

## Chapter 12

# LOOP CONSTRUCTORS

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**Q1. What is a loop? Also write its different types.**

**Ans.**

**Loop:**

It is a statement that is used to repeat a set of statements up to a fixed number of times or until a given condition is satisfied.

There are two types of Loops

Conditional Loop (while and do-while loop)

Counter loop (For Loop)

**Conditional Loop:**

It is a loop that executes a set of statements as long as a given condition remains true. There are two types of conditional loops

While Loop

do-while Loop

**Counter Loop:**

Counter loop is used to repeat a set of statements for a specified number of times.

For Loop

**Q2. What is while loop? Explain with the help of example and flow chart.**

**Ans.**

**While Loop:**

While loop statement is used to repeat a set of statements until a given condition is satisfied.

**Syntax:**

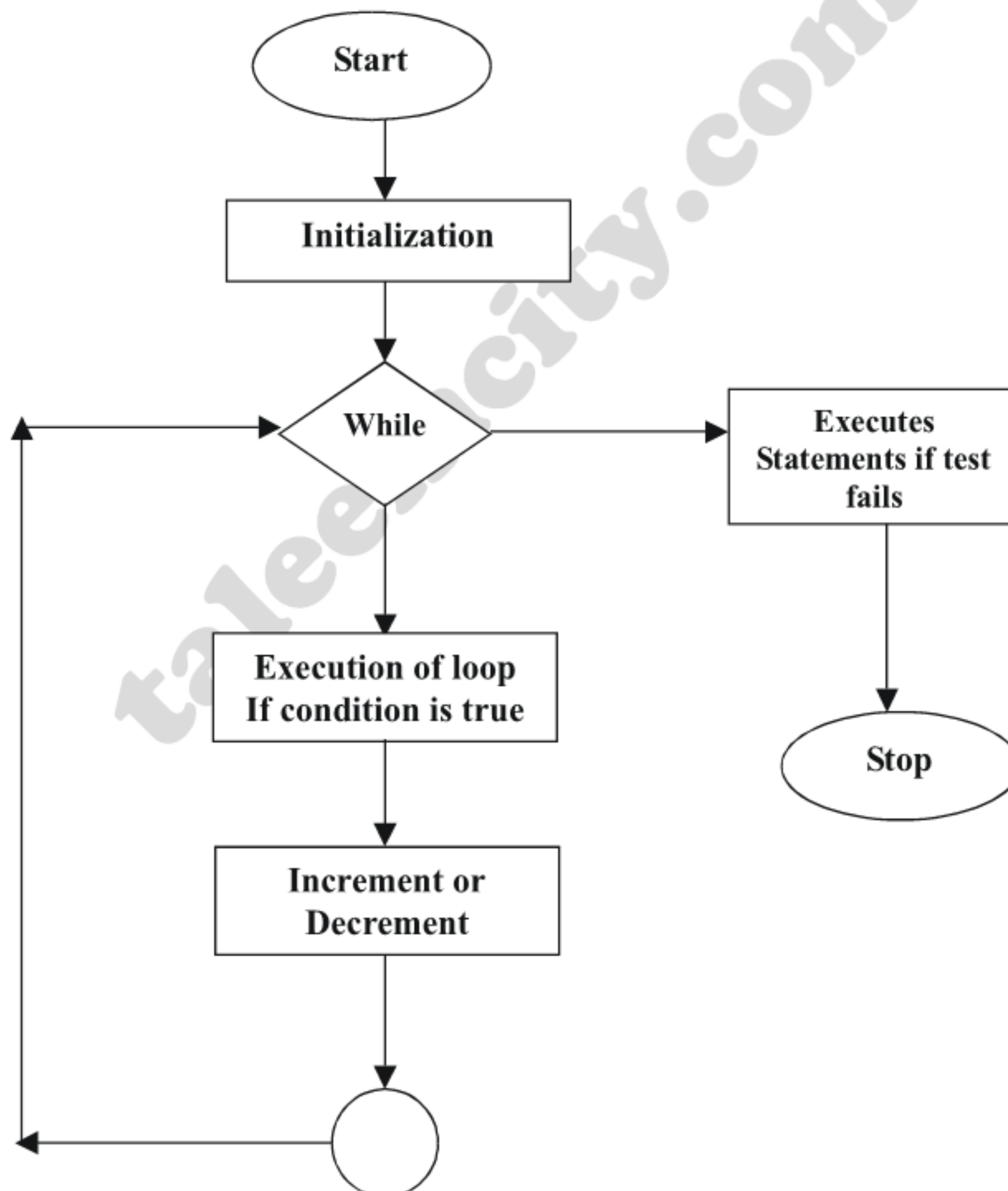
While (Relational or logical expression i.e. condition)

```
{  
    Statements (Body of loop)  
}
```

