COS 226, Fall 2020

Algorithms
and
Data Structures

Kevin Wayne · Maia Ginsburg · Dan Leyzberg

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FINE PRINT

I will be recording our class sessions to ensure that they are available to students regardless of their geographic location and time zone. Please contact me if you wish to be edited out of any recording in which you appear.

Because of privacy, compliance, and legal considerations, you may not post recording of this class online or share them with anyone other than students enrolled in this course.

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Intro to COS 226

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

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Intro to COS 226

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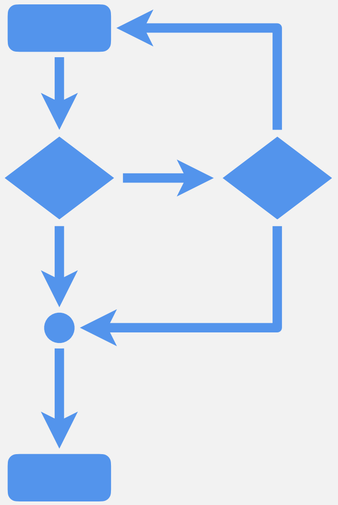
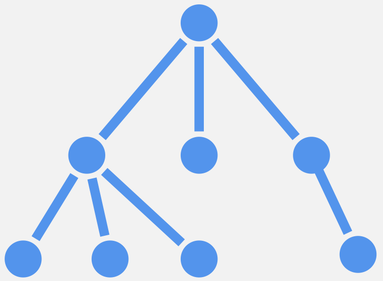
COS 226 course overview

What is COS 226?

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

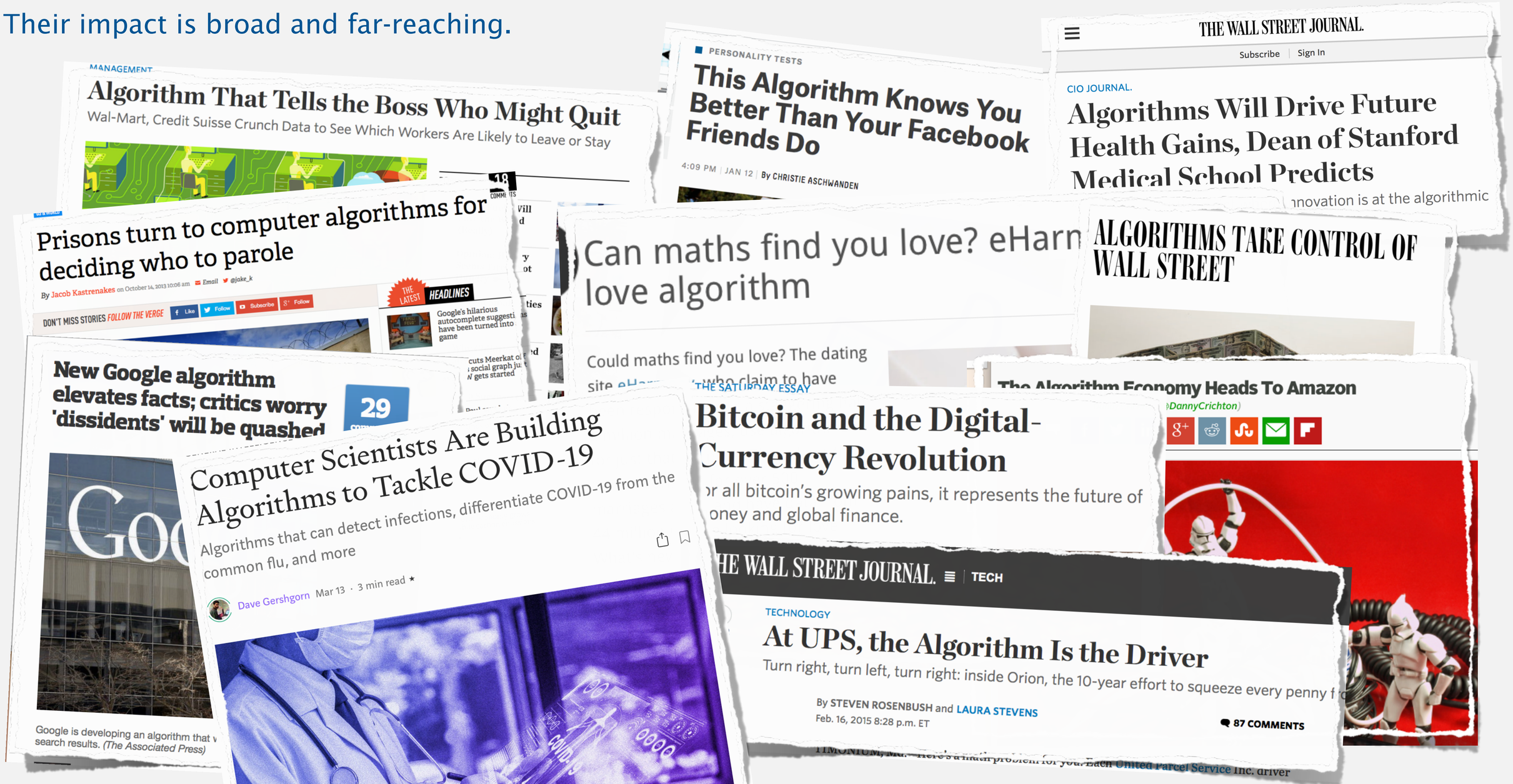




topic	algorithms and data structures
data types	stack, queue, union–find, priority queue
sorting	quicksort, mergesort, heapsort, radix sorts
searching	BST, red–black BST, hash table, kd-tree
graphs	BFS, DFS, Prim, Kruskal, Dijkstra, Ford–Fulkerson
strings	tries, suffix arrays, data compression

