COMP2012 (Fall 2022) Discrete Mathematics

Individual Assignment 2 Due Date: 23:59, 28th November, 2022

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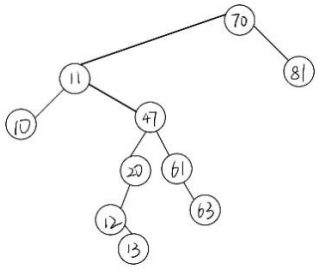
Student number	

Notes:

- This is an **individual** assignment.
- Please submit the **soft copy** of your answer to Blackboard (as a doc/docx/pdf file).
- You just need to write your answer. There is no need to copy questions.

Question 1.

1(a)



1(b)

Root is node 70.

Leaves are node 10, node 13, node 63, node 81.

1(c)

h = 5. It is not a balanced tree, because all leaves are not at level 4 or level 5.

1(d)

10, 11, 12, 13, 20, 47, 61, 63, 70, 81

1(e)

70, 11, 10, 47, 20, 12, 13, 61, 63, 81

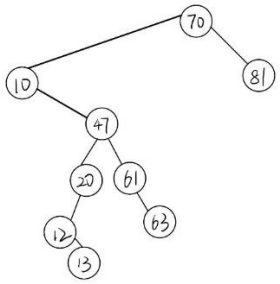
1(f)

10, 13, 12, 20, 63, 61, 47, 11, 81, 70

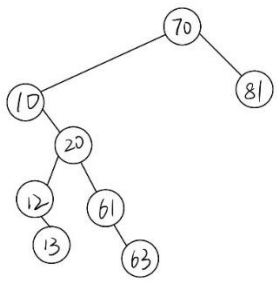
1(g)

70, 11, 47, 20, 12, 13

1(h)



1(i)



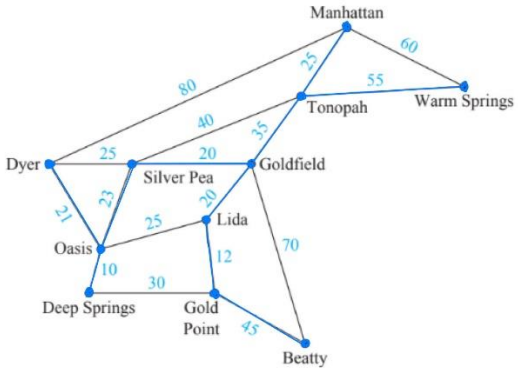
Question 2.

2(a)

As for Kruskal's algorithm, roads that does not complete a circuit may be added to the list.
Sort the roads' weight in an increasing order, then think about if it forms a circuit with existed paved roads or not. If it does not form a circuit, then we add this road to list.

Road Name	Weight of road	Form a circuit or not with existed paved roads
Oasis - Deep Springs	10	NO
Lida - Gold Point	12	NO
Lida - Goldfield	20	NO
Silver Pea - Goldfield	20	NO
Oasis - Dyer	21	NO
Oasis - Silver Pea	23	NO
Dyer - Silver Pea	25	YES
Tonopah - Manhattan	25	NO
Oasis - Lida	25	YES
Deep Springs - Gold Point	30	YES
Goldfield - Tonopah	35	NO
Silver Pea - Tonopah	40	YES
Gold Point - Beatty	45	NO
Tonopah - Warm Springs	55	NO
Manhattan - Warm Springs	60	YES
Goldfield - Beatty	70	YES
Manhattan – Dyer	80	YES

Overall, the roads that should be paved are
Oasis to Deep Springs,
Lida to Gold Point,
Lida to Goldfield,
Silver Pea to Goldfield,
Oasis to Dyer,
Oasis to Silver Pea,
Tonopah to Manhattan,
Goldfield to Tonopah,
Gold Point to Beatty,
Tonopah to Warm Springs.



Roads in blue color in this graph should be paved.

Question 3.