**Explanation:**

- When while statement is executed, the computer checks the given condition written in parentheses.
- If the given condition is true then the statements enclosed in the braces (body of loop) are executed.

- After the completion of first iteration control is shifted to while and the condition is again tested.
- This process is repeated until the condition is true.
- If the condition is false then control is transferred the statement that comes after the body of loop.
- **Infinite loop:** If the condition of loop never false then the loop never ends and it is called infinite loop.
- In loop body there must be a statement such that the condition in while loop becomes false.
- This loop is useful where the programmer does not know in advance how many times the body of loop will be executed.



- **Loop control variable:** A variable whose value controls the number of iterations is known as loop control variable.
- Loop control variable is always initialized before starting of the loop and incremented and decremented inside the loop body.

**Program:**

Program to print first 10 natural numbers and find their sum.

```
#include<stdio.h>
void main(void)
{
    int c=1, s=0; //declare and initialize loop control variable.
    while (c <= 10) //condition
    {
        printf("\n%d",c); //body of loop
        s=s+c;
        c++; // increment or decrement part
    }
    printf("Sum = %d",s);
}
```

**Program:**

Write a program in C language that display numbers from 1 to 5 square and cube of each number using while loop.

```
#include<stdio.h>
#include<conio.h>
void main( )
{
    int n;
    n=1;
    clrscr();
    while(n<=5)
    {
        printf("%d\t%d\t%d n",n,n*n, n*n*n);
        n=n+1;
    }
    getch( );
}
```

**Output:**

|   |    |     |
|---|----|-----|
| 1 | 1  | 1   |
| 2 | 4  | 8   |
| 3 | 9  | 27  |
| 4 | 16 | 64  |
| 5 | 25 | 125 |

**Program:**

Write a program in C language that takes an integer and prints it in reverse order.

```
#include<stdio.h>
#include<conio.h>
void main( )
{
    int n, x = 0;
    clrscr( );
    printf("Enter a number\t");
    scanf("%d",&n);
    while(n!= 0)
    {
        x=n%10 + 10*x;
        n=n/10;
    }
    printf("%d",x);
    getch( );
}
```

**Output:**

```
Enter a number      4321
1234
```

**Program:**

Write a program in C language that takes a number and decides whether it is prime number or not.

```
#include<stdio.h>
#include<conio.h>
void main( )
{
    int n, d, p;
    clrscr( );
    p=1;
```

```
d=2;
printf("Enter a number\t");
scanf("%d",&n);
while(d<=n/2)
{
    if(n%d==0)
        p=0;
    d=d+1;
}
if(p==0)
    printf("Not a prime number");
else
    printf("Prime number");
getch( );
}
```

