

CSC 211: Computer Programming

Loops (while, do while) and nested loops

Michael Conti

Department of Computer Science and Statistics
University of Rhode Island

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the while loop

Flowchart of while statement

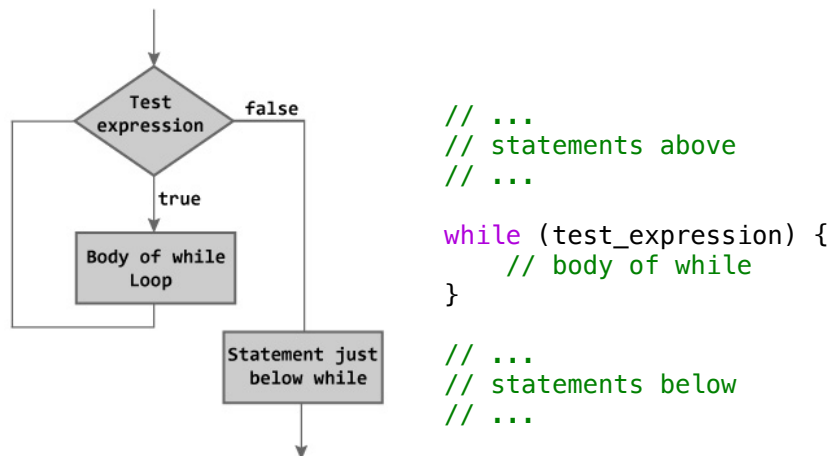


Figure: Flowchart of while Loop

<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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Question

```
int exp = 0;
int value = 0;

while(exp <= 16){
    if(exp == 0){
        value = 1;
    }
    else{
        value *=2;
    }

    exp++;

    std::cout << value << std::endl;
}
```

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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

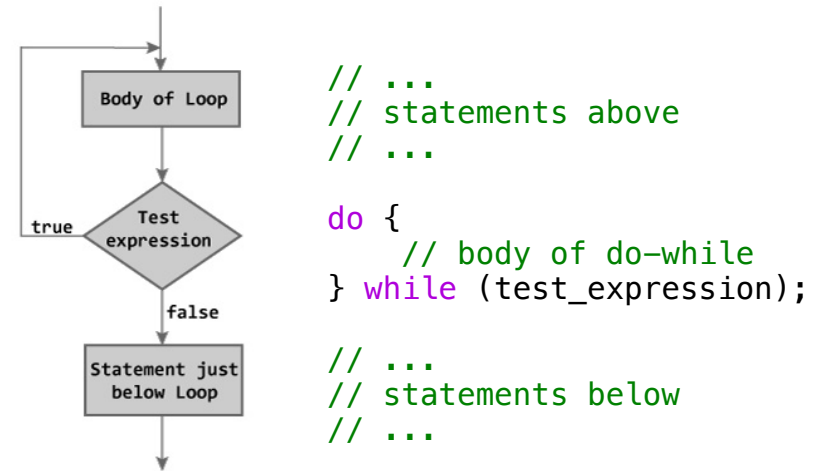


Figure: Flowchart of do...while Loop

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

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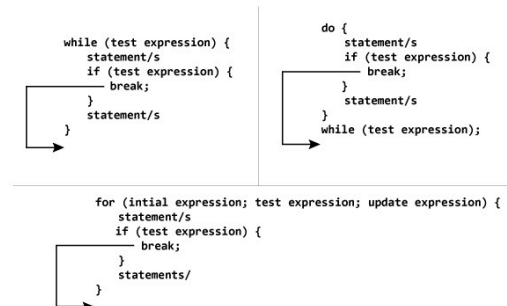
Example

```
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**
- Break will exit only inner loop if used in nested loop



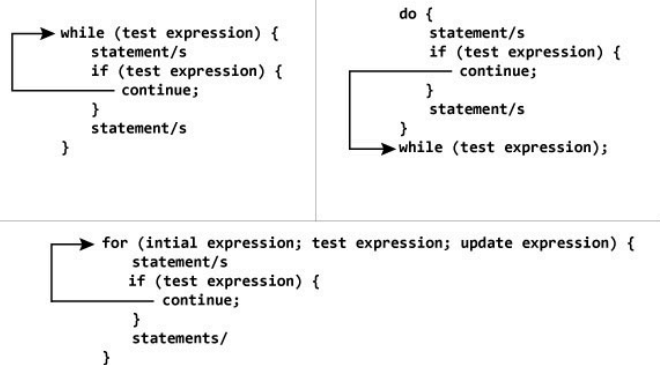
NOTE: The break statement may also be used inside body of else statement.

<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>

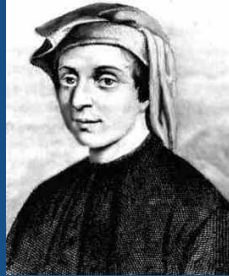
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Fibonacci sequence

$$F_0 = 0$$

$$F_1 = 1$$

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



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)

$$F_0 = 0$$

$$F_1 = 1$$

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

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

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Question?

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

$$F_0 = 0$$

$$F_1 = 1$$

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

```
int num = 50;
int f0 = 0, f1 = 1, fn = 0;
for (int i = 0; i < num; i++) {
    std::cout << f0 << " ";
    fn = f0 + f1;
    f0 = f1;
    f1 = fn;
}
```

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

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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 << '+' ; inner loop  
    }  
    std::cout << std::endl ;  
}
```

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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

- Output the following pattern using nested loops

```
int rows = 5;
for(int i = 1; i <= rows; ++i)
{
    for(int j = 1; j <= i; ++j)
    {
        std::cout << j << " ";
    }
    std::cout << "\n";
}
```

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Question?

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

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