

# **PRINCETON** UNIVERSITY

https://www.princeton.edu/~cos126



Fall 2024

COMPUTER

SCIENCE

#### brought to you by



Prof. Ruth Fong Instructor



Prof. Alan Kaplan Instructor



Prof. Kevin Wayne Instructor



Kobi Kaplan Course Admin





We will be recording lectures and making them available to students in Canvas.

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

Lecture slides available from course website: https://www.cs.princeton.edu/courses/cos126/schedule

# FINE PRINT

# Computer Science

# COS 126, FALL 2024

# digital revolution

course mechanics

course resources

OMPUTER SCIENCE

An Interdisciplinary Approach

R O B E R T S E D G E W I C K KEVIN WÁYNE

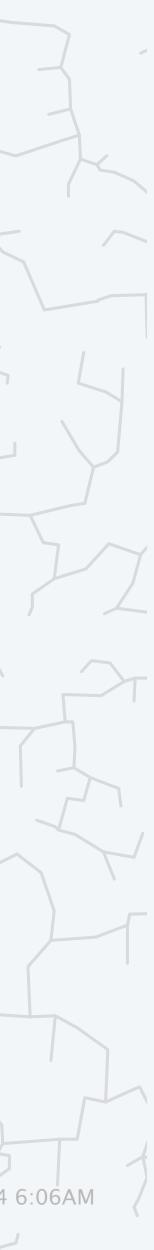
https://introcs.cs.princeton.edu

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#### ROBERT SEDGEWICK | KEVIN WAYNE

Last updated on 9/4/24 6:06AM





## COS 126 course objectives

Goal 1. Read, write, and reason about computer programs.

- Goal 2. Apply concepts to science, engineering, and beyond.
- Goal 3. Understand key ideas underlying computation and computer systems.

topic	ex
elements of programming	built-in data types, con
functions	user-defined function
object-oriented programming	user-defined types, e
algorithms and data structures	sorting, sea
computer science	theory of compu
design of computers	machine language

#### xamples

onditionals, loops, arrays, I/O

ions, modularity, recursion

encapsulation, immutability

arching, collections

uting, machine learning

ge, boolean logic, circuits

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# COS 126, FALL 2024

# digital revolution

OMPUTER CIENCE

An Interdisciplinary Appro

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- course mechanics course resources

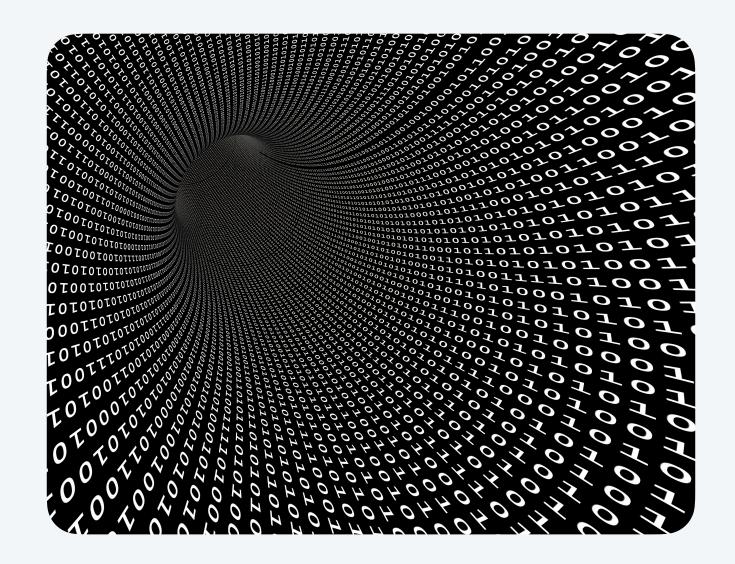


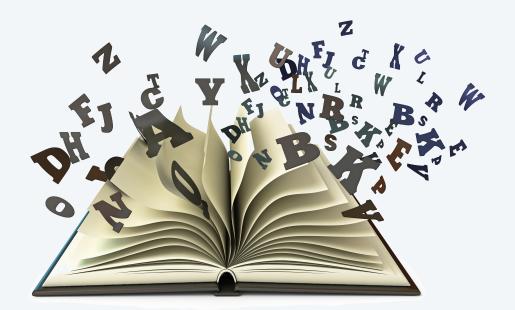
# The digital revolution

Key idea. "Everything" can be encoded as a sequence of bits (0s and 1s).

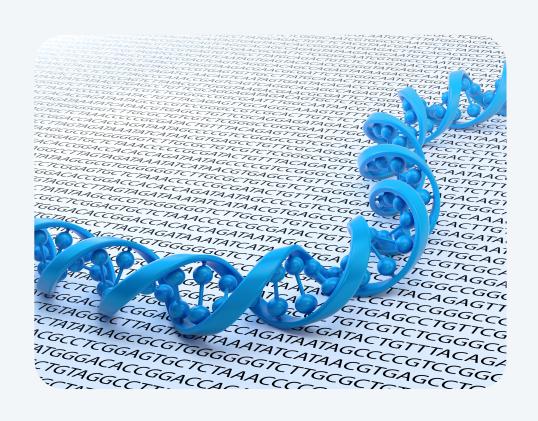
- Numbers and text.
- Pictures, songs, and movies.
- Biometrics.
- 3D objects.
- Computer programs.

