COS 226, Fall 2023

Algorithms
and
Data Structures

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Princeton University

Fine print

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.

https://algs4.cs.princeton.edu

Intro to COS 226

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

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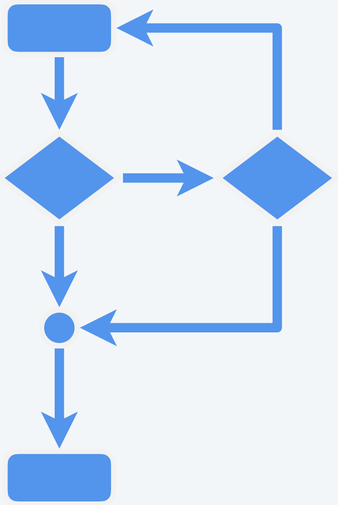
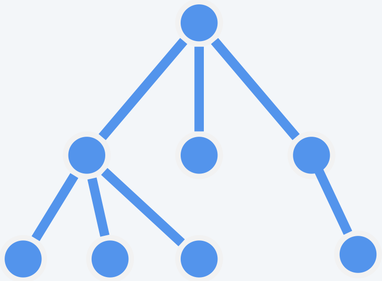
COS 226 course overview

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.

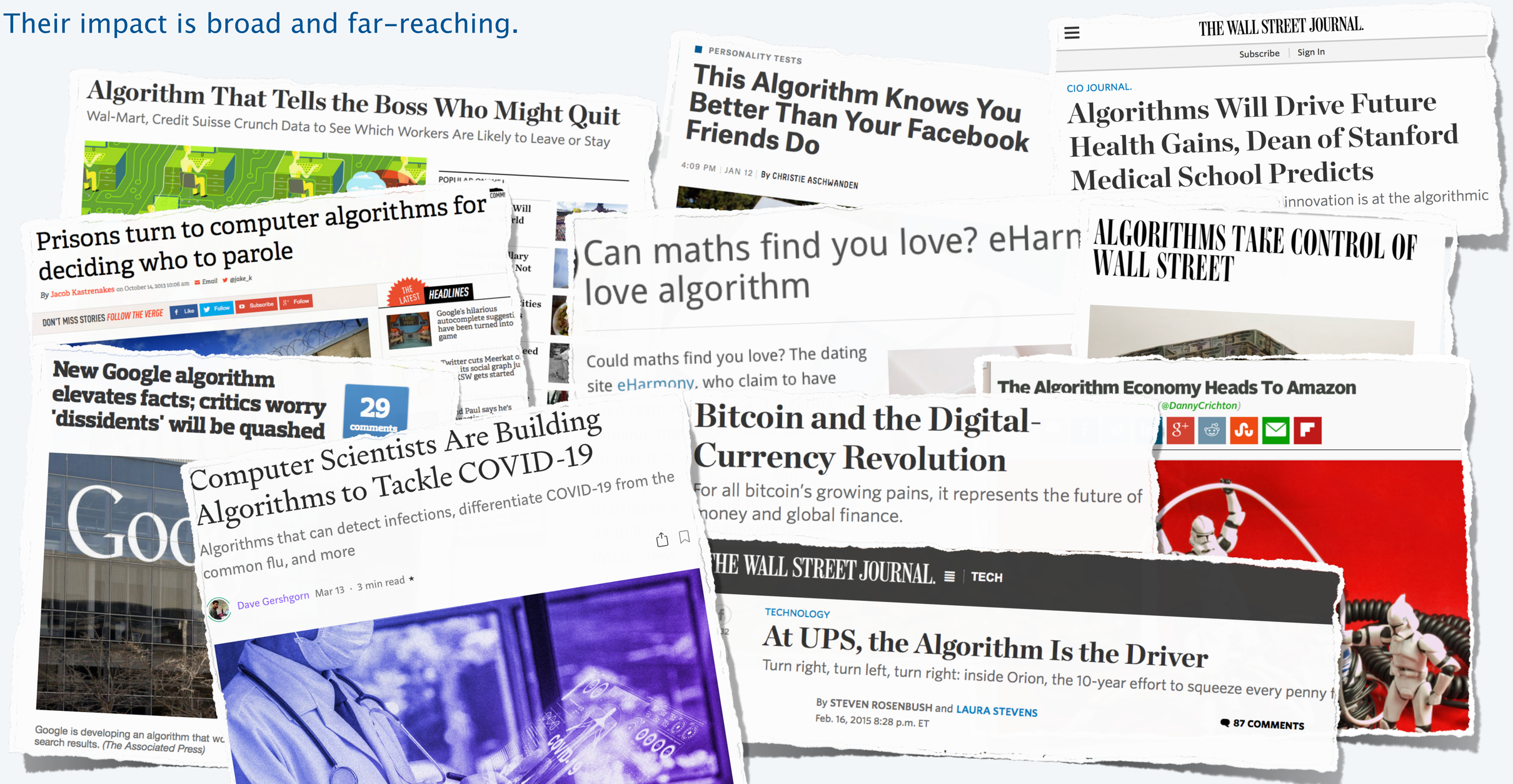




topic	algorithms and data structures 
data types	stack, queue, union–find
