

# CSE 11

# Accelerated Intro to Programming

## Lecture 5

Greg Miranda, Summer 2 2021

This lecture is being recorded

# Announcements

- PA3 due Thursday @ 11:59pm
- PA0.5 and PA1 resubmissions due Friday @ 11:59pm
  - PA0.5 – can also show a tutor your code running to get it checked off

# New Point Method

- Last time...
  - Used the Point class
  - Wrote simple method quadrant()
    - No parameters
    - Just used information about the point to return a String representing what quadrant it was in
- Different method (for us to try...)
  - Write a method called add()
    - Take an existing Point and another Point and add their x and y values together to get a new Point
  - Let's do a few steps together...

- Method header:
  - What is the header for this method going to look like?
- Examples:
  - Let's write some examples...
- Take a few minutes and try and write the body of the method

# New Class

- Try a new class, a new idea
  - Besides just  $x$  &  $y$  points
- Another geometry example
  - Useful to have pictures we can draw that correspond to the class
  - Another idea with a coordinate plane
    - Want to have a class that represents lines
      - What are some ways we represent lines?

- What are some methods we might want to write on a line?
  - One idea - like a calculator
    - We could provide the x value and get the y value back
      - A natural thing to want to compute about a line
        - Or about any 2D function
- Examples of lines
- What will this method look like?
  - Calculate a y value given an x value

# Double

- One of the things we had issues with integers and division
  - `int n = 15 / 2;`
    - We get truncation
- Java, and most programming languages, have a way to use a different kind of arithmetic
  - `double m = 15.0 / 2.0;`
    - Does fractional arithmetic
  - A different type
    - double – floating point number

- For most of our purposes – we can trust that doubles will be pretty accurate
  - We should only use doubles to represent things where we are okay with inaccuracy
    - The way that computers can round numbers can be surprising
      - `double oneThird = 1.0 / 3.0;`
      - `double twoThirds = 2.0 / 3.0;`
        - Doesn't round off at the end
      - `double anotherOne = (0.1 + 0.2) + 0.3;`
        - The internal representation of these numbers isn't perfect
          - Will learn all these reasons in great detail if you take CSE 30
        - There is some rounding happening even on simple cases
      - `double yetAnother = 0.1 + (0.2 + 0.3);`
        - So weird the order of parenthisation can matter



- Will start using doubles now as another data type
  - Just be aware: when we use them we are expecting some kind of rounding behavior
- How to mix doubles and ints?
  - `double divided = 15 / 2;`
    - 7.5?
  - `double dividedAgain = n / 2;`
    - How do we get the right answer?
- This is going to be important to us going forward
  - To be able to use doubles
  - Able to turn ints into calculations we can do with doubles

# Math

- Let's look at a few ways to manipulate numbers using more built-in methods in Java
  - Like built-in String methods we looked at before
- Square root of a number - common operation to do
  - `double sqrt2 = Math.sqrt(2);`
    - Takes an int or a double
      - `double sqrt2FromDouble = Math.sqrt(2.0);`
    - Answer is always a double
      - An approximation of the square root – not a full answer to the square root
- Raise a number to a power
  - `double cubeOf12 = Math.pow(12, 3);`
- Both methods are defined in Java's Math library

- More math methods
  - Max
    - `double maxOf45 = Math.max(4, 5);`
  - Min
  - And several other math methods as well
- Two ways to think of this based on what we've seen before
  - Definition 1
    - Math is a built-in object
  - Definition 2
    - Math is a built-in class
      - `sqrt`, `pow`, `max`, `min` are a special kind of a method
        - Calling them with the class name before the dot
        - Instead of writing an object before the dot
    - Defn2 is the correct way to think about it
      - Another feature called **static methods** that's coming up in future weeks