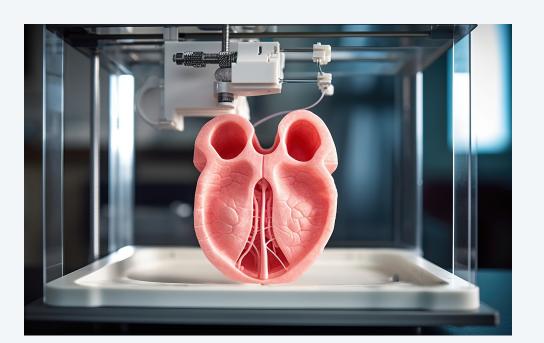


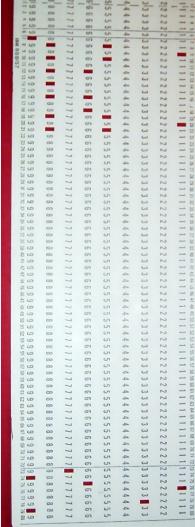












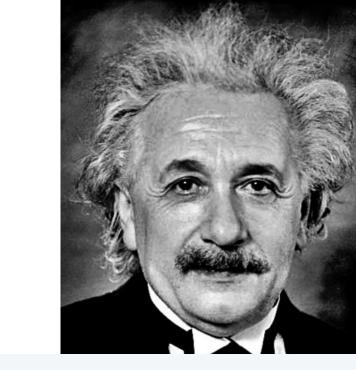




Key idea. "Everything" can be encoded as a sequence of bits (0s and 1s).Innovation 1. You can program computers to process bits.Innovation 2. Devices can use the Internet to send and receive bits.

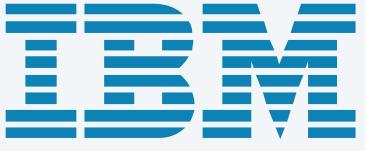
" Computers are incredibly fast, accurate, and stupid; humans are incredibly slow, inaccurate, and brilliant; together they are powerful beyond imagination."

- widely misattributed to Albert Einstein



From the way we work ...











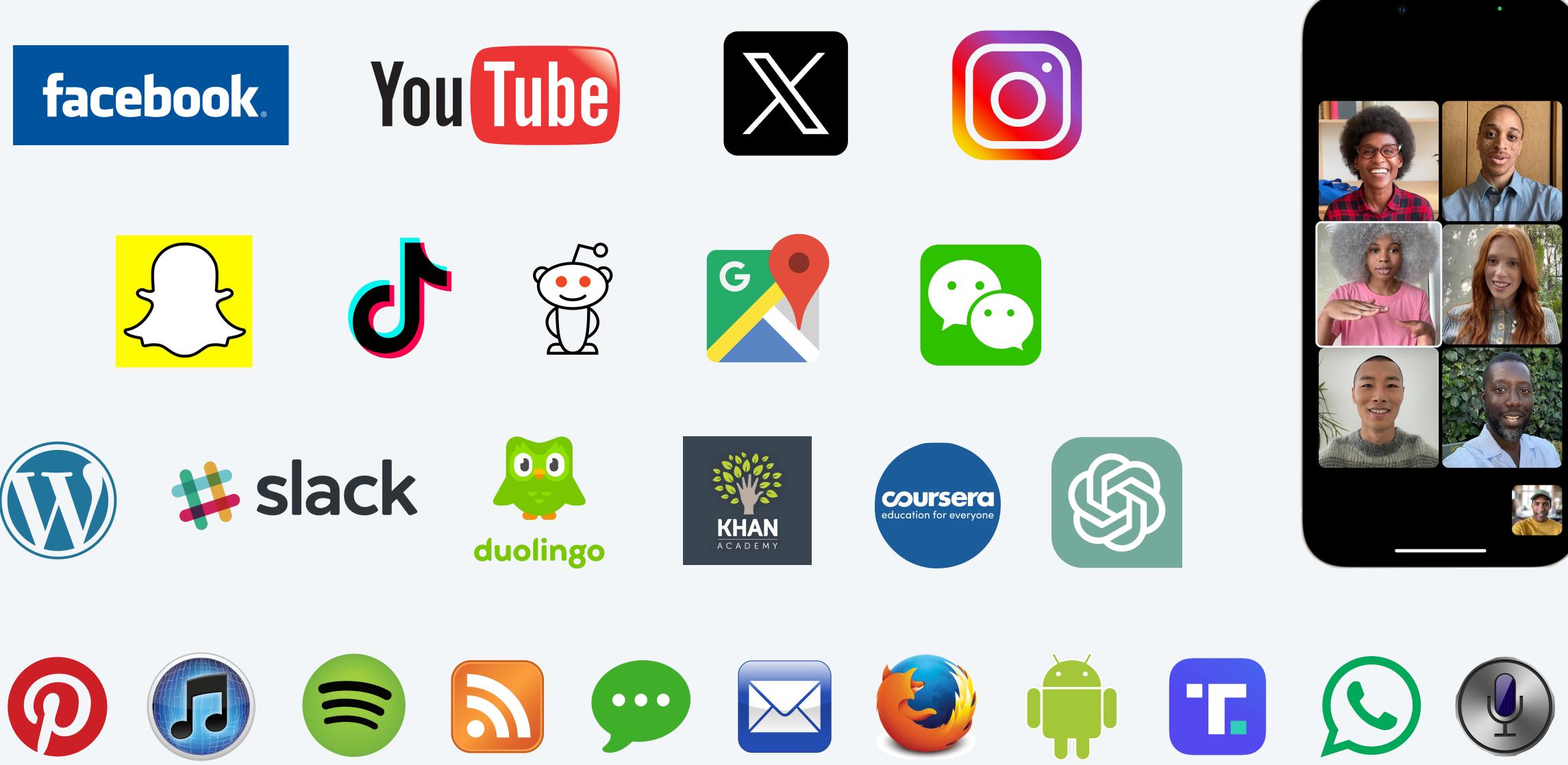


... to the way we live.













From the "new" economy ...



