COS 226 course overview

What is COS 226?

- Intermediate-level survey course.
- Programming and problem solving, with applications.
- Algorithm: method for solving a problem.
- Data structure: method to store information.

topic	data structures and algorithms
data types	stack, queue, bag, union-find, priority queue
sorting	quicksort, mergesort, heapsort, radix sorts
searching	BST, red-black BST, hash table
graphs	BFS, DFS, Prim, Kruskal, Dijkstra
strings	KMP, regular expressions, tries, data compression
advanced	B-tree, kd-tree, suffix array, maxflow

Why study algorithms?

Their impact is broad and far-reaching.

Internet. Web search, packet routing, distributed file sharing, ...

Biology. Human genome project, protein folding, ...

Computers. Circuit layout, file system, compilers, ...

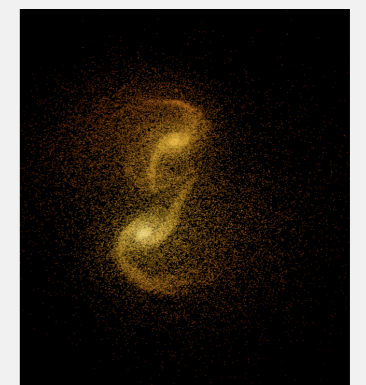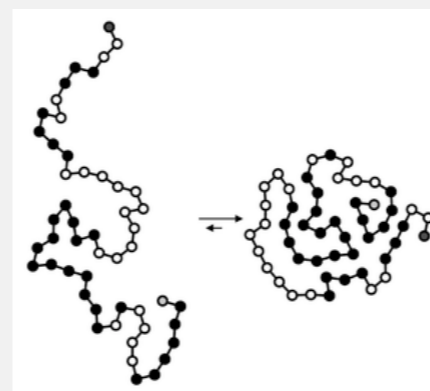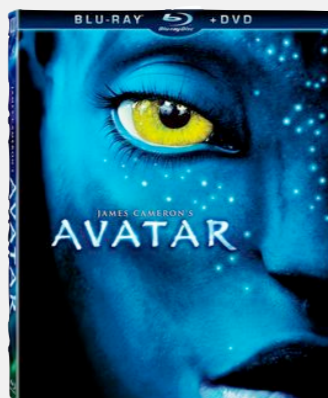Computer graphics. Movies, video games, virtual reality, ...

Security. Cell phones, e-commerce, voting machines, ...

Multimedia. MP3, JPG, DivX, HDTV, face recognition, ...

Social networks. Recommendations, news feeds, advertisements, ...

