Algorithm and Data Structures

Tutorial 4, 2024

Question

Greedy Algorithms

A greedy algorithm solves an optimization problem by making a locally optimal choice at each time. In this exercise you are required to implement some more algorithms and compare their performance.

Question 1

Implement the following algorithms (MST): Prim's algorithm or Kruskal's algorithm

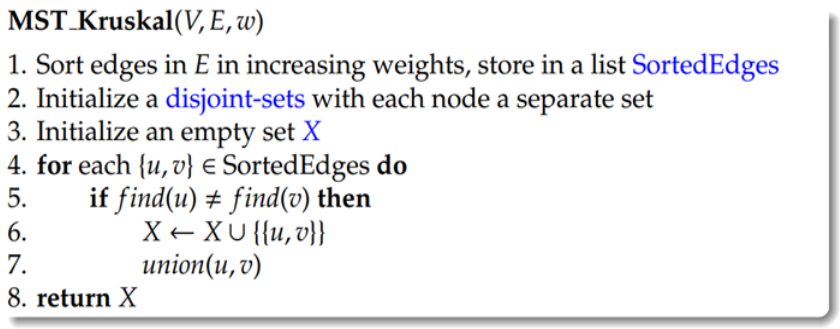
1.1 Implement the Kruskal's algorithm in MST as $SortedEdges()$ method in a disjoint-sets data structure. The disjoint-sets can be implemented by Lists or Trees. The underlying data structure of the disjoint-sets maintains a collection of disjoint sets such that each set has a unique representative element and supports the following operations:

(1) $MakeSet(u)$: Make a new set containing element u.

(2) $Union(u, v)$: Merge the sets containing u and v.

(3) $Find(u)$: Return the representative element of the set

1.2 Implement the Kruskal's algorithm in MST as $SortedEdges()$ method by calling the disjoint-sets data structure developed in 1.1 section. This method should follow the framework:



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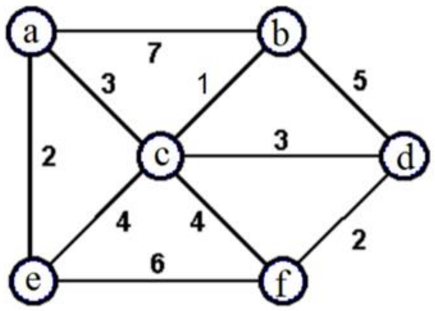
MST_Kruskal($V, E, w$)
Sort edges in $E$ in increasing weights, store in a list SortedEdges
Initialize a disjoint-sets with each node a separate set
Initialize an empty set $X$
for each $\{u, v\} \in$ SortedEdges do
    if $find(u) \neq find(v)$ then
        $X \leftarrow X \cup \{\{u, v\}\}$
        $union(u, v)$
return $X$
```

The set X contains all edges in an MST.

1.3 Implement the Kruskal's algorithm in MST in MST Kruskal() method which prints the MST of a graph G. You may test your algorithm using the graphs below,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