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COSC 336  
11/14/2019

## Assignment 7

**Problem 1:** Here is the solution for problem 1.

**Part A:** Given an adjacency matrix: we can do the following: We will call the matrix  $M[i][j]$

For  $i = 1$  to  $n$

For  $j = 1$  to  $n$

    If  $a[i,j] = 0$ , increment  $j$

    If  $a[i,j] = 1$ ,

        Set  $k$  to value of  $i$ ,

        Set new index  $L = 0$ .

        Increment through  $a[k,L]$  from ( $L = 1$  to  $n$ ), and whenever value is 1, append to the row  $i$ .

Copy original adjacency matrix and append to our new matrix

    This is order  $O(n^3)$  because we loop from 1 to  $n$  three times.

Here is our adjacency matrix for our example graph:

	1	1	1			
1		1		1		
1				1		
1					1	
	1	1				1
				1		1
				1	1	

And here is our adjacency matrix for our squared graph:

	1	1	1	1	1	
1		1	1	1		1
1	1		1	1		1
1	1	1			1	1
1	1	1		1	1	1
1			1	1		1
	1	1	1	1	1	

**Part B:** For  $i = 1$  to  $n$

For  $j = 1$  to  $n$

Set  $k =$  the value at  $a[i][j]$

Set  $L = 0$

Add values from  $a[k][L]$  from ( $L = 1$  to  $n$ ) to row  $i$  in our new adjacency list as long as the values are not already there or the value of  $i$ .

Copy original adjacency list and append it to our new list

This is order  $O(n^3)$  because we loop from 1 to  $n$  three times.

Here is our given adjacency list:

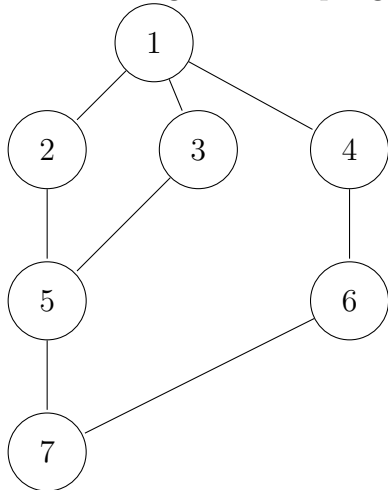
2	3	4	0	0	0	0
1	5	0	0	0	0	0
1	5	0	0	0	0	0
1	6	0	0	0	0	0
2	3	7	0	0	0	0
4	7	0	0	0	0	0
5	6	0	0	0	0	0

and after applying the algorithm our list is now:

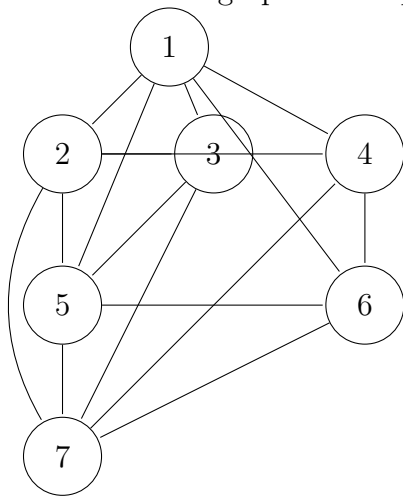
2	3	4	5	6	0	0
1	5	3	4	7	0	0
1	5	2	4	7	0	0
1	6	2	3	7	0	0
2	3	7	1	6	0	0
4	7	1	5	0	0	0
5	6	2	3	4	0	0

To explain these algorithms further, I have included the example graph and the square of the graph so we can better understand what the algorithms are achieving. The square of a graph is the graph with edges both of distance 1 and distance 2 between all the nodes on the graph.

Here is the given example graph:



And here is the graph after squaring it:



**Problem 2:** Here is the solution for problem 2.....

**Problem 3:** Here is the solution for problem 3. ...

**Problem 4:** Here is the solution for problem 4. ...