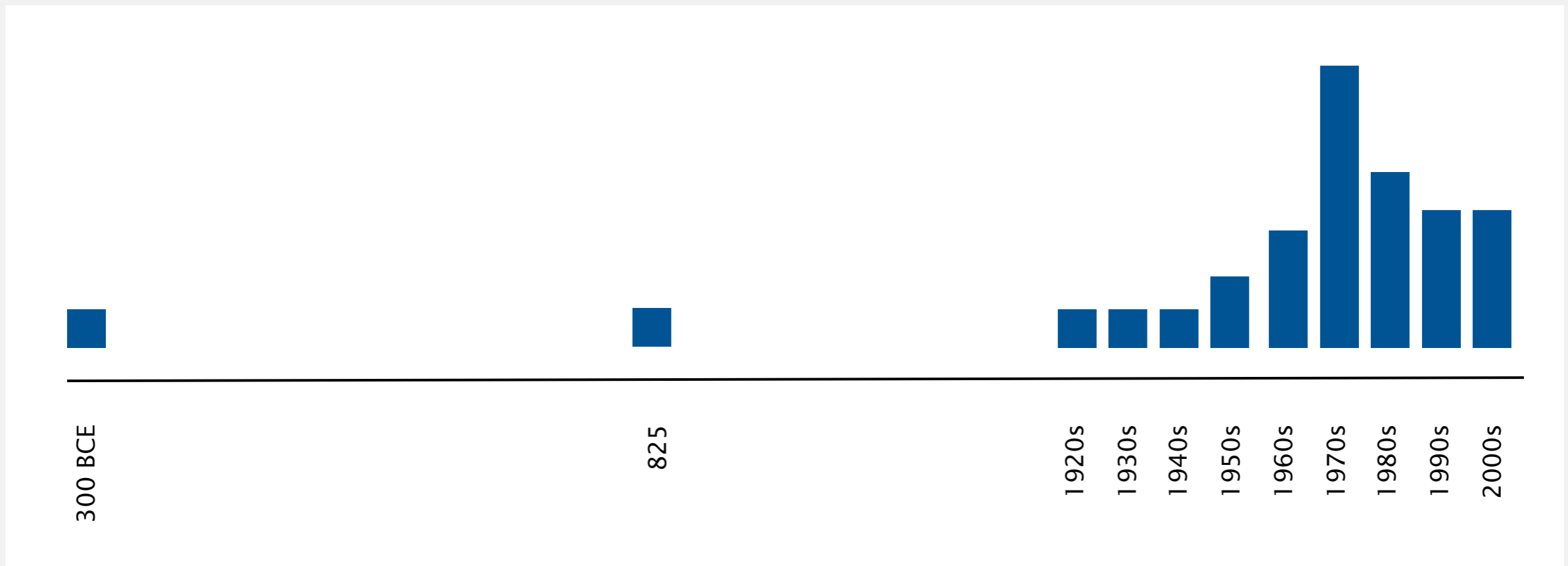Physics. N-body simulation, particle collision simulation, ...

⋮

Why study algorithms?

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 undergraduates in a course like this!

Why study algorithms?

To become a proficient programmer.

> *" I will, in fact, claim that the difference between a bad programmer and a good one is whether he considers his code or his data structures more important. Bad programmers worry about the code. Good programmers worry about data structures and their relationships. "*
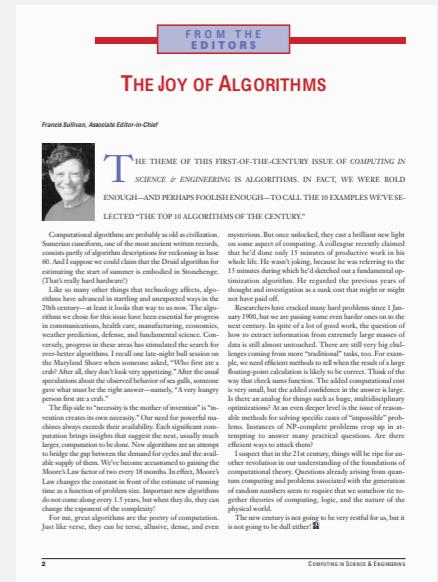>
> *— Linus Torvalds (creator of Linux)*

Why study algorithms?

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*

DEAR MYSTERY ALGORITHM THAT HOGGED GLOBAL FINANCIAL TRADING LAST WEEK: WHAT DO YOU WANT?

ON FRIDAY, A SINGLE MYSTERIOUS PROGRAM WAS RESPONSIBLE FOR 4 PERCENT OF ALL STOCK QUOTE TRAFFIC AND SUCKED UP 10 PERCENT OF THE NASDAQ'S TRADING BANDWIDTH. THEN IT DISAPPEARED.

By Clay Dillow   Posted October 10, 2012

0 Shares

Why study algorithms?

