

# Assignment 2

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## 2.1. Assignment:

What is happening here? How could you depict the structure in the source code by means of UML 2.0? Try to answer the questions below and explain why this happens.

```
class Material {  
    private void writeName() {  
        System.out.println("Material");  
    }  
} // class  
  
class Aurochs extends Material {  
    public void writeName () {  
        System.out.println("Aurochs");  
    }  
    public static void writeLatin() {  
        System.out.print("Bos primigenius");  
    }  
    public void writeDescription() {  
        this.writeName();  
    }  
} // class  
  
class Cow extends Aurochs {  
    public void writeName () {  
        System.out.println("Cow");  
    }  
    public static void writeLatin() {  
        Aurochs.writeLatin();  
        System.out.println("taurus");  
    }  
} // class
```

Now, imagine these variables given:

```
Cow cow = new Cow();  
Aurochs aurochs = cow;  
Material material = new Material();
```

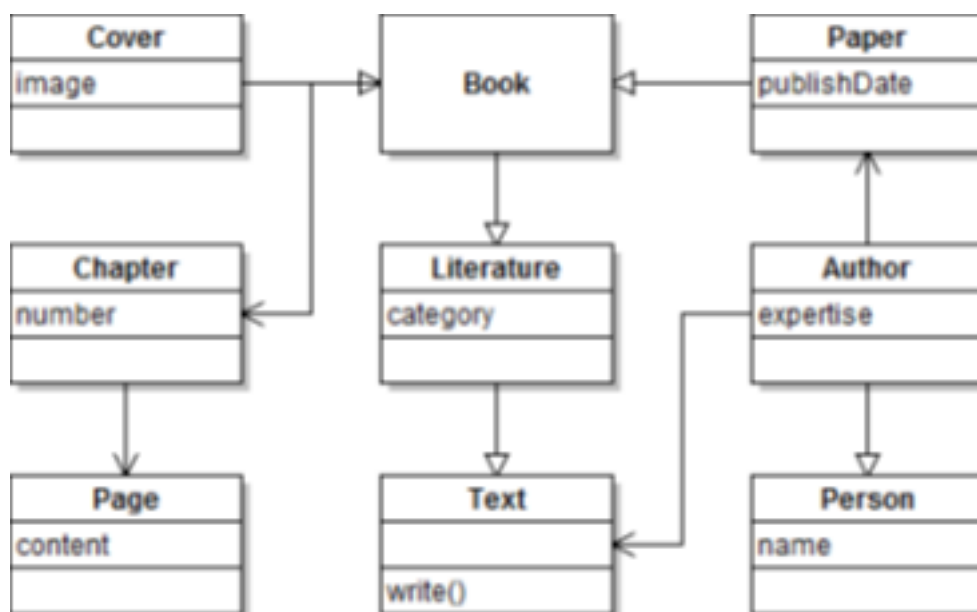
b) Please, go through the statements in the table below and describe the output. In case there is an error, please explain it in more detail and weather this is a compile or a runtime error. Do not forget to include the reason for the error.

Statement	Output or Description of Failure
cow.writeName();	
aurochs.writeName();	
((Material)aurochs).writeName();	
((Aurochs)cow).writeName();	
((Cow)aurochs).writeName();	
aurochs.writeLatin();	
auerochse.writeDescription();	
((Aurochs)material).writeName();	

## 2.2. Assignment:

Have a look at the inheritance / association structure of the UML diagram provided below. Try to come up with a well founded judgment about the quality how inheritance and association was implemented here.

Moreover, you should try to restructure the model and transform it into a good diagram. Please, provide the reasons why you did these transformations.



