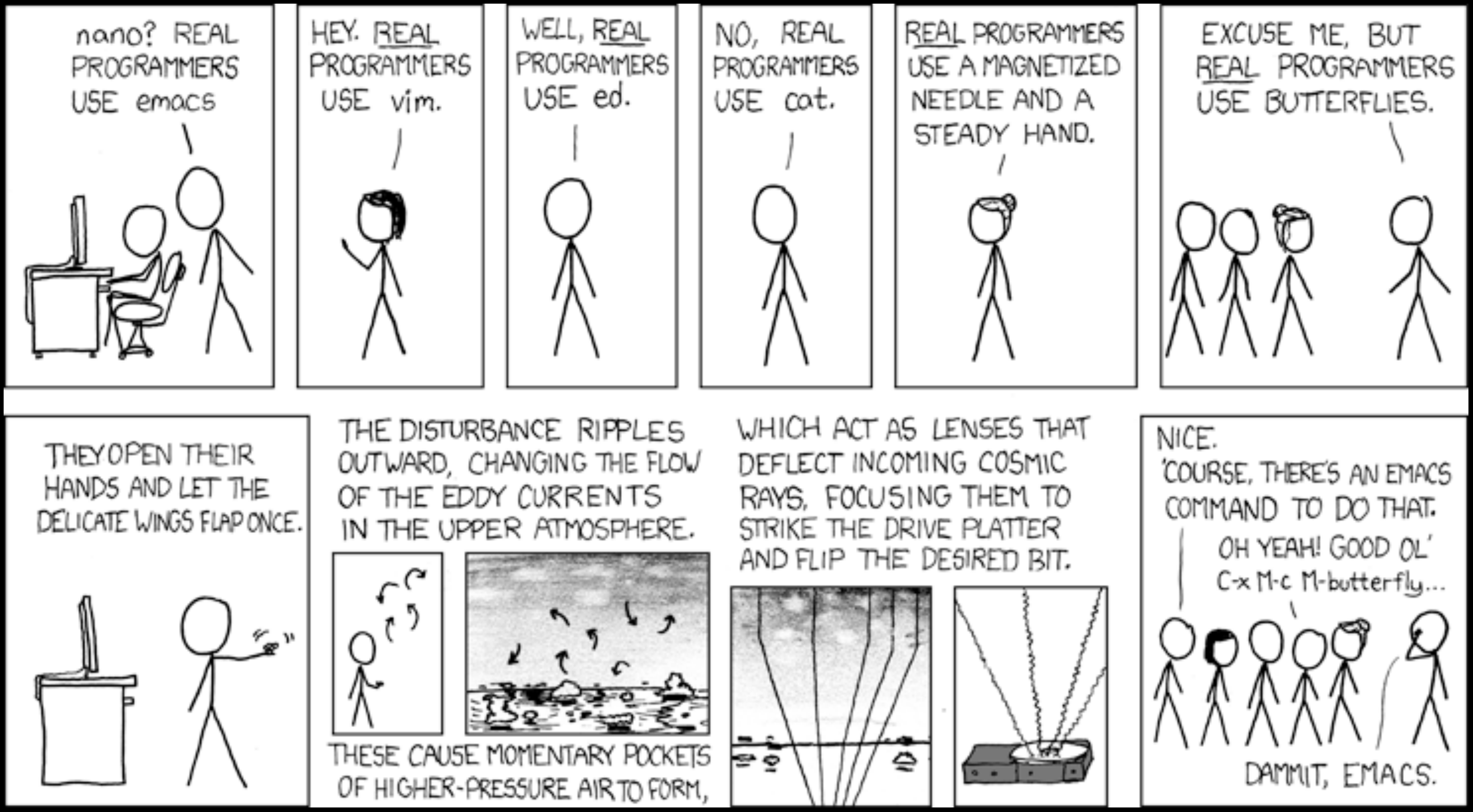
nano? REAL PROGRAMMERS USE emacs
HEY. REAL PROGRAMMERS USE vim.
WELL, REAL PROGRAMMERS USE ed.
NO, REAL PROGRAMMERS USE cat.
REAL PROGRAMMERS USE A MAGNETIZED NEEDLE AND A STEADY HAND.
EXCUSE ME, BUT REAL PROGRAMMERS USE BUTTERFLIES.
THEY OPEN THEIR HANDS AND LET THE DELICATE WINGS FLAP ONCE.
THE DISTURBANCE RIPPLES OUTWARD, CHANGING THE FLOW OF THE EDDY CURRENTS IN THE UPPER ATMOSPHERE.
THESE CAUSE MOMENTARY POCKETS OF HIGHER-PRESSURE AIR TO FORM,
WHICH ACT AS LENSES THAT DEFLECT INCOMING COSMIC RAYS, FOCUSING THEM TO STRIKE THE DRIVE PLATTER AND FLIP THE DESIRED BIT.
NICE.
'COURSE, THERE'S AN EMACS COMMAND TO DO THAT.
OH YEAH! GOOD OL' C-x M-c M-butterfly...
DAMMIT, EMACS.

