Algorithm definitions

“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.” — webster.com

“An algorithm is a finite, definite, effective procedure, with some input and some output.”

— Donald Knuth
Algorithm 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 *Kitāb al-jabr wa'l-muqābala*, which evolved into today's high school algebra text.
COS 226 vs. COS 423

COS 226. Implementation and consumption of classic algorithms.

- Stacks and queues.
- Sorting.
- Searching.
- Graph algorithms.
- String processing.

```java
private static void sort(double[] a, int lo, int hi)
{
    if (hi <= lo) return;
    int lt = lo, gt = hi;
    int i = lo;
    while (i <= gt)
    {
        if (a[i] < a[lo]) exch(a, lt++, i++);
        else if (a[i] > a[lo]) exch(a, i, gt--);
        else i++;
    }
    sort(a, lo, lt - 1);
    sort(a, gt + 1, hi);
}
```

Emphasizes critical thinking, problem-solving, and code.
COS 226 vs. COS 423

**COS 423.** Design and analysis of algorithms.

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

\[
\sum_{i=1}^{N} \sum_{j=i+1}^{N} \frac{2}{j - i + 1} = 2 \sum_{i=1}^{N} \sum_{j=2}^{N-i+1} \frac{1}{j} \\
\leq 2N \sum_{j=1}^{N} \frac{1}{j} \\
\sim 2N \int_{x=1}^{N} \frac{1}{x} \, dx \\
= 2N \ln N
\]

Emphasizes critical thinking, problem-solving, and rigorous analysis.
Why study algorithms?

Internet. Web search, packet routing, distributed file sharing, ...
Biology. Human genome project, protein folding, ...
Computers. Circuit layout, databases, caching, networking, 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, ...

We emphasize algorithms and techniques that are useful in practice.
Administrative stuff

Lectures.  [Kevin Wayne]
- Monday and Wednesday 11–12:20pm in Friend 006.
- Attendance is required.
- No electronic devices except to aid in learning.

Precept.  [Dan Larkin and Sachin Ravi]
- Thursday 4:30–5:20pm or Friday 11–11:50am in COS 105.
- Preceptor works out problems.
- Attendance is recommended.

Prerequisites.  COS 226 and COS 340, or instructor's permission.
Course website

- Syllabus.
- Office hours.
- Problem sets.
- Lecture slides.
- Electronic submission.
- ...

www.cs.princeton.edu/courses/archive/spring13/cos423
Grades

Problem sets.
- "Weekly" problem sets, due via electronic submission.
- Graded for correctness, clarity, conciseness, rigor, and efficiency.
- Use \textsc{\LaTeX} template for writing solutions.

Course grades.
- Primarily based on problem sets.
- Staff discretion used to adjust borderline cases.
- Undergrads: determined without considering grad students.
- Grads: determined using undergrad scale.
Collaboration

Collaboration policy. [see syllabus for full details; ask if unsure]

- Course materials (textbook, slides, handouts) are always permitted.
- No external resources, e.g., can't Google for solutions.

"Collaboration permitted" problem sets.

- You may discuss ideas with classmates.
- You must write up solutions on your own, in your own words.

"No collaboration" problem sets.

- You may discuss ideas with course staff.
Where to get help?

**Textbook.** Read the textbook—it's good!

**Piazza.** Online discussion forum.
- Low latency, low bandwidth.
- Mark as private any solution-revealing questions.

**Office hours.**
- High bandwidth, high latency.
- See web for schedule.

Where to get help?

- [www.piazza.com/class#spring2013/cos423](http://www.piazza.com/class#spring2013/cos423)
- [www.cs.princeton.edu/courses/archive/spring13/cos423](http://www.cs.princeton.edu/courses/archive/spring13/cos423)
Questions?