

FINAL ASSESSMENT/EXAMINATION

MAY - JULY 2018

Course Code and Title: DSAL2001 – Data Structures and Algorithms

Programme: BASc Computer Engineering

Date: Friday 27 July 2018 **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 16 pages and 4 questions.
2. You are required to answer ALL questions in the spaces provided.
3. Answers are to be written in pen (black or blue).
4. Drawings can be done in pencil.
5. The use of non-programmable calculators is allowed.
6. Write your STUDENT ID on each page in the space provided.
7. Questions DO NOT carry equal marks

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.

Student Id: _____

For Examiner's Use Only		
Questions	Total Marks	Marks Obtained
Question 1	20	
Question 2	30	
Question 3	25	
Question 4	25	
Total	100	

Question 1**Total: 20 marks**

- a) Given the following array, N, complete the table (*Table 1*) to show all the steps as the insertion sort algorithm is used to sort the array in **DESCENDING** order. [3 marks]

25	50	78	32	49	63	56
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Qu 1 - Array N

Step	Elements in array						
	25	50	78	32	49	63	56

Table 1

All rows may or may not be used for your answer

Question 1 continued

- d) Given the array, A, show the values of first, last and mid as the binary search algorithm is used to find 35. Also, state what the algorithm would return. [5 marks]

12	17	20	27	35	38	40	44	53	62	65	71
0	1	2	3	4	5	6	7	8	9	10	11

Qu 1 - Array A

Question 2

Total: 30 marks

- a) Write a method called **findLargest** that would be included in the `LinkedList` class to find and return the largest integer in a linked list. [7 marks]

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- b) Given a variable `n` that contains a positive integer, write Java code that uses a **Stack** to print the binary equivalent of the value in `n`. [8 marks]

1. The first step in the process of identifying a problem is to recognize that a problem exists. This involves gathering information about the situation and identifying the specific issue that needs to be addressed.

2. Once a problem has been identified, the next step is to define the problem clearly. This involves stating the problem in a concise and specific manner, identifying the scope of the problem, and determining the goals that need to be achieved.

3. The third step in the process is to generate potential solutions. This involves brainstorming ideas and considering different approaches to solving the problem. It is important to consider a wide range of options and to evaluate the potential benefits and drawbacks of each solution.

4. The fourth step is to select the best solution. This involves comparing the potential solutions and choosing the one that is most likely to be effective and feasible. It is important to consider the resources available and the time and effort required to implement each solution.

5. The final step in the process is to implement the chosen solution. This involves putting the solution into action and monitoring its progress. It is important to communicate the solution to all relevant parties and to ensure that everyone is working together to achieve the desired outcome.

Question 2 continued

- d) Given the following hash functions $h_1()$ and $h_2()$, use **double hashing** to insert the given keys into a hash table. For each key you must show all locations that the hashing algorithm would generate. [10 marks]

Keys: 10, 17, 45, 98, 67, 72, 23

```
public int h1(int key){
    return (key + 5) % 11;
}
```

```
public int h2(int key){
    return ((key * 2) % 5) + 1;
}
```

0	1	2	3	4	5	6	7	8	9	10

Qu 2 - Hash Table

Question 2 continued

Question 3**Total: 25 marks**

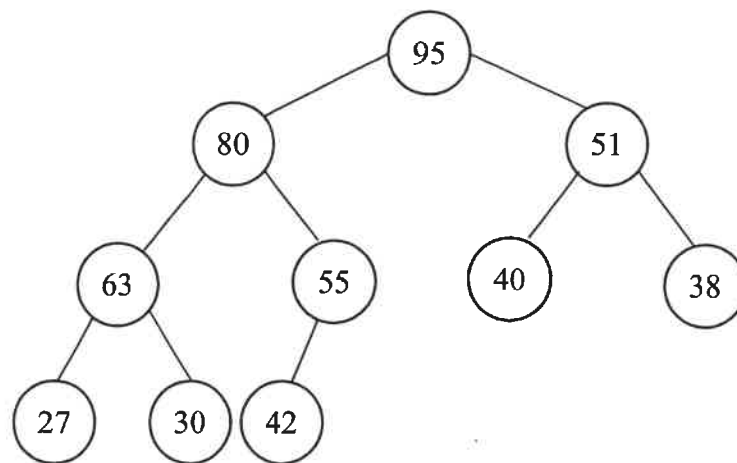
- a) Given the following values, construct a **Binary Search Tree** with the root as 75. [4 marks]

