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Cmsc 204, Dr. Alexander
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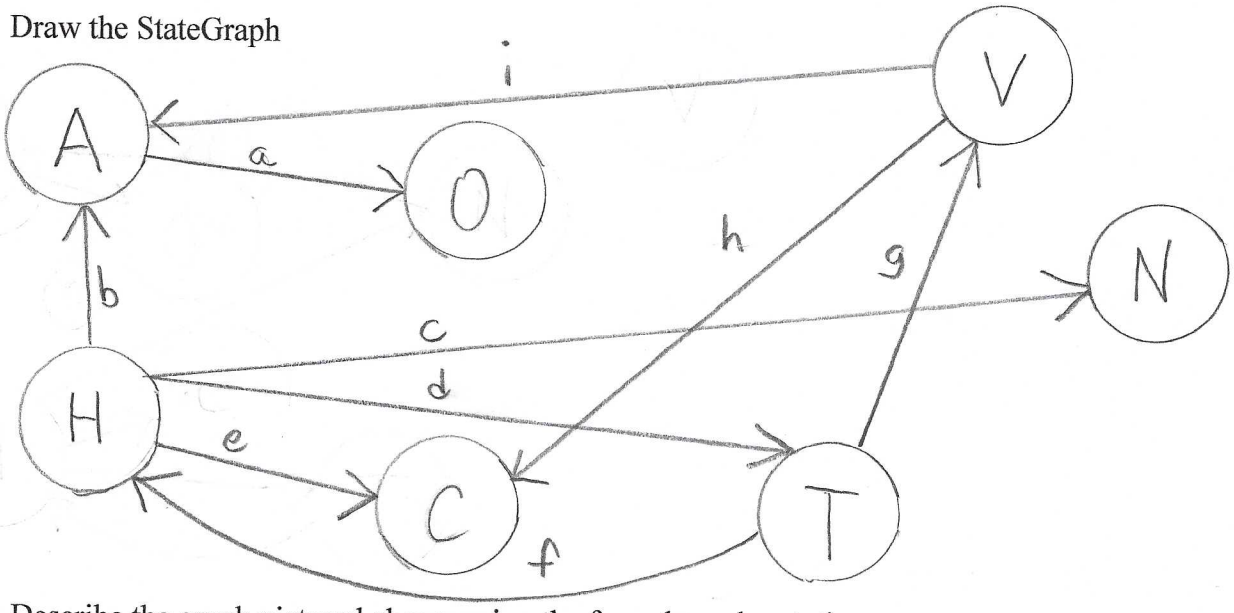
CMSC204
Kartchner

V(StateGraph) = {Oregon, Alaska, Texas, Hawaii, Vermont, NewYork, California}
E(StateGraph) = {(Alaska, Oregon), (Hawaii, Alaska), (Hawaii, Texas), (Texas, Hawaii), (Hawaii, California), (Hawaii, New York), (Texas, Vermont), (Vermont, California), (Vermont, Alaska)}

1. Draw the StateGraph



1. Describe the graph pictured above, using the formal graph notation.

V(StateGraph) = {A, C, H, N, O, T, V} or {Alaska, California, Hawaii, New York, Oregon, Texas, Vermont}

E(StateGraph) = {a, b, c, d, e, f, g, h, i} or {A→O, H→A, H→C, H→N, H→T, T→H, T→V, T→N, V→C, V→A}

