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SUBJECT: A program for transferring binary information back and forth between paper tape and magnetic tape.

To: S&EC Group and Group 61

From: Sheldon Best

Date: Sept. 1, 1954

Abstract: The program described in this memo can read 556 tapes from the paper tape readers and blocks from any magnetic tape unit. It can then punch this binary information out as a 556 tape or record it on any magnetic tape unit as a block which the input program can read in. Directions for using the program are mainly given in two diagrams of the manual intervention registers. The rest of the memo is concerned with explaining the diagrams and giving the details of the program's operation.

Introduction

At present, binary information which is to be read into the computer may be stored on a 556 paper tape or in a block on magnetic tape. Thus a block is the magnetic tape equivalent of a 556 tape. Each block stored on magnetic tape is identified by a block number and whenever a set of blocks are stored on a given magnetic tape unit, the blocks are arranged in order of increasing block numbers. The Group 11 input program can, under the proper conditions, search for and read in one or more of these blocks. For a detailed description of a block, see appendix A.

The program under discussion[1] is designed to read 556 tapes from either the photoelectric tape reader, PETR, or the mechanical tape reader, MTR, and also blocks from any tape unit, (i.e., units 0, 1, 2 or 3). The information read in is stored on the drums.[2] Finally it may be written as either a 556 tape for delayed or direct punching or as a block on one of the tape units 1, 2 or 3.

The reading and writing functions of this program are controlled by the left manual intervention register (LMIR), the right manual intervention register (RMIR), and the upper and lower activate buttons (UAB and LAB). Control of the reading process will be discussed first.

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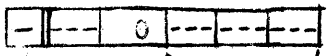
1. A copy will be filed in the tape room under the number 100-12-9054; or in the event of future modifications, the 3rd integer in this title may be increased by a small amount.

2. The information while stored on the drums may not be in the position indicated by the drum addresses. Thus no attempt should be made to operate a program read in this way.

SA 40 to initiate reading.

LMIR, Reading Control



N, block number if necessary

U	
0	Read block from MT#0
1	" " " " #1
2	" " " " #2
3	" " " " #3
4	Read 556 tape from PETR
5	" " " " MTR
7	Prepare to record on unit W. (See Fig. 2)

0	Don't stop after this reading process; proceed at once with the writing process.
1	Stop after this reading process

UAB pushed: Add a range (whose drum addresses are in the MIR's)

LAB pushed: Subtract a range (whose drum addresses are in the MIR's)

Both UAB and LAB pushed: Read in a block (or tape), but add the contents of the RMIR to the drum addresses.

FIGURE 1

Restart to initiate recording.

RMIR, writing control

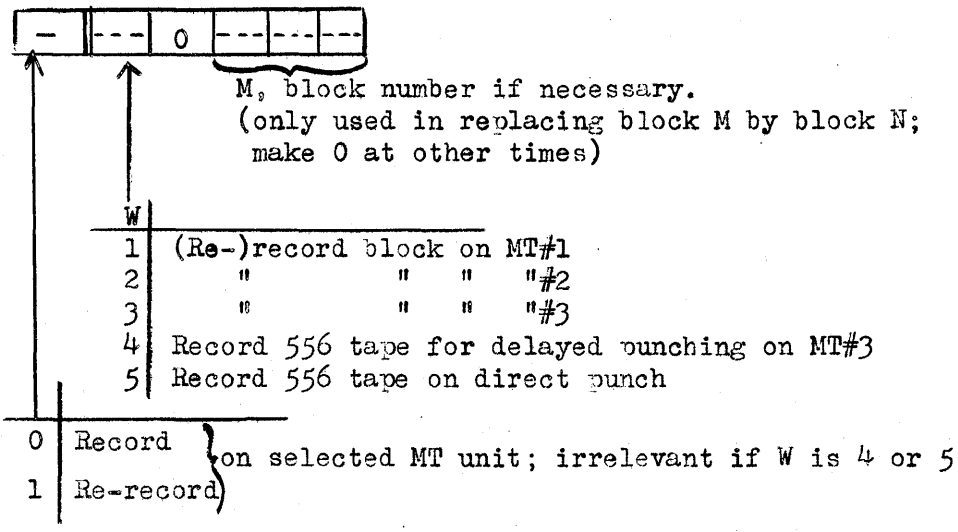


FIGURE 2

The Reading Process

The LMIR controls the reading as diagrammed in Fig. 1. The reading process is always initiated manually by starting over at 40(octal) (abbreviated SA40).

