

CSSE 220

Coupling and Cohesion Scoping

Please checkout VideoStore from your SVN

The plan

- Learn 3 essential object oriented design terms:
 - Encapsulation (done)
 - Coupling
 - Cohesion
- Scope (if we have time)

Coupling and Cohesion

- Two terms you need to memorize
- Good designs have **high cohesion** and **low coupling**

Consider the opposite:

- **Low cohesion** means that you have a small number of really large classes that do too much stuff
- **High coupling** means you have many classes that depend too much on each other

Imagine I want to make a Video Game.

Here are two classes in my design.

Which is more cohesive?

GameRunner

```
main(args:String)
loadLevel(levelName:String)
moveEnemies()
drawLevel(g:Graphics2D)
computeScore():int
computeEnemyDamage()
handlePlayerInput()
doPowerups(...)
runCutscene(cutsceneName:String)
//some more stuff
```

Image

```
loadImageFile(filename:String)
setPosition(x:int,y:int)
drawImage(g:Graphics2D)
```

*Note that in both these classes I've omitted the fields for clarity

Cohesion

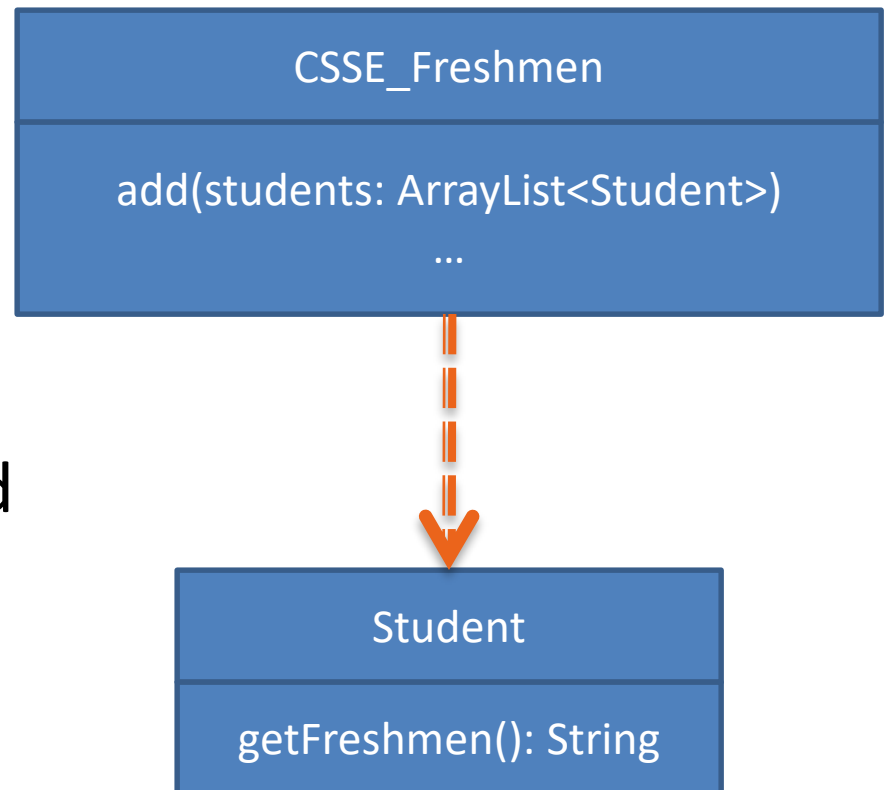
- **A class should represent a single concept.** All interface features should be closely related to the single concept that the class represents. Such a class is said to be cohesive.
 - Your textbook

On to coupling...

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



Coupling

- Coupling is when **one object depends strongly on another**

```
//do setup must be called first
this.otherObject.doSetup(var1, var2, var3);

//now we compute the parameter
int var4 = computeForOtherObject(var1, var2);
this.otherObject.setAdditionalParameter(var4);

//finally we display
this.otherObject.doDisplay(this.var5, this.var6);
```

