CS 300
Data Structures
Homework 5

Berkay Ersever

December 2018

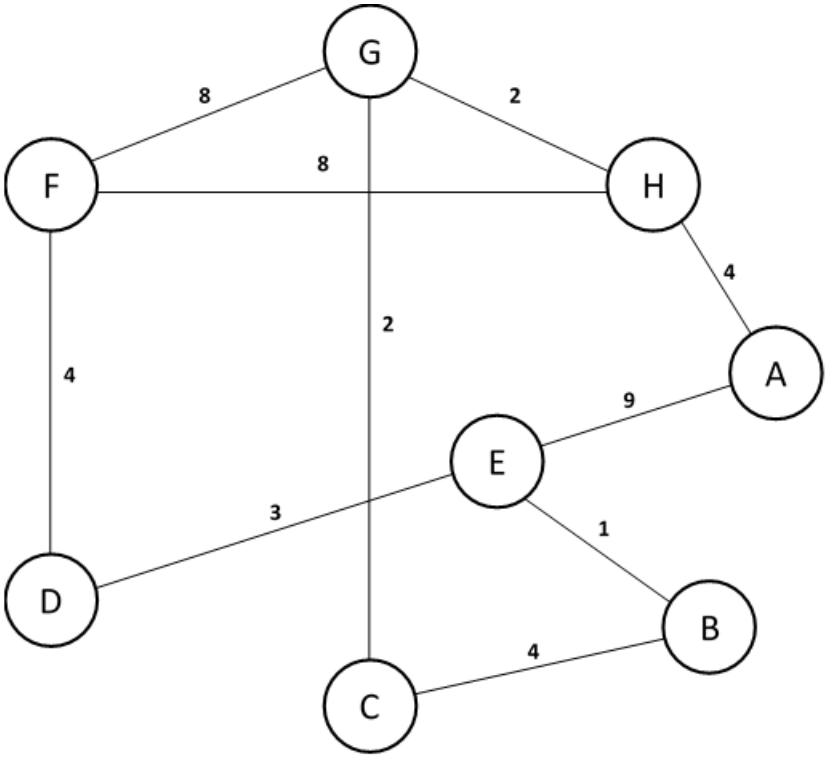
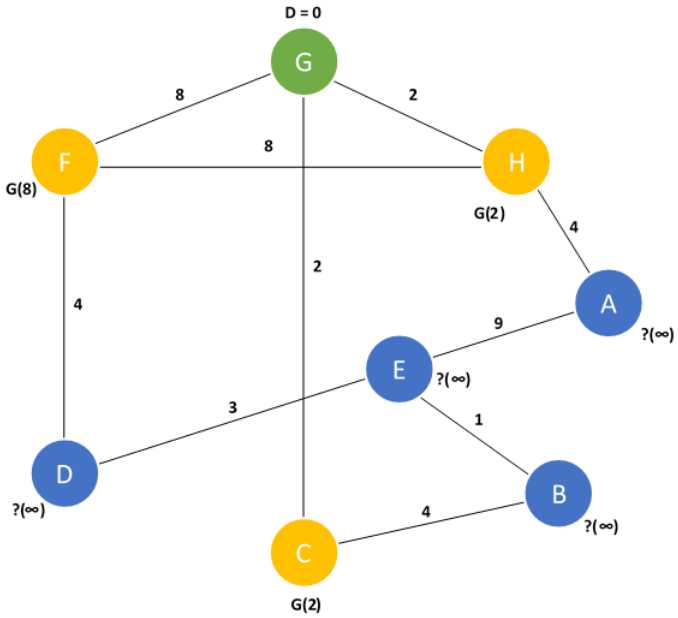


Figure 1: An undirected weighted graph

1. Starting from G, trace the operations of the Dijkstra's weighted shortest path algorithm on the graph given in Figure 1.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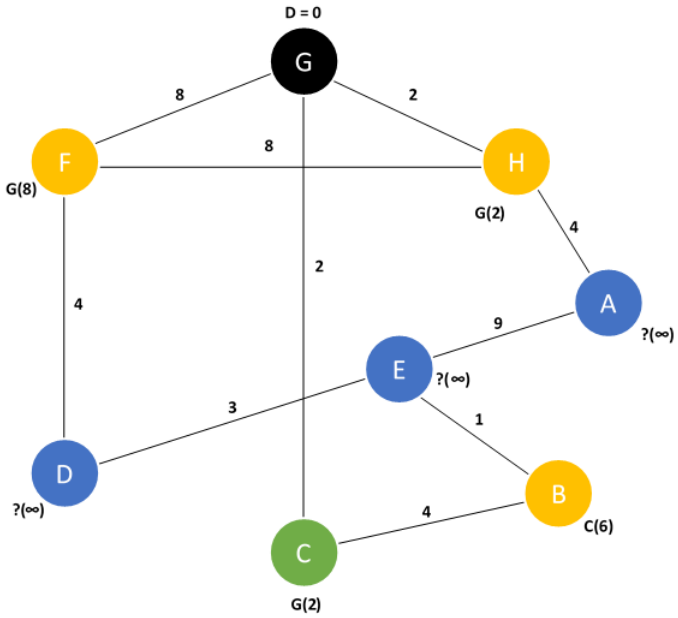
G
8
2
F
8
H
G(8)
G(2)
4
2
4
A
9
?(∞)
E
?(∞)
3
1
D
B
?(∞)
4
?(∞)
C
G(2)


D = 0
G
8
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F
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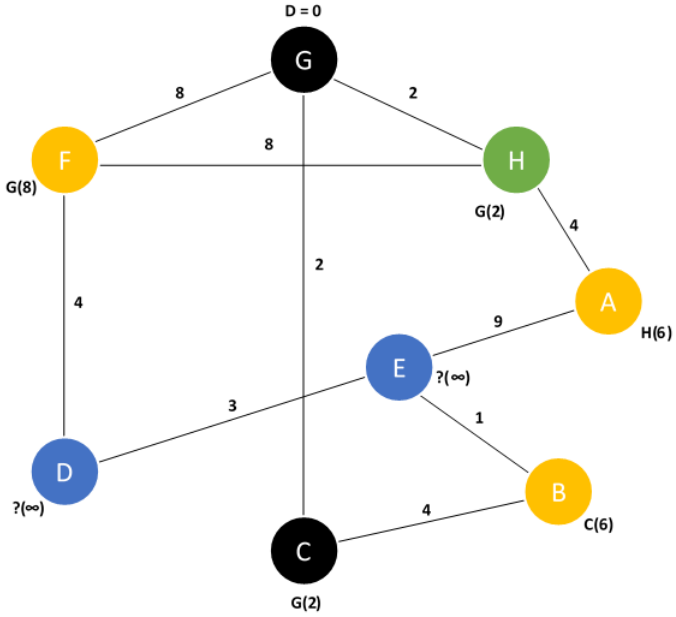
H
G(8)
G(2)
4
2
4
A
9
?(∞)
E
?(∞)
3
1
D
B
?(∞)
4
C(6)
C
G(2)


D = 0
G
8
2
F
8
H
G(8)
G(2)
4
2
4
A
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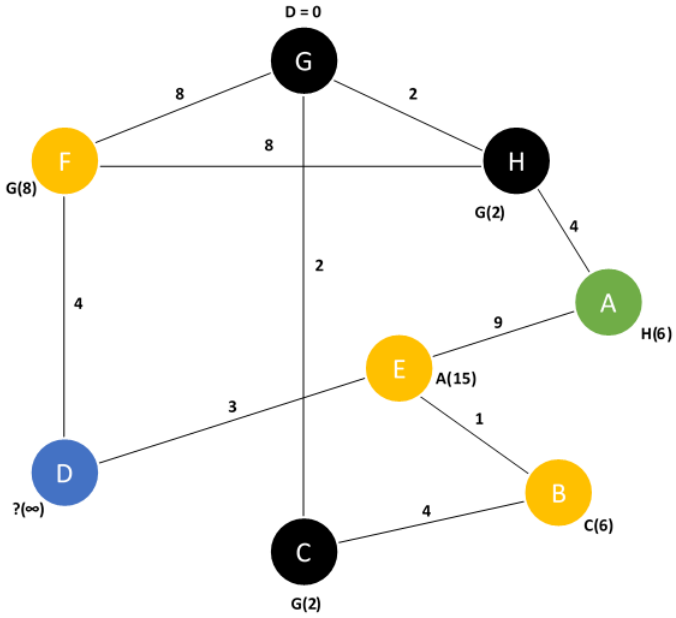
H(6)
E
?(∞)
3
1
D
B
?(∞)
4
C(6)
C
G(2)


D = 0
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F
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H
G(8)
G(2)
4
2
4
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H(6)
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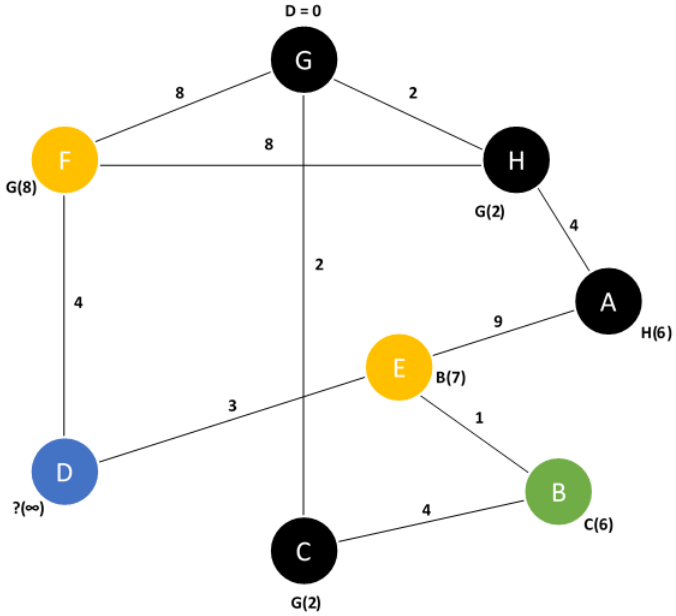
A(15)
3
1
D
B
?(∞)
4
C(6)
C
G(2)


D = 0
G
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2
F
8
H
G(8)
G(2)
4
2
4
A
9
H(6)
E
B(7)
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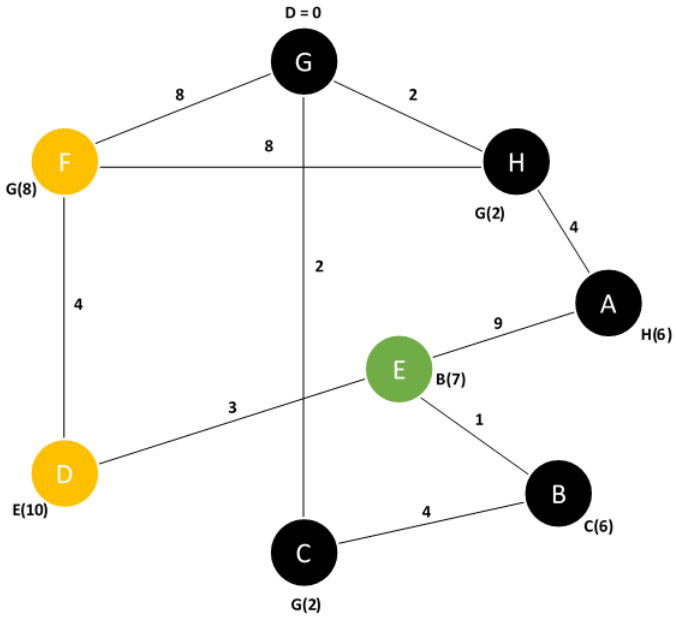
1
D
B
?(∞)
4
C(6)
C
G(2)


