Preliminaries

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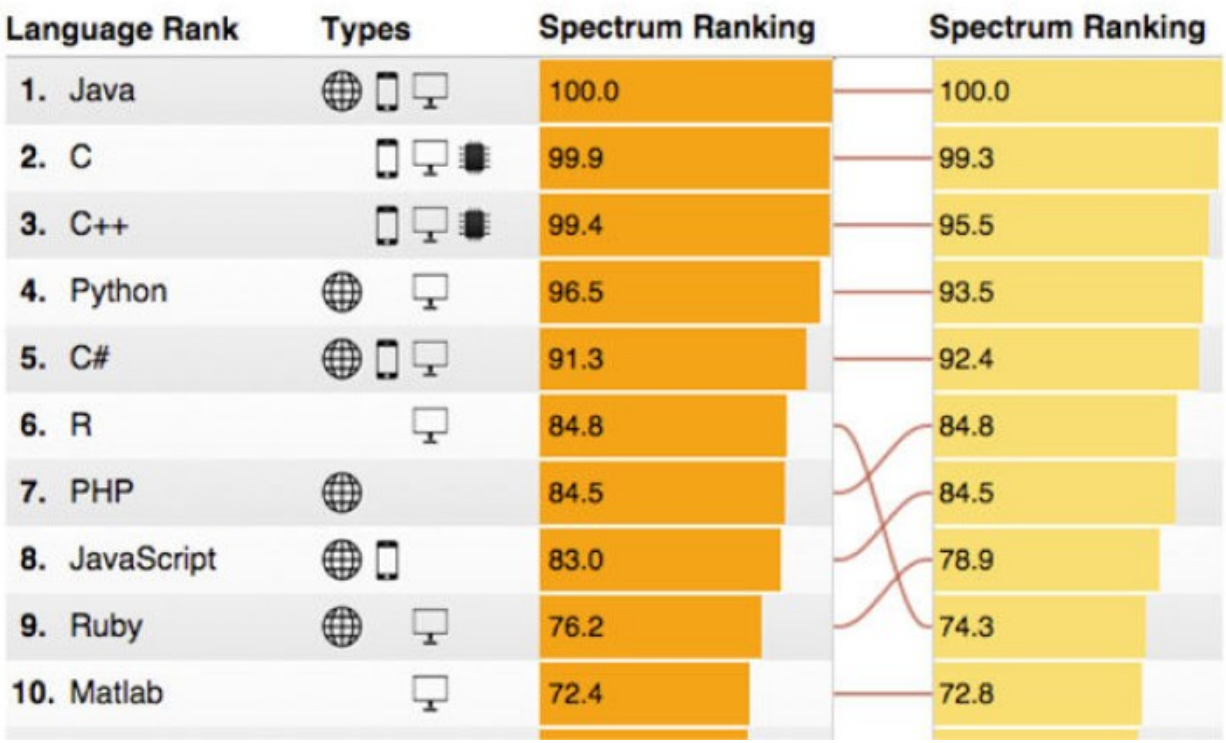
Lots of Programing Languages

- Top 10 most popular programming languages in 2015 (Stephen Cass, 2015)



Concepts of Programming Languages

- Constructs of contemporary programming languages
- Tools for critical evaluation of existing and future programming languages
- Preliminary study of compiler design
  - In-depth discussion of programming language structures
  - Formal method of describing syntax
  - Approaches to lexical and syntactic analysis.

Benefits

- Choosing appropriate languages
- Learning new languages
- Designing new languages
- Applying knowledge and skills in related areas
- Expressing ideas
- Overall advancement of computing

Programming Domains

- Application domains
  - Scientific applications
  - Business applications
  - Artificial intelligence
  - Systems programming
- Running platform
  - Web applications
  - Mobil applications
  - Enterprise applications
  - Embedded applications

Programming Domains and Impact

- Scientific applications
  - Floating point computations; use of arrays; e.g., Fortran
- Business applications
  - Produce reports, use *decimal* numbers and characters; e.g., COBOL
- Artificial intelligence
  - Symbols rather than numbers manipulated; use of linked lists; e.g., LISP
- Systems programming
  - Need efficiency because of continuous use; e.g., C
- Web Software
  - Collection of languages: markup (e.g., HTML), scripting (e.g., PHP), general-purpose (e.g., Java)

