8

Creating and Using Methods

Objectives

After completing this lesson, you should be able to:

- Add an argument to a method
- Instantiate a class and call a method
- Overload a method
- Work with static methods and variables
- Convert data values using `Integer`, `Double`, and `Boolean` object types

Topics

- Using methods and constructors
- Method arguments and return values
- Using static methods and variables
- Understanding how arguments are passed to a method
- Overloading a method

Basic Form of a Method

The void keyword indicates that the method does not return a value.

Empty parentheses indicate that no arguments are passed to the method.

```
1 public void display ()  {
2       System.out.println("Shirt description:" + description);
3       System.out.println("Color Code: " + colorCode);
4       System.out.println("Shirt price: " + price);
5 } // end of display method
```

Calling a Method from a Different Class

```
1  public class ShoppingCart {
2     public static void main (String[] args) {
3          Shirt myShirt = new Shirt();
4          myShirt.display();
5     }
6  }
```

Method

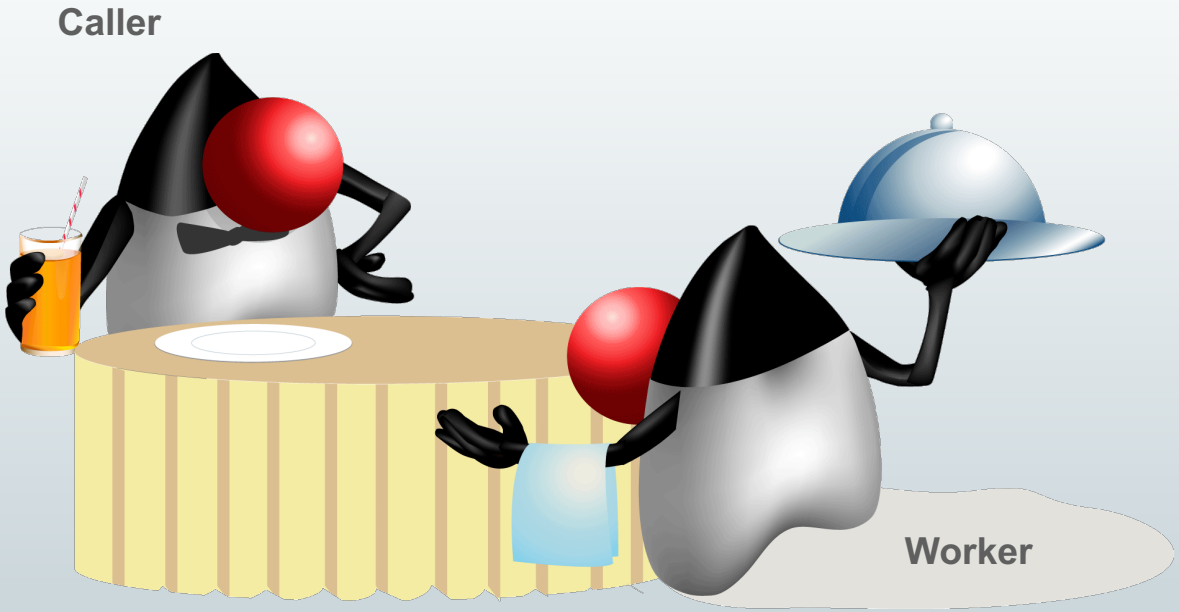
Dot operator

Reference variable

Output:

```
Item description:-description required-
Color Code: U
Item price: 0.0
```

Caller and Worker Methods



A Constructor Method

A constructor method is a special method that is invoked when you create an object instance.

- It is called by using the `new` keyword.
- Its purpose is to instantiate an object of the class and store the reference in the reference variable.

```
Shirt myShirt = new Shirt();
```

Constructor method is called.

- It has a unique method signature.

<modifier> ClassName()

Writing and Calling a Constructor

```
1  public static void main(String[] args){
2    Shirt myShirt = new Shirt();
3  }
```

```
1  public class Shirt {
2    //Fields
3    public String description;
4    public char colorCode;
5    public double price;
6
7    //Constructor
8    public Shirt(){
9        description = "--description required--";
10       colorCode = 'U'
11       price = 0.00;
12   }
13
14   //Methods
15   public void display(){
16      System.out.println("Shirt description:" + description);
17      System.out.println("Color Code: " + colorCode);
18      System.out.println("Shirt price: " + price);
19   }…
```

Calling a Method in the Same Class

```
1  public class Shirt {
2    public String description;
3    public char colorCode;
4    public double price;
5
6    public Shirt(){
7        description = "--description required--";
8        colorCode = 'U'
9        price = 0.00;
10
11       display();           //Called normally
12       this.display();      //Called using the 'this' keyword
13   }
14
15   public void display(){
16      System.out.println("Shirt description:" + description);
17      System.out.println("Color Code: " + colorCode);
18      System.out.println("Shirt price: " + price);
19    }
20 …
```

Topics

- Using constructors and methods
- Method arguments and return values
- Using static methods and variables
- Understanding how arguments are passed to a method
- Overloading a method

Method Arguments and Parameters

- An **argument** is a value that is passed during a method call:

```
Calculator calc = new Calculator();
double denominator = 2.0

                          Arguments
calc.calculate(3, denominator);          //should print 1.5
```

- A **parameter** is a variable defined in the method declaration:

```
                                3          2.0
public void calculate(int x, double y){
    System.out.println(x/y);
}                                 Parameters
```

Method Parameter Examples

- Methods may have any number or type of parameters:

```
public void calculate0(){
    System.out.println("No parameters");
}
```

