

# Computer Science 226

## Algorithms and Data Structures

### Spring 2009

Instructor:  
Prof. Sedgewick

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## Course Overview

- ▶ outline
- ▶ why study algorithms?
- ▶ usual suspects
- ▶ coursework
- ▶ resources (web)
- ▶ resources (books)

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### 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, union-find, priority queue
sorting	quicksort, mergesort, heapsort, radix sorts
searching	hash table, BST, red-black tree
graphs	BFS, DFS, Prim, Kruskal, Dijkstra
strings	KMP, Regular expressions, TST, Huffman, LZW
geometry	Graham scan, k-d tree, Voronoi diagram

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### 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.** CD player, DVD, MP3, JPG, DivX, HDTV, ...

**Transportation.** Airline crew scheduling, map routing, ...

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

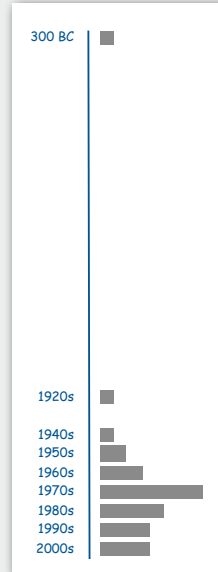
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## Why study algorithms?

### Old roots, new opportunities.

- Study of algorithms dates at least to Euclid
- Some important algorithms were discovered by undergraduates!

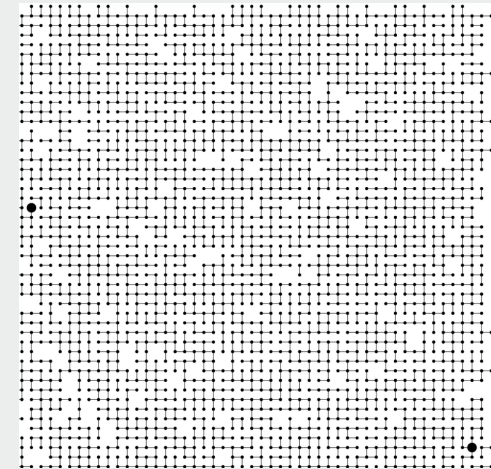


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## Why study algorithms?

To solve problems that could not otherwise be addressed.

Ex. Network connectivity. [stay tuned]



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## 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

*“An algorithm must be seen to be believed.”* — D. E. Knuth

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## Why study algorithms?

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

Computational models are replacing mathematical models in scientific enquiry

$$E = mc^2$$
$$F = ma \quad F = \frac{Gm_1m_2}{r^2}$$
$$\left[ -\frac{\hbar^2}{2m}\nabla^2 + V(r) \right] \Psi(r) = E \Psi(r)$$

20th century science  
(formula based)

```
for (double t = 0.0; true; t = t + dt)
  for (int i = 0; i < N; i++)
  {
    bodies[i].resetForce();
    for (int j = 0; j < N; j++)
      if (i != j)
        bodies[i].addForce(bodies[j]);
  }
```

21st century science  
(algorithm based)

*“Algorithms: a common language for nature, human, and computer.”* — Avi Wigderson

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## Why study algorithms?

For fun and profit.



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## Why study algorithms?

- Their impact is broad and far-reaching.
- Old roots, new opportunities.
- To solve problems that could not otherwise be addressed.
- For intellectual stimulation.
- They may unlock the secrets of life and of the universe.
- For fun and profit.

Why study anything else?

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## The usual suspects

**Lectures.** Introduce new material, answer questions.

**Precepts.** Answer questions, solve problems, discuss programming assignment.

first precept meets this week!

What	When	Where	Who	Office Hours
L01	MW 11-12:20	Bowen 222	Prof. Sedgewick	W 1-2 (Cafe Viv)
P01	Th 12:30	CS 102	Moritz Hardt	see web page
P01A	Th 12:30	Friend 108	Maia Ginsburg (lead preceptor)	see web page
P02	Th 1:30	Friend 008	Martin Suchara	see web page
P03	Th 3:30	Friend 109	Aravindan Vijayaraghavan	see web page

## FAQ.

- Not registered? Change precept? Use SCORE.
- See Donna O'Leary (CS 210) to resolve serious conflicts.
- See Maia Ginsburg (CS 205) for other course admin issues.

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## Coursework and grading

**8 programming assignments. 45%**

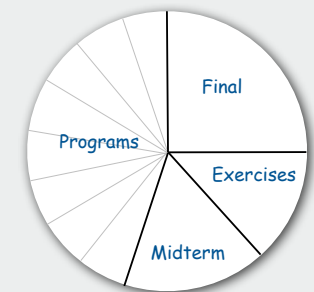
- Electronic submission.
- Due 11:00pm, starting Tuesday 2/10.

**Exercises. 15%**

- Due in lecture, starting Manday 2/9.

**Exams.**

- Closed-book with cheatsheet.
- Midterm. 15%
- Final. 25%



**Staff discretion.** To adjust borderline cases.

everyone needs to meet me (at least) once!

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## Resources (web)

### Course content.

- Course info.
- Exercises.
- Lecture slides.
- Programming assignments.



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



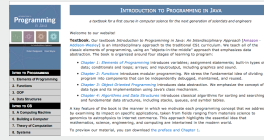
<https://moodle.cs.princeton.edu/course/view.php?id=40>

### Course administration.

- Check grades.
- Submit assignments.

### Booksites.

- Brief summary of content.
- Download code from lecture.



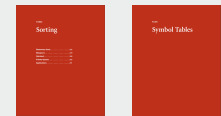
<http://www.cs.princeton.edu/IntroProgramming>  
<http://www.cs.princeton.edu/algs4>

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## Resources (books)

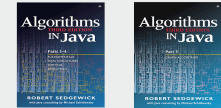
### Algorithms 4th edition

availability TBA



### Algorithms in Java, 3rd edition

- Parts 1-4. [sorting, searching] **recommended**
- Part 5. [graph algorithms] **required**



### Introduction to Programming **recommended**

- Basic programming model.
- Elementary AofA and data structures.



### Algorithms, 2nd edition

availability TBA

- Strings.
- Geometric algorithms.



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