CMPS 2200 Introduction to Algorithms – Fall 17

11/1/17

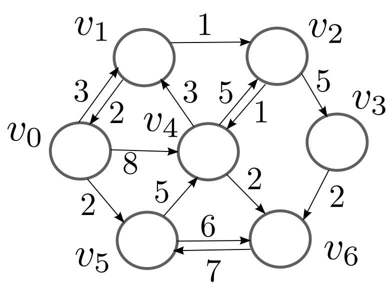
8. Homework

Due **11/8/17** at the beginning of class

Remember, you are allowed to turn in homeworks in groups of two. One writeup, with two names.

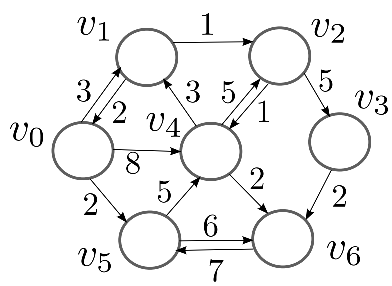
1. **Dijkstra (8 points)**
   Run Dijkstra's algorithm on the graph below, with source vertex v_0.

   (a) Show all the different stages of the algorithm, including d-values for each vertex, the set S, the priority queue, the vertex extracted from the priority queue, and the tree edges stored in the predecessor array. Also draw the shortest path tree edges into the graph.



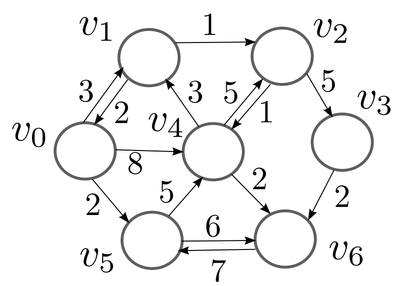
Q:

π: 0 1 2 3 4 5 6



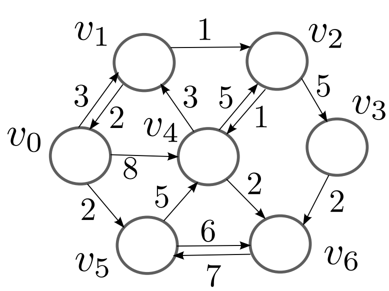
Q:

π: 0 1 2 3 4 5 6



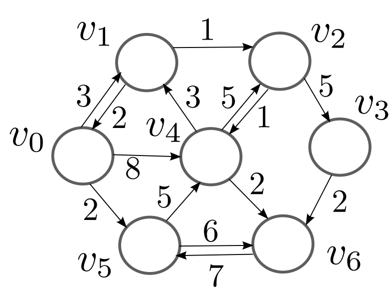
Q:

π: 0 1 2 3 4 5 6



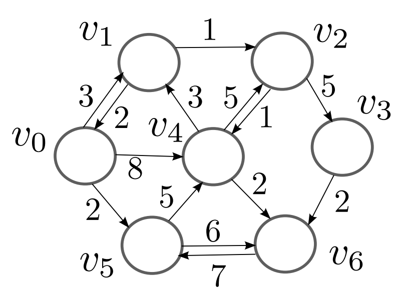
Q:

π: 0 1 2 3 4 5 6



Q:

π: 0 1 2 3 4 5 6



Q:

π: 0 1 2 3 4 5 6

   (b) List the shortest paths from v_0 to all other vertices.

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2. **Topological sort (9 points)**
   Let $G = (V, E)$ be a directed graph and assume it is stored in adjacency lists.

   (a) (3 points) Give pseudocode to compute the out-degree of each vertex in V.

   (b) (3 points) Give pseudocode to compute the in-degree of each vertex in V.

   (c) (3 points) The topological sort algorithm on slide 45 of the graph slides uses a queue. What happens if a stack is used instead – will the algorithm still coompute a valid topological sort? Justify your answer shortly.

3. **Dijkstra and negative edge weights (4 points)**
   Give an example of a directed connected graph with real edge weights (that may be negative) for which Dijkstra's algorithm produces incorrect answers. Justify your answer.