Algorithms
and
Data Structures

PRINCETON
UNIVERSITY

I will be recording lectures and make them available in Canvas.

Because of privacy, compliance, and legal considerations,
you may not record or redistribute recordings of this class.

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Intro to COS 226

- *motivation*
- *course structure*
- *assessments*
- *resources*

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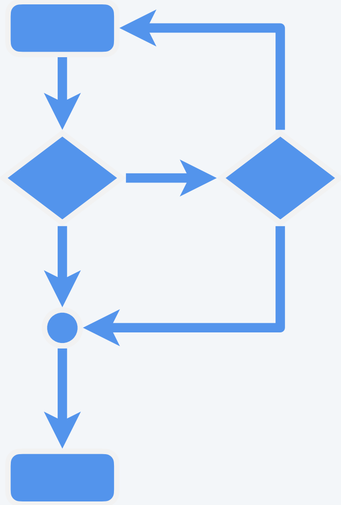
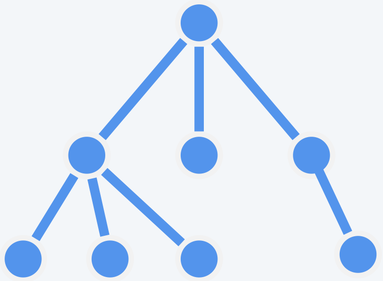
COS 226 course overview

What is COS 226?

- Algorithm: step-by-step procedure for solving a problem.
- Data structure: method for organizing data in a computer.
- Programming and problem solving, with applications.

