(CS1.301) Algorithm Analysis and Design (Monsoon 2023) Date: 29.08.2023

Deep Quiz 1

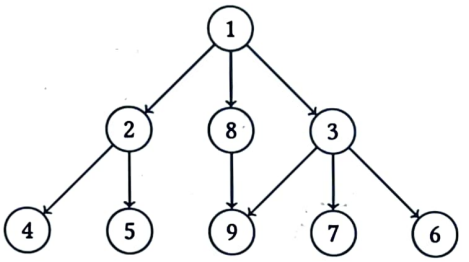
Alloted time: 45 minutes Total marks: 15

Instructions:

- There are a total of 4 questions with varying credit.
- Discussions amongst the students are not allowed. No electronic devices nor notes/books of any kind are allowed.
- Any dishonesty shall be penalized heavily.
- Place your identity cards on the table for verification.
- Be clear in your arguments. Vague arguments shall not be given any credit.

Question 1 [2 marks]

Let $G = (V, E)$ be a graph as drawn below. Suppose we were to run graph search algorithms from the



node 1 to discover the node 7, what is the sequence of nodes discovered before discovering the node 7 if the search algorithm used is

(a) Breadth-first search.

(b) Depth-first search.

Assume that each of these search algorithms prioritises a neighbour of least value.

Question 2 [2 marks]

Suppose the symbols a, b, c, d, e occur with frequencies 0.35, 0.25, 0.125, 0.20, 0.075, respectively.

(a) What is the Huffman encoding of this alphabet?

(b) If this encoding is applied to a file consisting of 1,000,000 characters from a, b, c, d, e, with the given frequencies, what is the length of the encoded file in bits.

Question 3 [6 marks]

We have a connected graph $G = (V, E)$, and a specific vertex $u \in V$. Suppose we compute a depth-first search rooted at u, and obtain a tree T that includes all nodes of G. Suppose we then compute a breadth-first search tree rooted at u, and obtain the same tree T. Prove that $G = T$. That is, if T is both a depth-first tree and breadth-first tree rooted at u, then G cannot contain any more edges than those in T.

Question 4 [5 marks]

Let the graph G have n vertices and m edges whose edge weights are all distinct. Give an algorithm to decide whether a given edge e is contained in a minimum spanning tree of G without actually constructing the Minimum Spanning Tree.