Semester Two of Academic Year (2014---2015) of BJUT

《Data Structures and Algorithms 2》 Final Exam Paper

Exam Instructions： **Answer any TWO questions**

Honesty Pledge：

I have read and clearly understand the Examination Rules of Beijing University of Technology and am aware of the Punishment for Violating the Rules of Beijing University of Technology. I hereby promise to abide by the relevant rules and regulations by not giving or receiving any help during the exam. If caught violating the rules, I would accept the punishment thereof.

Pledger： ______ **Class No:** ______________

BJUT Student ID： ______ **UCD Student ID:** ____________

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Notes：

The exam paper has 3 parts on 4 pages, with a full score of 100 points. You are required to use the given scratch paper attached only.

Total Score of the Exam Paper（For teachers' use only）

Item	Q1	Q2	Q3		**Total Score**
Full Score	50	50	50		
Obtained Score					

Obtained score

Question 1:

(a) What is a *tree*? List the operations that are typically associated with this Abstract Data Type. Provide a brief description of each operation.

(13 marks).

(b) One way to implement a priority queue is to use a *heap*. Heaps make use of two key properties: the *order property* and the *structural completeness property*. Give definitions for each of these properties.

(4 marks).

(c) Draw the heap that would be obtained after the following operations. Show the state of the heap after each operation.

insert(25), insert(31), insert(5), insert(7), remove(), insert(1), remove(), insert(33), insert(26)

(11 marks).

(d) An AVL tree is a self-balancing binary search tree. Explain how an AVL tree remains balanced, and why this is an advantage over a regular binary search tree.

(8 marks)

(e) The Knuth-Morris-Pratt (KMP) pattern matching algorithm can be used to locate the first occurrence of a pattern in a text. Give the pseudo code for the KMP pattern matching algorithm. Illustrate your answer by showing how the algorithm locates the pattern “abacab” in the text “abacaabacabcabacabaabb”.

(14 marks)

(50 marks total)

Obtained score

Question 2:

(a) Explain how values are removed from a binary search tree. Include in your answer descriptions of both situations that arise when dealing with removal from binary search trees. Illustrate these descriptions with an example for each scenario.

(8 marks)

(b) Explain how you would implement a *link-based binary tree*. In your answer, describe the internal structure of a node, identify what key data you must keep track of, and illustrate your description with a diagram of an example tree that contains three nodes.

(10 marks)

(c) Describe how a value is inserted into a Splay Tree. Include in your answer a discussion of how the tree is restructured. Illustrate your answer by constructing the Splay Tree that is generated by the performing each of the following operations:

insert(12), insert(14), insert(16), find(14), insert(11), insert(13),
insert(9), remove(16), insert(17)

(18 marks)

(d) How does *Merge Sort* work? Show how it can be used to sort the following integers:

15, 19, 30, 12, 27, 42, 8, 21, 35, 11, 5, 31

(14 marks)

(50 marks total)

Obtained score

Question 3:

(a) What is a *graph*? List and briefly describe each of the operations that make up the Graph ADT.

(10 marks).

(b) Given a graph with *n* vertices and *m* edges, what is the upper bound for *m* in a directed graph with no self-loops and no multiple edges?

(2 marks)

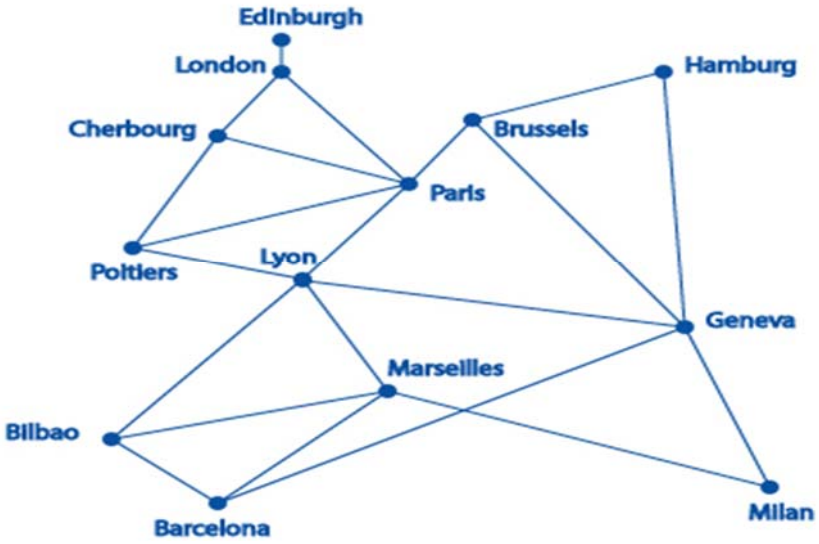
(c) Give definitions of the following graph concepts: *undirected edges*, *self-loops*, *incident edges*, *end vertices*, and *degree of a vertex*.

(8 marks).

(d) When implementing a graph ADT, there are three main approaches that can be taken. Describe each approach, illustrating your answer with a diagram that highlights the design underlying that approach.

(15 marks).

(e) Give psuedo code for the *Breadth First Search* graph algorithm. Using the graph below, show how its edges and vertices would be labeled by a breadth first search beginning at Hamburg.



(15 marks).

(50 marks total)