More sophisticated behavior

Using library classes to implement some more advanced functionality

The Java class library

- Thousands of classes
- Tens of thousands of methods
- Many useful classes that make life much easier
- A competent Java programmer must be able to work with the libraries.

Working with the library

You should:

- know some important classes by name;
- know how to find out about other classes.

Remember:

- We only need to know the interface, not the implementation.

Example

```
String str = "Some example string";
if (str.startsWith("something")) {
    // do something ...
}
```

- Where does ‘startsWith’ come from?
- What is it? What does it do?
- How can we find out?

Reading class documentation

- Documentation of the Java libraries in HTML format;
- Readable in a web browser
- Class API:
  Application Programming Interface
- Interface description for all library classes

Interface vs implementation

The documentation includes

- the name of the class;
- a general description of the class;
- a list of constructors and methods
- return values and parameters for constructors and methods
- a description of the purpose of each constructor and method

the *interface* of the class

Interface vs implementation

*The documentation **does not** include*

- private fields (most fields are private)
- private methods
- the bodies (source code) for each method

the *implementation* of the class

Using library classes

- Classes from the library must be imported using an *import* statement (except classes from *java.lang*).
- They can then be used like classes from the current project.

Packages and import

- Classes are organised in packages.
- Single classes may be imported:

```
import java.util.ArrayList;
```

- Whole packages can be imported:

```
import java.util.*;
```

Information Hiding

- The principle of Information Hiding states that internal details of a class's implementation should be hidden from other classes.

- It ensures better modularization of an application.

Information hiding

- Data belonging to one object is hidden from other objects.
- Know what an object can do, not how it does it.
- Information hiding increases the level of *independence*.
- Independence of modules is important for large systems and maintenance.

public vs private

- Public members (fields, constructors, methods) are accessible to all other classes.
- Private members are accessible only within the same class.

default / package access

- Not specifying any access modifier means “default access”, or “package-private”.
- Package access members are accessible to any class within the same package.

Which access modifier ?

- According to the principle of “Information Hiding”, programmers should **use the most restrictive** access modifier possible.
- Simply, prefer “private” over “public” whenever possible.
- Generally:
  - Almost all fields must be private.
  - Methods that implement a behaviour of this class must be public.
  - Methods with internal usage must be private.

NOTE

- Class access takes precedence over any access modifiers for members.

- A package-private class is not accessible to other classes outside the package; including all of its public members.

final / constant fields

- Class fields can be declared constant, using the "**final**" keyword.
- Final / constant fields can be initialized at the constructor.
- By convention, Java programmer use ALL_CAPS names for final fields.

```
private final int SIZE = 10;
```

static / class members

- The “static” keyword is used to specify **class members**.
- Class members don’t need an object to be accessed; they are accessible using the class name.
- Values of class members are **shared** among all objects.

