

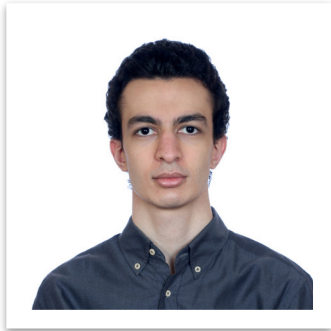
# CS 5800: Algorithms

<http://behnezhad.com/cs5800-fall23/>

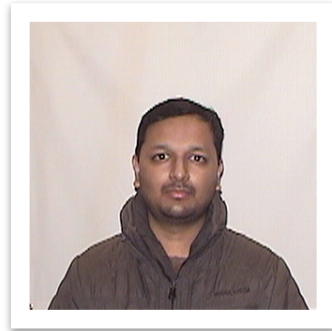
# CS5800: Algorithms

- **Instructor:** Soheil Behnezhad  
/so-hail be-ne-zaad/
- Joined Northeastern in August 2022
- **Pronouns:** He/Him
- **Office Hours:** Mondays 2pm-4pm (may change)
- **Research:** Theoretical Computer Science
  - Graph Algorithms
  - Algorithms for Big Data
  - Algorithms Under Uncertainty
- **Education:**
  - Postdoc: Stanford
  - PhD: University of Maryland
  - Undergrad: Sharif University

