

Department of Cybersecurity Technologies Engineering

PROGRAMMING ESSENTIALS

Lecture 5: Loops



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Lecture 5: Loops

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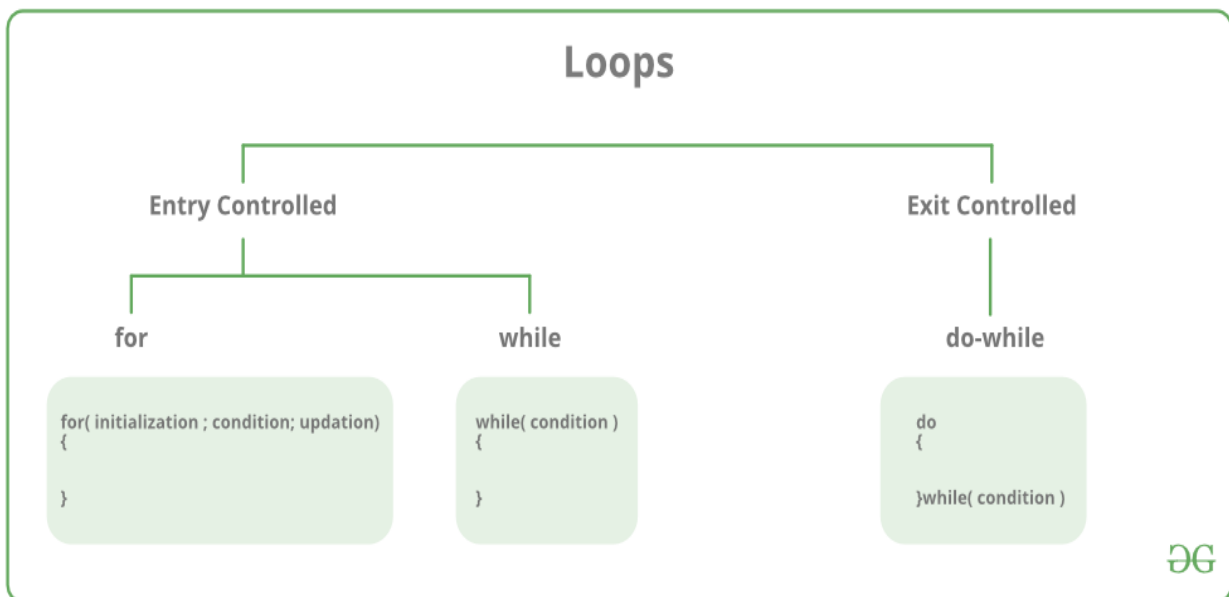
C++ Loops:

In Programming, sometimes there is a need to perform some operation **more than once** or (say) **n number** of times. Loops come into use when we need to repeatedly execute a block of statements.

In Loop, the statement needs to be written only once and the loop will be executed 10 times as shown below. In computer programming, a loop is a sequence of instructions that is repeated until a certain condition is reached.

There are mainly two types of loops:

1. **Entry Controlled loops:** In this type of loop, the test condition is tested before entering the loop body. For Loop and While Loop is entry-controlled loops.
2. **Exit Controlled Loops:** In this type of loop the test condition is tested or evaluated at the end of the loop body. Therefore, the loop body will execute at least once, irrespective of whether the test condition is true or false. the do-while loop is exit controlled loop.



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There are 3 types of loops in C++.

S.No.	Loop Type and Description
1.	while loop – First checks the condition, then executes the body.
2.	for loop – firstly initializes, then, condition check, execute body, update.
3.	do-while loop – firstly, execute the body then condition check

1. For Loop:

A For loop is a repetition control structure that allows us to write a loop that is executed a specific number of times. The loop enables us to perform n number of steps together in one line.

