Test Automation
Lecture 5 –
Inheritance

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Table of contents

- Basics – what is inheritance, when to use it , why use it
- Class – The basic unit of a java program. What's a package, static field and access modifiers
- Constructors in the context of inheritance
- Method overriding
- Examples from the Java API. Class Object

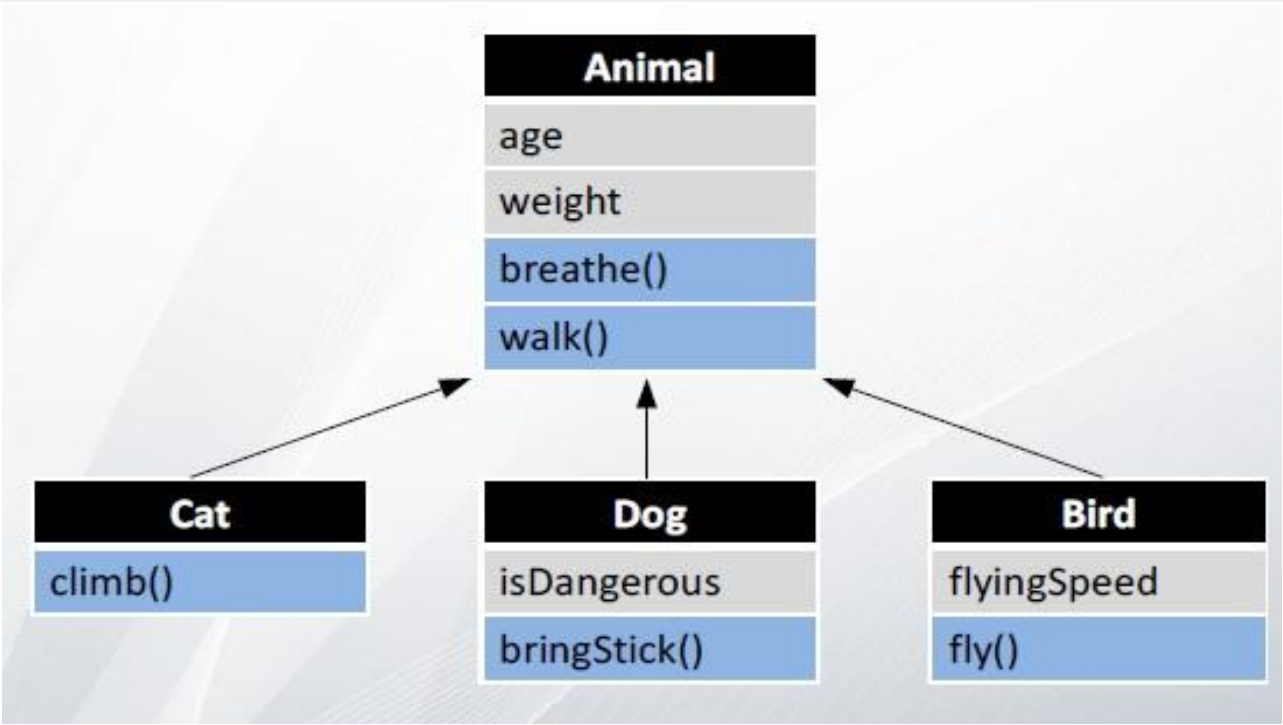
Basics

- Inheritance is one of principles of the OOP
- Inheritance is the ability of a class to implicitly gain some(or all) members of another class
- Inheritance builds a relationship between classes
- The class that gains the functionality is called subclass (child class or derived class). The other class is called base(parent or superclass)
- The main purpose of inheritance is reusability of the code

Problem

- Cats, dogs and birds have age and weight.
- They also can breathe and walk.
- Actually, they are animals and every animal has age, weight and can breathe and walk.

