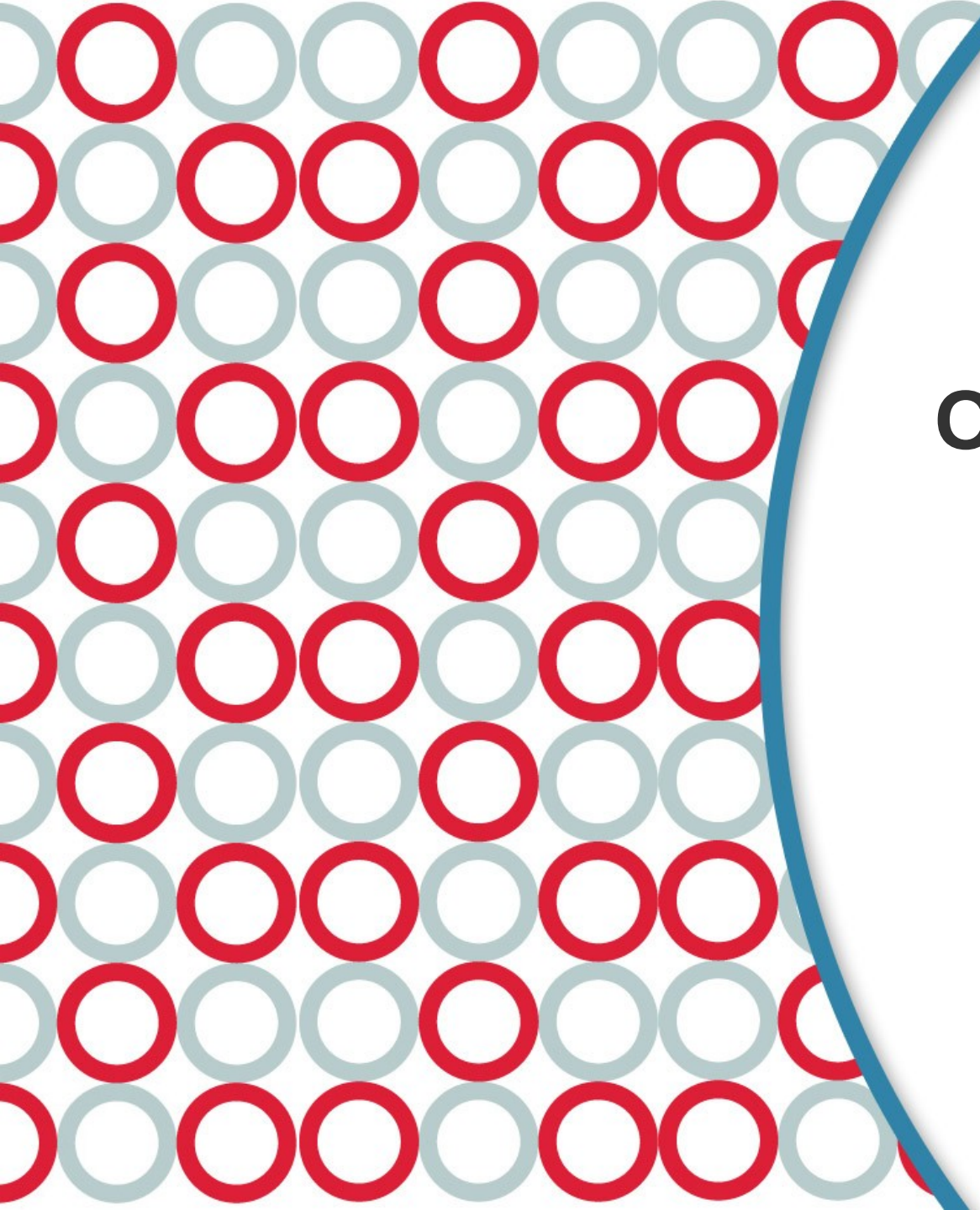


April 2022,
Course Java

Object Oriented Programming in Java

Trayan Iliev
tiliev@iproduct.org
http://iproduct.org

Copyright © 2003-2022 IPT - Intellectual Products & Technologies

About me

Trayan Iliev

– CEO of IPT – Intellectual Products & Technologies

– Oracle® certified programmer 15+ Y

– end-to-end reactive fullstack apps with Java, ES6/7, TypeScript, Angular, React and Vue.js

– 12+ years IT trainer

– Voxxed Days, jPrime, jProfessionals, BGOUG, BGJUG, DEV.BG speaker

– Organizer RoboLearn hackathons and IoT enthusiast (http://robolearn.org)

CC BY SA

Where to Find the Code?

Java Web Development projects and examples are available @ GitHub:

https://github.com/iproduct/java-fundamentals-2022

CC BY SA

Agenda for This Session

- OOP principles – Encapsulation, Inheritance and Polymorphism, Overriding / Overloading
- String Processing,
- Data Formatting, Resource Bundles, Regular Expressions
- java.util & java.math
- StringTokenizer, Date/Calendar,
- Locale, Random, Optional, Observable, Observable interface, BigDecimal

cc BY SA

Basic Concepts in OOP and OOAD

- interface and implementation – we divide what remains constant (contractual interface) from what we would like to keep our freedom to change (hidden realization of this interface)
- interface = public
- implementation = private
- This separation allows the system to evolve while maintaining backward compatibility to already implemented solutions, enables parallel development of multiple teams
- programming based on contractual interfaces

cc BY SA

Object-Oriented Approach to Programming

Key elements of the object model [Booch]:

- class, object, interface and implementation
- abstraction – basic distinguishing characteristics of an object
- capsulation – separating the elements of abstraction that make up its structure and behavior - interface and implementation
- modularity – decomposing the system into a plurality of components and loosely connected modules - principle: maximum coherence and the minimum connectivity
- hierarchy – class and object hierarchies