sorting	insertion sort, quicksort, mergesort, priority queue
searching	BST, red–black tree, hash table, k-d tree
graphs	BFS, DFS, Prim, Kruskal, Dijkstra
advanced	randomness, multiplicative weights, intractability ← *new this semester*

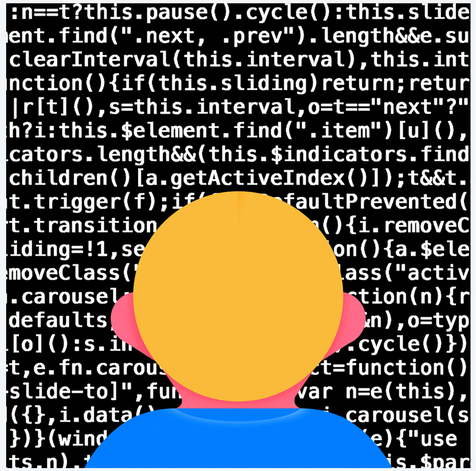
Why study algorithms and data structures?

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.

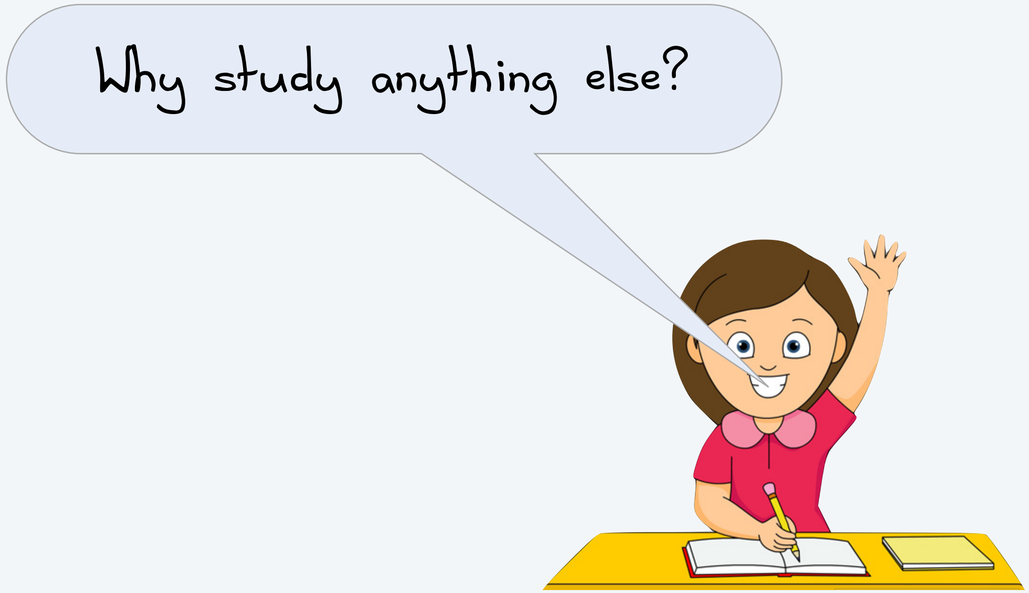
> *For me, great algorithms are the poetry of computation. Just like verse, they can be terse, allusive, dense, and even mysterious. But once unlocked, they cast a brilliant new light on some aspect of computing.*" — Francis Sullivan