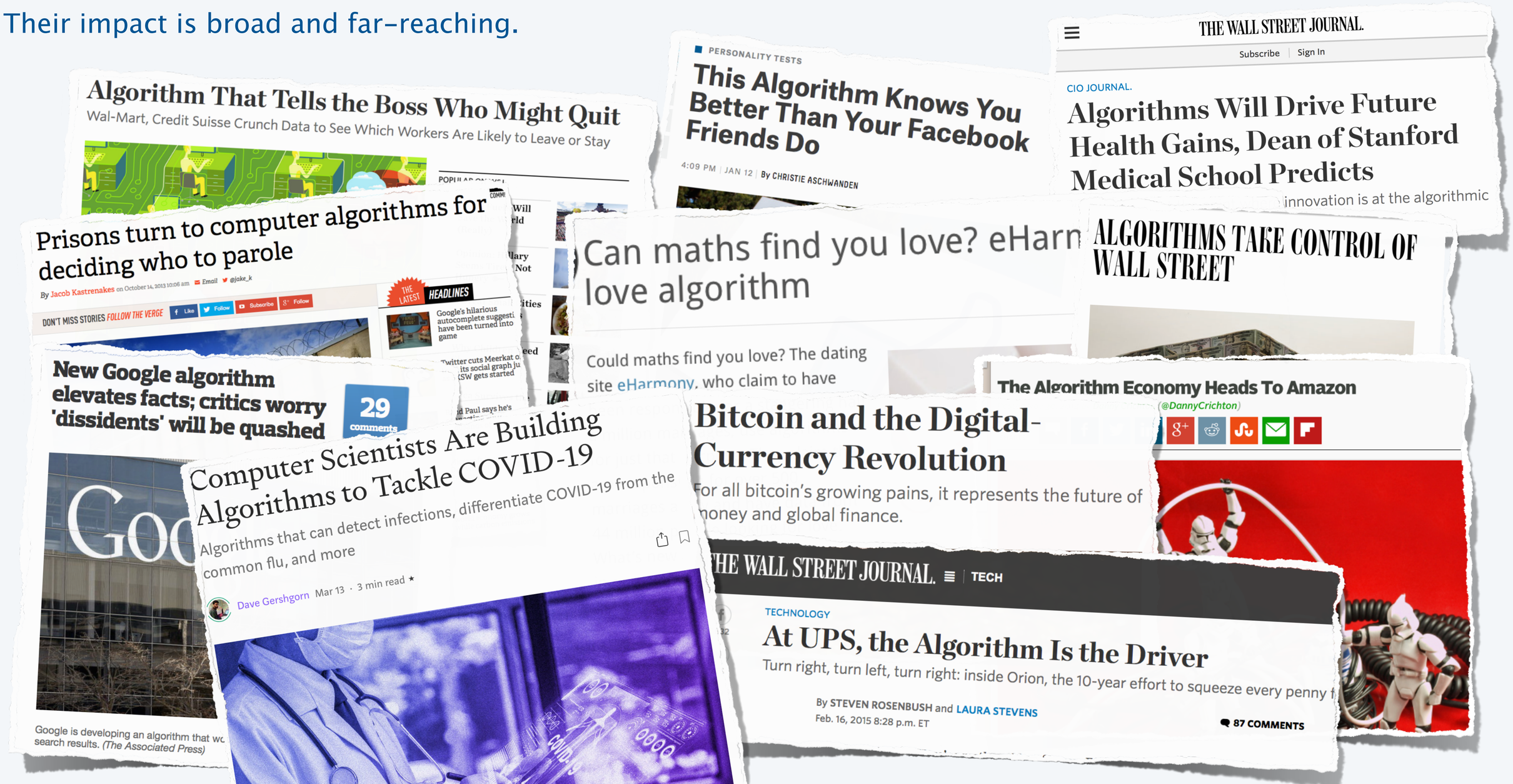




topic	algorithms and data structures 
data types	stack, queue, union–find
sorting	insertion sort, quicksort, mergesort, priority queue
searching	BST, red–black tree, hash table, k-d tree
graphs	BFS, DFS, Prim, Kruskal, Dijkstra
advanced	randomness, multiplicative weights, intractability

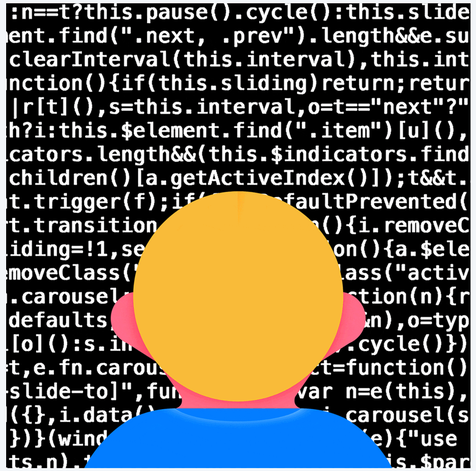
Why study algorithms and data structures?

Their impact is broad and far-reaching.



Why study algorithms and data structures?

To become a proficient programmer.



> *“ I will, in fact, claim that the difference between a bad programmer and a good one is whether [they] consider [their] code or [their] data structures more important. Bad programmers worry about the code. Good programmers worry about data structures and their relationships.”*
>
> — Linus Torvalds (architect of Linux and git)

Why study algorithms and data structures?

For intellectual stimulation.