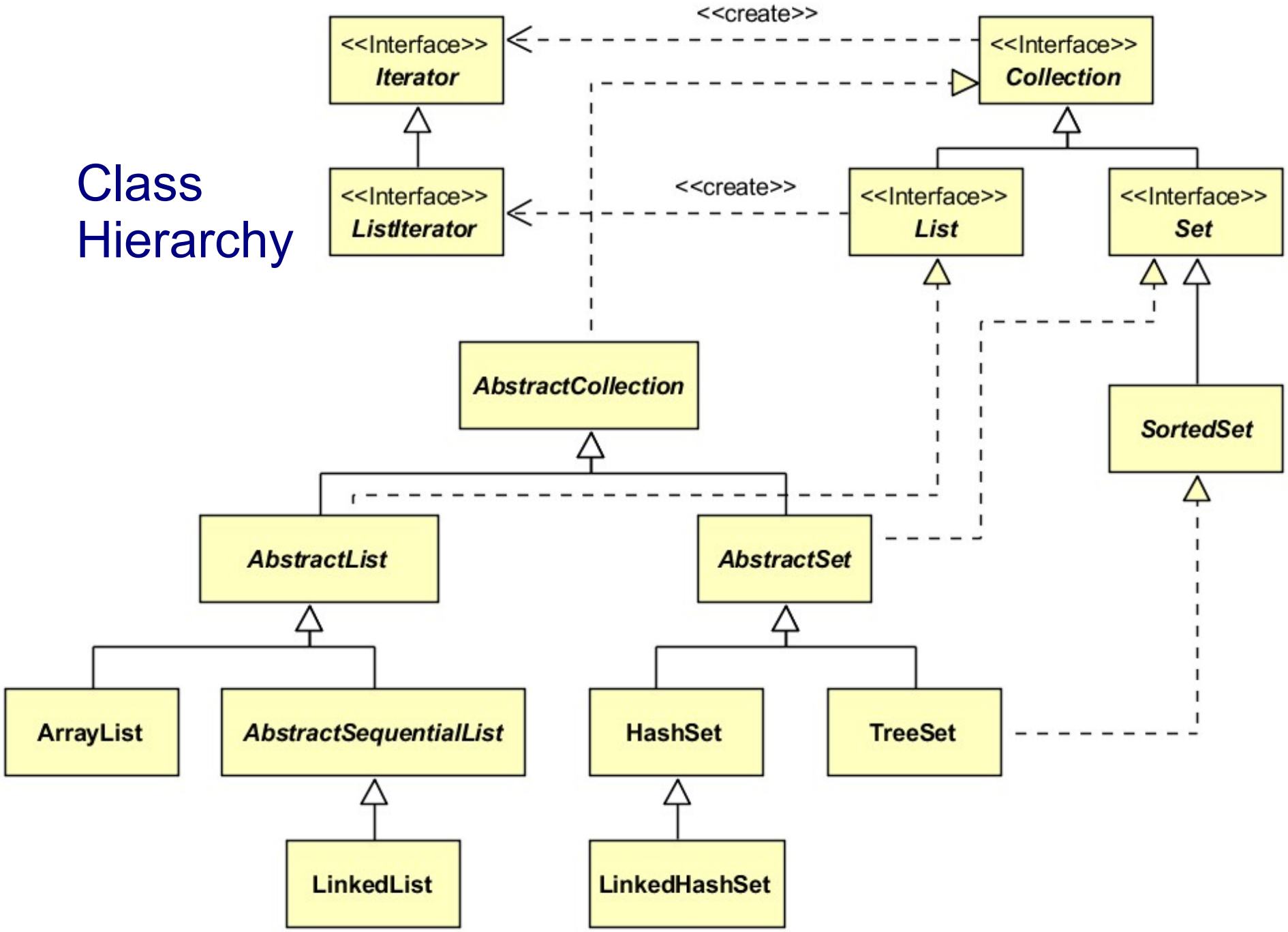
cc BY SA

SOLID Design Principles of OOP

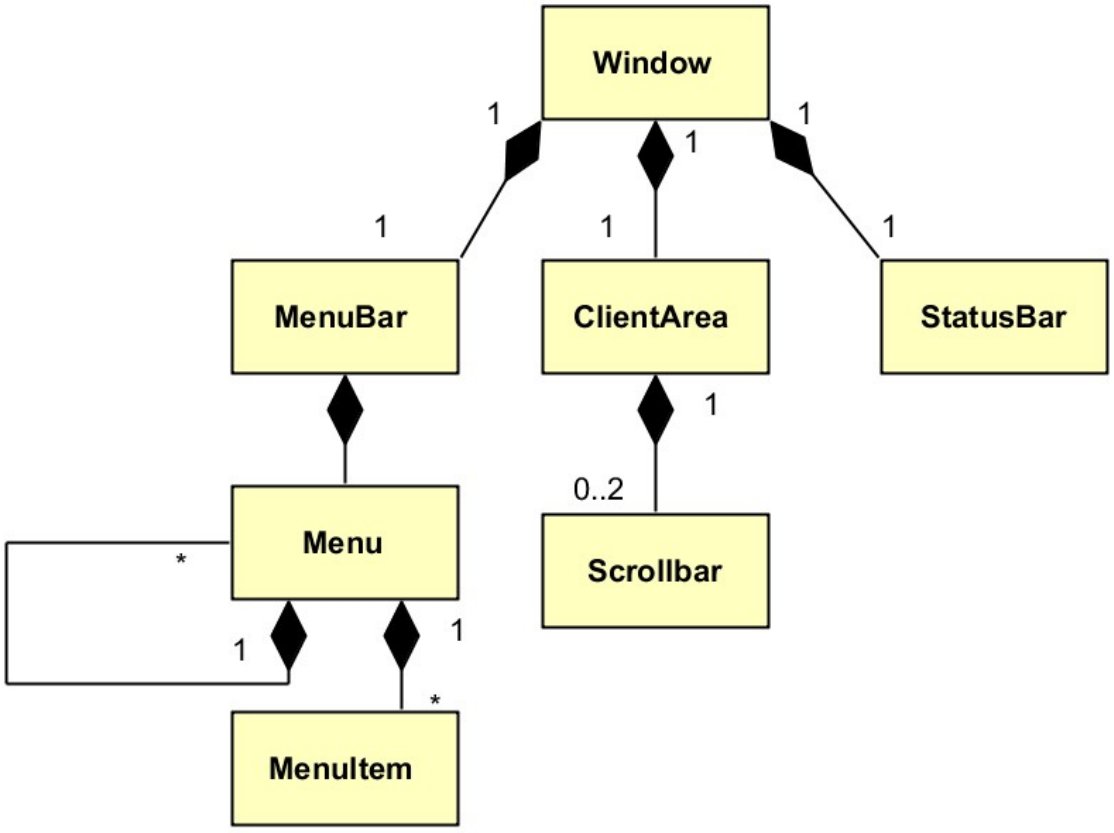
- Single responsibility principle - a class should only have a single responsibility, that is, only changes to one part of the software's specification should be able to affect the specification of the class.
- Open–closed principle - software entities should be open for extension, but closed for modification.
- Liskov substitution principle - Objects in a program should be replaceable with instances of their subtypes without altering the correctness of that program.
- Interface segregation principle - Many client-specific interfaces are better than one general-purpose interface.
- Dependency inversion principle - depend upon abstractions, not concretions.

cc BY SA

Class Hierarchy



Object Hierarchy



CC BY SA

Object-Oriented Approach to Programming

Additional elements of the object model [Booch]:

- typing – requirement for the class of an object such that objects of different types can not be replaced (or can in a strictly limited way)
  - static and dynamic binding
  - polymorphism
- concurrency – abstraction and synchronization of processes
- length of life – object-oriented databases

CC BY SA

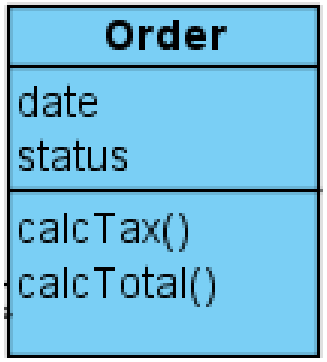
Classes

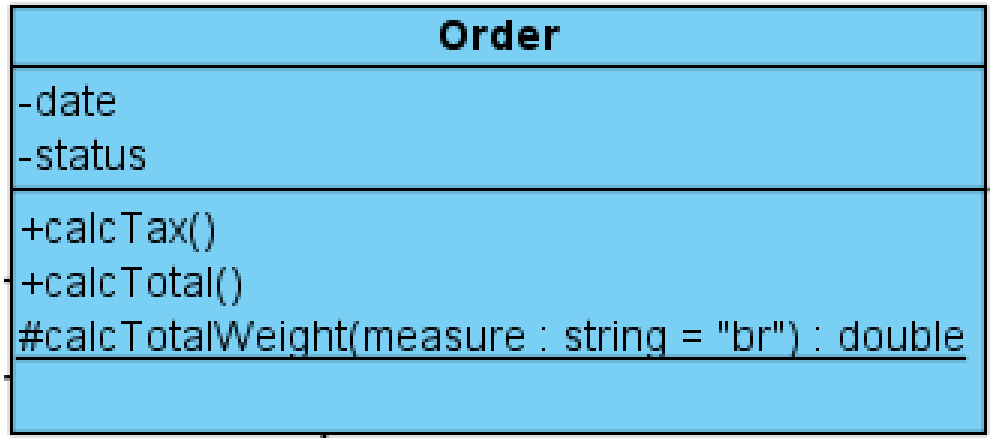
Class – describes a set of objects that share the same specifications of the characteristics (attributes and methods), constraints and semantics