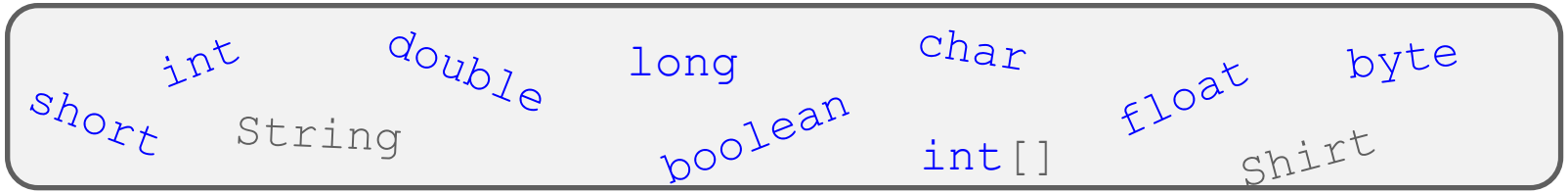
```
public void calculate1(int x){
    System.out.println(x/2.0);
}
```

```
public void calculate2(int x, double y){
    System.out.println(x/y);
}
```

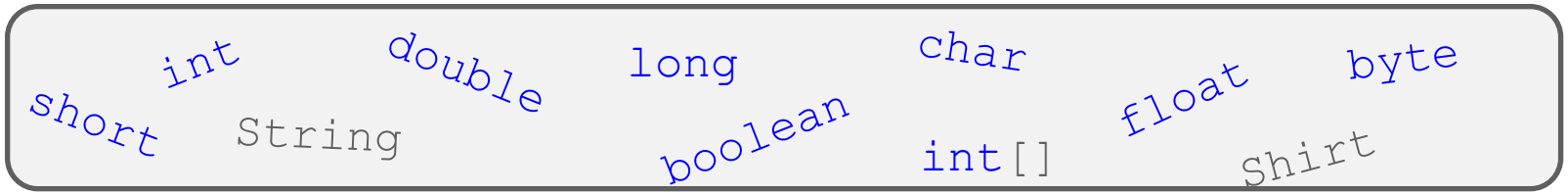
```
public void calculate3(int x, double y, int z){
    System.out.println(x/y +z);
}
```

Method Return Types

- Variables can have values of many different types:



- Method calls can also return values of many different types:



- How to make a method return a value:
  - Declare the method to be a non-void return type.
  - Use the keyword `return` within a method, followed by a value.

Method Return Types Examples

- Methods must `return` data that matches their return type:

```
public void printString(){
    System.out.println("Hello");
}
```

Void methods cannot return values in Java.

```
public String returnString(){
    return("Hello");
}
```

```
public int sum(int x, int y){
    return(x + y);
}
```

```
public boolean isGreater(int x, int y){
    return(x > y);
}
```

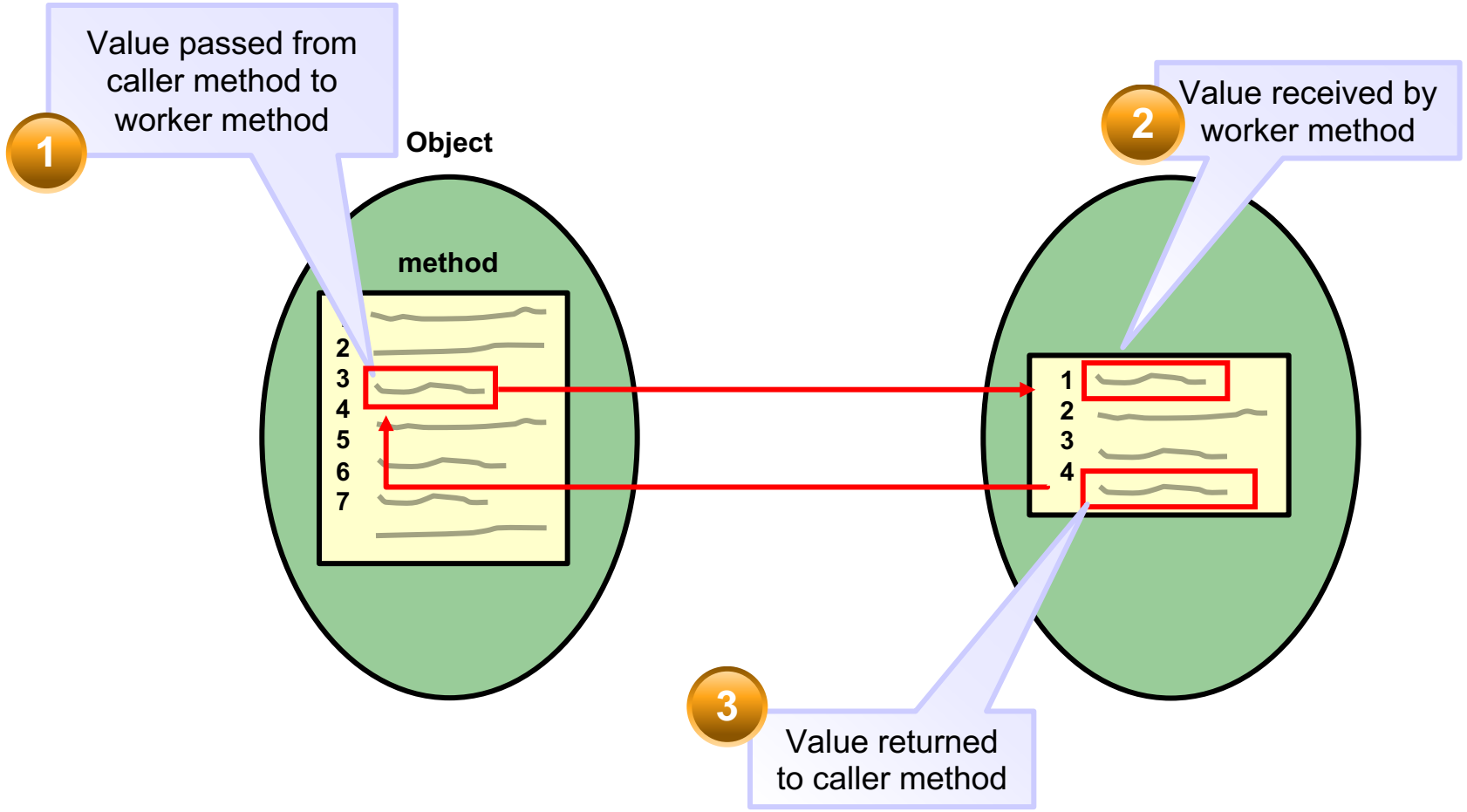
Method Return Animation

- The following code examples produce equivalent results:

```
public static void main(String[] args){
    int num1 = 1, num2 = 2;
    int result = num1 + num2;
    System.out.println(result);
}
```

```
public static void main(String[] args){
    int num1 = 1, num2 = 2;
    int result = sum(num1, num2);
    System.out.println(result);
}
public int sum(int x, int y){
    return(x + y);
}
```

