ELLIOTT 900

Volume 2:   PROGRAMMING INFORMATION

Part   1:   PROGRAMMING LANGUAGES

Section 4:   MTALGOL PROCEDURES

CONTENTS

Chapter 1:   INTRODUCTION

1. 1   Purpose

The MTALGOL procedures are a set of 900 Algol pro-
cedures which enable the programmer using Algol to write and read files
and blocks of data to and from magnetic tapes.

1. 2   Form of Distribution

The procedures are distributed on 900 MTALGOL, a
single relocatable binary tape, similar to the 900 Algol Library (Tape 3).

1. 3   Method of Use

The procedures are loaded and called as SIR code pro-
cedures to be added at run-time by entry at 1 1 using the basic paper tape
Algol system.   They must be declared as code procedures within the Algol
text.

When the FAS operating system is used, the MTALGOL
procedures will be loaded from the standard library tape.

1. 4   Configuration

A basic 900 series (18 bit) computer with 8192 words or
more of core store and at least one 9 kHz magnetic tape handler.

Chapter 2: FUNCTIONS

2. 1 Principles of Use

The MTALGOL procedures assume that files are read and written according to the formats described in 900 Manual, Volume 2. 7. 1. Thus it is possible to interchange files written by Algol, Fortran and SIR programs.

2. 1. 1 Formats on Tape

All magnetic tape reels to be processed by standard software must have a header block and the first two words of every data block, written in standard format (see Volume 2. 7. 1). The Algol procedures will always write in this standard format.

2. 1. 2 File Protection and Initialisation

Before data can be written onto or read from a tape the file on the tape must be 'opened' by procedure MTOPEN. Unless it is a SCRATCH tape (i. e. the header name is SCRATCH) the header block name must correspond exactly to the name used in MTOPEN. This procedure guards against unauthorised overwriting or reading of files. The reel must be prepared initially by using the utility program MTINIT, before any data can be written onto it. When it is necessary to use all available handlers for data, the systems file reel and any program files must be removed and replaced by suitably initialised reels before the program is run.

2. 1. 3 Closing Files

Before finishing a program, particularly when the tape reels are to be removed after the run, all files used by the program should be 'closed' by the procedure MTCLOSE. If a file has been written or updated, it must be closed for writing before the end of the program.

2. 1. 4 Transfer of Data

Data is read and written in blocks, corresponding

to the blocks physically recorded by the hardware. These blocks are written from or read into buffers in core store, which are specified by the user as integer arrays within his Algol program. Data is written and read by means of procedures MTWRITE and MTREAD respectively.

Real numbers may be transferred to and from the buffer by procedures RAPUT and RAGET respectively. Character strings may be transferred between the buffer and another medium by the procedures INSTRING and OUTSTRING (Volume 2. 1. 2, Chapter 2. 2. 6).

2. 1. 5 Declaration of Procedures

The individual procedures are described in 2. 2 to 2. 7. Each procedure used must be declared (as for code procedures) by the declarations shown at the beginning of each description.

2. 2 MTCHECK

"CODE" "PROCEDURE" MTCHECK (H, B, STAT, L);
"VALUE"H, "INTEGER"H, B, STAT; "LABEL"L;
"ALGOL";

This procedure is used to check the operation of the other magnetic tape Algol procedures. It must be used after each of the other procedures, before any other reference to any of the tapes, and its exact effect is defined in the individual procedure descriptions. The general effect is as follows:

H is the handler number required in the range 0 to 3.
The value of H must correspond to that used in the
previous procedure, except when checking the completion
of a rewind after MTCLOSE.
If the previous procedure was successful the exit from
MTCHECK is normal. In this case parameter B will
hold the block number of the last block read or written.
Parameter STAT will hold the status word read from the

magnetic tape controller on completion of the operation.

If the previous procedure was not successfully completed, MTCHECK does not exit normally, but exits to label L. In this case parameter B holds an error number. Parameter STAT again holds the status word, which will indicate the most recent hardware error state.

Values of B under error conditions are as follows:

B = 1   Repeated hardware error, failure after 20 attempts to read or write a block.

B = 2   File not opened by MTOPEN as names not compatible.

B = 3   Specified block for reading cannot be found.

B = 4   Handler in Manual or not available.

B = 5   Instruction ejected as 'do nothing', due to hardware error or manual interference.

B = 6   Attempt to write or read more than one block after the end of tape warning marker has been detected.

B = 7   File not opened for reading or writing before an attempt to read or write respectively.

B = 8   Write permit ring not in when attempting to write.

B = 9   Long block. The block read from magnetic tape is longer than the buffer allocated.

The following cases are not errors, but a branch to the label L is taken as special action may be required:

B = 0   The End of Tape warning marker has been detected while reading or writing the last specified block. If writing a file, the file should be closed for

writing, as no further data blocks are allowed

on that reel.

B = -1   The block specified to be read is a label block

(other than EOF (end of file) block).

B = -2   The block specified to be read is an EOF

(end of file) block.

