

Lab-9 Solve Sum of Subset using OI knapsack

OI Knapsack Using DP

OI Knapsack(P, W, m)

{ /* Here let $P[1..n]$, $W[1..n]$ be arrays of Profits and weights respectively

n is the number of items */

/* Let T be 2-D Array of following

Dimension $T[0..n, 0..m]$ */

for $i = 0$ to n

{ $T[i][0] \leftarrow 0$; }

y

for $j = 1$ to m

{ $T[0][j] \leftarrow 0$; }

y

for $i = 1$ to n

{ for $j = 1$ to m

{ if $j \leq W[i]$

$T[i][j] \leftarrow T[i-1][j]$

else

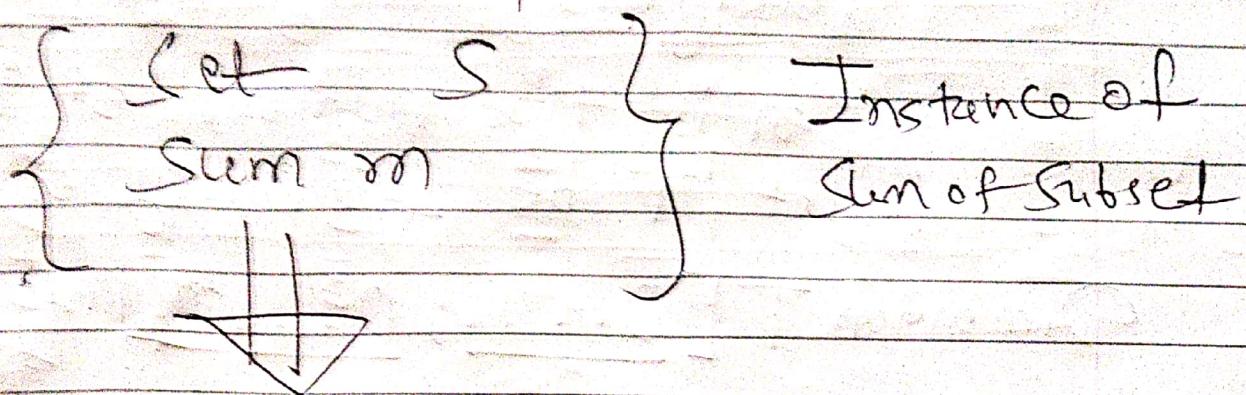
$T[i][j] \leftarrow \max\{T[i-1][j],$

$P[i] + T[i-1][j - W[i]]\}$

①

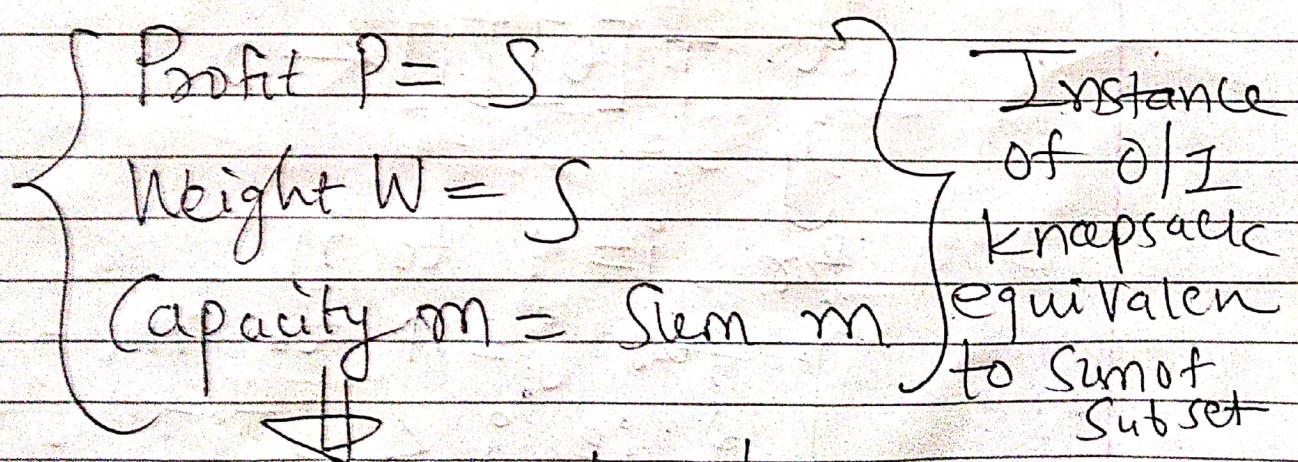
Return $T[n, m]$;

