10.1 Abstract Keyword

Introduction

In Java, the abstract keyword is a non-access modifier used with classes and methods (but not variables) to achieve **abstraction**, one of the four pillars of **Object-Oriented Programming (OOP)**. Abstraction allows us to define a template or blueprint without requiring a full implementation. It's mainly used to hide the complex implementation details and show only the essential features of an object.

Abstract Methods in Java

Sometimes, you may only want to declare a method in a superclass without providing its implementation. This can be achieved using the abstract keyword. Such methods are often referred to as **subclass responsibilities**, as the subclass must provide their implementation. The superclass only specifies that the method exists but does not define its behaviour.

To declare an abstract method, use the following syntax:

```
abstract return_type methodName(parameters);
```

Key Characteristics:

- Abstract methods have no body; they only include the method signature, followed by a semicolon.
- A subclass that extends an abstract class **must** override and provide the implementation for all abstract methods; otherwise, the subclass will also be abstract.

Abstract Classes in Java

An **abstract class** is a class that may contain abstract methods (methods without implementation) as well as concrete methods (methods with implementation). You cannot instantiate an abstract class directly; it serves as a blueprint for other classes.

To declare an abstract class, you use the abstract keyword:

```
abstract class ClassName {
    // Abstract methods
    abstract void methodName();

    // Concrete methods
    void concreteMethod() {
        // method body
    }
}
```

Example:

```
abstract class Car {
    // Abstract method
    public abstract void drive();

    // Concrete method
    public void playMusic() {
        System.out.println("Playing music...");
    }
}
```

Characteristics of the Abstract Keyword

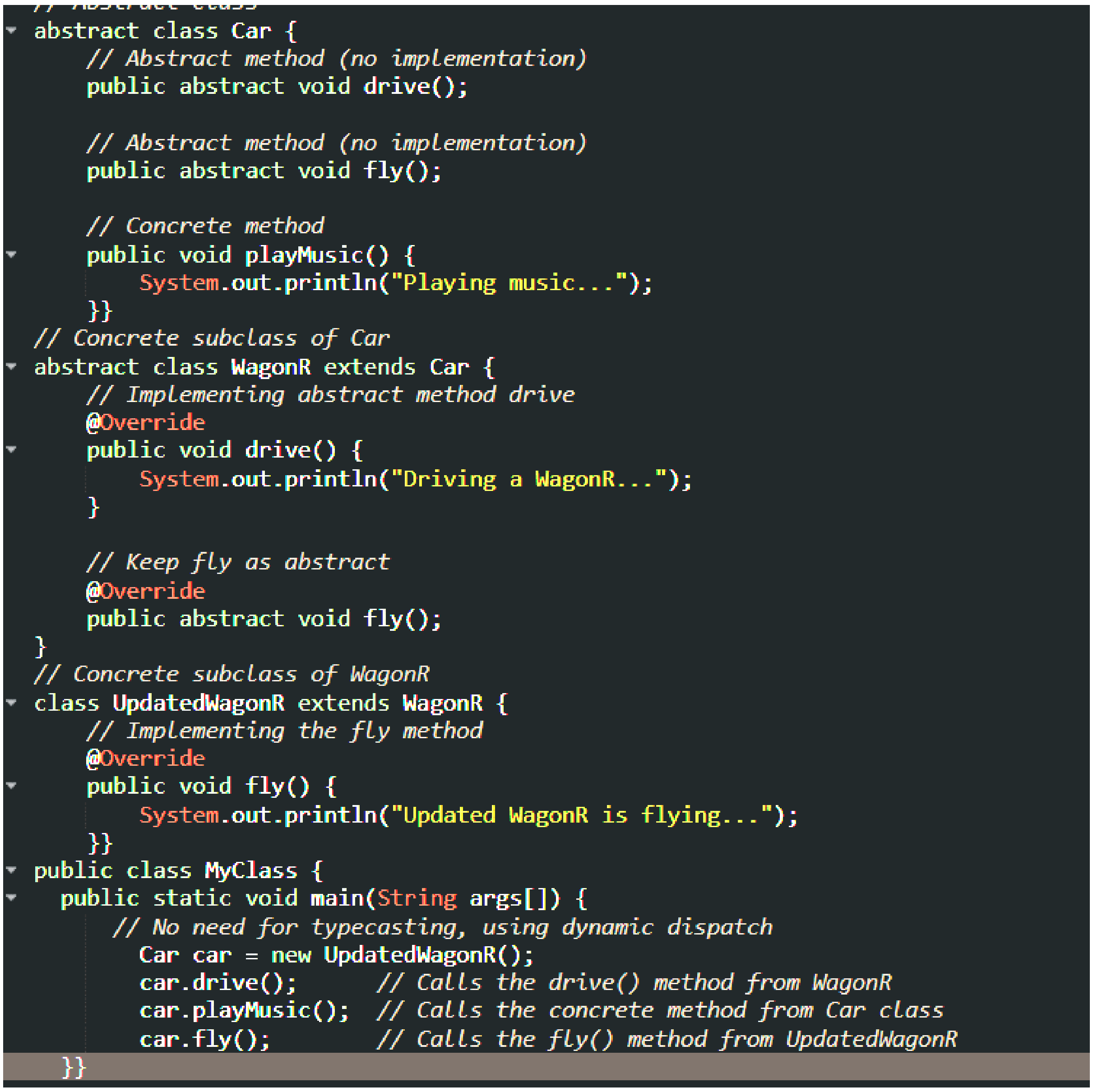
The abstract keyword in Java is mainly used to define abstract classes and methods. Here are some key characteristics:

- **Cannot Instantiate Abstract Classes:** You cannot create an object of an abstract class. The abstract class is meant to be extended by concrete (non-abstract) classes, which implement the abstract methods.
- **Abstract Methods Lack Implementation:** Abstract methods only provide a method signature and no implementation. The subclasses are responsible for defining these methods.
- **Abstract Classes Can Have Both Abstract and Concrete Methods:** Abstract classes may include concrete methods (methods with bodies) alongside abstract ones.
- **Abstract Classes Can Have Constructors:** Though you cannot instantiate abstract classes, they can still have constructors. These constructors are used by subclasses to initialize the inherited fields.

- **Can Contain Instance Variables:** Abstract classes can include instance variables, which can be accessed by both the abstract class and its subclasses.
- **Can Implement Interfaces:** Abstract classes can implement interfaces and must provide implementations for all interface methods unless the class itself is abstract.

Real-World Example

Let's consider a scenario where we want to create a blueprint for different types of cars:



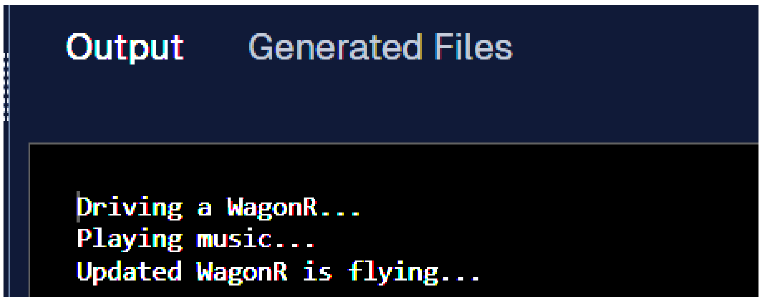
```java
abstract class Car {
    // Abstract method (no implementation)
    public abstract void drive();

    // Abstract method (no implementation)
    public abstract void fly();

    // Concrete method
    public void playMusic() {
        System.out.println("Playing music...");
    }}
// Concrete subclass of Car
abstract class WagonR extends Car {
    // Implementing abstract method drive
    @Override
    public void drive() {
        System.out.println("Driving a WagonR...");
    }

    // Keep fly as abstract
    @Override
    public abstract void fly();
}
// Concrete subclass of WagonR
class UpdatedWagonR extends WagonR {
    // Implementing the fly method
    @Override
    public void fly() {
        System.out.println("Updated WagonR is flying...");
    }}
public class MyClass {
  public static void main(String args[]) {
      // No need for typecasting, using dynamic dispatch
        Car car = new UpdatedWagonR();
        car.drive();      // Calls the drive() method from WagonR
        car.playMusic();  // Calls the concrete method from Car class
        car.fly();        // Calls the fly() method from UpdatedWagonR
  }}
```

Output:



```
Driving a WagonR...
Playing music...
Updated WagonR is flying...
```

Summary:

Here are the key takeaways regarding the abstract keyword in Java:

1. **Abstract Classes Cannot Be Instantiated:** You cannot create an object of an abstract class directly.
2. **Abstract Methods:** These methods are declared but not defined; they must be implemented in subclasses.
3. **Abstract Class Requirement:** If a class contains at least one abstract method, the class itself must be declared abstract.
4. **Concrete Methods in Abstract Classes:** An abstract class can contain both abstract and concrete methods.
5. **Abstract Class Constructors:** Abstract classes can have constructors, but they are only used by subclasses.