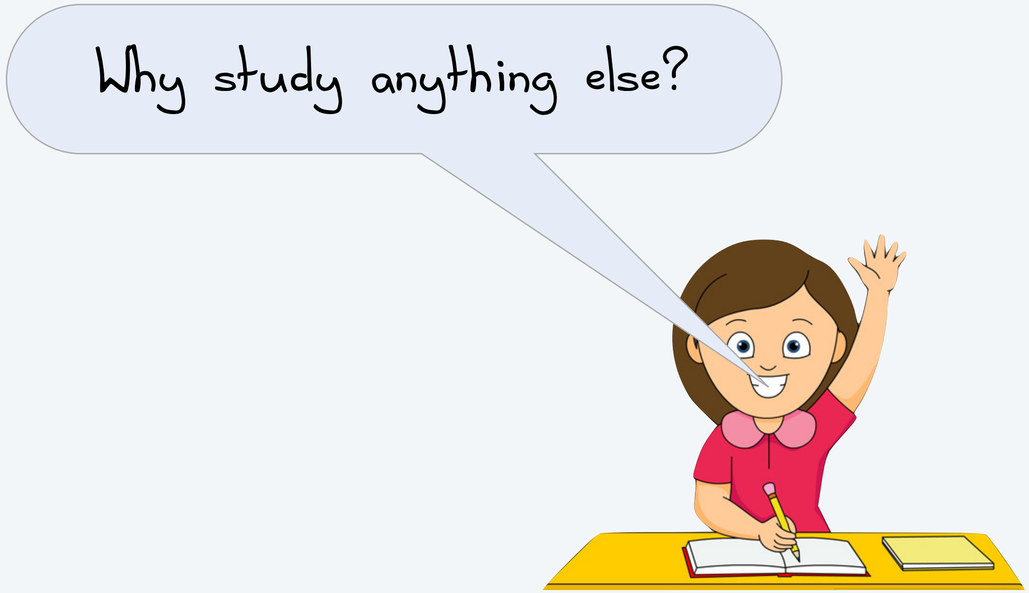
> *For me, great algorithms are the poetry of computation. Just like verse, they can be terse, allusive, dense, and even mysterious. But once unlocked, they cast a brilliant new light on some aspect of computing.*" — Francis Sullivan

Why study algorithms and data structures?

For fun and profit.

Why study algorithms and data structures?

- Their impact is broad and far-reaching.
- To become a proficient programmer.
- For intellectual stimulation.
- For fun and profit.



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Lectures

Live lectures. Introduce new material.

What	When	Where	Who	Office Hours
L01	TTh 11–12:20pm	Friend 101	Kevin Wayne Pedro Paredes	*see web*

Prof. Kevin Wayne

Prof. Pedro Paredes

Questions. Raise your hand and ask a question. ⟵ *carpe diem!*

Electronic devices. Permitted *only* to support lecture. ⟵ *viewing slides, taking notes, iClickers, …*

iClicker (required). To earn participation credit:

- Create iClicker Cloud account. ⟵ *using Canvas-preferred email*
- Answer multiple choice questions during lecture.

https://www.iclicker.com

If you could have more of one of the following, which would it be?

A. Fame. ⭐⭐⭐

B. Fortune. 💰💰💰

C. Friends. 💛💛💛

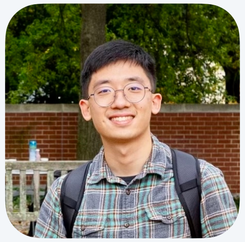
D. Free time. ⏳⏳⏳

Precepts

Active learning. Problem-solving, discussion, assignment prep, …

Victor Chu

Emma Farkash



Brendan Wang

Stanley Wei

Han Xu

Zhiyue Zhang

Anny Zhou

Special precept P04. F 1:30–2:50pm.

- Intended for students seeking a more advanced treatment of material.
- Covers topics beyond scope of the course.

Prof. Huacheng Yu

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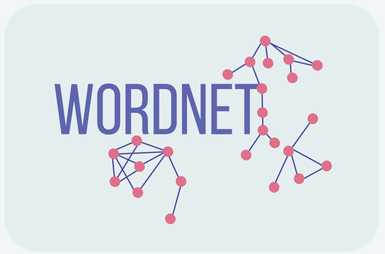
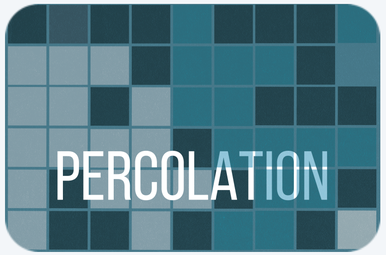
- *union–find*

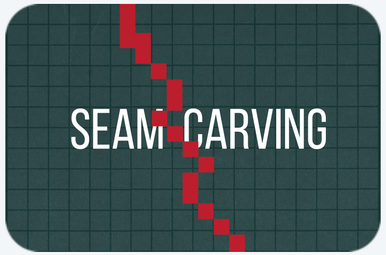
Programming assignments

Implement an efficient algorithm or data structure:



Solve an interesting application using a “textbook” algorithm:



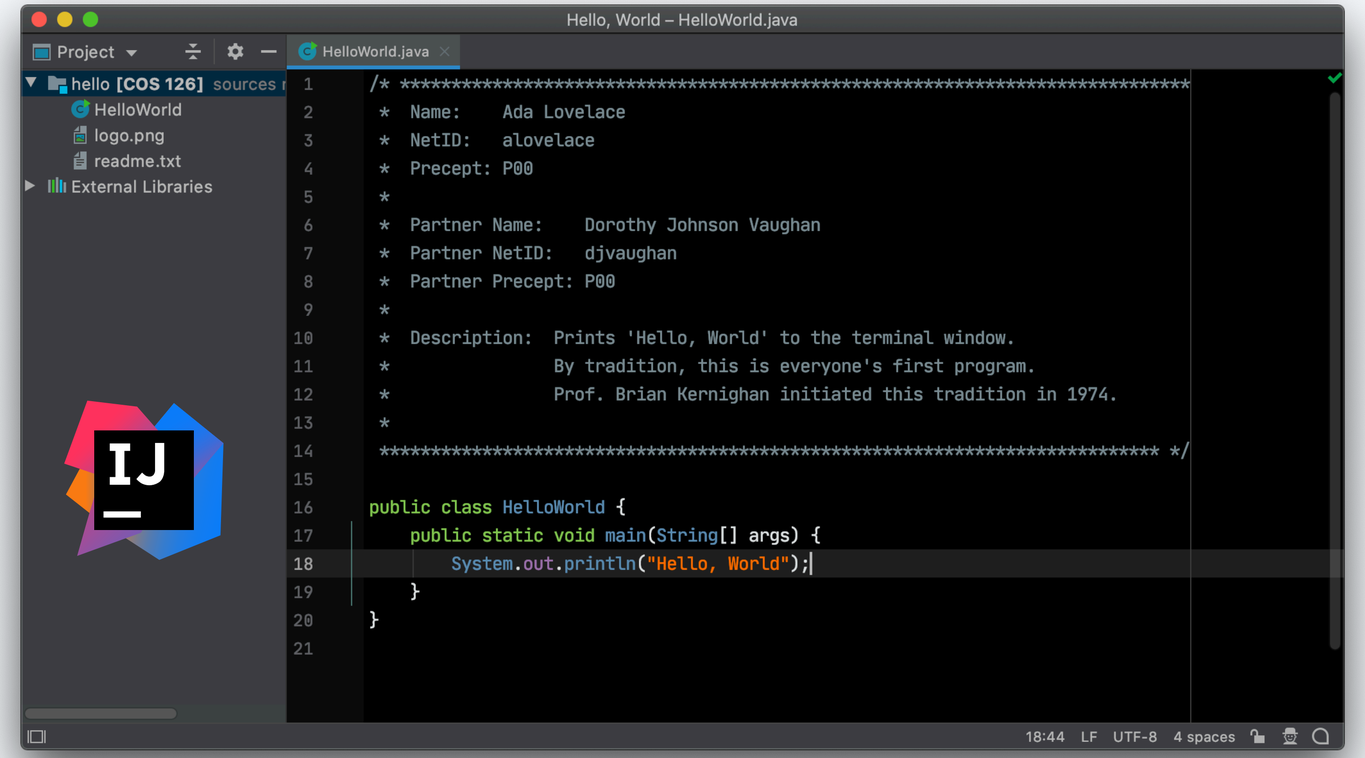


Pair programming encouraged on designated assignments.