D = 0
G
8
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H
G(8)
G(2)
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A
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B(7)
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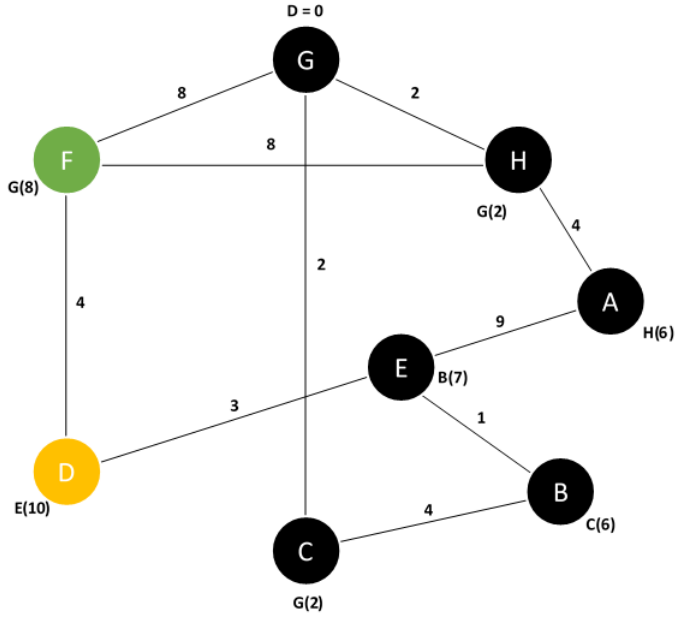
E(10)
4
C(6)
C
G(2)


D = 0
G
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F
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G(8)
G(2)
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2
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A
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H(6)
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B(7)
3
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D
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E(10)
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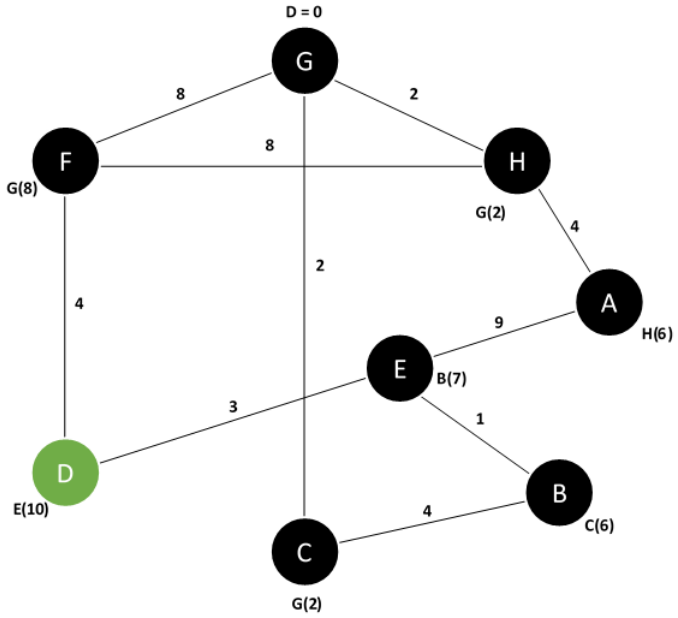
C(6)
C
G(2)


D = 0
G
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F
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H
G(8)
G(2)
4
2
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H(6)
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B(7)
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E(10)
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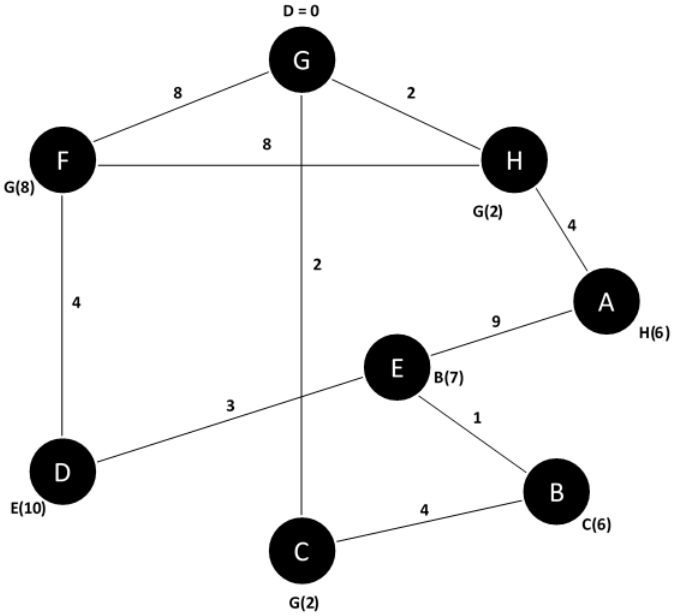
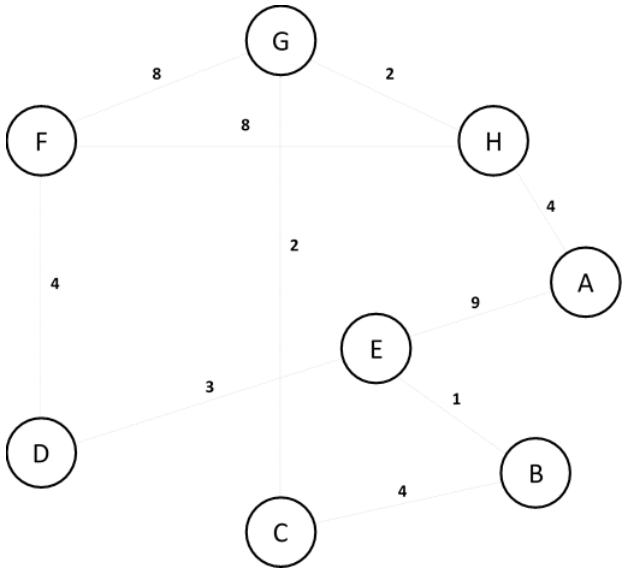
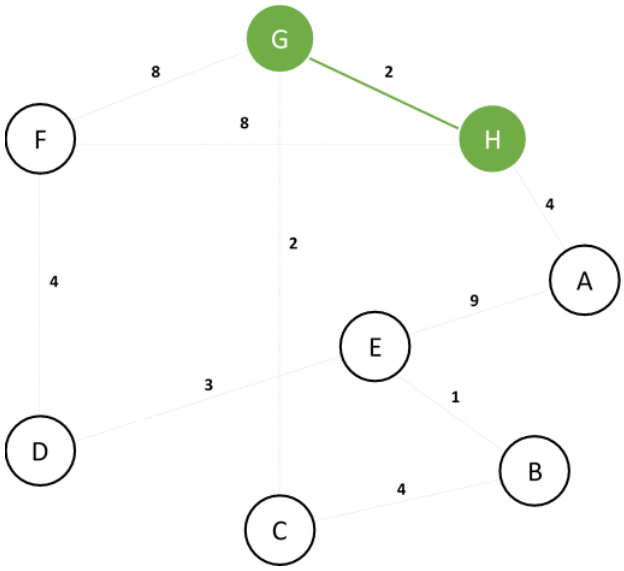
C(6)
C
G(2)



2. Starting from G, trace the operations of the Prim's minimum spanning tree algorithm on the graph given in Figure 1.

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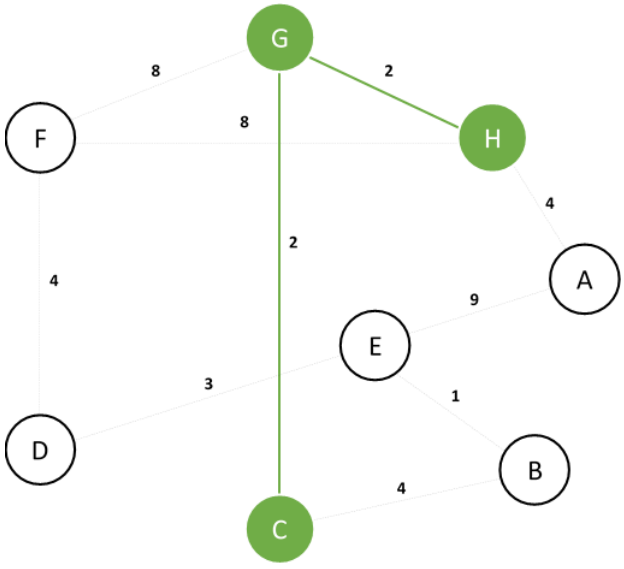
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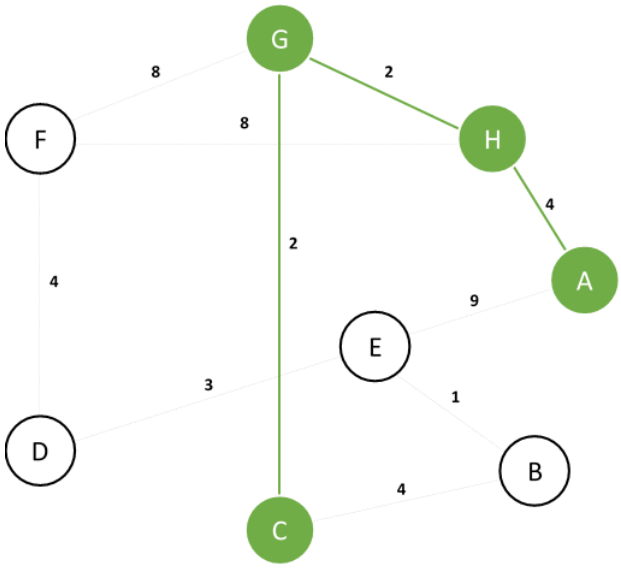
4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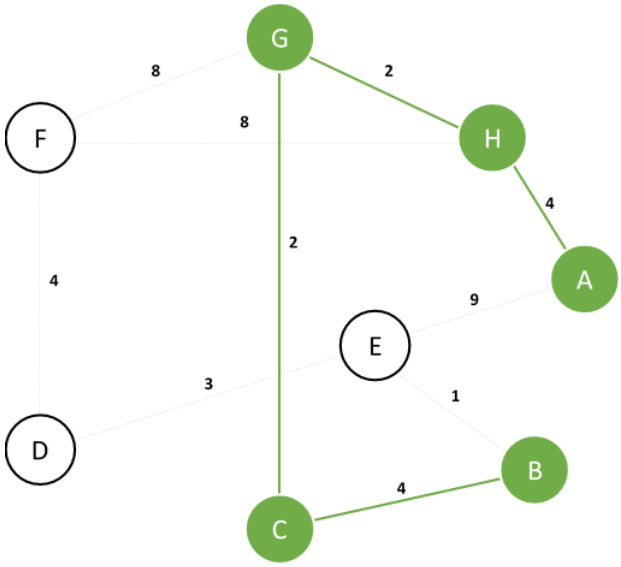
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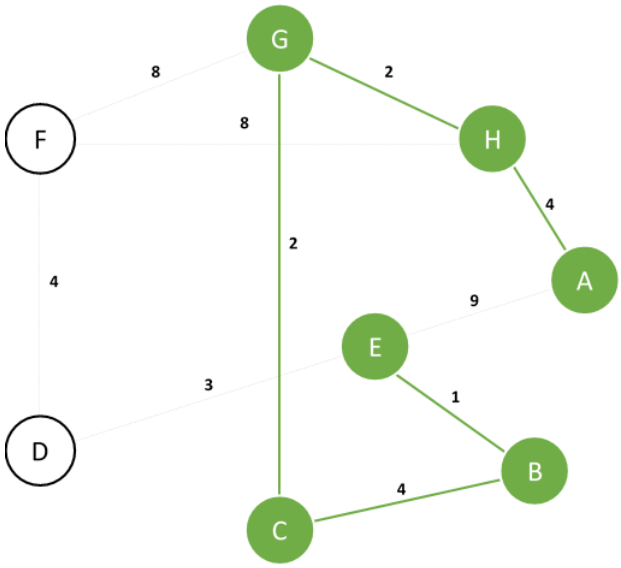
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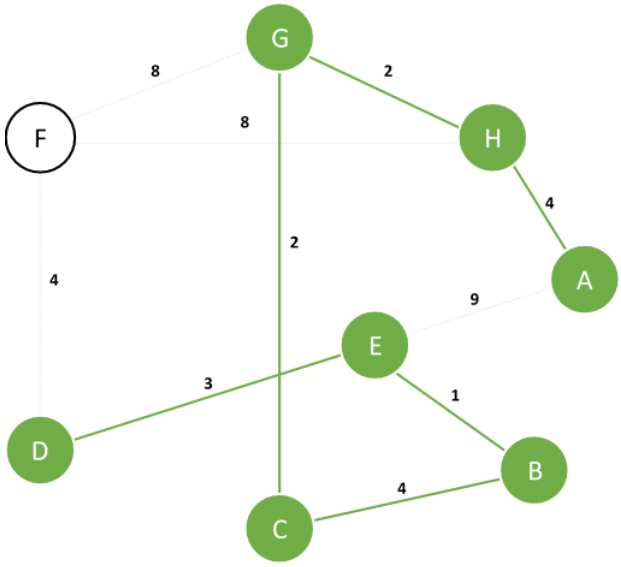
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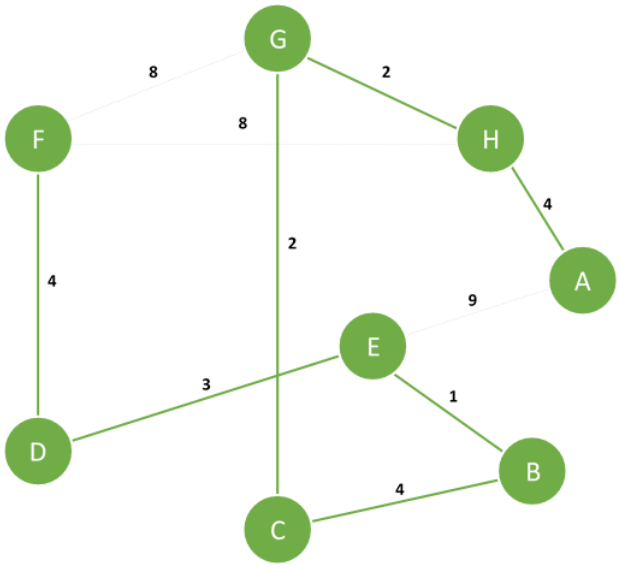
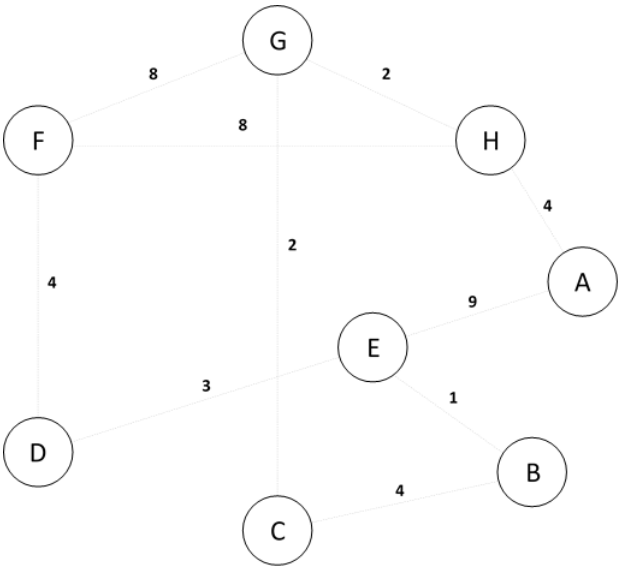
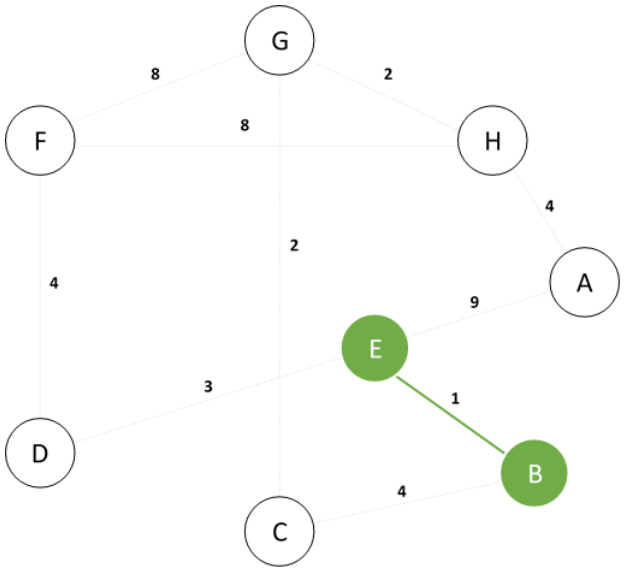


