THE UNIVERSITY OF TRINIDAD & TOBAGO

FINAL ASSESSMENT/EXAMINATION APRIL 2018

Course Code and Title: DSAL3001 – Algorithm Analysis and Design

Programme: Bachelor of Applied Science in Computer Engineering.

Date: Wednesday April 11, 2018 **Time:** 1:00 p.m. - 4:00 p.m. **Duration:** 3 hours

PLEASE READ ALL INSTRUCTIONS CAREFULLY BEFORE YOU BEGIN THIS EXAMINATION

Instructions to Candidates

1. **This paper has _11_ pages and _6_ questions for a total of _80_ marks.**
2. **You are required to answer all questions.**
3. **You are required to return the question script.**
4. **You must write on this question paper in ink. No Answer Booklet is required.**
5. **Additional writing paper may be requested if needed.**

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. a. Write a formal definition for Big O notation: [5 marks]

b. Use that formal definition to prove that $n + 2n \lg n$ is $O(n \lg n)$. [5 marks]

2. a. T(n) is the running time of an algorithm on an input of size n.
Given that $T(0) = 1$
$T(n) = 3 + T(n-1)$, for $n > 1$
Determine the order of the algorithm. State any assumptions made and show how you arrive at your answer. [5 marks]

b. T(n) is the running time of an algorithm on an input of size n.
Given that $T(0) = 1$
$T(n) = 3 + T(n-1) + T(n-1)$, for $n > 1$
Determine the order of the algorithm. State any assumptions made and show how you arrive at your answer. [5 marks]

3. Consider the following undirected, weighted graph:

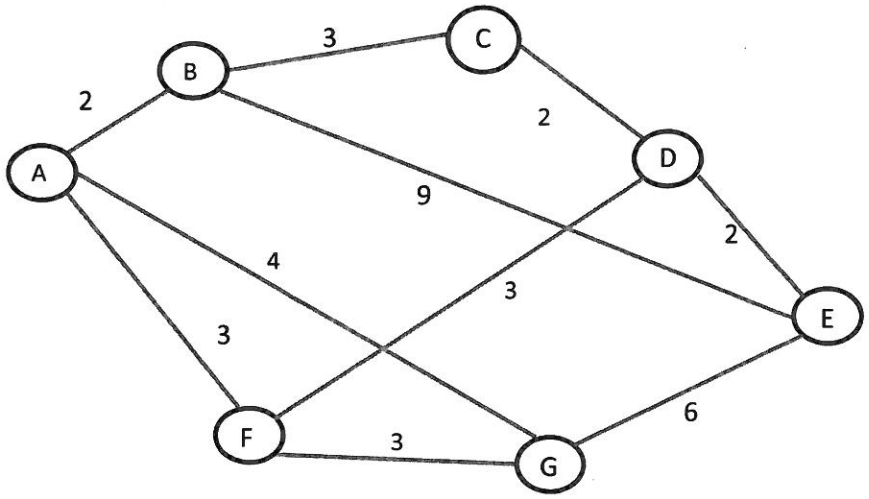


Fig 3.1

a. Using Dijkstra's algorithm, compute the shortest path to all other nodes starting from node A in Fig. 3.1 above.

i. Clearly show all information for each node at each pass of the algorithm in Table 3a.i below. [8 marks]

	Unvisted (Q)	Visited (S)	Current	A	B	C	D	E	F	G
	{A, B, C, D, E, F, G}	{ - }								
1										
2										
3										
4										
5										
6										
7										

Table 3a.i

ii. Show the shortest path to each node in the Table 3a.ii below. [2 marks]

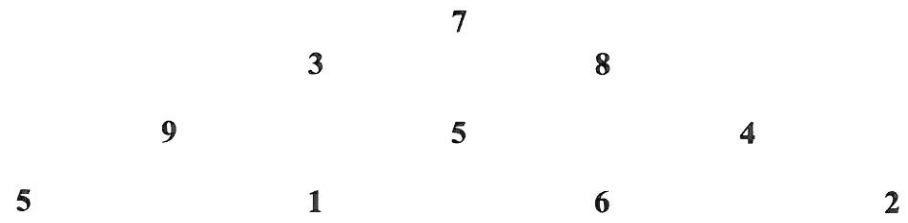
From	To	Route	Length
A			
A			
A			
A			
A			
A			

Table 3a.ii

b. State the complexity of the algorithm in terms of the number of nodes and edges. Explain your answer. [3 marks]

c. Would this algorithm work if there were edges with negative weights? Explain your answer. [2 marks]

4. A Triangle of numbers exists as shown below with n rows:



A valid path moves from top to bottom choosing either the right or left value in the row immediately below. The values on the path are added to yield the sum. The path in the triangle that produces the largest sum is required.

a. Determine the order of a brute-force algorithm that solves this problem. [3 marks]

b. Write an algorithm using memoization to solve this problem. [6 marks]

c. What is the order of your memoized algorithm for this problem? [3 marks]

d. Determine the largest value and show the corresponding path used. [3 marks]

5. 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. [3 marks]

   b. Use a more efficient algorithm to derive the LCS of A and B as follows

   A = x y x z y y z B = y z x y z y x z

   Show all your steps in the Table 5b below. [5 marks]

i \ *j*	0	x	y	x	z	y	y	z
0								
y								
z								
x								
y								
z								
y								
x								
z								

Table 5b

c. Describe the steps to produce the actual LCS from your answer to part b above.
[2 marks]

6. A truck driver uses a 10-ton truck to deliver products for a cargo-handling company. On a particular morning the driver is given a list of products which are ready for delivery showing the weight and the payment for each item. The driver must now choose the best combination of products so that he can get the maximum possible payment while keeping the total weight within the available capacity of his truck. The list is as follows:

Item no.	=	1	2	3	4
Payment	=	20	40	30	50
item weight	=	3	6	2	4

a. What is the order O( ) of an algorithm that checks all possible combinations to solve this problem? [4 marks]

b. What is the order of an algorithm that solves this problem with a Dynamic Programming approach? [4 marks]

c. Use a Dynamic Programming approach to solve this problem in the Table 6c below. [5 marks]

k\w	0	1	2	3	4	5	6	7	8	9	10
0	0	0	0	0	0	0	0	0	0	0	0
1	0										
2	0										
3	0										
4	0										

Table 6c

d. Write an algorithm using Dynamic Programming to solve the general form of this problem where the maximum capacity of a container is W, and the list as follows,

item no.	=	i_1	i_2	i_3	i_4	
value	=	v_1	v_2	v_3	v_4	
item weight	=	w_1	w_2	w_3	w_4	etc for n items

[7 marks]

END OF EXAMINATION.