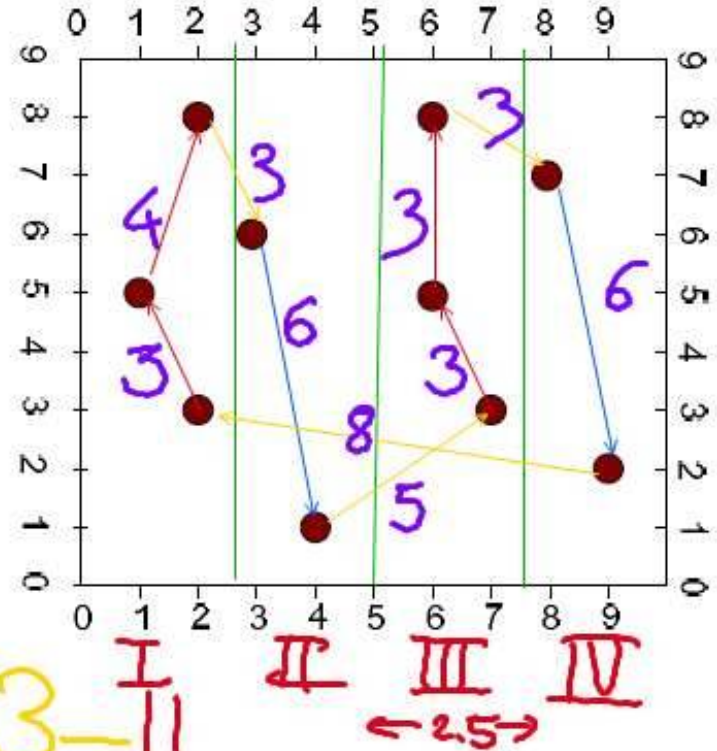
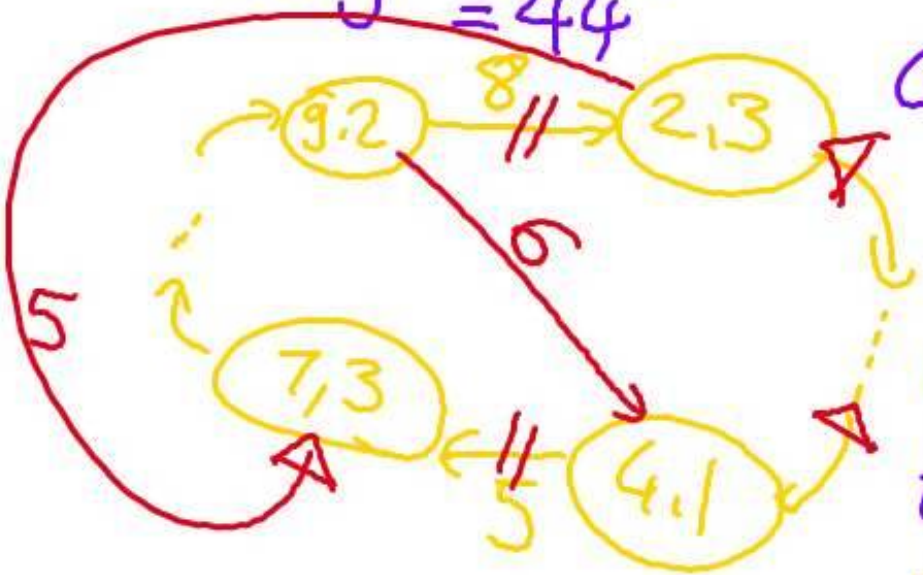
Apply the band heuristic with 4 vertical strips for finding an initial TSP tour of the • points to be visited. Show the tour in the figure. Calculate the tour length in terms of Rectilinear Distance. Calculate the gain of deleting the edge between (9,2)–(2,3) and the edge between (4,1)–(7,3). What is your decision for this swap? Why? [80pt]



