BSCMA1001: Activity Questions
Week-12
Graphs

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1 Lecture-12.1

1. Which of the following statements is (are) correct?
   - ◯ **If a graph has a negative cycle, shortest paths are not defined.**
   - ◯ A negative cycle is one which has only negative edge weights.
   - ◯ **In a weighted graph, the adjacency matrix records the weight where ever there is an edge and 0 if there is no edge.**
   - ◯ **Shortest path in a weighted graph need not be minimum in terms of number of edges.**

2 Lecture-12.2

Use the following information for questions 1, 2 and 3.

The Ministry of Earth Sciences (MoES) gave flood warning to the cities A, B, C, D, E, F and G which are very near to the foothills of Himalaya. At time 0 minutes, city B was completely flooded. In the graph (Figure AQ-12.1), vertices represent cities and edges represent how cities are connected.
Note: The weight of each edge indicates the time in minutes by which water reaches different cities.

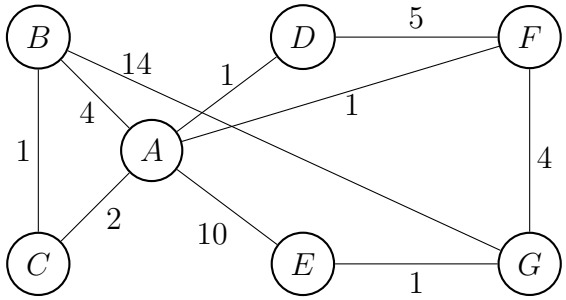


Figure AQ-12.1

1. At what time, will city G start flooding?
   - ◯ **8 min**
   - ◯ 15 min
   - ◯ 14 min
   - ◯ 6 min
2. What is the shortest path to reach city D from the source of flood (B)?
   - ◯ $B \longrightarrow A \longrightarrow D$.

◯ $B \longrightarrow C \longrightarrow A \longrightarrow F \longrightarrow D.$

◯ $\boldsymbol{B \longrightarrow C \longrightarrow A \longrightarrow D.}$

◯ $B \longrightarrow A \longrightarrow F \longrightarrow D.$

3. At what time will all the cities be flooded?

◯ 15 min

◯ 14 min

◯ 8 min

◯ **9 min**

3 Lecture-12.3

Use the following information for questions 1, and 2.

While using Bellman-Ford Algorithm for the graph shown below, let $D(v)$ be the shortest distance of vertex v from the source vertex after 7 iterations.

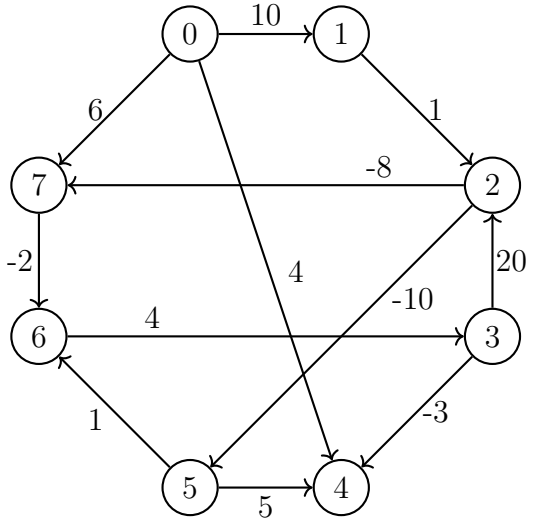


Figure AQ-12.2

1. Suppose the source vertex is 0. Which of the following options is (are) correct?

◯ **D(5) = D(6) = 1**

◯ **D(3) = 5**

◯ **D(4) = 2**

◯ D(4) = 5

2. If the source vertex is changed from vertex 0 to vertex 4, then which of the following options is (are) correct?

   ◯ **Bellman-Ford algorithm stabilizes after the first iteration.**

   ◯ Bellman-Ford algorithm will not be applicable.

   ◯ $D(v)$ is finite for some vertex v other than the source vertex.

   ◯ None of the above.

3. For what values of x can we use the Bellman-Ford algorithm to find the shortest path from a source vertex 0 to every other vertex in the graph given below?

