CptS 223 Homework #4 - Graphs

Please complete the homework problems on the following page using a separate piece of paper. Note that this is an individual assignment and all work must be your own. Be sure to show your work when appropriate.

1. [13] Define these terms as they relate to graph and graph algorithms:
Use mathematical terms where appropriate.

Graph: A graph G = (V, E) is a data structure for storing connected data, consists of a set of vertices,V, and a set of edges, E.

Vertices: A vertex represents the entity in the graph.

Edge: Each Edge is pair of (v, w), where v, w $\in$ V and represents the relationship between entities.

Undirected Graph: If all the edges are bidirectional, then the graph is undirected.

Directed Graph: If the edges feature a direction among them, each pair is ordered, then the graph is directed.

Path: A path in a graph is a sequence of vertices $w_1, w_2, w_2, \ldots, w_N$ such that $(w_i, w_{i+1}) \in E \; for \; 1 \leq i < N$.

Loop: A loop is an edge that connects a vertex to itself.

Cycle: A cycle is a path (with at least one edge) whose first and last vertices are the same.

Acyclic: A graph is acyclic if it has no cycles.

Connected: A graph is connected if there is a path from every vertex to every other vertex.

Sparse: A graph in which the number of edges is much less than the possible number of edges.

Weight: Sometimes an edge has a third component, known as either a weight or a cost, the meaning of the weight depends on what the graph representing.

2. [4] Under what circumstances would we want to use an adjacency matrix instead of an adjacency list to store our graph?

An adjacency matrix is an appropriate representation if the graph is dense: $|E| = \Theta(|V|^2)$.

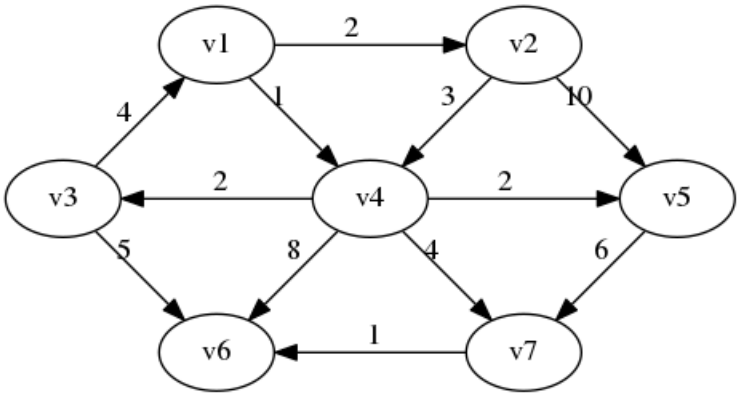
3. [6] Name three problems or situations where a graph would be a good data structure to use:

1) Networking

2) Traffic flow

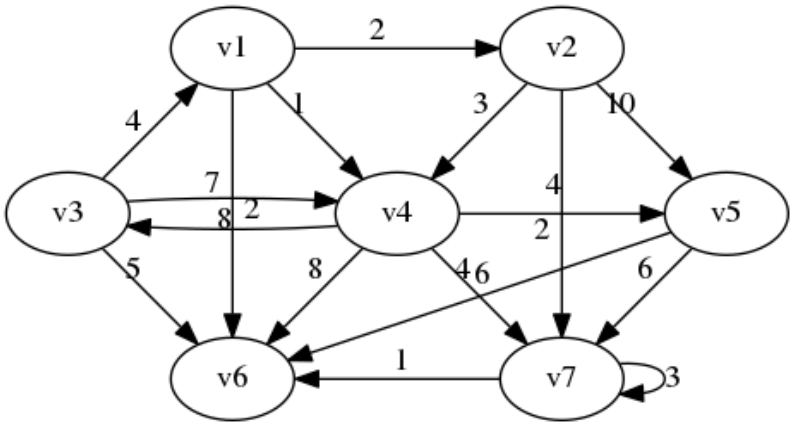
3) Course Prerequisite

4. [4] What kind of graph is this?