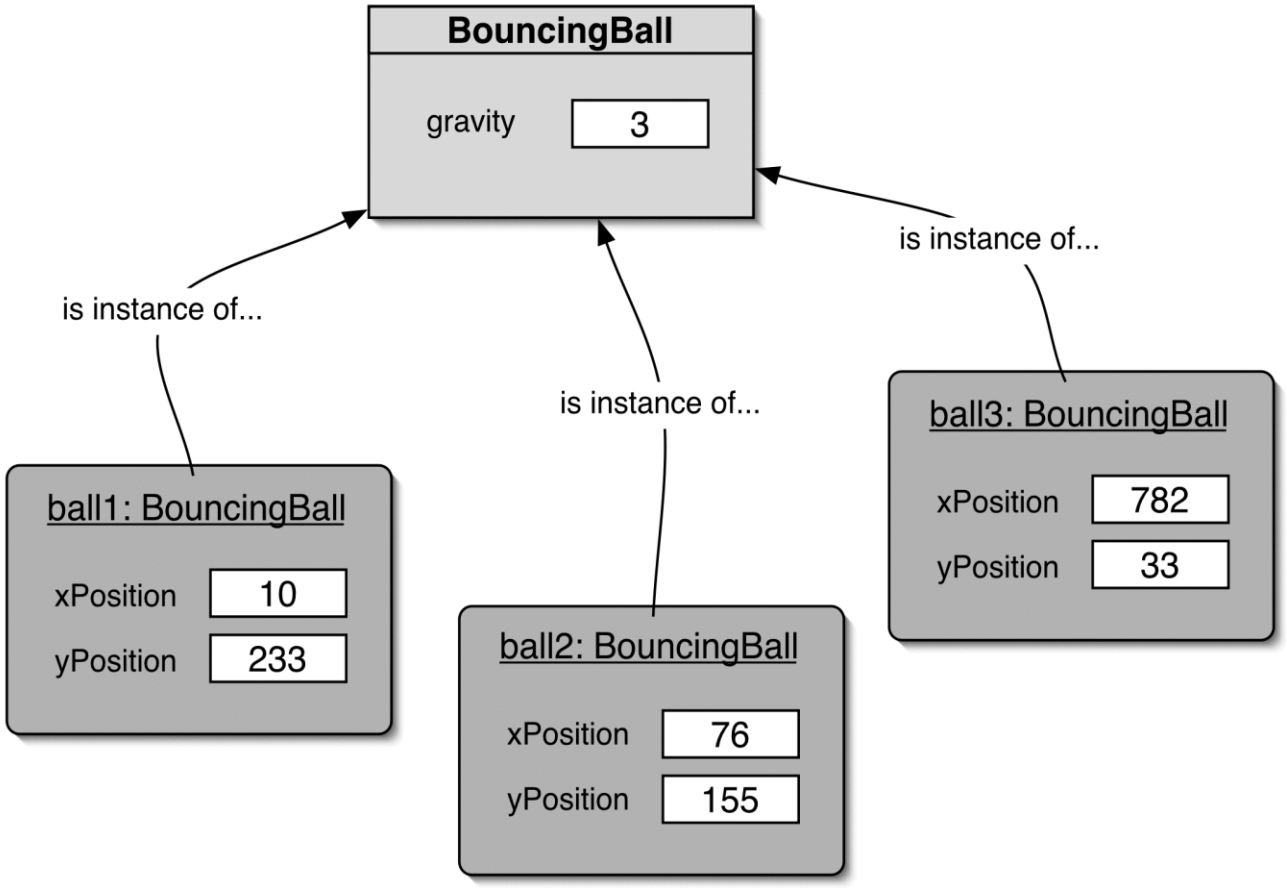
```
public class Test {
    private static int shared = 0;
    ...
```

static + final = Class variable

```
private static final int GRAVITY = 3;
```

- **private**: access modifier, as usual
- **static**: class variable
- **final**: constant

Class variables



Immutability

- Immutable objects are objects that once they are created, their state cannot be modified.

```
public class ImmutableClass {
    private int value;
    public ImmutableClass(int value) {
        this.value = value;
    }
    public int getValue() {
        return value;
    }
}
```

Immutability

- A well-know immutable class in Java is the “String” class.

```
String str = "testing";
str.toUpperCase();
System.out.println(str); // prints:  testing

str = str.toUpperCase();
System.out.println(str); // prints:  TESTING
```

Side note: String equality

```
if (input == "bye") {
    ...
}
```

tests identity

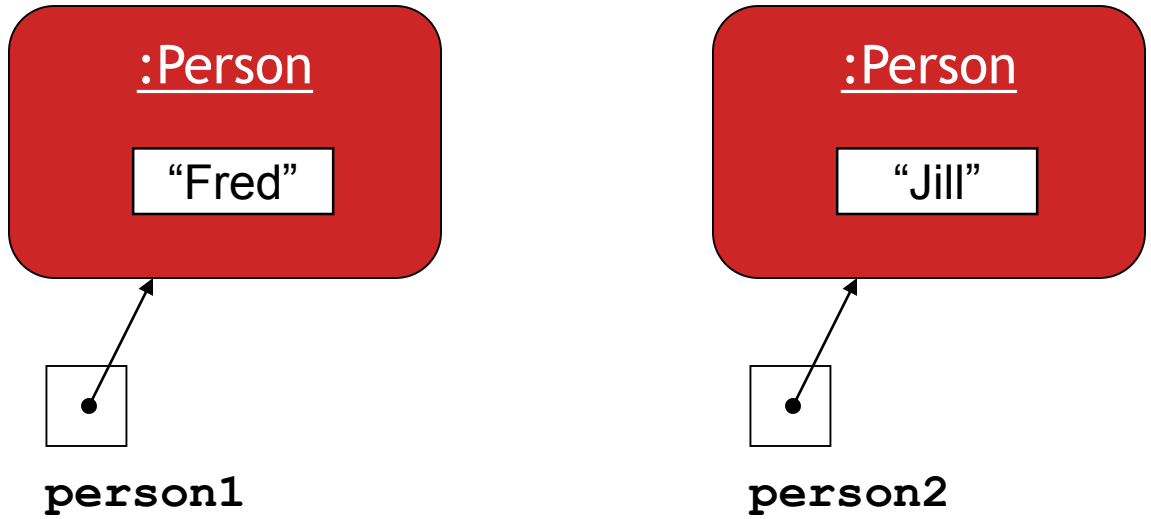
```
if (input.equals("bye")) {
    ...
}
```

