Z.501/23 NELSON RESEARCH LABORATORIES
STAFFORD E. E. CO. LTD.
MATHEMATICS DEPARTMENT.

Continuation to: NS y 108
Sheet No.: 1.

DEUCE PROGRAMME NEWS - No. 27. September, 1958.

1. AUTOMATIC INSTRUCTION MODIFIER (A.C.D. Haley, E.E., N.R.L. Stafford)

In DEUCE News No. 17 (Para. 15c) a warning was given against using A.I.M. to count through zero in QS17 or 18, as an uncontrolled carry occurred into the next minor cycle.

A retrospective modification (Kidsgrove change No. K269) to unit A.I.M. has the effect of suppressing carry at the end of the minor cycle of modification, so that it is now permissible to use A.I.M. for counting in QS17 or 18 without any restrictions.

No programmes will be affected by the modification, apart from any which disregard the warning against using the carry to modify the N1S digits of the next minor cycle. No such programmes exist in the N.R.L. programme library.

2. HOLLERITH TIMING SPECIFICATIONS (A.C.D. Haley, E.E., N.R.L. Stafford).

In a variety of applications, particularly of a data processing nature, a variable amount of computation follows the reading or punching of a card. In such cases the reader or punch is cleared at the end of the card, the computation follows and reader or punch is then recalled. If the time between clearing and recalling is less than some period which can be specified the reader or punch will appear to run continuously and will pass cards at 200 or 100 cards per minute respectively.

If the time exceeds the specified limit card cycles may be lost and the effective speed of operation will be halved.

The following specification limit should therefore be added to the Hollerith timing specifications previously published in the programming manual and elsewhere:-

> If the reader or punch is recalled not more than 20 major cycles after the single shot from the last row of a card passing through the same machine, no card cycle will be lost.

Clearly this imposes no firm restriction on programming, but allows more accurate estimates to be made of the time taken by a job.

Two new test programmes have been made to measure this period and these are in course of publication. They are:-

No. 431 (TH32) - Reader test : lost card cycles after 9-24 on last row.

No. 432 (TH33) - Punch test : lost card cycles after 9-24 on last row.

3. PROGRAMMING DEVICES.

(a) Obeying Instructions from the Reader-64 Column Operation. (D.J. Ozanne, E.E., N.R.L. Stafford).

To obey an instruction in the β field direct from the reader an instruction 0-0 go is needed. If this is stored in 1_1, and 1_1 is called by an instruction obeyed from the α field, the β field will be obeyed.

A typical sequence of instructions is:-

Q_0		0-0	W	T	X	Initially in TS count.
Q_2		0-0	0	0	X	Blank Y-row.
Q_4	1_1	29-1	27	27		Obey X-row .
1_1		0-0	0	0		Stored 0-0 Go instruction.
Q_3	1_0	A-B	W	27		Obey X-row β .
1_0		0-0	0	0	X	Blank m.c.
Q_2	1_1	C-D	W	29		Obey 0-row α .
		etc.				

These appear on the card as:

Y	Blank.	Blank.
X	1, 29-1, 27 27 Go.	1, A-B, W, 27, Go
0	1, C-D, W, 29 Go.	

By this means, 21 useful instructions may be obeyed from the first card following initial input. The use of 1_1 for the 0-0 Go instruction ensures sufficient delay for reader field switching.

(b) Multiplier and Divider Techniques. (J. Boothroyd, E.E., N.R.L. Stafford)

The DEUCE programming manual states the standard rules of procedure for 0-24 and 1-24 operations. A special issue of DEUCE News is now in preparation at E.E., N.R.L. Stafford describing programming devices which use the Multiplier-Divider Unit and which involve transfers to D16 while multiplication or division is in progress. The following are among the results which can be achieved by this technique:-

(i) Multiplier.

(a) Conversion of Binary Coded Decimal to Binary.

(b) Conversion of Card-row patterns to Binary.

(c) Word pattern re-arrangement (e.g. conversion of binary to Chinese binary and vice-versa).

(ii) Divider.

(a) Conversion of Binary to Binary Coded Decimal.