- attributes – instances of properties in UML, they can provide end of association, object *structure*
- operations - behavioral characteristics of a classifier, specifying name, type, parameters and constraints for invoking definitely associated with the operation behavior

CC BY SA

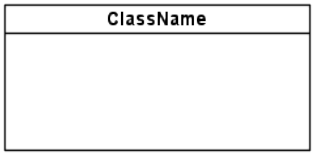
Classes - Graphical Notation in UML

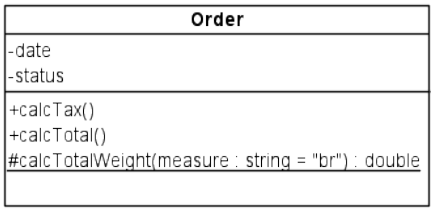


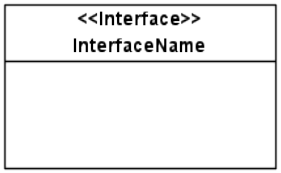


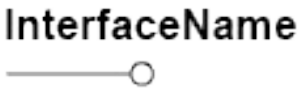
cc BY SA

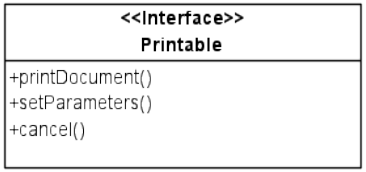
Elements of Class Diagrams





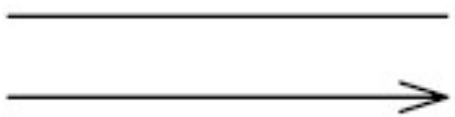






Types of connections:

- association



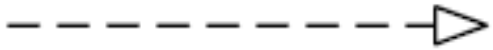
- aggregation

- composition

- dependence

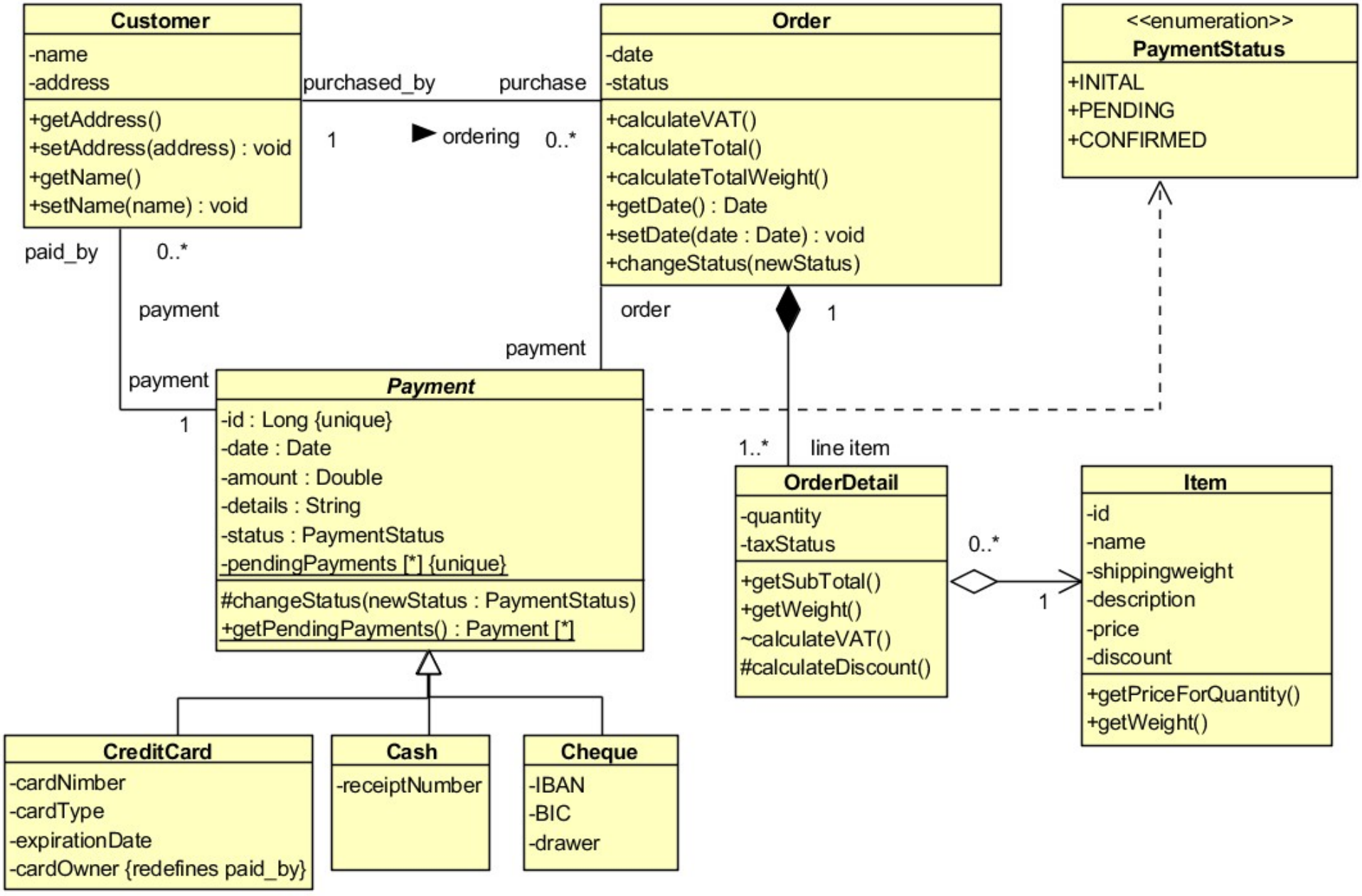
- generalization

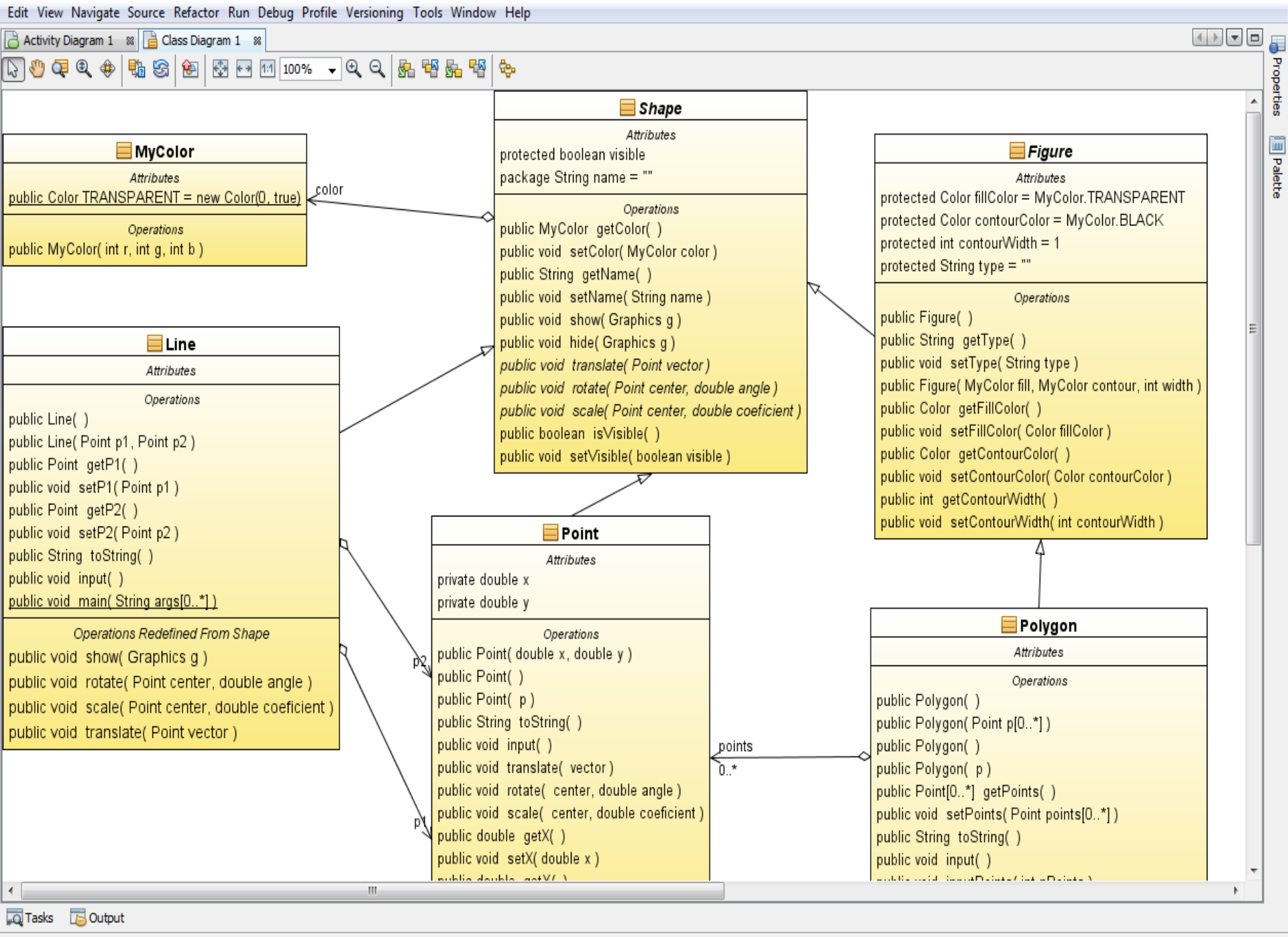
- realization



CC BY SA

Class Diagram - 1

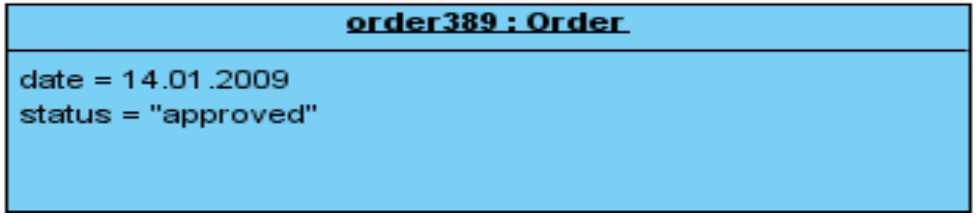



Edit View Navigate Source Refactor Run Debug Profile Versioning Tools Window Help
Activity Diagram 1
Class Diagram 1
100%
Properties
Palette
MyColor
Attributes
public Color TRANSPARENT = new Color(0, true)
Operations
public MyColor(int r, int g, int b)
color
Shape
Attributes
protected boolean visible
package String name = ""
Operations
public MyColor getColor( )
public void setColor(MyColor color)
public String getName( )
public void setName(String name)
public void show(Graphics g)
public void hide(Graphics g)
public void translate(Point vector)
public void rotate(Point center, double angle)
public void scale(Point center, double coeficient)
public boolean isVisible( )
public void setVisible(boolean visible)
Figure
Attributes
protected Color fillColor = MyColor.TRANSPARENT
protected Color contourColor = MyColor.BLACK
protected int contourWidth = 1
protected String type = ""
Operations
public Figure( )
public String getType( )
public void setType(String type)
public Figure(MyColor fill, MyColor contour, int width)
public Color getFillColor( )
public void setFillColor(Color fillColor)
public Color getContourColor( )
public void setContourColor(Color contourColor)
public int getContourWidth( )
public void setContourWidth(int contourWidth)
Line
Attributes
Operations
public Line( )
public Line(Point p1, Point p2)
public Point getP1( )
public void setP1(Point p1)
public Point getP2( )
public void setP2(Point p2)
public String toString( )
public void input( )
public void main(String args[0..*])
Operations Redefined From Shape
public void show(Graphics g)
public void rotate(Point center, double angle)
public void scale(Point center, double coeficient)
public void translate(Point vector)
p2
p1
Point
Attributes
private double x
private double y
Operations
public Point(double x, double y)
public Point( )
public Point(p)
public String toString( )
public void input( )
public void translate(vector)
public void rotate(center, double angle)
public void scale(center, double coeficient)
public double getX( )
public void setX(double x)
points
0..*
Polygon
Attributes
Operations
public Polygon( )
public Polygon(Point p[0..*])
public Polygon( )
public Polygon(p)
public Point[0..*] getPoints( )
public void setPoints(Point points[0..*])
public String toString( )
public void input( )
Tasks
Output

