CS 365 — Programming Language Concepts

The History of Programming Languages

Jan 11 and 13, 2010

The Lambda Calculus

$$\lambda m.\lambda n.\lambda z.\lambda s.m(nzs)s$$

Plankalkül

```
P1 max3 (V0[:8.0],V1[:8.0],V2[:8.0]) => R0[:8.0]
max(V0[:8.0],V1[:8.0]) => Z1[:8.0]
max(Z1[:8.0],V2[:8.0]) => R0[:8.0]
END

P2 max (V0[:8.0],V1[:8.0]) => R0[:8.0]
V0[:8.0] => Z1[:8.0]
(Z1[:8.0] < V1[:8.0]) -> V1[:8.0] => Z1[:8.0]
Z1[:8.0] => R0[:8.0]
END
```

Rojas et al, http://www.zib.de/zuse/Inhalt/Programme/Plankalkuel/Plankalkuel-Report/Plankalkuel-Report.htm

UNIVAC Short Code

```
X3 = (X1+Y1)/X1*Y1
X3 03 09 X1 07 Y1 02 04 X1 Y1
07Y10204X1Y1
0000X30309X1
```

http://en.wikipedia.org/wiki/Short_Code_(Computer_language)

FORTRAN

```
REAL SUM6,SUM7,SUM8,DIF6,DIF7,DIF8,SUMINF
*
OPEN(6,FILE='PRN')
SUM6=.9*(1.-0.1**6)/0.9
SUM7=.9*(1.-0.1**7)/0.9
SUM8=.9*(1.-0.1**8)/0.9
SUMINF=0.9/(1.0-0.1)
DIF6 = SUMINF - SUM6
DIF7 = SUMINF - SUM7
DIF8 = SUMINF - SUM8
WRITE(6,*) 'INFINITE SUM = ', SUMINF
WRITE(6,*) 'SUM6 = ', SUM6, '    INFINITE SUM - SUM6 = ', DIF6
WRITE(6,*) 'SUM7 = ', SUM7, '    INFINITE SUM - SUM7 = ', DIF7
WRITE(6,*) 'SUM8 = ', SUM8, '    INFINITE SUM - SUM8 = ', DIF8
STOP
END
```

http://www.engin.umd.umich.edu/CIS/course.des/cis400/fortran/Fortran_Example2.html

Fortran 77

```
      PROGRAM TPK
       REAL A(0:10)
      READ (5,*) A
      DO 10 I = 10, 0, -1
              Y = FUN(A(I))
              IF ( Y . LT. 400) THEN
                      WRITE(6,9) I,Y
 9                    FORMAT(I10. F12.6)
              ELSE
                      WRITE (6,5) I
 5                    FORMAT(I10,' TOO LARGE')
              ENDIF
10    CONTINUE
      END
      REAL FUNCTION FUN(T)
      REAL T
      FUN = SQRT(ABS(T)) + 5.0*T**3
      END
```

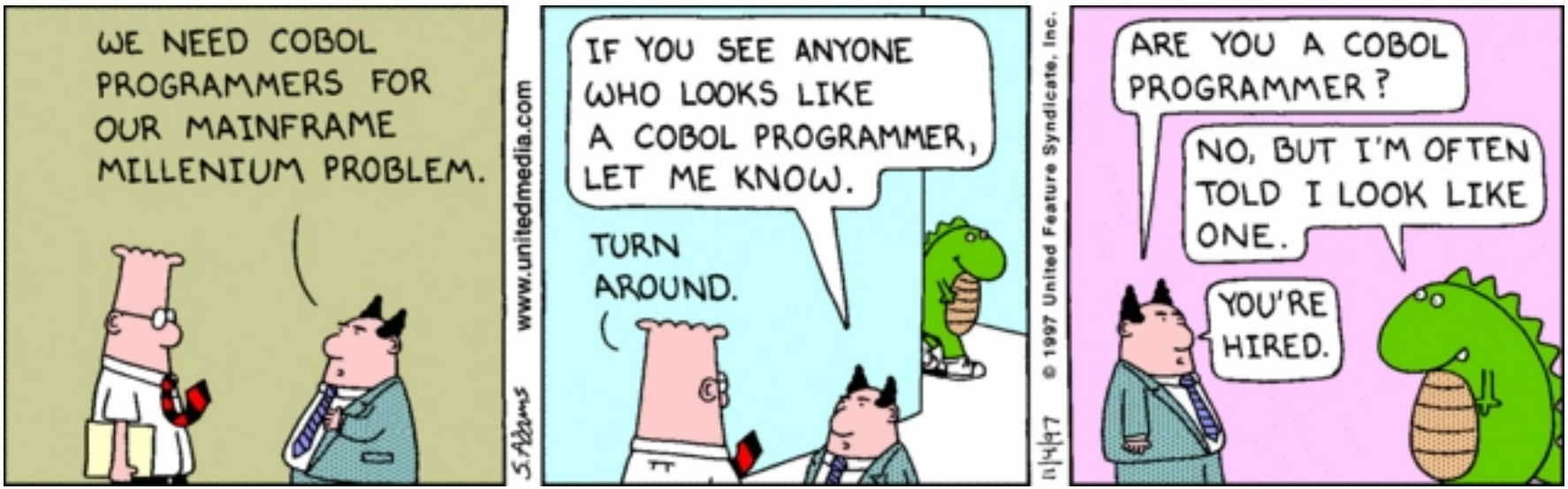
http://www.nsc.liu.se/ boein/f77to90/a7.html