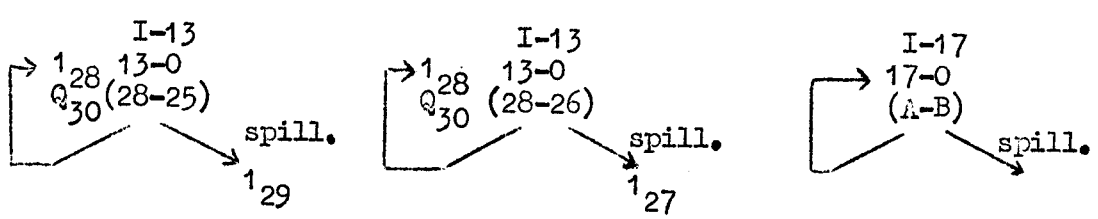
(b) Conversion of Binary pence to Binary pounds, shillings and pence or to Binary coded pounds, shillings and pence, in one division operation.

The contents of TS16 may be changed discontinuously by transfers to D16 at appropriate times during either operation or continuously by the use of T.C.A., in which case the required constants are previously stored in D.L.10. The report discusses the advantages of each method.

(c) Using "Quasi" Instructions Twice.

This device has been used on a number of occasions but has not appeared in DEUCE News before. It is often possible to obey an instruction both from its normal position and e.g. Q30, either via 13-0 or as a link of a first order subroutine. The instruction has the same N1S and timing number both times it is obeyed but since it is in a different m.c. it leads to two different instructions (in the same D.L.). Examples of this occur in A20FC (3_{10}), P21T (3_{26}) and Z04F/1 (3_{15}), Nos. 247, 265, 278 respectively. The device is of some use in library subroutines or where instruction space is important but is not worth the trouble in most programmes.

(d) The following devices can be used to incorporate a delay. (Stimulated by M.A. Kingsbury, E.E., N.R.L. Stafford).



4. THREE INITIAL CARDS.

Three new initial cards have been produced which combine the function of an initial card with other functions. The first is perhaps the most useful and will be published as a library programme.

(i) Combined initial card, stop detector and clear drum (J.F. O'Brien, E.E. Luton).

Y	Blank					
X	1	0- 1	1	10	22X	
0	1	0-1	d	0	28X	
1	1	21-28		1	1	
2	1	27-23		0	0	
3	1	4-24		0	28	
4	($4P_1$)	17-0	1	0	0	
5	1	31-30	1	0	(15)22	
6	1	12-24		0	6	
7	1	1-17		2	4	
8	1	0-1		5	0X	
9	1	31-29	1	0	28	Also punched in card columns 1 and 54.

This routine has so far been tested as an initial card, clear drum and stop detector; it may also perform the function of (ii) below. It is also proposed to punch P_{15-31} on the Y-row as an identification mark. This routine does not leave D.L.1 or D.S.21 empty, nor does it leave the read heads in position 0. It uses the A.I.M.

Some establishments have programmes which use 17-0 etc. in the "old fashioned" sense, i.e. not in the automatic modifier sense, and the modifier is then inhibited or made operative according to the programme being put on the machine. This is not considered desirable but is a useful temporary expedient and establishments doing this may be interested in the following.

Two initial cards have been produced which test whether the A.I.M. is or is not operative, as appropriate. They
(a) distinguish even and odd m.c.'s.
(b) clear OPS, TCB, AND TCA.
(c) leave all stores clear.
(d) set scope (in one case, I_M)
(e) test (i) I_M, that AIM is operative
(ii) I_F, that AIM is inoperative.

They cannot be run in with the machine stopped.

(ii) I_M - Test that AIM is Operative.

Y	Blank				
X	1,	4-24,		0,	26
0	1,	29-22,		1,	28
1	1,	21-28,		0,	28
2	1,	0-1,	1,	26,	29X
3	1,	0-1,		30,	29X
4	1,	30-17,	1,	0,	27
5	(13P_1)	17-0,	1,	25,	25
6	1,	12-24,		0,	0
7	1,	30-1	1,	1,	0
8	1,	0-17		2,	31X
9	1,	8-25,	d, 0(9)	3	P_{54}

If the AIM is off the machine goes into a loop with 6, 17-0 on IS lights, until AIM is made operative when it continues normally. If 1, 12-24 on 6-row is made a stopper the scope can be lined up with two instructions at the top and two at the bottom of D.L.1.

(iii) I_F - Test that AIM is not operative.

