

CS 365 — Programming Language Concepts

The History of Programming Languages

March 5 and 7, 2014

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_\(Computer_language\)](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
      FORMAT(I10. F12.6)
    ELSE
      WRITE (6,5) I
      FORMAT(I10,' TOO LARGE')
    ENDIF
  CONTINUE
END
REAL FUNCTION FUN(T)
REAL T
FUN = SQRT(ABS(T)) + 5.0*T**3
END
```

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.
```

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

LISP

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

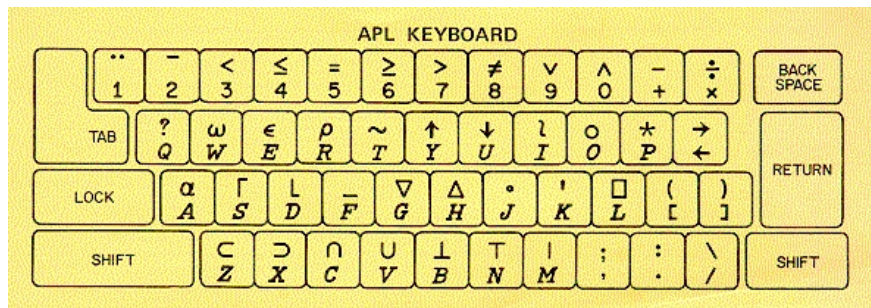
<http://www.engin.umd.umich.edu/CIS/course.des/cis400/lisp/convert.html>

LISP



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

APL



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

```
⌘[⌘X+.≠' ';]
```

```
11fe+{t1 ω∨.∧3 4=+/,~1 0 1°.θ-1 0 1°.φ<ω}
```

[http://en.wikipedia.org/wiki/APL_\(programming_language\)](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_\(programming_language\)](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_\(programming_language\)](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.wvc.edu/KU/PR/Prolog.html>

```
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;
```

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.
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_summation

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_\(programming_language\)](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>

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.*