COBOL

```
000100 ID DIVISION.
000200 PROGRAM-ID.  ACCEPT1.
000300 DATA DIVISION.
000400 WORKING-STORAGE  SECTION.
000500 01  WS-FIRST-NUMBER      PIC 9(3).
000600 01  WS-SECOND-NUMBER     PIC 9(3).
000700 01  WS-TOTAL             PIC ZZZ9.
000800*
000900 PROCEDURE DIVISION.
001000 0000-MAINLINE.
001100     DISPLAY 'ENTER A NUMBER: '.
001200     ACCEPT WS-FIRST-NUMBER.
001300*
001400     DISPLAY 'ANOTHER NUMBER: '.
001500     ACCEPT WS-SECOND-NUMBER.
001600*
001700     COMPUTE WS-TOTAL = WS-FIRST-NUMBER + WS-SECOND-NUMBER.
001800     DISPLAY 'THE TOTAL IS: ', WS-TOTAL.
001900     STOP RUN.
```

http://www.engin.umd.umich.edu/CIS/course.des/cis400/cobol/seccob.html

COBOL



Scott Adams, 1997

ALGOL

```
begin
  integer N;
  Read Int(N);

  begin
    real array Data[1:N];
    real sum, avg;
    integer i;
    sum:=0;

    for i:=1 step 1 until N do
      begin real val;
        Read Real(val);
        Data[i]:=if val<0 then -val else val
      end;

    for i:=1 step 1 until N do
      sum:=sum + Data[i];
    avg:=sum/N;
    Print Real(avg)
  end
end
```

http://www.engin.umd.umich.edu/CIS/course.des/cis400/algol/average.htm

LISP

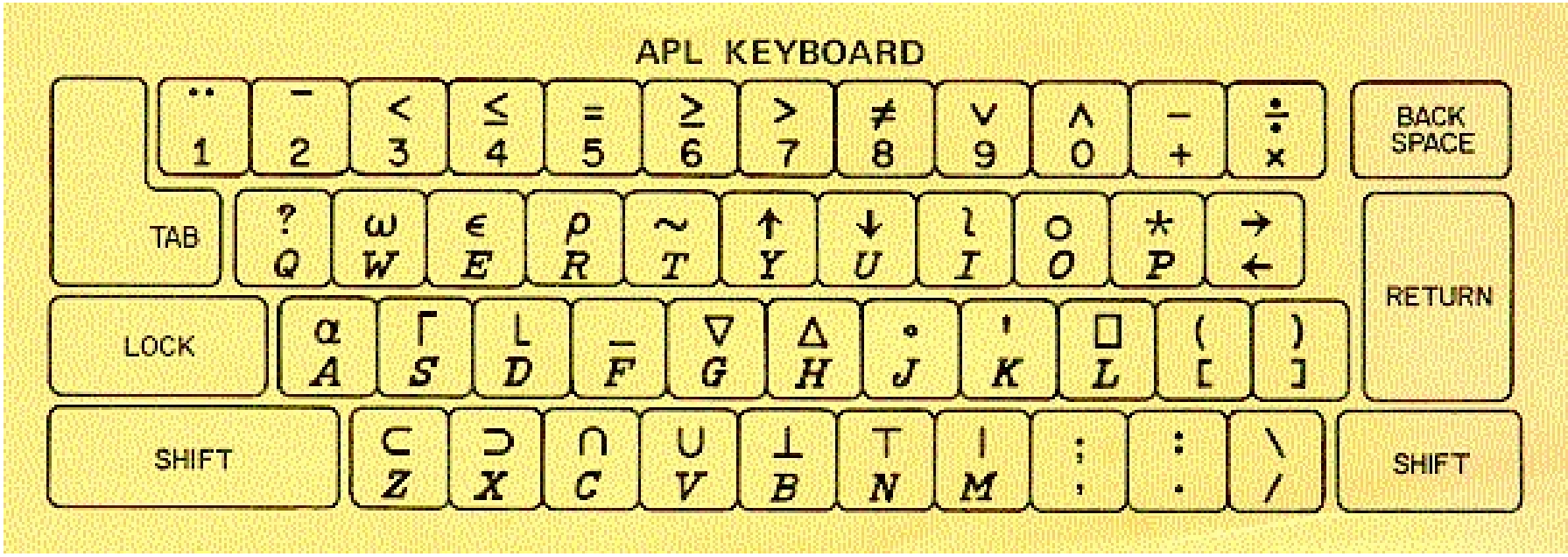
```
(defun convert ()
(format t "Enter Fahrenheit ")
  (LET (fahr)
    (SETQ fahr (read fahr))
    (APPEND '(celsisus is) (*(- fahr 32)(/ 5 9)) )
  )
)
```