Y	Blank.				
X	1,	4-24,		0,	26
0	1,	29-22,		1,	28
1	1,	21-28,		0,	28
2	1,	0-1,	1,	17,	16X
3	1,	0-1,	d,	10,	0X
4	1,	30-21,	1,	0,	4
5	1,	17-28,		0,	0
6	1,	12-24,		0,	4
7	1,	30-17,		1,	1
8	1,	17-0,		30,	24
9	1,	30-1,	1,	20,	19 P_{54}

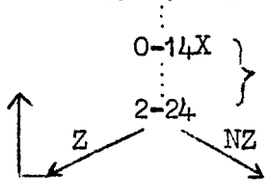
If AIM is operative the machine goes into a loop with 1, 17-0 on the IS lights until the AIM is inhibited when it continues normally.

5. USE OF TIL. (E.E., N.R.L. Stafford).

TIL is one of the less used facilities on the DEUCE particularly by beginners and it is often used inefficiently or unnecessarily, or not used when it could have been employed to advantage.

TIL has three main uses:-

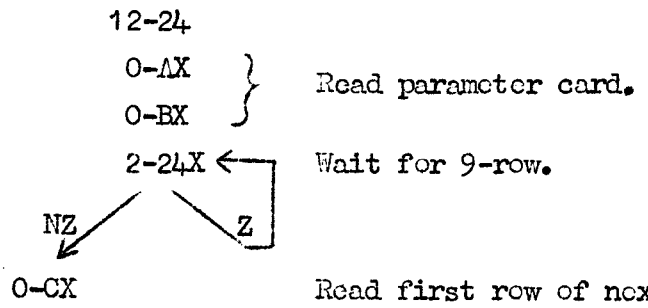
(i) In decimal read (or punch) routines. In this case the TIL discrimination (2-24) is used instead of a counter to determine when the last row of a card has been dealt with. It is generally used unstopped, e.g.



less than 11 m.s.
Is this 9-row?

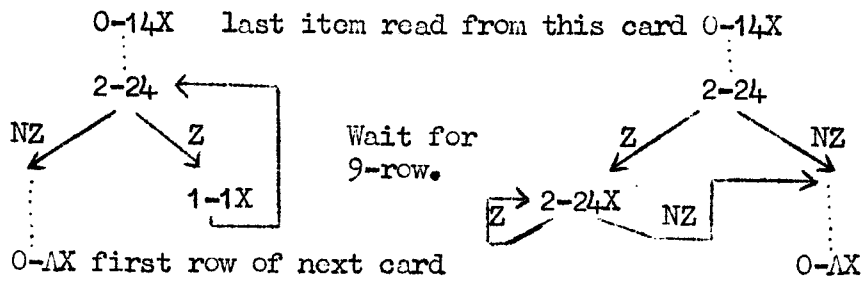
(ii) In reading (or punching) binary cards. In this case two possibilities arise:

(a) When the last card row which will be read is known. e.g. the first two rows of a binary parameter card may be read, followed by some more cards, viz:



Note that the stopper on 2-24 is necessary in this case since TIL comes on shortly before the 12th single shot. If the stopper were not present the instruction 0-CX would read the 9-row of the parameter card instead of the first row of the next card.

(b) When the last card row which will be read is not known when the programme is written, e.g. a programme to read a matrix, where the last element of a matrix row may come on any card row. There are two ways of programming this, the first of which is perhaps slightly less confusing, viz:

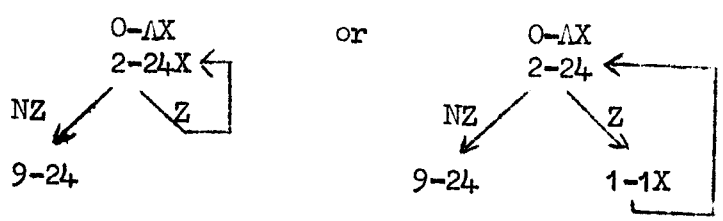


A simple 2-24↰ , either stopped or unstopped, is not enough since the last item to be read may or may not occur on the 9-row. Both the above could give an incorrect result if the time spent between 0-14X and 2-24 were too great (see Hollerith timings).