Problem



- Is this the same?
- Yes, but the common logic is only in the class Animal

Inheritance syntax in Java

- Inheritance in java is provided through the keyword *extends i.e the subclass class extends the superior*
- Each class can extend only one class

Animal example


```
package com.pragmatic.lesson5.inheritance.simple

public class Animal {
	int age;

	double weight;

	void breathe() {
		System.out.println("Breathing...");
	}
	void walk() {
		System.out.println("Walking...");
	}
}
```

Animal example

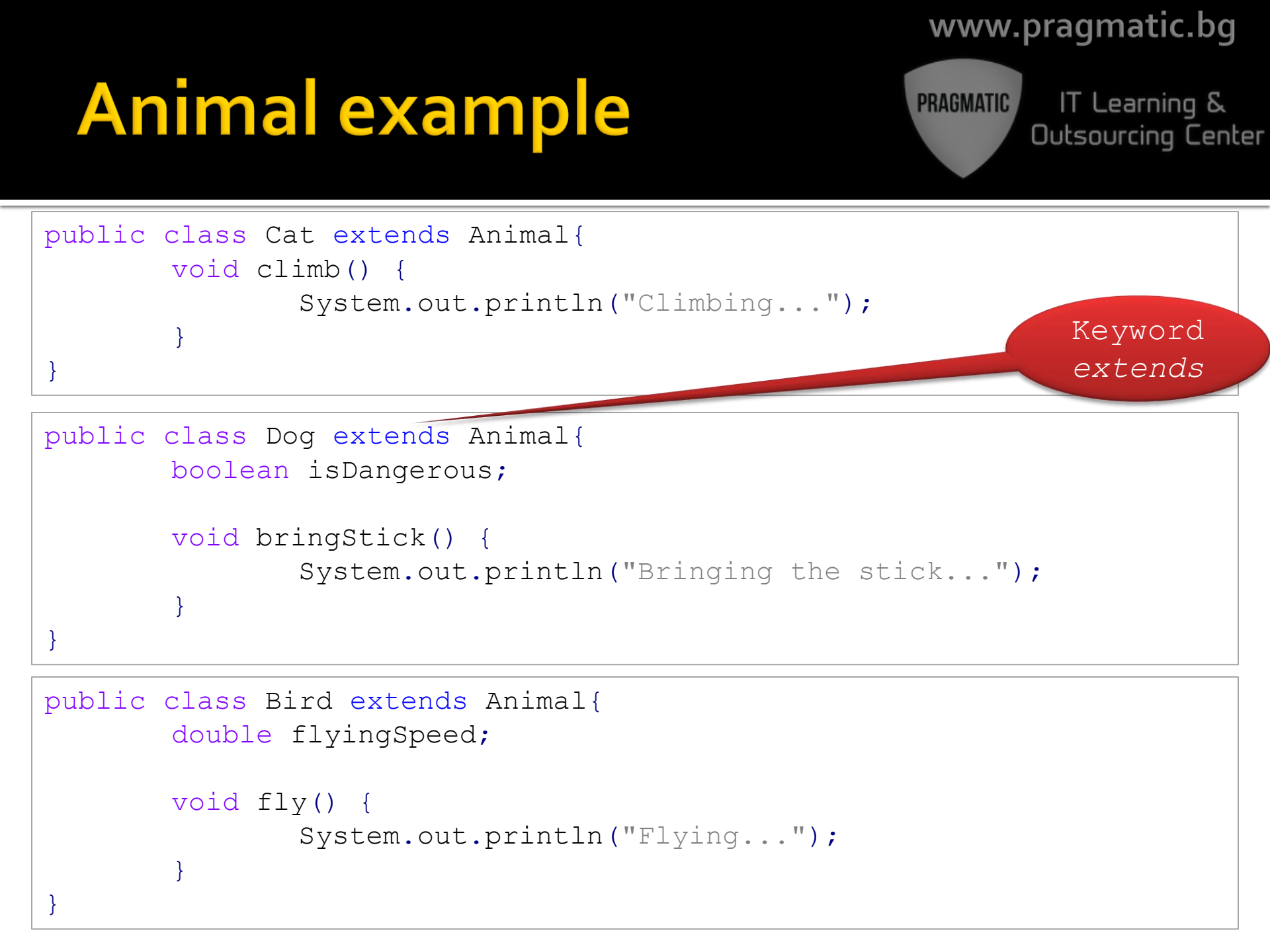
```
public class Cat extends Animal{
        void climb() {
                System.out.println("Climbing...");
        }
}
```

```
public class Dog extends Animal{
        boolean isDangerous;

        void bringStick() {
                System.out.println("Bringing the stick...");
        }
}
```

```
public class Bird extends Animal{
        double flyingSpeed;

        void fly() {
                System.out.println("Flying...");
        }
}
```