NETFLIX



DOORDASH

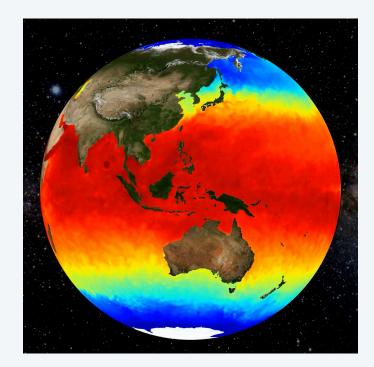
ALGORITHMS TAKE CONTROL OF WALL STREET

Today Wall Street is ruled by thousands of little algorithms, and they've created a new market—volatile, unpredictable, and impossible for humans to comprehend. Photo: Mauricio

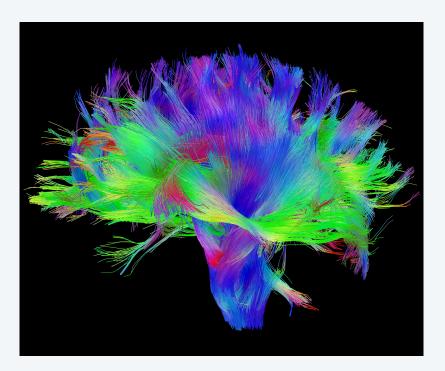




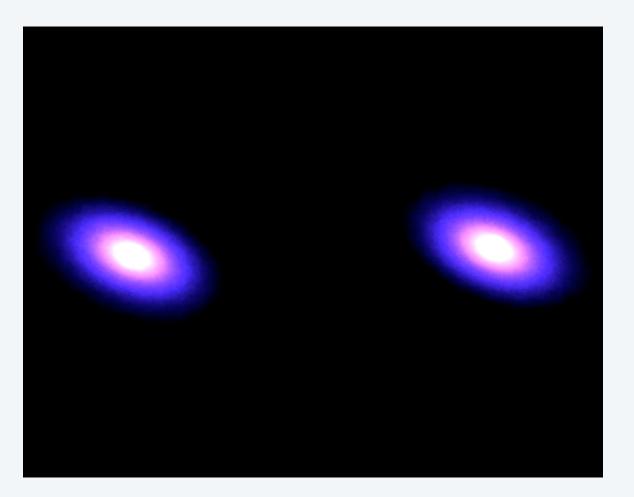
#### ... to the way we do science and engineering.