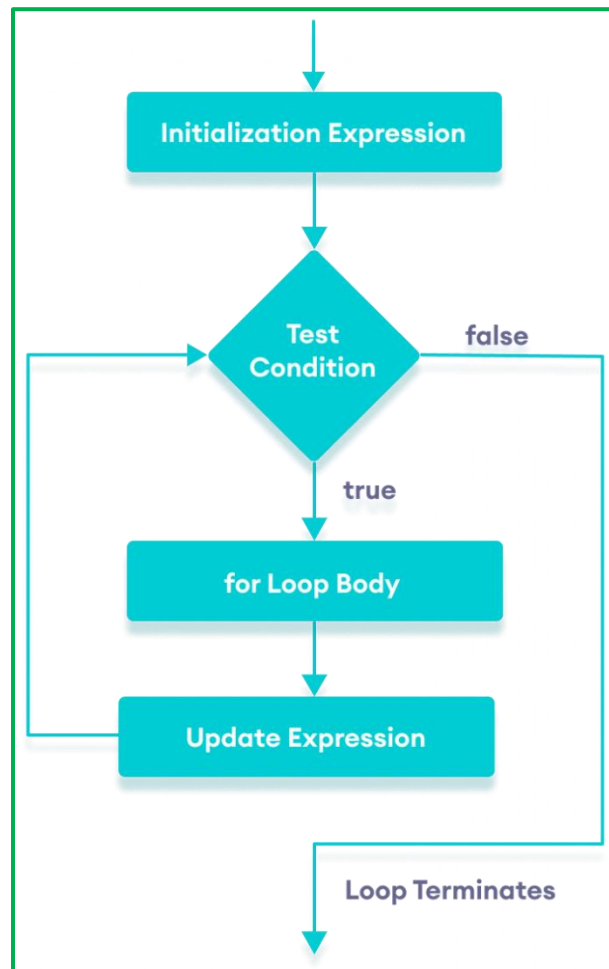
Syntax:

```
for (initialization; condition; update)
{
    // body of-loop;
}
```

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Here,

- **initialization** - initializes variables and is executed only once
- **condition** - if **true**, the body of **for** loop is executed
if **false**, the for loop is terminated
- **update** - updates the value of initialized variables and again checks the condition.



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Example 1: Write a C++ program to Print Numbers From 1 to 5?

```
#include <iostream>
using namespace std;
int main()
{
    for (int i = 1; i <= 5; ++i)
    {
        cout << i << " ";
    }
    return 0;
}
```

Example 2: Write a C++ program to Display a text 5 times?

```
#include <iostream>
using namespace std;
int main()
{
    string s;
    cout<<"Enter the String "<<endl;
    cin>>s;
    cout <<"the String will print 5 time is"<<endl;
    for (int i = 1; i <= 5; ++i)
    {
        cout <<s<<endl;
    }
    return 0;
}
```

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Example 3: Write a C++ Program to Find the sum of first n Natural Numbers?

```
#include <iostream>
using namespace std;
int main()
{
    int num, sum;
    sum = 0;
    cout << "Enter a positive integer: ";
    cin >> num;
    for (int i = 1; i <= num; ++i)
    {
        sum += i;
    }
    cout << "Sum = " << sum << endl;
    return 0;
}
```

1.1 Ranged Based for Loop

In C++11, a new range-based for loop was introduced to work with collections such as **arrays** and **vectors**. Its syntax is:

Syntax:

```
for (variable : collection)
{
    // body of loop
}
```

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Example 4: Write a C++ Program to print number from 1-10 using Range Based for Loop?

```
#include <iostream>
using namespace std;
int main()
{
    int num_array[] = {1, 2, 3, 4, 5, 6, 7, 8, 9, 10};
    for (int n : num_array)
    {
        cout << n << " ";
    }
    return 0;
}
```

1.2 C++ Infinite for loop

If the condition in a for loop is always true, it runs forever (until memory is full)

Syntax:

```
For (int i = 1; i > 0; i++)
{ // block of code }
```

Example 5: Write a C++ Program to Display Multiplication Table up to 10 for Entered number?

```
#include <iostream>
using namespace std;
int main()
{
    int n;
    cout << "Enter a positive integer: ";
    cin >> n;
    // run a loop from 1 to 10
    // print the multiplication table
    for (int i = 1; i <= 10; ++i) {
        cout << n << " * " << i << " = " << n * i << endl;
    }
    return 0;
}
```

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Example 6: C++ program to Display Multiplication Table up to a Given Range?

```
#include <iostream>
using namespace std;
int main() {
    int n, range;
    cout << "Enter an integer: ";
    cin >> n;
    cout << "Enter range: ";
    cin >> range;
    for (int i = 1; i <= range; ++i) {
        cout << n << " * " << i << " = " << n * i << endl;
    }
    return 0;
}
```

1.3 Nested for Loop

C++ programming allows using one for loop inside another for loop. This is known as nested for loop.

```
For (initialization expression; test expression; update expression)
{
    // body of the outer loop
    // statements we want to execute
    For (initialization expression; test expression; update expression)
    {
        // body of the inner loop
        // statements we want to execute
    }
}
```

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Example 7: C++ program to Display the following Shape using for loop

1
12
123
1234
12345.