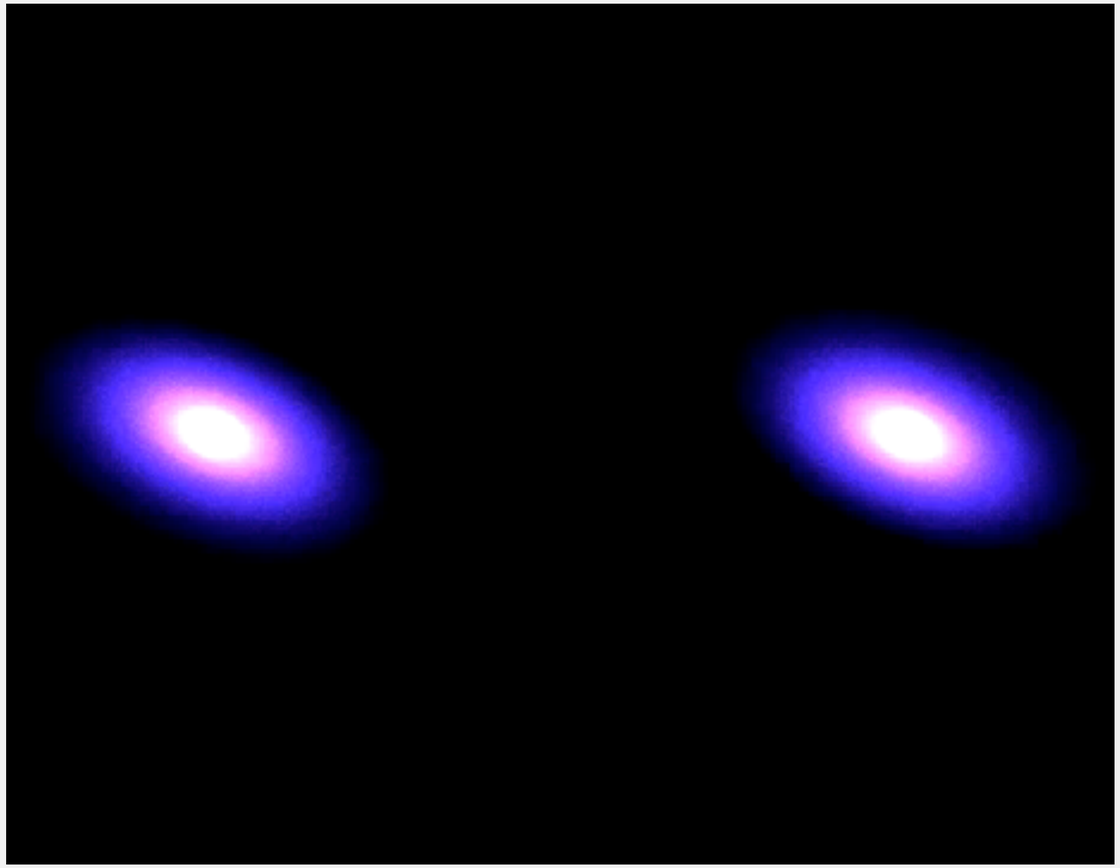
Why study algorithms and data structures?

Their impact is broad and far-reaching.



Why study algorithms and data structures?

They may unlock the secrets of life and of the universe.

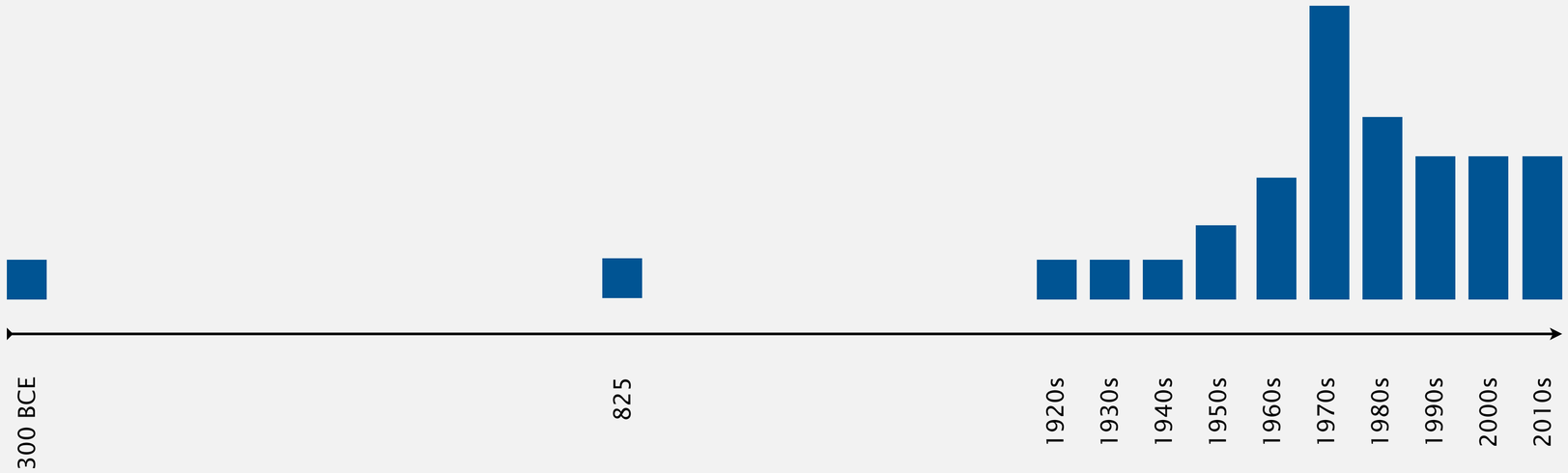


https://www.youtube.com/watch?v=ua7YlN4eL_w

Why study algorithms and data structures?

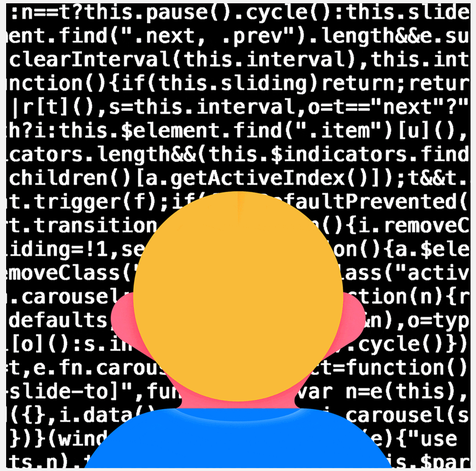
Old roots, new opportunities.

