

Scientific Computing

Announcements

Feb 19, 2025

- HW 3 assigned today
due in two weeks, March 5
- Wednesday, March 5 is also the in-person
midterm exam
- Friday, March 7, no lecture, extra office hours
while you work on take-home (time TBD)

Today

- Backtracking

Office Hours:

Mon + Fri

9:30am - 10:30am

Cudahy 307

Topic 7 - Backtracking

Like Divide+Conquer, Backtracking is a framework for finding the optimal solution in a search space without checking every candidate one-by-one.

Very simple idea: Build solutions one part at a time, and give up when a partial solution violates the constraints.

Ex #1: Knapsack

Capacity: 10

item	weight	value
* 1	8	13 *
2	3	7
* 3	5	10
* 4	5	10
* 5	2	1
6	2	1
* 7	2	1

Search space: All subsets of $\{1, 2, 3, 4, 5, 6, 7\}$ ($2^7 = 128$)

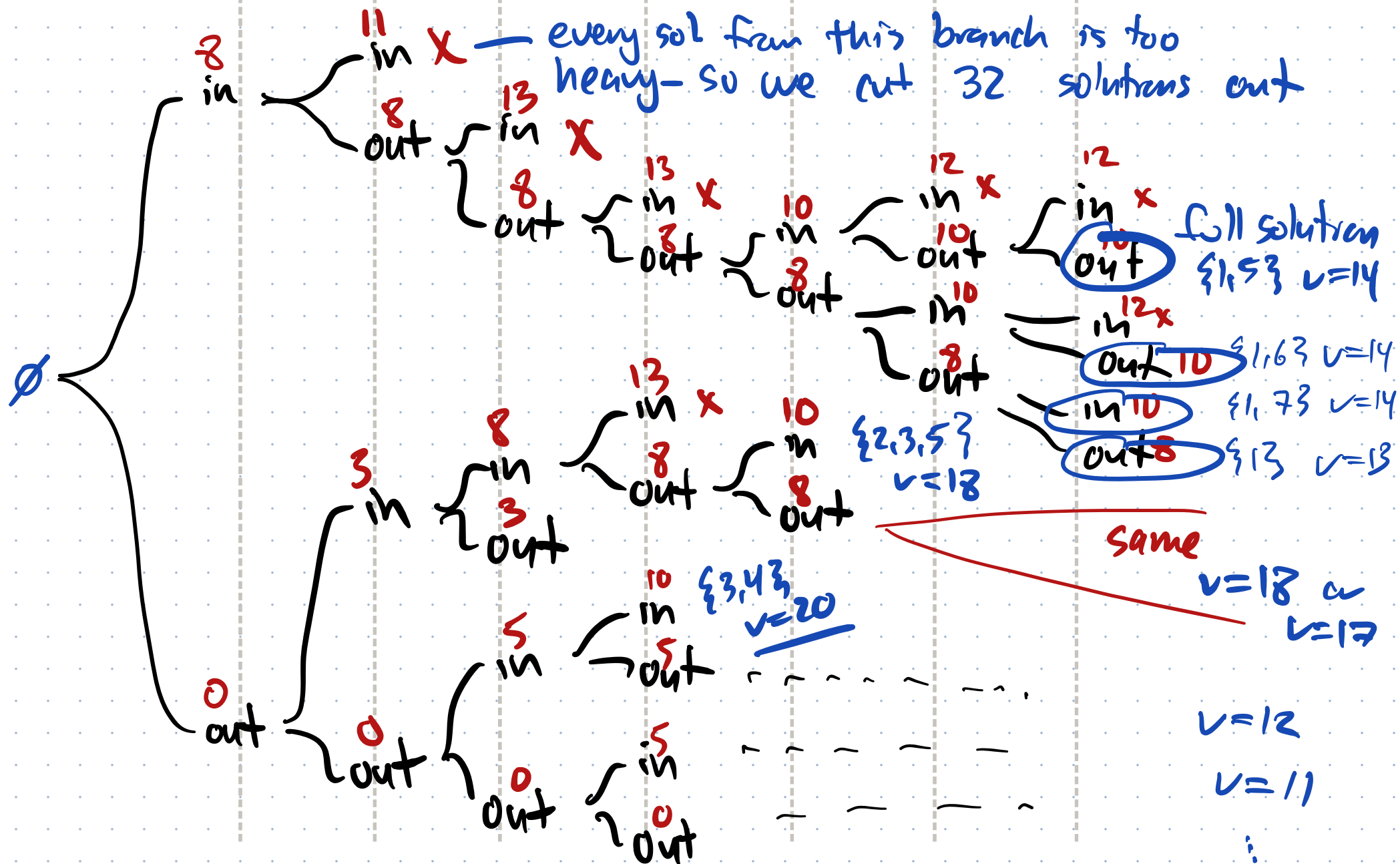
With brute force:

Possibilities: $\emptyset, \{1\}, \{2\}, \dots$
 $\{1, 3, 4, 5, 7\}, \dots$

not just too heavy, but
still too heavy if you
remove any single item,
so this is silly to even try!
128 possibilities

Waste of time to check $\{1, 3, 4, 5, 7\}$ because
 $\{1, 3, 4, 5\}$ was already too heavy

w/v
 $c=10$



Messy picture, but way better than brute force, especially with lots of items!

What are we doing?

- Putting a hierarchy on space (math: poset) / *partially built* decisions that builds the whole with the critical property that: if a candidate is bad, then the candidates below it must be bad.

So, we are checking or ruling out every candidate in the search space. In bad cases (high capacity, light items), we might not rule anything out, and so in the worst case this is as bad as brute force.

[demo]