toString
Encapsulation &
“this” keyword

Subset of the Supplement Lesson slides from: Building Java Programs, Chapter 8.2 & 8.4
by Stuart Reges and Marty Stepp (http://www.buildingjavaprograms.com/) & thanks to Ms Martin.

Printing objects

- By default, Java doesn't know how to print objects:

```
Point p = new Point();
p.x = 10;
p.y = 7;
System.out.println("p is " + p);   // p is Point@9e8c34



// better, but cumbersome;            p is (10, 7)
System.out.println("p is (" + p.x + ", " + p.y + ")");



// desired behavior
System.out.println("p is " + p);   // p is (10, 7)
```

The `toString` method

tells Java how to convert an object into a `String`

```
Point p1 = new Point(7, 2);
System.out.println("p1: " + p1);

// the above code is really calling the following:
System.out.println("p1: " + p1.toString());
```

- Every class has a `toString`, even if it isn't in your code.
  - Default: class's name `@` object's memory address (base 16)

```
Point@9e8c34
```

toString syntax

- Method name, return, and parameters must match exactly [these won’t work: tostring() or ToString()].

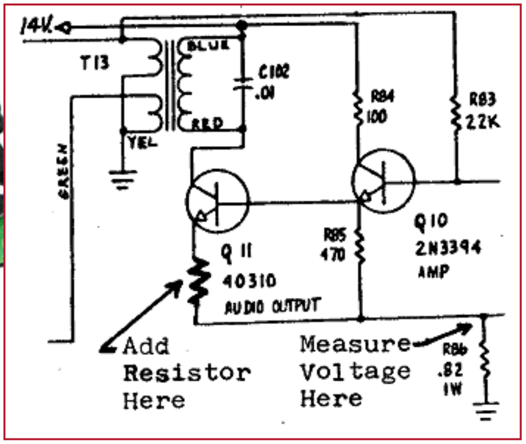
- Example:

```
// Returns a String representing this Point.
public String toString() {
    return "(" + x + ", " + y + ")";
}
```

Encapsulation

- **encapsulation**: Hiding implementation details from clients.

  - Encapsulation forces *abstraction*.
    - separates external view (behavior) from internal view (state)
    - protects the integrity of an object's data



Private fields

A field that cannot be accessed from outside the class

```
private type name;
```

– Examples:

```
private int id;
private String name;
```

- Client code won't compile if it accesses private fields:

```
PointMain.java:11: x has private access in Point
System.out.println(p1.x);
                      ^
```

Accessing private state

```
// A "read-only" access to the x field ("accessor")
public int getX() {
    return x;
}

// Allows clients to change the x field ("mutator")
public void setX(int newX) {
    x = newX;
}
```

– Client code will look more like this:

```
System.out.println(p1.getX());
p1.setX(14);
```

Point class, version 4

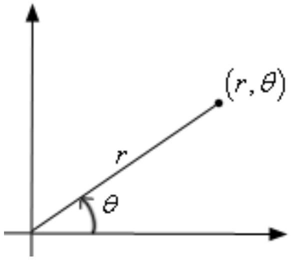
```
// A Point object represents an (x, y) location.
public class Point {
    private int x;
    private int y;
    public Point(int initialX, int initialY) {
        x = initialX;
        y = initialY;
    }
    public int getX() {
        return x;
    }
    public int getY() {
        return y;
    }
    public double distanceFromOrigin() {
        return Math.sqrt(x * x + y * y);
    }
    public void setLocation(int newX, int newY) {
        x = newX;
        y = newY;
    }
    public void translate(int dx, int dy) {
        setLocation(x + dx, y + dy);
    }
}
```

Benefits of encapsulation

- Abstraction between object and clients

- Protects object from unwanted access
  - Example: Can't fraudulently increase an `Account`'s balance.

- Can change the class implementation later
  - Example: `Point` could be rewritten in polar coordinates (r, θ) with the same methods.



- Can constrain objects' state (**invariants**)
  - Example: Only allow `Account`s with non-negative balance.
  - Example: Only allow `Date`s with a month from 1-12.

The `this` keyword

- **`this`** : Refers to the implicit parameter inside your class.

  (a variable that stores the object on which a method is called)

  - Refer to a field: `this.`**field**
  - Call a method: `this.`**method**`(`**parameters**`);`
  - One constructor can call another: `this(`**parameters**`);`

Variable shadowing

- **shadowing**: 2 variables with same name in same scope.
  - Normally illegal, except when one variable is a field.

```
public class Point {
    private int x;
    private int y;
    ...
    // this is legal
    public void setLocation(int x, int y) {
        ...
    }
```

  - In most of the class, `x` and `y` refer to the fields.
  - In `setLocation`, `x` and `y` refer to the method's parameters.

Fixing shadowing

```
public class Point {
    private int x;
    private int y;

    ...

    public void setLocation(int x, int y) {
        this.x = x;
        this.y = y;
    }
}
```

- Inside `setLocation`,
  - To refer to the data field `x`, say `this.x`
  - To refer to the parameter `x`, say `x`

Calling another constructor

Here's a clever use of this in constructors:

```
public class Point {
    private int x;
    private int y;

    public Point() {
        this(0, 0);        // calls (x, y) constructor
    }

    public Point(int x, int y) {
        this.x = x;
        this.y = y;
    }

    ...
}
```

- Avoids redundancy between constructors
- Only a constructor (not a method) can call another constructor