'is a' and a 'has a' relationship

- Two of the main techniques for code reuse are class inheritance and object composition
- 'is a' relationship is expressed with inheritance
- 'has a' relationship is expressed with composition

Example using classes House, Building and Bathroom

- Is a: House is a Building
- has a: House has a Bathroom

Inheritance vs Composition

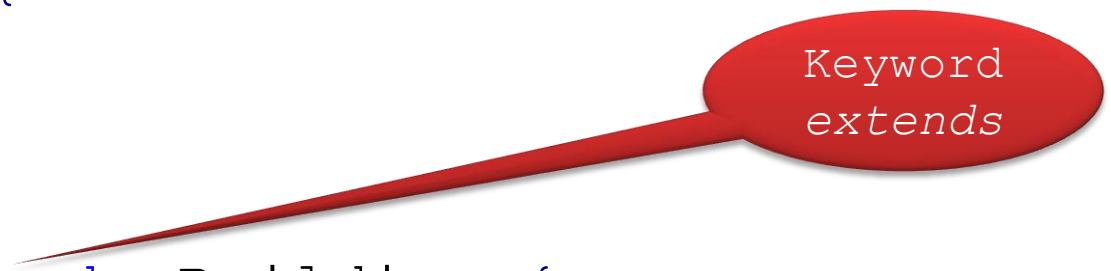
- Inheritance is uni-directional:

House is a Building. But Building is not a House.

- Inheritance uses *extends key word*

```
class Building {
      //...
}

class House extends Building {
      //...
}
```



- Composition is used when House has a Bathroom. It is incorrect to say House is a Bathroom

- Composition simply means using instance variables that refer to other objects. The class House will have an instance which refers to a Bathroom object

```
class House {
    Bathroom bathroom;
    //...
}
```

Inheritance Example

- Now lets take a look everything we've said about inheritance under the com.pragmatic.lesson5.inheritance.simple package

The Class - Package

- A Java package is a mechanism for organizing Java classes into namespaces
- Hierarchical units identical to folders – on the file system the packages are presented as folders
- Provide grouping of related types(classes)
- Provide access protection and space management
- Package names cannot contain java key words

Method overriding

- A subclass can predefine the methods of its parent
- This is called overriding
- To override a method:
  - Use its name as it's in the parent class
  - Use the same number and order of method arguments
  - Use the same return type(or subtype of the type returned by the overridden method. This is called a covariant return type)

Method overriding example

- Birds can fly. The eagle and the sparrow are birds and can fly. Although the eagle can fly highly and fast.

```
public class Eagle extends Bird{
    public void fly(){
      System.out.println("Flying highly like an eagle");
    }
}
```

```
public class Sparrow extends Bird{
     public void fly(){
       System.out.println("Flying like a sparrow");
     }
}
```

More about overriding

- Methods declared protected in a superclass must either be protected or public in subclasses; they cannot be private.

- Methods declared private are not inherited at all, so there is no rule for them.

More about overriding

- Overriding is used for Polymorphism

(we'll talk about this in the next lesson)

- You can invoke the parent method when overriding it - keyword *super* is used

Try to override method startEngine in class SportCar. In the body of the method first invoke startEngine of the parent, and then switch on the turbo.

More about overriding


```
public class Car {
    ...
    public void startEngine() {
      System.out.println("Starting engine...");
    }
    ...
}
```

```
public class SportCar extends Car {
    ...
    public void startEngine() {
      super.startEngine();
      switchTurbo(true);
    }
}
```

Overriding startEngine()

Invoking startEngine() of parent class

Try to override equals(Object obj) and toString() too.

