CSSE 220 Day 16

Designing Classes

Check out *DesigningClasses* project from SVN

Questions?

What is good object-oriented design?

- It starts with good classes…

Good Classes Typically

- Come from nouns in the problem description
- May…
  - Represent single concepts
    - `Circle`, `Investment`
  - Represent visual elements of the project
    - `FacesComponent`, `UpdateButton`
  - Be abstractions of real-life entities
    - `BankAccount`, `TicTacToeBoard`
  - Be actors
    - `Scanner`, `CircleViewer`
  - Be utility classes that mainly contain static methods
    - `Math, Arrays, Collections`

Q1

What Stinks? Bad Class Smells*

- Can't tell what it does from its name
  - `PayCheckProgram`
- Turning a single action into a class
  - `ComputePaycheck`
- Name isn't a noun
  - `Interpolate`, `Spend`

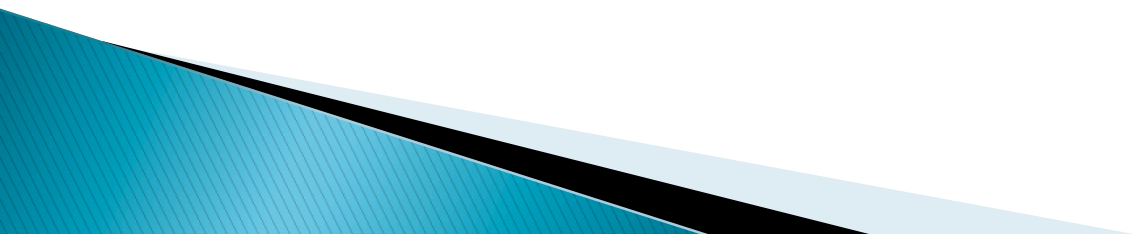
Function objects are an exception. Their whole purpose is to contain a single computation

*See http://en.wikipedia.org/wiki/Code_smell
http://c2.com/xp/CodeSmell.html

Q2

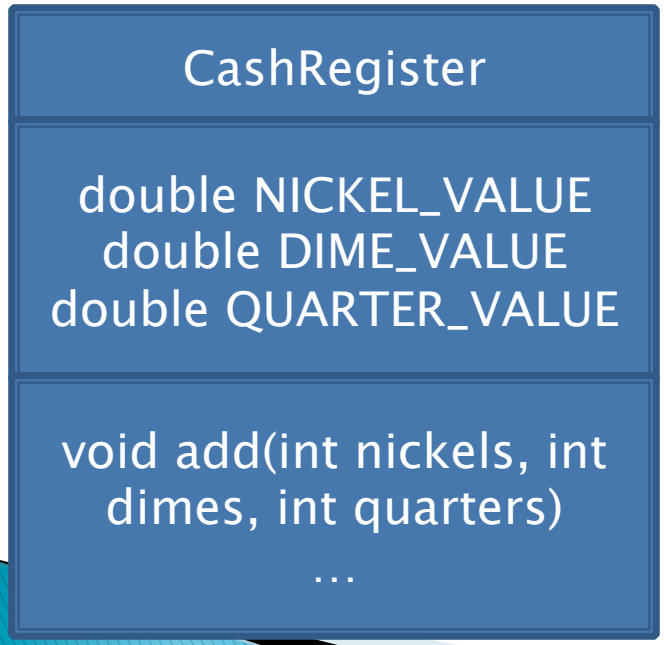
Analyzing Quality of Class Design

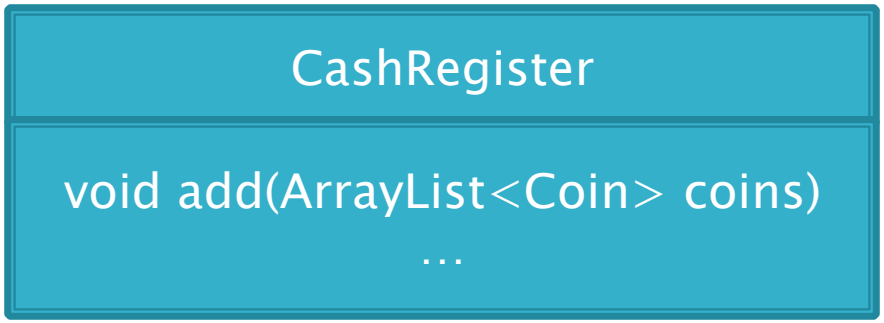
- Cohesion
- Coupling

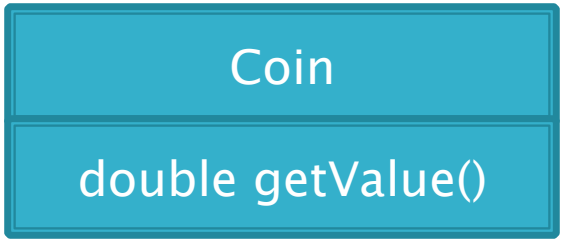


Cohesion

- A class should represent a single concept
- Public methods and constants should be cohesive
- Which is more cohesive?





