

COS 226, SPRING 2026

ALGORITHMS
and
DATA STRUCTURES

MARYAM HEDAYATI · **GILLAT KOL** · **PEDRO PAREDES**



PRINCETON
UNIVERSITY

FINE PRINT



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you may not record or redistribute recordings of this class.*



INTRO TO COS 226

- ▶ *motivation*
- ▶ *course structure*
- ▶ *grading and assessments*
- ▶ *support and resources*

<https://algs4.cs.princeton.edu>

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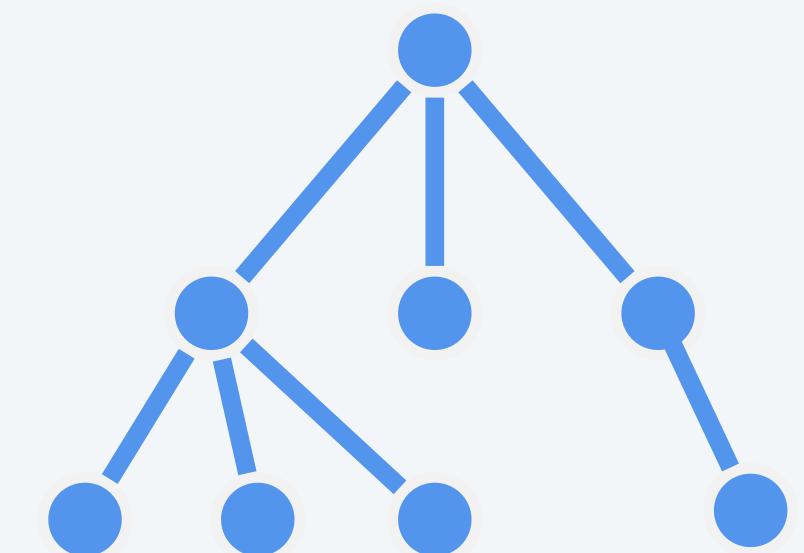
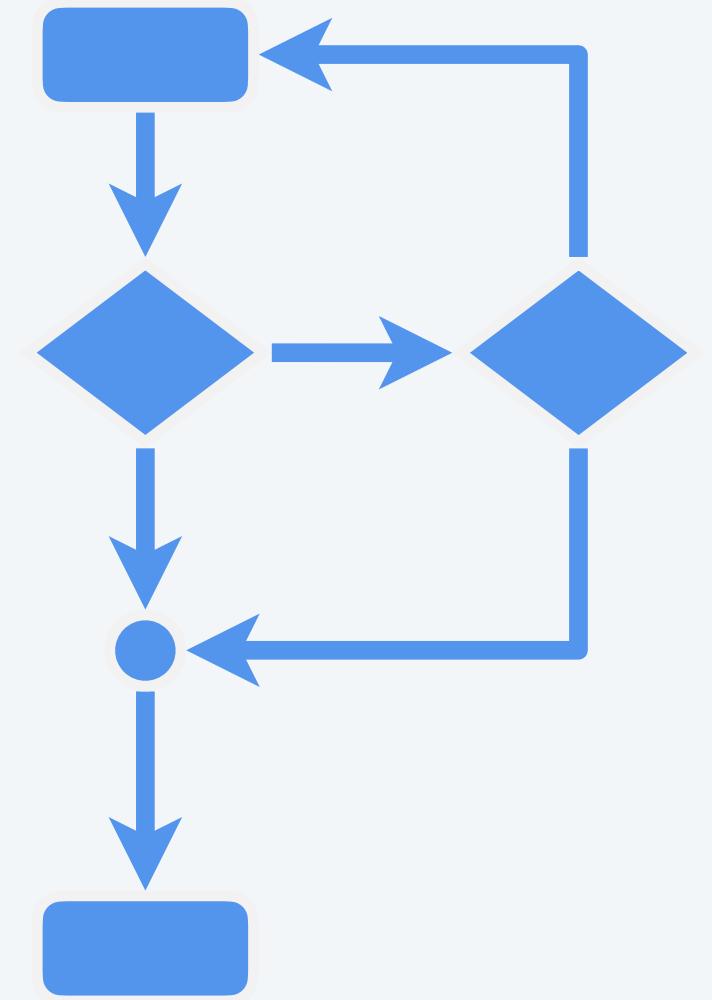


COS 226 course overview

What is COS 226?

- **Algorithm:** A step-by-step, well-defined procedure for solving a problem.
- **Data structure:** A way to organize data in a computer for efficient access and update.
- Programming and problem solving, with applications.

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



Why study algorithms and data structures?

Their impact is broad and profound.

Algorithm That Tells the Boss Who Might Quit

Wal-Mart, Credit Suisse Crunch Data to See Which Workers Are Likely to Leave or Stay

Prisons turn to computer algorithms for deciding who to parole

By Jacob Kastrenakes on October 14, 2013 10:06 am Email @jake_k

DON'T MISS STORIES FOLLOW THE VERGE

New Google algorithm elevates facts; critics worry 'dissidents' will be quashed

29
comments

Google is developing an algorithm that would elevate "trustworthiness" in its search results. (The Associated Press)

POPULAR

COMM

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44 mil

What's ne
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Google's hilarious
autocomplete suggesti
have been turned into
game

itter cuts Meerkat o
in its social graph ju
XSW gets started

Land Paul says he's
connecting with
thousands of teens over
Snapchat

Microsoft is celebrating
Day with an Xbox Music
Pass deal

For the first time, the
world economy grows
while carbon emissions

A collage of news clippings from The Wall Street Journal and CIO Journal. The top right clipping from CIO Journal discusses the future of algorithms in healthcare. The bottom left clipping from The Wall Street Journal discusses the algorithm economy and its impact on Amazon. The bottom right clipping from The Wall Street Journal discusses the use of algorithms at UPS. The collage includes images of a stormtrooper, a stack of US dollars, and social media sharing icons.

