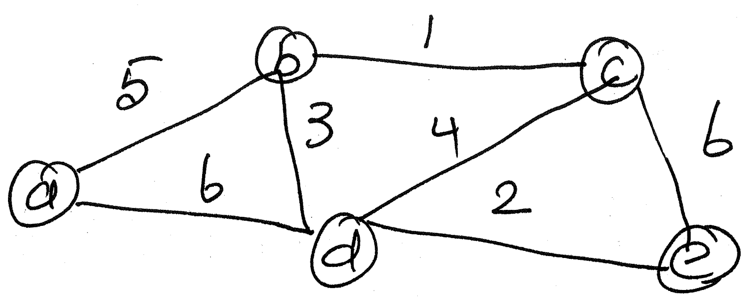
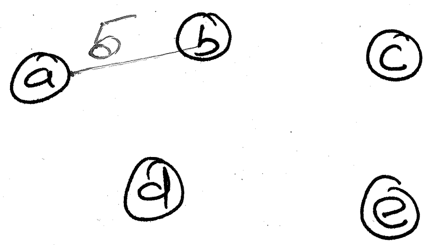
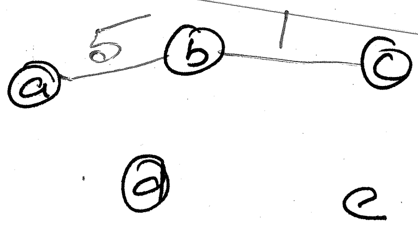
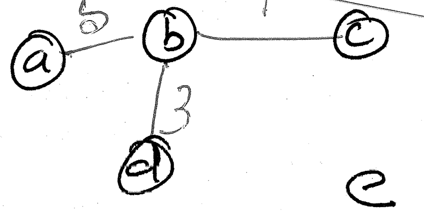
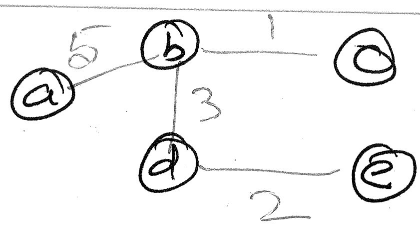
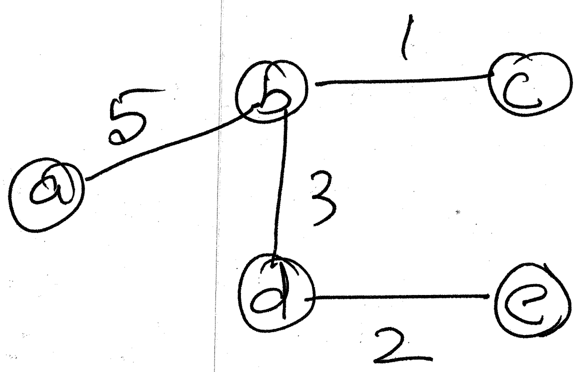
Prim's Minimum Spanning Tree



Tree vertices	Remaining vertices	Illustration	Reasons
a(−,−)	b(a,5), c(−,∞) d(a,6), e(−,∞)		There Exist direct path from (a,b) & (a,d). ∵(a,b) has min value. ~~consider that vertex as next starting~~ Make an Edge Connection with (a,b)
b(a,5)	c(b,1), d(b,3) e(−,∞)		(b,c) has min value. Make an Edge connection and Check it forms cycle or not. if it does not form cycle make Edge Connection.
c(b,1)	d(c,4) }, d(b,3) }, e(c,6)		(c,d) and (b,d). From c to d it has value 4. but (b,d) has min value 3. Since b is already in min state. So choose (b,d) make an Edge & check it forms cycle or not. if it does not form cycle make an Edge connection

Tree vertices	Remaining vertices	Illustration	Reason
d(b,3)	e(d,2)		