**Output:**

```
Enter a number      11
Prime number
```

**Q3. What is a do-while loop? Explain with the help of example and flow chart.**

**Ans.**

**do-while Loop:**

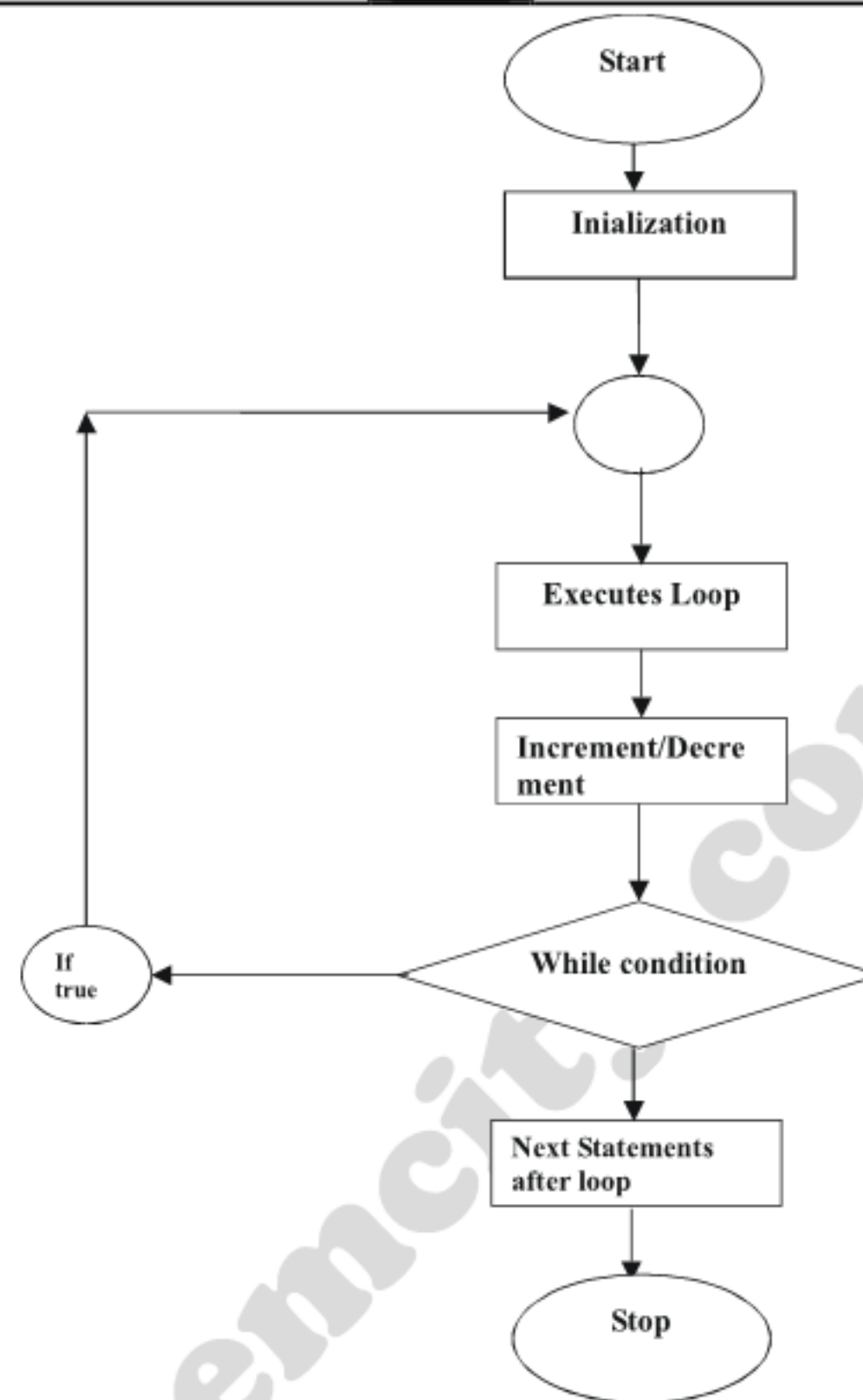
It is similar to while loop i.e. do-while loop is used to repeat a set of statements until a given condition is satisfied. In do-while loop condition is tested after the end of loop body.

|                |            |                                       |
|----------------|------------|---------------------------------------|
| <b>Syntax:</b> | <b>do</b>  | <b>//keyword and starting of loop</b> |
|                | {          | <b>// beginning of loop body</b>      |
|                | Statements |                                       |
|                | }          | <b>// end of loop body</b>            |

**While (Relational or logical expression i.e. condition);**

- In do-while the condition is written at the end of loop body therefore loop is executed at least once.
- After the execution of loop statements (first iteration) it tests the condition.
- If the given condition is true then the statements enclosed in the braces (body of loop) are executed again. This process is repeated until the condition is true.

