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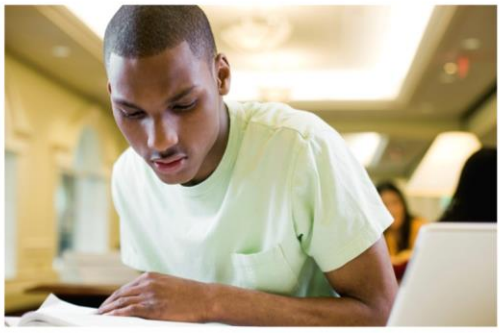
Java Foundations

7-4
Overloading Methods



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Objectives

- This lesson covers the following objectives:
  - Understand the effects of multiple constructors in a class
  - Define overloading of a method
  - Explain the method signature
  - Understand when overloading is and isn't possible

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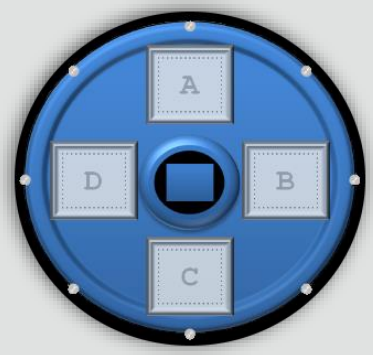
Exercise 1

- Play Basic Puzzle 8
  - https://objectstorage.uk-london-1.oraclecloud.com/n/lrvrlgaqj8dd/b/Games/o/JavaPuzzleBall/index.html
  - Consider the following:
  - What can you say about the lights surrounding each wheel?



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Why Did We Add Lights to the Wheels?

- Earlier builds didn't include these lights
  - They were never part of the original design
  - So why were they added?
- Lights were added to address player confusion
  - Some players didn't realize that the wheel would snap to the nearest 45° angle
  - Some players needed to rotate the wheel several times before they reached the next 45° increment
  - This caused confusion and frustration as players thought "**The wheel didn't rotate where I wanted it to**"

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The Plan to Solve These Issues

- Add eight lights to each wheel
  - Lights act as a “tick” mark
  - They show each 45° increment where the wheel could snap
- A single light may brighten, which shows:
  - The rotation where the wheel was grabbed
  - The rotation where the wheel will snap if it’s released

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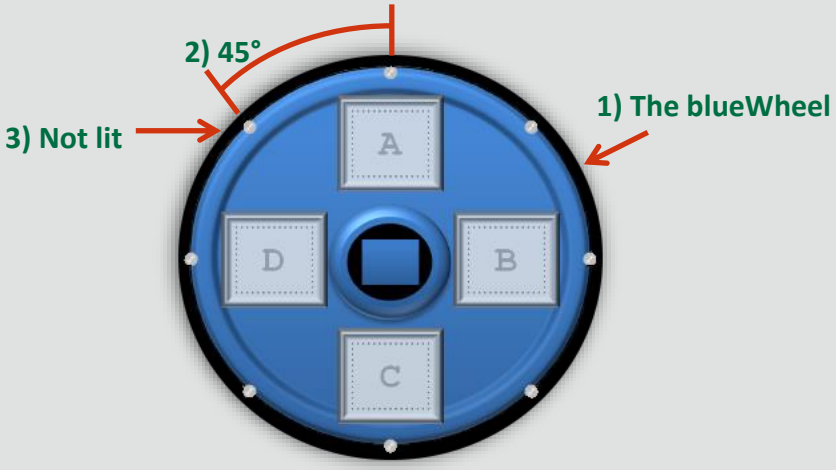
Light Properties

- A light requires the following properties:
  - The wheel it belongs to
  - Its rotation around that wheel
  - If it should be lit



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Programming the Light Class

- Here's a simplified version of this class:

```
public class UIWheelLight {
   //Fields
   public UIWheel wheel;
   public double rotation;
   public boolean isLit;

   //Constructor
   public UIWheelLight(UIWheel w, double r, boolean l){
      wheel = w;
      rotation = r;
      isLit = l;
   } //end Constructor
} //end class UIWheelLight
```


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Calling the UIWheelLight Constructor

- A constructor call would look something like this:

```
UIWheelLight light1 = new UIWheelLight(blueWheel, 45, false);
```

- But then we thought: "**I'm too lazy to type all that!**"
  - There's a legitimate reason for this
  - It isn't because we're bad programmers
  - It isn't because we're stupid

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Why It's Great to Be Lazy

- A little math told us …
  - There are eight lights on a wheel
  - One additional light will appear lit
  - 8/9 (or 89%) of lights will be instantiated unlit
  - 89% is a substantial majority
- Therefore, the final argument is redundant and will complicate code 89% of the time
- Complicated code is bad and should be minimized

```
UIWheelLight light1 = new UIWheelLight(blueWheel, 45, false);
```

Redundant

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Lights don't actually turn on and off. Instead, when a light should be "on," we instantiate a ninth light and position it on top of the corresponding "off" light.

