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Cpts223
HW4

## CptS 223 Homework #4 - Graphs

Due Date: Dec 11 2020 @ 11.59 pm

Please complete the homework problems using a separate document. 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 diagram consisting of set of edges and a set of vertices

Vertice Locations or nodes on a graph

Edge The connection between two vertices

Undirected Graph Edges don't have a direction. Can traverse to and back

Directed Graph Edges point in a direction with a front and back.

Path Traversal with no repeated vertex or edge

Loop Represented by (v,v). A reflexive relationship.

Cycle Traversal with no repeated edge and same start/endpoint.

Acyclic A graph with no cycles (opposite of above). Repeat edges.

Connected A graph where there are no isolated vertices without an edge.

Sparse Where the number of edges << possible number of edges

Weight The cost to traverse a specific edge.

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

When space is not a concern (adjacency matrixes take up a lot of space memory) or for dense graphs.

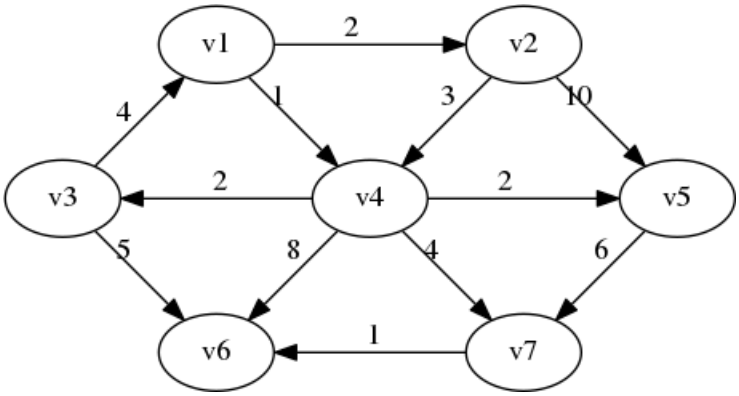
**3. [6]** Name three problems or situations where a graph would be a good data structure to use:

1.) In designing a map app to calculate optimal routes between two locations.

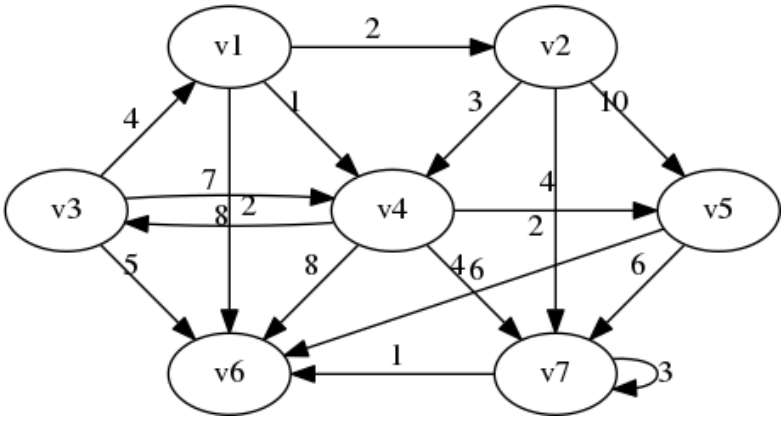
2.) In family trees, graphing connections between relatives.

3.) In social media, graphing connections to your friends and acquaintances.

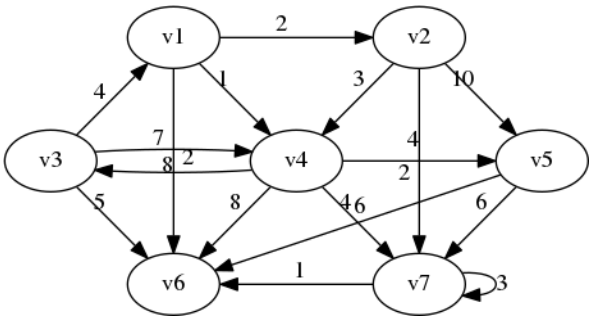
**4. [4]** What kind of graph is this? A strongly connected, directed, acyclic graph