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

> " *Computer models mirroring real life have become crucial for most advances made in chemistry today.... Today the computer is just as important a tool for chemists as the test tube.* "
>   — *Royal Swedish Academy of Sciences (Nobel Prize in Chemistry 2013)*
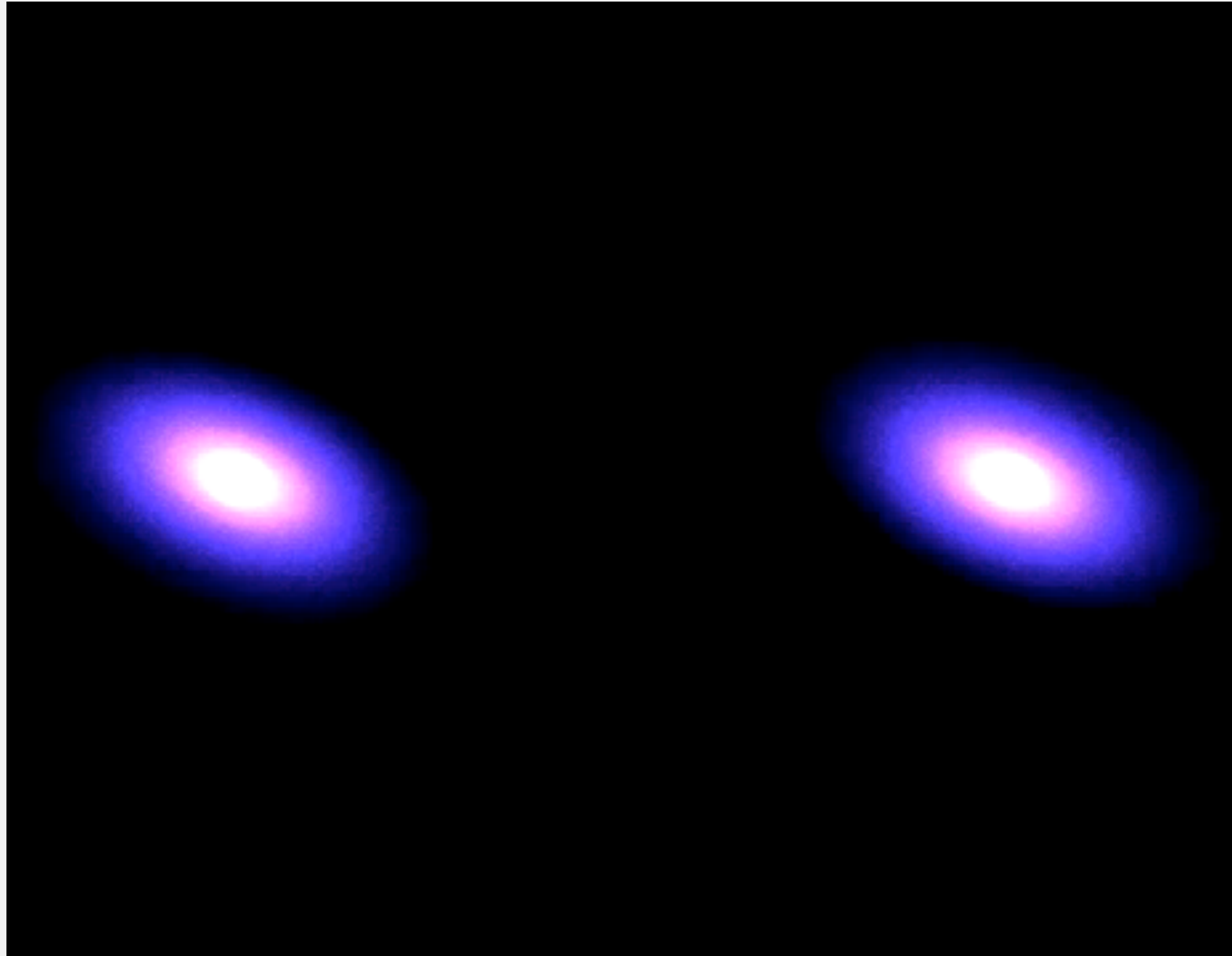
Martin Karplus, Michael Levitt, and Arieh Warshel
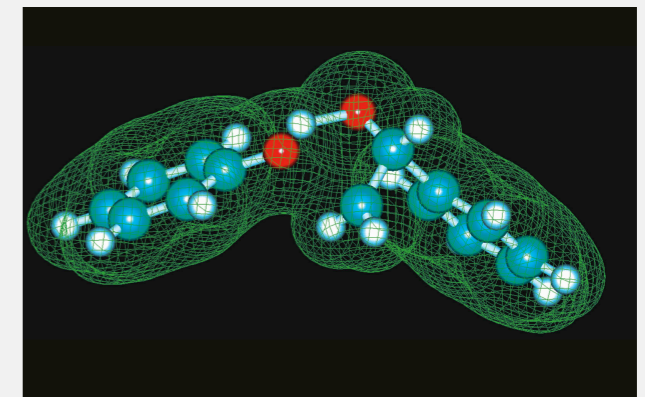
Why study algorithms?

