CSE 421 Course Overview and Introduction to Java

Lecture 1

Learning Objectives

- Knowledgeable in how sound software engineering principles for component-based design are manifested in a current popular programming language
  - SE principles: Resolve
  - Programming language: Java
- Proficient at Java programming
- Proficient at use of industrial-strength software development tools
- Informed in good programming practices

Pre- and Post-requisites

- Required background: CSE 321
  - Typed imperative programming paradigm
    - Control flow, types, variables, arrays
  - Encapsulation and information hiding
    - Client view vs implementation view
    - Abstract vs concrete templates/instances
  - Behavioral specifications
    - Mathematical model and constraints
    - Abstraction correspondence and conventions
    - Requires, ensures, and alters clauses
- Preparation for: CSE 560
  - Practical programming patterns
  - Tool support for software development

Course Content

- Language
- Tools
- Good programming practices

Course Content 1: Language

- Core syntax and features
  - Declarations, assignment, control flow
  - Methods, objects, classes, interfaces
  - Inheritance, polymorphism
  - Generics, exceptions
- Packages (ie Java component catalogs)
  - Collections (eg Map, Set, Queue, List...)
  - Logging, IO, Swing for GUIs

Course Content 2: Tools

- Eclipse
  - Industrial-strength open source IDE
  - Many (free) extensions available
- Javadoc
  - Industry-standard documentation utility for Java programs
- JUnit
  - Industry-standard library for unit testing programs
- CVS/SVN
  - Widely-adopted versioning systems for co-ordinating team development

