Inheritance

Extending Classes

SoftUni Team

Technical Trainers

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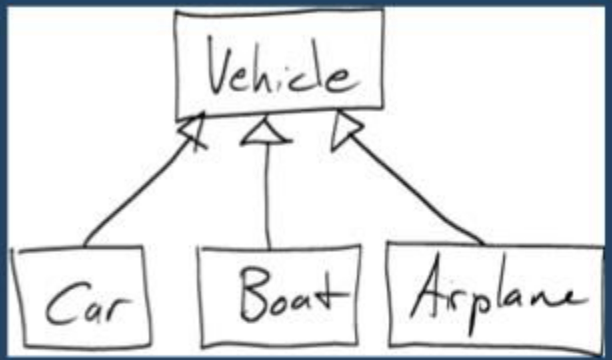
#java-advanced

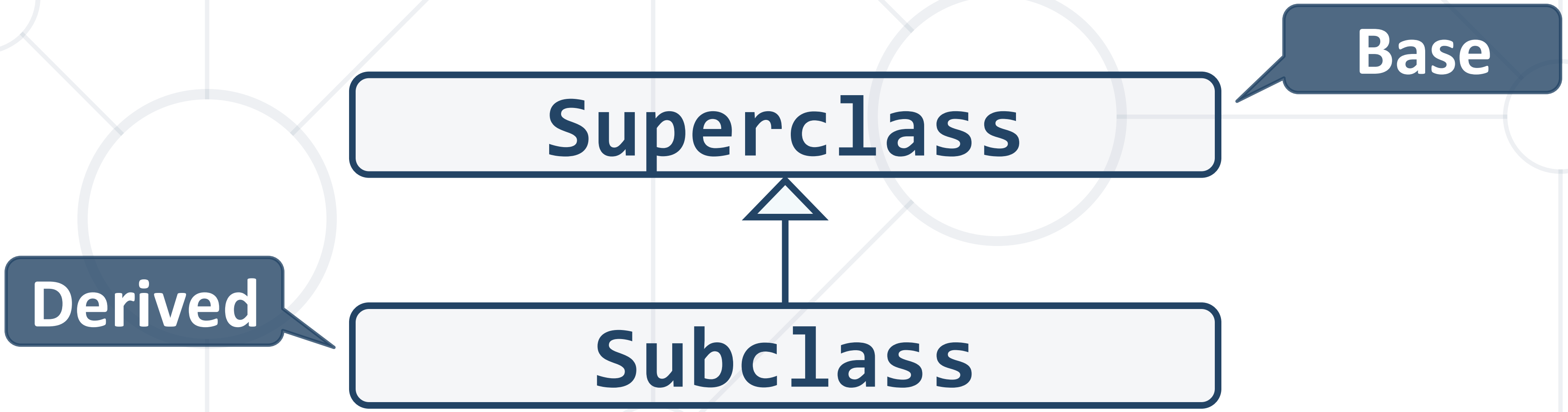


Inheritance

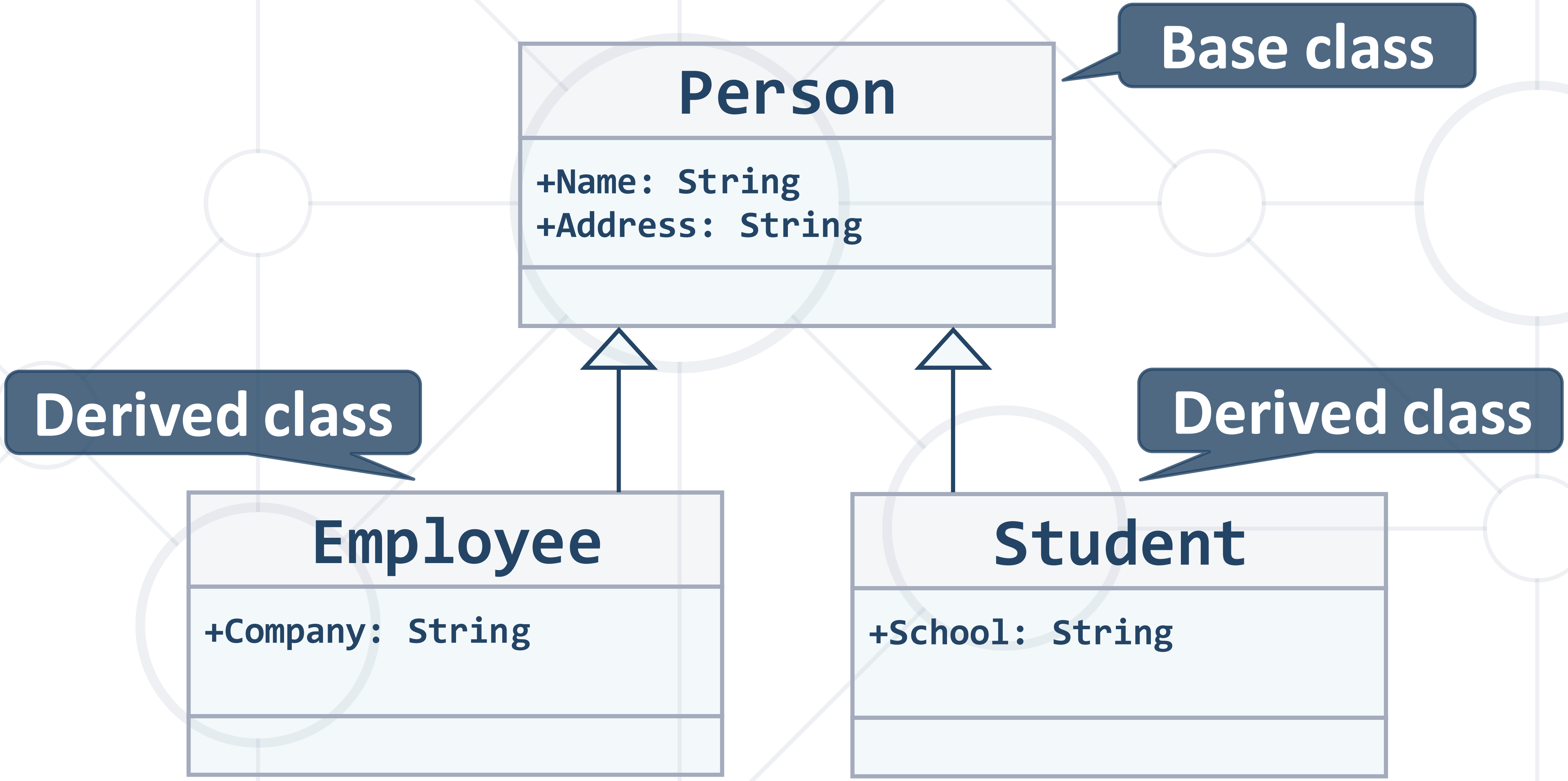
Extending Classes

Inheritance

- **Superclass** - Parent class, Base Class
  - The class giving its members to its child class
- **Subclass** - Child class, Derived Class
  - The class taking members from its base class