Objects

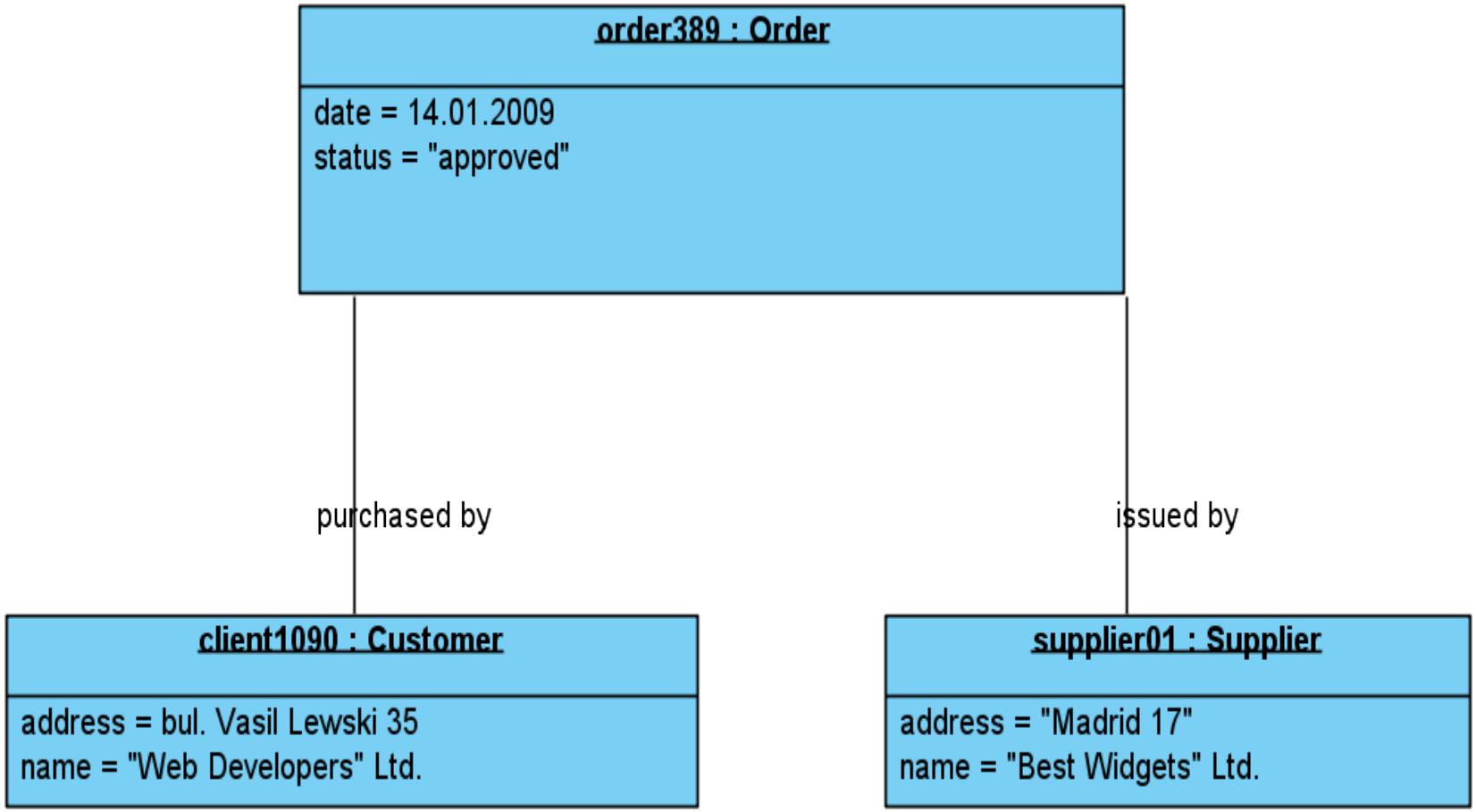
Instance specification = Object – represents an instance of the modeled system, for example class -> object association -> link, property -> attribute, etc.

- can provide illustration or example of object
- describes the object in a particular moment of time
- may be uncomplete
- Example:



CC BY SA

Object Diagram

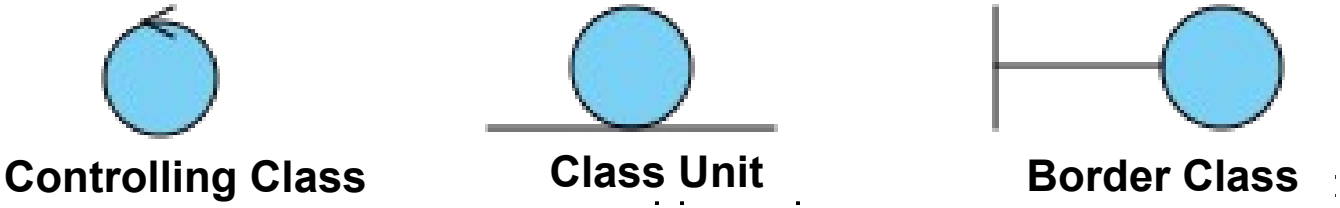


CC BY SA

Analysis Classes Stereotypes

Analysis classes are used in the mapping and analysis of system architecture - they present rather different roles and responsibilities, than specific classes to be realized, and are independent of implementation technology:

- <<controll>> - business logic
- <<entity>> - data
- <<boundary>> - user or system interface



cc BY SA

Reusing Classes

- Advantages of code reuse
- Ways of implementation:
  - Objects composition
  - Inheritance of classes (object types)
- Building complex objects by composition
- Initializing the references:
  - on declaration of the site
  - in the constructor
  - before using (lazy initialization)

CC BY SA

Class Inheritance - I

- Inheritance realization in Java™ language
  - Keyword **extends**
  - Keyword **super**
- Initialization of objects inheritance:
  1) base class; 2) inherited class
  - Calling the default constructors
  - Calling constructors with arguments
- Combining composition and inheritance

cc BY SA

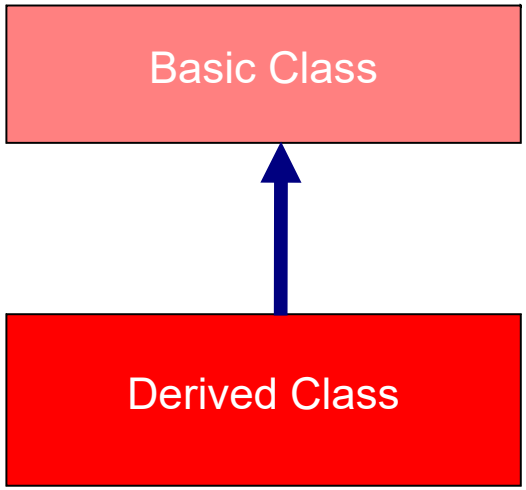
Class Inheritance - II

- Clearing of objects – realization in Java™
- Overloading and overriding methods of base class in derived classes
- When to use composition and when inheritance?
  - Do we need the interface of the base class?
  - Connection Type - „there is“ and „it is“?

CC BY SA

Class Inheritance - III

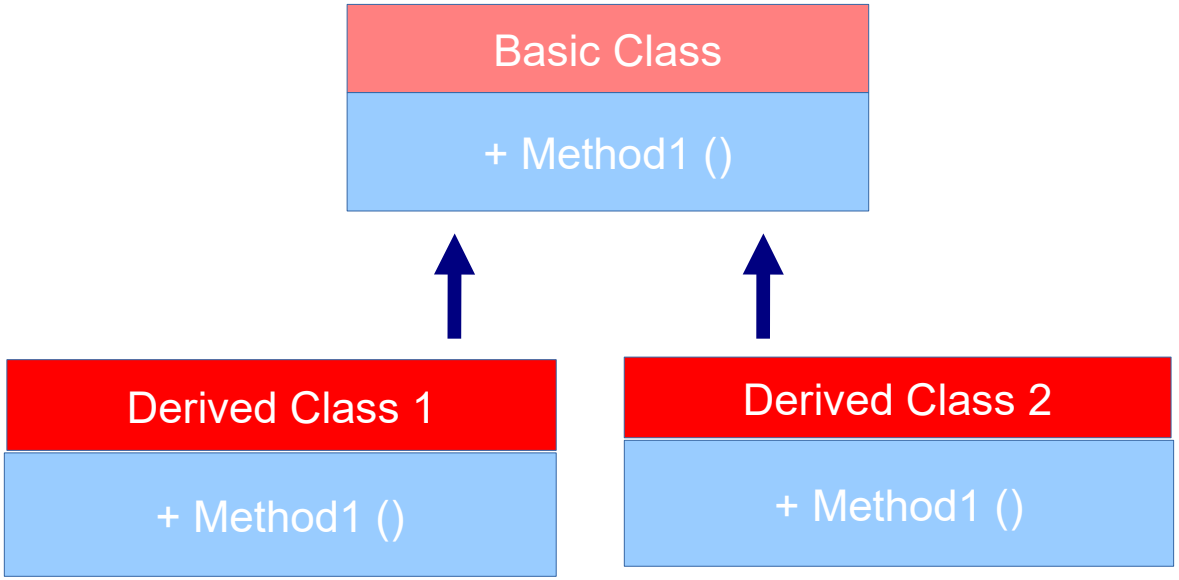
- Protected methods
- Upcasting
- Keyword final
  - Final data – defining constants
    - simple data type
    - objects
    - empty fields
    - arguments
  - Final methods
  - Final classes