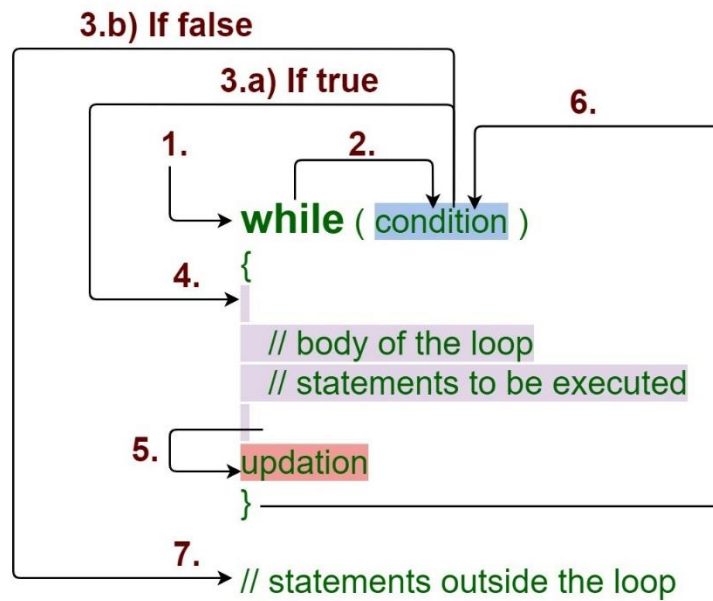
```
#include <iostream>
#include <conio.h>
using namespace std;
int main()
{
    int i,j;
    for(i=1; i<=6; i=i+1)
    {
        for(j=1; j<=i; j=j+1)
        {
            cout<<j;
        }
        cout<<endl;
    }
    return 0;
}
```

2. While Loop

While Loop in C++ is used in situations where we do not know the exact number of iterations of the loop beforehand. The loop execution is terminated on the basis of the test condition.

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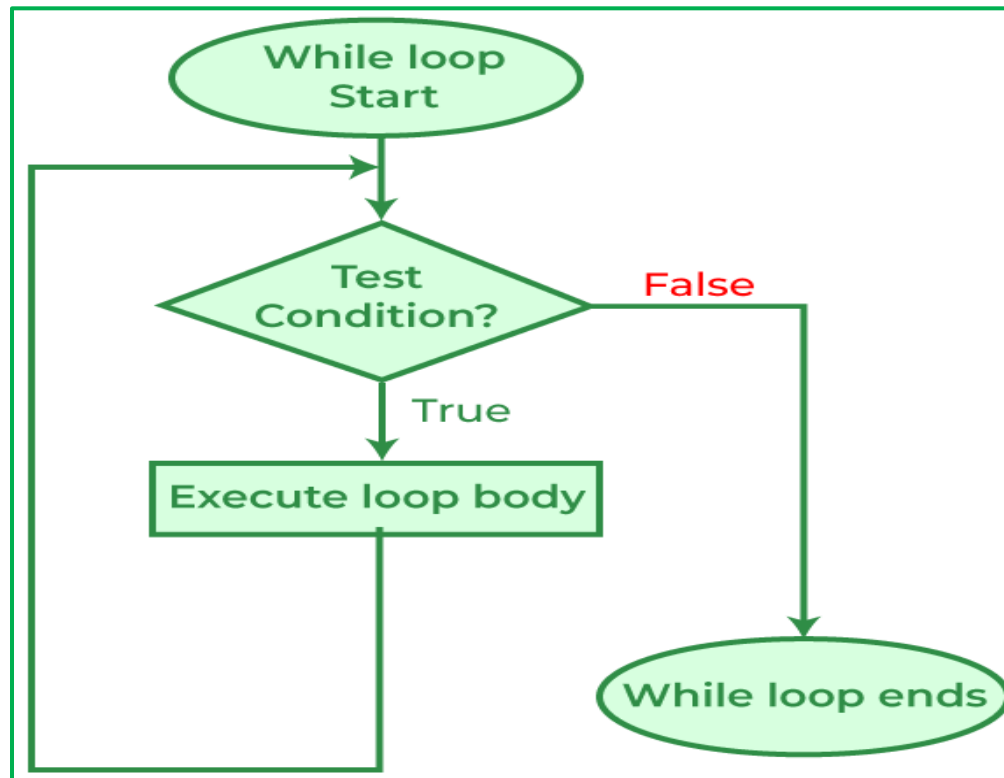
While Loop