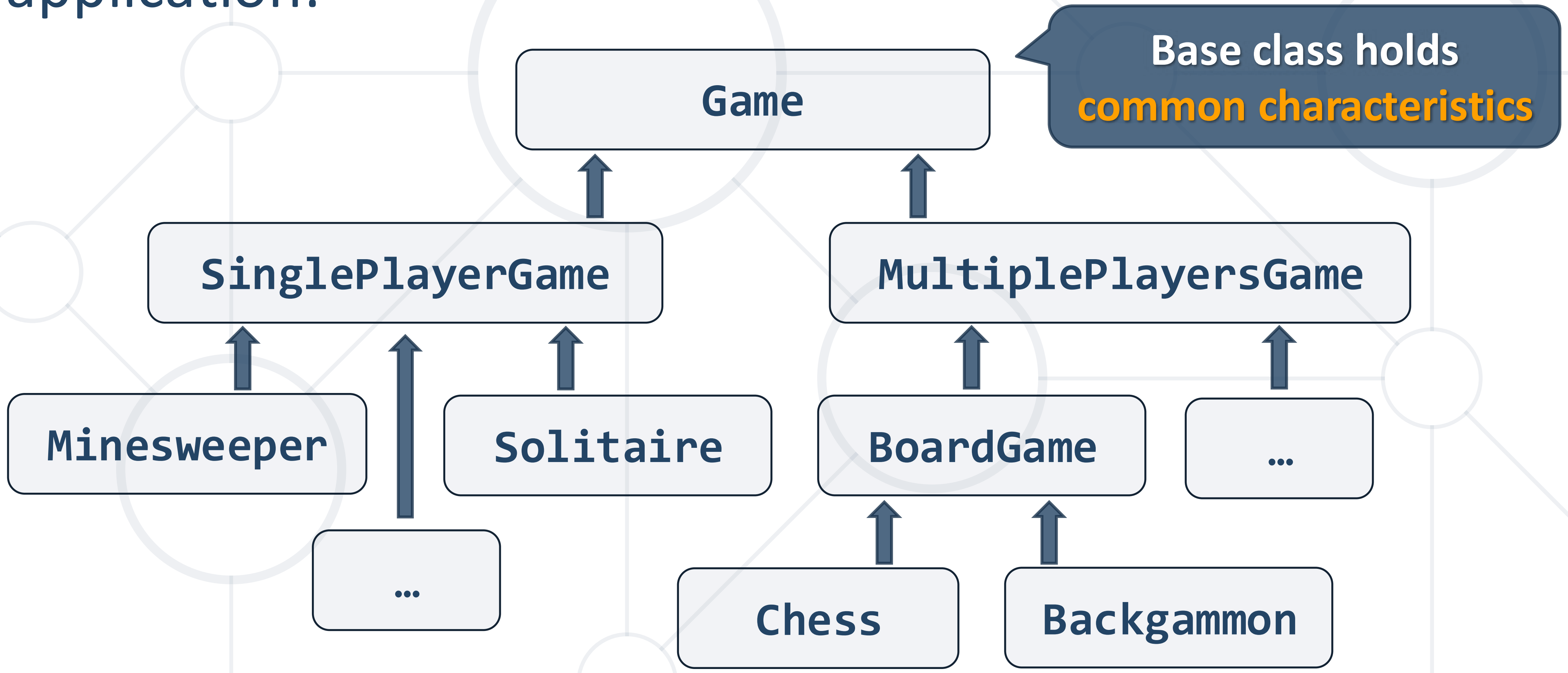


Inheritance – Example

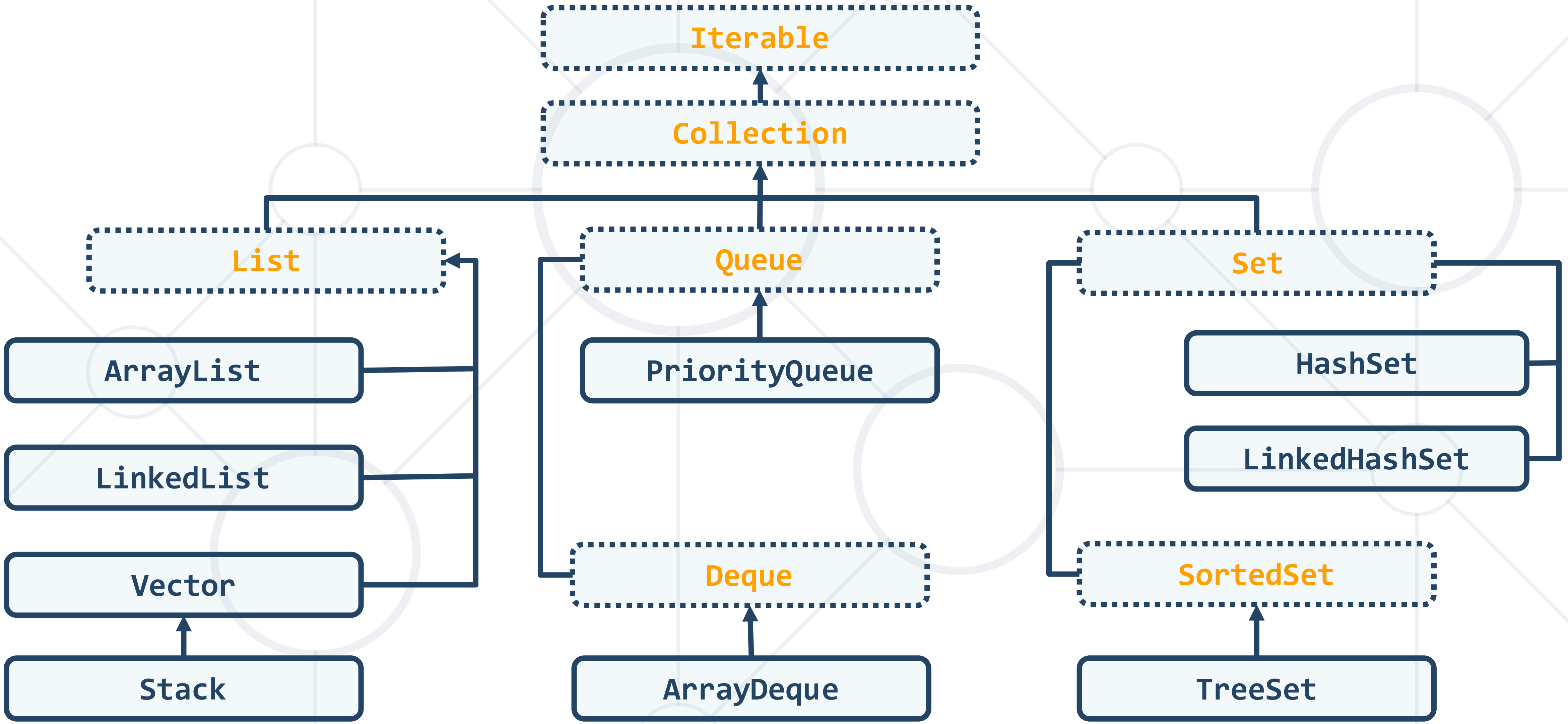


Class Hierarchies

- **Inheritance** leads to **hierarchies** of classes and/or interfaces in an application:

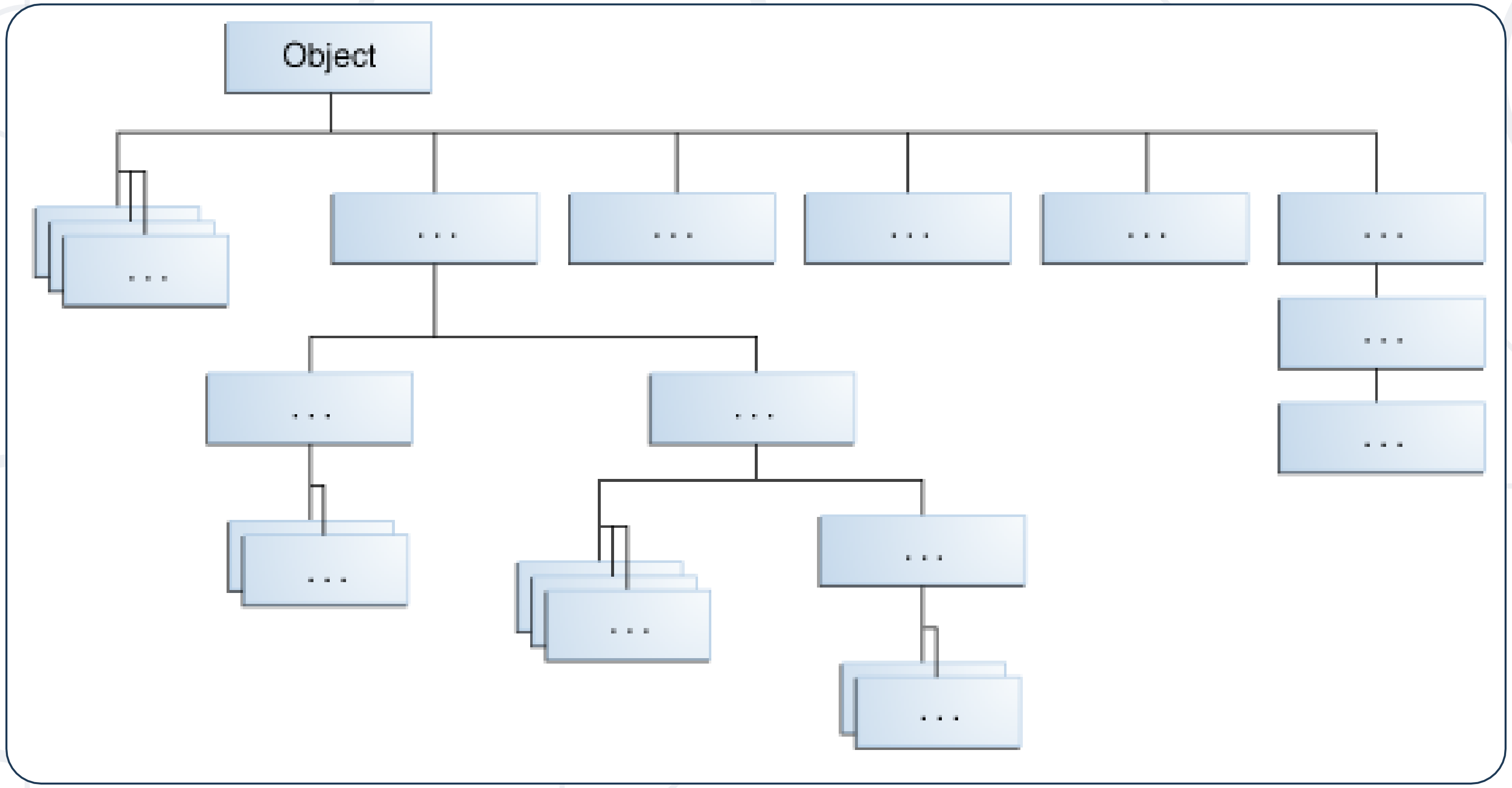


Class Hierarchies – Java Collection



Java Platform Class Hierarchy

- **Object** is at the root of Java Class Hierarchy

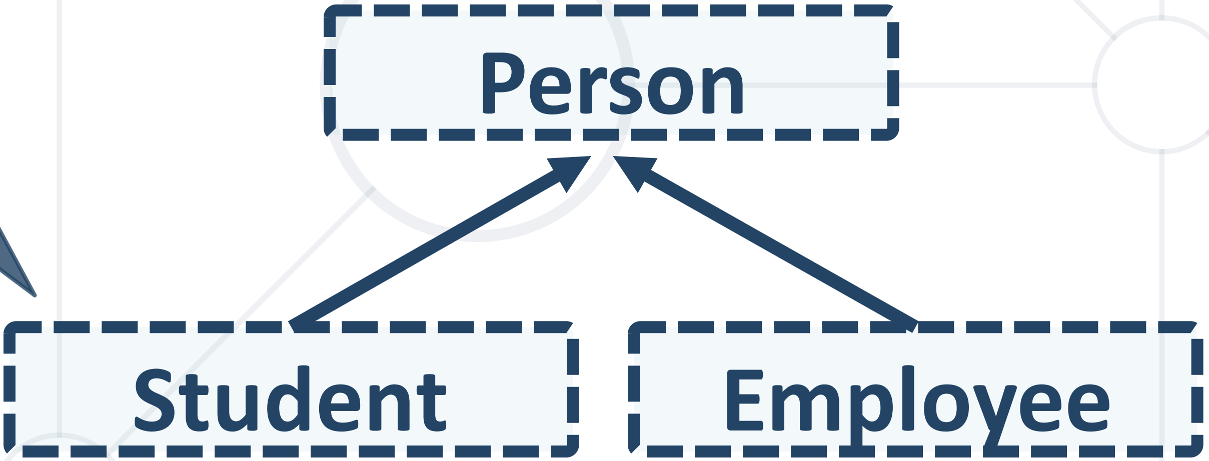


Inheritance in Java

- Java supports inheritance through **extends** keyword

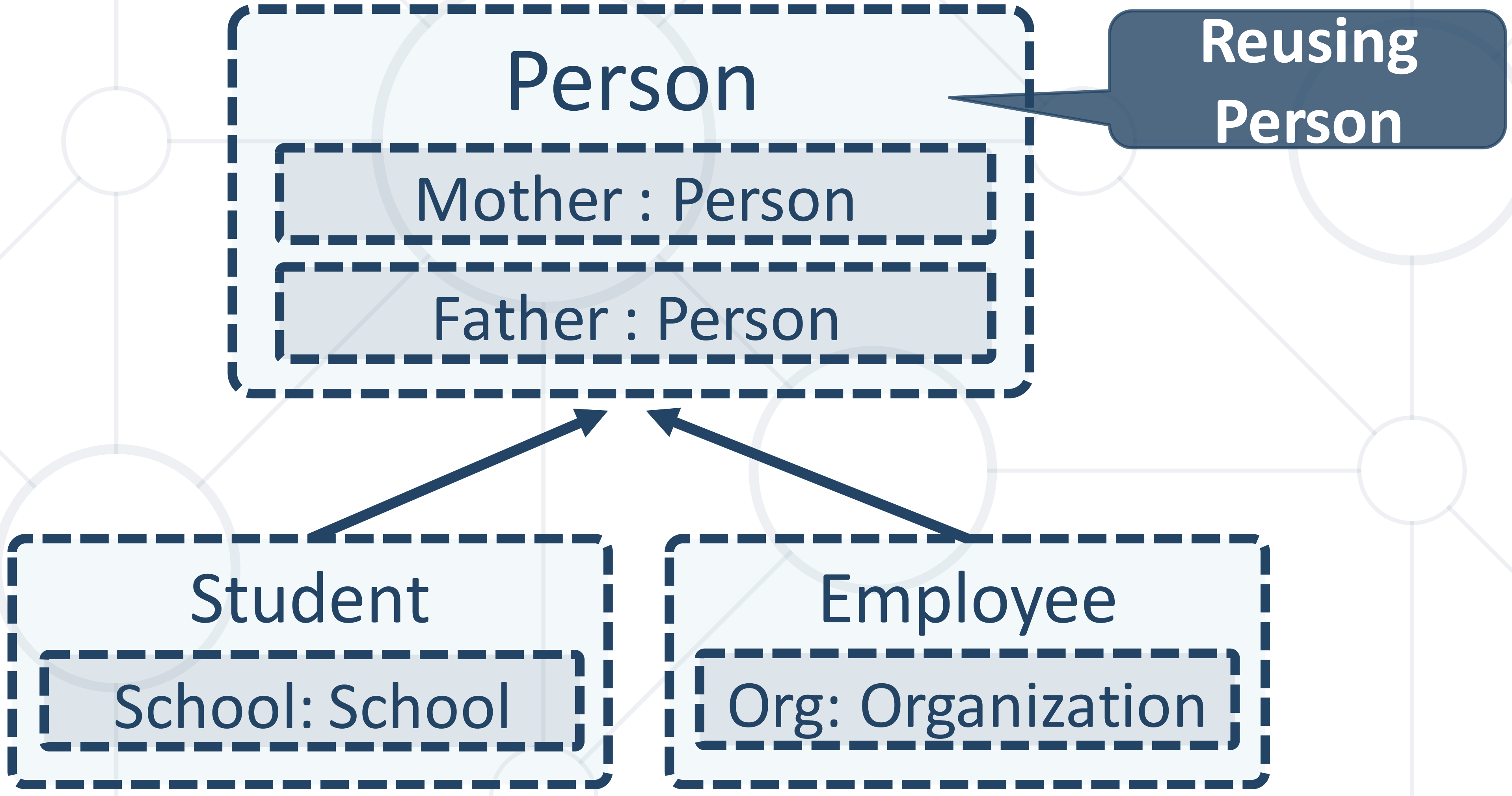
```
class Person { … }

class Student extends Person { … }
class Employee extends Person { … }
```

Student **extends** Person



Inheritance - Derived Class

- Class **takes all members** from another class



Using Inherited Members

- You can access inherited members as usual

```
class Person { public void sleep() { … } }
class Student extends Person { … }
class Employee extends Person { … }
```

```
Student student = new Student();
student.sleep();
Employee employee = new Employee();
employee.sleep();
```

