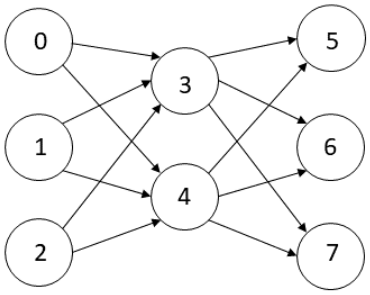
CS2302 - Data Structures

Spring 2020

Practice Exam # 3

1. A three-layer graph is a directed unweighted graph where the first a nodes have outgoing edges to the next b nodes, which have outgoing edges to the next c nodes. For example, the figure shows a three-layer graph with $a = 3, b = 2, c = 3$. Write the function *three_layer_graph(a,b,c)* that builds and returns a *three_layer_graph(a,b,c)* as described above, represented as an adjacency list.



2. The in-degree of a vertex v in a directed graph $G = (V, E)$ is the number of edges going into v. Write the function *in_degrees(G)* that receives a graph G represented as an adjacency matrix and returns a list of length $|V|$ containing the in-degrees of the vertices in V.

3. Write the function *dist_from_prev(G,prev,v)* that receives a graph G represented by an adjacency matrix, the array *prev* computed by Dijkstra's algorithm, and a vertex v and returns the length of the shortest path from the source to v.

4. A disjoint set forest is compressed if all paths from a leaf to a root have length at most 1. That is, for every node i, either i is a root or i's parent is a root. Write the function *compress(s)* that receives a disjoint set forest s and converts s into an equivalent compressed disjoint set forest.

5. The function *subsetsum_nr(S,goal)* attempts to solve subsetsum without using recursion, but it produces a runtime error. Fix it so it works properly.

6. A prime number is an integer that is only divisible by 1 and itself. The function *prime(n)* attempts to determine if n is prime using randomization, but it does not return the right result. Fix it so it works properly.

7. The function *edit_distance(s1,s2)* attempts to find the edit distance from string $s1$ to string $s2$ assuming that vowels can only be replaced by vowels and consonants can only be replaced by consonants, but it gives the wrong results for the example given (for instance, it does not allow 'I' to be replaced by 'O'). Fix it so it works properly. You may assume that all strings contain only letters.