Programming environment

Recommended IDE. Custom IntelliJ 2024.2 environment. ⟵ *upgrade to Fall 2024 version*

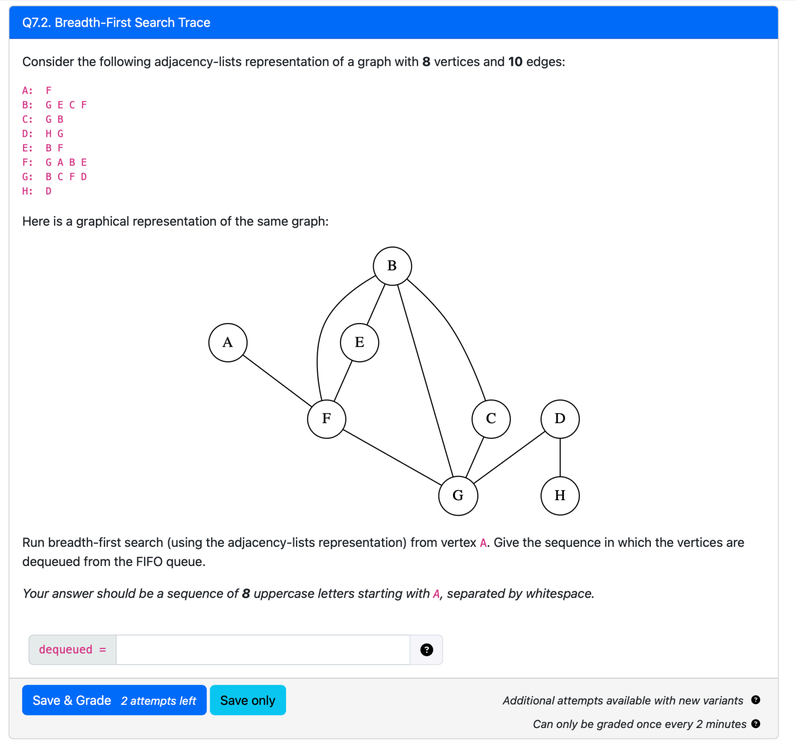
- Embedded Bash terminal.
- Autoformat, autoimport, autocomplete, …
- Continuous code inspection; integrated Checkstyle and SpotBugs.
- …



Quizzes

PrairieLearn platform.

- 2–3 short questions per lecture.
- Solve using pencil and paper.
- Unlimited attempts per question. ← *different variant for each attempt; delay between attempts*
- Your score = max over all attempts.



PrairieLearn

Midterm and final

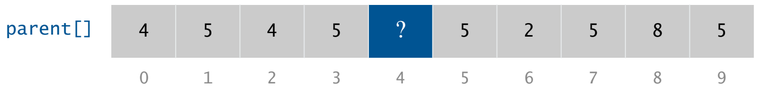
Written exams.

- Questions drawn from lectures, precepts, and quizzes.
- Emphasizes non-programming material.

COS 226 MIDTERM, SPRING 2023 3

3. **Data structures. (6 points)**

(a) Consider the following *parent-link* representation of a *weighted quick union* (link-by-size) data structure.



Which of the following values could be `parent[4]`?

Fill in all checkboxes that apply.

☐ 0 ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ 8 ☐ 9

Grading ~~A+~~

Programming assignments. 45%

- Due at 11:59pm on Mondays.
- Collaboration/lateness policies: see web.

Quizzes. 10%

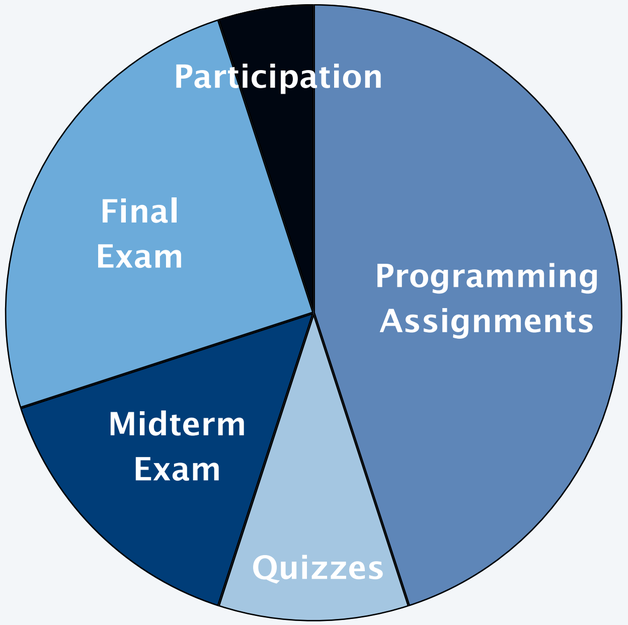
- Due at 11:59pm on Saturdays.
- Collaboration policy: see web.

