Computer Science 260 Midterm 2 – Oct 27 2022
Out of 56 possible marks NAME:_____

1. Attached find Graph1 on which BFS and DFS may be called. Each vertex processes its neighbours in alphabetical order; for example, vertex a has edges to vertices b, c, and d. When the neighbours of a are processed, it should be in the order b, c, d. **Order is important and marks will be deducted if different orderings are used.**

   (a) (1 marks) What is the auxiliary container that BFS uses: a stack or a queue?

   (b) (8 marks) Suppose BFS is run starting from a. Suppose that vertices are marked when they enter the auxiliary container (stack or queue). Give the order that BFS marks the vertices.

   (c) (3 marks) What is the fourth vertex to be removed from the auxiliary container (stack or queue)? What are the contents of the auxiliary container directly after four vertices have been removed from the container?

   (d) Suppose DFS is run starting from a. Suppose that vertices are marked when they enter the auxiliary container (stack or queue). Give the order that DFS marks the vertices.

   (e) (3 marks) What is the fourth vertex to be removed from the auxiliary container (stack or queue)? What is the contents of the auxiliary container after four vertices have been removed from the container in the execution of DFS from vertex a?

2. (10 marks) Run Dijkstra's algorithm on the following graph, with s as the source vertex. Each vertex v has associated with it some storage for its *label*. Show each label value in the order in which it occurs, with the associated vertex that is the predecessor in the shortest $s - v$ path. When a label becomes permanent, circle it, and list the order in which vertices became permanently labelled. A small example is provided. You can provide a table or, for each vertex of the graph, draw a list of (distance, previous vertex) pairs. Start your table or list with s having the value $(0, s)$, and all other vertices have the value $(\text{inf}, \emptyset)$.

3. (5 marks) Run Kruskal's algorithm on the following graph. List the edges in the order that you add them to the tree, e.g. "$(a, b), (a, d), \ldots$". Give the total weight of the tree at the end, and show the tree as bolded edges in the graph itself.

4. (5 marks) Run Prim's algorithm on the following graph. List the edges in the order that you add them to the tree, e.g. "$(a, b), (a, d), \ldots$". Give the total weight of the tree at the end, and show the tree as bolded edges in the graph itself.

5. Run MakeHeap on the following array. Show as much of your work as expediency allows.

90	40	7	13	44	3	4	5	1	60

6. (5 marks) Suppose you have n unit-length tasks $\{a, b, c, d, e, f, g, h, i, j\}$ to schedule on a single machine. Their deadlines and penalties are as in the chart below. Give a schedule (i.e., a list of the tasks, so that the first is assumed to be in time slot 1, the second in time slot 2, etc.) that is incurs the least total penalty, and identify which tasks to not meet their deadline, and what the total penalty for the entire schedule is.

Task	a	b	c	d	e	f	g	h	i	j
Deadline	8	3	7	1	2	3	4	2	9	4
Penalty	16	5	1	12	43	22	19	25	3	3