Overloading Constructors

- You can write more than one constructor in a class
  - This is known as overloading a constructor
  - A class may have an unlimited number of constructors
- Each overloaded constructor is named the same
- But they differ in any of the following ways:
  - Number of parameters
  - Types of parameters
  - Ordering of parameters

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Overloaded Constructors: Example

- Implementing this strategy in the UIWheelLight class looks something like this:

```
public class UIWheelLight {
     …
   //Constructors
   public UIWheelLight(UIWheel w, double r){
       wheel = w;
       rotation = r;
       isLit = false;
   }//end Constructor

   public UIWheelLight(UIWheel w, double r, boolean l){
      wheel = w;
      rotation = r;
      isLit = l;
   } //end Constructor
} //end class UIWheelLight
```

2 parameters

3 parameters

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Calling Overloaded Constructors

- An object may be instantiated by calling any of its class constructors
- You supply the arguments, and Java finds the most appropriate constructor

```
UIWheelLight light1 = new UIWheelLight(blueWheel, 45);
```

```
UIWheelLight light1 = new UIWheelLight(blueWheel, 45, false);
```


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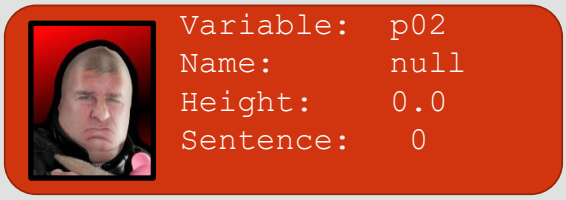
Exercise 2

- Continue editing the `PrisonTest` project
  - A version of this program is provided for you in the files `PrisonTest_Student_7_4.java` and `Prisoner_Student_7_4.java`
- Overload the existing constructor
  - Create your own zero-argument constructor
  - Calling this constructor should initialize fields with the following values
  - Instantiate an object with this constructor



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Recognizing Redundancy in Constructors

- Very similar code is repeated in these constructors
- It's possible to minimize this redundancy

```
public class UIWheelLight {
   //Constructors
   public UIWheelLight(UIWheel w, double r){
      wheel = w;
      rotation = r;
      isLit = false;
   }//end constructor

   public UIWheelLight(UIWheel w, double r, boolean l){
      wheel = w;
      rotation = r;
      isLit = l;
   }//end constructor
}//end class UIWheelLight
```

First occurrence

Repeated

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Constructors Can Call Other Constructors

- By using the this keyword, one constructor may call another

```
public class UIWheelLight {
   //Constructors
   public UIWheelLight(UIWheel w, double r){
      this(w, r, false);
   }//end constructor

   public UIWheelLight(UIWheel w, double r, boolean l){
      wheel = w;
      rotation = r;
      isLit = l;
   }//end constructor
}//end class UIWheelLight
```

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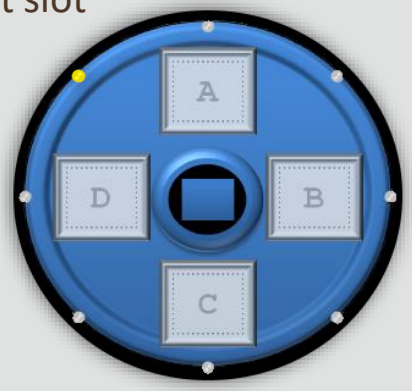
This is helpful because, if the logic in a constructor needs to change, then the code needs to be changed only in one place.

Light Behavior

- Depending on where you click, the yellow light behaves slightly differently
  - If you click the wheel, the light is positioned based on the location of the mouse cursor
  - If you click slot A, B, C, or D, the light is positioned based on the center of that slot



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How Did We Program This Subtle Difference in Behavior?

- We overloaded the method responsible for positioning the yellow light
- The code looks similar to this:

```
public class UIWheelLight {
   …
   public void setPosition(double x, double y){
      //Do math
   }//end method setPosition

   public void setPosition(double x, double y, UISlot s){
      //Do slightly different math
   }//end method setPosition
}//end class UIWheelLight
```


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x and y are the x-position and y-position where the mouse was clicked.