B = -3   The handler is still busy rewinding after a

call of MTCLOSE.

2. 3   MTOPEN

"CODE" "PROCEDURE" MTOPEN(H, A, T, S,)

"VALUE"H, T; "INTEGER" H, T; "STRING"S;

"INTEGER" "ARRAY"A; "ALGOL";

This procedure must be used to 'open' a file on a mag-
netic tape reel, before reading or writing data. When used it must be followed
by a call of MTCHECK.

H is the handler number required. The actual parameter
must be an integer in the range 0 to 3. Note that a program will be easier
to adapt if all references to a handler are by an integer variable, which may
be set at the beginning of the program.

S is a string giving the name of the file to be opened.
The actual string should contain only letters and figures, and must not con-
tain inner string quotes. Only the first 12 characters, not including the
opening or closing quote signs, are significant. A is an integer array used
as a buffer. It must be at least 56 elements long. The array elements are
referred to as $A[0]$, $A[1]$, ... to $A[55]$, assuming that the array is de-
clared as $A[0:n]$;. Once MTOPEN and MTCHECK have been used, this
array may be used for other purposes.

T is a parameter indicating the type of operation required.
The types of operation are:

T = -1   Open file for reading only. The name of the file must correspond exactly to the name given by parameter S. The tape is positioned ready to read the first data block.

T = 0   Open file for updating. The name of the file must correspond exactly to the name given by S. The tape is positioned ready to read or write the first data block.

T = 1   Open file for writing. The original name on the file must correspond to that given by S, or the reel must hold a scratch file, with name SCRATCH. A[28] to A[55] must be set to appropriate values, see below.

If the file is opened for updating the existing header block is checked but not overwritten. If information is to be added to the end of the file the program should read forwards until the EOF block is detected, go back one block, and start writing.

If the file is opened for writing, a new header block is written, and a complete new file must be written.

In each case, after the call of MTCHECK following MTOPEN the original header block read from the tape will be left in the buffer array A, in the first 28 elements; A[0] to A[27]. When opening for writing the header block is written from locations A[28] to A[55]. These locations should all be set to zero (or to appropriate values required for the header block locations 0; to 27;) before MTOPEN is used.

Optionally, the name of the file to be opened may be specified by a string input by INSTRING. This is done by specifying an empty string as parameter S and placing the actual file name in locations A[30] to A[34] of the array. An empty string is one consisting merely of the open

and close string quotes. The name should be packed into A[30] etc. as 6 bit internal code characters. Packed 3 characters per word, up to 12 characters, with trailing spaces (zeros) if the name is less than 12 characters long. If the name has been input by instring it will be preceded and terminated by string quotes in internal form. Thus either the magnetic tape file should be initialised with the name enclosed by quotes, or the string read by INSTRING should be placed in A[29] onwards and should start with a quote sign followed by two non significant characters, e.g. spaces.

The following program will open the file on handler 2 for reading, using a name read from paper tape.

```
integer H, I; integer array A[0: 100];
H:=    2;
I:=    29;
INSTRING (A, I);
MTOPEN (H, A, -1,´`);
```

If the data read from tape was of the form:

´ Ŝ) Ŝ) FILENAME2 Ŝ) Ŝ) Ŝ) `

where Ŝ represents space character, the file FILENAME2 will be opened.

2.4   MTWRITE

"CODE" "PROCEDURE" MTWRITE (H, A, P);
"VALUE" H, P; "INTEGER" H, P; "INTEGER" "ARRAY"A;
"ALGOL";

This procedure is used to write a block of data (or a label block) onto magnetic tape. When used it must be followed by a call of MTCHECK.

H is the handler number required (in the range 0 to 3).

A is an integer array which must contain the data block

to be written.   The first 2 words of the array must not contain significant data, as they will be overwritten when the block is written onto tape.

P must be set to the number of words to be written in the block.   This number includes the 2 locations at the lower end of the array, e. g. if AA[0] to AA [200] are to be output on handler 2, the call might be:

MTWRITE(2, AA, 201);

AA [0] and AA[1] will be overwritten.   This example assumes that AA is declared as <u>integer</u> <u>array</u> AA[0:300].

After the call of MTWRITE array A must not be referred to or altered until MTCHECK has been called.

The block will be written onto the tape, starting at the current position of the tape under the read/write heads.   Writing should normally be in sequence along the tape from the header block written by MTOPEN.   Each call of MTWRITE leaves the tape positioned ready for the next call.   When all blocks of a file have been written MTCLOSE should be used to close for writing.   The call of MTCHECK following each call of MTWRITE will give the block number of the block just written, and if necessary the program may keep a record of certain block numbers, so that they can be conveniently found by MTREAD.

If blocks are to be written from a different position, MTREAD should be used to position the tape.   As soon as a block is written all other blocks further along the tape should be considered unreadable, (though in exceptional circumstances they may be found using MTREAD to read a specific block number).   It is <u>not</u> possible to overwrite odd blocks in the middle of an existing file and preserve the rest of the file.   If random blocks are to be updated the whole file must be copied onto a new tape reel, updating or deleting the necessary blocks as they appear in the copying sequence.