Why study algorithms and data structures?

To become a strong programmer.



```
:n==t?this.pause():this.slide
ent.find(".next, .prev").length&&e.su
clearInterval(this.interval),this.int
nction(){if(this.sliding)return;retur
|r[t](),s=this.interval,o=t=="next"?
h?i:this.$element.find(".item")[u()],
icators.length&&(this.$indicators.find
children())[a.getActiveIndex()]);t&&t.
t.trigger(f);if(!t._faultPrevented(
t.transition))i.removeC
iding!=1,se
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moveClass('
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.carousel-item--active', 'acti
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}})(wind
e){"use
ts.n).t
is.$par
```

“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, eventually, profit.

Google



GitHub

P
PANDORA®

facebook

RSA
SECURITY

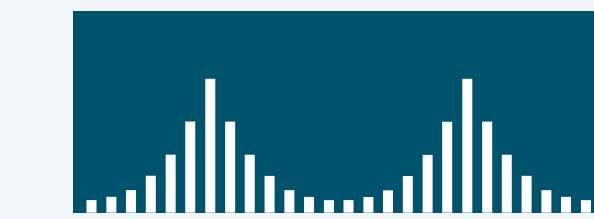
airbnb

NETFLIX



slack

CISCO SYSTEMS



in

Morgan Stanley

IBM

lyft



nVIDIA.®

TESLA

JANE
STREET

DE Shaw & Co

SPACEX

Adobe

UBER

zoom

PIXAR
ANIMATION STUDIOS

YAHOO!

amazon

intel®

Microsoft®

Akamai

Why study algorithms and data structures?

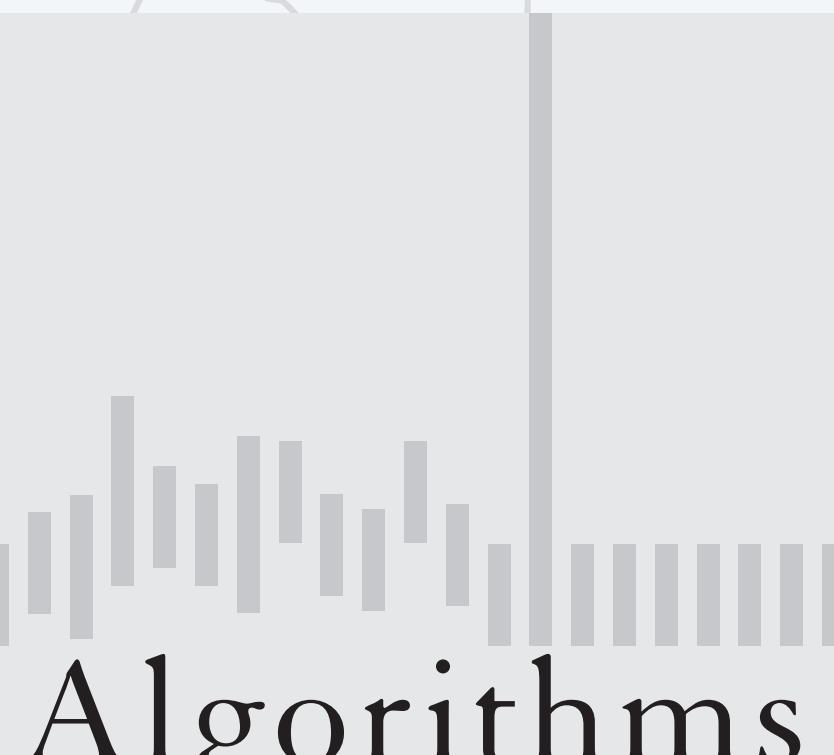
- Their impact is broad and profound.
- To become a strong programmer.
- For intellectual stimulation.
- For fun—and, eventually, profit.

Why study anything else?



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ROBERT SEDGEWICK | KEVIN WAYNE

<https://algs4.cs.princeton.edu>

Lectures

Live lectures. We introduce new material.

What	When	Where	Who	Office Hours
L01	TTh 1:20–2:40pm	Friend 101	Gillat Kol Maryam Hedayati Pedro Paredes	<i>see course website</i>



Prof. Maryam Hedayati



Prof. Gillat Kol

Questions. Please raise your hand and ask. ← *carpe diem!*

Electronic devices. Only for supporting the lecture (viewing slides, taking notes, iClickers).



Prof. Pedro Paredes

iClicker (required). To earn participation credit:

- Create an iClicker Cloud account. ← *use your Canvas-preferred email*
- Answer multiple-choice questions during lecture. ← *must answer 75% of questions
please enable location sharing!*



<https://www.iclicker.com>

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

- A. Fame. 
- B. Fortune. 
- C. Friends. 
- D. Free time. 

