Resume : Programming Language

Sylvain Julmy

May 31, 2018

1 Introduction

> **What is a Programming Language ?**
>
> A programming language is a notational system for describing computation in a machine-readable and human-readable form.
> - Louden

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

Generations of programming languages (higher level of abstraction at each level):

- 1GL : machine codes

- 2GL : symbolic assemblers

- 3GL : (machine-independent) imperative languages

- 4GL : domain specific application generators

- 5GL : AI languages ...

Programming languages differ on

- **Common constructs** : basic data types (numbers, etc.); variables; expressions; statements; keywords; control constructs; procedures; comments; errors ...

- **Uncommon constructs** : type declarations; special types (strings, arrays, matrices, ...); sequential execution; concurrency constructs; packages/modules; objects; general functions; generics; modifiable state; ...

A programming language is a problem solving tool and different paradigm are good at something :

- **Imperative style** : $program = algorithms + data$ good for decomposition.

- **Functional style** : $program = functions \circ functions$ good for reasoning.

- **Logic programming style** : $program = facts + rules$ good for searching.

- **Object-oriented style** : $program = objects + messages$ good for modeling.

What exactly is a programming language ?

A programming language is a tool used to describe and solve problems in a human and computer readable format.

How do compilers and interpreters differ ?

- A complier converts the high level instruction into machine language while an interpreter converts the high level instruction into an intermediate form.

- Before execution, entire program is executed by the compiler whereas after translating the first line, an interpreter then executes it and so on.

- List of errors is created by the compiler after the compilation process while an interpreter stops translating after the first error.

- An independent executable file is created by the compiler whereas interpreter is required by an interpreted program each time.

Why was FORTRAN developed ?

To write programs in conventional mathematical notation, and generate code comparable to good assembly programs. Most effort spent on code generation and optimization, its easy to learn and promoted by IMB. Innovations :

- Symbolic notation for subroutines and functions

- Assignments to variables of complex expressions

- DO loops

- Comments

- Input/output formats

- Machine-independence

What were the main achievements of ALGOL 60?

- BNF (Backus-Naur Form) introduced to define syntax (led to syntax-directed compilers)

- First block-structured language; variables with local scope

- Structured control statements

- Recursive procedures

- Variable size arrays

Why do we call C a "Third Generation Language" ?

C is a third generation language because it is completely machine-independent (we can code on a computer and compile it to any architecture we want) and its imperative.

What is a "Fourth Generation Language" ?

A fourth generation language is a language design to solve a very specific (area of) problem(s). Like SQL is to specificaly query database.

Why are there so many programming languages ?

They are a lot of different programming languages because there exists a lot of different problem to solve and each programming language owns advantages and disadvantages to solve some problem or another.

Why are FORTRAN and COBOL still important programming languages ?

A lot of business application are written in FORTRAN and in COBOL, making the move to another language is not easy.

Which language should you use to implement a spelling checker ?

Prolog (DCG)

Which language should you use to implement a filter to translate upper-to-lower case ?

Perl and another scripting language

Which language should you use to implement a theorem prover ?

Haskell or ML-like languages due to is type system.

Which language should you use to implement an address database ?

Object-oriented one and SQL to query it.

Which language should you use to implement an expert system ?

C/C++ or Rust ?

Which language should you use to implement a game server for initiating chess games on the internet ?

Java or OOP language, like Scala.

Which language should you use to implement a user interface for a network chess client ?

TCL or QT, design to build GUI.

2 Stack based programming

> **What is PostScript ?**
>
> is a simple interpretive programming language ... to describe the appearance of text, graphical shapes, and sampled images on printed or displayed pages.
>
> - introduced in 1985 by Adobe
>
> - display standard supported by all major printer vendors
>
> - simple, stack-based programming language
>
> - minimal syntax
>
> - large set of built-in operators
>
> - PostScript programs are usually generated from applications, rather than hand-coded

A PostScript program is a sequence of tokens, representing typed objects, that is interpreted to manipulate the display and four stacks that represent the execution state of a PostScript program:

- **Operand stack** : holds (arbitrary) operands and results of PostScript operators.

- **Dictionnary stack** : holds only dictionaries where keys and values may be stored.

- **Execution stack** : holds executable objects (e.g. procedures) in stages of execution.

- **Graphic state stack** : keeps track of current coordinates etc...

3

4

5

6

7

8

9

10

11

12

13