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	*see web*

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

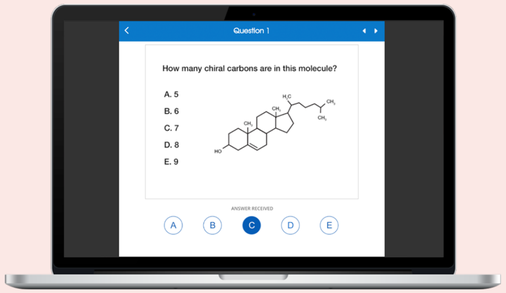
Electronic devices. Permitted *only* to support lecture. ⟵ *viewing slides, taking notes, iClickers, …*

iClicker (required). To earn participation credit:

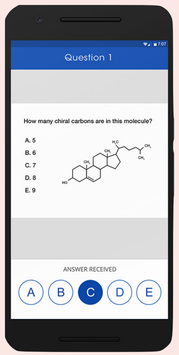
- Create iClicker Cloud account using Princeton email. ⟵ *free for Princeton students*
- Answer multiple choice questions during lecture.

https://www.iclicker.com

Which iClicker device are you using?



A. Web



B. iPhone

C. Android

Precepts

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


Prof. Pedro Paredes


Prof. Marcel Dall'Agnoll


Nataliia K.


Dongsheng Yang


Sabhya Chhabria


Wei Luo


Malinda Huang


Shelley Xia

Turing precept P08. F 11–12:20pm.

- Intended for students seeking a more advanced treatment of material.
- Covers topics beyond scope of the course.
- Transfer in/out in TigerHub.


Prof. Bob Tarjan
(Turing award '86)

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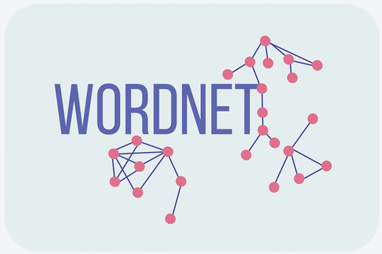
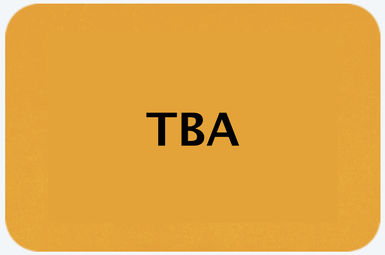
- *union–find*

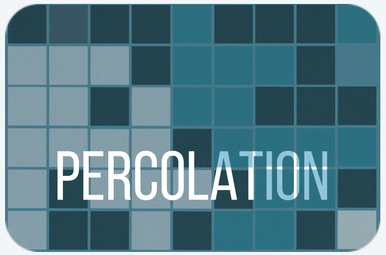
Programming assignments

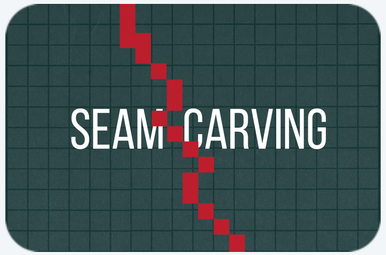
Implement an efficient algorithm or data structure:





Solve an interesting application using a “textbook” algorithm:



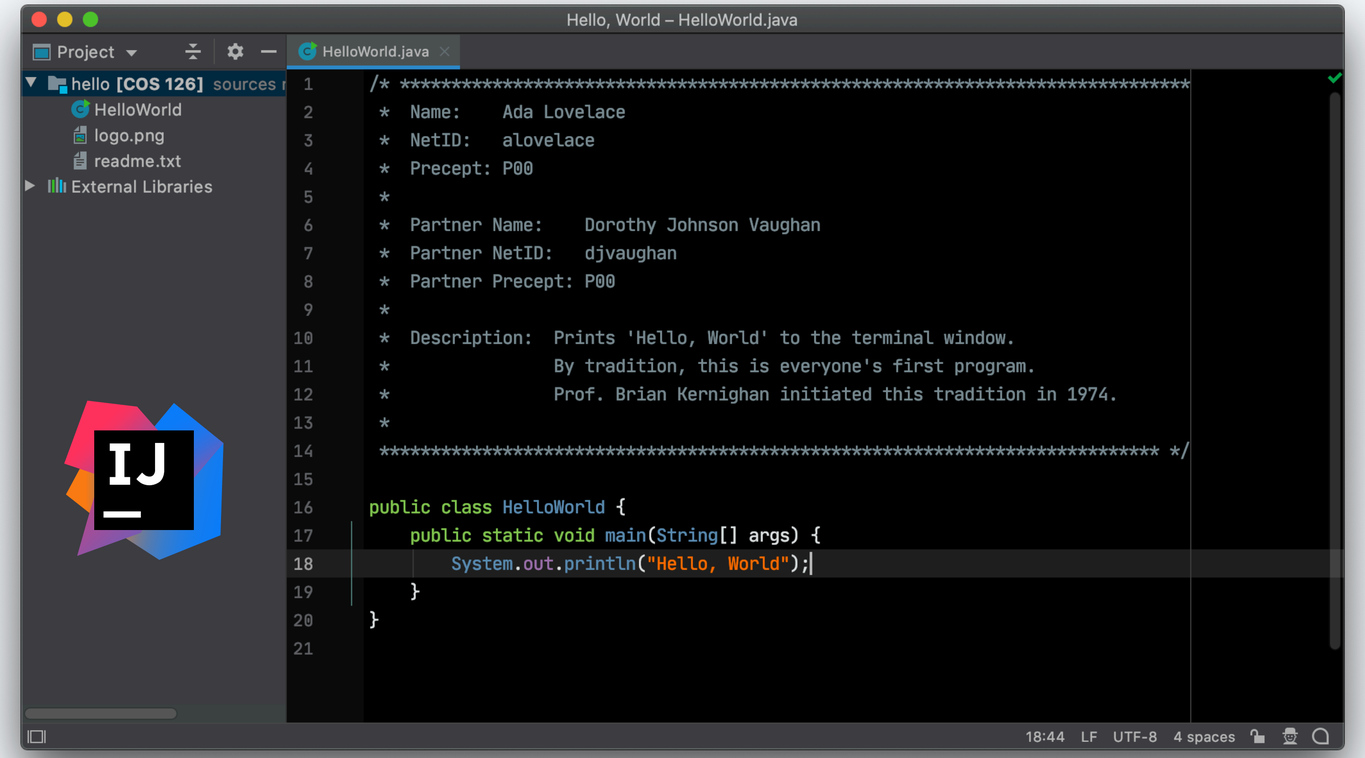


Pair programming encouraged on designated assignments.

Programming environment

Recommended IDE. Custom IntelliJ 2023.2 environment. ⟵ *upgrade to Fall 2023 version*

