ENCAPSULATION, CONSTRUCTORS, MORE INSTANCE METHODS

Talk to your neighbors:
Which is the best fruit?
Lecture Outline

• Announcements

• Warm Up

• More Instance Methods

• Encapsulation

• Constructors
Announcements

• Reminder: Quiz 0 Retake and Quiz 1 grades coming soon
Lecture Outline

• Announcements

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• More Instance Methods

• Encapsulation

• Constructors
What do p and p2 hold after the following code is executed?

```java
Point p = new Point();
p.y = 10;
Point p2 = p;
p.x = 3;
p2.y = 100;
p = new Point();
p.y = -99;
```

A. p: (3, 10)  p2: (3, 10)
B. p: (3, -99)  p2: (3, 100)
C. p: (0, -99)  p2: (3, 100)
D. p: (3, -99)  p2: (0, 100)
E. p: (0, -99)  p2: (3, 10)
What do p and p2 hold after the following code is executed?

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Point p = new Point();
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D. p: (3, -99)  p2: (0, 100)
E. p: (0, -99)  p2: (3, 10)
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(Review) Client v. Implementor

We have been the *clients* of many objects this quarter!

Now we will become the *implementors* of our own objects!
Practice: Think

What is the correct implementation of the distanceFrom instance method?

(A) public double distanceFrom() {
    double xTerm = Math.pow(x - x, 2);
    double yTerm = Math.pow(y - y, 2);
    return Math.sqrt(xTerm + yTerm);
}

(B) public static double distanceFrom(Point otherPoint) {
    double xTerm = Math.pow(otherPoint.x - x, 2);
    double yTerm = Math.pow(otherPoint.y - y, 2);
    return Math.sqrt(xTerm + yTerm);
}

(C) public double distanceFrom(Point otherPoint) {
    double xTerm = Math.pow(otherPoint.x - x, 2);
    double yTerm = Math.pow(otherPoint.y - y, 2);
    return Math.sqrt(xTerm + yTerm);
}

(D) public double distanceFrom(int otherX, int otherY) {
    double xTerm = Math.pow(otherX - x, 2);
    double yTerm = Math.pow(otherY - y, 2);
    return Math.sqrt(xTerm + yTerm);
}
Practice: Pair

What is the correct implementation of the `distanceFrom` instance method?

(A) `public double distanceFrom() {
   double xTerm = Math.pow(x - x, 2);
   double yTerm = Math.pow(y - y, 2);
   return Math.sqrt(xTerm + yTerm);
}

(B) \[ \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2} \]

```
public static double distanceFrom(Point otherPoint) {
   double xTerm = Math.pow(otherPoint.x - x, 2);
   double yTerm = Math.pow(otherPoint.y - y, 2);
   return Math.sqrt(xTerm + yTerm);
}
```

(C) `public double distanceFrom(Point otherPoint) {
   double xTerm = Math.pow(otherPoint.x - x, 2);
   double yTerm = Math.pow(otherPoint.y - y, 2);
   return Math.sqrt(xTerm + yTerm);
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(D) `public double distanceFrom(int otherX, int otherY) {
   double xTerm = Math.pow(otherX - x, 2);
   double yTerm = Math.pow(otherY - y, 2);
   return Math.sqrt(xTerm + yTerm);
}`
(PCM) toString

```java
public String toString() {
    return "String representation of object";
}
```

The toString() method is automatically called whenever an object is treated like a String!

*Why not write a print() method that prints out the String representation to the console?*
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Encapsulation

Objects *encapsulate* state and expose behavior.

Encapsulation is hiding implementation details of an object from its clients.

Encapsulation provides *abstraction*.
The `private` keyword is an access modifier (like `public`). Fields declared `private` cannot be accessed by any code outside of the object. We **always** want to encapsulate our objects’ fields by declaring them `private`. 
Accessors and Mutators

Declaring fields as private removes all access from the user.

If we want to give some back, we can define instance methods.

<table>
<thead>
<tr>
<th>Accessors (“getters”)</th>
<th>Mutators (“setters”)</th>
</tr>
</thead>
<tbody>
<tr>
<td>getX()</td>
<td>setX(int newX)</td>
</tr>
<tr>
<td>getY()</td>
<td>setY(int newY)</td>
</tr>
<tr>
<td></td>
<td>setLocation(int newX, int newY)</td>
</tr>
</tbody>
</table>
Encapsulation

Objects *encapsulate* state and expose behavior.

Encapsulation is hiding implementation details of an object from its clients.

Encapsulation provides *abstraction*.

Encapsulation also gives the implementor flexibility!
Encapsulation

While users can still access and modify our Point’s fields with the instance methods we defined, *we have control of how they do so.*

Can only accept positive coordinate values

Can swap out our underlying implementation to use polar coordinates instead!
Lecture Outline

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• Constructors
Constructors

Constructors are called when we first create a new instance of a class.

```java
Point p = new Point();
```

If we don’t write any constructors, Java provides one that takes no parameters and just sets each field to its default value.
Constructor Syntax

```java
public Point(int initialX, int initialY) {
    x = initialX;
    y = initialY;
}
```

If we write *any* constructors, Java no longer provides one for us.
this keyword

The **this** keyword refers to the current object in a method or constructor.

You can use it to refer to an object’s fields

```java
this.x, this.y
```

You can use it to refer to an object’s instance methods

```java
this.instanceMethod(param1, param2, ...);
```

You can use it to call one constructor from another

```java
this(0, 0)
```