COS 423, Spring 2018

Theory of Algorithms

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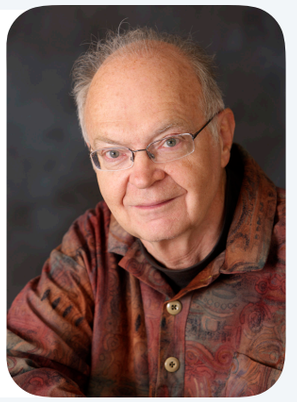
Algorithm definition

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

— Donald Knuth



COS 226 vs. COS 423

COS 226. Implementation and consumption of classic algorithms.

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

```
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]) swap(a, lt++, i++);
      else if (a[i] > a[lo]) swap(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.

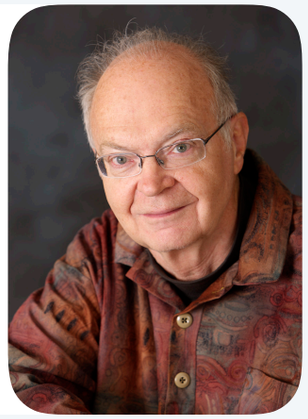
- Greed.
- Divide-and-conquer.
- Dynamic programming.
- Duality.
- Data structures.
- Intractability.

$$\begin{aligned}
\sum_{i=1}^{n} \sum_{j=i+1}^{n} \frac{2}{j-i-1} &= 2 \sum_{i=1}^{n} \sum_{j=2}^{n-i+1} \frac{1}{j} \\
&\leq 2n \sum_{j=1}^{n} \frac{1}{j} \\
&\sim 2n \int_{x=1}^{n} \frac{1}{x} dx \\
&= 2n \ln n
\end{aligned}$$

Emphasizes critical thinking, problem-solving, and rigorous analysis.

Why study algorithms?