Tour length = 5(3)+4+5+2(6)+8
= 44



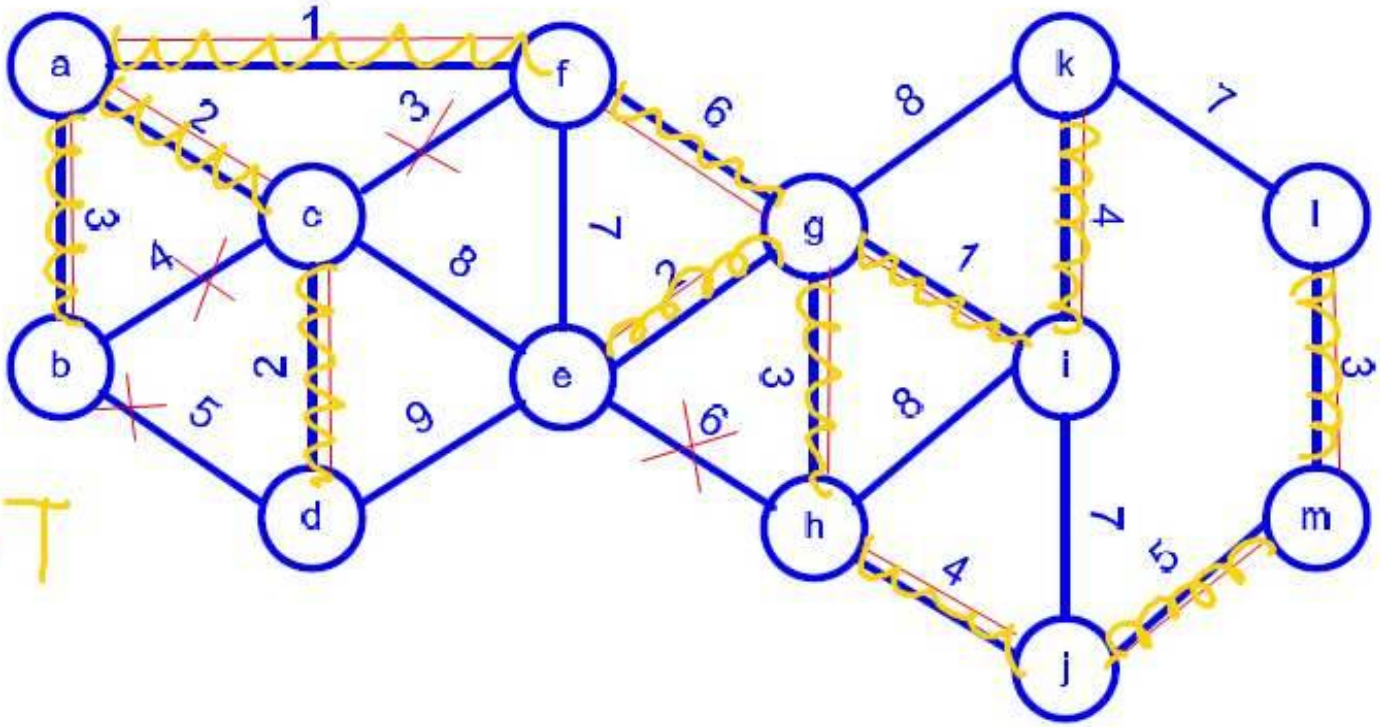
GAIN = 13 − 11
= 2

Since GAIN > 0
We will MAKE THE SWAP
to reduce the length of the
tour 44 → 42

Length MST = 2(0)+3(2)+3(3)+2(4)+5+6

= 36

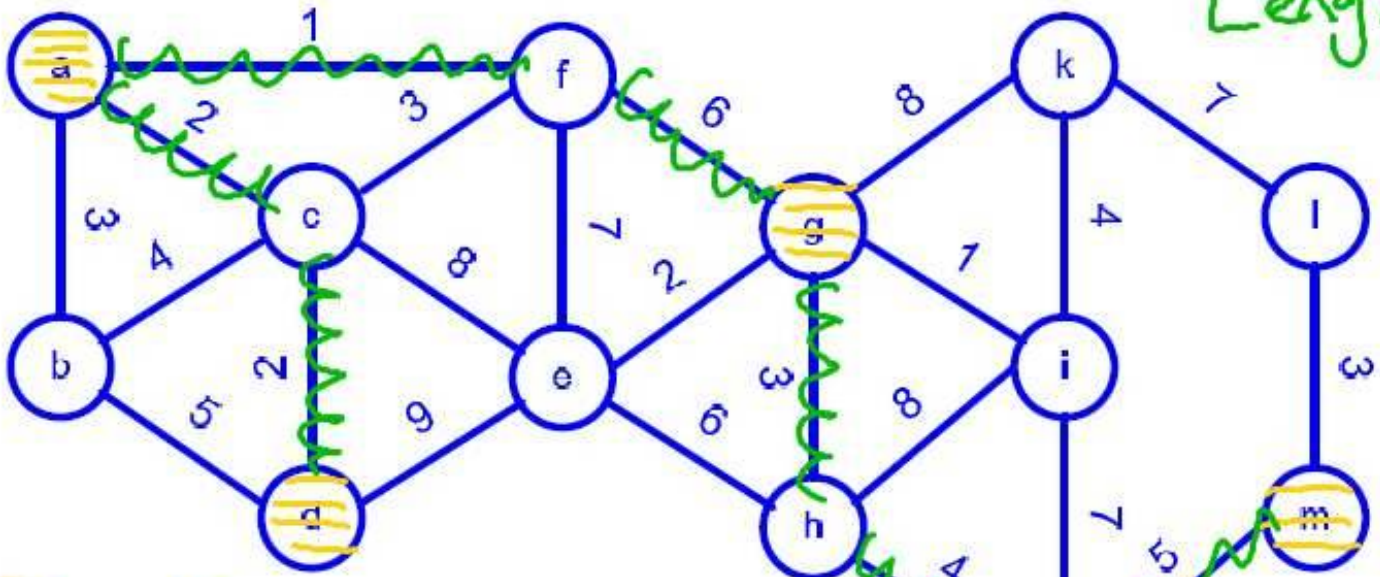