- Study of algorithms dates at least to Euclid.
- Named after Muḥammad ibn Mūsā al-Khwārizmī.
- Formalized by Church and Turing in 1930s.
- Some important algorithms were discovered by undergrads in a course like this!



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] considers [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)*

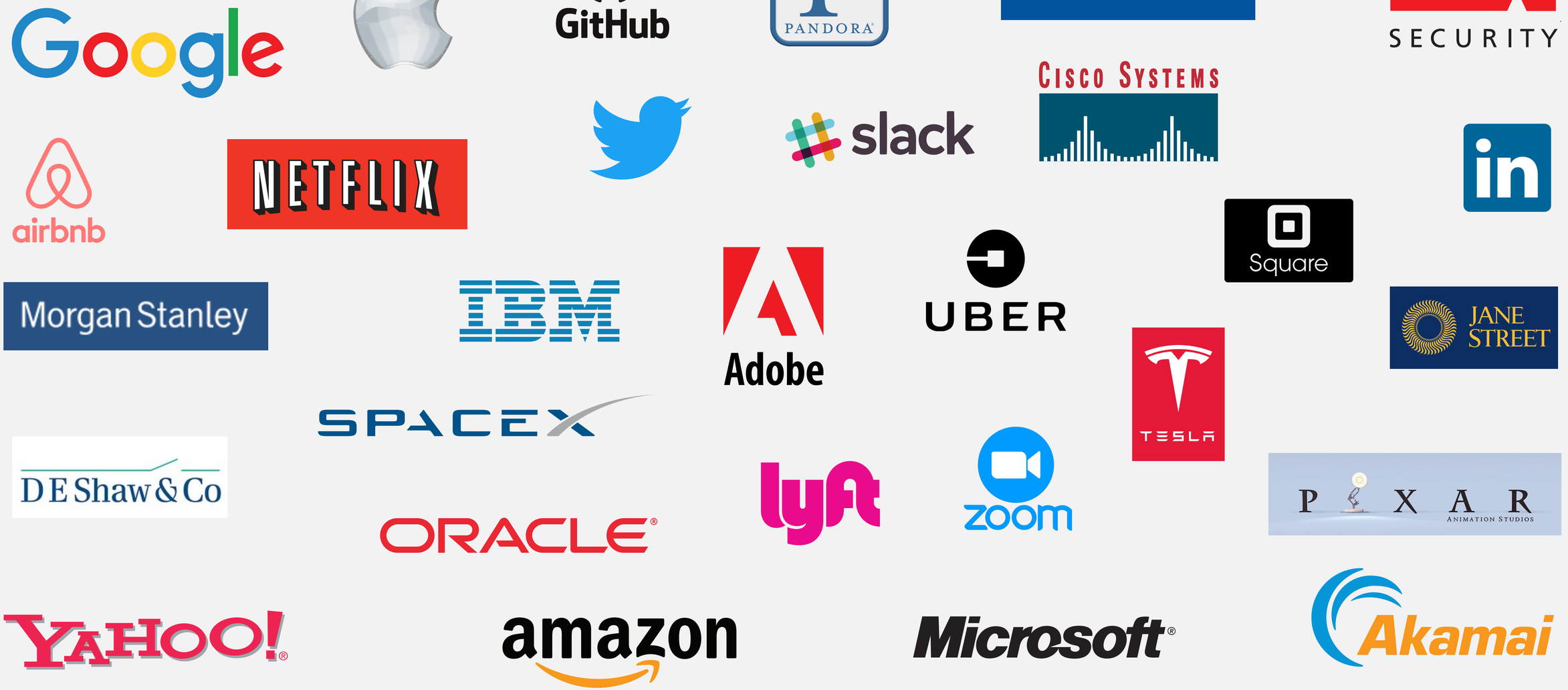
Why study algorithms and data structures?

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.
- They may unlock the secrets of life and of the universe.
- Old roots, new opportunities.
- 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	Zoom	Kevin Wayne	*see web*

Attendance. Required.

Waivers. As verified by your residential college.

Zoom links. Available via Canvas.

Zoom recordings. Available via Canvas.

Live questions during lecture. Raise hand and unmute.

Live questions after lecture. Stay in Zoom.

Side channel for questions during lecture. Zoom Chat today.

Student response system (required).

- Multiple choice questions to increase engagement.
- Register iClicker Reef using your Princeton email address.

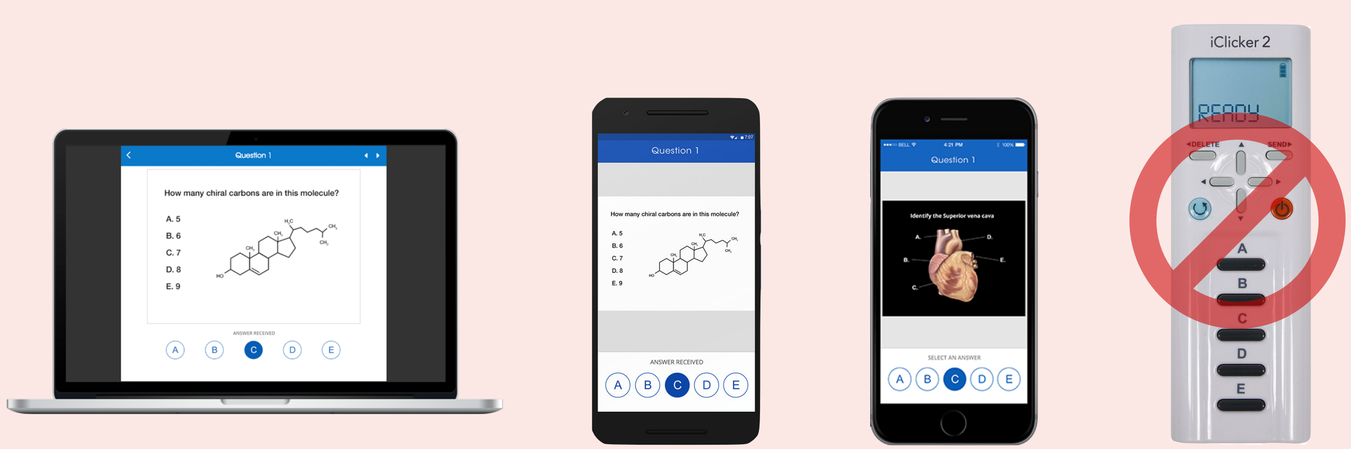
Which iClicker are you using?