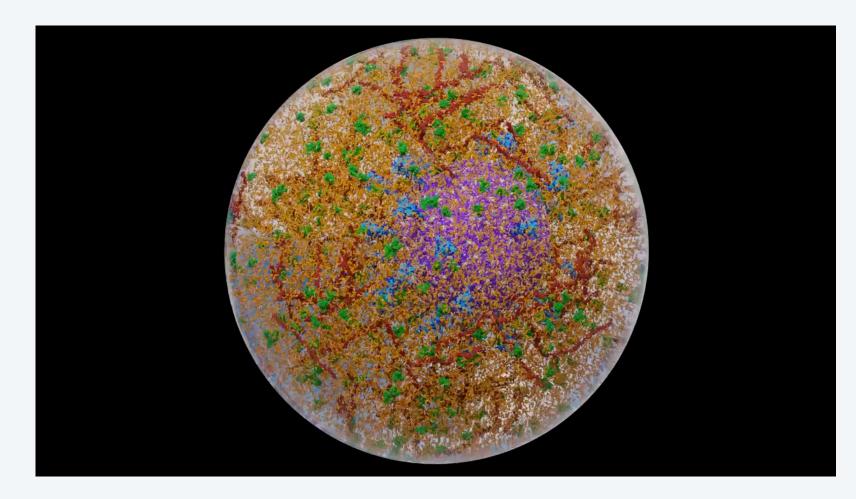


ocean modeling



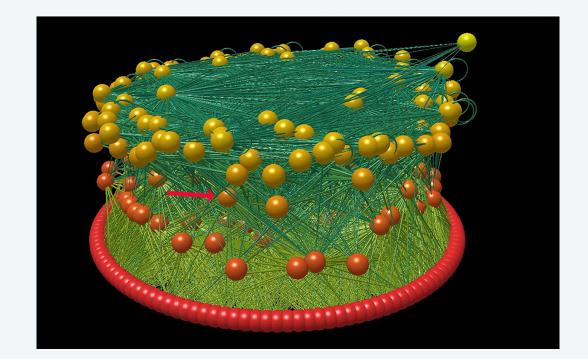
diffusion MRI of brain



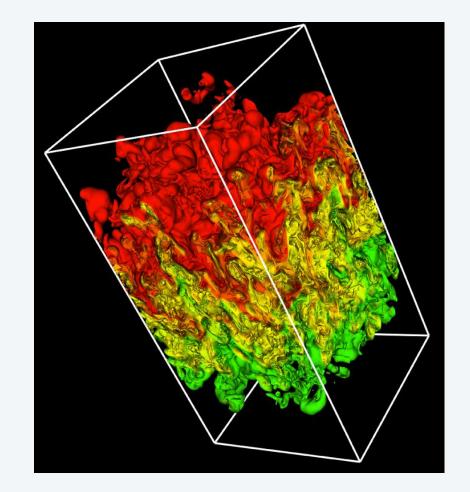


an aerosol droplet containing coronavirus

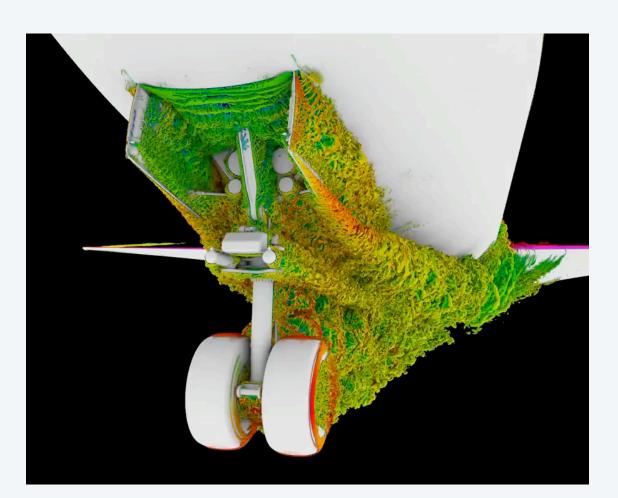
#### colliding galaxies



ancestral Pueblo food web



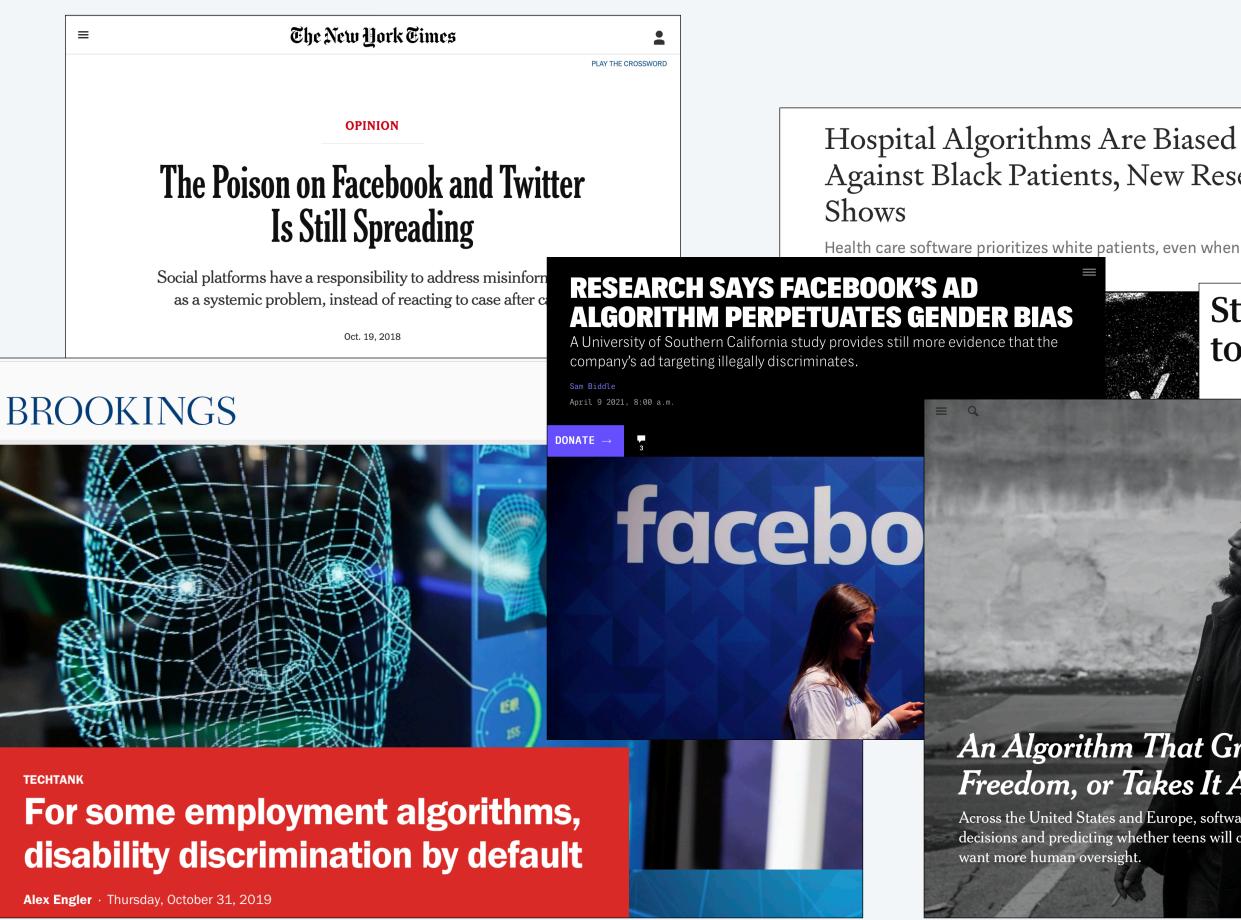
nuclear physics



airflow over landing gear

# The digital revolution has only just begun

Welcome aboard. You're already a consumer. Now, become a creator! In the service of humanity. Use your new superpower responsibly!



**OVERBOOKED** Airlines are price gouging in the path of Hurricane Irma—and algorithms are to blame

Against Black Patients, New Research

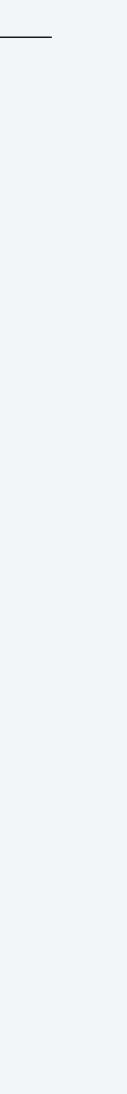
Health care software prioritizes white patients, even when they're not

Student proves Twitter algorithm 'bias' toward lighter, slimmer, younger faces

New Hork Times

#### An Algorithm That Grants Freedom, or Takes It Away

Across the United States and Europe, software is making probation decisions and predicting whether teens will commit crime. Opponents