2. a. Is there a path from Oregon to any other state in the graph? No

   b. Is there a path from Hawaii to every other state in the graph? Yes

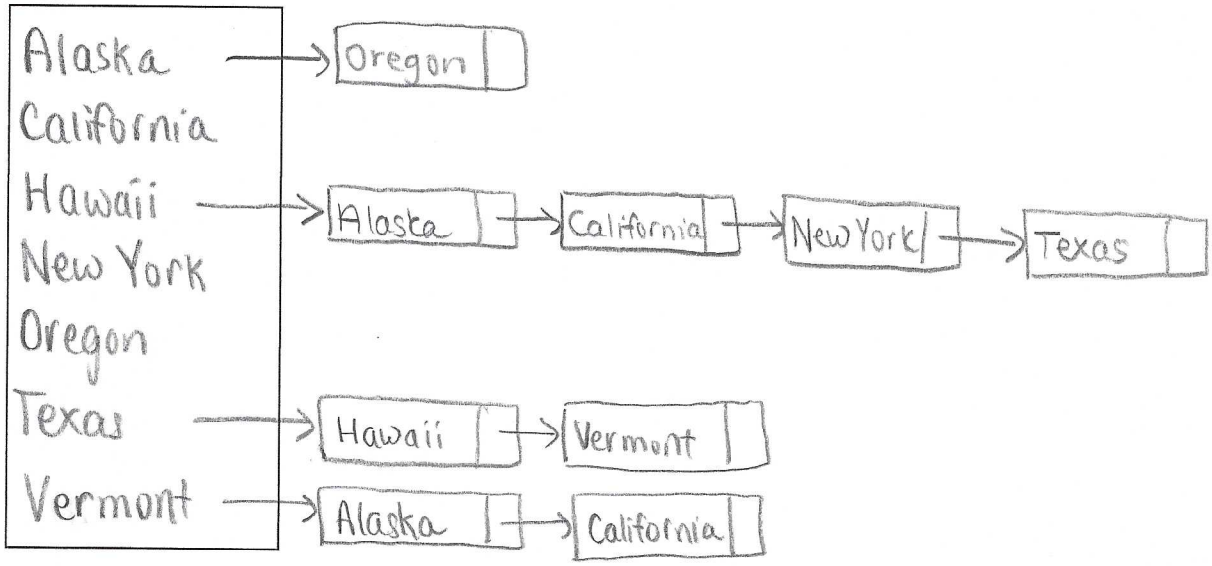
   c. From which state(s) in the graph is there a path to Hawaii?

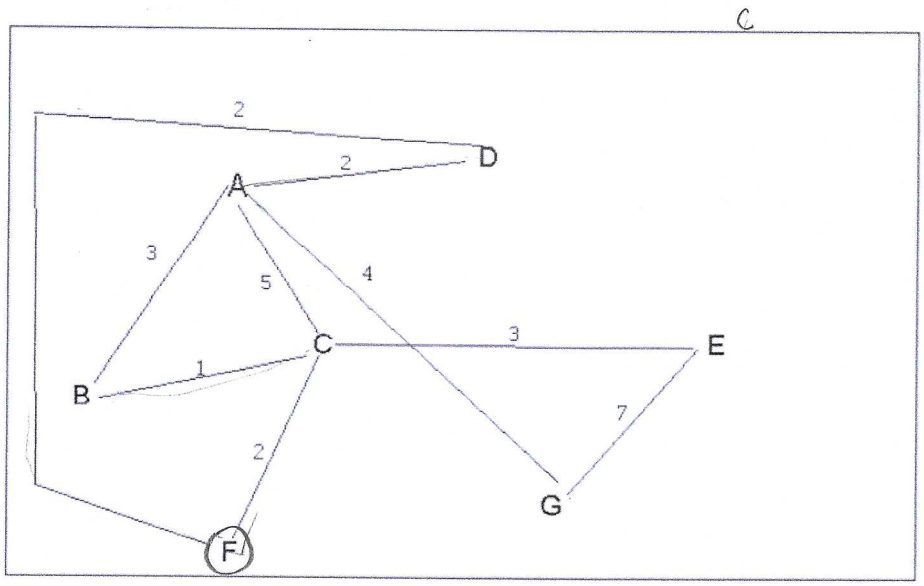
   Texas

3. a. Show the adjacency matrix that would describe the edges in the graph. Store the vertices in alphabetical order

States	A	C	H	N	O	T	V
Alaska	0	0	0	0	1	0	0
California	0	0	0	0	0	0	0
Hawaii	1	1	0	1	0	1	0
New York	0	0	0	0	0	0	0
Oregon	0	0	0	0	0	0	0
Texas	0	0	1	0	0	0	1
Vermont	1	1	0	0	0	0	0

