4. Object-Oriented Programming Concepts

Java

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Outline

What Is an Object?

Real-world objects

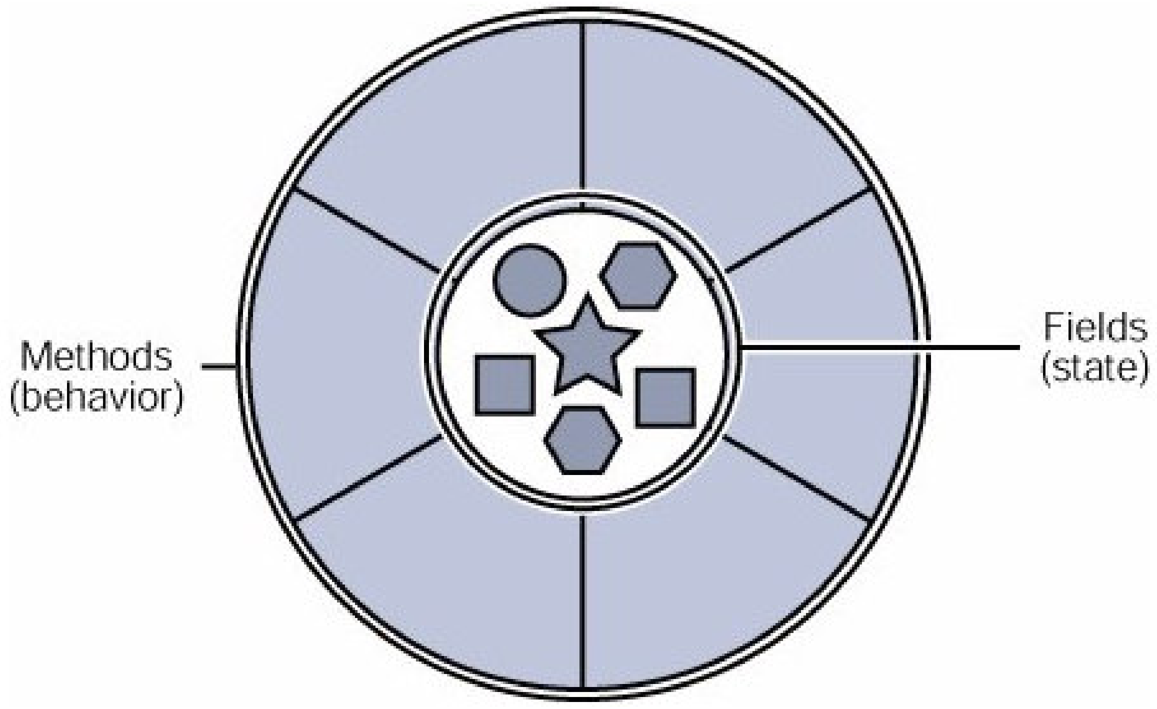
- **Real-world objects**:
  - your bicycle
  - your desk lamp
  - your desk radio
  - your television set
  - ….
- Real-world objects have two characteristics:
  - **State**
  - **Behavior**

Real-world objects

- **Bicycles**:
  - **States**: current gear, current pedal cadence, current speed
  - **Behavior**: changing gear, changing pedal cadence, applying brakes
- **Desktop lamp**:
  - **States**: on, off
  - **Behavior**: turn on, turn off
- **Desktop radio**:
  - **States**: on, off, current volume, current station
  - **Behavior**: turn on, turn off, increase volume, decrease volume, scan

Software objects

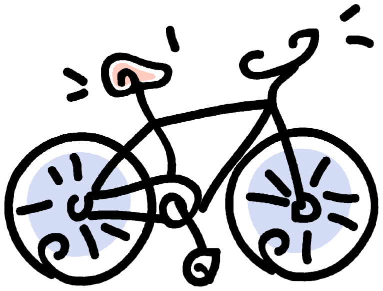
- An object stores its state in **fields** (**variables**)
- An object represents its behavior through **methods** (**functions**)