Reusing Constructors

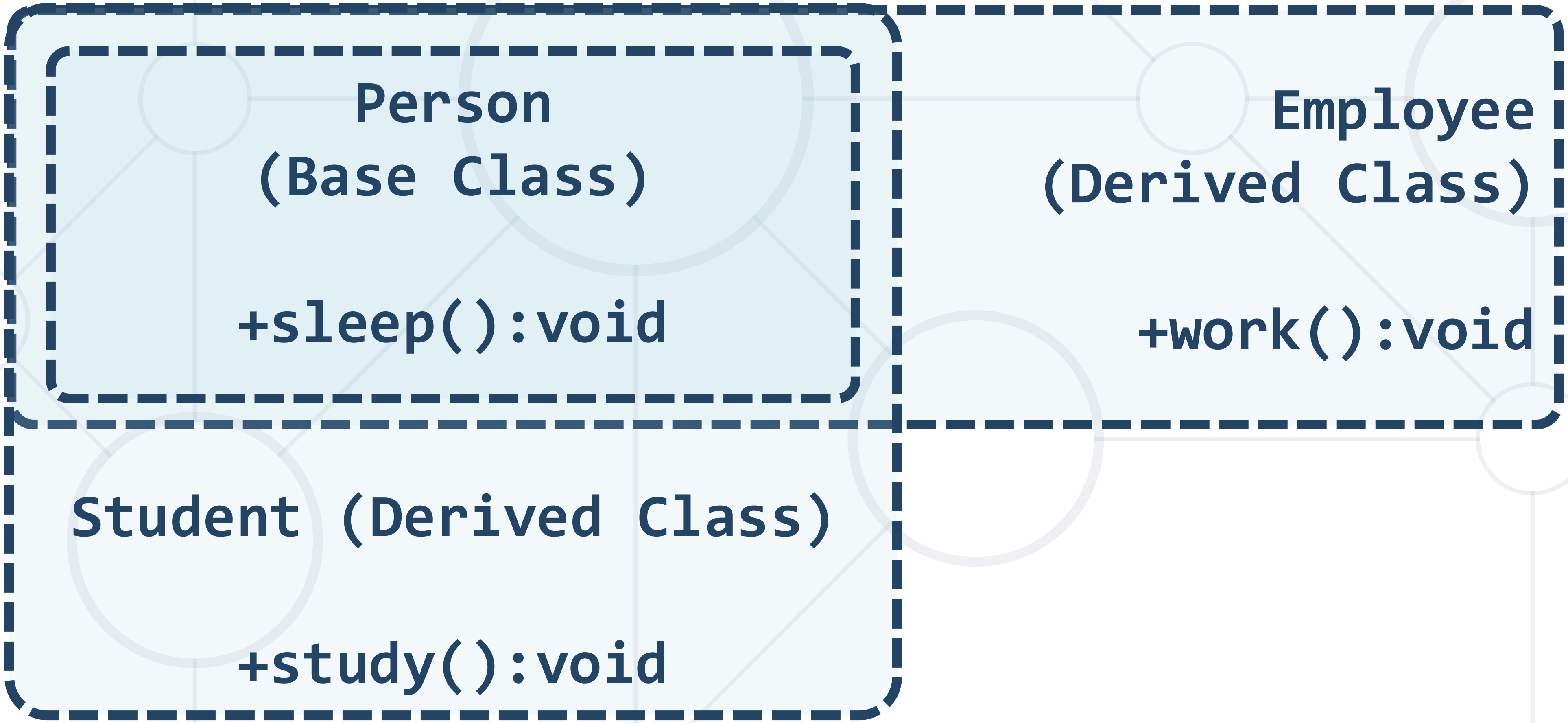
- Constructors are **not inherited**
- Constructors **can be reused** by the child classes

```
class Student extends Person {
  private School school;
  public Student(String name, School school) {
    super(name);
    this.school = school;
  }
}
```

Constructor call should be first

Thinking About Inheritance - Extends

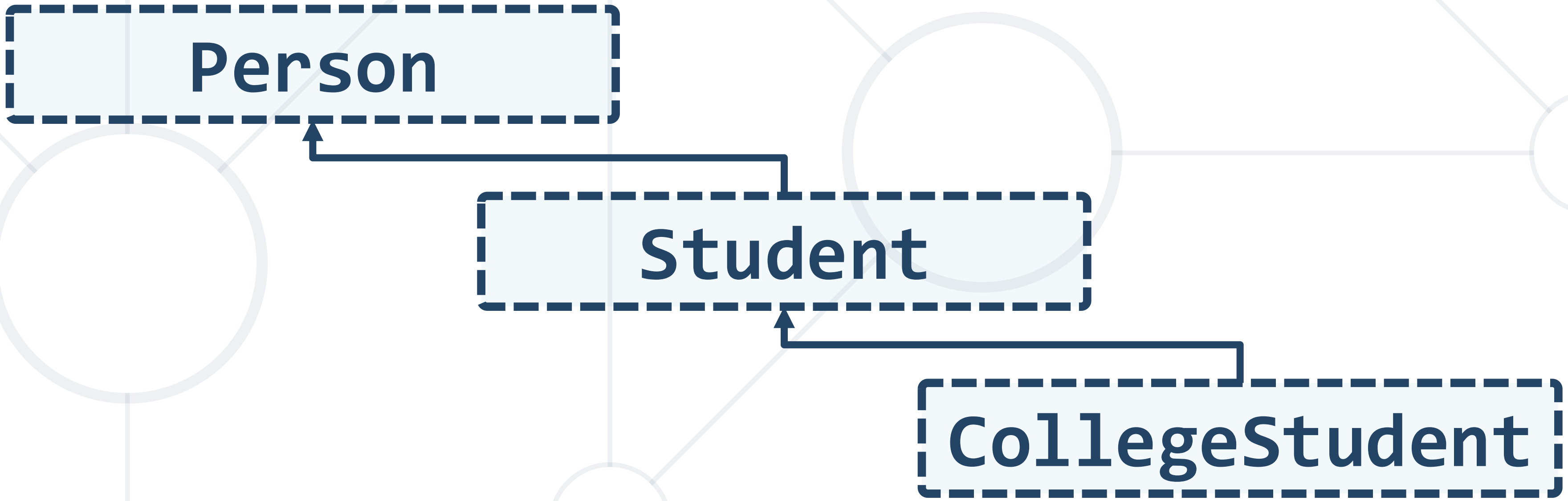
- Derived class instance **contains** instance of its base class



Inheritance

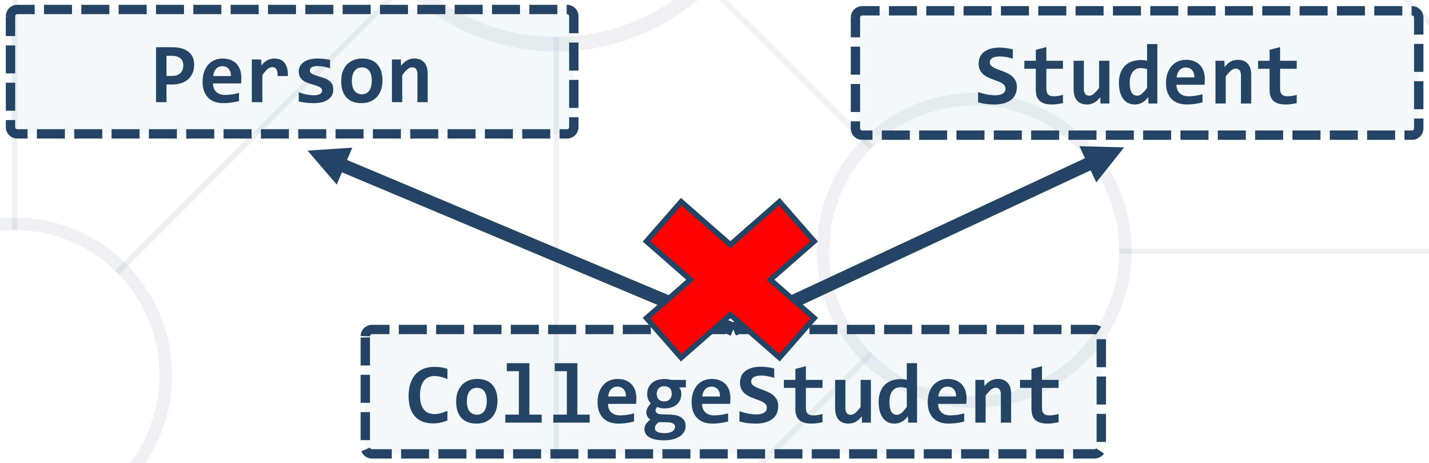
- Inheritance has a **transitive relation**

```
class Person { … }
class Student extends Person { … }
class CollegeStudent extends Student { … }
```



Multiple Inheritance

- In Java there is no **multiple** inheritance
- Only **multiple interfaces can be implemented**