Precepts

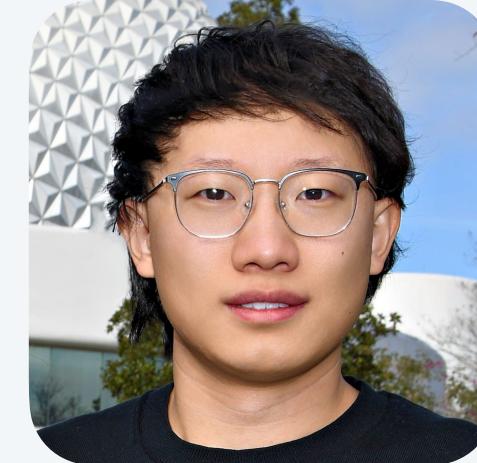
Active learning. Problem solving, discussion, assignment preparation, ...



Prof. Maryam Hedayati



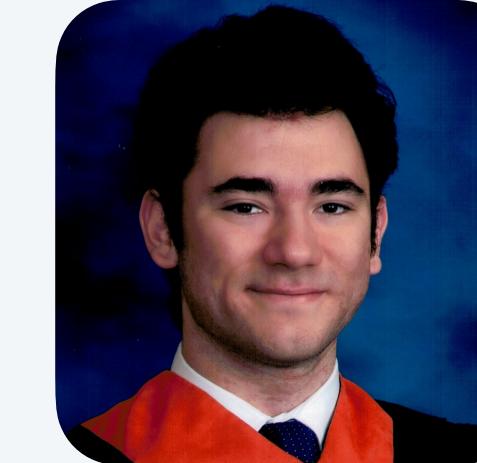
Jiatong Yu



Yang Duan



Frederick Qiu



Alkin Kaz



Lacey DeLucia



Andy Nguyen



Patty Liu

Special precept P04. Friday 1:20-2:40pm.

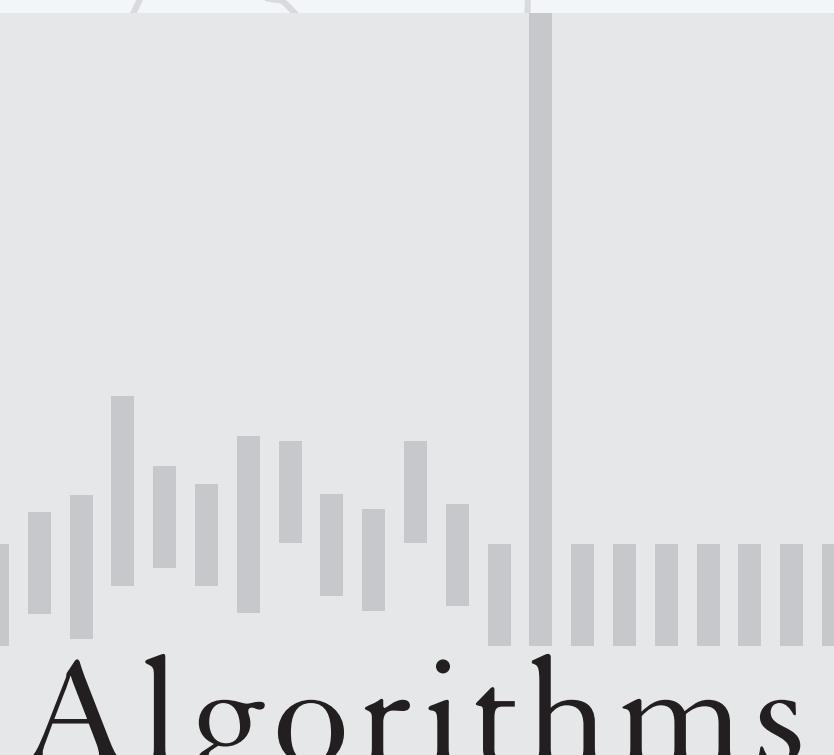
- Intended for students seeking a more advanced treatment of the material.
- Covers topics beyond the scope of the course.
- Add/drop via TigerHub.



Prof. Pedro Paredes

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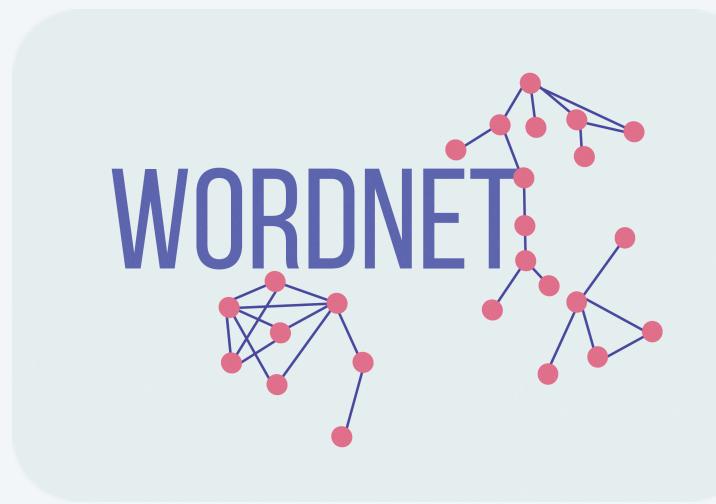
ROBERT SEDGEWICK | KEVIN WAYNE