- If the condition is false then control is transferred the statement that comes after the while statement.
- Infinite loop: If the condition of loop never false then the loop never ends and it is called infinite loop.
- In loop body there must be a statement such that the condition in do-while loop becomes false.
- This loop is useful where the programmer does not know in advance how many times the body of loop will be executed.
- The do-while loop is important in such situations where we need to execute a certain statements at least once.
- Loop control variable: A variable whose value controls the number of iterations is known as loop control variable.
- Loop control variable is always initialized before starting of the loop and incremented and decremented inside the loop body.



**Program:**

Program to print first 10 natural numbers using do-while

```
#include<stdio.h>
void main (void)
{
    int c=1;
    do                                // starting of loop
    {
        printf ("\n%d", c);          //body of loop
        c++;                          // increment or decrement part
    }
    while (c <= 10);                  // condition
}
```

**Program:**

Write a program in C language that display all even numbers in a specified range using do while loop.

```
#include<stdio.h>
#include<conio.h>
void main( )
{
    int n, start, end;
    clrscr( );
    printf("Enter starting number\t");
    scanf("%d",&start);
    printf("Enter ending number\t");
    scanf("%d",&end);
    n=start;
    do
    {
        if(n%2==0)
            printf("%d\n",n);
        n=n+1;
    } while(n<=end);
    getch( );
}
```

**Output:**

```
Enter starting number      1
Enter ending number       10
2
4
6
8
```

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**Program:**

Write a program in C language that takes two numbers from user and displays the result of first number raise to power second using do while loop.

```
#include<stdio.h>
#include<conio.h>
void main( )
{
    int x,y,z,r;
    clrscr( );
    printf("Enter first number\t");
    scanf("%d",&x);
    printf("Enter second number\t");
    scanf("%d",&y);
    z=1;
    r=1;
    do
    {
        r=r*x;
        z=z+1;
    } while(z<=y);
    printf("Answer is %d",r);
    getch( );
}
```

**Output:**

```
Enter first number      3
Enter second number    4
Answer is 81
```

**Q4. What are the differences and similarities of while and do-while loop?**

**Ans.**

**Similarities and Difference between while and do-while loop:**

- Both are conditional loops.
- Both executed a set of statements as long as given condition is true.
- In while loop condition is tested before starting the loop.

- In while loop statements are executed if the given condition is true only.
- while statement does not end with semicolon (;).
- In do-while condition is tested after execution of loop statements.
- In do-while loop the condition is tested after the loop body therefore statements are executed at least once.
- do-while statement ends with semicolon (;).

**Q5. What is for loop? Explain with the help of example and flow chart.**

**Ans.**

**For Loop:**

This loop is used to repeat a set of statements for a fixed number of times i.e. in for we know how many times the body of loop is executed.

