THE UNIVERSITY OF TRINIDAD AND TOBAGO

# FINAL ASSESSMENT/EXAMINATION APRIL 2017

**Course Code and Title:** DSAL3001 – Algorithm Analysis and Design

**Programme:** Bachelor of Applied Science in Computer Engineering.

**Date:** Wednesday April 5, 2017 **Time:** 1:00pm - 4:00pm **Duration:** 3 hours

**PLEASE READ ALL INSTRUCTIONS CAREFULLY BEFORE YOU BEGIN THIS EXAMINATION**

## Instructions to Candidates

1. **This paper has _5_ pages and _7__ questions.**
2. **You are required to answer all questions.**
1. **You are required to return the question script.**

## Key Examination Protocol

1. Students please note that academic dishonesty (or cheating) includes but is not limited to plagiarism, collusion, falsification, replication, taking unauthorised notes or devices into an examination, obtaining an unauthorised copy of the examination paper, communicating or trying to communicate with another candidate during the examination, and being a party to impersonation in relation to an examination.
2. The above mentioned and any other actions which compromise the integrity of the academic evaluation process will be fully investigated and addressed in accordance with UTT's academic regulations.
3. Please be reminded that speaking without the Invigilator's permission is NOT allowed.

1. Given that a formal definition for Big O notation is as follows:

$O(g(n)) = \{ f(n)$: $\exists$ positive constants $c$ and $n_0$ such that $f(n) \leq c \cdot g(n) \ \forall n \geq n_0\}$

Show that $2\lg n + 3$ is $O(\lg n)$. [5 marks]

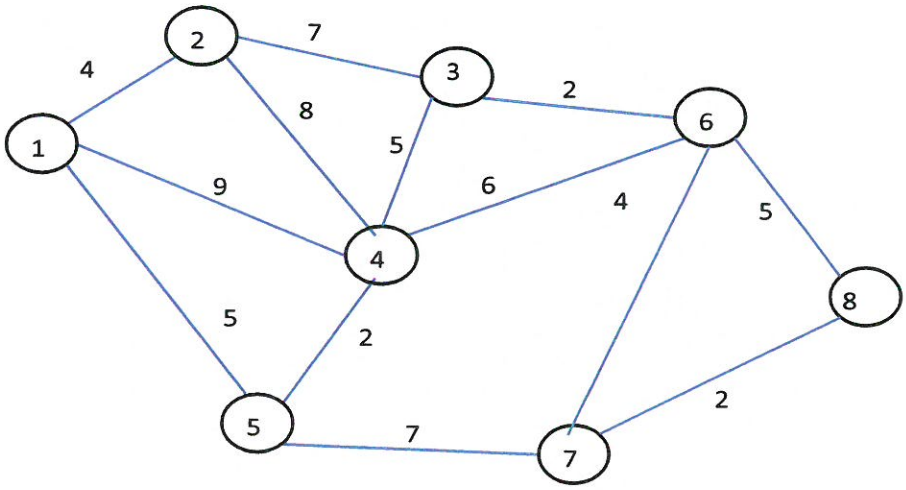
2. T(n) is the running time of an algorithm on an input size n. Given that

$T(1) = 1$

$T(n) = 2\,T(n/2) + c$, for $n > 1$ and a constant c

Determine the order of the algorithm, state any assumptions made. [5 marks]

3. Consider the following undirected, weighted graph:




a. Using Dijkstra's algorithm, compute the shortest path to all other nodes starting from node 1. [10 marks]

Clearly show all information for each node at each pass of the algorithm.

b. Explain the complexity of the algorithm in terms of the number of nodes and edges. [2 marks]

c. Dijkstra's algorithm is considered to be a greedy algorithm. Explain what a greedy algorithm is. Include in your explanation, what its strengths and weaknesses are. [3 marks]

4. Given two strings A of length n, and B of length m, we need to find their longest common Subsequence (LCS), i.e. the longest sequence of characters that appear left-to-right, but not necessarily in a contiguous block, in both strings.

   a. Determine the complexity of a brute force algorithm to solve this problem. Explain how you arrive at your answer. [2 marks]

   b. Use a more efficient algorithm to produce the table used to derive the LCS of A and B as follows showing all your steps:

      A = MPROACV B = PLLROVCA [5 marks]

   c. Write an algorithm that produces the table to solve this problem. [5 marks]

   d. Describe the algorithm that gives the actual LCS from the table. [3 marks]

5. You are given n copies of a book. One of the books is known to contain a duplicated chapter of only a few pages so that you cannot tell which one it is just by looking at them. You are required to find the book with the duplicated chapter. It is suggested that we could weigh the books or measure the thickness of the books to find the one with the duplicated chapter.

   a. Describe an algorithm of O(n) to solve this problem. [5 marks]

   b. Describe an algorithm of O(log n) to solve the same problem. [5 marks]

6. Consider the following function:

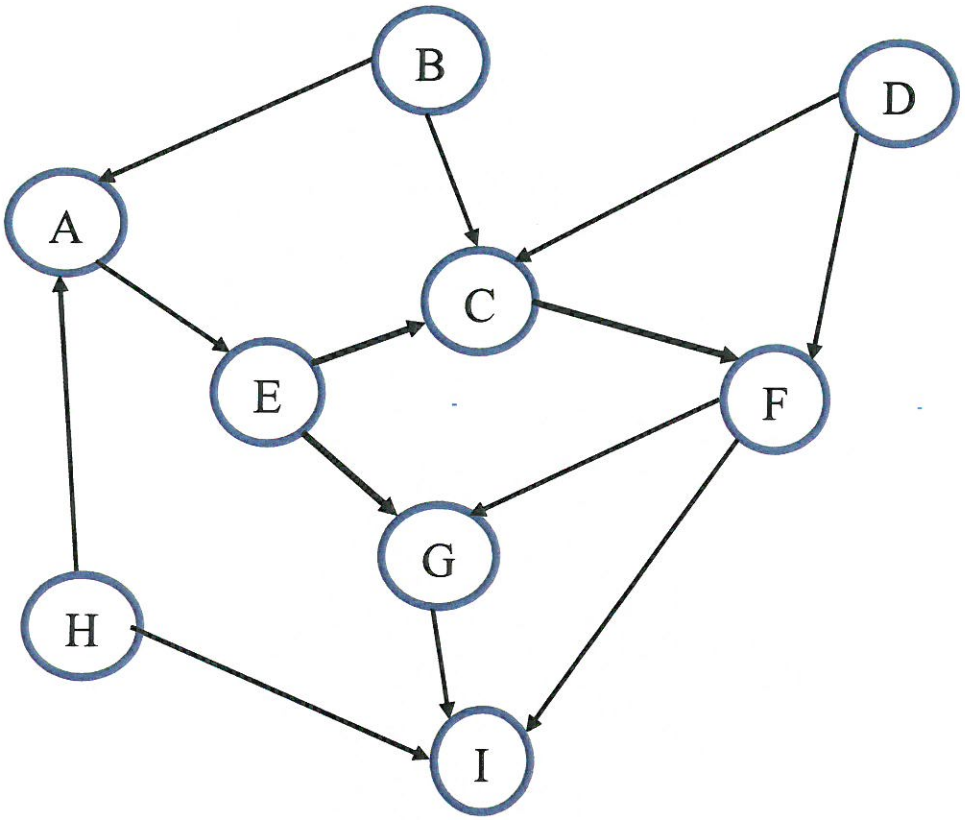
```
void   DoThis (A, m, n)
//input : Array A(m .. n)

      x ← A[m]; i ← m; j ←n;

      while A[i] ≤ x and i ≤ n do i ← i +1;
      while A[j] > x and j ≥ m do j ← j -1;
      if i< j then
          swap A[i] ↔ A[j];
      return A;
```

a. What task does this function perform?
Explain what the function does in general terms, not line by line. [4 marks]

b. What is the time complexity of the function? [3 marks]

c. If A[m .. n] = [27, 31, 07, 45, 16, 21, 30, 65, 53], what is the output? [3 marks]

7.




The Directed Acyclic Graph above shows the prerequisites of the various tasks on a project undertaken by a contractor. A project manager wishes to determine the order in which the tasks should be performed so as to avoid any unnecessary delays.

a. What algorithm should the Project Manager use to do this? [3 marks]

b. From the above graph, produce a feasible order in which to perform the tasks. Show step by step how you arrive at your answer. [5 marks]

(c) Is it possible to have more than one feasible order? Explain why or why not. [2 mark]

END OF EXAM!