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Assignment :

Knapsack problem using dynamic programming

Dynamic programming array :

	0	1	2	3	4	5	6	7	8	9	10
0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	30	30	30	30	30	30	30	30
2	0	0	0	30	45	45	45	75	75	75	75
3	0	0	25	30	45	55	70	75	75	100	100
4	0	0	25	36	45	61	70	81	91	106	111

when $i=0$; $v[0,0], v[0,1], v[0,2], v[0,3], v[0,4], v[0,5], v[0,6], v[0,7], v[0,8], v[0,9], v[0,10] = 0$

$j=0$; $v[0,0], v[1,0]\ v[2,0], v[3,0], v[4,0] = 0$

1. $i=1, w_1=3, p_1=30$

$j=1 \Rightarrow v[1,1] = v[0,1] = 0$

$j=2 \Rightarrow v[1,2] = v[0,2] = 0$

$j=3 \Rightarrow v[1,3] = \max\{v[0,3], v[0,0]+30\} = 30$

$j=4 \Rightarrow v[1,4] = \max\{v[0,4], v[0,1]+30\} = 30$

$j=5 = v[1,5] = \max\{v[0,5], v[0,2]+30\} = 30$

$j=6 = v[1,6] = \max\{v[0,6], v[0,3]+30\} = 30$

$j=7 \Rightarrow v[1,7] = \max\{v[0,7], v[0,4]+30\} = 30$

$j=8 \Rightarrow v[1,8] = \max\{v[0,8], v[0,5]+30\} = 30$

$j=9 \Rightarrow v[1,9] = \max\{v[0,9], v[0,6]+30\} = 30$

$j=10 \Rightarrow v[1,10] = \max\{v[0,10], v[0,7]+30\} = 30$

II: $i=2, \quad w_2=4, \quad P_2=45$

$j=1 \Rightarrow v[2,1] = v[1,1] = 0$

$j=2 \Rightarrow v[2,2] = v[1,2] = 0$

$j=3 \Rightarrow v[2,3] = v[1,3] = 30$

$j=4 \Rightarrow v[2,4] = \max\{v[1,4], v[1,0]+45\} = 45$

$j=5 \Rightarrow v[2,5] = \max\{v[1,5], v[1,1]+45\} = 45$

$j=6 \Rightarrow v[2,6] = \max\{v[1,6], v[1,2]+45\} = 45$

$j=7 \Rightarrow v[2,7] = \max\{v[1,7], v[1,3]+45\} = 45$

$j=8 \Rightarrow v[2,8] = \max\{v[1,8], v[1,4]+45\} = 45$

$j=9 \Rightarrow v[2,9] = \max\{v[1,9], v[1,5]+45\} = 45$

$j=10 \Rightarrow v[2,10] = \max\{v[1,10], v[1,6]+45\} = 75$

III: $i=3, \quad w_3=2, \quad P_3=25$

$j=1 \Rightarrow v[3,1] = v[2,1] = 0$

$j=2 \Rightarrow v[3,2] = \max\{v[2,2], v[2,0]+25\} = 25$

$j=3 \Rightarrow v[3,3] = \max\{v[2,3], v[2,1]+25\} = 30$

$j=4 \Rightarrow v[3,4] = \max\{v[2,4], v[2,2]+25\} = 45$

$j=5 \Rightarrow v[3,5] = \max\{v[2,5], v[2,3]+25\} = 55$

$j=6 \Rightarrow v[3,6] = \max\{v[2,6], v[2,4]+25\} = 70$

$j=7 \Rightarrow v[3,7] = \max\{v[2,7], v[2,5]+25\} = 75$

$j=8 \Rightarrow v[3,8] = \max\{v[2,8], v[2,6]+25\} = 75$

$j=9 \Rightarrow v[3,9] = \max\{v[2,9], v[2,7]+25\} = 100$

$j=10 \Rightarrow v[3,10] = \max\{v[2,10], v[2,8]+25\} = 100$

Step 4: $i=4$, $w_4=3$, $P_4=36$

$j=1 \Rightarrow v[4,1] = v[3,1] = 0$

$j=2 \Rightarrow v[4,2] = v[3,2] = 25$

$j=3 \Rightarrow v[4,3] = \max\{v[3,3], v[2,0]+36\} = 36$

$j=4 \Rightarrow v[4,4] = \max\{v[3,4], v[3,1]+36\} = 45$

$j=5 \Rightarrow v[4,5] = \max\{v[3,5], v[3,2]+36\} = 61$

$j=6 \Rightarrow v[4,6] = \max\{v[3,6], v[3,3]+36\} = 70$

$j=7 \Rightarrow v[4,7] = \max\{v[3,7], v[3,4]+36\} = 81$

$j=8 \Rightarrow v[4,8] = \max\{v[3,8], v[3,5]+36\} = 91$

$j=9 \Rightarrow v[4,9] = \max\{v[3,9], v[3,6]+36\} = 106$

$j=10 \Rightarrow v[4,10] = \max\{v[3,10], v[3,7]+36\} = 111$

We know that the optimal solution is

$$v[n,m] = v[4,10] = 111$$

expressing using n-tuple

x_1	x_2	x_3	x_4
0	0	0	0

Since $v[4,10] \neq v[3,10]$ 4th object selected

$i=3$, $j=7$, $x_4 = 1$

since $v[3,7] = v[2,7]$, 3rd object not selected

$i=2$, $j=7$, $x_3 = 0$

Since $v[2,7] \neq v[1,7]$, 2nd object selected

$i=1$, $j=3$ $x_2=1$

$v[1,3] \neq v[0,3]$, 1st object is selected

$i=0$, $j=0$, $x_1 = 1$

∴ objects 1, 2, & 4 are selected

~~to~~ ~~opt~~ for optimal solution.

i.e (1, 2, 4) = 111