Lecture 7
Objects and Classes

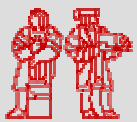
An Introduction to Data Abstraction

MIT AITI

June 13th, 2005

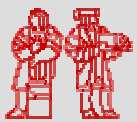
What do we know so far?

- Primitives: int, double, boolean, String*
- 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 anytime.
- Is this all we need?



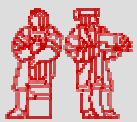
So what's the problem?

- Some data "sticks" together.
  - `String[] names`
  - `int[] grades`
- Methods start to get complicated.
- Methods can only return one type.
- Programmers don't want to think about all the underlying types.



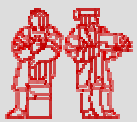
Abstraction

- Objects are tools for abstraction.
- We abstract away details to deal with complex problems.
- Abstraction is a fundamental concept in computer science.
- There can be too much abstraction.
- The art is knowing which details to hide away and which to preserve.



What is an object?

- Objects have two parts:
  - State: Properties of an object.
  - Behavior: Things the object can do.
- Car Example:
  - State: Color, engine size, automatic
  - Behavior: Brake, accelerate, shift gear
- Person Example:
  - State: Height, weight, gender, age
  - Behavior: Eat, sleep, exercise, study



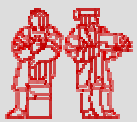
What is an Object?

Figures removed for copyright reasons.

See http://java.sun.com/docs/books/tutorial/java/concepts/object.html

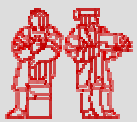
A Generic Object

An Bicycle Object



Why use objects?

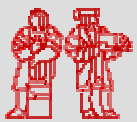
- Modularity: Once we define an object, we can reuse it for other applications.
- Information Hiding: Programmers don't need to know exactly how the object works. Just the interface.
- Example:
  - Different cars can use the same parts.
  - You don't need to know how an engine works in order to drive a car.



Our first Class: LightSwitch

```
class LightSwitch {
    boolean on = true;
}
```

- The keyword class tells java that we're defining a new type of Object.
- Classes are a blueprint.
- Objects are instances of classes.
- Everything in Java (except primitives) are Objects and have a Class.



Classes

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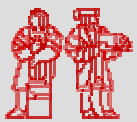
See "MyBike" and "YourBike" figures at http://java.sun.com/docs/books/tutorial/java/concepts/class.html

A Bicycle Class

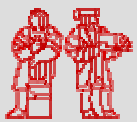
Two instances of the Bicycle Class



Our first Class: LightSwitch

```
class LightSwitch {
    boolean isOn = true;
}
```

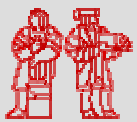
- What state do LightSwitches have?
- State stored in fields; here it's "isOn".
- Fields are accessed using:
  - variableName.fieldName
  - (We'll discuss other types of fields later.)
- What behavior do LightSwitches have?



Adding Behavior

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

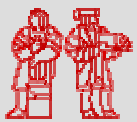
- The this keyword means this particular object. Objects know themselves.
- `this.isOn` accesses the `isOn` field.
- What behavior does LightSwitch have now?



Using Objects

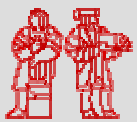
```
public static void main(String[] args) {
      LightSwitch s = new LightSwitch();
      System.out.println(s.isOn);
      s.flip();
      System.out.println(s.isOn);
}
```

- 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

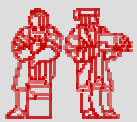
- Constructors provide objects with the data they need to initialize themselves, like “How to Assemble” instructions.
- Objects have a default constructor that takes no arguments, like LightSwitch().
- We can define our own constructors that take any number of arguments.
- Constructors have NO return type and must be named the same as the class:
  - ClassName(argument signature) { body }



Constructors

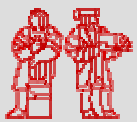
```
class LightSwitch {
    boolean isOn;
   void flip() {
         this.isOn = !this.isOn;
   }
   LightSwitch(boolean startState) {
         this.isOn = startState;
   }
}
```

- The LightSwitch() constructor no longer works. How do we instantiate an object?



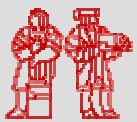
Multiple Constructors

- We can have multiple constructors.
- Constructors can call each other.
  - ```
    LightSwitch() {
     LightSwitch(true);
    }
    ```
  - ```
    LightSwitch(boolean startState){
     this.isOn = isOn;
    }
    ```



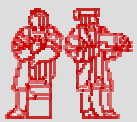
Pop Quiz

- 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?



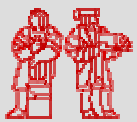
BankAccount Example

```
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
```



EC.S01 Internet Technology in Local and Global Communities
Spring 2005-Summer 2005