Lecture 06: Classes and Objects

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What do we know so far?

- **Primitives:** `int, float, double, boolean, char`
- **Variables:** Stores values of one type.
- **Arrays:** Store many of the same type.
- **Control Structures:** If-then, For Loops.
- **Methods:** Block of code that we can pass arguments to and run multiple times.
- **Is this all we want?**
Object-Oriented Programming

• Programming using *objects*

• An object represents an entity
  – Real world object: String, car, watch, …
  – Abstract object: list, network connection, …

• Objects have two parts:
  – **State**: Properties of an object.
  – **Behavior**: Things the object can do.
Objects

• Car Example:
  – State: Color, engine size, automatic
  – Behavior: Brake, accelerate, shift gear

• Person Example:
  – State: Height, weight, gender, age
  – Behavior: Eat, sleep, exercise, study
Why use objects?

- **Modularity**: Once we define an object, we can reuse it for other applications.

- **Abstraction**: Programmers don’t need to know exactly how the object works. Just the interface.

- **Encapsulation**: Hide the internal mechanisms to keep consistency.
Abstraction

• We abstract away details to deal with complex problems.
  – Necessary for forming relationships between complex pieces of code.
  – The art is knowing which details to hide away and which to preserve.
  – What is a forms of abstraction have we seen so far?

• Example:
  – Different cars can use the same parts.
  – You don’t need to know how an engine works in order to drive a car.
Classes

A Bicycle Class

Two instances of the Bicycle Class
Our first Class: LightSwitch

class LightSwitch {
    boolean isOn = true;
}

- What is the state of a LightSwitch?
- State stored in fields; here it’s “isOn”.
- Fields are accessed using:
  - variableName.fieldName
    - (We’ll discuss other types of fields later)
- What are the behaviors of a LightSwitch?
Our First Class: LightSwitch

class LightSwitch {
}

• class keyword tells Java you are creating a class
• The class must reside in a file named ClassName.java
  – Ex: LightSwitch.java
• Currently, our class does nothing...
Adding State

class LightSwitch {
  boolean isOn = true;
}

• What is the state of a LightSwitch?
• State stored in fields; here it’s “isOn”.
• Fields are accessed using:
  – variableName.fieldName
  – (We’ll discuss other types of fields later)
• What are the behaviors of a LightSwitch?
Adding Behavior

class LightSwitch {
    boolean isOn = true;
    void flip() {
        this.isOn = !this.isOn;
    }
}

• We define methods in a class to add behavior
  – Methods change the state of the object and affect system state
• this.isOn accesses the isOn field.
• What behavior does LightSwitch have now?
**this Keyword**

- Reference to the current object
  - The object whose method is being called

- Used to access fields:

```java
class SimpleClass {
    int x = 0;  //Field of SimpleClass

    void foo(int x) {
        this.x = x;
    }
}
```
Using Objects

```java
public static void main(String[] args) {
    LightSwitch s = new LightSwitch();
    System.out.println(s.isOn);
    s.flip();
    System.out.println(s.isOn);
}
```

- The `new` keyword creates a new object.
- `new` must be followed by a constructor.
- We call methods like:
  - `variableName.methodName(arguments)`
- What does this code output?
Constructors

- Constructors initialize the object after memory is allocated.
  - We can pass constructors data needed during initialization

- Objects have a default constructor that takes no arguments, like LightSwitch()
Constructors

• We can define our own constructors that take any number of arguments.
  – LightSwitch(boolean startState)

• Constructors have NO return type and must be named the same as the class:
  – ClassName(argument signature) { body }
The LightSwitch() constructor no longer works. How do we instantiate an object?
Multiple Constructors

- We can have multiple constructors.
- Constructors can call each other.

```java
LightSwitch() {
    this(true);
}
LightSwitch(boolean startState){
    this.isOn = startState;
}
```
Review

• What two properties do objects have?
• What is the difference between a class and an object?
• What is a field?
• What does the this keyword mean?
• What does the new keyword do?
• What is a constructor?
BankAccount Example

```java
public class BankAccount {
    double balance;
    String name;
    BankAccount(String name, double openBalance) {
        this.name = name;
        this.balance = openBalance;
    } // Continued next slide
    ...
```
BankAccount Example

... 

double deposit(double amount) {
    balance += amount;
    return balance;
}

boolean withdraw(double amount) {
    if (amount < balance) {
        balance -= amount;
        return true;
    } else return false;
}

} // End BankAccount Class