A. Web app.

B. iPhone app.

C. Android app.

D. ~~Hardware.~~



Precepts

Discussion, problem-solving, assignment prep, …

Maia Ginsburg
Faculty
Lead Preceptor

Dan Leyzberg
Faculty
Lead Preceptor

Zak Kincaid
Faculty
Preceptor

Anat Kleiman
Graduate Student
Preceptor

Deniz Oktay
Graduate Student
Preceptor

Victor Ongkowijaya
Graduate Student
Preceptor

Chris Sciavolino
Graduate Student
Preceptor

Precepts

What	When	Where	Who	Office Hours
P02	Th 3–4:20pm		Dan Leyzberg	*see web*
P03	F 11–12:20pm		Maia Ginsburg	*see web*
P04	F 11–12:20pm		Anat Kleiman	*see web*
P05	F 11–12:20pm		Zak Kincaid	*see web*
P06	F 1:30–2:50pm		Deniz Oktay	*see web*
P07	F 1:30–2:50pm		Chris Sciavolino	*see web*
P08	F 3–4:20pm		Victor Ongkowijaya	*see web*
P09	F 4:30–5:50pm		Maia Ginsburg	*see web*
P10	Th 4:30–5:50pm		Dan Leyzberg	*see web*

Robert Sedgewick | Kevin Wayne

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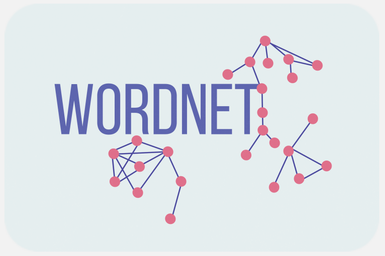
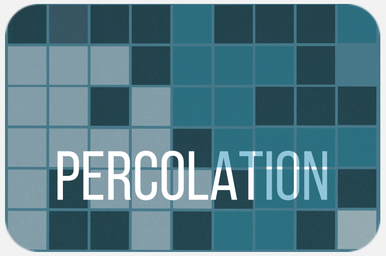
- *union–find*

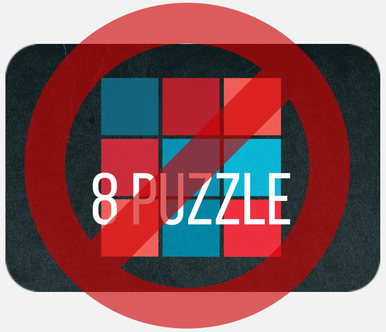
Programming assignments

Implement an efficient algorithm or data structure:



Solve an interesting application using a “textbook” algorithm:



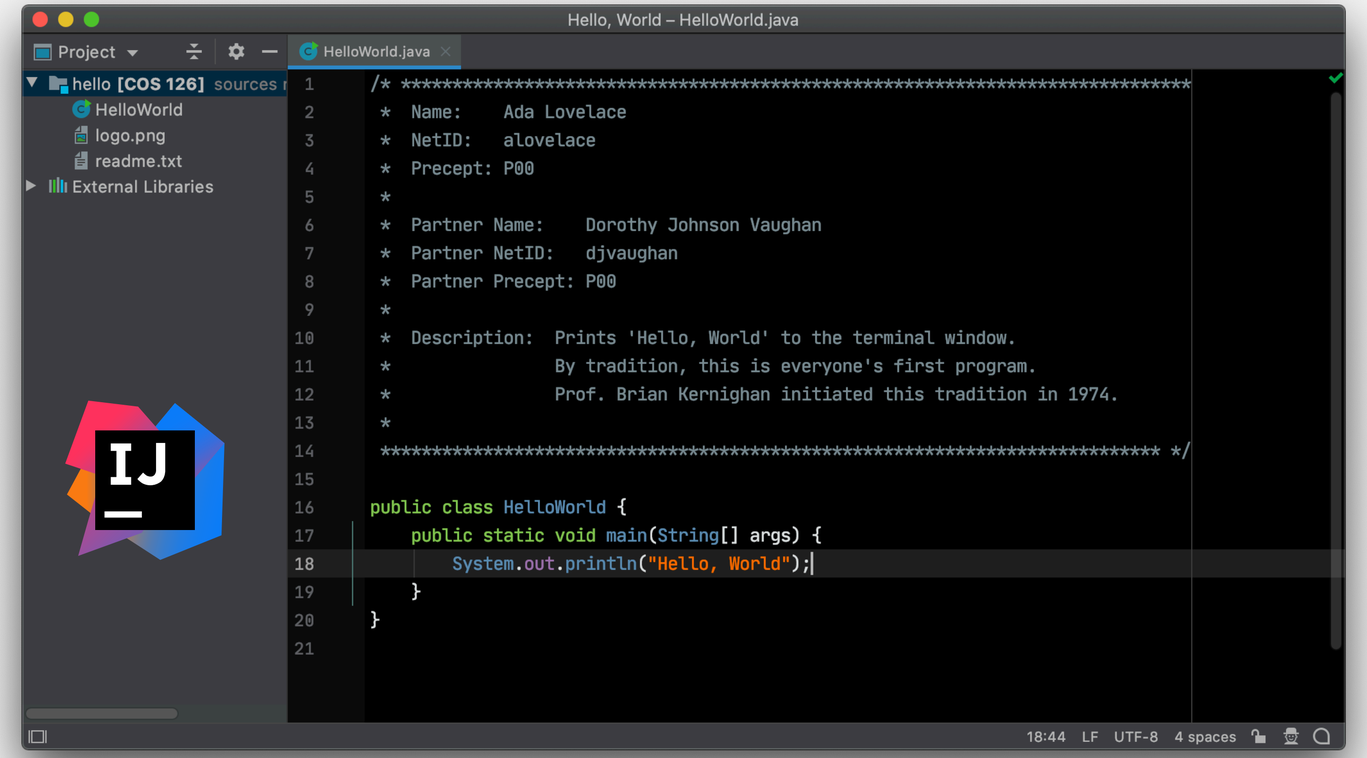


Pair programming (via Zoom) encouraged on designated assignments.

