COS126 Exam 1 Mini-Test

1. **Short Answer**

   1. Write the value of `(double) ( 22 / 7 )`.

   2. Write this number using Java's scientific notation, (without using `Math.pow`):
      $6.022 \cdot 10^{23}$

   3. True or False. Any `for` loop can be converted into an equivalent `while` loop.

   4. True or False. Any recursive method can be re-written as a non-recursive method using loops.

   5. True or False. The following condition will compile in Java.
      `(a < b < c)`

   6. You have a program called `Recipe.java` which reads from standard input and writes to standard output. You have compiled it. The command-line to run it so it reads keyboard input and writes to the terminal screen is: `java Recipe`.
      Write the command-line to run it so it reads input redirected from a file named cookbook.txt.

      Write the command-line to run it so it reads input from cookbook.txt and writes to an output file named meal.txt

      Write the command-line to run it so it reads keyboard input and pipes the output to another compiled program named `HungryThing.java`.

2. **Arrays, Functions, Analysis of Algorithms (from Fall05 Exam 1, question 6)**

The following two methods do the same job. They each take an ORDERED array of `ints` and a target number as arguments.

```
public static boolean mystery1(int[] array, int target) {
   for (int i = 0; i < array.length; i++) {
      if (array[i] == target) return true;
      else if (array[i] > target) return false;
   }
   return false;
}
```

```
public static boolean mystery2(int[] array, int target) {
   int low = 0;
   int high = array.length - 1;
   while (low <= high) {
      int mid = (low + high) / 2;
      if (array[mid] == target) return true;
      else if (array[mid] < target) low = mid + 1;
      else high = mid - 1;
   }
   return false;
}
```

Use this array to answer the following questions:

```
int[] a =  { 2, 5, 11, 14, 15, 27, 31};
```

a) What does `mystery1(a, 5)` return?

b) Fill in the trace table to show that `mystery2(a, 5)` returns the same thing.

target	low	hi	mid	return value

2. Continued

c) What do `mystery1(a, 20)` and `mystery2(a, 20)` return?

d) In general, what do these methods do?

e) How many comparisons with the target will `mystery1(a, 32)` make?

f) How many comparisons with the target will `mystery2(a, 32)` make?

g) Which one would you use for an array of a million elements?

h) Why?

3. **Recursion, Debugging (from Spring04, Exam 1, Question 4)**

There's a bug in the following recursive program. You need to find it and fix it.

```
public class Series{
    public static int func(int j){
       if (j==1) return 1;
       return 2*func(j-1)+5*func(j-2);
    }

    public static void main(String[] args) {
        int N=Integer.parseInt(args[0]);
        if (N<0) {
            System.out.println(‘‘invalid argument’’);
            return;
        }
        System.out.println(func(N));
    }
}
```

a. Draw the recursion tree for func(3). You only need to draw the tree up to 3 levels, which means the height of the recursion tree should be no greater than 3.

b. From the recursion tree in (a), do you see a problem with the program? Explain what is the problem.

4. **Performance.** The following table gives approximate running times for a program with N inputs for various values of N.

N	time
1000	5 seconds
2000	20 seconds
5000	2 minutes
10000	8 minutes

Which of the following best describes the likely running time of this program for $N = 100,000$?

V. A few minutes

W. A few hours

X. Half a day

Z. A few days