ENCE 202
FORTRAN
Handout 1

Introduction to FORTRAN

by

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ENCE 202
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Department of Civil and Environmental Engineering
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Introduction

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- FORTRAN
  - FORTRAN = FORmula TRANslation
  - Developed for the IBM 704 Computer
  - Developed by *John Backus* and a team of 13 other programmers
  - Developed between 1954 and 1957

Introduction

- FORTRAN is a high-level language such as BASIC, C, and C++
- A *compiler* translates each statement in the program into a sequence of basic machine language instruction

$$X = A * B + C$$

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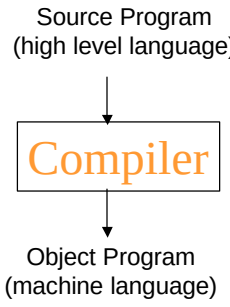


Program Development

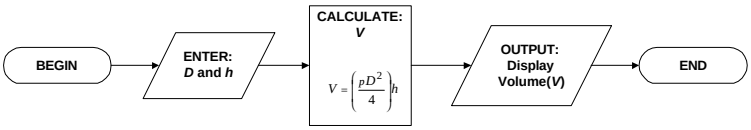
- A program consists of
  - Input
  - An execution logic (computation)
  - Output
- A flow chart is used to develop the structure

Program Development

- EXAMPLE 1: Volume of a Cylinder
  - Input:
    - Diameter, *D*
    - Height, *h*
  - Computation
    - $V = \left(\frac{pD^2}{4} \right) \times h$
  - Output:
    - Volume, *V*

Program Development

- Flow Chart for Example 1



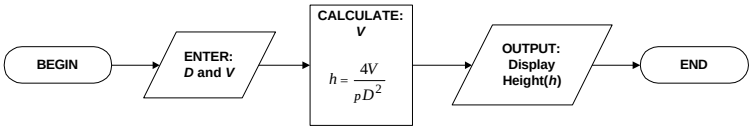
  - A flow chart is a block diagram that summarizes the program structure and logic flow

Program Development

- EXAMPLE 2: Height of a Cylinder
  - Input:
    - Diameter, *D*
    - Volume, *V*
  - Computation
    - $h = \dfrac{4V}{pD^2}$
  - Output:
    - Height, *h*

Program Development

- Flow Chart for Example 2



  - A flow chart is a block diagram that summarizes the program structure and logic flow

Fundamentals of FORTRAN

- The following is a format of a simple program:
  - PROGRAM NAME
  - Opening documentation use
  - Variables declaration
  - Program statements
  - END

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Fundamentals of FORTRAN

- FORTRAN Statements
  - Positions 7 to 72 of a line can be used. To continue on the next line, use any character on position 6 of the next line
- Constants
  - Examples
    - -12
    - 1.2345
    - 12.45-e10

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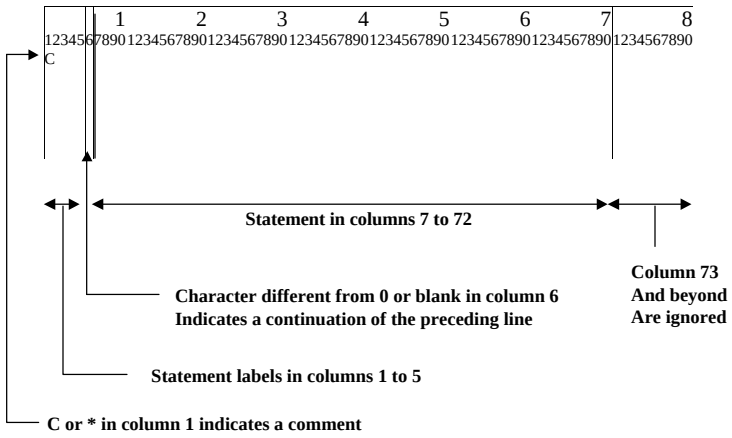

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Fundamentals of FORTRAN

- Data Types
  - Integer
  - Real
  - Double Precision
  - Complex
  - Character
  - Logical

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- Variables
  - Variables starts with a letter
  - The first letter defines the variable type
    - Integer or real
  - The default types are
    - I, J, K, L, M, and N
    - These are integers variables if they are used as the first letter in names
    - Otherwise, they are treated as real variables

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Fundamentals of FORTRAN

- Type Statements
  - REAL *list of variables*
  - INTEGER *list of variables*
  - CHARACTER*n *list of variables with size n (default n = 1)*
  - PARAMETER ($param_1 = value_1$, $param_2 = value_2$, ….etc)
  - DATA $list_1/data_1/$, $list_2/data_2/$, , $list_n/data_n?$

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- Examples: Type statements

```
REAL X, Speed, Height
INTEGER I, M, Q
CHARACTER*2 Var1, Var2
PARAMETER (PI = 3.14159, E = 2.71)
DATA w/1.3/, x,y/2.3, 5.6/
DATA w,x,y/1.3, 2.3, 5.6
```

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- Arithmetic Operations
  - Addition +
  - Subtraction -
  - Multiplication *
  - Division /
  - Exponentiation **

    Example:

    Area = (3.14)*(D**2)/4

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- Priority Rules

  ** from right to left

  * and / from left to right

  + and - from left to right

  NOTE:

  To avoid confusion, always use parentheses

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Fundamentals of FORTRAN

- Standard Library Functions
  - Examples
    - SQRT (argument), Square Root
    - ABS (x), Absolute value
    - COS (y) Cosine of argument
    - LN(x) Natural Logarithm
    - Etc.

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- Assignment Statements

Variable = expression

  - Examples

```
x = 0.234
y = sqrt(x) / 2 + height**3
```

Fundamentals of FORTRAN

- List-directed Input and Output

  PRINT *, *output-list* (*separators are commas*)

- Examples:

  PRINT * ➔ (print a blank line)

  PRINT *, 'Test, Test' ➔ Test, Test

  PRINT *, 'Interest' =, Int ➔ Interest = 5

Fundamentals of FORTRAN

- List-directed Input and Output

  READ *, *input-list* (*separators are commas*)

- Examples:

  PRINT *, 'Enter Velocity and Time?'

  READ *, 'VELOC0, TIME

  READ *, Int, A

  Note: It is a good practice to prompt the user that input is needed, using PRINT statement before READ with prompt information

Example: Simple Program

- This program calculates the velocity and height of a projectile given its initial height, velocity,and constant acceleration

$$\text{Height}: \quad h = \frac{1}{2}at^2 + v_0 t + h_0$$

$$\text{Velocity}: \quad v = at + v_0$$

Example: Simple Program


```
      PROGRAM PROJECT
C
C     This program calculates the velocity and height of a projectile given its
C     initial height, initial velocity, and constant acceleration. Variables used are:
C     HGHT      :     initial height
C     HGHT      :     height at any time
C     VELOC     :     initial vertical velocity
C     VELOC     :     vertical velocity at any time
C     ACCEL     :     vertical acceleration (Gravity)
C     TIME  :         time elapsed since projectile was launched

      REAL HGHT  , HGHT, VELOC  , VELO, ACCEL, TIME

      ACCEL = - .
      PRINT *, `Enter initial height, initial velocity, and time?`
      READ *, HGHT  , VELOC  , TIME

      HGHT =   .  * ACCEL * TIME **   +VELOC   * TIME + HGHT
      VELOC = ACCEL * TIME + VELOC

      PRINT *,  `AT TIME `, TIME,  ` THE VERTICAL VELOCITY IS `, VELOC
      PRINT *, `AND THE HEIGHT IS `, HGHT
      END
```