SNS COLLEGE OF TECHNOLOGY

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DEPARTMENT OF INFORMATION TECHNOLOGY

19ITT101-PROGRAMMING IN C AND DATA STRUCTURES

I YEAR - II SEM

UNIT 1 – INTRODUCTION TO C

TOPIC 7 – Variables

VARIABLES

- A **variable** is a data name that may be used to store a data value.

- A variable may take different values at different times during execution.

- Some examples of variables' names are:
  - Average
  - height
  - Total
  - Counter_1
  - class_strength

- variable names may consist of letters, digits, and the underscore(_) character, and are subject to the following conditions:

RULES FOR NAMING VARIABLES

1. They must begin with a letter.
    - Some systems permit underscore as the first character.
2. ANSI standard recognizes a length of 31 characters.
    - However, length should not be normally more than eight characters, since only the first eight characters are treated as significant by many compilers.
3. Uppercase and lowercase are significant.
    - That is, the variable ‘Total’ is not the same as ‘total’ or ‘TOTAL’.
4. It should not be a keyword.
5. White space is not allowed.

➢ Some examples of valid variable names are:

John Value T_raise Delhi x1 ph_value mark sum1

➢ Invalid examples include: 123 (area) % 25th

DECLARATION OF VARIABLES

- After designing suitable variable names, we must declare them to the compiler.
- Declaration does two things:
    1. It tells the compiler what the variable name is.
    2. It specifies what type of data the variable will hold.

- IMPORTANT NOTE:

"The declaration of variables must be done before they are used in the program"

PRIMARY TYPE DECLARATION

- A variable can be used to store a value of any data type.
  - That is, the name has nothing to do with its type.
- The syntax for declaring a variable is as follows:

  data-type v1,v2,....vn ;
- v1, v2, ...vn are the names of variables.
- Variables are **separated by commas.**
- A declaration statement must end with a semicolon.

- For example, valid declarations are:
  - int count;
  - int number, total;
  - double ratio;

- int and double are the keywords to represent integer type and real type data values respectively

Program to Add Two Integers

```c
#include <stdio.h>
int main() {

    int number1, number2, sum;

    printf("Enter two integers: ");
    scanf("%d %d", &number1, &number2);

    // calculating sum
    sum = number1 + number2;

    printf("%d + %d = %d", number1, number2, sum);
    return 0;
}
```

Output

```
Enter two integers: 12
11
12 + 11 = 23
```

USER-DEFINED TYPE DECLARATION

typedef Identifier:

- C supports a feature known as “type definition” that allows **users to ‘define’ an “identifier”** that would represent an existing data type.
- The user-defined data type identifier can later be used to declare variables.
- It takes the general form:
  - typedef type identifier;
- Where ‘type’ refers to an existing data type and “identifier” refers to the “new” name given to the data type.
- Remember that the new type is ‘new’ only in name, but not the data type.

USER-DEFINED TYPE DECLARATION

- Syntax: typedef type identifier;

- Some examples of type definition are:

```
typedef   int   units;
typedef   float  marks;
```

  - Here, **units** symbolizes **int** and **marks** symbolizes **float**.
- They can be later used to declare variables as follows:

```
units batch1, batch2;
marks name1[50], name2[50];
```

  - Here, batch1 and batch2 are declared as **int** variable and name1[50] and name2[50] are declared as **floating point** array variables.

- The main advantage of typedef is that we can create meaningful data type names for increasing the readability of the program.

USER-DEFINED TYPE DECLARATION

- **enum Identifier:**
- Another user-defined data type is enumerated data type provided by ANSI standard.
- It is defined as follows:

  enum identifi er {value1, value2, ... valuen};
- The “identifier” is a user-defined enumerated data type which can be used to declare variables that can have one of the values enclosed within the braces (known as enumeration constants).
- After this definition, we can declare variables to be of this ‘new’ type as below:

  enum identifier v1, v2, ... vn;
- The enumerated variables v1, v2, ... vn can only have one of the values value1, value2, ... Value n.

USER-DEFINED TYPE DECLARATION

- Syntax: enum identifier {value1, value2, ... valuen};
- An example:

```
enum day {Monday,Tuesday, ... Sunday};
enum day week_start, week_end;

week_start = Monday;
week_end = Sunday;

if(week_st = = Tuesday)
week_end  = = Monday;
```

- The compiler automatically assigns integer digits beginning with "**0**" to all the enumeration constants.
- That is, the enumeration constant value1 is assigned 0, value2 is assigned 1, and so on.
- However, the automatic assignments can be overridden by assigning values explicitly to the enumeration constants.

