



C-PROGRAMMING

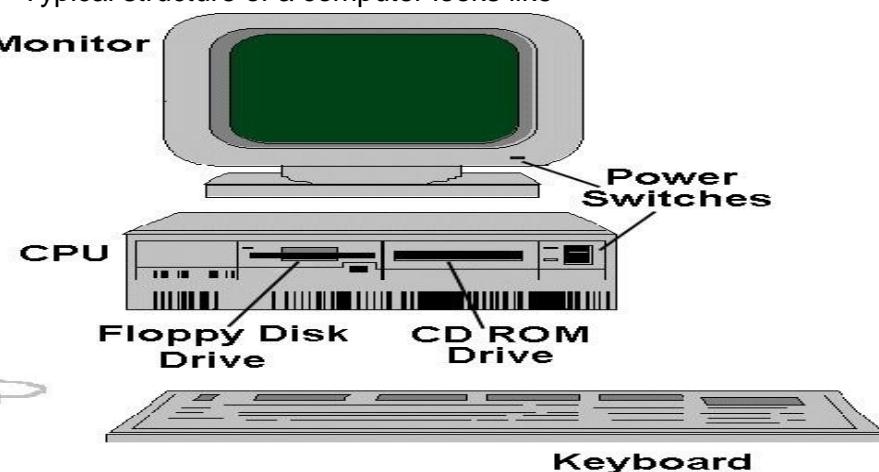
Notes by – Preetam Dutta Sir

Ph No. - 9875445424

Module(1&2) e-notes

What is a Computer?

- Computer
 - Device capable of performing computations and making logical decisions
 - Computers process the data under the control of sets of instructions called computer programs
- Computer Consists of two parts they are Hardware and Software
- Hardware
 - Various devices comprising a computer
 - Keyboard, screen, mouse, disks, memory, CD-ROM, and processing units, mother board etc..
- Software
 - Programs that run on a computer



Working principle of a computer involves following steps

Instruction phase

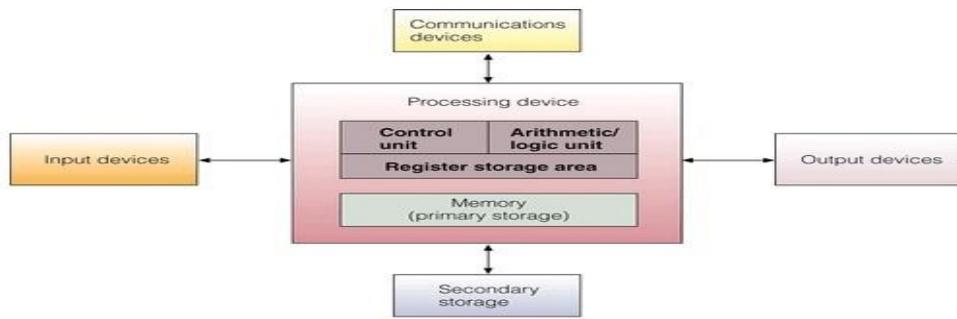
- **Step 1: Fetch instruction from the memory**
- **Step 2: Decode instruction**

Execution phase

- **Step 3: Execute the instruction**
- **Step 4: Store the results**

Now the question is how to write such Instructions?

Hence we require a programming language to communicate with machine by writing instructions. Instruction can be written in Machine language or assembly language or High level language.



Naturally a language is the source of communication between two persons, and also between person to machine like computer. The languages we can use to communicate with the computer are known as Computer programming languages.

Generally there are three major types of languages are available and as follows:

1. Machine languages

- Strings of numbers giving machine specific instructions
- Example:

+1300042774

+1400593419

+1200274027

2. Assembly languages

- English-like abbreviations representing elementary computer operations (translated via assemblers)
- Example:

Load BASic

Add Basic,da,gross

Move gross,total

3. High level languages

► The set of commands available in high level language is very simple and

easy to understand.

- Code is similar to everyday use of English sentence
- Use mathematical notations (translated via compilers)
- Example:

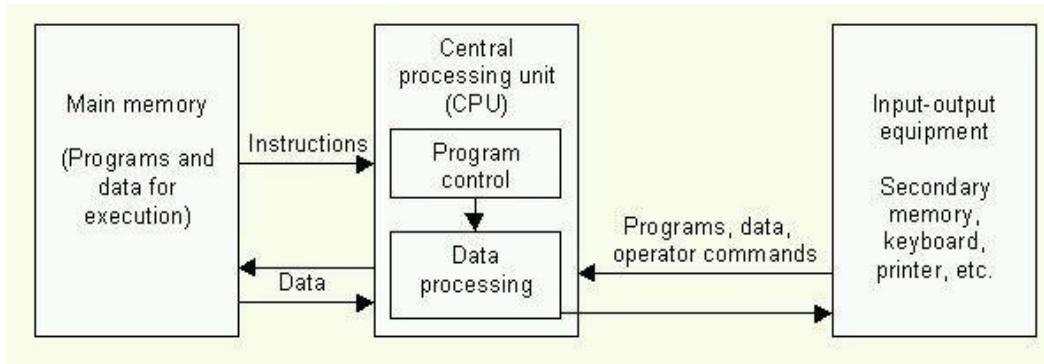
Totalsal = basic + da

"High-level" is a relative term, C programming language is a relatively low-level and also high-level language. Pascal, Fortran, COBOL, Java etc are typical examples for high-level languages. Application specific languages are Matlab, Javascript, VBScript etc.

What is Programming ?

- *A programming is a tool for developing executable models for a class of problem domains.*
- *A programming language is a notational system for describing computation in a machine-readable and human-readable form.*
- *A vocabulary and set of grammatical rules for instructing a computer to perform specific tasks. It usually refers to high-level languages, such as BASIC, C, C++, etc...*

- Computers are based on the stored program concept given by Von Neumann. It consists of Central Processing Unit(CPU) main memory, input output devices, ports, buses etc.,
- Actions performed by CPU are written through program. Hence Program is a sequence of instructions.



Tools such as flowcharts, Algorithm and pseudocodes are used to develop program

Pseudocodes:

Since each programming language uses a unique syntax structure, understanding the code of multiple languages can be difficult. Pseudocode helps this problem by using **conventional syntax** and **basic English phrases** that are universally understood

Pseudocode is an **informal** program description that does not contain code syntax or underlying technology considerations. It summarizes a program's steps (or flow) but excludes underlying details. Hence, By describing a program in pseudocode, programmers of all types of languages can understand the function of a program.

Example

```

If student's marks is greater than or equal to 35
Print "pass"
else
    Print "fail "
  
```

• Algorithm:

It is an effective step-by-step procedure to perform the solution to a given problem. It can be expressed using notations. Natural language like English is used to write these steps.

• Flowcharts:

- It is a diagram showing a sequence of activities to be performed for the solution of a problem.

- A set of conventional symbols are used to draw flowcharts
 - Graphically depicts the logical steps to carry out a task and shows how the steps relate to each other.
 - An organized combination of shapes, lines, and text that graphically illustrates a process or structure
 - Flowchart is a pictorial representation showing all the steps of a process
- Some of the symbols used do design flowcharts are

Symbol	Name	Meaning
	Flowline	Used to connect symbols and indicate the flow of logic.
	Terminal	Used to represent the beginning (Start) or the end (End) of a task.
	Input/Output	Used for input and output operations, such as reading and displaying. The data to be read or displayed are described inside.
	Processing	Used for arithmetic and data-manipulation operations. The instructions are listed inside the symbol.
	Decision	Used for any logic or comparison operations. Unlike the input/output and processing symbols, which have one entry and one exit flowline, the decision symbol has one entry and two exit paths. The path chosen depends on whether the answer to a question is "yes" or "no."



Connector

Used to join different flowlines.



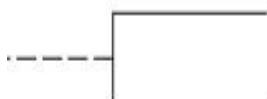
Offpage Connector

Used to indicate that the flowchart continues to a second page.



Predefined Process

Used to represent a group of statements that perform one processing task.