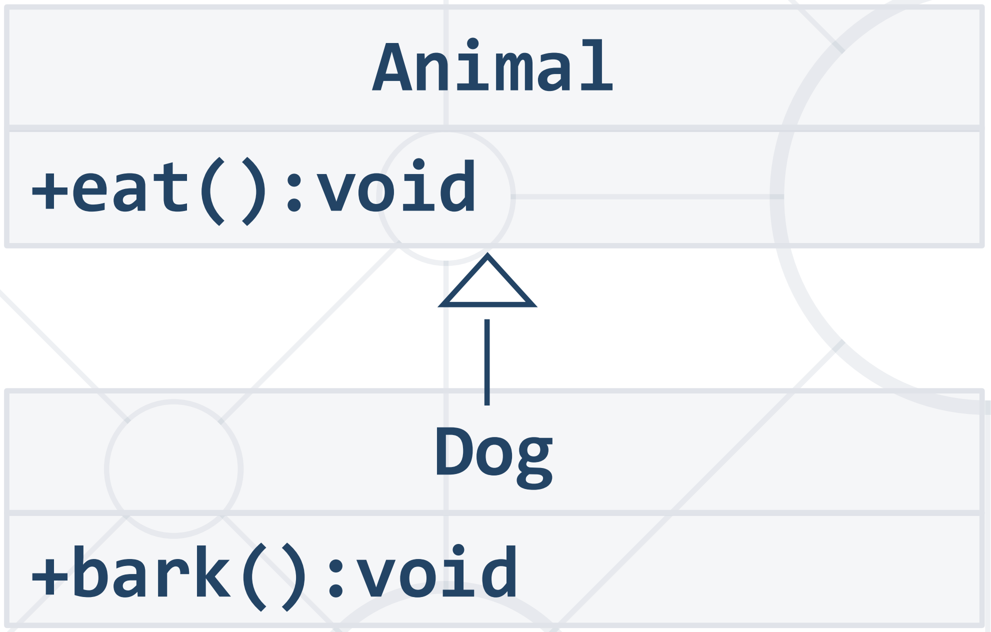


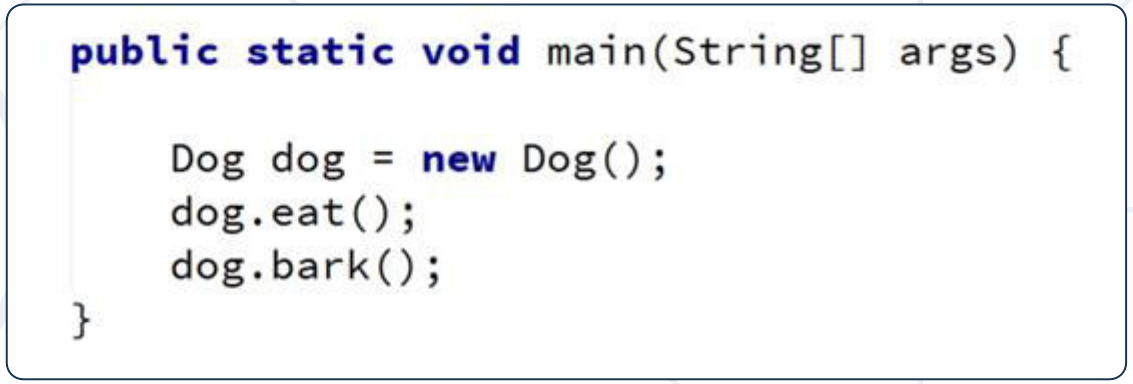
Access to Base Class Members

- Use the **super** keyword

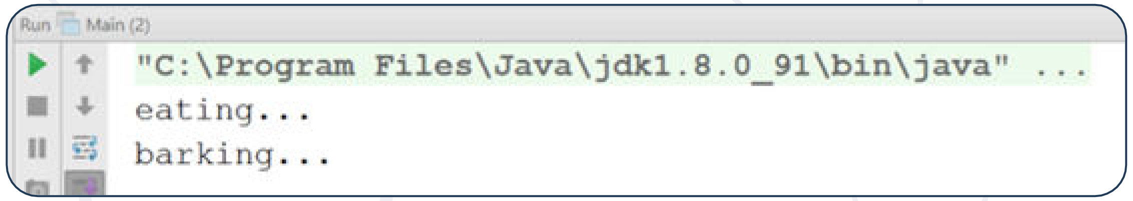
```
class Person { … }

class Employee extends Person {
  public void fire(String reasons) {
    System.out.println(
        super.name +
        " got fired because " + reasons);
  }
}
```

Problem: Single Inheritance





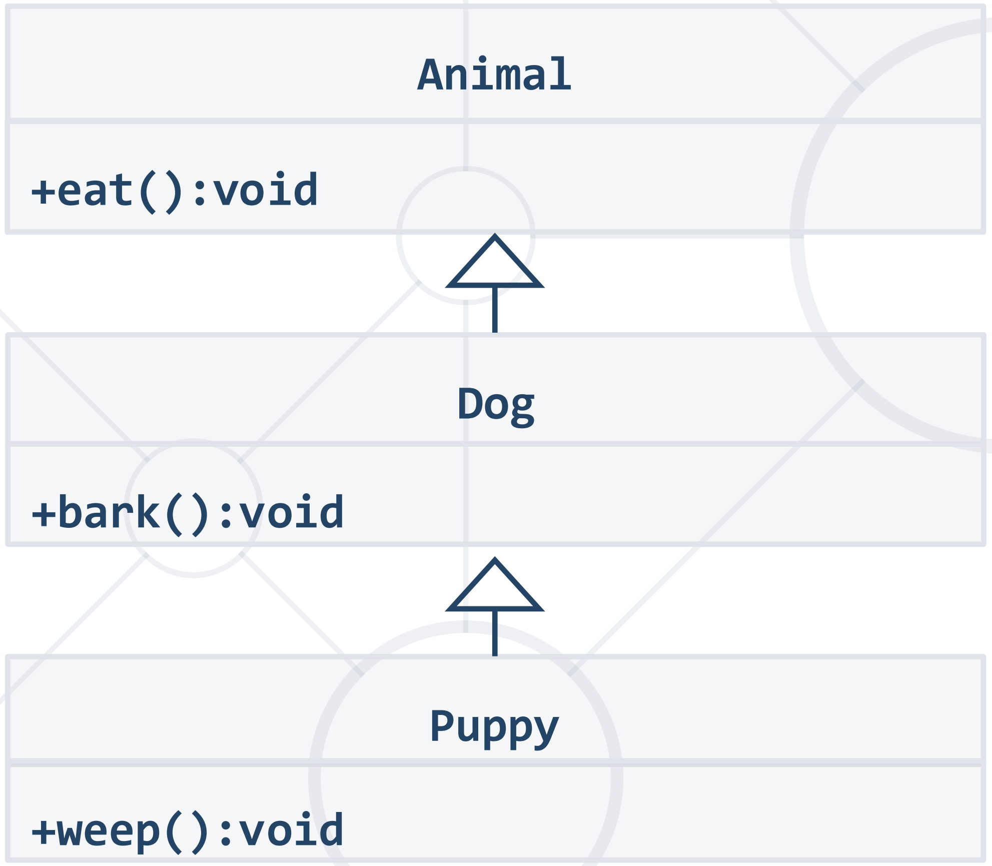
```
public static void main(String[] args) {

    Dog dog = new Dog();
    dog.eat();
    dog.bark();
}
```



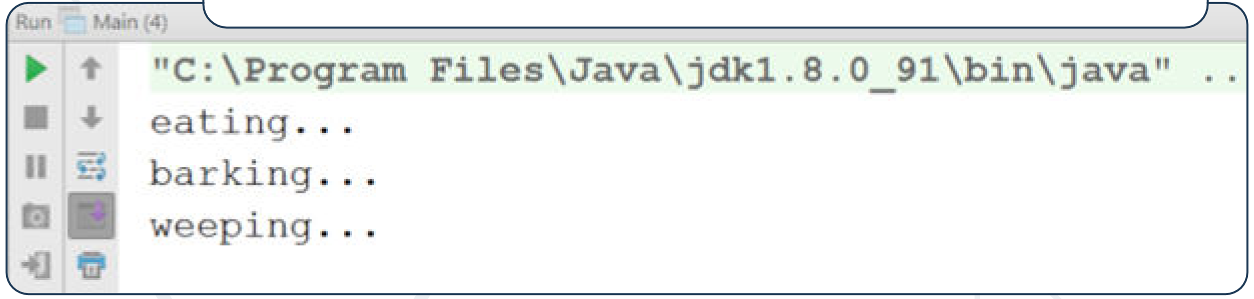
```
"C:\Program Files\Java\jdk1.8.0_91\bin\java" ...
eating...
barking...
```

