

CS101 Midterm Exam, Spring 2008

February 28, 2008

Instructions: This exam is open book. You can use any reference books in the exam. But no computers are allowed. Partial credits will be given in the marking. All the programs **MUST** be written using **JAVA**. Be concise and to the point. If you do not know the answer, give your best guess. The total marks are 100 points. There is also a bonus question worth of 20 points. You have 1 hour and 15 mins to complete the exam.

1 Program Tracing [20 points]

Trace the following program and write the output.

```
int a = 1;
int b = 1;
int N = 3;
for(int n = 0; n < N; n++) {
    int c = a + b;
    b = a;
    a = c;
}
System.out.println("a = " + a);
System.out.println("b = " + b);
```

2 Functions and Arguments [20 points]

What is the output of the following program. Justify your answer.

```
public class Add {
    public static void add(int x, int y, int sum)
    {
        sum = x + y;
    }

    public static void main(String[] args)
    {
        int x = 10;
        int y = 20;
```

```

        int sum;
        add(x, y, sum);
        System.out.print(sum);
    }
}

```

3 Product of a Sequence [20 points]

Write a recursive function to compute $1 \cdot 3 \cdot 5 \cdot \dots \cdot (2n-1)$. The function's interface is as follows:

```
public static int prod(int n)
```

4 Iterations [20 points]

Re-implement the function in question Q3 using `while` loop and `for` loop respectively.

— CHOOSE EITHER QUESTION 5 OR QUESTION 6 —

5 Standard Input and Output [20 points]

Write a class with a main method to read from a standard input and process the data. The input has alternate int and double numbers, like

```

10 123.4
20 256.3
-30 0.02
...

```

You can use `StdIn.readInt()` and `StdIn.readDouble()` to read the numbers from the input stream. Write a procedure to compute the average of the *positive* integers and the maximum value of the doubles for all the numbers in the stream. Note that we do not know how many numbers are in the stream. To check whether there is still data coming in, use `StdIn.isEmpty()`. `StdIn.isEmpty()` will return true when there is no further data in the stream.

6 String Processing [20 points]

Write a function to check whether string `a` includes all the characters in string `b`. For example, "123abc" contains all the characters in "cb", but does not contain all the characters in "cd". The interface of the function should be like

```
public static boolean hasAllCharacters(String a, String b)
```

You can use the function `s.charAt(i)` to get the char at position `i` in string `s` and function `s.length()` to get the string's length. The index of characters of a string `s` is from 0 to `s.length()-1`. [Hints: consider using nested `for` loops to write your program. The basic idea is: for each character in string `b`, check whether the character is the same as some character in string `a`.]

— YOU CAN STOP HERE OR PROCEED TO GET THE BONUS MARKS —

7 Bonus Question [20 points]

Write a function to check whether one string is *embedded* in another. If one string's characters are "dispersed" in another string in the same order, we say that the first string is embedded in the second one. For example "abc" is embedded in "12axyzbefc" but "cb" and "ad" are not. Write a recursive function to solve the problem. The interface of the function is

```
public static boolean isEmbeddedString(String a, String b)
```

which tests whether string `a` is embedded in string `b`.