CS 430 - First Quiz

Please work on separate paper, and write only the final solution here. Also, check your work as you are not able to run the code, so it better be right. This is a closed notex closed books test.

There are two problems on this test. Each will be graded on the scale 1-50; your grade will be the highest score plus half of the lowest score (so maximum is 75!). You have 50 minutes. Good luck!

Problem 1 Write C/C++/Java code for the problem below. Do not declare or use any class or procedure.

You are given a tree represented by the following data structure. The vertices are labeled by numbers $0, 1, \ldots, n-1$. An array P of size n gives for every vertex its parent in the tree. Note that a node can have many children, but only one parent. The root does not have any parent, and the entry in the array will be -1. An example of such an array is $< 1, -1, 3, 1 >$ which corresponds to the tree on the board. In addition, you are given an $n \times n$ matrix $D[i][j]$ which gives the non-negative length of the edge from vertex i to vertex j.

Write a function with input parameter an integer j ($0 \leq j \leq n-1$) which returns the length of the **shortest** edge on the path in the tree from node j to the root of the tree. If j is the root, return -1.

Problem 2 If connected graph $G = (V, E)$ has $|V|$ vertices and $|E|$ edges, what is the maximum number of edges that can be removed from E while keeping G connected? That is, find maximum $|F|$ where $F \subseteq E$ is such that the graph $(V, E \setminus F)$ is conected. Express your result in terms of $|E|$ and $|V|$, if possible, and argue as much as you can (a complete proof would be the most preferable) that your result is correct.