Syntax:

```
while (test_expression)
{
    // statements
    update_expression;
}
```

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Example 8: C++ Program to print numbers from 1 to 7 using while loop?

```
#include <iostream>
using namespace std;
int main() {
    int i = 1;
    // while loop from 1 to 5
    while (i <= 6) {
        cout << i << " ";
        ++i;
    }
    return 0;
}
```

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Example 9: C++ program to find the sum of positive numbers, if the user enters a negative number, the loop ends?

```
#include <iostream>
using namespace std;
int main()
{
    int number, sum = 0;
    // take input from the user
    cout << "Enter a number: ";
    cin >> number;
    while (number >= 0) {
        // add all positive numbers
        sum += number;
        // take input again if the number is positive
        cout << "Enter a number: ";
        cin >> number;
    }
    // display the sum
    cout << "\nThe sum is " << sum << endl;
    return 0;
}
```

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Example 10: C++ program to input a 4-digit number and find the sum of its digits using while loop?

```
#include <iostream>
using namespace std;
int main()
{
    int n,r,sd=0;
    cout<<"Enter a 4 digit number ";
    cin>>n;
    if(n>=1000 && n<=9999)
    {
        while(n>0)
        {
            r=n%10;    // return the last digit of the number as remainder
            sd=sd+r;
            n=n/10;    // removes the last digit of the number
        }
        cout<<"Sum of digits = "<<sd;
    }
    else
    {
        cout<<"Not a 4 digit number";
    }
    return 0;
}
```

2.1 Nested While

C++ programming allows using one while loop inside another while loop. This is known as nested while loop

Syntax:

```
while(test_expression 1)
{ // body of the outer loop
    // statements we want to execute
    while(test expression 2)
    { // body of the inner loop
        // statements we want to execute
        update_expression; }
    update_expression; }
```

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Example 11: C++ program to Display the following Shape using While loop?

1
12
123
1234
12345

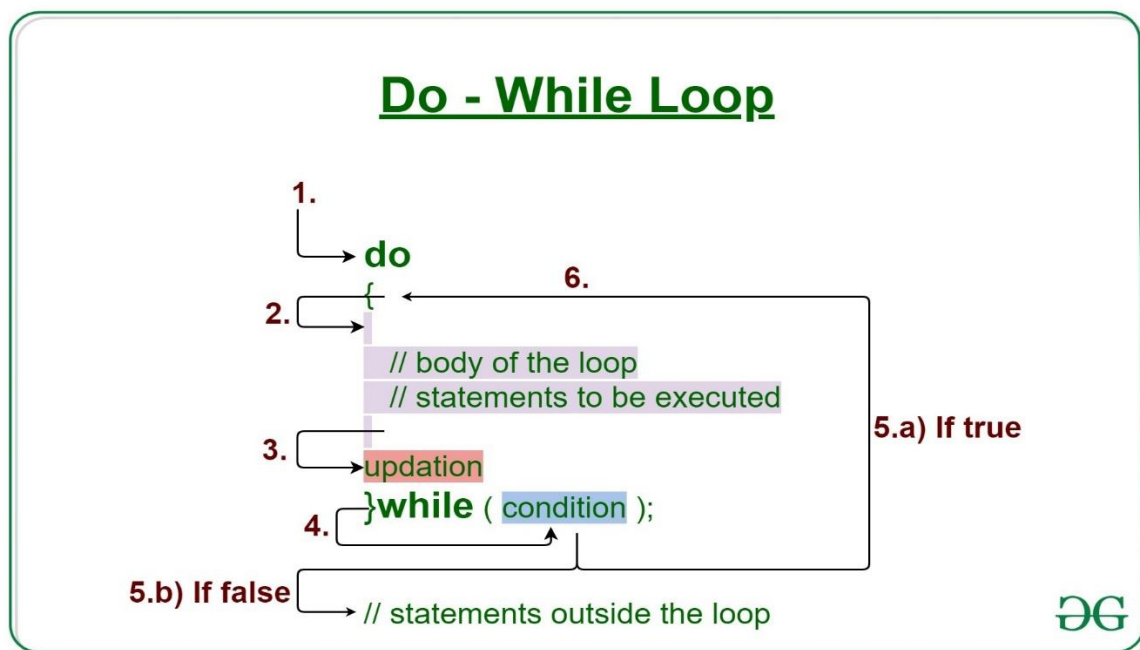
```
#include <iostream>
using namespace std;
int main()
{
    int i=1,j;
    while(i<=5)
    {
        j=1;
        while(j<=i)
        {
            cout<<j;
            j++;           // it means j=j+1
        }
        cout<<"\n";
        i++;               // it means i=i+1
    }
    return 0;
}
```

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3. Do.... While

A do while loop in C++ programming is almost similar to while loop with an only difference that the test condition is checked at the end of the loop. A do while loop is also known as Exit Controlled loop because the test condition is evaluated, after the execution of the body of the do while loop.