Language Evaluation

- Readability
- Writability
- Reliability
- Cost

Readability

- Overall simplicity
- Orthogonality
- Data types
- Syntax considerations

Writability

- Simplicity and orthogonality
- Support for abstraction
- Expressivity

Reliability

- Type checking
- Exception handling
- Aliasing
- Readability and writability

Cost

- Training programmers to use the language
- Writing programs (closeness to particular applications)
- Compiling programs
- Executing programs
- Language implementation system: availability of free compilers
- Reliability: poor reliability leads to high costs
- Maintaining programs

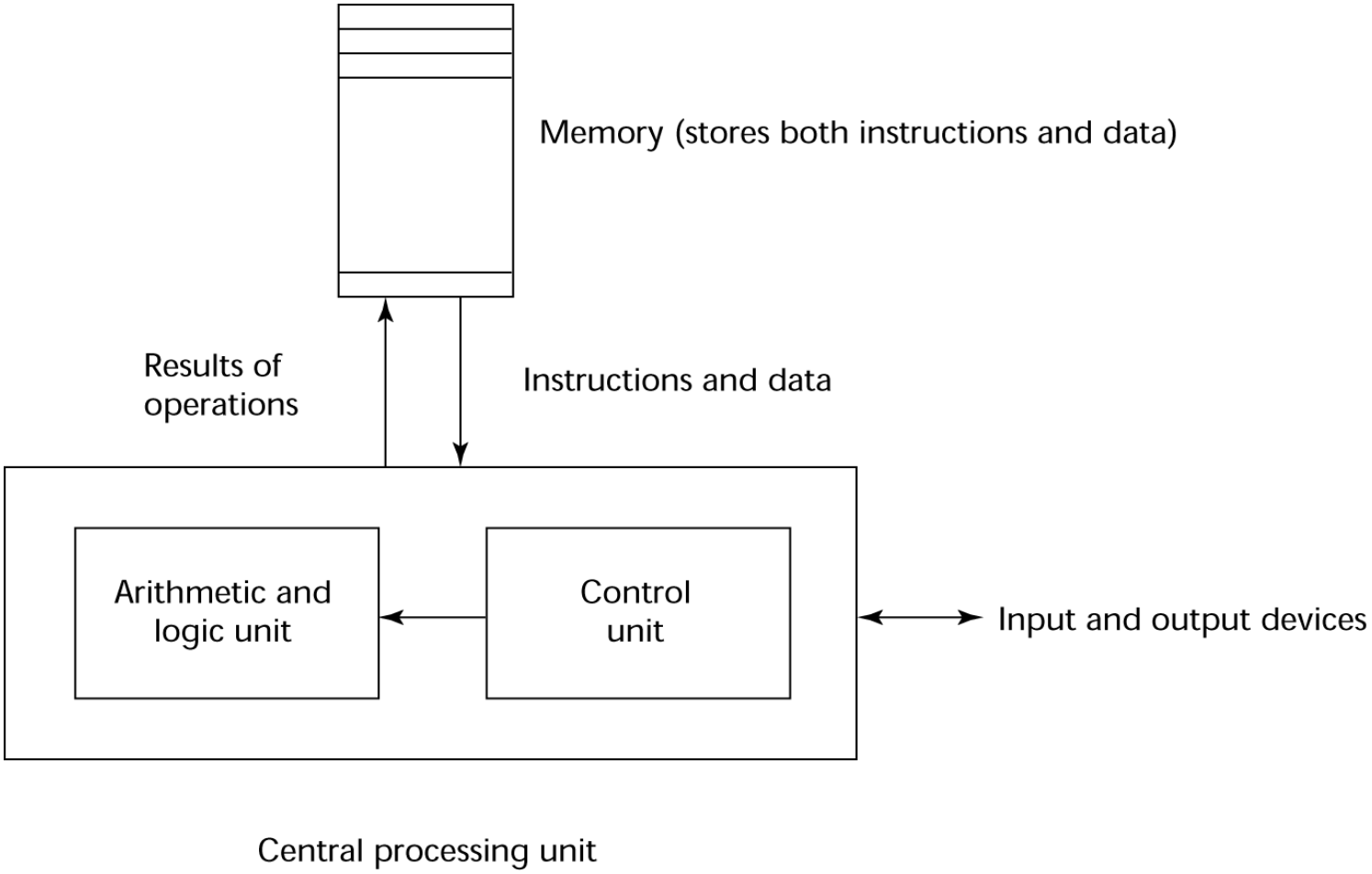
Other Considerations

- Portability
- Generality
- Well-definedness

Influence on Language Design

- Computer Architecture
  - Von Neumann Architecture
- Program Design Methodologies
  - Machine efficiency to human efficiency
  - Process oriented to data-oriented
  - Data-oriented to object oriented