CC BY SA

Polymorphism - I

- Upcasting



- Abstract methods and classes – abstract
- Order of constructor calls
- Inheritance and expansion

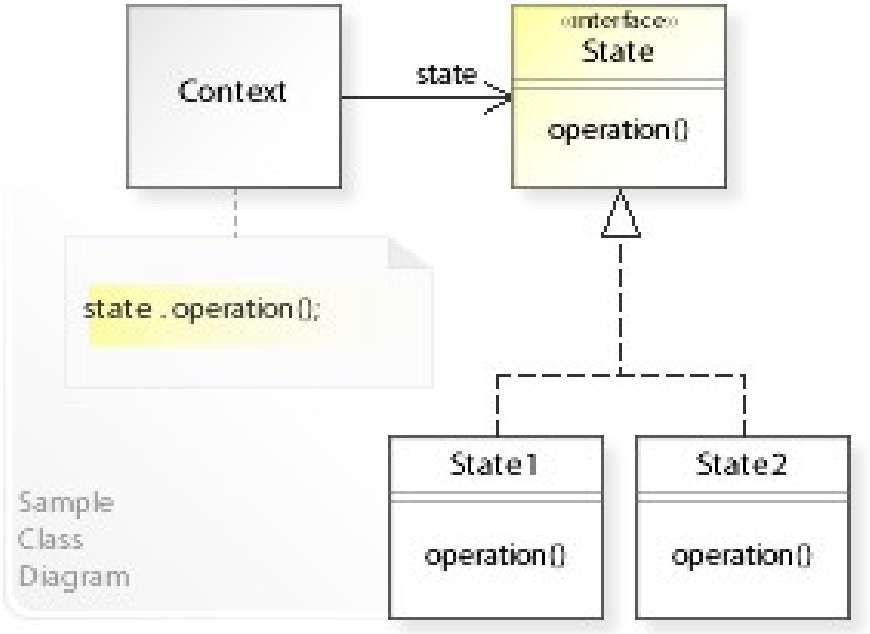
CC BY SA

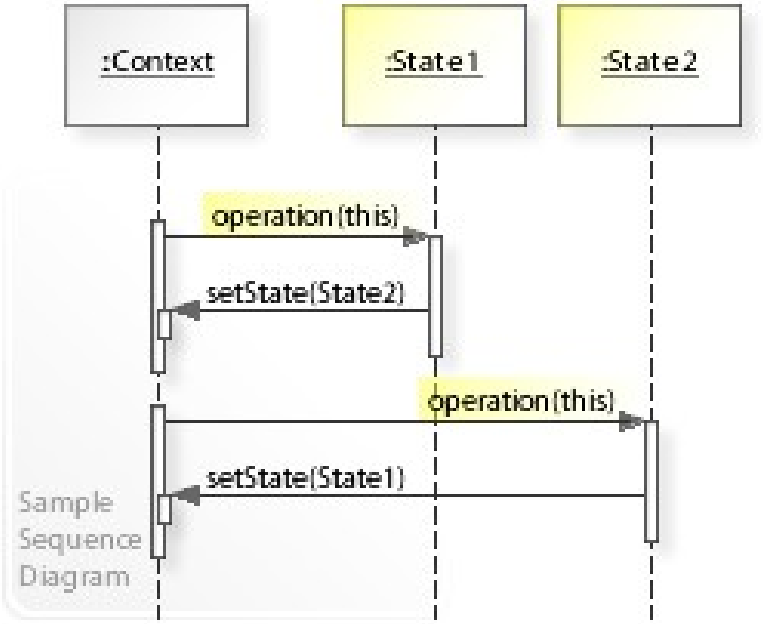
Polymorphism - II

- Polymorphism – by default, unless the method is declared as static or final (private methods become automatically final)
- When constructing objects with inheritance each object cares about its attributes and delegate initialization of parental attributes on parental constructor or method
- Using polymorphic methods in constructor
- Covariance types of return (from Java SE 5)
- Composition <-> Inheritance - **State** Design Pattern

CC BY SA

State Design Pattern





By Vanderjoe - Own work, CC BY-SA 4.0, https://commons.wikimedia.org/w/index.php?curid=63061518

Interfaces and Multiple Inheritance

- Interfaces – keywords: interface, implements
- Multiple inheritance in Java
- Interface expansion through inheritance
- Constants (static final)
- Interface incorporation

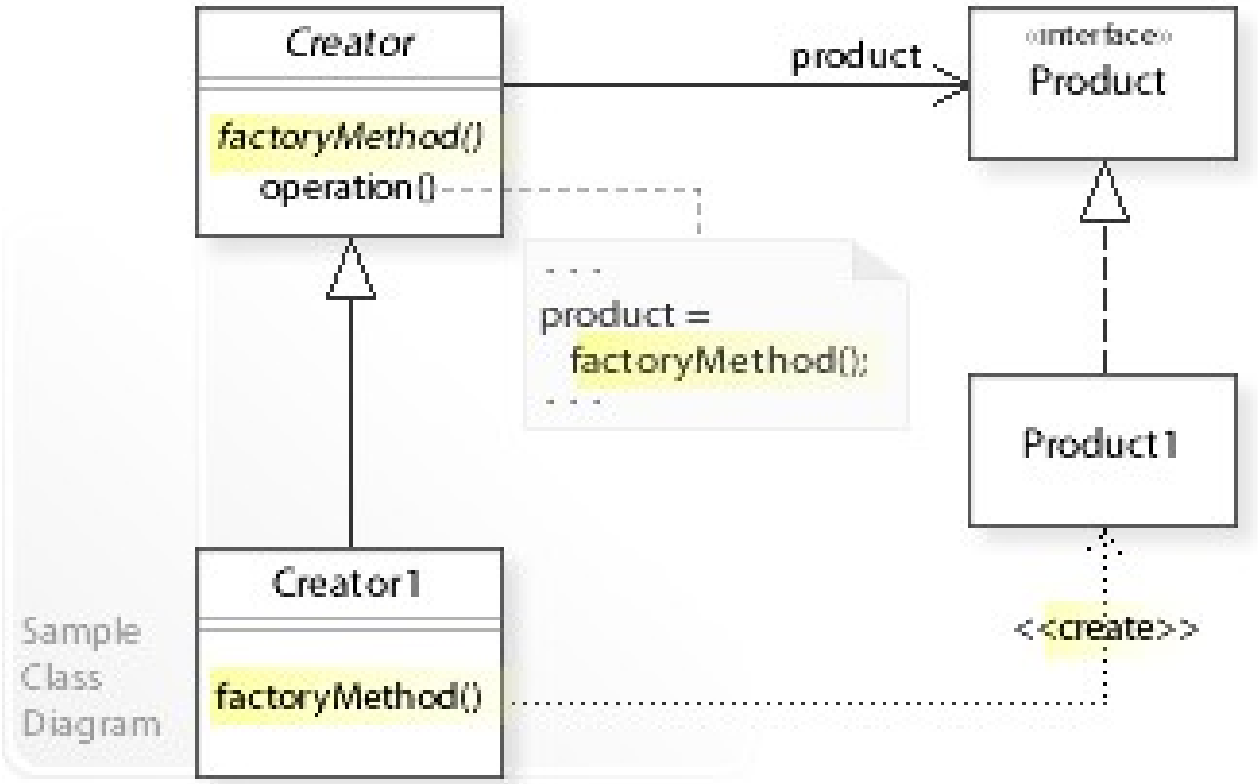
CC BY SA

Advantages of Using Interfaces

- Interfaces cleanly separate requirements type of the object from many possible implementations and make our code more universal and usable
- Reusable Design Pattern: Adapter – It allows to adapt existing realization interface that is required in our application
- Inheritance (expansion) of interfaces
- Reusable Design Pattern: Factory Method – creating reusable client code, isolated from the specifics of the particular server implementation