3. Trace the operations of Kruskal's minimum spanning tree algorithm on the graph given in Figure 1.

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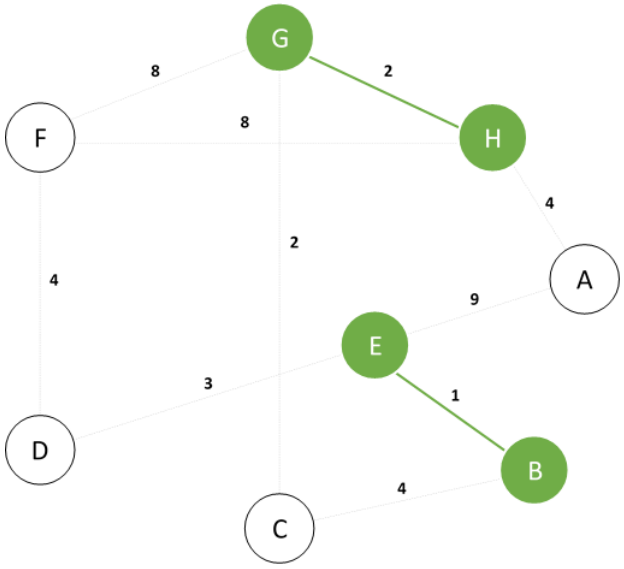
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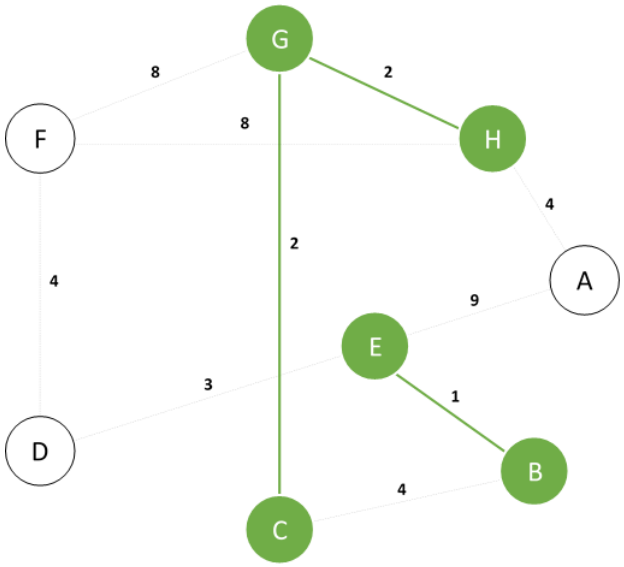
G
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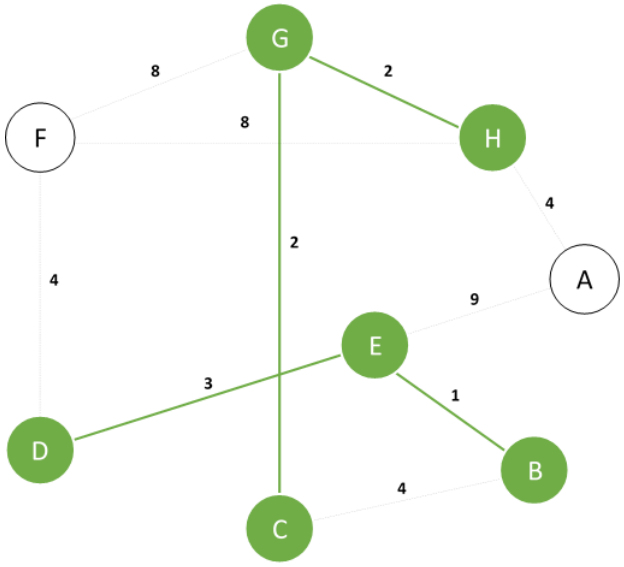
G
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A
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E
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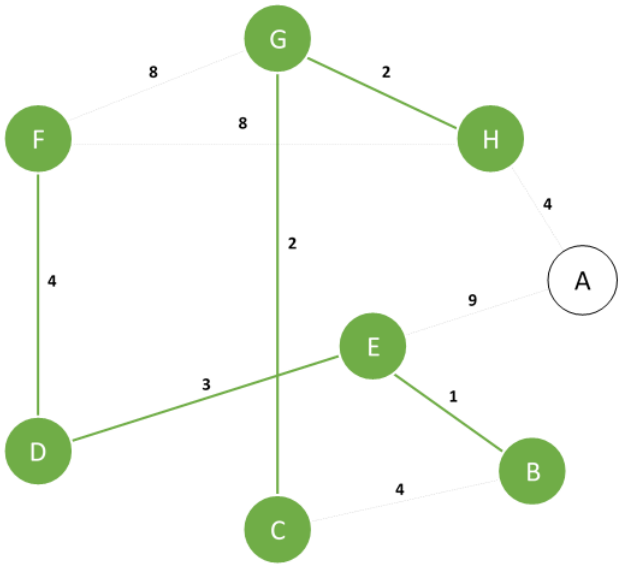
D
B
4
C


G
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8
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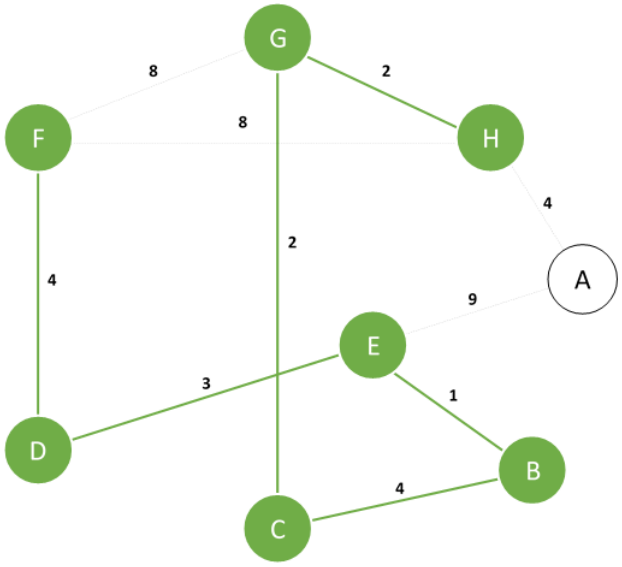
9
3
1
4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C
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4
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4
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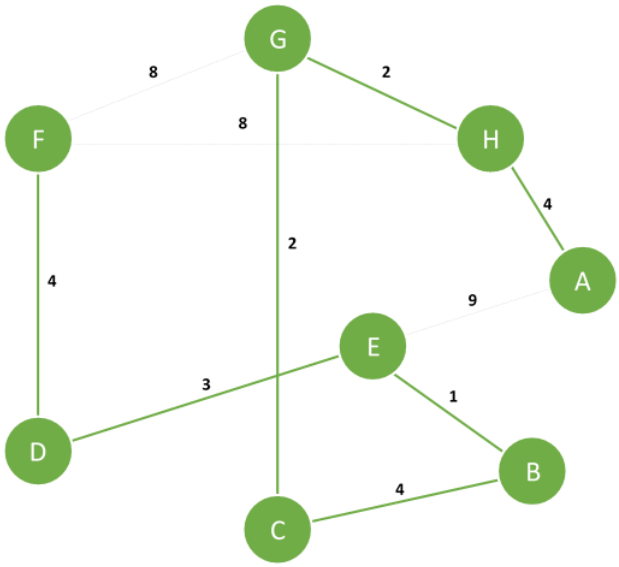
3
1
4