Check your solution here :https://judge.softuni.bg/Contests/1574/Inheritance-Lab

Problem: Multiple Inheritance



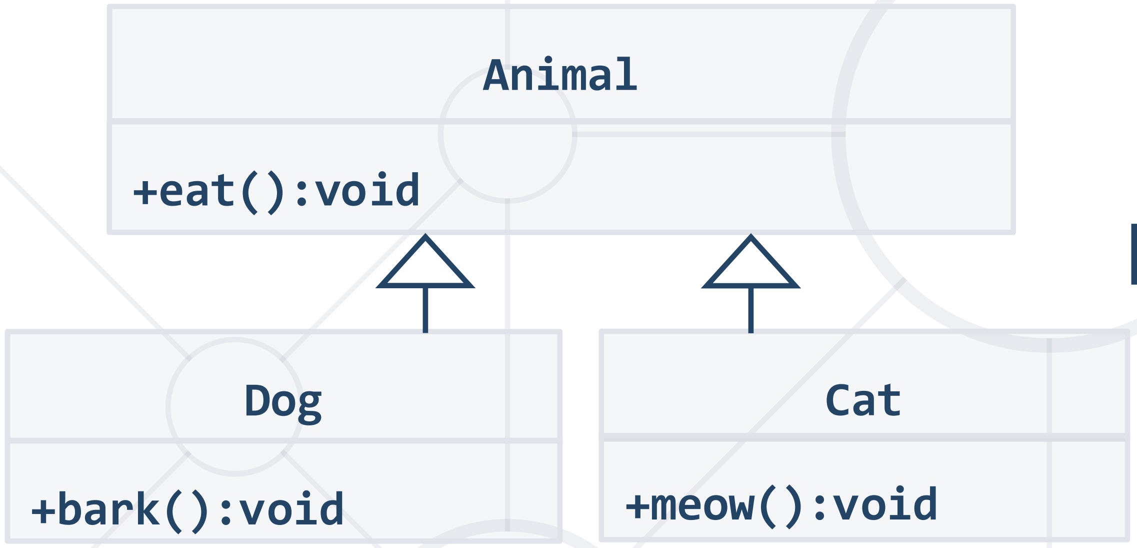
```java
Puppy puppy = new Puppy();
puppy.eat();
puppy.bark();
puppy.weep();
```



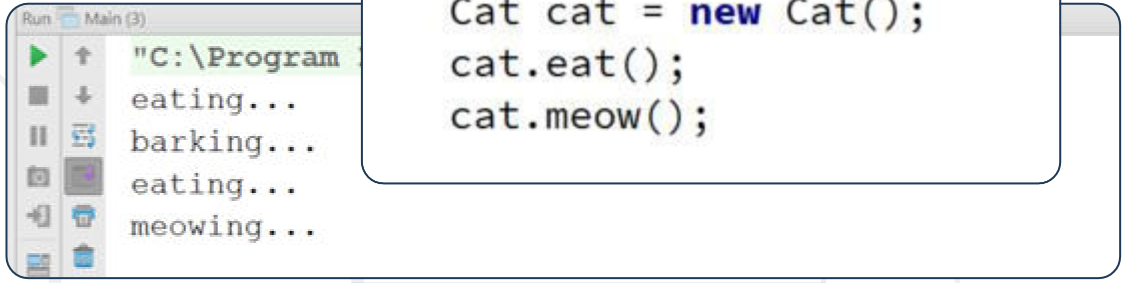
```
"C:\Program Files\Java\jdk1.8.0_91\bin\java" ..
eating...
barking...
weeping...
```

Check your solution here :https://judge.softuni.bg/Contests/1574/Inheritance-Lab

Problem: Hierarchical Inheritance



```
Dog dog = new Dog();
dog.eat();
dog.bark();

Cat cat = new Cat();
cat.eat();
cat.meow();
```



```
"C:\Program
eating...
barking...
eating...
meowing...
```

Check your solution here :https://judge.softuni.bg/Contests/1574/Inheritance-Lab

Reusing Classes

Reusing Code at Class Level

Inheritance and Access Modifiers

- Derived classes **can acces all public** and **protected** members
- Derived classes can access **default** members **if in same package**
- **Private** fields **aren't inherited** in subclasses (can't be accesssed)

```
class Person {
  protected String address;
  public void sleep();
  String name;
  private String id;
}
```

Can be accessed through other methods

Shadowing Variables

- Derived classes **can hide** superclass variables

```
class Person { protected int weight; }
```

```
class Patient extends Person {
  protected float weight;
  public void method() {
    double weight = 0.5d;
  }
}
```

hides int weight

hides both

Shadowing Variables - Access

- Use **super** and **this** to specify member access

```java
class Person { protected int weight; }
```

```java
class Patient extends Person {
  protected float weight;
  public void method() {
    double weight = 0.5d;
    this.weight = 0.6f;
    super.weight = 1;
  }
}
```

Local variable

Instance member

Base class member

Overriding Derived Methods

- A **child class** can redefine existing methods

```
public class Person {
   public void sleep() {
      System.out.println("Person sleeping"); }
}

public class Student extends Person {
   @Override
   public void sleep(){
      System.out.println("Student sleeping"); }
}
```

Method in base class **must not be final**

Signature and return type **should match**

Final Methods

- **final** – defines a method that **can't be overridden**

```
public class Animal {
  public final void eat() { … }
}
```

```
public class Dog extends Animal {

  @Override
  public void eat() {} // Error…
}
```

Final Classes

- Inheriting from a final classes is forbidden

```
public final class Animal {
  …
}
```

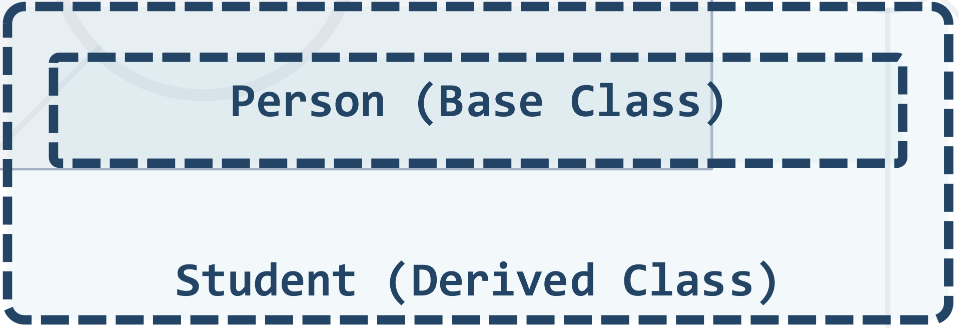
```
public class Dog extends Animal { }       // Error…
public class MyString extends String { } // Error…
public class MyMath extends Math { }      // Error…
```

Inheritance Benefits - Abstraction

- One approach for providing abstraction

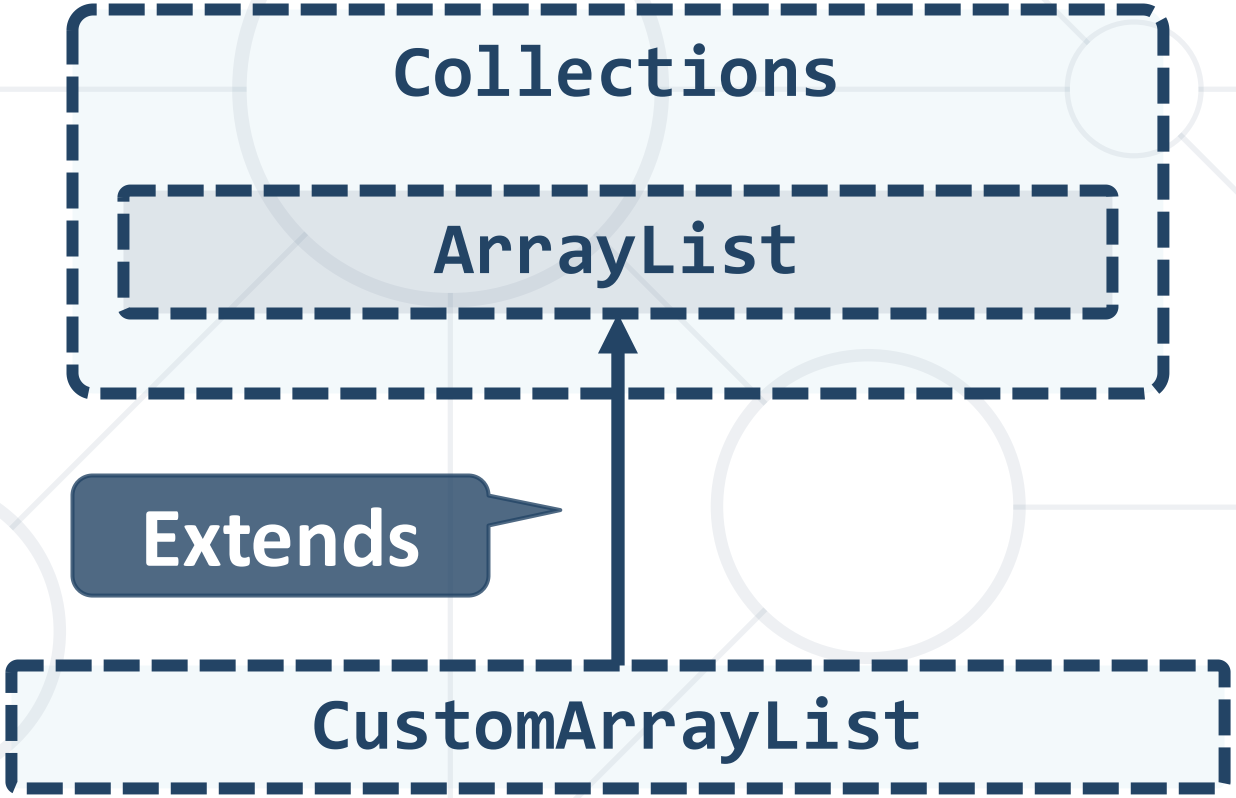
Focus on common properties

```
Person person = new Person();
Student student = new Student();

List<Person> people = new ArrayList();

people.add(person);
people.add(student);
```