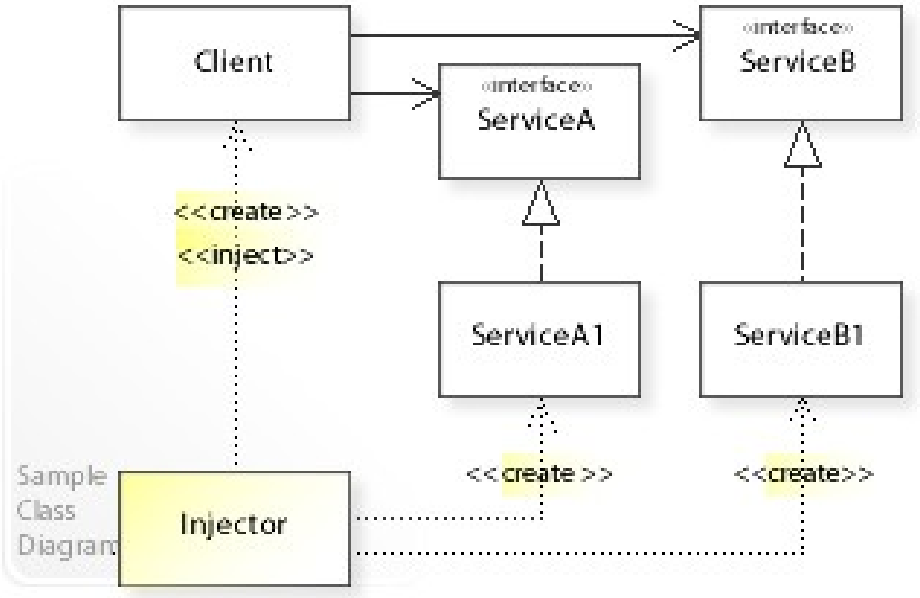
CC BY SA

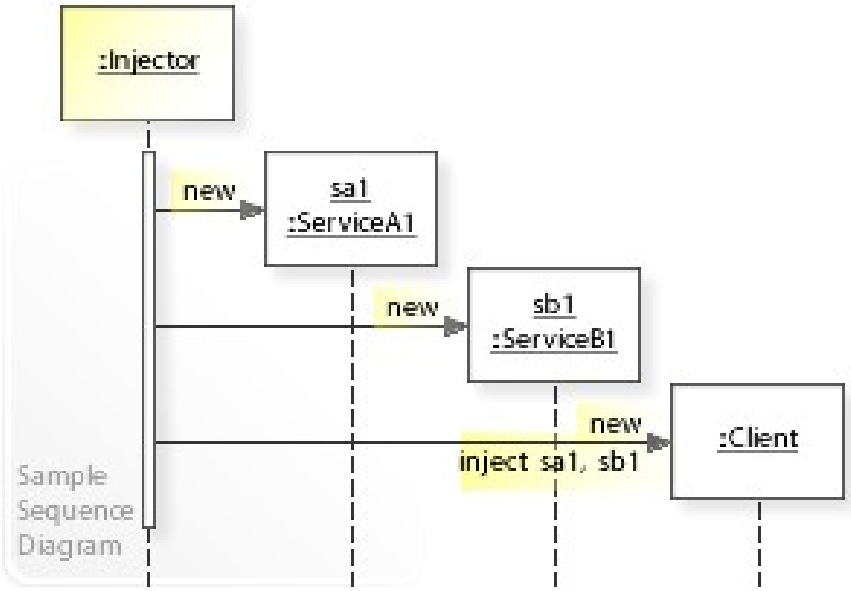
Factory Method Design Pattern



By Vanderjoe - Own work, CC BY-SA 4.0, https://commons.wikimedia.org/w/index.php?curid=63061518

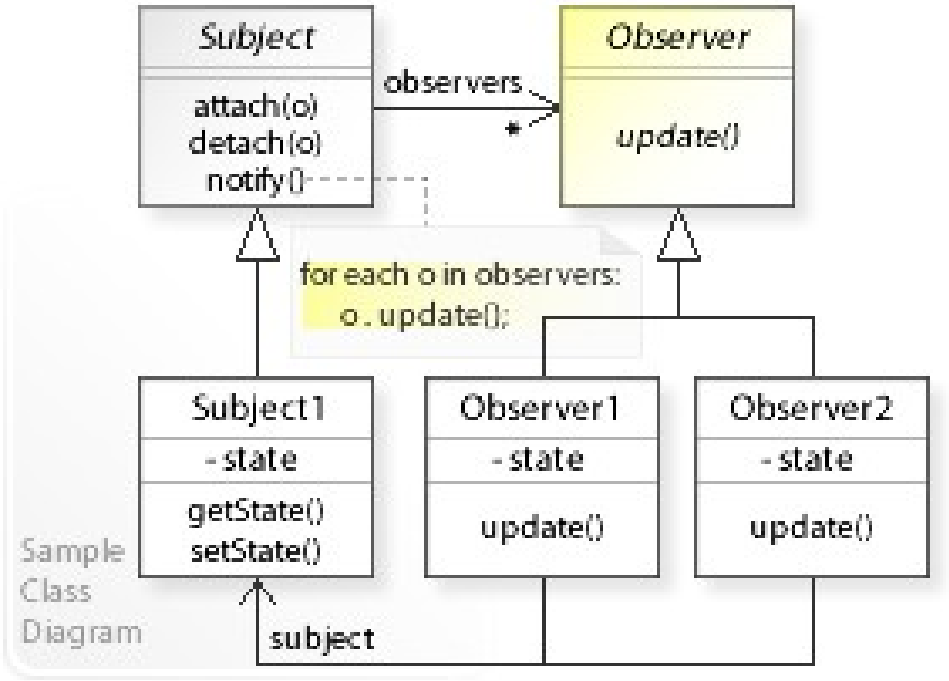
Dependency Injection Design Pattern

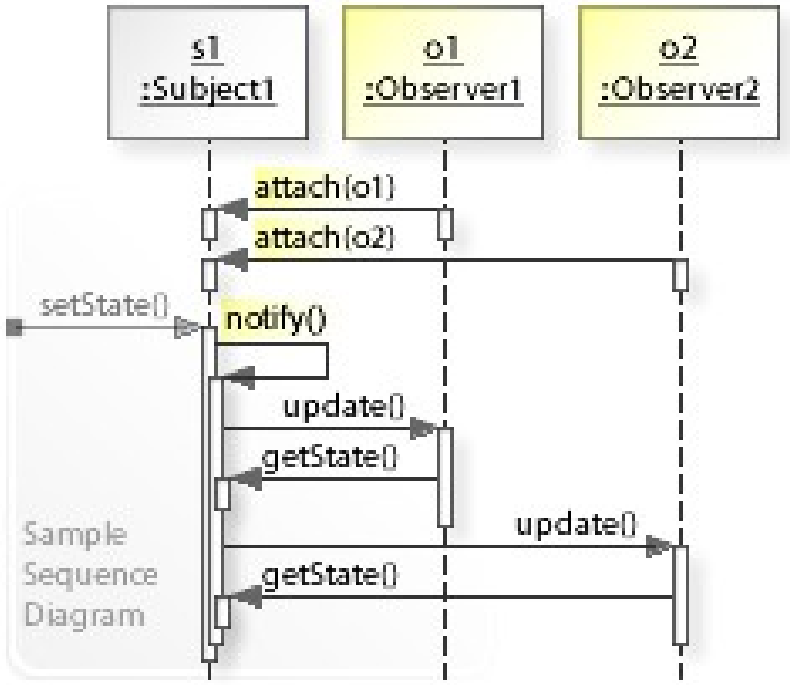




By Vanderjoe - Own work, CC BY-SA 4.0, https://commons.wikimedia.org/w/index.php?curid=63061518