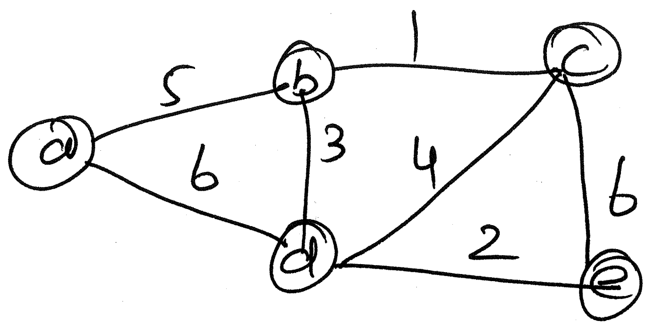
Final minimum Spanning tree is

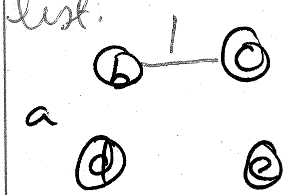
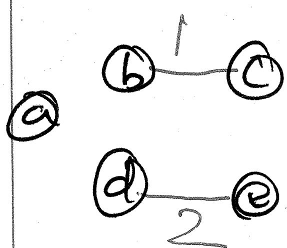
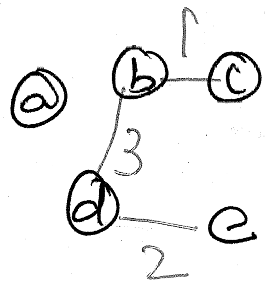
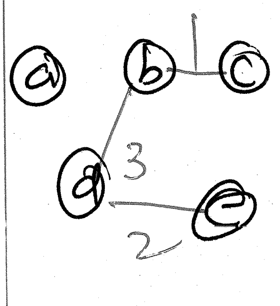


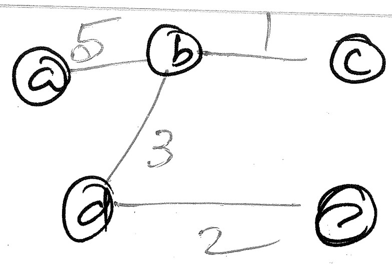
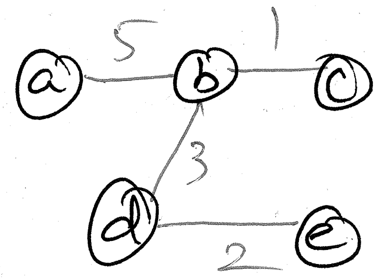
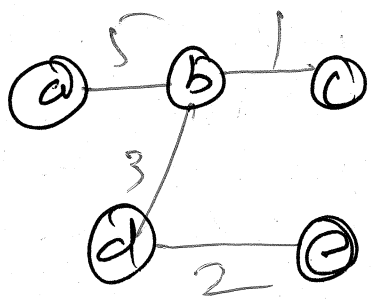
Minimum Spanning Tree Value = 5+1+3+2

= 11

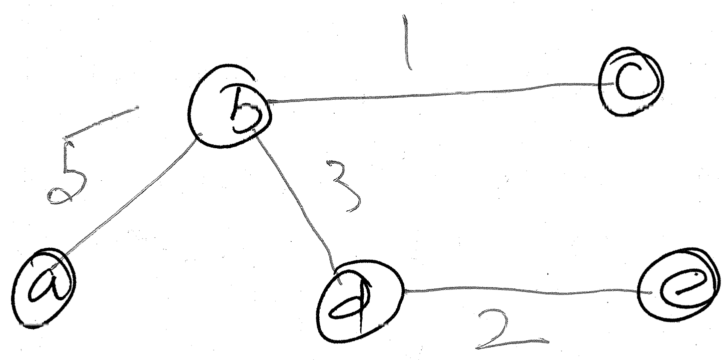
Kruskal's Algorithm



Tree Edges	Sorted List of Edges	Illustration	Reason
	write down the Edge values in Ascending order.		
	bc de bd cd ab ad cd 1 2 3 4 5 6 6		
	Choose First min value from the given list. (Value is 1)		
bc 1	Choose Next min value (Value is 2), make an Edge connection and check it form cycle or not. if it doesn't form cycle make Edge connection		
de 2	Choose next min value (Value is 3), make an Edge connection and check it forms cycle or not.		
bd 3	Choose next min value (Value is 4) and make Edge connection, before Check it forms cycle not.		
cd 4	if we add (c,d) it forms cycle, discard that vertex.		