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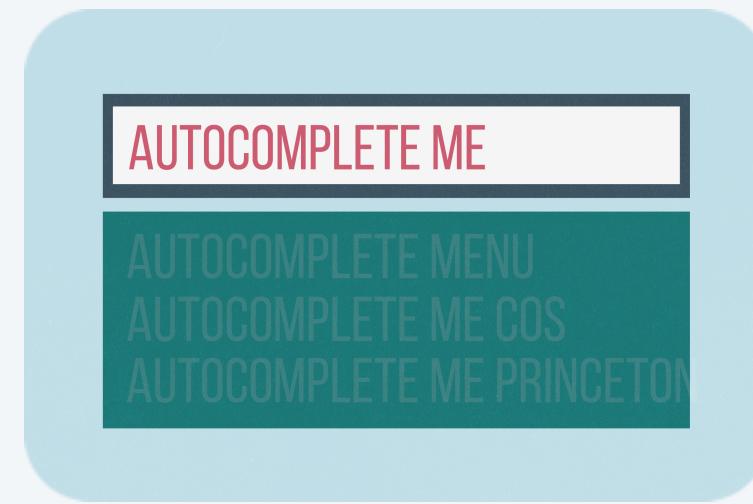
Programming assignments



Implement efficient algorithms and data structures.



Apply “textbook” algorithms to interesting applications.



Pair programming is encouraged on designated assignments.



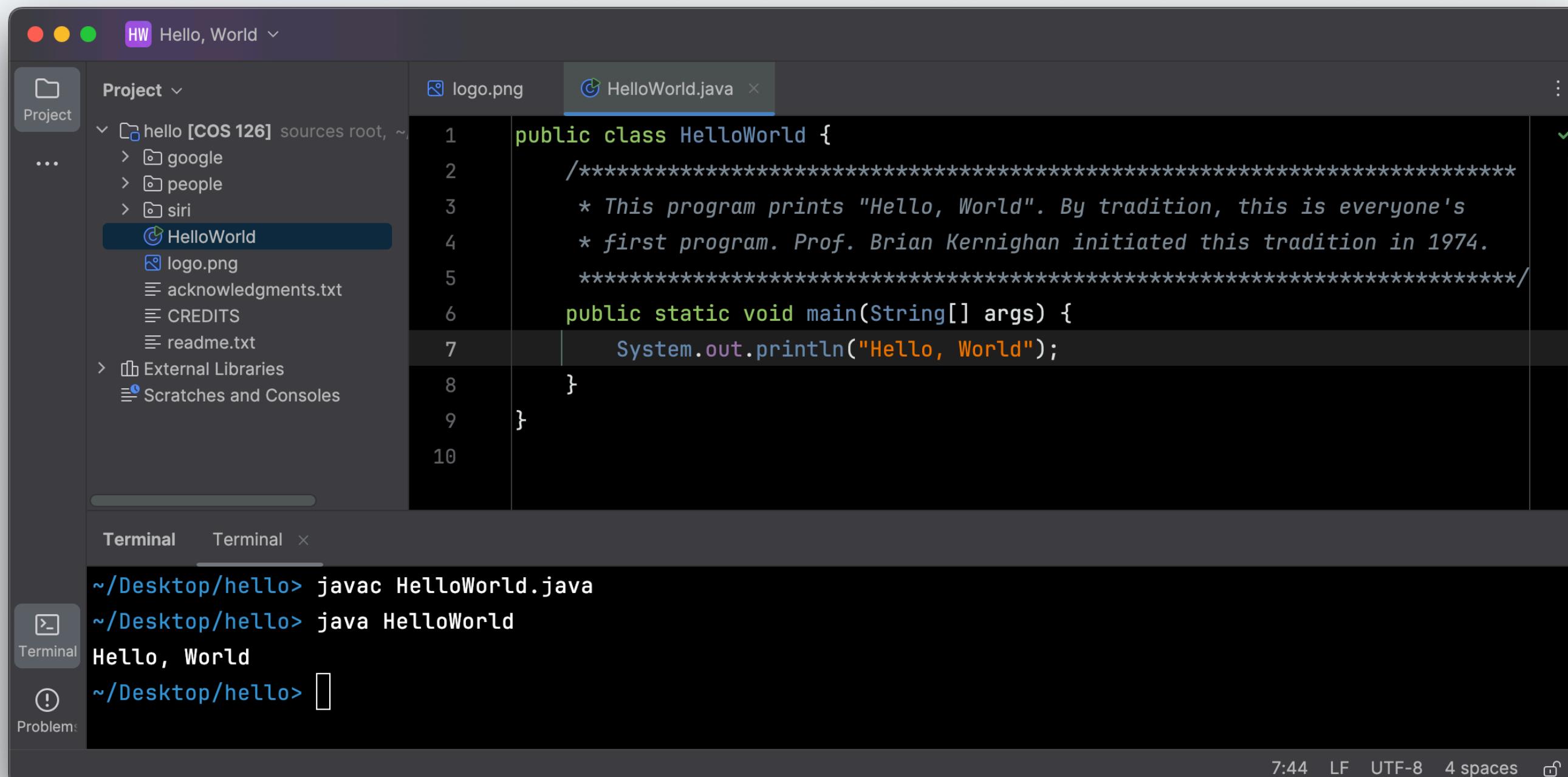
Programming environment (IntelliJ)



Recommended IDE: custom IntelliJ 2025.2 environment.

*use our fall 2025 version
(see lab TAs for troubleshooting)*

- Embedded terminal (Bash).
- Highlights common errors as you type.
- Automatic formatting, imports, and code completion.
- ...



