

## What makes programming languages such an interesting subject?

- The amazing variety
- The intriguing evolution
- The connection to programming practice
- The many other connections

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## Programming Languages

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## Imperative Languages

- Hallmarks of imperative languages:
  - Assignment
  - Iteration
  - Order of execution is critical

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## The amazing variety

- There are very many, very different languages
- (ca 2500)
- Often grouped into four families:
  - •Imperative
  - •Functional
  - •Logic
  - •Object-oriented

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## Object-Oriented Languages

- Hallmarks of object-oriented languages:
  - Usually imperative, plus...
  - Constructs to help programmers use
  - "objects"—little bundles of data that know how
  - to do things to themselves

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## Functional Languages

- Hallmarks of functional languages:
  - No assignment, no side effects
  - Heavy use of recursion: no iterations

### Logic Languages:

Hallmark of logic languages  
•Program expressed as rules in formal logic.

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## No clear winner

- Obviously, there is no best language for all situations. The best language might depend on many things:
  - Type of program
  - Reason the program is built
  - Size of program
  - Programmer familiarity

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## What is the best programming language?

- Java
- Fortran
- Cobol
- C
- C++
- PHP
- Javascript
- C#
- ML
- Prolog

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## Language Standards

- The documents that define language standards are often drafted by international committees
- Can be a slow and complicated process
- Fortran 82 8X 88 90 standard released in 1991

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## Cont..

- Time available
- Cost
- Legacy

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## History of major programming languages

- There are about 2500 languages known.
- A genealogical diagram can be found at [www.levenez.com](http://www.levenez.com)
- Languages change. You cannot keep a favorite language forever. So observing language evolution can be useful.

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## Programming domains

- Scientific applications
- Business applications
- Artificial intelligence
- Scripting languages
- Systems programming
- Internet and Web

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## Cont..

- But:
  - Difficult notation
  - Published very late in 1972
  - Never implemented

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## Plankalkül (1945)

- **Plankalkül (Konrad Zuse)** = calculus for a computing plan
- a language to express computations on Z4
- Has:
  - floating point data types, records, expressions with paranthesis, conditional statements but no else, repetition of statements algorithms for chess on 60 pages

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## Pseudocodes 1949

- Expressions coded, left to right
- Some operations

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## Machine code

- What was wrong with machine code?
  - Poor readability
  - Difficult to modify
  - No hardware with floating point arithmetic, no indexing

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## Cont...

- Most of the calculations were numeric.
- Computers were more expensive than programmers, so no dynamic storage

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## Fortran 1954

- IBM 704 system has floating point instructions in hardware
- FORTRAN = mathematical FORMula TRANslating
  - System – first compiled high level language
  - Promised the efficiency of machine code and the ease of programming of pseudocodes. Almost succeeded. Code was very fast.

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## Cont..

- **Goals:**
  - Close to mathematical notations
  - Good for describing algorithms
  - Must be translatable to machine code

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## ALGOL 58 and ALGOL 60

- **Situation:** Languages were developed around single architecture IBM
  - or UNIVAC, communication was difficult.
  - No universal language
  - No portable language
  - In 1958 ACM (USA) + GAMM (EUR) came together to discuss the design of one international language – compromises about spheres of influence.

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## ALGOL 60

- **New features:** block structure, subprogram recursion, stack dynamic
- memory
- **Success:** standard way to publish algorithms for 20 years
- All imperative languages are based on it.
- First machine independent language
- First language whose syntax was formally defined by BNF grammar **Failure:** Never widely used in USA (lack of support from IBM (Fortran compilers were faster), no I/O, formal syntax description)

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## ALGOL 58

- **Algol 58 features:**
  - Concept of type
  - Names have any length
  - Compound statements
  - Semicolon as separator
  - Assignment operator as :=
  - Else-if clause

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## Time sharing: BASIC 1964

- **BASIC**
  - Easy to learn and use by non science students
  - Supposed to be a liberal arts programming language
  - First widely used with time sharing

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## COBOL

- First language required by DoD (USA department of defence).
- Must look like simple English (managers can read code).
- Still the most widely used business applications language.

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## ADA

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- **Contributions:**

- Packages for data abstraction
- Exceptions handling
- Generic programming units
- Concurrency
- Compilers very difficult

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## SIMULA 67

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- Based on ALGOL 60 for system simulations
- Contributions:
  - coroutines
  - A structure called class
  - Classes are base for data abstraction
  - Classes include data and functionality
  - Objects and inheritance

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## Any Questions?

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## What makes a language successful?

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- Expressive power
- Ease of use for a novice
- Ease of implementation
- Open source
- Excellent compilers
- Economics, patronage and inertia

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