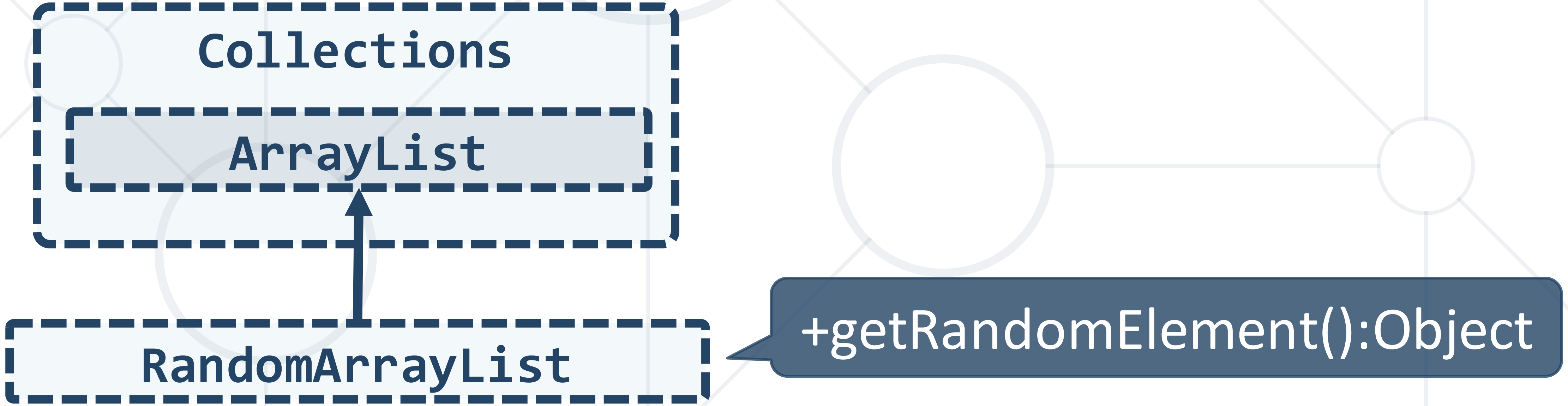
Inheritance Benefits – Extension

- We can **extend a class** that we **can't otherwise change**



Problem: Random Array List

- Create an array list that has
  - All functionality of an ArrayList
  - Function that returns and removes a random element



Check your solution here :https://judge.softuni.bg/Contests/1574/Inheritance-Lab

Solution: Random Array List

```java
public class RandomArrayList extends ArrayList {
  private Random rnd; // Initialize this…

  public Object getRandomElement() {
    int index = this.rnd.nextInt(super.size());
    Object element = super.get(index);
    super.remove(index);
    return element;
  }
}
```

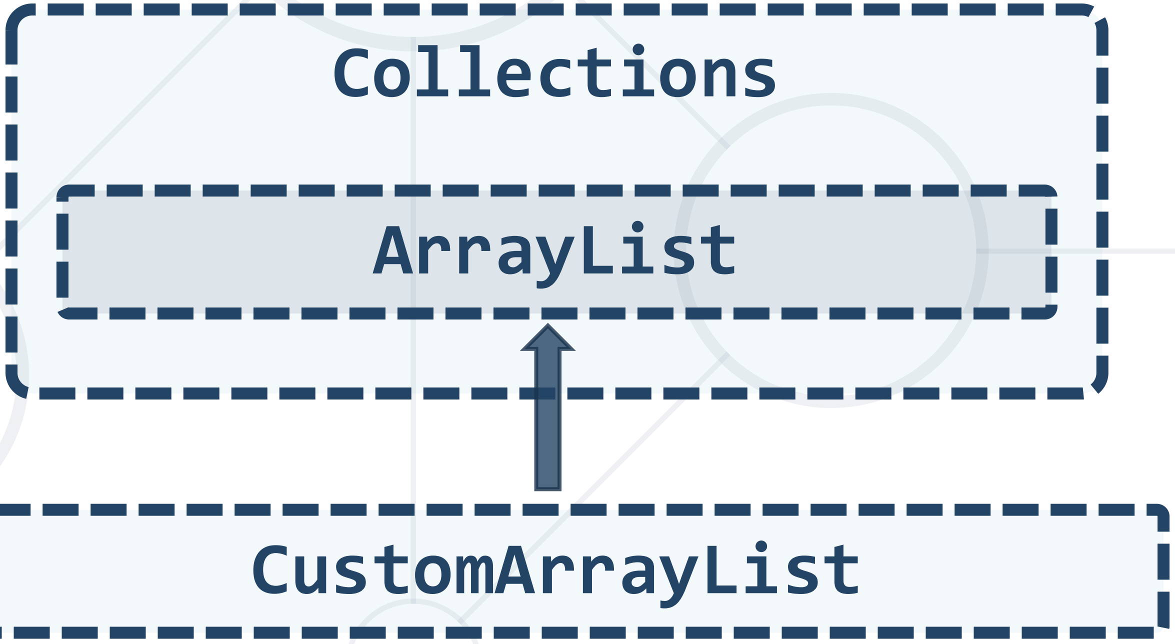
Check your solution here :https://judge.softuni.bg/Contests/1574/Inheritance-Lab

Types of Class Reuse

Extension, Composition, Delegation

Extension

- **Duplicate code** is error prone
- **Reuse classes** through **extension**
- Sometimes the only way