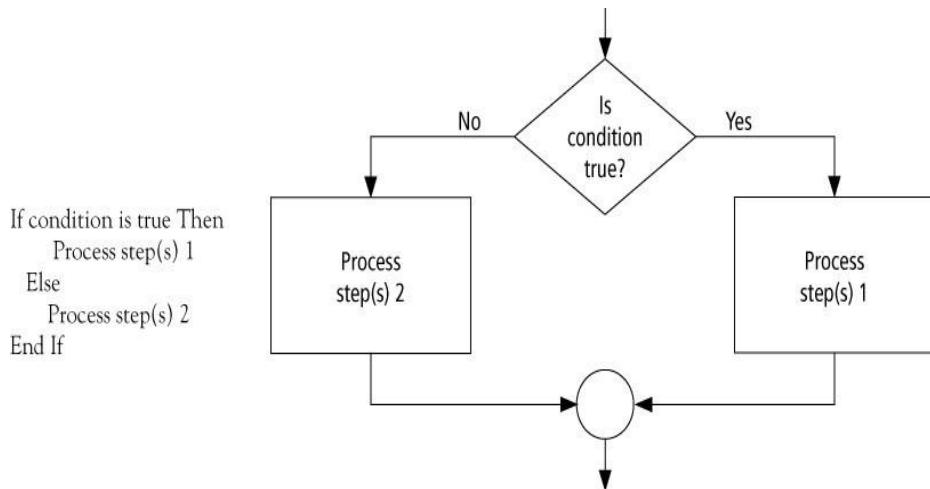


Annotation

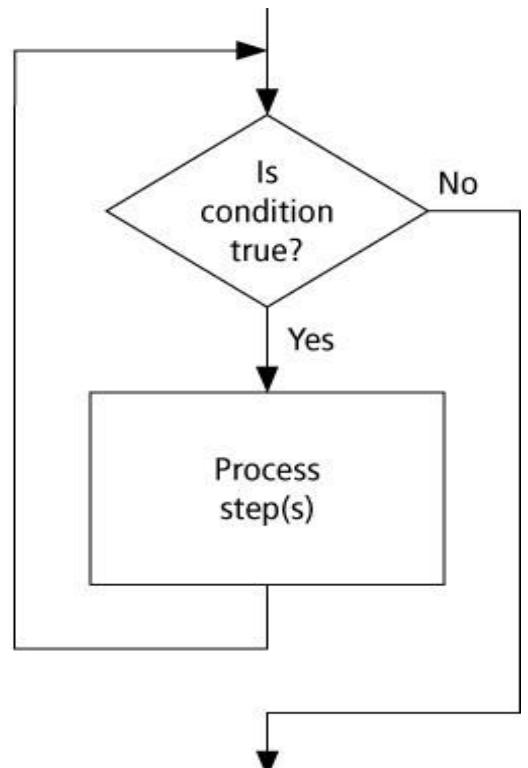
Used to provide additional information about another flowchart symbol.

Example to demonstrate some of the flowcharts are

1.



Do While condition is true
 Process step(s)
 Loop



2.

Pseudocode to calculate class average grade

: Determine the average grade of a class

Initialize Counter and Sum to 0

DoWhile there are more data

Get the next Grade

Add the Grade to the Sum

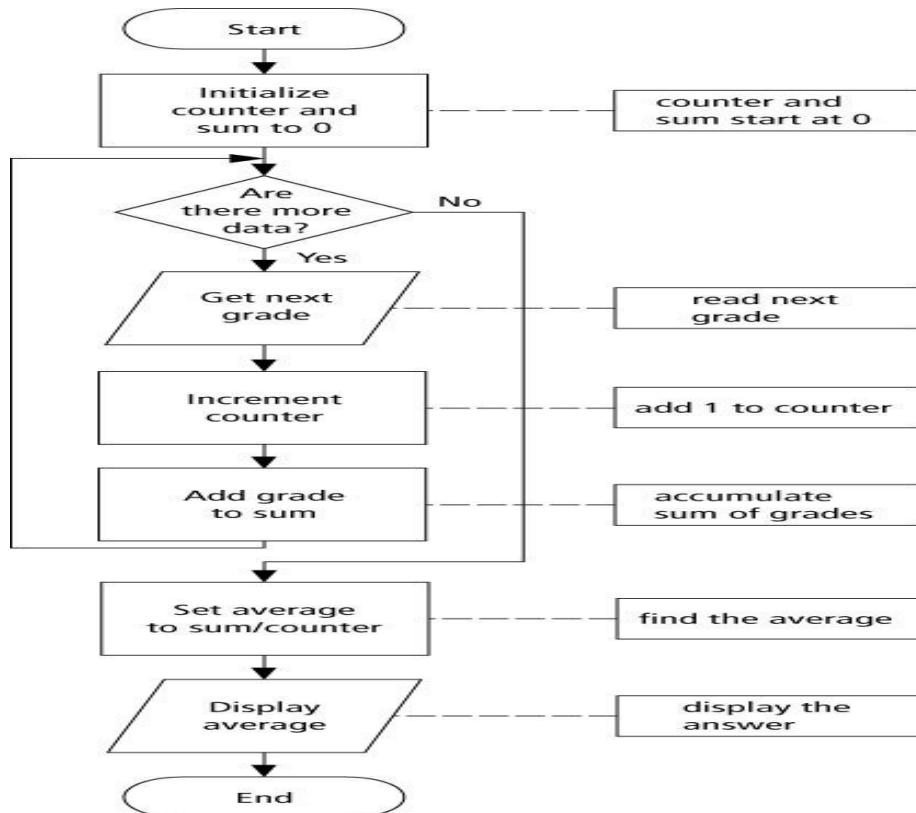
Increment the Counter

Loop

Compute Average = Sum / Counter

Display Average

Flowchart representation



History of C Programming Language

□ The C programming language was designed by

Dennis Ritchie at Bell Laboratories in the early

1970s



- Influenced by following previous High level languages
- ALGOL 60 (1960),
- CPL (Cambridge, 1963),
- BCPL (Martin Richard, 1967), (Basic Combined Programming Language)
- B (Ken Thompson, 1970)

B language is modified by Ritchie and new Language is named as C

- C is a general-purpose language which has been closely associated with the UNIX OS for which it was developed - since the system and most of the programs are written in C.

C Standards

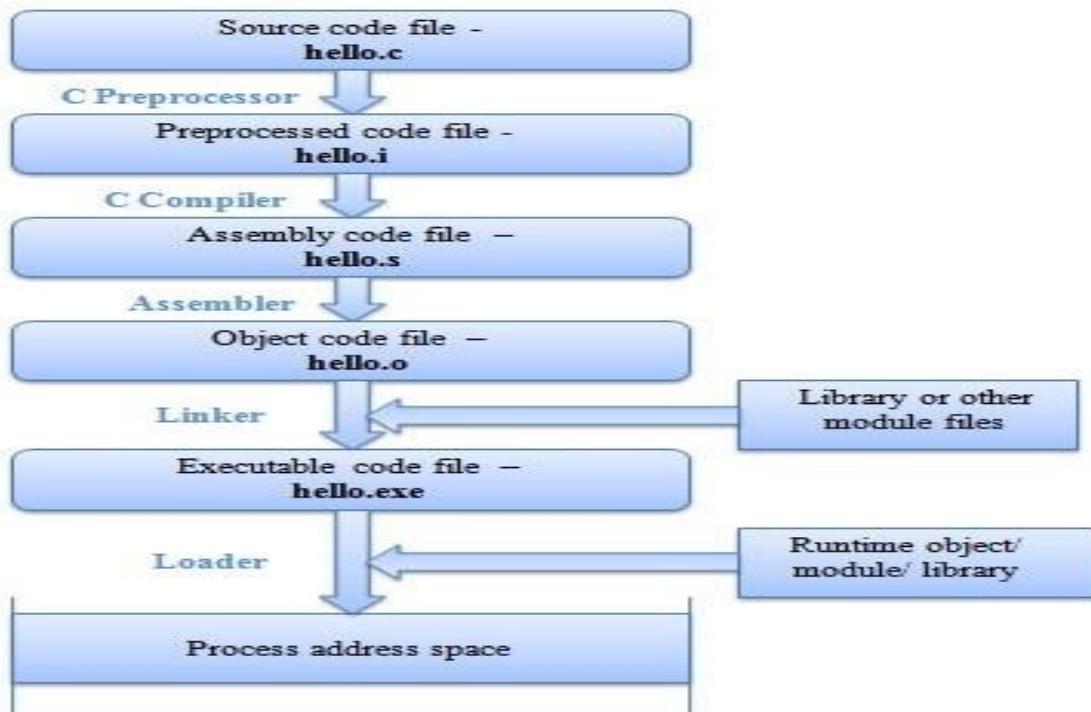
- Standardized in 1989 by ANSI (American National Standards Institute) known as ANSIC
- International standard (ISO) in 1990 which was adopted by ANSI and is known as C89
- As part of the normal evolution process the standard was updated in 1995 (C95) and 1999 (C99)

