

CSC 211: Computer Programming

Loops (while, do while) and nested loops

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the while loop

Flowchart of while statement

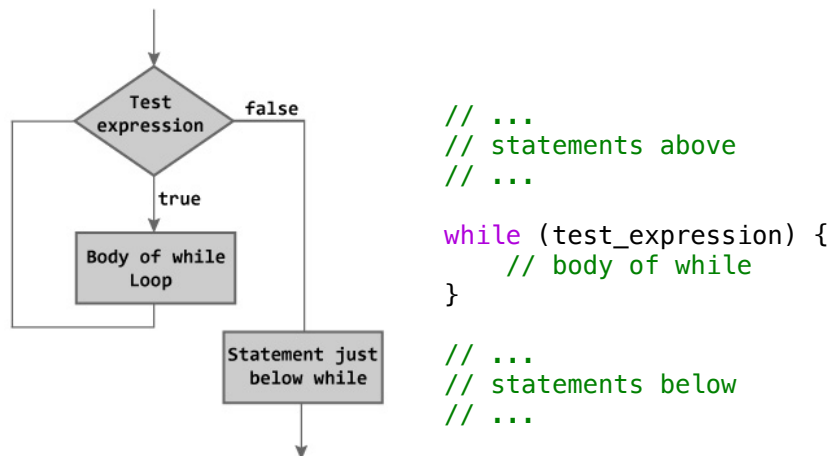


Figure: Flowchart of while Loop

<https://www.programiz.com/cpp-programming/do-while-loop>

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A while Statement with a Single Statement Body

```
while (Boolean_Expression)  
    Statement
```

← Body

A while Statement with a Multistatement Body

```
while (Boolean_Expression)  
{  
    Statement_1  
    Statement_2  
    .  
    .  
    .  
    Statement_Last  
}
```

Body

from: Problem Solving with C++, 10th Edition, Walter Savitch

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What is the output?

```
int n = 2023;

while (n > 0) {
    std::cout << n % 10 << std::endl;
    n /= 10;
}
```

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Question

- Write a single while loop to print the powers of two from 2^0 to 2^{16} .
- No `cmath` allowed!

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Any **for** loop can
be rewritten as
a **while** loop, and
vice-versa

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do-while, break,
continue

Flowchart of do-while statement

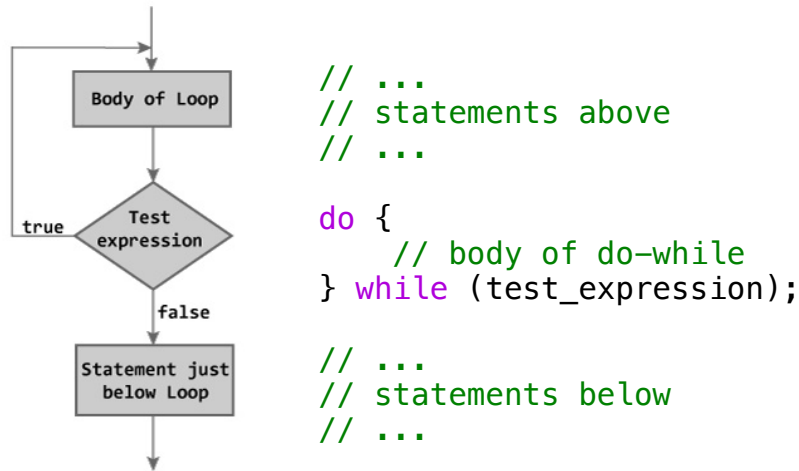


Figure: Flowchart of do...while Loop

<https://www.programiz.com/cpp-programming/do-while-loop>

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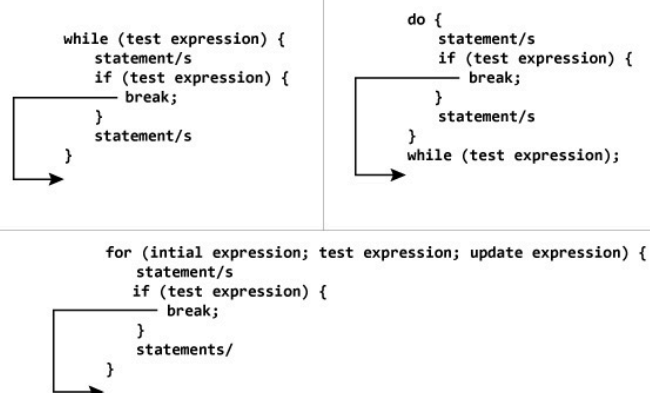
Example

```
int num;  
  
do {  
    std::cout << "Enter a number: ";  
    std::cin >> num;  
} while (num < 0 || num > 100);  
  
// do something with num  
// ...
```