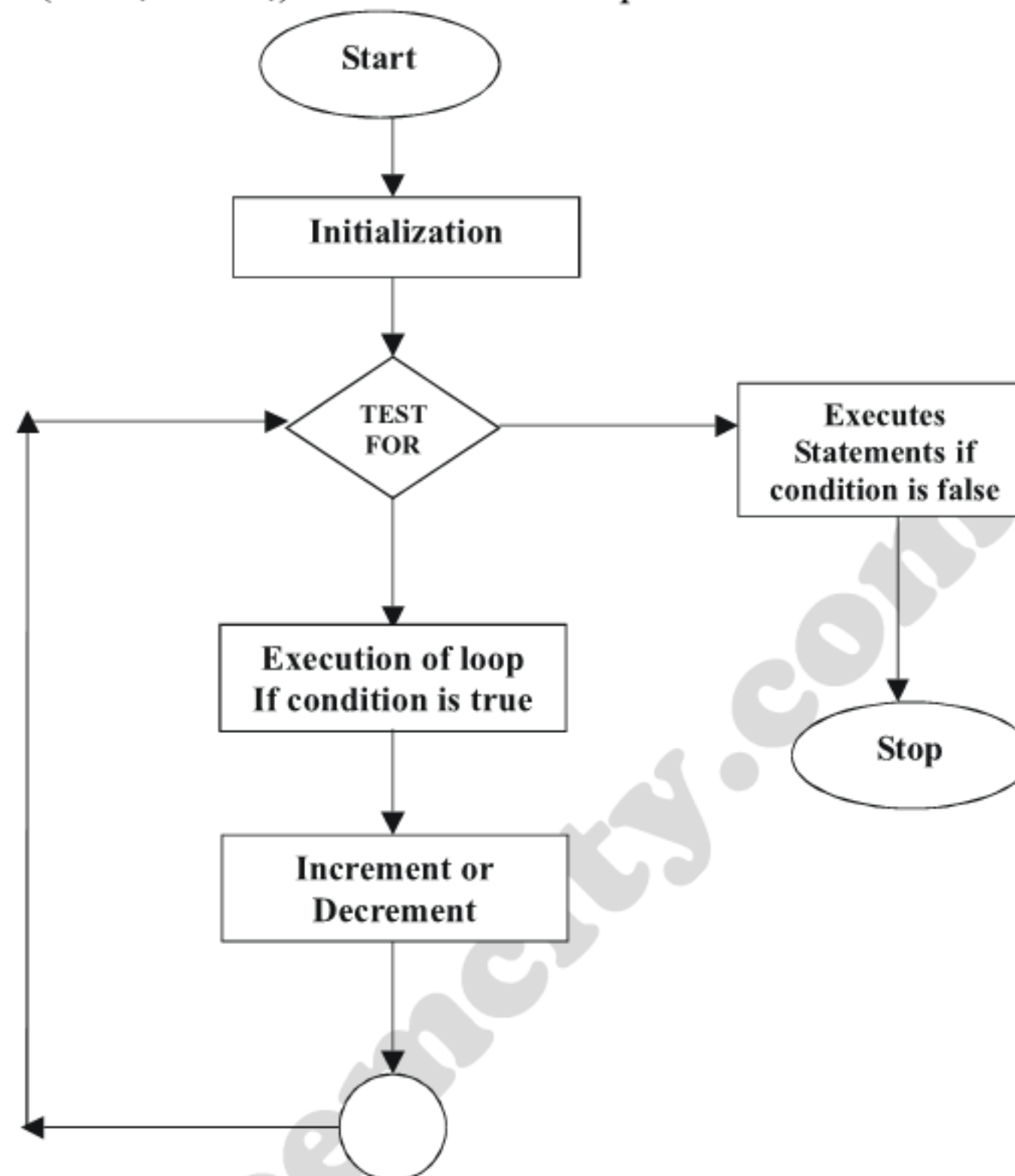
**Syntax:**

**for( initialization; condition; increment/decrement)**

```
{  
    Statements (loop body)  
}
```

- There are three expressions in for loop.
- **Initialization of loop control variable:** It is executed only in first iteration. Data type for this variable usually integer.
- **Test condition:** After initialization condition is tested and if condition is true then the loop body is executed.
- **Increment or decrement:** After execution of statements the increment or decrement part is executed.
- For the next iteration, the condition is again tested.
- If it is true then loop body is executed and then increment and decrement part is executed and condition is checked again.
- This process continues as long as loop condition is true.
- If it is false, then the for-loop is terminated.
- The control is transferred to the instruction following the for loop.
- All the expressions are separated by semicolon are optional. Its syntax is:

for (        ;        ; ) It is an infinite loop



### Similarities & Difference between while and for Loop:

- Both are used to repeat set of statements
- The structure of for loop is different from while and do while loop.
- In for loop all the three parts (initialization, condition, and increment/decrement) are in the same line and while and do while contains these part at different places.
- The while and do while executes a set of statements until a given condition is true but in for loop number of iterations are specified.

