Computer Science 226
Algorithms and Data Structures
Fall 2007

Instructors:
Bob Sedgewick
Kevin Wayne

Course Overview

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

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

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.

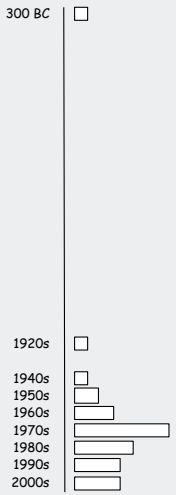
...

Why study algorithms?

Old roots, new opportunities

Study of algorithms dates at least to Euclid

Some important algorithms were discovered by undergraduates!

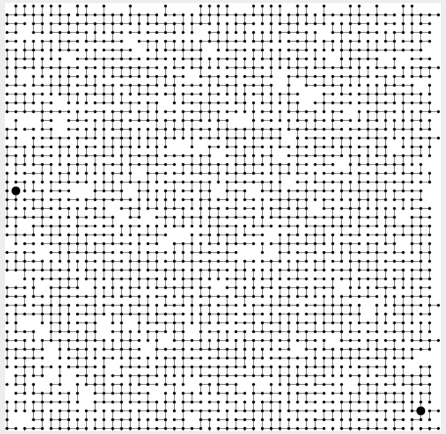


Why study algorithms?

To be able solve problems that could not otherwise be addressed

Example: Network connectivity

[stay tuned]



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

Why study algorithms?

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

Computational models are replacing mathematical models in scientific enquiry

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

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

Why study algorithms?

For fun and profit

Why study algorithms?

- Their impact is broad and far-reaching
- Old roots, new opportunities
- To be able 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?

The Usual Suspects

Lectures: Bob Sedgewick
- TTh 11-12:20, Bowen 222
- Office hours T 3-5 at Cafe Viv in Frist

Course management (everything else): Kevin Wayne

Precepts: Kevin Wayne
- Thursdays.
  - 1: 12:30 Friend 110
  - 2: 3:30 Friend 109
- Discuss programming assignments, exercises, lecture material.
- First precept meets Thursday 9/20
- Kevin's office hours TBA

Need a precept time? Need to change precepts?
- email Donna O'Leary (CS ugrad coordinator)
  doleary@cs.princeton.edu

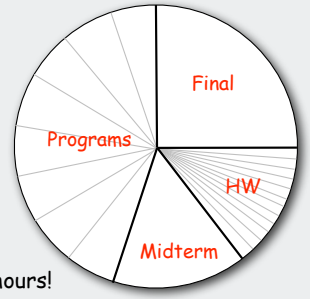
Check course web page for up-to-date info

Coursework and Grading

7-8 programming assignments. 45%
- Due 11:55pm, starting Monday 9/24.
- Available via course website.

Weekly written exercises. 15%
- Due at beginning of Thursday lecture, starting 9/20.
- Available via course website.

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



Staff discretion. Adjust borderline cases.
- Participation in lecture and precepts
- Everyone needs to meet us both at office hours!

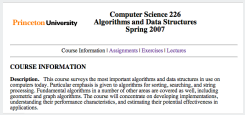
Challenge for the bored. Determine importance of 45-15-15-25 weights

Resources (web)

Course content.

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

- syllabus
- exercises
- lecture slides
- programming assignments (description, code, test data, checklists)



Course administration.

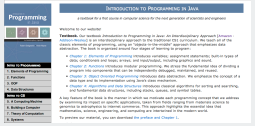
`https://moodle.cs.princeton.edu/course/view.php?id=24`

- programming assignment submission.
- grades.

Booksites.

`http://www.cs.princeton.edu/IntroCS`
`http://www.cs.princeton.edu/IntroAlgsDS`

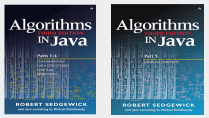
- brief summary of content.
- code.
- links to web content.



Resources (books)

Algorithms in Java, 3rd edition

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

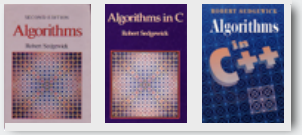


Introduction to Programming in Java

- basic programming model
- elementary AofA and data structures

Algorithms in Pascal(!)/C/C++, 2nd edition

- strings
- elementary geometric algorithms



Algorithms, 4th edition

(in preparation)