

Weimar, 25<sup>th</sup> February 2021

**Online exam WiSe 2020**

**Object-oriented modelling and programming in engineering**

Name, First Name: (blockletters)			
Master Degree Programme		Student No.	

Task	1	2	3	4	5	6	7	8	9	10	11	12	13	14	$\Sigma$	
max. points	6	9	6	5	11	13	4	4	13	6	12	10	12	12	123	p.
achieved points																

Number of additional sheets	
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Provide each extra sheet with your name, first name and student number.

**Declaration**

I have taken note of the examination regulations that apply to me.

Weimar, 25<sup>th</sup> February 2021

Signature: .....

**Reference**

- *Candidates may complete the front cover of this paper but must NOT write anything else until the start of the examination period is announced.*
- *The test will take place in the period from 9:00 to 11:00 (120 minutes).*
- *Answer ALL questions.*
- *No calculators are permitted in this examination.*
- *No electronic devices capable of storing and retrieving text, including electronic dictionaries, may be used.*
- *DO NOT turn examination paper over until instructed to do so.*
- *Total No. of Printed Pages = 11*

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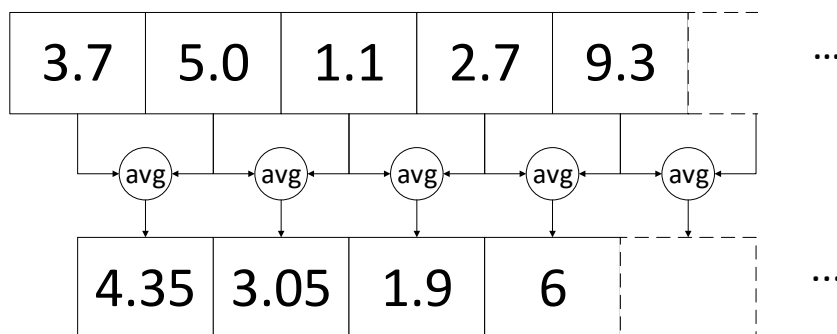
## Control structures

4. What kind of diagram can be used to model the algorithmic control flow in a program? Briefly draw and explain the core components of this kind of diagram.

[5 points]

5. An array stores a sequence of double values. The steps (I to VI) listed below describe a method to calculate the average values of neighboring values. Figure 1 shows an example for the calculation. Draw a Nassi-Shneiderman diagram to visualize the steps for this algorithm, using the steps listed below.

- I) The method is called `getAverages`
- II) A double array with  $n$  elements is the input for the method
- III) Calculate the average value for the first and second number
- IV) Do the same for the second and third number
- V) Calculate the other average values, in the same manner
- VI) Return all average values as an array (of length  $n-1$ )



[11 points]

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6. Draw a Nassi-Shneiderman diagram for the method plotted below, and name what this method is doing.

```
public String myMethod(int a, int b, int c)
{
    int count = 0;
    int d = Integer.MAX_VALUE;
    String result = "";
    int temp = a;

    while (count <= c && d > 0)
    {
        int nextChar = temp / b;
        result = result + Integer.toString(nextChar);
        if (count == 0 && c > 0)
        {
            result = result + ",";
        }
        d = temp % b;
        temp = d * 10;
        count++;
    }
    return result;
}
```

[13 points]

## Various

7. Decide on a suitable datatype in Java for each of the following four scenarios and explain your decisions.

- 1) You want to store the fact if a book in library is lent.
- 2) You want to store the year of publishing of a book
- 3) You want to store the price of a book
- 4) You want to store the category of a book, whereby the category is represented by a single letter.

[4 points]

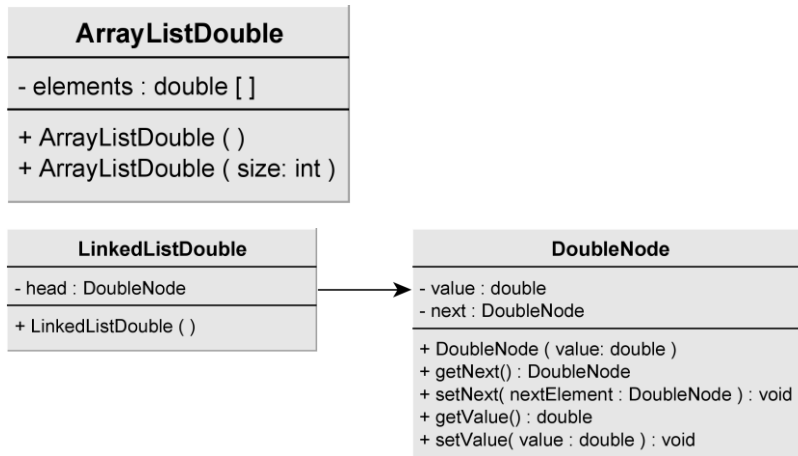
8. What is the **output** of the following lines of code? Using a **sketch**, **briefly explain** how the pointers (handles) of the object variables a, b and c are being redirected.

```
6 char[] a = {'H', 'e', 'l', 'l', 'o'};
7 char[] b = {'O', 'O', 'M', 'P', 'E'};
8
9 char[] c = a;
10 a = b;
11 a[2] = 'O';
12 b[4] = 'S';
13
14 System.out.println(a);
15 System.out.println(b);
16 System.out.println(c);
```

[4 points]

9. Using the UML diagrams below, **explain** the differences between an array list and a linked list. **Implement** a Java method for both types of list implementation that sets every third element in the list to 0. Assume that the head of the *LinkedListDouble* is initialized. Concerning the linked list implementation, invoking the method “getNext()” on the attribute “head” returns the first element of the list. Hint for the implementation: the operator modulo ‘%’ returns the rest of an integer division, e.g.  $2 \% 3 = 2$  or  $6 \% 3 = 0$ .

