Wed, Morch 9 - Day 19 Topic 8- Branch and Bound (continued) General Procedure: the search space or some subspace function bb(S, best_sol = None) (maximizing) if best_sol is None: best-score = - 00 C> returns best sol in the subspace S eke: best-score = Score (best-sol) if |S| = |: (the subspace only has a single |S| = |: (the subspace only has a single |S| = |: (the subspace only has a single |S| = |: (the subspace only has a single |S| = |: (the subspace only has a single |S| = |: (the subspace only has a single |S| = |candidate = the one thing in S bayl value = score (candidate) + candidate [USP if value > best_score: Satisfies the return candidate constraints eke: return best_sol > if bound(si) > best_score : do better best_sol = bb/s !!! #case where 5/71 * best_score = score (best_sol)

> if bound (Sz) > best-score: best_sol= bb (52, best_sol) return best sol I the either the best sol passed remore then in, or the best solution in S, whichever is better you get backtracking Keloration Let's try to figure out a bound for the knapsack problem. (apacity: 14 value weight ;tem Branching: just like 8 capacity: before value: 7 > item 1 is in or out 13 2 3)Ù -> item 2 is in or at 5 5 Ч 0 5 Bound: Suppose we have 2

decided item) is out

and item Z is in.

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2

2

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How can we find an upper bound on the best we could possibly do with the rest of the solution? * Greedy gol is not an UB, it's a LB. * Add up the value of everything
remaining is technically on UB,
but a not very good one.
* Computing the UB can't be too slow.

Capacity: 14				
;tem	pacity:14 Weight	value	The truck is	
~~~	-s-		relaxation.	
2	3	7	Sometimes its	
3	5	10	easier to find	
Ч	5	0	an up if you	
5	2	1	adjust the problem	
6	٢	(	to be move	
7	τ	1	permissible.	

Fractional Knappack: You are allowed to take fractions of items.

apacity:14 Stem weight value take				
<u>stem</u>	weight	value	take	
(	8	13	0.5 50% 416.5	
2	3	7	1 (00% 3/7	
3	5	10	1 100% 5/10	
Ч	5	0	04 40% 2/4	
5	2	1	14/27.5	
6	٢	(	19121.2	
7	τ	(		

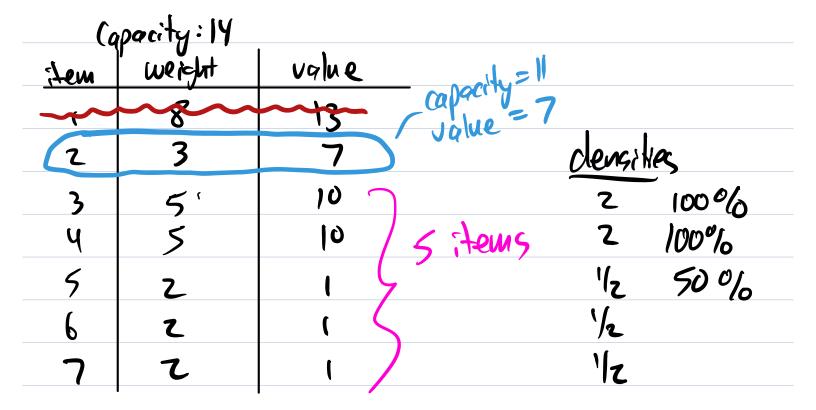
Theorem: A greedy and optimal solution to the Fractional Knapsack problem ran be found by: found by: (1) Order the items by weight, decreasing (2) take items from the top in full, until you can't anymore (3) take whatever fraction of the next item that you can.

(apacity: 14 value density order weight fem Y 13/8 8 3 2.5% 13 1.625 ( (1) 100% 3 7 2.333 2 100% 5 Ć 2 )Ù 3 5 5 Ч 5 ג (3) 100% 0 5 3 0.5 2_ 28.625 Ć) 6 J.S Z 7 0.5 2

If capacity = 10, you get an optimal Score of 21, which begts the optimal score of 20 for the regular knopsack problem with the some items.

Fractional Greedy = Fractional Optimal Z Regular Optimal

Therefore, we can get an UB for the regular knapsack problem by computing the greedy fractional solution on the remaining items.



capacity = 10 vglue: 7+10+10+ = 27.5

Capacity=10, B+B tree Greedy sol: (18) 20 (most value-deuse) И 3 Item 2 Item 1 bd:21 bd=17.67 in too hequy N 601:21 12:50 60:18 0yt 601:18 V 044 6d-20 ìN Value 20 pg:50 in out bd: 12.5 bd: 12.5 bd=21 Oy