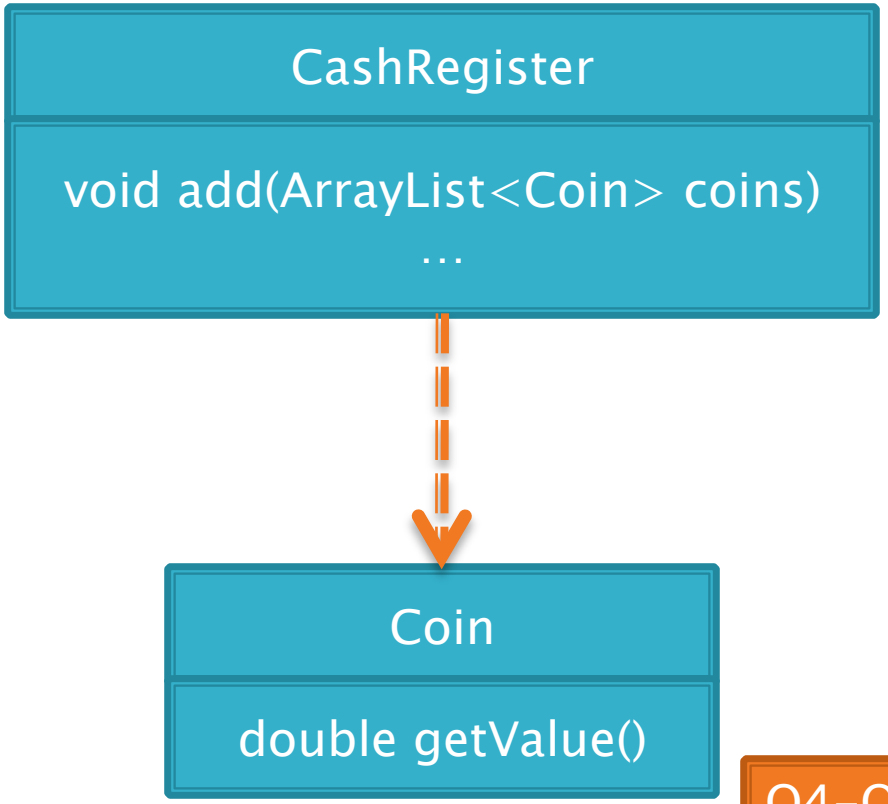


Q3

Dependency Relationship

- When one class requires another class to do its job, the first class depends on the second

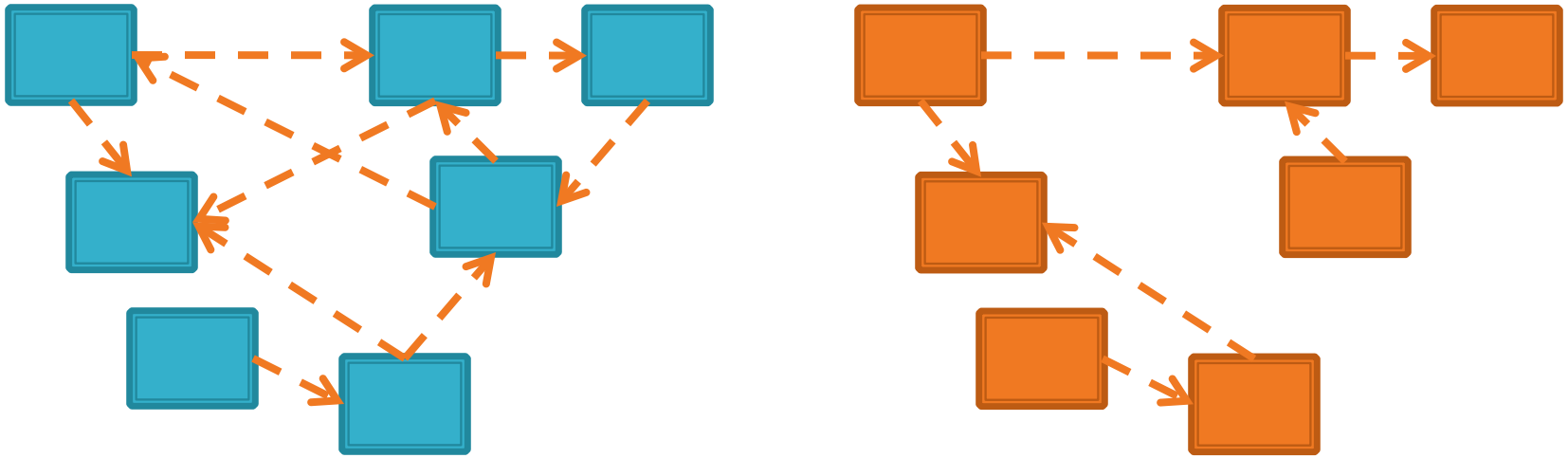
- Shown on UML diagrams as:
  - dashed line
  - with open arrowhead



