Lecture 0: Introduction & Overview of Course

Rafael Oliveira

University of Waterloo
Cheriton School of Computer Science

rafael.oliveira.teaching@gmail.com

January 7, 2021

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
  - Student drop-in hours
  - Responses from survey
  - Words of Wisdom
  - Questions?

What is this course about?

Many fundamental problems and algorithms are *arithmetic or algebraic* in nature, or involve an *intrinsic algebraic structure*:

What is this course about?

Many fundamental problems and algorithms are *arithmetic or algebraic* in nature, or involve an *intrinsic algebraic structure*:

- Multiplying two matrices
- Computing determinant of a matrix
- Factoring a number or a polynomial
- Decomposing algebraic varieties into irreducible components
- Solving polynomial equations
- Linear, semidefinite, hyperbolic programming
- many more...

What is this course about?

Many fundamental problems and algorithms are *arithmetic or algebraic* in nature, or involve an *intrinsic algebraic structure*:

- Multiplying two matrices
- Computing determinant of a matrix
- Factoring a number or a polynomial
- Decomposing algebraic varieties into irreducible components
- Solving polynomial equations
- Linear, semidefinite, hyperbolic programming
- many more...

This course aims to:

What is this course about?

Many fundamental problems and algorithms are *arithmetic or algebraic* in nature, or involve an *intrinsic algebraic structure*:

- Multiplying two matrices
- Computing determinant of a matrix
- Factoring a number or a polynomial
- Decomposing algebraic varieties into irreducible components
- Solving polynomial equations
- Linear, semidefinite, hyperbolic programming
- many more...

This course aims to:

- introduce you to *why* such problems are fundamental
- *why* the algebraic approach is important

What is this course about?

Many fundamental problems and algorithms are *arithmetic or algebraic* in nature, or involve an *intrinsic algebraic structure*:

- Multiplying two matrices
- Computing determinant of a matrix
- Factoring a number or a polynomial
- Decomposing algebraic varieties into irreducible components
- Solving polynomial equations
- Linear, semidefinite, hyperbolic programming
- many more...

This course aims to:

- introduce you to *why* such problems are fundamental
- *why* the algebraic approach is important
- expand your algorithms & complexity toolkit (algebraic algorithms, use of symmetries, algebra and geometry of the problems, etc.)

What to expect from me?

Here is what you can expect from me:

- Give lectures
- Provide homework which helps you understand the material better
  - this is a graduate class, so there will be no trick questions
  - the subject matter is already complex enough
- Host fun and interesting office hours
- Be active on Rocketchat (to the extent that I will be able to, without hurting the points above)

What to expect from me?

Here is what you can expect from me:

- Give lectures
- Provide homework which helps you understand the material better
  - this is a graduate class, so there will be no trick questions
  - the subject matter is already complex enough
- Host fun and interesting office hours
- Be active on Rocketchat (to the extent that I will be able to, without hurting the points above)

I care much more about your **learning** rather than your **grades**. I also care much more about your **exploration** of this vast field of algebraic complexity rather than **forcing on you** any opinion on what are the "important problems." So I am designing a course which reflects that.

What do I expect from you?

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

- Do the homework
- Help with grading
- Participate in class (asking questions, correcting me, etc.)
- Come to office hours if you have questions or want to explore more
- 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!
- Participate 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.

What do I expect from you?

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

- Do the homework
- Help with grading
- Participate in class (asking questions, correcting me, etc.)
- Come to office hours if you have questions or want to explore more
- 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!
- Participate 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.

There will be no participation points, as this is a grown up course. But participation is encouraged, and only makes the course more interesting!

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

- Logistics
  - Structure of Lectures
  - Homework
  - Final Project
  - Student drop-in hours
  - Responses from survey
  - Words of Wisdom
  - Questions?

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
- Videos will be posted on youtube shortly after lecture (please let me know if you **cannot** access youtube nor zoom!)

Homework

We will have 4 problem sets for this class. See *assignments* section in

`https://cs.uwaterloo.ca/~r5olivei/courses/2021-winter-cs860/`

Homework

We will have 4 problem sets for this class. See *assignments* section in

`https://cs.uwaterloo.ca/~r5olivei/courses/2021-winter-cs860/`

Due dates (tentative):

- January 29th
- February 22nd
- March 22nd
- April 12th

Homework

We will have 4 problem sets for this class. See *assignments* section in

`https://cs.uwaterloo.ca/~r5olivei/courses/2021-winter-cs860/`

Due dates (tentative):

- January 29th
- February 22nd
- March 22nd
- April 12th

Each homework will have n questions, where $n \sim 6$ and you will be required to turn in only $n - 1$ of them. Please list collaborators.

Homework

We will have 4 problem sets for this class. See *assignments* section in

`https://cs.uwaterloo.ca/~r5olivei/courses/2021-winter-cs860/`

Due dates (tentative):

- January 29th
- February 22nd
- March 22nd
- April 12th

Each homework will have n questions, where $n \sim 6$ and you will be required to turn in only $n - 1$ of them. Please list collaborators.

In addition, I will post practice problems (won't be graded/don't turn in) which are selected so that you can get a better understanding of the material. I am a strong believer that we only *learn by doing*.

Final Project (undergrads only)

https://cs.uwaterloo.ca/~r5olivei/courses/2021-winter-cs860/final-project/

- Topic of your choice (see page above for suggestions)
- Undergraduates can pair up for final project (not mandatory to pair though)
- Goal: write code, work on an open problem and/or present a survey on a problem or area of your choice within algebraic complexity.
- To turn in: project report (around 10 pages - see LaTeX template)
- If you are programming something, then report has to be documentation and reasoning/explanation for correctness of your program.
- 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

Student drop-in hours

(For now) I will (attempt to) hold student drop-in hours on

- Mondays from 5pm-6pm
- Fridays from 11am-12pm

This should comfortably cover all of the time zones that the students from the class are in. Other times could be set by appointment.

You are always welcome to attend the drop-in hours to ask questions about the course, about the final project, and about research in general. My drop-in hours will be hosted via zoom, and a link for the will be sent to you.

Questions?