cs2220: Engineering Software

Class 2:
Introduction Java

Fall 2010
University of Virginia
David Evans

Course Announcements

**Assistant Teacher:** Robbie Hott
Help for PS1: Friday, 2:30-3:30pm (Thornton Stacks)

**Office Hours**
Extended Thursday to be 11am-12:30pm
Extended Monday to be 1:30-3:30pm
Added Wednesday, noon-1pm
My door is (almost) always open – feel free to stop by outside of office hours

Survey Responses

![Java Experience Chart]

See the web post for my answers to your questions.

Survey Responses

Bar chart showing the distribution of topics:
- Bioinformatics: 8
- Crypto: 9
- Finance: 9
- Instant Messaging: 3
- Language: 12
- Poker/Games: 12
- Twitter: 2
- Web: 10

We will not have assignments involving Twitter or Instant Messaging!

but...if you don’t like the assigned project, you can always propose your own.

Late Policy

Why Java?
Why learn a new language?

Money?

New Ways of Thinking

J S Bach, “Coffee Cantata”, BWV 211 (1732)

“Jamais Jamais Jamais” from Harmonice Musices Odhecaton A. (1501)

Modern Music Notation

Roman Haubenstock-Ramati, Concerto a Tre

John Cage, Fontana Mix
Thought and Action

- Languages change the way we think
  - BASIC: think about GOTO
  - Scheme: think about procedures
  - Algol, Pascal: think about assignments, control blocks
  - Java: think about types, objects
- Languages provide abstractions of machine resources
  - Hide dangerous/confusing details: memory locations, instruction opcodes, number representations, calling conventions, etc.
  - Hiding more increases simplicity, but limits expressiveness

Why so many programming languages?

Fundamental Differences

- All equivalently powerful!
  - Universal languages: all capable of simulating each other
- Fundamental differences
  - Expressiveness: how easy it is to describe a computation
  - “Truthiness”: likelihood that a program means what a programmer things it means
  - Safeness: impact of programmer mistakes
- There is a fundamental conflict between expressiveness and truthiness/safeness

Programming Language Design Space

Shortest HelloWorld in Java

```java
public class HelloWorld {
    public static void main(String[] args) {
        System.out.println("Hello!");
    }
}
```

print ("Hello!")
(display "Hello!")
public class HelloWorld
{
public static void main(String[] args) {
System.out.println ("Hello!");
}
}
class object Actual computation
Structural punctuation
**Pragmatic Differences**
- Performance of available compilers, interpreters
- Tools available
- Libraries
- Portability
- Availability/cost of programmers

**What is Java?**
A. Island in Indonesia known for coffee and volcanoes
B. A Programming Language (Java™)
C. A Portable Low-Level Language (JVML)
D. A Platform (JavaVM)
E. A (semi-)successful marketing strategy
   - JavaScript is not related to Java or Java™
F. All of the above

**Java History**
- 1991: “Stealth Project” formed at Sun
  - Computing for consumer electronics market
- James Gosling tasked with selecting a programming language for project
  - Started with C++, but found inadequate
    - In later classes, we’ll talk about why
  - Developed extensions and subtractions that led to new language “Oak”
- 1993: Web arrives
- 1995: Sun releases HotJava browser and Java PL, Netscape incorporated into browser

**Buzzword Description**
“A simple, object-oriented, distributed, interpreted, robust, secure, architecture neutral, portable, high-performance, multithreaded, and dynamic language.” — [Sun95]

**Non-Buzzword Description**
Java sacrifices **expressiveness** for “truthiness”: A Java program is ~5x larger than the corresponding Scheme or Python program
Java sacrifices **performance** for safety, “truthiness”, and portability: A Java program is ~3x slower than a comparable C++ program (but 10x faster than the comparable Python program)

Caveat: these numbers are “guesses” and gross simplifications. Real numbers depend on the program (and programmer!).

As the course proceeds, we will discuss how well it satisfies these “buzzwords”. You should especially be able to answer how well it satisfies each of the blue ones in your final interview.
Java Programming Language

**Syntax**
- Similar to C++
- Designed to be easy for C++ programmers to learn

**Semantics (what programs mean)**
- Similar to Scheme
- Designed to make it easier to reason about properties of programs

Programming Systems

**Why use a virtual machine?**

- **Portability**
  If you can implement a Java VM on your machine, then you can run all Java programs

- **Security**
  A VM can limit what programs can do to the real machine

- **Simplicity**
  VM instructions can be simpler than machine instructions

Summary

Languages change the way we think
Programming languages must trade-off expressiveness and “truthiness”
cs2220 uses a language designed primarily for truthiness because that makes it easier to build dependable, complex, maintainable programs

Beginning of class Tuesday: Problem Set 1 Due