DECLARATION OF STORAGE CLASS

- Variables in C can have not only data type but also **storage class** that provides information about their location and visibility.
- The storage class decides **the portion of the program** within which the variables are recognized.
- Consider the following example:

```
/* Example of storage classes */
        int m;
        main()
        {
                int i;
                float balance;
                ....
                function1();
        }
        function1()
        {
                int i;
                float sum;
                ....
        }
```

DECLARATION OF STORAGE CLASS

The variable **m** which has been declared before the **main** is called "global variable".

- It can be used in all the functions in the program.
- It need not be declared in other functions.
- A **global variable** is also known as an external variable.

- The variables **i, balance and sum** are called "local variables".
- Because they are declared inside a function.
- Local variables are **visible and meaningful only inside** the functions in which they are declared.
- They are not known to other functions.

- This is called SCOPE OF A VARIABLE

- Note that the variable **i** has been declared in both the functions.
- Any change in the value of i in one function does not affect its value in the other.

```
/* Example of storage classes */
        int m;
        main()
        {
                int i;
                float balance;
                ....
                function1();
        }
        function1()
        {
                int i;
                float sum;
                ....
        }
```

DECLARATION OF STORAGE CLASS

- There are four storage class specifiers:

Storage class	Meaning
auto	Local variable known only to the function in which it is declared. *Default is auto*.
static	Local variable which exists and retains its value even after the control is transferred to the calling function.
extern	Global variable known to all functions in the file.
register	Local variable which is stored in the register.

- The storage class is another qualifier (like long or unsigned) that can be added to a variable declaration as shown below:

```
auto int count;
register char ch;
static int x;
extern long total;
```

- Static and external (extern) variables are automatically initialized to zero.
- Automatic (auto) variables contain undefined values (known as ‘garbage’) unless they are initialized explicitly.

DECLARATION OF STORAGE CLASS

```
#include<stdio.h>
#include<conio.h>
Void main()
{
    int c= 340;
    Printf(“C = %d”, c);
     {
          int c = 450;
          Printf(“C = %d”, c);
     }
    Printf(“C = %d”, c);
    getch();
}
```

Output:
C = 340
C = 450
C = 340

```
#include<stdio.h>
#include<conio.h>
Void main()
{
    int static c= 340;
    Printf(“C = %d”, c);
     {
          int c = 450;
          Printf(“C = %d”, c);
     }
    Printf(“C = %d”, c);
    getch();
}
```

Output:
C = 340
C = 340
C = 340

ASSIGNING VALUES TO VARIABLES

- Variables are created for use in program statements such as:

```
value = amount + inrate * amount;
while (year <= PERIOD)
{
        ....
        ....
        year = year + 1;
}
```

- In the first statement, the **numeric value** stored in the variable **inrate** is multiplied by the value stored in **amount** and the product is added to **amount**.
- The result is stored in the 'variable' value.
- This process is possible only if the variables amount and inrate have already been given values.
- The variable value is called the **target variable**.
- While all the variables are declared for their type, the variables that are used in expressions (on the right side of equal (=) sign of a computational statement) must be assigned values before they are encountered in the program.
- Similarly, the variable **year** and the symbolic constant **PERIOD** in the while statement must be assigned values before this statement is encountered.

ASSIGNMENT STATEMENT

- Values can be assigned to variables using the assignment operator "= " as follows:

  variable_name = constant;

- Ex. are:

  initial_value = 0;
  fi nal_value = 100;
  balance = 75.84;
  yes = 'x';

- C permits multiple assignments in one line.
- For example

  initial_value = 0; fi nal_value = 100; are valid statements.

- An assignment statement implies that the value of the variable on the **left** of the 'equal sign' is set equal to the value of the quantity (or the expression) on the **right**.
- The statement:

  year = year + 1;

  - means that the 'new value' of year is equal to the 'old value' of year plus 1.

