COS126 Exam 1 Mini-Test

1. Short Answer

1. Here is a 16-bit two’s complement binary integer: 1111111111101100. Convert it to decimal. Circle your answer.

2. Write the value of \(\text{double} \ (22 \div 7)\).

3. Write the value of \(b\) after the following two statements are executed. Remember that Java ints use 32-bit 2’s-complement representation:
   ```java
   int a = 2147483647; // 2^31 - 1
   int b = a + 1;
   ```

4. Write this number using Java’s scientific notation, (without using \texttt{Math.pow()}):
   \(6.022 \cdot 10^{23}\)

5. Write a TOY statement to clear Register 5 to zero.

6. You have a program called \texttt{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: \texttt{java Recipe}.

   Write the command-line to run it so that, instead of reading input from the keyboard, it reads input redirected from a file named \texttt{cookbook.txt}.

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

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

2. Arrays, Functions

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

```java
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.

<table>
<thead>
<tr>
<th>target</th>
<th>low</th>
<th>hi</th>
<th>mid</th>
<th>return value</th>
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</thead>
<tbody>
<tr>
<td>2</td>
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<td>31</td>
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</tbody>
</table>
2. Cont’d
   c) What do mystery1(a, 20) and mystery2(a, 20) return?

   d) In general, what do these methods do?

3. Performance. The following table gives approximate running times for a program with \( \textit{N} \) inputs for various values of \( \textit{N} \).

\[
\begin{array}{|c|c|}
\hline
\textit{N} & \textit{time} \\
\hline
1000 & 5 \text{ seconds} \\
2000 & 20 \text{ seconds} \\
5000 & 2 \text{ minutes} \\
10000 & 8 \text{ minutes} \\
\hline
\end{array}
\]

Which of the following best describes the likely running time of this program for \( \textit{N} = 100,000 \)?

V. A few minutes  
W. A few hours  
X. Half a day  
Z. A few days
4. Recursion, Debugging

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

```java
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.