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Introduction to 'C++' Language

Control Statements and Loops in C Plus Plus

Module 4 - Loops in C Plus Plus

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Introduction:

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.

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For example: Suppose we want to print "Hello World" 10 times. This can be done in two ways as shown below:

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Manual Method (Iterative Method)

Manually we have to write cout for the C++ statement 10 times. Let's say you have to write it 20 times (it would surely take more time to write 20 statements) now imagine you have to write it 100 times, it would be really hectic to re-write the same statement again and again. So, here loops have their role.

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// C++ program to Demonstrate the need of loops

```
#include <iostream>
using namespace std;
```

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```
int main()
```

```
{
cout << "Hello World\n";
cout << "Hello World\n";
cout << "Hello World\n";
cout << "Hello World\n";
cout << "Hello World\n";
return 0;
```

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```
}
```

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Output

```
Hello World
Hello World
Hello World
Hello World
Hello World
```

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NOTE: In computer programming, a loop is a sequence of instructions that is repeated until a certain condition is reached.

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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.

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 expr; test expr; update expr)
{
    // body of the loop
    // statements we want to execute
}
```

Explanation of the Syntax:

- **Initialization statement:** This statement gets executed only once, at the beginning of the for loop. You can enter a declaration of multiple variables of one type, such as `int x=0, a=1, b=2`. These variables are only valid in the scope of the loop. Variable defined before the loop with the same name are hidden during execution of the loop.

- **Condition:** This statement gets evaluated ahead of each execution of the loop body, and abort the execution if the given condition get false.

- **Iteration execution:** This statement gets executed after the loop body, ahead of the next condition evaluated, unless the for loop is aborted in the body (by `break`, `goto`, `return` or an exception being thrown.)

Example of For Loop:

```
C++
// C++ program to Demonstrate for loop
#include <iostream>
using namespace std;
```

```
int main()
{
    for (int i = 1; i <= 5; i++) {
        cout << "Hello World\n";
    }
}
```

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```
return 0;
}
```

**Output**

Hello World  
Hello World  
Hello World  
Hello World  
Hello World



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**While Loop**

While studying for loop we have seen that the number of iterations is known beforehand, i.e. the number of times the loop body is needed to be executed is known to us. while loops are 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 conditions.

**Syntax:**

```
initialization expression;
while (test_expression)
{
    // statements

    update_expression;
}
```

**Example: C++ program to Demonstrate while loop**

```
#include <iostream>
using namespace std;

int main()
{
    // initialization expression
    int i = 1;

    // test expression
    while (i < 6) {
        cout << "Hello World\n";

        // update expression
        i++;
    }
    return 0;
}
```

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---

}

**Output**

Hello World  
Hello World  
Hello World  
Hello World  
Hello World

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**Do-while loop**

In Do-while loops also the loop execution is terminated on the basis of test conditions. The main difference between a do-while loop and the while loop is in the do-while loop the condition is tested at the end of the loop body, i.e do-while loop is exit controlled whereas the other two loops are entry-controlled loops.

**Note:** In a do-while loop, the loop body will **execute at least once** irrespective of the test condition.

**Syntax:**

```
initialization expression;
do
{
    // statements
    update_expression;
} while (test_expression);
```

**Note:** Notice the semi - colon (“;”) in the end of loop.

**Example: C++ program to Demonstrate do-while loop**

```
#include <iostream>
using namespace std;

int main()
{
    int i = 2; // Initialization expression

    do {
        // loop body
        cout << "Hello World\n";

        // update expression
        i++;
```

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```
} while (i < 1); // test expression
```

```
return 0;
```

```
}
```

Output

Hello World

What about an Infinite Loop?

An infinite loop (sometimes called an endless loop) is a piece of coding that lacks a functional exit so that it repeats indefinitely. An infinite loop occurs when a condition is always evaluated to be true. Usually, this is an error.

Example: C++ program to demonstrate infinite loops

```
// using for and while loop  
// Uncomment the sections to see the output  
#include <iostream>  
using namespace std;  
int main()  
{  
    int i;  
    // This is an infinite for loop as the condition  
    // expression is blank  
    for (;;) {  
        cout << "This loop will run forever.\n";  
    }  
    // This is an infinite for loop as the condition  
    // given in while loop will keep repeating infinitely  
    /*  
    while (i != 0)  
    {  
        i-- ;  
        cout << "This loop will run forever.\n";  
    }  
    */  
    // This is an infinite for loop as the condition  
    // given in while loop is "true"  
    /*  
    while (true)  
    {  
        cout << "This loop will run forever.\n";  
    }  
    */
```

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```
*/  
}
```

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**Output:**  
This loop will run forever.  
This loop will run forever.  
.....

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Assignment

Ques 1: Write a Program to print the following output: 5 4 3 2 1 0

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Ques 2: Find the sum of first n Natural Numbers  
Enter a positive integer: 10  
Sum = 55

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Ques 3: Write a program to print a pyramid pattern of stars (\*) with n rows.  
Example for n = 4:  
\*  
\*\*\*  
\*\*\*\*\*  
\*\*\*\*\*

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Ques 4: Write a program to print the multiplication table of a number n up to 10.  
Example for n = 5:

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5 × 1 = 5  
5 × 2 = 10  
...  
5 × 10 = 50

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Ques 5: Write a program to check if a number is a palindrome.  
Example:  
• Input: 121  
• Output: Palindrome

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