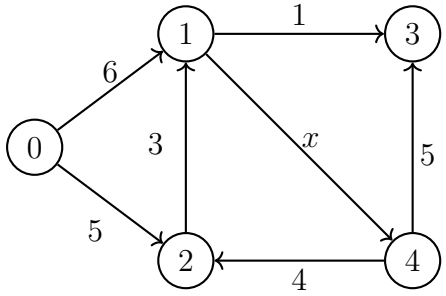


Figure AQ-12.3

   ◯ (-6,∞)

   ◯ (-14,∞)

   ◯ **(-7,∞)**

   ◯ (-21,∞)

4 Lecture-12.4

1. Which of the following is (are) matched correctly?

   (a) **For transitive closure - Warshall algorithm.**

   (b) **For all pair shortest path - Floyd-Warshall algorithm.**

   (c) **For single source shortest distance for non-negative edge weights - Dijkstra's algorithm.**

   (d) **For single source shortest distance for negative or non-negative edge weights - Bellman-Ford algorithm.**

Use the graph (Figure AQ-12.4) for questions 2, 3, 4 and 5.
(Hint: Use Floyd-Warshall Algorithm.)

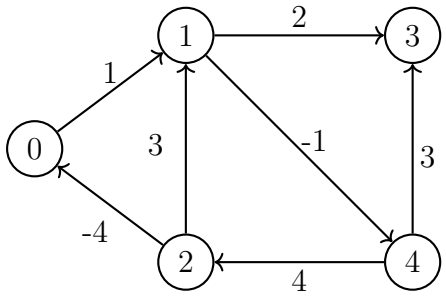


Figure AQ-12.4

2. Which of the following matrices represents SP^0?
Ans: option(b)

SP^0	0	1	2	3	4
0	∞	1	∞	∞	∞
1	∞	∞	∞	2	-1
2	-4	3	∞	∞	∞
3	∞	∞	-4	∞	∞
4	∞	∞	4	3	∞

(a)

SP^0	0	1	2	3	4
0	∞	1	∞	∞	∞
1	∞	∞	∞	2	-1
2	-4	3	∞	∞	∞
3	∞	∞	∞	∞	∞
4	∞	∞	4	3	∞

(b)

SP^0	0	1	2	3	4
0	∞	∞	-4	∞	∞
1	1	∞	3	∞	∞
2	∞	∞	∞	∞	4
3	∞	2	∞	∞	3
4	∞	-1	∞	∞	∞

(c)

SP^0	0	1	2	3	4
0	∞	1	∞	∞	∞
1	∞	∞	∞	2	-1
2	-4	3	∞	∞	∞
3	∞	∞	∞	∞	∞
4	∞	∞	3	4	∞

(d)

3. Which of the following matrices represents SP^3?
Ans: option(a)

SP^3	0	1	2	3	4
0	∞	1	∞	3	0
1	∞	∞	∞	2	-1
2	-4	-3	∞	-1	-4
3	∞	∞	∞	∞	∞
4	0	1	4	3	0

(a)

SP^3	0	1	2	3	4
0	∞	1	∞	∞	∞
1	∞	∞	∞	2	-1
2	-4	-3	∞	-1	-4
3	∞	∞	∞	∞	∞
4	∞	1	4	3	∞

(b)

SP^3	0	1	2	3	4
0	∞	1	∞	∞	∞
1	∞	∞	∞	2	-1
2	-4	-3	∞	-1	-4
3	∞	∞	∞	∞	∞
4	0	1	4	3	∞

(c)

SP^3	0	1	2	3	4
0	∞	1	∞	∞	∞
1	∞	∞	∞	2	-1
2	-4	-3	∞	∞	-4
3	∞	∞	∞	∞	∞
4	∞	1	4	3	0

(d)

4. Which of the following matrices represents SP^5?
Ans: option(c)

SP^5	0	1	2	4	3
0	0	1	4	3	0
1	-1	0	3	2	-1
2	-4	-3	0	-1	-4
3	∞	∞	-4	∞	∞
4	0	1	4	3	0

(a)

SP^5	0	1	2	3	4
0	0	1	4	3	0
1	-1	0	3	2	-1
2	-4	-3	0	-1	-4
3	∞	∞	-4	∞	∞
4	0	1	4	3	0

(b)

SP^5	0	1	2	3	4
0	0	1	4	3	0
1	-1	0	3	2	-1
2	-4	-3	0	-1	-4
3	∞	∞	∞	∞	∞
4	0	1	4	3	0

(c)