# TA Team



Amir Azarmehr



Rishabh Chhaparia



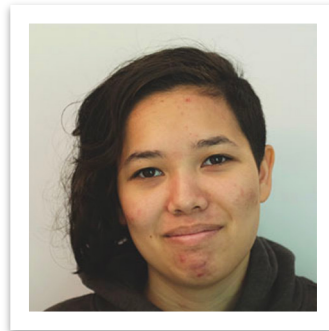
Mili Parikh



Pravin Pawar



Hemasumant  
Rasineni

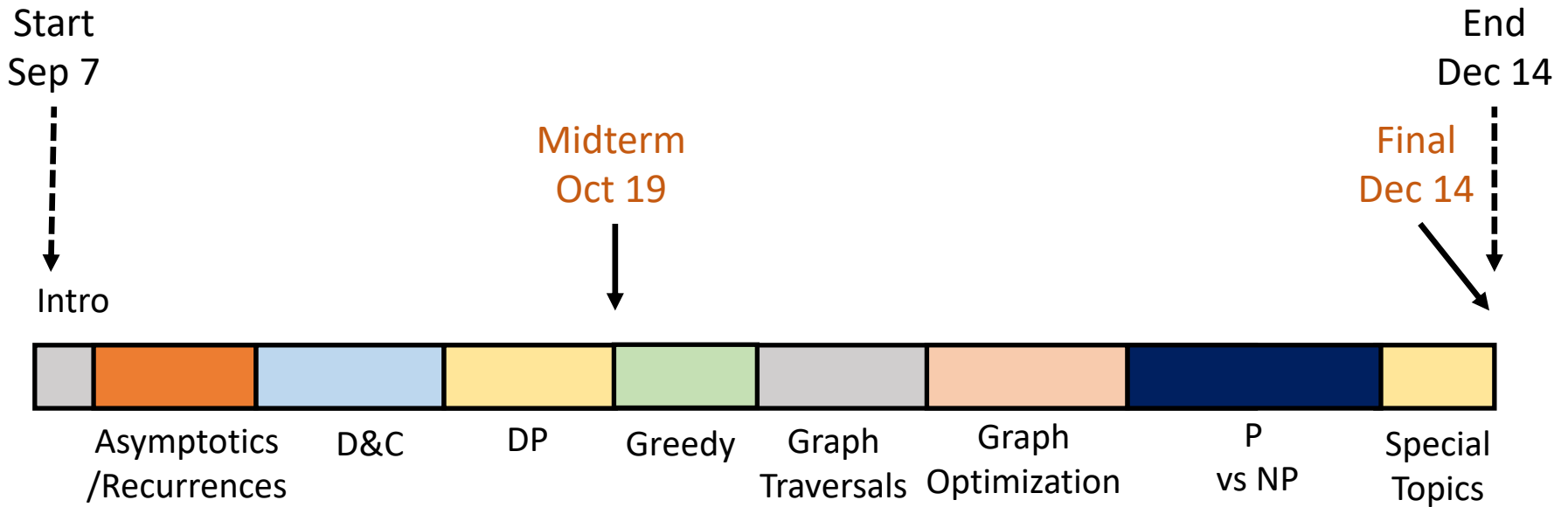


Jamie Tjia

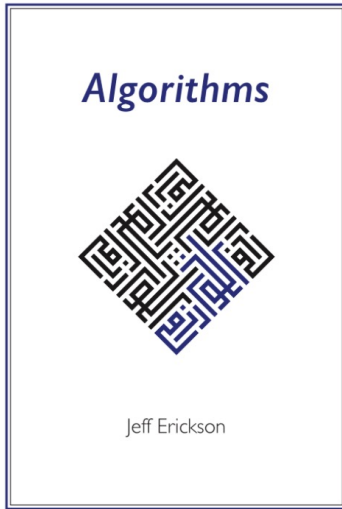


Ryan Zhu

# Course Structure



# Resources



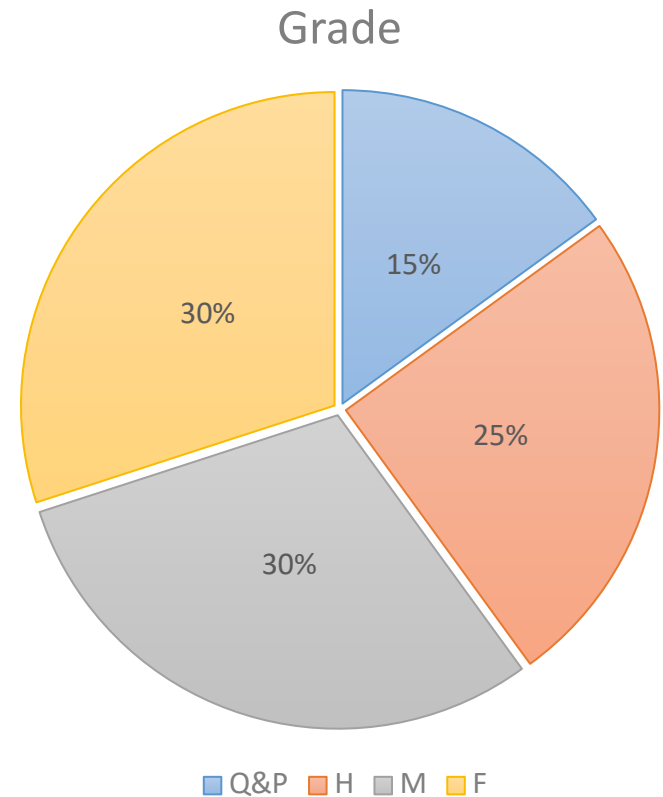
Main Textbook:  
**Algorithms** by Jeff Erickson  
(freely available)

## Other useful books

- **Introduction to Algorithms**  
by T. Cormen, C. Leiserson, R. Rivest, and C. Stein
- **Algorithm Design**  
by J. Kleinberg and É. Tardos

# Grading

- 15% Quizzes & Participation
- 25% Homework Assignments
- 30% Midterm
- 30% Final Exam



# Homework

- 25% of grade
- **No late submissions — start early**
- Lowest HW score will be dropped from your grade
- Solutions must be typeset in **LaTeX**
  - We will provide the template
  - You can use Overleaf or your favorite editor
- PDFs and source codes must be submitted to **gradescope** (integrated with Canvas)

# Quizzes

- Some weeks, we will have a quiz posted on Canvas covering material taught in the preceding lectures.
- Typical schedule: out on Friday, due Monday night.
- No quiz this week.



