COM241

Programming Languages Concepts

Assoc. Prof. Dr. Mehmet Serdar Güzel

Slides are mainly adapted from the following course page:
http://www.cs.utexas.edu/~shmat/courses/cs345/

Lecturer

- Instructor: Assoc. Prof Dr. Mehmet S Güzel
  - Office hours: Tuesday, 1:30-2:30pm
  - Open door policy – don't hesitate to stop by!
- Watch the course website
  - Assignments, lab tutorials, lecture notes

Course Materials

- Textbook:

  Mitchell. "Concepts in Programming Languages." (Fifth Edition)

- Harbison, Steele. "C: A Reference Manual."

  (5th edition)

- Occasional assigned readings

Syllabus

- Review of fundamental concepts underlying contemporary programming languages
  - Goal: understand paradigms of programming languages
  - Examples drawn from C, C++, C#, Java, Scheme, Python, PhP
- Procedural
- Functional
- Data-oriented
- Object-oriented
- Script
- Concurrent

Course Goals

- Language as an outline for problem-solving
  - Understand the languages so as to having a fair comparison
  - History of the state-of-the-art programming languages
  - Be prepared for new programming languages, paradigms and tools

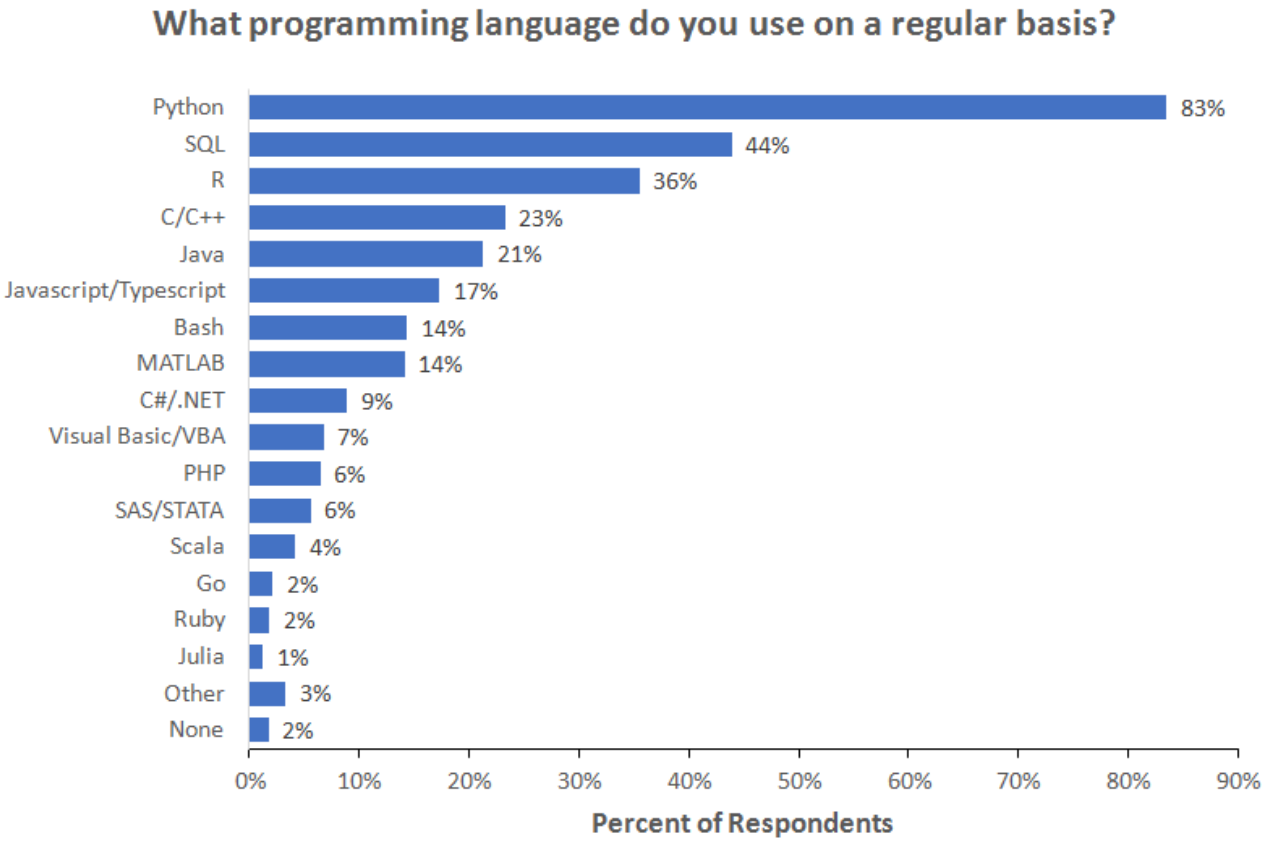
- Language tradeoffs
  - Every suitability has its cost
    - Recognize the cost of presenting an abstract view of machine
    - Understand tradeoffs based on language design

What's Worth Studying?

- Popular languages and standards
  - C, C#, C++, Java and Python
  - Imperative and object-oriented languages
- Important application ideas
- Performance challenges
  - Concurrency
- Design tradeoffs
- Concepts that research community is exploring for new programming languages and tools

Languages in Common Use

[F. Labelle]



Note: Data are from the 2018 Kaggle Machine Learning and Data Science Survey. You can learn more about the study here: http://www.kaggle.com/kaggle/kaggle-survey-2018. A total of 18827 respondents answered the question.

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Flon's Axiom

"There is not now, nor has there ever been,
nor will there ever be,
any programming language in which
it is the least bit difficult to write bad code."

- Lawrence Flon

Latest Issues

- Commercial issues
  - Increasing use of type-safe languages: Java, C#, …
  - Scripting and other languages for Web based applications
  - Scripting languages for AI and Robotics (Python)
- Teaching trends: Java and C# replacing C++
- Research and development issues
  - Modularity
  - Program analysis
    - Automated error detection, programming environments, compilation
  - Isolation and security
    - Sandboxing, language-based security, …

Support for Abstraction

- Data
  - Pre-defined types and classes
  - Class libraries
- Procedural
  - Pre-defined functions
  - Standard libraries

Reliability

- Program behavior is the same on different platforms
  - E.g., early versions of Fortran
- Type errors are detected
  - E.g., Semantic errors are properly trapped
  - E.g., C vs. C++
- Memory leaks are prevented
  - E.g., C# vs. Java
- Pointers are unreliable
  - E.g., C++, C

Orthogonality

- **Orthogonality** in a **programming language** means that a relatively small set of primitive constructs can be combined in a relatively small number of ways to build the control and data structures of the **language**.

Efficient Implementation

- Embedded systems
  - Real-time response (drones)
  - Failures of early Ada implementations
- Web applications
  - Responsiveness to users (e.g., Yandex search)
- Corporate database applications
  - Efficient search and updating
- AI applications
  - Mimicking human behaviors