### Example: program to print first 10 natural numbers using for loop

```

#include<stdio.h>
void main (void)
{
    int c;
    for (c=1;c<=10;c++)           // starting of loop
    {
        printf ("\n%d", c);       //body of loop
    }
}
  
```

```
}  
}
```

**Example: Print 10 Even Numbers in descending order and find sum using for loop.**

```
#include<stdio.h>  
void main( )  
{  
    int i, s=0;  
    for(i=20;i>=2;i-=2)  
    {  
        printf("\ni = %d",i);  
        s += i;  
    }  
    printf("\n Sum = %d", s);  
}
```

**Example: Print 10 Even Numbers in ascending order and find sum using for loop.**

```
#include<stdio.h>  
void main( )  
{  
    int i,s=0;  
    for(i=2;i<=20;i+=2)  
    {  
        printf("\ni = %d",i);  
        s += i;  
    }  
    printf("\n Sum = %d", s);  
}
```

**Example: Print 10 odd Numbers in ascending order and find sum using for loop.**

```
#include<stdio.h>  
void main( )  
{  
    int i,s=0;  
    for(i=1;i<=19;i+=2)  
    {  
        printf("\ni = %d",i);  
        s += i;  
    }  
}
```

```

    }
    printf("\n Sum = %d", s);
}

```

**Example: Calculate sum of reciprocal of 10 Natural Numbers using for loop.**

**$S=1+1/2+1/3+-----+1/10$**

```

#include<stdio.h>
void main( )
{
    int i;
    float s=0;
    for(i=1;i<=10;i++)
        s = s + 1.0/i;
    printf("\n Sum = %.2f", s);
}

```

**Example: Calculate sum of reciprocal of 10 even Numbers using for loop.**

**$S=1/2+1/4+1/6+-----+1/20$**

```

#include<stdio.h>
void main( )
{
    int i;
    float s=0;
    for(i=2;i<=20;i+=2)
        s = s + 1.0/i;
    printf("\n Sum = %.2f", s);
}

```

**Example: Print squares of 10 natural numbers and Calculate sum of squares of 10 natural Numbers using for loop.**

**$S=1^2+2^2+3^2+-----+10^2$**

```

#include<stdio.h>
void main( )
{
    int i, s=0;
    for(i=1;i<=10;i++)
    {
        printf("\n %d \t %d",i, i*i);
        s = s + (i*i);
    }
}

```

```

    }
    printf("\n Sum = %d", s);
}

```

**Example: Print cubes of 10 natural numbers and Calculate sum of cubes of 10 natural Numbers using for loop.**

$S=1^3+2^3+3^3+-----+10^3$

```

#include<stdio.h>
void main( )
{
    int i, s=0;
    for(i=1;i<=10;i++)
    {
        printf("\n %d \t %d",i, i*i*i);
        s = s + (i*i*i);
    }
    printf("\n Sum = %d", s);
}

```

**Q6. What is nested loop? Explain with the help of example and flow chart.**

**Ans.**

#### **Nested Loop:**

- Nested loop mean loop inside the body of another loop is called nested loop.
- Nesting can be done up to any level.
- Nested loop increases the complexity of the program.
- There is no restriction on the type of loops that may be placed in the body of other loops.

**Example: Produce the following output using nested FOR loops**

```

*
**
***
****
*****
*****
*****
*****

```

```

#include<stdio.h>
void main ( )
{
    int r, c;
    for (c=1;c<=7; c++)
    {
        for (r = 1;r <= c;r++)

```

```

        printf("*");
        printf("\n");
    }
}

```

**Example: Produce the same output using nested loops (internal loop is while)**

```

#include<stdio.h>
void main ( )
{
    int r, c;
    for (c=7;c>=1; c--)
    {
        r=1;
        while(r<=c)
        {
            printf("*");
            r++;
        }
        printf("\n");
    }
}