Characteristics of C Programming languages:

- Direct access to memory layout through pointer manipulation
- Concise syntax, small set of keywords
- Block structured language
- Some encapsulation of code, via functions
- Type checking (pretty weak)

- C is portable(program written for one computer can be run on another computer with little modification) C has an ability to extend itself.
- C was invented to write operating system called UNIX
- The language was formalized by American National Standard Institute (ANSI) 1988
- Unix is written using C
- C is widely used to develop system softwares
- C is a case sensitive program

Compilation Model:



Compilation process in UNIX/LINUX environment:

- To compile and link a C program that is contained entirely in one source file
cc program.c

• The executable program is called a.out by default. If you don't like this name, choose another using the -o option:

```
cc program.c -o exciting_executable
```

Compilation process in Turbo C environment:

To type c Program: click File -> open -> noname.cpp is created (cpp stands for c plus plus)



Type the program in the editor

```
#include<stdio.h>
void main()
{
    int d;
    printf("Hello World");
    scanf("%d",d);
}
```

The screenshot shows the same Turbo C IDE interface as above, but the editor window now contains a simple C program. The code includes a header inclusion for stdio.h, a main function definition, and a printf and scanf statement. The status bar at the bottom shows "1 : 1" and "F1 Help F2 Save F3 Open Alt-F9 Compile F9 Make F10 Menu".

Run the Program by pressing (Ctrl+F9)

The screenshot shows a vintage-style C compiler interface. The menu bar includes File, Edit, Search, Run, Compile, Debug, Project, Options, Window, and Help. The title bar says PAVAN1.CPP. A status bar at the bottom shows F1 Help, Alt-F8 Next Msg, Alt-F7 Prev Msg, Alt-F9 Compile, F9 Make, F10 Menu. A message box titled "Compiling" displays the following information:

Main file: PAVAN1.CPP
Compiling: EDITOR → PAVAN1.CPP
Total File
Lines compiled: 315 315
Warnings: 0 0
Errors: 0 0
Available memory: 1969K
Success : Press any key

Below the message box, the text "1:1" is visible.

Output of the program will be displayed as shown below:

A black terminal window with white text. The first line reads "Hello World_". There is a single blank line below it.

General structure of C program

Pre-processor directives(#include..)

```
int main()
{
    Declaration statements;
    executable statements;    return
    0;
}
```

Example Programs:

1.

```
#include <stdio.h>
```

```
//program prints hello C world  
Int main() { printf ("Hello C  
world!"); return 0;  
}
```

Output: **Hello C world!**

Header files:

- The files that are specified in the include section is called as header file
- These are precompiled files that has some functions defined in them
- We can call those functions in our program by supplying parameters
- Header file is given an extension .h
- C Source file is given an extension .c

Example: # include <stdio.h>

main ()

- This is the entry point of a program
- When a file is executed, the start point is the main function
- From main function the flow goes as per the programmers instructions.
- There may or may not be other functions written by user in a program
- Main function is compulsory for any c program

Comment lines in C Program:

- Single line comment (line starts with two slashes //) – // (double slash)

- Termination of comment is by pressing enter key • Multi line comment (starts with / * and end with *)

```
/*....  
.....*/
```

This can span over to multiple lines

Output Statement printf()

printf() statement is used to output the expression values and messages on to the output screen. General structure of printf() is printf(" message placeholder", variables); printf(" value of c= %d",c);

- printf() is a library function declared in <stdio.h>
 - Syntax: printf(*FormatString*, *Expr*, *Expr*...)
 - *FormatString*: String of text to print
 - *Exprs*: Values to print
 - *FormatString* has placeholders to show where to put the values (note: #placeholders should match #Exprs)
 - Placeholders: %s (print as string), %c (print as char),
 %d (print as integer),
 %f (print as floating-point)
 - \n indicates a newline character
- Example: printf("Original input : %s\n", input);

Example program:

```
#include <stdio.h>  
// program prints a number of type int  
int main()  
{  
    int number = 10;  
    printf ("The Number is %d", number);  
    return 0;  
}
```

Output: The Number is 10

Input statement scanf() scanf () ; //used to

take input from console(user).

`scanf("%d", &a);`

- Remember to use & symbol along with integer/floating variable.
Does not use at the time of reading character/string type data.

Some of the format specifier

- %c for The character.
- %d for The integer format specifier.
- %f for The floating-point format specifier.
- %s for The string format specifier.

Example:

- **Input**

```
scanf("%d",&a);
```

Gets an integer value from the user and stores it under the name “a”

- **Output**

```
printf("%d",a);
```

Prints the value present in variable a on the screen

```

1  /* Fig. 2.5: fig02_05.c
2   Addition program */
3  #include <stdio.h>
4
5  int main()
6  {
7      int integer1, integer2, sum;           /* declaration */
8
9      printf( "Enter first integer\n" );    /* prompt */
10     scanf( "%d", &integer1 );            /* read an integer */
11     printf( "Enter second integer\n" );   /* prompt */
12     scanf( "%d", &integer2 );            /* read an integer */
13     sum = integer1 + integer2;          /* assignment of sum */
14     printf( "Sum is %d\n", sum );        /* print sum */
15
16     return 0;   /* indicate that program ended successfully */
17 }
```

Variables:

Variables are data that will keep on changing

Declaration

```
<<Data type>> <<variable name>>;
int a;
```

Initialization

```
<<varname>>=<<value>>;  
a=10;
```

Usage (updation)

```
<<varname>>      a=a+1;  
//increments the value of a by 1
```

Rules to declare a variable:

- Should not be a reserved words like int, float, sin etc..
- Should start with a letter or an underscore(_)
- Can contain letters, numbers or underscore.
 - Choose a name that reflects the role of the variable in a program, e.g.
- Good: customer_name, ss_number;
- Bad : cn, ss;
- No other special characters are allowed including space
- Variable names are case sensitive
 - say variable **A** (**Big letter**) and **a** (**small letter**) are different

Some properties of a variable:

- Represent storage units in a program
- Used to store/retrieve data over life of program
- Type of variable determines what can be placed in the storage unit
- *Assignment* – process of placing a particular value in a variable
- Variables must be *declared* before they are assigned
- The value of a *variable* can change; A *constant* always has the same value

Tokens:

- Token is a sequence of one or more characters that is significant as a group
- Six types of tokens are: keywords, identifiers(variables),constants, string literals, operators and other separators **keywords**- reserved words for **example** **sqrt,pow,sin,int** **identifiers**- names given to variables **example: a,sum**

Constants: integer, floating and character **example:** 10,10.0 **Operators:**

arithmetic, relational, logical **example:** <, ==, !=, &&, ||

Separators: white spaces, comments **example:** //...

Datatype size and its range

- Primary : int, float, char
 - int (signed/unsigned)(2,4Bytes): used to store integers.
 - char (signed/unsigned)(1Byte): used to store characters – used to store a decimal number.
- User Defined:
 - typedef: used to rename a data type
- `typedef int integer;` can use `integer` to declare an int. – enum, struct, union

TYPE OF DATA	DATA TYPE	SIZE (IN BYTES) 16 BIT COMPUTER	RANGE
Character	char	1	Signed -128 to 127 Unsigned: 0 to 255
integer	int	2	Signed: -32768 to 32767 Unsigned: 0 to 65535
Real number	float	4	
Double precision	double	8	

Constants

- Constant is a quantity whose value cannot be changed during program execution.
- C supports four type of constants integer, floating, character and enumeration constants

Integer Constant

- Represents a signed integer of typically 2 or 4 or 8 bytes (16 or 32 or 64 bits)
- Precise size is machine-dependent

- It is a number that has an integer value.
- It can be specified in decimal, octal or hexadecimal form

example: 5, 125,

Floating Constant

- Floating constant have mantissa and exponent part(optional includes the letter e or E)
ddd.dddE(+/-)dd
- Mantissa(significant part) contains digit followed by decimal point(.)and then digit
453.678

Character Constant

- It is grouped into two categories: integer character, wide character
integer character is a sequence of one or more character enclosed in single quotes
'a'
- The character within the single quote may be any character (except backslash or newline or single quote)
example : 'd' 'f'

Some points to be remembered about C Programs are

- all *statements* end with a semicolon!
- Commas separate multiple declarations
- Blank lines have no effect
- Extra spaces between *tokens* has no effect.
- *Comments* are ignored by the compiler

Invisible Characters in C language

- Some special characters are not visible directly in the output stream. These all begin with an escape character (i.e. \):
 - \n newline
 - \t horizontal tab
 - \a alert bell
 - \v verticaltab

Operators in C Programming languages

Some of the operators used in c language are

- Arithmetic operators
- Conditional operators
- Bitwise operators
- Relational operators
- Logical operators
- Assignment operators
- Increment and decrement operators
- Special operators

1. Arithmetic Operator: arithmetic operations are performed on integer or floating point data i.e.

Integer Arithmetic

Operands in a single arithmetic expression
Operation is integer arithmetic

E.g. If $a=10$ and $b=4$
 $a-b=6$
 $a+b=14$
 $a/b=2$
 $a\%b=2$

Real Arithmetic :

Real operator is known as real arithmetic.