Passing Arguments and Returning Values



More Examples

```
1 public void setCustomerServices() {
2     String message ="Would you like to hear about "
3           +"special deals in your area?";
4     if (cust.isNewCustomer()) {
5
6         cust.sendEmail(message);
7     }
8 }
```

```
1 public class Customer{
2     public boolean isNew;
3
4     public boolean isNewCustomer(){
5         return isNew;
6     }
7     public void sendEmail(String message){
8         // send email
9     }
10 }
```

Return a boolean

String argument required

Code Without Methods

```
1  public static void main(String[] args){
2     Shirt shirt01 = new Shirt();
3     Shirt shirt02 = new Shirt();
4     Shirt shirt03 = new Shirt();
5     Shirt shirt04 = new Shirt();
6
7     shirt01.description = "Sailor";
8     shirt01.colorCode = 'B';
9     shirt01.price = 30;
10
11    shirt02.description = "Sweatshirt";
12    shirt02.colorCode = 'G';
13    shirt02.price = 25;
14
15    shirt03.description = "Skull Tee";
16    shirt03.colorCode = 'B';
17    shirt03.price = 15;
18
19    shirt04.description = "Tropical";
20    shirt04.colorCode = 'R';
21    shirt04.price = 20;
22 }
```

Better Code with Methods

```
 1  public static void main(String[] args){
 2    Shirt shirt01 = new Shirt();
 3    Shirt shirt02 = new Shirt();
 4    Shirt shirt03 = new Shirt();
 5    Shirt shirt04 = new Shirt();
 6
 7    shirt01.setFields("Sailor", 'B', 30);
 8    shirt02.setFields("Sweatshirt", 'G', 25);
 9    shirt03.setFields("Skull Tee", 'B', 15);
10    shirt04.setFields("Tropical", 'R', 20);
11 }
```

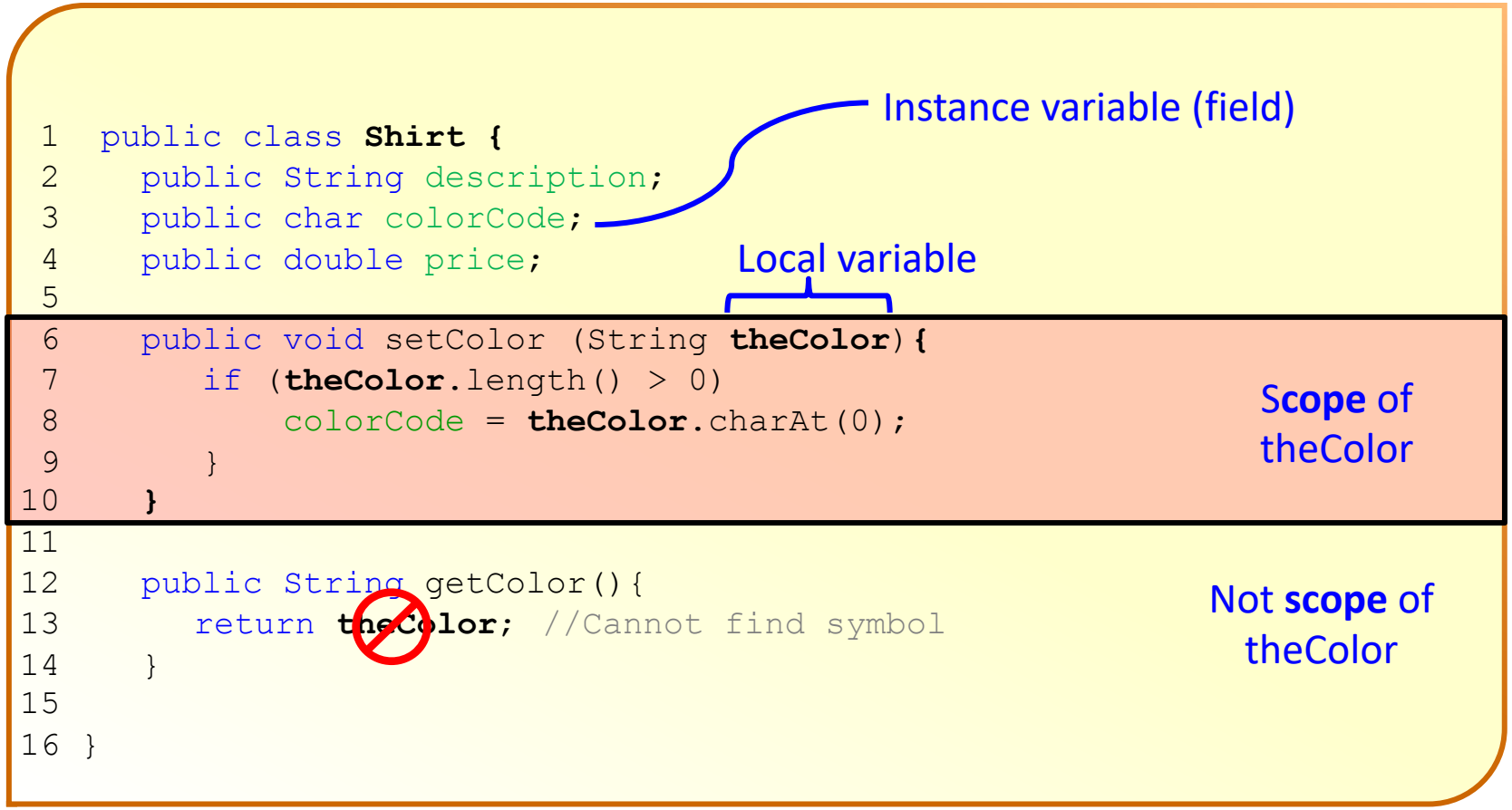
```
 1  public class Shirt {
 2    public String description;
 3    public char colorCode;
 4    public double price;
 5
 6    public void setFields(String desc, char color, double price){
 7        this.description = desc;
 8        this.colorCode = color;
 9        this.price = price;
10   }
11 …
```