In the do while loop, the body of the loop will execute at least once even after the test condition is false.

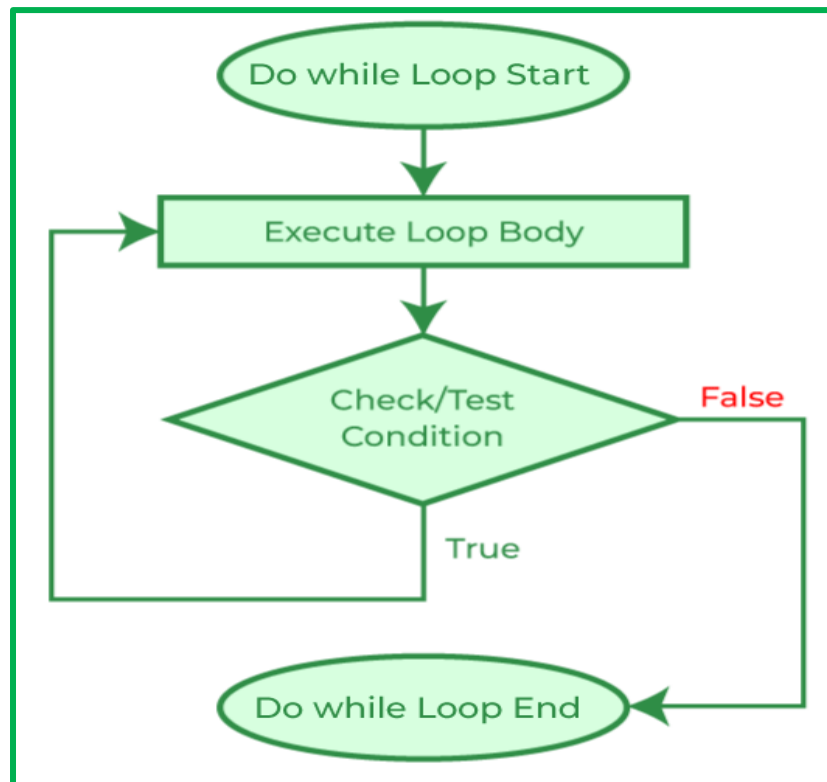


Syntax:

```
do
{
// loop body

update_expression;
}
while (test_expression);
```

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Example 12: C++ program to print numbers from 1 to 10 using Do-while?

```
#include <iostream>
using namespace std;
int main()
{
    int i=1;
    do
    {
        cout<<i<<" ";
        i=i+1;
    }
    while(i<=10);
    return 0;
}
```

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Example 13: C++ program to print all the even numbers from 10 to 20 on the screen using do while loop.

```
#include <iostream>
using namespace std;
int main()
{
    int i=10;
    do
    {
        cout<<i<<endl;
        i=i+2;
    }
    while(i<=20);
    return 0;
}
```

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Example 14: C++ program to print all the numbers from 10 to 1 in reverse order on the screen using do while loop.

```
#include <iostream>
using namespace std;
int main()
{
    int i=10;
    do
    {
        cout<<i<<endl;
        i=i-1;
    }
    while(i>=1);
    return 0;
}
```

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3.1 Nested do while Loop

Syntax

```
do
{
    // body of the outer loop
    // statements we want to execute

    do
    {
        // body of the inner loop
        // statements we want to execute

        update expression;
    }
    while(test expression);

    update_expression;
}
while(test expression);
```

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Example 15: C++ program to Display the following Shape using Do...While loop?

1
12
123
1234
12345

```
#include <iostream>
using namespace std;
int main()
{
    int i=1,j;
    do
    {
        j=1;
        do
        {
            cout<<j;
            j++;           // it means j=j+1
        }
        while(j<=i);
        cout<<"\n";
        i++;              // it means i=i+1
    }
    while(i<=5);
    return 0;
}
```