Before we start

Talk to your neighbors:


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Lecture Outline

• Announcements

• Warm Up

• More Instance Methods

• Encapsulation

• Constructors
Announcements

- Culminating Project 2 (C2) due tomorrow, Thursday July 30th
  - Programming Project will be released on Friday, focused on OOP

- Minimum grade guarantees in Syllabus
  - Minimum grade calculator tool

- Quiz 1 was last week, we have some quiz makeups to administer then we'll be releasing grades
  - Grades will be released ~Friday
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Practice : Think

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

Point p = new Point();
p.x = 3;
p.y = 10;
Point p2 = p;
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?

```
Point p = new Point();
p.x = 3;
p.y = 10;
Point p2 = p;
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 is the correct implementation of the `distanceFrom` instance method?

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

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

(B) ```java
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) ```java
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) ```java
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);
}
```
What is the correct implementation of the distanceFrom instance method?

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

(A)

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

(B)

```java
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)

```java
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)

```java
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);
}
```
Abstraction

The separation of ideas from details, meaning that we can use something without knowing exactly how it works.

You were able use the Scanner class without understanding how it works internally!
Client v. Implementor

We have been the clients of many objects this quarter!

Now we will become the implementors of our own objects!
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**toString**

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

The `toString()` method is automatically called whenever an object is treated like a String!
private String toString() {
    return "String representation of object";
}

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

**Wait:** Why not write a print() method that prints out the String representation to the console? All toString() does is return a String!
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  • Encapsulation
• Constructors
Encapsulation

Objects *encapsulate* state and expose behavior.

**Encapsulation** is hiding implementation details of an object from its clients. (Clients = chaos, y’all.)

Encapsulation provides *abstraction*. 
**private**

The `private` keyword is an access modifier (like `public`).

Fields declared `private` cannot be accessed by any code outside of the class.

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!
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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;
}
```
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.setX(newX)
```

You can use it to call one constructor from another

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