FOCAL

pdp **8/i**
pdp **8/L**

FOCAL*
lets you
tame a computer

LEARN TO USE A COMPUTER AS A SOPHISTICATED CALCULATOR IN MINUTES

In a few minutes you can learn to use a full-scale computer for sophisticated calculations. Without learning to program, you can do table generation, line plots, income taxes and even complex integral calculations. FOCAL makes using the computer as simple as using a desk calculator.

LEARN TO WRITE COMPUTER PROGRAMS IN A FEW HOURS

In addition, FOCAL is very flexible. It is the ideal way to begin learning to program a computer. FOCAL allows the student or computer novice to learn to write programs using straight-forward commands. FOCAL allows him to check his program as he prepares it— adding, changing, or deleting. FOCAL will even tell him where and how he went wrong if he makes an error.

FOCAL programs will perform more complex calculations and repeat tedious problems easily. They will instruct the computer to automatically make decisions and perform tasks based on user input. Plotting, calculating, comparing, and formatting—easily written FOCAL programs can even monitor data and control experiments.

FOCAL is the most powerful language available for small computers. Unlike any other language, FOCAL features 14 functions, automatic error tracing, and character editing. Even with all these features, FOCAL leaves enough memory to solve 6-level simultaneous equations.

NOW MULTI-USER FOCAL

Up to seven users can now run FOCAL simultaneously on DIGITAL's PDP-8/I computer. This makes available an easy to operate system offering all the advantages of FOCAL at the lowest per user cost ever. Schools, engineering establishments, research labs, accounting firms, or anyplace that used to feel a computer was either too expensive or too complicated to program can now have a dedicated computer at a fraction of comparable costs.

AS A DESK CALCULATOR

Sitting at the teletype, simply type:

FOR ADDITION, SUBTRACTION, MULTIPLICATION AND DIVISION

USER: TYPE 25.38 + 12.479 — 4.629 * 4.7 / 1.558

FOCAL: = + 23.8948

FOR SINE AND COSINE OF RADIANS

USER: TYPE FSIN(1.57) + FCOS(.147)

FOCAL: = + 1.9892

FOR SQUARE ROOT

USER: TYPE FSQT(21.56)

FOCAL: = + 4.6433

FOR EXPONENTIATION

USER: TYPE 25↑2

FOCAL: = + 625.0000

TO COMPUTE 300 FACTORIAL

USER: SET A=1
FOR I=1,300; SET A=A*I
TYPE %, A

FOCAL: = +0.306051E+615

It's that easy, FOCAL prints out the answers instantly—no programming, no complicated symbols, no waiting. FOCAL leaves the user with a detailed print out of all his work.

TO LEARN PROGRAMMING

Writing programs is an easy step by step process with FOCAL. The user numbers each step or text line from 1.01 to 15.99. The computer then follows the numbered commands after it is given "GO" from the user. That's all, programs can be basic or complicated. They can all do complex operations and be stored on paper tape.

EUCLIDIAN ALGORITHM FOR GREATEST COMMON DIVISOR

```
Ø1.Ø1 C EUCLIDIAN ALGORITHM₃"FOR₃"GREATEST COMMON DIVISOR-*Ø1.1Ø ASK "THE
Ø1.2Ø IF (D-N) 1.3,1.3; SET S=N; SET N=D; SET D=S
Ø1.3Ø SET R=N-D*FITR(N/D) ;SET N=D;SET₃"D=R; IF₃"(R) 1.3,1.4,1.3
Ø1.4Ø TYPE "     GCD ",%4,N, !!
*
*GO
THE TWO NUMBERS ARE :544  :5321    GCD =     17
*GO
THE TWO NUMBERS ARE :19    :31    GCD =    1
```