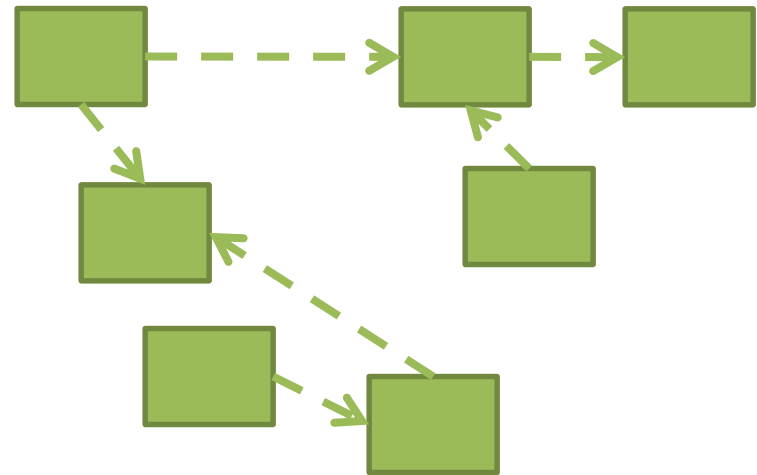
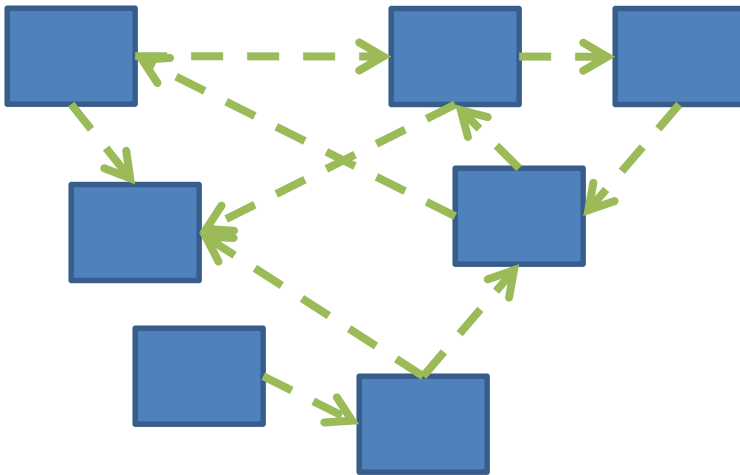
Note that in this design, GameRunner probably had many objects of the image class, but Image does not know the GameRunner class even exists. That's a sign of low coupling between Image and GameRunner.

GameRunner
<pre>main(args:String) loadLevel(levelName:String) moveEnemies() drawLevel(g:Graphics2D) computeScore():int computeEnemyDamage() handlePlayerInput() doPowerups(...) runCutscene(cutsceneName:String) //some more stuff</pre>

Image
<pre>loadImageFile(filename:String) setPosition(x:int,y:int) drawImage(g:Graphics2D)</pre>

Coupling

- Lot's of dependencies → high coupling
- Few dependencies → low coupling



If we do our design job carefully

- We will break our larger problem into several classes
- Each of these classes will do one kind of thing (i.e. they will have *high cohesion*)
- Our classes will only need to depend on each other in specific, highly limited ways (i.e. they will have *low coupling*). Many classes won't even be aware of most of the other classes in the system.

Imagine that you're writing code to manage a school's students

Things your design should accommodate:

- Handle adding or removing students from the school
- Setting the name, phone number, and GPA for a particular student
- Compute the average GPA of all the students in the school
- Sort the students by last name to print out a report of students and GPA

Discuss and come up with a design with those near you.
How many classes does your system need?

Note that

- Cohesion makes us want:
 - Many smaller classes
 - Classes do only one thing
- If classes are too small
 - Tend to need to depend on each other
 - Coupling rises

Hints for Designing Classes

- Look for the nouns in your problem, consider making them classes
- Keep any one class from getting too “fat” – containing too many methods or fields
- Avoid Plural Nouns
- Avoid Parallel Structures

Practice

- Step 1 – Get into pairs
- Step 2 – Do the Video Store Quiz (you should talk together but each of you will submit a separate page)
- Step 3 – the mystery step, where we try and fix the problem

The Mystery Step

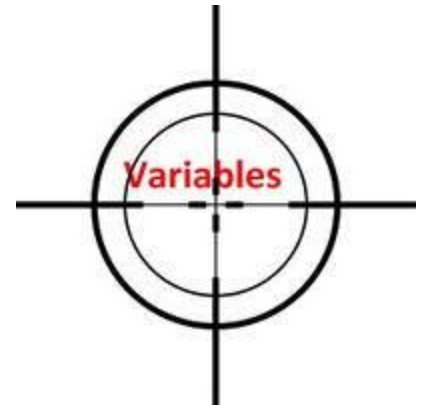
- The problem is that the customer object is not very cohesive – knows way too much about how things should be priced
- Add the following:
 - Add `getCost(int daysRented)` method to `Movie`
 - Add `getCharge()` in `Rental` that uses the new `getCost` method
 - Don't write new calculations, move existing code into these new methods and update as necessary
- Try to do something similar to rental points if you can