3. b. Show the adjacency lists that would describe the edges in the graph



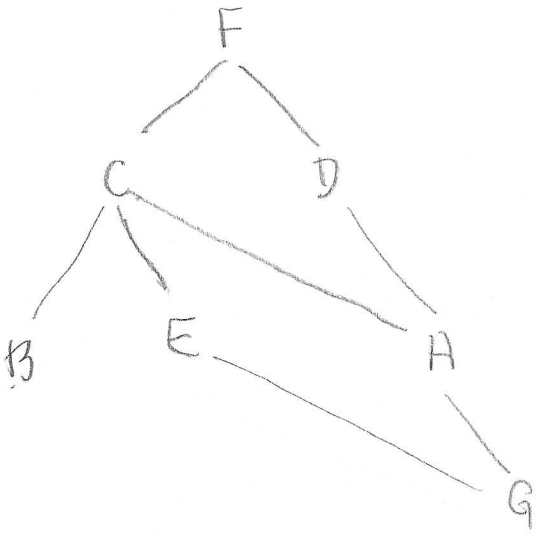


4 a. Which of the following lists the graph nodes in depth first order beginning with E?

A) E, G, F, C, D, B, A
B) G, A, E, C, B, F, D
C) E, G, A, D, F, C, B
D) E, C, F, B, A, D, G

4 b. Which of the following lists the graph nodes in breadth first order beginning at F?

A) F, C, D, A, B, E, G
B) F, D, C, A, B, C, G
C) F, C, D, B, G, A, E
D) a, b, and c are all breadth first traversals

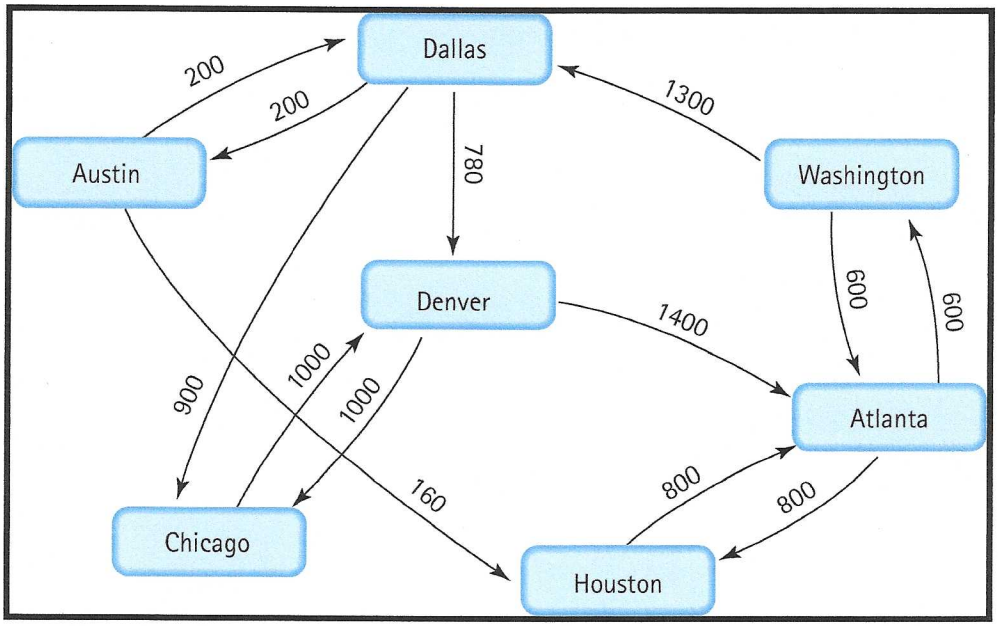


F C D B E A G

Depth First

topVertex	nextNeighbor	Visited	VertexStack	TraversalOrder
E		E	E	E
	C	C	CE	EC
C	A	A	ACE	ECA
A	B	B	BACE	ECAB
B	—	—	ACE	ECAB
A	D	D	DACE	ECABD
D	F	F	FACE	ECABDF
F	—	—	ACE	ECABDF
A	G	G	GACE	ECABDFG
G	—	—	ACE	
A	—	—	CE	
C	—	—	E	

ECABDFG



5. Find the shortest <u>distance</u> from Atlanta to every other city

Atlanta - Washington — At-W (600) *

Atlanta - Denver — At-W-Da-De (600+1300+780) = 2680 *
At-W-Da-C-De (600+1300+900+1000) = 3800