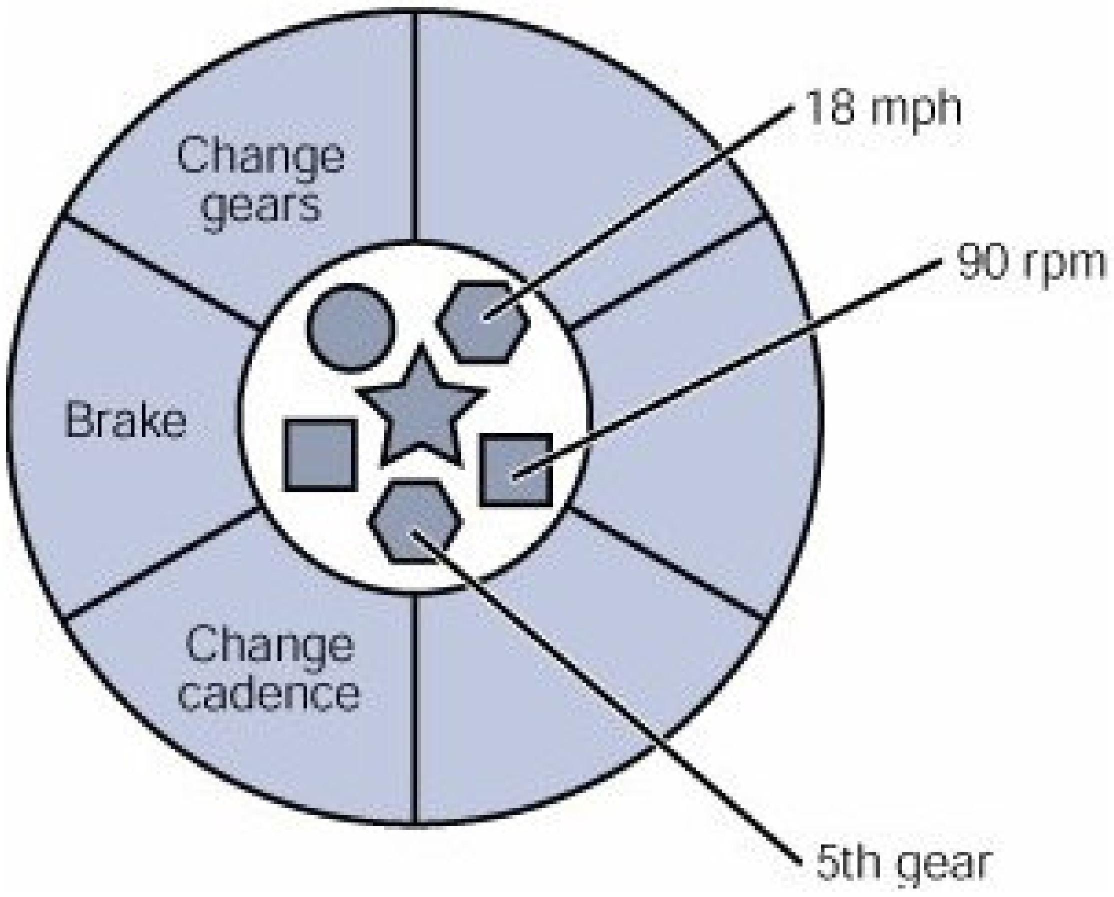


Data Encapsulation

- **Data encapsulation**
  - Methods operate on an **object's internal state**
  - Hiding internal state and requiring all interaction to be performed through an object's methods is known as **data encapsulation**.

A bicycle modeled as a software object





Benefits of objects-oriented programming

- **Modularity**:
  - The source code for an object can be written and maintained independently of the source code for other objects.
- **Information-hiding**:
  - By interacting only with an object's methods, the details of its internal implementation remain hidden from the outside world.
- **Code re-use**:
  - If an object already exists (perhaps written by another software developer), you can use that object in your program.
- **Debugging ease**:
  - If a particular object turns out to be problematic, you can simply remove it from your application and plug in a different object as its replacement.

What Is a Class?

What Is a Class?