Even Better Code with Methods

```
1  public static void main(String[] args){
2    Shirt shirt01 = new Shirt("Sailor", "Blue", 30);
3    Shirt shirt02 = new Shirt("SweatShirt", "Green", 25);
4    Shirt shirt03 = new Shirt("Skull Tee", "Blue", 15);
5    Shirt shirt04 = new Shirt("Tropical", "Red", 20);
6  }
```

```
1  public class Shirt {
2    public String description;
3    public char colorCode;
4    public double price;
5
6    //Constructor
7    public Shirt(String desc, String color, double price){
8        setFields(desc, price);
9        setColor(color);
10   }
11   public void setColor (String theColor){
12       if (theColor.length() > 0)
13           colorCode = theColor.charAt(0);
14       }
15   }
16 }
```

Variable Scope




```
1  public class Shirt {
2    public String description;
3    public char colorCode;
4    public double price;
5
6    public void setColor (String theColor){
7       if (theColor.length() > 0)
8           colorCode = theColor.charAt(0);
9       }
10   }
11
12   public String getColor(){
13      return theColor; //Cannot find symbol
14   }
15
16 }
```

Advantages of Using Methods

Methods:

- Are reusable
- Make programs shorter and more readable
- Make development and maintenance quicker
- Allow separate objects to communicate and to distribute the work performed by the program

Topics

- Using constructors and methods
- Method arguments and return values
- Using static methods and variables
- Understanding how arguments are passed to a method
- Overloading a method

Static Methods and Variables

The `static` modifier is applied to a method or variable.

It means the method/variable:

- Belongs to the *class* and is shared by all objects of that class
- Is *not unique* to an object instance
- Can be accessed without instantiating the class

Comparison:

- A **static variable** is shared by all objects in a class.
- An **instance variable** is unique to an individual object.

Example: Setting the Size for a New Item

```
1 public class ItemSizes {
2     static final String mSmall = "Men's Small";
3     static final String mMed = "Men's Medium";
4 }
```

Passing the static `mMed` variable to the `setSize` method

```
Item item1 = new Item();
item1.setSize(ItemSizes.mMed);
```

```
1 public class Item {
2     public String size;
3     public void setSize(String sizeArg){
4         this.size = sizeArg;
5     }
6 }
```

Creating and Accessing Static Members

- To create a static variable or method:

```
static String mSmall;
static void setMSmall(String desc);
```

- To access a `static` variable or method:
  - From another class

```
ItemSizes.mSmall;
ItemSizes.setMSmall("Men's Small");
```

  - From within the class

```
mSmall;
setMSmall("Men's Small");
```

When to Use Static Methods or Fields

- Performing the operation on an individual object or associating the variable with a specific object type is not important.
- Accessing the variable or method before instantiating an object is important.
- The method or variable does not logically belong to an object, but possibly belongs to a utility class, such as the `Math` class, included in the Java API.
- Using constant values (such as `Math.PI`)

Some Rules About Static Fields and Methods

- Instance methods can access static methods or fields.
- Static methods cannot access instance methods or fields. Why?

```
1 public class Item{
2    int itemID;
3    public Item(){
4       setId();
5    }
6    static int getID(){
7       // whose itemID??
8    }
```

Static Fields and Methods Versus Instance Fields and Methods

```
public class Item{
  static int staticItemID;
  int instanceItemID;
  static main(){
     Item item01 = new Item();

1    staticItemId = 6;
2    instanceItemID = 3
3    showItemID();
4    item01.showItemID();

  }
  showItemID(){
  ...println(staticItemId);
  ...println(instanceItemId);
  }
}
```

Object (instance) referenced by item01.

```
static int staticItemID;
int instanceItemID;
static main(){ ... }

showItemID(){

5  ...println(staticItemID);
6  ...println(instanceItemID);

}
```

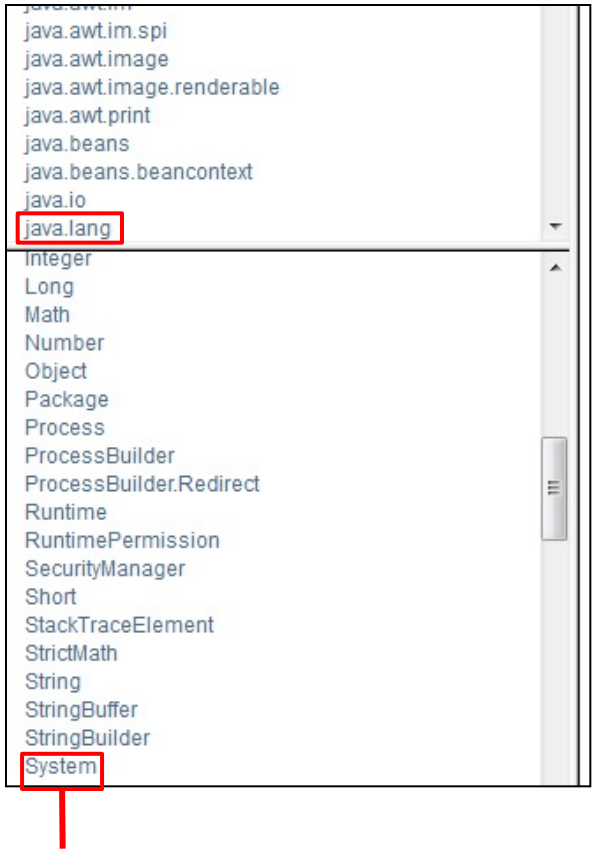
Other instances of Item

Static Methods and Variables in the Java API

Examples:

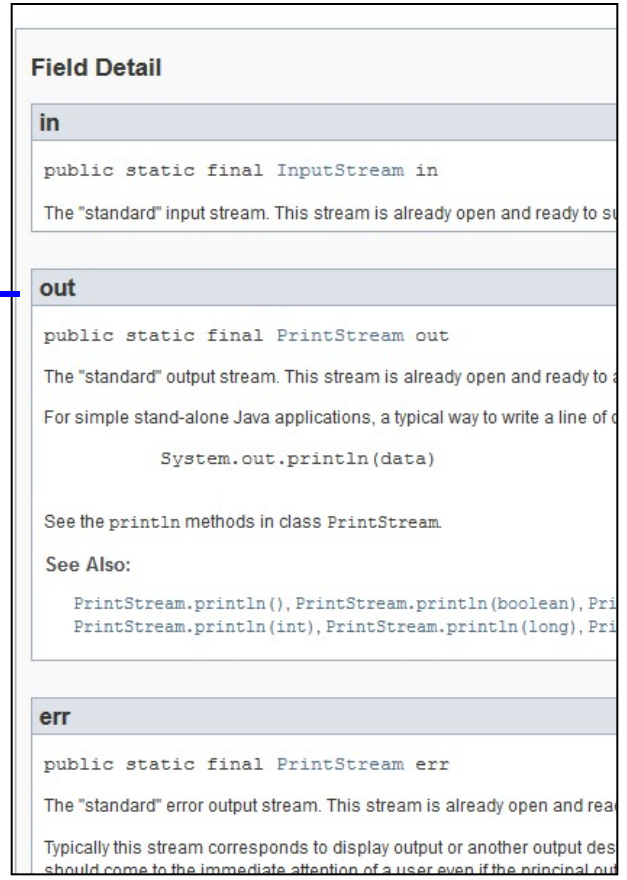
- Some functionality of the `Math` class:
  - Exponential
  - Logarithmic
  - Trigonometric
  - Random
  - Access to common mathematical constants, such as the value PI (`Math.PI`)
- Some functionality of the `System` class:
  - Retrieving environment variables
  - Access to the standard input and output streams
  - Exiting the current program (`System.exit` method)

Examining Static Variables in the JDK Libraries

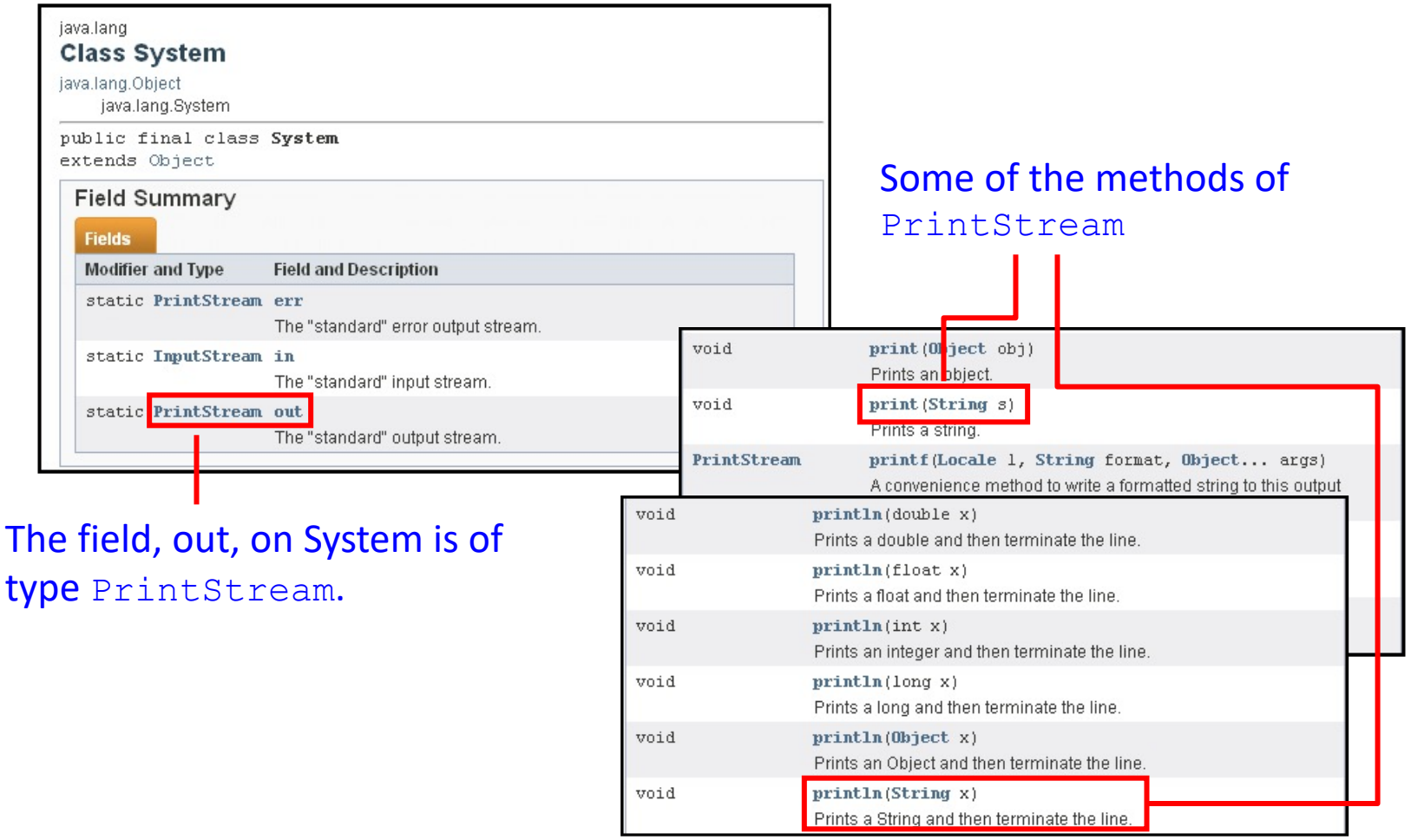


`System` is a class in `java.lang`.

`out` is a static field of `System` and contains and is an object reference to a `PrintStream` object.



