

CSC 211: Computer Programming

Introducing loops (for)

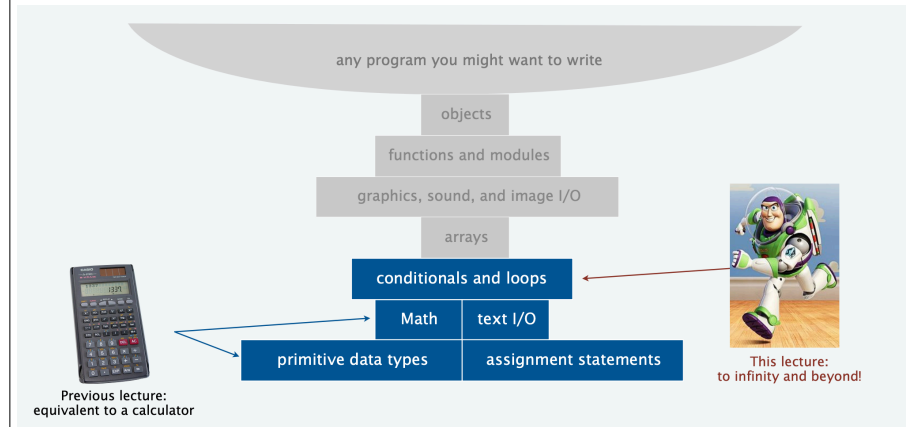
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Basic building blocks



<https://introcs.cs.princeton.edu/java/lectures/>

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Flowchart of if statements

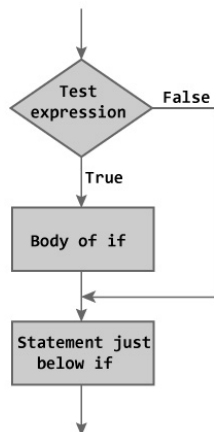


Figure: Flowchart of if Statement

```
// ...  
// statements above  
// ...  
  
if (test_expression) {  
    // body of if  
}  
  
// ...  
// statements below  
// ...
```

<https://www.programiz.com/cpp-programming/if-else>

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Flowchart of if statements

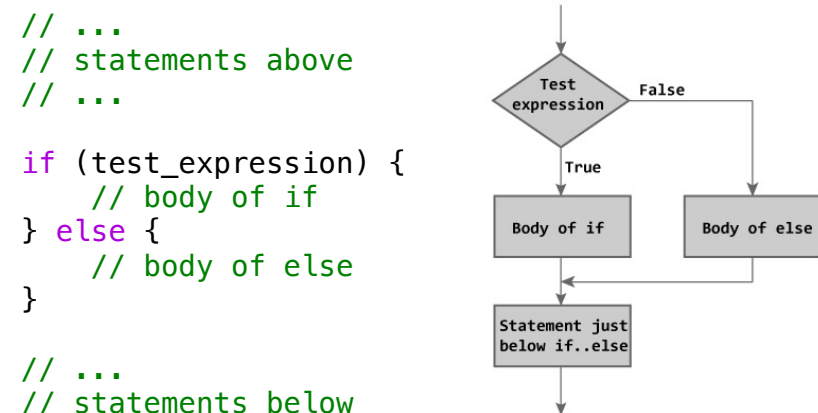


Figure: Flowchart of if...else Statement

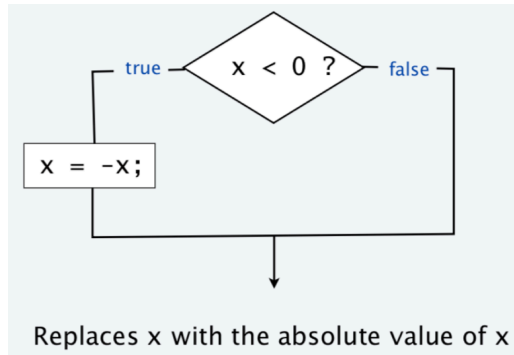
```
// ...  
// statements above  
// ...  
  
if (test_expression) {  
    // body of if  
} else {  
    // body of else  
}  
  
// ...  
// statements below  
// ...
```

<https://www.programiz.com/cpp-programming/if-else>

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if statement examples

Example: `if (x < 0) x = -x;`

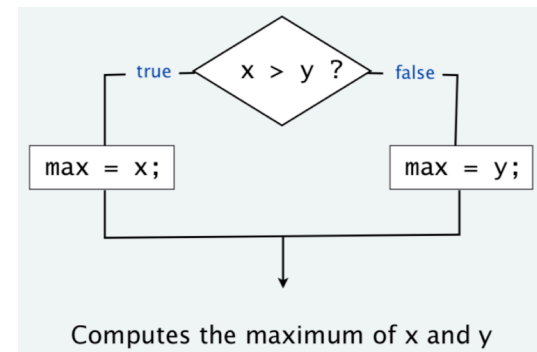


<https://introcs.cs.princeton.edu/java/lectures/>

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if statement examples

Example: `if (x > y) max = x;`
`else max = y;`



<https://introcs.cs.princeton.edu/java/lectures/>

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The increment/decrement operators