Values: 75, 50, 60, 90, 85, 80, 30, 88

- b) What is the output of a PRE ORDER depth first traversal of the BST created in a) above.[4 marks]

Question 3 continued

- c) Write a **recursive** method that does an IN ORDER traversal of a binary tree. [5 marks]



Qu 3 - Binary Max Heap

- d) Draw the array representation of the max-heap given above (*Qu3 - Binary Max Heap*). [2 marks]

Question 3 continued

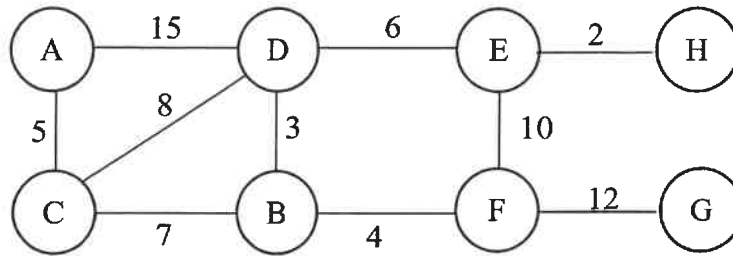
- e) Redraw the entire max-heap as the following operations are carried out on the given heap (*Qu3 – Binary Max Heap*).

Note - each new operation must be carried out on the updated heap.

i. Insert 99 [4 marks]

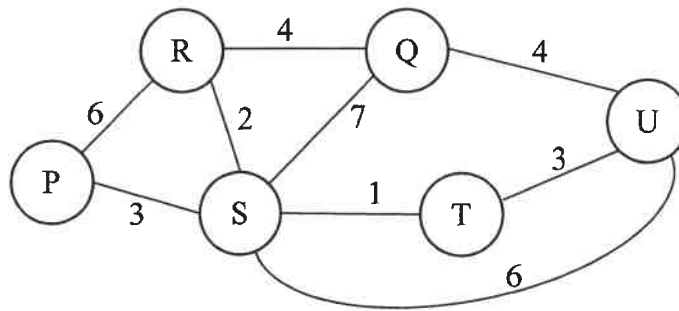
ii. Insert 45 [2 marks]

iii. Remove-max [4 marks]

Question 4**Total Marks: 25***Qu 4 - Graph 1*

- a) Given the graph above (*Qu 4 – Graph 1*), state the order that the nodes would be visited as a **breadth first traversal** of the graph is done starting from vertex A. Where necessary, the vertices are processed in alphabetical order. [4 marks]

- b) Use Kruskal's algorithm to draw a minimum spanning tree for the graph given above (*Qu 4 – Graph 1*) [4 marks]

Question 4 continued*Qu 4 - Graph 2*

- c) Complete the table below (Table 2) by using Dijkstra's algorithm to find the minimum cost from vertex P to every other vertex for the graph above (*Qu 4 – Graph 2*). For each vertex you must show the final cost from P and the vertex through which the cost was calculated. [10 marks]

Vertex	Cost	Previous Vertex
P	0	-

Table 2

All rows may or may not be used for your answer

Question 4 continued

d) An adjacency matrix is given below; draw the graph that it represents.

[7 marks]

	I	J	K	L	M
I	0	5	0	0	0
J	0	0	3	0	4
K	0	3	0	0	0
L	10	0	0	0	6
M	0	0	9	6	0

Qu 4 - Adjacency Matrix

END OF EXAMINATION