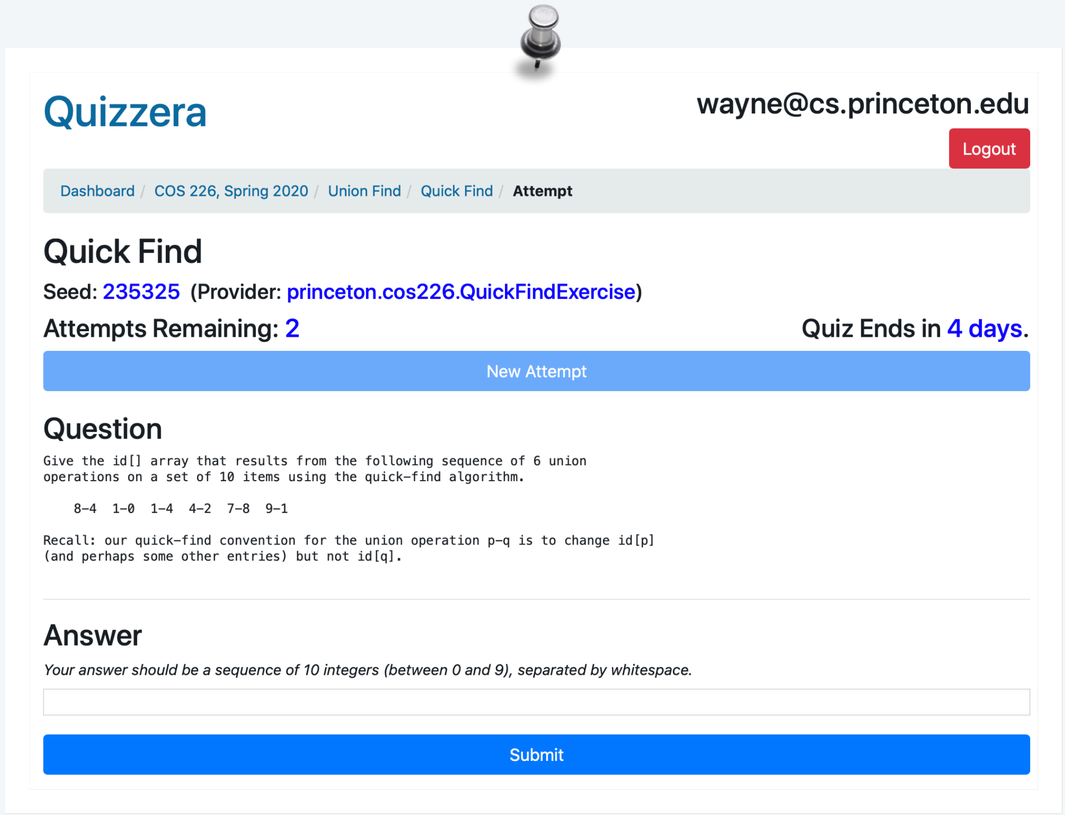
- Embedded Bash terminal.
- Autoformat, autoimport, autocomplete, …
- Continuous code inspection; integrated Checkstyle and SpotBugs.
- …



Quizzes

Quizzera platform.

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



Midterm and final

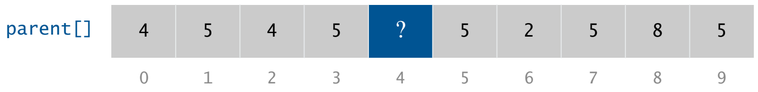
Written exams.

- 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 via TigerFile.
- Collaboration/lateness policies: see web.

Quizzes. 10%

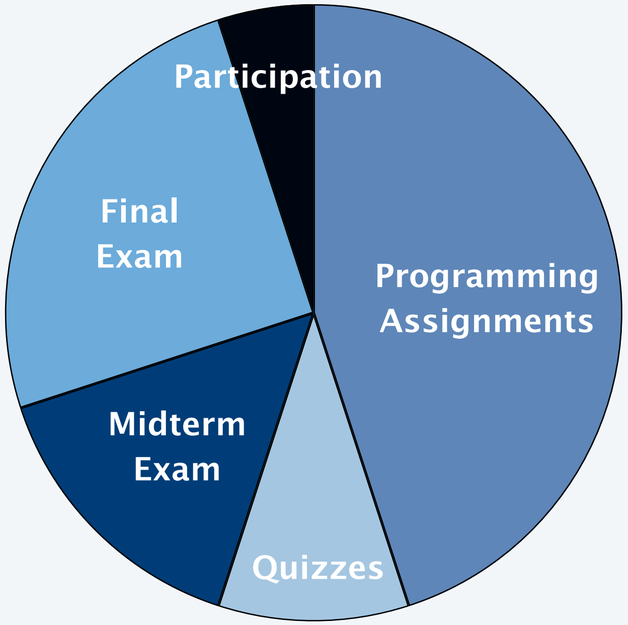
- Due at 11:59pm on Fridays via Quizzera.
- Collaboration/lateness policies: see web.

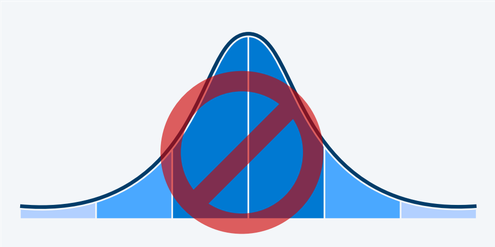
Exams. 15% + 25%

- 80-minute midterm on Tuesday, October 10.
- 3-hour final, as scheduled by Registrar.