SP^5	0	1	2	3	4
0	0	1	4	3	0
1	∞	∞	∞	2	-1
2	-4	3	∞	∞	∞
3	∞	∞	∞	∞	∞
4	∞	∞	3	4	∞

(d)

5. If $SP^i = SP^j$, for some $i, j \in \{0, 1, 2...5\}$, then which of the following may be the values of i and j?

   (a) $i = \mathbf{4}$ **and** $j = \mathbf{3}$

   (b) $i = \mathbf{3}$ **and** $j = \mathbf{4}$

   (c) $i = 2$ and $j = 3$

   (d) $i = 3$ and $j = 2$

5 Lecture-12.5

1. Which of the following is (are) correct with respect to the spanning tree G?
   (a) **G is connected.**
   (b) **G is acyclic.**
   (c) G has n edges.
   (d) **Among the different spanning trees, one with minimum cost is minimum cost spanning tree.**

Use the graph (Figure AQ-12.5) for questions 2 and 3.

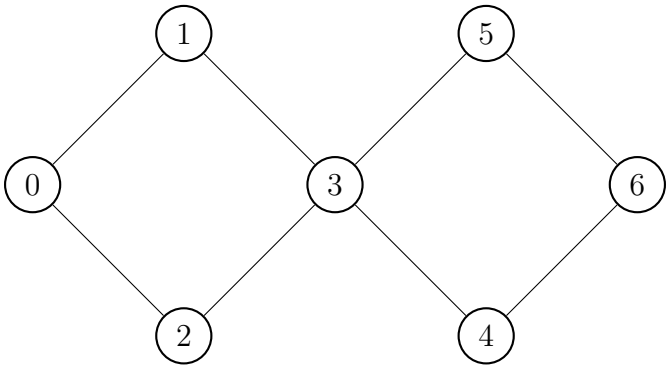
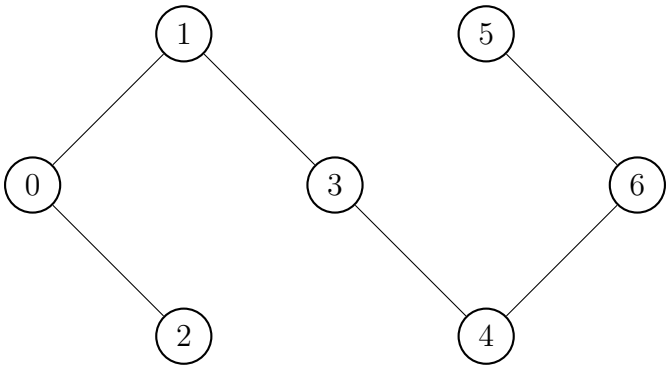
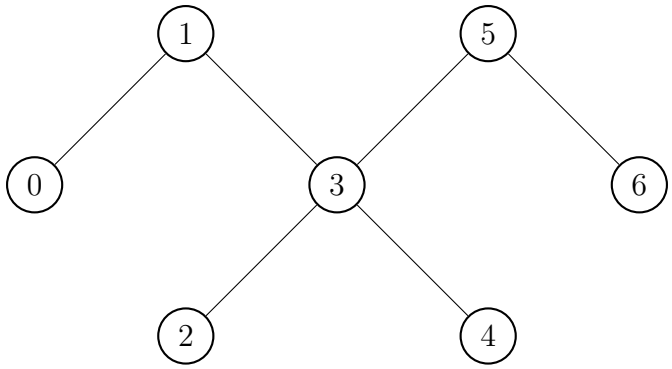


Figure AQ-12.5

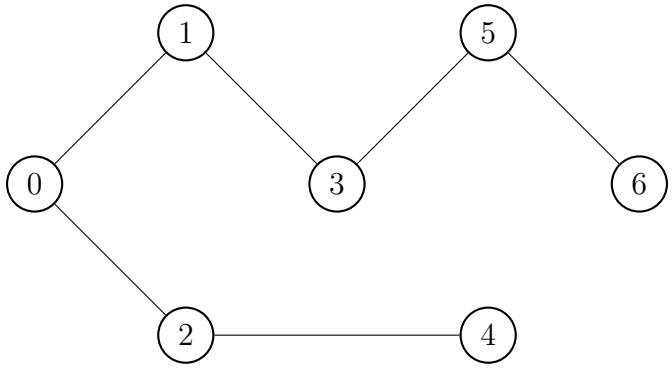
2. Which of the following graphs is not a spanning tree of the graph given in Figure AQ-12.5? [Option: c]