" Algorithms are the life-blood of computer science… the common denominator that underlies and unifies the different branches. " — *Donald Knuth*



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. Particle collision simulation, n-body simulation, ...

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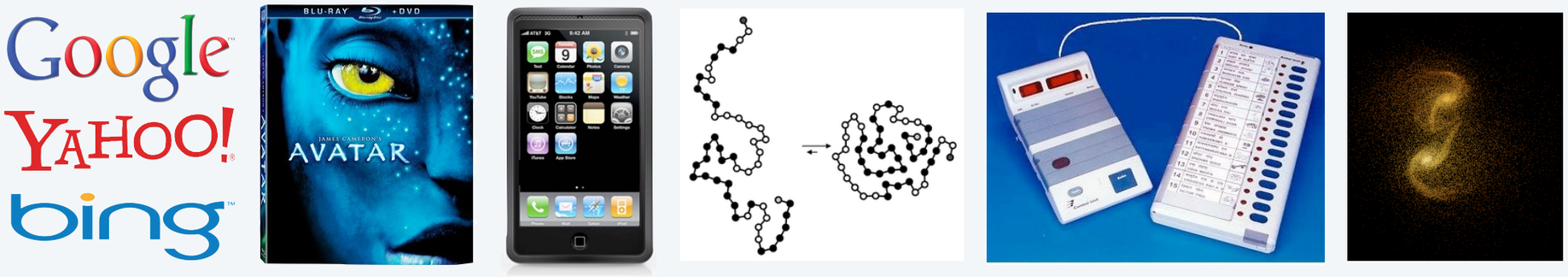
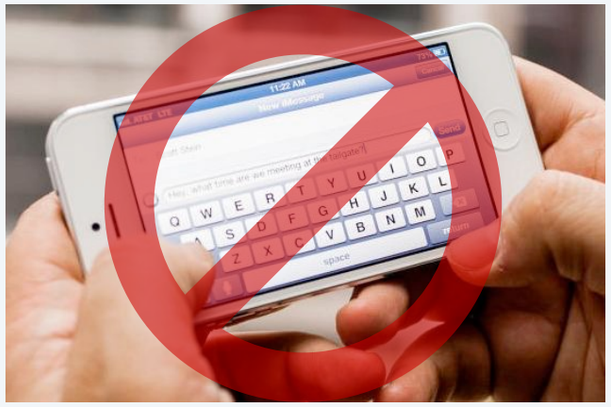


We emphasize algorithms and techniques that are useful in practice.

Lectures

- Monday and Wednesday 11–12:20pm in Green 0-S-6.
- Attendance is required.
- No electronic devices except to aid in learning. ← viewing lecture slides taking notes



iClicker

Student response system (required).

- Register your iClicker in Blackboard.
- Available at Labyrinth Books ($30).
- Use only one device per lecture.

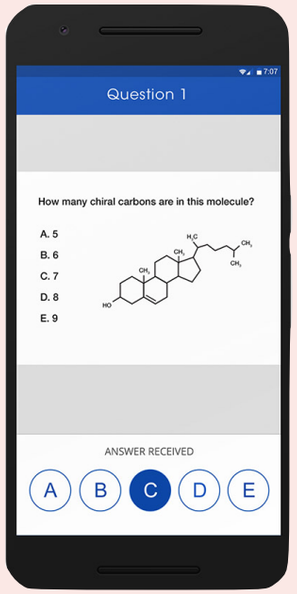
Which model of iClicker are you using?

A. iClicker.

B. iClicker+.

C. iClicker 2.

D. iClicker Reef.



TECHNICAL JOB INTERVIEW QUESTIONS

Google

IBM

facebook

