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To: SAEC Group, Programmers  
 From: M. R. Weinstein  
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 SUBJECT: FLAD POST-MORTEMS & ff TAPES

**ABSTRACT:** A new type of post-mortem request tape will allow a print-out of drum storage as instructions with floating addresses, showing the core memory addresses at which they operate. This flad post-mortem, initiated by an ff tape, will be available shortly.

### 1. Need

Post-mortems are desired that will print out storage in the same form as it was put in. This routine will bring the post-mortem output much closer to the flexowriter print of an ff tape for sequences of instructions. Still, preset parameters, t, and the exact configuration of automatic output requests cannot be printed out. A much more complicated program would be necessary to print out words in exactly the same form as they were stored. However, by giving the address sections of instructions that refer to storage as flads, with stems as needed, this post-mortem will permit a programmer to check his routine without constant reference to the flad table and consequent mental arithmetic. For greater convenience in comparing the post-mortem with the ff print, flad tags are printed. No attempt has been made to include modes that would print out numbers as this is already adequately treated by the generalized post-mortem program.

Note: The symbols g, t, and g will represent a space, a tab, and a carriage return, respectively. Numbers in the text are decimal if no qualification is made, except for 10, which is either ten or eight, depending upon whether decimal or octal numbers are considered.

### 2. Flad Post-Mortem

This routine will print out instructions from a specified range. The address section of an instruction affecting storage is given as a flad plus or minus a stem. The third letter of the WWI shift and cycle instructions is printed correctly; slh2 is printed instead of sl51d as in the generalized post-mortem. Flad tags are printed in red as they occur. In general, the format is the same as that of the generalized pm.

a. A request is complete when an output device, a number base, a mode, an initial address, and a final address have all been specified. Furthermore, if the range does not lie in core memory, the correct current (core memory) address corresponding to the initial drum address should be specified for the proper interpretation of the instruction OUT and the correct insertion of the appropriate flag tags.

b. An output device is selected by the words DELAYED, DIRECT, and SCOPE. A device remains selected until a new selection is made. The delayed printer is assumed until a selection is made. The device selected at the time the final address is specified governs the treatment of the request. For the present, the word SCOPE will have the same meaning as DELAYED. The rules of paragraph 3.b.(2) apply to these words.

c. A number base is specified by DECIMAL or OCTAL. A base remains selected until a new selection is made. Until OCTAL appears, integers will be considered as decimal. The number base of the print-out is determined by the base selected at the time the mode word was read. Thus these words have two logically distinct functions, to interpret integers in the IN tape and to set the number base in the post-mortem. The rules of paragraph 3.b.(2) apply.

d. The mode words determine which type of instructions are to be printed.

ii	means	print <u>interpreted</u> <u>instructions</u> only
wi	means	print <u>whirlwind</u> <u>instructions</u> only
is	means	start printing out <u>interpreted</u> <u>instructions</u> , but <u>switch</u> to <u>whirlwind</u> <u>instructions</u> after <u>OUT</u> , switching back after <u>IN</u> , etc.
ws	means	start with <u>whirlwind</u> <u>instructions</u> and <u>switch</u> after <u>IN</u> or <u>OUT</u> .

A mode remains selected until another mode word appears; until a selection is made, ws is assumed. Paragraph 3.b.(3) applies to mode words. The last mode word before the final address decides the handling of the request.

e. Initial addresses are specified as one would refer to first register of the range on an IN mod tape. An initial address word may be any sum or difference of integers, octal fractions, and flags terminated by a |. When both a drum address and a current address are to be specified, the drum address has the prefix DA. There may be any number of initial address words in a request. See paragraph 5 for a detailed description of the effect of address words. If requests are contiguous, the initial address may be omitted; the first word of the new request will come from the next register

of the drum after the last word of the previous request and will be treated as if it were in the next register of core memory. DA32 | 32| is assumed at the start of an ff tape. A "1" in the sign digit of an octal fraction requests the buffer drum.

f. Final addresses are specified by sums and differences of integers, octal fractions, and flads terminated by a t or a c. These terminal characters also terminate the request, so there can be at most one final address word to a request. If the final address is omitted, one word is printed out. A range should not be greater than 2048 registers; this is the maximum for one request. There may be any reasonable number of requests on one ff tape. Paragraph 5.b.(1) contains the rules for address words; 5.b.(3) for DA. See also paragraph 5.