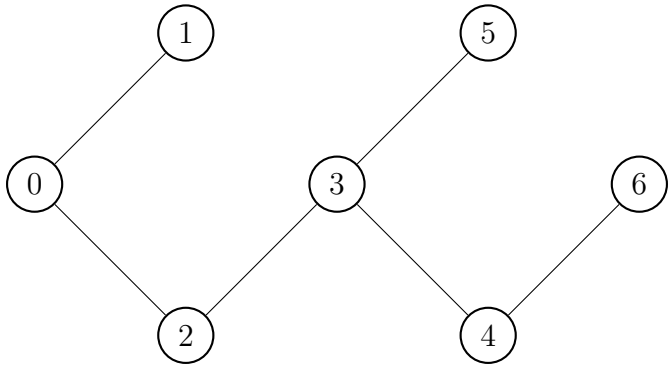
(a)



(b)



(c)



(d)

3. How many spanning trees are possible for the graph shown in Figure AQ-12.5?
   Answer: 16

4. Suppose the graph shown in Figure AQ-12.6 is a spanning tree of a graph G.

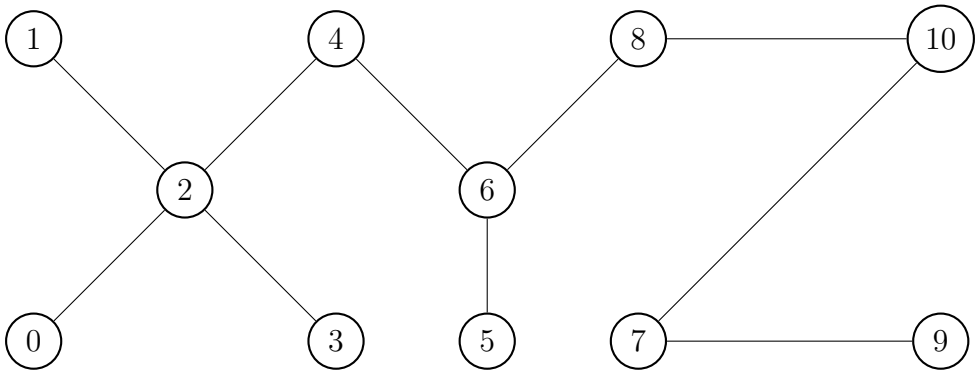
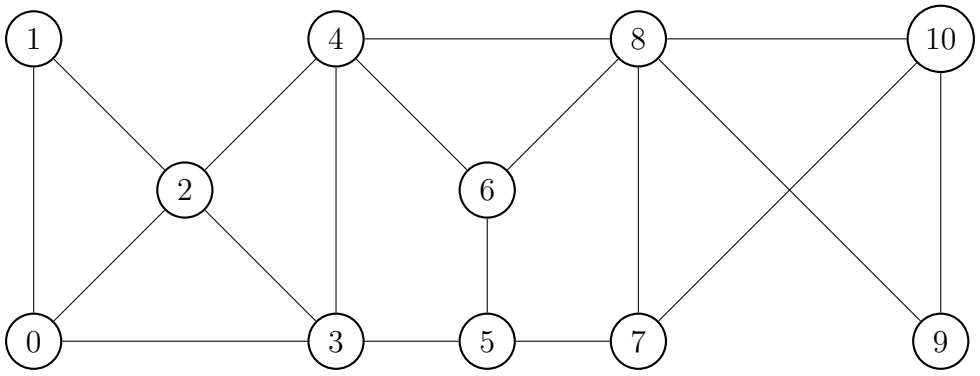
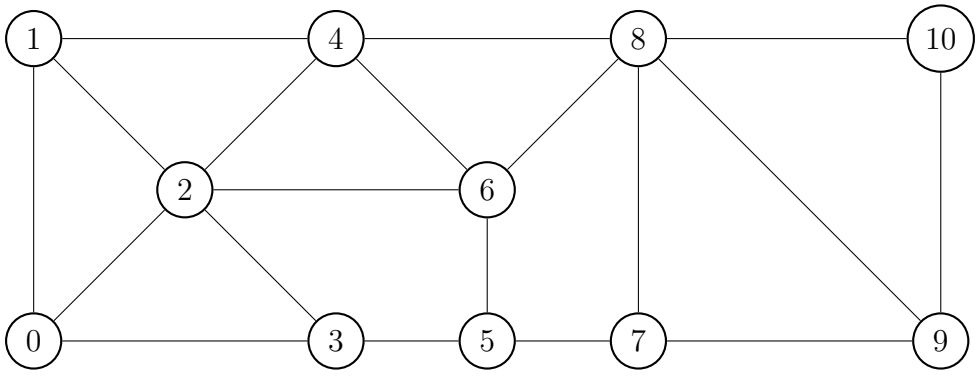


