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# CS/ENGRD 2110 FALL 2015

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

## Miscellaneous

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CMS available. Visit course webpage:  
[www.cs.cornell.edu/courses/CS2110/](http://www.cs.cornell.edu/courses/CS2110/)  
 Click "Links", then "CMS for 2110". Not enrolled? Ask Megan mlg34@cs.cornell.edu to enroll you (needs your netid)

Look at [videoNote.com/cornell/](http://videoNote.com/cornell/) to see a previous lecture. Our lectures are being recorded.

Please download ppt slides the evening before each lecture, have them available in class. Please don't ask questions on the piazza about that material the day before the lecture!

Download DrJava? download the jar file, not the app. See Piazza note @15.

## Java OO (Object Orientation)

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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

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

## Java OO

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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

Methods may have **parameters**

Method calls may have **arguments**

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

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

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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**

```
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 on it is a statement

### Evaluation of new-expression creates an object

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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`

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

JFrame

### 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();
```

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

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

`JFrame@25c7f37d`

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

JFrame

h `JFrame@25c7f37d`  
 JFrame

### 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();`

```
x = y;
g = h;
h JFrame@25c7f37d
JFrame
```

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

JFrame

### 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

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

Easy re-use of program part!

`C@6667f34e`

```
C@6667f34e
hide() show()
setTitle(String) getTitle()
getX() getY() setLocation(int, int)
getWidth() getHeight() ...
```

JFrame

C

### 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 */ Specification, as a comment
    public int area() {
        return getWidth() * getHeight();
    }
}
    
```

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()	
area()	C

### Inside-out rule for finding declaration

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```

/** 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.

C@6667f34e	JFrame
getWidth() getHeight() ...	
area() { return getWidth() * getHeight(); }	C

### Inside-out rule for finding declaration

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```

/** 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.

C@2abcde14	JFrame
getWidth() getHeight() ...	
area() { return getWidth() * getHeight(); }	C

C@6667f34e	JFrame
getWidth() getHeight() ...	
area() { return getWidth() * getHeight(); }	C

### Class definition with a procedure definition

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```

/** 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

C@6667f34e	JFrame
... setSize(int, int) getWidth() getHeight()	
area() setWtoH()	C

### Using an object of class Date

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```

/** 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.

C@6667f34e	JFrame
... setSize(int, int) setTitle(String)	
area() { } setWtoH() setTitleToDate	C

### About null

18

```

v1 C@16
v2 null
    
```

`C@16` points to an object of class C with `getName()` method.

`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!

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```
/** 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