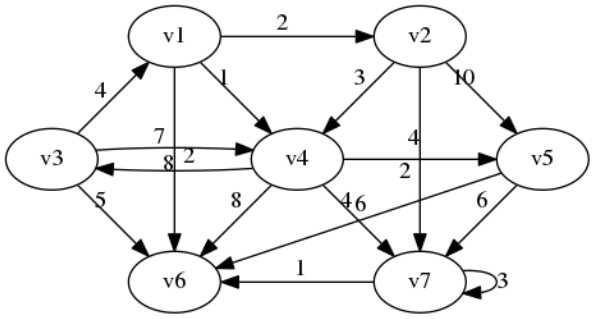
This is a directed, weighted, and cyclic graph.

5. [4] Identify the loop in this graph:

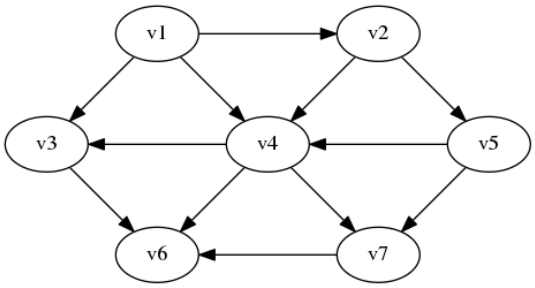
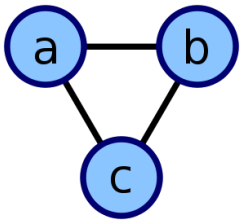
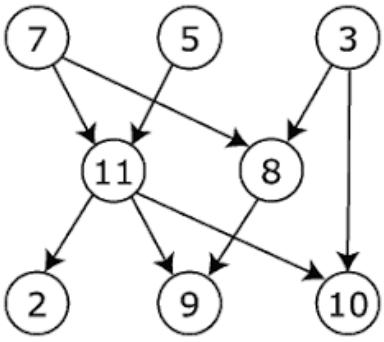


Path 3 is the loop.

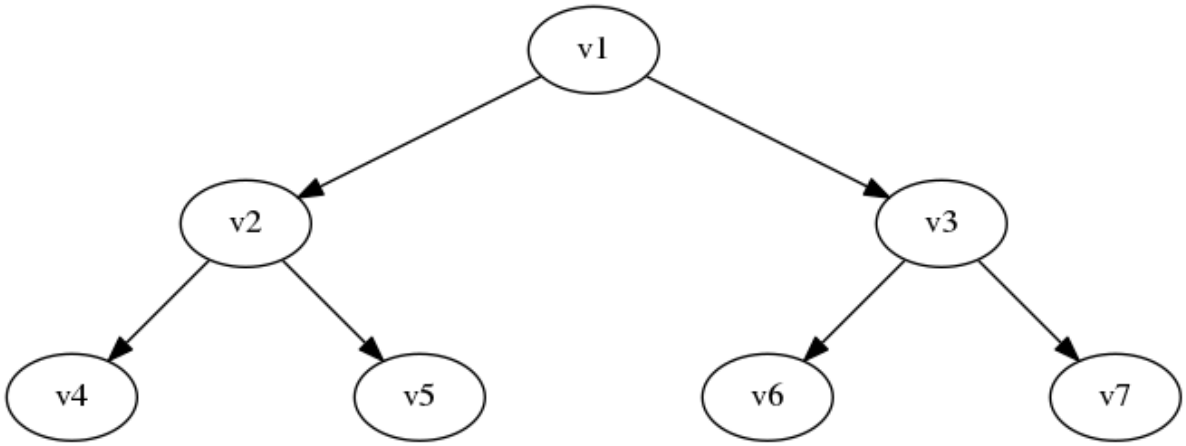
6. [4] How many vertices and edges are in this graph:

	Vertices: 7 Edges: 17

7. [6] Are these cyclic or acyclic graphs?

	Cyclic? No
	Cyclic? Yes
	Cyclic? No

8. [5] A tree is a particular kind of graph. What kind of graph is that?



This is a directed and acyclic graph.