3(a)

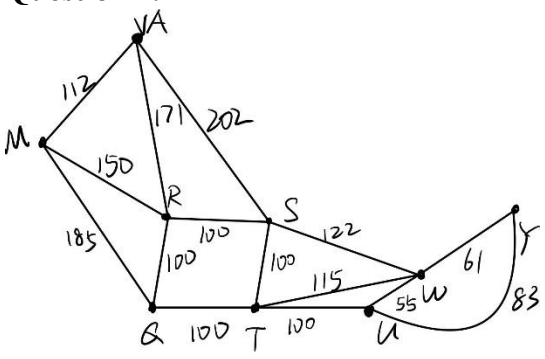
X = (B NOR NOT A) NAND (A XOR C)

3(b)

Truth table

A	B	C	NOT A	B NOR (NOT A)	A XOR C	X
1	1	1	0	0	0	1
1	1	0	0	0	1	0
1	0	1	0	1	0	0
1	0	0	0	1	1	0
0	1	1	1	0	1	0
0	1	0	1	0	0	1
0	0	1	1	0	1	0
0	0	0	1	0	0	1

Question 4.



4(a)

Find lowest path from Q to buildings/towers using Dijkstra's algorithm.

[Initialization] D = (Q: 0), (R: ∞), (M: ∞), (T: ∞), (VA: ∞), (S: ∞), (U: ∞), (W: ∞), (Y: ∞)

[Iteration 1] Extract vertex **Q**, update vertices M, R, T

Q: $d = 0$

D = (R: 100), (M: 185), (T: 100), (VA: ∞), (S: ∞), (U: ∞), (W: ∞), (Y: ∞)

[Iteration 2] Extract vertex **R,** update vertices VA, S
Q: $d = 0$, R: $d = 1$
D = (M: 185), (T: 100), (VA: 271), (S: 200), (U: ∞), (W: ∞), (Y: ∞)

[Iteration 3] Extract vertex **M**, no update vertex
Q: $d = 0$, R: $d = 1$, M: $d = 1$
D = (T: 100), (VA: 271), (S: 200), (U: ∞), (W: ∞), (Y: ∞)

[Iteration 4] Extract vertex **T**, update vertices S, W, U
Q: $d = 0$, R: $d = 1$, M: $d = 1$, T: $d = 1$
D = (VA: 271), (S: 200), (U: 200), (W: 215), (Y: ∞)

[Iteration 5] Extract vertex **VA**, no update vertex
Q: $d = 0$, R: $d = 1$, M: $d = 1$, T: $d = 1$, VA: $d = 2$
D = (S: 200), (U: 200), (W: 215), (Y: ∞)

[Iteration 6] Extract vertex **S**, no update vertex
Q: $d = 0$, R: $d = 1$, M: $d = 1$, T: $d = 1$, VA: $d = 2$, S: $d = 2$
D = (U: 200), (W: 215), (Y: ∞)

[Iteration 7] Extract vertex **U**, update vertex Y
Q: $d = 0$, R: $d = 1$, M: $d = 1$, T: $d = 1$, VA: $d = 2$, S: $d = 2$, U: $d = 2$
D = (W: 215), (Y: 283)

[Iteration 8] Extract vertex **W**, update vertex Y
Q: $d = 0$, R: $d = 1$, M: $d = 1$, T: $d = 1$, VA: $d = 2$, S: $d = 2$, U: $d = 2$,
W: $d = 2$,
D = (Y: 276)

[Iteration 9] Extract vertex **Y**, no update vertex
Q: $d = 0$, R: $d = 1$, M: $d = 1$, T: $d = 1$, VA: $d = 2$, S: $d = 2$, U: $d = 2$
W: $d = 2$, Y: $d = 3$
D = ∅

(i) Core Q to Tower M: from Q directly to tower M.
Q to M: 185 meters
Lowest cost distance from Core Q to Tower M is 185 meters.

(ii) Core Q to Classroom Y302: from Q to T to W to Y
100 + 115 + 61 = 276 meters
Lowest cost distance from Core Q to Core Y is 276 meters.

(iii) Core Q to 7-Eleven: from Q to R to VA
100 + 171 = 271 meters
Lowest cost distance from Core Q to VA is 271 meters.

4(b)
Q to T to U to Y

End of Assignment 2