CS 421 Lecture 14: History of programming languages

- Announcements

- Lecture outline
  - Language paradigms
  - Lineage
  - PL examples

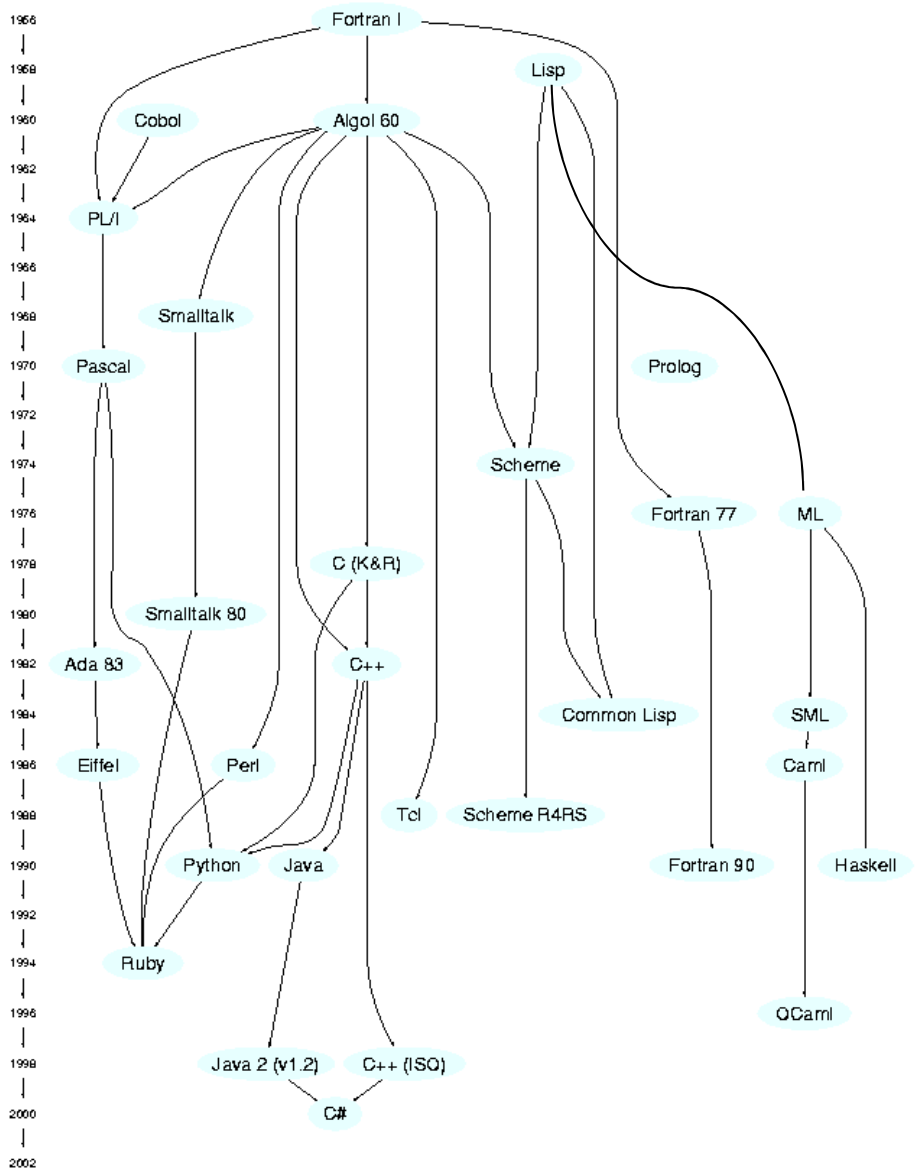
Announcements

- No midterm discussion (yet)
- Unit project
  - Information posted on the web site
  - Only for grad students taking 4 credit hours
  - Initial proposal due next Monday

