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Programming in Java

OOP Principles

Trayan Iliev

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

Agenda for This Session

- **Encapsulation**
  - What is Encapsulation?
  - Validation of input data;
  - Mutable and Immutable Objects;
  - Keyword final;
- **Inheritance**
  - Class Hierarchies;
  - Inheritance in Java;
  - Accessing Members of the Base Class;
  - Types of Class Reuse;
  - When to Use Inheritance;
  - Code reuse strategies – choosing inheritance vs. composition.
- **Abstraction**
  - Implementing Interfaces;
  - Creating and extending Abstract Classes;
  - Interfaces vs Abstract Classes;
- **Understanding Polymorphism**
  - Differences between method *overriding* and *overloading*.
  - Depending on abstractions, not implementations – *Dependency Inversion (DI) Principle;*
- **SOLID principles**

Where to Find the Code?

Java Web Development projects and examples are available @ GitHub:

https://github.com/iproduct/course-java-fd

Basic Concepts in OOP and OOAD

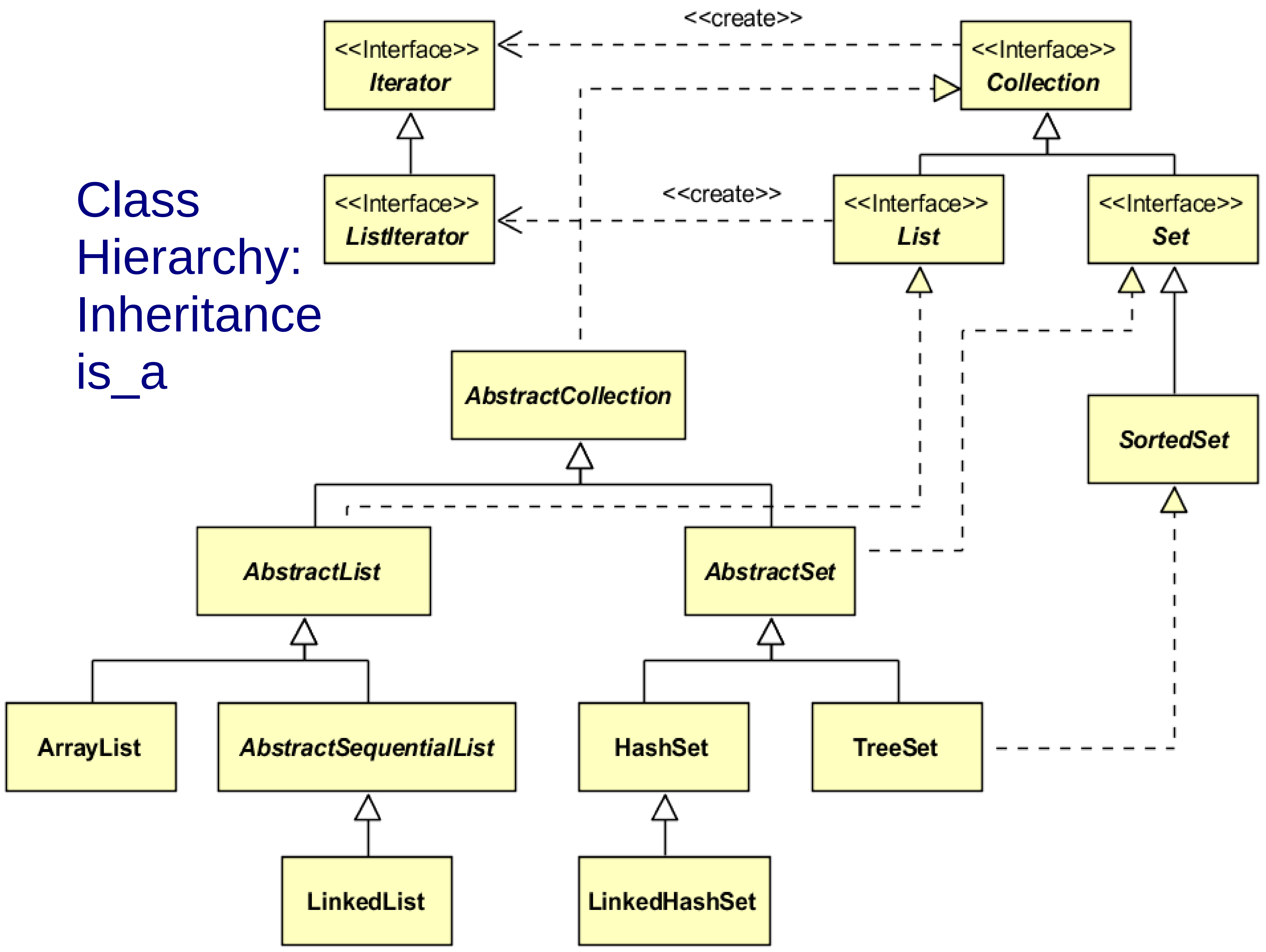
- interface and implementation – we divide what remains constant (contractual interface) from what we would like to keep our freedom to change (hidden realization of this interface)
- interface = public
- implementation = private
- This separation allows the system to evolve while maintaining backward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

