

INSTITUTE OF TECHNOLOGY BLANCHARDSTOWN

Year	Year 3
Semester	Semester 1 - Repeat
Date of Examination	Friday 23rd August 2013
Time of Examination	1.00pm – 3.00pm

Prog Code	BN302	Prog Title	Bachelor of Science in Computing in Information Technology	Module Code	COMP H3025
Prog Code	BN013	Prog Title	Bachelor of Science in Computing in Information Technology	Module Code	COMP H3025
Prog Code	BN104	Prog Title	Bachelor of Science (Honours) in Computing	Module Code	COMP H3025

Module Title	Data Structures and Algorithms
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External Examiner(s): *Mr Michael Barrett*
Dr Tom Lunney

Instructions to candidates:

- 1) To ensure that you take the correct examination, please check that the module and programme which you are following is listed in the tables above.
- 2) This paper consists of four questions. Candidates should answer ALL questions.
- 3) All questions carry equal marks.

DO NOT TURN OVER THIS PAGE UNTIL YOU ARE TOLD TO DO SO

Question 1

- a) Describe the difference between a Data Structure and an Abstract Data Type, *ADT*.

(4 marks)

- b) Describe in pseudo code how you would remove an item from an array based *singly* linked list ADT.

You may assume the existence of the other class members in *ListArrayBased*.

(6 marks)

- c) Describe, with the aid of a diagram and suitable fragments of pseudo code, how you would remove a specific node from a reference based singly linked list. Account for all special cases.

You may assume the existence of the other class members in *ListReferenceBased*.
Use diagrams to support your answer.

(6 marks)

- d) Assume that a Node class for a doubly linked list ADT contains an *item* attribute, as well as *next* and *previous* node attributes. Write out brief pseudo code descriptions of the steps taken to add items to the following positions within a doubly linked list:

- (i) The end of the list
- (ii) The beginning of the list
- (iii) Overwriting the first item in the list

Use diagrams to support your answer.

(9 marks)

(Total 25 marks)

Question 2

- a) Identify four applications of a Stack ADT for text and string processing.
(4 marks)
 - b) Outline and compare the different possible implementations of a Stack ADT. Outlining the advantages and disadvantages of each.
(6 marks)
 - c) Write a Java interface structure to declare the method signatures of the five operations of the ADT Queue. The methods should throw a QueueException if appropriate.
(5 marks)
 - d) Write a complete Java class and driver program to build a public class called QueueArrayBased that implements a QueueInterface over a logically “circular” array.
(10 marks)
- (Total 25 marks)

Question 3

a) Explain, with the aid of diagrams, the following terms in relation to a Tree ADT:

- | | | | |
|-----|------------------|------|-------------------------|
| i. | Root of a Tree | iii. | Ancestor of a Tree Node |
| ii. | Height of a Tree | iv. | Complete Tree |

(4 marks)

b) Construct an alphabetically sorted ADT Binary Tree (Binary Search Tree) using the following list of political surnames:

Obama, Bush, Clinton, Reagan, Cameron, Brown, Blair, Thatcher, Kenny, Ahern, Haughey

(6 marks)

c) Draw the following graph:

$G = (\{1, 2, 3, 4, 5, 6\}, \{\{1, 2\}, \{1, 4\}, \{2, 5\}, \{2, 6\}, \{3, 4\}, \{3, 5\}, \{3, 6\}, \{4, 5\}, \{5, 6\}\})$

(6 marks)

d) For the graph in part (c) above, list the order in which vertices are visited for:

i. Depth First Traversal

(2 marks)

ii. Breath First Traversal

(2 marks)

e) Briefly describe how Dijkstra's shortest path algorithm operates

(5 marks)

(Total 25 marks)

Question 4

- a) Describe your understanding of the phrase "Analysis of Algorithms". Make reference to an algorithm's growth rate in your answer.

(4 marks)

- b) Briefly describe the efficiency of the linear and binary search techniques. Make reference to the worst case analysis for both techniques and also a brief description of their operation strategies.

(5 marks)

- c) Describe the operation of the SelectionSort approach to sorting data. Your discussion should make reference to the operation strategy behind SelectionSort and how this affects its growth rate in terms of the Big O notation analysis.

(4 marks)

- d) Trace the execution of the SelectionSort algorithm using appropriate diagrams on an array containing the following numeric data:

38	15	10	39	12
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(5 marks)

- e) Write pseudo-code or Java code for the SelectionSort method. Include comments that explain the code.

(7 marks)

(Total 25 marks)