Class - Access modifiers

- Access modifiers are used to
  - Control access to classes (top level), methods, constructors or fields (bottom level) from outside the class
- For top level (classes) there are *public, package* and in some cases *private(inner classes)*
- For bottom level: *public, protected, package and private*

Explaining *public*, *private* and *default*

- *public* – gives access to the class, field or method from everywhere outside the class
- *private* – access is restricted only within the class
- *default/package* – visible from within the class and all other classes in the package
- *protected* – the fields and methods are visible to the *classes* within the same package and in the child classes
- Nice explanation - http://www.java-made-easy.com/java-access-modifiers.html

Access modifiers in inheritance

- *public, private* and default(package)
- *protected* fields and methods is visible to the *classes* within the same package and in the child classes

Table with access levels:

	Class	Package	Subclass (in the same pkg)	Subclass	World
public	Yes	Yes	Yes	Yes	Yes
protected	Yes	Yes	Yes	Yes	No
default	Yes	Yes	Yes	No	No
private	Yes	No	No	No	No

Purpose of access modifiers

- Problem: If all fields of class Person are public they will be accessible from everywhere which violates the Encapsulation principle of OOP
- Accessibility directly to fields is dangerous and unsecure
- For accessing private fields outside the class are used public methods called „getter“ and „setter“
- Lets demonstrate some things under the com.pragmatic.lesson5.inheritance.cars package

Getters and setters

- Getters are used for getting the value of private field outside the class.
- It should be implemented only if is necessary
- Setters are void methods and are used for setting the value of private field outside the class
- Validation can be implemented as part of the setter's body

Getter and setter example


```
private int age;

public int getAge() {
      return age;
}

public void setAge(int age) {
      if(age >= 0) {
            this.age = age;
      }
}
```

Keyword *final*

- Final is a keyword or reserved word in java and can be applied to member variables, methods, class and local variables in Java.
- You use the final keyword in a method declaration to indicate that the method cannot be overridden by subclasses
- A class that is declared final cannot be inherited
- Setting fields or argument of some reference type as final don't guarantee that its state won't be changed. It only guarantee that the reference won't be changed. In other words, final is only about the reference itself, and not about the contents of the referenced object.

Using keyword *final* for method's parameters

- The same logic as when using with fields – the parameter cannot be changed in the method's body

```
public void setAgeFromOtherPerson(final Person person)
{
        this.age = person.getAge();
}
```

- !!! Be careful with fields and parameters of some reference type. Once again:

Setting fields or argument of some reference type as final don't guarantee that its state won't be changed. It only guarantee that the reference won't be changed.

Using keyword *final* for variable in some block of code


```
public class Demo {
	public static void main(String[] args) {
		Car bmw = new Car("BMW 330", true, "Red");
		Car ford = new Car("Ford Fiesta", false,
"Black", 2000, 330);
		final Car MY_CAR = bmw;
		MY_CAR = ford; // !!!COMPILE ERROR!!!

		final int MY_AGE = 20;
		MY_AGE = 21; // !!!COMPILE ERROR!!!
	}
}
```

Static fields

- Keyword *static* indicate the field as static
- Static fields belong to the class – not the instances of a class
- Static fields are shared between the objects because they belong to the class
- Static reference can be and should be referenced via class' name, example: Class.field

Static fields

If some object change the value of a static fields, its changed in all object of this class

Try it with few simple objects!

Subclass Constructors

- Invocation of a superclass constructor must be the first line in the subclass constructor
- Keyword *super* is used for this
- If a constructor does not explicitly invoke a superclass constructor, the Java compiler automatically inserts a call to the default constructor of the superclass.

