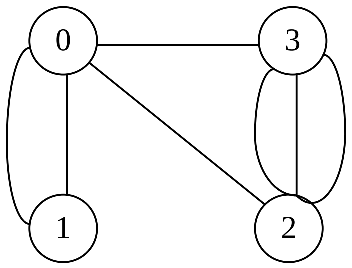
EECS2040 Data Structure Hw #5 (Chapter 6 Graph)

due date 5/30/2022 (Part 1: 2% of final Grade)

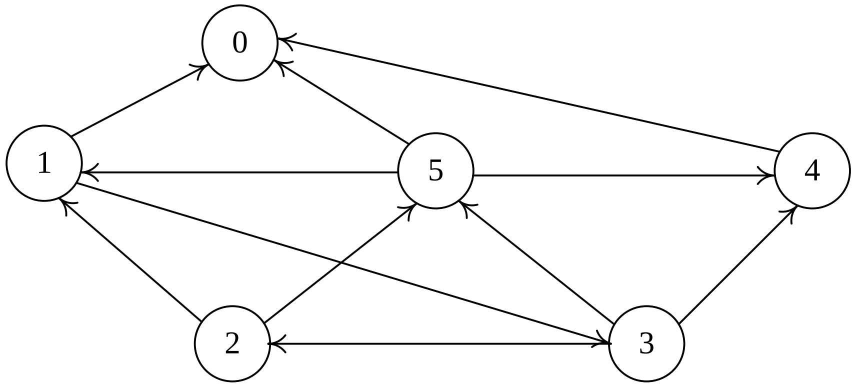
Format: Use a text editor to type your answers to the homework problem. You need to submit your HW in an HTML file or a DOCX file named as **Hw5-SNo.docx** or **Hw5-SNo.html**, where SNo is your student number. Submit the **Hw5-SNo.docx or Hw5-SNo.html** file via eLearn. Inside the file, you need to put the **header and your student number, name (e.g., EECS2040 Data Structure Hw #5 (Chapter 6) due date 5/30/2022 by SNo, name)** first, and then the **problem** itself followed by your **answer** to that problem, one by one. The grading will be based on the correctness of your answers to the problems, and the **format**. Fail to comply with the aforementioned format (file name, header, problem, answer, problem, answer,…), will certainly degrade your score. If you have any questions, please feel free to ask me.

Part 1

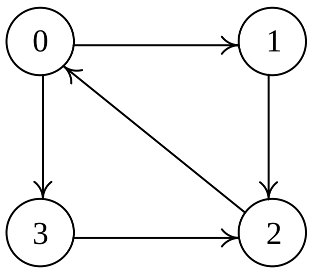
1. (10%) Does the multigraph below have an Eulerian walk? If so, find one.



2. (10%) For the digraph below obtain
   (a) The in-degree and out-degree of each vertex
   (b) Its adjacency-matrix
   (c) Its adjacency-list representation
   (d) Its strongly connected components



3. (10%) Is the digraph below strongly connected? List all the simple paths.



4. (10%) Draw the complete undirected graphs on one, two, three, four, and five vertices. Prove that the number of edges in an n-vertex complete graph is n(n-1)/2.

5. (4%) Apply depth-first and breadth-first searches to the complete graph on four vertices. Assume that vertices are numbered 0 to 3, are stored in increasing order in each list in the adjacency-list representation, and both traversals begin at vertex 0. List the vertices in the order they would be visited.

6. (6%) Let *G* be a graph whose vertices are the integers 1 through 8, and let the adjacent vertices of each vertex be given by the table below:

Vertex	***Adjacent Vertices***
1	(2, 3, 4)
2	(1, 3, 4)
3	(1, 2, 4)
4	(1, 2, 3, 6)
5	(6, 7, 8)
6	(4, 5, 7)
7	(5, 6, 8)
8	(5, 7)

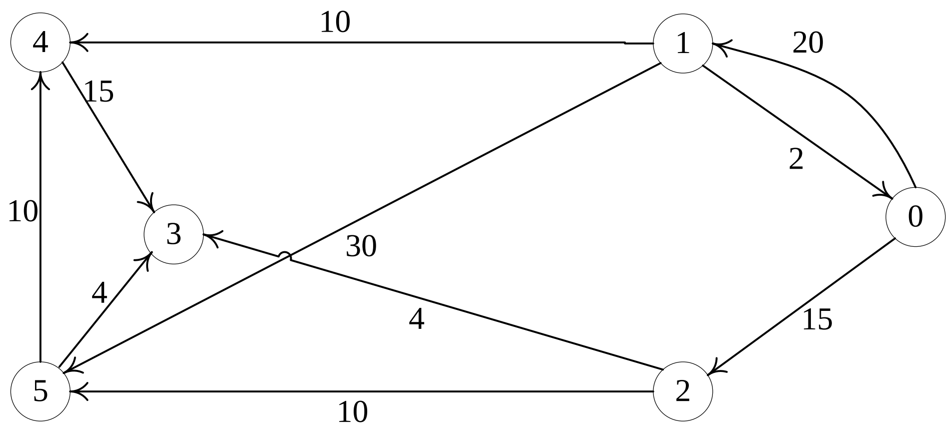
Assume that, in a traversal of *G*, the adjacent vertices of a given vertex are returned in the same order as they are listed in the table above.

(a) Draw *G*.