tests equality

- Strings should always be compared with `.equals`

Identity vs equality

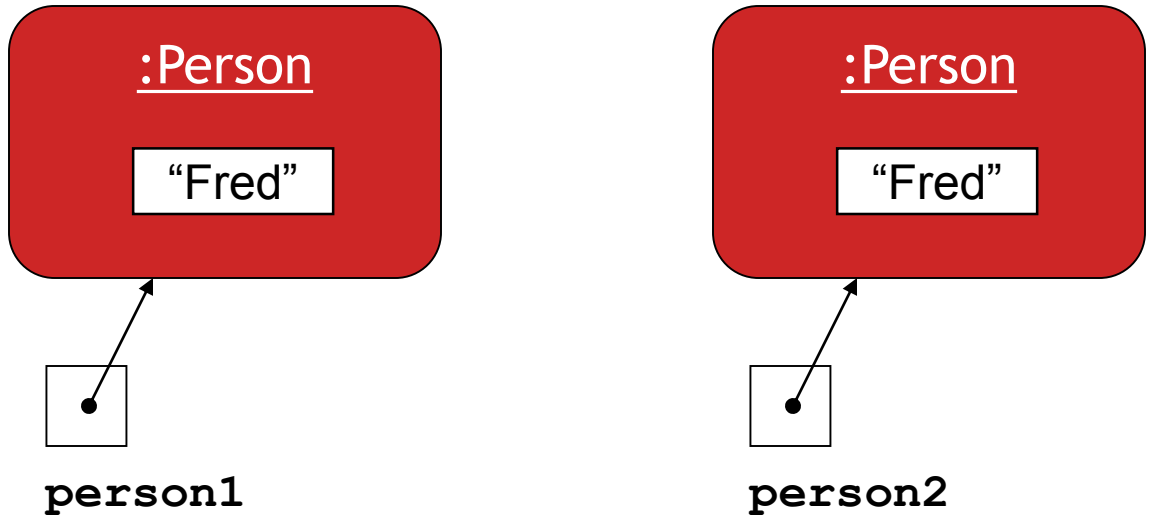
Other (non-String) objects:




```
person1 == person2 ?
```

Identity vs equality

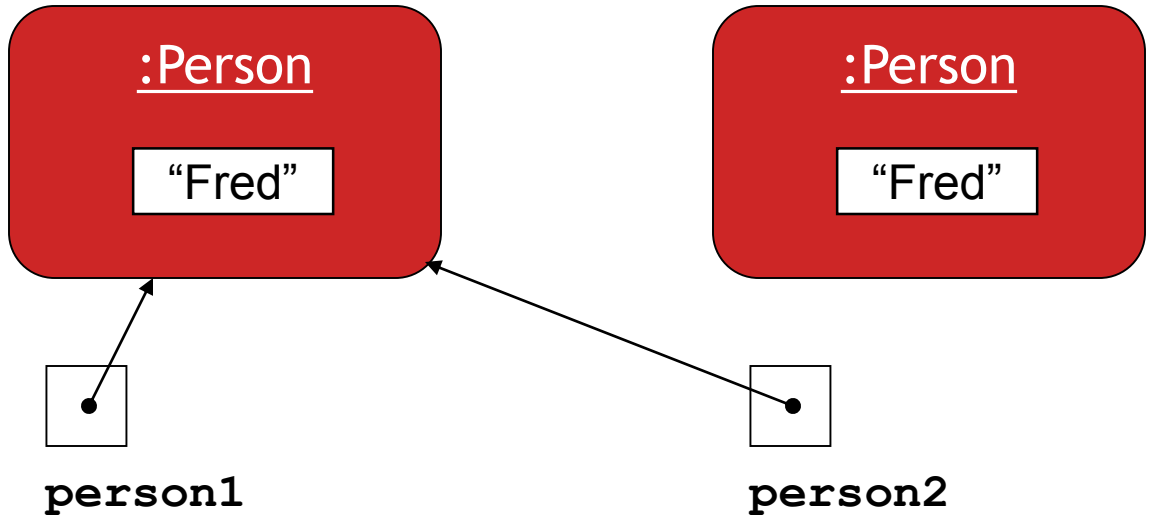
Other (non-String) objects:




```
person1 == person2 ?
```

Identity vs equality

Other (non-String) objects:

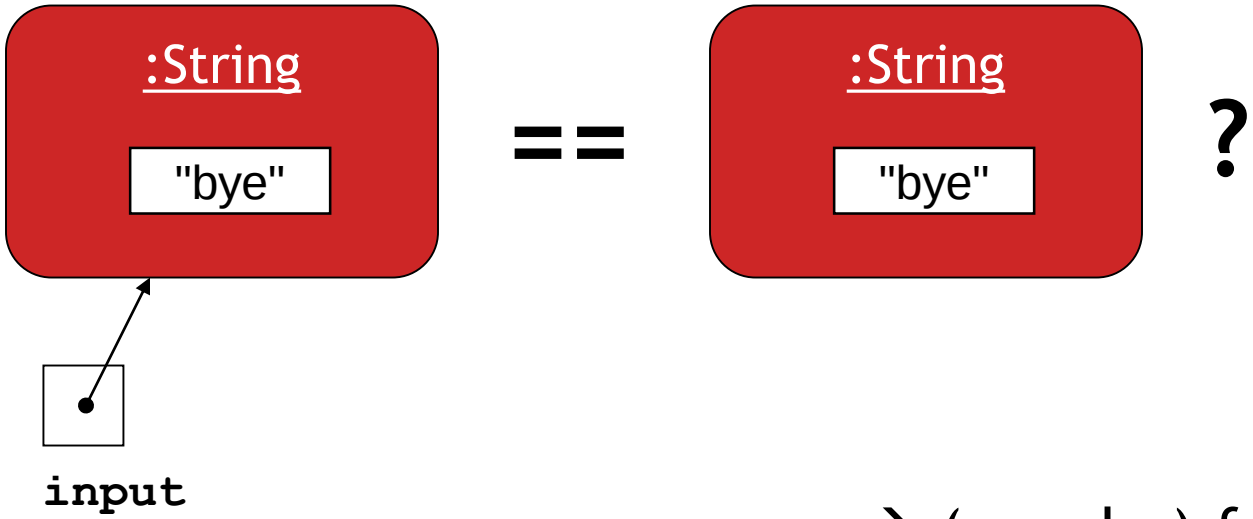



```
person1 == person2 ?
```

Identity vs equality (Strings)

```
String input = reader.getInput();
if (input == "bye") {
    ...
}
```

== tests identity

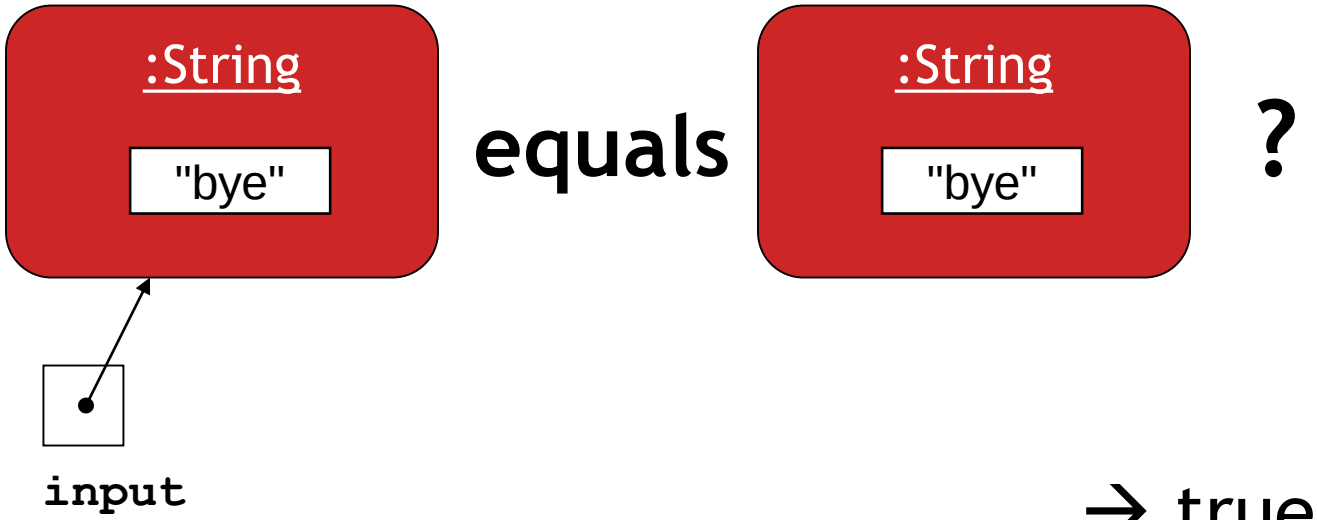


→ (may be) false!

Identity vs equality (Strings)

```
String input = reader.getInput();
if (input.equals("bye")) {
    ...
}
```

equals tests equality



→ true!

Review

- Java has an extensive class library.
- A good programmer must be familiar with the library.
- The documentation tells us what we need to know to use a class (interface).
- The implementation is hidden (information hiding).
- We document our classes so that the interface can be read on its own (class comment, method comments).