



# UNIVERSITY OF RUHUNA

Faculty of Engineering

End-Semester 4, Examination in Engineering, November 2017

Module Number: EE4303    Module Name: Data Structures and Algorithms

Part-B

[2 hours]

[Answer all questions, each question carries 7.5 marks]

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- Q1. a) Array and Linked Lists are basic data structures.
- Explain using a diagram, how an Array and a Linked List are stored in main memory. [2 marks]
  - Give one advantage and one disadvantage of an Array over a Linked List. [1 marks]
- b) Singly Linked List can be represented using a Node class and LinkedList class. Assume that C++ language is used to implement following program.
- Write the Node class. [1 marks]
  - Write a method to print node data in the list. [1.5 marks]
  - Write a method to insert an element to the end of the Singly Linked List class. [2 marks]
- Q2. a) Tree data structures can be used for searching.
- Draw the resulting tree when you insert following number sequence to an empty binary search tree.  
20, 12, 20, 66, 15, 30, 68, 35, 21, 14 [1 mark]
  - Write an algorithm to insert a node with a given key value to the binary search tree using C++ syntax. [2 marks]
  - Explain using diagrams how a node with a given key value is deleted from the binary search tree. [1.5 marks]
- b) AVL tree is a special binary search tree.

- i) Explain the AVL property of a node. [1 mark]
- ii) Explain the single rotation and double rotation techniques which are used to balance an AVL tree. [2 marks]

Q3. a) Insertion sort algorithm is one of the simplest sorting algorithms.

- i) Explain the algorithm by using diagrams. [1.5 mark]
- ii) What is the asymptotic time complexity of the algorithm? [1 mark]

b) Quick sort algorithm is one of the basic sorting algorithms.

- i) Explain the Quick sort algorithm using last element of an array as the pivot element. [1.5 marks]
- ii) Calculate the asymptotic time complexity of the Quick sort algorithm for the average case. [1 mark]

c) Merge sort algorithm is one of the basic sorting algorithms.

- i) Explain the merge sort algorithm for a given array of elements. [1.5 marks]
- ii) Calculate the asymptotic time complexity of the algorithm [1 mark]

Q4. a) Explain how you would represent graph shown in Figure Q4.a using adjacency list and adjacency matrix. [2 marks]

b) Explain the depth first search operation on the graph shown in Figure Q4.a taking  $a$  as the starting node. [1.5 mark]

c) Explain Prim's algorithm for finding the minimum spanning tree shown in Figure Q4.a taking  $a$  as the starting node. [2 mark]

d) Explain the Dijkstra's algorithm for finding shortest paths from vertex  $c$  in the weighted graph shown in Figure Q4.a. [2 mark]

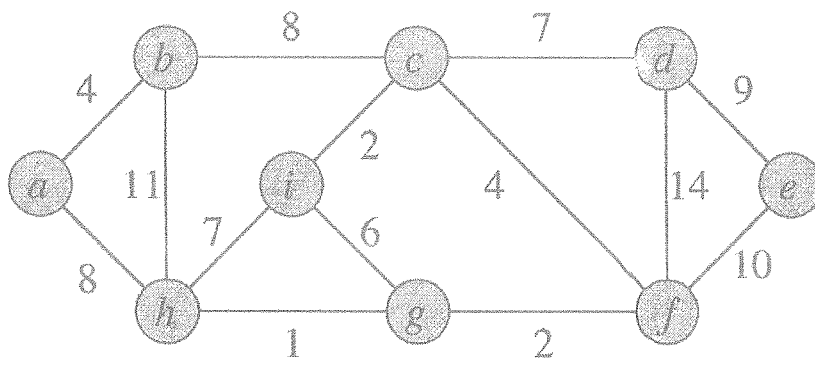


Figure Q4.a: A figure of a weighted undirected graph.