Decimal and exponential notation

If x,y are floats

$$x=6.0/7.0=0.857143$$

$$y=-2.0/3.0=-0.666667$$

Mixed –mode Arithmetic

One of the operands is real and the other is integer

For example

$$19/10.0=1.9$$

Assignment Operator:

In addition, C has a set of shorthand assignment operators of the form.

var oper = exp;

Example

$x = a + b$

Simple Programs

1. Write a program to calculate area of triangle

```
#include<stdio.h> int main() { int len,bre,area;  
printf(" enter length and breadth of triangle");  
scanf("%d%d",&len,&bre); area=0.5*len*bre;  
printf("\narea of triangle=%d",area); return 0;  
}
```

OUT PUT

enter length and breadth of triangle

4 5 area of
triangle=10

2. Write a program to calculate area of circle

```
#include<stdio.h>  
  
#define pi 3.14  
  
int main()  
{ int r; float area; printf(" enter  
radius of the circle\n");  
scanf("%d",&r); area= pi * r * r;  
printf("\narea of circle = %f", area);  
return 0;  
}
```

OUT PUT

enter radius of the circle

5

area of circle=78.5

3. Write a program to calculate area and perimeter of a circle

```
#include<stdio.h>

#define pi 3.14

int main()

{ int

r;

float area,peri; printf("enter

radius of the circle);

scanf("%d",&r); area=pi*r*r;

peri = 2*pi*r; printf(" area of circle =

%fn", area); printf(" perimeter of a

circle=%f",peri); return 0;

}
```

OUT PUT

enter radius of circle

4

area of circle= 50.24

perimeter of a circle=25.12

4. Write a program to calculate simple interest

```
#include<stdio.h> int

main()

{ int p; float r,t,interest,total; printf(" enter principal amount

"); scanf("%d",&p); printf(" enter rate of interest and time

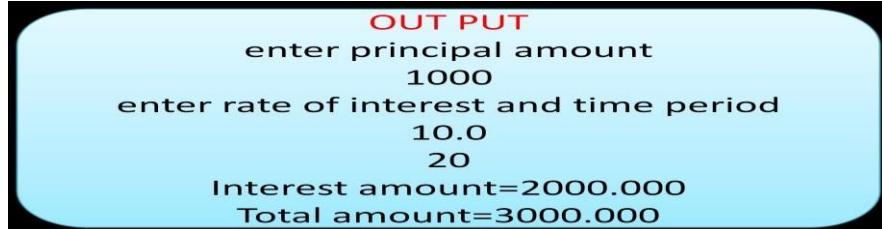
period"); scanf("%f%f",&r,&t); interest=(p*r*t)/100.0;
```

```

total=p+interest;    printf("interest amount=%f\n total amount=
%f",interest,total);   return 0;
}

```

OUT PUT



```

enter principal amount
1000
enter rate of interest and time period
10.0
20
Interest amount=2000.000
Total amount=3000.000

```

Mathematical Library functions:

In order to calculate mathematical values of sin(), cos(), exp() etc. C language provides built-in library functions.

- Library facilities are usually provided in the languages to keep the language simple and to do many mathematical calculations.
- Some of the library header files available in C are **input/output facility**
<stdio.h> (scanf, printf, gets, puts....) **mathematical operations**
<math.h>(sqrt, sin, cos, log, pow...) **string manipulation oper**
<string.h>(strcpy, strcat, strlen..) **console input/output** **<conio.h>** (getch,
...)
- These header should be included in the program using **#include**
preprocessor directive statement ex: **#include<math.h>**
- This header file gives many built in mathematical library functions such as trigonometric, logarithmic, exponential etc..

Function Name	C function call	meaning
sqrt	sqrt(x)	Square root
power	pow(x,y)	of x X rise to Y
exponential	exp(x)	
log10	log10(x)	

log	log(x)	Natural logarithm of x
sin	sin(x)	Sine of (x)
cos	cos(x)	Cosine of (x)
tan	tan(x)	Tangent of (x)
absolute	abs()	a

```
#include<stdio.h>
#include<math.h>
Void main()
{
    float x y;
    float sqroot, sinx; cosx,tanx;
    x=144.0;
    sqroot=sqrt(x);
    y=144*(3.142/180.0);
    sinx=sin(y);
    cosx=cos(y);
    tanx=tan(y);
    printf("square root of x=%f \n",sqroot);
    printf("sine value of y=%f \n",sinx);
    printf("cosine value of y=%f \n",cosx);
    printf("tangent value of y=%f \n",tanx);
    getch();
}
```

When you run the program you get the following output.

displays the computation of square, cosine, sine and tangent value of a number by using mathematical function in c.

```
Square root of x=12.000000
Sine value of y= xxxxx
Cosine value of y= xxxxxx
Tangent value of y= xxxxxx
```

1. Program to calculate area of triangle when sides of triangle is given

```
#include<stdio.h>
int main() { int
a,b,c;
float area,s;
printf("enter three sides length of a triangle");
scanf("%d%d%d",&a,&b,&c);
s=(a+b+c)/2.0 area=sqrt(s * (s-a)*
```

```
(s-b) * (s-c)); printf(" area of  
triangle=%f",area);  
    return 0;  
}
```

OUT PUT

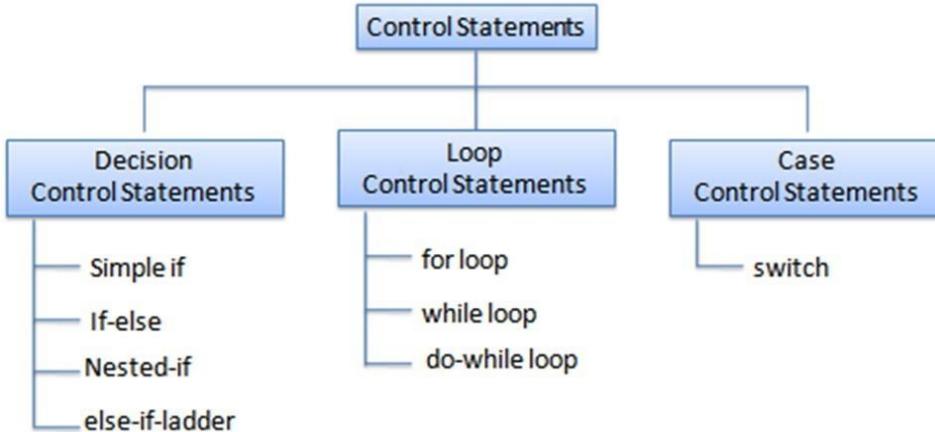
```
enter three sides length of a triangle  
3 4 5  
area of triangle=6
```

Relational Operator: In order to find the relation between any two values relational operator are used for example a is greater than b, result may be true or false depends on the value of a and b, some of the relational operators are:

Operator	Meaning
<	a is less than b
>	a is greater than b
<=	a is less than or equal to b
>=	a is greater than or equal to b
==	a is equal to b
!=	a is not equal to b

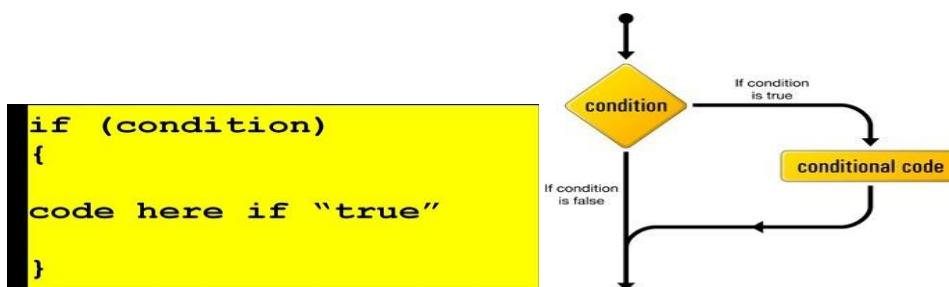
Control Statements :