- A class is the **blueprint** from which individual objects are created.
- Example:
  - Each bicycle was built from the same set of blueprints and therefore contains the same components is an instance of the class of objects known as bicycles.
- Java program:
  - Bicycle.java
  - BicycleDemo.java

BicycleDemo class

- The output of this test prints the ending pedal cadence, speed, and gear for the two bicycles:

```
cadence:50 speed:10 gear:2
cadence:40 speed:20 gear:3
```

What Is Inheritance?

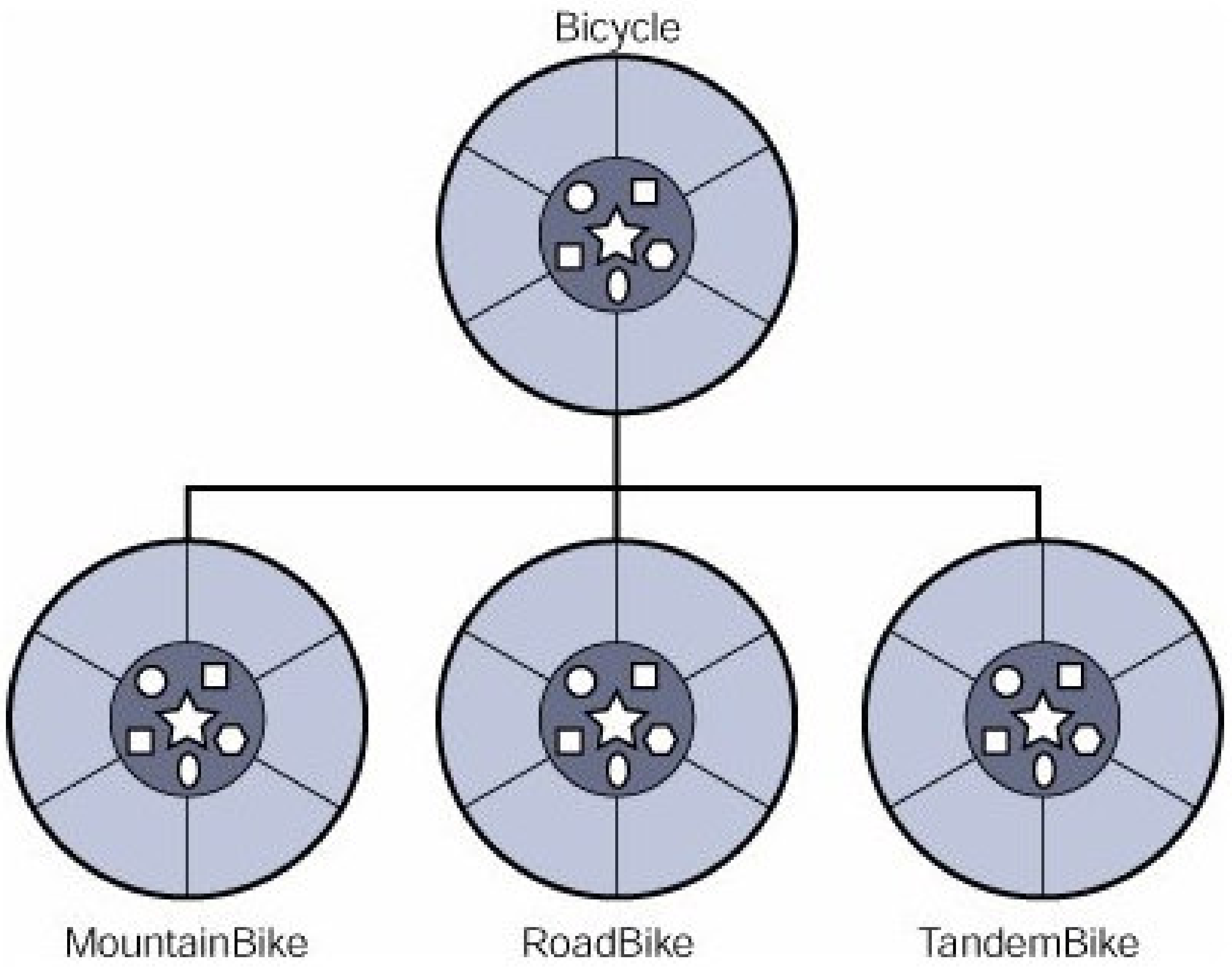
What Is Inheritance?

