Boğaziçi University, Dept. of Computer Engineering

CMPE 250, DATA STRUCTURES AND ALGORITHMS

Spring 2011, Midterm 1

Name: _____

Student ID: _____

Signature: _____

- Please print your name and student ID number and write your signature to indicate that you accept the University honour code.
- During this examination, you may not use any notes or books.
- Read each question carefully and **WRITE CLEARLY**. Unreadable answers will not get any credit.
- There are **5** questions. Point values are given in parentheses.
- You have **120 minutes** to do all the problems.

Q	1	2	3	4	5	Total
Score						
Max	20	20	20	20	20	100

1. What is .. (Give short answers. Long answers do not get any credit.)

   (a) the notation $O(g(n)) = f(n)$? (2pt)

   (b) the notation $\Theta(g(n)) = f(n)$? (2pt)

   (c) the notation $o(g(n)) = f(n)$? (2pt)

   (d) a data structure with last in first out property ? (2pt)

   (e) a Priority Queue ? (2pt)

   (f) a up-percolation operation in the context of a heap ? (2pt)

   (g) the infix expression for $abcd + *-$? (2pts)

   (h) the meaning of the expression `float** p;` in C++ ? (2pt)

   (i) the output of the following code segment C++ ? Explain (2pts)

```
char a = 'c'; char& c=a; c = 'a'; cout << 'a' << a << 'c' << c;
```

   (j) a possible way of allocating dynamic memory in C++ ? (2pt)

(20 points)

2. Show the result of inserting $10, 12, 1, 14, 6, 5, 8, 15, 3, 9, 7, 4, 11, 13, 2$ into a initially empty binary heap (one at a time). *(20 points)*

3. (a) State the formula to find the positions of the parent and children of an element at position j in a 3-heap, where this heap is stored as an array.

   [Hint: Remember the layout for a heap that leaves the first array positions empty if necessary.]

   (b) Suppose now, that the same 3-heap is represented by using explicit links with node pointers. Give an algorithm to find the tree node that is at implicit position i.

(20 points)

4. Suppose you have an integer vector, and you need to write a function, which reverses this vector. The function should generate a new vector, and it shouldn't change the contents of the original vector. The function will not be a member of a class, and must be efficient (i.e. it should not copy any unnecessary array elements). Implement this function in C++.

   [Hint: call by value or call by reference?] *(20 points)*

5. Write an algorithm which tests whether a given binary tree is a BST or not. *(20 points)*