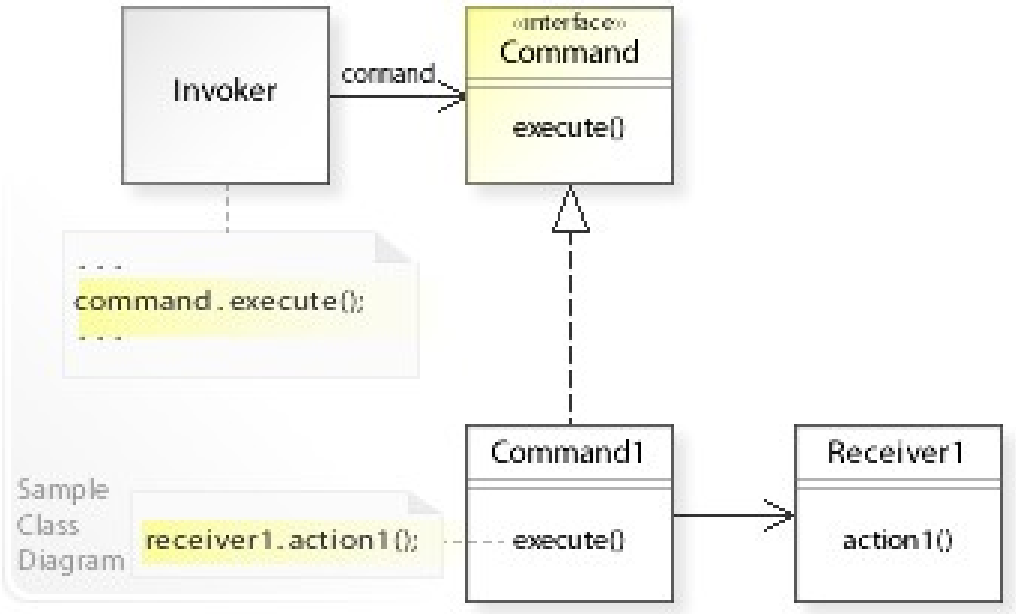
Observer Design Pattern

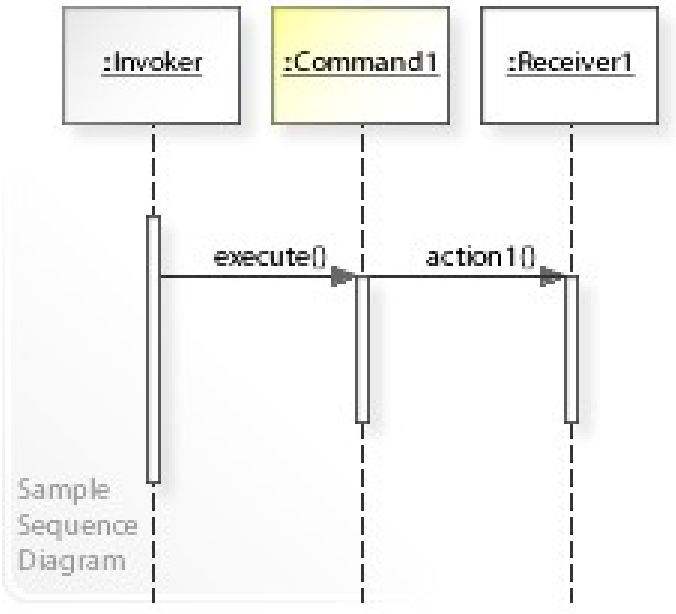




By Vanderjoe - Own work, CC BY-SA 4.0, https://commons.wikimedia.org/w/index.php?curid=63061518

Command Design Pattern





By Vanderjoe - Own work, CC BY-SA 4.0, https://commons.wikimedia.org/w/index.php?curid=63061518

Inner Classes - I

- Inner Classes group logically related classes and control their visibility
- Closures – internal class has a constant connection to containing outside class and can access all its attributes and even final arguments and local variables (if defined in the method or block)
- Inner classes can be anonymous if used once in the program. Construction.
- Reference to the object from an external class - .this and creating an object from internal class in the context of containing object of the outer class - .new

cc BY SA

Inner Classes - II

- Inner Classes
  - defined in an external class
  - defined in method
  - defined in a block of operators
  - access to the attributes of the outer class and to the arguments of the method which are defined in
- Anonymous inner classes
  - realizing public interface
  - inheriting class
  - instance initialization
  - static inner classes

cc BY SA

Enumeration Types

```
public class MyEnumeration {
   public enum InvoiceType { SIMPLE, VAT }
   public static void main(String[] args) {
     for(InvoiceType it : InvoiceType.values())
         System.out.println(it);
     }
}
```

Резултат: SIMPLE
VAT

cc BY SA

Обработка на изключения в Java

- Задължителна обработка на изключенията в езика Java → сигурен и надежден код
- Разделяне на бизнес логиката на програмата от кода за обработка на грешки
- Клас **Throwable** → класове Error и Exception
- Генериране на изключения – ключова дума **throw**
- Обработка на изключения:
  - **try – catch – finally** блок
  - прехвърляне към извикващия метод - **throws**

CC BY SA

Try-Catch-Finally Block

❖Оператор **try** за изпълнение на несигурен код, множество **catch** блокове за обработка на изключения и **finally** за гарантиран clean-up накрая на обработката:

```
try {
    //код, който може да генерира изключения Ex1, Ex2, …
} catch(Ex1 ex) {  // изпълнява се само при Ex1
    //вземаме подходящи мерки за разрешаване на проблем 1
} catch(Ex2 ex) {  // изпълнява се само при Ex2
    //вземаме подходящи мерки за разрешаване на проблем 2
} finally {
    //изпълнява се винаги, независимо дали има изключение
}
```

cc BY SA

Обработка на изключения в Java - 2

- Реализация на собствени изключения
- Конструктори с допълнителни аргументи
- Влагане и повторно генериране на изключения – причина Cause
- Специфика при обработката на **RuntimeException** и неговите наследници
- Завършване чрез **finally**

cc BY SA

Новости при обработката на изключения в Java 7

- Обработка на множество изключения от в една и съща **catch** клауза:

```
catch (Exception1|Exception2 ex) {
    ex.printStackTrace();
}
```

- Програмен блок **try-with-resources**

```
String readInvoiceNumber(String myfile) throws IOException {
        try (BufferedReader input = new BufferedReader(new
                FileReader(myfile))) {
                        return input.readLine();
                }
}
```

CC BY SA

Thank's for Your Attention!

Trayan Iliev

CEO of IPT – Intellectual Products

& Technologies

http://iproduct.org/

http://robolearn.org/

https://github.com/iproduct

https://twitter.com/trayaniliev

https://www.facebook.com/IPT.EACAD

https://plus.google.com/+IproductOrg

CC BY SA