

Anonymous Classes

for
File & Sorting
(Ch 4.3 – 4.5)

Java Odds & Ends (For Assignment 2)

Command Line

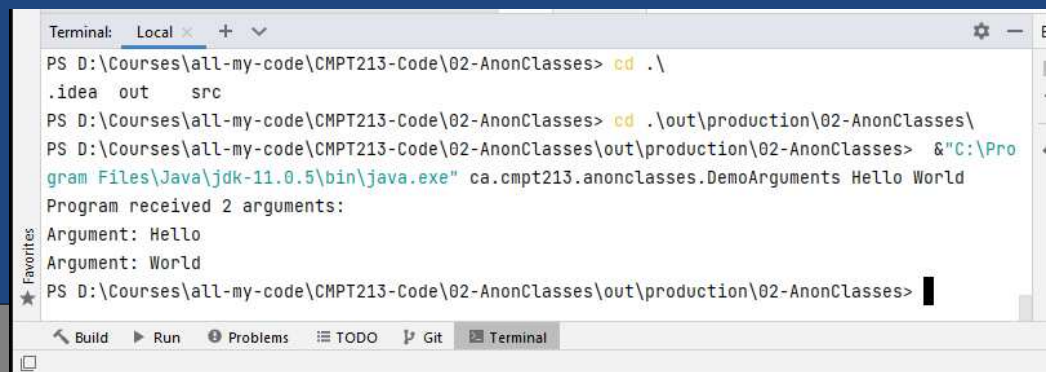
- Compile your project and open a terminal / command line to:
..
- **Run:** `java <package>.<class> your args here`

```
package ca.cmpt213.as1content;
public class DemoArguments {
    public static void main(String[] args) {
        // Print all arguments
        for (String arg : args) {
            System.out.println("Argument: " + arg);
        }
    }
}
```

```
C:\...\daProject\out\production\daProject> java ca.cmpt213.as2content.DemoArguments Hello world!
Argument: Hello
Argument: World!
C:\...\daProject\out\production\daProject>
```

Full Java Path

- Often you may need to type the full path to your Java executable for your computer to find it.
 - Open the IntelliJ Terminal
 - Change directory:
`cd out/production/<prj name>/`
 - Run on Windows:
`&"C:\Program Files\Java\jdk-11.0.5\bin\java.exe"
ca.cmpt213.anonclasses.DemoArguments Hello World`
 - Run on Mac/Linux (likely):
`/usr/bin/java ca.cmpt213.anonclasses.DemoArguments Hello World`



```
Terminal: Local x + v
PS D:\Courses\all-my-code\CMPT213-Code\02-AnonClasses> cd .\
.idea out src
PS D:\Courses\all-my-code\CMPT213-Code\02-AnonClasses> cd .\out\production\02-AnonClasses\
PS D:\Courses\all-my-code\CMPT213-Code\02-AnonClasses\out\production\02-AnonClasses> &"C:\Program Files\Java\jdk-11.0.5\bin\java.exe" ca.cmpt213.anonclasses.DemoArguments Hello World
Program received 2 arguments:
Argument: Hello
Argument: World
PS D:\Courses\all-my-code\CMPT213-Code\02-AnonClasses\out\production\02-AnonClasses>
```

Formatted Printing

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

Common Conversion Specifiers

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

Formatted Printing (cont)

- **Formatting floats and columns**

- Round to 2 decimal-point places...
- Use at least 5 columns to print...
- Print with comma groupings...

- **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**...
 - 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)

..

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..
 - Is it a directory? `file.isDirectory()`
 - Get all files in the folder..

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:..
- Interface
 - An interface is..
- 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..

(Similar to inheritance).

- 2) Instantiate our custom-filter.

- 3) Pass our custom-filter to File's listFiles() function.

- 4) Use the results!

Anonymous Classes

- Anonymous class:
- Useful when you need a short custom class to..
 - 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

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());  
    }  
}
```



Note the ()

Anonymous Object & Class

- Anonymous Object...
- Anonymous 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  
        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);
- Elements in the collection must implement the **Comparable** (generic) interface:

```
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:  
    ArrayList<Pen> list = new ArrayList<Pen>();  
    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);  
    }  
}
```

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..
 - 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

Multiple Sort Orders

- What about sorting by a number of different orders?
 - The **Comparable** interface only allows us to define..
 - 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 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());`

Sorting Example with Comparator

```
public static void main(String[] args) {  
    // Create the list with some items:  
    ArrayList<Pen> list = new ArrayList<Pen>();  
    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..
 - Often used as anonymous classes, and anonymous objects.
 - These are examples of the..
- **Strategy Pattern**
 -
 - 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**.