Fundamental Methods

Important common methods

Methods Inherited from Object

- Every class inherits some methods from Object.
- Some methods are key to object behavior

java.lang.Object
#clone() : Object
+equals(Object): bool
+finalize() : void
+getClass() : Class
+hashCode() : int
+toString() : String
+wait() : void

How the Methods are Used

toString( ) - implicitly invoked whenever Java needs to display an object as a String:

```
System.out.println( x );              // calls x.toString()
String greet = "Hello, "+person; // person.toString()
```

equals(Object other) - test for equality. Used by List.contains(something), List.indexOf(something).

```
List<Course> courses = Registrar.getMyCourses();
Course prog1 = new Course("01219114","Prog 1",3);
if ( courses.contains(prog1) ) ...
```

toString()

Most classes should define their own `toString()` method.

Exceptions:

- inherits a usable toString() from a parent class
- object is not intended to be printed; e.g. controllers, UI classes, "transport objects", utility classes like Math or Arrays.

@Override (annotation) is optional. Used by compiler to detect accidental misspelling.

```
public class MenuItem {
    @Override
    public String toString() {
        return itemName;
    }
```

Course without "equals"

```
public class Course {
  private final String id;
  private String name;
  private int credits;
  public Course(String id, String name, int cred) {
     this.id = id;
     this.name = name;
     this.credits = cred;
  }
  ... get/set methods, but no "equals"
```

final *means you cannot change the value after it is set the first time.*
final *attributes must be set in a constructor.*

Use of "equals"

Course does not define "equals" method,
so it inherits "equals" from Object.
What does object.equals() method do?

```
Course c1 = new Course("01219114","Programming",3);
Course c2 = c1;
System.out.println(c1 == c2); // true
System.out.println(c1.equals(c2)); // also true

// WHAT IF WE COMPARE c1 TO AN IDENTICAL COURSE c2?
c2 = new Course("01219114","Programming",3); //same!
System.out.println( c1.equals(c2) ); // false!
```

Object.equals( ) is just ==

The Object **`equals`** method is same as **`==`**

This is (usually) not what we want.

```
public class Object {

    public boolean equals(Object obj) {
        return this == obj;
    }
```

Collections (List, Set) use equals

```
List<Course> courselist = new ArrayList<Course>();
Course c1 = new Course("01219114","Programming",3);
Course c2 = new Course("01219114","Programming",3);


courselist.add( c1 );


// what courses have I enrolled in?
courselist.contains( c1 )     // true
courselist.contains( c2 )     // false
```

When *should* 2 Courses be equal?

1. Depends on the application.
2. Should be clearly defined and documented.

Course Enrollment Application

- a department might *change* the name of a course.
- Registrar relies on course ID to decide if student has taken a course or is enrolled in a course.

When *should* 2 Courses be equal?

Therefore (design decision based on application use):

Two course objects are equal if they have the same id (even if other attributes, like name, are different).

Writing equals( )

```
public class Course {
  /** Two courses are equal if they have same id.
   */
  @Override
  public boolean equals(Object obj) {
    if (obj == null) return false;
    if (obj.getClass() != this.getClass())
        return false;
    // cast it to Course so we can get attributes
    Course other = (Course)obj;
    // Finally! compare course IDs (as Strings)
    return this.id.equals( other.getId() );
  }
```

4-Step Template for equals( )

```
@Override
public boolean equals(Object obj) {
    if (obj == null) return false;                  //1
    if (obj.getClass() != this.getClass())          //2
        return false;
    // cast to this class so we can get attributes
    Course other = (Course)obj;                     //3
    // Finally! compare this and other the way your
    // application wants.
    return ____________________________________;    //4
  }
```

Must be "Object" not Course

4-Step Template explained

```
@Override
public boolean equals(Object obj) {
    1. Check that argument is not null
    if (obj == null) return false;
    2. Argument must be same class as this class
    if (obj.getClass() != this.getClass())
        return false;
    3. Cast to this class so we can get attributes
    Course other = (Course)obj;
    4. Compare this and other as your app requires
    return this.id.equals( other.getId() );
  }
```

Must be "Object" not Course

These 4 steps are ALL necessary!

```
@Override
public boolean equals(Object obj) {
    1. Required to avoid NullPointerException later
    if (obj == null) return false;
    2. Can't compare Course & Dog or Course & String
    if (obj.getClass() != this.getClass())
        return false;
    3. "Object" doesn't have attributes of a Course
    Course other = (Course)obj;
    4. Domain logic.  Why we wrote this method!
    return this.id.equals( other.getId() );
  }
```

Find 4 Errors

```
public class Course {
    private final String id;

    @Override
    public boolean equal(Object obj) {
        if (obj.getClass() != this.getClass())
            return false;
      if ( obj.equals(null) ) return false;
      Course other = (Course)obj;
      // compare course IDs (Strings)
      return this.id == obj.id;
  }
```

Find the Errors, again

```
public class Course {
  private final String id;

  public boolean equals(Course obj) {
    if (obj == null) return false;
    Course other = (Course)obj;
    // compare course IDs (Strings)
    return this.equals(other.getId());
  }
```

Don't write nested if - Points deducted

1. Harder to follow the logic.
2. Possible "dangling else" error.

```
@Override
public boolean equals(Object obj) {
    boolean check = false; // no var named "check"!
    if (obj != null) {
       if (obj.getClass() == this.getClass()) {
          Course other = (Course)obj;
          if ( this.id.equals( other.getId() )
             check = true;
        }
    }
    return check;
}
```

Practice - write equals

On paper or in an editor, write **`equals`** for the Money class.

Two Money objects are equal if the amount **and** currency are same.

```
public class Money {
    private String currency;
    private double amount;
    /**
     * Money objects are equal if & only if
     * the currency and amount are the same.
     */
    public boolean equals(Object obj) {
        //TODO
    }
```

Solution

```
/**
 * Money objects are equal if & only if
 * the currency and amount are the same.
 */
    public boolean equals(Object obj) {
        //TODO
    }
```

A variation on equals

Sometimes it makes sense for objects of different classes to be "equal". (Don't do this on exam, unless specified.)

```
@Override
public boolean equals(Object obj) {
    1&2. obj is not null and an instance of
       this class or a subclass of this class
    if ( !(obj instanceof Course) ) return false;
    3. Cast it to our class to access the attributes
    Course other = (Course)obj;
    4. Domain logic: When are two objects equal?
    return this.id.equals( other.getId() );
  }
```

Other Important Methods to Know

`int hashCode()` - hash of object data, used by HashSet, HashMap, and some other collections. Should be *consistent* with equals:

a.equals(b) => a.hashCode() == b.hashCode()

but not the converse.

`clone( )` - make a *deep copy* of an object. This is covered in OOP2.

Reference

Big Java, 5E

Oracle *Java Tutorial*

- toString(), equals(), Object class