ONE-DIMENSIONAL ARRAYS

Need for Arrays

Exercise

Read the IDs and the grades for all ICS 101 students.
Compute and print the average of the students.
Print the grades and IDs of all students who got
a grade below the average.

One Dimensional Array Declaration

Arrays must be declared using a declaration statement

Declaration of an integer array LIST consisting of 20 elements.

```
INTEGER  LIST (20)
```

Declaration of a logical array FLAG that consists of 30 elements.

```
LOGICAL  FLAG (30)
```

Declaration of a character array NAMES that consists of 15 elements with each element of size 20.

```
CHARACTER  NAMES (15)*20
```

Declaration of a real array YEAR used to represent rainfall in years 1983 to 1994.

```
REAL  YEAR (1983: 1994)
```

One Dimensional Array Declaration

Declaration of a real array TEMP with subscript ranging from -20 to 20.

```
REAL  TEMP (-20:20)
```

Implicit type declaration

```
DIMENSION  ALIST(100), KIT(-3:5), XYZ(15)

INTEGER  XYZ

REAL  BLIST(12), KIT
```

One Dimensional Array Initialization

What is Initialization?

- Initialization Using the Assignment Statement
- Initialization Using the READ Statement

Initialization Using the Assignment Statement

Declare a real array LIST consisting of 3 elements. Also initialize each element of LIST with the value zero.

```
      REAL  LIST(3)
      DO  5  K  = 1, 3
         LIST(K ) = 0.0
 5    CONTINUE
```

Declare an integer array POWER2 with subscript ranging from 0 up to 10 and store the powers of 2 from 0 to 10 in the array.

```
      INTEGER  POWER2 (0:10)
      DO  7  K  =  0, 10
         POWER2(K ) = 2 ** K
 7    CONTINUE
```

One Dimensional Array Initialization

Initialization Using the READ Statement

an array can be read

- as a whole
- in part

Examples on Reading 1-D Arrays

Example 1: Read all the elements of an integer array X size 4 .The four input data values are in a single input data line as follows
10, 20, 30, 40

Solution 1: (Without Array Subscript)

```
INTEGER  X(4)
READ*, X
```

One Dimensional Array Initialization

Solution 2: (Using an Implied Loop)

```
INTEGER  X(4), K
READ*, (X(K), K = 1, 4)
```

Example 2: Read all the elements of an integer array X of size 4. The four input data values appear in four input data lines as follows

10
20
30
40

Solution:

```
INTEGER  X(4), J
DO 22  J = 1, 4
   READ*, X(J)
22  CONTINUE
```

One Dimensional Array Initialization

Example 3: Read an integer one-dimensional array of size 100.

Solution 1: (Using a DO Loop)

```
      INTEGER  A(100), K
      DO  77  K = 1, 100
         READ*, A(K)
77    CONTINUE
```

Solution 2: (Using an implied Loop)

```
      INTEGER  A(100), K
      READ*, (A(K), K = 1, 100)
```

One Dimensional Array Initialization

Example 4: Read the grades of N students into an array SCORE. The value of N is the first input data value followed by N data values in the next input line. Assume the input is:

```
        6
55, 45, 37, 99, 67, 58
```

Solution :

```
INTEGER  SCORE(100), K, N
READ*, N
READ*, (SCORE(K), K = 1, N)
```

Printing One-Dimensional Arrays

Example 1: Read an integer array X of size 4 and print:

- the entire array X in one line;
- one element of array X per line; and
- array elements greater than 0.

If the input is given as

7 0 2 - 4

Solution :

```
      INTEGER  X(4), K
      READ*, X
      PRINT*, 'PRINTING THE ENTIRE ARRAY IN ONE LINE'
      PRINT*, X
      PRINT*, 'PRINTING ONE ARRAY ELEMENT PER LINE'
      DO 33 K = 1, 4
         PRINT*, X(K)
 33   CONTINUE
```

Printing One-Dimensional Arrays

Solution (cont) :

```
      PRINT*, 'PRINTING ARRAY ELEMENTS GREATER THAN 0'
      DO 44 K = 1, 4
         IF (X(K)  .GT.  0)  PRINT*, X(K)
 44   CONTINUE
      END
```

the output of the program is as follows:

```
PRINTING THE ENTIRE ARRAY IN ONE LINE
   7         0           2         -4
PRINTING ONE ARRAY ELEMENT PER LINE
   7
   0
   2
  -4
PRINTING ARRAY ELEMENTS GREATER THAN 0
   7
   2
```

Complete Examples on One-Dimensional Arrays

Example 1: Write a FORTRAN program that reads a one – dimensional integer array X of size 10 elements and prints the maximum element and its index in the array.

