History & Evolution of Programming Languages

CMPSC 460 – Principles of Programming Languages

Introduction

1. What is the first high level programming language?

2. Why do we use *i*, *j*, *k*, for integer variable names?

3. What is the first object oriented language?

Fortran

- Programming in the 1950s:
  - Programming is an art
  - Lack of index registers
  - Lack of floating point
  - Primitive input/output instructions

The History of Fortran I, II, and III

Fortran I Example

```
C IA, IB, AND IC MAY NOT BE NEGATIVE
C FURTHERMORE, THE SUM OF TWO SIDES OF A TRIANGLE
C IS GREATER THAN THE THIRD SIDE, SO WE CHECK FOR THAT, TOO
      IF (IA) 777, 777, 701
  701 IF (IB) 777, 777, 702
  702 IF (IC) 777, 777, 703
  703 IF (IA+IB-IC) 777,777,704
  704 IF (IA+IC-IB) 777,777,705
  705 IF (IB+IC-IA) 777,777,799
  777 STOP 1
```

- From: http://en.wikipedia.org/wiki/Fortran

Fortran I Overview

- First implemented version of Fortran
  - Names could have up to six characters
  - No data typing statements
  - Post-test counting loop (**DO**)
  - User-defined subprograms
  - Three-way selection statement (arithmetic **`IF`**)

Fortran 95 Example

```
program Arrays
integer :: ia(4,3)
integer :: x = 1
   do j = 1,3
     do i = 1,4
         ia(i,j) = x * x
         x = x + 1
         print *,ia(i,j)
     enddo
    enddo
end program Arrays
```

Functional Programming: LISP

- LISt Processing language
  - Designed at MIT by John McCarthy
    - Recursive functions of symbolic expressions and their computation by machine, Part I
- AI research needed a language to
  - Process data in lists (rather than arrays)
  - Symbolic computation (rather than numeric)

The First Step Toward Sophistication: ALGOL

- Environment of development
  - Many high level languages were being developed for specific machines
  - No portable language; all were machine-dependent
- ALGOL 58 was the result of:
  - Preliminary report: international algebraic language

ALGOL 60 Overview

- The syntax and semantics of the proposed international algebraic language of the Zurich ACM-GAMM Conference".
- Report on the algorithmic language ALGOL 60
- Revised report on the algorithmic language ALGOL 60

ALGOL 60 - Example

```
comment ALGOL 60
          Example Program  ;
begin
  integer array intlist [1: 99] ;
 integer x, y;
  x := 10;
  y := 5;
  intlist[1] := x /y;
  if (intlist[1] > 0)  ∧ (intlist[1] < 3)  then
    begin
       ...
      end;
else
    ...
end
```

ALGOL 60 Overview

- New features
  - Block structure (local scope)
  - Two parameter passing methods
  - Subprogram recursion
  - Stack-dynamic arrays
  - No I/O and no string handling

ALGOL 60 Design Debates

- Phrase-level control vs label-oriented control:

```
GO TO 27
IF (A-B) 5,6,7

do 10, 14, 50 i=4, 20, 2
```

- Edsgar Dijkstra's famous letter in 1968:
  - "Go to statement considered harmful"

ALGOL 60 Evaluation

- Successes
  - It was the standard way to publish algorithms for over 20 years
  - All subsequent imperative languages are based on it
  - First machine-independent language
  - First language whose syntax was formally defined (BNF)

ALGOL 60 Evaluation (continued)

- Failure
  - Never widely used, especially in U.S.

Computerizing Business Records: COBOL

"Mathematical programs should be written in mathematical notations, data processing programs should be written in English statements."

"The use of COBOL cripples the mind; its teaching should, therefore, be regarded as a criminal offence. "

Edsgar Dijkstra

COBOL - Example

```
IDENTIFICATION DIVISION.
..
ENVIRONMENT DIVISION.
...
DATA DIVISION.
FILE SECTION.
FD  BAL-FWD-FILE
    LABEL RECORDS ARE STANDARD
    RECORD CONTAINS 80 CHARACTERS.
01  BAL-FWD-CARD.
    02 BAL-ITEM-NO         PICTURE IS 9(5) .
    02 BAL-ITEM-DESC       PICTURE IS X(20) .
    02 FILLER              PICTURE IS X(5) .
    02 BAL-UNIT-PRICE      PICTURE IS 999V99.
    02 BAL-REORDER-POINT   PICTURE IS 9(5) .
    02 BAL-ON-HAND         PICTURE IS 9(5) .
    02 BAL-ON-ORDER        PICTURE IS 9(5) .
    02 FILLER              PICTURE IS X(30) .
PROCEDURE DIVISION.
000-PRODUCE-REORDER-LISTING.
    OPEN INPUT BAL-FWD-FILE.
    OPEN OUTPUT REORDER-LISTING.
    PERFORM 120-CALCULATE-AVAILABLE-STOCK
    ...
    CLOSE BAL-FWD-FILE.
    CLOSE REORDER-LISTING.
    STOP RUN.
...
120-CALCULATE-AVAILABLE-STOCK.
ADD BAL-ON-HAND BAL-ON-ORDER
    GIVING AVAILABLE-STOCK.
```

The Beginning of Data Abstraction: SIMULA 67

- Designed by Nygaard and Dahl
- Based on ALGOL 60 and SIMULA I
  - SIMULA 67 common base proposal
- Primary Contributions
  - Coroutines - a kind of subprogram
  - Classes, objects, and inheritance

