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Scientific Programming Department
I.C.T. 1900 Series.

FORTRAN NOTE 9
21.6.65.

ARRAY ADDRESSING IN FORTRAN IV

This note supersedes the section on array addressing in
FORTRAN NOTE 1.

Array Addressing in FORTRAN IV

1. The general basis of array element addressing is the same as for the current FORTRAN on the 1900. Associated with each array is an "Array Header" which contains information about the structure of the array.

Entry points in the Arithmetic Package ($\%FAP4$ - compiled into all FORTRAN IV programs) are provided to calculate the address of the actual array element from the information given in the header and from parameters which give the required subscripts.

For single word or two word array elements the entry point is $\%FAP4 + 20$.

Both entry points require the same parameters as follows:

On entry, $X3$ = address of array header.

$X1$ = link.

Other parameters (one per subscript) must follow the CALL instruction and must be instructions which, if obeyed, will place the address of the subscript in $X3$.

On exit, the address of the desired array element is in $X3$. The calling routine will be re-entered at the location following the last subscript instruction.

Array Header

The array header is made up as follows:

1st word Sign bit = 0 for 1 word or 4 word elements.
= 1 for 2 word elements.

next 5 bits next 5 bits = No. of dimensions in array.

next 18 bits next 18 bits = Base address (Address of element 0, 0, -- 0).

2nd word Address of element 1, 1, 1

3rd word Address of 1st word past end of Array.

This is the array header for a one-dimensional array. For an array of more than one dimension, succeeding words give the partial products of dimensions as follows:

4th word D_1 ≥ 2 dimensions.

5th word $D_1 D_2$ ≥ 3 dimensions.

⋮

last word $D_1 D_2 \dots D_{n-1}$ n dimensions.

where D_i is the maximum value the i th subscript may take.

Communication of array information between procedures by means of Formal Parameters.

A procedure (i.e. function or subroutine) is introduced by one of the statement types.

```
SUBROUTINE X (....., A, .....
```

```
FUNCTION X (....., A, .....
```

where 'A' may be a variable, a function name or an Array name. If 'A' is to be an array name it must be included in a statement of one of the following forms:

1. DIMENSION A

2. DIMENSION A (i, j, k,

This form could alternatively appear in a Type or COMMON statement.

If 'A' is introduced by a statement of the first type, then the array is completely defined as to structure and size outside the called procedure.

If 'A' is introduced by a statement of the second type, then the starting address is defined outside the procedure but the array structure and size to be used within the procedure are as defined in this statement.

The dimensions (i, j, k,) for an array defined within a procedure may be either unsigned integers or integer variables.

For a dummy array introduced by a statement of the second type, the structure is defined by the values of i, j, ... at the time the subroutine is entered and can change for different uses of the same subroutine.

The structure of such an array is independent of the original definition of that array (in the calling routine). An array must, however, be given its maximum size in its original definition.

Note that only arrays passed as formal parameters of a procedure may have a variable structure.

%FARHD

The structuring of a dummy array is done by means of a FORTRAN library routine called %FARHD.

%FARHD has two entry points

1. Word 0 - to structure a one or two word element array.
2. Word 1 - to structure a four word element array.

On entry to %FARHD:

X3 contains the address at which %FARHD is to generate an array header.

X6 contains the address of a word which contains the address of the header for the original array.

X1 = link (CALL 1 %FARHD or %FARHD + 1)

Following the call to %FARHD is a parameter list:

1st word. number of Dimensions in new array structure.

Following words. - a series of instructions (one per dimension), which if obeyed would place in X3 the address of a word containing that dimension.

On exit from %FARHD, a new array header will have been generated starting at the address originally specified in X3.

The word originally specified by the contents of X6 will now contain the address of the new header.

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