To solve problems that could not otherwise be addressed.

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

Why study algorithms?
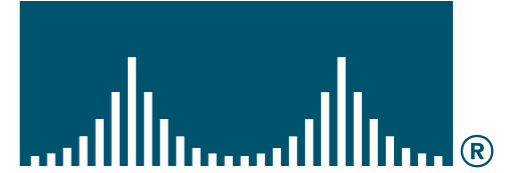
For fun and profit.

Why study algorithms?

- Their impact is broad and far-reaching.

- Old roots, new opportunities.

- To become a proficient programmer.

- For intellectual stimulation.

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

- To solve problems that could not otherwise be addressed.

- For fun and profit.

Lectures

Traditional lectures. Introduce new material.

Electronic devices. Permitted, but only to enhance lecture.

no

no

no

What	When	Where	Who	Office Hours
L01	**MW 11–12:20**	**McCosh 10**	**Kevin Wayne**	see web

Lectures

Traditional lectures. Introduce new material.

Flipped lectures.
- Watch videos online before lecture.
- Complete pre-lecture activities.
- Attend two "flipped" lecture per week (interactive, collaborative, experimental).
- Apply via web by midnight today; results by noon tomorrow.

What	When	Where	Who	Office Hours
L01	MW 11–12:20	McCosh 10	Kevin Wayne	see web
L02	MW 11–12:20	Frist 307	Andy Guna	see web

Precepts

Discussion, problem-solving, background for assignments.

What	When	Where	Who	Office Hours
P01	Th 11–11:50	Friend 108	Andy Guna †	see web
P01A	Th 11–11:50	Friend 109	Shivam Agarwal	see web
P02	Th 12:30–1:20	Friend 108	Andy Guna †	see web
P03	Th 1:30–2:20	Friend 108	Swati Roy	see web
P04	F 10–10:50	Friend 108	Robert MacDavid	see web
P05	F 11–11:50	Friend 108	Robert MacDavid	see web
P05A	F 11–11:50	Friend 109	Shivam Agarwal	see web
P06	F 2:30–3:20	Friend 108	Jérémie Lumbroso	see web
P06A	F 2:30–3:20	COS 102	Josh Wetzel	see web
P06B	F 2:30–3:20	Friend 112	Ryan Beckett	see web
P07	F 3:30–4:20	Friend 108	Jérémie Lumbroso	see web