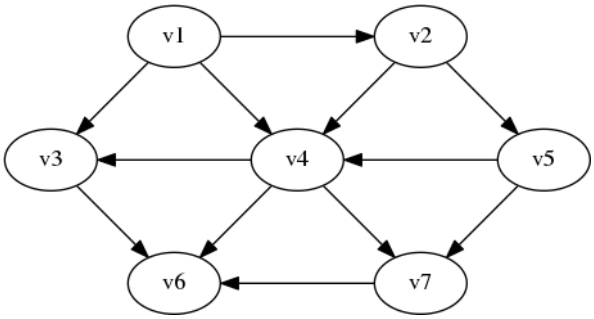
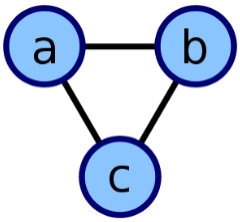
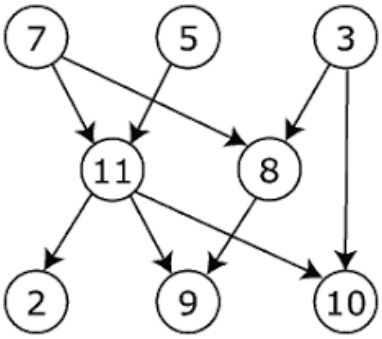

**5. [4]** Identify the loop in this graph: The loop (3) at v7



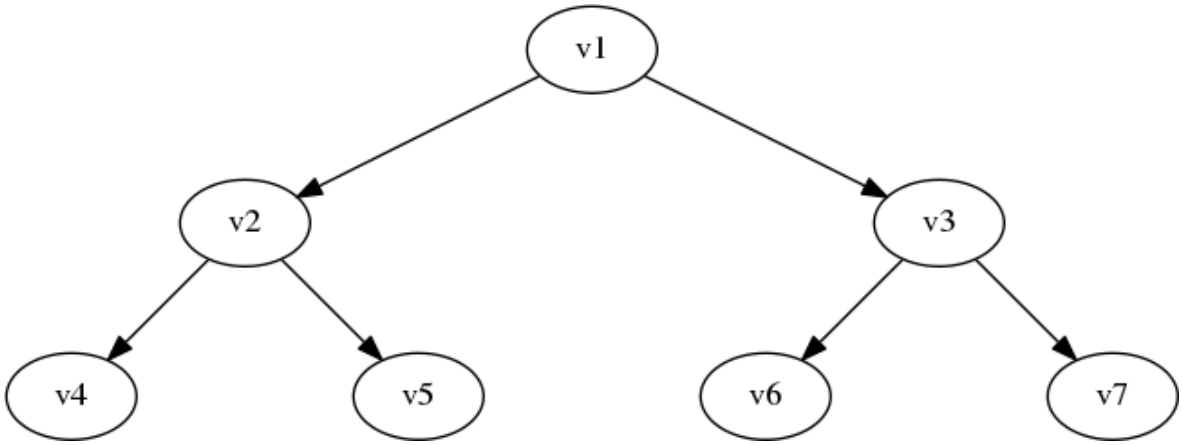
**6. [4]** How many vertices and edges are in this graph:

| | |
|---|---|
|  | Vertices 7<br>Edges 17 |

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

| | |
|---|---|
|  | Cyclic?<br>Yes [No] |
|  | Cyclic?<br>[Yes] No |
|  | Cyclic?<br>Yes [No] |