### 3. ff Tapes

The only input mode contemplated is through ff (flexowriter flad pm) tapes, as there is no convenient way of setting up all the input parameters in the MIRs. An ff tape has a title, a body, and a termination, and each must be prepared according to the rules of this section. To operate an ff tape, it is now necessary to set the right MIR to 0.00004, press the Examine Selector Panel button, place the tape in the PEIR, and press the Read-in button. In the near future the Group II program will be modified to read in ff tapes automatically.

a. The title must begin with the characters ff, that is, no character may precede the first f or separate it from the second. Thereafter a title of up to 100 characters may occur. In any case, the title shall be terminated by a c.

b. The body contains one or more requests. Each request contains one or more words and is terminated by a c or a t. A word is of one of three types, address, a literal word of three or more letters, or a two-letter symbol.

(1) An address is made up of one or more syllables. A syllable may be an octal fraction, an integer, or a flad. Plus or minus signs should separate syllables; the + may be omitted before a flad. s is equivalent to +. The usual rules for typing numbers apply. Initial zeros should be suppressed. The point indicates an octal fraction and should not be used indiscriminately. Note that any syllables not mentioned are illegal. Unassigned flads in the request will be treated like other illegal words; see paragraph 6. An initial address word must be terminated by a !; a final address, by a c or t.

(2) The literal words are DECIMAL, OCTAL, DELAYED, DIRECT, and SCOPE. For these words, the first three letters suffice and additional characters before the terminating character will be ignored. The terminating character is s, t, or c; the latter two also terminate the request, and so should be used with care.

(3) The two letter symbols are ii, wi, is, ws, and DA. No terminal character is necessary.

(4) Equivalent characters are letter o and number 0, letter l and number 1, e and t and sssss (i.e., five or more spaces will be considered a tab). Delete, 7th hole feed, color change, upper and lower case are always ignored. Keeping in mind that the back space and manual movement of the carriage are illegal, one may conclude that "if it looks right, it probably is right." Extra terminating characters are ignored.

c. The termination of an ff tape is t or c, followed by two vertical bars.

#### 4. Output

After the title and e, DECIMAL (or OCTAL) and DA m|c are printed for every request, where m is the initial drum address (equal to the initial current address if DA did not appear in the requesting tape), the actual location of the beginning of the block of instructions printed out. The format of the body of the printout is the same as in other post-mortems except that the left-most column contains the current addresses, that is, virtual addresses, of the block and not actual addresses. If the pm is of the buffer drum, DA m + 1.00000 will be printed. Both the drum address and the current address are given absolutely as integers.

a. Whirlwind instructions that refer to storage, and the illegal instructions rs and sb, will have the address section given as a floating address. Thus, absolute addresses will normally be given only for si, sxr, srh, slr, slh, clc, and clh. For the latter instructions digit 6 is examined to determine the third letter and then discarded before the address is printed. STOP will be printed. An automatic in-cut request such as MCA+.123 or FORMAF will be printed out as AIOR<sup>n</sup>, where n is the absolute address of the appropriate block. The same request in several places therefore has the same superscript. No bits are lost in the post-mortem; in the machine STOP is sp85; AIOR<sup>n</sup>, spa. By examining the print-out, one may translate the instructions into octal fractions, say.

b. The interpreted instructions that always are given with absolute addresses are isc, icr, lcl, and icd. The illegal instructions are given as si, clc, or md with floating addresses. No check is made to see if cycle and buffer instructions are legal; words like lad5b2+c and lax2b will be printed in any case. IN, OUT, and ISTOP will be printed. The words ISOA, IDIB, etc. are rendered AIOR<sup>n</sup> as explained in the previous paragraph. Note that an illegal instruction will not cause a switch in the is or ws modes. In the ws mode, OUT is always printed when it occurs.