Constructor chaining – Part 1

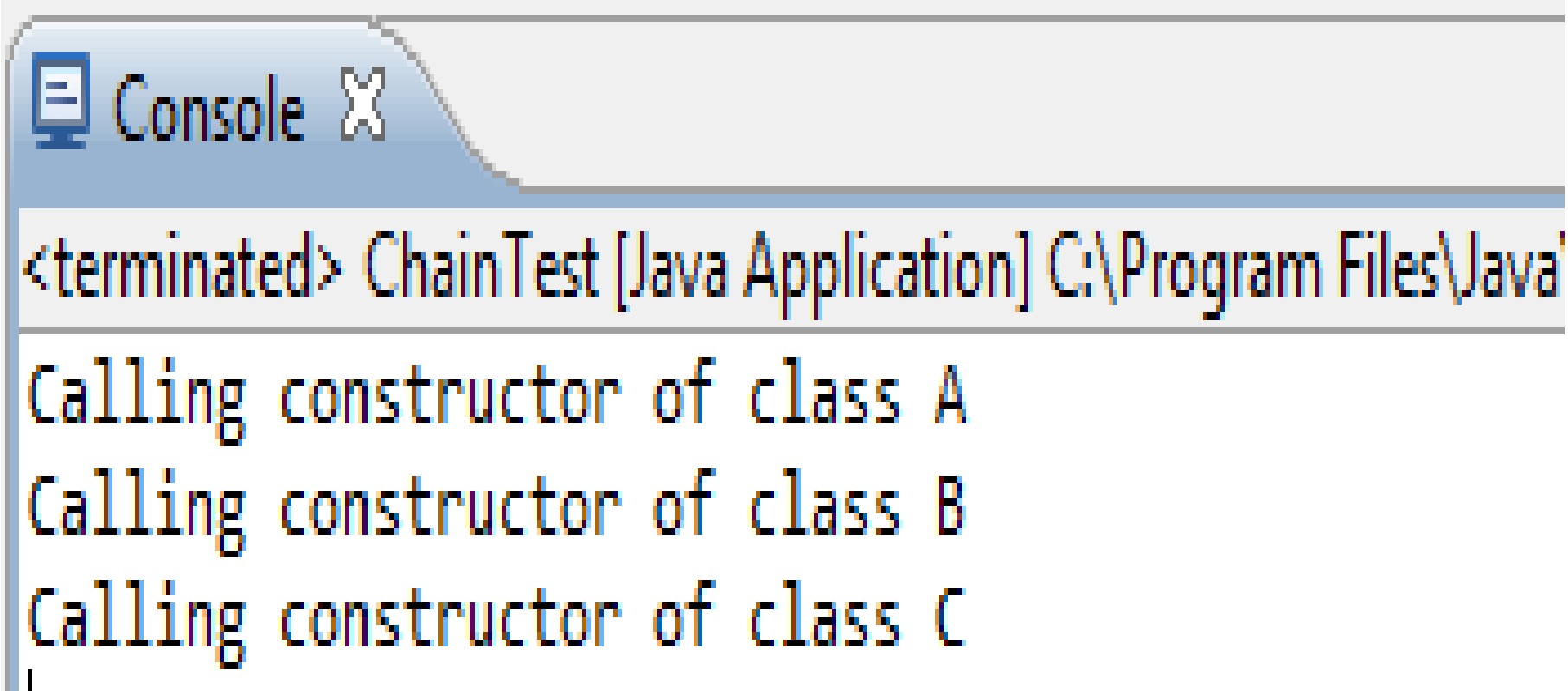
- When a subclass constructor invokes a constructor of its superclass, either explicitly or implicitly, there will be a whole chain of constructors calls

```
public class A {
    public A() {
     System.out.println("Calling constructor of class A");
    }
}
```

```
public class B extends A{
    public B() {
     System.out.println("Calling constructor of class B");
    }
}
```

```
public class C extends B{
    public C() {
     System.out.println("Calling constructor of class C");
    }
}
```

