

# Programming Language History and Evolution

In Text: Chapter 2

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## Brief Overview of Paradigms

- Procedural/Imperative
- Functional/Applicative
- Logic
- Object-oriented (closely related to imperative)
- Problem-oriented/application-specific

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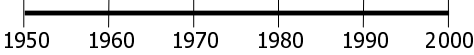
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## An Overview of PL History



1950    1960    1970    1980    1990    2000

- 1950's: Discovery and description
- 1960's: Elaboration and analysis
- 1970's: Technology
- 1980's: New paradigms
- 1990's: Internet influences

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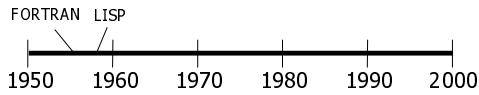
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## 1950's: Discovery and Description



- FORTRAN (54-57, and on and on):
  - First widely used compiled language
  - Relatively efficient
- LISP (56-62):
  - First functional language, first support for recursion, activation records, run-time stack, etc.
  - First garbage collector, implicit dynamic memory mgmt.
  - Interpreter-based

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## Overview: Procedural/Imperative

- Describes **how** the computer should achieve solution
- Key features:
  - Stored memory
  - Mutable variables
  - Sequencing, selection, iteration
  - Pointers?

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## Overview: Functional/Applicative

- Based on mathematics of recursive functions
- Key features:
  - **No** mutable variables
  - Everything is an expression
  - Everything is a function
  - No iteration (loops)
  - Recursion, recursion, recursion!

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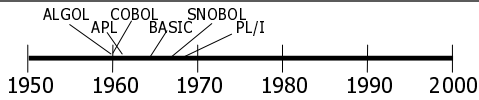
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## 1960's: Elaboration and Analysis



- ALGOL 58, 60: first universal language; introduced: BNF, block structure, call-by-value, stack-based evaluation, stack-based arrays
- APL: applicative, no precedence, interpreted
- COBOL: English-style syntax, file/record structure
- BASIC: interactive time-sharing terminals
- SNOBOL: pattern matching
- PL/I: the kitchen sink

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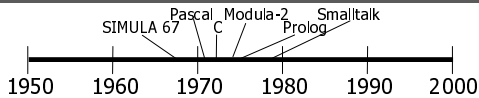
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## 1970's: Technology



- SIMULA 67: classes, inheritance, data abstraction
- Pascal: small, elegant, structured prog., teaching
- C: systems programming, efficiency
- Modula-2: Pascal + modules, better for sys. prog.
- Prolog: first logic language, AI-oriented
- Smalltalk: pure OO, interpreted, entire system

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## Overview: OOP

- Based on procedural/imperative style, with added data+code abstraction & encapsulation
- Key features:
  - Encapsulation
  - Inheritance
  - Polymorphism/dynamic binding

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## Overview: Logic

- Based on predicate logic
- Declarative: describes **what** problem is to be solved, but not how
- Key features:
  - **No** mutable variables
  - "Statements" are logical predicates or assertions
  - Every statement succeeds or fails
  - Few explicit control constructs
  - Recursion, recursion, recursion!
  - Must understand implementation model to use

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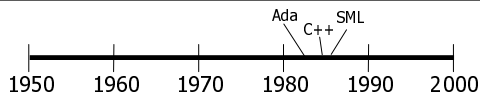
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## 1980's: New Paradigms



- Ada: DoD, long committee-based development, large & complex, packages, tasks, generics, exceptions, from real-time to payroll apps.
- C++: OOP in a popular, widespread language, often seen as a "hybrid"
- Standard ML, Hope, Miranda, Haskell: functional languages

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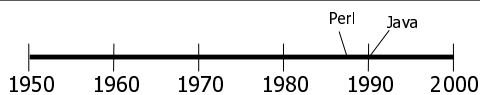
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## 1990's: Internet Influences



- Scripting: Perl, TCL, Visual Basic, JavaScript, Python, ...
- Java: designed for portable binaries and internet use, "clean" OO compared to C++, garbage collection, compiled/interpreted hybrid

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### Recap of Paradigms

- Procedural/Imperative
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### Paradigms: Key Differentiating Factors

- What distinguishes one paradigm from another?

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### Languages: Key Differentiating Factors

- What distinguishes one paradigm from another?

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