كليـــة العلـــــوم

قسم الأمن السيبراني

Subject: Programming Fundamentals

First Stage

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Lecture (7)

Loop Statements in C++

Objective:

2024-2025

By the end of this lecture, students will:

1. Understand the purpose of loop statements.
2. Learn the syntax and use cases for `while`, `do...while`, and `for` loops.
3. Differentiate between the three types of loops and apply them in practical examples.

1. Introduction to Loops

Loops allow us to execute a block of code repeatedly until a certain condition is met.

- They help reduce redundancy and make code more efficient and readable.
- Types of loops in C++:
  - `while` loop
  - `do...while` loop
  - `for` loop

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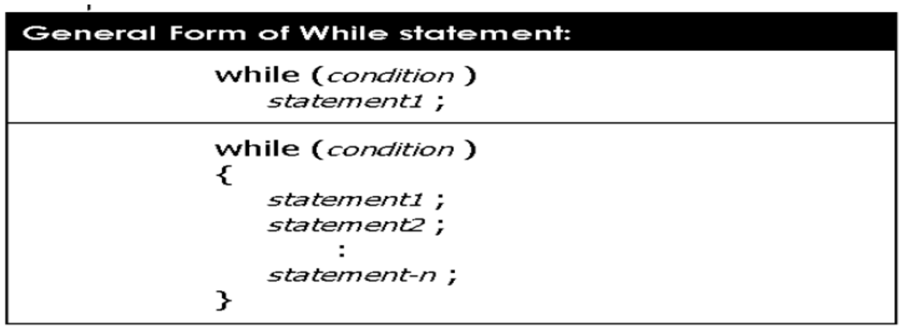
2. The `while` Loop

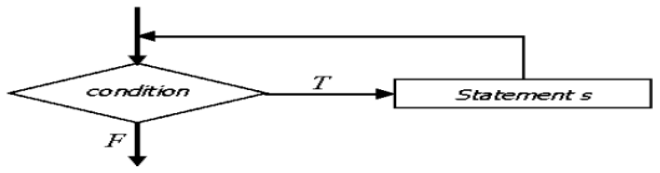
- **Definition**: Executes a block of code as long as the given condition is `true`.
- **Syntax**:



General Form of While statement:

```
while (condition )
      statement1 ;
```

```
while (condition )
{
      statement1 ;
      statement2 ;
            :
      statement-n ;
}
```



- **Key Point**: The condition is evaluated *before* the loop body runs.

Example:

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

int main() {
    int i = 1;
    while (i <= 5) {
        cout << "Iteration " << i << endl;
        i++;       // Increment
    }
    return 0;
}
```

Use Case: Reading input until a valid value is provided.

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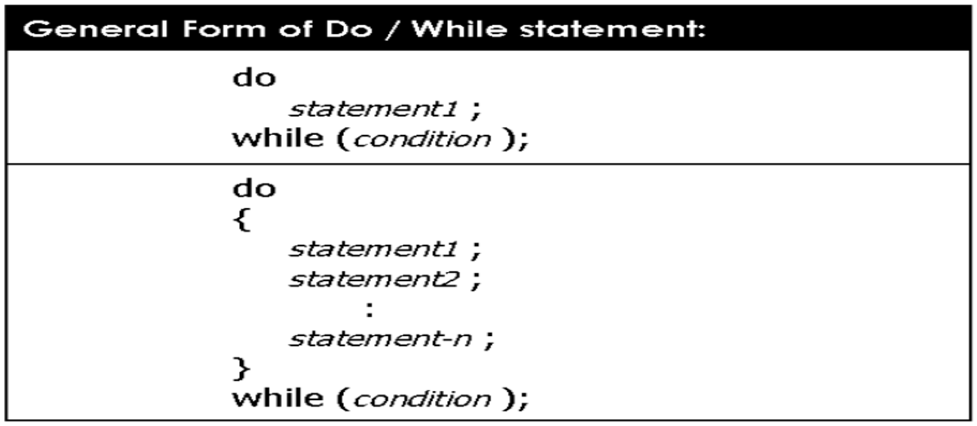
3. The `do...while` Loop

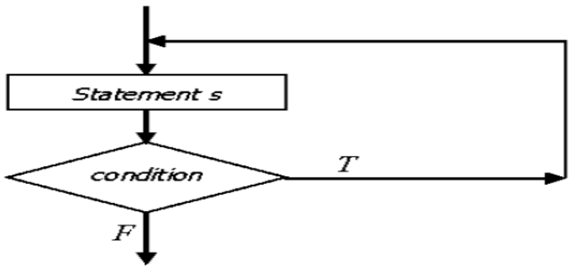
- **Definition**: Executes the block of code once, and then repeats as long as the condition is **`true`**.
- **Syntax**:



General Form of Do / While statement:

```
do
    statement1 ;
while (condition );
```

```
do
{
    statement1 ;
    statement2 ;
        :
    statement-n ;
}
while (condition );
```



- **Key Point**: The condition is evaluated *after* the loop body runs, guaranteeing at least one execution.

Example:

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

int main() {
    int number;
    do {
        cout << "Enter a number greater than 10: ";
        cin >> number;
    } while (number <= 10);

    cout << "You entered: " << number << endl;
    return 0;

}
```

Use Case: Input validation where at least one attempt is needed.

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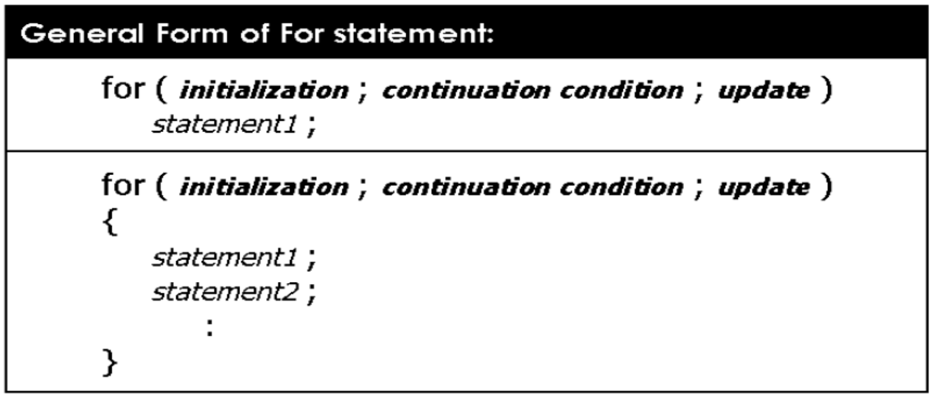
4. The `for` Loop

- **Definition**: Ideal for situations where the number of iterations is known beforehand.
- **Syntax**:



General Form of For statement:

```
for ( initialization ; continuation condition ; update )
    statement1 ;

for ( initialization ; continuation condition ; update )
{
    statement1 ;
    statement2 ;
        :
}
```

- **Key Point**: Combines initialization, condition-checking, and increment in one line.

Example:

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

int main() {
    for (int i = 1; i <= 5; i++) {
        cout << "Iteration " << i << endl;
    }
    return 0;
}
```

Use Case: Iterating through arrays or a fixed range of values.

5. Comparison of Loop Statements

Feature	while	do...while	for
Condition Check	Before the loop	After the loop	Before the loop
Best Use Case	Unknown iterations	At least one iteration needed	Known iterations

6. Practical Example

Task: Print the sum of numbers from 1 to 10 using all three loops.

Using `while`:

```
int sum = 0, i = 1;
while (i <= 10) {
    sum += i;
    i++;
}
cout << "Sum: " << sum << endl;
```

Using *do...while*:

```
int sum = 0, i = 1;
do {
    sum += i;
    i++;
} while (i <= 10);
cout << "Sum: " << sum << endl;
```

Using `for`:

```
int sum = 0;
for (int i = 1; i <= 10; i++) {
    sum += i;
    }
cout << "Sum: " << sum << endl;
```

7. Common Mistakes

1. **Infinite Loops**: Forgetting to update the variable in the loop body. Example:

```
int i = 1;
   while (i <= 5) {
       cout << i << endl;      // No increment
   }
```

2. **Incorrect Condition**: Using a wrong or overly restrictive condition.

```
int number = 0;
// Trying to enter a positive number
do {
    cout << "Enter a positive number: ";
    cin >> number;
} while (number > 0);     // Incorrect condition: This should be "number <= 0"
cout << "You entered: " << number << endl;
```