EECS 477:

Introduction to Algorithms

Lec 1: Introduction

Euiwoong Lee

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(Real Serious)
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Today's plan

- Slides
  - Introduction
- More slides (from 376)
  - Divide and Conquer recap.
- Whiteboard?
  - Advanced divide and conquer.

People

- **Instructor**: Euiwoong Lee (email: euiwoong@umich.edu)
  - First name sounds like: Ui-Ung
  - Started Fall 2020
  - Research focus: Approximation algorithms and NP-hardness (of approximation).
    - See how it affected schedule.
  - Previously taught:
    - EECS 477 (F 23, W 24)
    - EECS 376 (W 23, F 21)
    - EECS 586 (Graduate Algorithms)
    - EECS 598 (Advanced Approximation Algorithms), EECS 498 (Algorithms for Data Science).

People

- **Teaching assistants:**
  - Amatya Sharma (GSI, amatya@umich.edu)

Meeting time

- Lectures: Tuesday and Thursday 12:00 - 1:20 PM at 1017 DOW.
  - Mostly “whiteboard” lectures
  - Hand-written notes available.
  - No single “textbook” (or many textbooks); more on syllabus.
  - Some “recap slides” from 376
- Discussions 011: Friday 09:30 - 10:30 AM at 1206 DOW.
- Discussions 012: Friday 11:30 – 11:30 PM at 1940 COOL.
  - It is okay to go to any section as long as seats are available.
- Office hours: Thursday 2:00-4:00pm (Euiwoong, BBB 3641), Monday 3:00-5:00pm (Amatya, EECS 4419).

Recommended Backgrounds

- EECS 376
  - (Computational) problem, polynomial-time algorithm, big O, NP-hard, …
  - Basic algorithms: Divide and Conquer, Dynamic Programming.
  - Probability: Expectation, variance, independence, …
- EECS 281: Basic graph theory and data structures
  - Vertex, edge, path, cycle, cut, tree, …
  - Stack, queue, heap, hashing, …
  - Depth/Breadth First Search (DFS/BFS) …
- **Linear Algebra (Ma 214, Ma 217, Ma 417, Ma 419, Rob 101, …)**
  - Vectors, linear subspace, matrices, rank, etc.
  - Solving system of linear equations (gaussian elimination), eigenvalues, etc.
  - **I will assume you took a linear algebra course.**
    - But we will not use much; self-studying relevant parts will be enough.
  - ***Mainly needed for second half (and later part of first half).***

Grading

- Homework 40%. Midterm exam 30%. Final exam 30%.
- The class will operate on a standard 90/80/70/60 scale. We might "curve up". (E.g., if your raw score is 80, you are guaranteed to get some form of B.)
- Participation in lectures/discussions/piazza.
  - Up to 2 points as extra credits.
- A grade of A+ is only awarded for exceptional work at the discretion of the instructor. Some examples of exceptional work in addition to a good score are
  - Active participation in lectures/discussions/piazza.
  - Quality of HW/exam solutions.
  - Optional problems in HWs.

Homeworks

- There will be 6 HWs. Submitted via Gradescope.
- Late HWs will not be accepted, but the lowest score will be dropped.
- One additional drop can be arranged due to special circumstances, with some official documentation explaining them.
- Recommend to write the solution using LaTeX.
- Collaboration is allowed and encouraged, but everyone must submit their own solution, which should be written up from scratch (and not copy/pasted - there should not be exactly identical text matches). Please list your collaborators in the submission.
  - To find collaborators: Use Piazza / Come to Office Hours / ???
- We will also use Piazza (https://piazza.com/class/m07eyiejfgeda) for questions.

Exams

- Both midterm and final are 24-hour take-home exams.
  - Can you full 24 hours, but “designed” to be taken in 3-4 hrs.
- Midterm: Oct 9 (Wed) 5 pm – Oct 10 (Thu) 5 pm.
  - Break: Oct 14 (Mon) – Oct 15 (Tue).
  - No class on Oct 10.
- Final: Dec 12 (Thu) 5 pm – Dec 13 (Fri) 5 pm.
  - Last Lecture: Dec 5 (Thu)

Diversity

- All members of this class are expected to contribute to a respectful, welcoming and inclusive environment for every other member of the class. Your suggestions are encouraged and appreciated.

Student Well-Being

- If you are experiencing concerns, seeking help is a courageous thing to do for yourself and those who care about you.
- If the source of your stressors is academic, please contact the instructor so that we can find solutions together.
- For personal concerns, U-M offers many resources, some of which are listed at Resources for Student Well-being. You can also search for additional resources on that website.

Accessibility

- Students who are experiencing a disability-related barrier should contact Services for Students with Disabilities https://ssd.umich.edu/; 734-763-3000 or ssdoffice@umich.edu). SSD typically recommends accommodations through a Verified Individualized Services and Accommodations (VISA) form.

- Please turn in VISA forms by Sep 20 (Fri) to ensure full accommodations.