Reading blocks from magnetic tape: When reading a block from magnetic tape, the program searches for and reads in block N from unit U if either N or U has been changed since the last reading process and N is not 0. If N and U have not been changed or if N is 0, the next block on unit U is read. N and U are defined in Fig. 1.

Combining tapes or blocks by multiple read-ins: By making the sign of LMIR a 1, the computer may be made to stop after the reading process; and another reading process may be initiated by another SA40. In this way, any number of blocks and/or 556 tapes may be superimposed.

Logging Titles: The information accumulated during the reading process has a logging title associated with it. This logging title will be the same as that of the last 556 tape or block read which had a logging title with more characters in it than merely fb2 , i.e., in multiple read-ins, later logging titles displace earlier ones except for the dummy logging title fb2 .

Sp blocks: The sp block associated with the stored information is always the same as that of the last 556 tape or block read in.

Assignment of block numbers: A block number is always associated with the information read in although use is made of this block number only if the information is then written unto a magnetic tape unit as a block. The block number is assigned in this way:

I. If the last thing read was a block from magnetic tape, the number of that block becomes the block number for the stored information.

II. If the last thing read was a 556 tape:
   (a) and the LMIR has been changed since the last reading process and N is not 0, then N is the block number assigned to the stored information.
   (b) and the LMIR hasn't been changed or if N is 0, then the block number is the third integer in the logging title if and only if the logging title contains two dashes, e.g., in the case of the logging title fb 100-0-300, the block number would be 300. The logging title fb3671m626, however, doesn't assigned a block number.

III. If neither rules I nor II achieve assignment of the block number, it is one greater than the block number at the last writing process.

As soon as a block number is assigned, it is displayed in the indicator lights as the address of a ca. The block numbers are always octal integers between 10 and 776(octal), inclusive.

Removing redundancies, optimizing: During reading, a record is built up of the locations of all words read in. In this way all redundancies due to some words being overwritten by others are removed and only the record of the last word stored in a given location remains.

The Writing Process

The writing process is controlled by the RMIR as diagrammed in Fig. 2. The writing process is always initiated manually by a restart. This restart may be given if the computer stops after a reading process. The computer doesn't stop after a reading process if the sign of the LMIR is a 1. In this case the writing process is initiated automatically. After a writing process, the computer automatically initiates a reading process if the si 1 switch is OFF. If the si 1 switch is ON, the computer stops. A restart at this time initiates another writing process, which writes the same information in the form directed by the contents of the RMIR at the time of the restart.

Punching 556 tapes: The 556 tapes punched by this program have a visual title and a logging title. The -n+1 blocks are subdivided every 100 (octal) words. Ditto blocks are punhced out whenever this saves tape. No ditto block extends past any drum address which is a multiple of 2000(octal), but -n+1 blocks up to length 64 may be dittoed.

Recording blocks on magnetic tape: In order to record a block on magnetic tape, the unit involved[3] must either be positioned to within a previously recorded set of blocks or it must be prepared to receive the block. To do the latter, the first octal digit, U_4 of the LMIR is made a 7 and the corresponding octal digit of the RMIR is made equal to the unit number. With these settings, a SA40 marks off on the specified unit both the beginning and end of a null set of blocks. As blocks are recorded, the end marker is moved down the tape.

If the number M in the RMIR is 0, or if the RMIR is unchanged since the last writing process, recording block N consists in searching in the set of numbered blocks for the block with the largest block number less than N and recording block N immediately following this block. Finally, an end marker is put down following block N to indicate that N is now the last block in the set.

If the RMIR has been changed and M is not 0, the process is exactly the same except that block N is recorded following the block with the largest block number less than M. This provides a way of replacing recorded blocks by others with different block numbers.

Re-recording blocks on MT: One of a set of blocks previously recorded on a magnetic tape unit[3] may be modified individually by re-recording it provided that the modification doesn't involve lengthening the block.

The unit must first be positioned to somewhere in the set of blocks.

If the RMIR is unchanged since the last writing process or if M is 0, (See Fig. 2), re-recording block N consists in searching for the old block

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3. Recording or re-recording on Unit 0 can only be done through the recording circuits of Unit 1 by throwing a special locked switch which interchanges units 0 and 1 as far as the computer is concerned.