Tree Edges	Sorted list of Edges	Illustration	Reason
ab 5	Choose next min Value (value is 5) and make an Edge Connection also Check it forms cycle or not.		
ad 6	Choose next min Value (value is 6) and make an Edge connection. it forms cycle. so discard that vertex		
cd 6	Choose next min Value (value is 6) and make an Edge Connection. it forms cycle. so discard that vertex		

Final Kruskal's MST is



Knapsack using Dynamic programming

item	weight	Value
1	3	25
2	2	20
3	1	15
4	4	40
5	5	50

Knapsack Capacity
$W = 6$

I Define Initial Condition

$P(0, j) = 0$ for $j >= 0$
$P(i, 0) = 0$ for $i >= 0$

$P(0,0) = 0$	$P(1,0) = 0$
$P(0,1) = 0$	$P(2,0) = 0$
$P(0,2) = 0$	$P(3,0) = 0$
$P(0,3) = 0$	$P(4,0) = 0$
$P(0,4) = 0$	$P(5,0) = 0$
$P(0,5) = 0$	$P(6,0) = 0$
$P(0,6) = 0$	

II Compute $P(i, j)$

$P(i,j) = P(i-1, j)$ if $j - w_i < 0$

$P(i,j) = \max\{P(i-1,j),\ P_i + P(i-1, j-w_i)\}$ if $j - w_i >= 0$

III Compute

$P(1,1) = 0$
$P(1,2) = 0$
$P(1,3) = 25$
$P(1,4) = 25$
$P(1,5) = 25$
$P(1,6) = 25$

$w_1 = 3 \quad P_1 = 25$

$$P(1,1) = P(i-1,j) \text{ if } j - w_i < 0$$
$$= P(0,1) \qquad 1 - 3 < 0$$
$$\boxed{P(1,1) = 0}$$

$$P(1,2) = P(i-1,j) \text{ if } j - w_i < 0$$
$$= P(0,2) \qquad 2 - 3 < 0$$
$$\boxed{P(1,2) = 0}$$

$$P(1,3) = P(i-1,j) \text{ if } j - w_i < 0$$
$$3 - 3 < 0 \text{ Fails}$$

So use

$$= \max\{P(i-1,j), P_i + P(i-1, j-w_i)\}$$
$$= \max\{P(0,3), P_1 + P(0,(3-3))\}$$
$$= \max\{P(0,3), P_1 + P(0,0)\}$$
$$= \max\{0, 25+0\}$$
$$\boxed{P(1,3) = 25}$$

$P(1,4) = P(i-1, j)$ if $j - w_i < 0$

$4 - 3 < 0$ fails

$= \max\{P(i-1, j), P_i + P(i-1, j-w_i)\}$

$= \max\{P(1-1, 4), P_1 + P(0, 4-3)\}$

$= \max\{P(0,4), 25 + P(0,1)\}$

$= \max\{0, 25\}$

$\boxed{P(1,4) = 25}$

$P(1,5) = P(i-1, j)$ if $j - w_i < 0$

$5 - 3 < 0$ fails

$= \max\{P(i-1, j), P_i + P(i-1, j-w_i)\}$

$= \max\{P(1-1, 5), P_1 + P(0, 5-3)\}$

$= \max\{P(0,5), 25 + P(0,2)\}$

$= \max\{0, 25\}$

$\boxed{P(1,5) = 25}$

$P(1,6) = P(i-1, j)$ if $j - w_i < 0$

$6 - 3 < 0$ fails

$= \max\{P(i-1, j), P_i + P(i-1, j-w_i)\}$

$= \max\{P(0,6), P_1 + P(0, 6-3)\}$

$= \max\{P(0,6), 25 + P(0,3)\} = \max\{0, 25\}$

$\boxed{P(1,6) = 25}$

IV compute

$P(2,0) = 0$

$P(2,1) = 0$

$P(2,2) = 20$

$P(2,3) = 25$

$P(2,4) = 25$

$P(2,5) = 45$

$P(2,6) = 45$

$$\overset{i}{P}(\overset{}{2},\overset{j}{0}) \overset{P(i-1,j))}{=} P(1,0) = 0 \quad 0 - \cdot$$

