CSEp521: Algorithms

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Algorithms

- A recipe for mapping inputs to outputs efficiently
- Studied long before there were computers
- Eg: Gaussian elimination, gcd, multiplication …
- How to design algorithms?
- How to analyze efficiency and prove correctness?

Algorithms: Why?

Physics is like sex: sure it may give some practical results, but that's not why we do it.

-Richard Feynman

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Skills you will learn:

- how to communicate your algorithms
- how to convince others that they work

Algorithms: Why?

Goal: be able to

- Describe a correct algorithm
- Describe a correct algorithm that other people can implement
- Describe a correct algorithm that other people can implement and understand

Approximate Schedule

Weeks 1-2: Introductions, asymptotics, some basic algorithms. Graphs, trees, connectivity, testing bipartiteness.

Weeks 2/3: Greedy algorithms for Interval Scheduling, Minimum Spanning Tree, Set Cover, Vertex Cover

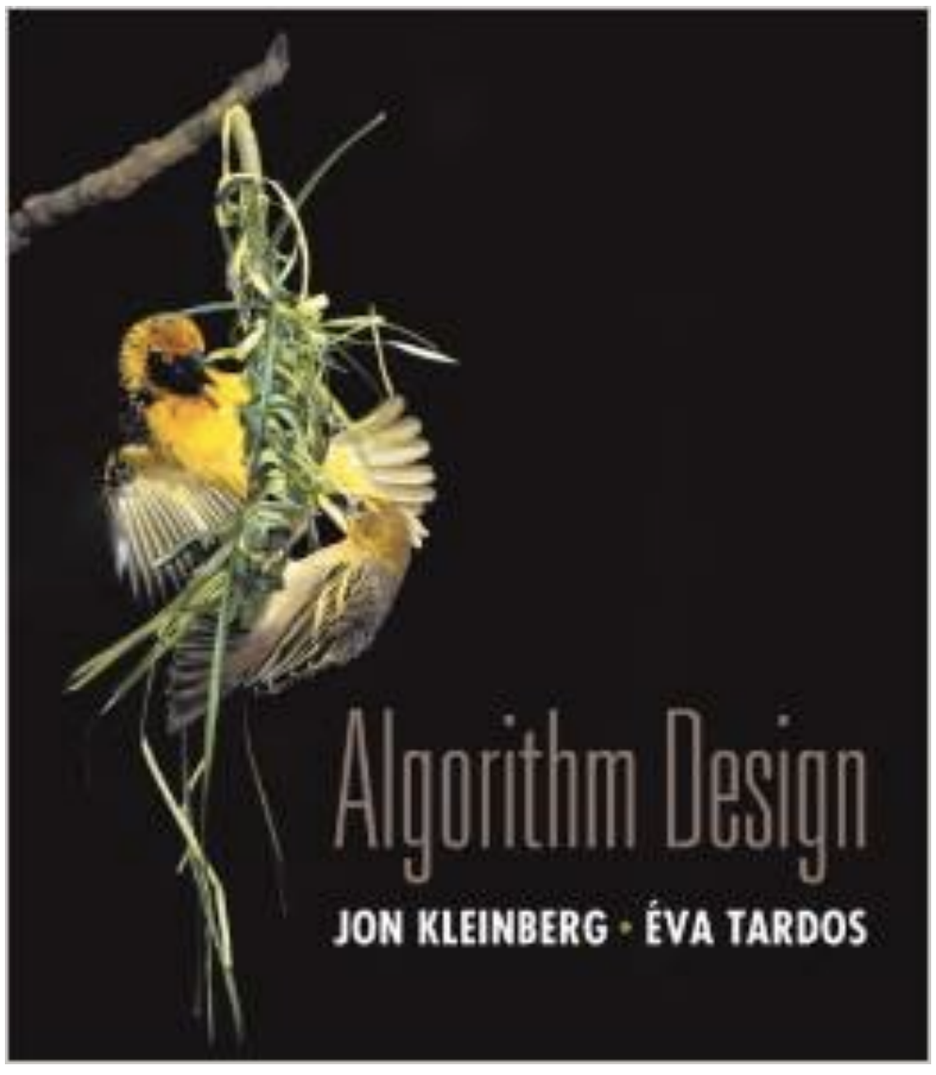
Weeks 4/5: Divide and Conquer. Algorithms for Sorting, Selection, Closest, Multiplication. Midterm

Week 6: Dynamic Programming. Algorithms for Edit Distance, Longest Path, Knapsack.