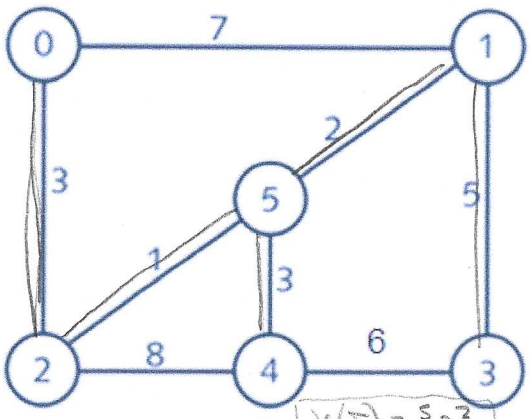
Atlanta - Dallas — At-W-Da (600+1300) = 1900 *

Atlanta - Austin — At-W-Da-Au (600+1300+200) = 2100 *

Atlanta - Chicago — At-W-Da-C (600+1300+900) = 2800 *
At-W-Da-De-C (600+1300+780+1000) = 3680

Atlanta - Houston — At-H (800) *
At-W-Da-Au-H (600+1300+200+160) =

6. Find the minimal spanning tree using Prim's algorithm. Use 0 as the source vertex . Show the steps.



	Weight
0 → 2	3
2 → 5	1
5 → 1	2
5 → 4	3
1 → 3	5

a) Vertex (0) added. $V(T) = \{0\}$, $E(T) = \{\}$, $N = \{1,2,3,4,5\}$

b) Edges [7] and [3] are considered. Edge [3] and vertex (2) will be added. $V(T) = \{0,2\}$, $E(T) = \{(0,2)\}$, $N = \{1,3,4,5\}$

c) Edges [7] and [1] and [8] considered. Edge [1] and vertex (5) will be added. $V(T) = \{0,2,5\}$, $E(T) = \{(0,2),(2,5)\}$, $N = \{1,3,4\}$

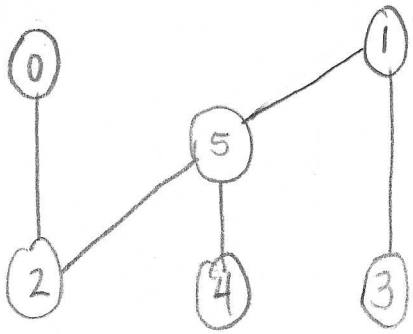
d) Edges [8], [2] and [3] considered. Edge [2] and vertex (1) will be added. $V(T) = \{0,1,2,5\}$, $E(T) = \{(0,2),(2,5),(5,1)\}$, $N = \{3,4\}$

e) Edges [8], [3] and [5] considered. Edge [3] and vertex (4) will be added. $V(T) = \{0,1,2,4,5\}$, $E(T) = \{(0,2)(2,5)(5,1)(5,4)\}$, $N = \{3\}$

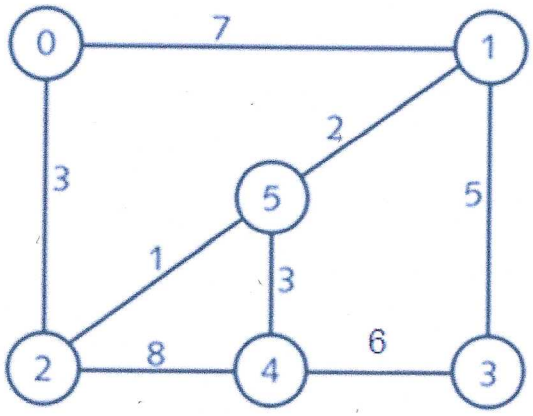
f) Edges [6] and [5] considered. Edge [5] and vertex (3) will be added. $V(T) = \{0,1,2,3,4,5\}$, $E(T) = \{(0,2)(2,5)(5,1),(5,4)(1,3)\}$, $N = \{\}$

MST

	0	1	2	3	4	5
0	0	0	1	0	0	0
1	0	0	0	1	0	0
2	0	0	0	0	0	1
3	0	0	0	0	0	0
4	0	0	0	0	0	0
5	0	1	0	0	1	0



7. Find the minimal spanning tree using Kruskal's algorithm. Show the weights in order and the steps.



① List all edges and weights.
② Put them in order by weight.
③ Add edges to MST until every vertex can get to every other vertex
a) Don't add connection if both vertices are already connected
b) If one vertex is not in a set of vertices, add edge