Rule of Thumb: No Global Variables

- Or static variables that are used like globals
- A static variable can be accessed/modified in any function at any time
- As a result many parts of the code can be coupled to a single class

Variable Scope

Scope is the region of a program in which a variable can be accessed

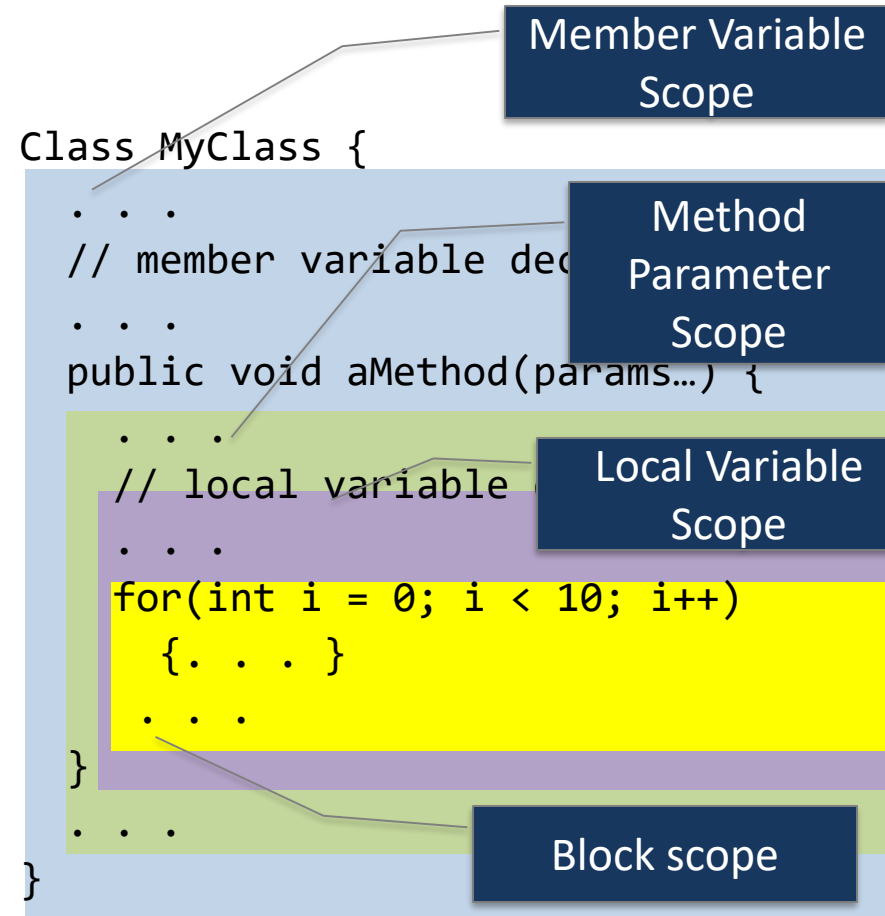


- *Parameter scope*: the whole method body
- *Local variable scope*: from declaration to block end

```
public double myMethod() {  
    double sum = 0.0;  
    Point2D prev = this.pts.get(this.pts.size() - 1);  
    for (Point2D p : this.pts) {  
        sum += prev.getX() * p.getY();  
        sum -= prev.getY() * p.getX();  
        prev = p;  
    }  
    return Math.abs(sum / 2.0);  
}
```

Member Scope (Field or Method)

- **Member scope:** anywhere in the class, including *before* its declaration
 - Lets methods call other methods later in the class
- **public static** class members can be accessed from outside with “class qualified names”
 - `Math.sqrt()`
 - `System.in`



Overlapping Scope and Shadowing

```
public class TempReading {  
    private double temp;  
  
    public void setTemp(double temp) {  
        this.temp = temp;  
    }  
    // ...  
}
```

What does this
“temp” refer to?

Always qualify field references with
this. It prevents accidental
shadowing.

Work Time

- Crazy Eights – see due date on schedule page
- Work with your partner on the Crazy Eights project
 - Get help as needed
 - Finding your partner...

Before you leave today, make sure that you and your partner have ***scheduled a session to complete the Crazy Eights project***

- Where will you meet?
 - ***Try the CSSE lab F-217/225***
- When will you meet?
 - ***Consider this evening,***
7 to 9 p.m. ***Exchange contact info*** in case one of you needs to reschedule.
- ***Do it with your partner.*** If your partner bails out, ***DON'T*** do it alone until you communicate with your instructor.