Brock University

Final Exam: Spring 2007 Number of Pages: 14
Course: COSC 2P03 Number of Students: 16
Date of Examination: July 14th, 2007 Number of Hours: 3
Location of Examination: Bob Davis Gym - Walker Complex TIME: 1900-2200
Instructor: S. Thompson

Total Marks: 132

No examination aids (including, but not limited to, calculators, textbooks and laptops) are permitted. Use or possession of unauthorized materials will automatically result in the award of a zero grade for this examination.

A minimum of 40 percent must be obtained on this final examination in order to achieve a passing grade in this course.

Answer all questions on the exam paper itself.

Question 1 [11 Marks]

a) For each of the following running times for a given input N, show the complexity of the algorithm in Big O notation

1. $N * (N*\log N + N^2)$
2. $2^N + 3^N + 7^N$
3. $N * N * N^{1/2}$
4. $N + \log(\log(\log N)))$
5. $N * \log(N * N)$

b) Explain when to use and when not to use recursion. Give examples if necessary.

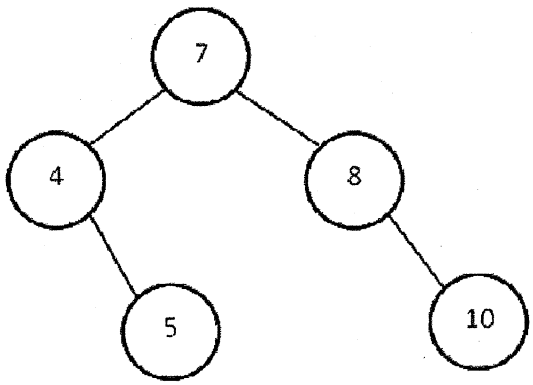
Question 2 [10 Marks]

Given the following Node structure, write an iterative method in Java to insert a string into a Binary Search Tree. Your method should return the root of the tree (parameter 'node' is the current root).

```
class BinarySearchNode {
        public BinarySearchNode leftNode;
        public BinarySearchNode rightNode;
        public String           nodeKey;
        BinarySearchNode( String s ) {
                nodeKey = s;
                leftNode = null;        rightNode = null;
        }
};
...
static BinarySearchNode Insert( BinarySearchNode node, String valToInsert ) {
```

Question 3 [14 Marks]

Given the following AVL-Balanced Binary Search Tree, successively insert the values 6, 9, 11, and 12 and perform the appropriate rotations until the tree is balanced. You are required to show the tree after the insertion (i.e. prior to rebalancing) and after rebalancing (if required).



Question 4 [8 Marks]

a) Explain the term 'adoption' with reference to B-trees

b) Describe how to determine the ideal number and size of leaf and non-leaf nodes in a B+tree

Question 5 [15 Marks]

a) Run the BuildHeap algorithm to create a minHeap from the following array, showing the array after each percolate and highlighting (or circling) the elements of the array that have changed in that iteration. You can assume the first element is at index 1.

8	12	14	3	15	9	16	7	6	1	11	2	10	13	5

b) Draw the final result in tree form

Question 6 [15 Marks]

a) Compare and contrast quicksort vs mergesort, being sure to describe the advantages and disadvantages of each algorithm

b) Perform a Radix sort on the following list of integers, showing each bucket after every pass over the entire list: 12, 146, 312, 783, 5, 943, 456, 784, 564, 234, 144, 145, 541, 869, 999, 1

Question 7 [10 Marks]

Define or briefly explain the following terms with respect to Hashing:

a) Separate Chaining

b) Load Factor

c) Open Addressing

d) Primary Clustering

e) Secondary Clustering

Question 8 [16 Marks]

Define or briefly explain the following terms with respect to Graphs:

a) Simple Cycle

b) Weakly Connected Graph

c) Complete Graph

d) Indegree of a Vertex

e) Articulation Point

f) Path

g) Adjacency Matrix

h) Dijkstra's Algorithm

Question 9 [10 Marks]

Describe what a minimum spanning tree is. Then compare and contrast Prim's and Kruskal's algorithms for finding a minimum spanning tree.

Question 10 [10 Marks]

Given the following class for a vertex in a depth first spanning tree write, in Java, an algorithm for determining the 'low' value of the node and whether the corresponding graph is biconnected.

```
public class DFSTVertex {
        public int      lowValue;      // calculate this
        public LinkedList<DFSTVertex> children;   // already calculated
        public LinkedList<DFSTVertex> backEdges;        // already calculated
        public int      vertexNum;   // value assigned during depth first
                                     // spanning tree creation, already calculated
}
```

Question 11 [13 Marks]

a) State the 5 Algorithm Design Techniques discussed in this course

b) Pick one of the techniques in part a). Describe the technique and give 3 examples of algorithms that use (or could) it. Give a short description on how each algorithm uses it.

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