CS 211: Existing Classes in the Java Library

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Week 3-2

Logisitics

Logistics

- P1 last night: Questions?
- Late policy?
- Lab 3 Exercises this week
- Play with `Scanner`
- Introduce it today

Goals

- Class Library and `import`
- `Math`, `Array`, `String`, `Scanner`
- Simple input from users/files
- Next session: Make Classes

Classes

```
public class C {
  public static int f;          // static field
  public static void m(){       // static method
    int i;                      // local variable
    ...;
  }
}
```

- All methods and fields in java live within a `class` (or interface)
- Classes are partly a namespace: a place for names to exist
- `static` methods and fields belong to the class: There is one for the whole class
- Consider `CallCounts.java` to see a demo of `static` methods and fields
- Draw some pictures to see how this looks in memory
- Class definitions live in global memory

Java Namespaces

- No such thing as a "global" variable
- No such thing as a "global" function
  - Every variable in a scope
  - Every scope in a class
  - Every class in a package
- `static` means class-level
  - There is one of it (method/field)
  - It is not associated with any particular object
  - It can be accessed through the class using dot
- Related concept: *namespace*, library system, `package`
- Access to stuff in classes is controlled
  - `public` - everybody (use this for the first project)
  - Soon `private`, `protected`, default

It's a packaged world

- Every method/field is part of a class or interface
- Every class/interface is part of a package
- The java library is divided into packages of related classes
  - `java.lang`: Essentials, automatically imported (`Math`, `String`, `Integer`, `Object`)
  - `java.util`: Mostly essential stuff (`Scanner`, `Arrays`)
  - `java.util.concurrent`: For multiple processors
  - `javax.swing`: GUI stuff (windows, buttons)
- There is a default package that unspecified classes live in
  - Default package is screwy: other packages can't look inside
  - Command line and DrJava don't care
  - Eclipse and NetBeans probably do
  - Pay attention to project specs

Mostly Static Classes

`java.lang.Math`

- Javadoc for Math class
- For mathy operations and a few useful constants
- Calculate the square root of pi?
- Calculate E to the 2.75 power?

`java.util.Arrays`

- Javadoc for Arrays class
- Useful ops for arrays
- Sort an array of doubles? of booleans?
- Nicely stringify an array of integers for printing?

Answers are in the provided `MathAndArrays.java`

Math and Arrays are oddities

- Most classes in java don't consist of all static members.
- Most classes you do stuff like

```
SomeClass s = new SomeClass(arg1,arg2);
s.doSomething(arg3);
```

- But you'll never do

```
Math m = new Math();
Arrays a = new Arrays(stuff);
```

because these don't have a constructor

String: A Proper Object of Sequential Characters

```
String s;
s = new String("hello");
System.out.println(s);
String t = "sweet stuff";
```

Keeps track of length

```
int n = s.length();
int m = t.length() - 1;
```

Wait, that's really confusing

- A field `length` (for arrays)
- Versus a method `length()` (function for `String`)

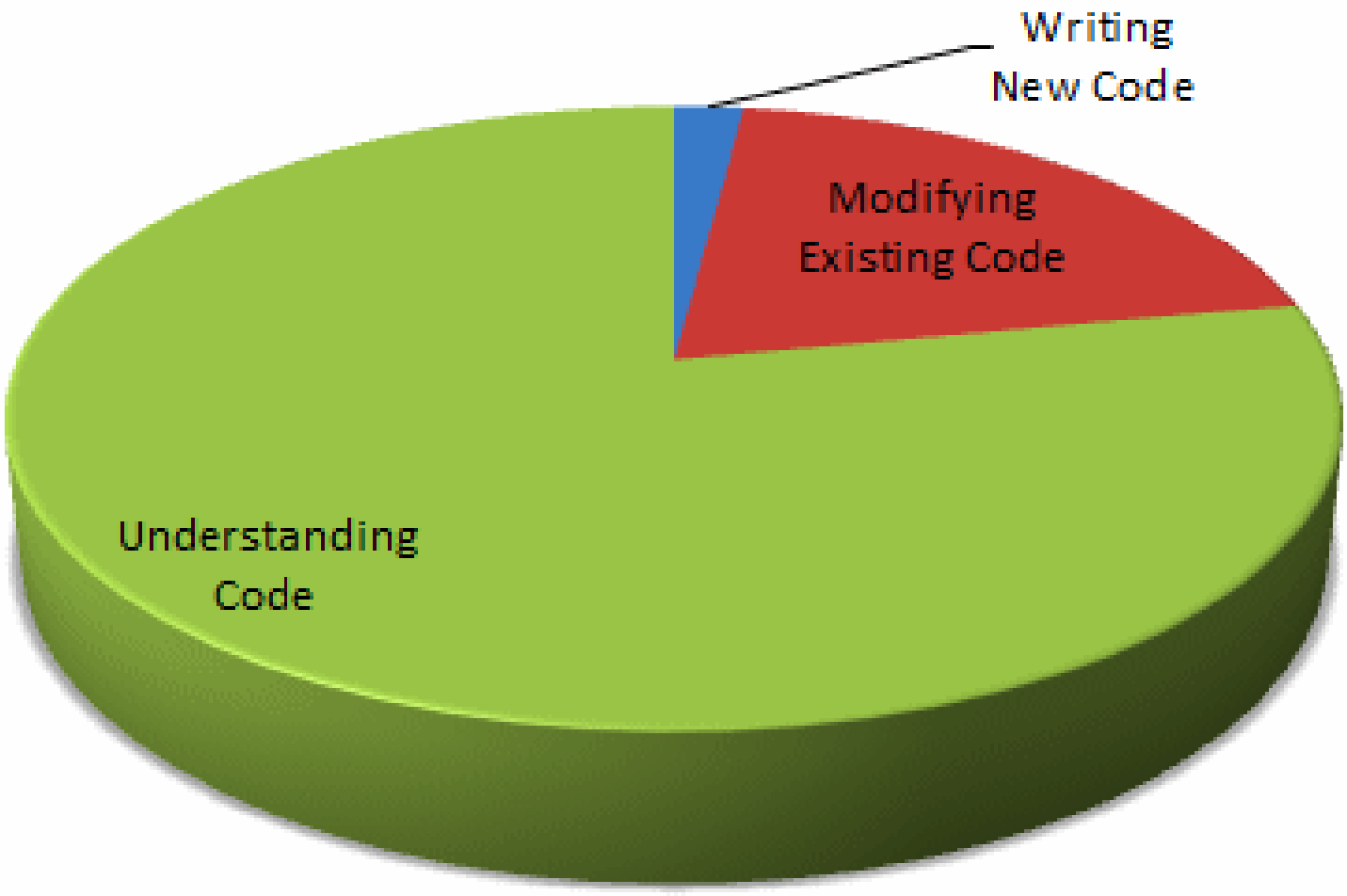
```
char ca[] = new char[10];
String s = "0123456789";
if(ca.length == s.length()){
  System.out.println("Same size");
}
```

