect from me:

- ▶ Give lectures
- ▶ Provide homework which helps you understand the material better
- ▶ Be very present/interactive during office hours
- ▶ Help you with choosing your final project topic
- ▶ Give feedback on you final project mid way
- ▶ Be active on rocketchat (to the extent that I will be able to, without hurting the points above)

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This is my first time teaching this course, my goal is to give you a broad and formal introduction to this vast field of complexity theory and its many connections.

What do I expect from you?

If you are taking the class, I expect that you:

- ▶ Do the homework
- ▶ Participate in class (asking questions, correcting me, etc.)
- ▶ Always ask yourself: "why is this important? Why should I care?"
- ▶ Explore the topics, and/or some area that fascinates you!
- ▶ Always keep an open mind!
- ▶ Be kind to your classmates and myself
- ▶ Participate a lot on rocketchat (asking question, answering your classmates' questions if you know the answer)
- ▶ Provide me feedback on how the course is going
- ▶ Let me know if any problems arise during the term, so we can help as soon as possible.

Structure of lectures

Lectures will be live, but in (somewhat) asynchronous format (to benefit everyone). This means:

- ▶ Each lecture will have the same duration as a regular lecture
- ▶ However, each lecture will be divided into 2-3 parts (not necessarily same duration) with short breaks in between

  This depends on how many concepts we will cover in each lecture.

- ▶ I will try to record the lectures (but please attend the live class if you can/are not sick!)
- ▶ Videos will be posted on youtube shortly after lecture

Purpose of Lectures and Homework

The purpose of a story is not to hold your attention,
but to put you back doing your work, inner and outer.
A story is not for presenting some explicit meaning,
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The purpose of a lecture is not to exhaustively explain a concept,
but to give you a basic understanding of the material
and instigate your own exploration, of the material and of yourself.

The purpose of homework isn't to repeat what was taugh,
but for you to further your understanding and (meta-) skills.

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We will have 4 sets of homework for this class. See *assignments* section in `https://cs.uwaterloo.ca/~r5olivei/courses/2022-fall-cs860/homework/`.

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In addition, I will post practice problems (won't be graded/don't turn in). I am a strong believer in *learning by doing*.

Homework Submissions

- We will use rocketchat for homework submissions
- We strongly recommend you to write your solutions in LaTeX.
- If you are handwritting your solution, please:
  1. Write in a clearly legible manner
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▶ Solutions will be posted within 10 days after the homework is due.

▶ You will grade each other's homework (important so you can develop your mathematical maturity) - I will help if needed.

▶ Late submissions will be dealt with as follows: each late day will have a penalty of 25% on your total grade for that homework.

Final Project

https://cs.uwaterloo.ca/~r5olivei/courses/
2022-fall-cs860/final-project/

▶ Topic of your choice (see page above for suggestions)

           I must approve the topic though!

▶ Project is individual

▶ Goal:
  1. work on an open problem
  2. survey a problem or area of your choice within complexity theory
  3. cover some result suggested in page above

▶ Individual work: each student will be required to do a 20 min presentation on their project, and then there will be a 10 min period for questions (by everyone)

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Proposal 1:

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- ▶ we don't have class during reading week
- ▶ you get breaks on the following dates:
  - ▶ September 12th to 16th
  - ▶ October 31st to 3rd   (FOCS 2022)
  - ▶ November 8th to 18th

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Proposal 2: we maintain class schedule, and I teach over zoom when I am away.

Best Usage of Rocketchat

► We strongly encourage everyone to interact a lot on rocketchat

► Whenever you have a question about the material or the HW, please ask them on rocketchat (as chances are other students also have same question).

► To encourage participation, I will wait for $\sim 6 - 12$h before answering a question, so that you have a chance to collaboratively work through it.

► I will do my best to answer lecture-related questions on rocketchat with the timeline above as well

Questions?