† lead preceptor

Coursework and grading

Programming assignments. 45%

- Due at 11pm on Wednesdays via electronic submission.
- Collaboration/lateness policies: see web.
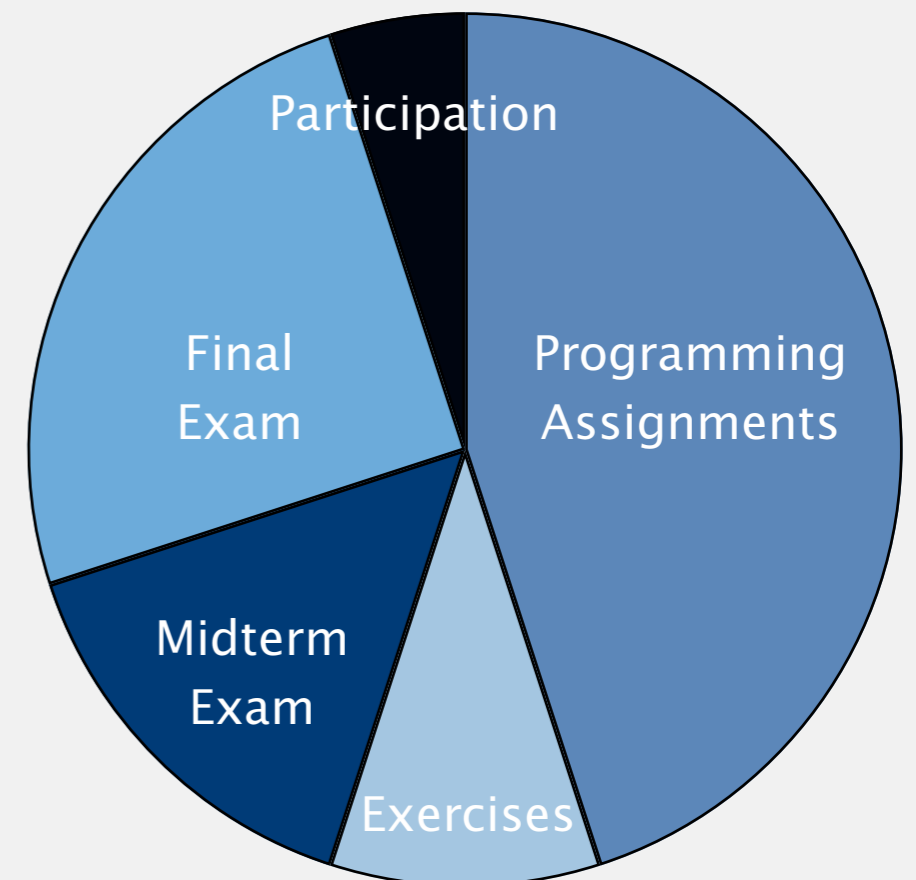
Exercises. 10%

- Due at 11pm on Sundays via Blackboard.
- Collaboration/lateness policies: see web.

Exams. 15% + 25%

- Midterm (in class on Wednesday, March 11).
- Final (to be scheduled by Registrar).

Participation. 5%

- Attend and participate in precept/lecture.
- Answer questions on Piazza.

Pie chart: Programming Assignments, Exercises, Midterm Exam, Final Exam, Participation

i‣clicker

Required device for lecture.

- Any hardware version of i‣clicker.
- Available at Labyrinth Books ($25).
- You must register your i‣clicker in Blackboard.

  (sorry, insufficient WiFi in this room to support i‣clicker GO)
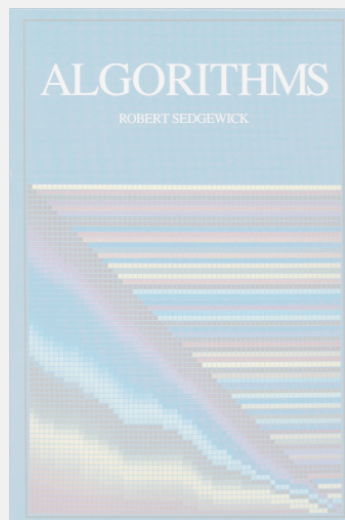
save serial number
to maintain resale value

Which model of i‣clicker are you using?

A. i‣clicker.

B. i‣clicker+.

C. i‣clicker 2.

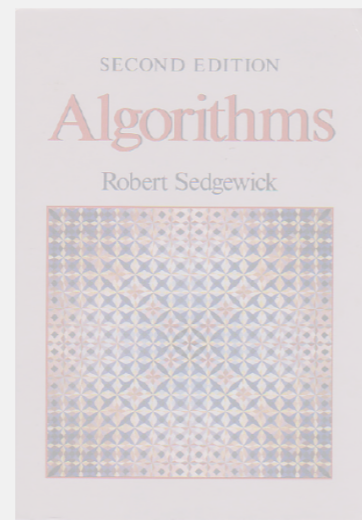D. I don't know.

