# CS310 Data Structures and Algorithms Spring 2020

Homework 5 & 6

30 Points, 5 Questions

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Fill the worksheet, upload in blackboard as a PDF. Add as many pages as you may need to answer the questions. You may write and scan (make sure it is readable)
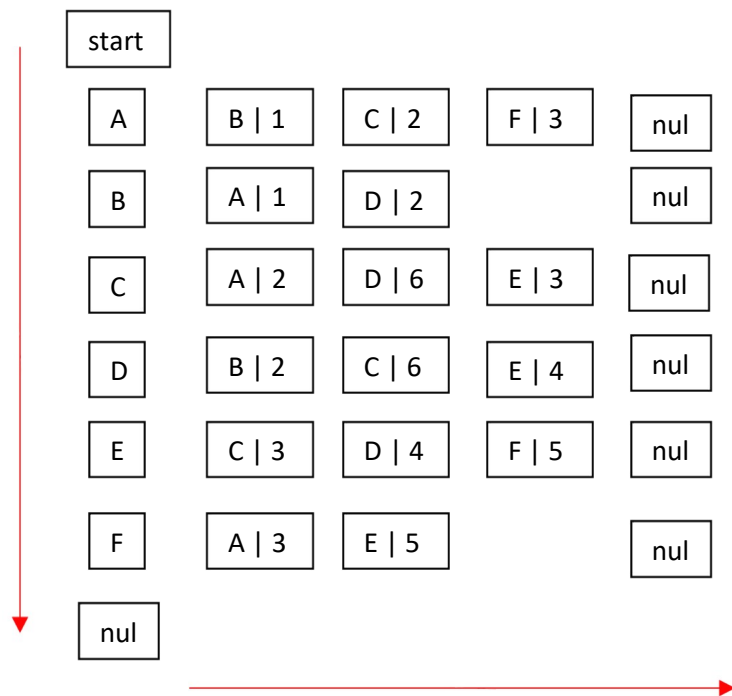
1. Represent the Following graph as both adjacency matrix and adjacency list. Make sure to label which is the list and which is the matrix. (10 Points)
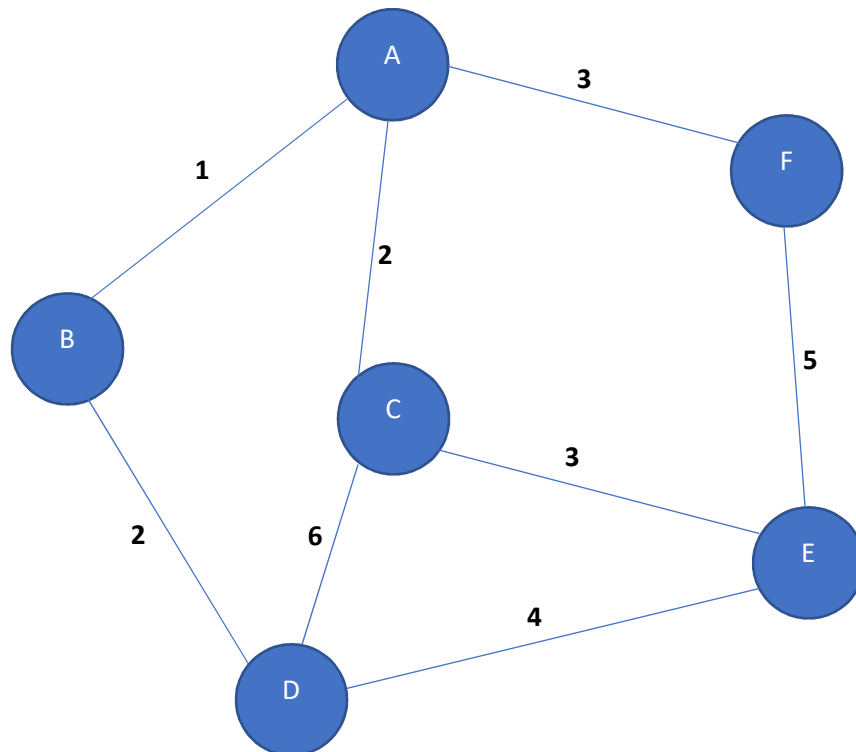
Matrix