Programming environment

Recommended IDE. Custom IntelliJ 2020.1 environment. ← upgrade to latest version

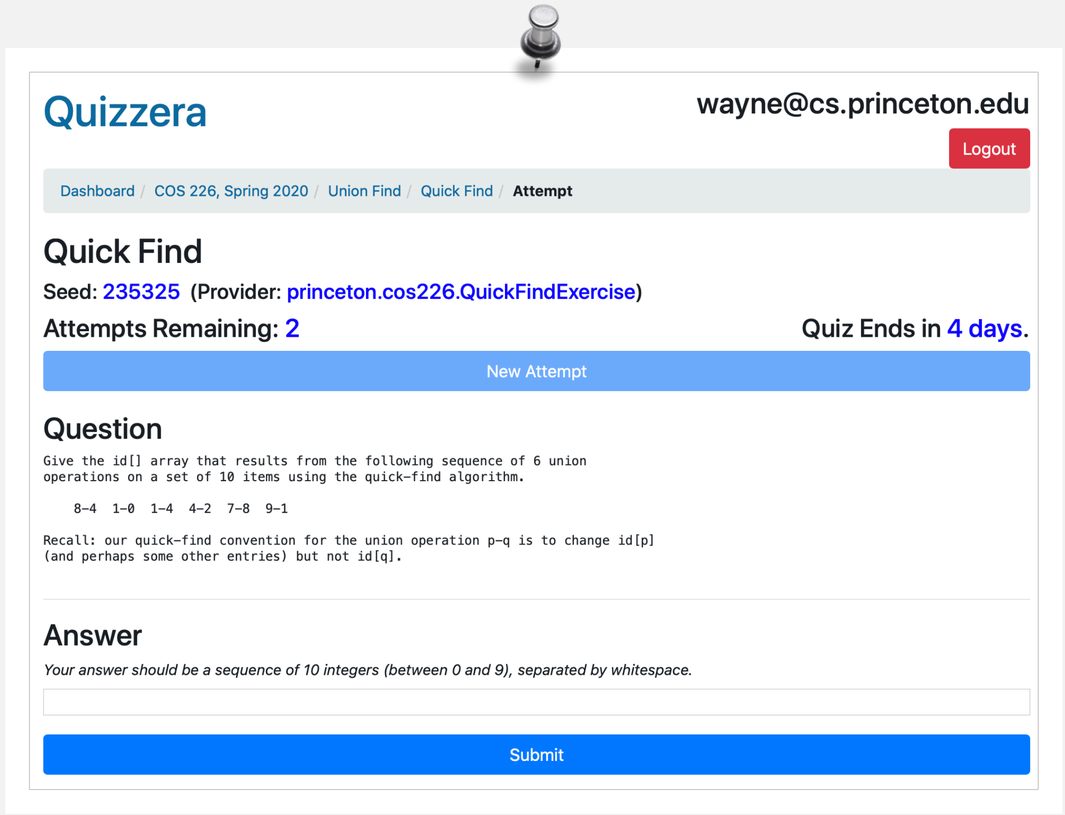
- Continuous code inspection; integrated Checkstyle and SpotBugs.
- Autoformat, autoimport, and autocomplete.
- Embedded Bash terminal.
- ...



Quizzes

Quizzera platform.

- 2–3 short questions per lecture.
- Solving using pencil and paper.
- 3 attempts per question (score = max of each question).



