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Programming Languages Division

FORTRAN NOTE 22
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Dynamic Peripheral Allocation. (Compile time)

Dynamic Allocation System in Fortran IV compilers

Introduction: All peripherals are allocated and released dynamically by the compiler and a record is kept in a Lower Common area called 'TAPER' of peripherals in current use.

The area TAPER: This area is six words in length, each word referring to a particular type of peripheral, as follows.

- Word 0: Magnetic tape library
- Word 1: Magnetic tape input (source or s/c)
- Word 2: Slow peripheral input (card or paper tape)
- Word 3: Listing peripheral (printer or paper tape)
- Word 4: (a) Scratch magnetic tape OR (b) slow peripheral output.
- Word 5: Final output magnetic tape.

All these words are relevant to the magnetic tape compiler XFAM, in which case alternative (a) for word 4 is the one applicable.

The paper tape compiler XFAP and the card compiler XFAC do not use words 0, 1 and 5, and alternative (b) for word 4 is applicable.

Each word of TAPER is composed of the following elements.

- Bit 0: = 0 if not in current use (but see note (a) below)
= 1 if in current use
- Bits 1-8: Indicates peripheral type (e.g. 3 for card reader)
- Bits 9-23: Indicates unit number (see note (b) below)

Notes: a) In all words of TAPER except word 1, a '0' in the sign bit implies that the peripheral is not allocated to the program. In the case of word 1, a '0' in the sign bit does not necessarily mean this, but indicates only that the peripheral is not in current use. This is necessary because it may be required that an input tape be left positioned at a certain point until it is known whether any further data is required from it.

In the case of word 1, therefore, a further indicator MTI is used: If MTI = 0, the peripheral is not allocated; if MTI = 1 it is allocated.

b) In ~~#~~XFAM the following unit numbers are used for the magnetic tapes:-

- Unit 0: Tape containing library
- Unit 1: Final output tape
- Unit 2: Input tape
- Unit 3: Scratch Tape

For all three compilers, the slow input peripheral is unit 0 and the listing peripheral is always unit 1.

c) It is not of course possible for more than one of each kind of peripheral to be allocated to the compiler at the same time. Thus if a new input magnetic tape is requested, the old one is necessarily released first.

Release of Peripherals

The release of a peripheral is in all cases effected by entering the cued routine RPER, after setting X1 equal to the number of the appropriate word in TAPER. If RPER discovers that the peripheral is not allocated, it does nothing. Otherwise it removes the sign bit from the correct word of TAPER, then releases the peripheral.

If an input magnetic tape is to be released, RPER ascertains from the indicator MTI, whether the peripheral is allocated or not, instead of from TAPER+1. MTI and the sign bit of TAPER+1 are always left as zero.

Use of RPER: The calling line is
CALL 5 RPER

On input: X1 = appropriate word; of TAPER (0 to 5)

On exist: X1 is unchanged.

Uses: X2, X5, X6

Allocation of Peripherals

All peripherals are allocated dynamically by calling the cued routine APER.

The calling line is CALL 5 APER
On input: X1 = appropriate word of TAPER (0-5)
 X7 = counter modifier: Type/unit no.
On exit: The allocation is complete.
 X1 and X7 are unaltered
 X3 = unit number
 X2 = Peripheral type
Uses: All accumulators except X0.

On entry to APER, the counter/modifier in X7 is transferred immediately to the appropriate word in TAPER.

If the peripheral is not magnetic tape, APER will then attempt to allot it and if unsuccessful will type "Halted xx" where xx is CR, LP etc. When allotted, the appropriate sign bit in TAPER is set to '1'.

If a magnetic tape is to be allocated, more complex operations take place. APER looks at the common area MFIL to find out the name and generation number of the file required; it then sets up a control area accordingly and opens the tape. Finally the sign bit in the appropriate word of TAPER is set to '1' and if this word is word 1, MTI is also set to 1.

Initial allocation of peripherals

A listing peripheral is allocated if or when the user requests it by means of the intersegment statement LIST.

