UNIVERSITY OF ILLINOIS

DIGITAL COMPUTER

LIBRARY ROUTINE V 2 - 120

TITLE	Tchebyscheff Polynomials (DOI or SADOI)
TYPE	Closed
NUMBER OF WORDS	15
TEMPORARY STORAGE	0 and (n + 1) locations at S3, 1S3,..., nS3.
ERROR	2^{-39+n} maximum
DURATION	1.3 n milliseconds
READ AROUND	69
PRESET PARAMETER	Register 3 must contain the address at which the series $T_0, T_1, \ldots, T_n$ is to start.

DESCRIPTION

The routine calculates the Tchebyscheff Polynomials $T_r(x) = \cos r(\cos^{-1}x)$ up to and including $T_n(x)$, $n > 0$. It is entered with $x/16$ in R_1 and with the orders

p	50 nF
	50 pF
p + 1	26 qF

where q is the location of this code and $n > 0$.

The polynomials $T_0(x), T_1(x), \ldots, T_n(x)$ (all times 2^{-9}) are stored at locations S3, 1S3,...,nS3. For calculations, the recursion relationship is used:

$T_n^{\ast} = 2^{5} x^{\ast} T_{n-1}^{\ast} - T_{n-2}^{\ast}$, where asterisks denote scaled values as stored.

The Tchebyscheff function is useful outside of its range of orthogonality in many problems; this routine is so arranged that a maximum range of $\pm$ 512 in the function may be used, if the amplitude of the oscillating part is one.

ARGUMENT LIMITATIONS

For $|x| > 1$ the functions increase rapidly so that the following limitations of argument must be observed to remain below the 512 limit.

n	$\|x\| <$	n	$\|x\| <$
1	16	11	1.205
2	16	12	1.171
3	5.089	13	1.146
4	2.917	14	1.125
5	2.125	15	1.109
6	1.745	16	1.0953
7	1.532	17	1.0842
8	1.399	18	1.0750
9	1.312	19	1.0673
10	1.250	20	1.0606

RT: 10/13/60
DATE NOVEMBER 25, 1953
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9/23/55
RCH
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LOCATION	ORDER OOK(V2)		NOTES PAGE 1 V2
0	40 F		Store argument
	K5 F		
1	42 12L		Plant link
	L4 12L		
2	46 6L		Plant counting constant
	L5 F		
3	10 5F		Set T_1^X
	40 1S3		
4	19 8F		Set T_0^X
	40 S3		
5	L5 13L		Enter cycle
	22 9L		
6	70 ( )F	By 2	Becomes 70 (n-2)S3
	50 ( )F	By 9'	50 r S3
7	75 F	From 11'	
	00 5F		
8	L0 ( )F	By 10'	L0 (r - 1) S3
	40 ( )F		40 (r + 1) S3
9	L5 8L		Cycle to form T_{r+1}
	42 6L	From 5'	Modify addresses
10	L4 14L		
	40 8L		
11	L0 6L		
	32 6L		Count
12	50 4094S3		Waste
	23 ( )F	By 1	Link
13	FL 4095S3		
	40 1S3		
14	00 1F		
	00 1F		