The screenshot shows the IntelliJ IDEA interface with the following components:

- Project View:** Shows a Java project structure with a package named "hello". Inside "hello", there are files: "google", "people", "siri", "HelloWorld" (selected), "logo.png", "acknowledgments.txt", "CREDITS", "readme.txt", "External Libraries", and "Scratches and Consoles".
- Code Editor:** Displays the content of the "HelloWorld.java" file. The code is as follows:

```
1  public class HelloWorld {  
2      //*****  
3      * This program prints "Hello, World". By tradition, this is everyone's  
4      * first program. Prof. Brian Kernighan initiated this tradition in 1974.  
5      //*****  
6      public static void main(String[] args) {  
7          System.out.println("Hello, World");  
8      }  
9  }  
10 }
```

- Terminal:** Shows the output of the terminal commands:
~/Desktop/hello> javac HelloWorld.java
~/Desktop/hello> java HelloWorld
Hello, World
~/Desktop/hello>
- Status Bar:** Shows the time as 7:44, line separator as LF, encoding as UTF-8, and code style as 4 spaces.

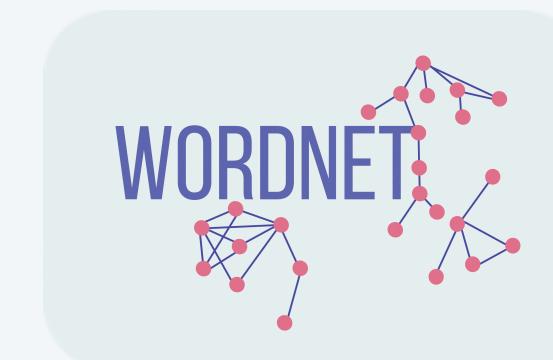


Completion credit (7%).

- Earned by submitting any code that compiles by the completion deadline (1% per assignment).
- You will receive autograder feedback for any code you submit by the completion deadline.
- Autograder feedback is helpful for making sure your code works, so we highly encourage submitting the complete assignment on time.
- Your grade doesn't depend on autograder feedback

Code review credit (28%).

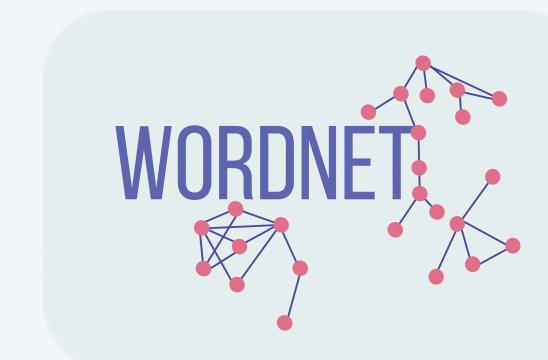
- Earned by demonstrating your understanding of your code during a one-on-one code review with a TA (4% per assignment).
- Code reviews are 20 minutes with a TA, dates listed on assignments pages.
- The TA is not trying to trick you, and the questions should be easy if you wrote your own code.
- 25% partial credit per component for acknowledging incomplete work.





Our recommendation.

- Write your own code from scratch and aim to finish by completion deadline
- Start early to give yourself time to debug
- Use the autograder to catch bugs and check completeness
- When you're stuck, use course resources (Ed, office hours, lab TAs)
- Honest partial progress is better than code you don't understand





PrairieLearn platform.

- 2-3 short questions after each lecture.
- Solve using pencil and paper (not GenAI).
- Unlimited attempts per question. ← *different variant each attempt; short delay between attempts*
- Your score = best score over all attempts.

Q7.2. Breadth-First Search Trace

Consider the following adjacency-lists representation of a graph with **8** vertices and **10** edges:

```
A: F
B: G E C F
C: G B
D: H G
E: B F
F: G A B E
G: B C F D
H: D
```

Here is a graphical representation of the same graph:

```
graph LR
    A((A)) --- F((F))
    B((B)) --- E((E))
    B --- C((C))
    B --- F
    C --- G((G))
    D((D)) --- H((H))
    E --- B
    E --- F
    F --- A
    F --- B
    F --- E
    G --- C
    G --- F
    H --- D
```

Run breadth-first search (using the adjacency-lists representation) from vertex **A**. Give the sequence in which the vertices are dequeued from the FIFO queue.

Your answer should be a sequence of **8** uppercase letters starting with **A**, separated by whitespace.

dequeued = ?

Save & Grade 2 attempts left Save only

Additional attempts available with new variants ?
Can only be graded once every 2 minutes ?



Written exams.

- Questions drawn from lectures, precepts, programming assignments, and quizzes.
- Emphasizes **conceptual** questions rather than code-writing.

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3. Data structures. (6 points)

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

parent[]	4	5	4	5	?	5	2	5	8	5
	0	1	2	3	4	5	6	7	8	9

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 breakdown A+

Programming assignments (35%).

- Completion credit & code reviews
- Due at 11:59pm on Mondays (2 optional late days per assignment).
- Collaboration/lateness policies: see course website.

Quizzes (10%).