Object-Oriented Approach to Programming

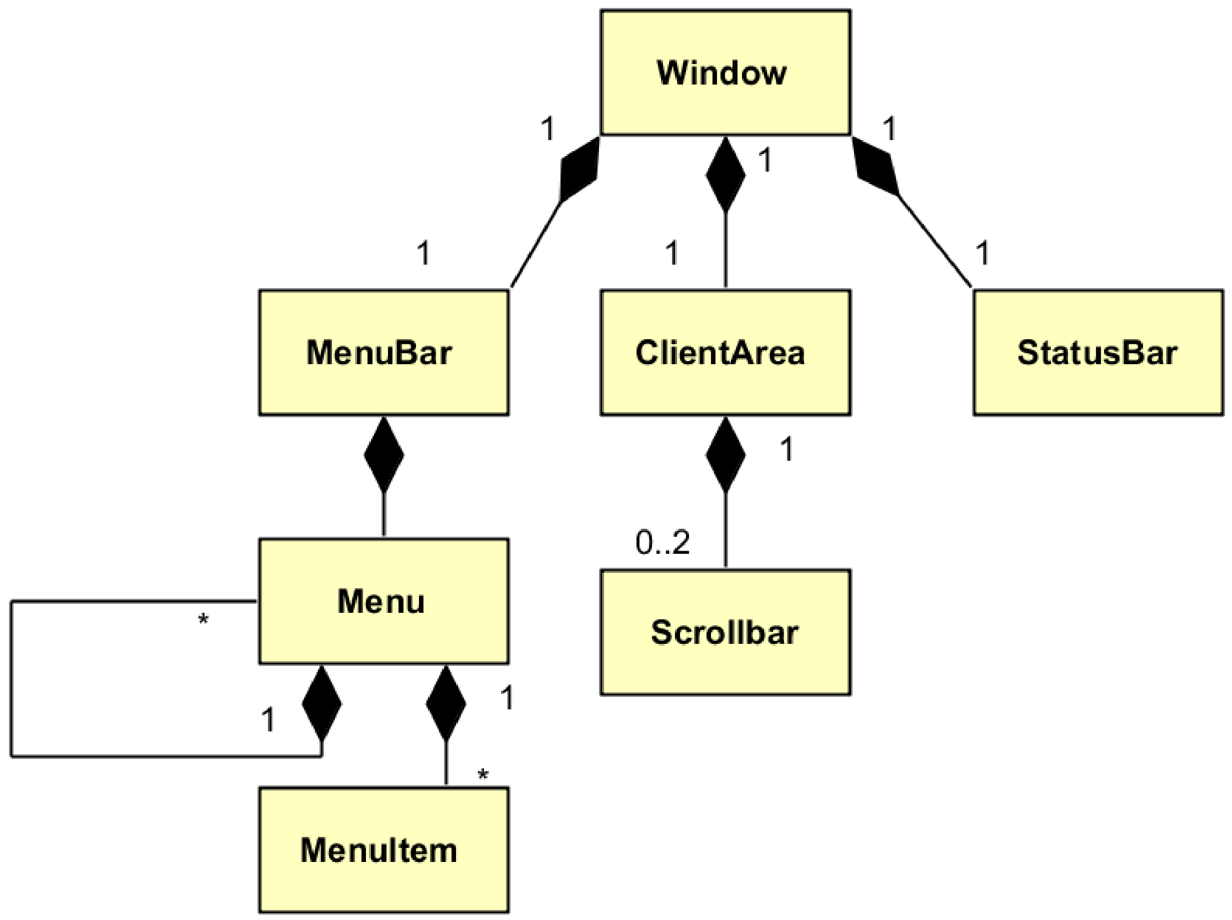
Key elements of the object model [Booch]:

- 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

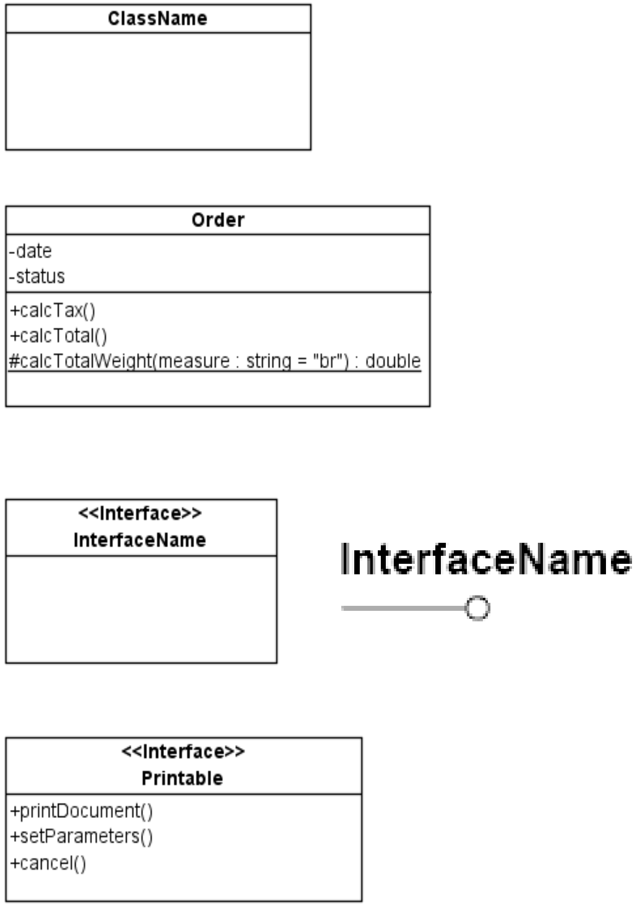
Class Hierarchy: Inheritance is_a



Object Hierarchy: Composition, has_a