http://www.engin.umd.umich.edu/CIS/course.des/cis400/lisp/convert.html

LISP

http://deskthority.net/viewtopic.php?f=2&t=98

APL



http://www.rexswain.com/aplinfo.html

```
X[⍋X+.≠' ';]
```

```
life←{↑1 ⍵∨.∧3 4=+/,¯1 0 1∘.⊖¯1 0 1∘.⌽⊂⍵}
```

http://en.wikipedia.org/wiki/APL_(programming_language)

SNOBOL

```
        &TRIM         =         1
        WORDPAT       =         BREAK(&LCASE &UCASE) SPAN(&LCASE &UCASE "'-") . W
        COUNT         =         ARRAY('3:9',0)
READ    LINE          =        INPUT                                  :F(DONE)
NEXTW   LINE WORDPAT  =                                              :F(READ)
        COUNT<SIZE(WORD)> = COUNT<SIZE(WORD)>+ 1          :(NEXTW)
DONE    OUTPUT         =          "WORD LENGTH     NUMBER OF OCCURRENCES"
        I         =         2
PRINT   I         =         I + 1
        OUTPUT         =          LPAD(I,5) LPAD(COUNT<I>,20)         :S(PRINT)

END
```

http://www.engin.umd.umich.edu/CIS/course.des/cis400/snobol/word.html

BASIC

```
10 INPUT "ENTER TWO NUMBERS SEPARATED BY A COMMA:
20 LET S = N1 + N2
30 LET D = N1 - N2
40 LET P = N1 * N2
50 LET Q = N1 / N2
60 PRINT "THE SUM IS ", S
70 PRINT "THE DIFFERENCE IS ", D
80 PRINT "THE PRODUCT IS ", P
90 PRINT "THE QUOTIENT IS ", Q
100 END
```

http://www.engin.umd.umich.edu/CIS/course.des/cis400/basic/mathoper.htm

LOGO

```
FORWARD 100 ; draws a square with sides 100 units long
LEFT 90
FORWARD 100
LEFT 90
FORWARD 100
LEFT 90
FORWARD 100
LEFT 90
```

http://en.wikipedia.org/wiki/Logo_(programming_language)

Forth

```
0 CONSTANT ${
: ->$$  CELLS + CELL+ @ COUNT ; ( addr ix -- 'strings )
: }$ CREATE  ( addr*u u -- )    DUP , 0 ?DO , LOOP
DOES>   ( ix -- c-addr u ) DUP @ 1- ROT -  ->$$ ;
: }s$ CREATE  ( addr*u u -- )    DUP 3 / , 0 ?DO , LOOP
DOES>   ( ix -- c-addr u ) DUP @ 1- ROT -  3 *  3 CHOOSE +  ->$$ ;
: }r$ CREATE  ( addr*u u -- )    DUP , 0 ?DO , LOOP
DOES>   ( -- c-addr u )    DUP @ CHOOSE  ->$$ ;
S" phrases.forth" INCLUDED
' filler >BODY @ CONSTANT #phrases
' intros >BODY @ CONSTANT #intros
: Split-At-Char  ( addr1 n1 char -- addr2+n2 n1-n2 addr2 n2 )
LOCALS| ch |
ch SKIP
2DUP  ch SCAN  TUCK 2>R - 2R>  2SWAP ;
: CR'        CR  0 linecount ! ;
: SPACE'     linecount @ IF  SPACE  1 linecount +!  THEN ;
: TYPE'      DUP linecount +!  TYPE ; ( char -- )
: -FITS?     linecount @ +  RMARGIN > ; ( #chars -- TRUE=fits-on-this-line )
: ANOTHER?  DUP ; ( #chars -- TRUE=string-not-empty )
```