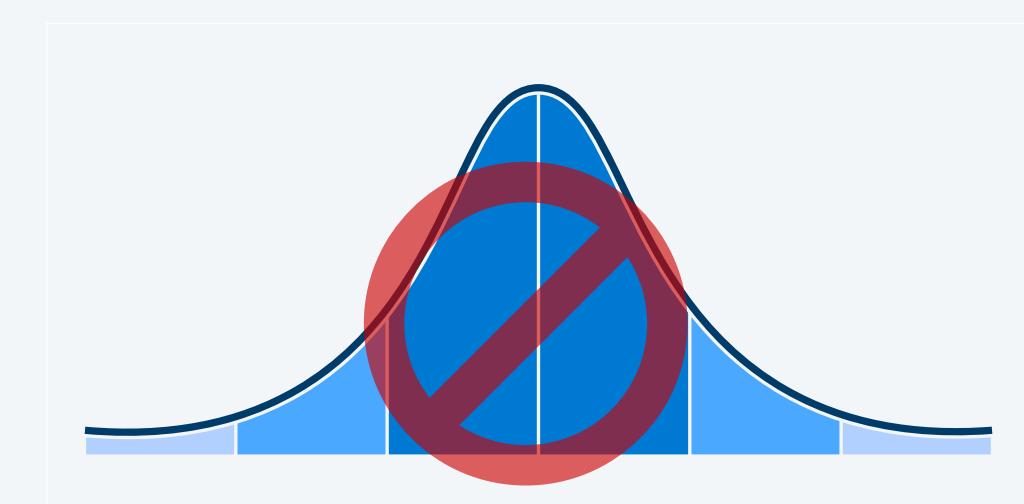
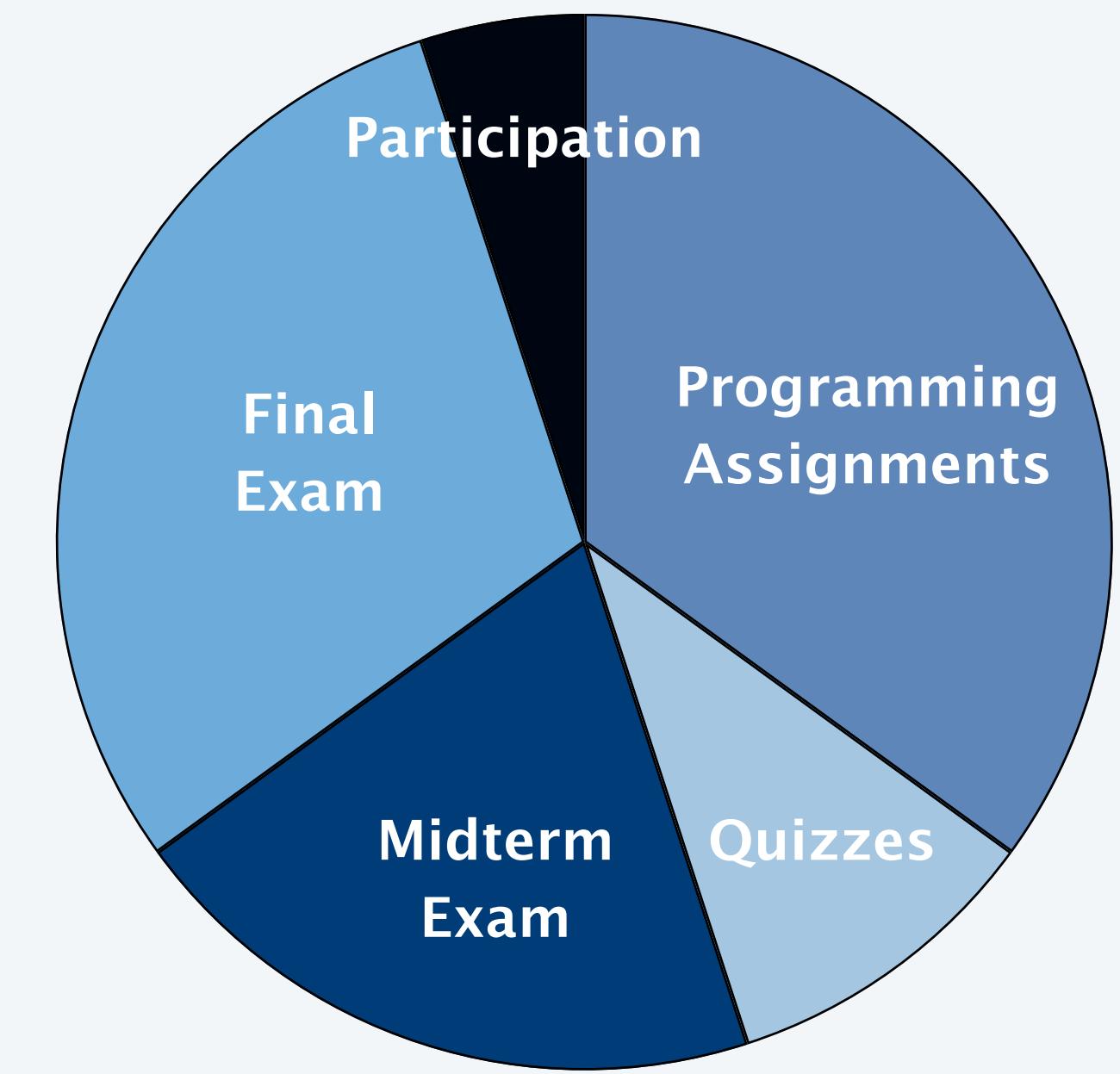
- Due at 11:59pm on Saturdays.
- Collaboration/lateness policies: see course website.

Written exams (50%).

- 80-minute midterm exam on Tuesday, March 3.
- 3-hour in-person final exam on Saturday, May 9.

Active participation (5%).

- iClicker participation in lectures.
- Collaborative participation in precepts.



grade	score
A	93.0%
A-	90.0%
B+	87.0%
:	:

course grades and uncurved
(no rounding of percentages)

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Required textbook



Textbook readings. From *Algorithms 4th edition* by R. Sedgewick and K. Wayne,
Addison-Wesley Professional, 2011, ISBN 0-321-57351-X.