G
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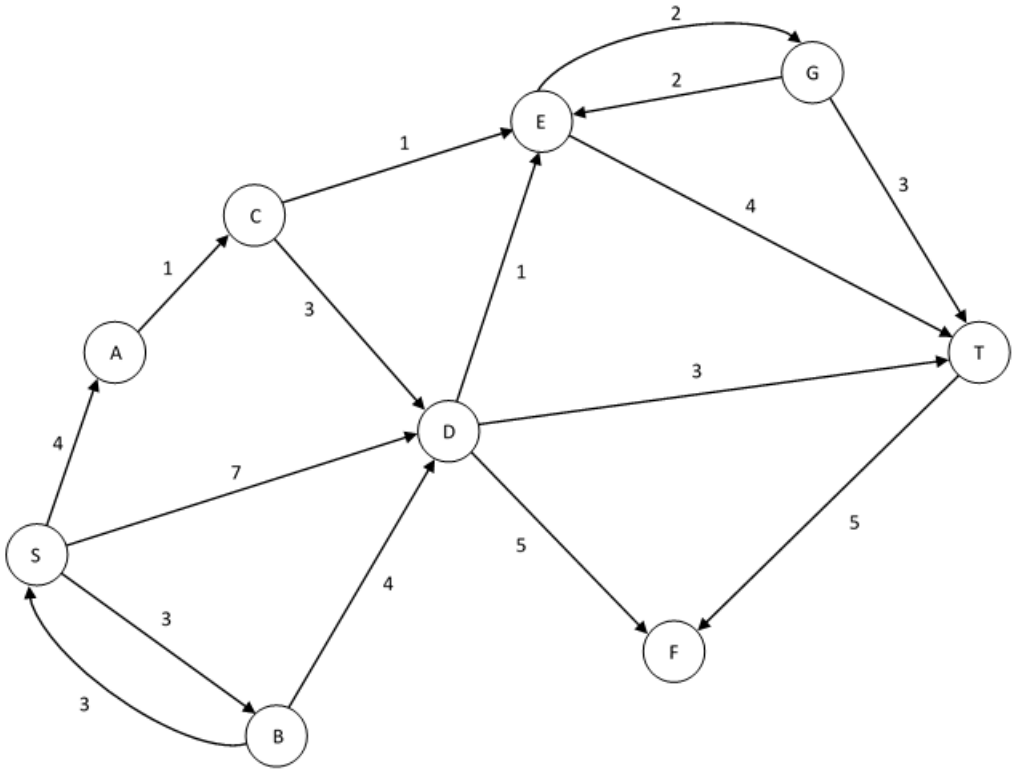
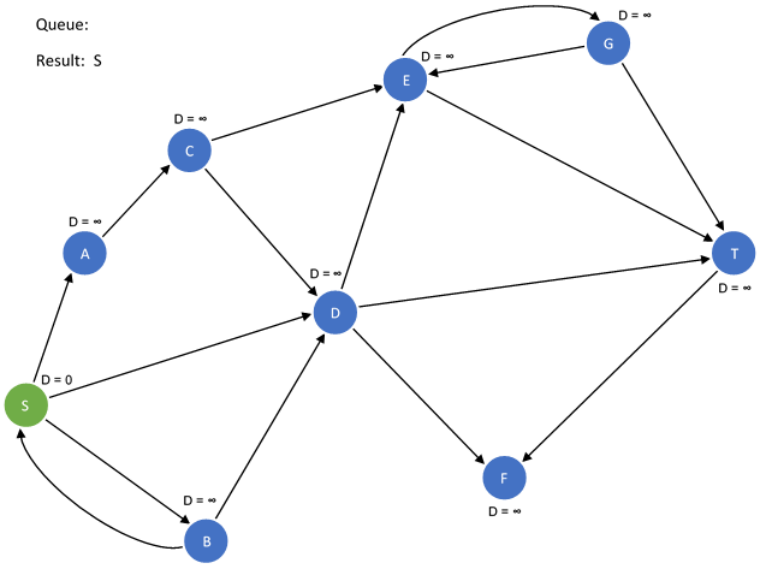
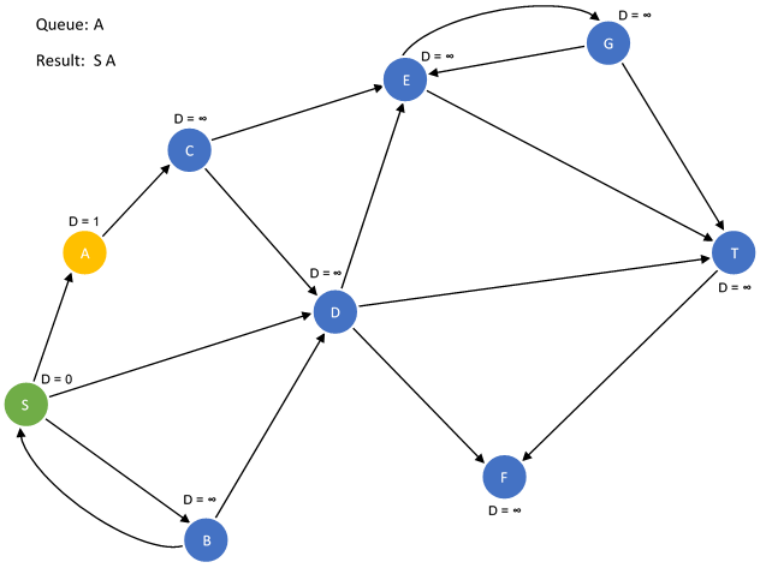
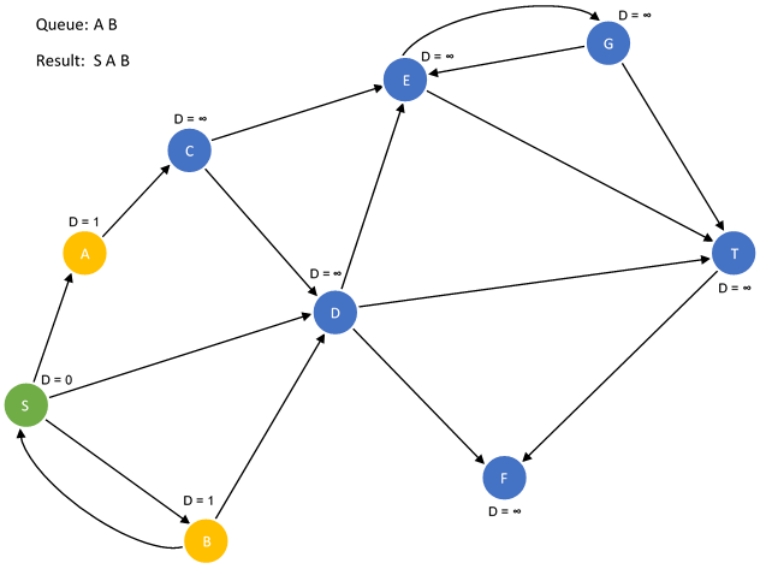


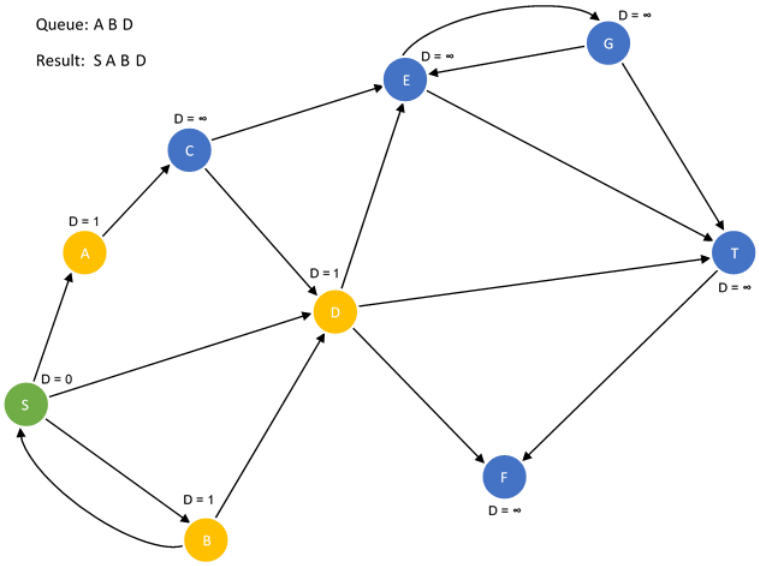
Figure 2: A directed weighted graph

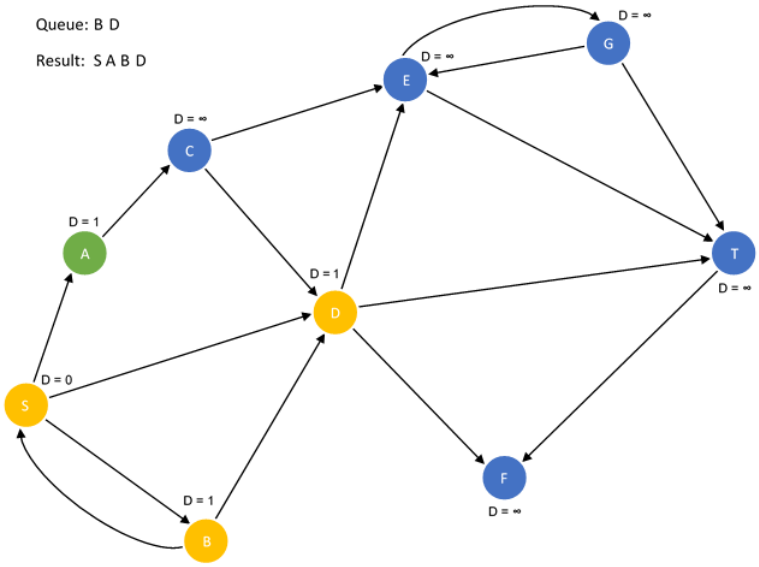
4. Starting from S, trace the operations of breadth-first traversal on the graph given in Figure 2.

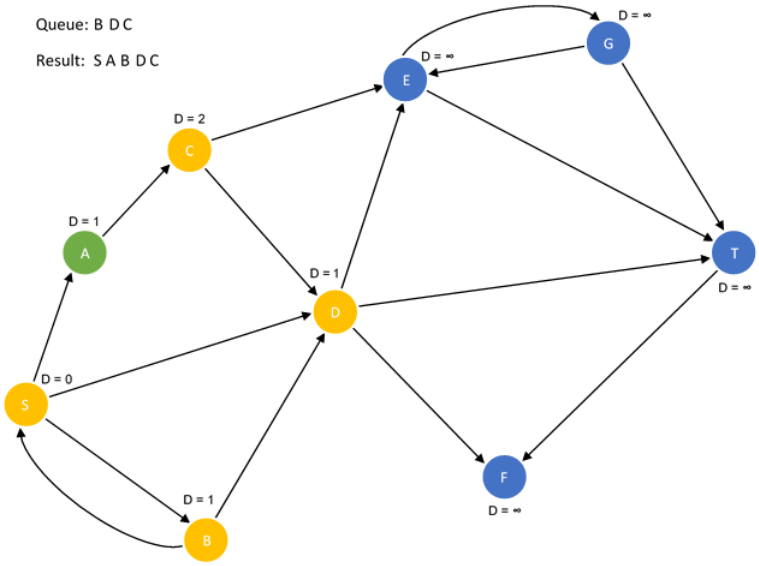

Queue:
Result: S
D = ∞
G
D = ∞
E
D = ∞
C
D = ∞
A
D = ∞
D
T
D = ∞
D = 0
S
F
D = ∞
D = ∞
B

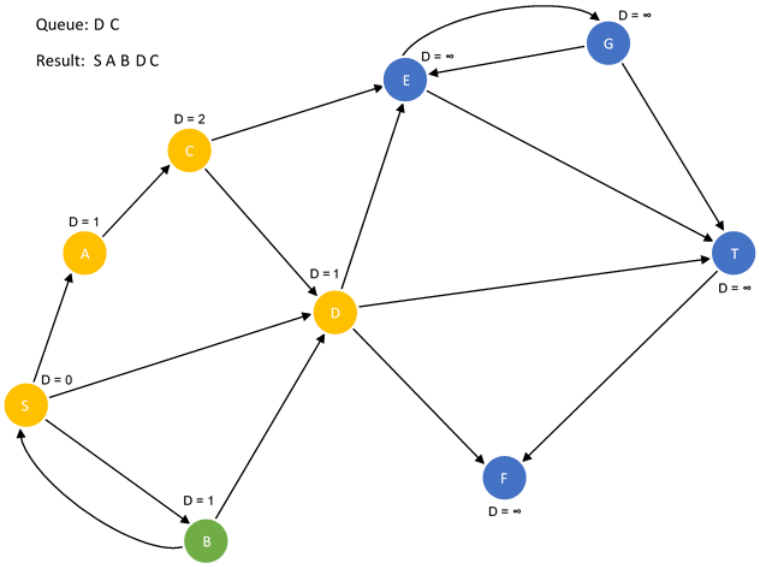

Queue: A
Result: S A
D = ∞
G
D = ∞
E
D = ∞
C
D = 1
A
D = ∞
D
T
D = ∞
D = 0
S
F
D = ∞
D = ∞
B

