

Anonymous Classes

for
File & Sorting
(Ch 4.3 – 4.5)

Java Odds & Ends (For Assignment 2)

Formatted Printing

- Use printf() to print formatted numbers:
System.out.printf(<format string>, <arg0>, ...);
 - Format String: [text and conversion specifiers](#)
 - Arguments: Extra data to print.
- Example:
System.out.printf("%s! Is it %b that you're %d?%n",
"Waldo", true, 42);

Common Conversion Specifiers

%d	decimal (int)
%x	hexadecimal
%f	float
%s	String
%b	boolean
%n	new line (like \n)

Formatted Printing (cont)

- Formatting floats and columns
 - Round to 2 decimal-point places: `%.2f`
 - Use at least 5 columns to print: `%.5d %5.2f`
 - Print with comma groupings: `%,d %,10.2f`
- Examples
 - `double a = 154.7599;`
 - `int b = 98765431;`
 - `System.out.printf("Values: %,15.2f, %,5d%n", a, b);`
 - Values: 154.76, 98,765,431
- PrintWriter Note
 - Using PrintWriter to write to System.out, call its flush() method when done output.

Wrappers & Shuffle

- Primitive data types cannot be use when you need a class (such as in an ArrayList).
 - Wrapper: [a class to hold a primitive value](#)
 - Java has immutable wrappers for primitive data types: Integer, Double, Boolean, Character, etc

- Example:

```
// Create the ArrayList
```

```
List<Double> values = new ArrayList<>();
```

```
// Make a Double wrapper object from the double value.
```

```
values.add(new Double(6));
```

```
values.add(new Double(0));
```

```
values.add(4);
```

```
// Shuffle (generate a random permutation):
```

```
java.util.Collections.shuffle(values);
```

Can be done without
new Double(4)

.. [called autoboxing](#)

File, FileFilter and Anonymous Classes

File Class

- File Access
 - Use the File class to work with file names:
`File file = new File("C:/t/file.txt");`
- Useful methods:
 - Get the path `file.getAbsolutePath()`
 - Does the file exist? `file.exists()`
 - Get it's size in bytes.. `file.length()`
 - Is it a directory? `file.isDirectory()`
 - Get all files in the folder..
`file.listFiles()`
`file.listFiles(FileFilter filter)`

FileFilter

- Making listFiles() filter
 - We need to tell listFiles() what type of files we want.
 - Let's write a method it can call to ask us (for each file) if we want to accept it: `boolean accept (File pathName)`
- Interface
 - An interface is: `a set of methods a class can choose to implement`
- Java puts accept() into an interface

```
public interface FileFilter {  
    boolean accept(File pathName);  
}
```


Using FileFilter

- Process to use FileFilter:
 - 1) Write a custom-filter class which..
implements the FileFilter interface

(Similar to inheritance).
 - 2) Instantiate our custom-filter.
 - 3) Pass our custom-filter to File's listFiles() function.
 - 4) Use the results!

note: in demoFileFilter, if comment “implements FileFilter”

—> error (check to see)

—> create FileFilter, not TxtFilter

—> reason: program to an interface not implementation

Anonymous Classes

- Anonymous class:

instance of an unnamed class which is defined on the fly

- Useful when you need a short custom class to use just once:

- custom sorting
- filtering files in a list
- a button's callback

- Generic Example

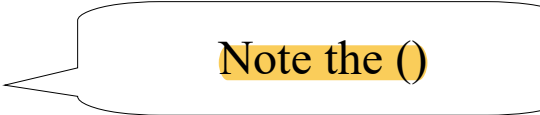
```
public static void main(String[] args) {  
    ClickHandler buttonAction = new ClickHandler() {  
        @Override  
        public void handleClick(){  
            System.out.println("Clicked!");  
        }  
    };  
    setButtonCallback(buttonAction);  
}
```

ClickHandler
is the interface
(fictitious).

Use IDE to add
required methods
to the anonymous
class.
(IntelliJ: Alt-Enter)

Use a anonymous FileFilter

```
private static void demoFileFilter() {  
    // Create the filter (an anonymous class)  
    FileFilter filter = new FileFilter() {  
        @Override  
        public boolean accept(File file) {  
            return file.getName().endsWith(".txt");  
        }  
    };  
  
    // Use the filter (with callback)  
    File folder = new File("C:/t/");  
    File[] fileList = folder.listFiles(filter);  
  
    for (File subFile : fileList) {  
        System.out.println(" sub file: " + subFile.getAbsolutePath());  
    }  
}
```



Anonymous Object & Class

- Anonymous Object:..an unnamed object
- Anonymous Class:..an unnamed class

```
private static void demoFileFilter() {  
    File folder = new File("C:\\t\\");  
  
    // Create filter (anonymous object of an anonymous class)  
    File[] fileList = folder.listFiles(new FileFilter() {  
        @Override                                didn't create a filter object here —> ano object  
        public boolean accept(File file) {  
            return file.getName().endsWith(".txt");  
        }  
    });  
  
    for (File subFile : fileList) {  
        System.out.println(" sub file: " + subFile.getAbsolutePath());  
    }  
}
```