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break statement

- The break statement will cause an **immediate exit**



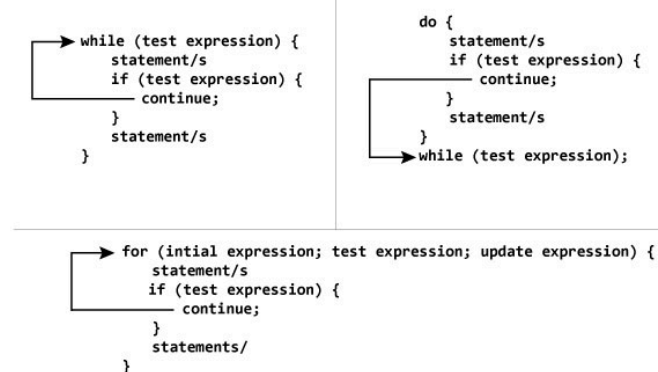
NOTE: The break statement may also be used inside body of else statement.

<https://www.programiz.com/cpp-programming/break-continue>

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continue statement

- The continue statement will **interrupt an iteration**



NOTE: The continue statement may also be used inside body of else statement.

<https://www.programiz.com/cpp-programming/break-continue>

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What is the output?

```
for (int i = 1 ; i <= 10 ; i++) {  
    if (i % 2 == 0) {  
        continue;  
        std::cout << i << " ";  
    } else {  
        std::cout << i << " ";  
    }  
}
```

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A single repetition
of the loop body is
called **Iteration**

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Loops everywhere ...



<https://techterms.com/definition/rendering>

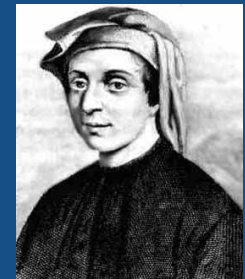
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Fibonacci sequence

$$F_0 = 0$$

$$F_1 = 1$$

$$F_n = F_{n-1} + F_{n-2}$$



0 1 1 2 3 5 8 13 21 34 ...

The **Fibonacci sequence** first appears in the book **Liber Abaci** (1202) by Fibonacci, using it to calculate the growth of rabbit populations. The sequence had been described by Indian mathematicians as early as the **sixth century**.

from: wikipedia

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Question?

- Write a program to print the first 50 terms of the Fibonacci sequence (pick your favorite loop)

$$F_0 = 0$$

$$F_1 = 1$$

$$F_n = F_{n-1} + F_{n-2}$$

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Nested loops

Question

- Output the following pattern using a single loop

```
+++++
+++++
+++++
+++++
+++++
```

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Another solution ...

- Nested loops:** loops inside loops

```
                                outer loop
for (int i = 0 ; i < 5 ; i++) {
    for (int j = 0 ; j < 10 ; j++) {
        std::cout << '+';
    }
    std::cout << std::endl;
}
```

inner loop

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“Simple, elegant solutions are more effective, but they are harder to find than complex ones, and they require more time, which we too often believe to be unaffordable”



Niklaus Wirth, a Swiss computer scientist. In 1984 he won the Turing Award for developing a sequence of innovative computer languages: Euler, Pascal, Modula, etc.

from: wikipedia

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What is the output?

```
for (int i = 0 ; i < 5 ; i++) {  
    for (int j = 0 ; j < (i + 1) ; j++) {  
        std::cout << '+';  
    }  
    std::cout << std::endl;  
}
```

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Question

- Output the following pattern using nested loops

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

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Question?

- Write a program that outputs all prime numbers from 1 to 100

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