Class objective

- Learn more algorithms!
  - EECS 281: lacks theoretical analysis
  - EECS 376: not enough

EECS 376 Schedule

Unit	Day	#	Material
Design and Analysis of Algorithms	Mon 30 Aug	1	Introduction
	Wed 1 Sep	2	The Potential Method and Divide and Conquer
	Discussion	*1*	*Review: Proofs, Asymptotic Notation, Information*
	Mon 6 Sep		***No Class - Labor Day***
	Wed 8 Sep	3	Divide and Conquer 2
	Discussion	*2*	*Divide and Conquer*
	Mon 13 Sep	4	Dynamic Programming
	Wed 15 Sep	5	Greedy Algorithms
	Discussion	*3*	*Dynamic Programming and Greedy*
Computability	Mon 20 Sep	6	Formal Languages and Finite Automata
	Wed 22 Sep	7	Turing Machines and Decidability
	Discussion	*4*	*Finite Automata and Turing Machines*
	Mon 27 Sep	8	Diagonalization
	Wed 29 Sep	9	Acceptance and Halting Problem
	Discussion	*5*	*Diagonalization and Acceptance*
	Mon 4 Oct	10	Reducibility
	Wed 6 Oct	11	Recognizability
	Discussion	*6*	*Reducibility and Undecidability*
	Mon 11 Oct	12	Kolmogorov Complexity and Rice's Theorem
Midterm	Wed 13 Oct	13	Material Review
	Discussion	*7*	*Rice's Theorem and Material Review*
	Mon 18 Oct		***No Class - Fall Break***
	Wed 20 Oct		Midterm
	Discussion		***No Class - Midterm***

Unit	Day	#	Material
Complexity	Mon 25 Oct	14	The Classes P and NP
	Wed 27 Oct	15	The Cook-Levin Theorem
	Discussion	*8*	*NP Overview*
	Mon 1 Nov	16	Reductions and NP-Completeness
	Wed 3 Nov	17	NP-Complete Problems 2
	Discussion	*9*	*NP-Completeness*
	Mon 8 Nov	18	Search and Approximation Algorithms
	Wed 10 Nov	19	Approximation Algorithms 2
	Discussion	*10*	*Approximation*
Randomness in Computation	Mon 15 Nov	20	Probability, Randomness in Computation
	Wed 17 Nov	21	Randomness in Computation 2
	Discussion	*11*	*Randomness and Modular Arithmetic Review*
	Mon 22 Nov	22	Monte Carlo Methods and Chernoff Bounds
	Wed 24 Nov		***No Class - Thanksgiving***
	Discussion		***No Class - Thanksgiving***
Cryptography	Mon 29 Nov	23	One-time Pad, Diffie-Hellman, and Discrete Logarithm
	Wed 1 Dec	24	RSA and Factoring
	Discussion	*12*	*Fast Modular Exponentiation, Diffie-Hellman, and RSA*
Special Topics	Mon 6 Dec		Special Topics (Untested Material)
Final Exam	Wed 8 Dec	25	Wrap-up
	Discussion	*13*	*Wrap-up and Material Review*
	Wed 15 Dec		Final Exam

Topics

- The course will consist of the following six units. Each unit will have 4-5 lectures and one homework based on them.
- First half: advanced 281/376 materials with new idea from randomness
  - 1. Divide and Conquer / Dynamic Programming
  - 2. Greedy / Graph algorithms and Data structures
  - 3. Randomized algorithms (including Hashing and Streaming)
- Second half: coherent theory of poly-time (discrete/continuous) optimization
  - 4. Max-flow Min-cut and Linear programming
  - 5. Approximation algorithms
  - 6. Multiplicative weight update and Online algorithms
- Textbooks: no fixed one, but see Syllabus for helpful books for each unit.

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- More “comprehensive understanding” of algorithms
  - One problem, if solvable, can be solved by many algorithms
  - Connections between different algorithms / problems

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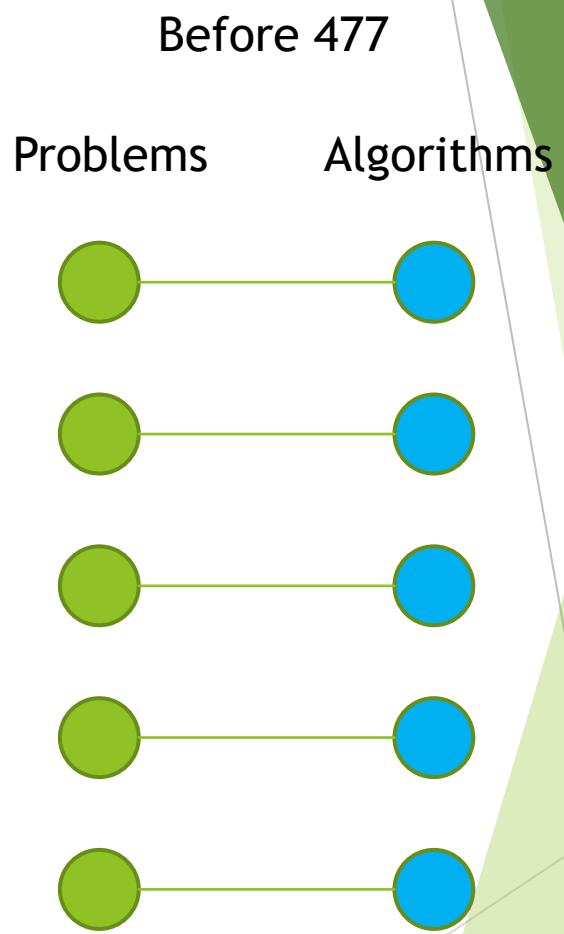

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