

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

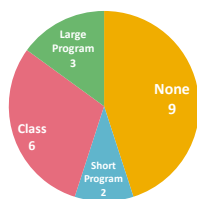
Extended Thursday to be 11am-12:30pm

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

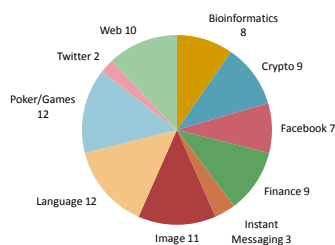
Survey Responses



Java Experience

See the web post for my answers to your questions.

Survey Responses

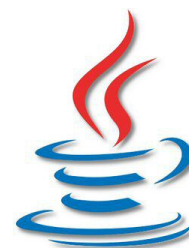


We will not have assignments involving Twitter or Instant Messaging!

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

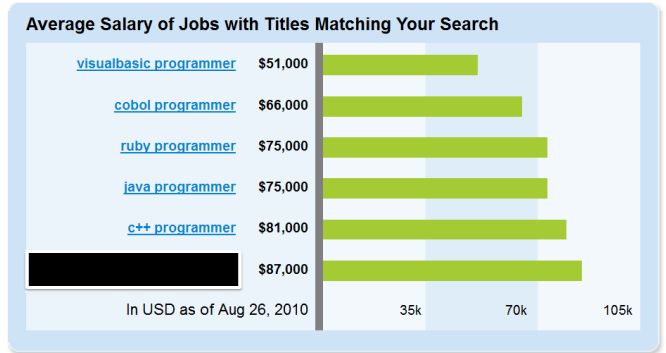
Late Policy

Why Java?



Why learn a new language?

Money?



According to <http://www.simplyhired.com>

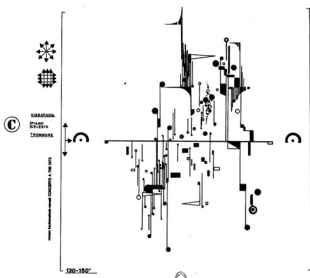
New Ways of Thinking



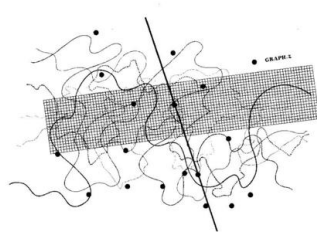
"Jamais Jamais Jamais" from Harmonie Musiques Odhecaton A. (1501)

J S Bach, "Coffee Cantata", BWV 211 (1732) www.npi.com/homepage/teritowe/jsbhand.html

Modern Music Notation



Roman Haubenstock-Ramati, Concerto a Tre



John Cage, Fontana Mix

<http://www.medienkunstnetz.de/works/fontana-mix/audio/1/>

I
TACET
II
TACET
III
TACET

4:55"
FOR ANY INSTRUMENT OR COMBINATION OF INSTRUMENTS
John Cage

OPERATED © 1960 BY NATIONAL BUREAU OF STANDARDS, JULY 27, 1961

NOTES: THE TITLE OF THIS WORK IS THE TOTAL LENGTH IN MINUTES AND SECONDS OF ITS PERFORMANCE. AT WOODSTOCK, NY, AUGUST 29, 1958, THE TITLE WAS 4:33" AND THE THREE PARTS WERE 3', 2'40", AND 1'20". IT WAS PERFORMED BY DAVID TUDOR, PIANIST, WHO INDICATED THE BEGINNINGS OF PARTS BY CANDLELIGHT, THE BEGINS BY OPERAS, THE KETTLEWED LID. AFTER THE WOODSTOCK PERFORMANCE, A COPY IN PROBABILISTIC MUTATIONS WAS MADE FOR TRIMIN PROPOSES. IN IT THE TIMELENGTHS OF THE MOVEMENTS WERE 30", 2'25", AND 1'40". HOWEVER, THE WORK MAY BE PERFORMED BY ANY INSTRUMENT (S) AND THE MOVEMENTS MAY LAST ANY LENGTHS OF TIME.