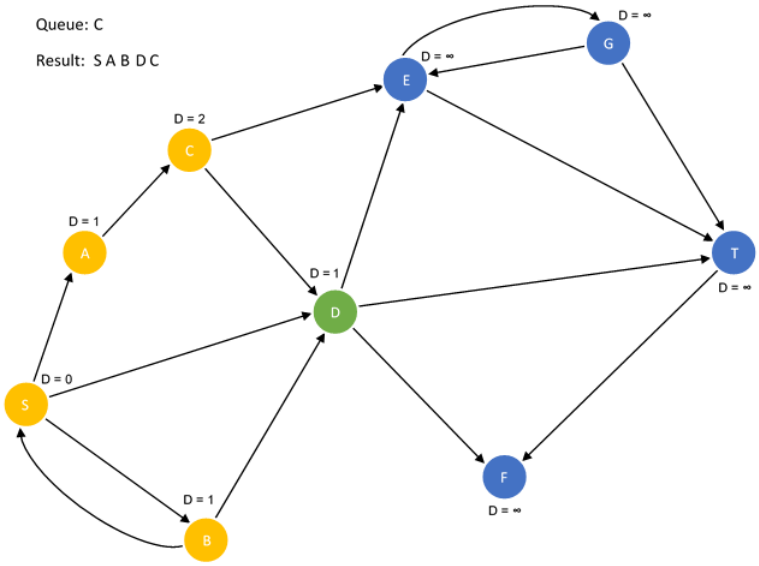

Queue: A B
Result: S A B
D = ∞
G
D = ∞
E
D = ∞
C
D = 1
A
D = ∞
D
T
D = ∞
D = 0
S
F
D = ∞
D = 1
B

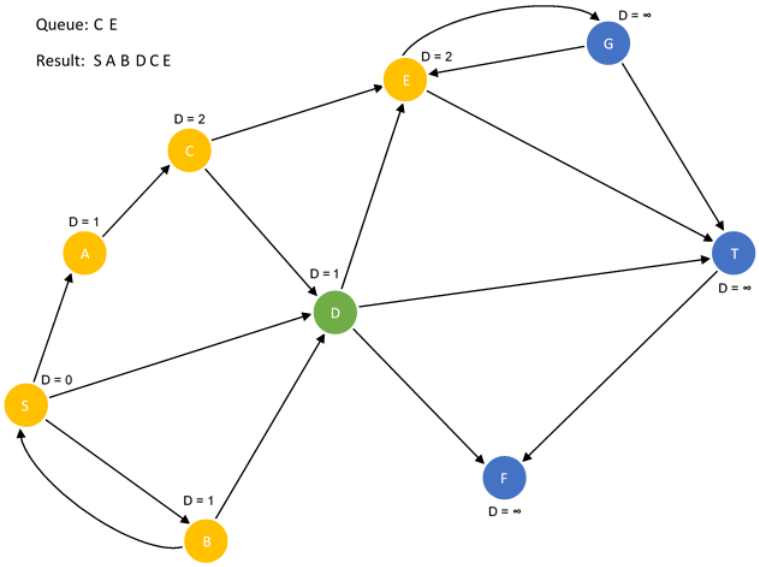

Queue: A B D
Result: S A B D
D = ∞
G
D = ∞
E
D = ∞
C
D = 1
A
D = 1
D
T
D = ∞
D = 0
S
F
D = ∞
D = 1
B

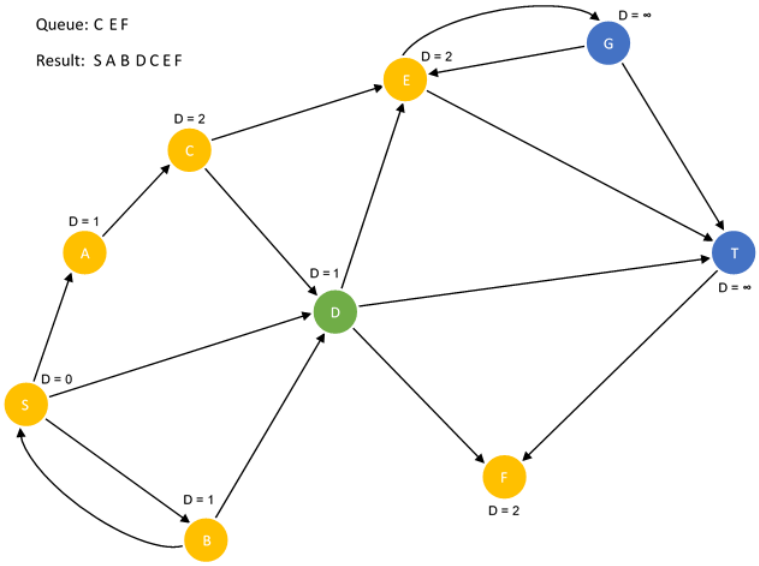

Queue: B D
Result: S A B D
D = ∞
G
D = ∞
E
D = ∞
C
D = 1
A
T
D = ∞
D = 1
D
D = 0
S
F
D = ∞
D = 1
B

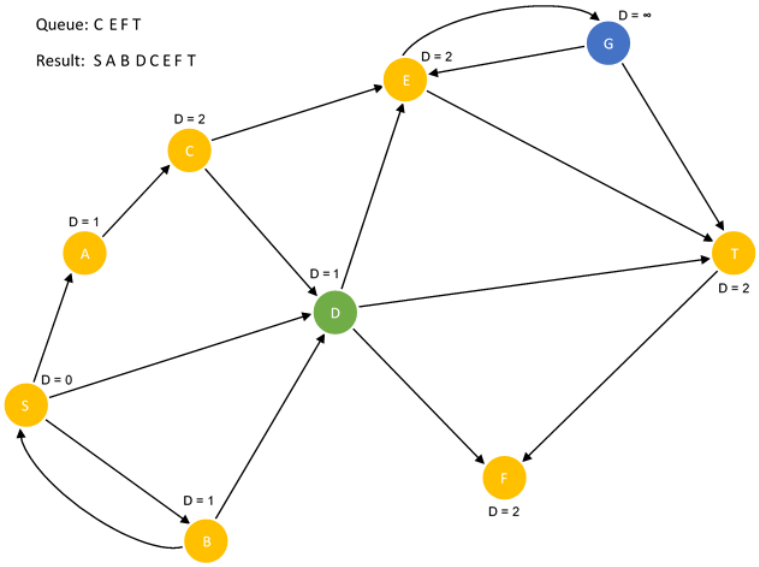

Queue: B D C
Result: S A B D C
D = ∞
G
D = ∞
E
D = 2
C
D = 1
A
T
D = ∞
D = 1
D
D = 0
S
F
D = ∞
D = 1
B

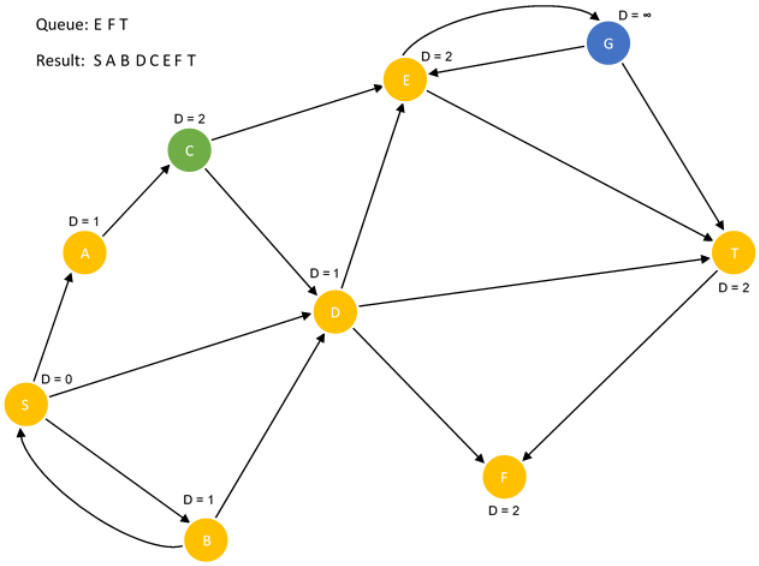

Queue: D C
Result: S A B D C
D = ∞
G
D = ∞
E
D = 2
C
D = 1
A
T
D = ∞
D = 1
D
D = 0
S
F
D = ∞
D = 1
B

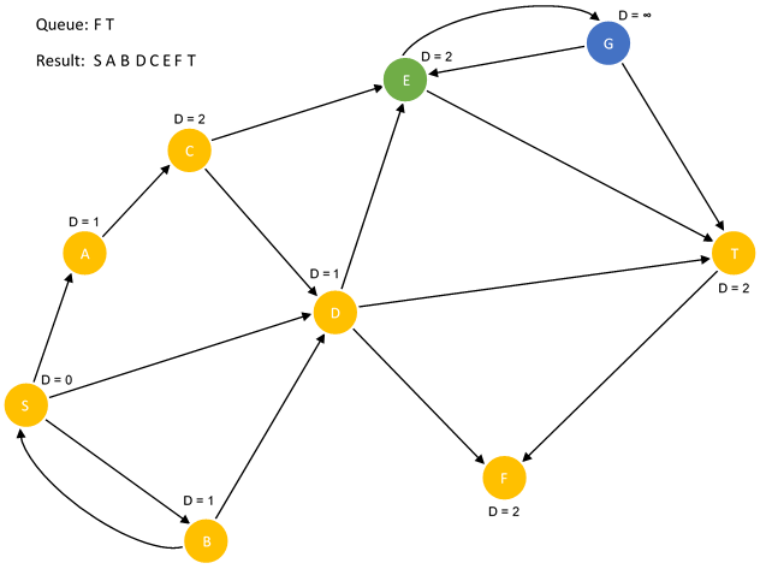

Queue: C
Result: S A B D C
D = ∞
G
D = ∞
E
D = 2
C
D = 1
A
T
D = ∞
D = 1
D
D = 0
S
F
D = ∞
D = 1
B

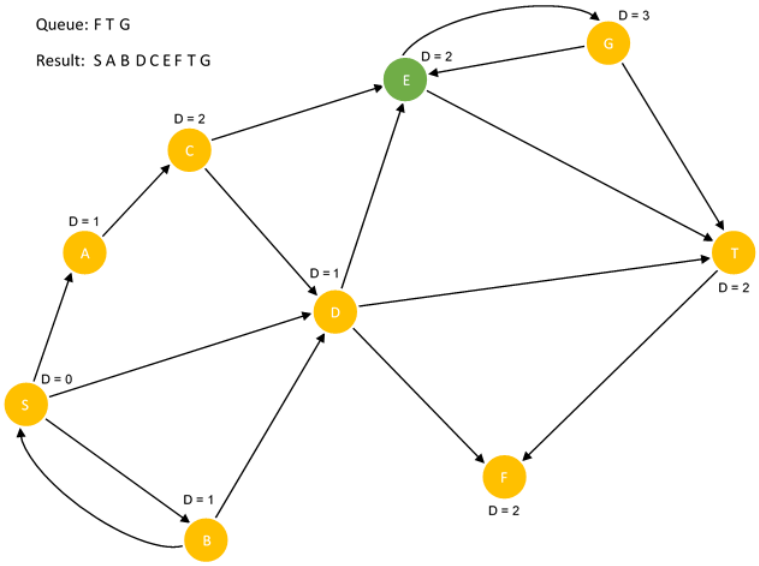

Queue: C E
Result: S A B D C E
D = ∞
G
D = 2
E
D = 2
C
D = 1
A
T
D = ∞
D = 1
D
D = 0
S
F
D = ∞
D = 1
B

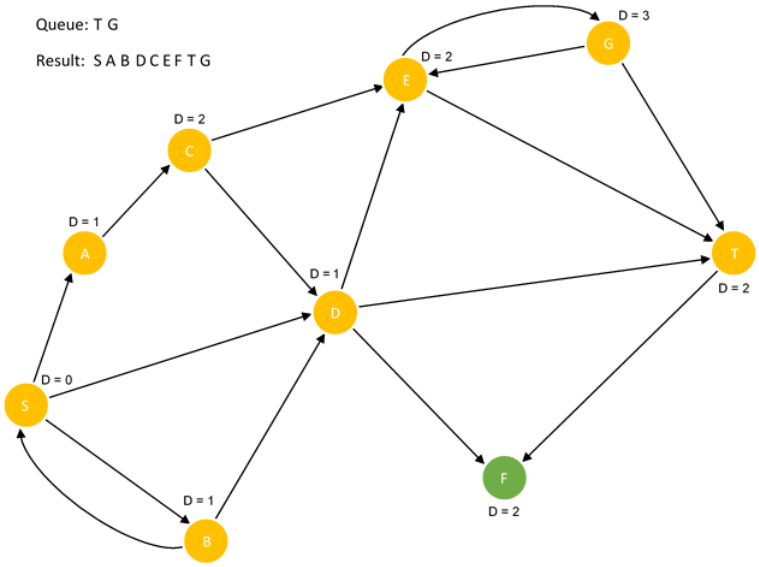

Queue: C E F
Result: S A B D C E F
D = ∞
G
D = 2
E
D = 2
C
D = 1
A
T
D = ∞
D = 1
D
D = 0
S
F
D = 2
D = 1
B