[40pt] Find the minumum spanning tree and the associated cost(length).



MST

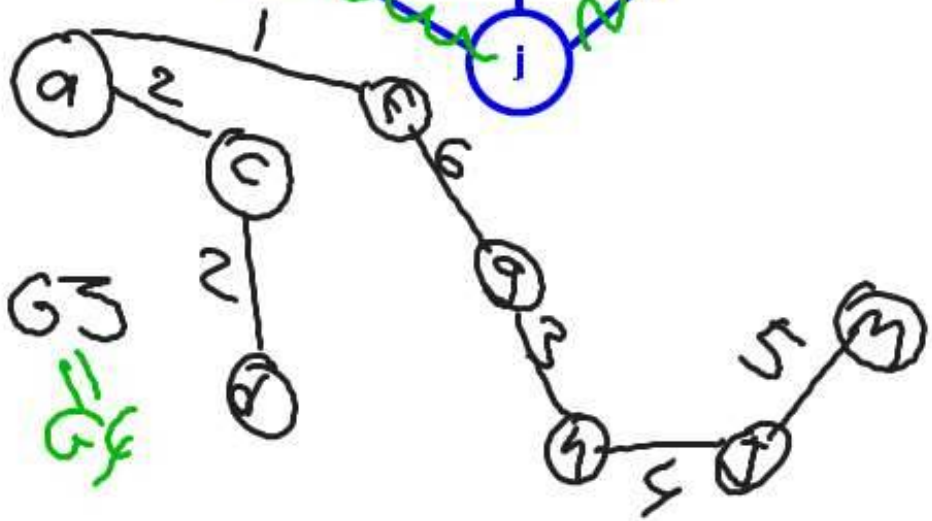
[40pt]Find a solution for the Steiner tree problem and the associated cost(length) where the selected set is $R = \{a, d, g, m\}$.

