Arithmetric C++

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Calculations

Often when we write programs to simulate complex phenomena.

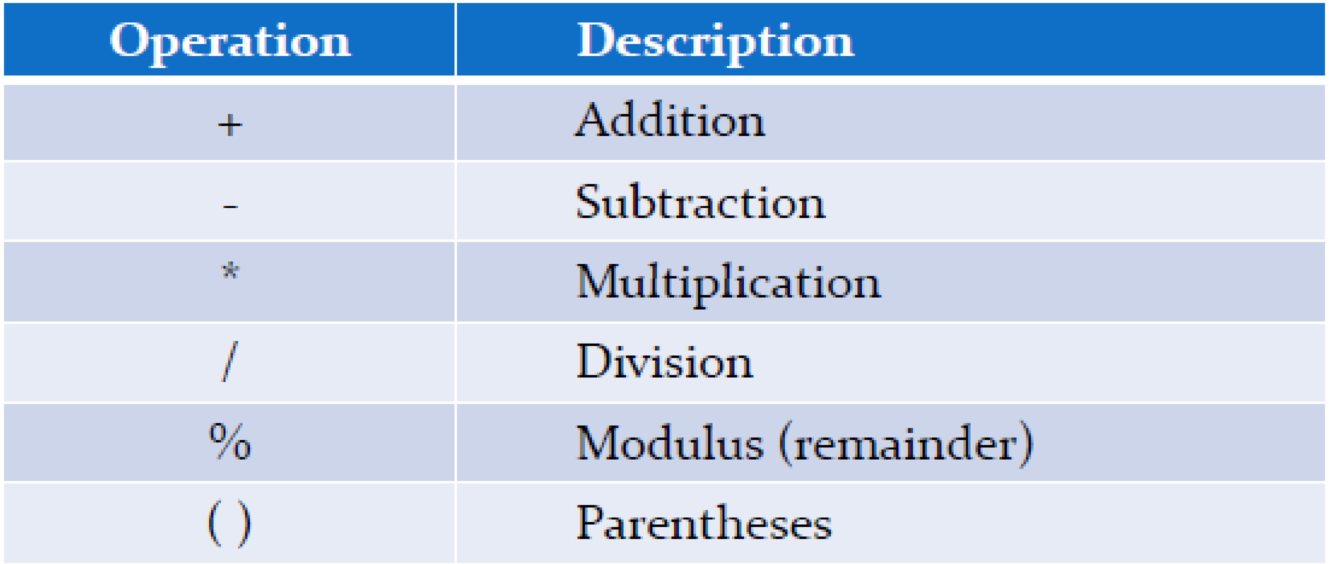
For example, simulations to predict the earthquakes, tsunamis or hurricanes all involve mathematical calculations.

Or it could be data analysis of experiments performed in a research labs.

We need to be able to perform calculations!

Arithmetic

- Note: C++ does not directly support Exponent operation.



Operation	Description
+	Addition
-	Subtraction
*	Multiplication
/	Division
%	Modulus (remainder)
( )	Parentheses

Order of Operations

Operation	Name	Precedence
()	Parentheses	Operations in the parentheses have the highest precedence. Should be evaluated first.
^	Exponent	This operation is not supported in C++.
* / %	Multiplication Division Modulus	Have equal precedence. Evaluated from left to right.
+ -	Addition Subtraction	Have Equal Precedence. Evaluated from left to right.

Examples of Expressions

- Finding the remainder of 5 / 2

  5 % 2 =

- Find the remainder of the sum of two numbers divided by 2

  A) number1 + number2 % 2 =

  B) 2 % number1 + number2 =

  C) (number1 + number2) % 2 =

- Is the answer A, B or C?

Integer Division

- Integer division in C++ will truncate any decimal value, for example:
  - 5 / 2 = 2 for an integer division
  - 4 / 2 = 2 this means 5 / 2 = 4 / 2
  - 10/ 3 = 3
  - 11 / 2 = 5
- The resulting type is an Integer.
- What makes this an integer division?
  - ***Both*** the dividend and divisor are integers (not decimal).

Double (decimal) Division

- Double division in C++ will retain the appropriate decimal value, for example:
  - 5 / 2.0 = 2.5
  - 4 / 2.0 = 2.0 // on the screen you see 2 printed
  - 10.0/ 3 = 3.333333…
  - 11.0 / 2.0 = 5.5
- The resulting type is a **Double.**
- What makes this a decimal division?
  - Either the dividend or divisor must be a decimal.

All Other Operations

- Same rules apply to Addition, Subtraction and Multiplication.

- If both values are of type int, the result is int.

- If either is of type double, the result is double.

Data Types and Order of Operation

- Look at the example below:
- 5.0 + 5 / 2
  - What is the resulting data type of the first operation?
    - int
  - What is the resulting data type of the second operation?
    - double
- 5 + 5 / 2.0
  - What is the resulting data type of the first operation?
    - double
  - What is the resulting data type of the second operation?
    - double

Type Casting

If we want to convert from an **int to a double for a more** precise result we can do so with type casting.

Type casting is a temporary change from one type to another.

To type cast from int to double we can do the following:

```
double value = (double) 5 / 2;
 //value = 2.5
```

Type Casting (cont.)

- We can also type cast from double to an int, this will truncate the decimal value.

- Example:

```
double total = 100.5;

int value = (int) total;

//value = 100
```

Lab Exercise

- Write a program to convert temperature from Fahrenheit to Celcius

  C = (F-32)*5/9   (Formula)

- The output depends on the type of variables and how the expression on the right is written
- For example:

  If f and c are double, the output will be true double

  If f is int and c is double, the output will be rounded
- The output also depends on how the terms are grouped

  C = (F-32) * (5/9) is always zero (5/9 = 0)

Solution

```
#include <iostream>
using namespace std;
int main(){
    int f;
    double c;
    cout << "Enter a temperature in degrees Fahrenheit :"  ;
    cin >> f;
    c = (f - 32) * 5 / (double) 9; //makes 9 to 9.0
    cout << "In Celsius that is: " << c << endl;
    cout << “The temperature in Celcius is: “ << (f-32)*5/9
    << endl;
    cout << “The temperature in Celcius is: “ << 5/9* (f-32)
    <<endl; // Notice the strange result!
    return 0;
}
```