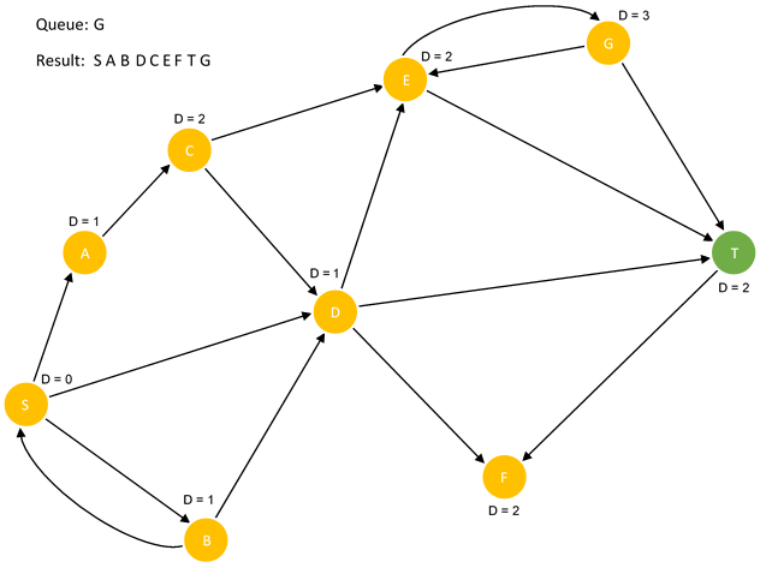

Queue: C E F T
Result: S A B D C E F T
D = ∞
G
D = 2
E
D = 2
C
D = 1
A
T
D = 2
D = 1
D
D = 0
S
F
D = 2
D = 1
B

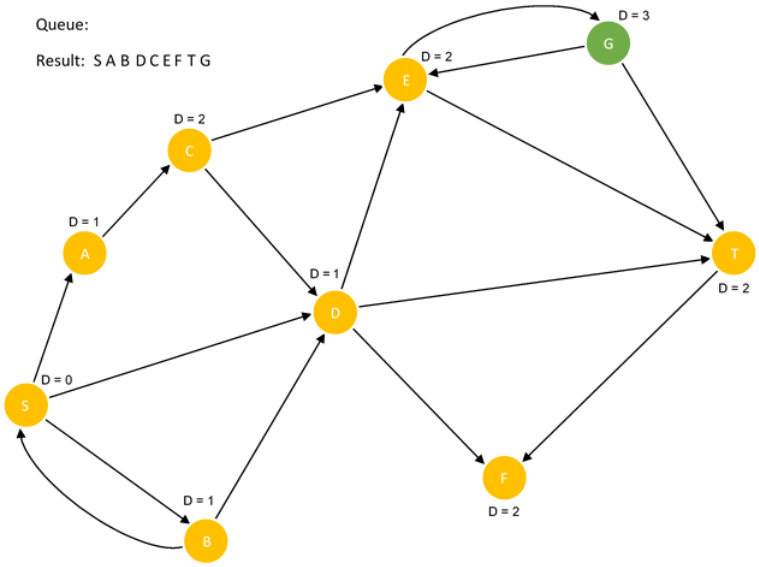

Queue: E F T
Result: S A B D C E F T
D = ∞
G
D = 2
E
D = 2
C
D = 1
A
T
D = 2
D = 1
D
D = 0
S
F
D = 2
D = 1
B

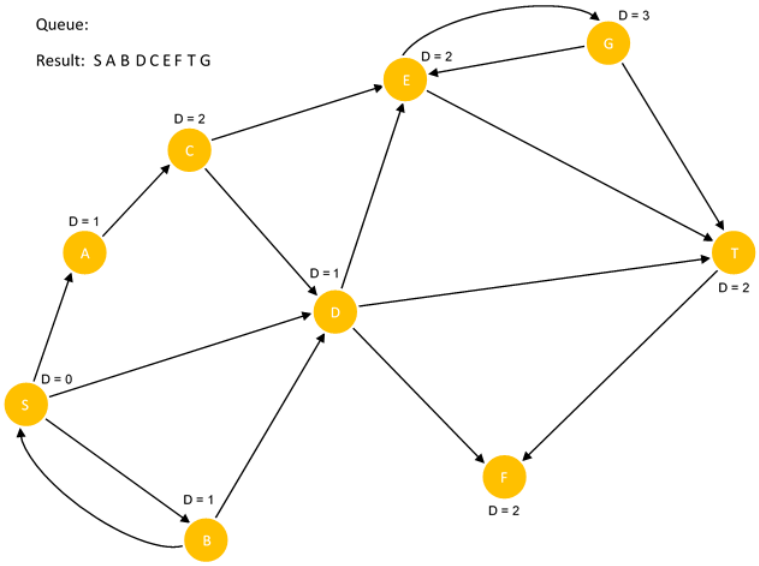

Queue: F T
Result: S A B D C E F T
D = ∞
G
D = 2
E
D = 2
C
D = 1
A
T
D = 2
D = 1
D
D = 0
S
F
D = 2
D = 1
B


Queue: F T G
Result: S A B D C E F T G
D = 3
G
D = 2
E
D = 2
C
D = 1
A
T
D = 2
D = 1
D
D = 0
S
F
D = 2
D = 1
B


Queue: T G
Result: S A B D C E F T G
D = 3
G
D = 2
E
D = 2
C
D = 1
A
D = 1
D
T
D = 2
D = 0
S
F
D = 2
D = 1
B


Queue: G
Result: S A B D C E F T G
D = 3
G
D = 2
E
D = 2
C
D = 1
A
D = 1
D
T
D = 2
D = 0
S
F
D = 2
D = 1
B

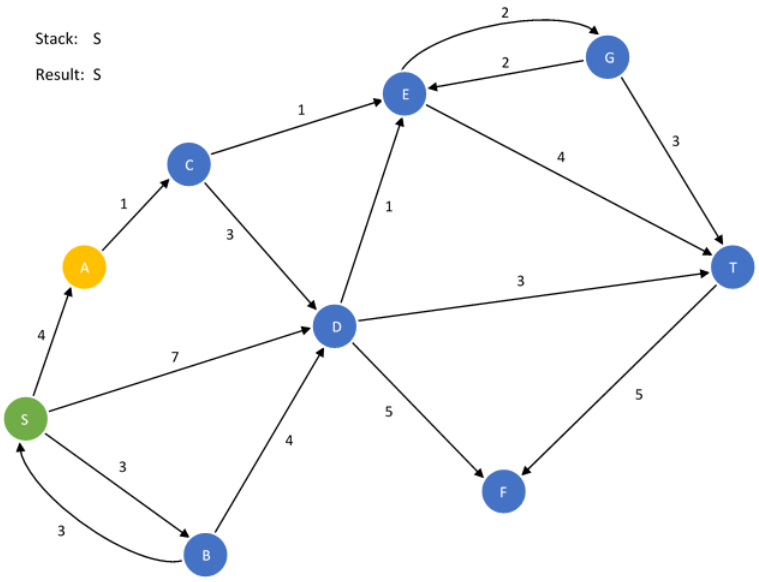

Queue:
Result: S A B D C E F T G
D = 3
G
D = 2
E
D = 2
C
D = 1
A
D = 1
D
T
D = 2
D = 0
S
F
D = 2
D = 1
B

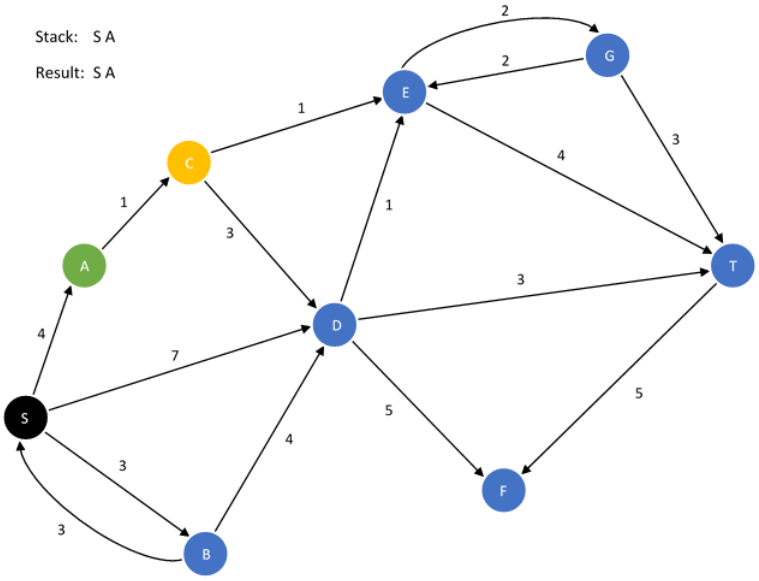

Queue:
Result: S A B D C E F T G
D = 3
G
D = 2
E
D = 2
C
D = 1
A
D = 1
D
T
D = 2
D = 0
S
F
D = 2
D = 1
B

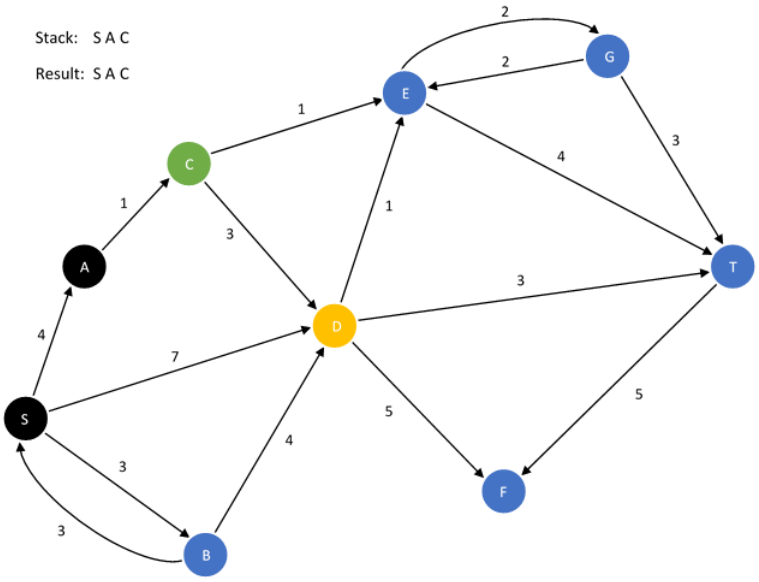
S - A - B - D - C - E - F - T - G

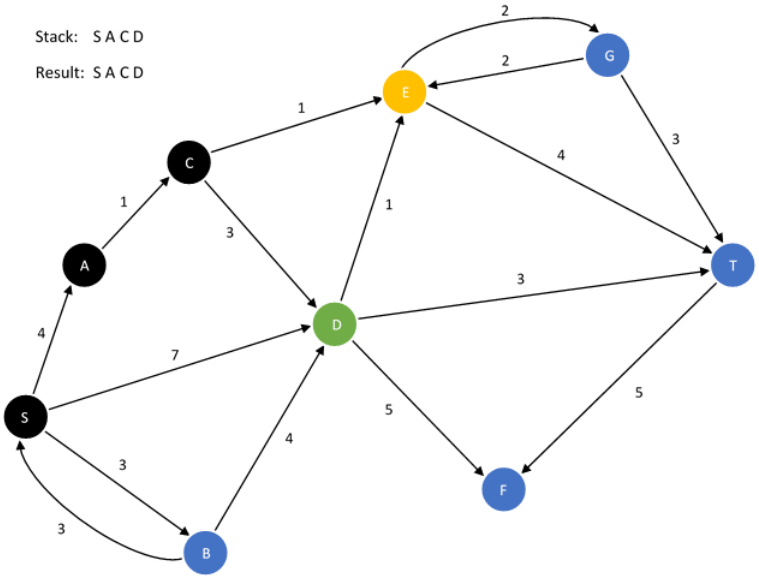
5. Given Figure 2 and starting from S,

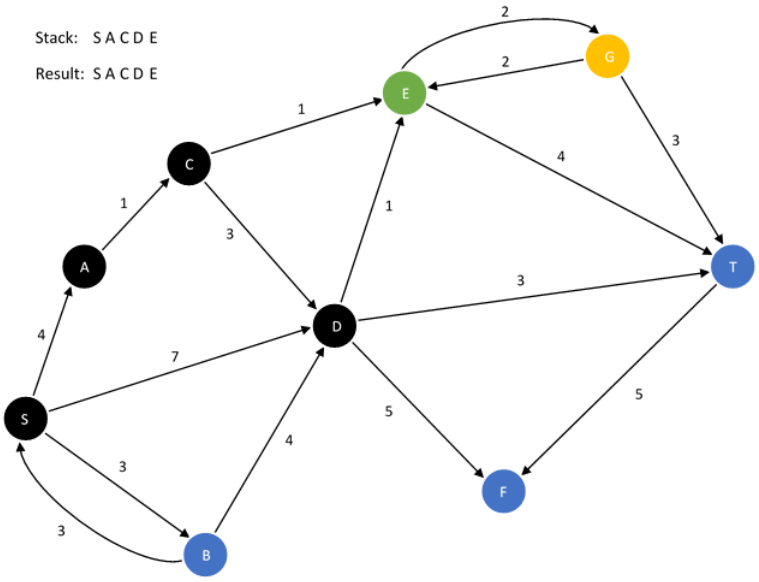
a) Trace the operations of depth-first traversal.

