LEC 12

CSE 122

Advanced OOP

BEFORE WE START

Talk to your neighbors:

What are your plans over the summer?

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Questions during Class?

Raise hand or send here

sli.do #cse122

Lecture Outline

- Announcements ◀
- Constructors Recap
- Equals
- Bigger Example
- Interfaces Review
- Shapes!
- Comparable

Announcements

- Programming Assignment 3 (P3) releasing later tonight
  - Focused on OOP and interfaces!
- Quiz 2 (LAST ONE) in section Thursday 8/8
- Finals week coming up! Prep materials coming next week

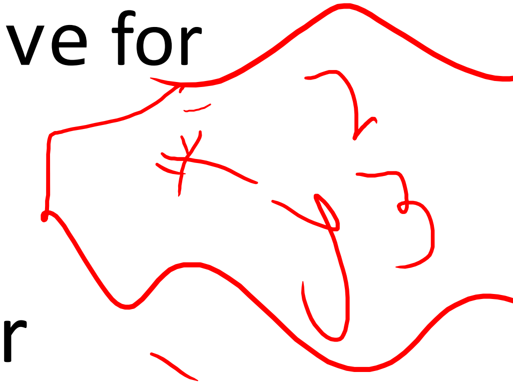
Lecture Outline

- Announcements
- **Equals** ◀
- Bigger Example
- Interfaces Review
- Shapes!
- Comparable

Equals (PCM Review)

The `equals()` method returns `true` if the given parameter is considered equal to this object, and `false` otherwise.

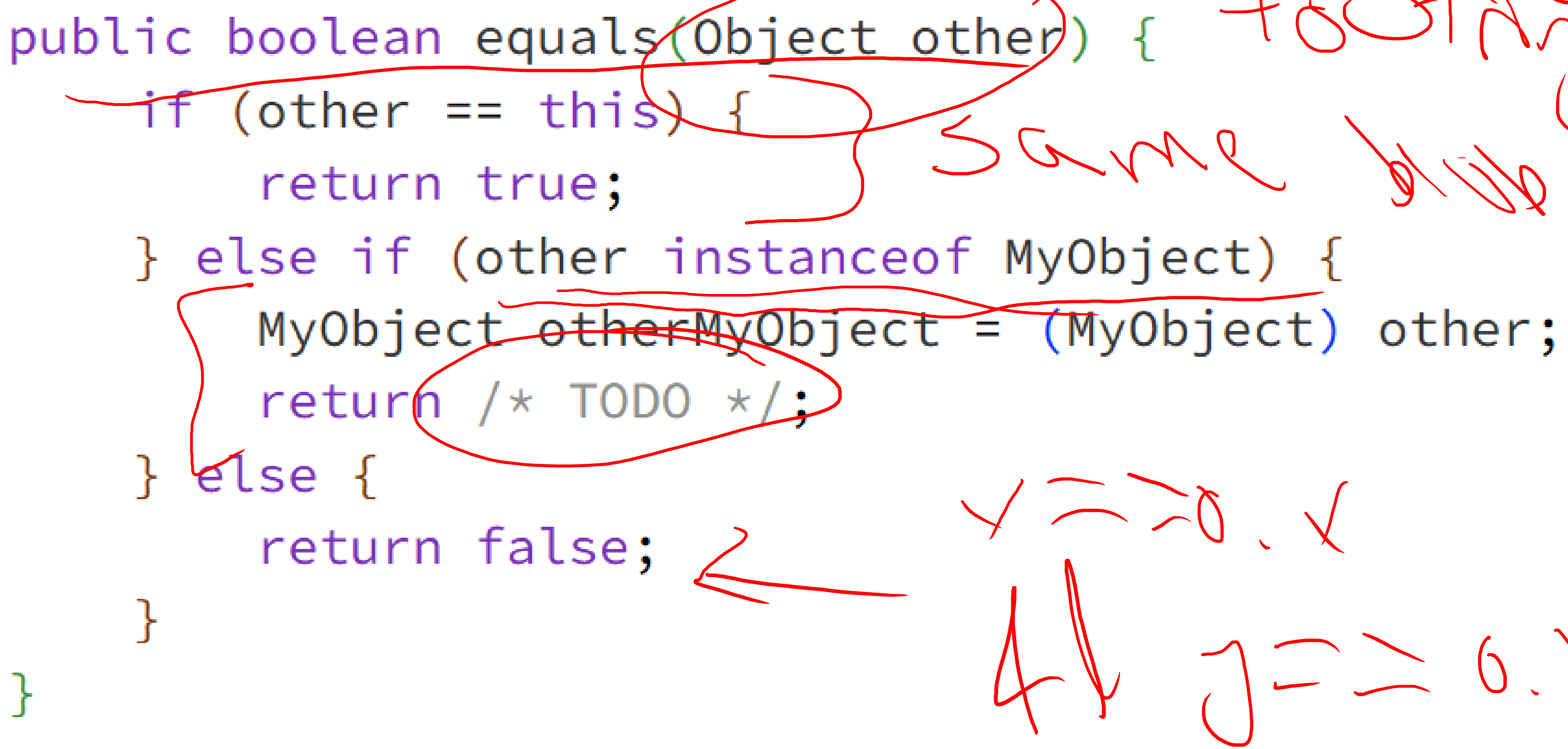
- Used by lots of library methods! e.g. `contains`, `remove` for specific elements, etc.



Each class has one provided by Java, but it checks for **reference equality**. (Thanks?)

If you want equals to check for **value equality**, you need to write this method yourself.