(a) and (b) are only relevant if there are more cards to follow the TIL discrim. If there are no more cards and the reader is therefore cleared with 9-24 no TIL discrim. is necessary viz:

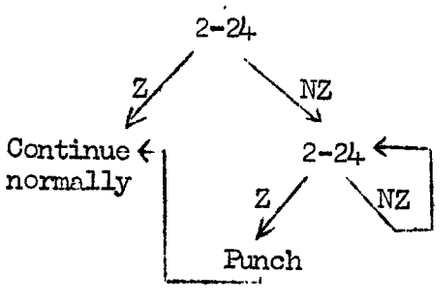
0-AX last item read.
9-24 Clear read.

is quite sufficient and



are unnecessary.

(iii) As a means of manually causing a programme to take an alternative route, by use of the TIL key on the control panel, e.g. depression of the TIL key causes a programme to punch out, viz:



The 2-24 ↰ NZ may be necessary since entering a punch routine with TIL on may cause chaos. It is probably better to use the "P32 on the ID" device in this case but if this is not possible TIL provides a good second choice.

6. LONG TIL ON 80 COLUMN MACHINE ONLY.

With the introduction of the 80 column reader there is a facility known as "LONG TIL". (It has also been called "UNTIL" which is a graphical description of the facility if we allow ourselves to forget the etymology) LONG TIL only comes into effect when an 80 column operation is initiated, leaving all the facilities listed in paragraph 5 above unchanged for a normal reading or punching operation using the stoppers.

When an 80 col. operation is initiated (by use of 10-241 or 12-241) the long TIL signal appears immediately, and remains on until the 80 col. operation has been completed, or until a clear read instruction is obeyed. If the read or punch operation is restrained due to lack of cards, or the machine not ready, the long TIL will still appear and continue until the operation has been effected by making the machine ready. For programme testing uses however, it may be necessary to put the long TIL off, so the TIL key on the control panel of an 80 col. m.c. will have an additional position labelled TIL OFF.

An important implication of the above notes is worth mentioning. It is that a check for end of long TIL should always be programmed in 80 column working, at least before any reference to D.L.12 is made. If this precaution is not observed it will be possible to extract false information from D.L.12, in the belief that it has just been read in, whereas the machine may be stopped awaiting cards in the reader.

LONG TIL always overides normal TIL.

7. CONVERSION OF THE DEUCE LIBRARY TO 64 COLUMN.

(a) In the interests of standardisation it is proposed to transfer the N.R.L. Blackheath DEUCE library to 64 column cards, the transfer being effective from 1st November, 1958.

(b) From this date subroutines will be kept in the 64 column α field leaving programmers to use them either in this form or by using ZP46T to convert their assembled programmes to 64 column. Bricks will remain in the α field, at least until a GIP is written which accepts 64 column bricks. Programmes will be maintained for full 64 column operation, except for the fact that data for existing 32 column programmes will of course be read from the α field only i.e. existing programmes will be converted with ZP46T where possible.

(c) New Programmes and subroutines will be issued to other DEUCE owners in the form in which they want them, but to stimulate 64 column working all routines issued to 64 column machines will be in the form described in (b) above, unless a specific request not to is received. (This again will be effective from 1st November 1958). Routines in the "old-fashioned" 32 column form will continue to be issued to "old-fashioned" DEUCES.

(d) It is necessary to check that no existing 32 column programmes break the rules for 64 column operation, particularly insofar as it affects the availability of Source 0. A programme to do this has been made and the check is in progress. The programme looks for instructions of the form:

0-A GO ($A \neq 24, 30, 31$)
8-24 1
10-24 1) These would be an embarrassment
12-24 1) on an 80 column machine.

The last three may be in existing programmes in error. Instructions detected as 0-A GO will be either (i) negative constants.
(ii) 0-0 waste instructions.
(iii) other 0-A instructions.

(i) can be ignored. Most of (ii) will be innocuous in the case of programmes, only those occurring where the reader is running need to be altered and perhaps not even then. In the case of subroutines however most of (ii) will have to be altered. Where a subroutine can be used with the reader running the 0-0 may cause an unwanted field switching. (iii) may or may not mean that the routine must be re-programmed. Only one subroutine R01/2, No. 127, needs altering in this way and the amendment appears elsewhere in this issue. An investigation into programmes is proceeding. It will of course be necessary for individual programmers to deal with any private programmes, data, etc. they hold.

(e) It may be as well, if any re-programming is necessary to remember that the timing of the I.B.M. 528 reader (64/80 column reader) is different from the 32/64 column Hollerith reader; in particular (i) time between rows is increased, (ii) time between cards is decreased and (iii) the "missed card allowance" is decreased. (ii) could of course be overcome by running the reader at half speed.