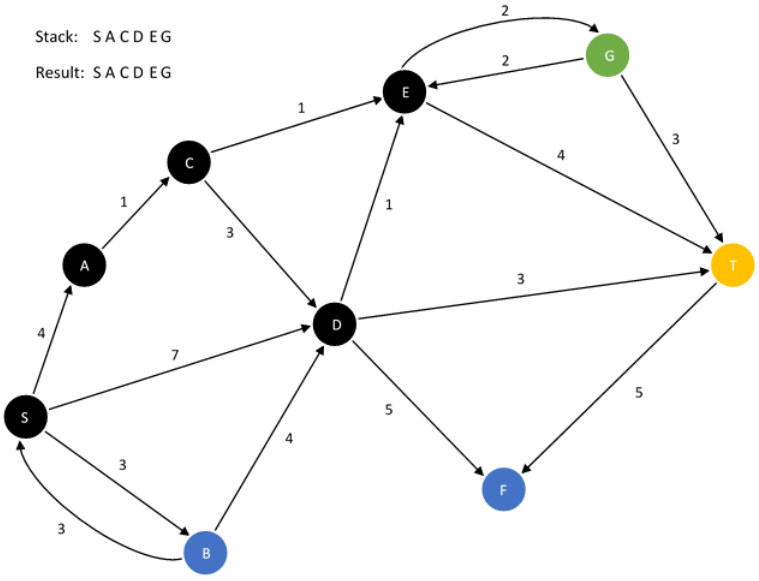


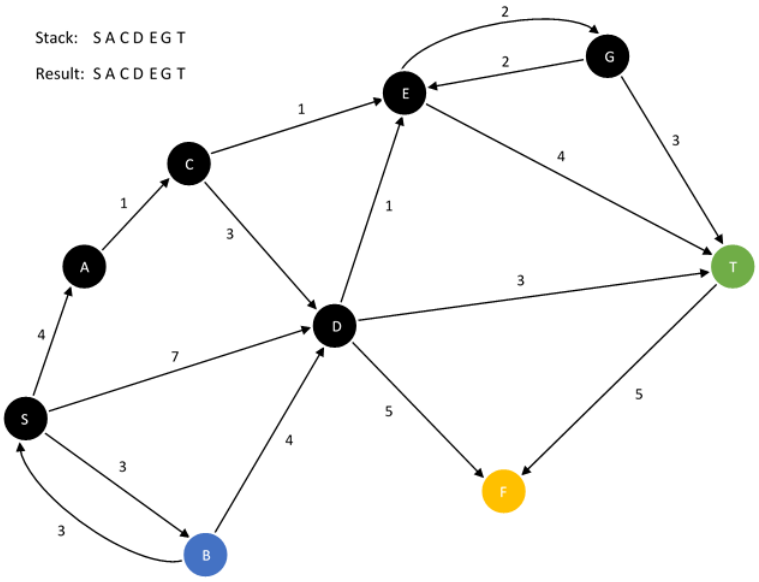


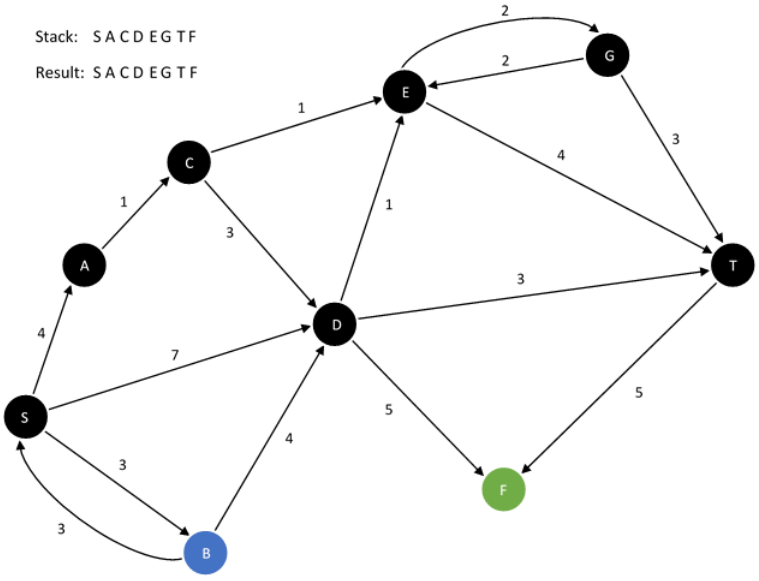

Stack: S A C
Result: S A C
S
A
B
C
D
E
F
G
T
1
2
3
4
5
7

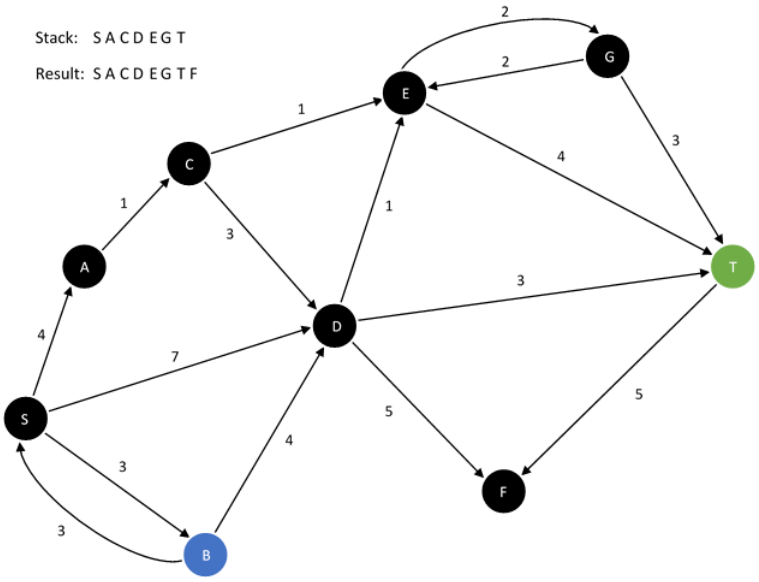

Stack: S A C D
Result: S A C D
S
A
B
C
D
E
F
G
T
1
2
3
4
5
7

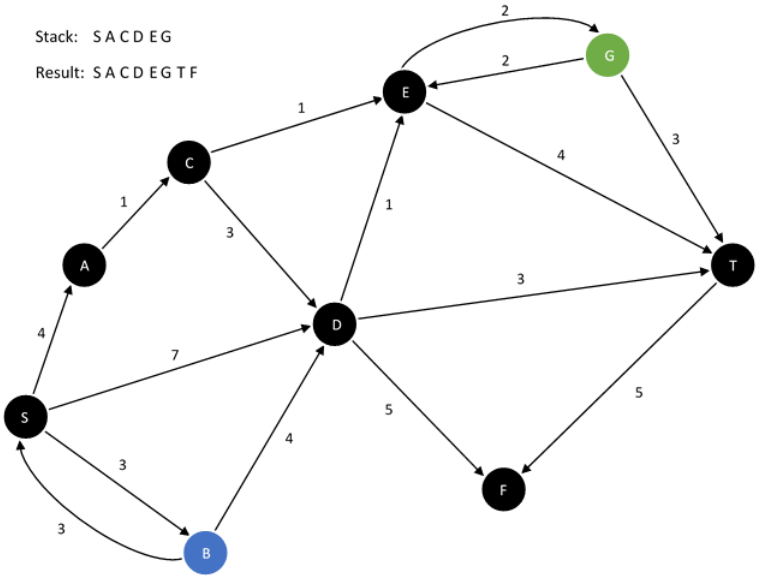

Stack: S A C D E
Result: S A C D E
S
A
B
C
D
E
F
G
T
1
2
3
4
5
7


Stack: S A C D E G
Result: S A C D E G
S
A
B
C
D
E
F
G
T
1
2
3
4
5
7


Stack: S A C D E G T
Result: S A C D E G T
S
A
B
C
D
E
F
G
T
1
2
3
4
5
7


Stack: S A C D E G T F
Result: S A C D E G T F
S
A
B
C
D
E
F
G
T
1
2
3
4
5
7


Stack: S A C D E G T
Result: S A C D E G T F
S
A
B
C
D
E
F
G
T
1
2
3
4
5
7


Stack: S A C D E G
Result: S A C D E G T F
S
A
B
C
D
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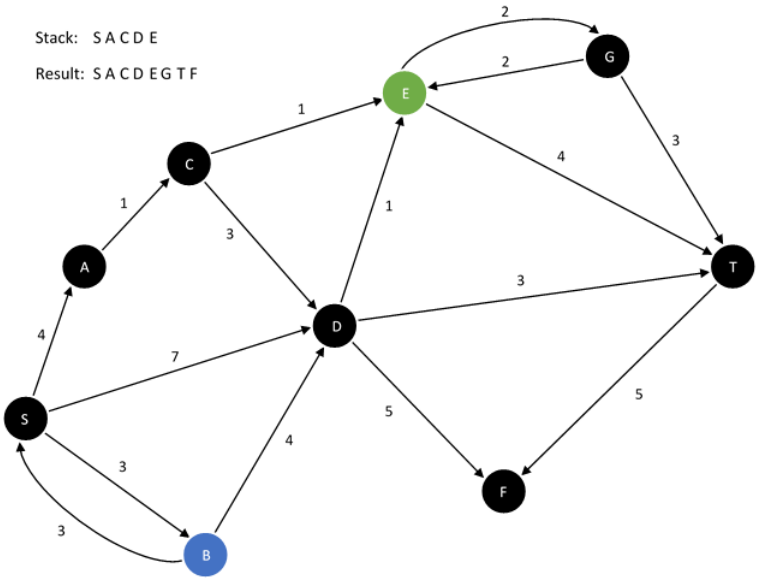
F
G
T
1
2
3
4
5
7


Stack: S A C D E
Result: S A C D E G T F
S
A
B
C
D
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F
G
T
1
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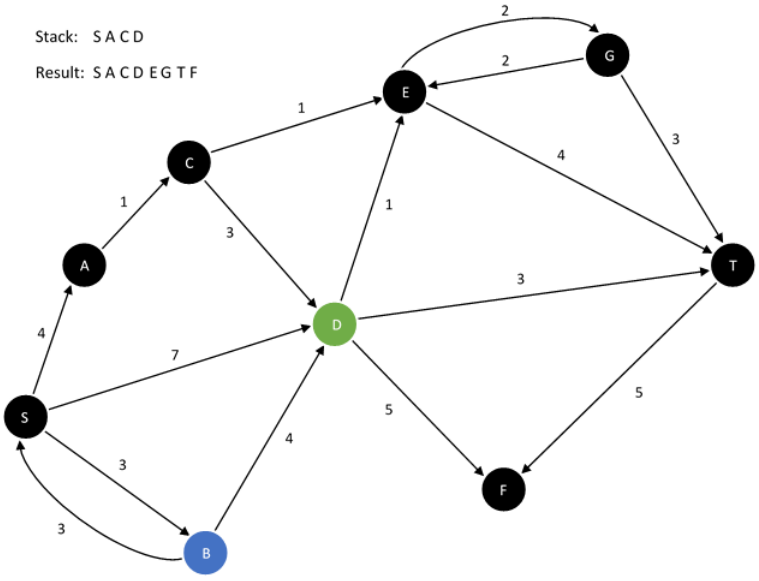
3
4
5
7


