

Lecture 1: Introduction to C++ Programming

Curtin FIRST Robotics Club (FRC) Pre-season Training

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1. Programming
2. C++
3. Environment Setup
4. Editing, Compiling, and Execution

Programming

What is a Computer Program?

A computer program is a collection of instructions that performs a specific task when executed by a computer. A computer requires programs to function, and typically executes the program's instructions in a central processing unit.

A part of a computer program that performs a well-defined task is known as an algorithm. A collection of computer programs, libraries and related data are referred to as software.

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5. Run your program and see if it works.

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5. Run your program and see if it works.
 - Yes? Hurray! Victory!

Recipe to writing programs:

1. Understand the problem.
2. Think of a solution.
3. Describe the solution in as much detail as possible.
You may use diagrams or plain English to do this.
4. Translate your solution into a program.
5. Run your program and see if it works.
 - Yes? Hurray! Victory!
 - No? Go back to 1

Think like a computer!

What steps do you need to take to draw a smiley face?



Example Code Appreciation

Lets just take a minute to appreciate what it took to make that smiley face



```
1 {center}
2 \begin{tikzpicture}
3 \path[fill=yellow,
4       draw=yellow!75!red]
5       (0,0) circle (1cm);
6 \fill[red] (45:5mm) circle (1mm);
7 \fill[red] (135:5mm) circle
8   \> (1mm);
9 \draw[line width=1mm,red]
10  \> (215:5mm) arc
11  \> (215:325:5mm);
12 \end{tikzpicture}
13 \end{center}
```

And act like it totally didn't take me like ... 2 hours to figure out how to do it.

C++

C++ is a general-purpose programming language with a bias towards systems programming that:

- Is a better C,
- Supports data abstraction,
- Supports object-oriented programming, and
- Supports generic programming.

Why choose C++

The C++ programming language is an extension of C that was developed by (the god himself) Bjarne Stroustrup in the early 1980s at Bell Laboratories.

Example C++ Program (Hello World)

```
1 #include <iostream>
2
3 int main()
4 {
5     cout << "Hello World!";
6     return 0;
7 }
8
```

```
[user@pc]$ Hello World!
```

Environment Setup

Editing, Compiling, and Execution

A Simple Program to Add Two Numbers

The following is an example of a simple program written in C++.

```
1 #include <iostream>
2 using namespace std;
3
4 int main()
5 {
6     int num1, num2, total;
7
8     cout << "Enter integers to be added:" << endl;
9     cin >> num1 >> num2;
10    total = num1 + num2;
11    cout << "The sum is " << total << endl;
12
13    return 0;
14 }
```

I double dare you to guess what this program does.

A Simple Program to Add Two Numbers

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13    return 0;
14 }
```

This program is designed to read two numbers typed by the user at the keyboard; Compute their sum and display the result on the screen.

A Simple Program to Add Two Numbers

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11    cout << "The sum is " << total << endl;
12
13    return 0;
14 }
```

What could we do to make understanding this program easier?

A Simple Program with Comments

Add comments!

```
1 // Program to add two integers typed by user at keyboard
2 #include <iostream>
3 using namespace std;
4
5 int main()
6 {
7     int num1, num2, total;
8
9     cout << "Enter integers to be added:" << endl;
10    cin >> num1 >> num2;
11    total = num1 + num2;
12    cout << "The sum is " << total << endl;
13
14    return 0;
15 }
```

A Not So Simple Program Because OMG whoever wrote this is an ass

Or hey, if you want to guarantee yourself a job

```
1 #include <iostream>
2 using namespace std;
3 int main(){
4     int n,b,memes = 42;
5     cout<<"gimmie:" <<endl;
6     cin>>n>>b;
7     memes=n+b;
8     cout<<"got em" <<memes+1-1<<endl;
9     return (pow(meme, 0) - 1);}
```

C++ uses notation that may appear strange to non-programmers (and me). The notation is part of the programming language **syntax**.

Syntax Formal rules that specify the structure of a legal program.

The notation and explanations which follow will appear strange if you have never written a computer program.

Don't worry about them or how the program works. This will be explained in more detail later.