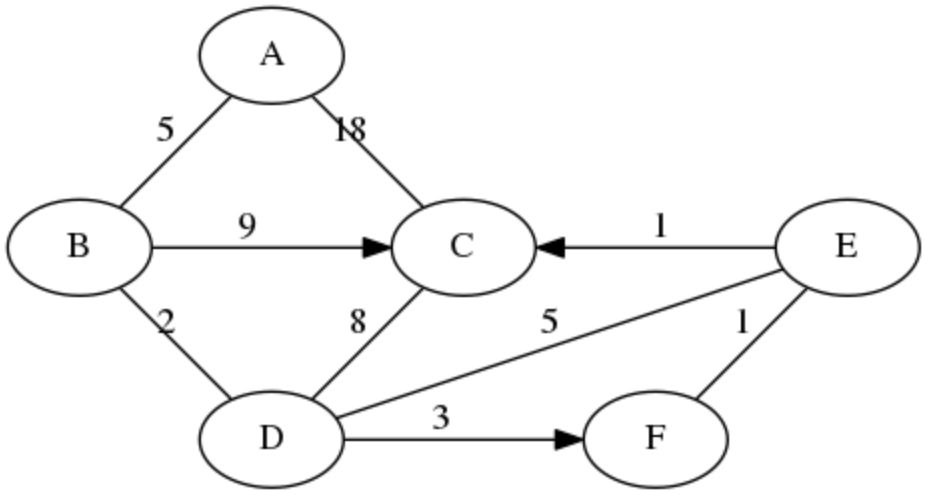
9. [4] What is the difference between a breadth-first search and a depth first search?

Depth-first search traverse through left subtree(s) first, then traverse through the right subtree(s).

Breadth-first search traverse through on level of children nodes, then traverse through the level of grandchildren nodes(and so on).

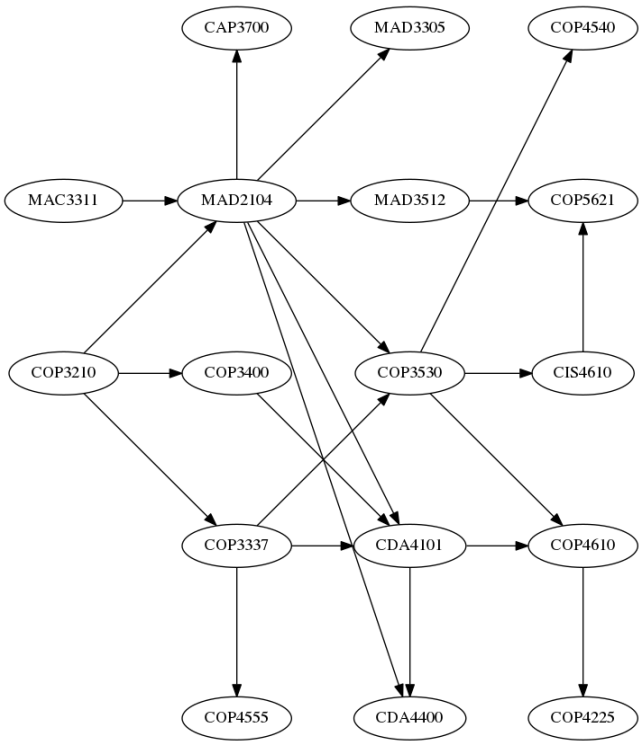
10. [10] Dijkstra's Algorithm. Use Dijkstra's Algorithm to determine the shortest path starting at **A**. Note that edges without heads are bi-directional. To save time, you do not have to add items to the "priority queue" column after it has been discovered (listed in the "distance" column). Use the table below to show your work.

What's the shortest route (by weight) from A to C? A → B → D → F → E → C, the weight is 12.



Node: Distance	Priority Queue
A: 0	A
B : 5	D:7, C:14, C:18
D: 7	F:10, E:12, C:14, C:15, C:18
F:10	E:11, E:12, C:14, C:15, C:18
E:11	C:12, E:12, C:14, C:15, C:18
C:12	E:12, C:14, C:15, C:18
	* The rest of the elements in priority queue are removed.

11. [10] Topo sort. Show the final output of running Topo Sort on this graph:



What's the vertice with the largest degree and its value?

- MAD2104 with the largest degree of 8.

What's the vertice with the highest indegree and its value?

- CDA4101 with the highest indegree of 3.

What's the vertice with the highest outdegree and its value?

- MAD2104 with the highest outdegree of 6.

Topo sort output:

MAC3311 - 0	COP3210 - 0					
MAD2104- 1	COP3400 - 1	COP3337- 1				
CAP3700 - 2	MAD3305- 2	MAD3512- 2	COP3530 - 2	CDA4101 - 2	COP4555 - 2	
COP 4540 - 3	COP4610 - 3	CIS4610 - 3	CDA4400 - 3			
COP5621 - 4	COP4225 - 4					