



# Introduction of Programming Languages



# Programming Language Concepts

- ▶ What is a programming language?
  - ▶ Why are there so many programming languages?
  - ▶ What are the types of programming languages?
  - ▶ Does the world need new languages?
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# What is a Programming Languages


- ▶ A programming language is a set of rules that provides a way of telling a computer what operations to perform.
  - ▶ A programming language is a set of rules for communicating an algorithm
  - ▶ It provides a linguistic framework for describing computations
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# What is a Programming Language?

*A programming language is a notational system for describing computation in a **machine-readable** and **human-readable** form.*

*A programming language is a tool for developing **executable models** for a class of problem domains.*

# What is a Programming Language

- ▶ English is a **natural language**. It has words, symbols and grammatical rules.
  - ▶ A programming language also has words, symbols and rules of grammar.
  - ▶ The grammatical rules are called **syntax**.
  - ▶ Each programming language has a different set of syntax rules.
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# Why Are There So Many Programming Languages

- ▶ Why does some people speak French?
  - ▶ Programming languages have evolved over time as better ways have been developed to design them.
    - First programming languages were developed in the 1950s
    - Since then thousands of languages have been developed
  - ▶ Different programming languages are designed for different types of programs.
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# Levels of Programming Languages

High-level program

```
class Triangle {  
    ...  
    float surface()  
        return b*h/2;  
}
```


Low-level program

```
LOAD r1,b  
LOAD r2,h  
MUL r1,r2  
DIV r1,#2  
RET
```

Executable Machine code

```
0001001001000101  
0010010011101100  
10101101001...
```

# What Are the Types of Programming Languages


- ▶ First Generation Languages
  - ▶ Second Generation Languages
  - ▶ Third Generation Languages
  - ▶ Fourth Generation Languages
  - ▶ Fifth Generation Languages
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# First Generation Languages

- ▶ Machine language
  - Operation code – such as addition or subtraction.
  - Operands – that identify the data to be processed.
  - Machine language is machine dependent as it is the only language the computer can understand.
  - Very efficient code but very difficult to write.

# Second Generation Languages

- ▶ Assembly languages
    - Symbolic operation codes replaced binary operation codes.
    - Assembly language programs needed to be “assembled” for execution by the computer. Each assembly language instruction is translated into one machine language instruction.
    - Very efficient code and easier to write.
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# Third Generation Languages

- ▶ Closer to English but included simple mathematical notation.
  - Programs written in **source code** which must be translated into machine language programs called **object code**.
  - The translation of source code to object code is accomplished by a machine language system program called a **compiler**.

# Third Generation Languages (cont'd.)

- ▶ Alternative to compilation is interpretation which is accomplished by a system program called an **interpreter**.
- ▶ Common third generation languages
  - FORTRAN
  - COBOL
  - C and C++
  - Visual Basic

# Fourth Generation Languages


- ▶ A high level language (4GL) that requires fewer instructions to accomplish a task than a third generation language.
- ▶ Used with databases
  - Query languages
  - Report generators
  - Forms designers
  - Application generators