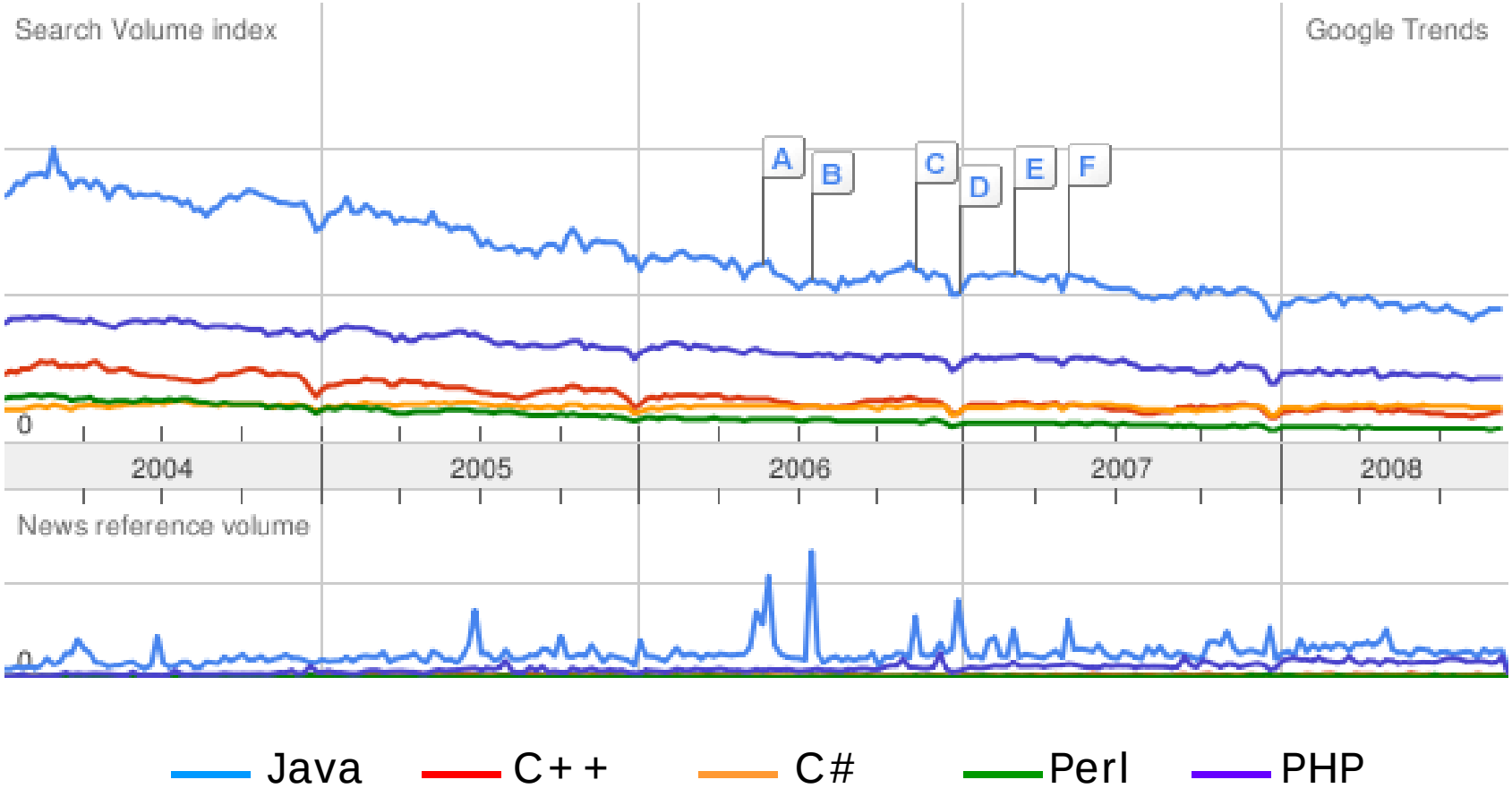
Course Content 3: Good Practices

- Problem:
  - Complex language mechanisms make it easy to produce code that is wrong, brittle, inextensible, and hard to maintain
- "Solution":
  - Good programming practices form a discipline that helps (but does not guarantee) developers write better code
- Simple syntactic idioms
  - Naming conventions, coding conventions
  - Decoupling by "programming to the interface"
- Complex design patterns
  - Single-point of control (eg factories, MVC)
  - Maintaining an invariant (eg immutable, singleton)

What is Java?

- Developed by Sun Microsystems
  - James Gosling
  - Birth: 1994 (progenesis from Oak)
- Based on C/C++
  - Similar syntax, control, data structures
  - Imperative, object-oriented
- Originally designed for building Web/Internet applications
  - Now often viewed as a “general purpose” programming language
- Currently enjoys wide-spread acceptance
  - Had immediate impact, then continued success

Volume of Google Searches



Major Java Myths

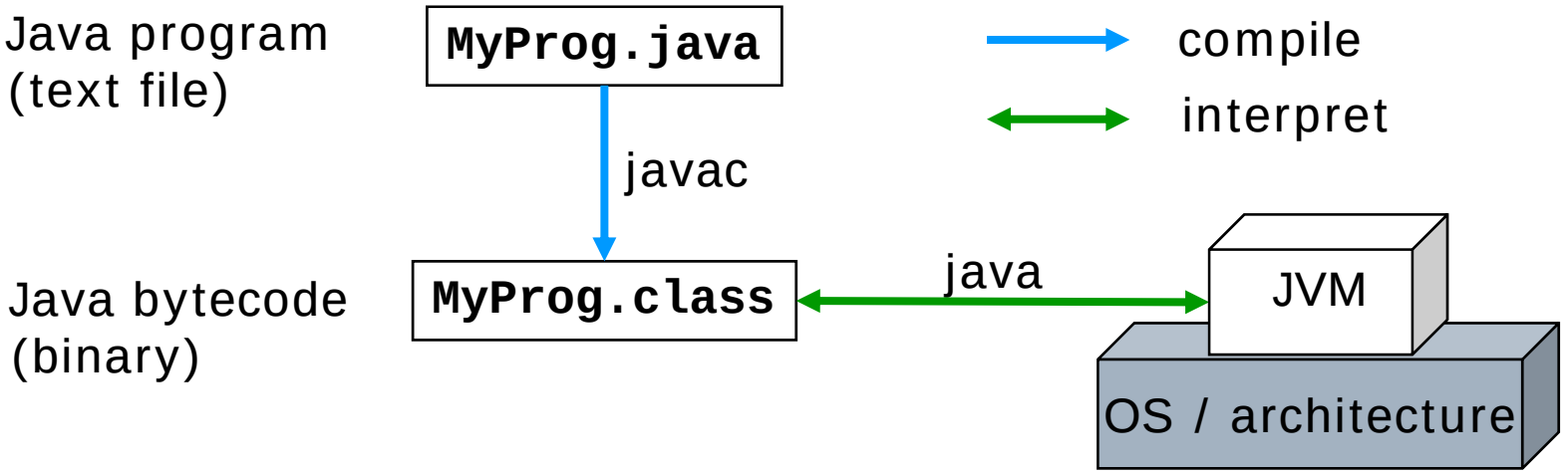
1. Java is a small, simple language
   - True initially, but every revision to the language has added functionality and *complexity*
2. Java does not have pointers
   - References (ie pointers) are *ubiquitous*
3. Once I start using Java, I can forget all that Resolve/C++ stuff
   - Understanding sound principles for component-based software is *even more* important

Resources

- On line tutorials from Sun (“trails”)
  - http://java.sun.com/docs/books/tutorial
- On line API documentation
  - http://java.sun.com/javase/6/docs/api
- Carmen
  - http://carmen.osu.edu
  - class news, discussions, grades
  - lab submission (in “dropbox”)
- Class website
  - Handouts, lecture notes, lab assignments
  - Pointers to more resources