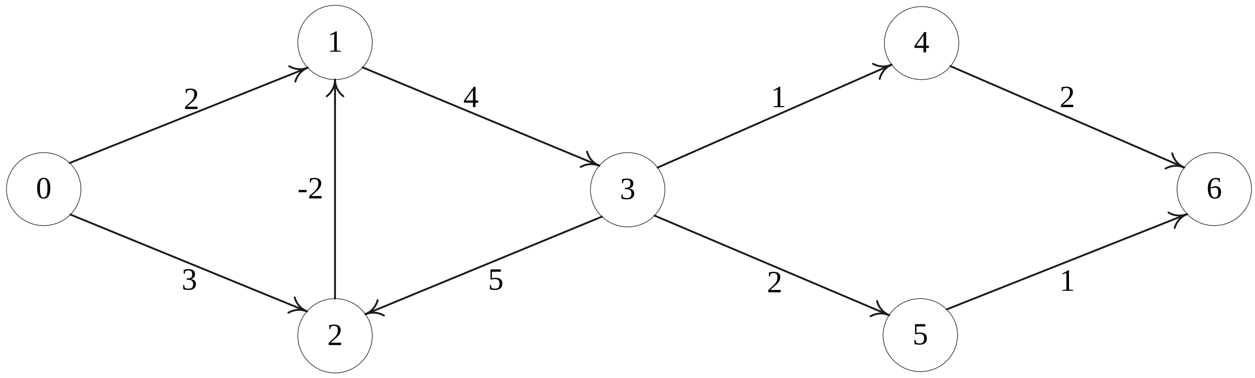
(b) Give the sequence of vertices of *G* visited using a DFS traversal starting at vertex 1.

(c) Give the sequence of vertices visited using a BFS traversal starting at vertex 1.

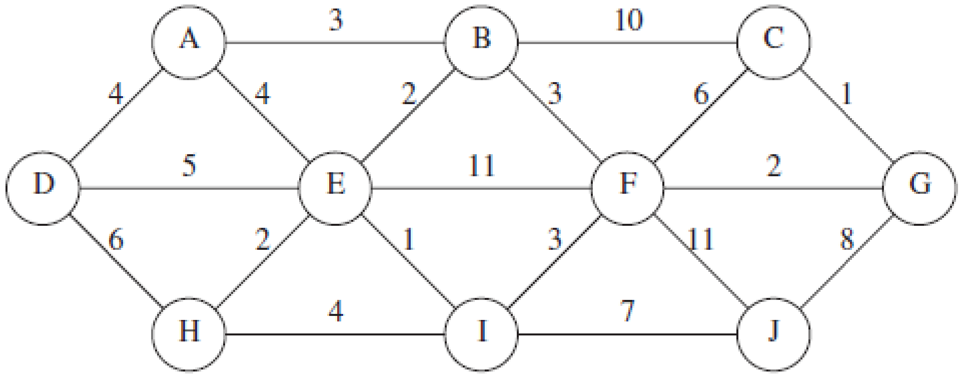
7. (10%) Use ShortestPath (Program 6.8) (Dijkstra's algorithm) to obtain, in nondecreasing order, the lengths and the paths of the shortest paths from vertex 0 to all remaining vertices in the graph below.



8. (10%) Using the directed graph below, explain why ShortestPath (Program 6.8) will not work properly. What is the shortest path between vertices 0 and 6?



9. (10%) For the weighted graph G shown below,



(a) Find a minimum spanning tree for the graph using both Prim's and Kruskal's algorithms.

(b) Is this minimum spanning tree unique? Why?

10. (10%) Does the following set of precedence relations (<) define a partial order on the elements 0 through 4? Why?

$0 < 1;\ 1 < 3;\ 1 < 2;\ 2 < 3;\ 2 < 4;\ 4 < 0$

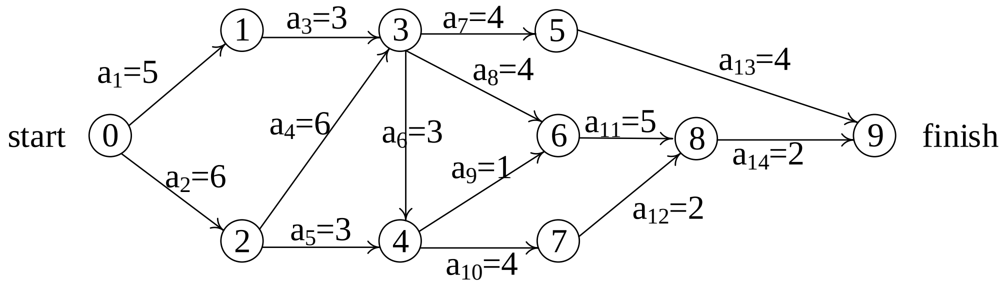
11. (10%) For the AOE network shown below,

(a) Obtain the early, $e(a_i)$, and late, $l(a_i)$, start times for each activity. Use the forward-backward approach.

(b) What is the earliest time the project can finish?

(c) Which activities are critical? Fill the table below for answers to (a), (b), and (c).

(d) Is there any single activity whose speed-up would result in a reduction of the project finish time?



activity	Early time $e(a_i)$	Late time $l(a_i)$	slack	critical
a_1				
a_2				
a_3				
a_4				
a_5				
a_6				
a_7				
a_8				
a_9				
a_{10}				
a_{11}				
a_{12}				
a_{13}				
a_{14}				