$$= \cancel{\max}\{P(i-1,j), P_i + P(i-1, j-w_i)\}$$

$$= \max\{P($$

$W_2 = 2 \quad P_2 = 20$

~~ou~~ if $j - w_i \geq 0$

$$P(\overset{i}{2},\overset{j}{1}) = \max\{P(i-1,j), P_i + P(i-1, j-w_i)\}$$

$$= \max\{P(1,1), P_2 + P(1, 1-2)$$

$$P(\overset{i}{2},\overset{j}{1}) = P(i-1,j) \text{ if } j - w_i < 0$$

$$= P(1,1)$$

$$\boxed{P(2,1) = 0}$$

$$P(\overset{i}{2},\overset{j}{2}) = \quad j - w_i$$

$$2 - 2 \geq = 0$$

$$= \max\{P(i-1,j), P_i + P(i-1, j-w_i)\}$$

$$= \max\{P(1,2), P_2 + P(1, 2-2)\}$$

$$= \max\{0, 20 + P(1,0)\}$$

$$= \max\{0, 20\}$$

$$\boxed{P(2,2) = 20}$$

$$\overset{i}{P}(\overset{i}{2},\overset{j}{3}) = \max\{P(i-1,j), P_i + P(i-1, j-w_i)\}$$

$j - w_i$

$3 - 2 < 0$ ×

$3 - 2 \geq 0$ ✓

$$= \max\{P(1,3), P_2 + P(1,1)\}$$

$$= \max\{25, 20+0\}$$

$$\boxed{P(2,3) = 25}$$

$$P(\overset{i}{2},\overset{j}{4}) = \max\{P(i-1,j), P_i + P(i-1, j-w_i)\}$$

$$= \max\{P(1,4), P_2 + P(1, 4-2)\}$$

$$= \max\{25, 20 + P(1,2)\}$$

$$= \max\{25, 20+0\}$$

$$\boxed{P(2,4) = 25}$$

$$P(\overset{i}{2},\overset{j}{5}) = \max\{P(i-1,j), P_i + P(i-1, j-w_i)\}$$

$$= \max\{P(1,5), P_2 + P(1,3)\}$$

$$= \max\{25, 20+25\}$$

$$\boxed{P(2,5) = 45}$$

$$P(\overset{i}{2},\overset{j}{6}) = \max\{P(i-1,j), P_i + P(i-1, j-w_i)\}$$

$$= \max\{P(1,6), P_2 + P(1, 6-2)\}$$

$$= \max\{25, 20+25\}$$

$$\boxed{P(2,6) = 45}$$

V Compute

$P(3,0) = 0$

$P(3,1) = 15$

$P(3,2) = 20$

$P(3,3) = 35$

$P(3,4) = 40$

$P(3,5) = 45$

$P(3,6) = 60$

$\overset{i\ j}{P(3,0)} = P(i-1,j)$

$= P(2,0)$

$w_3 = 1 \quad P_3 = 15 \quad \boxed{P(3,0) = 0}$

$\overset{i\ j}{P(3,1)} =$

$j - w_i < 0$

$j - w_i \geq 0$

$1 - 1 \geq 0$

$= \max\{P(i-1,j), P_i + P(i-1, j-w_i)\}$

$= \max\{P(2,1) + P_3 + P(2,0)\}$

$= \max\{0, 15+0\}$

$\boxed{P(3,1) = 15}$

$\overset{i\ j}{P(3,2)} = \max\{P(i-1,j), P_i + P(i-1, j-w_i)\}$

$= \max\{P(2,2), P_3 + P(2, 2-1)\}$

$= \max\{20, 15 + P(2,1)\}$

$= \max\{20, 15\}$

$\boxed{P(3,2) = 20}$

$$P(\overset{i}{3},\overset{j}{3}) = \max\{P(i-1,j), P_i + P(i-1, j-w_i)\}$$
$$= \max\{P(2,3), P_3 + P(2, 3-1)\}$$
$$= \max\{P(2,3), P_3 + P(2,2)\}$$
$$= \max\{25, 15 + 20\}$$
$$= \max\{25, 35\}$$
$$\boxed{P(3,3) = 35}$$

