assignment- 15

Monday, 18 November 2024 4:46 PM

C-13.2 Show that every language L in P is polynomial-time reducible to the language M={5}, that is, the language that simply asks if the binary encoding of the input is equal to 5.

- Since L is in P which is polynomial time, and it's reducible by language M.
  Assume that there is an algorithm A(x) that will return yes if the input is equal to 5

```
if   A(x) = yes    then
        return 5
else
        return 10
```

A. Show that the MST decision problem is polynomial-time reducible to the Subset Sum problem.

Final > MST2SubSetSum.go

```
1   Algorithm MST2SubSetSum(G, k):
2       T = MST(G)
3       for e in T.Edges()
4           w = w +  e.weight()
5
6       for e in G.Edges()
7           S = S +  e.weight()
8
9       if w <= k:
10          return (S, w)
11      else:
12          return (S, k)
13
```

B. Show the shortest path decision problem is polynomial-time reducible to the MST decision problem. Hint: convert the shortest path problem to a decision problem, then reduce to MST problem.

Final > ShortestPath2MST.go

```
1   Algorithm ShortestPath2MST(G, s,t,k)
2       newGraph := new empty graph()
3
4       for each (u,v) in G.edges()
5           if u is reachable from s && v is reachable from t
6               newGraph.insertVertex(u)
7               newGraph.insertVertex(v)
8               newGraph.insertEdge(u, v, weight(u, v))
9
10      shortestPathWeight <- ShortestPath(G, s, t)
11
12      if shortestPathWeight <= k:
13          return (newGraph, shortestPathWeight)
14      Else:
15          return (newGraph, k)
```

Decision problem

∴ Given a graph $G = (V, E)$ and two vertices s,t and a max k, Does there exist a path from s to t with total weight $\leq k$?