



# UNIVERSITY OF RUHUNA

Faculty of Engineering

End-Semester 4, Examination in Engineering, November 2016

Module Number: EE4303    Module Name: Data Structures and Algorithms

Part-B

[1 hour and 45 minutes]

[Answer all questions, each question carries 5 marks]

Q1. a) Tree data structures can be used for searching.

i) Draw the resulting tree when you insert following number sequence to an empty binary search tree.

27, 12, 2, 46, 11, 40, 76, 25, 21, 14

[1 mark]

ii) Write an algorithm to insert a node with a given key value to the binary search tree.

[1 mark]

b) AVL tree is a special binary search tree.

i) Explain the AVL property of a node.

[1 mark]

ii) Draw the resulting tree diagrams when you insert following sequences to an AVL tree.

53, 79, 91, 110, 141, 85, 150, 2, 41, 4

[2 marks]

Q2. Doubly Linked List can be represented using a Node class and LinkedList class. LinkedList has the references to the first and last element of the list.

a) Write code for the Node class.

[1 mark]

b) Write a method to print the node data in the list.

[1 mark]

c) Write a method to insert an element to a given position in the Linked List class.

[1.5 marks]

- d) We need to keep the linked list sorted in ascending order all the time. How do you change the insert method you wrote part Q2c) to perform this. [1.5 marks]

- Q3. a) A heap is a specialized tree-based data structure that satisfies the heap property.
- i) What is max-heap property? [1 mark]
  - ii) Draw the binary max heap that results from inserting: 4, 1, 3, 2, 16, 9, 10, 14, 8, 7 in that order into an initially empty binary max heap. [1.5 marks]
- b) 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 the advantages of using a hash table. [1 mark]
- b) What is *hash collision* and explain one method of resolving it. [1.5 mark]
- c) The input sequence (23451, 453, 66343, 14121, 4459, 19239, 929, 3458 ) needed to be stored in an Array of size 10. By using the hash function  $h(X) = X \bmod 10$ , show the result of
- i) Separate chaining hash table. [1 mark]
  - ii) Open addressing hash table using linear probing. [1.5 marks]

- Q5. a) Explain how you would represent graph shown in Figure Q5.a using adjacency list and adjacency matrix. [1 mark]
- b) Explain the breadth first search operation on the graph shown in Figure Q5.a taking H1 as the starting node. [2 marks]

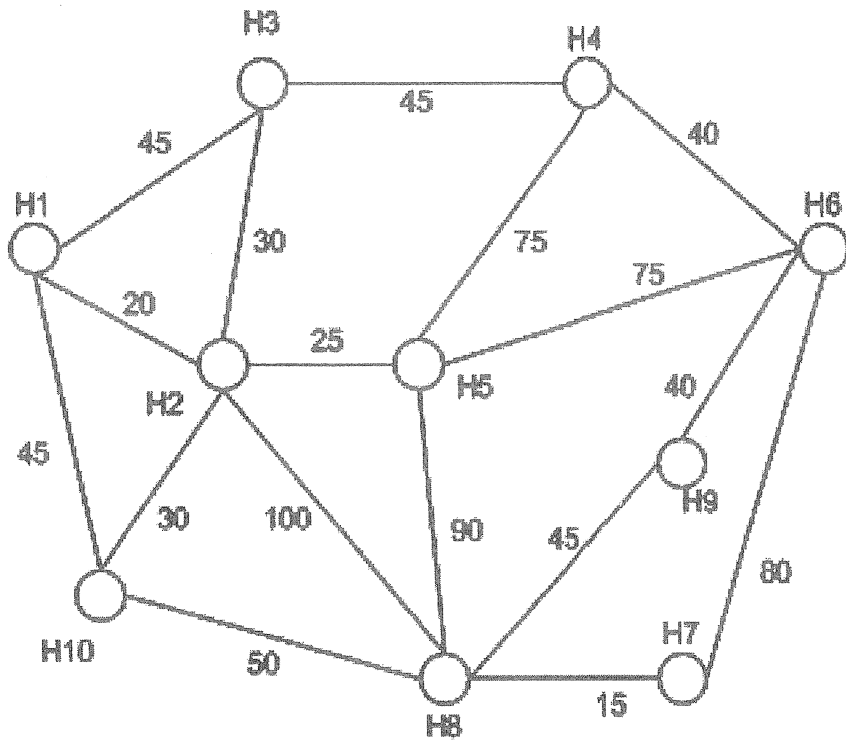


Figure Q5.a: A figure of a undirected graph.

- c) Explain Prim's algorithm for finding the minimum spanning tree shown in Figure Q5.a) taking  $H1$  as the starting node.

[2 marks]