University of Nevada, Las Vegas Computer Science 477/677 Spring 2023
## Assignment 5: Due Saturday April 1, 2023, 11:59 PM

Name:_____

You are permitted to work in groups, get help from others, read books, and use the internet. You will receive a message from the graduage assistant, Sepideh Farivar, telling you how to turn in the assignment.

1. Write pseudocode for the Floyd-Warshall algorithm. for a weighted directed graph of n vertices. Assume that the vertices are numbered $1 \ldots n$, and that $W[i, j]$ is the weight of the edge, if any, from i to j. If there is no such edge, the value of $W[i, j]$ is given to be ∞. Your output should be two arrays, V and B (for back). The value of $V[i, j]$ is the length of the shortest path from i to j, and the value of $B[i, j]$ is the next-to-the-last vertex in the shortest path from i to j. For any vertex i, $B[i, i]$ is undefined.

2. Write pseudocode for the Bellman-Ford algorithm. Your code should include the shortcut that ends computation if it is certain that all shortest paths have been found.

3. Walk through Kruskal's algorithm to find the minimum spanning tree of the weighted graph shown below. Indicate the steps of Union/Find.
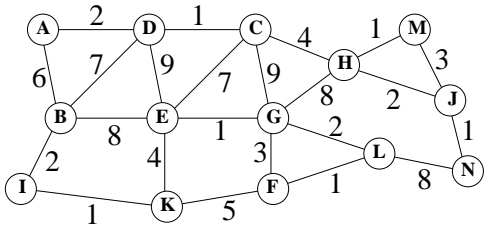
5. (Demonstration only) Walk through the steps of heapsort for the array WIORGBNCVQ. Show the array after each exchange. Here is my answer. (Find my error, if any!)

```
123456789a Hexadecimal indices of the array implementation of max-heap.
WIORGBNCVQ Initial array.
WIORQBNCVG Bubbledown(G).
WIOVQBNCRG Bubbledown(R).
WVOIQBNCRG Bubbledown(I).
WVORQBNCIG Bubbledown(I). Max-heap order, End Heapify.
GVORQBNCIW W swapped to final position.
VGORQBNCIW Bubbledown(G).
VROGQBNCIW Bubbledown(G).
VROIQBNCGW Bubbledown(G). Max-heap order restored. End Phase 1.
GROIQBNCVW V swapped to final position.
RGOIQBNCVW Bubbledown(G).
RQOIGBNCVW Bubbledown(G). Max-heap order restored. End Phase 2.
CQOIGBNRVW R swapped to final position.
QCOIGBNRVW Bubbledown(C).
QIOCGBNRVW Bubbledown(C). Max-heap order restored. End Phase 3.
NIOCGBQRVW Q swapped to final position.
OINCGBQRVW Bubbledown(N). Max-heap order restored. End Phase 4.
BINCGOQRVW O swapped to final position.
NIBCGOQRVW Bubbledown(B). Max-heap order restored. End Phase 5.
GIBCNOQRVW N swapped to final position.
IGBCNOQRVW Bubbledown(G). Max-heap order restored. End Phase 6.
CGBINOQRVW I swapped to final position.
GCBINOQRVW Bubbledown(C). Max-heap order restored. End Phase 7.
BCGINOQRVW G swapped to final position.
CBGINOQRVW Bubbledown(B). Max-heap order restored. End Phase 8.
BCGINOQRVW C swapped to final position.  End phase 9. Sorted.
```

6. Walk through the steps of heapsort for the array UBRYPQSVFMT. Show the array after each exchange.

1	2	3	4	5	6	7	8	9	10	11
U	B	R	Y	P	Q	S	V	F	M	T