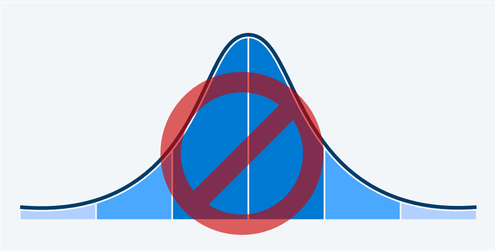
Written exams. 15% + 25%

- 80-minute midterm on Tuesday, March 4.
- 3-hour in-person final, on Sunday, May 11.

Active participation. 5%

- iClicker participation in lecture.
- Collaborative participation in precept.





grade	score
A	93.0%
A–	90.0%
B+	87.0%
⋮	⋮

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Resources (textbook)

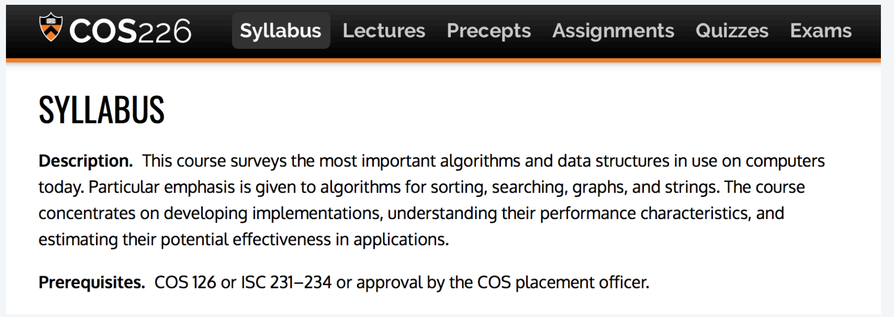
Readings (required). *Algorithms* 4^{th} *edition* by R. Sedgewick and K. Wayne, ← *Labyrinth Books, Amazon, …*
Addison-Wesley Professional, 2011, ISBN 0-321-57351-X.

4^{th} edition (2011)

Resources (web)

Course content.

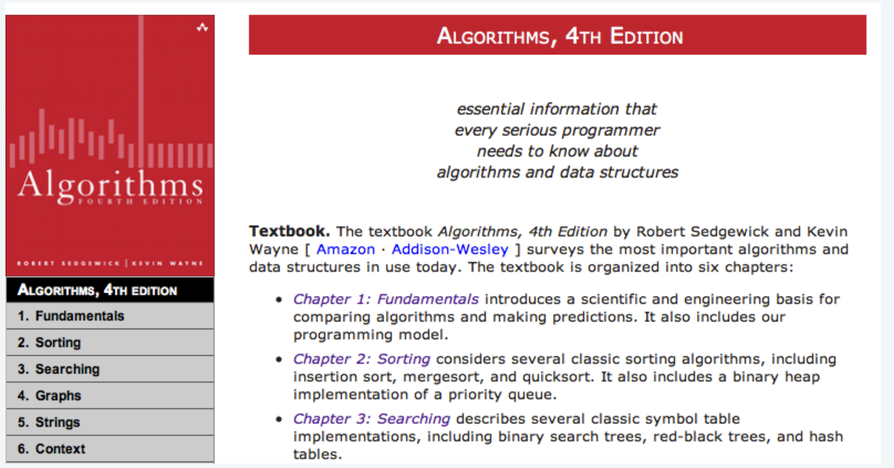
- Course info.
- Lecture slides.
- Precept lessons.
- Programming assignments.
- Quizzes.
- Exam archive.



https://www.princeton.edu/~cos226

Booksite.

