

COS 423: Theory of Algorithms

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Princeton University
Spring 2005

Administrative Stuff

Lectures. Kevin Wayne

- MW 10 - 10:50, Friend 109.
- Attendance is expected.

Precept. Amit Agarwal, Joshua Podolak

- Monday 8pm, room TBA.
- Preceptor works out problems.

see me after class



Prereq. COS 226 and COS 341, or instructor's permission.

Textbook. *Algorithm Design* by Éva Tardos and Jon Kleinberg.

- Available at Triangle Copy, 150 Nassau Street.

Course web site. www.cs.princeton.edu/courses/archive/spring05/cos423

2

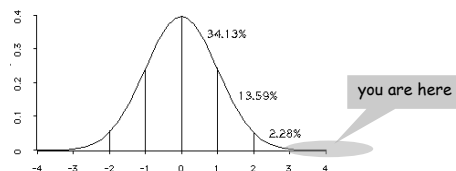
Grades

Grading.

- "Weekly" problem sets, due Wednesday 11am in class.
- Class participation, staff discretion for borderline cases.
- No exams. ← subject to change at instructor's whim
- See handout on writing solutions.

Course grades.

- Undergrads: determined without considering grad students.
- Grads: determined using undergrad scale.



3

Collaboration

Collaboration policy. (see handout; ask if unsure)

- Course materials are always permitted.
- You are encouraged to attend office hours as needed.
- No external resources, e.g., Google, Tarjan.

"Collaboration permitted" problem sets.

- Can form study group of up to 3 students.
- Study group must work on each problem jointly.
- You must write up solutions individually.

"No collaboration" problem sets.

- Can always consult course staff.

4

Algorithms

Algorithm.

- [webster.com] A procedure for solving a mathematical problem (as of finding the greatest common divisor) in a finite number of steps that frequently involves repetition of an operation.
- [Knuth, TAOCP] An algorithm is a finite, definite, effective procedure, with some input and some output.

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

5

Etymology

Etymology. [Knuth, TAOCP]

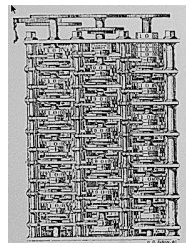
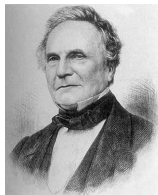
- *Algorism* = process of doing arithmetic using Arabic numerals.
- A misperception: *algiros* [painful] + *arithmos* [number].
- True origin: Abu 'Abd Allah Muhammad ibn Musa al-Khwarizm was a famous 9th century Persian textbook author who wrote *Kitab al-jabr wa'l-muqabala*, which evolved into today's high school algebra text.



6

Theory of Algorithms

"As soon as an Analytic Engine exists, it will necessarily guide the future course of the science. Whenever any result is sought by its aid, the question will arise - By what course of calculation can these results be arrived at by the machine in the *shortest time*? - Charles Babbage



7

Algorithmic Paradigms

Design and analysis of computer algorithms.

- Greedy.
- Divide-and-conquer.
- Dynamic programming.
- Network flow.
- Randomized algorithms.
- Intractability.
- Coping with intractability.

Critical thinking and problem-solving.

8

Applications

Wide range of applications.

- Caching.
- Compilers.
- Databases.
- Scheduling.
- Networking.
- Data analysis.
- Signal processing.
- Computer graphics.
- Scientific computing.
- Operations research.
- Artificial intelligence.
- Computational biology.
- . . .

We focus on algorithms and techniques that are **useful in practice**.