Week 7: Flows and Cuts. Algorithms for Matching, Graph Partitioning.

Weeks 8-10: Linear programming, Randomized algorithms, Semidefinite programming

Text Book



Everything you need to know will be in slides. Videos of lectures will be posted on website.

Evaluation

Final: 35%

Take home

Midterm: 25%

Take home

Homework every week: 40%

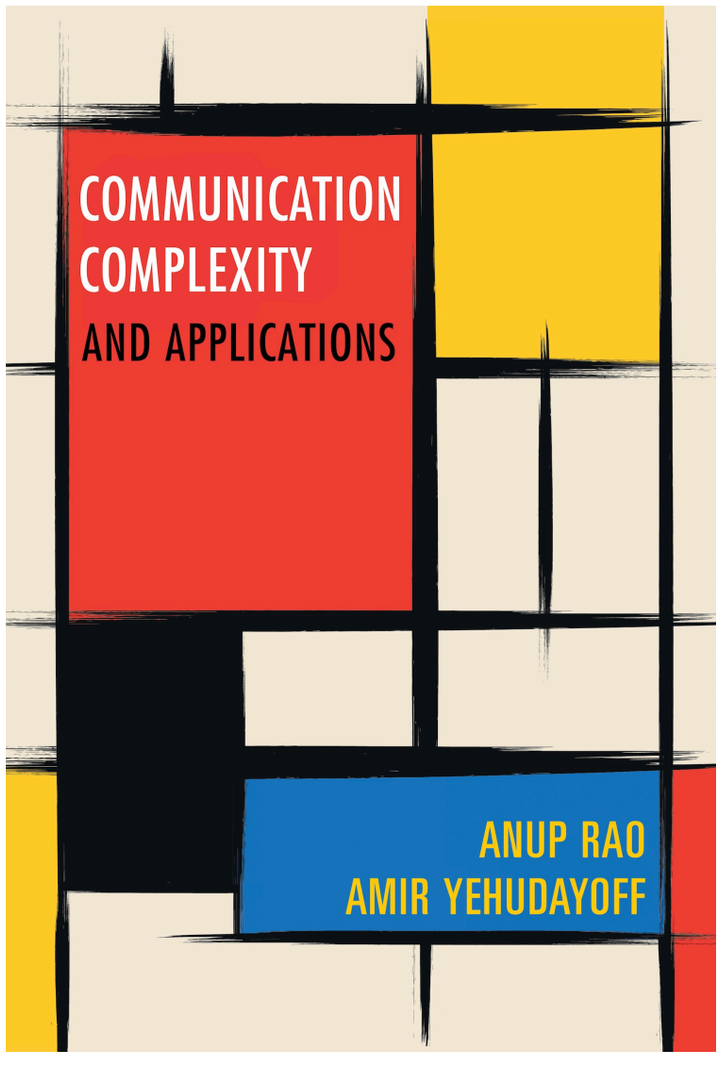
-You must write up solutions by yourself, but you can/should discuss homework with others.

To get the most out of this class...

- Start working on the homework early, problems are often deceptively hard.
- Talk to {professor, TA, students}. Brainstorming sessions really really help!

Anup's research: Communication Complexity

If two or more people need to compute a function that depends on all their inputs, how long does their conversation need to be?



A recent result

Thm: Suppose $A, B \subseteq \{\pm 1\}^n$, X uniform in A, Y uniform in B. Then as long as $|A| \cdot |B| \geq 2^{1.01n}$, for any number k,

$$\Pr_{X,Y}[\langle X, Y \rangle = k] \leq O(1/\sqrt{n}) .$$