FOR TRIMIN KRAMER

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**

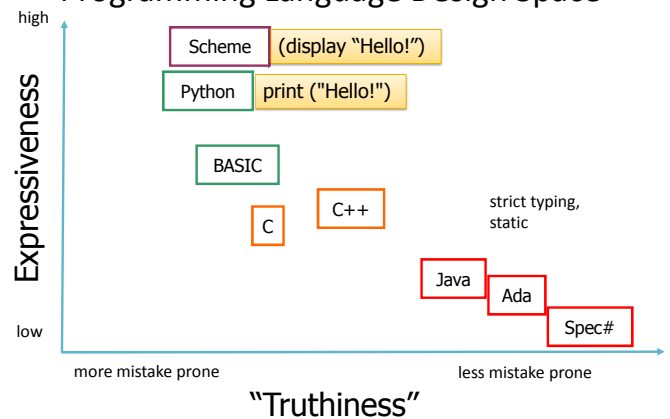
Why so many programming languages?



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

```

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

```

Annotations for the code above:

- `public class HelloWorld {` is labeled **class header**.
- `public static void main(String[] args) {` is labeled **method header**.
- `System.out.println ("Hello!");` is labeled **Actual computation**.
- `}` (closing class) is labeled **class object**.
- `}` (closing method) is labeled **Structural punctuation**.

Pragmatic Differences

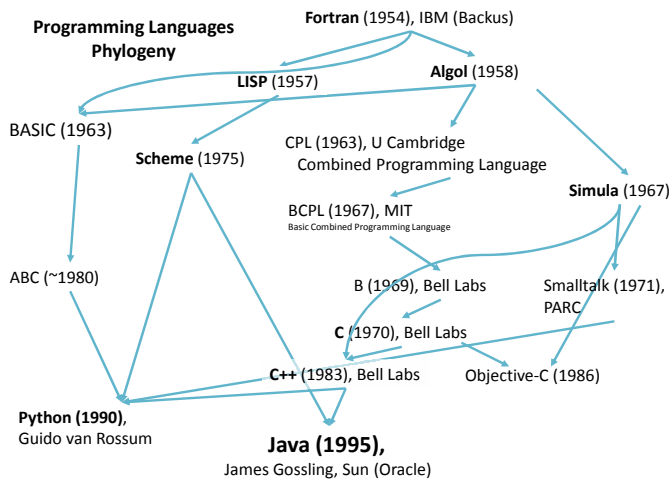
- Performance of available compilers, interpreters
- Tools available
- Libraries
- Portability
- Availability/cost of programmers



What is Java?



- Island in Indonesia known for coffee and volcanoes
- A Programming Language (Java™)
- A Portable Low-Level Language (JVML)
- A Platform (JavaVM)
- A (semi-)successful marketing strategy
 - JavaScript is not related to Java or Java™
- 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

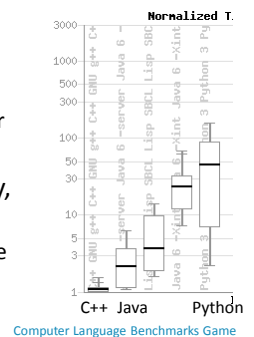
“A ~~simple~~, **object-oriented**, distributed, interpreted, **robust**, **secure**, architecture neutral, portable, high-performance, multithreaded, and dynamic language.” [Sun95]

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.

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!).

Java Programming Language

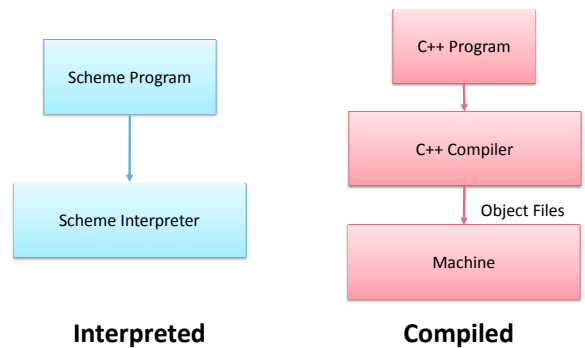
Syntax

- 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

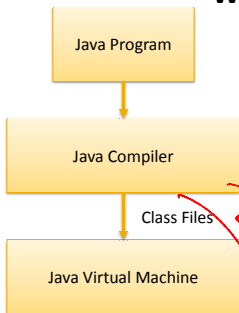
Programming Systems



Java VM



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

Handwritten notes:
 ← Java VM
 Machine Code Java Script

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**