EEN511
Happy Test
Lucky 13th November 2013
No Books,
No Puppies.

Name:

Student number:

Sign here if you did not give or receive aid in any form during this test, and did not consult any written or printed material apart from this test:

Don't write in these boxes.

Question	Out of	Grade
1	33	
2	33	
3	33	
4	1	

1. This is not a question about a feature of some programming languages or libraries.

    A. What exactly is an enumeration
    B. What does it mean to say that a set or collection is enumerable?
    C. What is the significance of a set *not* being enumerable?
    D. What exactly is an Integer Decision Function?
    E. Either i. Prove that the set of all possible Integer Decision Functions is not enumerable.
        or ii. Prove that the set of all Real numbers is not enumerable.

2. The basic and well-known combinatoric formula, $C(n, r) = n ! / (r ! \times (n - r) !)$ is unfortunately prone to unnecessary overflow ($C(20, 20)$ is only 1, but the intermediate calculation of 20 ! would overflow, causing an incorrect result). This is an alternative implementation which does not have that problem:

    ```
    int C(int n, int r)
    { if (r == 0) return 1;
      if (r == n) return 1;
      return C(n-1, r-1) + C(n-1, r); }
    ```

    A. What would its running time be (big O)? It has two inputs, so you may have to think about how best to express the answer.
    B. Write another efficient implementation based on this one, but using dynamic programming.

3.

Either A: This is an array of integers:

12	15	7	20	14	4	9	16	2	6

In the first phase of heapsort, it is converted into a heap in place (not using another array). There are ten numbers, so this conversion takes ten steps. Draw the array/heap exactly as it would be after each of those ten steps. That means draw ten diagrams.

or B: Draw a *perfectly balanced* binary tree containing these seven numbers:

10, 20, 30, 40, 50, 60, 70.

Now some more numbers are to be added to this tree one by one. The AVL method is to be used to keep the tree balanced. Draw diagrams showing exactly how the tree would be after each of the insertions. These are the numbers to be added, and they are to be added in the order given:

74, 85, 76, 91, 82, 79, 73, 34, 35.

or C: Draw the shallowest possible 2-3-tree containing these eight numbers:

10, 20, 30, 40, 50, 60, 70, 80.

Now some more numbers are to be added to this tree one by one. Draw diagrams showing exactly how the tree would be after each of the insertions. These are the numbers to be added, and they are to be added in the order given:

84, 95, 86, 99, 92, 89, 83, 24, 25.

4.

Draw a picture of a cat stuck in a tree.