c. Flds will be printed if the stem is greater than -10 and there is some fld with value greater than the address section or if the stem is less than 257. Addresses in test storage are

given absolutely. The stem for the Whirlwind instruction  $ca$  must be non-negative. The flad that yields the smallest stem will be used. If stems are numerically equal, the positive one will be used. If two flads have the same value, the one whose letter comes later in the sequence p,u,z,i,m,s,j,d,v,n,g,k,x,y,t,a,e,w,f,q,b,c,r,h will be chosen. If they have the same value and the same letter, the one with the greatest number will be used. Thus if  $p8 = d2$ ,  $d2$  will be printed; if  $g3 = g9$ ,  $g9$ . All flad tags will be printed in red and followed by commas before the appropriate word.

## 5. Address Words

As in the conversion program, a current address indicator and a drum address indicator are maintained.  $CAI_i$  will refer to the initial contents, that is to say the contents at the time the word in question is read, of the current address indicator;  $DAI_f$  to the final contents, the contents after the word is read, of the drum address indicator, etc. Note that  $DAI = CAI = 32$  at the beginning.

a. Initial address words are of three types:  $n|$ ,  $DAm|$ , and  $DAm|n|$ . The word  $n|$  will set  $CAI_f = n = CAI_i + (n - CAI_i)$  and  $DAI_f = DAI_i + (n - CAI_i)$ . The word  $DAm|$  will set  $DAI_f = m$  and leave  $CAI$  unchanged,  $CAI_f = CAI_i$ . The words  $DAm|n|$  will set  $DAI_f = m$  and  $CAI_f = n$ ; in this case only DEC or OCT may separate the two addresses.

b. Final address words are of two types:  $DAm_t$ , and  $nt$ . The word  $DAm_t$  has the effect  $DAI_f = m+1 = DAI_i + (m+1 - DAI_i)$ ,  $CAI_f = CAI_i + (m+1 - DAI_i)$ ;  $DAI_i$  and  $CAI_i$  are stored as the initial addresses of the request and  $(m+1 - DAI_f)$  is stored as the number of words to be printed out if this quantity is greater than zero and less than 2049; if it is too small, one word is printed; too large, 2048 words. The word  $nt$  has a similar effect;  $CAI_f = n+1 = CAI_i + (n+1 - CAI_i)$ ,  $DAI_f = DAI_i + (n+1 - CAI_i)$ , and  $DAI_i$ ,  $CAI_i$ , and  $(n+1 - CAI_i)$  are stored. A  $t$  will have the effect  $CAI_f = CAI_i + 1$ ,  $DAI_f = DAI_i + 1$ , and  $CAI_i$ ,  $DAI_i$ , and 1 are stored if any word other than DEC or OCT has appeared after the last  $t$ .

## 6. Illegal Requests

Because of the nature of post-mortems, it is undesirable that an ff tape should be stopped during read-in. Thus if the title and the termination are proper, an ff tape will read-in. An illegal character in the body of the tape will set an indicator and then be ignored. A similar procedure is followed in the case of illegal words or unassigned flads. When a request is terminated a check is made to see if a reasonable amount of sense can be made of it. When the request is performed, the word PROPER will be printed first on the DA line, and a print-out follows if the request can be interpreted.

If multiple requests are made on the same tape, it is wise to make each request complete so that an error in an early request cannot affect later ones.

### 7. Example

Suppose that one wished to examine a section of a program from -3a4 to 7a6 which starts in the interpretive mode but contains several IN and OUT instructions and that the program is OCTAL. Furthermore, a DECIMAL Whirlwind subroutine starts at s4, followed by an interpreted subroutine beginning at z3 of 39 registers. Also, one has stored a program on group 2 by typing DA 0.10000 | 90 | on the fc tape. A sequence of Whirlwind instructions is desired from g12 to -lcl, where these flads were assigned far down in the group 2 program. An ff tape for this might be typed:

ff NAME NUMBER

oct -3a4 | is7a6      dec s4 | wi-lz3      iiz3+38

DA0.10000 | 90 | g12 | wi-lcl      ||

All these requests would be printed on the delayed typewriter.

Signed: 

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