TO CHANGE THE BASE OF A POSITIVE INTEGER

```
Ø1.Ø4 ERASE
Ø1.Ø5 ASK "CONVERT",D," FROM BASE",B1," TO BASE",B2, !
Ø1.1Ø SET I=1
Ø1.2Ø SET E=D/(1Ø↑I) ; SET R2=FITR[(E+.ØØØØ1-FITR(E))*1Ø]
Ø1.3Ø SET ANS=ANS+R2*B1↑(I-1) ; SET R2=R2*1Ø+(I-1)
Ø1.4Ø SET D=FITR(D)-FITR(R2) ;1F (D) 1.5, 1.5, 1.41
Ø1.41 SET I=I+1;  GOTO 1.2Ø
Ø1.5Ø SET J=2Ø
Ø1.6Ø SET I=ANS
Ø1.7Ø SET A=I/B2
Ø1.8Ø SET I=FITR(A)
Ø1.9Ø IF (-A) 1.91, 1.93
Ø1.91 SET D(J)=(A-I)*B2
Ø1.92 SET J=J-1; GOTO 1.7
Ø1.93 FOR L=J-2Ø,-1; TYPE %1, D(21+L)
Ø1.94 TYPE %, !!!; GOTO 1.Ø4
USER TYPES "GO" AND FOCAL ASKS A NUMBER, ITS PRESENT
BASE AND THE DESIRED NEW BASE.
*
*GO
CONVERT:7 FROM BASE:1Ø TO BASE:2
=+1=+1=+1
```

THE SOLUTION OF THE INITIAL CONDITION PROBLEM DESCRIBED BY THE DIFFERENTIAL EQUATION

$$\frac{d^2X}{dt^2} - K_1 \frac{dX}{dt} + K_2X = 0$$

FOR A SET OF GIVEN INITIAL VALUES

```
Ø1.Ø1 SET N=5; SET C=Ø
Ø1.1Ø ASK ?X2 X1 X K1 K2? ! ?DT? !!
Ø1.2Ø SET X2=-X*K2+K1*X1
Ø1.3Ø SET X1=X1+DT*X2
Ø1.4Ø SET X=X+DT*X1
Ø1.5Ø SET C=C+1
Ø1.6Ø IF (C/N-FITR(C/N)) 1.7Ø,1.7Ø,1.2Ø
Ø1.7Ø DO 2; GOTO 1.2Ø

Ø2.Ø5 IF (X-4Ø) 2.Ø6; TYPE "OFF SCALE", !;QUIT
Ø2.Ø6 IF (-X-2Ø) 2.1Ø; TYPE "OFF -SCALE", !;QUIT
Ø2.1Ø FOR I=Ø,X+2Ø; TYPE " "
Ø2.2Ø TYPE "*", !
```

USER TYPES "GO" AND FOCAL ASKS FOR INITIAL VALUES
AND A DESIRED TIME INCREMENT "DT".

THE OUTPUT IS A PLOT OF POSITION "X" VERSUS TIME "T".
EACH POINT REPRESENTS FIVE TIME INCREMENTS.

FOCAL OPERATIONS AND THEIR SYMBOLS

Exponentiation (↑) Multiplication (*) Division (/)
Addition (+) Subtraction (—)

Up to two alphanumeric letters are accepted as variable names and all may be subscripted. Any of the following parenthetical pairs may be used. ( ), [ ], and < > nested to any depth. All commands except Write, Modify, Quit, and Erase may be combined on the same line if separated by a semicolon.

FOCAL'S FOURTEEN FUNCTIONS

FSQT( )	Square Root
FABS( )	Absolute Value
FSGN( )	Sign Part of the Expression
FITR( )	Integer Part of the Expression
FRAN( )	A Noise Generator
FEXP( )	Natural Base to the Power
FSIN( )	Sine
FCOS( )	Cosine
FATN( )	Arctangent
FLOG( )	Naperian Log
FDIS( )	Scope Functions
FADC( )	Analog to Digital Input Function
FNEW( )	User Function
FCOM( )	Storage Function

FOCAL ERROR DIAGNOSTICS

Error messages are typed in the following format:

?nn.nn @ nn.nn   (error code   @   line number)

