

# Basic C++

Chapters 1-5

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# Structure of a C++ Program

- Hello world:

```
//This program outputs a message to the screen
#include <iostream>
using namespace std;

int main() {
    cout << "Hello world!" << endl;
}
```

- In general:

```
//This is a comment
#include <includefile> ...
using namespace std;

int main() {
    statements ...
}
```

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# Variables, Data Types

- **Variable:** portion of memory that stores a value
- **Identifier:** name of a program element
- Fundamental data types

short	float	bool
int	double	char
long	long double	

- **Variable Declaration** statement

```
datatype identifier;
```

```
float hours;
```

- **Variable Initialization** statement:

```
datatype identifier = constant;
```

```
int count = 0;
```

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# Constants

- **Literals** (specific value of a given type)

```
1
75
-2
```

```
12.45
-3.8
6.25e-5
```

```
true
false
```

```
'A'
'2'
```

- **Named Constants:**  
variable whose value cannot be changed

```
const datatype identifier = constant;
```

```
const double TAX_RATE = 0.0675;
```

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## Assignment statement, expressions

- To change the value of a variable:

```
variable = expression;
```

```
count = 10;
```

- \* **The lefthand side must be a variable**
- \* The righthand side is an *expression* of the right type
- What is an expression?
  - \* an expression has a type and evaluates to a value
    - ✦ literal
    - ✦ named constant
    - ✦ variable
    - ✦ arithmetic expression
    - ✦ etc.

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## Arithmetic and Relational Operations

- arithmetic operators:

+ addition  
- subtraction  
\* multiplication  
/ division  
% modulo

```
x + 10
7 % 2
8 + 5 * 10
```

Watchout: Integer division!!

- relational operators (result is bool):

== Equal to  
!= Not equal to  
> Greater than  
< Less than  
>= Greater than or equal to  
<= Less than or equal to

```
7 < 25
89 == x
x % 2 != 0
8 + 5 * 10 <= 100 * n
```

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## Logical Operations, precedence

- logical operators (values and results are bool):

! not  
&& and  
|| or

```
x < 10 && x > 0
y == 10 || y == 20
!(a == b)
```

- operator precedence (which happens first?):

!  
+- (unary)  
\*/ %  
+- (binary)  
<> <= >=  
== !=  
&&  
||

```
!(y == 10) || y == 20 && x > 3 * z
```

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## More assignment statements

- Compound assignment

operator	usage	equivalent syntax:
+=	x += e;	x = x + e;
-=	x -= e;	x = x - e;
*=	x *= e;	x = x * e;
/=	x /= e;	x = x / e;

- increment, decrement

operator	usage	equivalent syntax:
++	x++; ++x;	x = x + 1;
--	x--; --x;	x = x - 1;

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## Type conversions

- Implicit

- assignment:

```
int x;  
double d = 3.1415;  
x = d;  
cout << x << endl;
```

the type of expression on the right will be converted to type of variable on left, possibly losing information.

- binary operations:

```
int x = 10;  
double d = 2.3;  
cout << x + d << endl;
```

the operand with the lower ranking type is converted to the type of the other.

- Explicit

```
int x, y;  
...  
float avg = static_cast<float>(x)/y;
```

or

```
float avg = x/(float)y; //C-style notation
```

Order of types:

```
double  
float  
long  
int  
char
```

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## Basic Input/Output

- Output (cout and <<)

```
cout << expression;  
cout << expr1 << expr2;
```

```
cout << "hello";  
cout << "Count is: " << count << endl;
```

- Input (cin and >>)

```
cin >> variable;  
cin >> var1 >> var2;
```

right hand side must be a variable!

```
cin >> x;  
cout << "Enter the height and width: ";  
cin >> height >> width;
```

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## Control structures: if else

- if and else

```
if (expression)  
    statement1  
else  
    statement2
```

statement may be a compound statement (a block: {statements})

- if expression is true, statement1 is executed
  - if expression is false, statement2 is executed

- the else is optional:

```
if (expression)  
    statement
```

- nested if else

```
if (expression1)  
    statement1  
else if (expression2)  
    statement2  
else if (expression3)  
    statement3  
else  
    statement4
```

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## Control structures: loops

- while

```
while (expression)  
    statement
```

statement may be a compound statement (a block: {statements})

- \* if expression is true, statement is executed, repeat

- for:

```
for (expr1; expr2; expr3)  
    statement
```

- \* equivalent to:

```
expr1;  
while (expr2) {  
    statement  
    expr3;  
}
```

- do while:

```
do  
    statement  
while (expression);
```

statement is executed.  
if expression is true, then repeat

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## Control structures: switch

- **switch stmt:**

```
switch (expression) {  
    case constant: statements  
    ...  
    case constant: statements  
    default: statements  
}
```

- execution *starts* at the case labeled with the value of the expression.
- if no match, *start* at default
- use break to exit switch (usually at end of *statements*)
- **example:**

```
switch (ch) {  
    case 'a':  
    case 'A': cout << "Option A";  
               break;  
    case 'b':  
    case 'B': cout << "Option B";  
               break;  
    default: cout << "Invalid choice";  
}
```

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## The string class

- **string literals:** represent sequences of chars:

```
cout << "Hello";
```

- To define string variables:

```
string firstName, lastName;
```

- Operations include:

- = for assignment
- .size() member function for length
- ==, <, ... relational operators (alphabetical order)
- [n] to access one character

```
string name = "George";  
for (int i=0; i<name.size(); i++)  
    cout << name[i] << " ";
```

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## File Input/Output

- **#include <fstream>**
- **Output (ofstream)**

```
ofstream fout;  
fout.open("filename.txt");  
fout << "hello";  
fout << "Count is: " << count << endl;  
fout.close();
```

- **Input (ifstream)**

```
ifstream fin;  
fin.open("data.txt");  
if (!fin) { Check for file open errors  
    cout << "error opening file" << endl;  
    return (0);  
}  
int x;  
fin >> x; right hand side must be a variable!  
cout << "x is " << x << endl;  
fin.close();
```

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