Using Static Variables and Methods: `System.out.println`

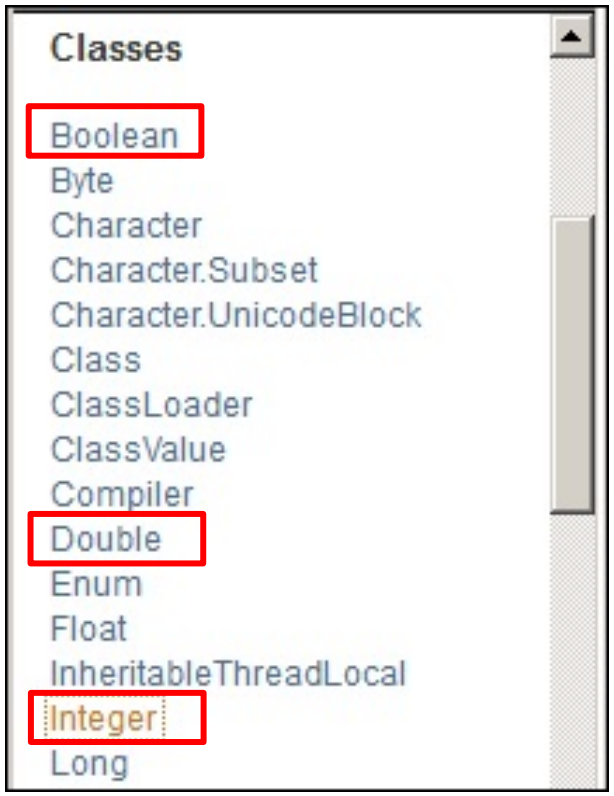


More Static Fields and Methods in the Java API

Java provides wrapper classes for each of the primitive data types.

- `Boolean`: Contains a single field of type `boolean`
- `Double`: Contains a single field of type `double`
- `Integer`: Contains a single field of type `int`

They also provide utility methods to work with the data.



Converting Data Values

- Methods often need to convert an argument to a different type.
- Most of the object classes in the JDK provide various conversion methods.

Examples:

- Converting a String to an `int`

```
int myInt1 = Integer.parseInt(s_Num);
```

- Converting a String to a `double`

```
double myDbl = Double.parseDouble(s_Num);
```

- Converting a String to `boolean`

```
boolean myBool = Boolean.valueOf(s_Bool);
```

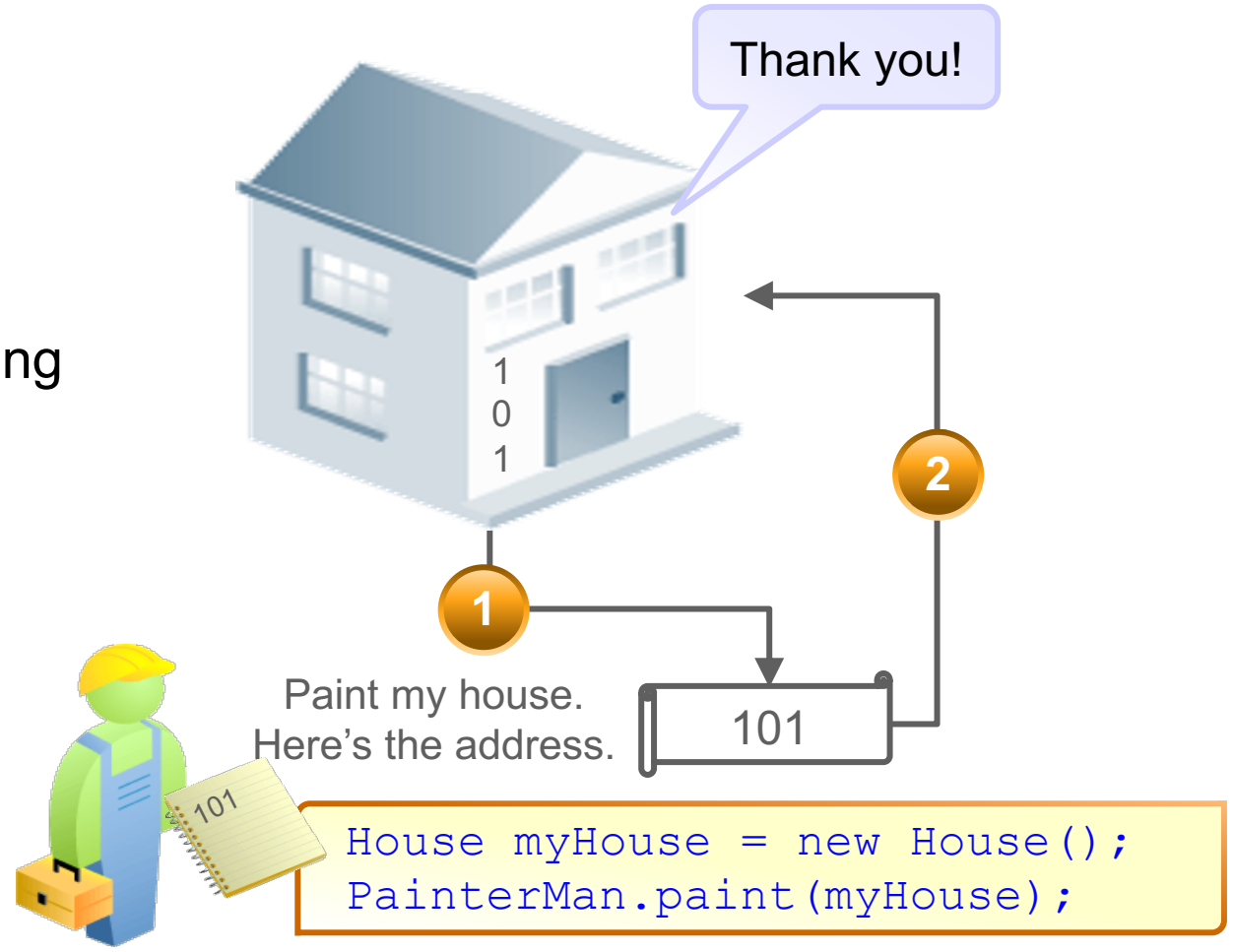
Topics

- Using constructors and methods
- Method arguments and return values
- Using static methods and variables
- Understanding how arguments are passed to a method
- Overloading a method