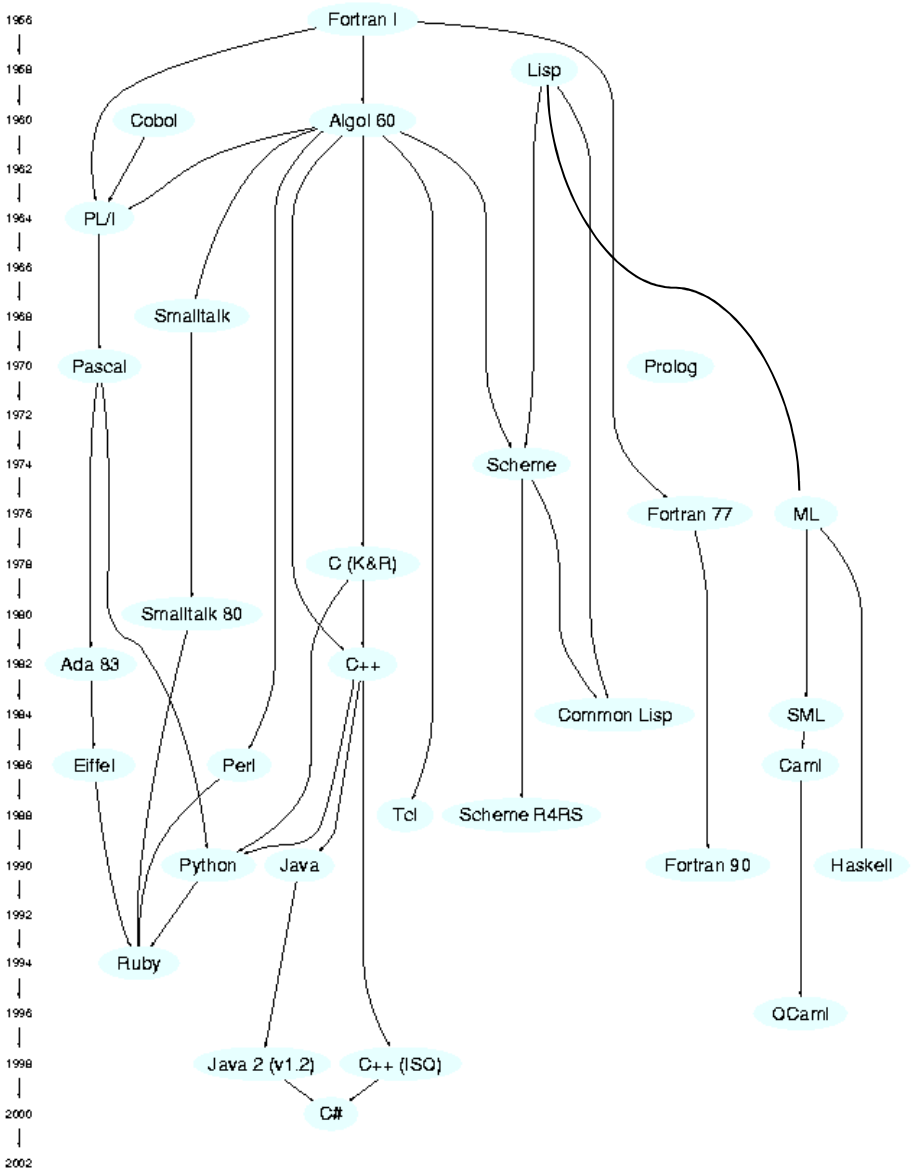
Language paradigms

- *Imperative programming* – execute small steps in sequence
  - *Object-oriented programming* – encapsulate functions into packages containing data and operations
- *Functional programming* – evaluate expressions instead of executing commands
  - *Lazy evaluation* – don't evaluate until needed
- *Logic programming* – specify solution in logic