E. I don't have one yet.
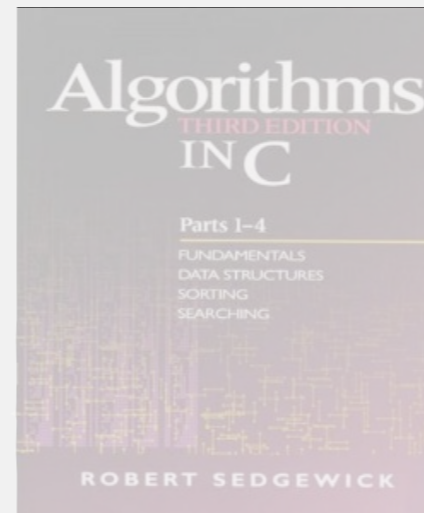
Resources (textbook)

Required reading. Algorithms 4th edition by R. Sedgewick and K. Wayne, Addison-Wesley Professional, 2011, ISBN 0-321-57351-X.

1st edition (1982)   2nd edition (1988)   3rd edition (1997)

4th edition (2011)

Available in hardcover and Kindle.
- Online: Amazon ($60 hardcover, $50 Kindle, $20 rent), …
- Brick-and-mortar: Labyrinth Books (122 Nassau St.).
- On reserve: Engineering library.

Resources (web)

Course content.

- Course info.
- Lecture slides.
- Flipped lectures.
- Programming assignments.
- Exercises.
- Exam archive.

PRINCETON UNIVERSITY

COMPUTER SCIENCE 226
ALGORITHMS AND DATA STRUCTURES
SPRING 2015

Course Information | Lectures | Flipped | Assignments | Exercises | Exams

COURSE INFORMATION

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, and string processing. Fundamental algorithms in a number of other areas are covered as well, including geometric and graph algorithms. The course will concentrate on developing implementations, understanding their performance characteristics, and estimating their potential effectiveness in applications.

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

Booksite.

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

Algorithms
FOURTH EDITION
ROBERT SEDGEWICK | KEVIN WAYNE

ALGORITHMS, 4TH EDITION
1. Fundamentals
2. Sorting
3. Searching
4. Graphs
5. Strings
6. Context

ALGORITHMS, 4TH EDITION

essential information that every serious programmer needs to know about algorithms and data structures

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:

- *Chapter 1: Fundamentals* introduces a scientific and engineering basis for comparing algorithms and making predictions. It also includes our programming model.
- *Chapter 2: Sorting* considers several classic sorting algorithms, including insertion sort, mergesort, and quicksort. It also includes a binary heap implementation of a priority queue.
- *Chapter 3: Searching* describes several classic symbol table implementations, including binary search trees, red-black trees, and hash tables.

http://algs4.cs.princeton.edu

Resources (people)

Piazza discussion forum.

- Low latency, low bandwidth.
- Mark solution-revealing questions as private.

http://piazza.com/princeton/spring2015/cos226

Office hours.

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

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

Computing laboratory.

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

http://labta.cs.princeton.edu

What's ahead?

Today. Attend traditional lecture (everyone).

Wednesday. Attend traditional/flipped lecture.

Thursday/Friday. Attend precept (everyone).

FOR i = 1 to N

    Sunday: two sets of exercises due.

    Monday: traditional/flipped lecture.

    Tuesday: programming assignment due.

    Wednesday: traditional/flipped lecture.

    Thursday/Friday: precept.

protip: start early

Q+A

Not registered? Go to any precept this week.

Change precept? Use SCORE.

All possible precepts closed? See Colleen Kenny-McGinley in CS 210.

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

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

Even the genius asks questions.