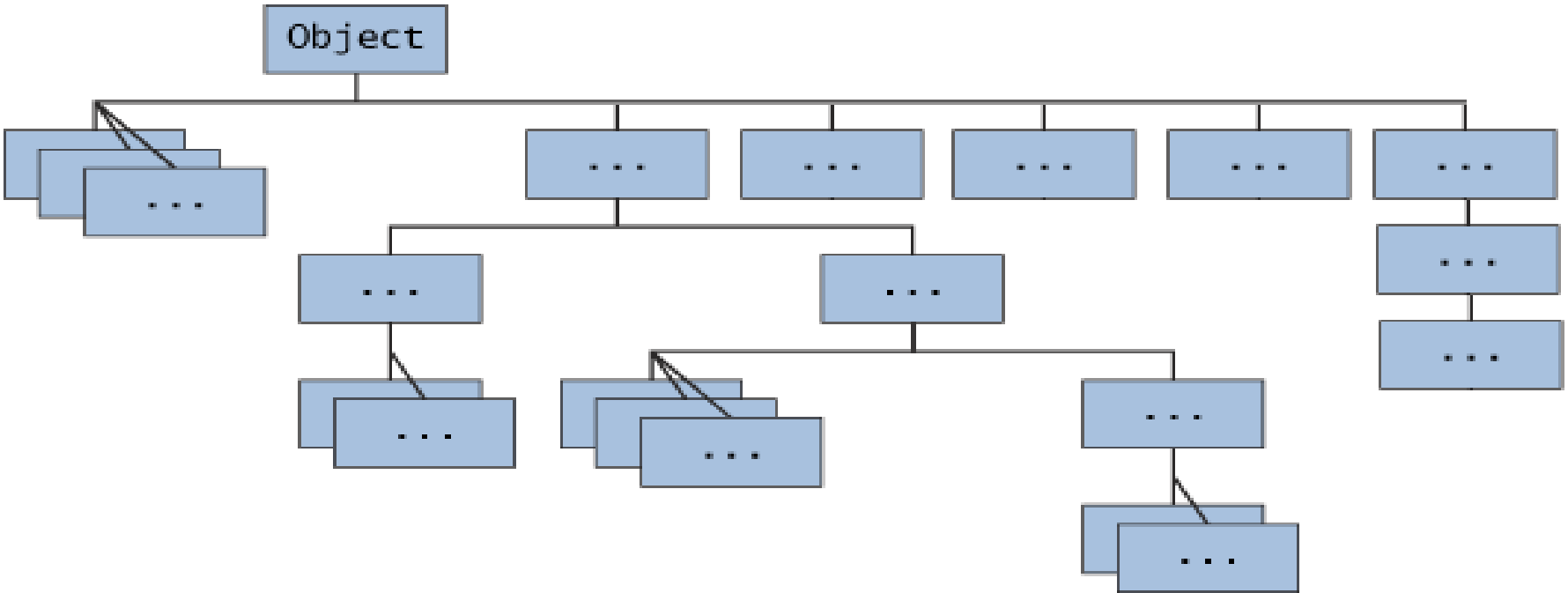
Constructor chaining – Part 2



Now lets have a look at the example under com.pragmatic.lesson5.inheritance.constructors

Java Class Hierarchy

- java.lang.Object is parent of all classes in Java
- It defines behavior common to all classes
- When you write class which don't extends other class, it implicitly derive from Object



Some methods of class Object

- Create a new class. Then instantiate it and use

Ctrl + Space in eclipse to view Object's methods

- `boolean equals(Object obj)`

Indicates whether some other object is "equal to" this one.

- `String toString()`

Returns a string representation of the object.