→ Now Sum of subset problem has two inputs



→ To solve sum of subset using 0/1 knapsack

→ We need to create instance of 0/1 knapsack from instance of sum of subset.



→ Now solve 0/1 knapsack using Dynamic Programming

(2)

→ If profit given by 0/1 knapsack i.e. profit value at last row, last column is same as Capacity then there exist atleast 1 subset which sums to m i.e. Capacity.

→ If profit returned is less than m then there doesn't exist any subset which sums to m.

$$JF T[n,m] == m$$

Yes

No

There exist at least 1 subset which sums to m

There is no subset which sums to m but there is subset such that its sum is less than m.

Find the subset using

Table T.

We assume that we give proper input for sum of subset i.e.

Sum $m <$ Sum of all the elements of Set S

③

★ Sum of Subset Instance

Set $S = \{10, 20, 30, 40\}$
 $m = 50$



Is there any subset of S which sums to 50?

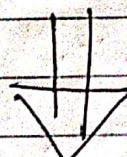


We want to solve it using 0/1 knapsack.

$$P = \{10, 20, 30, 40\} = S$$

$$W = \{10, 20, 30, 40\} = S$$

Capacity of knapsack = 50 = m



Now solve it using 0/1 knapsack
 Dynamic Programming algorithm.



Create a Table. Solve 0/1 knapsack.

Then using that try to get

The solution of Sum of Subset problem.

$$\text{P} = \{1, 2, 3, 4\}$$

$$W = \{1, 2, 3, 4\}$$

Capacity $m = 5$

\rightarrow capacity

	0	1	2	3	4	5
0	0	0	0	0	0	0
1	0	1	1	1	1	1
2	0	1	2	3	3	3
3	0	1	2	3	4	5
4	0	1	2	3	4	5

~~5~~ = 5 (m)

$$T[i, j] = \max \{ T[i-1, j],$$

$$P[i] + T[i-1, j-W[i]] \}$$

There exist at least 1 short

Initialize $T[0, 0] = 0$ i.e. 0th row to 0.

$T[0, 0] = 0$ i.e. 0th column to 0.

If $j < W[i]$

$$T[i, j] = T[i-1, j]$$

else

$$T[i, j] = \max \{ T[i-1, j], P[i] + T[i-1, j-W[i]] \}$$

Here $T[4, 5] = 5$ = Desired sum

If has exact soln?

{1, 0, 0, 1} and {0, 1, 1, 0} are two solns

(5)

$$\frac{S}{2} = \{1, 4, 5\}$$

$$m = 8$$

↓

$$P = \{1, 4, 5\}$$

$$W = \{1, 4, 5\}$$

$$m = 8$$

Table	0	1	2	3	4	5	6	7	8
0	0	0	0	0	0	0	0	0	0
1	0	1	1	1	1	1	1	1	1
2	0	1	1	1	4	5	5	5	5
3	0	1	1	1	4	5	6	6	6

$$T[1,1] = \max \{ T[0,1], T[0,0] + y \}$$
$$= \max \{ 0, 0 + 1 \} = 1 \quad \text{No Subs exists}$$

$$T[1,2] = \max \{ T[0,2] - 0, T[0,2-1] + 1 \}$$
$$= 1$$

$$T[2,2] = \max \{ T[1,2], - + T[1,-ve]$$
$$= -$$

$$T[3,8] = \max \{ T[2,8], 5 + T[2,3] \}$$
$$= 6$$

⑥