# Memory Models

- More practice with drawing diagrams for laying out objects
  - Build up a little more of a visual language for
    - Drawing objects
    - Drawing what's happening inside Java
- Code from the reading

```

class Point {
    int x;
    int y;
    Point(int x, int y) {
        this.x = x;
        this.y = y;
    }
    double distance(Point other) {
        return Math.sqrt(Math.pow(this.x - other.x, 2)
            + Math.pow(this.y - other.y, 2));
    }
}
class CircRegion {
    Point center;
    int radius;
    CircRegion(Point center, int radius) {
        this.center = center;
        this.radius = radius;
    }
    boolean contains(Point p) {
        return this.center.distance(p) < this.radius;
    }
}
class ExamplesRegion {
    CircRegion c1 = new CircRegion(new Point(200, 50), 10);
    Point circleTest1 = new Point(209, 50);
    boolean contains1 = this.c1.contains(this.circleTest1);
}

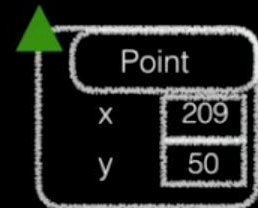
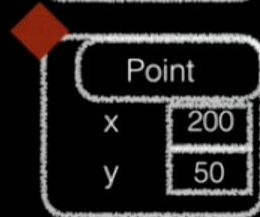
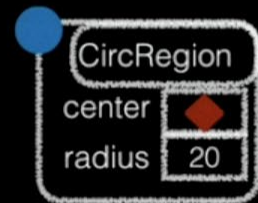
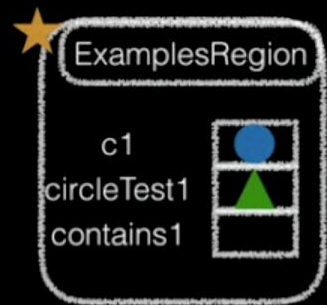
```

```
class Point {
```

```
    double distance(Point other) {  
        return Math.sqrt(Math.pow(this.x - other.x, 2)  
            + Math.pow(this.y - other.y, 2));  
    }  
}  
class CircRegion {
```

```
    boolean contains(Point p) {  
        return this.center.distance(p) < this.radius;  
    }  
}
```

```
    this.c1.contains(this.circleTest1);
```



```

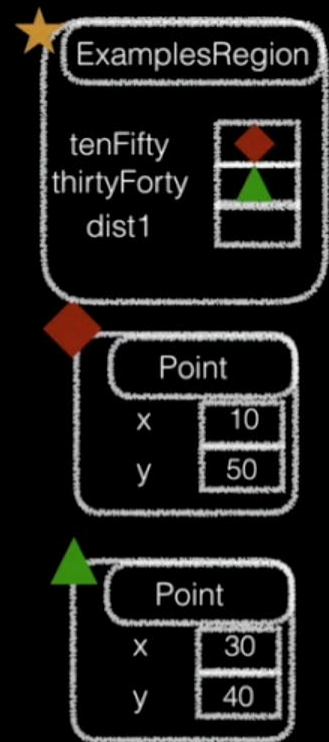
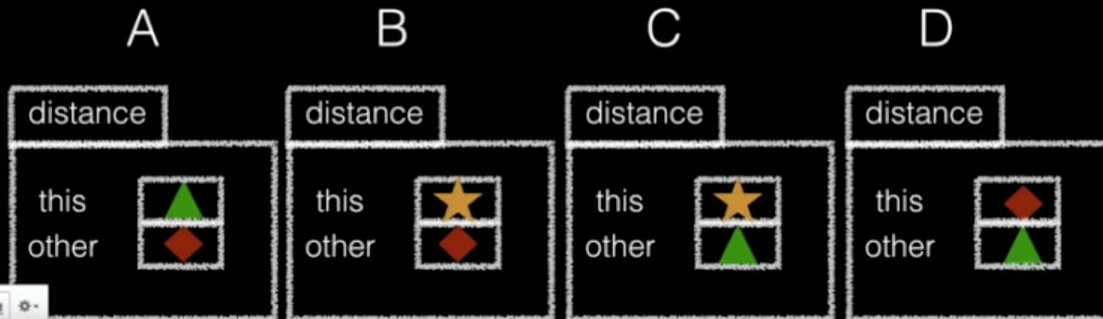
class Point {
    int x;
    int y;
    Point(int x, int y) {
        this.x = x;
        this.y = y;
    }
    double distance(Point other) {
        return Math.sqrt(Math.pow(this.x - other.x, 2)
            + Math.pow(this.y - other.y, 2));
    }
}

class ExamplesRegion {
    Point tenFifty = new Point(10, 50);
    Point thirtyForty = new Point(30, 40);

    double dist1 = this.tenFifty.distance(this.thirtyForty);
}

```

Which of these is the stack frame that's created for the call to distance?



```

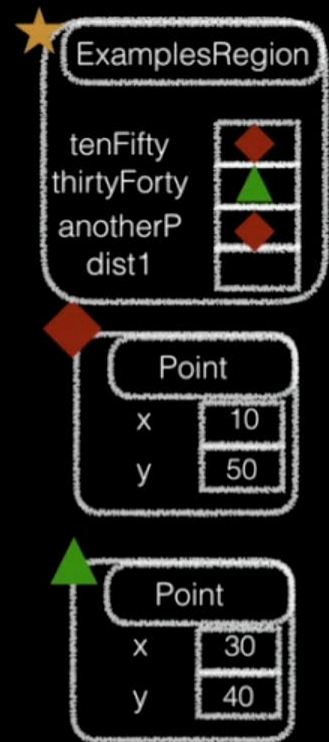
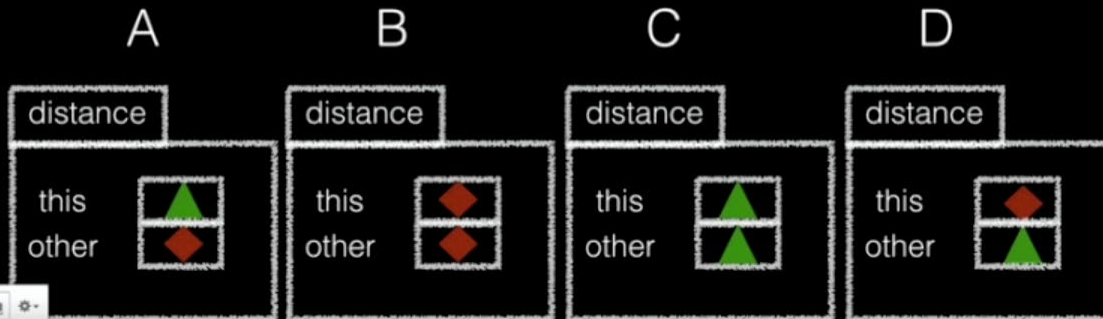
class Point {
    int x;
    int y;
    Point(int x, int y) {
        this.x = x;
        this.y = y;
    }
    double distance(Point other) {
        return Math.sqrt(Math.pow(this.x - other.x, 2)
            + Math.pow(this.y - other.y, 2));
    }
}

class ExamplesRegion {
    Point tenFifty = new Point(10, 50);
    Point thirtyForty = new Point(30, 40);
    Point anotherP = tenFifty;

    double dist1 = this.tenFifty.distance(this.anotherP);
}