http://www.forth.com/starting-forth/sf12/wordgame.forth

Lucid

```
prime
  where
     prime = 2 fby (n whenever isprime(n));
     n = 3 fby n+2;
     isprime(n) = not(divs) asa divs or prime*prime > N
                        where
                          N is current n;
                          divs = N mod prime eq 0;
                        end;
  end
```

http://en.wikipedia.org/wiki/Lucid_(programming_language)

Prolog

```
gcd(A,B,GCD) :- A = B, GCD = A.
gcd(A,B,GCD) :- A < B, NB is B - A, gcd(A,NB,GCD).
gcd(A,B,GCD) :- A > B, NA is A - B, gcd(NA,B,GCD).

fib(0,1).
fib(1,1).
fib(N,F) :- N > 1, N1 is N - 1, N2 is N - 2,
    fib(N1,F1), fib(N2,F2), F is F1 + F2.

ack(0,N,A) :- A is N + 1.
ack(M1,0,A) :- M > 0, M is M - 1, ack(M,1,A).
ack(M1,N1,A) :- M1 > 0, N1 > 0, M is M - 1, N is N - 1,
   ack(M1,N,A1), ack(M,A1,A).
```

http://cs.wwc.edu/KU/PR/Prolog.html

PL/I

```
BUBBLE:   PROCEDURE(ARRAY,N); /* BUBBLE SORT*/
          DECLARE (I,J) FIXED BIN(15);
          DECLARE S BIT(1);          /* SWITCH */
          DECLARE Y FIXED BIN(15); /* TEMPO */
          DO I = N-1 BY -1 TO 1;
            S = '1'B;
            DO J = 1 TO I;
              IF X(J)>X(J+1) THEN DO;
                S = '0'B;
                Y = X(J);
                X(J) = X(J+1);
                X(J+1) = Y;
                END;
              END;
            IF S THEN RETURN;
            END;
          RETURN;
          END SRT;
```

http://www.engin.umd.umich.edu/CIS/course.des/cis400/pl1/pl1bubble.html

Pascal

```
program ArithFunc;

  const
    Sentinel =0.0;
  var
    X:Real;
begin
   writeln('After each line enter a real number or 0.0 to stop');
   writeln;
   writeln('X', 'Trunc(x)' :16, 'Round(X)' :10, 'Abs(X)' :10,
           'Sqr(X)' :10, 'Sqrt(Abs(X))' :15);
   readln (X);
   while X <> Sentinel do
     begin
       writeln (Trunc(X) :17, Round(X) :10, Abs(X) :10:2,
                 Sqr(x) :10:2, Sqrt(Abs(X)) :10:2);
       readln(X);
     end
end.
```

http://www.engin.umd.umich.edu/CIS/course.des/cis400/pascal/arithmetic.

Ada

```
package body ArrayCalc is
        function sum return integer is
                temp: integer;
        -- Body of function sum
                begin
                temp := 0;
                for i in 1..v.sz loop
                        temp := temp + v.val(i);
                        end loop;
                        v.sz:=0;
                        return temp;
                        end sum;
                procedure setval(arg:in integer) is
                        begin
                        v.sz:= v.sz+1;
                        v.val(v.sz):=arg;
                        end setval; end;
```

http://www.engin.umd.umich.edu/CIS/course.des/cis400/ada/array_summatio

BCPL

```
// Routine to compute a checksum of a
// named file, simplified from a compiler example.
GET "libhdr"

LET start() = VALOF
  $( LET args      = VEC 50
     LET instream  = 0
     LET outstream = 0
     LET sum       = 314159

     IF rdargs("FROM/A,TO/K", args, 50) = 0 DO
     $( writes("Bad arguments for CHECKSUM*n")
        RESULTIS 20
     $)

     instream := findinput(args!0)
     IF instream = 0 DO $( writef("can't open %s*n", args!0)
                           RESULTIS 20
                        $)
     selectinput(instream)
```

http://cgibin.erols.com/ziring/cgi-bin/cep/cep.pl?_alpha=b

B

```
printn(n,b) {
        extrn putchar;
        auto a;

        if(a=n/b) /* assignment, not test for equality */
                printn(a, b); /* recursive */
        putchar(n%b + '0');
}
```

http://en.wikipedia.org/wiki/B_(programming_language)