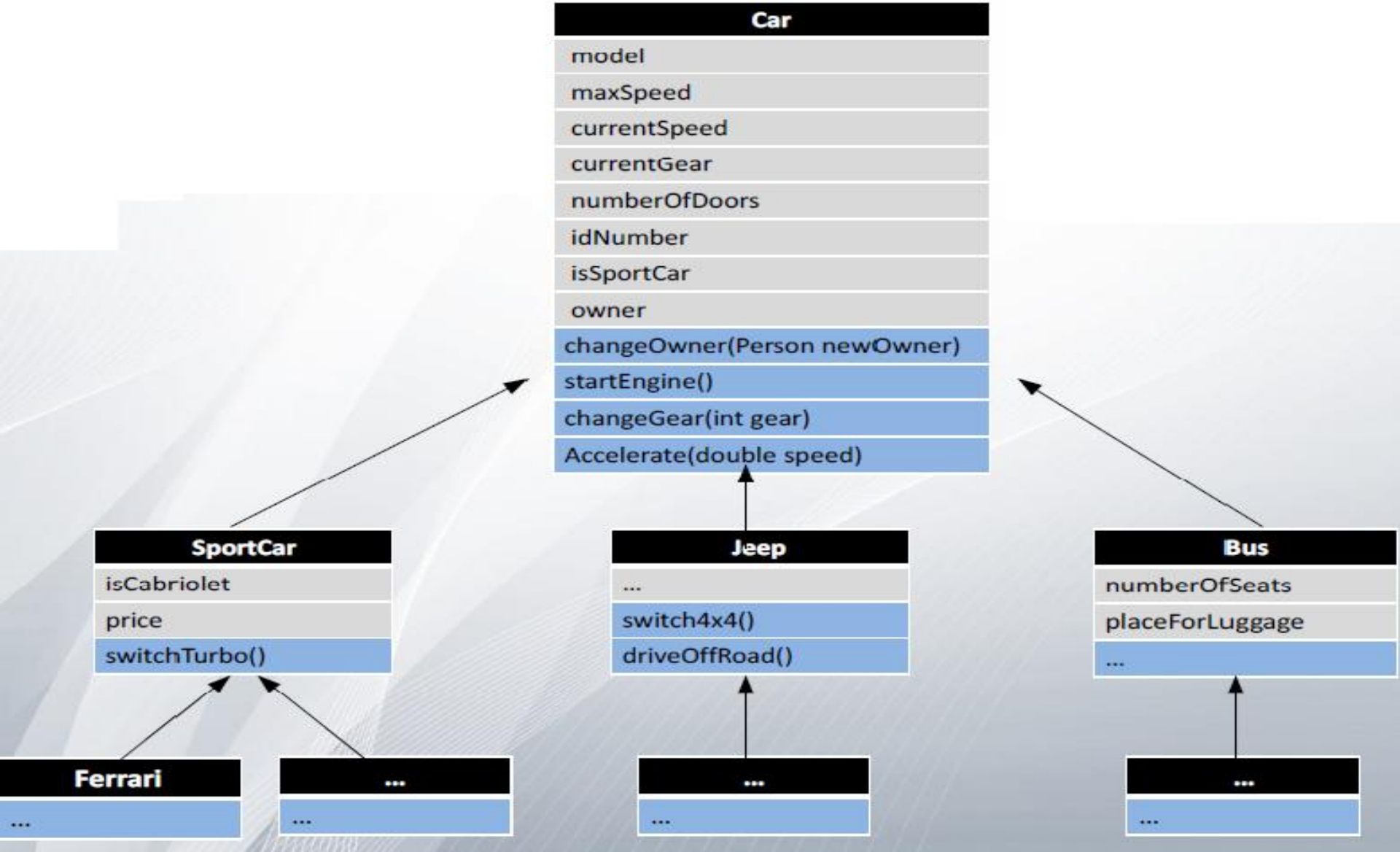
(later we'll write some equals and toString methods)

Cars example

Let's create Car hierarchy to demonstrate all described in the previous slides

We can use classes Car and Person from com.pragmatic.lesson5.inheritance.cars

Cars example



Using keyword *super* for fields and methods

- Subclasses classes can use functionality of the parent class through the keyword *super*
- Super can be used for fields, methods or constructors of the super class
- You can declare a field in the subclass with the same name as the one in the superclass (not recommended)

Try setting isSportCar to true in class Car.
What happen if class SportCar declare its own field isSportCar?

Summary

- What is inheritance and how to use it?
- 'Is a' and 'has a' relationship
- Access modifiers in context of inheritance
- Invoking constructors of the superclass and constructor chaining
- Java hierarchy
- How to use *super* keyword*?*
- What is method overriding?
- What is the constraints when overriding method?