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Worksheet 25: Work with either ONE or TWO other students to complete this worksheet. You must work with at least one other student on this assignment, and should submit one paper. Be sure to describe your key idea at a high level.

1. Describe an algorithm that takes, as an argument, a directed graph G = (V, E) and returns a Boolean True if the graph has the transitive property, and False if it does not. Clearly indicate the representation of the graph G (adjacency matrix? Adjacency list?). (3 points

KEY IDEA:

Iterating through every vertex in G, represented by v, we check to see if there are any strongly connected vertices to v, represented by w. Then we check to see if there are any strongly connected vertices to w that are not v. If there are then it is transitive.

Algorithm Transitive($G = (V, E)$):

Input: Adjacency Matrix G

Output: True if G has the transitive property

PROCESS:

```
for r <— 0 to length(G):
    for c <— 0 to length(G[0]):  // For every vertex in G
        v <— G[r][c]
        if v == 1 AND G[c][r] == 1:          // IS Strongly Connected
            for c2<- 0 to length(G[c]):  //For every vertex adjacent from v
                w<— G[c][c2]
                if w == 1 AND c2 != r:  //Not to vertex v
                    if G[c2][c] == 1:    //Strongly connected to third vertex
                        return true

return false
```

2. Describe an algorithm that takes, as an argument, a directed graph G = (V, E) and returns a graph, H, that is the transitive closure of G. In other words, H = (V, F) where E $\subseteq$ F and H has the transitive property. Clearly indicate the representation of the graph G (adjacency matrix? Adjacency list?), and H should have the same representation structure. (3 points)
KEY IDEA:

The Key Idea is that we will return an adjacency matrix consisting of vertices with the value 1 or 0. We'll create an empty graph H and mark all entries to 0. Then we check if the distance between j and i is infinite then the vertex cannot be reached and represented by 0 in the graph H. Else, j is reachable and the value of the vertex will be represented by 1 in the graph H.

Algorithm TransitiveClosure(*G = (V, E)*):

Input: _____A graph G given pairs of vertices represented by V, E_____

Output: _____A graph H, that indicates H having the transitive property. _____

PROCESS:

```
Int path[][] = new int [V][V] //initialize empty output array of path distances
Int i,j,k
Iterate through V using i
        Iterate through V using j
                Add each vertex[i][j] to path[i][j]
Add vertex k to the end of the set
Iterate through V using k;
        Iterate through V using I;
                Iterate through V using j
                If k is on a path from i to j;
                        Set value of path from i to j to 1
                Otherwise;
                        Set 0
Print(path);
```