- Brief summary of content.
- Download code from book.
- APIs and Javadoc.



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Resources (people)

Online discussion forum.

- Low latency, low bandwidth.
- Designate post as private only when necessary.
- See Ed FAQ for guidelines.

https://us.edstem.org/courses/70149

Office hours.

- High bandwidth, high latency.
- See web for schedule.

https://www.princeton.edu/~cos226

Intro COS lab.

- Undergrad lab TAs.
- For help with debugging.
- See web for schedule.

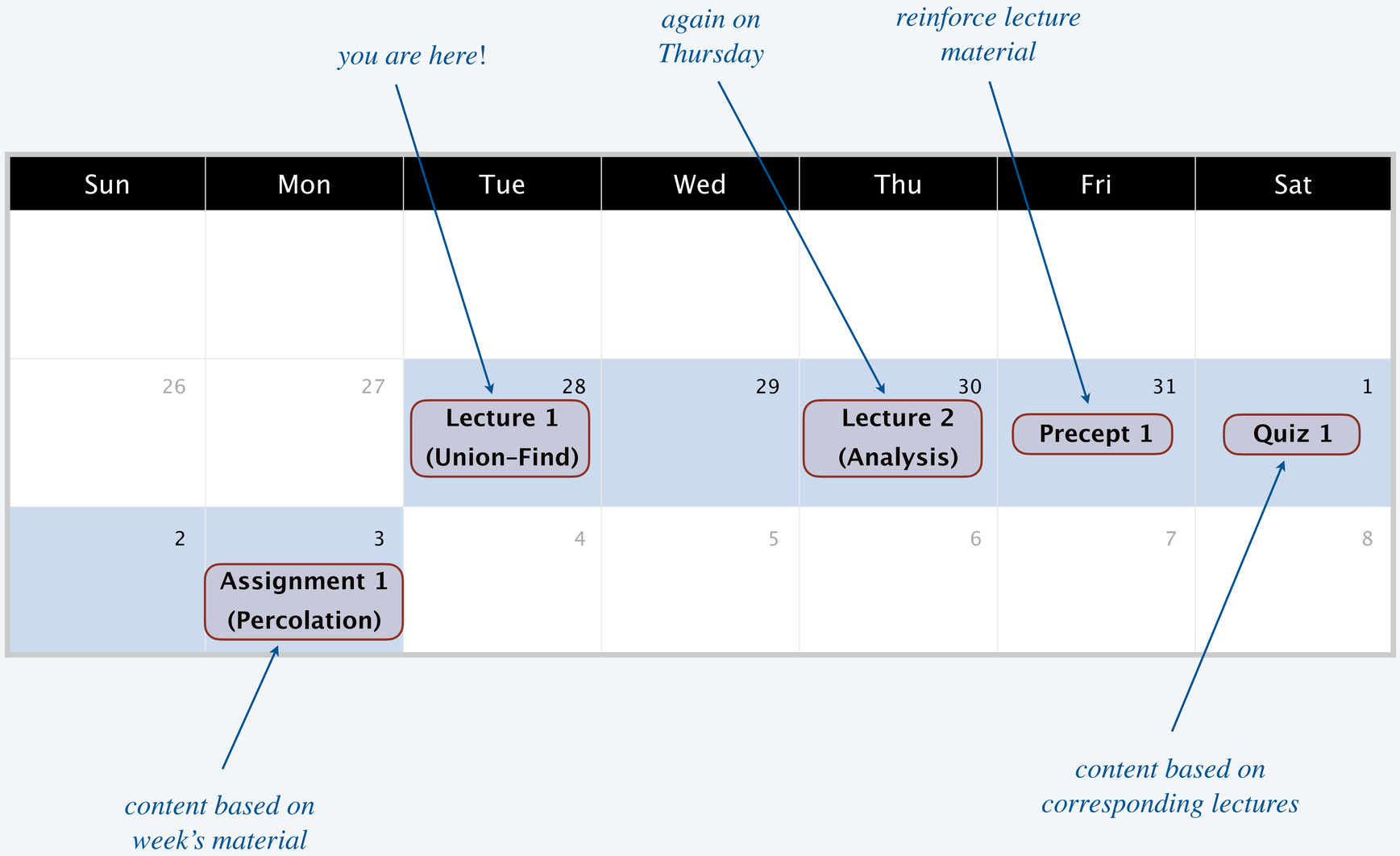
https://introlab.cs.princeton.edu

Resources (ed tech)

Platform	What
Ed	*discussion forum, precept lessons*
IntelliJ	*Java IDE*
PrairieLearn	*quizzes*
TigerFile	*assignment submissions*
codePost	*assignment feedback*
Gradescope	*exam feedback*
Canvas	*grades, lecture recordings*
iClicker	*lecture participation*

also use for communication with course staff (do not email)

A typical week (including this one!) 📆



Administrative Q+A

Not registered? Register today. ← *must be enrolled to access various platforms*