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



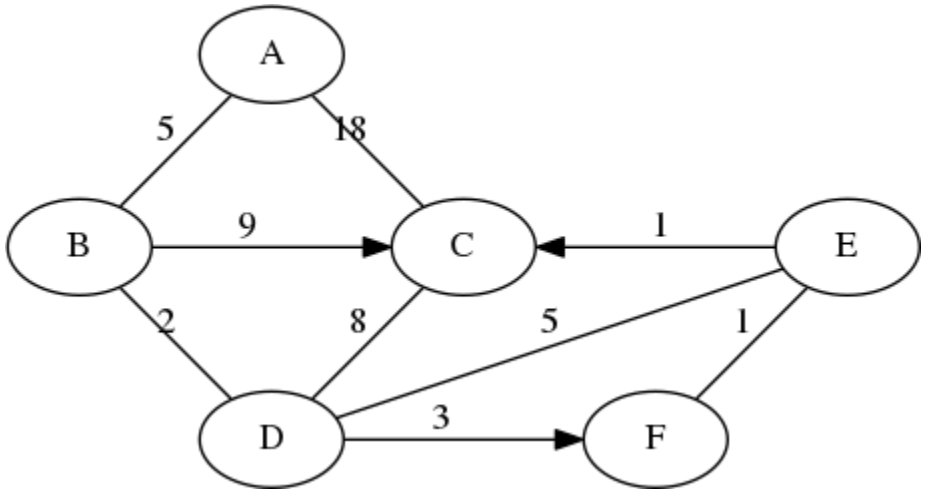

Weakly Connected Directed acyclic graph

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

Breadth-first search is a vertex-based technique that uses the queue data structure to traverse the tree  starting at a vertex, marking it and then going to its adjacent. Depth-first search is faster and is an edge-based technique that uses the stack data structure that pushes vertices onto the stack and  pops visited vertices once there are no vertices.

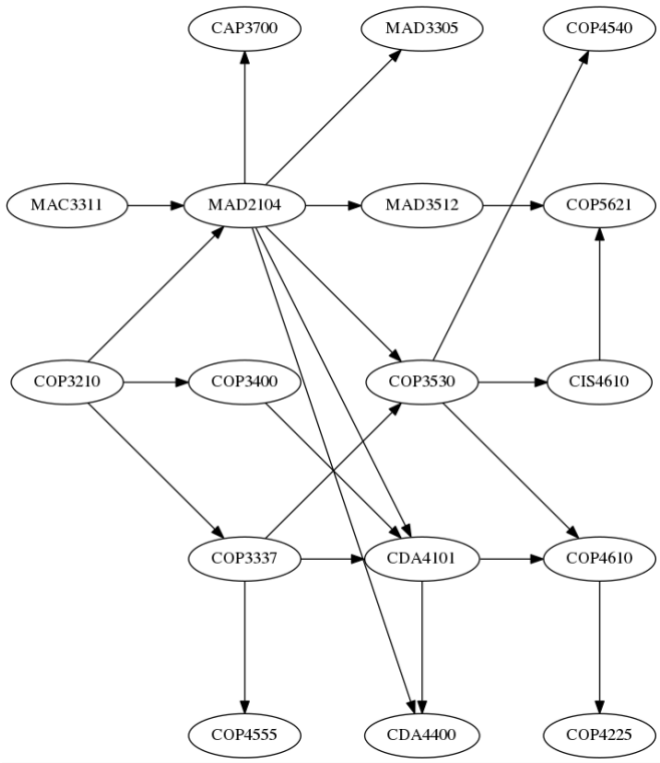
**10. [10] Dijkstra's Algorithm.** Use Dijkstra's Algorithm to determine the shortest path starting at **A**. Note that edges without heads are bi-directional. To save time, you do not have to add items to the "priority queue" column after it has been discovered (listed in the "distance" column). Use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

What's the shortest route (by weight) from A to C? A -> B->D->F->E->C [12]




| Node: Distance | Priority Queue |
|---|---|
| A:0 | B:5, C:18, D:∞,F: ∞,E: ∞ |
| B:5 | D:7, C:14, F: ∞, E: ∞ |
| D:7 | F:10, E:12, C:15, E: ∞ |
| F:10 | E:11, C: ∞ |
| E:11 | C:12 |
| C:12 | |
| | |
| | |
| | |

**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 - 8

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

CDA4101 - 3

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

MAD2104 - 6

Topo sort output: From Top down:
MAC3311 , COP3210, MAD2104, CAP3700, MAD3305, MAD3512, COP3400, COP3530, COP4540, CIS4610, COP5621, COPS3337, CDA4101, COP4610, COP4555, CDA4400, COP4225