Solution:

```
      INTEGER  X(10), MAX, INDEX, K
      READ*, X
      MAX = X(1)
      INDEX = 1
      DO 1  K = 2, 10
         IF (X(K) .GT. MAX) THEN
            INDEX = K
            MAX =  X(K)
         ENDIF
    1 CONTINUE
      PRINT*, 'MAXIMUM ELEMENT:', MAX, 'INDEX:', INDEX
      END
```

Example 2: Reversing a One-Dimensional Array: Write a FORTRAN Program that reads an integer one-dimensional array of size N. The program then reverses the elements of the array and stores them in reverse order in the same array.
For example, if the elements of the array are:
33 20 2 88 97 5 71
the elements of the array after reversal should be:
71 5 97 88 2 20 33
The program prints the array, one element per line.

Solution:

```
      INTEGER  NUM(100), TEMP, N, L, K
      READ*, N, (NUM(L), L = 1, N)
      DO 10  K = 1, N / 2
         TEMP = NUM(K)
         NUM(K) = NUM(N + 1 - K)
         NUM(N + 1 - K) = TEMP
10    CONTINUE
      DO 20  L = 1, N
         PRINT*, NUM(L)
20    CONTINUE
      END
```

One-Dimensional Arrays and Subprograms

Example 1: Summation of Array Elements: Read 4 data values into an array LIST (of size 10) and print the sum of all the elements of array LIST using a function SUM.

Solution:

```
C     MAIN  PROGRAM
      INTEGER  LIST (10), SUM, K
      READ*, (LIST(K),  K  = 1, 4)
      PRINT*, 'SUM OF ALL THE ELEMENTS =' , SUM(LIST, 4)
      END
C     FUNCTION SUBPROGRAM
      INTEGER   FUNCTION SUM (MARK, N)
      INTEGER   N, MARK(N), J
      SUM = 0
      DO  10  J = 1, N
         SUM = SUM + MARK(J)
 10   CONTINUE
      RETURN
      END
```

One-Dimensional Arrays and Subprograms

Example 2: Counting Negative Numbers within a One-Dimensional Array:

Write a subroutine FIND that takes a one-dimensional array and its size as two input arguments. It returns the count of the negative and non-negative elements of the array.

Solution:

```
C     SUBROUTINE SUBPROGRAM
      SUBROUTINE  FIND (A, N, COUNT1, COUNT2)
      INTEGER  N , A(N), COUNT1, COUNT2, K
      COUNT1 = 0
      COUNT2 = 0
      DO 13 K = 1, N
         IF (A(K) .LT. 0) THEN
            COUNT1 = COUNT1 + 1
         ELSE
            COUNT2 = COUNT2 + 1
         ENDIF
13    CONTINUE
      RETURN
      END
C     MAIN  PROGRAM
      INTEGER  A(100), N,  COUNT1, COUNT2, K
      READ*,  N,  (A(K),  K = 1, N)
      CALL FIND (A, N, COUNT1, COUNT2)
      PRINT*. 'COUNT OF  THE  NEGATIVE ELEMENTS =' , COUNT1
      PRINT*. 'COUNT OF  THE  NON-NEGATIVE ELEMENTS =' , COUNT2
      END
```

Exercises

What is the output of the following program?

```
      INTEGER A(4), B(4), G, K, N
      G(K) = K ** 2
      READ*, A
      DO 60 N = 1, 4
         B(N) = G(A(5 - N))
60    CONTINUE
      PRINT*, B
      END
```

Assume the input for the program is:

10, 20, 30, 40

The Output			
1600	900	400	100

What is the output of the following program?

```
      INTEGER X(5), Y(5), N, K
      READ*, N, (X(K), Y(K), K = 1, N)
      DO 5 K = X(N), Y(N)
         PRINT*, ('X', J = X(K), Y(K))
    5 CONTINUE
      END
```

Assume the input for the program is:

4, 1, 2, 3, 3, 3, 4, 2, 4

The Output

X
XX
XXX