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DEUCE Subroutine No. 15. (S06)

Report by

N. Dowell.

SUMMARY.

The attached document contains working details of a second-order DEUCE subroutine for summing a power series of up to 32 terms, to the same number (p) of binary places as the coefficients.

The sub-routine was originally prepared at R.A.E., but has been tested, corrected, copied into all delay lines and tested in each at N.R.L. Blackheath.

ENCLOSURES.

Sheet 1 - DEUCE Subroutine No. 15 (S06).
Figure sheet No. S6/10013.

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Description. Second Order subroutine for summing a series of up to 32 terms to p binary places. Uses fast, 'nested' multiplication with round off.
Compactness sacrificed for speed. Storage of coefficients is left to programmer.

Data. x, the argument (with 30 b.p.)
Coefficients a_r, $0 \leq r \leq n$ (with p b.p.) $n \leq 31$

Result. $c = \sum_{r=0}^{n} a_r x^r$ (with p b.p.)

Uses. M12 (D.L.B, m.c's. 12-17, 19-22, 24, 25, 27)
Coefficients a_r (D.L.C, m.c's. t, t+1, ... t+n)

Note There are (n + 1) terms in the series.

Instructions for Use.

Stores Used.	13	14	15	16	21
Entry	$CP_5 + tP_{17}$	Link	nP_{17}	x	-
Exit	0	c	0	x	xq_1

Occupies. m.c's. 0-9, 11, 18, 23, 26, 29-31 of D.L. A.

Entry. m.c. 18

Time. $(4n + 2\frac{1}{4})$ m.s. plus 1 m.s. for every coefficient stored outside the range m.c. 12 - m.c. 26

Parameters. BP_2 in m.c. 9
$CP_5 + tP_{17}$ in TS 13

Waste Instruction 1, 0-0, 0, 25 in m.c. 4.

D.L. A Track

Card Nos.

mc	NIS	S	D	C	W	T	
							Y
							X
							0
							1
0	A	15	13		0	0	2
1		Store for I					3
2	A	13	28		0	0	4
3	A	30	21		0	1	5
4	1	0	0		0	25	6
5	A	28	26		0	0	7
6	A	15	25		0	0	8
7	A	13	15		0	0	9
8	0	13	0		0	0	Y
9	B	A	13		0	1	X
10							0
11	A	A	13		1	6	1
12							2
13							3
14							4
15							5
16							6
17							7
18	A	A	25		3	9	8
19							9
20							Y
21							X
22							0
23	A	0	13		20	14	1
24							2
25							3
26	A	21	25		1	2	4
27							5
28							6
29	A	14	1		0	0	7
30	A	13	14		0	0	8
31	A	13	A		0	2	9

A_{18} A_{23} - 25 — Construct basic fetch instruction I (A, C-13, 20+p, 14)

A_{29} 14 - 1_{31}

A_{31} 13 - A_1 — Store I

A_3 30 - 21_3

A_6 16 - 25 — Modify I by adding in turn (n, n-1, ...) x P_{17}

A_8 13 - 0

Q_{10} C_{p+n} - 13 — Fetch a_n, a_{n-1} in turn

A_{26} 21_3 - 25 — Form $q_N = a_N + x\, q_{N+1}$

A_{30} 13 - 14 — Prepare for M12 if necessary

A_0 15 - 13

A_2 13 - 28 — Has counter reached zero?

Z: A_4 0 - 0

1_{31} (LINK)

Nz: A_5 28 - 26 — Count down one

A_7 13 - 15 — $N\,P_{17} \rightarrow (N-1)\,P_{17}$

A_9 A_{11} - 13

B_{12} M 12 — Multiply q_N by x

1_{30} (A_1 - 13)

Mathematical Note.

If $q_n = a_n$ and $q_r = a_r + x q_{r+1}$ $(0 \leqslant r \leqslant n-1)$

then $q_{n-1} = a_{n-1} + x\,(a_n)$

$q_{n-2} = a_{n-2} + x\left(a_{n-1} + x\,a_n\right)$

and finally $q_0 = a_0 + x\left(a_1 + x\,a_2 + x^2 a_3 + \ldots + x^{n-1} a_n\right)$

Coding and Flow Diagram for subroutine S06 - Sum a series.	Date File Ref. Sheet Ref. S6/10013