



FREIE UNIVERSITÄT BOZEN

LIBERA UNIVERSITÀ DI BOLZANO

FREE UNIVERSITY OF BOZEN · BOLZANO

Fakultät für Informatik

Facoltà di Scienze e tecnologie informatiche

Faculty of Computer Science

Computer Programming
and
Introduction to Programming
Written Examination

6.2.2020

FIRST NAME		LAST NAME	
STUDENT NUMBER		SIGNATURE	

Instructions for students:

Write First Name, Last Name, Student Number and Signature where indicated. If not, the examination can not be marked.

Do not speak to any other student during the examination. If you speak to another student, your examination will be cancelled.

Use a pen, not a pencil.

Write neatly and clearly.

Reply to the following questions. You cannot consult any material.

1. How many bits (minimum) are needed to represent the 20 regions of Italy
2. What are the results of the following expressions? Make explicit the type of the result:

```
12 / 4
12.0 / 4
10 / 3
12 % 3
3 % 10
```

3. For each of the following expressions, indicate the order in which the operators will be evaluated by writing a number beneath each operator.

- a % (b - c) * d * e
- (a + b) * (c / d) % e
- a + b / c * d

4. Write the output of these statements:

```
int a = 0;
a = --a + 4;
System.out.println(a);
a = 0;
a = a++ + 4;
System.out.println(a);
```

5. Write the output of these statements, if there is any:

```
double d = 5.0;
int i = d / 3;
System.out.println(i);
```

6. How many types of variables the Java language has? Describe them. A constant is not a variable! I am non asking how many data types are in Java!

7. What is the output of the following statements?

```
String person1 = "pippo";  
String person2 = person1;  
person2 = "caio";  
System.out.println(person1);
```

8. What output is produced by the following code fragment?

```
public static void main (String[] args)  
{  
    final int MAX = 10;  
    for (int r = 1; r <= MAX; r +=2)  
    {  
        for (int s = 1; s <= r/2; s++)  
            System.out.print ("+");  
        System.out.println();  
    }  
}
```

9. Write a method called `multiple` that accepts two integer parameters and returns true if the first parameter is a multiple of the second, or the second is a multiple of the first, and false otherwise. It also returns false if either parameter is zero. We say that b is multiple of a if $b=na$, for some integer n .

10. Consider the class `rectangle` defined below. Write a boolean method of the class that will check that the length and the width are in the golden ratio. It must return true if length and width are in the golden ratio, and false otherwise. Two quantities $a>b>0$ are in the golden ratio if and only if $(a+b)/a = a/b$.

```
public class Rectangle {  
    private double length = 0;  
    private double width = 0;  
}
```

11. Implement a static method *goldenCompute* that given a double parameter *b* returns the value of the number *a* (double), such that, $a > b$ and *a* and *b* are in the golden ratio. (Hint: compute first *a* for $b=1$ and then multiply the obtained number *a* by *b*, in order to obtain the final result.)

12. Which instance data are accessible in class A3?

```
public class A1 {
    public int x;
    private int y;
    protected int z;
    ... }
public class A2 extends A1 {
    protected int a;
    private int b;
    public int c;
    ...}
public class A3 extends A2 {
    private int q;
    ...}
```

13. If `SportPlayer` is the parent of `TennisPlayer`, is the following sequence of statements legal?

```
SportPlayer splayer = new SportPlayer();
TennisPlayer tplayer = new TennisPlayer();
tplayer = (TennisPlayer) splayer;
```

14. Consider the following “mystery” method. If the method is called with the following two dimensional array $a = \{\{1, 2, 3\}, \{4, 5, 6\}\}$ as parameter, what will be the array elements after the execution of the method?

```
public static void mystery(int[][] a) {
    int n = Math.min(a.length, a[0].length);
    for (int i = 0; i < n; i++)
        for (int j = i+1; j < n; j++) {
            int p = a[i][j];
            a[i][j] = a[j][i];
            a[j][i] = p;
        }
}
```

15. What is printing the following code?

```
public class Inherit2 {

    class Figure {
        void display() {
            System.out.println("Figure");
        }
    }

    class Rectangle extends Figure {
        void display() {
            System.out.println("Rectangle");
        }
    }

    class Box extends Rectangle {
        void display() {
            System.out.println("Box");
        }
    }

    Inherit2() {
        Figure f = new Figure();
        Rectangle r = new Rectangle();
        Rectangle b = new Box();
        f.display();
        f = r;
        f.display();
        r.display();
        f=b;
        b.display();
    }

    public static void main(String[] args) {
        new Inherit2();
    } }
```

16. Write a method called *multiConcat* that takes a String and an integer as parameters. It returns a String that consists of the string parameter concatenated with itself count times, where count is the integer parameter. For example, if the parameter values are "hi" and 4, the return value is "hihihihi". Return the original string if the integer parameter is less than 2.

17. Fill the gaps (???) with the right text:

```
public void selectionSort(Comparable<T>[] list)
{
    int min;
    Comparable<T> temp;
    for (int index = ???; index < list.length - 1; index++)
    {
        min = index;
        for (int scan = index + 1; scan < list.length; scan++)
            if (list[???].compareTo((T)list[???]) < 0)
                min = scan;
        // Swap the values
        temp = list[min];
        list[min] = list[index];
        list[index] = temp;
    }
}
```

18. Write a static method that computes an approximation of the sine function by using the following series:

$$\sin(x) = x - \frac{x^3}{3!} + \frac{x^5}{5!} - \dots = \sum_{n=0}^{\infty} \frac{(-1)^n x^{2n+1}}{(2n+1)!}$$

```
dopublic static double sin(double x, int k) {...}
```

This method will return the result of the computation of the series where the index n ranges from 0 to k (not to infinite!). Assume that a static method `fact(int n)`, which returns the (int) factorial of n , is already declared in your code.

19. What does the following recursive method compute? Give the return value if the parameters are $n1=2, n2=5$. How is it called the function $f(x)$ that is computed as `mystery(1,x)`?

```
public int mystery(int n1, int n2) {  
    int result;  
    if (n2 - n1 == 0) {  
        result = n1;  
    } else {  
        int mid = (n1 + n2) / 2;  
        result = mystery(n1, mid) * mystery(mid + 1, n2);  
    }  
    return result;  
}
```

20. Implement a recursive method (`public double harm(int n){...}`) that computes the harmonic numbers (double) according to the following definition:

$$H_1 = 1$$

$$H_{n+1} = H_n + 1/(n+1)$$