.. Note the });

Sorting with Comparable

Sorting

- Java & Sorting
 - built-in sorting for collection: arrays, ArrayList, etc.
 - Calling Java's sort method for collections:
`java.util.Collections.sort(myCars);` *sort() is static*
 - Elements in the collection **must implement** the **Comparable** (generic) **interface**:

generic: must be given an object type

```
interface Comparable<Type> {  
    // Compare this object with the specified object returning  
    //      negative integer for      this < obj  
    //      zero for                  this == obj  
    //      positive integer for      this > obj  
    int compareTo(Type obj);  
}
```

Sorting Example

```
public static void main(String[] args) {  
    // Create the list with some items:  
    List<Pen> list = new ArrayList<>();  
    list.add(new Pen("Green", 14));  
    list.add(new Pen("Orange", 20));  
    list.add(new Pen("Blue", 75));  
  
    // Sort the list  
    java.util.Collections.sort(list);  
  
    // Output the list.  
    for (Pen item : list) {  
        System.out.println(item);  
    }  
}
```

instead of using compareTo, can we add to list then use
collections.sort(list.getColor)?
—> no, cuz list doesn't have .getColor()

Output:

```
Pen [Blue, 75%]  
Pen [Green, 14%]  
Pen [Orange, 20%]
```

```
class Pen implements Comparable<Pen> {  
    String colour;  
    int filled;  
    // ... Some content omitted...  
  
    @Override  
    public int compareTo(Pen other) {  
        return colour.compareTo(  
            other.colour);  
    }  
}
```

Notes on sort

- Comparable interface defines the `natural order`
 - This is the one order which you choose as the default order for your class.
- `java.util.Collections.sort()` method does:
 - Copies all elements into an array,
 - Sorts the array,
 - Copies each element back into the original data type
- Guaranteed “fast” sort
 - $O(n \log(n))$ performance (which is good)

Sorting with Comparator

Comparator: sort with multiple order

Comparable: sort with natural order

Multiple Sort Orders

- What about sorting by a number of different orders?
 - The Comparable interface only allows us to define..
one ordering
 - What if I want to sort Pens by colour, or by filled %?
- Must create a Comparator:
 - Create an extra little class which implements a custom comparison function.
 - This class implement the Comparator interface.
 - We create an instance of this class when sorting.

Comparator Interface

- Comparator interface: *used for special comparator objects*
 - Used by sort algorithms.
 - It's a **generic** type: so you specify a type.

```
interface Comparator<Type> {  
    // Compare 2 objects for custom order.  
    // Returns:  
    //      negative integer for      o1 < o2  
    //      zero for                  o1 == o2  
    //      positive integer for      o1 > o2  
    int compare(Type o1, Type o2);  
}
```

Implement Comparator

- Make a new class which has one purpose:
 - Implement `compare()` to give the special sort order.

```
class PenSortByFilled implements Comparator<Pen> {  
    // Return a negative number if o1 < o2  
    // Return 0 if equal.  
    // Return a positive number if o1 > o2.  
    @Override  
    public int compare(Pen o1, Pen o2) {  
        return o1.getFilled() - o2.getFilled();  
    }  
}
```

- Call `sort()` by passing an instance of this class:
`java.util.Collections.sort(list, new PenSortByFilled());`

`PenSortByFilled()`

not anonymous class bcuz it has a name

but is an anonymous object cuz theres nothing pointing to it?

Sorting Example with Comparator

```
public static void main(String[] args) {  
    // Create the list with some items:  
    List<Pen> list = new ArrayList<>();  
    list.add(new Pen("Green", 14));  
    list.add(new Pen("Orange", 20));  
    list.add(new Pen("Blue", 75));  
  
    // Sort the list  
    Collections.sort(list, new PenSortByFilled());  
  
    // Output the list.  
    for (Pen item : list) {  
        System.out.println(item);  
    }  
}
```

Output:

```
Pen [Green, 14%]  
Pen [Orange, 20%]  
Pen [Blue, 75%]
```

Strategy Pattern

- FileFilter & Comparator
 - Each defines a special purpose class to..
implement a small algorithm
 - Often used as anonymous classes, and anonymous objects.
 - These are examples of the Strategy Pattern
- Strategy Pattern
 - encapsulating an algorithm into a class
 - The algorithm (in our anonymous classes) can change without changing the general function (java.util.Collections.sort()).

Summary

- Formatted printing with `printf()`: `%n`, `%d`, `%f`, ...
- Wrappers: Turn primitives into objects.
 - `Double`, `Integer`, `Boolean`, `Character`
- File: For working with files
 - `FileFilter` interface for filtering files.
- Sorting
 - Natural order (single order): `Comparable`
 - Custom order (many orders): `Comparator`
- Anonymous classes & objects
 - Example of the Strategy Pattern.