The following is an overview.

Every C++ program consists of a header and a main body and has the following structure:

```
1 // Comment statements which are ignored by computer
2 /* Also a comment */
3 #include < header file name >
4
5 int main()
6 {
7     declaration of variables;
8     statements;
9
10    return 0;
11 }
```

Program Structure and Syntax

```
1 // Program to add two integers typed by user at keyboard
2 #include <iostream>
3 using namespace std;
4
5 int main()
6 {
7     int num1, num2, total;
8
9     cout << "Enter integers to be added:" << endl;
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14    return 0;
15 }
```

Line 1

- Lines beginning with `//` indicate that the rest of the line is a **comment**.
- Comments are inserted by programmers to help people read and understand the program.
- Can be placed anywhere in a program.

Program Structure and Syntax

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3 using namespace std;
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5 int main()
6 {
7     int num1, num2, total;
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9     cout << "Enter integers to be added:" << endl;
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14    return 0;
15 }
```

Line 2

- Lines beginning with **#** are instructions to the compiler's preprocessor.
- The **include** instruction says "what follows is a file name, find that file and insert its contents right here".
- Here the file `iostream` contains the definitions of **cin**, **cout**.

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8
9     cout << "Enter integers to be added:" << endl;
10    cin >> num1 >> num2;
11    total = num1 + num2;
12    cout << "The sum is " << total << endl;
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14    return 0;
15 }
```

Line 3

- Specifies that names used in the program (ie. **cin** and **cout**) are defined in the standard libraries.
- This is used to avoid problems with other libraries which may also use these names.

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```
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```

Line 5

- When the program is executed the instructions will be executed in the order they appear in the main body of the program.
- The main body is delimited by `main()` and the curly braces `{ }`.
- This line also specifies that `main()` will return a value of type integer (`int`) on its completion (see line 14).

Program Structure and Syntax

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14    return 0;
15 }
```

Line 6

- The opening (left) brace marks the beginning of the main body of the program.
- The main body consists of instructions which are **declarations** defining the data or **statements** on how the data should be processed.
- All C++ declarations and statements must end with a semicolon;

Program Structure and Syntax

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3 using namespace std;
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7     int num1, num2, total;
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```

Line 7

- This is a declaration. The words num1 and num2 are the names of **variables**.
- A variable is a location in the computer's memory where a value can be stored for use by a program.
- The declaration also specifies the variable **type**

Program Structure and Syntax

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8
9     cout << "Enter integers to be added:" << endl;
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12    cout << "The sum is " << total << endl;
13
14    return 0;
15 }
```

Line 9

- This statement instructs the computer to output the **string** of characters contained between the quotation marks, followed by a new line **endl**.
- The location of the output is denoted by **cout** which in this case will be the terminal screen.

Program Structure and Syntax

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13
14    return 0;
15 }
```

Line 10

- This statement instructs the computer to read data typed in at the keyboard (standard input), denoted by `cin`.
- These values are **assigned to** (stored in) variables `num1` and `num2`.

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14    return 0;
15 }
```

Line 11

- This statement is an **arithmetic expression** which assigns the value of the expression `num1 + num2` (sum of integer values stored at `num1` and `num2`) to the variable `total`.

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14    return 0;
15 }
```

Line 12

- Instructs the computer to display the value of the variable total.

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12    cout << "The sum is " << total << endl;
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14    return 0;
15 }
```

Line 14

- The last instruction of every program is the return statement.
- The return statement with the int value 0 (zero) indicates to the operating system that the program has terminated successfully.

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14    return 0;
15 }
```

Line 15

- The closing (right) brace marks the end of the main body of the program.

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```

Blank lines

- Lines 4, 8 and 13 are used to make the program more readable.
- They will be ignored by the compiler.
- **Whitespace** (spaces, tabs and newlines) are also ignored (unless within quotation marks).

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```

Indentation

- It does not matter where you place statements, either on the same line or on separate lines.

C++ programs go through 3 main phases during development:

Editing Writing the program,

Compiling Translating the program to executable code and detecting syntax errors, and

Debugging Running the program and checking for logical errors.