Passing an Object Reference

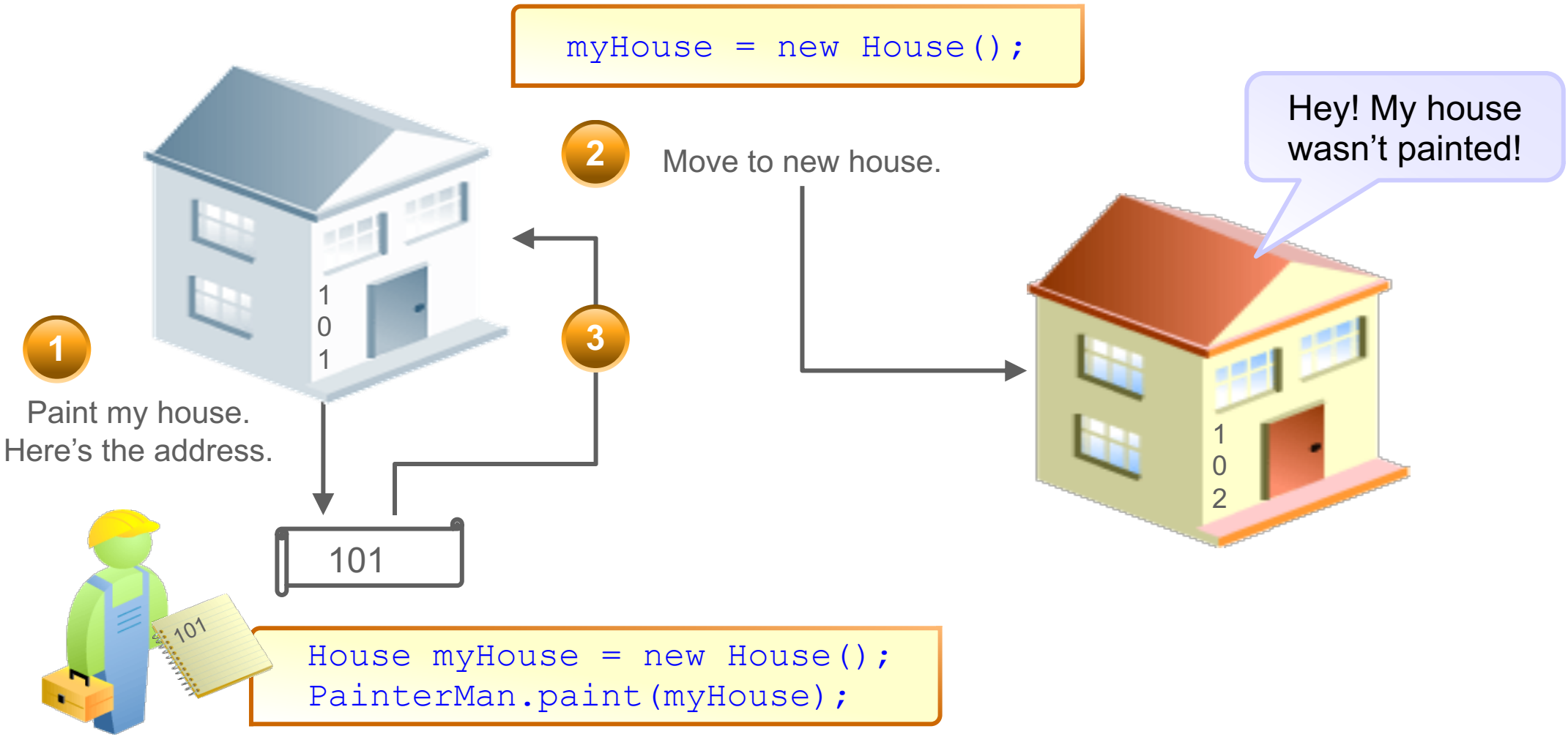
An object reference is similar to a house address. When it is passed to a method:

- The object itself is not passed
- The method can access the object using the reference
- The method can act upon the object




```
House myHouse = new House();
PainterMan.paint(myHouse);
```

What If There Is a New Object?



A Shopping Cart Code Example

```
1  public class ShoppingCart {
2      public static void main (String[] args) {
3          Shirt myShirt = new Shirt();
4          System.out.println("Shirt color: " + myShirt.colorCode);
5          changeShirtColor(myShirt, 'B');
6          System.out.println("Shirt color: " + myShirt.colorCode);
7      }
8      public static void changeShirtColor(Shirt theShirt, char color) {
9          theShirt.colorCode = color;     }
10 }
```

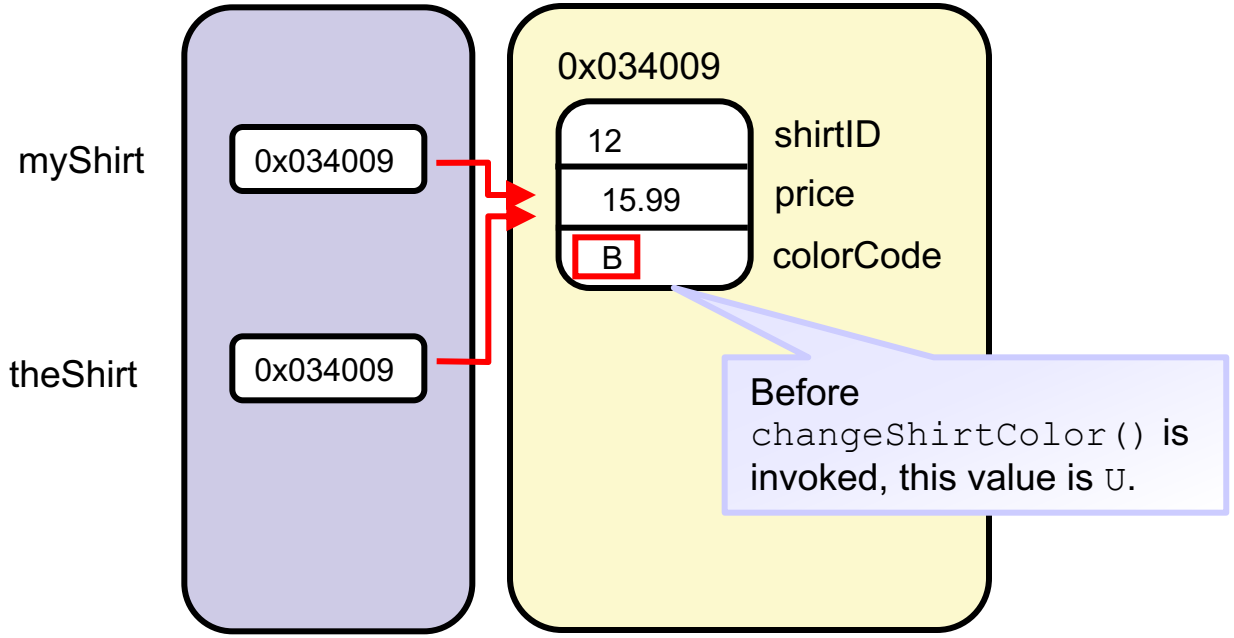
theShirt is a new reference of type Shirt.