History of programming languages



History of programming languages



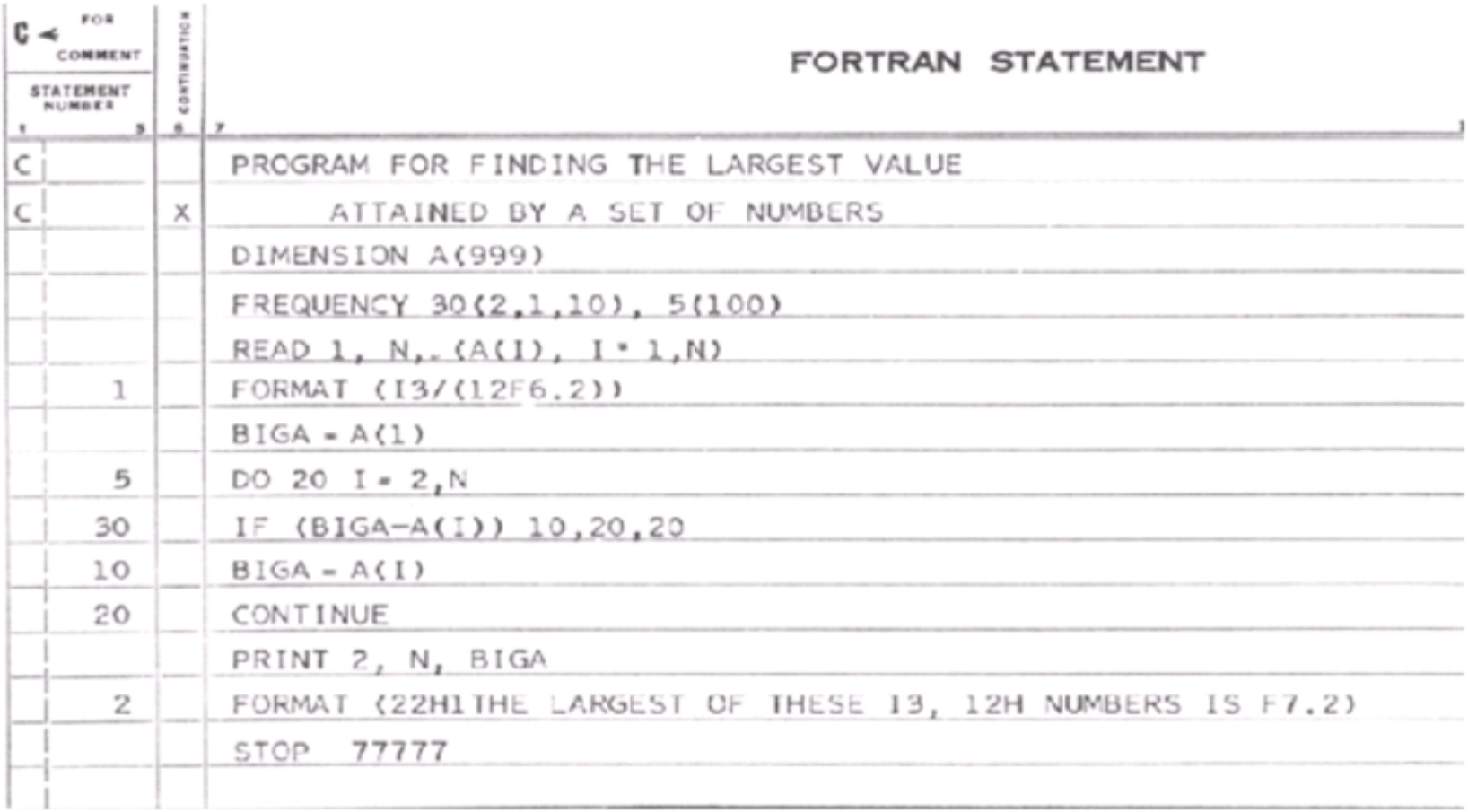
Main line

Functional

O-O

Fortran

- 1957 – John Backus – IBM 704



C ← FOR COMMENT	STATEMENT NUMBER	CONTINUATION	FORTRAN STATEMENT
C			PROGRAM FOR FINDING THE LARGEST VALUE
C		X	ATTAINED BY A SET OF NUMBERS
			DIMENSION A(999)
			FREQUENCY 30(2,1,10), 5(100)
			READ 1, N,.(A(I), I = 1,N)
	1		FORMAT (I3/(12F6.2))
			BIGA = A(1)
	5		DO 20 I = 2,N
	30		IF (BIGA-A(I)) 10,20,20
	10		BIGA = A(I)
	20		CONTINUE
			PRINT 2, N, BIGA
	2		FORMAT (22H1THE LARGEST OF THESE I3, 12H NUMBERS IS F7.2)
			STOP 77777

