

Tutorial - 7 Solutions

①

Q(1) Weighted Interval Selection / Activity Scheduling problem

(a)

Interval/activity	a	b	c	d	e	f
start point	0	1	5	2	8	9
end point	4	6	7	10	11	12
value(v)	2	4	4	7	2	1

(1) Sort the intervals w.r to finish/end point (in non-decreasing order)

1 2 3 4 5 6
a, b, c, d, e, f

(2) For every interval j ,
 Define $p(j) = i$, such that i is the largest index $i < j$,
 and ~~interval~~ intervals i and j
 do not overlap, if such i does
 not exist, then $p(j) = 0$.

$$p(1) = p(a) = 0$$

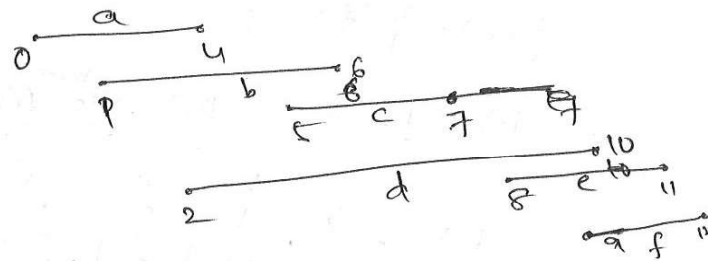
$$p(2) = p(b) = 0$$

$$p(3) = p(c) = 1$$

$$p(4) = p(d) = 0$$

$$p(5) = p(e) = 3$$

$$p(6) = p(f) = 2$$



$$M[0] = 0 \quad \& \quad M[j] = \max \left\{ M[j-1], v_j + M[p(j)] \right\}$$

for $j = 1, \dots, 6$.

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

Since $M[6] = M[5]$, interval 6 (f) is not in the solution

$M[6] \neq M[4]$, interval e is in the solution. However,

the interval d is not in the solution since $d \leftarrow e$ interval - sect.

$M[3] \neq M[2] \Rightarrow c$ in the solution, so b is not in the solution. Finally, a is also in the solution.

Sol.
 $\{a, c, e\}$

(b) ~~3~~ ~~5~~ ~~8~~ ~~9~~ ~~10~~ ~~11~~ ~~12~~ ~~13~~ ~~14~~ ~~15~~ ~~16~~ ~~17~~ ~~18~~ ~~19~~ ~~20~~ ~~21~~ ~~22~~ ~~23~~ ~~24~~ ~~25~~ ~~26~~ ~~27~~ ~~28~~ ~~29~~ ~~30~~ ~~31~~ ~~32~~ ~~33~~ ~~34~~ ~~35~~ ~~36~~ ~~37~~ ~~38~~ ~~39~~ ~~40~~ ~~41~~ ~~42~~ ~~43~~ ~~44~~ ~~45~~ ~~46~~ ~~47~~ ~~48~~ ~~49~~ ~~50~~ ~~51~~ ~~52~~ ~~53~~ ~~54~~ ~~55~~ ~~56~~ ~~57~~ ~~58~~ ~~59~~ ~~60~~ ~~61~~ ~~62~~ ~~63~~ ~~64~~ ~~65~~ ~~66~~ ~~67~~ ~~68~~ ~~69~~ ~~70~~ ~~71~~ ~~72~~ ~~73~~ ~~74~~ ~~75~~ ~~76~~ ~~77~~ ~~78~~ ~~79~~ ~~80~~ ~~81~~ ~~82~~ ~~83~~ ~~84~~ ~~85~~ ~~86~~ ~~87~~ ~~88~~ ~~89~~ ~~90~~ ~~91~~ ~~92~~ ~~93~~ ~~94~~ ~~95~~ ~~96~~ ~~97~~ ~~98~~ ~~99~~ ~~100~~ ~~101~~ ~~102~~ ~~103~~ ~~104~~ ~~105~~ ~~106~~ ~~107~~ ~~108~~ ~~109~~ ~~110~~ ~~111~~ ~~112~~ ~~113~~ ~~114~~ ~~115~~ ~~116~~ ~~117~~ ~~118~~ ~~119~~ ~~120~~ ~~121~~ ~~122~~ ~~123~~ ~~124~~ ~~125~~ ~~126~~ ~~127~~ ~~128~~ ~~129~~ ~~130~~ ~~131~~ ~~132~~ ~~133~~ ~~134~~ ~~135~~ ~~136~~ ~~137~~ ~~138~~ ~~139~~ ~~140~~ ~~141~~ 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Q(2) Case Knapsack size = 8