Methods of Strings

Start reading Java Docs:
http://docs.oracle.com/javase/8/docs/api/java/lang/String.html
Look for the following methods

- Dynamically construct a string
- How to retrieve a specific character from a string
- How to concatenate two strings
- Determine if a string starts with another string
- How to pull a substring out of a string
- Compare two strings for equality?
- How to add characters onto the end of a string

Which brings me to my next point



From http://www.codinghorror.com/blog/2006/09/when-understanding-means-rewriting.html

Concatenation

Diagram 1

What does

```
String a = "hello";
String b = " world";
String c = a+b;
```

actually do in memory?

Diagram 2

How about

```
String s = "";
for(int i=0; i<10; i++){
  s = s + i;
}
```

String Equality

Show a memory Diagram

```
String a = new String("hello");
String b = a;
String c = new String("hello");
String d = a + "";
```

What is printed

```
System.out.println(a == b);
System.out.println(a.equals(b));
System.out.println(a == c);
System.out.println(a.equals(c));
```

Scanner

Sometimes you need input. Scanner is good for this.

```
// Short demo of the scanner class for input
import java.util.Scanner;
public class ScannerDemo{
  public static void main(String args[]){
    Scanner input = new Scanner(System.in);
    int i = input.nextInt();
    double d = input.nextDouble();
    String s = input.next();
    System.out.println("" + i + " " + d + " " +s);
  }
}
```

See the larger ScannerDemoBig.java for more info

- How do you know about all these methods for Scanner?
- What about String? or System?
- Where do you suppose mathematical functions are stored?

Constructors for Scanner

Read from the Terminal

```
// Constructs a new Scanner that produces values
// scanned from the specified input stream.
Scanner(InputStream source)

Scanner in = new Scanner(System.in);
```

Read from a String

```
// Constructs a new Scanner that produces values
// scanned from the specified string.
Scanner(String source)

Scanner in = new Scanner("Give me a 1 Give me a 2");
```

Scanner Basics

In `java.util`

- Several constructors, for `System.in` and `File` sources
- `nextInt()`, `nextDouble()`, `next()`, etc.
- `nextLine()`: whole line
- `hasNext()`: `true` if more to read
- `close()`: when reading files

File class

- Lives in the package `java.io`
- `import java.io.File;`
- "An abstract representation of file and directory pathnames."
- How do we get at it?

```
File f = new File("some-file.txt");
String s = "stuff.dat";
f = new File(s);
```

Useful for many things but our primary interest at the moment is for reading from files using a `Scanner`

Reading from files with Scanner

```
// Constructs a new Scanner that produces values
// scanned from the specified file.
Scanner(File source)
```

open
```
Scanner fin = new Scanner(new
    File("myfile.txt"))
```

read
```
int i = fin.nextInt();
```

- Frequently done in a loop

close
```
fin.close();
```

See `ScanAFile.java`

A Closing Problem: The Longest Word

```
public static String longestWord(Scanner in)
```

- Takes an open `Scanner`
- Reads to the end of input
- Returns the longest word in the stream
- Ties go to earlier word
- Return `""` if no words in the stream

```
> import java.util.Scanner;
> LongestWord.longestWord(new Scanner("word1 word123"))
"word123"
> String s = "some gargantuan words and tiny words";
> Scanner in = new Scanner(s);
> LongestWord.longestWord(in)
"gargantuan"
> LongestWord.longestWord(new Scanner("   "))
""
```