Figure AQ-12.6

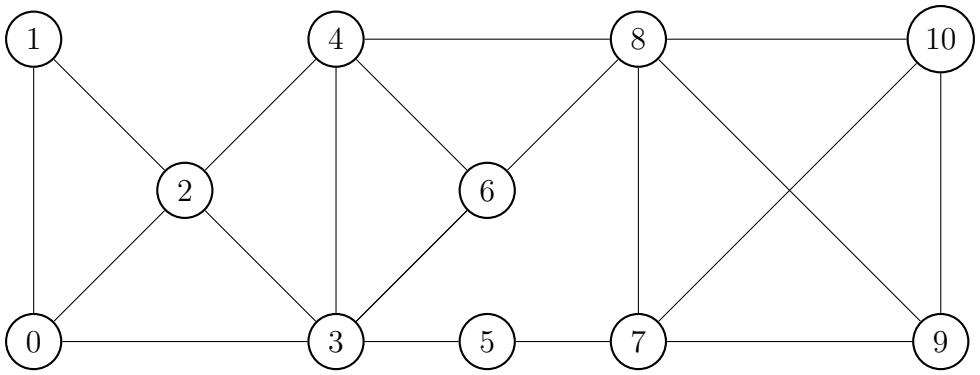
Which of the following graphs may represent G? [option: d]



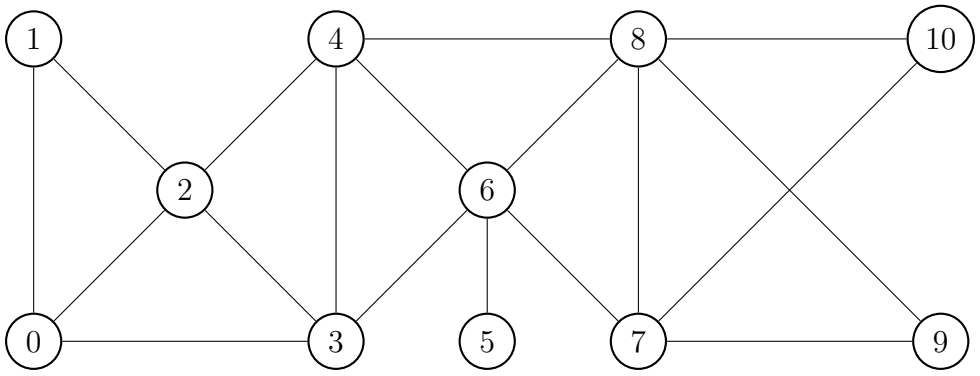
(a)



(b)



(c)



(d)

6 Lecture-12.6

Use the following information for questions 1, 2 and 3:
An undirected weighted graph G is given in Figure AQ-12.7.