Overloading Methods

- Any method can be overloaded, including …
  - Constructors
  - Methods that model object behaviors
  - Methods that perform calculations
- All versions of an overloaded method are named the same
- But differ in any of the following ways:
  - Number of parameters
  - Types of parameters
  - Ordering of parameters

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Number of Parameters

- Each overloaded method below has a different number of parameters

```
public class Calculator {

   public double sum(double num1){
      return num1;
   }//end method sum

   public double sum(double num1, double num2){
      return num1 + num2;
   }//end method sum

   public double sum(double num1, double num2, double num3){
      return num1 + num2 + num3;
   }//end method sum

}//end class Calculator
```


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Type of Parameters

- Each overloaded method below has parameters of different types

```
public class Calculator {

   public double sum(double num1, double num2){
      return num1 + num2;
   }//end method sum

   public double sum(int num1, int num2){
      return num1 + num2;
   }//end method sum

}//end class Calculator
```


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Order of Parameters

- Each overloaded method has parameters in a different order

```
public class Calculator {

   public double sum(int num1, double num2){
      return num1 + num2;
   }//end method sum

   public double sum(double num1, int num2){
      return num1 + num2;
   }//end method sum

}//end class Calculator
```


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Calling Overloaded Methods

- You supply the arguments, and Java finds the most appropriate method

```
public class CalculatorTest{

   public static void main(String[] args){
      Calculator calc = new Calculator();

      calc.sum(1, 2);
      calc.sum(1, 2, 3);
      calc.sum(1.5, 4.5);
   }//end method main

}//end class CalculatorTest
```


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Exercise 3

- Continue editing the `PrisonTest` project
- Write a method that prints every Prisoner field
  - This should be a zero-argument method
- Overload this method to accept a boolean argument
  - If the boolean is true, this method should call the think() method
- Call both versions of this method on an object

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Recognizing Redundancy in Methods

- Very similar code is repeated in these methods
- It's possible to minimize this redundancy

```
public class Calculator{
   …
   public double calcY(double m, double x){
      double y = 0;
      y = mx;
      return y; ;
   }//end method calcY
   public double calcY(double m, double x, double b){
      double y = 0;
      y = mx + b;
      return y;
   }//end method calcY
}//end class Calculator
```

First occurrence

Repeated

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Methods Can Call Other Methods in the Same Class

- In this example, one method returns a value to the other

```
public class Calculator{
   …
   public double calcY(double m, double x){
      return calcY(m,x,0);
   }//end method calcY

   public double calcY(double m, double x, double b){
      double y = 0;
      y = mx + b;
      return y;
   }//end method calcY
}//end class Calculator
```


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This is helpful because, if the calculations are wrong or need to be adjusted, then the code needs to be changed only once.

Exercise 4

- Continue editing the `PrisonTest` project
- Identify and minimize any repeated code in the constructor and display() methods
- Run the program to make sure the program still works properly

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The Method Signature

- A method signature is created from the …
  - Name of the method
  - Number of parameters
  - Type of parameters
  - Order of parameters
- As long as one of these differ, a method's signature will be unique

This is the method signature

```
public void setPosition(double x, double y){
   //Do math
}//end method setPosition
```


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Not the Method Signature

- The method signature does not include …
  - Name of parameters
  - Method return type
- Changing either of these isn't enough to overload a method

These aren't part of the method signature

```
public void setPosition(double x, double y){
   //Do math
}//end method setPosition
```


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Matching Method Calls to Signatures

- In this example, counting makes it easy to see which version of sum() should be called
- The method call has three arguments
- Which method signature has three parameters?

```
    sum(1, 2, 3);
```

```
public class Calculator {

   public double sum(double num1, double num2){
      return num1 + num2;
   }//end method sum
   public double sum(double num1, double num2, double num3){
      return num1 + num2 + num3;
   }//end method sum
}//end class Calculator
```


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Not Matching Parameter Names

- Can you tell which version of sum() should be called if the parameter names differ?
- You can't
- And neither can Java

```
sum(1, 2);
```

```
public class Calculator {

   public double sum(double num1, double num2){
      return num1 + num2;
   }//end method sum
   public double sum(double x, double y){
      return x + y;
   }//end method sum
}//end class Calculator
```


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Not Matching Return Types

- Can you tell which version of sum() should be called if the return types differ?
- No
- And neither can Java

```
     sum(1, 2);
```

```
public class Calculator {

   public double sum(double num1, double num2){
      return num1 + num2;
   }//end method sum
    public int sum(double num1, double num2){
      return num1 + num2;
   }//end method sum
}//end class Calculator
```


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Overload First

- Methods aren't properly overloaded until their signatures differ
- When this is true, then you're welcome to modify the return type and parameter names

```
    sum(1, 2);
```

```
public class Calculator {

   public double sum(double num1, double num2){
      return num1 + num2;
   }//end method sum
   public int sum(double num1, double num2, double num3){
      return num1 + num2 + num3;
   }//end method sum
}//end class Calculator
```


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Overloading Methods Summary

- 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

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Summary

- In this lesson, you should have learned how to:
  - Understand the effects of multiple constructors in a class
  - Define overloading of a method
  - Explain the method signature
  - Understand when overloading is and isn't possible

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