

CUHK(SZ)-CSC1003 Final Exam

Feb. 2, 2023

Name:

Student ID:

Note:

- a. This is a closed exam. No notes, calculators, or dictionaries are allowed.
- b. This exam paper has nine pages in single-sided printing, including the cover page.
- c. Answer all questions within 120 minutes.

Example Question:

Read the following Java program, and write down your answer(s).

```
public class HelloWorld {  
    public static void main(String[] args) {  
        System.out.println("Hello World!");  
    }  
}
```

What is the output of the program when running “java HelloWorld”?

Hello World!

1. (10 points) Circle **ONE** solution that best suits each question. (2 points each)

(1) Is Java an object-oriented, procedural, or functional programming language?

- A. object-oriented
- B. procedural
- C. functional
- D. None of the above

(2) How many **distinct** values can be represented by a 7-bit value?

- A. 64
- B. 128
- C. 256
- D. 1024

(3) A _____ is a program that executes compiled Java code on a specific platform.

- A. Java Virtual Machine
- B. Java Compiler
- C. Java Source Code Editor
- D. Java Docs

(4) Which of the following Java statements declares and allocates a 2-dimensional array of integers with five columns and four rows:

- A. `int array[5][4];`
- B. `int array[4][5];`
- C. `int[][] array = new int[5][4];`
- D. `int[][] array = new int[4][5];`

(5) Comparing with Java, a Python program

- A. is directly interpreted into machine instructions.
- B. needs to be compiled into machine instructions before execution.
- C. runs as a standalone application without a virtual machine.
- D. is suitable for developing large-scale system applications.

2. (20 points) Answer the following short questions. (4 points each)

(1) For two integer variables “i” and “j”, assume “i = 1” and “j = 2”. What is the difference between two Java statements “(double) (i / j)” and “((double) i) / j”?

(2) Declare and allocate a double array with 1003 elements. Write down the Java code.

(3) Write one line of Java code that declares, allocates, and initializes an array of type integer with exactly 4 elements whose values are 97, 33, 44, and 12, in that order.

(4) Write a Java conditional statement that tests if a given integer variable named “grade” is no less than 50 or not. If its value is 50 or above, output “passed” on the screen; otherwise, output “failed”.

(5) Read the following Java code, and estimate the order of growth of operations as a function of input “N”. Is it $\log N$, N , $N \log N$, N^2 , N^3 , 2^N , or ...?

```
public static int f(int N) {  
    if (N == 0) return 1;  
    int sum = f(N/2) + f((N-1)/2);  
    for (int i = 0; i < N; i++) {  
        sum = sum + i;  
    }  
    return sum;  
}
```

3. (5 points) Write a Java loop that computes the average of an array of integers called “iArray” that has been previously declared and initialized. Store the result in a variable of type integer called “iAverage” that has been previously declared and initialized to zero.

4. (5 points) Read the following Python code and write down the output.

```
sum = 0
for i in range(1, 10):
    sum = sum + (i * i)
    if (sum > 100): break
print("sum = ", sum)
```

5. (5 points) What will happen when running the following Python code?

```
balance = 10
while True:
    if (balance < 10): continue
    balance = balance - 1
    print("balance = ", balance)
```

6. (10 points) Write down the outputs when running the following Java program:

```
public class Question6 {  
    public static void main(String[] args) {  
        String S1 = new String("CSC1003");  
        String S2 = new String(" is taught");  
        String S3 = new String(" at CUHK-SZ");  
  
        int iSize1 = S1.length() + 3;  
        System.out.println(iSize1);  
  
        String S123 = S1 + S2 + S3;  
        System.out.println(S123);  
  
        boolean bEquals1 = S1 == "CSC1003";  
        System.out.println(bEquals1);  
  
        boolean bEquals2 = S1.equals("CSC1003");  
        System.out.println(bEquals2);  
  
        boolean bEquals3 = S123 == S1 + S2 + S3;  
        System.out.println(bEquals3);  
    }  
}
```

1st line of output:

2nd line of output:

3rd line of output:

4th line of output:

5th line of output:

7. (5 points) Consider the following Java methods.

```
static String r(int m) {  
    if (m > 0) return "+" + r(m-1);  
    else return "";  
}  
static String s(int m, int n) {  
    if (n > 0) return "-" + s(m,n-1) + "-";  
    else return r(2*m);  
}
```

Write down the output of "System.out.println(s(3,2));"

8. (5 points) Read the following Java program which converts a positive integer to binary. Modify the program with minimum effort so that it also works for the input of an integer "0". Show your modification in the box provided below.

```
public class Question8 {  
    public static String convert(int N) {  
        if (N == 1) return "1";  
        return convert(N / 2) + (N % 2);  
    }  
    public static void main(String[] args) {  
        int N = Integer.parseInt(args[0]);  
        System.out.println(convert(N));  
    }  
}
```

9. (15 points) Read the following Java program which tries to compute the Fibonacci numbers, and answer the following questions.

```
public class Question9 {  
    public static long fib(int n) {  
        if (n == 0) return 0;  
        if (n == 1) return 1;  
        return fib(n-1) + fib(n-2);  
    }  
    public static void main(String[] args) {  
        int n = Integer.parseInt(args[0]);  
        System.out.println(fib(n));  
    }  
}
```

What problem would you expect to happen when running “java Question9 80” on a desktop computer? Why? Write down a short answer. (5 points)

Modify the program to fix the problem. (10 points)

10. (20 points) The following Java code defines a “MyRectangle” class with four public data members representing the x- and y-coordinates of the bottom-left vertex and top-right vertex of a rectangle, whose sides are parallel to the x- or y-axis.

```
public class MyRectangle {
    // Data members
    public int vertex1X; // x-coordinate of bottom-left vertex
    public int vertex1Y; // y-coordinate of bottom-left vertex
    public int vertex2X; // x-coordinate of top-right vertex
    public int vertex2Y; // y-coordinate of top-right vertex

    // Constructor
    public MyRectangle(int v1X, int v1Y, int v2X, int v2Y) {
        vertex1X = v1X;
        vertex1Y = v1Y;
        vertex2X = v2X;
        vertex2Y = v2Y;
    }

    // Returns area of rectangle
    public int area() {
        /***** to be completed -- refer to part (a) *****/
    }

    // Returns the overlap region of this and rect
    public MyRectangle overlap(MyRectangle rect) {
        /***** to be completed -- refer to part (b) *****/
    }

    // Returns the overlap region of all rectangles in the array
    public static MyRectangle overlapAll(MyRectangle[] rectangles) {
        /***** to be completed -- refer to part (c) *****/
    }
}
```

For example, the statement “new MyRectangle(20,80,30,90)” creates a rectangle with bottom-left vertex at position (20,80), and top-right vertex at (30,90).

10. (continued...)

(a) Complete the “area()” method, which computes the area of a rectangle. (5 points)

(b) Complete the “overlap(MyRectangle rect)” method. This method returns a rectangle which is the overlapped region of two rectangles. In the event that there is no overlap, it should return a rectangle with both bottom-left vertex and top-right vertex at position (0,0). (10 points)

(c) Using the “overlap(MyRectangle rect)” method written above in part (b), complete the “overlapAll(MyRectangle[] rectangles)” method which returns the overlapped region of all the rectangles in the array. You may assume that there is at least one element in the array. (5 points)