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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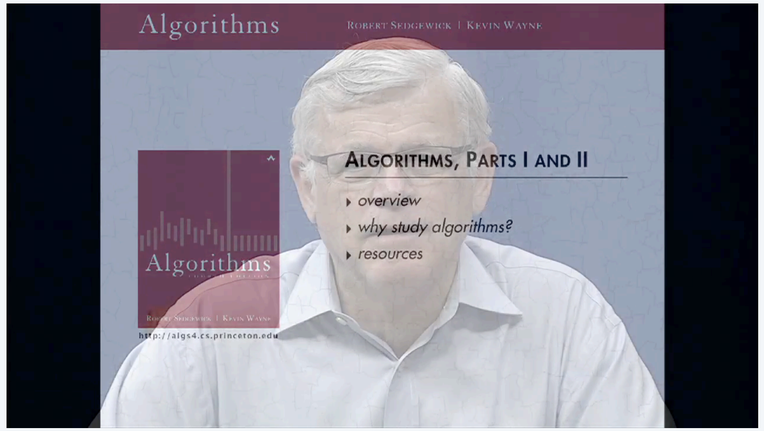
Resources (textbook)

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

Studio–produced videos (optional). By R. Sedgewick and K. Wayne.

4th edition (2011)

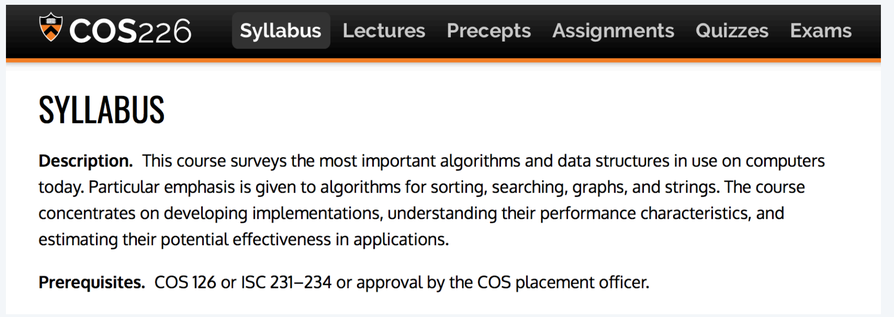


https://www.cubits.ai

Resources (web)

Course content.

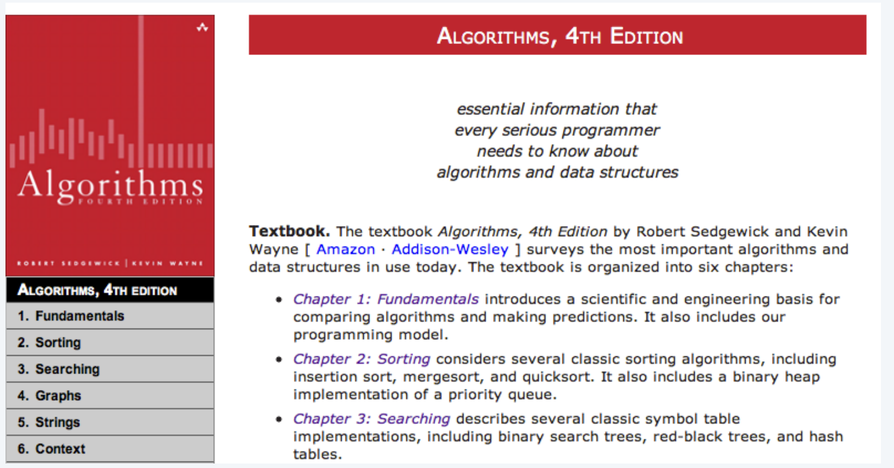
- Course info.
- Lecture slides.
- Precept lessons.
- Programming assignments.
- Quizzes.
- Exam archive.



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/41414

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.