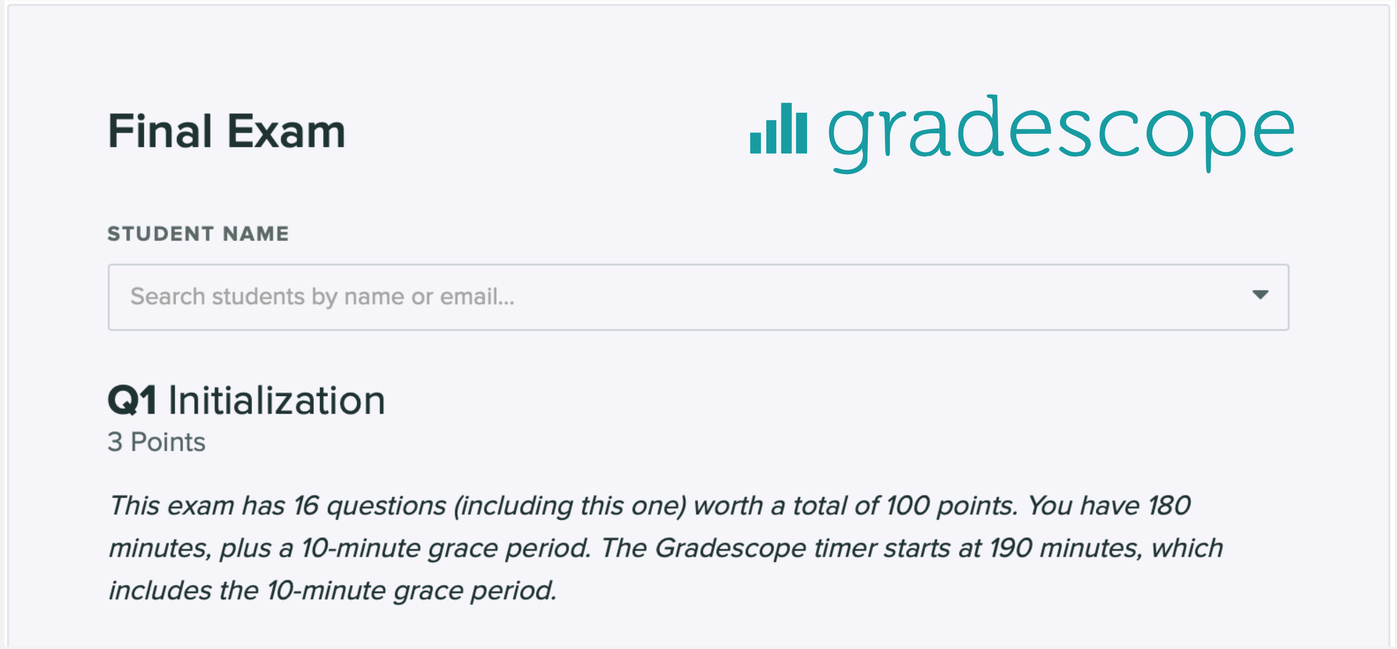
Midterm and final

Written exams.

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

Midterm. 90-minute remote exam (24-hour window).

Final. 3-hour remote exam (24-hour window).



Grading ~~A+~~

Programming assignments. 45%

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

Quizzes. 10%

- Due at 11:59pm on Fridays via Quizzera.
- Collaboration/lateness policies: see web.

Exams. 15% + 25%

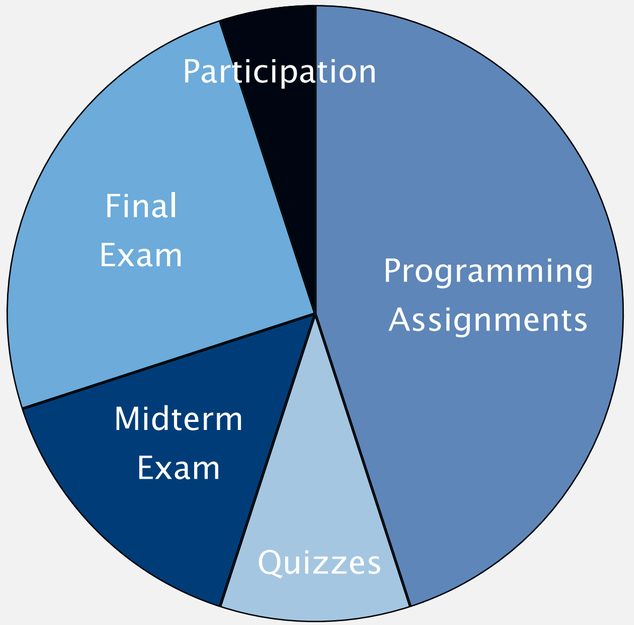
- Midterm (Monday, October 19).
- Final (to be scheduled by Registrar).

Active participation. 5%

- Participate in precept/lecture.

  [perfect attendance not required to earn 100% of participation points]

- Answer questions in online discussion forum.



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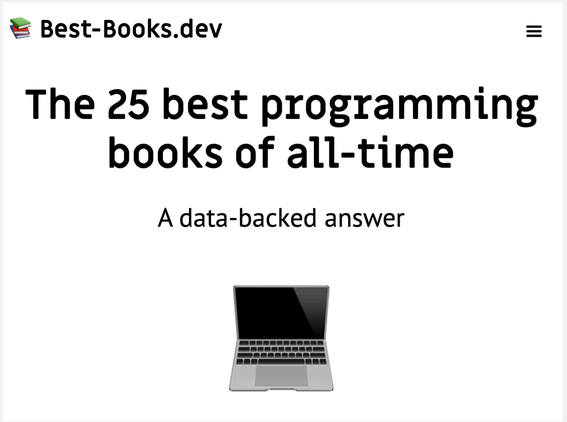
Resources (textbook)

Readings (required). Algorithms 4th edition by R. Sedgewick and K. Wayne, Addison-Wesley Professional, 2011, ISBN 0–321–57351–X.

4th edition (2011)