	A	B	C	D	E	F
A	0	1	2	0	0	3
B	1	0	0	2	0	0
C	2	0	0	6	3	0
D	0	2	6	0	4	0
E	0	0	3	4	0	5
F	3	0	0	0	5	0

List

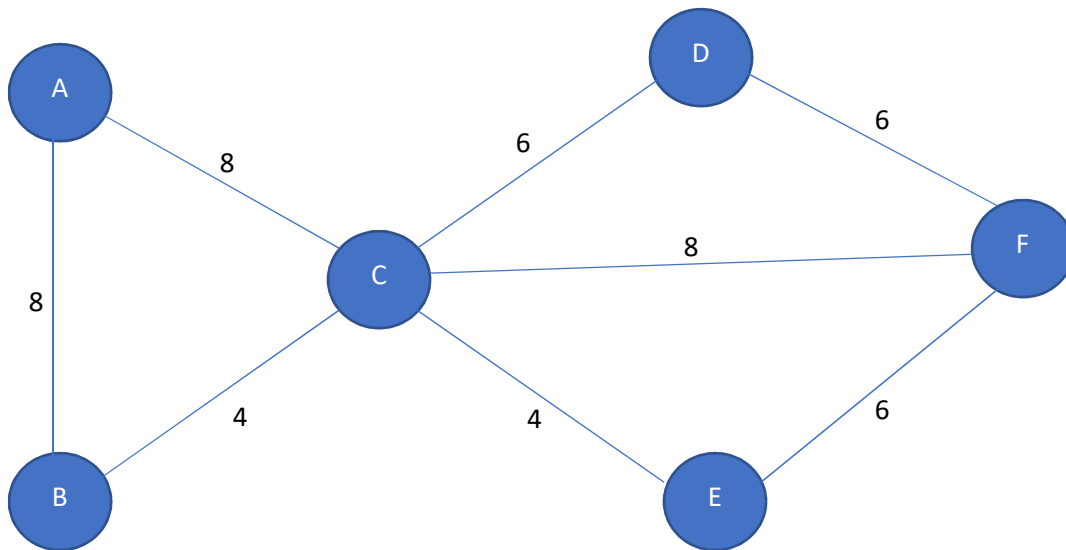| start				
A	B | 1	C | 2	F | 3	nul
B	A | 1	D | 2		nul
C	A | 2	D | 6	E | 3	nul
D	B | 2	C | 6	E | 4	nul
E	C | 3	D | 4	F | 5	nul
F	A | 3	E | 5		nul
nul				

2. Which of the following is true about the graph in Question 1 (2 Points)
   a. It is a weighted directed graph
   b. It is an unweighted undirected graph
   c. **It is a weighted undirected graph**
   d. It is an unweighted directed graph

3. Use the following graph to answer all questions in this part. (6 Points)

a. Use the Prim's Algorithm to find the Minimum Spanning Tree of the above graph.
   Show the order in which the nodes are discovered and then draw the final result of the algorithm along with the weights.

b. Use the Kruskal's Algorithm to find the Minimum Spanning Tree of the above graph.
   Show the order in which the nodes are discovered and then draw the final result of the algorithm along with the weights.

c. Are your answers in 3 (a) and 3(b) the same?

d. If you answered yes to 3(c), explain why and when they will be different. If you answered no to 3(c), explain why and when they will be the same?

a.

Known	Unknown	PQ
A	A	1) A,B – 8
B	B	A,C – 8
C	C	2) B, C – 4
E	D	4) C, D – 6
D	E	C,F – 8
F	F	3) C, E - 4
		E,F - 6
		5) D, F - 6
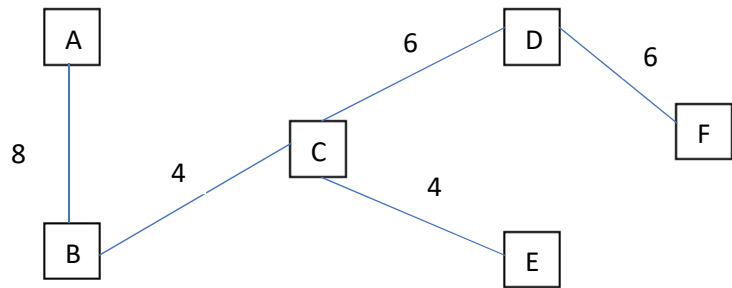
b. Edge Count < 5 (6 - 1)

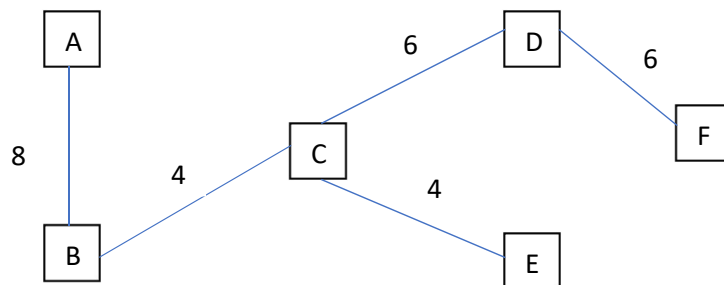B,C – 4

C,E – 4

C, D – 6

D, F – 6

F, E – 6 X

A, B – 8

C, F – 8

A, C – 8

c. The answers are in fact the same.

d. They are the same, when choosing between which to make first in the case of D,F and E,F, I chose the same in each case. This is where they could have gone different. Because of the same weight, I was able to choose which to go first, and in this case, which ever didn't go first, couldn't go at all because it would create a cycle.