```

**Example: Produce the following output using nested FOR loops**

```

*****
*****
*****
****
***
**
*

```

```

#include<stdio.h>
void main ( )
{
    int r, c;
    for (c=7;c>=1; c--)
    {
        for (r=1;r<=c;r++)
        {
            printf("*");

```

```
    }  
    printf("\n");  
}  
}
```

**Example: Produce the same output using nested loops (internal loop is while)**

```
#include<stdio.h>  
void main ( )  
{  
    int r, c;  
    for (c=7;c>=1; c--)  
    {  
        r=1;  
        while(r<=c)  
        {  
            printf("*");  
            r++;  
        }  
        printf("\n");  
    }  
}
```

**Example: Produce the same output using nested loops (internal loop is do-while)**

```
#include<stdio.h>  
void main ( )  
{  
    int r, c;  
    for (c=7;c>=1; c--)  
    {  
        r=1;  
        do  
        {  
            printf("*");  
            r++;  
        }  
    }  
}
```

```
        while(r<=c);  
        printf("\n");  
    }  
}
```

**Example: Produce the above output using nested loops (both loops are while)**

```
#include<stdio.h>  
void main ( )  
{  
    int r, c;  
    c=7;  
    while(c>=1)  
    {  
        r=1;  
        while(r<=c)  
        {  
            printf("*");  
            r++;  
        }  
        c--;  
        printf("\n");  
    }  
}
```

**Example: Produce the above output using nested loops (outer loop is do-while)**

```
#include<stdio.h>  
void main ( )  
{  
    int r, c;  
    c=7;  
    do  
    {  
        r=1;  
        while(r<=c)  
        {  
            printf("*");  
            r++;  
        }  
    }
```

```
        c--;  
        printf("\n");  
    }  
    while(c>=1);  
}
```

**Q7. What is sentinel control loop? Explain with the help of example.**

**Ans.**

**Sentinel controlled loop:**

- The values which are used to end the loops are called sentinel values and the loop that ends with a sentinel value is called sentinel controlled loop.
- Sentinel loop is used when exact number of repetitions is unknown.
- General form of sentinel controlled loop:
  - o Get a data value.
  - o Compare data value with sentinel value.
  - o If it is not sentinel value then process the data.
  - o Get another value using loop.

**Example: find the average marks of the students in a class.**

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

```
void main ( )
```

```
{
```

```
    int sum=0,marks, tot_std=0;
```

```
    float avg;
```

```
    do
```

```
    {
```

```
        printf("\nEnter marks of a student or press -ve number to exit");
```

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

```
        if(marks>=0)
```

```
        {
```

```
            tot_std++;
```

```
            sum += marks;
```

```
        }
```

```
    }
```

```
    while (marks>=0);
```

```
    if(tot_std > 0)
```

```
    {
```

```

        avg = sum / (float)tot_std;
        printf("\n Average Marks are = %.2f" , avg );
    }
    else
        printf("\n Enter marks of at least one student");
}

```

**Q8. What is goto statement? Explain with the help of an example.**

**Ans.**

**goto Statement:**

- The goto statement performed unconditional transfer of control to the named label.
- The label must be in the same function.

**Syntax:**

**goto label;**

-----  
-----

**label: statement**

**Example: calculate the square root of positive numbers.**

```

#include<stdio.h>
#include<math.h>
void main ( )
{
    float num;
c:   printf("\n Enter a +ve Number  ");
    scanf("%f", &num);
    if( num < 0)
        goto c;
    else
        printf("\n Square root of Number is %.2f",sqrt(num));
}

```

**Example: Print the factorial of a number using while**

```

#include<stdio.h>
void main ( )
{
    int n,c=1;
    printf("\n Enter any Number 0 to 7  ");
    scanf("%d", &n);
}

```

```
while(n>=1)
{
c=c*n;
n--;
}
printf("\n The Factorial of given number = %d ", c);
}
```

**Q9. What is an array? Explain with the help of an example.**

**Ans.**

**ARRAY:**

- It is a collection of variables stored in a contiguous portion of memory having common name and same data type.
- Each element of an array has separate subscript.
- The index always starts with 0.
- Declaration of the array:

```
Data_type array_name[size];
```

**Example:**

```
char name[30];
```

```
int a[5];
```

name array contains 30 cells (variables of character type) and variables starts from name[0] to name[29] and a[5] array contains 5 variable of int type which are: a[0], a[1], a[2], a[3] and a[4].