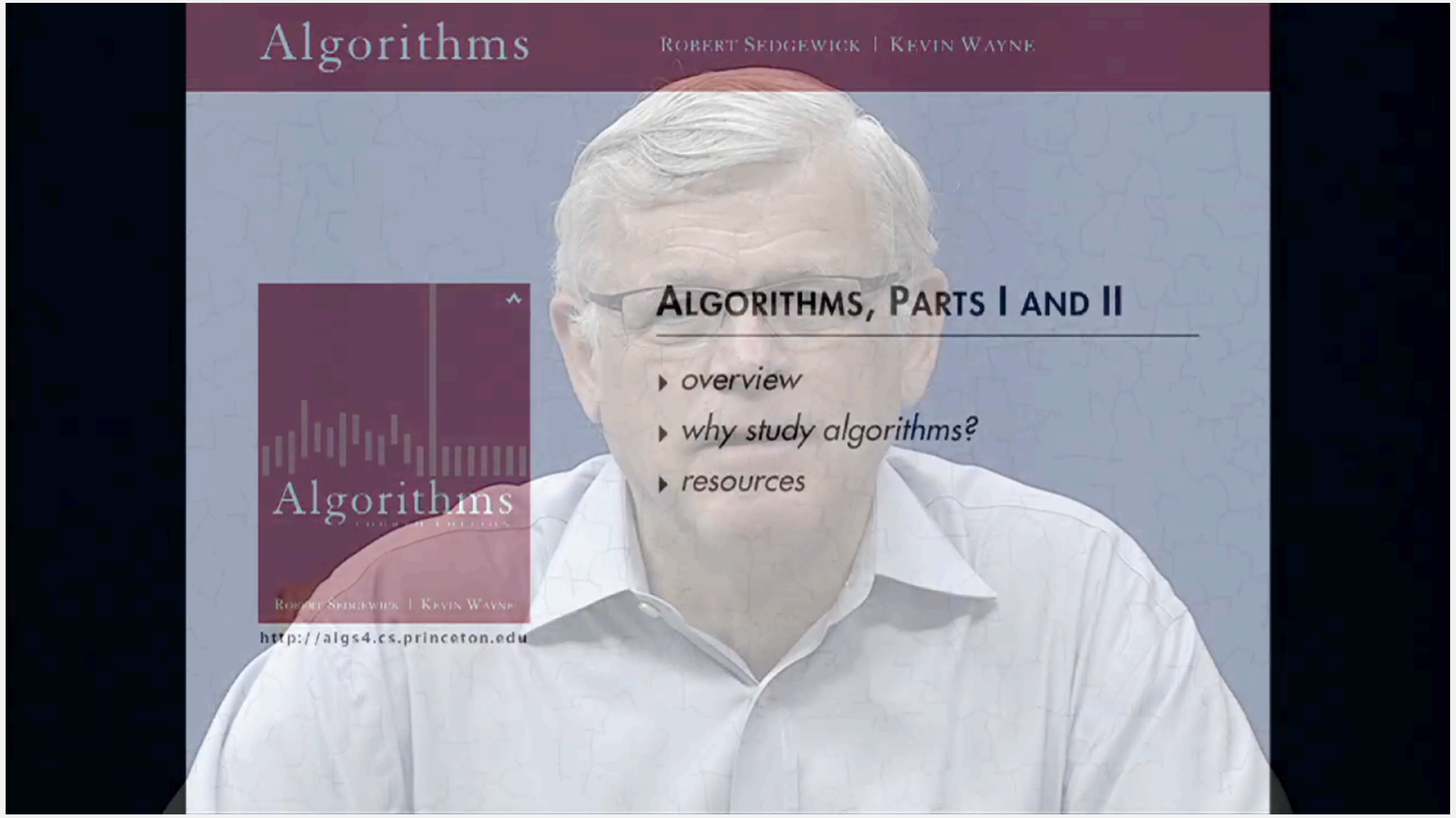
Available from various vendors and formats.

- Amazon: $70 hardcover, $58 Kindle, ...
- ~~Labyrinth: $63 hardcover, $40 rent.~~
- Safari Tech Books Online, $0.

Resources (studio-produced videos)

Studio-produced videos (optional).

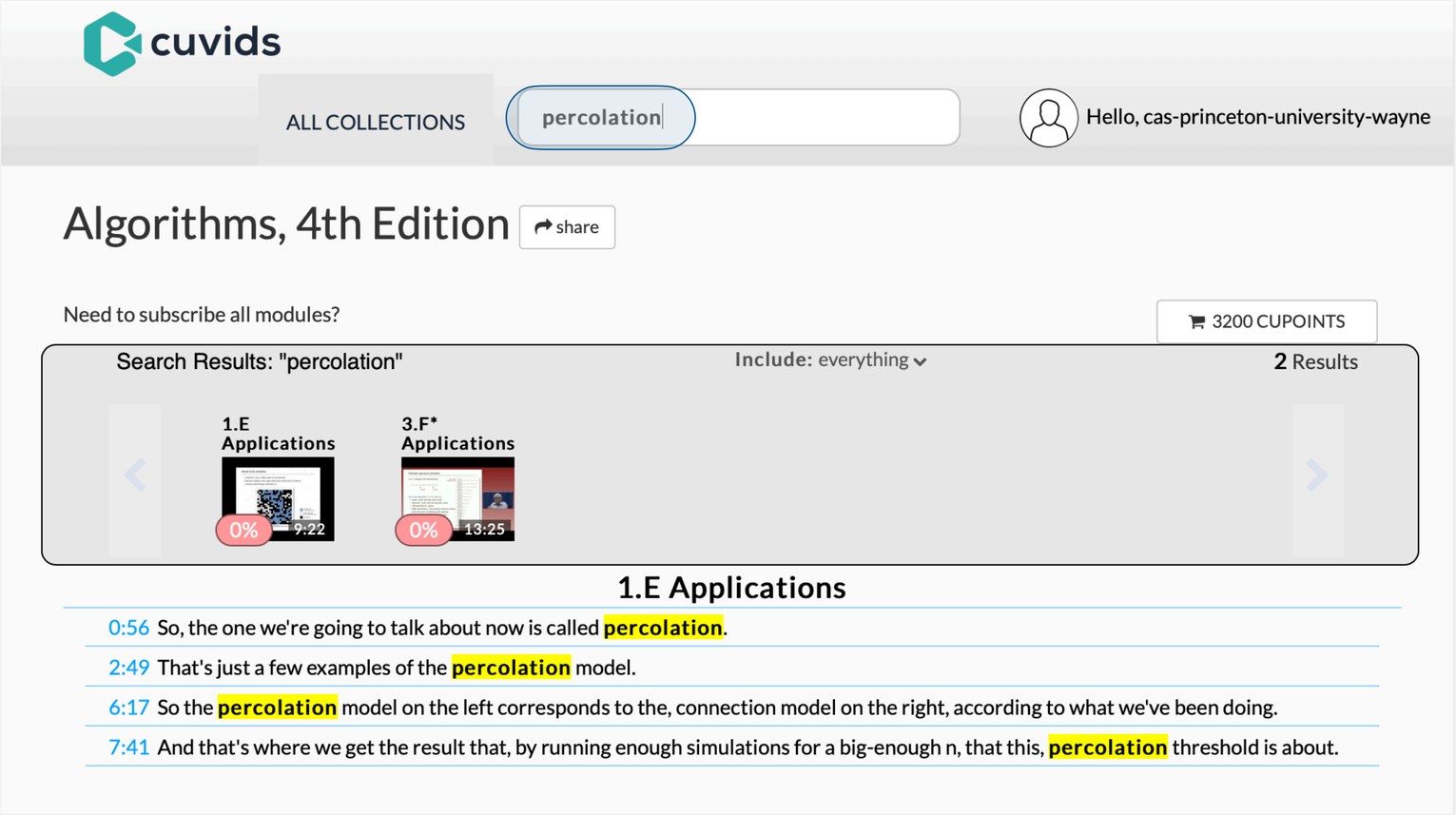
- Different perspective.



