CS/ENGRD 2110
FALL 2014

Lecture 2: Objects and classes in Java
http://courses.cs.cornell.edu/cs2110

Java OO (Object Orientation)

Note: Assignment A0 and VideoNote available

Python and Matlab have objects and classes.

Strong-typing nature of Java changes how OO is done and how useful it is. Put aside your previous experience with OO (if any).

This lecture:

First: describe objects, demoing their creation and use.

Second: Show you a class definition and how it contains definitions of functions and procedures that appear in each object of the class.

Third: Talk about keyword **null**.

Fourth (if there is time). Show you a Java application, a class with a "static" procedure with a certain parameter.

Homework

1. Study material of this lecture.
2. Visit course website, click on Resources and then on Code Style Guidelines. Study
   - 3. Documentation
     - 3.1 Kinds of comments
     - 3.2 Don't over-comment
     - 3.4 Method specifications
       - 3.4.1 Precondition and postcondition
3. Spend a few minutes perusing slides for lecture 3; bring them to lecture 3.

Java OO

References to course text and JavaSummary.pptx

Objects: B.1 slide 10-16
Calling methods: B.2-B.3 slide 18
Class definition: B.5 slide 11
public, private: B.5 slide 11, 12
Indirect reference, aliasing: B.6 slide 17
Method declarations: B.7
Parameter vs argument: B.12-B.14 slide 14

Text mentions fields of an object. We cover these in next lecture

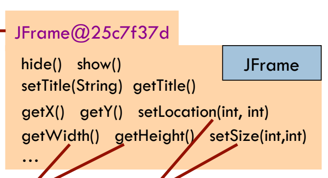
Methods may have parameters
Method calls may have arguments

Text uses value-producing method for function and void method for procedure. Get used to terminology: function and procedure

Drawing an object of class javax.swing.JFrame

Object is associated with a window on your computer monitor

Name of object, giving class name and its memory location (hexadecimal). Java creates name when it creates object


JFrame@25c7f37d
JFrame
hide() show()
setTitle(String) getTitle()
getX() getY() setLocation(int, int)
getWidth() getHeight() setSize(int,int)
…

Object contains methods (functions and procedures), which can be called to operate on the object

Function: returns a value; call on it is an expression
Procedure: does not return a value; call is a statement to do something

Evaluation of new-expression creates an object

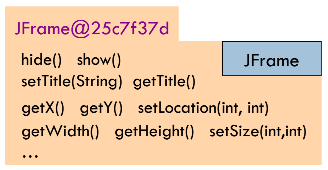
Evaluation of JFrame@25c7f37d
new javax.swing.JFrame()

creates an object and gives as its value the name of the object

If evaluation creates this object, value of expression is

JFrame@25c7f37d

9
2 + 3 + 4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…

A class variable contains the name of an object

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Type JFrame: Names of objects of class JFrame

```
JFrame h;
h= new javax.swing.JFrame();
```

Consequence: a class variable contains not an object but the name of an object. Objects are referenced indirectly.

If evaluation of new-exp creates the object shown, name of object is stored in h

h JFrame@25c7f37d
JFrame

JFrame@25c7f37d

JFrame

hide() show()
setTitle(String) getTitle()
getX() getY() setLocation(int, int)
getWidth() getHeight() setSize(int,int)
…

A class variable contains the name of an object

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If variable h contains the name of an object, you can call methods of the object using dot-notation:

Procedure calls: h.show(); h.setTitle("this is a title");

Function calls: h.getX() h.getX() + h.getWidth()

h JFrame@25c7f37d
JFrame

JFrame@25c7f37d

JFrame

hide() show()
setTitle(String) getTitle()
getX() getY() setLocation(int, int)
getWidth() getHeight() setSize(int,int)
…

Class definition

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Class definition: Describes format of an object (instance) of the class.

```
/** description of what the class is for */
public class C {
    declarations of methods (in any order)
}
```

This is a comment

Access modifier **public** means C can be used anywhere

Class definition C goes in its own file named
C.java
On your hard drive, have separate directory for each Java program you write; put all class definitions for program in that directory. You'll see this when we demo.

