

COS 226

Algorithms and Data Structures Princeton University Fall 2009

Kevin Wayne

Algorithms in Java, 4th Edition · Robert Sedgwick and Kevin Wayne · Copyright © 2009 · September 17, 2009 5:23:22 AM

Course Overview

- ▶ outline
- ▶ why study algorithms?
- ▶ usual suspects
- ▶ coursework
- ▶ resources

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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

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, ...

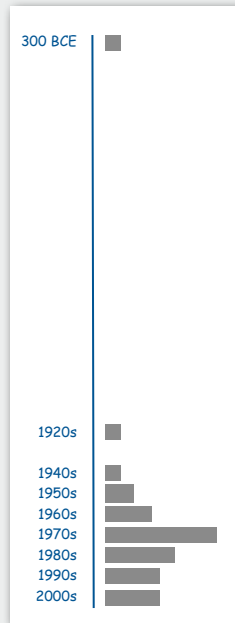
Physics. N-body simulation, particle collision simulation, ...

...

Why study algorithms?

Old roots, new opportunities.

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

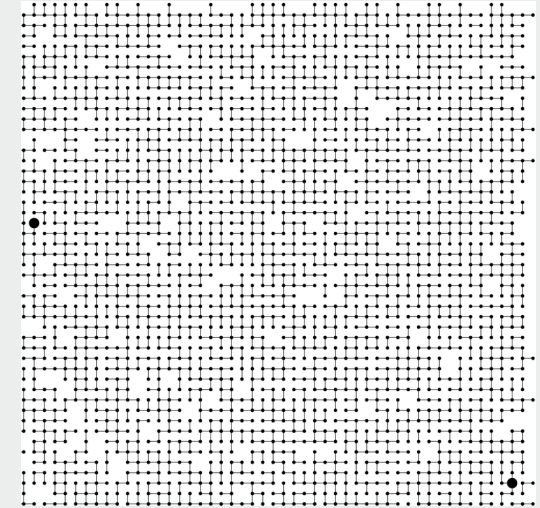


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Why study algorithms?

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 inquiry.

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

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 today!

What	When	Where	Who	Office Hours
L01	TTh 11-12:20	Bowen 222	Kevin Wayne	see web page
P01	Th 12:30	Friend 109	Anu Venugopalan	see web page
P02	Th 3:30	Friend 111	Berk Kapicioglu	see web page
P03	TBA	TBA	Corey Toler-Franklin	see web page

FAQ.

- Not registered? Change precept? Use SCORE.
- See Donna O'Leary (CS 210) to resolve serious conflicts.

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Coursework and grading

8 programming assignments. 45%

- Electronic submission.
- Due 11pm, starting Wednesday 9/23.

Exercises. 15%

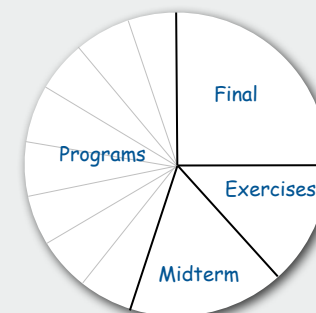
- Due in lecture, starting Tuesday 9/22.

Exams.

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

Staff discretion. To adjust borderline cases.

everyone needs to meet me in office hours
(at least) once this month!



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Course content.

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

PRINCETON UNIVERSITY
Computer Science 226
Algorithms and Data Structures
Fall 2009

Course Information | Assignments | Exercises | Lectures

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>

Booksites.

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

ALGORITHMS, 4TH EDITION

what every serious programmer needs to know about data structures and algorithms

This booksite supplements the textbook (under development) *Algorithms, 4th Edition* by Robert Sedgwick and Kevin Wayne. Currently, it's just intended for COS 226 students as a convenient location to find the source code from lecture.

Textbook. This book surveys the most important algorithms and data structures in use today. The broad perspective taken makes the book an appropriate introduction to the field. The book is organized into 8 chapters:

- *Chapter 1: Fundamentals* considers a scientific and engineering basis for comparing algorithms and making predictions.
- *Chapter 2: Data Types* introduces fundamental data

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

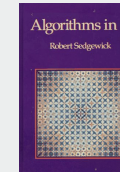
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Required readings.

- Algorithms 4th edition. [selected chapters available at Triangle copy]
- Algorithms in Java, 3rd edition, Part 5. [Labyrinth books]
- Algorithms in Java, 3rd edition, Part 1-4. [selected chapters online]
- Algorithms in C, 2nd edition. [selected chapters online]

Recommended Java reference.

- Introduction to Programming in Java. [Labyrinth books]



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