Up to 20 attempts are made to write the block specified,

and small patches of bad tape are erased over before the block is written.

If a label block is to be written parameter P should be given value (number of words - 131071-1).

2. 5   MTREAD

"CODE" "PROCEDURE" MTREAD(H, A, N);

"VALUE"H, N; "INTEGER"H, B; "INTEGER" "ARRAY"A;

This procedure is used to find and read a specified block on a magnetic tape reel. Since all blocks are numbered, a block with a given number may be found, searching forwards or backwards along the tape.

H is the handler number required (in the range 0 to 3).

A is an integer array which is used as a buffer for input of blocks. The whole array is used. After reading and successfully checking with MTCHECK the block specified by N will be held in A, with the first two words holding special information inserted by MTWRITE when the block was written.

N parameter specifies the block to be found and read. If N = 0 the next block in sequence is read. If N is positive, non-zero then the block with number N is found.

The array A should not be referred to until after the call of MTCHECK following MTREAD. If the actual block specified to be read is a label block then MTCHECK exits to label L. However, the block will still be read correctly into array A, with the block number in the first location of A.   second   ADH   10/11/2012

The search for a numbered block will start with a rewind or a number of backspace movements if necessary, then will continue forward till the block is found. The search forward is not fundamentally quicker than reading repetitively with MTREAD (H, A, O), unless there are a number of bad patches on the tape.

Up to 20 attempts will be made to read the actual block specified, other blocks are ignored. The actual block length (number of words) will be found in the second location of A, unless a label is read when this location holds (the length -131072).

2.6 MTCLOSE

"CODE" "PROCEDURE" MTCLOSE(H, T);

"VALUE"H, T; "INTEGER" H, T; "ALGOL";

This procedure is used to 'close' a magnetic tape file after reading or writing is complete. Files that have been written or updated must be closed for writing once the last block has been added. In general, at the end of a program run, or before a reel is removed, any reels used by the program should be closed.

MTCLOSE may also be used to rewind a tape without closing the file.

H is the handler number required, in the range 0 to 3.

T is a parameter giving the type of operation required, as follows:

T = 1   Close file for writing. Write an End of File label and rewind tape.

T = 2   Close file for writing and reading. Write an End of File label and rewind.

T = 3   Close file for reading only. Rewind tape (only use if file not opened for writing).

T = 0   Rewind tape without closing file.

After closing for writing (T = 1 or T = 2), MTCHECK must be used before any other reference to any of the tapes. After this (and after any other call of MTCLOSE) MTCHECK may be used at any time to check whether the rewind operation is complete.

2. 7   RAPUT and RAGET

These procedures are not directly concerned with magnetic tape handling and the rules for magnetic tape procedures do not apply. They are introduced to facilitate the handling of real numbers, since integer arrays are used for the magnetic tape buffers. They may be described as follows:

"CODE" "PROCEDURE" RAPUT(A, I, R);

"VALUE" I, R, "INTEGER" "ARRAY" A; "INTEGER" I;

"REAL"R; "ALGOL";

"COMMENT" RAPUT stores the value of R in packed form in the (I+1)th and (I+2)th locations of A, (that is in A [I] and A [I+1] if A is declared as A[0;n]). Error Number 5 if I is out of range;

"CODE" "REAL" "PROCEDURE" RAGET(A, I);

"VALUE"I; "INTEGER" "ARRAY"A; "INTEGER"I;

"ALGOL";

"COMMENT"RAGET takes the real value packed in the (I+1)th and (I+2)th locations of A, as stored by RAPUT. There is no check on the value of I.

Chapter 3:   STORE USED

Approximate core store used:

MTCHECK, MTOPEN, MTREAD, together =	570 words
MTCLOSE	60 words
MTWRITE	110 words
RAPUT and RAGET	50 words
Total:	790 words

Chapter 4:   TIME TAKEN

The time taken for these procedures is governed almost entirely by the tape movement times, and it is virtually independent of the processor speed.

Approximate times, assuming no re-reads or re-writes due to tape errors, may be calculated as follows, if W is the number of words in a block:

MTWRITE	$18 + 0.33\,W$ millisec.
MTOPEN	28 millisec. plus rewind time, to open for reading or updating
	80 millisec. plus rewind time, to open for writing
MTCLOSE	20 millisec. to close for writing
	1 millisec. to close for reading
MTCHECK	0.8 millisec (100 microsec. on 905, $1\mu S$ store)
MTREAD	$18 + 0.33\,W$ millisec. to read next block.

If MTREAD is used to search for a given block number N and L is the number of the last block read or written, then the time taken in seconds is very approximately given by:

if $N > L$ then $(N-L) * (18 + 0.33\,W)/1000$

else if $N \leqslant L/2$ then $(L/150) * (W/66 + 0.75) + (N/1000) * (18 + 0.33\,W)$

else $(L - N + 2) * (18 + 0.33\,W)/1000;$

In this case W is the average number of words in a block.