## 2.3. Assignment:

The source code below depicts another inheritance hierarchy. Look into the details of this hierarchy and identify kinds of Meyer's inheritance taxonomy; again explain your rationales. Moreover, change the code to a more reasonable inheritance structure; explain your rationales.

```
public class GeoObject {
    public String color;
    public Integer identifier;

    public String getColor() {
        return color;
    }

    public void setColor(String color) {
        this.color = color;
    }

    public Integer getIdentifier() {
        return identifier;
    }

    public void setIdentifier(Integer identifier) {
        this.identifier = (identifier > 0) ? identifier : new Integer(0);
    }
}

public class Circle extends GeoObject {
    public Integer diameter;

    public Integer getDiameter() {
        return diameter;
    }

    public void setDiameter(Integer diameter) {
        this.diameter = (diameter > 0) ? diameter : new Integer(0);
    }
}

public class Ellipse extends GeoObject {
    public Integer diameter;
    public Integer conjugateDiameter;

    public Integer getDiameter() {
        return diameter;
    }

    public Integer getConjugateDiameter() {
        return conjugateDiameter;
    }

    public void setDiameter(Integer diameter) {
        this.diameter = (diameter > 0) ? diameter : new Integer(0);
    }

    public void setConjugateDiameter(Integer conjugateDiameter) {
        this.conjugateDiameter = (conjugateDiameter > 0) ?
            conjugateDiameter : new Integer(0);
    }
}
```

## **2.4. Assignment:**

Try to find an example of view inheritance. Draw a sketch of your example as an UML 2.0 class diagram. Write the source code as well. Show how your example works by using JUnit.

## **2.5. Assignment:**

Draw and implement an example of implementation inheritance. Explain why this is implementation inheritance and no other type of Meyer Inheritance. Finally, discuss how to avoid implementation inheritance in your example and in general. Show how your example works by using JUnit.

## **2.6. Assignment:**

Try to find an example of functional variation inheritance. Draw a sketch of your example as an UML 2.0 class diagram. Write the source code as well. Show how your example works by using JUnit.

## 2.7. Assignment: Polymorphism

The next assignment is inspired by question asked in many job interviews at big IT companies nowadays. The question will proof a wide spectrum of important programming skills: recursion, trees, OO and of course polymorphism.

The question focuses on the topic "evaluation of terms with the operators +, -, \*, /" and consists of two parts.

Part 1: How do you go from an arithmetic expression (as a string) such as "( 2 + 2 ) \* 2" to an expression tree.

Part 2: Let's say this is a 2-person project, and your partner, who we'll call "Ernie", is responsible for transforming the string expression into a tree. You get the easy part: you need to decide what classes Ernie is to construct the tree with.

For Part 1 describe a solution concept, you may use images for providing better understanding.

For Part 2 write a solution using OO and polymorphism. You may start implementing a more intuitive solution. If so, please explain the disadvantages compared to a polymorphic solution.

Part 3: Please extend your solution for recognizing the following new operator:

- %: modulo

Write a small application, which shows, that your solution can be used to evaluate arbitrary arithmetic expressions.

**You don't need to implement a parser, only if you want to. ;)**

Please provide your complete eclipse project with all source files and necessary dependencies.

## 2.8. Assignment: Polymorphism, Inheritance & Patterns

The famous Design Patterns, described by Erich Gamma et al. in their book, make use of the power of polymorphism and inheritance.

Identify at least 3 Design Pattern with polymorphism and inheritance, implement your chosen patterns in appropriate examples.

Explain the types and usage of polymorphism and inheritance. How do polymorphism and inheritance help to solve the common problems which motivate the design patterns?

### Hints:

We would like to ask you to use the templates provided in the L<sup>2</sup>P room for answering the exercises and for drawing the UML sketches.

Wherever you are asked to provide sketches, you should use the “copy to clipboard” feature and paste the exports to your solution.

Please, your results shall be handed in as a compressed file containing all necessary files and data named „**GroupX\_AssignmentX\_OOSC2019.zip**“; replace the **X** with your group identifier. Your submission should be submitted via Moodle Learning Room.

Please include the following materials in your submission:

- all documents as PDF
- all UML diagrams as images (jpg,png) and included in the PDF
- source code / dependencies via GIT and the corresponding git commit id in the PDF