Change precept? Use TigerHub.

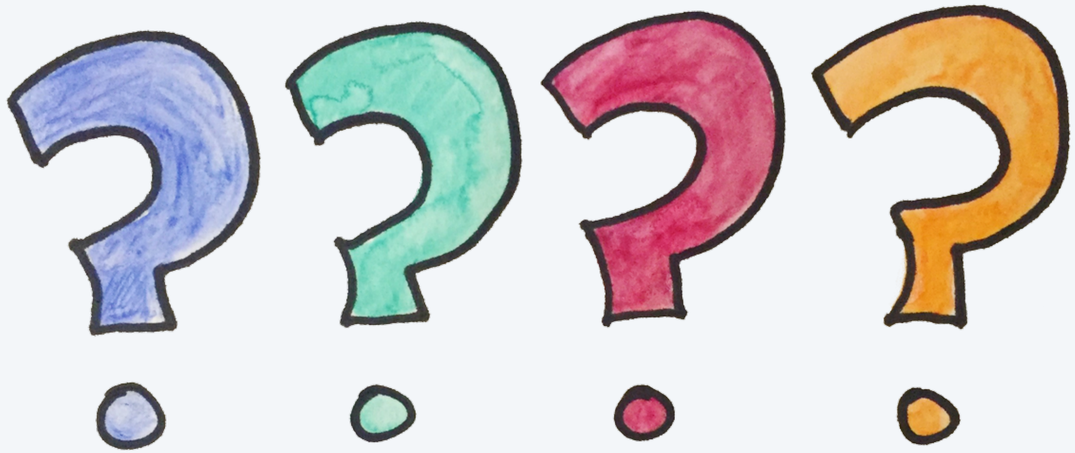
All non-conflicting precepts closed? Contact our course admin, Kobi Kaplan.

Kobi Kaplan

Placed out of COS 126 / ECE 115? Review Sections 1.1–1.2 of Algorithms 4/e.

Haven't met COS 226 prerequisites? See COS placement officer.

Additional administrative questions. Ask now, after class, or any time in Ed Discussion.



Credits

image	source	license
THX Eclipse Deep Note	THX Ltd.	
Wireframe Tiger	Audrey Cheng ’20	by author
Programmer	Wall Street Journal	
Student Raising Hand	classroomclipart.com	educational use
Hands Raising Smarphones	Adobe Stock	education license
A is for Algorithms	comtechpass.com	
Assignment Logos	Kathleen Ma ’18	by author
Normal Distribution	Adobe Stock	education license
Pair Programming	Adobe Stock	education license
Office Hours	clipground.com	CC BY 4.0
COS Lab TAs	Pulkit Singh ’20	by author
Question Marks	pikpng.com	non-commercial use
Elbow Bump	The Noun Project	CC BY 3.0
Countdown Timer	YouTube	