UNIVERSITY OF MISSOURI-COLUMBIA
COLLEGE OF ENGINEERING
DEPARTMENT OF ELECTRICAL ENGINEERING AND COMPUTER SCIENCE

CS 4050/7050 – DESIGN AND ANALYSIS OF ALGORITHMS I

Spring 2024

ASSIGNMENT 4 - MINIMUM SPANNING TREE (MST) ALGORITHM

Due Date: Friday April 19th , 2024, at 5:00 pm

(100 points)

1 Goals

In this Assignment you will Implement the Prim's minimum spanning tree algorithm for a weighted undirected graph using a heap data structure. The time complexity of the algorithm should be:
O((|V | + |E|) log |V |).

2 Description and Requirements

The heap data structure should be implemented as an abstract data type on a set of elements, where each element has an id and a key, with the following operations. (Please check course notes on heaps for implementation details). (In this Assignment you can use either Java or C++ project).

- ***heap_ini(keys, n)***: initializes a heap with the array keys of n elements indexed from 1 to n, where key[i] is the key of the element whose id is i.
- ***in_heap(id)***: returns true if the element whose id is id is in the heap;
- ***min_key()***: returns the minimum key of the heap;
- ***min_id()***: returns the id of the element with minimum key in the heap;
- ***key(id)***: returns the key of the element whose id is id in the heap;
- ***delete_min()***: deletes the element with minimum key from the heap;
- ***decrease_key(id, new_key)***: sets the key of the element whose id is id to new_key if its current key is greater than new_key.

An input graph file will be available. The format of the input file is the following:

- The first line of the input file contains an integer indicating number of vertices of the input graph.
- Each of the remaining lines contains a triple "**i j w**" indicating an edge between vertex **i** and vertex **j** with cost **w**.
- Vertex **1** can be considered as the root.

The output of your program should be the following:

- The input graph in adjacency list representation format listing each edge with its weight.
- The edges (with their weights) of the minimum spanning tree, in the order in which they are produced by the Prim's algorithm.

3 Hand In

- You need to ZIP the project (folder name should be as "group#_cs4050_7050_assignment4").
- Submit this zip file to Canvas assignment link at the due date mentioned above.