# COS 126, FALL 2024

# digital revolution

# course mechanics

• course resources

### OMPUTER SCIENCE

An Interdisciplinary Approach

ROBERT SEDGEWICK KEVIN WAYNE

https://introcs.cs.princeton.edu

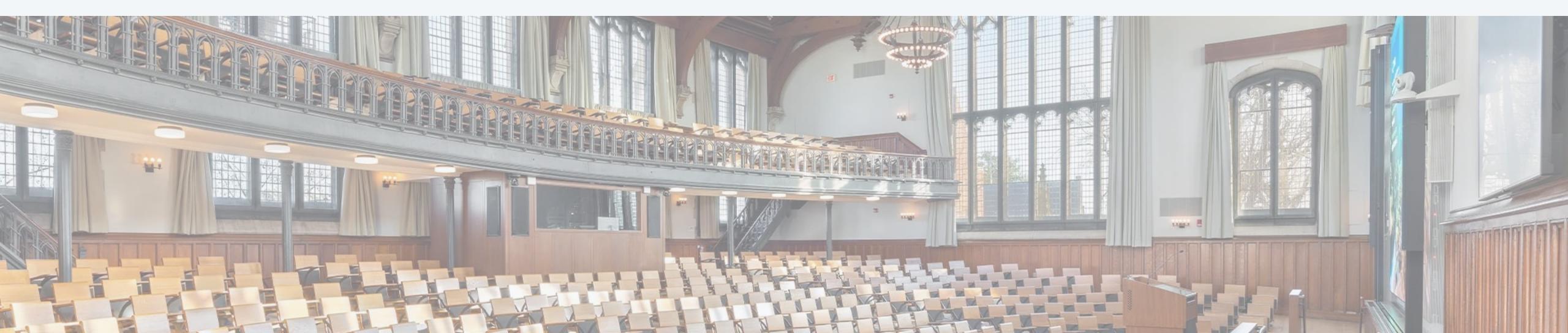


Live lectures. [MW 1:30-2:50pm] Introduce new material.

Questions. You are encouraged and expected to participate.

- Raise your hand and ask a question. *carpe diem*!
- Ask (anonymously) in Ed. *course staff will monitor forum* (may answer or share with class)

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

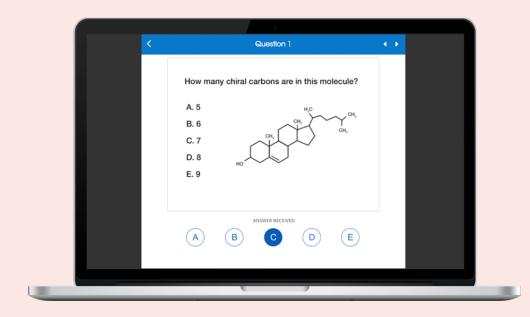


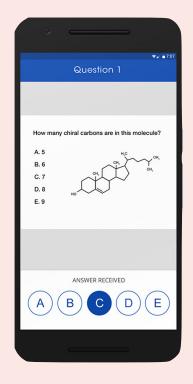
## Intro to COS 126: quiz 1

iClicker. To earn participation credit:

- Register for course.
- Answer multiple choice questions during lecture.

#### Which iClicker device are you using?







B. iPhone





https://www.iclicker.com



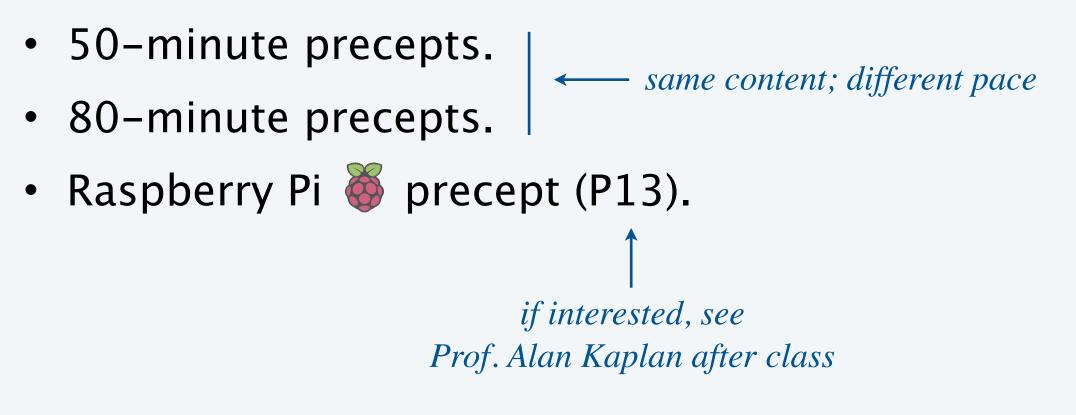






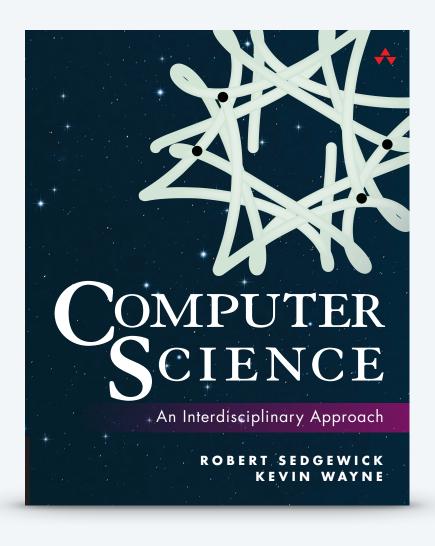
## Precepts

Active learning. Discussion, problem solving, pair programming, ...

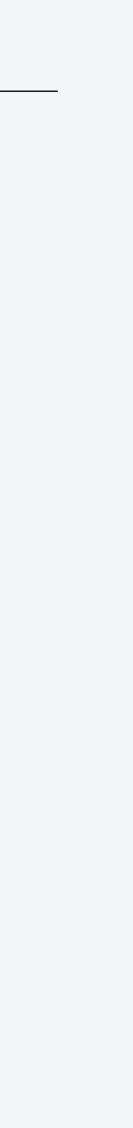




Textbook readings (required). *Computer Science: An Interdisciplinary Approach* by R. Sedgewick and K. Wayne, Addison–Wesley Professional, 2016.



ISBN-13: 978-0-321-90575-8 ISBN-10: 0-321-90575-X ISBN-10: 0-321-90575-X 9: 780331: 9057:38



Programming assignments (37.5%). Assigned weekly.

Final project (7.5%). Capstone programming assignment.