- The order in which the statements are executed are called control flow
- The statements that are used to control the flow of execution of program are called control statements
- C Language supports following control statements



If Statement:

- Branching is the process of choosing the right branch for execution, depending on the result of “conditional statement”.



if (condition)	if (condition)
statement;	{ statements; }
next_statement;	next_statement;

1. Write a Program to find biggest among two numbers

```

#include <stdio.h> int
main()
{   int a,
b;
    printf( " enter two numbers.");      scanf("%d
%d",&a,&b);
    if (a>b) printf(" a is the biggest number");
    if(b>a)printf(" b is the biggest number");  if
(a==b)printf(" a and b are equal");  return
0;

```

}

OUT PUT

enter two numbers:
2 3
b is the biggest number

Or

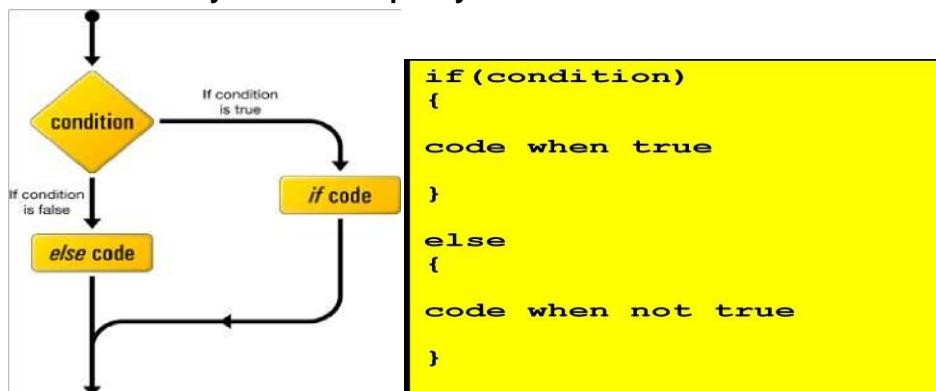
enter two numbers:
5 3
a is biggest number

Or

enter two numbers:
4 4
a and b are equal

2. If –else statement:

Unlike “if statement” where you could only specify code for when condition is true; for “if else statement” you can also specify code for when the condition is not True (false)



Program to find biggest among two numbers using (if-else)

```
#include <stdio.h> int
main()
{ int a, b; printf(" enter two numbers:");
scanf("%d%d",&a,&b); if (a>b) printf(" a
is the biggest number"); else printf(" b is
the biggest number"); return 0;
}
```

7 8
b is biggest number

Or

enter two numbers:
4 1
a is biggest number

3. Nested- if statement:

- Using “if...else statement” within another “if...else statement” is called ‘nested if statement’.

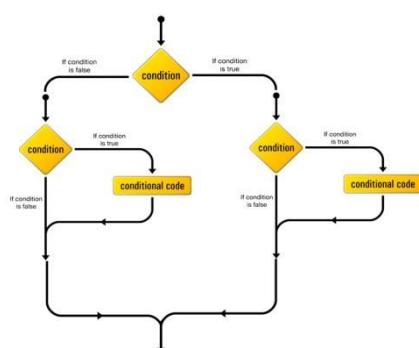
“Nested if statements” is mainly used to test multiple conditions

The if-else constructs can be nested (placed one within another) to any depth.

General forms: if-if-else and if-else-if.

The if-if-else constructs has the following form (3 level of depth example)

```
if(condition_1)
    if(condition_2)
        if(condition_3)
            statement_4;
        else
            statement_3;
    else
        statement_2;
else
    statement_1;
next_statement;
```



```
if (condition)
{
    if (condition)
    {
        code when true
    }
    else
    {
        if (condition)
        {
            code when true
        }
    }
}
```

Program to find biggest among two numbers using nested-if statement:

```
#include <stdio.h> int
main()
{ int a, b; printf( " enter two numbers:");
scanf("%d%d",&a,&b); if (a>b) printf(" a is the
biggest number"); else if (b>a) printf(" b is the
biggest number"); else printf(" a and b are
equal"); return 0;
}
```

OUT PUT

```

enter two numbers:
9 7
a is the biggest number

Or
enter two numbers:
6 8
b is the biggest number

Or
enter two numbers:
4 4
a and b are equal

```

4. Logical Operator

Operator	Meaning
&&	Logical AND
	Logical OR
!	Logical NOT

Inputs		and	or
a	b	a & b	a b
0	0	0	0
0	1	0	1
1	0	0	1
1	1	1	1

1. Program to find quadrant for the given co-ordinates

```
#include<stdio.h> int
main();
{ int x,y; printf("Enter the coordinates for quadrants:");
scanf("%d%d",&x,&y); if(x>0 && y>0) printf("the co-ordinate
lies on 1st quadrant"); else if(x<0 && y>0) printf("the co-ordinate
lies in 2nd quadrant"); else if(x<0 && y<0) printf("the co-ordinate
lies in 3rd quadrant"); else if(x>0 && y<0) printf("the co-ordinate
lies in 4th quadrant"); else if(x==0 && y==0) printf("the co-
```

```

ordinate is on origin"); else if(x==0) printf("the co-ordinate lies
in y-axis"); else printf("the co-ordinate lies in x-axis");
}

```

Input co-ordinates	OUT PUT
25,78	the co-ordinate lies on 1 st quadrant
-105,40	the co-ordinate lies on 2 nd quadrant
-105,-150	the co-ordinate lies on 3 rd quadrant
85,-125	the co-ordinate lies on 4 th quadrant
0, 0	the co-ordinate lies in origin
0,25	the co-ordinate lies in y-axis
30,0	the co-ordinate lies in x-axis

2. Program to declare student result

```

int main()
{
    int s1,s2,s3; float avg; printf( "enter 3 subject
marks"); scanf("%d%d%d",&s1,&s2,&s3);
avg=(s1+s2+s3)/3.0; if ( (s1<35)|| (s2<35)|| (s3<35))
printf(" fail"); else if (avg>=70) printf(" Distinction");
else if ((avg>=60) && (avg < 70)) printf(" First class");
else if ((avg>=50) &&(avg < 60)) printf(" Second class");
else printf (" pass class"); return0;
}

```

OUTPUT

```

enter 3 subject marks
35 35 35
pass class
Or
enter 3 subject marks
50 65 50
Second class
Or
enter 3 subject marks
70 75 70
Distinction
Or
enter 3 subject marks
62 68 66
First class
Or
enter 3 subject marks
20 35 60
fail

```

1. Program to calculate Roots of Quadratic equation (Lab program)

- Quadratic equation of the form $ax^2+bx+c=0$ is having two roots. Root is a value of x when it is substituted to the above equation it satisfies(i.e. LHS=RHS ($F(X)=y=0$))
- Root is a point on the x-axis where $y=0$. In quadratic equation it cuts x-axis at two points. (i.e. two roots)
- Root value depends on the discriminant value(b^2-4ac)
- If discriminant is zero -- roots are equal (i.e. $r_1=r_2$)
- If discriminant is greater than zero – roots are distinct
- If discriminant is less than zero – roots are imaginary

```
#include<stdio.h>
#include<math.h>
int main()
{ float a,b,c;    float d,r1,r2,re,ri;
printf("enter the co-efficients");
scanf("%f%f%f",&a,&b,&c);
d=b*b-4*a*c;    if (d==0){    r1=
b/(2*a);    printf("roots are real
and equal")
    printf("root1=%f\n root2=%f",r1,r1);
    }
else if (d>0){    r1=-b+sqrt(d)/
(2*a);    r2=-b-sqrt(d)/(2*a);
printf("roots are distinct\n");
    printf("root1=%f\n root2=%f",r1,r2);
    } else {    re=-b/(2*a);
ri=sqrt(abs(d))/(2*a); printf("roots are
complex conjugates\n");
    printf("real part=%f\n img part=%f",re,ri);
    }
return 0;
}
```

```

Output 1: enter the co-efficients
1 2 1
roots are real and equal
root = -1.00
Output 2: enter the co-efficients
1 3 2
roots are distinct
root1= -1.00   root2= -2.00
Output 3: enter the co-efficients
1 2 3
roots are complex conjugates
real part = -1.00  img part= 1.41

