

Announcements

Section plans: week of May 4-5: quiz + review of material since the prelim

Final (cumulative): Saturday May 9th at 9am.

If you have a conflict, please fill out [this form](#) ASAP

Final info on canvas, solutions will be posted Tuesday
↑ with a few practice questions

Practice final and more practice questions will be posted later today, with solutions posted Thursday

Thursday May 7, 3-7pm, in Hollister B14: final review led by a few TAs

Please fill out course evaluation: especially comments on sections

[TA application](#) deadline has been extended: due May 10th

Office hour schedule: see Web: M, T, R morning, F as usual, few on W

Courses and topics related

x8xx
related to algo
math contents

Next year:

4814: complexity in the fall

4830: crypto in the spring

2850: Networks (INFO 2040), fall

6850: The Structure of
Information Networks, fall

6820: graduate Algorithms,
spring

Beyond next year

4813: quantum computing

4850: Probability, Vectors, and
Matrices in Computing

6840: Algorithmic Game Theory

New course: Modern
Algorithmic toolbox

Other Area of Algorithms

Online Algorithms

- Matching problem on hw9
- Uber/lyft

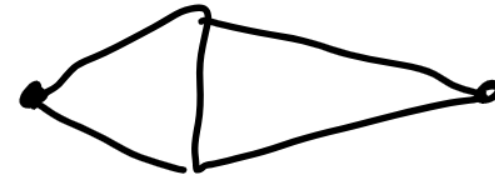


- Google ads

Algorithmic Game Theory

6840

- Selfish routing



- Ad auctions

Plan today: review for final plus a bit on algorithms/complexity beyond 4820

Topics

- Pc1* {
- Greedy
 - Dynamic programming
 - Divide and Conquer
- Pc2* {
- Stable matching
 - Flows and Cuts

- NP-completeness
 - Approximation algorithms
 - Use of hardness in crypto
 - computability
- since prelim 2*

Algorithm Design

- Greedy *
 - Dynamic programming
 - Divide and Conquer
 - Stable matching
 - Flows and Cuts, Matching
 - Approximation *
- } prelim 1
- } prelim 2

Proofs

Proving algorithms correct

Reductions

- NP-completeness
- computability

- not recognizable: ω -halting: "is given (M, x) will run forever"
- not decidable: reduction to halting
or section or hw problems

Problem

is it in P or NP-complete

given $G = (V, E)$ $s, t \in V$

(a) $\exists?$ $s-t$ path using $\leq k$ edges

(b) $\exists?$ $s-t$ path using $\geq k$ edges

(a) shortest path $\in P$

(b) $k = n-1$ Mem. Path

Approximation example: knapsack

n items v_i value w_i weight weight limit W

find subset I $\sum_{i \in I} w_i \leq W$ & $\max \sum_{i \in I} v_i = \text{OPT}$

Assume $w_i \leq W/2$ give 2-approx

Alg: sort v_i/w_i decreasing order & add till it fits

Claim this is 2 approx

Claim 1 if we can cut last item to make total W

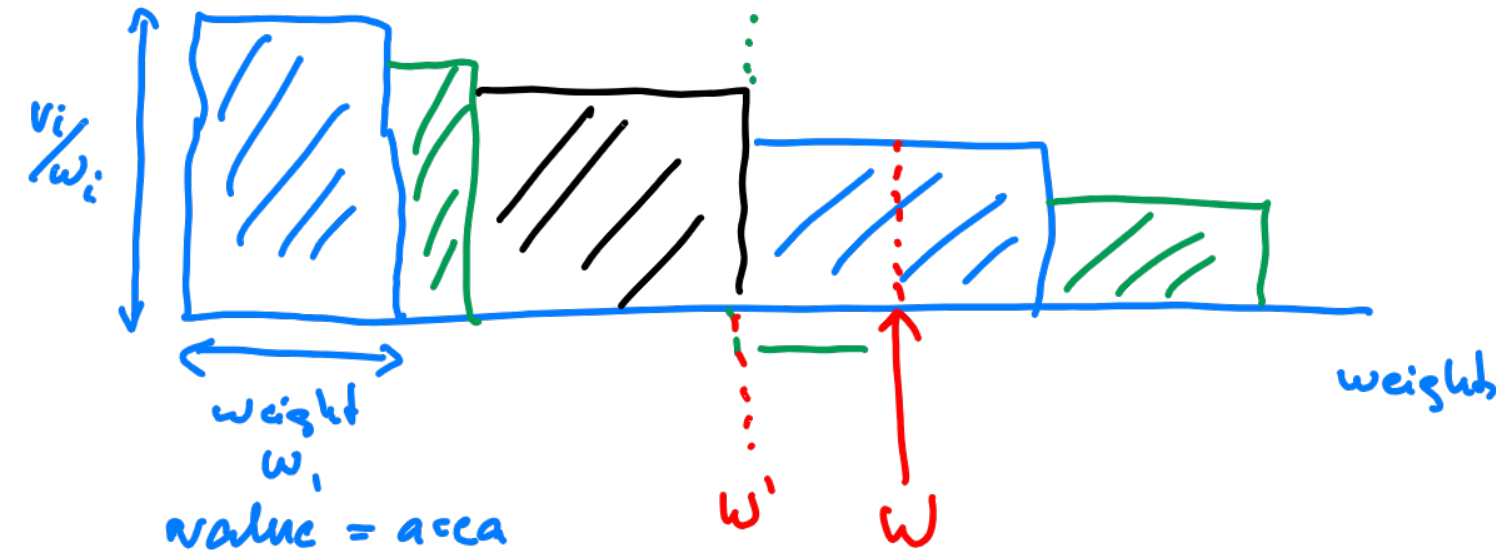
\Rightarrow resulting solution optimal

\Rightarrow upper bound.

Claim 2: total weight $\geq W/2$

due to $w_i \leq W/2$

\Rightarrow value optimal for $W/2 \Rightarrow \geq \frac{1}{2} \text{OPT}$



Approximation example: ~~knapsack~~

bounds on OPT
- load balancing



t_1, \dots, t_n

$$\text{OPT} \geq \frac{1}{k} \sum_i t_i$$

- knapsack

- vertex cover

$x_i \in \{0, 1\}$ if v taken or not

trivial bound

load balancing

$$\text{OPT} \geq \max_i t_i$$

Join by Web PollEv.com/evatardos772



Weights $w_i \leq W/3$ what does greedy achieve

A: 2-approx

B: $3/2$ approx

C: optimal

D: I have no clue

Fast item $w/3$ max

\Rightarrow knapsack $\geq 2/3 W$ full