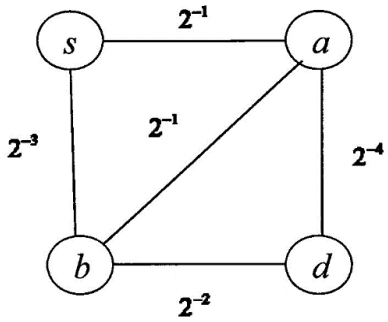
NANYANG TECHNOLOGICAL UNIVERSITY
School of Electrical & Electronic Engineering

IE2108 Data Structures and Algorithms

Tutorial No. 12 (Sem 1, AY2022-2023)

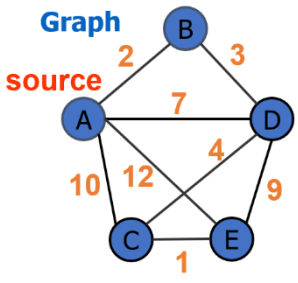
1. Suppose that $G=(V, E)$ is a tree represented by adjacency lists. Write an algorithm in pseudocode that constructs the adjacency lists for a new graph $G' =(V, E')$ with the same set of vertices V as G, and with edges between any two vertices if and only if they are 2 hops away in G , i.e., G' contains the edge (u, v) in E' if and only if there is a path of length 2 in G connecting u and v.

2. Consider a weighted graph G. If (u,v) is an edge in the graph, let $w(u,v)$ denote its weight. Suppose that all edge weights are between 0 and 1. Given a starting vertex s and a destination vertex d, we wish to find a path $(s,u\_1, u\_2, \ldots, u\_m, d)$ with maximum edge weight product $w(s,u\_1)\times w(u\_1,u\_2)\times\cdots\times w(u\_m,d)$. Suggest an efficient algorithm to do this and trace its steps for the graph.

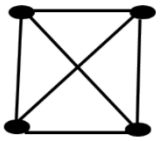


3. Trace the pseudocode for Dijkstra's algorithm for the graph below. Show `u, v, Q, dist[v]` and `previous[v]` in each iteration.

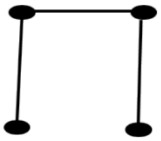
```
function Dijkstra(Graph, source) {
  for each vertex v in Graph {
    dist[v] = infinity
    previous[v] = NULL
  }
  dist[source] = 0
  Q = the set of all nodes in Graph
  while (Q is not empty) {
    u = node in Q with smallest dist[]
    remove u from Q
    for each u's neighbor v in Q {
      temp=dist[u]+ dist_between(u,v)
      if temp < dist[v]     {
        dist[v] = temp
        previous[v] = u
      }
    }
  }
  return previous[ ]
}
```



4. Here is a picture of an undirected graph with 4 nodes that contains every non-self edge:



Here is a picture of just one possible spanning tree for this graph:



Draw fifteen more spanning trees for this same graph.

5. Peter needs to drive from city A to city B. There are multiple possible roads he can take. Some of the roads are toll roads and some are toll-free. How can you design a method to help Peter minimize the number of toll roads? You only need to describe your method – there is no need to write pseudocodes.