Resources (studio-produced videos)

Studio-produced videos (optional).

- Different perspective.
- Transcript search.

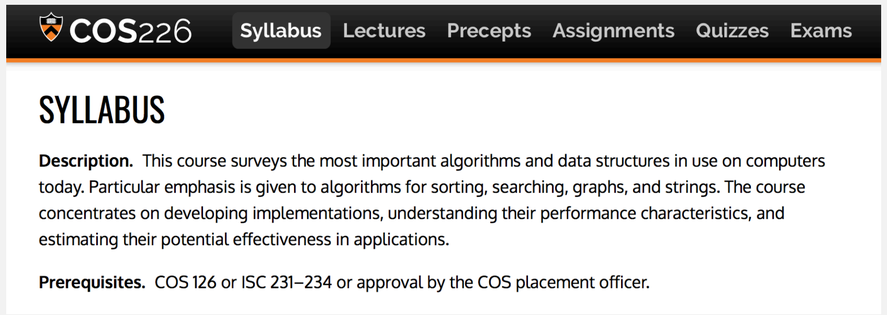


https://cuvids.io

Resources (web)

Course content.

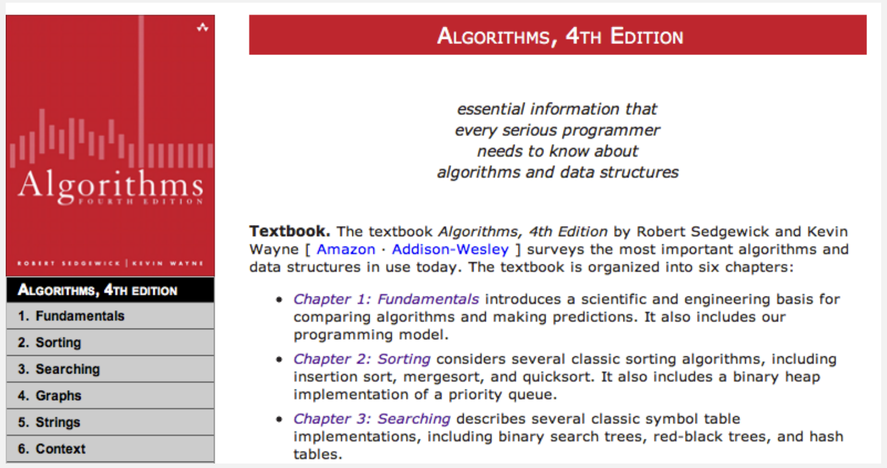
- Course info.
- Lecture slides.
- Programming assignments.
- Quizzes.
- Exam archive.



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.
- See Ed Discussion for guidelines.
- Use Ed; do not email course staff.

https://us.edstem.org/courses/638

Office hours.

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

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

"Computing laboratory."

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

https://labta.cs.princeton.edu

A typical week (including this one!)

you are here!

again on Thursday

support lecture material; assignment prep

Sun	Mon	Tue	Wed	Thu	Fri	Sat
						1
2	3	4 Lecture 1 (Union-Find)	5	6 Lecture 2 (Analysis)	7 Precept 1 Quiz 0, 1, 2	8
9	10 Assignment 1 (Percolation)	11	12	13	14	15

content based on week's material

content based on corresponding lectures

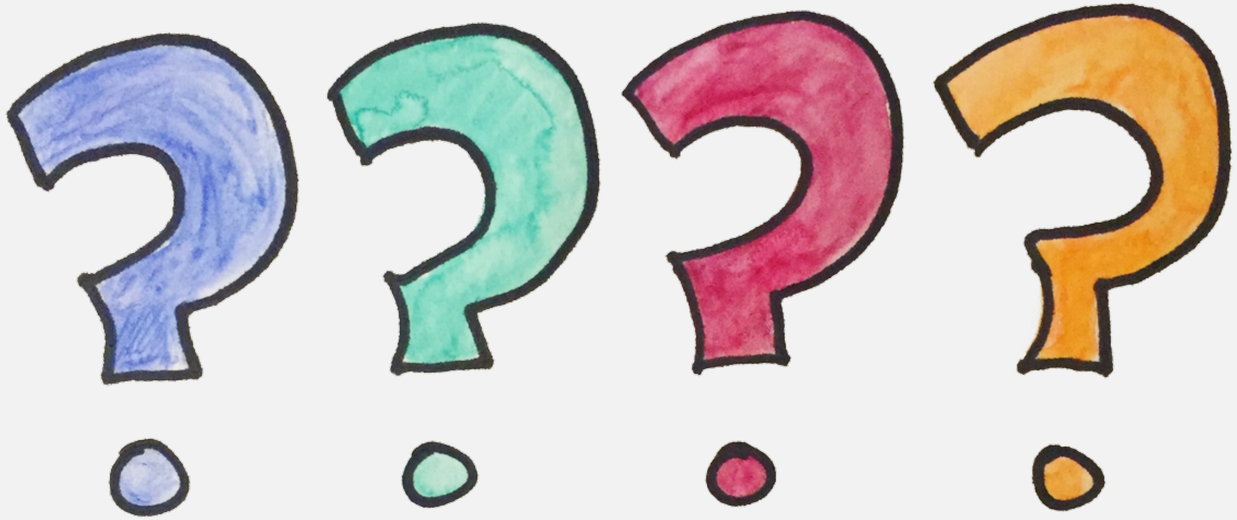
Administrative Q+A

Not registered? Register ASAP; attend any precept this week (Zoom links in Canvas).

Change precept? Use TigerHub.

All non-conflicting precepts closed? Contact Colleen Kenny.

Haven't taken COS 126? See COS placement officer.

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

Additional administrative questions. Ask now in Zoom; ask anytime in Ed Discussion.