# Academic Integrity Policies

- You cannot collaborate on quizzes and exams.
- You are encouraged to work with your classmates on the homework problems.
  - You may not use the internet
  - You may not collaborate with people outside the class
- **Homework Collaboration Policy:**
  - You must write all solutions by yourself
  - You may not share any written solutions
  - You must state all your collaborators
  - We reserve the right to ask you to explain any solution
- **Maintain highest academic integrity standard throughout, including all tests and assignments**

# Discussion Forum

- We will use Piazza for discussions
  - Ask questions and help your classmates
  - Please use private messages sparingly



# Recordings

Lecture recordings may be available on Canvas under  
**Zoom Meetings > Cloud Recordings**

# Anonymous Feedback

You can send me anonymous feedback here:

<https://forms.gle/dqbSzU3oVy3fhuyP6>

(Link is available on the course webpage too)

# Algorithms

- What is an algorithm?

*An explicit, precise, unambiguous, mechanically-executable sequence of elementary instructions for solving a computational problem.*

*-Jeff Erickson*



- Essentially all computer programs (and more) are algorithms for some computational problem.

# Algorithms

- What is **algorithms**?

*The study of how to solve computational problems.*

- Abstract and formalize computational problems
- Identify useful algorithmic tools for solving computational problems
- Analyze and compare algorithms
  - This class: correctness, running time, space usage
  - Beyond: parallelism, robustness, simplicity, extensibility

# Why would we do this?

- **Improve problem solving:**
  - How/why do algorithms really work?
  - How to attack new problems?
  - Which design techniques work well?
  - How to compare different solutions?
  - How to know if a solution is the best possible?

# Why would we do this?

- **Improve communication:**
  - How to explain solutions?
  - How to convince someone that a solution is correct?
  - How to convince someone that a solution is best?



# Why would we do this?

- **Improve the world:**
  - Algorithms are pervasive
  - Can increase productivity
  - Can increase social utility
  - Can increase fairness

# Why would we do this?

- **Inventors we all admire**

**Edison/Tesla**

electricity

**Guttenberg**

printing press

**Edward Jenner**

smallpox vaccine

# Why would we do this?

- **Inventors we all admire**

<b>Edison/Tesla</b>	electricity
<b>Guttenberg</b>	printing press
<b>Edward Jenner</b>	smallpox vaccine

- **Many modern inventions are algorithmic**

<b>Dijkstra</b>	Shortest path	⇒ internet routing
<b>Cooley,Tukey</b>	Fast Fourier Transform	⇒ audio/image processing
<b>Rivest-Shamir-Adleman</b>	RSA protocol	⇒ securing internet
<b>Knuth</b>	Text search	⇒ word processors
<b>Hamming/Shannon</b>	Error-correcting code	⇒ CDs, communications
<b>Page</b>	PageRank	⇒ Google search

# Why would we do this?

- Many of the world's most successful companies are tech companies
- These companies want you to solve **algorithms** problems on the spot

Company	Sector	Market Cap (in USD)
#1 Apple	Technology	\$2.744 trillion
#2 Microsoft	Technology	\$2.353 trillion
#3 Saudi Aramco	Oil & Gas	\$2.224 trillion
#4 Alphabet (Google)	Technology	\$1.624 trillion
#5 Amazon	E-commerce	\$1.336 trillion
#6 Nvidia	Technology	\$1.069 trillion
#7 Berkshire Hathaway	Diversified Investments	\$770.43 billion
#8 Meta Platforms	Social Media	\$725.89 billion
#9 Tesla	Automotive	\$682.99 billion
#10 Eli Lilly	Pharmaceuticals	\$518.71 billion

# Why would we do this?

- **Understand the natural world:**
  - Brains, cells, networks, etc. often viewed as algorithms.

# Why would we do this?

- **Fun:**
  - Yes, seriously, fun.