Stack: S A C D
Result: S A C D E G T F
S
A
B
C
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G
T
1
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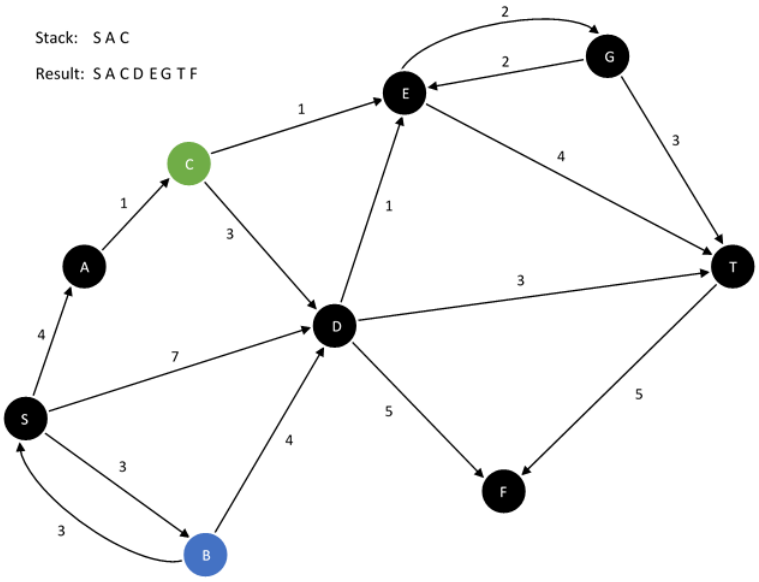
7


Stack: S A C
Result: S A C D E G T F
S
A
B
C
D
E
F
G
T
1
2
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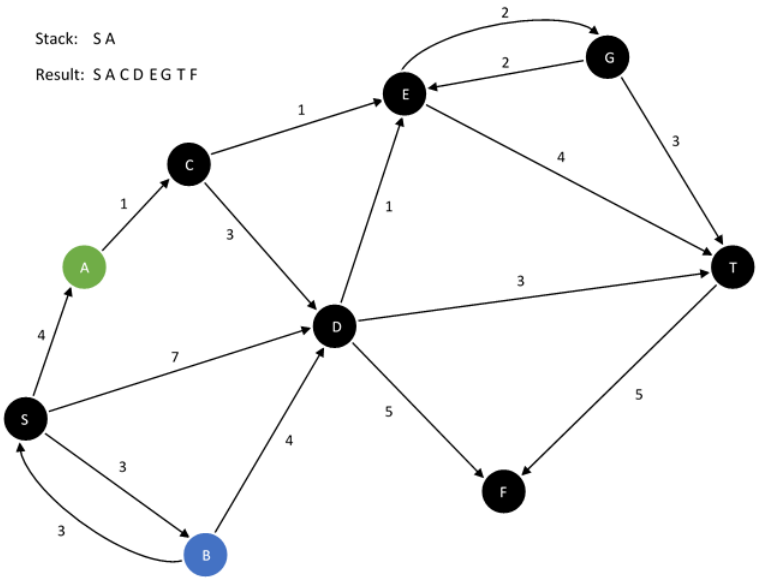
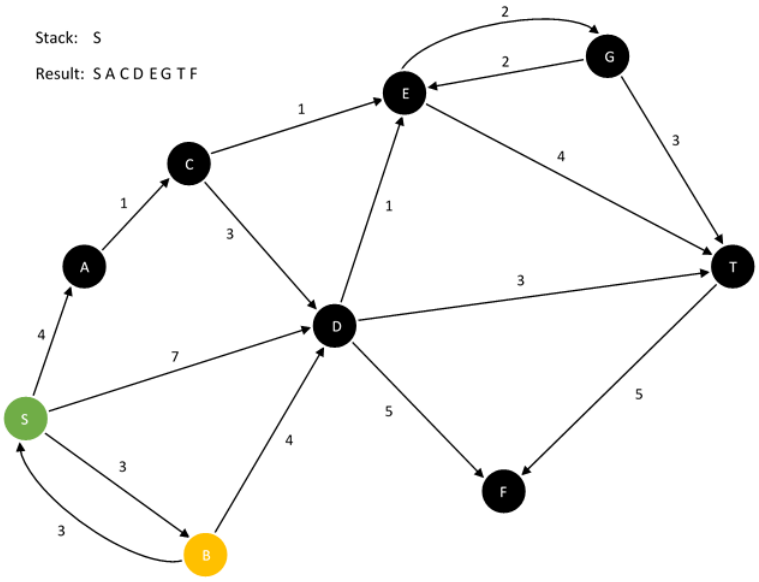
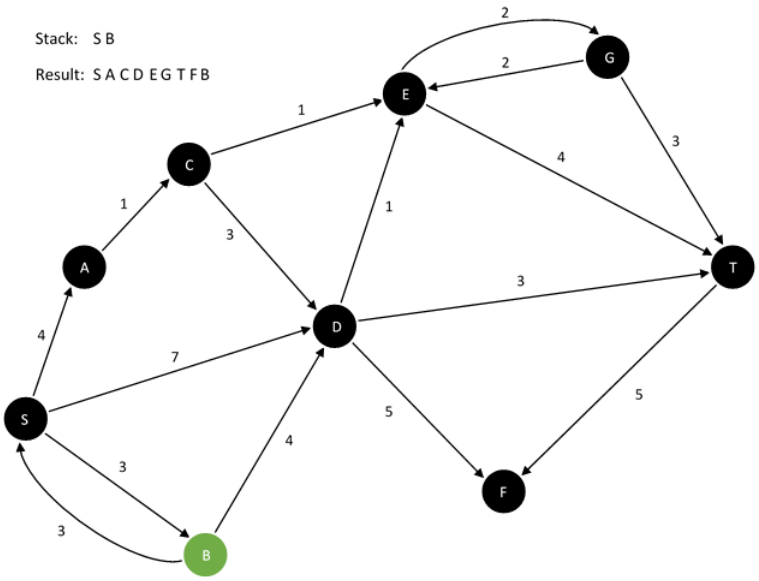
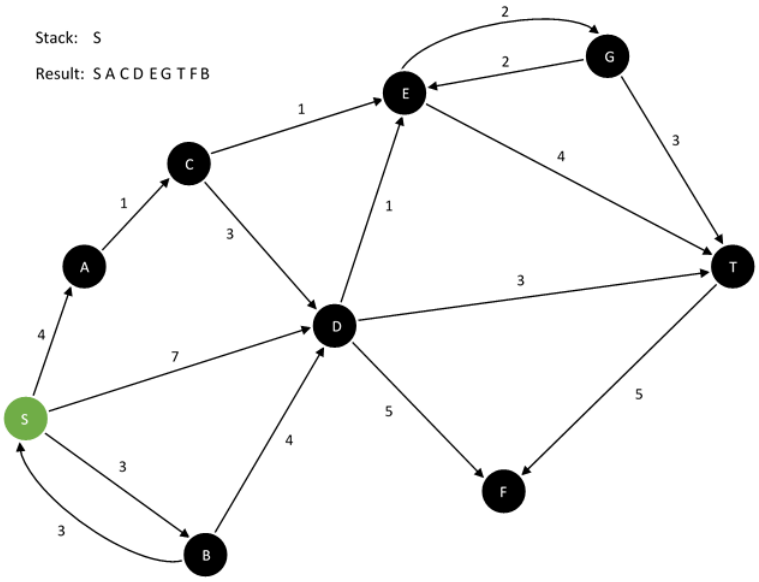
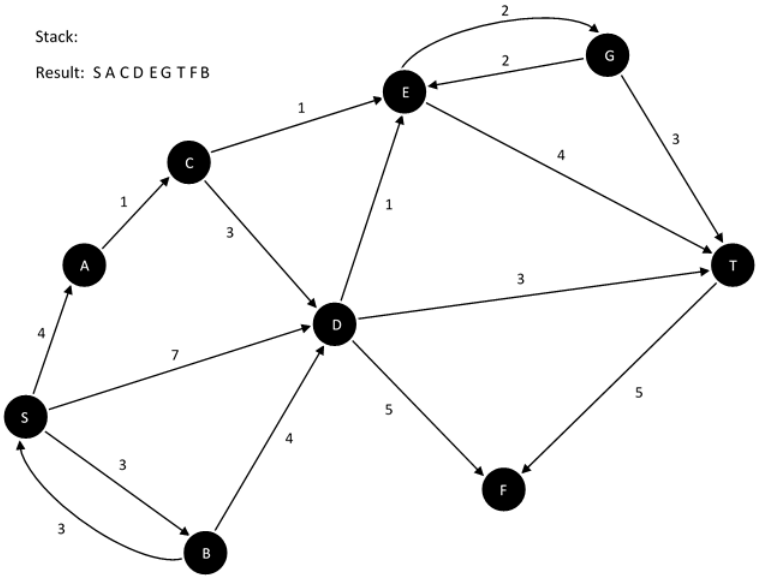
5
7


Stack: S A
Result: S A C D E G T F
S
A
B
C
D
E
F
G
T
1
2
3
4
5
7


Stack: S
Result: S A C D E G T F
S
A
B
C
D
E
F
G
T
1
2
3
4
5
7


Stack: S B
Result: S A C D E G T F B
S
A
B
C
D
E
F
G
T
1
2
3
4
5
7


Stack: S
Result: S A C D E G T F B
S
A
B
C
D
E
F
G
T
1
2
3
4
5
7


Stack:
Result: S A C D E G T F B
S
A
B
C
D
E
F
G
T
1
2
3
4
5
7

b) Give the post-order numbers for all the nodes.

Nodes	F	T	G	E	D	C	A	B	S
Post-Order	1	2	3	4	5	6	7	8	9

c) Give the pre-order numbers for all the nodes.

Nodes	S	A	C	D	E	G	T	F	B
Pre-Order	1	2	3	4	5	6	7	8	9

d) List the tree arcs, cross arcs, forward arcs and backward arcs.

Tree Arcs	**Cross Arcs**	**Forward Arcs**	**Backward Arcs**
S→B	B→D	S→D	G→E
S→A		C→E	B→S
A→C		D→T	
C→D		D→F	
D→E		E→T	
E→G			
G→T			
T→F			

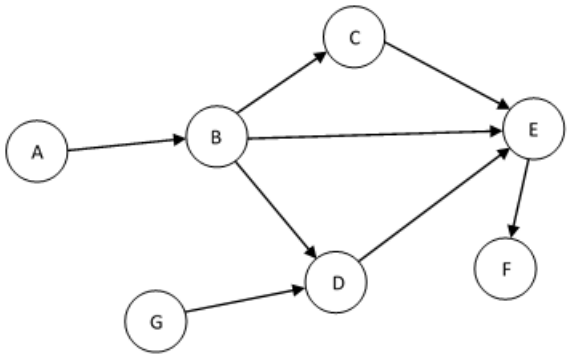
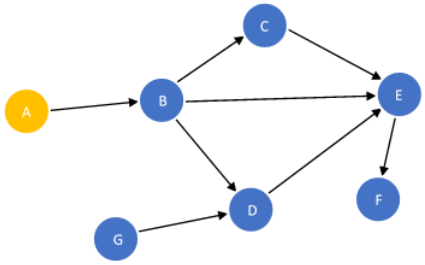
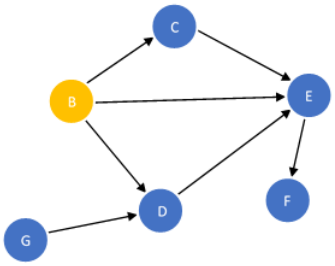
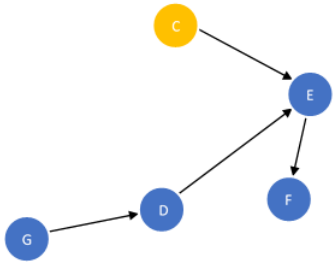


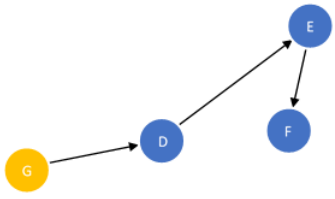
Figure 3: An example DAG

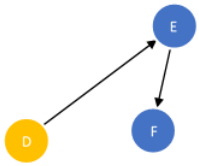
6. Find a topological ordering of the graph given in Figure 3.











Topological ordering of the graph: A-B-C-G-D-E-F