Nintendo

Cisco Systems

JANE STREET

Morgan Stanley

NETFLIX

Adobe

RSA SECURITY™

D E Shaw & Co

ORACLE

PANDORA

Akamai

YAHOO!

amazon

Microsoft

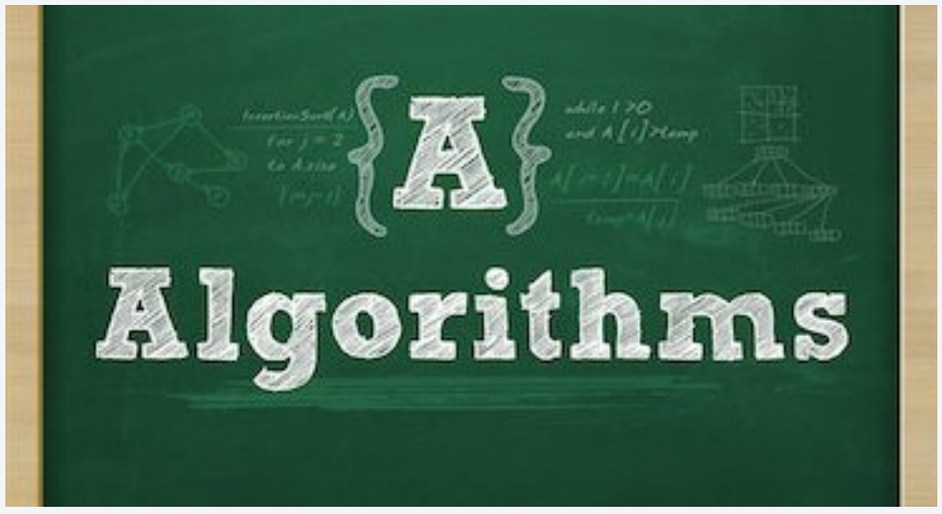
PIXAR ANIMATION STUDIOS

Precepts

- Friday 11–11:50am in Friend 004 or
  Monday 7:30–8:20pm in Friend 006.

precept begins Friday/Monday

- Preceptor solves problems and answers questions.
- Attendance is strongly recommended.

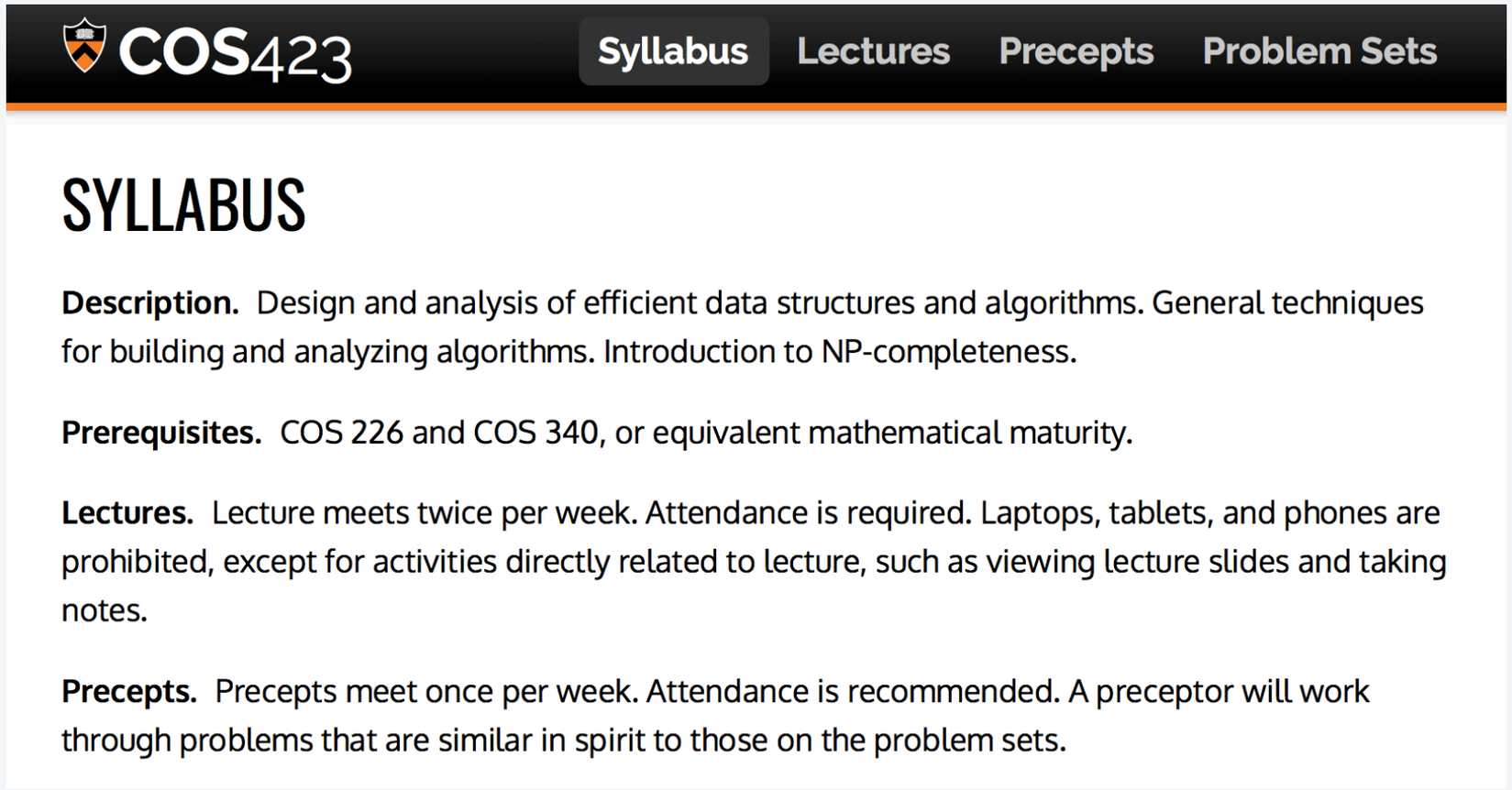


Qasim Nadeem

James Bartusek

Course website

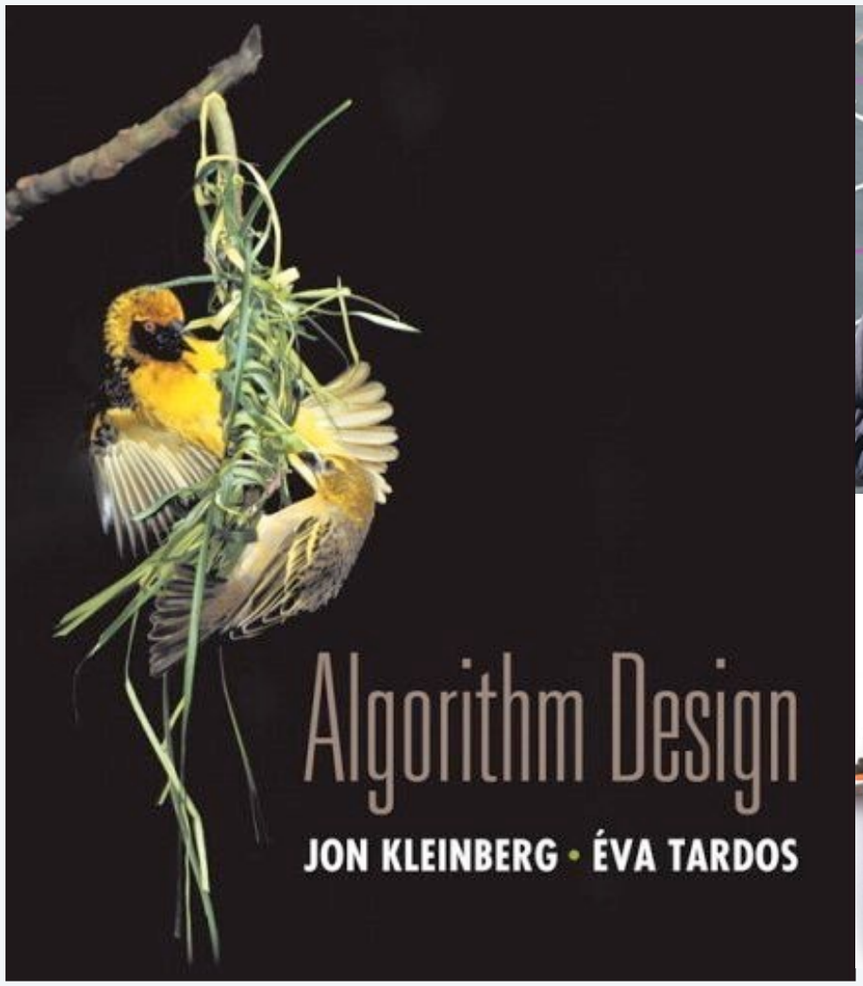
- Office hours.
- Problem sets.
- Lecture slides.
- Course policies.
- Electronic submission.
- ...

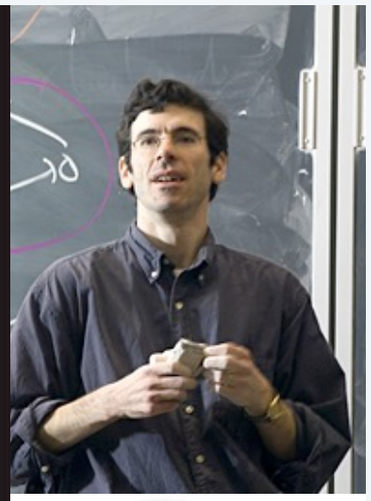


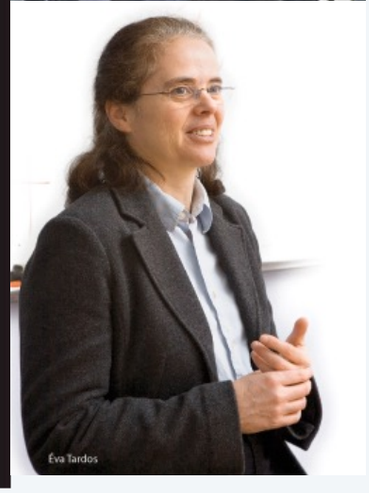
www.cs.princeton.edu/courses/archive/spring18/cos423

Textbook

Required reading. *Algorithm Design* by Jon Kleinberg and Éva Tardos. Addison-Wesley 2005, ISBN 978-0321295354.







Grades

Problem sets.

- "Weekly" problem sets, due via electronic submission. ← problem set 1 is due due Wednesday 2/14
- Graded for correctness, efficiency, rigor, clarity, and conciseness.
- Use LaTeX template for writing solutions.

Course grades.

- Primarily based on problem sets.
- iClicker participation.
- Staff discretion used to adjust borderline cases.

Collaboration

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

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

"Collaboration permitted" problem sets.

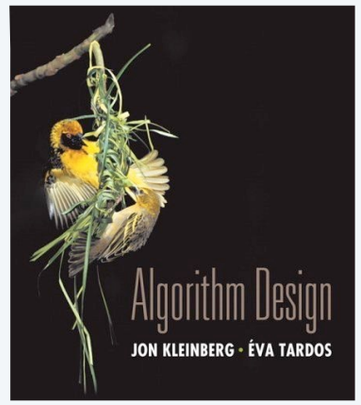
- You may discuss ideas with classmates.
- You must write up solutions on your own, in your own words.

"No collaboration" problem sets.

- You may discuss ideas with course staff only.

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.

piazza

www.piazza.com/princeton/spring2018/cos423

Office hours.

- High bandwidth, high latency.
- See course website for schedule.

www.cs.princeton.edu/courses/archive/spring18/cos423

Questions?

Not registered? Get registered.

Haven't taken COS 226 and COS 340? See me.