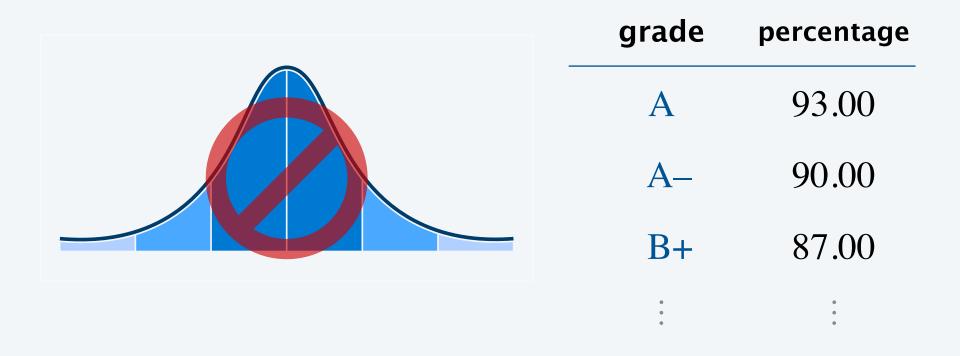
Exams (50%).

- Two written exams.
- One programming exam.

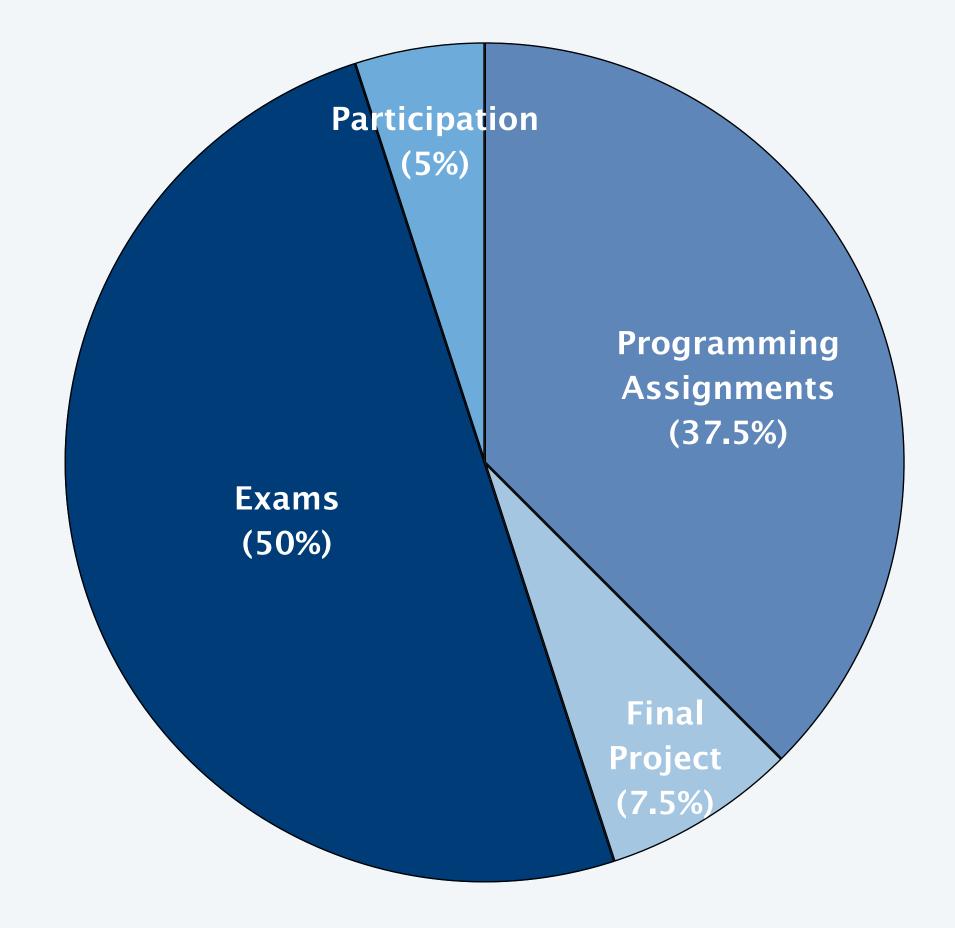


Participation (5%). Participate in lectures/precepts.

Course grades. Uncurved (no rounding).









**Programming.** An essential part of the experience in learning CS.

### Desiderata.

- Illustrate a fundamental CS concept.
- Apply a new programming construct.
- Highlight the role of computation in an important domain.
- You solve the problem from scratch, on your own computer!

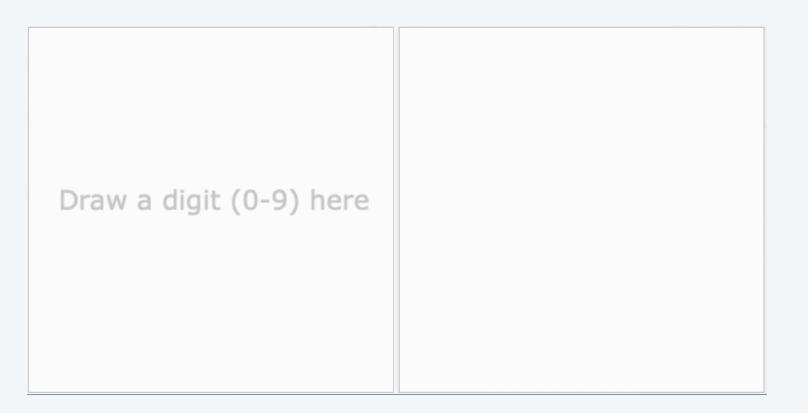


Image Classifier (assignment 6)



**Guitar Hero** (assignment 7)

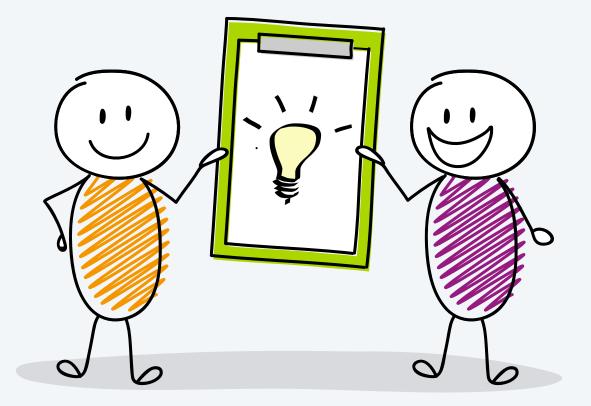




#### Executive summary.

- Do discuss concepts with others.
- Do acknowledge any collaboration with others.
- Do partner with a classmate (on designated assignments).
- Do not copy code from others (or generative AI tools).