# Fifth Generation Languages

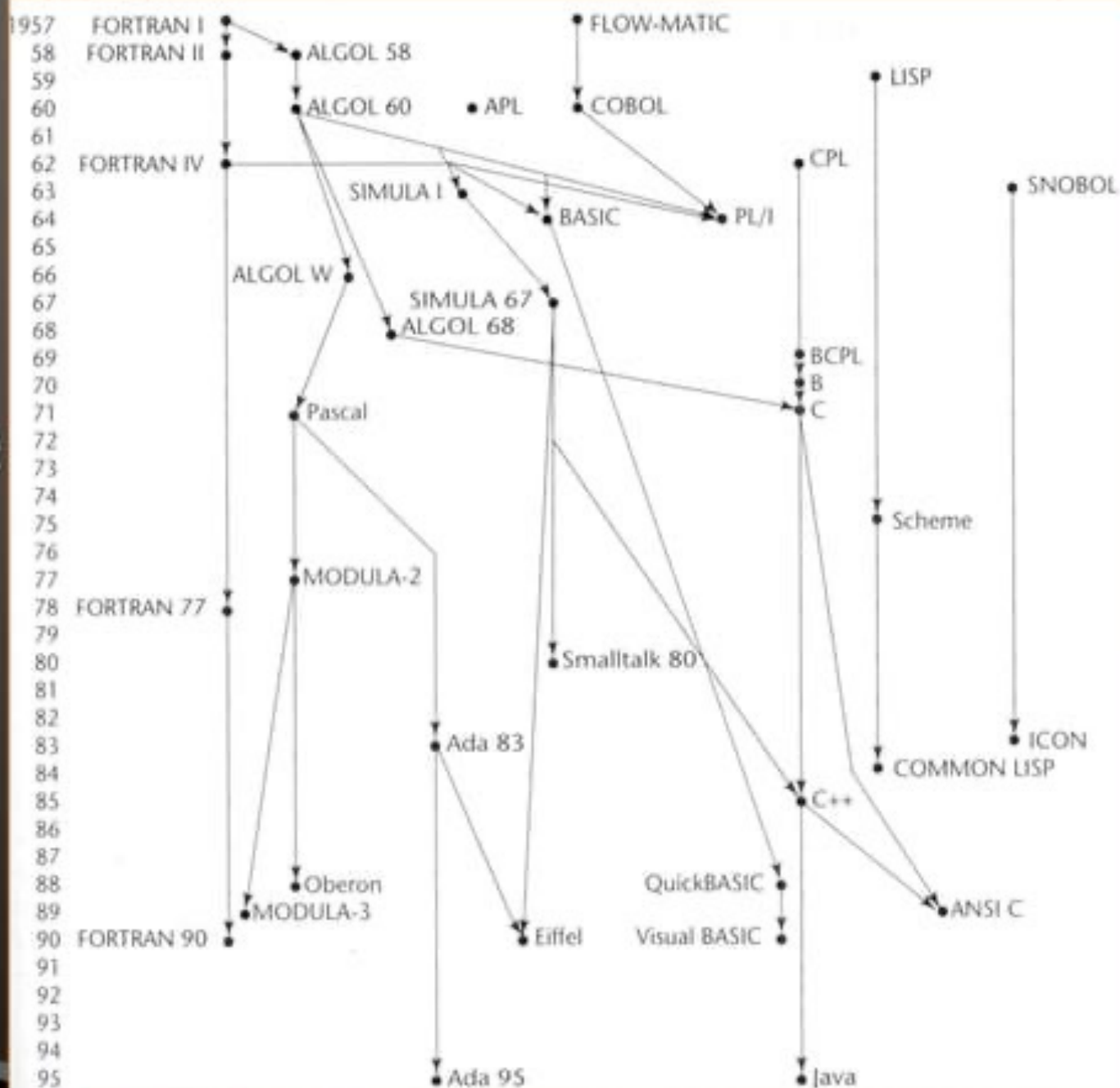
- ▶ Declarative languages
- ▶ Functional(?): Lisp, Scheme, SML
  - Also called applicative
  - Everything is a function
- ▶ Logic: Prolog
  - Based on mathematical logic
  - Rule- or Constraint-based




# Beyond Fifth Generation Languages

- ▶ Though no clear definition at present, natural language programs generally can be interpreted and executed by the computer with no other action by the user than stating their question.
  - ▶ Limited capabilities at present.
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# Language Family Tree



# The principal paradigms


- ▶ Imperative Programming (C)
  - ▶ Object-Oriented Programming (C++)
  - ▶ Logic/Declarative Programming (Prolog)
  - ▶ Functional/Applicative Programming (Lisp)
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# Programming Languages

- ▶ Two broad groups
  - Traditional programming languages
    - ▢ Sequences of instructions
    - ▢ First, second and some third generation languages
  - Object-oriented languages
    - ▢ Objects are created rather than sequences of instructions
    - ▢ Some third generation, and fourth and fifth generation languages


# Traditional Programming Languages

## ▶ FORTRAN

- FORMula TRANslation.
  - Developed at IBM in the mid-1950s.
  - Designed for scientific and mathematical applications by scientists and engineers.
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# Traditional Programming Languages (cont'd.)

