

PSG COLLEGE OF TECHNOLOGY
DEPARTMENT OF APPLIED MATHEMATICS AND COMPUTATIONAL SCIENCES
VI Semester MSc TCA
Work sheet – Dynamic Programming

1. Implement a 0/1 knapsack problem using DP for the following test case and find the items that are included in the knapsack

Knapsack capacity is 26 wt : 12 7 11 8 9 profit : 24 13 23 15 16 ans : 01110\

Hint : Knapsack can be used as a base for any resource allocation problem like finding maximum sum sub array, coin changing problem

2. Given a value N, if we want to make change for N cents, and we have infinite supply of each of $S = \{S_1, S_2, \dots, S_m\}$ valued coins, how many ways can we make the change? The order of coins doesn't matter.

For example, for $N = 4$ and $S = \{1, 2, 3\}$, there are four solutions:

$\{1, 1, 1, 1\}, \{1, 1, 2\}, \{2, 2\}, \{1, 3\}$. So output should be 4. For $N = 10$ and $S = \{2, 5, 3, 6\}$, there are five solutions: $\{2, 2, 2, 2, 2\}, \{2, 2, 3, 3\}, \{2, 2, 6\}, \{2, 3, 5\}$ and $\{5, 5\}$. So the output should be 5.

Hint : Any general DP model can be looked out for an optimal solution, using the below given formulation

The deterministic DPE (for minimization of an additive cost criteria) can be loosely written as

$$V_j(\text{current state}) = \min_{\text{all feasible decisions}} \{ \text{cost during the current stage} + V_{j+1}(\text{new state}) \}.$$

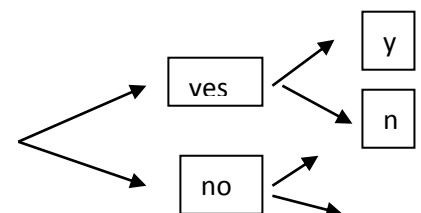
3. You are a freelance contractor and your available jobs change weekly. The jobs are split into two groups, ls and hs. If you choose a job from hs, you must prepare the week beforehand by taking no job. Ls jobs require no such preparation.

Determine your optimal plan of working, given two arrays l and h of size n where n is the amount of weeks.

	0	1	2	3	4
l	30	5	20	25	500
h	0	50	70	100	110

What is the optimal solution? 650

Hint : DP can also be approached with a binary tree like structure eg.



4. Suppose you are consulting for a company that manufactures PC equipment and ships it to distributors all over the country. For each of the next n weeks, they have a projected supply s_i of equipment (measured in kgs.) which has to be shipped by an air freight carrier.

Each week's supply can be carried by one of two air freight companies, A or B.

Company A charges a fixed rate r per kg (so it costs $r*s_i$ to ship a week's supply s_i)

Company B makes a contracts for a fixed amount c per week, independent of the weight. However, contracts with company B must be made in blocks of four consecutive weeks at a time.

A schedule for the PC company, is a choice of air freight compant (A or B) for each of the n weeks, with the restriction that company B, whenever it is chosen, must be chosen for blocks of four contiguous weeks at a time. The cost of the schedule is the total amout paid to company A and B, according to the description above.

Example : Suppose $r=1$, $c=10$ and the sequence of values is 11, 9, 9, 12, 12, 12, 12, 9, 9, 11

Find an optimal schedule.