(3)

Item	A	B	C	D	E	F
profit	7	8	14	5	10	15
Size	2	1	5	2	4	3

Table $V[i][j]$, with 7 rows and 9 columns,
 ~~Knapsack size~~ of knapsack

		0	1	2	3	4	5	6	7	8
Item	0	0	0	0	0	0	0	0	0	0
A 1	0	0	7	7	7	7	7	7	7	7
B 2	0	8	8	15	15	15	15	15	15	15
C 3	0	8	8	15	15	15	22	22	29	
D 4	0	8	8	15	15	17	22	22	29	
E 5	0	8	8	15	15	18	22	25	29	
F 6	0	8	8	15	23	23	30	30	33	

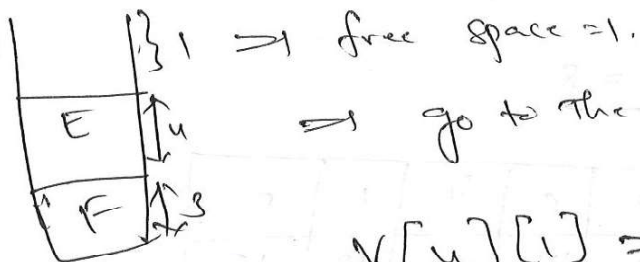
$$V[0][w] = 0 \text{ \& } V[i][0] = 0 \text{ for all } i$$

$$V[i][w] = \max \left\{ V[i-1][w], V_i + V[i-1][w-s_i] \right\} \text{ if } w \leq s_i$$

$\therefore M[6][8] = 33$. So, the optimal value = 33.

$M[6][8] > M[5][8] \Rightarrow$ item 6 (F) is picked.

\therefore only size 5 is left free in knapsack, so go to the cell $V[5][5] \Rightarrow$ item 5 (E) is picked.



(u)

\Rightarrow go to the cell $V[u][1]$

$V[u][1] = V[3][1]$, so item 4 is not picked

$\Rightarrow \cancel{V[3][1]} = V[2][1] \Rightarrow$ item 3 is also not picked

$\Rightarrow V[2][1] > V[1][1] \Rightarrow$ item 2 is picked $\in CB$

4 Bag is full.

\Rightarrow optimum set of items

$= \{B, E, F\}$ with

Value = 33.

Q(2) (b)

Knapsack size = 12

(5)

item	A	B	C	D	E
profit	24	13	23	15	16
size	5	6	4	8	7

V[i][j]

w (size of Knapsack)

	0	1	2	3	4	5	6	7	8	9	10	11	12
0	0	0	0	0	0	0	0	0	0	0	0	0	0
A 1	0	0	0	0	0	24	24	24	24	24	24	24	24
B 2	0	0	0	0	0	24	24	24	24	24	24	24	24
C 3	0	0	0	0	23	24	24	24	24	47	47	47	47
D 4	0	0	0	0	23	24	24	24	24	47	47	47	47
E 5	0	0	0	0	23	24	24	24	24	27	47	47	47

$$V[0][w] = 0, V[i][0] = 0$$

$$V[i][w] = \max \left\{ V[i-1][w], V[i-1][w-s_i] + V[i][s_i] \right\} \text{ if } w \leq s_i$$

$$\Rightarrow V[5][12] = 47 \Rightarrow \text{optimum value} = 47$$

$$V[5][12] = V[4][12] = V[3][12] \Rightarrow \text{items E (5) \& D (4) are not picked into the solution}$$

$$V[3][12] > V[2][12] \Rightarrow \text{item 3 (C) is picked into the solution}$$

$$\left. \begin{array}{l} 8 \\ \text{u} \end{array} \right\} 12 \therefore \text{Bag free space} = 8 \text{ and need to fill with items from 1, 2, 3}$$

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⇒ Then look at cell $V[2][8]$.

$$V[2][8] = 24$$

$V[2][8] = V[1][8]$, ⇒ Item 2 (8) is not picked into the solution

⇒ But $V[1][8] > V[0][8]$ ⇒ Item 1 is picked (A)

12

A

C

8

3

Free = 4, Bag is not full, but no items left to pick

⇒ Solution = { A, C } with profit = 47

$$0 = [2][2] V[2][2]$$