N in the numbered set of blocks and replacing it with the new block N.

If the RMIR has been changed and M is not 0, the re-recording process replaces block M by block N.

Other Functions of the Program

This program has several less important functions which cannot be classified as either reading or writing processes. After these special functions, the computer always stops; and a subsequent restart will initiate a recording process.

Adding a range: By putting the initial drum address[4] of a range in the LMIR, the final drum address in the RMIR, pushing the upper activate button and starting over at 40, +0's may be added to the stored information in every drum register lying within the range which wasn't previously filled during a reading process.

Subtracting a range: By putting the initial drum address in the LMIR, the final drum address in the RMIR, pushing the lower activate button and starting over at 40, every reference previously made to drum registers within the range may be eliminated from the stored information.

Adding a constant to drum addresses: If both the UAB and the LAB are pushed, starting over at 40 causes a 556 tape or a block to be read in as specified by the contents of the LMIR except the drum addresses have the contents of the RMIR added to them.

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4. A 1 in the sign digit indicates the buffer drum.

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Appendix A: the Form of Blocks

The form of a block recorded on magnetic tape is shown in the following diagram.

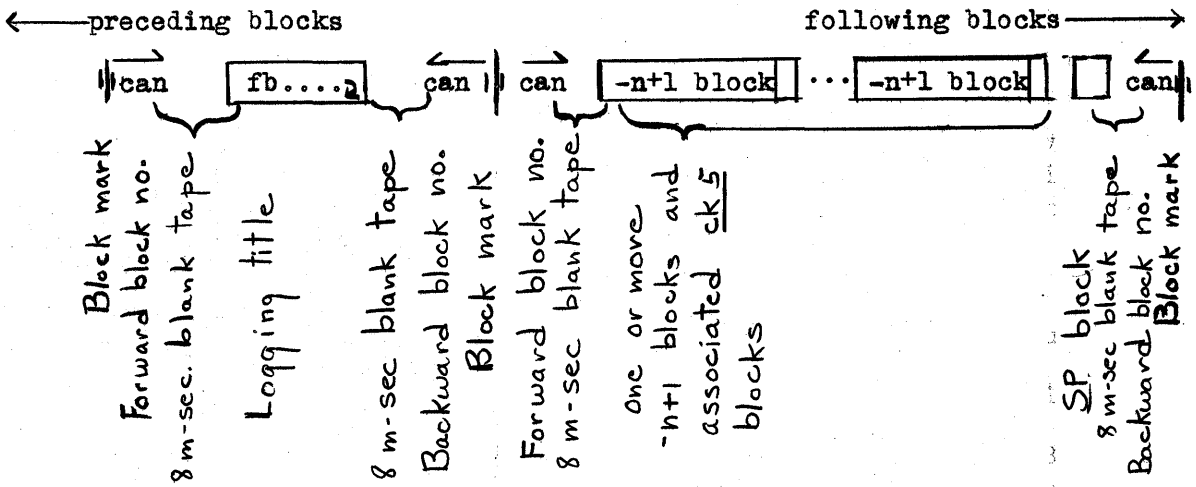

Diagram of Block n

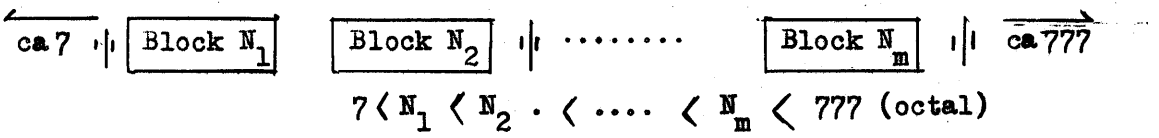

Diagram of a set of blocks; showing end markers and inequalities existing between block numbers.

Appendix B: Restrictions and comments

The MIR's and the activate register are examined only immediately after some process has been initiated manually. Their contents at other times is immaterial.

The maximum number of drum groups which may be referred to by a tape (or tapes) read in by this program is 13.

A block to be recorded on magnetic tape should be limited to 512 words although at the present time a somewhat longer block is possible.

When searching is taking place for a certain block, the number of the block being searched for appears in FF2 and the block number most recently found appears in FF3.

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