①

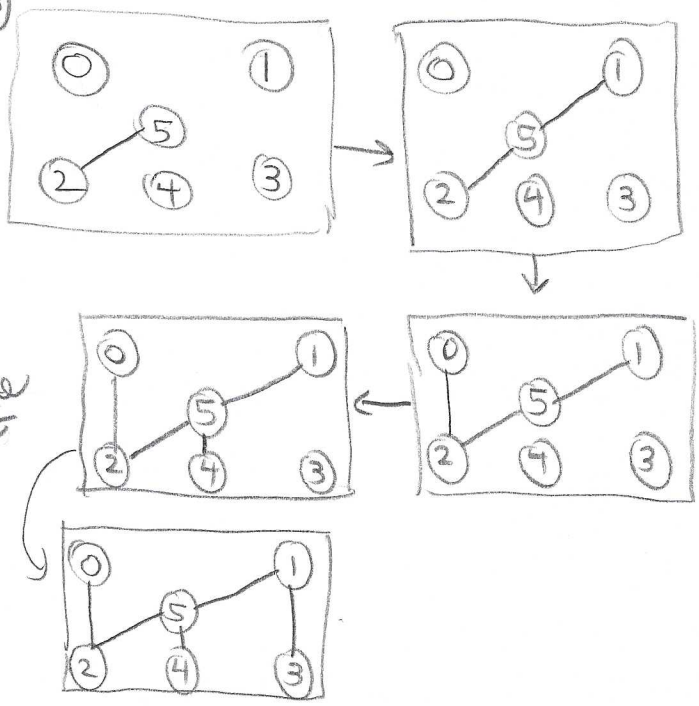
Edge	Weight
0-1	7
0-2	3
1-3	5
1-5	2
2-4	8
2-5	1
3-4	6
4-5	3

②

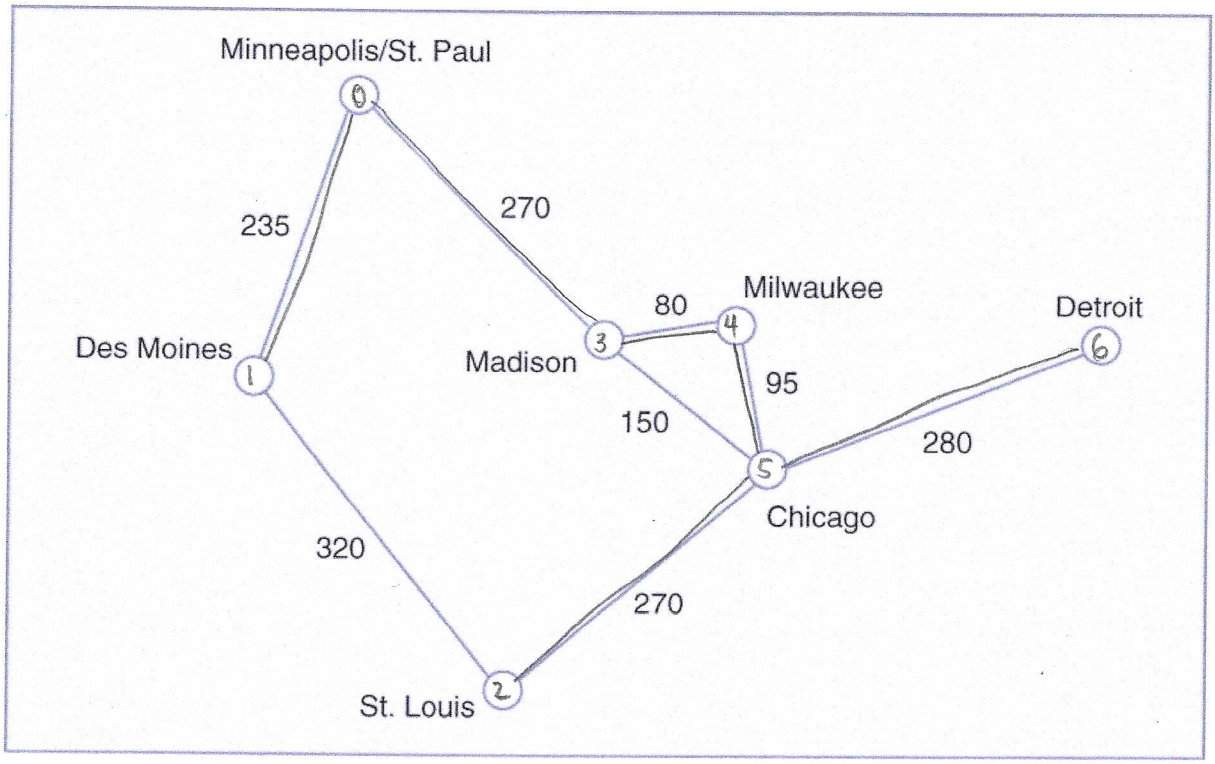
Edge	Weight
2-5	1 ✓
1-5	2 ✓
0-2	3 ✓
4-5	3 ✓
1-3	5 ✓
3-4	6
0-1	7
2-4	8

