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DECUS NO.	FOCAL8-143
TITLE	REPEATED MATRIX MULTIPLICATION
AUTHOR	J. A. Peperstraete
COMPANY	Katholieke Universiteit Leuven Heverlee, Belgium
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SOURCE LANGUAGE	FOCAL

REPEATED MATRIX MULTIPLICATION

DECUS Program Library Write-up

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ABSTRACT.

The repeated matrix multiplication program multiplies an unlimited number of matrices. The intermediary results are typed out only on users request, so that a considerably amount of time is saved. The user types the input data of all subsequent matrices to be multiplied, at the end he asks the resulting productmatrix which is typed out in matrix-like format.

The program detects itself if a new matrix is conform with the result of previous multiplications. The reduced storage volume is the programs major advantage: there are never more than three matrices in core, so, at each moment the total amount of available space (about 85 signed values) has to be divided among these three; e.g. when the previous result is a 3 x 3 matrix, the new matrix may be of order 12 x 3 etc.

REQUIREMENTS.

Minimum hardware : PDP-8/4k , ASR 33

Other programs needed : FOCAL 8/69 without extended functions

Storage requirement : 30 lines of Focal script.

Executation time : less than 10 sec. for maximum input volume

USAGE.

Loading: The program is loaded under control of Focal. It occupies 30 textlines between 01.01 and 02.25. (Before loading the paper tape, change loc 2163 from 4551 to 7000).

Start up: The program is started by Focal's 'GO' command. The current multiplication may be interrupted by returning control to Focal (CTRL/C) and restart the program.

Linking to other programs: The resulting productmatrix can be found after line 2.13 as C(N), with N as explained in [1] pag. 9.43, and may be used in other programs.

Changing the output format:

Originally the elements of the productmatrix are typed in floating point, and arranged in matrix like format; however if the numbers of columns is more than 4 the program switches over to column per column format.
To change the output elements format from floating to fixed point, the user may simply modify the first command of line 02.12. e.g. T % 6.02, instead of T %.

DESCRIPTION.

1. When FOCAL is running, the program starts after typing GO on TTY, it answers by typing "MATRIX MULTIPLICATION".
2. The program asks if intermediary results are wanted; if the answer is 'Y' (for YES) the productmatrix of each multiplication is typed out. If the user answers 'N' (or anything else for NO) the productmatrix is only typed out on users request (see pnt. 4)
3. The program asks for MATRIX A, the number of COLUMNS, ROWS, and waits for input data, which are organised in the commonly used matrixformat.
4. Step 3 is repeated for matrix B. The program detects if B is conform with A, if not, it informs the user and asks to change B.
5. The program calculates [C] = [A] * [B] and takes [C] as a new [A]. If the answer on step 2 was yes, the matrix [C] is now typed.
6. Step 4 and 5 are now repeated until control is transferred to focal (CTRL/C). If the user answered NO on step 2 he can get the previous product matrix by typing a Ø when the program asks the number of columns of a new matrix.

APPLICATIONS.

The program is primarily intended for matrixmultiplication in the analysis and synthesis of control systems, and as a didactical tool in the theory of state variables and circuit synthesis.
Moreover this program can be used as a general matrix multiplication program for numerical analysis, operational research,matrix algebra,etc.

REFERENCES

[1] Introduction to programming 1969 DEC.
[2] Programming Languages 1970 DEC.

C-FOCAL,1969

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01.01 T !!,"MATRIX MULTIPLICATION",!!,"DO YOU WANT INTERMEDIARY "
01.02 A "RESULTS ? TYPE 'Y' FOR YES.",O,!!,"MATRIX A."
01.03 A !,"HOW MANY COLUMNS ?",IM,"    ROWS ?",JM,!!
01.04 S J=0
01.05 S I=0
01.06 A A(J+I*JM),"      "; S I=I+1; I (I-IM)1.06
01.07 T !!; S J=J+1; I (J-JM)1.05
01.10 A !!!,"FOLLOWING MATRIX :",!,"HOW MANY COLUMNS ?",U
01.11 I (U)1.12,1.19; A "   ROWS ?",LM,!!; I (IM-LM)1.12,1.14
01.12 T !!,"THE NEW MATRIX WILL NOT BE CONFORM WITH THE ACTUAL "
01.13 T "RESULT ;",!,"PLEASE ,TRY AGAIN."; G 1.10
01.14 S L=0; S KM=U
01.15 S K=0
01.16 A B(L+K*LM),"      ";S K=K+1; I (K-KM)1.16
01.17 T !!;S L=L+1; I (L-LM)1.15,2.02
01.19 S KM=IM; G 2.10

02.02 SET P=0
02.03 SET Q=0
02.04 S M=0; S L=Q+P*JM; S C(L)=0
02.05 S C(L)=C(L)+A(Q+M*JM)*B(M+P*LM)
02.06 S M=M+1; I (M-IM)2.05
02.07 S Q=Q+1; I (Q-JM)2.04
02.08 S P=P+1; I (P-KM)2.03
02.09 I (O-25)2.24,2.10,2.24
02.10 T !!,"PRODUCTMATRIX IS :"; F J=0,(JM-1); D 2.12
02.11 G 2.24
02.12 T % !!; I (4-KM)2.13; F K=0,(KM-1);T C(J+K*JM),"    "
02.13 F K=0,(KM-1); T !,C(J+K*JM),"    "
02.24 F N=0,(JM*KM-1);SET A(N)=C(N)
02.25 S IM=KM; G 1.10
*@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@?0
*
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