[13 points]



## UML

10. What aspects of software systems can be represented by a UML class diagram? Furthermore, explain the terms Class, Association, and Cardinality by the means of a self-chosen UML class diagram.

[6 points]

11. Have a look at the source code below. Draw the UML class diagram for the two classes. Describe how inheritance can be used to improve the depicted implementation. Draw the new UML class diagram, with appropriate symbols for inheritances.

[12 points]

```
2 public class LivingRoom {
3
4     private double area;
5     private Object table;
6
7     public double getArea()
8     {
9         return this.area;
10    }
11
12    public void setArea(double newArea)
13    {
14        this.area = newArea;
15    }
16
17    public Object getTable()
18    {
19        return this.table;
20    }
21
22    public void setTable(Object newTable)
23    {
24        this.table = newTable;
25    }
26 }
```

```
2 public class Office {
3     private double area;
4     private int officeId;
5
6     public Office(int myOfficeId)
7     {
8         this.officeId = myOfficeId;
9     }
10
11    public double getArea()
12    {
13        return this.area;
14    }
15
16    public void setArea(double newArea)
17    {
18        this.area = newArea;
19    }
20
21    public int getOfficeId()
22    {
23        return this.officeId;
24    }
25 }
```



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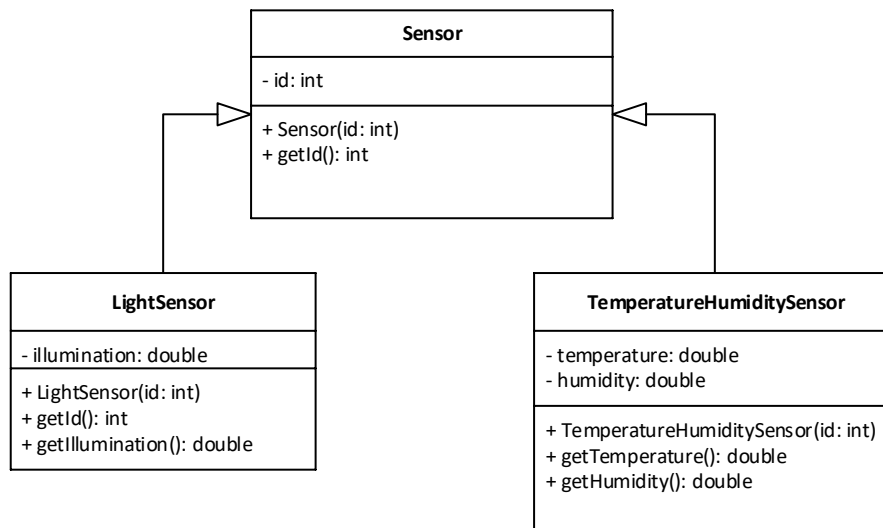
12. Draw a UML class diagram for the class structure described below.

- I)** The name of the class is 'Node'
- II)** The class has n related 'children' of type 'Node'
- III)** The class 'Node' has an 'id' of type integer
- IV)** For initialization (construction), at least the 'id' is necessary
- V)** A method for adding a child is necessary, called 'addChild'
- VI)** A method for deleting a child is necessary, called 'removeChild'. The method takes the node id as parameter

[10 points]

## Writing Source Code

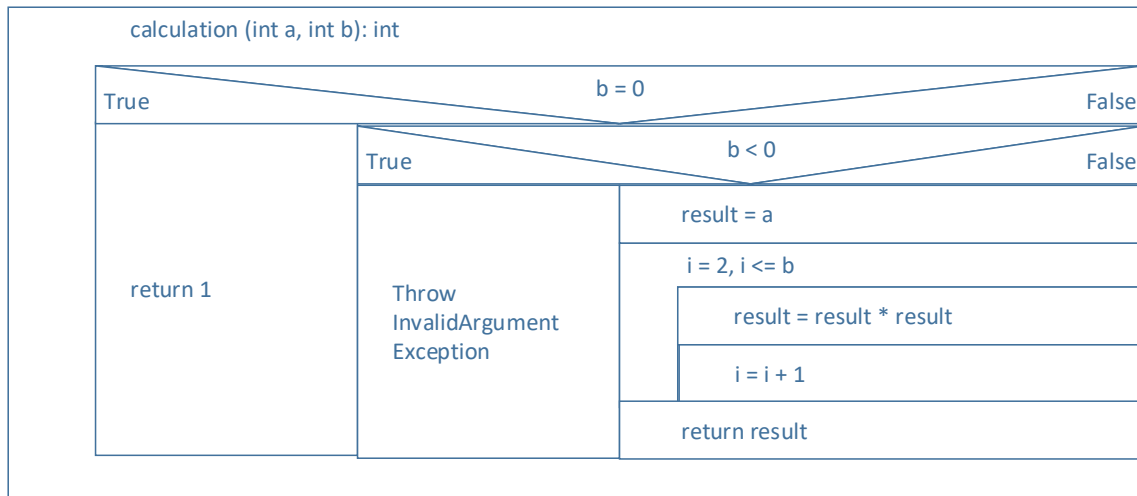
13. Write the source code in Java based on the UML diagram depicted below. Note, that the implementation code for the methods' bodies is not needed.



[12 points]

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14. Write a method in Java that is described in the Nassi-Shneiderman diagram below, and name what this method calculates.



[12 points]