SIMULA 67 - Example

```
class Point(x,y); real x,y;
        begin
          boolean procedure equals(p); ref(Point) p;
             if p =/= none then
                  equals := abs(x - p.x) + abs(y - p.y) < 0.00001
          real procedure distance(p); ref(Point) p;
             if p == none then error else
                  distance := sqrt(( x - p.x )**2 + (y - p.y) ** 2);
end ***Point***

p :- new Point(1.0, 2.5);
q :- new Point(2.0,3.5);
if p.distance(q) > 2 then ...
```

Programming Based on Logic: Prolog

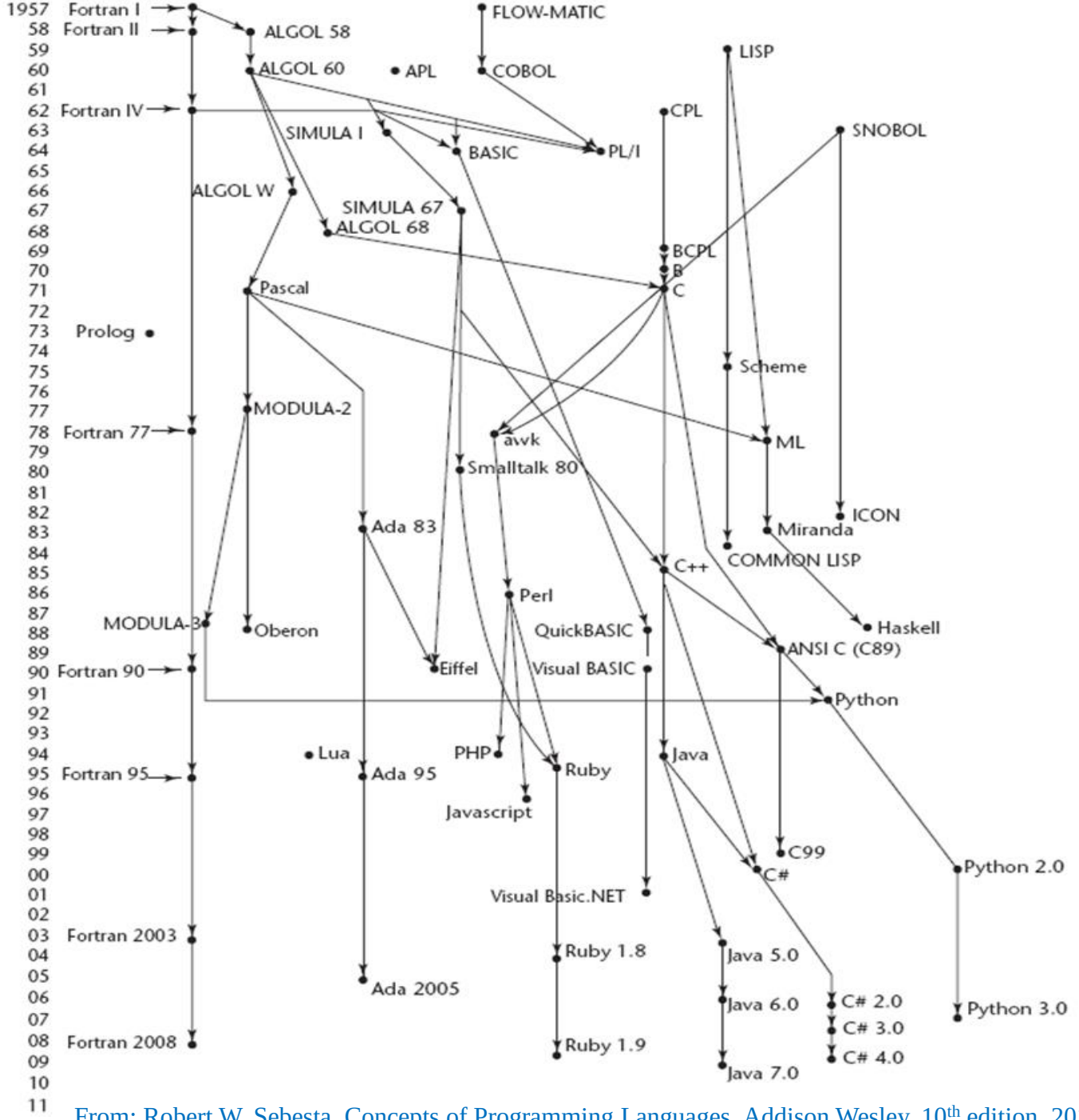
- Developed, by Comerauer, Roussel and Kowalski
  - First interpreter was developed in 1972
- Non-procedural
- Small application areas

History's Largest Design Effort: Ada

- More than 450 programming languages were used in DoD projects.
- Huge design effort, involving hundreds of people, much money, and about eight years
- First published in 1979:

Ada Evaluation

- Contributions
  - Packages - support for data abstraction
  - Exception handling - elaborate
  - Generic program units
  - Concurrency - through the tasking model



From: Robert W. Sebesta, Concepts of Programming Languages, Addison Wesley, 10th edition, 2012

References

- Michael L. Scott, Programming Language Pragmatics, Morgan Kaufmann, 3rd edition, 2009.
- Robert W. Sebesta, Concepts of Programming Languages, Addison Wesley, 10th edition, 2012
- Adam Brooks Webber, Modern Programming Languages, Franklin, Beedle & Associates Inc., 2nd edition, 2010.