The subroutine STOUT makes the initial allocation of an output peripheral. In #-XFAM it allocates a scratch tape, writes a tape-mark to it and zeroes word 5 of TAPER. In #XFAP and #XFAC it allocates a tape punch or card punch respectively.

The subroutine STINP allocates the initial input peripheral, and this will always be a card reader or paper tape reader depending on whether the compiler is entered at word 21 or 22 or at word 20. Words 0 and 1 of TAPER are zeroised.

Change of Peripherals during compilation

This can be effected by means of the intersegment statement "READ FROM".

For all three compilers, the following two forms are permissible:

- (1) READ FROM (TR)
- (2) READ FROM (CR)

For \neq XFAM (in which input may be from magnetic tape), the following are also permissible.

- (3) READ FROM (MT, Filename (G))
- (4) READ FROM (MT, Filename (G). Subfilename)
- (5) READ FROM (MT, . Subfilename)

Here, G is the generation number of the file and need not be specified. If not specified G = 0 is assumed. Type (3) can be used for obtaining input from a simple file. To obtain input from a composite file, types (4) or (5) must be used, and the subfile name must always be specified. Type (4) is used to open a tape and input a subfile. Type (5) can be used to input a subfile from a magnetic tape that is already opened; in this case the subfile requested must not be further back on the tape. Obviously it saves time to use type (5) rather than type (4) wherever possible; for type (4), if the tape is already open, it will first be released then re-opened.

Treatment of READ FROM by the compiler: The actual transfer from the current to a new input peripheral is effected by the cued routine RDFR.

The calling line is CALL 0 RDFR

On input: X1 = appropriate word of TAPER (0 to 5)
X7 = counter/modifier: Type/unit no
If magnetic tape, MFIL must be set up (see below)
On exit: X1 and X7 are unaltered.
Uses: All accumulators.

If reading from magnetic tape the Common Area MFIL is set up previously as follows:

Words 0, 1, 2: File name (word 0 = zero if not specified)
Word 3: Generation number (zero if not specified)
Words 4, 5, 6: Subfile name (word 4 = zero if not specified)

In the case of READ FROM (CR) and READ FROM (TR), RDFR merely releases the current peripheral (by calling RPER) and allocates the one requested (by calling APER).

The following, more complicated, operations are carried out if input from a magnetic tape has been requested:-

If a READ FROM statement occurs while actually reading magnetic tape, it is simply ignored. Otherwise the first word of MFIL is examined. If it is not zero any magnetic tape input file currently allocated to the program is released and the one requested is allocated. If the first word of MFIL is zero, the compiler checks (from MTI) that a tape is indeed allocated and sets the appropriate sign bit in TAPER+1 to '1'.

The tape is then positioned ready for reading the first record to be input. In the case of a composite file, the compiler also notes from the subfile sentinel whether the contents of the subfile are source or semi-compiled. In the case of a simple file, only semi-compiled. In the case of a simple file, only semi-compiled input is acceptable.

The slow peripheral remains allocated to the program when a magnetic tape is being read, and control returns automatically to the slow peripheral in the following circumstances:-

- (a) On detecting a tape-mark in the case of a simple file.
- (b) On reading the end of the subfile in the case of a composite file.

In case (a), the tape is rewound and released, but in case (b) it is left positioned at the end of the subfile in case a further subfile is required from it at a later time (however, bit 0 of TAPER+1 is set to zero at this point).

Final Release of Peripherals

All peripherals which have been allocated during compilation are released before the final Halt is reached. Entry at word 27 of store will also cause all peripherals to be released followed by a typed message "Halted PF". This facility is included to make it possible to begin compilation again at any stage.

Halts in the Dynamic Allocation System

(a) The following halts indicate that a particular peripheral is not available to the compiler. To continue compilation the operating must put the appropriate peripheral on line and GØ:-

Halted	TR	(paper tape reader)
Halted	TP	(paper tape punch)
Halted	LP	(line printer)
Halted	CR	(card reader)
Halted	CP	(card punch)

(b) The following halt occurs if entry has been made at word 27 to release all peripherals:-

Halted PF

This indicates that all peripherals have been released.

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