done

③



8. Find the minimal spanning tree using the algorithm you prefer. Use Minneapolis/St. Paul as the source vertex

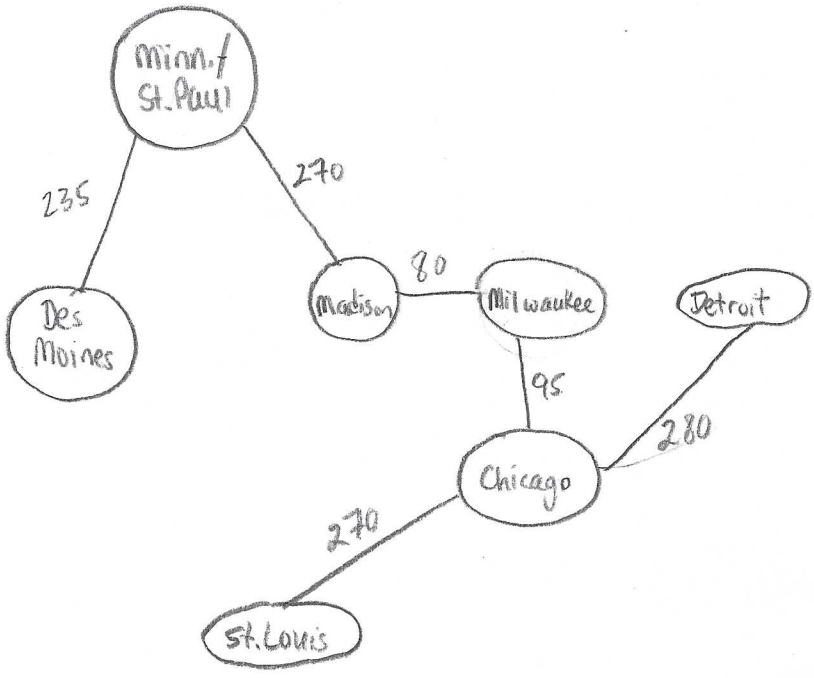


Edge	Weight
0 - 1	235
0 - 3	270
1 - 2	320
2 - 5	270
3 - 4	80
3 - 5	150
4 - 5	95
5 - 6	280

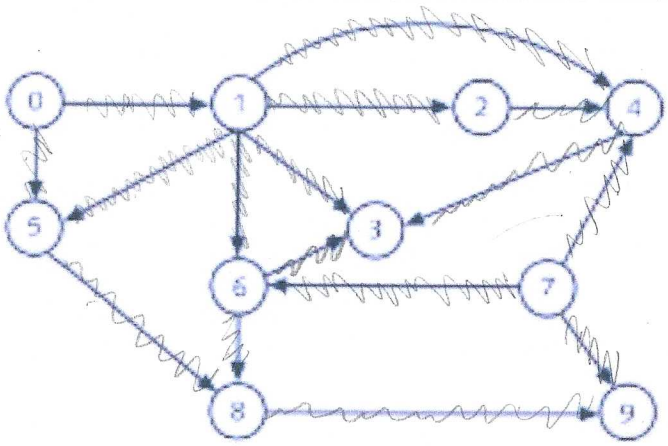
Edge	Weight
3-4	80 ✓
4-5	95 ✓
3-5	150 ×
0-1	235 ✓
0-3	270 ✓
2-5	270 ✓
5-6	280 ✓
1-2	320 ×