$$P(\overset{i}{3},\overset{j}{4}) = \max\{P(i-1,j), P_i + P(i-1, j-w_i)\}$$
$$= \max\{P(3-1,4), P_3 + P(3-1, 4-1)\}$$
$$= \max\{P(2,4), P_3 + P(2,3)\}$$
$$= \max\{25, 15 + 25\}$$
$$\boxed{P(3,4) = 40}$$

$$P(\overset{i}{3},\overset{j}{5}) = \max\{P(i-1,j), P_i + P(i-1, j-w_i)\}$$
$$= \max\{P(2,5), P_3 + P(2,4)\}$$
$$= \max\{45, 15 + 25\}$$
$$\boxed{P(3,5) = 45}$$

$$P(\overset{i}{3},\overset{j}{6}) = \max\{P(i-1,j), P_i + P(i-1, j-w_i)\}$$
$$= \max\{P(2,6), P_3 + P(2,5)\}$$
$$= \max\{45, 15 + 45\}$$
$$\boxed{P(3,6) = 60}$$

VI Compute

$P(4,0) = 0$

$P(A,1) = 15$

$P(A,2) = 20$

$P(A,3) = 35$

$P(4,4) = 40$

$P(4,5) = 55$

$P(4,6) = 60$

$w_4 = 4$

$P_4 = 40$

$P(\overset{i}{4},\overset{j}{0}) = P(i-1,j)$

$= P(3,0) = 0$

$P(\overset{i}{A},\overset{j}{1}) = P(i-1,j)$ ~~$P(A,0) = 0$~~

$= P(4-1,1)$

$= P(3,1)$

$\boxed{P(A,1) = 15}$

$j - w_i < 0 \quad 1-4<0$

$j - w_i \geq 0 \quad 1-4 \geq 0$

$\max\{P(i-1,j), P_i + P(i-1, j-w_i)\}$

$= \{P(3,1), 40 + P(3, 1-4$

$P(\overset{i}{4},\overset{j}{2}) = P(i-1,j)$

$= P(3,2)$

$\boxed{P(A,2) = 20}$

$j - w_i < 0$

$2 - 4 < 0$

$P(\overset{i}{A},\overset{j}{3}) = P(i-1,j)$

$= P(3,3)$

$\boxed{P(4,3) = 35}$

$j - w_i$

$3 - 4$

$P(\overset{i}{A},\overset{j}{4}) = \max\{P(i-1,j), P_i + P(i-1, j-w_i)\}$

$j - w_i$

$0 - 0$

$= \max\{P(3,4), P_4 + P(3,0)\}$

$= \max\{40, 40+0\}$

$\boxed{P(A,4) = 40}$

$$P(\overset{i}{4},\overset{j}{5}) = \max\{P(i-1,j),\ P_i + P(i-1, j-w_i)\}$$
$$= \max\{P(3,5),\ P_4 + P(3, 5-4)\}$$
$$= \max\{P(3,5),\ P_4 + P(3,1)\}$$
$$= \max\{40,\ 40+15\}$$
$$\boxed{P(4,5) = 55}$$

$$P(\overset{i}{4},\overset{j}{6}) = \max\{P(i-1,j),\ P_i + P(i-1, j-w_i)\}$$
$$= \max\{P(4-1,6),\ P_4 + P(3, 6-4)\}$$
$$= \max\{P(3,6),\ P_4 + P(3,2)\}$$
$$= \max\{60,\ 40+20\}$$
$$\boxed{P(4,6) = 60}$$