```

Which of these is the stack frame that's created for the call to distance?

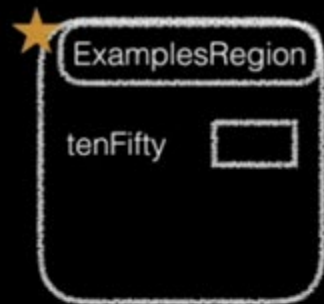




# Constructors

- Now that we understand the Stack, we have what we need to understand constructors

```
class Point {  
    int x;  
    int y;  
    Point(int x, int y) {  
        this.x = x;  
        this.y = y;  
    }  
  
}  
  
class ExamplesRegion {  
    Point tenFifty = new Point(10, 50);  
}
```

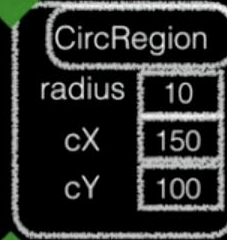


# Constructor Summary

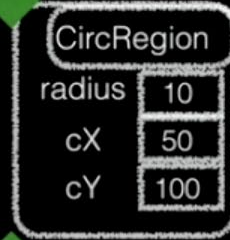
- Constructors:
  - Are special methods, called when **new** is used
  - Are passed the newly-constructed object as **this**, and any arguments
  - Typically assign values into fields using **this.field = value**
- When new is used:
  - A fresh object, with a new reference is created with uninitialized fields
  - The constructor with parameters that match the arguments is called
  - The whole new expression evaluates to the new reference

```
class CircRegion2 {  
    int radius;  
    int cX;  
    int cY;  
    CircRegion2(int radius, int cX, int cY) {  
        this.radius = radius;  
        this.cX = cX + 100;  
        this.cY = cY;  
    }  
}  
class ExamplesRegion {  
    CircRegion2 cr2 = new CircRegion(10, 50, 100);  
}
```

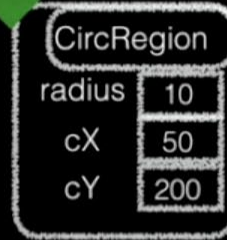
A



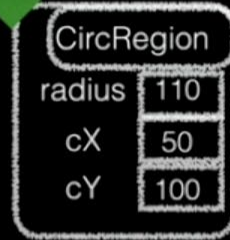
C



B



D



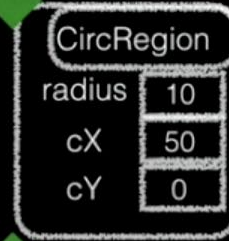
```

class CircRegion2 {
    int radius;
    int cX;
    int cY;
    CircRegion2(int radius) {
        this.radius = radius;
        this.cX = 0;
        this.cY = 0;
    }
}

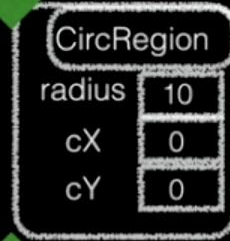
class ExamplesRegion {
    CircRegion2 cr2 = new CircRegion(10);
}

```

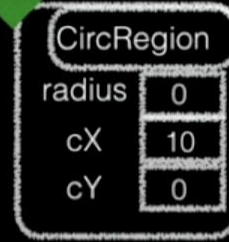
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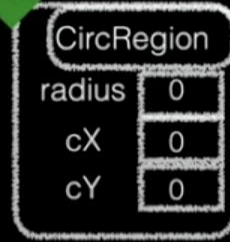
C



B



D



# Tester

- `import tester.*;`
  - `tester.jar` – java archive
    - Libraries that contain classes that we can use in our own code
      - `Tester`
  - `Tester` class allows us to create methods to unit test our code
    - Unit testing – compare actual values versus expected values
      - `t.checkExpect(<actual value>, <expected value>);`
    - Goal: get all tests to pass
      - Confidence that your code/solution is correct

# Local Variables

- Local variables are defined inside the body of a method
  - They are 'local' to the method in which they are defined in
- Used temporarily while the method is running, then are removed
  - Similar to parameters
  - Added to the stack frame for the method
- No default value
  - Must be assigned a value before it's read from
    - i.e. used as an expression