```

2. Program to check whether the given year is Leap year or not (Lab Program)

A year is leap if it is divisible by 4 but not by 100 or is divisible by 400

ex: 1996,2000,2004 -- leap year

```

1900,2002,2100 --not a leap year Algorithm leap(year)    read(year)
if(year is divisible by 4 and year is not divisible by 100) or is divisible by 400
print "given year is leap year"      else
    print " given year is not a leap year"
End of the algorithm
(((year%4==0) &&(year%100 != 0)) || year%400 == 0)

```

- ```
#include<stdio.h> int main()
{ int year; printf("enter the year");
scanf("%d",&year); if(((year%4==0) &&(year%100 !=
0)) || year%400==0) printf("given year %d is leap
year",year); else printf("given year %d is not a leap
year",year); return 0;
}
```

**OUT PUT**

```

enter the year
2010
given year 2010 is leap year
Or
enter the year
2013
given year 2013 is not a leap year

```

## **Arithmetic Operators:**

- **Prefix Increment : ++a –**

– example:

```

» int a=5;
» b=++a; // value of b=6; a=6;
» Postfix Increment: a++ –

```

example

```

» int a=5;
» b=a++; //value of b=5; a=6;

```

- **Modulus (remainder): %**

– example:

```
» 12%5 = 2;
```

– **Assignment by addition: += –**

example:

```
» int a=4;
```

» a+=1; //(means a=a+1) value of a becomes 5 We

Can use -, /, \*, % also

- **Comparison Operators:**

<, > , <=, >= , !=, ==, !,

**&&, || .**

– example:

```
» int a=4, b=5;
```

» a<b returns a true(non zero number) value. »

**Bitwise Operators: <<, >>, ~, &, | , ^ .**

– example

```
» int a=8;
```

» a= a>>1; //value of a becomes 4

- Meaning of  $a+b*c$ ? is it  $a+(b*c)$  or  $(a+b)*c$ ?
- All operators have precedence over each other
- \*, / have more precedence over +, - .
  - If both \*, / are used, associativity comes into picture. (more on this later)
  - example :  
 »  $5+4*3 = 5+12= 17.$
- Precedence rules decides the order in which different operator are applied.
- Associativity rule decides the order in which multiple occurrences of the same level operator are applied
- 

### Precedence Table:

| Highest on top  |
|-----------------|
| ++ -- (Postfix) |
| ++ -- (Prefix)  |
| *    /    %     |
| +    -          |
| <<       >>     |
| <       >       |
| &               |
|                 |
| &&              |
|                 |

# **Switch Statement:**

switch statement begins with switch keyword. It is the combination of multiple cases separated by break statement. Only one case will be executed at any time and break statement takes the control outside the switch statement. If there is no match for the case statement default statement will be executed.

```
switch(condition)
{
 case template_1 : statement(s);
 break;
 case template_2 : statement(s);
 break;
 case template_3 : statement(s);
 break;
 ...
 ...
 case template_n : statement(s);
 break;

 default : statement(s);
}
next statement;
```

## **1. Program to Simulate simple calculator**

```
#include<stdio.h> int
main()
{ float
a,b,c; char
op;
printf("Enter the expression in the form of a op b:");
Scanf("%f%c %f",&a,op,&b); switch(op)
{
 case '+' : c=a+b;
 break; case '-' : c=a-
b;
 break;
 case '*' : case
'x' :
 case 'X' : c=a*b;
```

```

 break;
case '/': c=a/b;
 break;
}
printf("c=%f\n",c);
return 0;
}

```

**OUT PUT**

```

Enter the expression of the form a op b:
5+3
C=8.000
Or
Enter the expression of the form a op b:
8-4
C=4.000
Or
Enter the expression of the form a op b:
4*3
C=12.000
Or
Enter the expression of the form a op b:
3x5
C=15.000
Or
Enter the expression of the form a op b:
12X5
C=60.000
Or
Enter the expression of the form a op b:
12/6
C=2.000

```

## 2. Program to calculate area of geometric objects as per user request

```

#include<stdio.h> int
main()
{
float a,b,area; int choice; printf("Enter the
choice(1:square,2:rectangle,3:circle ");
scanf("%d",&choice); switch(choice)
{
 case 1 : printf("enter side length");
 scanf("%f",&a); area=a*a;
 break;
 case 2 : printf("enter length and
breadth"); scanf("%f

```

**while (condition)**

statement(s);

**next\_statement;**

```
%f",&a,&b); area=a*b;
```

```

case 3:printf("enter the radius")
scanf("%f",&a)
area=3.14*a*a; break;
default: printf("in valid choice");
 break;
}
printf(" area=%f\n",area);

return 0;
}

```

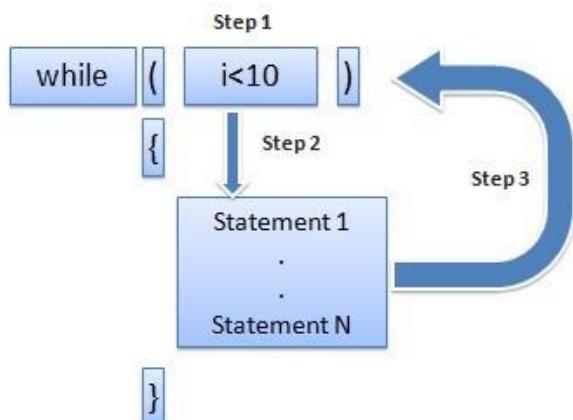
## While LOOP : It executes the statement within the loop until the condition is satisfied.

- Executes a block of statements as long as a specified condition is TRUE.
- The general while loop construct,
- The (condition) may be any valid C expression.
- The statement(s) may be either a single or a compound (a block of code) C statement.
- When while statement encountered, the following events occur:
  1. The (condition) is evaluated.
  2. If (condition) evaluates to FALSE (zero), the while loop terminates and execution passes to the next \_statement.
  3. If (condition) evaluates as TRUE (non zero), the C statement(s) is executed.
  4. Then, the execution returns to step number 1 until condition becomes FALSE.

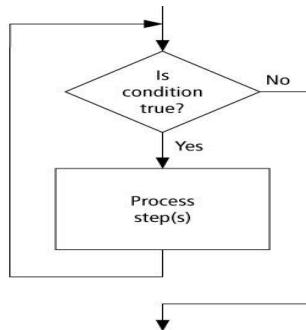
```

initialization
while (condition)
{
 //body
 iteration
}

```



Do While condition is true  
Process step(s)  
Loop



**simple while loop example**

```
#include <stdio.h> int
main(void)
{
 int n = 1;
 // set the while condition
 while(n <= 12)
 {
 // print
 printf("%d ", n); //increment
 // by 1, repeats
 n++;
 }
 // a newline
 printf("\n"); return
0;
}
```

Output:

A screenshot of a Windows command prompt window titled "C:\WINDOWS\system32\cmd.exe". The window displays the numbers 1 through 12, each preceded by a "%d" placeholder. Below the numbers, the text "Press any key to continue . . ." is visible. The window has standard Windows-style scroll bars on the right side.

```
//simplewhileloopexample
#include <stdio.h> int
main(void)
{
 int n=1,sum=0; //
 set the while condition
 while(n <=50)
 {
 sum=sum+n;
 //increment n by 1, repeats
 n++;
 }
}
```

```

 }
 //a newline printf("sum upto 1 to
50is=%d",sum); return 0;
}

```

### **while – loop example**

To sum=  $2^2+4^2+\dots+50^2$

```

simple while loop example
#include <stdio.h> int
main(void)
{ int n=2;
float sum=0.0;
 // set the while condition
while(n <= 50)
{
 sum=sum+pow(n,2);
//increment n by 1, repeats
n=n+2;
}
printf("sum upto 2^2 to 50^2 is =
%d",sum); return 0;

```

### **3. GCD using Euclidian's algorithm**

- Let m and n represent two numbers and variable r represent remainder of the division  
 $r=m \% n$   
**Algorithm GCD(m,n)**  
**read (m,n)**  
**while( $n > 0$ ) { r = m  
% n; m = n;  
n = r;**  
**}**  
**print("gcd of m and n is", m)**  
**#include<stdio.h> int main()**  
**{ int m,n,r; printf("enter two  
integer number"); scanf("%d  
%d",&m,&n); while(n > 0) { r=m  
%n; m=n; n=r;  
}**  
**printf("GCD of m and n is :%d", m);**  
**return 0;**  
**}**

| step | m  | n    | $m \% n$ |
|------|----|------|----------|
| 1    | 50 | 35   | 15       |
| 2    | 35 | 15   | 5        |
| 3    | 15 | 5    | 0        |
| 4    | 5  | 0(s) |          |

