

Midterm 2 Standard 22 - (Dynamic Programming) Backtracking to find solutions

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1 Instructions

- The solutions **should be typed**, using proper mathematical notation. We cannot accept hand-written solutions. Here's a short intro to \LaTeX .
- You should submit your work through the **class Canvas page** only. Please submit one PDF file, compiled using this \LaTeX template.
- You may not need a full page for your solutions; pagebreaks are there to help Gradescope automatically find where each problem is. Even if you do not attempt every problem, please submit this document with no fewer pages than the blank template (or Gradescope has issues with it).
- You **may not collaborate with other students**. **Copying from any source is an Honor Code violation. Furthermore, all submissions must be in your own words and reflect your understanding of the material.** If there is any confusion about this policy, it is your responsibility to clarify before the due date.
- Posting to **any** service including, but not limited to Chegg, Discord, Reddit, StackExchange, etc., for help on an assignment is a violation of the Honor Code.

2 Standard 22 - (Dynamic Programming) Backtracking to find solutions

2.1 Problem 1

Problem 1. Considering the following input and subsequent lookup table for the Knapsack problem with a capacity $W = 8$, identify and justify the optimal collection of items.

item:	1	2	3	4	5
value:	2	4	8	9	10
weight:	1	3	5	6	7

capacities:	0	1	2	3	4	5	6	7	8
{}	0	0	0	0	0	0	0	0	0
{1}	0	2	2	2	2	2	2	2	2
{1, 2}	0	2	2	4	6	6	6	6	6
{1, 2, 3}	0	2	2	4	6	8	10	10	12
{1, 2, 3, 4}	0	2	2	4	6	8	10	11	12
{1, 2, 3, 4, 5}	0	2	2	4	6	8	10	11	12

Answer. The optimal collection of items for a maximum weight $W = 8$ is items 1 and 5 or items 2 and 3. This is because items 1 and 5 have a combined weight of 8 and a combined value of 12 and items 2 and 3 also have a combined weight of 8 and a combined value of 12. The cell in the lookup table where capacity is 8 and the subset of items that can be used is $\{1, 2, 3, 4, 5\}$ has a maximum value of 12 which matches the combined value of both items 1 and 5 and items 2 and 3. \square