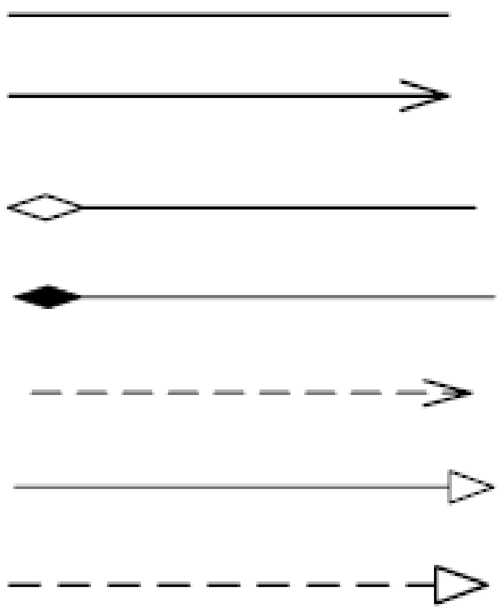


Elements of Class Diagrams

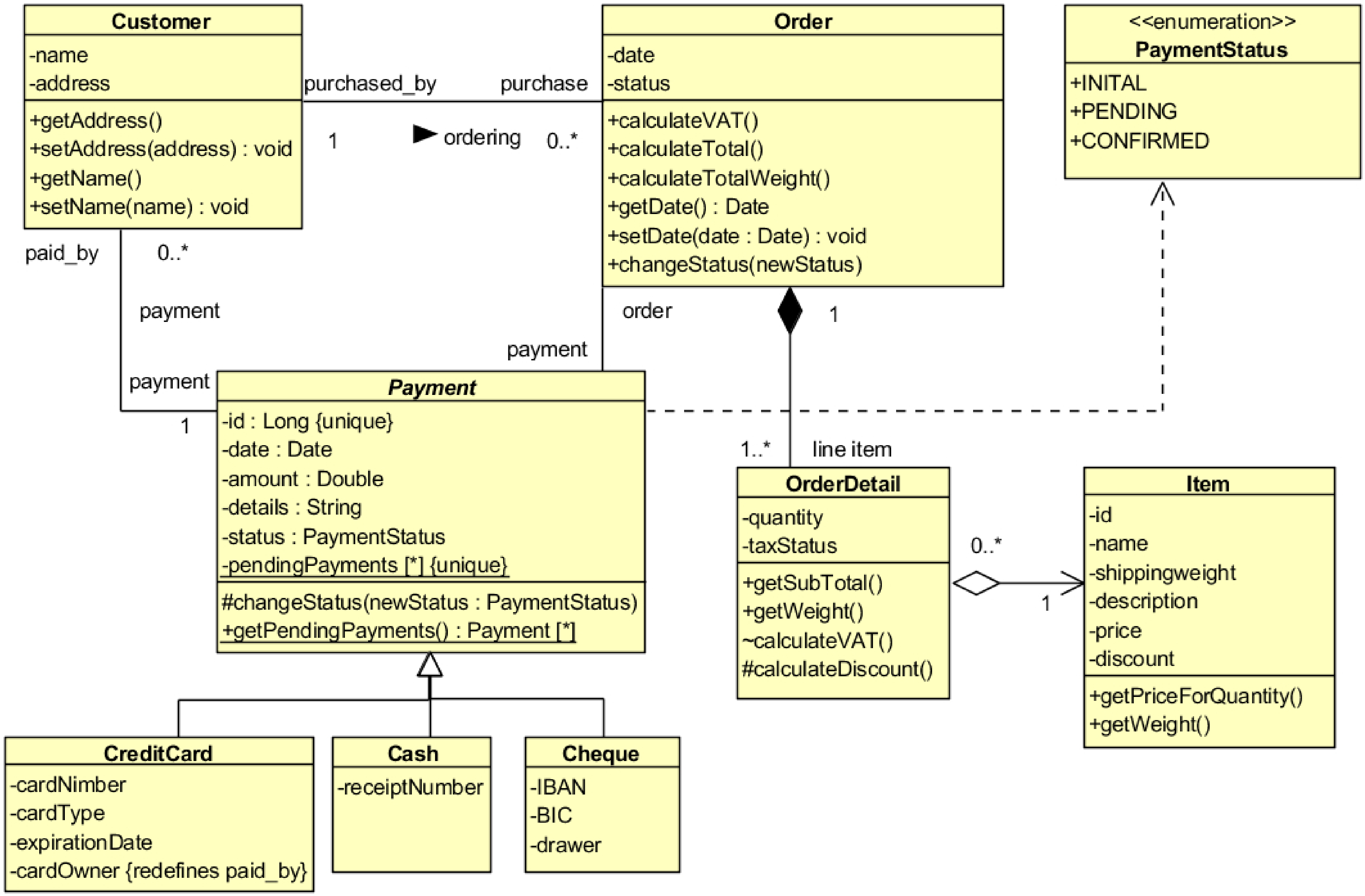


Types of connections:

- association
- aggregation
- composition
- dependence
- generalization
- realization



Class Diagram - 1



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)

Class Inheritance - I

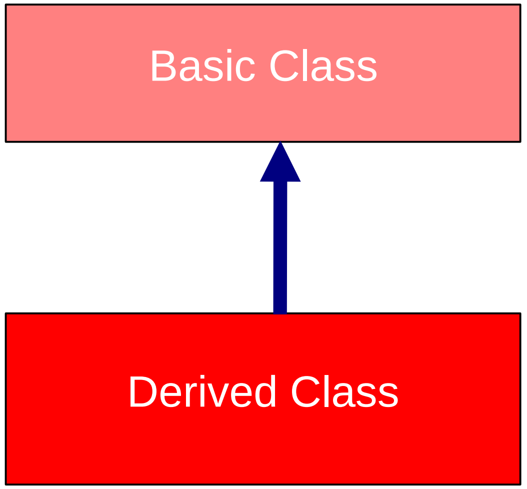
- Inheritance realization in Java™ language
  - Keyword **extends**
  - Keyword **super**
- Initialization of objects inheritance:
  1) base class; 2) inherited class
  - Calling the default constructors
  - Calling constructors with arguments
- Combining composition and inheritance

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“?

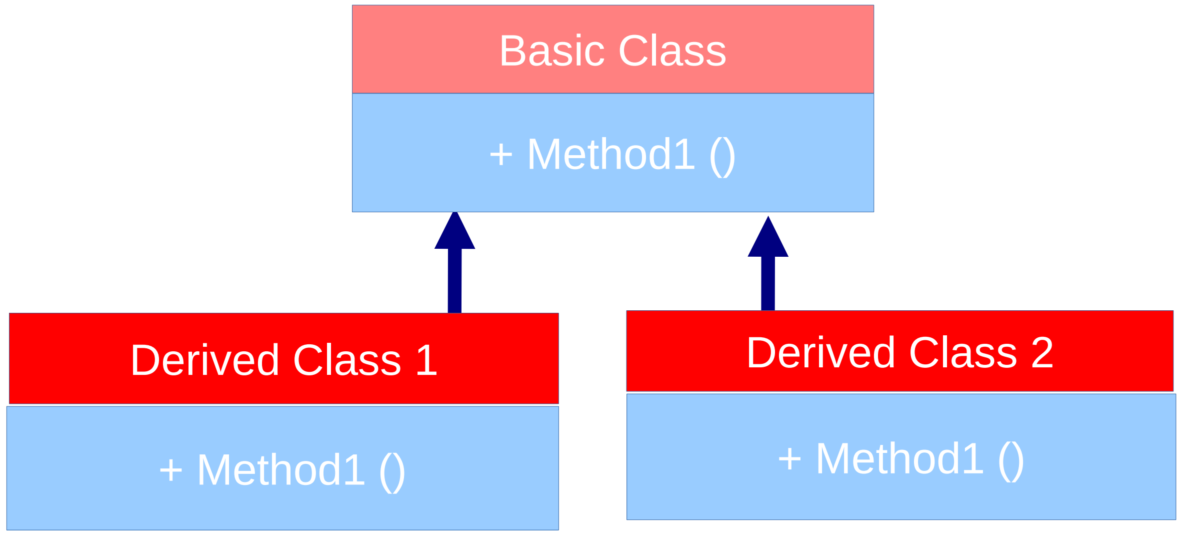
Class Inheritance - III

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



Polymorphism - I

- Upcasting



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

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

Interfaces and Multiple Inheritance

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

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

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

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
  - – implementing public interface
  - – inheriting class
  - – instance initialization
  - – static inner classes

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.

Resources

- SOLID Principles in Wikipedia – https://en.wikipedia.org/wiki/SOLID

Thank’s for Your Attention!

Trayan Iliev

CEO of IPT – Intellectual Products & Technologies

http://iproduct.org/

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