(f) A list of all instructions which are being altered in subroutines in the N.R.L. Stafford library, is included in this issue. Opinions may differ as to whether it is strictly necessary to alter any particular instruction but this is left to the establishment concerned. The list errs on the safe side if at all. The N.R.L. Stafford cards will have waste instructions punched as 8-8 although 1-1 is probably just as good. It is thought to be unnecessary to alter reports, flow diagrams and coding sheets.

8. DEUCE COLUMNS AND CARD COLUMNS.

The distinction between card columns and DEUCE columns was noted in DEUCE News No. 13 (although not everyone appears to have observed this). In view of paragraph 7 above it seems better to refer to DEUCE Columns in connection with 32 column work since the DEUCE column numbers will be the same whether the user is reading the 32 column DEUCE field or the 64 α field.

9. DEFINITION OF DOUBLE LENGTH MATRIX.

An m by n double length matrix is stored as follows in the machine by several Scheme B bricks at present in course of publication.

m.c. 1 of first track	m the number of rows.
m.c. 2 of first track	2n where n is the number of columns.
m.c. 3 of first track	p the number of binary places in the elements of the matrix 1 where for instance p = 32 denotes the binary point appearing between the even and odd minor cycles of the elements.
m.c. 4 and 5.	The first double length element, with most significant half in the odd minor cycle .

Subsequent double length elements are stored in consecutive pairs of minor cycles, and as usual the grand sum is stored in m.c. 0 of the first track this being the truncated sum of all the single length words in the matrix and its parameters. It will be clear therefore that such a matrix can be read

and punched by normal scheme B bricks, and that an m by n double length matrix occupies (2 mn + 4) minor cycles.

10. PUBLICATION OF SUBROUTINES ETC.

The publication department is continually faced with the problem of whether or not to publish a particular subroutine, brick or programme. It has been the practice in the past to publish more or less any routine which either (i) performed some new operation which may have been of use to someone else or (ii) which was some improvement on an existing routine. There are however three disadvantages in publishing more or less everything submitted, (a) the confusion caused by multiplicity, (b) the amount of work involved in publication, (c) the possibility of the routine never being used anyway. Since the size of the DEUCE library has increased (i) and (ii) have had to be made more rigorous. Thus it must be fairly certain that a routine will be of use to at least one other person before it is published. Similarly a routine which is an improvement on an existing routine should be considerably better than the existing one. For instance it would hardly be worth publishing a revised version of a 3 D.L. subroutine which saved 2 instructions and had no other advantages. It may also be that a quick inspection of the flow diagram shows that further improvement could have been made.

It will be realised that the above criteria are anything but rigid, and the judgment of a Soloman is sometimes required in deciding on the worth of a particular routine. If anyone has any ideas which will help in making this decision they will be very welcome.

It is hoped that the above will not discourage people from sending in subroutines, programmes, etc. because this is quite the reverse of what is desired. However, it has been said before and will probably be said again that routines submitted in the standard form require less work than those which do not and therefore are more favourably received. The standard layout for subroutine reports is defined in DEUCE News No. 26. (paragraphs 1.4 and 1.5) and soon becomes familiar. Most of the published standard bricks are in the standard form e.g. LZ18B/1, LF03B (Nos. 415, 421). In the case of programmes, these differ so widely that it is difficult to define a standard layout. The write-up should however contain precise operating instructions which a machine operator can understand e.g. FP08, LE06, ZP34, ZP46T (Nos. 367, 352, 314, 426). A copy of the cards, flow diagram and coding (which should all agree with each other) should also be sent with the report.

11. WASTE INSTRUCTIONS.

In view of paragraph 7 above the use of 0-0 as a waste instruction is more dangerous than it used to be and will be inadmissable in most library subroutines. To avoid any possibility of error it is better to use some other waste instruction, e.g. 1-1.

12. NEW PROGRAMMES.

The following programmes are complete and details will shortly be published.

(i) The second version of the Tabular Interpretive Programme (from Bristol Engines).

This interpretive programme is similar in philosophy to the earlier version, but has many improvements. It is faster, operates in block-floating, has more constants, automatic instruction modification, and easy facilities for counting round loops.