First class definition

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```
/** An instance (object of the class) has (almost) no methods */
public class C {

}
```

Then, execution of

```
C k;
k= new C();
```

creates object shown to right and stores its name in k

k C@25c7fd38
C

C@25c7fd38

C

Class extends (is a subclass of) JFrame

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```
/** An instance is a subclass of JFrame */
public class C extends javax.swing.JFrame {

}
```

C: subclass of JFrame
JFrame: superclass of C
C *inherits* all methods that are in a JFrame

C@6667f34e

JFrame

hide() show()
setTitle(String) getTitle()
getX() getY() setLocation(int, int)
getWidth() getHeight() …

C

Object has 2 partitions:
one for JFrame methods,
one for C methods

Easy re-use of program part!

Class definition with a function definition

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```
/** An instance is a subclass of JFrame with a function area */
public class C extends javax.swing.JFrame {
  /** Return area of window */
  public int area() {
    return getWidth() * getHeight();
  }
}
```

Spec, as a comment

Function calls automatically call functions that are in the object

You know it is a function because it has a return type

C@6667f34e

JFrame

…
getWidth() getHeight()

C

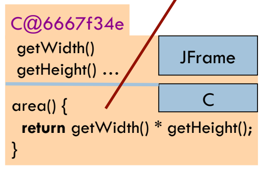
area()

Inside-out rule for finding declaration

```
/** An instance … */
public class C extends javax.swing.JFrame {
   /** Return area of window */
   public int area() {
      return getWidth() * getHeight();
   }
}
```

The whole method is in the object

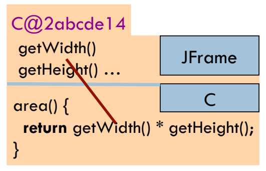
To what declaration does a name refer? Use **inside-out rule**: Look first in method body, starting from name and moving out; then look at parameters; then look outside method in the object.

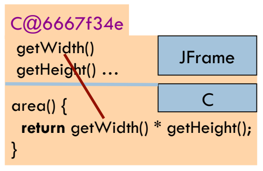


Inside-out rule for finding declaration

```
/** An instance … */
public class C extends …JFrame {
  /** Return area of window */
  public int area() {
    return getWidth() * getHeight();
  }
}
```

Function area: in each object. getWidth() calls function getWidth in the object in which it appears.





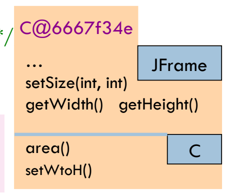
Class definition with a procedure definition

```
/** An instance is a JFrame with more methods */
public class C extends javax.swing.JFrame {
   public int area() {
      return getWidth() * getHeight();
   }

   /** Set width of window to its height */
   public void setWtoH() {
      setSize(getHeight(), getHeight());
   }
}
```

Call on procedure setSize

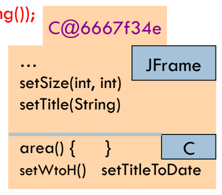
It is a procedure because it has **void** instead of return type



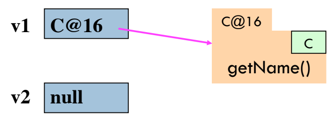
Using an object of class Date

```
/** An instance is a JFrame with more methods */
public class C extends javax.swing.JFrame {
  …
  /** Put the date and time in the title */
  public void setTitleToDate() {
     setTitle((new java.util.Date()).toString());
  }
}
```

An object of class java.util.Date contains the date and time at which it was created.
It has a function toString(), which yields the data as a String.



About null



null denotes the absence of a name.

v2.getName() is a mistake! Program stops with a NullPointerException

You can write assignments like: v1= **null**;

and expressions like: v1 == **null**

Hello World!

```
/** A simple program that prints Hello, world! */
public class myClass {

   /** Called to start program. */
   public static void main(String[ ] args) {
      System.out.println("Hello, world!");
   }
}
```

args is an array of String elements

We explain **static** next week. **Briefly**: there is only one copy of procedure main, and it is not in any object