← eCampus, Amazon, ...



4th edition (2011)



Course website.

- Syllabus and course policies.
- Lecture slides.
- Precept worksheets.
- Programming assignments.
- Quizzes.
- Exam archive.

The screenshot shows a dark-themed website for COS226. At the top, there is a navigation bar with the COS226 logo and links for Syllabus, Lectures, Precepts, Assignments, Quizzes, and Exams. The main content area is titled "SYLLABUS". Below the title, there is a description of the course: "Description. This course surveys the most important algorithms and data structures in use on computers today. Particular emphasis is given to algorithms for sorting, searching, graphs, and strings. The course concentrates on developing implementations, understanding their performance characteristics, and estimating their potential effectiveness in applications." The URL <https://www.princeton.edu/~cos226> is displayed at the bottom of the page.

Book website (booksite).

- Brief chapter summaries.
- Downloadable code from the book.
- APIs and Javadoc.

The screenshot shows a page for the book "Algorithms, 4th Edition" by Robert Sedgewick and Kevin Wayne. The page features a red header with the book's title. Below the header, there is a quote: "essential information that every serious programmer needs to know about algorithms and data structures". The main content area describes the textbook: "Textbook. The textbook *Algorithms, 4th Edition* by Robert Sedgewick and Kevin Wayne [[Amazon](#) · [Addison-Wesley](#)] surveys the most important algorithms and data structures in use today. The textbook is organized into six chapters:". Below this, there is a list of chapters: 1. Fundamentals, 2. Sorting, 3. Searching, 4. Graphs, 5. Strings, and 6. Context. The URL <https://algs4.cs.princeton.edu> is displayed at the bottom of the page.



Have you already met the person sitting next to you?

- A. Yes.
- B. No.





Ed discussion forum. ← *please use Ed, not email*

- For quick questions.
- Designate post as private only when necessary.
- Read the Ed FAQ for guidelines.



<https://edstem.org/us/courses/94725/>

Office hours.

- For longer discussions.
- See the course website for the schedule.



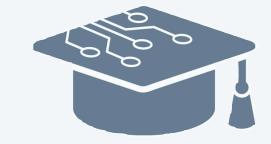
<https://www.princeton.edu/~cos226>

Intro COS lab.

- Run by undergrads.
- For help with debugging.
- See the course website for the schedule.



<https://introlab.cs.princeton.edu>



Platform	What it's for
 Ed	<i>discussion forum, precept lessons</i> ← <i>also use for communication with course staff (do not email)</i>
 IntelliJ	<i>Java IDE (programming environment)</i>
 PrairieLearn	<i>quizzes</i>
 TigerFile	<i>assignment submissions</i>
 Gradescope	<i>exam grading and feedback</i>
 Canvas	<i>grades</i>
 iClicker	<i>in-lecture polls and participation</i>

Non-resources: generative AI tools

GenAI policy. Using GenAI is **not permitted** on exams and quizzes, and **highly discouraged** on assignments



Pedagogical rationale.

- Build a strong foundation in programming.
- Strengthen critical-thinking and problem-solving skills.
- Prepare to use GenAI effectively and responsibly in the future.
- Crush exams and technical interviews.

