LOGICAL EXPRESSIONS AND CONTROL STATEMENTS

Lecture-5

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Repetition Structure

There are two basic types of repetition structures:

- **Loops controlled by a counter:**

  the body of the loop is executed once for each value of some control variable in a specified range of values. *DO loop*

- **Loops controlled by a logical expression:**

  the decision to continue or to terminate repetition is determined by the truth or falsity of some logical expression. *DO WHILE loop.*

Repetition Structure cont'd

- In solving problems, we may frequently need to execute some expression /statement repeatedly. Situations where the number of repetitions may be determined in advance is called **Deterministic repetition**.
- However, it often happens that the condition to end a repeat structure (or loop) is only satisfied during the execution loop of the loop itself. This type of repeat structure is called **Non-deterministic repetition.**

Repetition Structure cont'd

- **Iterative or Counting Loop**

A loop that execute a block of statements a specified number of times is called Iterative DO loop or counting loop. The counting loop construct has the form

```
DO    index = istart, iend, icr
      Statement 1
       ……….
      Statement n
END DO
```

Repetition Structure cont'd

- *index is an integer variable*
- *istart is the initial value index is given*
- *iend is the final value*
- *icr is the increment by which index is changed. If it is omitted, unity is assumed*
- *istart, iend* and *icr* may be positive or negative constants, variables or expressions, but they should always be integers.

```
DO  index = istart, iend, icr
        Statement 1
        ……
        Statement n
END DO
```

Repetition Structure cont'd

CONTINUE Statement

The CONTINUE Statement is a dummy statement. It is dummy in the sense that it has no effect on the execution of the program. This statement is used primarily as a convenient point for placing a statement label, particularly as the terminal.

```
DO n    index = istart, iend, icr
        Statement 1
        ……
 n CONTINUE
```

Do loop Examples

Example 1: Degrees to radians conversion program

```
PROGRAM CONVRT
      INTEGER DEGREE
      CONFAC = 3.141593/180.0
!CONVERSION FACTOR FROM DEGREES TO RADIANS
      DO 10, DEGREE = 0,360,10
        RADIAN = DEGREE*CONFAC
        Write(*,*) DEGREE,'   degree equals ',RADIAN,  'radian'
     10    CONTINUE
      END
```

Do loop Example

Example 2: Write a program that reads an integer N and computes N!.

```
program factorial
implicit none
integer N !number of iteration
integer::F=1
write(*,*)'GIVE THE NUMBER WHOSE FACTORIAL HAVE TO BE DETERMINED'
read(*,*) N !Number whose factorial have to  be  determined
do N = 1 , N
     F = F*N
end do
write(*,*) 'FACTORIAL OF',N,'IS',F
end program factorial
```

Nested DO Loop

It is possible for one loop to be completely inside another loop. **If one loop is completely inside another one, the two loops are called nested loops.** The following example shows two nested DO loops used to calculate and write out the product of two integers.

```
PROGRAM NESTED_LOOP
IMPLICIT NONE
INTEGER :: i, j, multiplication
DO  i=1,3
       DO j=1,3
              multiplication=i*j
              WRITE(*,*) i,'*',j,'=', multiplication
        END DO
END DO
END PROGRAM NESTED_LOOP
```

Non Deterministic Repetition

Sometimes it is not possible to determine the number of iteration count. In such situation, Non Deterministic Repetition is used.

1.DO: conditional EXIT

The general form of DO: conditional EXIT is

```
DO
      IF (LOGICAL_EXPRESSION) EXIT
   STATEMENT 1
    …….
   STATEMENT n
END DO
```

The EXIT statement provides a means to exit from an otherwise endless loop. It may in fact go anywhere in the loop. However, it is best for it to go either at the top or at the end.

Non Deterministic Repetition cont'd

2.DO WHILE

- A DO construct may be headed with DO WHILE statement

```
DO WHILE (Logical_Expression)
      Statement1
       ……..
      Statement n
END DO
```

- If the logical expression is true, statements 1 through n will be executed, and then control will return to the DO WHILE statement. This process will be repeated until the logical expression becomes false. When control returns to the DO WHI LE statement and the logical expression is false, the program will execute the first statement after the END DO.

Non Deterministic Repetition cont'd

3. Alternate for DO WHILE

- **GO TO** statement within IF construct can be used in place of DO WHILE loops:

```
n       IF (logical-expression) THEN
                statement sequence
        GO TO n
        END IF
```

- Wherever possible, use an IF construct in preference to GOTO statements.