Von Neumann Architecture



Language Categories

- Imperative
- Functional
- Logic
- Markup/programming hybrid

Design Trade-Off

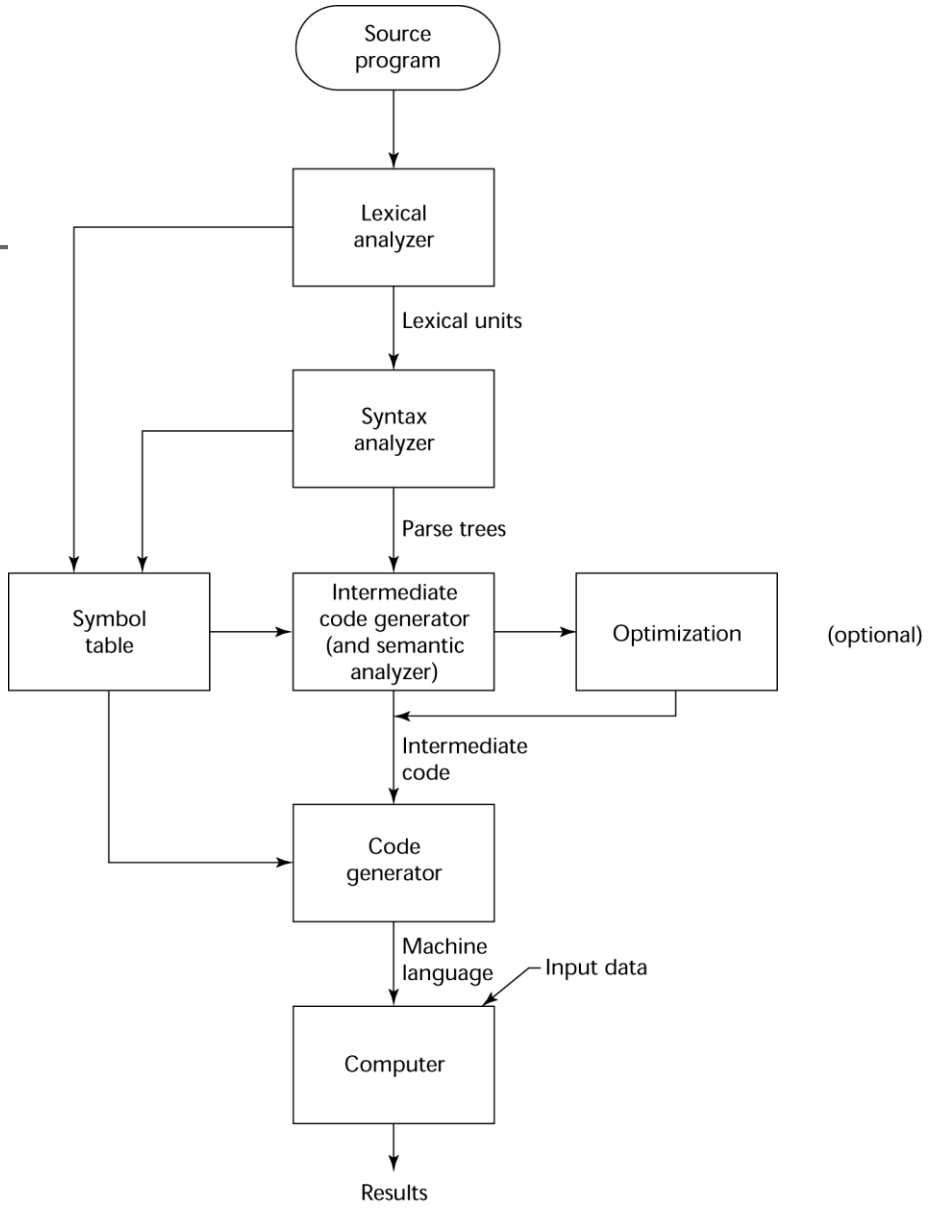
- Reliability vs. cost of execution
- Readability vs. writability
- Writability vs. reliability