VII Compute

$P(5,0) = 0$ $\quad w_5 = 5$

$P(5,1) = 15$ $\quad P_5 = 50$

$P(5,2) = 20$

$P(5,3) = 35$

$P(5,4) = 40$

$P(5,5) = 55$

$P(5,6) = 6\cancel{5}8$

$$P(\overset{i}{5},\overset{j}{0}) = P(i-1,j)$$
$$= P(\cancel{4},0)$$
$$\boxed{P(5,0) = 0}$$

$$P(5,1) = P(i-1, j) = P(4,1)$$

$$\boxed{P(5,1) = 15}$$

$$P(5,2) = P(i-1, j) = P(4,2)$$

$$\boxed{P(5,2) = 20}$$

$$P(5,3) = P(4,3)$$

$$\boxed{P(5,3) = 35}$$

$$P(5,4) = P(i-1, j) = P(4,4)$$

$$\boxed{P(5,4) = 40}$$

$$P(5,5) = P(i-1, j) = P(4,5)$$

$$\boxed{P(5,5) = 55}$$

$$P(5,6) = P(i-1, j) = P(4,6)$$

$$\boxed{\cancel{P(5,6) = 60}}$$

$j - w_i$
$6 - w_5$
$6 - 1$
$5 \geq 0$

$$= \max\{P(i-1, j),\ P_i + P(i-1, j-w_i)\}$$
$$= \max\{P(4,6),\ P_5 + P(4,5)\}$$
$$= \max\{60,\ 50+15\} = 65$$

25	20	15	40	50		
3	2	1	4	5		
x_1	x_2	x_3	x_4	x_5	Capacity	Profit
0	0	0	0	0	0	0
0	0	0	0	1	5	
0	0	0	1	0	4	
0	0	0	1	1	9	
0	0	1	0	0	1	
0	0	1	0	1	6 ✓	65
0	0	1	1	0	5	
0	0	1	1	1	10	
0	1	0	0	0	2	
0	1	0	0	1	7	
0	1	0	1	0	6 ✓	60
0	1	0	1	1	11	
0	1	1	0	0	3	
0	1	1	0	1	8	
0	1	1	1	0	7	
0	1	1	1	1	12	
1	0	0	0	0	3	
1	0	0	0	1	8	
1	0	0	1	0	7	
1	0	0	1	1	12	
1	0	1	0	0	4	
1	0	1	0	1	9	
1	0	1	1	0	8	
1	0	1	1	1	13	
1	1	0	0	0	5	
1	1	0	0	1	10	
1	1	0	1	0	9	
1	1	0	1	1	14	
1	1	1	0	0	6 ✓	60
1	1	1	0	1	11	
1	1	1	1	0	10	
1	1	1	1	1	15	

Capacity

i	0	1	2	3	4	5	6
0	0	0	0	0	0	0	0
1	0	0	0	25	25	25	25
item 2	0	0	20	25	25	45	45
3	0	15	20	35	40	45	60
4	0	15	20	35	40	55	60
5	0	15	20	35	40	55	$\boxed{65}$

Maximum profit is 65

Now find feasible subset.

1) $P[5,6] = V[4,6]$

$65 = 60$

It is not equal. if it is not equal ~~consider~~ include that item (i.e item 5)

Now Capacity = Total capacity - included object capacity

$= 6 - 5$

Remaining Capacity. $= 1$

2) Now Consider Capacity 1 with item 4

i.e $P[4,1] = V[3,1]$

$15 = 15$

Values are equal. if values are equal, we can't include that item.

i.e item 4 is not included.

3) Now Consider Capacity 1 with item 3

i.e $P[3,1] = V[2,1]$

$15 = 0$

Values are not equal. if values are not equal we can include item 3 in the set.

Now capacity = Remaining Capacity − included object Capacity

$= 1 - 1$

Capacity $= 0$

∴ optimal set i.e feasible subset is $= \{5, 3\}$

Total capacity $= 5 + 1 = 6$

Total profit $= 50 + 15 = \underline{65}$