

Question 1.

- a) Given are the following classes

```
class L {
    int i;

    L (int i) {
        this.i = i;
    }

    void inc () {
        i += 1;
    }
}

class M {
    int k;

    M (int k) {
        this.k = k;
    }

    void dec () {
        k -= 1;
    }
}

class N {
    L l;
    M m;

    N () {
        l = new L(11);
        m = new M(19);
    }
}
```

and a program with the following statements/declarations

```
N obj1 = new N();
L obj2 = new L(13);

void println (N n, L l) {
    out.printf("%d, %d, %d\n", n.l.i, n.m.k, l.i);
}
```

What is the output of a call to the following method  
doSomething() in the same program as the given declarations?

```
void doSomething () {
    println(obj1, obj2);
    obj1.l.inc();
    obj2.inc();
    println(obj1, obj2);
    obj2 = obj1.l;
    obj1.m.dec();
    println(obj1, obj2);
    obj2.inc();
    obj1.m.dec();
    println(obj1, obj2);
    obj1.l = obj2;
    obj1.l.inc();
    println(obj1, obj2);
}
```

- b) Given is the following heading of a method y()

```
double y (int x, int numberOfTerms)
```

This method has to approximate the following series with infinitely many terms in a "numberOfTerms"

$$y(x) = -x/3 + x^3/(5*2!) - x^5/(7*3!) + x^7/(9*4!) - x^9/(11*5!) + \dots$$

Here  $x^i$  is the notation for "x to the power i" and  $x!$  the notation for "x factorial". Program this method without using the methods in the class Math. Assume: numberOfTerms  $\geq 1$  and  $x \geq 0$ .

- c) Declare a variable "matrix" that contains a two-dimensional array of integers with 13 rows and 17 columns. Do this using structured programming.

Write a boolean method special() that for a random two-dimensional array of positive integers returns in the function result whether this array has the property special.

For this question a two-dimensional array of integers with k rows had the property special when for every row with index i ( $0 \leq i \leq k-2$ ) it holds that the sum of the numbers in this row is smaller than the sum of the row with index i+1.

Examples:     array 1 4 7 10 is special and array 1 4 7 10 is not  
                  2 5 8 11                                2 5 7 1  
                  3 6 9 12                                3 6 9 12

- d) Give the output of the following program.

```
class Question1d {
    PrintStream out;
    int p, q;

    Question1d() {
        out = new PrintStream(System.out);
        p = 3; q = 4;
    }

    void print (int a, int b) {
        out.printf("%d - %d\n", a, b);
    }

    void m1 (int a, int q) {
        a = p + q;
        m2(p);
        print(a, p);
    }

    void m2 (int p) {
        p += 2;
        q *= 3;
        print(p, q);
    }

    void start() {
        print(p, q);
        m1(q, p);
        print(p, q);
    }

    public static void main(String argv[]) {
        new Question1d().start();
    }
}
```

Question 2.

- a) Given are the following classes that can be used for storing the data of books.

```
class Book {  
    String title,  
        genre,  
        author;  
    double price;  
    int registrationNumber; // unique number for each book  
  
    // The constructors and methods are irrelevant for this question.  
}  
  
class BookStore {  
  
    static final int MAX_NUMBER_OF_BOOKS = 2500;  
  
    Book[] bookArray;  
    int numberOfBooks;  
  
    ...  
}
```

Write a default constructor and a method add() for the class BookStore. The default constructor has to initialize the BookStore object to an empty book store with 0 books to which a maximum of 2500 books can be added. The method add has to provide the option to add 1 Book object to a BookStore object.

- b) Create for the class BookStore the method

```
BookStore cheapBooks ()
```

that returns the cheap books in a new BookStore object.  
For this question a book is defined as cheap when it is cheaper than 17.50 euros.

When you recognize a subproblem, program this in a separate method in the correct class.

- c) Given is that the class BookStore contains a method

```
BookStore genre (String s)
```

This method returns in a new BookStore object all books that have the genre of the given string.

Program using the methods cheapBooks() and genre() and without using a loop the method

```
BookStore popularBooks ()
```

that returns in a new BookStore object all popular books.  
For this question a book is defined as popular when it is a cheap book of the genre "Detective".

- d) Write for the class BookStore a method

```
void remove (int registrationNumber)
```

with which a sold book can be removed out of the BookStore object.

Question 3.

- a) Pascal's triangle is known from mathematics. Below the first six rows of this triangle are given.

```

          1
        1 1
      1 2 1
    1 3 3 1
  1 4 6 4 1
1 5 10 10 5 1

```

For this question we will number the rows starting with 1, to make sure that for the printed part of the triangle the top row (where only the '1' is printed) is the row with number 1 and the bottom row is the row with number 6.

For a random row with number  $i$  it holds that this row contains  $i$  elements. When we define  $\text{pascal}(i, j)$  as the  $j$ -th number of the  $i$ -th row, then it holds that this number is equal to 1 if  $j$  indicates the first or last number of that row. For each number in between, it holds that this number can be computed by summing the  $(j-1)$ -th and  $j$ -th number.

Write a recursive method `pascal` to compute the  $j$ -th number of the  $i$ -th row. The heading of the method `pascal` should be as follows:

```
int pascal (int i, int j)
```

When writing this method you can assume the calling this method will be done correctly, or that a call like `pascal(1, 10)` or with values for the argument  $\leq 0$  will not happen.

- b) Write a recursive method

```
void print2 (int n)
```

that for  $n \geq 0$  prints the numbers 0 t/m  $n$  twice on 1 line. The first time descending and the second time ascending. Between the two rows of numbers the number -1 will be printed. When  $n$  is negative, the number -1 will be printed.

For the call `print2(6)` the output should be

```
6 5 4 3 2 1 0 -1 0 1 2 3 4 5 6
```

- c) Write a recursive method

```
int numberOfLetters (char[] row, int start, int end)
```

that returns how many of the characters in row on index positions start to end are letters.

HINT: You can test whether a character is a letter using the method `isLetter()` in the class `Character`.

Evaluation

Question	a	b	c	d	total
1.	4	4	4	4	16
2.	2	4	3	3	12
3.	2	3	3		8
				-- +	36

The end result  $E$  is computed using the total number of points  $T$  as follows :

$$E = T / 4 + 1$$