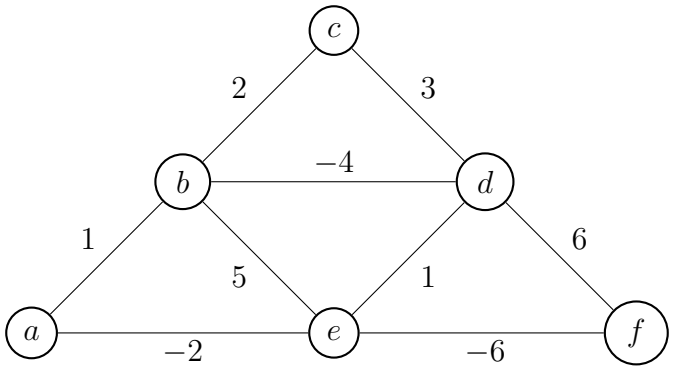
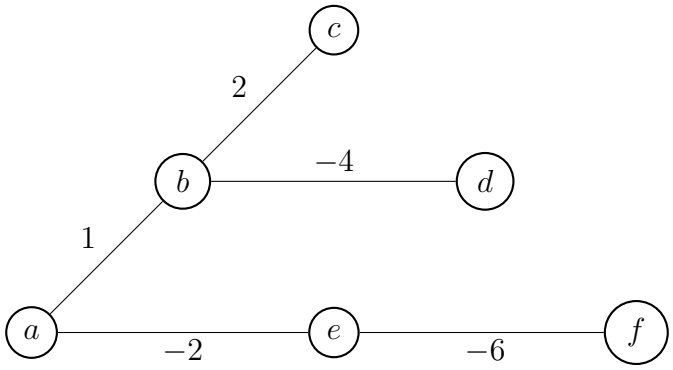
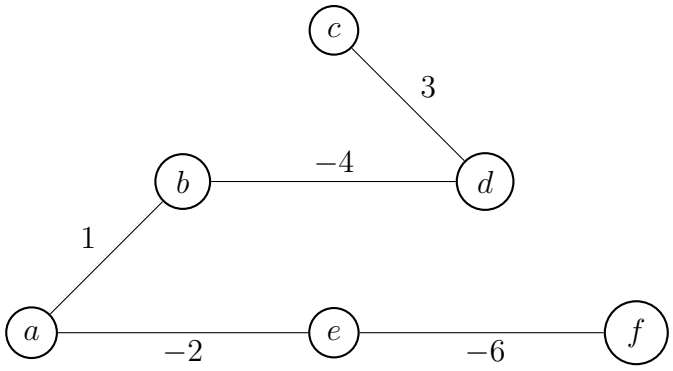


Figure AQ-12.7

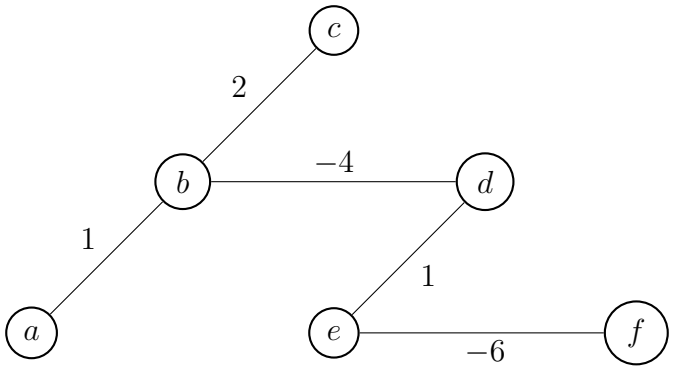
1. If we perform Prim's algorithm on G, then which of the following options may represent a minimum cost spanning tree? [Options: a,d]



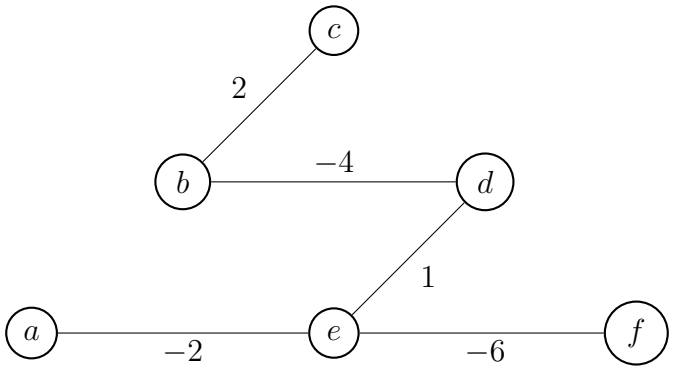
(a)



(b)



(c)



(d)

2. Which of the following is the order in which edges are added to the minimum cost spanning tree? [Option: a]

   (a) $(e, f), (a, e), (e, d), (b, d), (b, c)$

   (b) $(e, f), (b, d), (a, e), (a, b), (b, c)$

   (c) $(e, f), (a, e), (b, d), (e, d), (b, c)$

(d) $(e, f), (e, d), (b, d), (a, b), (b, c)$

3. What is the weight of the minimum cost spanning tree? [answer: -9]

7 Lecture-12.7

Use the following information for questions 1, 2 and 3:
An undirected weighted graph G is given in Figure AQ-12.8.