**Example: Input and output of an array**

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

```
void main( )
```

```
{
```

```
int a[5];
```

```
a[0]=0;a[1]=10;a[2]=20;a[3]=30;a[4]=40; // initialization
```

```
printf("%d %d %d %d %d", a[0],a[1],a[2],a[3],a[4]);
```

```
}
```

**Q.10 Explain the purpose of “continue” statement.****Ans.****continue statement:**

The continue statement is usually used inside the body of a loop. It transfer the control back to the beginning of the loop. When the continue statement is executed, the control ignores the remaining statements in the loop body. It directly moves back to the first statement as a next iteration. Consider the following example:

**Program:**

Write a C program that prints digits from 1 to 10 but 3 and 7 shouldn't be printed.

```
#include <stdio.h>
#include <conio.h>
void main ( )
{
    int a;
    for (a = 1; a <= 10; a ++ )
    {
        if ( (a. == 3) || ( a == 7) )
            continue;
        printf (“\n \t %d” , a);
    }
    getch ( );
}
```

**Program:**

Write a program in C language that displays the following output using nested loop.

|   |   |    |    |    |
|---|---|----|----|----|
| 1 | 2 | 3  | 4  | 5  |
| 2 | 4 | 6  | 8  | 10 |
| 3 | 6 | 9  | 12 | 15 |
| 4 | 8 | 12 | 16 | 20 |

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

```
void main ( )
{
    int x,y;
    clrscr( );
    for (x = 1; x <= 4;x++)
    {
        for (y = 1; y <= 5;y++)
            printf("%d\t",x*y);
        printf("\n");
    }
    getch ( );
}
```

**Program:**

Write a program in C language that displays the following output using nested loop.

```
1
1    4
1    4    9
1    4    9    16
1    4    9    16    25
```

```
# include <stdio.h>
# include <conio.h>
void main ( )
{
    int x,y;
    clrscr( );
    x=1;
    for (x = 1; x <= 5;x++)
    {
        for (y = 1; y <= x;y++)
            printf("%d\t",y*y);
        printf("\n");
    }
    getch ( );
}
```

```
}
```

**Program:**

Write a program in C language that displays the following output using nested loop.

```
1
1 2
1 2 3
1 2 3 4
1 2 3 4 5
```

```
# include <stdio.h>
# include <conio.h>
void main ( )
{
    int x,y;
    clrscr( );
    x=1;
    for (x = 1; x <= 5;x++)
    {
        for (y = 1; y <= x;y++)
            printf("%d\t",y);
        printf("\n");
    }
    getch ( );
}
```

**Program:**

Write a program to print numbers from 1 to 10 in ascending order by using one variable and 10 to 1 in descending order by using another variable. Use only one for loop.

```
# include <stdio.h>
void main ( )
{
    int a,b;
    for (a=1,b=10;a<=10;a++,b-- )
        printf("a = %d\t b = %d\n", a, b);
}
```

**Program:**

Write a program to print the output as shown below:

|   |   |   |    |    |
|---|---|---|----|----|
| 1 | 2 | 3 | 4  | 5  |
| 1 | 3 | 5 | 7  | 9  |
| 1 | 4 | 7 | 10 | 13 |

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

```
void main ( )
```

```
{
```

```
    int u,i,n;
```

```
    clrscr( );
```

```
    u = 1;
```

```
    while (u<=3)
```

```
    {
```

```
        i = 1;
```

```
        n = 1;
```

```
    while (i<=5)
```

```
    {
```

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

```
        n = n+u;
```

```
        i = i+1;
```

```
    }
```

```
    printf("\n");
```

```
    u = u+1;
```

```
}
```

```
printf("\nPress a key to continue ...");
```

```
}
```