http://xkcd.com/378/

CS 152: *Programming Language Paradigms*

Returning to Java

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San José State University

Returning home to Java

It's the last day of class, so let's do something simple in Java…

…sort a list of numbers.

Sorting a list of numbers in Java 1

```
public static void sortNums (List lst) {
  for (int i=0; i<lst.size()-1; i++) {
    for (int j=0; j<lst.size()-1; j++) {
      if (((Integer) lst.get(j)).intValue() >
          ((Integer) lst.get(j+1)).intValue()){
        Integer tmp = (Integer) lst.get(j);
        lst.set(j, lst.get(j+1));
        lst.set(j+1, tmp);
      }
    }
  }
}
```

Now we can call our sorting algorithm:

```
List lint = new ArrayList(
    Arrays.asList(1,2,93,-1,3));
sortNums(lint);
```

Except that we could also call:

```
List lstr = new ArrayList(
    Arrays.asList("hi","there"));
sortNums(lstr);
```

Generalizing our sort algorithm

```
public static void sort (List lst,
                         Comparator cmp) {
  for (int i=0; i<lst.size()-1; i++) {
    for (int j=0; j<lst.size()-1; j++) {
      if (cmp.compare(lst.get(j),
                      lst.get(j+1)) > 0) {
        Object tmp = lst.get(j);
        lst.set(j, lst.get(j+1));
        lst.set(j+1, tmp);
      }
    }
  }
}
```

But calling this function is a little ugly:

```
sort(lint, new Comparator() {
  public int compare(Object o1,
                     Object o2) {
    Integer x = (Integer) o1;
    Integer y = (Integer) o2;
    return x.intValue()
         - y.intValue();
 }});
```

Using generics (Java 5)

```
public static <T> void sort (List<T> lst,
                             Comparator<T> cmp) {
  for (int i=0; i<lst.size()-1; i++) {
    for (int j=0; j<lst.size()-1; j++) {
      if (cmp.compare(lst.get(j),
                      lst.get(j+1)) > 0) {
        T tmp = lst.get(j);
        lst.set(j, lst.get(j+1));
        lst.set(j+1, tmp);
      }
    }
  }
}
```

And calling this gets a little better:

```
sort(lint, new Comparator<Integer>() {
  public int compare(Integer x,
                     Integer y) {
    return x - y;
 }});
```

Still, compare that to the equivalent in JavaScript:

```
sort(lint, function(x,y){
  return x-y;
});
```

Java 8 Closures

Java 8 introduces lambdas (closures).

We can now write this function more concisely:

```
sort(lint,
   (Integer x,Integer y) -> x-y);
```

Extended Closure Example

(in class)

A (Partial) List of Function Interfaces

Interface	Parameter types	Return type
`Supplier<T>`	`None`	`T`
`Consumer<T>`	`T`	`void`
`BiConsumer<T,U>`	`T, U`	`void`
`Predicate<T>`	`T`	`boolean`
`ToIntFunction<T>`	`T`	`int`
`Function<T,R>`	`T`	`R`
`BiFunction<T,U,R>`	`T, U`	`R`

Limitations of Java Lambdas

- Java lambdas are *not* objects

```
// COMPILE ERROR!
Object o = (x) -> x+1;
```

- Java lambdas only close over *values*, not variables

Counter class

```
Supplier<Integer> ctr =
        Counter.makeCounter();
out.println(ctr.get()); // 0
out.println(ctr.get()); // 1
out.println(ctr.get()); // 2
```

Broken `makeCounter` method

```
import java.util.function.Supplier;

public class Counter {
    public static Supplier<Integer> makeCounter() {
        int n = 0;
        return () -> n++; // error
    }
}
```

"Local variable n defined in an enclosing scope must be final or effectively final"

Working `makeCounter` method

```
import java.util.function.Supplier;

class IntHolder {
    int n = 0;
}

public class Counter {
    public static Supplier<Integer> makeCounter() {
        IntHolder ih = new IntHolder();
        return () -> ih.n++;
    }
}
```

Heap allocated memory, so modification is OK. The *reference* is not modified (effectively final).