Code	Meaning
?00.00	Manual Start given from console.
?01.00	Interrupt from keyboard via control-C.
?01.40	Illegal step or line number used.
?01.78	Group number is too large.
?01.96	Double periods found in a line number.
?01.:5	Line number is too large.
?01.;4	Group zero is an illegal line number.
?02.32	Nonexistant Group referenced by 'DO'.
?02.52	Nonexistant Line referenced by 'DO'.
?02.79	Storage was filled by push-down-list.
?03.05	Nonexistant line used after 'GOTO' or 'IF'.
?03.28	Illegal command used.
?04.39	Left of "="in error in 'FOR' or 'SET'.
?04.52	Excess right terminators encountered.
?04.60	Illegal terminator in 'FOR' command.
?04.:3	Missing argument in Display command.
?05.48	Bad argument to 'MODIFY'.
?06.06	Illegal use of function or number.
?06.54	Storage is filled by variables.
?07.22	Operator missing in expression or double 'E'.
?07.38	No operator used before parenthesis.
?07.:9	No argument given after function call.
?07.;6	Illegal function name or double operators.
?08.47	Parenthesis do not match.
?09.11	Bad argument in 'ERASE'.
?10..:5	Storage was filled by text.
?11.35	Input buffer has overflowed.
?20.34	Logarithm or zero requested.
?23.36	Literal number is too large.
?26.99	Exponent is too large or negative.
?28.73	Division by zero requested.
?30.05	Imaginary square roots required.
?31.<7	Illegal character, unavailable command, or unavailable function used.

NOTE:
The above diagnostics apply only to the version of FOCAL, 1969, issued on tape DEC-08-AJAE-PB.

FOCAL COMMAND SUMMARY

Command	Abbr.	Example of Form	Explanation
TYPE	T	TYPE FSQT(AL 3 + FSQT(B))	Evaluates expression, types out =, and result in current output format
		TYPE "TEXT STRING"!	Types text. Use ! to generate carriage return line feed
WRITE	W	WRITE ALL	Focal prints the entire indirect program
		WRITE 1	Focal types out all group 1 lines
		WRITE 1.1	Focal prints line 1.1
IF	I	IF (X) 1.2,1.3,1.4;	Where X is identifier or expression

Control is transferred to the first, second, or third line number if (X) is less than, equal to, or greater than zero respectively. If the semicolon is encountered prematurely the remainder of the line is executed.

| MODIFY | M | MODIFY 1.15 | Enables editing of characters on line 1.15 |

The next character typed becomes the search character. FOCAL will then position itself after the search character; then the user may:

1) type new text, or
2) push form-feed to go to the next occurrence, or
3) push bell to change the search character, or
4) push rubout to delete backwards, or
5) push left arrow to kill backwards, or
6) push carriage return to end the line, or
7) push line-feed to save the rest of the line.

QUIT	Q	QUIT	Returns control to user
RETURN	R	RETURN	Terminates DO subroutines
SET	S	SET A = 5/B*SCALE(3)	Substitution statement
ASK	A	ASK ALPHA(I + 2*J)	Focal types a colon for each variable; the user types a value to define each variable.
COMMENT	C	COMMENT	If a line begins with the letter C, the remainder of the line will be ignored.
CONTINUE	C	C	
DO	D	DO 4.14	Execute line 4.14; return
		DO 4	Execute all group 4 lines, return when group is expended or when a RETURN is encountered.
		DO ALL	Execute entire indirect text as a subroutine.
ERASE	E	ERASE	Erases the symbol table.
		ERASE 2	Erases all group 2 lines.
		ERASE 2.1	Deletes line 2.1
		ERASE ALL	Deletes all user text.
FOR	F	FOR I = x,y,z; TYPE I	The command string following the semicolon is executed for each value. x,y,z are constants, variables, or expressions. x = initial value of I y = value added to I until I is greater than z. y is assumed = 1 if omitted.
GO	G	GO	Starts indirect program at lowest numbered line number.
GOTO	G	GOTO 3.4	Starts indirect program at line 3.4
GO?		GO?	Traces indirect program until an error is encountered.
*LINK	L	"Call Name"	Types octal bounds of indirect program and transfers to 7600 to link up with Disk Monitor or 8 Lib Sys
X X X X	START	Text	
X X X X	END	Text	
X X X X	END	Variables	
X X X X	END	Free Core	

FOCAL

a new conversational language
developed by Digital Equipment Corporation
for its PDP-8 family of small computers

APPLICATIONS

Computer aided instruction
Trigonometric problems
Numbers systems and base conversion
Geometric design
Factor analysis
Binomial expansions
Statistics
Single or multi-function plotting
Linear algebra (simultaneous equations, matrices etc.)
Differential equations
Table generation
Simulation
Least squares fit
Eigenvalues
Digital filter design
Closed circuit traverse analysis
Measurement units conversion
Data monitoring
Compound interest
Stocks and bonds analysis
Decision theory
Budgeting
Scope and plotter output, and A/D input
Many others

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