Topic 28
classes and objects, part 2

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:
    ```java
    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.

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- What is output by the following client code?
  - The code is not part of the Point class.
  
  Point p1 = new Point(5, 10); // x, y
  p1.x = 12;
  System.out.println(p1.x);

  A. 0
  B. 5
  C. 12
  D. no output due to syntax error
  E. no output due to runtime error

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:

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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.

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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`

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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