- Suppose there are three kinds of bicycles
  - **Mountain bikes**, **road bikes**, and **tandem bikes**
- All share the characteristics of bicycles (current speed, current pedal cadence, current gear).
- Yet each also defines additional features that make them different:
  - tandem bicycles have two seats and two sets of handlebars
  - road bikes have drop handlebars;
  - mountain bikes have an additional chain ring

What Is Inheritance?

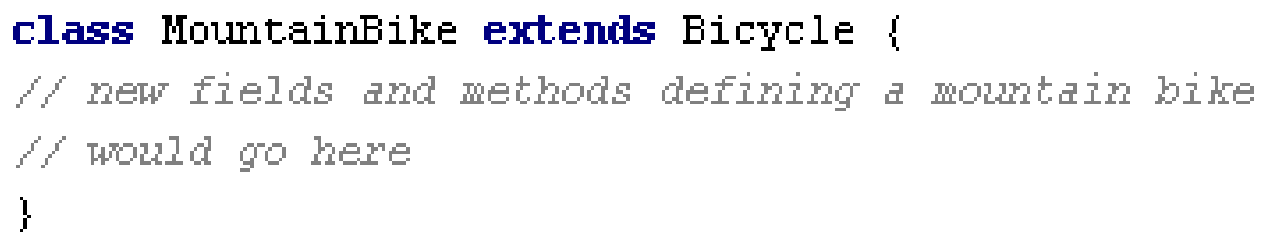
- **Superclass**
  - Bicycle now becomes the **superclass** of **MountainBike**, **RoadBike**, and **TandemBike**.
- **Inheritance**
  - Object-oriented programming allows classes to inherit commonly used state and behavior from a superclass.
- In the Java programming language, each class is allowed:
  - to have one direct superclass, and
  - each superclass has the potential for an **unlimited** number of subclasses

A hierarchy of bicycle classes



Creating a subclass

- The syntax for creating a subclass:



```
class MountainBike extends Bicycle {
// new fields and methods defining a mountain bike
// would go here
}
```

- This gives **MountainBike** all the same fields and methods as **Bicycle**, yet allows its code to focus exclusively on the features that make it unique.

What Is an Interface?

What Is an Interface?

- An **interface** is a group of related methods with empty bodies.
- A bicycle's behavior, if specified as an interface, might appear as follows:

```
interface Bicycle {
    void changeCadence(int newValue);
    void changeGear(int newValue);
    void speedUp(int increment);
    void applyBrakes(int decrement);
    void printStates();
}
```

What Is an Interface?

- To implement this interface, the name of your class would change to **ACMEBicycle**, and you'd use the **implements** keyword in the class declaration:

```
class ACMEBicycle implements Bicycle {
    // remainder of this class implemented as before
}
```

- If your class claims to implement an interface, all methods defined by that interface **must appear** in its source code before the class will successfully compile.

What Is a Package?

What Is a Package?

- A **package** is a namespace that organizes a set of related classes and interfaces.
- You can think of packages as being similar to different folders on your computer.
- The Java platform provides an enormous **class library** (classified in packages) suitable for use in your own applications.
- This library is known as the "**Application Programming Interface**," or "**API**" for short.

Application Programming Interface (API)

- API's packages represent the tasks most commonly associated with general purpose programming.
- The Java Platform API Specification contains the complete listing for all packages, interfaces, classes, fields, and methods supplied by the Java Platform 6, Standard Edition:
  - http://java.sun.com/javase/6/docs/api/

References

References

- S. Zakhour, S. Hommel, J. Royal, I. Rabinovitch, T. Risser, M. Hoeber, **The Java Tutorial: A Short Course on the Basics**, 4th Edition, Prentice Hall, 2006. (Chapter 2)

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