Nashorn

Scripting in Java with Nashorn

You might wish to integrate a Scripting environment into your application.

- Java provides a ScriptingEngine API to facilitate this environment.
- Java 6 & 7 provided support for Rhino JavaScript.
- Java 8 includes a new JavaScript implementation, called Nashorn.

Using `jjs` to experiment with Java APIs

(in-class demo)

Using Nashorn

```
ScriptEngineManager manager =
         new ScriptEngineManager();
ScriptEngine engine = manager
       .getEngineByName("nashorn");
String script =
   "var inc = function(x) {" +
   "  print('Incrementing x');" +
   "  return x+1; }; inc(5)";
engine.eval(script);
```

Moving values between Nashorn and Java

```
engine.put("x", 4);
int i = (int)engine.eval("x + 1");
System.out.println(i);

String s = (String) engine.eval(
            "x + '9ers forever'");
System.out.println(s);
```

Lab: Lambdas & Nashorn

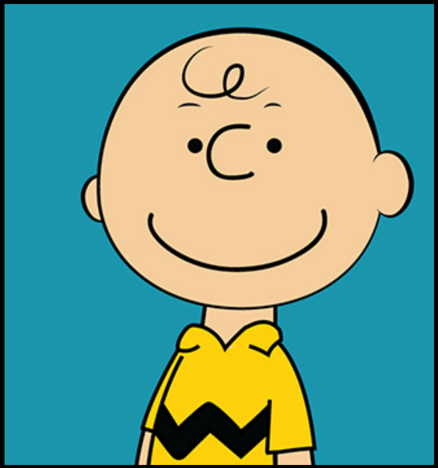
Today, you will write a class to list files, using Java 8 lambdas & Nashorn.

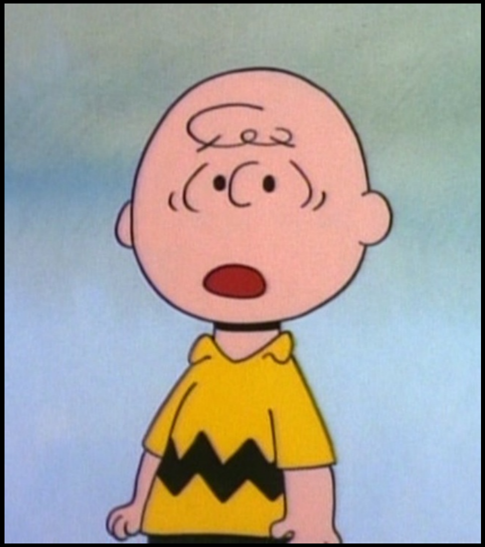
Details are in Canvas.

Final thoughts:

how this class has warped you beyond repair

When you stared this class, you knew how to program.





But now, maybe you are not so sure anymore.

Before, learning a new language might have seemed like a huge task

It took me 4 years to really learn Java. How can I learn a new one?