The Java Virtual Machine (JVM)

- An abstract computer architecture
  - The software that executes Java programs
  - Part of Java Runtime Environment (JRE)
- Java program compiled into bytecode
- Java bytecode then interpreted by JVM



Implications of JVM

- Portability
  - Sun slogan: “Write once, run anywhere”
  - JVM is ubiquitous
- Environment configuration
  - path variable
    - for shell to find java / javac executables
  - classpath variable
    - for JVM to find bytecode at execution time
- Dynamic extensibility
  - JVM can find bytecode on-the-fly
- Performance
  - Extra layer comes at (small) penalty in performance

Environment Setup: JDK 1.5

- Version 1.5 == version 5
- Lab: CL 112 (& Baker 310 if available)

  http://www.cse.ohio-state.edu/cs/labs.shtml
- Follow these steps:
  - log into the solaris (ie stdsun) or linux (ie stdlogin) environment
  - subscribe to JDK-CURRENT

    $ subscribe JDK-CURRENT
  - log out and log back in
- Confirm set-up

  $ java –version

  java version “1.5.0_08”

  . . .

Install Java Platform at Home

- Can be installed on different platforms:
  - Solaris, Windows, Linux, …
- Trail: Getting Started > “Hello World!”
  - Download OS-specific Java Development Kit (JDK)
    - Tools for program development (eg javac)
    - JRE
  - Create simple program (with a text editor)
  - Compile (with javac)
  - Run (with java)
- Make sure to download:
  - *J2SE JDK* (not J2EE, not JRE)
  - *Version 6* (1.6.0_07, ie update 7)

Getting Started: 1. Creating Source File

- Using any text editor:
  - Create a file HelloWorldApp.java
  - Copy the following code into this file:

```
public class HelloWorldApp {
   public static void main(String[] args) {
      // Display "Hello World!"
      System.out.println("Hello World!");
   }
}
```

- Note:
  - Class name must match file name
  - Java is CASE SENSITIVE!

Getting Started: 2. Compiling the Program

- Compile using javac

```
$ javac HelloWorldApp.java
```

- Generates a file named HelloWorldApp.class

```
$ ls
HelloWorldApp.class  HelloWorldApp.java
```

- Problem

```
javac: command not found
```

- Cause
  - Shell can not find javac executable
- Solutions
  - Use full path on command line

```
$ /usr/local/jdk1.5.0_08/bin/javac HelloWorldApp.java
```

  - Set path environment variable

```
$ export PATH=$PATH:/usr/local/jdk1.5.0_08/bin/javac
```

Getting Started: 3. Running the Program

- From same directory, run using java

```
$ java HelloWorldApp
Hello World!
```

- Note:
  - argument is HelloWorldApp, *not* a file (.java or .class)
- Problem

```
Exception in thread "main" java.lang.NoClassDefFoundError:
   HelloWorldApp
```

- Cause
  - JVM can not find HelloWorldApp bytecode (ie .class file)
- Solutions
  - Explicitly set classpath on command line

```
$ java –classpath ~/421/example  HelloWorldApp
```

  - Set classpath using environment variable

```
$ export CLASSPATH=.:~/421/example
```

Language Basics: Statements

- Similar to C/C++
- Control flow:
  - if, if-else, if-else if
  - switch
  - for, while, do-while
  - break
  - continue
- Statements
  - Separation with ;
  - Blocks with { . . . }
- Comments with // or /* . . . */
- Operators
  - arthmetic: + - * / % ++ -- ...
  - logical (for booleans): & | ^ ! && ||
  - bit (for integer types): & | ^ ~ << >> >>>
  - relational: == != < > <= >=

Good Practice: Single-Statement Conditionals

- Always include body of if-else in braces, even if it is a single statement
- The following is correct, but discouraged:

```
if (!isDone)
   retry = true;
```

- Instead, write:

```
if (!isDone) {
    retry = true;
}
```

Supplemental Reading

- Sun trails
  - Getting Started
  - Learning the Java Language > Language Basics
- Java overview white paper
  - http://java.sun.com/docs/white/langenv/
- Another walk-through of simple application
  - “Essentials of the Java Programming Language, Part 1”
  - http://developer.java.sun.com/developer/onlineTraining/Programming/BasicJava1/compile.html
  - Lessons 1 and 2

Summary

- Main course learning objective
  - Applying solid SE principles in Java programming
- Course content
  - Language, tools, good practices
- JVM
  - .java (source) vs .class (bytecode)
  - javac (compiler) vs java (interpretter)
- Environment configuration
  - Setting class and classpath
- Sample program: Hello World