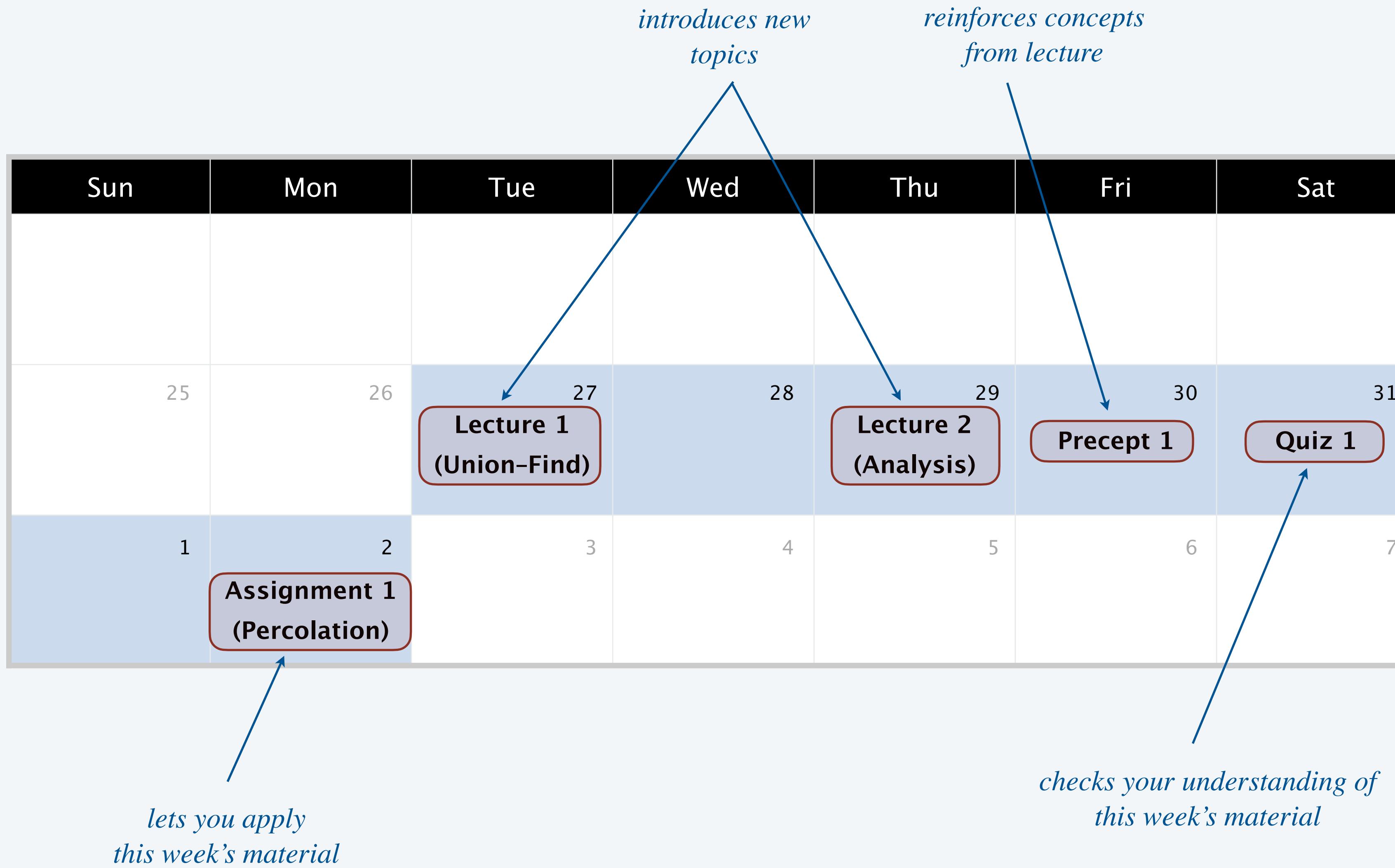


Grade incentive.

- Code reviews require you to understand how your code works and was written.
- Partial credit for honest incomplete work.

A typical week in COS 226 (including this one!)

17



Administrative questions



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

Change your precept? Use TigerHub.

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

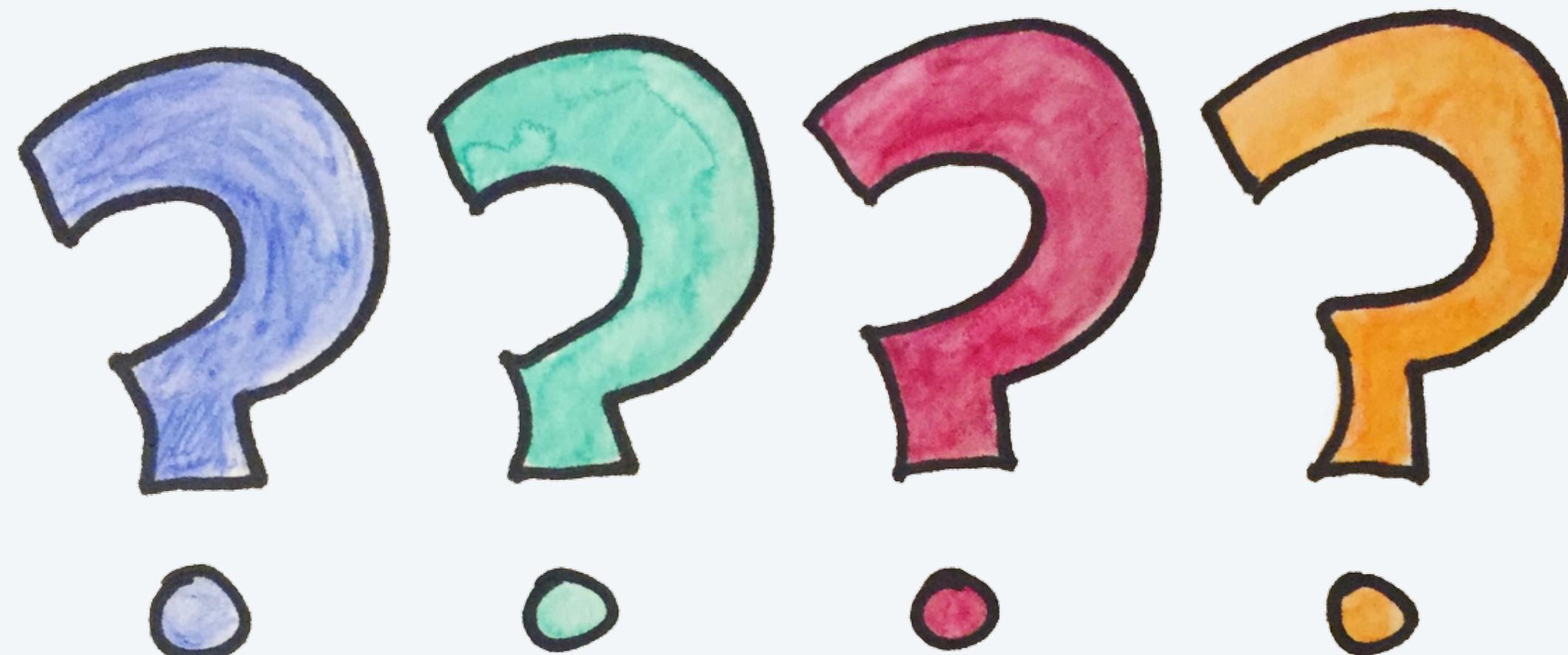


Kobi Kaplan

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

Haven't completed the COS 226 prerequisites? See the COS placement officer.

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



Credits

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