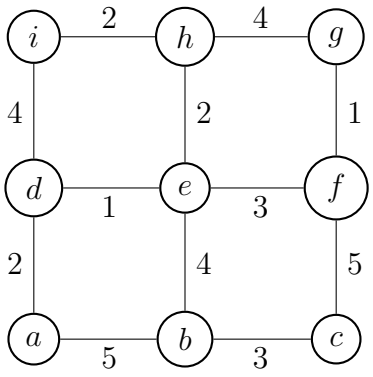
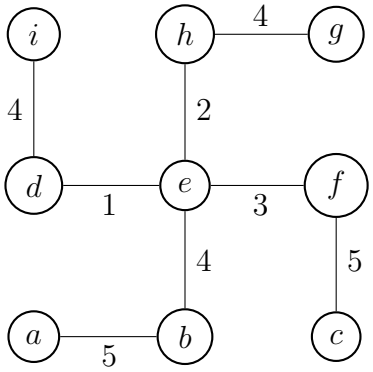
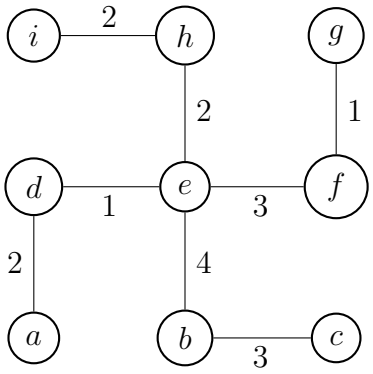


Figure AQ-12.8

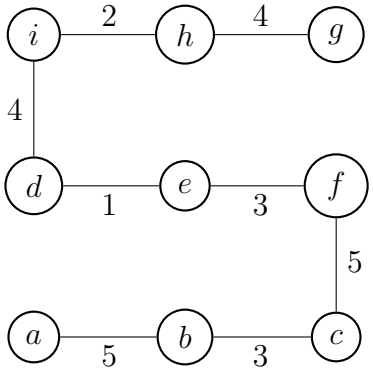
1. If we perform Kruskal's algorithm on G (Figure AQ-12.8), then which of the following options may represent the minimum cost spanning tree? [option: b]



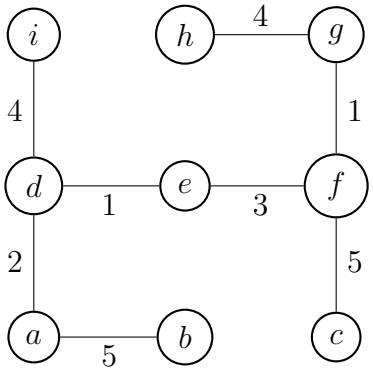
(a)


i
h
g
d
e
f
a
b
c
2
2
1
1
3
2
4
3

(b)


i
h
g
d
e
f
a
b
c
2
4
4
1
3
5
5
3

(c)


i
h
g
d
e
f
a
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4
4
1
1
3
2
5
5

(d)

2. Which of the following options is (are) correct w.r.t the graph G (Figure AQ-12.8)? [Options: a,c,d]

   (a) The minimum cost spanning tree of the graph G is unique.

   (b) There can be more than one minimum cost spanning tree of the graph G because there are some edges with equal weights.

   (c) The weight of the minimum cost spanning tree of the graph G is 18.

   (d) The order in which the edges are added to the minimum cost spanning tree is not unique.

3. Find the number of edges that are removed from the graph G (Figure AQ-12.8) to obtain the minimum cost spanning tree. [Answer: 4]

4. Suppose Prim's algorithm and Kruskal's algorithm are performed on a graph G separately to find the minimum cost spanning tree. Which of the following options will always be same for both the algorithms? [Options: a,c,d]

   (a) The weight of the minimum cost spanning tree of the graph G.

   (b) The order in which the edges are added to the minimum cost spanning tree.

   (c) Number of edges in the minimum cost spanning tree.

   (d) The minimum weight edge in the minimum cost spanning tree.