Topic 29
classes and objects, part 3

“And so, from Europe, we get things such as ... object-oriented analysis and design (a clever way of breaking up software programming instructions and data into small, reusable objects, based on certain abstraction principles and design hierarchies.)”

-Michael A. Cusumano, The Business Of Software

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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

```java
private type name;
```

- Examples:

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

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

  ```java
  PointMain.java:11: x has private access in Point
  System.out.println(pl.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(pl.getX());
  pl.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 Accounts with non-negative balance.
  - Example: Only allow Dates with a month from 1-12.

The keyword this

reading: 8.3
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 `this(parameters)`
  can call another:

**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**

```
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