Equals (PCM Review)



```java
public boolean equals(Object other) {
    if (other == this) {
        return true;
    } else if (other instanceof MyObject) {
        MyObject otherMyObject = (MyObject) other;
        return /* TODO */;
    } else {
        return false;
    }
}
```

public String toString()

same obj

x == o.x

&& y == o.y

Object

By taking a parameter of type `Object`, the equals method can be passed any type of object.

More to come in CSE 123 on the Java mechanisms that make this work!

We can use the `instanceof` keyword in Java to determine if the parameter is actually a `Point`

Almost there…

This is actually **still an imperfect implementation** because we would also need to write a `hashCode()` method for our object to work with `HashSet`, `HashMap`, etc. but more to come on that in CSE 331 and beyond ☺

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- **Bigger Example**
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Student class

Write a `Student` class that you can construct by saying:

```
new Student(1234567, "Miya")
```

where the first parameter is their student number and the second parameter is their name. Your `Student` class should also implement the following methods:

- `getName()` returns the student's name
- `getStudentNumber()` returns the student's number
- `setName(String newName)` sets the student’s name to the given `newname`
- `toString()` returns a `String` representation of the student formatted as `"name (studentNumber)"`
- `equals(Object other)` that returns `true` if the given parameter is considered equal to this object

Student class

What if we added a field to the Student class:

```
    private boolean isMale;
```

Yikes—You are the *designer* now. Think carefully about what assumptions you are making!

Also…

Why shouldn’t we include a `setStudentNumber` method?

Course class

Write a Course class that represents a course at UW. Implement the following methods and constructors:

Constructors

- Write a constructor so that you can construct a Course by saying `new Course(23213, "CSE 122", 4)` where the first parameter is the course's SLN, the second parameter is the code for the course, and the third parameter is the number of credits.
- Write another constructor so that you can construct a Course by saying `new Course(23239, "CSE 122", 4, enrollment)` where the first parameter is the course's SLN, the second parameter is the code for the course, the third parameter is the number of credits, and the fourth parameter is a `Student[]` containing a `Student` for each student enrolled in the course.

Course class

Instance Methods

- `updateRoster(Student[] students)` replaces the current roster with the content of the given students
- `addStudent(Student s)` adds the given student to the roster if they are not already on it
- `dropStudent(Student s)` removes the given student from the roster if they are on it
- `checkStudentEnrolled(Student s)` returns true if the given student is on the current roster, and false otherwise
- `getSLN()` returns the course's SLN
- `getCourseCode()` returns the course's code
- `getCredits()` returns the number of credits for the course
- `getRoster()` returns a copy of the course's roster

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- Equals
- Bigger Example
- **Interfaces Review**
- Shapes!
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Recall from L6: Wait, ADT? Interfaces?

- **Abstract Data Type (ADT)**: A *description of the idea* of a data structure including what operations are available on it and how those operations should behave. For example, the English explanation of what a list should be.

- **Interface**: Java construct that lets programmers *specify what methods a class should have*. For example the `List` interface in java.

- **Implementation:** *Concrete code* that meets the specified interface. For example, the `ArrayList` and `LinkedList` classes that implement the `List` interface.

Interfaces

Interfaces serve as a sort of “certificate”– in order for a class to implement an interface, it must fulfill the certificates requirements.

The certificates requirements are certain methods that the class must implement.

`Lists`

One ADT we've talked a lot about in this course is a list.

Within Java, there exists a `List` interface – its contract includes methods like:

`add`, `clear`, `contains`, `get`, `isEmpty`, `size`

There's also an `ArrayList` class (implementation)

To get the certificate, it <u>must</u> include <u>all</u> these methods (and any others the `List` interface specifies)

Interfaces vs. Implementation

Interfaces require certain methods, but they do not say anything about how those methods should be implemented – that's up to the class! 🏅

`List` is an interface

- `ArrayList` is a class that implements the `List` interface
- `LinkedList` is a class that implements the `List` interface
- …

Why interfaces?

List<...> =

Flexibility

new A...<>()

```
public static void method(Set<String> s) {…}
```

This method can accept either a:

- `HashSet<String>` or
- `TreeSet<String>` or
- Any other class that implements `Set` and whose element type is `String`!

Why interfaces?

Abstraction

Interfaces also support *abstraction*
(the separation of ideas from details)

Lecture Outline

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- Equals
- Bigger Example
- Interfaces Review
- **Shapes!**
- Comparable

Classes can Implement Multiple Interfaces

A class can implement multiple interfaces – it’s like one person getting multiple certificates!

If a class implements an interface A and an interface B, it’ll just have to include all of A’s required methods along with all of B’s required methods

Classes can Implement Multiple Interfaces

```
public interface Parallel {
    public int numParallelPairs();
}

public class Square implements Shape, Parallel {
    ...
        public int numParallelPairs() {
                return 2;
    }
}
```

Shape sq = new Square();

Parallel sq = new Square();

But Square would have to implement:

- getPerimeter, getArea from Shape

    AND

- `numParallelPairs` from `Parallel`

An interface can extend another

You can have one interface extend another

So if `public interface A extends B`, then any class that implements A must include all the methods in A's interface and all the methods in B's interface

Food Handler

Food Manager extends Handler

An interface can extend another

We can write another interface

`Polygon` that extends `Shape`

`Make modifications such that:`

- `Square` is a `Polygon` (and `Shape`)
- `Triangle` is a `Polygon` (and `Shape`)
- `Circle` is a `Shape` (but *not* a `Polygon`)

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- Interfaces Review
- More Shapes!
- **Comparable**

Comparable

TreeSet uses an **interface** called Comparable<E> to know how to sort its elements!

Only has one required method:

```
public int compareTo(E other)
```

Its return value is:

- < 0 if this is "less than" other
- 0 if this is equal to other
- > 0 if this is "greater than" other