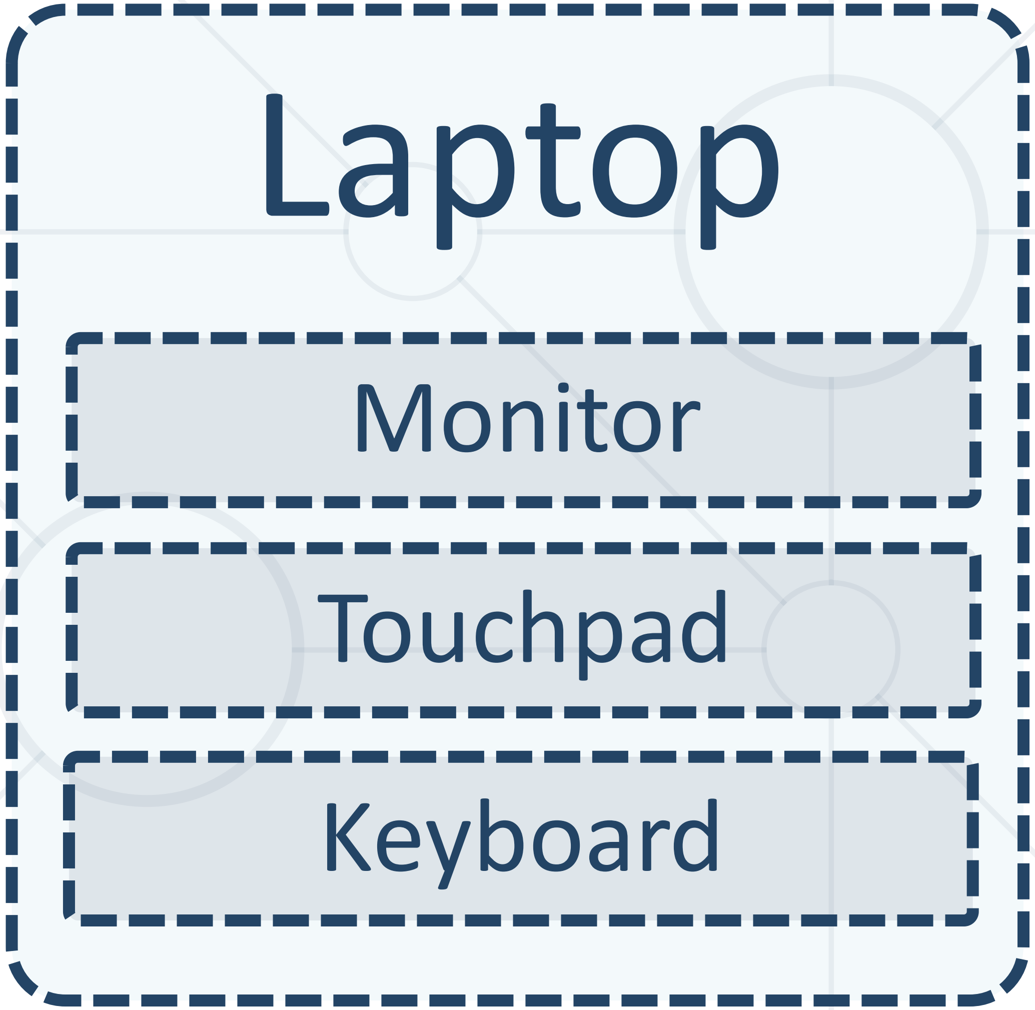


Composition

- Using classes to define classes

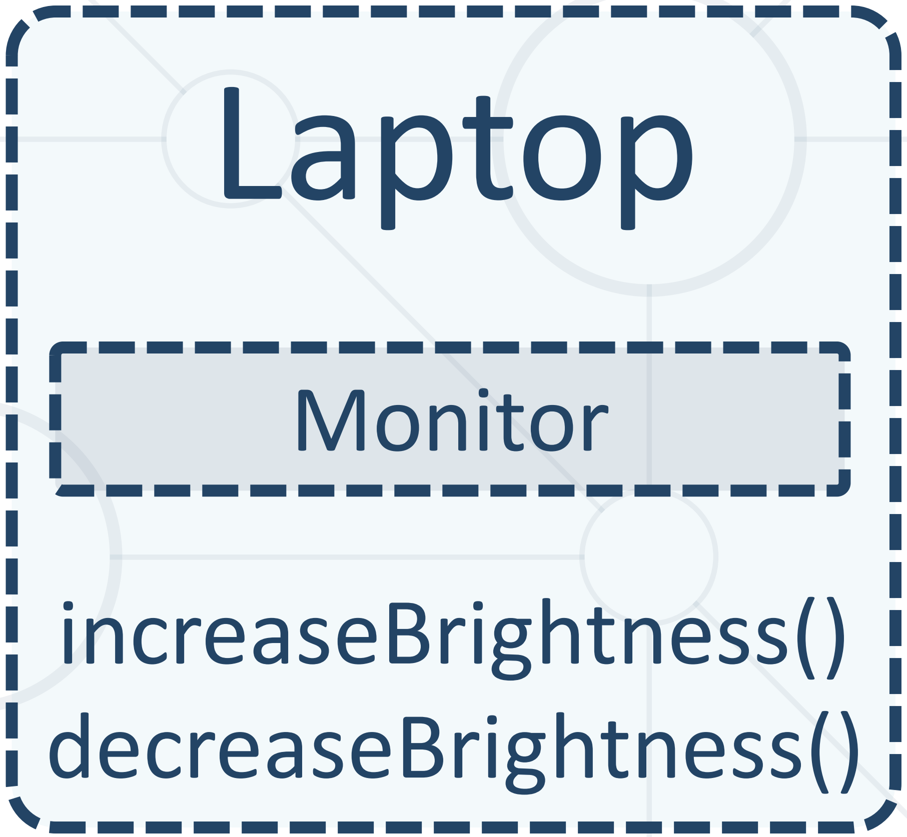
```
class Laptop {
  Monitor monitor;
  Touchpad touchpad;
  Keyboard keyboard;
  …
}
```

Reusing classes



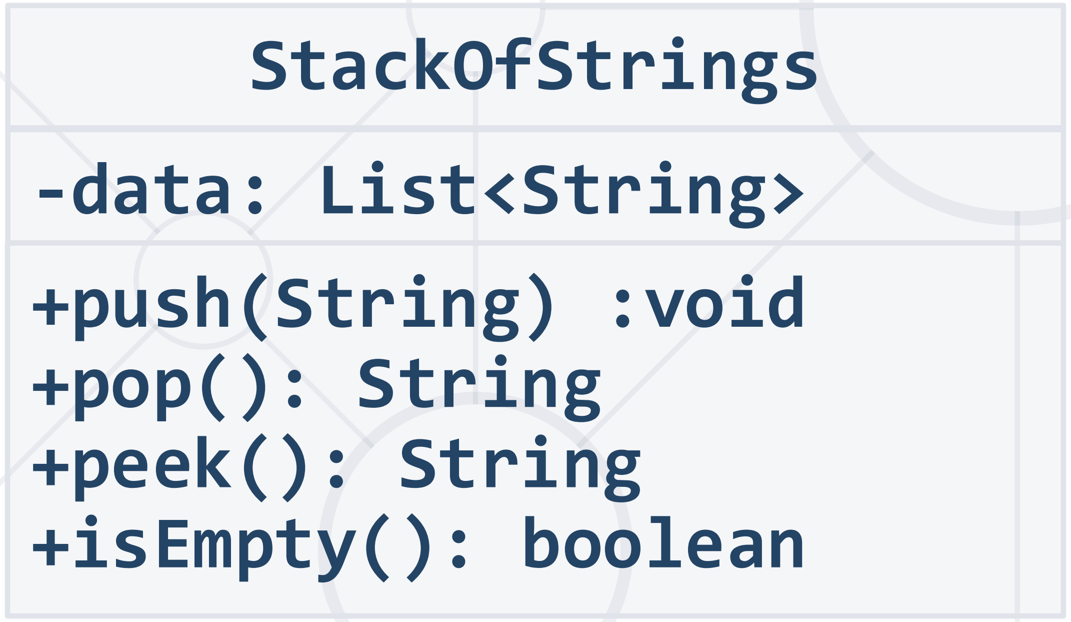
Delegation

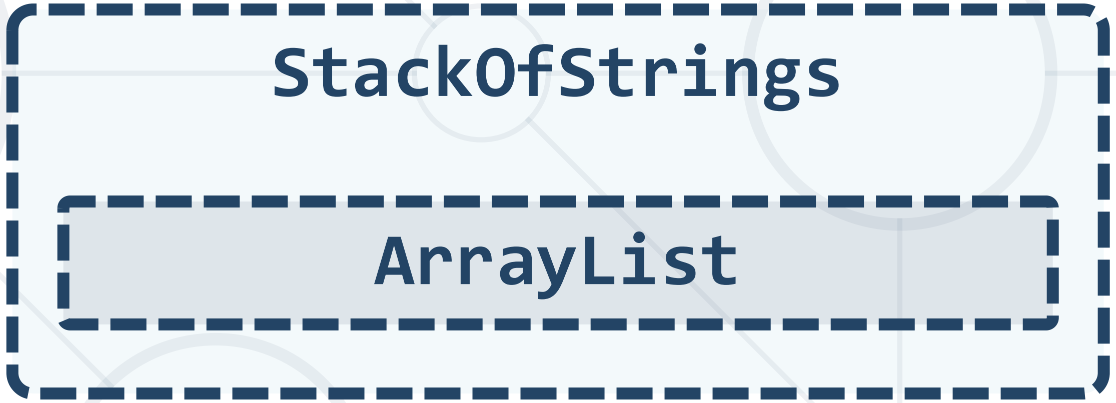
```
class Laptop {
  Monitor monitor;
  void incrBrightness() {
    monitor.brighten();
  }

  void decrBrightness() {
    monitor.dim();
  }
}
```



Problem: Stack of Strings

- Create a simple Stack class which can store only strings





```
StackOfStrings sos = new StackOfStrings();
sos.push("one");
System.out.println(sos.pop());
System.out.println(sos.isEmpty());
System.out.println(sos.peek());
```

Check your solution here :https://judge.softuni.bg/Contests/1574/Inheritance-Lab

Solution: Stack of Strings

```java
public class StackOfStrings {
  private List<String> container;
  // TODO: Create a constructor
  public void push(String item) { this.container.add(item); }
  public String pop() {
    // TODO: Validate if list is not empty
    return this.container.remove(this.container.size() - 1);
  }
}
```

Check your solution here :https://judge.softuni.bg/Contests/1574/Inheritance-Lab

When to Use Inheritance

- Classes share **IS-A** relationship ← **Too simplistic**
- Derived class **IS-A-SUBSTITUTE** for the base class
- Share the **same role**
- Derived class is the **same as the base class** but adds a **little bit more functionality**

Summary

- Inheritance is a powerful tool for **code reuse**
- **Subclass inherits** members from **Superclass**
- Subclass can **override** methods
- Look for classes with the **same role**
- Look for **IS-A** and **IS-A-SUBSTITUTE** for relationship
- Consider **Composition** and **Delegation** instead

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