Non Deterministic Repetition cont'd

Example:

```
program dowhile
implicit none
real::x
logical::repeat
repeat=.true.
do while (repeat)
  write(*,*)'enter a real number x,'
  write(*,*)'or a negative number to exit'
  read(*,*)x
  if (x.gt.0.0)then
    write(*,*)'The square root is',sqrt(x)
    else
      repeat=.false.
      end if
      end do
      end program dowhile
```

Assignment

Problem 1: Write a program that reads an integer N and computes sum of squares of first N positive integers.

Problem 2: Write a program to find all three digit prime numbers; that is find all prime numbers between 100 and 999

Assignment

Problem 3: Write a program to read a set of numbers, count them, and calculate the mean, variance, and standard deviation of the set of numbers. The mean variance and standard deviation of numbers x_1, x_2, x_3……..x_n can be calculated using the following formulas:

$$\text{mean} = \frac{1}{n}\sum_{i=1}^{n} x_i \ ,$$

$$\text{variance} = \frac{1}{n}\sum_{i=1}^{n} x_i^{\,2} - \frac{1}{n^2}\left(\sum_{i=1}^{n} x_i\right)^2$$

$$\text{S.D.} = \sqrt{\text{variance}}$$

Assignment

Problem 4:

One of the most widely used cubic equation of state is the Soave modification of Redlich-Kwong (SRK) equation:

$$P = RT(V - b) - \alpha a / V(V + b)$$

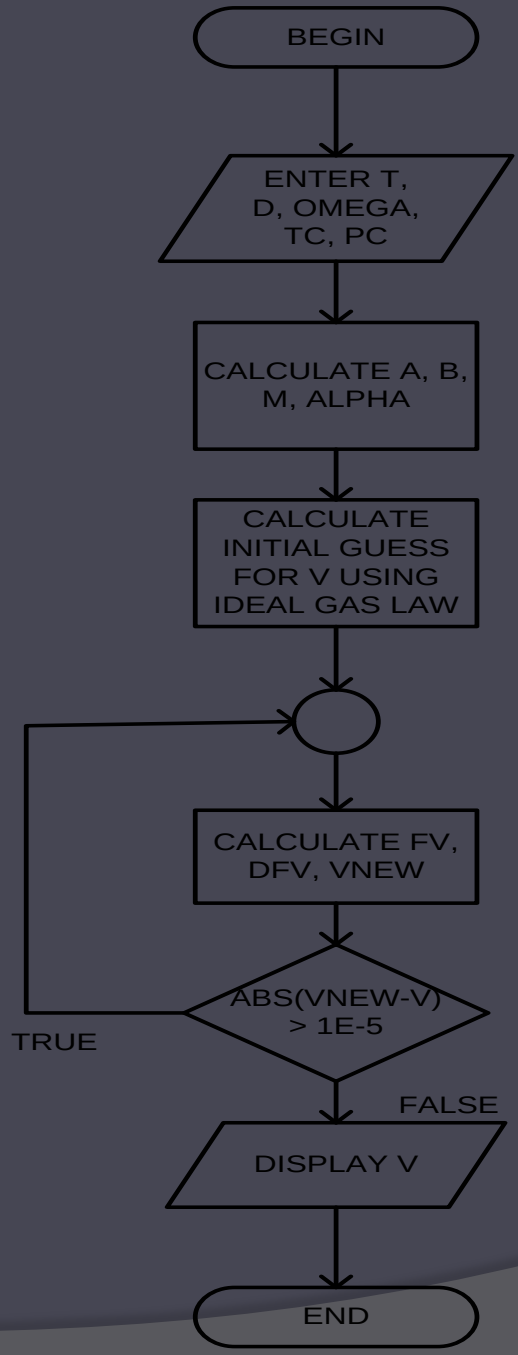
Here, $a = 0.42747\, R^2 T_c^2 / P_c$

$b = 0.08664\, RT_c / P_c$

$\alpha = [1 + m(1 - \sqrt{(T/T_c)})]^2$

$m = 0.48508 + 1.55171\,\omega - 0.15613\omega^2$

Write a program that uses the SRK equation of state to estimate volume of gas for a given temperature and pressure


BEGIN
ENTER T, D, OMEGA, TC, PC
CALCULATE A, B, M, ALPHA
CALCULATE INITIAL GUESS FOR V USING IDEAL GAS LAW
CALCULATE FV, DFV, VNEW
ABS(VNEW-V) > 1E-5
TRUE
FALSE
DISPLAY V
END