Fortran IV

```
C AREA OF A TRIANGLE - HERON'S FORMULA
C INPUT - CARD READER UNIT 5, INTEGER INPUT, ONE BLANK CARD FOR END-OF-DATA
C OUTPUT - LINE PRINTER UNIT 6, REAL OUTPUT
C INPUT ERROR DISPAY ERROR MESSAGE ON OUTPUT
  501 FORMAT(3I5)
  601 FORMAT(4H A= ,I5,5H  B= ,I5,5H  C= ,I5,8H  AREA= ,F10.2,12HSQUARE UNITS)
  602 FORMAT(10HNORMAL END)
  603 FORMAT(23HINPUT ERROR, ZERO VALUE)
      INTEGER A,B,C
   10 READ(5,501) A,B,C
      IF(A.EQ.0 .AND. B.AND.0 .OR. C.AND.0) GO TO 50
      IF(A.EQ.0 .OR. B.EQ.0 .OR. C.EQ.0) GO TO 90
      S = (A + B + C) / 2.0
      AREA = SQRT( S * (S - A) * (S - B) * (S - C))
      WRITE(6,601) A,B,C,AREA
      GO TO 10
   50 WRITE(6,602)
      STOP
   90 WRITE(6,603)
      STOP
      END
```

COBOL

```
      $ SET SOURCEFORMAT"FREE"
IDENTIFICATION DIVISION.
PROGRAM-ID.  Iteration-If.
AUTHOR.  Michael Coughlan.

DATA DIVISION.
WORKING-STORAGE SECTION.
01  Num1            PIC 9  VALUE ZEROS.
01  Num2            PIC 9  VALUE ZEROS.
01  Result          PIC 99 VALUE ZEROS.
01  Operator        PIC X  VALUE SPACE.

PROCEDURE DIVISION.
Calculator.
    PERFORM 3 TIMES
       DISPLAY "Enter First Number      : " WITH NO ADVANCING
       ACCEPT Num1
       DISPLAY "Enter Second Number     : " WITH NO ADVANCING
       ACCEPT Num2
       DISPLAY "Enter operator (+ or *) : " WITH NO ADVANCING
       ACCEPT Operator
       IF Operator = "+" THEN
          ADD Num1, Num2 GIVING Result
       END-IF
       IF Operator = "*" THEN
          MULTIPLY Num1 BY Num2 GIVING Result
       END-IF
       DISPLAY "Result is = ", Result
    END-PERFORM.
    STOP RUN.
```

ALGOL 60

```
procedure Absmax(a) Size:(n, m) Result:(y) Subscripts:(i, k);
    value n, m; array a; integer n, m, i, k; real y;
comment The absolute greatest element of the matrix a, of size n by m
is transferred to y, and the subscripts of this element to i and k;
begin integer p, q;
    y := 0; i := k := 1;
    for p:=1 step 1 until n do
    for q:=1 step 1 until m do
        if abs(a[p, q]) > y then
            begin y := abs(a[p, q]);
            i := p; k := q
            end
end Absmax
```