ASSIGNMENT STATEMENT

- During assignment operation, C converts the type of value on the right-hand side to the type on the left.
- This may involve **truncation** when real value is converted to an integer.
- It is also possible to assign a value to a variable at the time the variable is declared.
- This takes the following form:

  data-type variable_name = constant;
- Some examples are:

  int fi nal_value = 100;
  char yes = ‘x’;
  double balance = 75.84;
- The process of giving initial values to variables is called **initialization**.
- C permits the initialization of more than one variables in one statement using multiple assignment operators.
- For example

  p = q = s = 0;
  x = y = z = 10;
- are valid. The first statement initializes the variables p, q, and s to zero while the second initializes x, y, and z with 10.

READING DATA FROM KEYBOARD

- Another way of giving values to variables is to input data through keyboard using the **scanf** function.
- It is a general input function available in C and is very similar in concept to the **printf** function.
- It works much like an INPUT statement.
- The general format of **scanf** is as follows:

  scanf(“control string”, &variable1,&variable2,. ..);
- The control string contains the format of data being received.
- The ampersand symbol **&** before each variable name is an operator that specifies the variable name’s address.

```
#include <stdio.h>
int main()
{
int number1, number2, sum;
printf("Enter two integers: ");
scanf("%d %d", &number1, &number2);
sum = number1 + number2;
printf("%d + %d = %d", number1, number2, sum);
}
```

OUTPUT:

```
 Enter two integers:  12    11
12+11 = 23
```

READING DATA FROM KEYBOARD

```
#include <stdio.h>
int main()
{
int number1, number2, sum;
printf("Enter two integers: ");
scanf("%d %d", &number1, &number2);
sum = number1 + number2;
printf("%d + %d = %d", number1, number2, sum);
}
```

OUTPUT:

```
Enter two integers:  12    11
12+11 = 23
```

```
scanf("%d %d", &number1, &number2);
```

- When this statement is encountered by the computer, the execution stops and waits for the value of the variable number to be typed in.
- Since the control string “%d” specifies that an integer value is to be read from the terminal, we have to type in the value in integer form.
- Once the number is typed in and the ‘Return’ Key is pressed, the computer then proceeds to the next statement.
- Thus, the use of scanf provides an interactive feature and makes the program ‘user friendly’.

READING DATA FROM KEYBOARD

Entire Data types in c:

Data type	Size(bytes)	Range	Format string
Char	1	128 to 127	%c
Unsigned char	1	0 to 255	%c
Short or int	2	-32,768 to 32,767	%i or %d
Unsigned int	2	0 to 65535	%u
Long	4	-2147483648 to 2147483647	%ld
Unsigned long	4	0 to 4294967295	%lu
Float	4	3.4 e-38 to 3.4 e+38	%f or %g
Double	8	1.7 e-308 to 1.7 e+308	%lf
Long Double	10	3.4 e-4932 to 1.1 e+4932	%lf

DEFINING SYMBOLIC CONSTANTS

#define symbolic-name value of constant

- Valid examples of constant definitions are:

```
#define STRENGTH 100
#define PASS_MARK 50
#define MAX 200
#define PI 3.14159
```

- Symbolic names are sometimes called constant identifiers.
- Since the symbolic names are constants (not variables), they do not appear in declarations.

Statement	Validity	Remark
#define X = 2.5	Invalid	'=' sign is not allowed
# define MAX 10	Invalid	No white space between # and define
#define N 25;	Invalid	No semicolon at the end
#define N 5, M 10	Invalid	A statement can define only one name.
#Define ARRAY 11	Invalid	define should be in lowercase letters
#define PRICE$ 100	Invalid	$ symbol is not permitted in name

DEFINING SYMBOLIC CONSTANTS

- The following rules apply to a #define statement which define a symbolic constant:

1. Symbolic names have the same form as variable names. (Symbolic names are written in **CAPITALS** to visually distinguish them from the normal variable names, which are written in lowercase letters.
2. No blank space between the pound sign '#' and the word define is permitted.
3. '#' must be the first character in the line.
4. A blank space is required between #define and symbolic name and between the symbolic name and the constant.
5. #define statements must not end with a semicolon.
6. After definition, the symbolic name should not be assigned any other value within the program by using an assignment statement. For example, STRENGTH = 200; is illegal.
7. Symbolic names are NOT declared for data types. Its data type depends on the type of constant.
8. #define statements may appear anywhere in the program but before it is referenced in the program (the usual practice is to place them in the beginning of the program).