Length=23

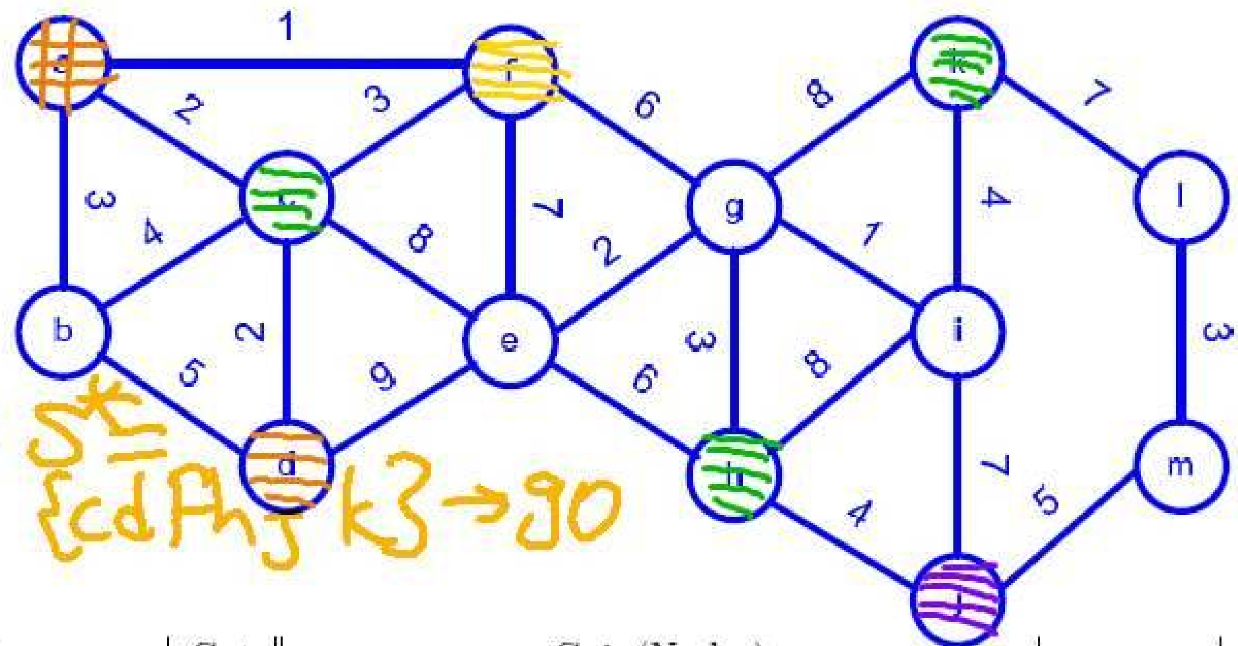


G1

G2



G3 = G4



Greedy's S* = {cdfhjk} → 90

GREEDY STOPS →

NON GREEDY STOPS →

|-5|>3 Threshold

Iter #	S =?	Cut Size	a	b	c	d	e	f	g	h	i	j	k	l	m	Decision	New cut size
1	{chk}	59	2	4	-10	12	4	11	-2	-21	-4	8	-19	-4	8	(d)	59+12
2	{cdhk}	71	2	-6	-15		-14	11	-2	-21	-4	8	-19	-4	8	(f)	71+11
3	{cdfhk}	82	0	-6	-9		-28		-16	-21	-4	8	-19	-4	8	(j) TB	82+8
4	{cdfhjk}	90	0	-6	-9		-28		-16	-13	-18		-19	-5	-2	(a)	90
5	{acdfhjk}	90		-12	-5		-28		-16	-13	-8		-19	-4	-2	(m)	90-2
6	{acdfhjkm}	88		-12	-5		-28		-16	-13	-8		-19	-6			
7	{ }																
8	{ }																
9	{ }																
10	{ }																
11	{ }																
12	{ }																

Nongreedy solutions

are available, with quantities, times, and values shown in the table. We have 5 days available.

Job	Possible #	Time per job	Value per job
1	4	1	3
2	2	4	15
3	3	2	8
4	3	3	12

$0 \leq d_i \leq$

d_n: # jobs in category n selected,

x_n: # days remaining when we reach n.

Transformation functions:[5pt]

$x_3 = t_4(x_4, d_4) = ?$ $x_4 - 3d_4$

$x_2 = t_3(x_3, d_3) = ?$ $x_3 - 2d_3$

$x_1 = t_2(x_2, d_2) = ?$ $x_2 - 4d_2$

$x_0 = t_1(x_1, d_1) = ?$ $x_1 - d_1$

Return functions:[5pt]

$r_4(x_4, d_4) = ?$ $12d_4$

$r_3(x_3, d_3) = ?$ $8d_3$

$r_2(x_2, d_2) = ?$ $15d_2$

$r_1(x_1, d_1) = ?$ $3d_1$

Stage 1:[10pt]

x_1	d_1^*	$f_1(x_1)$
0		
1		

Stage 2:[15pt]

d_2:	$r_2(x_2, d_2) + f_1(x_1)$							
x_2	0	1	2	3	4	d_2^*	$f_2{}^*$	x_1
0								
1								