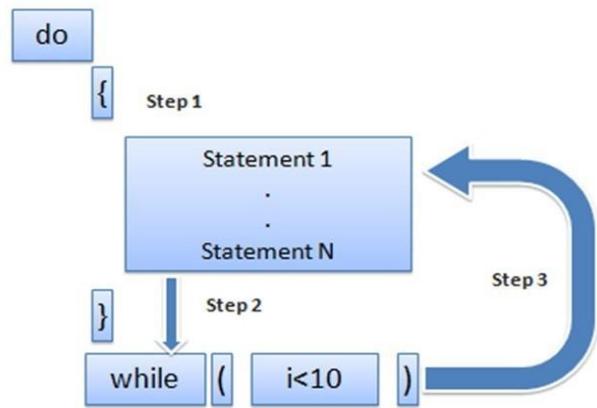
**OUT PUT**

enter two integer number  
50 35  
GCD of m n is :5

**Do-While Loop:** This statement is used when we want to execute the body of the loop at least once.

```
do statement (s) ;
while (condition)
next_statement;
```

- Executes a block of statements as long as a specified condition is true at least once.
- Test the condition at the end of the loop rather than at the beginning, as demonstrated by the for and while loops.
- (condition) can be any valid C expression.
- When the program encounter the do-while loop, the following events occur:
  - The statement(s) are executed.
  - The (condition) is evaluated. If it is TRUE, execution returns to step number 1. If it is FALSE, the loop terminates and the next\_statement is executed.
- This means the statement(s) in the do-while will be executed at least once.



```

#include <stdio.h>
main()
{ int i=10; do{
 printf("Hello %d\n",i);
 i = i -1;
}while (i > 0);
}
Output:
Hello 10
Hello 9
Hello 8
Hello 7
Hello 6
Hello 5
Hello 4
Hello 3
Hello 2
Hello 1

```

## 1. Program to check the given number is palindrome or not

If the given number and its reverse is also same then the given number is called palindrome ex: 1221, 343

```
#include<stdio.h>
int main()
{
 int num,rev=0,temp;
 printf("Enter a number: ");
 scanf("%d",&num);
 temp=num; while(num!=0){
 digit=num%10;
 num=num/10;
 rev=rev*10+digit;
 }
 if(rev==temp) printf("%d is
palindrome",temp); else
 printf("%d is not a palindrome",temp); return
 0;
}
```

| num  | digit | rev  |
|------|-------|------|
| 3467 |       | 0    |
| 3467 | 7     | 7    |
| 346  | 6     | 76   |
| 34   | 4     | 764  |
| 3    | 3     | 7643 |
| 0    |       |      |

1. Check the given number is Armstrong number or not using C program

**Definition of Armstrong number:**

**Those Numbers Which Sum Of The Cube Of Its Digits Is Equal To That Number Are Known As Armstrong Numbers.**

**For Example 153 Since  
 $1^3 + 5^3 + 3^3 = 1 + 125 + 9 = 153$**

```
#include<stdio.h>
int main()
{
 int num,r,sum=0,temp;
 printf("Enter a number: ");
 scanf("%d",&num);
 temp=num; while(num!=0){
 r=num%10;
 num=num/10;
 sum=sum+(r*r*r);
 }
 if(sum==temp)
 printf("%d is an Armstrong number",temp);
 else
 printf("%d is not an Armstrong number",temp);
 return 0;
}
```

## For statement:

- for loop is used for repetitive execution of a statement or group of statements.

```
for(initial_expr; final_expr; update_expr)
```

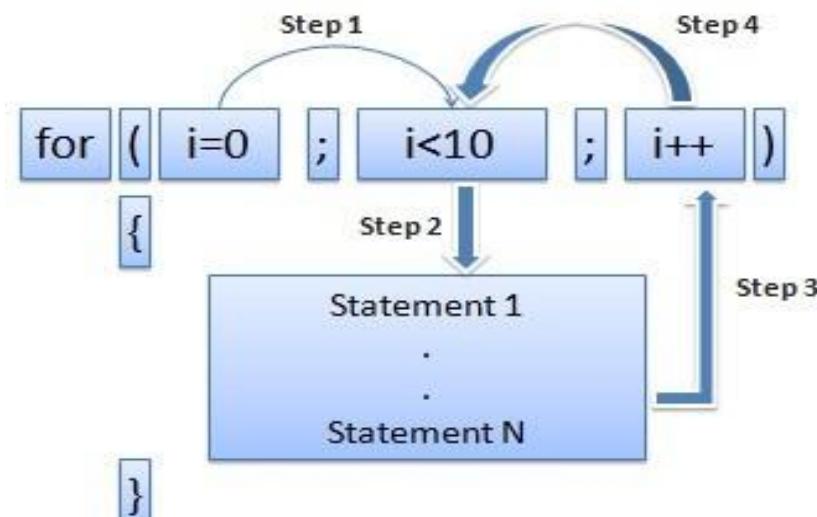
```
{
 statements;
}
```

example:

```
for(i=1; i<=10; i++)
{
 sum= sum+i;
}
```

```
for initialization condition iteration

/body
```



- Initial\_expr is usually an assignment expression.
- Update\_expr is an increment/decrement expression
- Final\_expr is the relational expression results in T or F Print the numbers in the given range say m to n    `scanf("%d%d",&m,&n);    for (i=m;i<=n;i++)       printf("%d \t",i);`

- ```
for( x=0.1;x<=1.0;x+=0.2)    printf("%f\n",x,x*x);
```

```
0.1 0.01 0.3
0.09 0.5
0.25
0.7 0.49
0.9 0.81
```

1. Program to find factorial of a given number

Algorithm fact

```
read n  fact=1
for i=n down to 2
fact=fact*i  print
(fact) end
```

```
#include<stdio.h>
Int main()
{ int n,i,fact=1
printf("enter the positive number:");
scanf("%d",&n)
for(i=n;i<=2;i--)
    fact=fact*i;
printf ("factorial of %d is %d",n,fact);
getch();
}
```

Output:

```
enter the positive number : 3
factorial of 3 is 6
```

- for loop is a very flexible construct.
- Can use the decrementing counter instead of incrementing. For example,

```
for(nCount=100; nCount > 0; nCount--)
```
- Can use counter other than 1, for example 3,

```
for(nCount = 0; nCount < 1000; nCount += 3)
```
- initial_value can be omitted if the test variable has been initialized beforehand.
- However the semicolon must still be there. For example,

```
nCount=1; for(; nCount < 1000; nCount++)
```
- The for statement(s) can be followed by a null (empty) statement, so that task is done in the for loop itself.

Null statement consists of a semicolon alone on a line. For example

```
for(count = 0; count < 20000; count++)
;
```

- This statement provides a pause (delay) of 20,000 milliseconds.

for loop – Example sum=0+1+2+.....+20

```
nsum=0;for(irow=1;irow<=20;irow++) nsum=nsum+
irow; printf("\n Sum of the first 20 natural numbers =
%d“,nsum);
```

The above program segment will compute and display the sum of the first 20 natural numbers

Nested for loop

- Example:
- for(i=1;i<=2,i++)
- { for(j=1;j<=3;j++)
- c=i*j;
- } for i=1 j varies from 1 to 3 for i=2 j varies from 1 to 3

```
#include <stdio.h>
#include <conio.h>
void main()
{
    int i,j;
    for( i=1; i<=4;i++)
    { for (j=1; j<=10; j++)
        {
            printf("%d X %d=%d\t",i,j,i*j);
        }
        printf("\n");
    }
    getch();
}
```

Output:

```
1×1=1    1×2=2    1×3 =3    1×4=4    1×5 =5
1×6=6    1×7=7    1×8=8    1×9=9    1×10=10

2×1=2  2×2=4 .....
3×1=3  3×2=6  3×3=9 .....
4×1=4  4×2=8  4×3=12 .....
```

- Write a program to print the below structure using “*”

```
*
*
*
*
*
#include <stdio.h>
#include <conio.h>
void main()
{   int
i,j;
for( i=1; i<=4;i++)
{ for (j=1; j<=i; j++)
{
printf("*\t"
);
}
printf("\n");
}
getch();
}
```

- Write a program to print the below structure using “*”

```

* * * *
* * *
* *
*

#include <stdio.h>
#include <conio.h>
void main()
{
    int
i,j;
    for( i=4; i>=1;--i)
    { for (j=1; j<=i; ++j)

    {
        printf("*\t"
    );
        }
        printf("\n");
    }
    getch();
}

```

Continue statement:

- continue keyword forces the next iteration to take place immediately, skipping any instructions that may follow it.
- The continue statement can only be used inside a loop (for, do-while and while) and not inside a switch-case selection.
- When executed, it transfers control to the condition (the expression part) in a while or do-while loop, and to the increment expression in a for loop.