Output:

```
Shirt color: U
Shirt color: B
```

Passing by Value

```
Shirt myShirt = new Shirt();
changeShirtColor(myShirt, 'B');
```



Reassigning the Reference

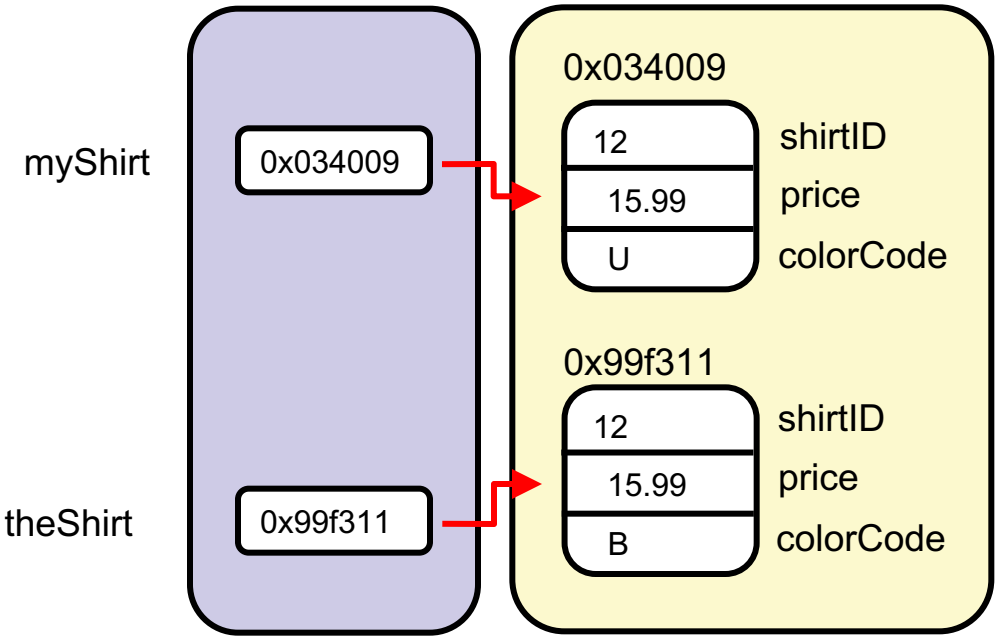
```
 1 public class ShoppingCart {
 2     public static void main (String[] args) {
 3         Shirt myShirt = new Shirt();
 4         System.out.println("Shirt color: " + myShirt.colorCode);
 5         changeShirtColor(myShirt, 'B');
 6          System.out.println("Shirt color: " + myShirt.colorCode);
 7     }
 9     public static void changeShirtColor(Shirt theShirt, char color) {
10         theShirt = new Shirt();
11         theShirt.colorCode = color;
12 }
```

Output:

```
Shirt color: U
Shirt color: U
```

Passing by Value

```
Shirt myShirt = new Shirt();
changeShirtColor(myShirt, 'B');
```



Topics

- Using constructors and methods
- Method arguments and return values
- Using static methods and variables
- Understanding how arguments are passed to a method
- Overloading a method

Method Overloading

Overloaded methods:

- Have the same name
- Have different signatures
  - The **number** of parameters
  - The **types** of parameters
  - The **order** of parameters
- May have different functionality or similar functionality
- Are widely used in the foundation classes

Using Method Overloading

```
1  public final class Calculator {
2
3      public static int sum(int num1, int num2){
4          System.out.println("Method One");
5          return num1 + num2;
6      }
7
8      public static float sum(float num1, float num2) {
9          System.out.println("Method Two");
10         return num1 + num2;
11     }
12     public static float sum(int num1, float num2) {
13         System.out.println("Method Three");
14         return num1 + num2;
15      }
```

The method type

The method signature

Using Method Overloading

```
1  public class CalculatorTest {
2
3      public static void main(String[] args) {
4
5          int totalOne = Calculator.sum(2, 3);
6          System.out.println("The total is " + totalOne);
7
8          float totalTwo = Calculator.sum(15.99F, 12.85F);
9          System.out.println(totalTwo);
10
11         float totalThree = Calculator.sum(2, 12.85F);
12         System.out.println(totalThree);
13     }
14 }
```

Method Overloading and the Java API

Method	Use
`void println()`	Terminates the current line by writing the line separator string
`void println(boolean x)`	Prints a boolean value and then terminates the line
`void println(char x)`	Prints a character and then terminates the line
`void println(char[] x)`	Prints an array of characters and then terminates the line

Quiz

Which method corresponds to the following method call?

```
myPerson.printValues(100, 147.7F, "lavender");
```

a. `public void printValues (int i, float f)`

b. `public void printValues (i, float f, s)`

c. `public void printValues (int i, float f, String s)`

d. `public void printValues (float f, String s, int i)`

Summary

In this lesson, you should have learned how to:

- Add an argument to a method
- Instantiate a class and call a method
- Overload a method
- Work with static methods and variables
- Convert data values using `Integer`, `Double`, and `Boolean` object types