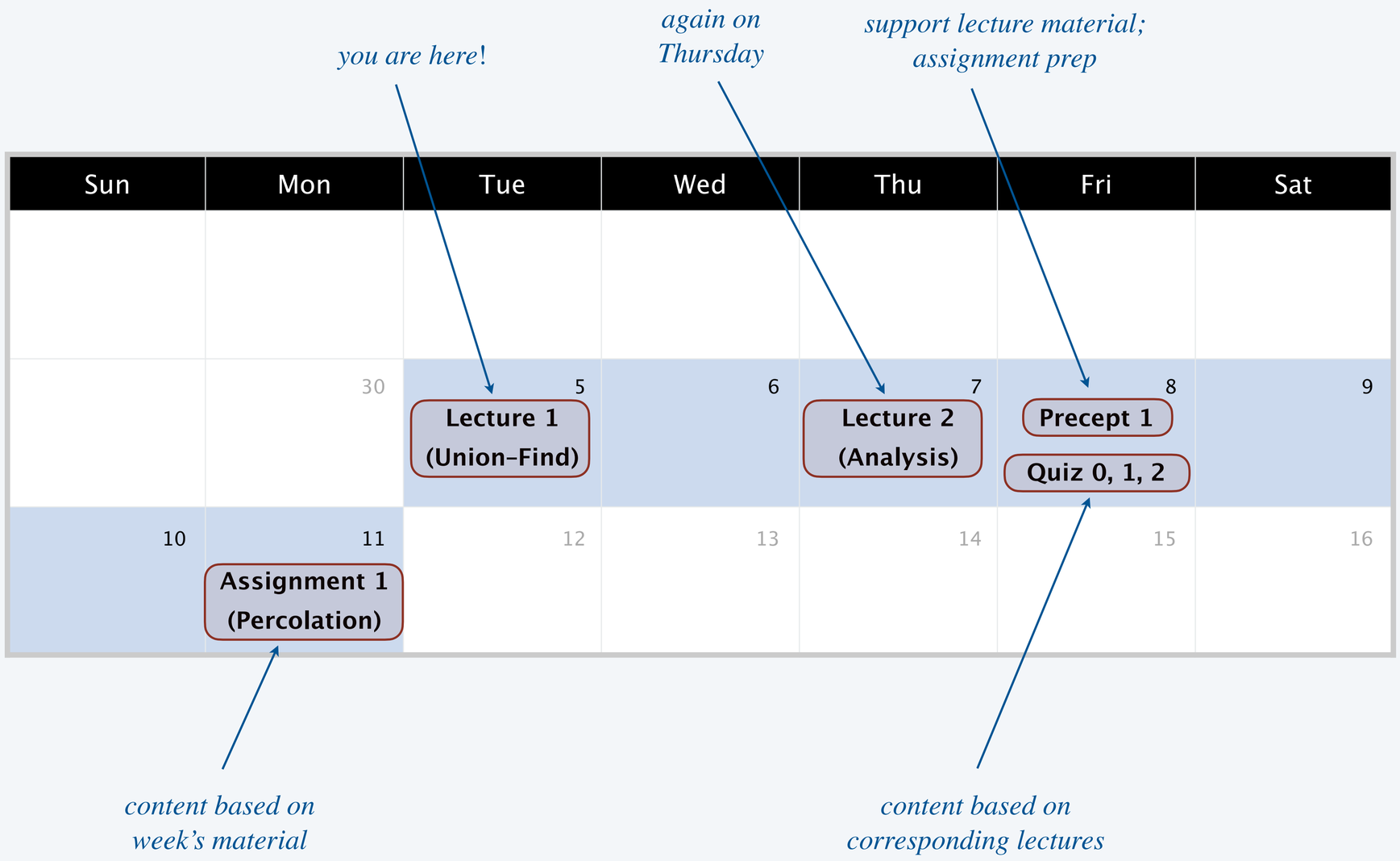
https://introlab.cs.princeton.edu

Resources (ed tech)

Platform	What
Ed	*discussion forum, precept lessons*
IntelliJ	*Java IDE*
Quizzera	*quizzes*
TigerFile	*assignment submissions*
codePost	*assignment feedback*
Gradescope	*exam feedback*
Canvas	*grades, lecture recordings*
iClicker	*in-class polls*
CUbits	*studio-produced videos*

also use for communication with course staff

A typical week (including this one!)



Administrative Q+A

Not registered? Register today.

Change precept? Use TigerHub.

All non-conflicting precepts closed? Contact our course admin, Sue Giranda.

Sue Giranda

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, 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
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	

Introduction: quiz 2

Have you met the person sitting next to you?

A. Yes.

B. No.