Q4-Q6

Coupling

- Lots of dependencies == high coupling
- Few dependencies == low coupling

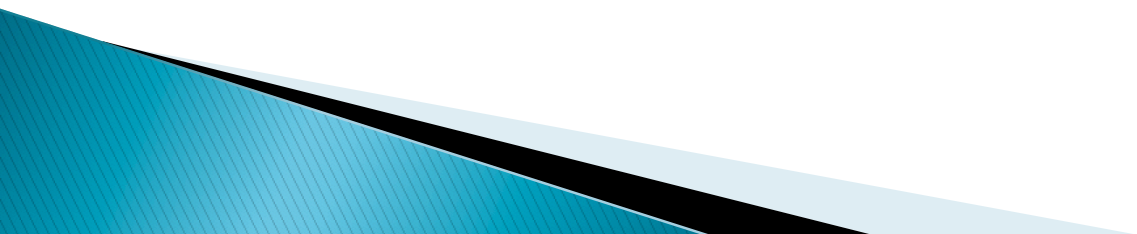


- Which is better? Why?

Q7

Quality Class Designs

- High cohesion
- Low coupling



Accessors and Mutators Review

- **Accessor method**: accesses information *without changing any*
- **Mutator method**: *modifies* the object on which it is invoked

Q8

Immutable Classes

- Accessor methods are very predictable
  - Easy to reason about!
- **Immutable classes**:
  - Have only accessor methods
  - No mutators
- Examples: **`String`**, **`Double`**
- Is **`Rectangle`** immutable?

Immutable Class Benefits

- Easier to reason about, less to go wrong
- Can pass around instances “fearlessly”

Side Effects

- Side effect: any modification of data

- Method side effect: any modification of data *visible* outside the method
  - Mutator methods: side effect on implicit parameter
  - Can also have side effects on other parameters:
    - ```
      public void transfer(double amt, Account other)
      {
          this.balance -= amt;
          other.balance += amt;
      }
      ```

Avoid this if you can!
      ```

Quality Class Designs

- High cohesion
- Low coupling
- Class names are nouns
  - Method names are verbs
- Immutable where practical
  - Document where not
- Inheritance for code reuse
- Interfaces to allow others to interact with your code

Coming attractions

Class Design Exercise

- See HW16 –Chess exercise
  Work in groups of three or four on the whiteboards

Static

- Static fields and methods …

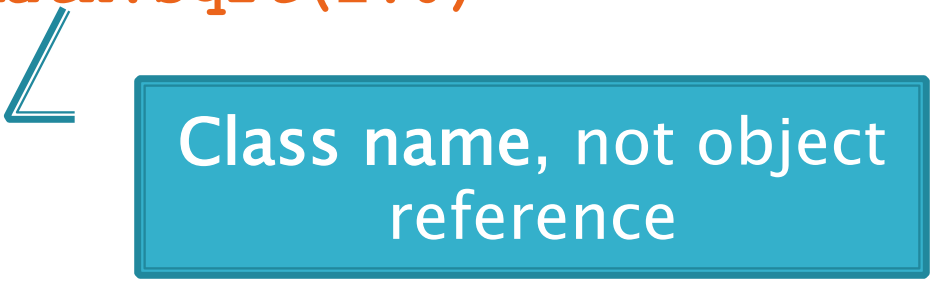
What is `static` Anyway?

- `static` members (fields and methods)…
  - are **not** part of objects
  - are **part of the class itself**

- Mnemonic: objects can be passed around, but static members stay put

Static Methods

- Cannot refer to `this`
  - They aren't in an object, so there is no `this`!
- Are called without an implicit parameter
  - `Math.sqrt(2.0)`



- Inside a class, the class name is optional but much clearer to use (just like this for instance fields and methods)

When to Declare Static Methods

- The `main()` method is static
  - Why is it static?
  - What objects exist when the program starts?

When to Declare Static Methods

- Helper methods that don't refer to this
  - Example: creating list of **`Coordinates`** for glider

- Utility methods like *sin* and *cos* that are not associated with any object

  - Another example:

```
public class Geometry3D {
    public static double sphereVolume(double radius) {
        ...
    }
}
```

Q10

Static Fields

- We've seen static final fields

- Can also have static fields that aren't final
  - Should be private
  - Used for information shared between instances of a class
    - Example: the number of times a particular method of the a class is called by ANY object of that class

Q11

Two Ways to Initialize

- private static int nextAccountNumber = 100;

- or use “static initializer” blocks:

```
public class Hogwarts {
        private static ArrayList<String> FOUNDERS;

        static {
                FOUNDERS = new ArrayList<String>();
                FOUNDERS.add("Godric Gryfindor");
                // ...
        }

        // …
}
```

A Polygon exercise

- Run the program in the polygon package
- Read all the TODO's in the Polygon class
- Do and test the TODO's for most number of sides, asking questions as needed
- Do and test the TODO's for least number of sides
  - You might find the constant Integer.MAX_VALUE helpful

Q12-Q13

Work Time

- Homework 16: Polygon