4. Hashing (6 Points)

The properties of the hashtable for this question are as follows:

Size = 12
Collison Resolution Method: **Open Addressing**
Hash functions:
`H(k) = 3 - (k mod 12)`

The following keys have to be inserted into the Hash Table **in sequence**:
33, 10, 9, 13, 12, 45, 26, 17

Fill the values in the Hash Table below, also **showcase the working** of how you find the index for each value inserted.

Index	Value
0	
1	26
2	13
3	12
4	17
5	
6	33
7	10
8	9
9	45
10	
11	

Do you think the above Hash Function is effective? What could make it better? What in your opinion is a "good" hash function? 2 extra points for proper reasoning.

Entry	H(k) = | 3 – (k mod 12) |	Index
33	6	6
10	7	7
9	6	6 filled, 7 filled, so 8
13	2	2
12	3	3
45	6	6, 7, 8 filled, so 9
26	1	1
17	2	2, 3 filled, so 4

The hashing function is effective, as a very common hashing function for an array of size n, is k mod n. I don't think the 3- is necessary, because that doesn't change where certain entries go versus just kmod12. I acutally prefer separate chaining. But when chaining, each chain is sorted. This would make hashing much more organized and efficient. The only issue with this would be it requires additional memory.

5. Dijkstra's Algorithm (6 Points)
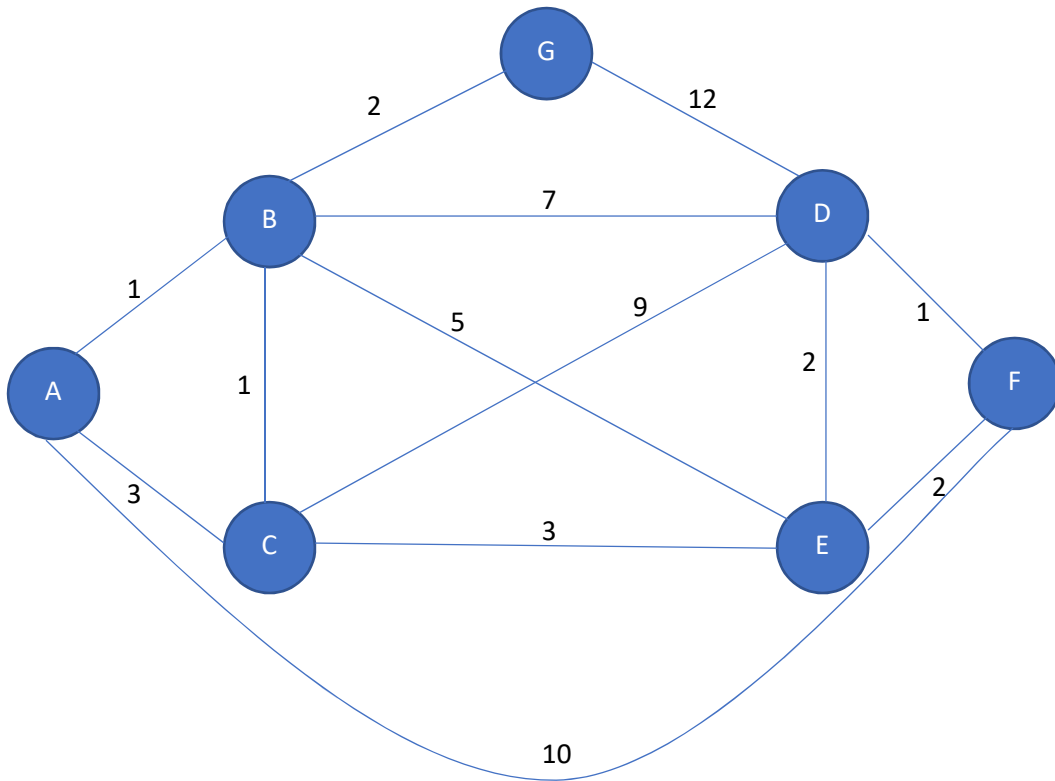
Calculate the single shortest path from A to every other vertex in the above graph using Dijkstra's algorithm.

Show the steps in the table given below, cross out old values and fill new ones as better paths are discovered through the algorithm.

Once you have stepped through the whole algorithm, write the lowest cost path from A to F.

Order in which the vertices are discovered: A – B – C – G – E – D – F

Vertex	Known (mark Y when discovered)	Cost	Path
A	Y1	0	
B	Y2	1	A
C	Y3	~~3~~ 2	~~A~~ B
D	Y6	~~8~~ 7	~~B~~ E
E	Y5	~~6~~ 5	~~B~~ C
F	Y7	~~10~~ 7	~~A~~ E
G	Y4	3	B

Shortest Path from A to F is: A – B – C – E - F