$V(T) = \{0, 1, 2, 3, 4, 5, 6\}$

$E(T) = \{(0,1)(0,3)(3,4)(4,5)(5,2)(5,6)\}$



9. List the nodes of the graph in a breadth first topological ordering. Show the steps using arrays predCount, topologicalOrder and a queue



1. Count the number of predecessors of each vertex
2. Remove 0-pred vertices from the graph & put in queue
3. Repeat 1 & 2 until empty graph
4. Queue = topological order

answer:

predCount$_0$

[0]	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]
0	1	1	3	3	2	2	0	2	2

topologicalOrder

0	7	1	2	5	6	4	8	3	9

queue

0	7	1	2	5	6	4	8	3	9

predCount$_1$

[0]	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]
0		1	3	2	1	1		2	1

predCount$_2$

[0]	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]
		0	2	1	0	0		2	1

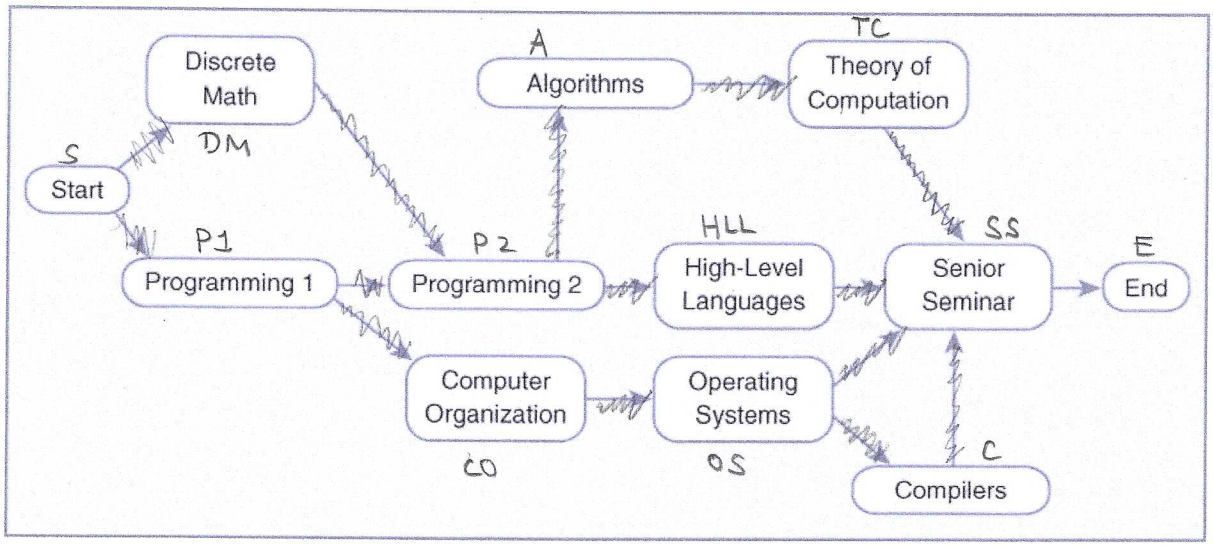
predCount$_3$

[0]	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]
			1	0				0	1

predCount$_4$

0	1	2	3	4	5	[6]	[7]	[8]	[9]
0	0	0	0	0	0	0	0	0	0

10. List the nodes of the graph in a breadth first topological ordering.



answer:

	S	Dm	P1	P2	CO	A	OS	HLL	TC	SS	C	E
pred Count	0	1	1	2	1	1	1	1	1	4	1	1
topological order	S	DM	P1	P2	CO	A	OS	HLL	TC	C	SS	E
queue	S	Dm	P1	P2	co	A	OS	HLL	Tc	c	SS	E
pred Count$_1$		0	0	2	1	1	1	1	1	4	1	1
pred Count$_2$				0	0	1	1	1	1	4	1	1
pred Count$_3$						0	0	0	1	4	1	1
pred Count$_4$									0	2	0	1
pred Count$_5$										0		1

Start
Discrete Math
Programming 1
Programming 2
Computer Organization
Algorithms
Operating Systems
High Level Languages
Theory of Computation
Compilers
Senior Seminar
End