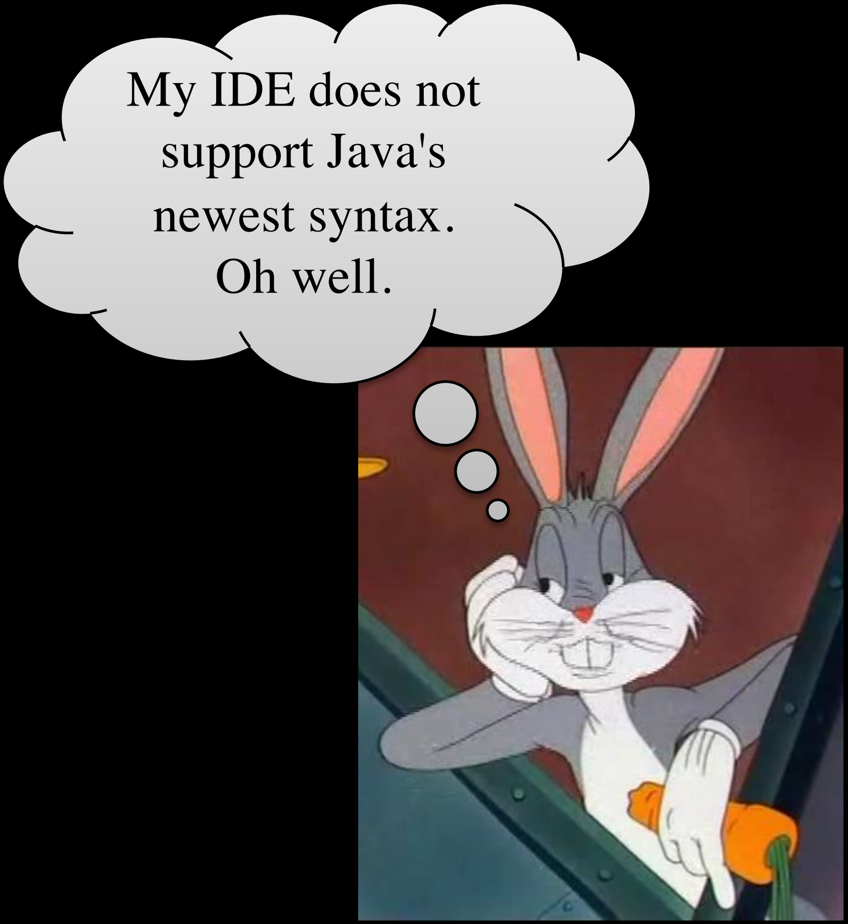
Now perhaps it does not seem so daunting.

Hopefully, you will see more elegant solutions

I'll need 63 different classes to handle each case.

One lambda should solve this…

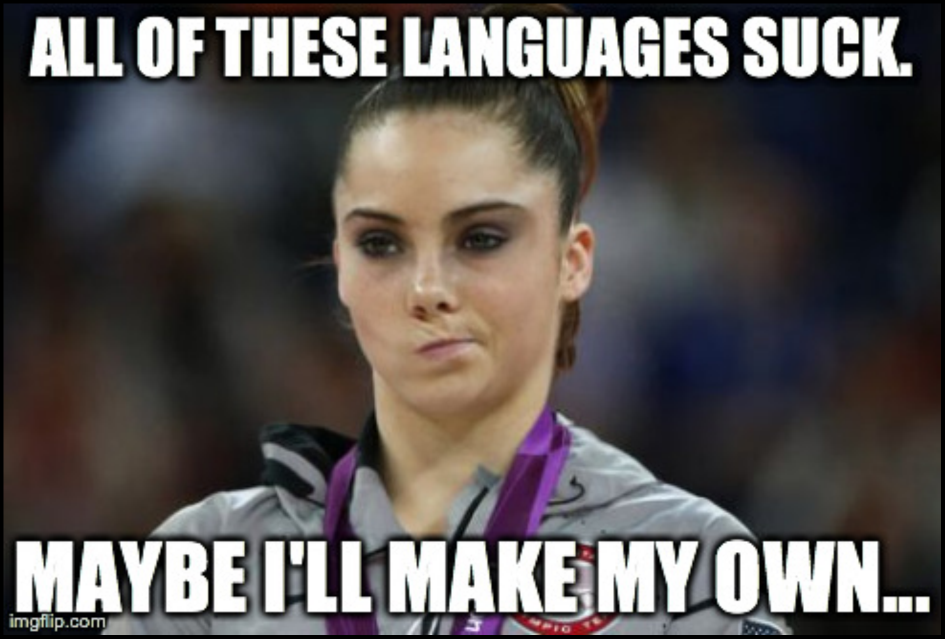
New options may open up to you



Hmm… It looks like I just new to change a few lines of the grammar…

LOOK AT HOW WONDERFUL JAVA IS!
BEST PROGRAMMING LANGUAGE EVER!
memegenerator.net

Your view on languages may change



Warning: This way lies madness.

"That's all Folks!"