CIS263 - Final Exam Winter - 2023
100 points - 7 questions - 5 pages

Name: _____

1. (10 points) Consider a Union-Find data structure with five elements (labeled 0 through 4). Initially every element is its own partitition (equivalence class). Show the state of the data structure (both as a forest of trees and as an array) after performing the following operations.

   - union(3,4)

   - union(1,2)

   - union(1,3)

   - union(0,1)

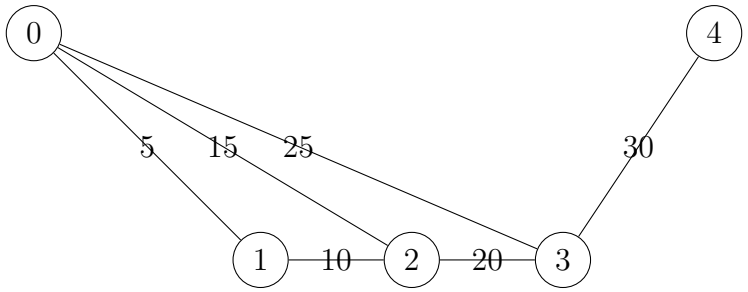
2. (10 points) Given the final state of the Union-find data structure from the previous question, what would the function find(2) return? What would the function find(4) return?

3. (10 points) Write in front of each of the following instances of the Partition problem YES if that instance has a solution or NO if it does not. If there is a solution (or perhaps several) write (one of) the solution(s).

   - $\{1, 4, 6, 9\}$
   - $\{1, 3, 3, 5\}$
   - $\{1, 2, 2, 3, 4\}$
   - $\{6, 8, 13\}$
   - $\{2, 8, 12\}$

4. (20 points) Consider the following graph. Find the minimum spanning tree for this graph using Kruskal's algorithm.This is the corresponding set of edges with their weights. What is the total cost of the minimum spanning tree?

   0 1 5
   1 2 10
   0 2 15
   2 3 20
   0 3 25
   3 4 30



5. (15 points) What is the minimum editing distance between the strings "abbc" and "addc"?

6. (15 points) An independent set in a graph is a set of vertices withtout any edges among them. Write pseudocode to find if a subset of vertices is independent. Assume that the adjacency matrix of the graph is available. The paremeter to the procedure is a set of vertices. The procedure will return true or false.

7. (20 points) Consider the problem of placing 4 queens on a board of size 4 x 4. Show how would a backtracking algorithm solve the problem.