PL/1

```
FINDSTRINGS: PROCEDURE OPTIONS(MAIN)
  /* READ A STRING, THEN PRINT EVERY */
  /* SUBSEQUENT LINE WITH A MATCH */

  DECLARE PAT VARYING CHARACTER(100),
          LINEBUF VARYING CHARACTER(100),
          (LINENO, NDFILE, IX) FIXED BINARY;

  NDFILE = 0; ON ENDFILE(SYSIN) NDFILE=1;
  GET EDIT(PAT) (A);
  LINENO = 1;
  DO WHILE (NDFILE=0);
    GET EDIT(LINEBUF) (A);
    IF LENGTH(LINEBUF) > 0 THEN DO;
      IX = INDEX(LINEBUF, PAT);
      IF IX > 0 THEN DO;
        PUT SKIP EDIT (LINENO,LINEBUF)(F(2),A)
      END;
    END;
    LINENO = LINENO + 1;
  END;
  END FINDSTRINGS;
```

Pascal

```
  { EXAMPLES.PAS }
  { A set of examples to demonstrate features of Extended Pascal }

  { Prospero Software, January 1993 }

  {  ----------------------------------------  }

PROGRAM strings1 (output);

  { Extended Pascal examples }
  { Variable length strings and substrings }

VAR a,b: string(20);  { a,b have capacity 20 }
    n: 1..10;

BEGIN
  a := '1234567890';
  FOR n := 1 TO 10 DO
      writeln(a[1..n],'.',substr(a,n+1));
    { The indexed string yields characters 1 to n of string a; }
    { function substr takes the remaining characters }
  a := 'The quick brown fox';
  b := 'the lazy dog.';
  writeln(a+' jumps over '+b);
    { + operator concatenates strings }
  a[5..6] := 'sl';
  b[5..6] := 'do';
  writeln(a,' laughs at ',b);
END.
```

SIMULA 67

```
Class Rectangle (Width, Height); Real Width, Height;
                                ! Class with two parameters;
 Begin
    Real Area, Perimeter;   ! Attributes;

    Procedure Update;       ! Methods (Can be Virtual);
    Begin
      Area := Width * Height;
      Perimeter := 2*(Width + Height)
    End of Update;

    Boolean Procedure IsSquare;
      IsSquare := Width=Height;

    Update;                 ! Life of rectangle started at creation;
    OutText("Rectangle created: "); OutFix(Width,2,6);
    OutFix(Height,2,6); OutImage
 End of Rectangle;
```

Smalltalk

```
Class Primes Object primeGenerator lastFactor
Methods Primes 'all'
        " Usage
                >       p<-Prime new
                >       p first
                >       p next
                >       ..."
        first
                primeGenerator <- ( 2 to: 100 ).
                lastFactor <- (primeGenerator first).
                ^ lastFactor
|
        next    |myFilter|
                myFilter <- ( FactorFilter new).
                primeGenerator <- ( myFilter
                                        remove: lastFactor
                                        from: primeGenerator ).
                lastFactor <- (primeGenerator next).
                ^ lastFactor
!
```

Objective C

```
#import <stdio.h>
#import "Fraction.h"

int main( int argc, const char *argv[] ) {
    // create a new instance
    Fraction *frac = [[Fraction alloc] init];

    // set the values
    [frac setNumerator: 1];
    [frac setDenominator: 3];

    // print it
    printf( "The fraction is: " );
    [frac print];
    printf( "\n" );

    // free memory
    [frac release];

    return 0;
}
```

APL

```
PRIMES : (~R∈R∘.×R)/R←1↓⍳R
```

Haskell

```
fac 0     = 1
fac (n+1) = (n+1)*fac(n)

reverse [] = []
reverse (a:x) = reverse x ++ [a]

qsort [] = []
qsort (x:xs) = qsort (filter (< x) xs) ++ [x] ++ qsort (filter (>= x) xs)
```

PROLOG

```
quick_sort([],[]).
quick_sort([H|T],Sorted):-
        pivoting(H,T,L1,L2),
        quick_sort(L1,Sorted1),
        quick_sort(L2,Sorted2),
        append(Sorted1,[H|Sorted2]).

pivoting(H,[],[],[]).
pivoting(H,[X|T],[X|L],G):-X=<H,pivoting(H,T,L,G).
pivoting(H,[X|T],L,[X|G]):-X>H,pivoting(H,T,L,G).
```