Full details. See course syllabus.



share ideas





not code



# COS 126, FALL 2024

digital revolution - course mechanics

### course resources

### OMPUTER CIENCE

An Interdisciplinary Approd

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### Course website.

Syllabus and course policies.

- Lecture slides.
- Programming assignments.
- Exam archive.
- Getting help.
- $\bullet$ . . .

### Booksite.

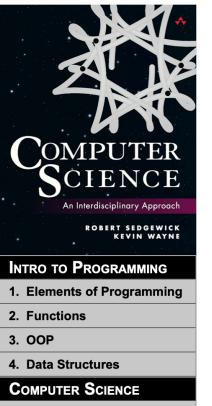
- Download code from book.
- Brief summary of content.
- For use while online.

#### Syllabus

#### **Course Description**

This course is an introduction to computer science in the context of scientific, engineering, and commercial applications. The goal of the course is to teach basic principles and practical issues, while at the same time preparing students to use computers effectively for applications in computer science, physics, biology, chemistry, engineering, and other disciplines. Topics include: programming in Java; hardware and software systems; algorithms and data structures; fundamental principles of computation; and scientific computing, including simulation, optimization, and data analysis.

#### https://www.princeton.edu/~cos126



5. Theory of Computing

6. A Computing Machine

7. Building a Computer

PROGRAMMING IN JAVA · COMPUTER SCIENCE · AN INTERDISCIPLINARY APPROACH

textbooks for a first course in computer science for the next generation of scientists and engineers

**Online content.** This booksite contains tens of thousands of files, fully coordinated with our textbook and also useful as a standalone resource. It consists of the following elements:

- Excerpts. A condensed version of the text narrative, for reference while online.
- Lectures. Curated studio-produced online videos, suitable for remote instruction.
- Java code. Hundreds of easily downloadable Java programs and our I/O libraries for processing text, graphics, and sound.
- Data. Real-world data sets for testing code (ours and yours).
- Exercises. Selected exercises from the book and "web exercises" developed since its publication, along with solutions to selected exercises

#### https://introcs.cs.princeton.edu



R Resources (people)

Ed Discussion forum. ← please use Ed, not email

- Quick questions.
- Read Ed Discussion FAQ for etiquette.

**Office hours.** ← *protip: attend* 

- Longer discussions.
- See course website for schedule.

Intro COS Lab. ← opens Friday

- Run by undergrads.
- For help with debugging.

McGraw group drop-in study halls.

- Led by undergrads.
- For help with concepts.



https://introlab.cs.princeton.edu



https://edstem.org/us/courses/60428



https://www.princeton.edu/~cos126

# The McGraw Center for Teaching & Learning

https://mcgraw.princeton.edu/undergraduates

# Resources (programming environment)

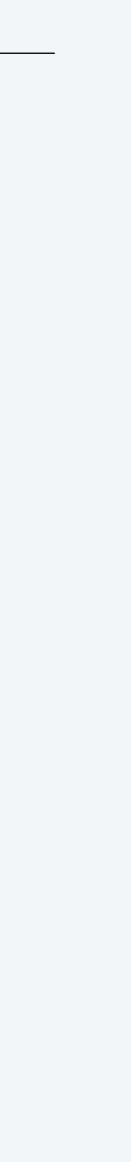


#### use our fall 2024 version Recommended IDE. Custom IntelliJ 2024.2 environment. (see lab TAs for troubleshooting)

- Embedded Bash terminal.
- Autoformat, autoimport, autocomplete, ...
- Continuous code inspection.
- Al assistant. *not in this course*
- •