- Increment (`++`) and decrement (`--`) are **unary** operators that add or subtract one, to or from their operand, respectively
 - ✓ **pre-increment** and **pre-decrement** operators increment (or decrement) their operand by 1, and the value of the expression is the resulting incremented (or decremented) value
 - ✓ **post-increment** and **post-decrement** operators increase (or decrease) the value of their operand by 1, but the value of the expression is the operand's original value prior to the increment (or decrement) operation

from: wikipedia

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The increment/decrement operators

Example:

```
int a = 5;
```

```
std::cout << 5 + ++a
```

v.s

```
int a = 5;
```

```
std::cout << 5 + a++;
```

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Trace the code

```
int x;  
int y;  
  
x = 1;  
y = ++x;  
  
// Checkpoint a (status of x and y?)  
y = x++;  
  
// Checkpoint b (status of x and y?)  
x = 5;  
y = x--;  
  
// Checkpoint c (status of x and y?)  
y = --x;  
  
// Checkpoint d (status of x and y?)
```

from: wikipedia

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the for loop

Flowchart of for statement

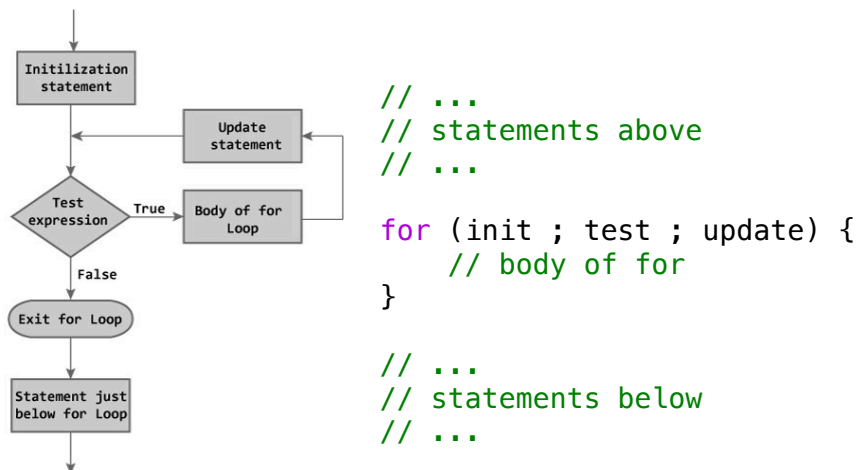


Figure: Flowchart of for Loop

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

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1. initialization 4. update

2. boolean

```
for (int i = 0 ; i < 3 ; i++) {  
    std::cout << i << ' ' ;  
}
```

3. statement

then go back to step 2

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A for Statement

//Illustrates a for loop.

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

```
int main()
{
    int sum = 0;
    for (int n = 1; n <= 10; n++) //Note that the variable n is a local
        sum = sum + n;           //variable of the body of the for loop!

    cout << "The sum of the numbers 1 to 10 is "
          << sum << endl;
    return 0;
}
```

Diagram annotations:

- Initializing action (points to `int n = 1`)
- Repeat the loop as long as this is true. (points to `n <= 10`)
- Done after each loop body iteration (points to `n++`)

Output

The sum of the numbers 1 to 10 is 55

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

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What is the output?

```
int value = 0;

for (int i = 0 ; i < 5 ; i++) {
    value += (i * 10);
}

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

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for Loop with a Multistatement Body

Syntax

```
for (Initialization_Action; Boolean_Expression; Update_Action)
{
    Statement_1
    Statement_2
    .
    .
    Statement_Last
}
```

Diagram: A large right curly brace groups the statements from `Statement_1` to `Statement_Last`, with the label `Body` to its right.

Example

```
for (int number = 100; number >= 0; number--)
{
    cout << number
          << " bottles of beer on the shelf.\n";
    if (number > 0)
        cout << "Take one down and pass it around.\n";
}
```

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

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Examples

```
int n = 1;
```

```
for ( ; n <= 10 ; n = n + 2)
    std::cout << n << std::endl;
```

```
for (n = 10 ; n > 0 ; n -= 2) std::cout << n << std::endl;
```

```
for (n = 0 ; n > -30 ; n = n - 7) {
    std::cout << n << std::endl;
}
```

```
for (double x = 16.0 ; x >= 2.0 ; x = sqrt(x)) {
    std::cout << x;
    std::cout << std::endl;
}
```

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What is the output?

```
for (int count = 1 ; count <= 10 ; count++);  
std::cout << "Hello\n";
```

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Careful with the semi-colon

- Semi-colon is used to end statements
- Placing it after the parenthesis of a `for` loop creates an **empty statement**

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Different output?

```
for (int count = 1 ; count <= 10 ; count++){  
    std::cout << count << std::endl;  
}
```

V.S

```
for (int count = 1 ; count <= 10 ; ++count){  
    std::cout << count << std::endl;  
}
```

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Question

- Write a single for loop to print the first 50 even numbers

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Question

- Write a single for loop to print the average of the first 25 multiples of 3