Stage 1:[10pt]

x_1	d_1^*	$f_1(x_1)$
0	0	0
1	1	3
2	2	6
3	3	9
4	4	12
5	4	12
6	4	12
7	4	12
8	4	12
9	4	12

Need 1 day/unit

$d_1 \leq 4$

\$3/unit

Stage 2:[15pt]

d_2: x_2	$r_2(x_2,d_2)+f_1(x_1)$ 0	1	2	3	4	d_2^*	f_2^*	x_1
0	0+0					0	0	0
1	0+3					0	3	1
2	0+6					0	6	2
3	0+9					0	9	3
4	0+12	15+0				1	15	0
5	0+12	15+3				1	18	1
6	0+12	15+6				1	21	2
7	0+12	15+9				1	24	3
8	0+12	15+12	30+0			2	30	0
9	0+12	15+12	30+3			2	33	1

Need (4) days/unit

$d_2 \leq (2)$

\$(15)/unit

d_3:	$r_3(x_3, d_3) + f_2(x_2)$							
x_3	0	1	2	3	4	d_3^*	$f_3{}^*$	x_2
0	0+0	X	X	X		0	0	0
1	0+3	X	X	X		0	3	1
2	0+6	8+0	X	X		1	8	0
3	0+9	8+3	X	X		1	11	1
4	0+15	8+6	16+0	X		2	16	0
5	0+18	8+9	16+3	X		2	19	1
6	0+21	8+15	16+6	24+0		3	24	0
7	0+24	8+18	16+9	24+3		3	27	1
8	0+30	8+21	16+15	24+6		2	31	3
9	0+33	8+24	16+18	24+9		2	34	4

$d_3 \leq 3$
$8/piece
2 days/piece

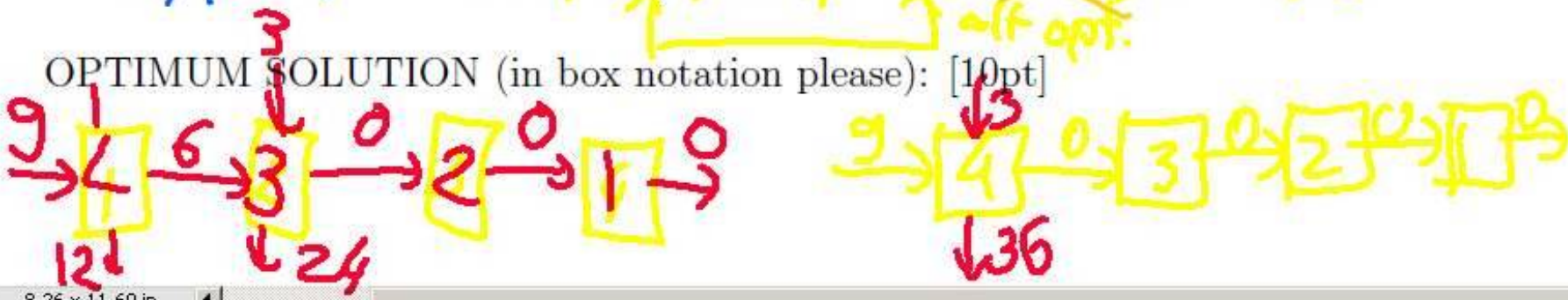
$d_4 \leq 3$
$12/piece
3 days/piece

Stage 4:[10pt]

d_4:	$r_4(x_4, d_4) + f_3(x_3)$							
x_4	0	1	2	3	4	d_4^*	$f_4{}^*$	x_3
9	0+34	12+24	24+11	36+0		1	36	0

if opt.

OPTIMUM SOLUTION (in box notation please): [10pt]



What if we have 8 days available? Please answer in box notation and indicate the total cost.

$d_4 \leq 3$

$12/unit

3 days/unit

Stage 4: [10pt]

d_4:	$r_4(x_4, d_4) + f_3(x_3)$							
x_4	0	1	2	3	4	d_4^*	$f_4{}^*$	x_3
8	0+31	12+18	24+6	~~X~~	~~X~~	0	31	8

OPT!

Box Notation: [10pt]