## ▶ COBOL

- COmmon Business Oriented Language.
  - Developed in 1959.
  - Designed to be common to many different computers.
  - Typically used for business applications.
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# Traditional Programming Languages (cont'd.)

## ▶ BASIC

- Beginner's All-purpose Symbolic Instruction Code.
- Developed at Dartmouth College in mid 1960s.
- Developed as a simple language for students to write programs with which they could interact through terminals.

# Traditional Programming Languages (cont'd.)

## ▶ C


- Developed by Bell Laboratories in the early 1970s.
- Provides control and efficiency of assembly language while having third generation language features.
- Often used for system programs.
- UNIX is written in C.

# Object-Oriented Programming Languages

- ▶ Simula


- First object-oriented language
- Developed by Ole Johan Dahl in the 1960s.

- ▶ Smalltalk

- First purely object-oriented language.
  - Developed by Xerox in mid-1970s.
  - Still in use on some computers.
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# Object-Oriented Programming Languages (cont'd.)

- ▶ C++


- It is C language with additional features.
  - Widely used for developing system and application software.
  - Graphical user interfaces can be developed easily with visual programming tools.
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# Object-Oriented Programming Languages (cont'd.)

## ▶ JAVA

- An object-oriented language similar to C++ that eliminates lots of C++'s problematic features
- Allows a web page developer to create programs for applications, called **applets** that can be used through a browser.
- Objective of JAVA developers is that it be machine, platform and operating system independent.

# Special Programming Languages

- ▶ Scripting Languages
    - JavaScript and VBScript
    - Php and ASP
    - Perl and Python
  - ▶ Command Languages
    - sh, csh, bash
  - ▶ Text processing Languages
    - LaTeX, PostScript
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# Special Programming Languages (cont'd.)

## ► HTML


- HyperText Markup Language.
- Used on the Internet and the World Wide Web (WWW).
- Web page developer puts brief codes called **tags** in the page to indicate how the page should be formatted.

# Special Programming Languages (cont'd.)

- ▶ XML

- Extensible Markup Language.
- A language for defining other languages.

# A language is a language is a language

- ▶ Programming languages are languages
  - ▶ When it comes to mechanics of the task, learning to speak and use a programming language is in many ways like learning to speak a human language
  - ▶ In both kind of languages you have to learn new vocabulary, syntax and semantics (new words, sentence structure and meaning)
  - ▶ And both kind of language require considerable practice to make perfect.
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# But there is a difference!

- ▶ Computer languages lack ambiguity and vagueness
- ▶ In English sentences such as *I saw the man with a telescope* (Who had the telescope?) or *Take a pinch of salt* (How much is a pinch?)
- ▶ In a programming language a sentence either means one thing or it means nothing

# What determines a “good” language

- ▶ Formerly: Run-time performance
  - (Computers were more expensive than programmers)
- ▶ Now: Life cycle (human) cost is more important
  - Ease of designing, coding
  - Debugging
  - Maintenance
  - Reusability
- ▶ FADS



# Criteria in a good language design

- ▶ **Writability:** The quality of a language that enables a programmer to use it to express a computation clearly, correctly, concisely, and quickly.
- ▶ **Readability:** The quality of a language that enables a programmer to understand and comprehend the nature of a computation easily and accurately.
- ▶ **Orthogonality:** The quality of a language that features provided have as few restrictions as possible and be combinable in any meaningful way.
- ▶ **Reliability:** The quality of a language that assures a program will not behave in unexpected or disastrous ways during execution.
- ▶ **Maintainability:** The quality of a language that eases errors can be found and corrected and new features added.



# Criteria (Continued)

- ▶ **Generality:** The quality of a language that avoids special cases in the availability or use of constructs and by combining closely related constructs into a single more general one.
- ▶ **Uniformity:** The quality of a language that similar features should look similar and behave similar.
- ▶ **Extensibility:** The quality of a language that provides some general mechanism for the user to add new constructs to a language.
- ▶ **Standardability:** The quality of a language that allows programs written to be transported from one computer to another without significant change in language structure.
- ▶ **Implementability:** The quality of a language that provides a translator or interpreter can be written. This can address to complexity of the language definition.