Implementation Method

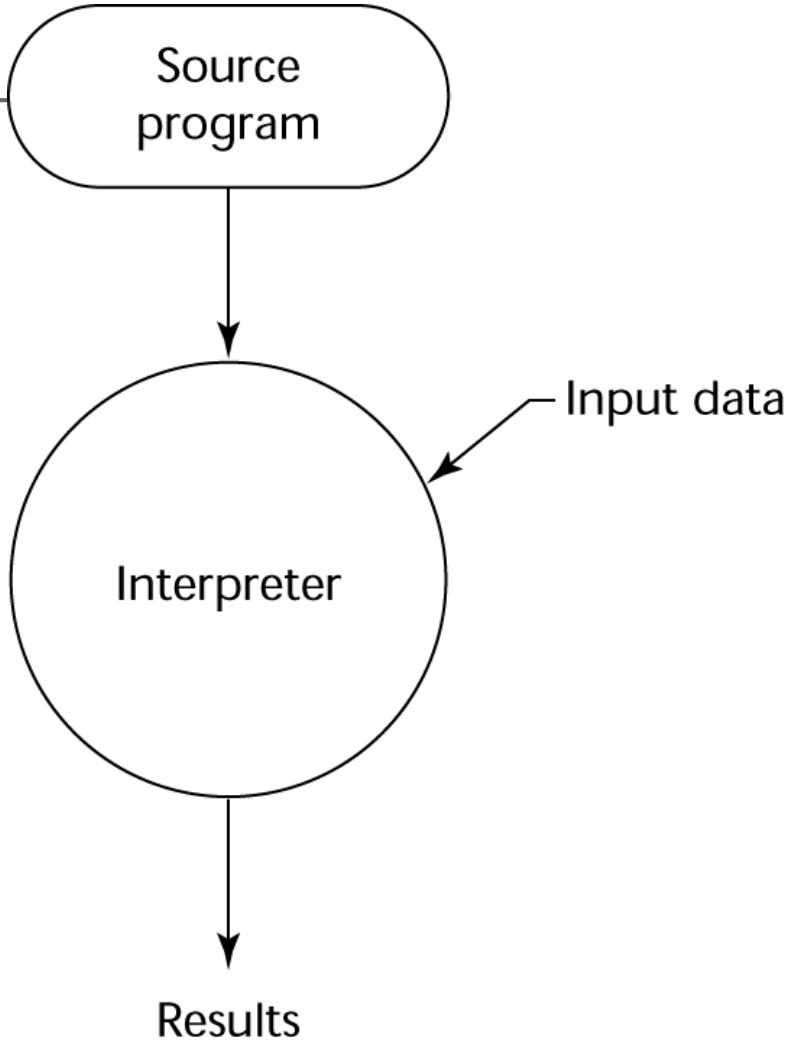
- Compilation
- Pure Interpretation
- Hybrid Implementation Systems

Compilation

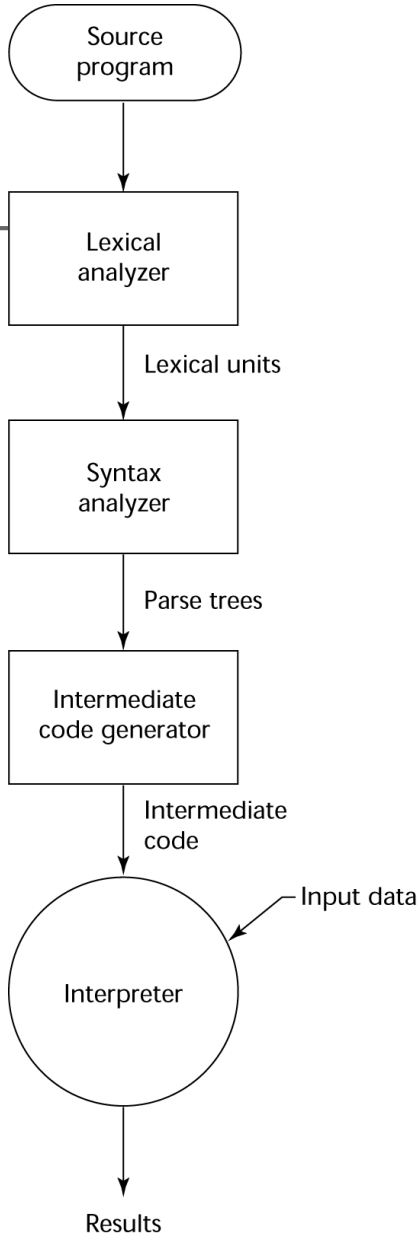
- Source language to machine language
- Slow translation
- Fast execution
- Translation phases
  - Lexical analysis
  - Syntax analysis
  - Semantic analysis
  - Code generation
- Linking and loading



Interpretation



Hybrid Implementation



Summary

- Benefits of studying concepts of programming languages
- Evaluation criteria for programming languages
- Major influences on language design
- Major methods of implementing programming languages