Simula

```
BEGIN INTEGER X, N, SUM, MAX;

IF LASTITEM THEN OUTTEXT ("NULL LIST") ELSE
BEGIN SUM:=MAX:=ININT;
N:=1;

WHILE  LASTITEM DC
BEGIN X:=ININT;
N:=N+1;
IF X > MAX THEN MAX:=X;
SUM:=SUM+X;
END;
OUTTEXT("LIST LENGTH = ");      OUTINT (N, 6);
OUTTEXT(",            HIGHEST = ");     OUTINT (MAX, 6);
OUTTEXT(",      AVERAGE = ");   OUTFIX (SUM/N, 2,, 8);

END;
OUTIMAGE;
END
```

http://www.engin.umd.umich.edu/CIS/course.des/cis400/simula/f1.html

Smalltalk

```
|scfk|
f := Array new: 26.
s := Prompter prompt: 'Enter line'
default: ''.
1 to: 26 do [:i | f at: i put: 0].
1 to: s size do: [:i |
c := (s at: i) asLowerCase.
c isLetter
ifTrue: [
k := c asciiValue - &a asciiValue + 1
]
].
^f
```

http://www.engin.umd.umich.edu/CIS/course.des/cis400/smalltalk/freq.htm

Humor

Eternal Flame by Bob Kanefsky

(Parody on *God lives on Terra* by Julia Ecklar)

I was taught assembler
in my second year of school.
It's kinda like construction work –
with a toothpick for a tool.
So when I made my senior year,
I threw my code away,
And learned the way to program
that I still prefer today.

Humor

Now, some folks on the Internet
put their faith in C++.
They swear that it's so powerful,
it's what God used for us.
And maybe it lets mortals dredge
their objects from the C.
But I think that explains
why only God can make a tree.

Humor

For God wrote in Lisp code
When he filled the leaves with green.
The fractal flowers and recursive roots:
The most lovely hack I've seen.
And when I ponder snowflakes,
never finding two the same,
I know God likes a language
with its own four-letter name.

Humor

Now, I've used a SUN under Unix,
so I've seen what C can hold.
I've surfed for Perls, found what Fortran's for,
Got that Java stuff down cold.
Though the chance that I'd write COBOL code
is a SNOBOL's chance in Hell.
And I basically hate hieroglyphs,
so I won't use APL.

Humor

Now, God must know all these languages,
and a few I haven't named.
But the Lord made sure, when each sparrow falls,
that its flesh will be reclaimed.
And the Lord could not count grains of sand
with a 32-bit word.
Who knows where we would go to
if Lisp weren't what he preferred?

Humor

And God wrote in Lisp code
Every creature great and small.
Don't search the disk drive for man.c,
When the listing's on the wall.
And when I watch the lightning burn
Unbelievers to a crisp,
I know God had six days to work,
So he wrote it all in Lisp.

Yes, God had a deadline.
So he wrote it all in Lisp.

Are programming languages languages?

In some universities, the systems used [to program computers] (BASIC, PASCAL, LISP, etc), metaphorically referred to as "programming languages," can now be substituted for the study of French, German, or Russian, the faster to make the students computer literate. These are not, of course, languages at all; they are coding systems.

Theodore Roszak, "Computers and Reason"

Are programming languages languages?

The typical person's understanding of the language he uses, however, is not so profound as to prevent him from labeling someting as a language that might resemble one only superficially. Thus, it is not surprising that the systems of notation which we use to communicate with our compuers came to be known as "programming languages." In fact, the very first programmer, Lady Lovelace, seems to have had the idea of a programming language as early as 1846...

In view of the venerable past of the programming language concept, it would be pedantic to attempt to demonstrate that programming languages are not "real" languages. Languages are what they say they are, and we ar perfectly entitiled to include systems of communication between man and computer under the same rubric as systems of communication between man and man or beast and beast.

Gerald Weinberg, The Psychology of Computer Programming