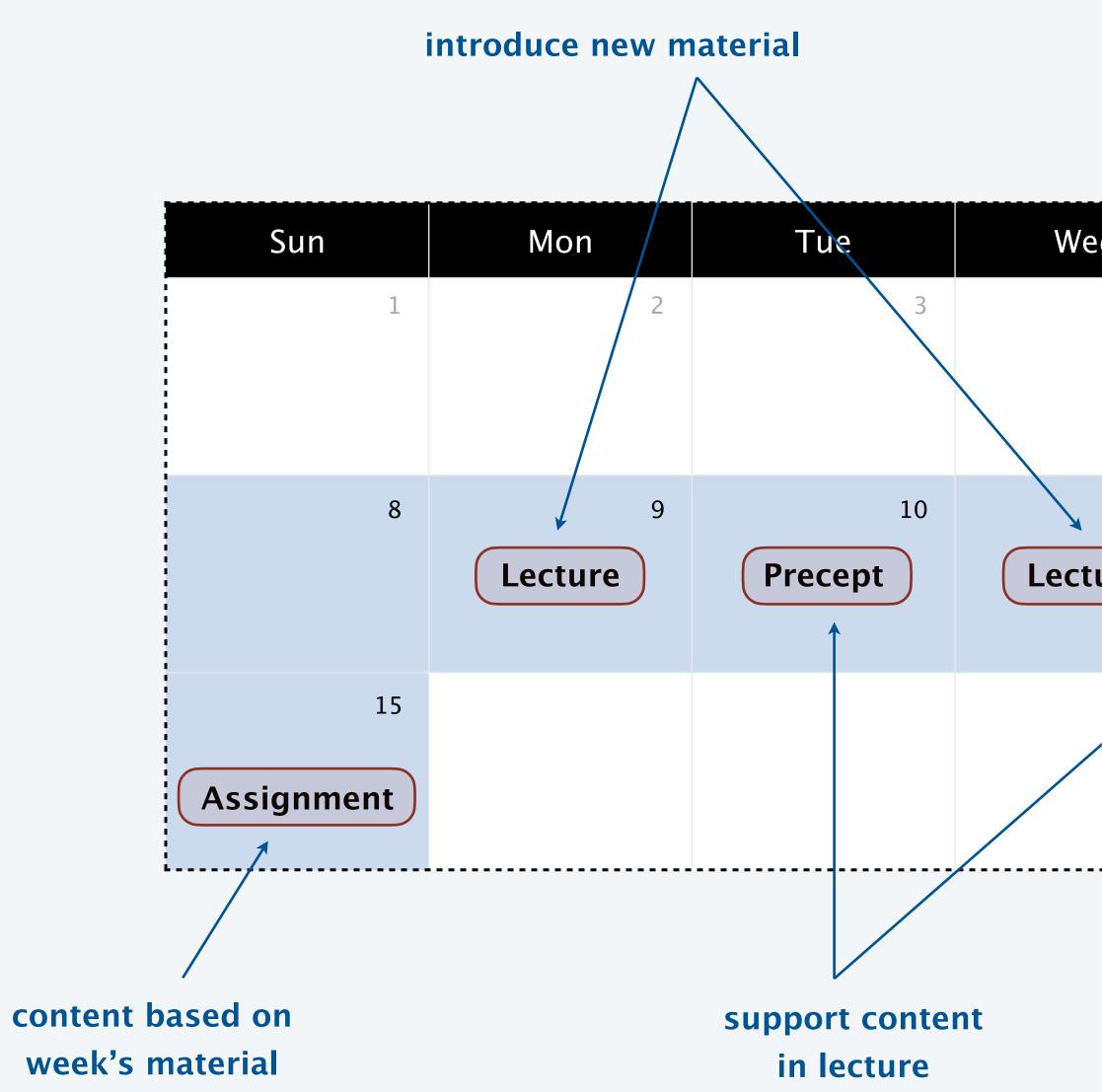
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ogram. Prof. Brian Kernighan initiated this tradition in 1	974.	
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out.println("Hello, World");		
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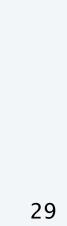






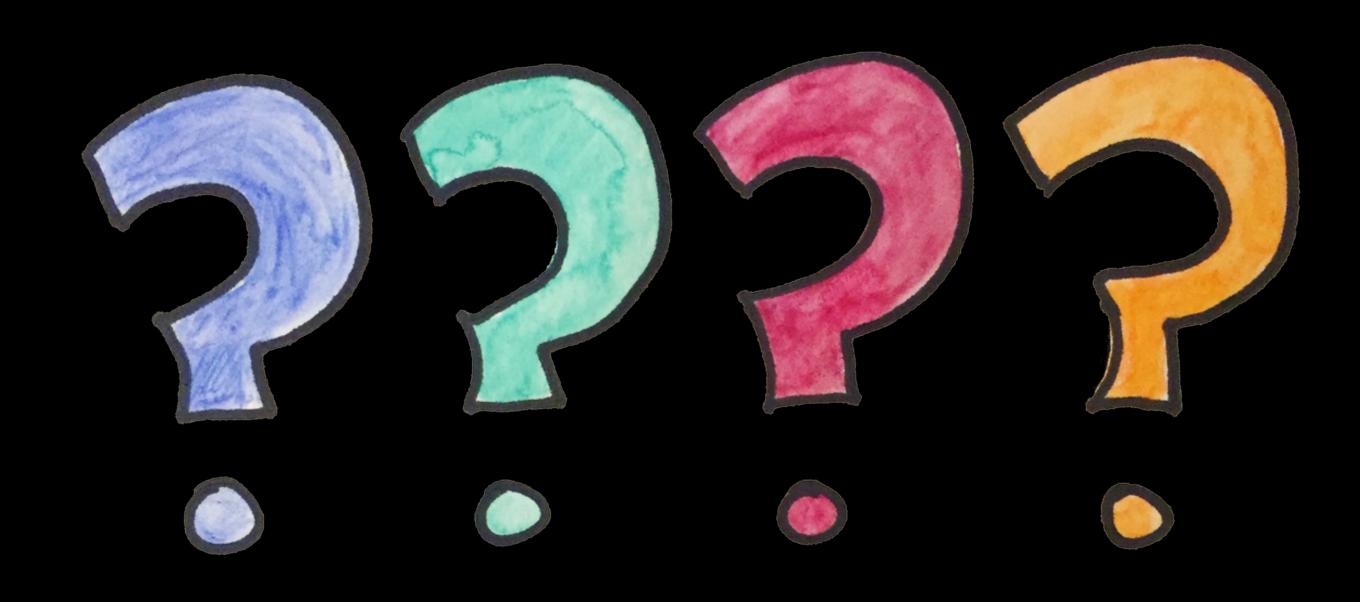


Ned	Thu	Fri	Sat
4	5	6	7
11 cture	12 Precept	13	14





#### raise your hand and ask





# or ask anonymously on Ed (use 🍑 to upvote)



## Credits

#### media

Crowd Cheering Wireframe Tiger Programmer Albert Einstein Binary Tunnel Open Book with Letters Panda in Snow DNA Sequencing 3D Printer

Fortran Punch Card

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## Credits

#### media

Ocean Modeling

Diffusion MRI Scan <u>Hur</u>

Pueblo Food Web

Nuclear Physics

Colliding Galaxies

Airflow Over Landing Gear

<u>NAS</u>

Coronavirus Simulation

McCosh 50

Normal Distribution

Handwritten Digit Demo

Stairway to Heaven

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## Credits

#### media

Collaborating Hands

Cartoon People Sharing

Light Bulb Idea

<u>Clk</u>

Ice Breaker

Countdown Timer

Office Hours

COS Lab TAs

McGraw Center

Student Raising Hand

Question Marks

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