Unlike the break statement, continue does not force the termination of a loop, it merely transfers control to the next iteration.

```

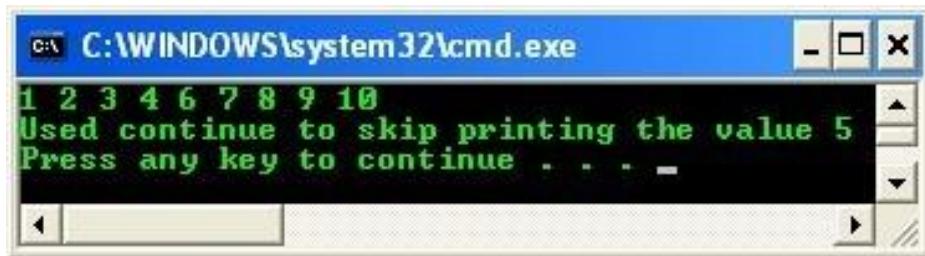
//using the continue in for structure
#include <stdio.h>int
main(void)
{
    int inum;    for(inum=1;
inum <= 10; inum++)

```

```

{
    // skip remaining code in loop only if iNum == 5
    if(iNum==5)        continue;        printf("%d ",
iNum);
}
printf("\nUsed continue to skip printing the value 5\n");
return 0;

```



Goto Statement:

- The goto statement is one of C unconditional jump or branching.
- When program execution encounters a goto statement, execution immediately jumps, or branches, to the location specified by the goto statement.
- The statement is unconditional because execution always branches when a goto statement is came across, the branching does not depend on any condition.
- A goto statement and its target label must be located in the same function, although they can be in different blocks.
- Use goto to transfer execution both into and out of loop.
- However, using goto statement strongly not recommended.
- Always use other C branching statements.
- When program execution branches with a goto statement, no record is kept of where the execution is coming from.

Example:

```

#include <stdio.h>
int main() { /* local variable
definition */ int a=10; /* 
do loop execution */
LOOP: do {

    if( a==15){ /* skip
the iteration */ a=a+
1; goto LOOP;
}

printf("value of a: %d\n", a);
a++;

}while( a < 20 );

return 0;
}

```

Output:

```

value of a: 10 value
of a: 11 value of a:
12 value of a: 13
value of a: 14 value
of a: 16 value of a:
17 value of a: 18
value of a: 19

```

1. Program to check the given number is prime or Not

```

#include<stdio.h>
#include<conio.h>
void main()
{ int n,l,r;
scanf("%d",&n)
for (i=2;i<=n/2;i++)

```

```

{ r= n % i; if ( r== 0 ) { printf
("given number is not prime");
getch(); exit(0);
}
}

printf(" given number is prime");
getch();
return 0;

```

Remarks: if we check the number up to half of the given number whether it is divisible or not is enough.

- **Conditional operator:** (? :Operator)

The conditional operator consists of 2 symbols the question mark (?) and the colon (:) Syntax:

exp1 ? exp2: exp3 example:

a=16 b=25; x=(a>b)?a:b; working of above expression can be analyzed as follows:

```

if (a>b)
    x=a;
else
    x=b;

```

- The ?:operator is just like an if...else statement except that because it is an operator you can use it within expressions.
- ?: is a ternary operator in that it takes three values, this is the only ternary operator C has.
- ?: takes the following form:

if condition is true ? then X return value : otherwise Y value;

```
#include <stdio.h> main()
{ int a , b; a=10; printf( "Value of b is
%d\n",(a==1)?20:30); printf( "Value of b is
%d\n", (a == 10) ? 20: 30 );
}
```

Output:

Value of b is 30

Value of b is 20

```
Step 1: n=x=4  
x-n/x=4-1=3 >0.001  
x=(4+1)/2=2.5  
  
Step 2: 2.5-4/2.5=0.9>0.001  
x=(2.5+1.6)/2=2.05  
  
Step 3: 2.05-4/2.05=0.098  
x=(2.05+1.95)/2=2.0  
  
Step4: 2.0-4/2.0= 0.00 >0.001  
  
square root of 4 is = 2.0
```

Break statement:

The **break** statement in C programming has the following two usages –

- When a **break** statement is encountered inside a loop, the loop is immediately terminated and the program control resumes at the next statement following the loop.
- It can be used to terminate a case in the **switch** statement.
If you are using nested loops, the break statement will stop the execution of the innermost loop and start executing the next line of code after the block.

```

#include <stdio.h>

int main () {
    int a = 10;

    while( a < 20 )
    {
        printf("value of a: %d\n", a);
        a++;
    }

    if( a > 15) {
        /* terminate the loop using break statement */
        break;
    }
}

return 0;
}

```

Output:

```

value of a: 10
value of a: 11 value
of a: 12 value of a:
13 value of a: 14
value of a: 15

```

2. Bitwise operator

- It takes the operand as string of bits
- Bit operations are carried out on the data & bitwise AND operator
 | bitwise OR operator
 ~ NOT operator
 << left shift operator
 >> right shift operator

- $X=4$

$x = x << 3$

	64	32	16	8	4	2	1
	0	0	0	0	1	0	0
First shift	0	0	0	1	0	0	0
Second shift	0	0	1	0	0	0	0
Third shift	0	1	0	0	0	0	0

Answer $x = 32$

- $X=96$

$x = x >> 3$

	64	32	16	8	4	2
98	1	1	0	0	0	0
First shift(48)	0	1	1	0	0	0
Second shift(24)	0	0	1	1	0	0
Third shift (12)	0	0	0	1	1	0

Answer x= 12

```
#include<stdio.h>
int main()
{ int a,b:
    a=98;
    b=4;
    a= a>>3;
    b=b<<3;
    printf(" right shift of a for 3 times results in=%d\n",a);
    printf("left shift of b for 3 times results in =%d",b);
    return 0;
}
```

Output:

right shift of a after 3 times results in=12
 left shift of b after 3 times results in =32

Type Casting:

- Process of converting an expression of a given type to another type example: int to float
float to int
- When two operands in an expression are different, user explicitly changes the data type, this is known type conversion

```
#include<stdio.h>
int main()
{   int a=3;
    float b=0.0;
    b=1/a;
    printf("b=%f",b);
}

output
b=0.0
```

```
#include<stdio.h>
int main()
{   int a=3;
    float b=0.0;
    b=1/(float)a;
    printf("b=%f",b);
}

output
b=0.3333
```

3. Special operator

Comma operator: combines multiple expressions into single expression. The value of right most expression is assigned to left expression $x=(a=4,b=5,c=2,c+a*b); \quad x=22$

4. Size of operator: sizeof()

used to determine size of the operand based on its datatype

```
float r= 12.45;
```

```
int y;      y=sizeof(r);      value of y is 4  
because size of float is 4 bytes.
```

Formatted output statement:

```
a= 14  
printf("%d", a) → 14  
printf("%4d",a) → bb14  
printf("%4.3d",a) → b014  
printf("%-4d",a) → 14bb  
printf("%-4.3d",a) → 014b  
Note: b → stands for  
blank  
  
float a=10.437 printf("%f",a) → 10.437000(it  
provides 6 digit  
after decimal point) printf("%w.df",a)      w->  
number of columns for integer part      d-> number of  
digits to be limited after      the decimal point  
Printf("%4.2f",a) -> 10.44
```

Comparison of getchar(),getche(),getch() functions

- getchar() -> used to read single character at run time. Given value is displayed on the screen and the compiler wait for another character to be typed.
- getche()-> it is used to get a character from console and echoes to the screen. The given value is displayed on the screen and the compiler does not wait for another character to be typed
- getch() -> is used to get a character from console but does not echo to the screen.

Exercises:

- What is a variable and constant? List the rules to be followed while declaring a variable.
- What are data types? List the data types available in C programming language • List and explain with appropriate example the various operators used in c language.
- Compare while loop with do-while loop of C programming language.
- Write a program to exchange (swap) two numbers.
- Write a program to check the given number is prime or not
- Write a program to generate fabinocci series

1 1 2 3 5 8 13

