

CH-230-A

Programming in C and C++

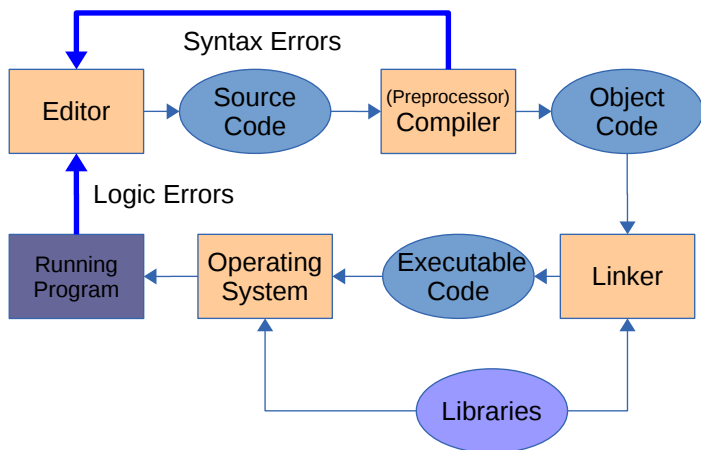
C/C++

Lecture 1

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Program Development Cycle



Integrated Development Environment (IDE)

- ▶ You can use the editor of your choice and compile from the terminal
- ▶ For C: `gcc -Wall -o executable program.c`
- ▶ For C++: `g++ -Wall -o executable program.cpp`
- ▶ If you do not know any of the above, you can use [Code::Blocks](#) or [Visual Studio Code](#)

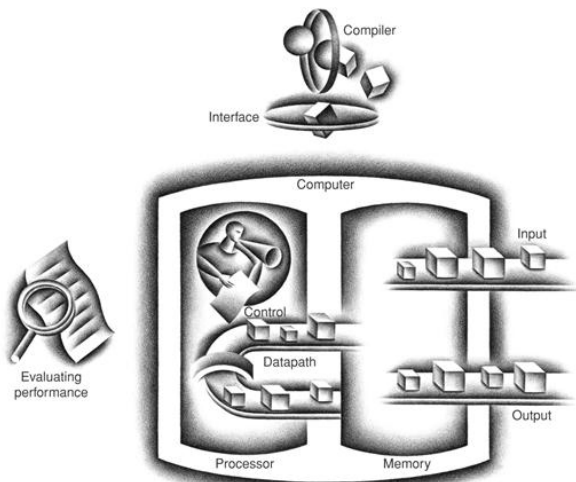
IDE Installation

- ▶ Alternative 1: [Code::Blocks](#)
 - ▶ Download and install Code::Blocks from:
<http://codeblocks.org/downloads/26>
 - ▶ If you are a Windows user download (contains IDE + compiler)
[codeblocks-20.03mingw-setup.exe](#)
- ▶ Alternative 2: [Visual Studio Code](#)
 - ▶ Download and install Visual Studio Code
<https://code.visualstudio.com/Download>
 - ▶ Download and install compiler Mingw-w64
<https://www.mingw-w64.org/downloads/#mingw-builds>
 - ▶ Assuming that you installed Mingw-w64 to this path:
C:\Mingw-w64, Windows users have to add to the environment variable PATH in the following: C:\Mingw-w64\mingw32\bin\
- ▶ Alternative 3: [Visual Studio Community 2019](#)
 - ▶ Only for Windows users
 - ▶ Download and install <https://visualstudio.microsoft.com/thank-you-downloading-visual-studio/?sku=Community&rel=16>

Different Compilers Behave Differently

- ▶ Different compilers behave differently
- ▶ Even different versions of the same compiler may deliver different results in terms of the compilation process
- ▶ Make sure that your solution runs without warnings or errors on Grader
- ▶ If errors or warning appear, you can fix them and resubmit the solution
- ▶ The Grader server runs gcc and g++ version 10.2.1

Five Classic Components of the Computer



Higher Programming Languages

- ▶ Use symbolic names
- ▶ Loops, conditions

High-level language
program (in C)

```
1  swap(int v[], int k) {  
2      int temp;  
3      temp = v[k];  
4      v[k] = v[k+1];  
5      v[k+1] = temp;  
6  }
```

High-level language
program (in C)

Compiler

Assembly language
program (for MIPS)

Assembler

Binary machine
language program
(for MIPS)

```
swap(int v[], int k) {  
    int temp;  
    temp = v[k];  
    v[k] = v[k+1];  
    v[k+1] = temp;  
}
```

```
swap:  
    muli    $2, $5, 4  
    add     $2, $4, $2  
    lw      $15, 0($2)  
    lw      $16, 4($2)  
    sw      $16, 0($2)  
    sw      $15, 4($2)  
    jr      $31
```

```
000000001010000100000000000011000  
00000000000110000001100000100001  
10001100011000100000000000000000  
100011001111001000000000000000100  
10101100111100100000000000000000  
101011000110001000000000000000100  
00000011111000000000000000001000
```


Compiling and Running

- ▶ The following command performs compilation and linking
`$> gcc -o hello hello.c`
- ▶ If no compilation errors, an executable called `hello` will be created
- ▶ If you do not specify `-o` the executable will be called `a.out`
- ▶ To execute the program just type its name
`$> ./hello`

About C

- ▶ Widely used general purpose language
- ▶ Advantages: small, efficient, portable, structured
- ▶ Disadvantages: not user-friendly
- ▶ C is an imperative language
- ▶ You will find many of its characteristics in other imperative languages, such as Pascal or Fortran, but also in scripting languages such as Perl, PHP, Python, etc.

Imperative Languages

- ▶ Computation is described in terms of:
 - ▶ State (variables)
 - ▶ Operations to change this state (assignments, loops, etc.)
- ▶ Imperative: first do this, than do that, ...
- ▶ There exists other approaches (functional programming, logic programming, object-oriented programming, etc.)

The First Program

- ▶ A true classic: Hello world
- ▶ Open editor → New file
- ▶ Type text below, then save as `hello.c`

```
1  /* This is my first C program */
2  #include <stdio.h>
3
4  int main() {
5      printf("Hello world\n");
6      return 0;
7  }
```

The printf Library Function

- ▶ `printf` is a library function used to output data
- ▶ To use `printf`, the header file `stdio.h` has to be included
- ▶ `stdio` stands for Standard I/O
- ▶ `stdio` contains the specification of many general purpose functions for I/O
- ▶ `printf` is a very rich and powerful function
- ▶ Basic use: printing a sequence of characters
- ▶ The following line calls the `printf` function
`printf("Hello world\n");`
- ▶ The sequence of characters is called string
- ▶ The sequence is surrounded by quotes

Basic Data Types of C

Data type	C identifier
Character	<code>char</code>
Integer number	<code>int</code>
Floating point number	<code>float</code>
Double precision number	<code>double</code>
No type	<code>void</code>

Moreover there exist some modifiers that can be applied to the basic data types

Formatting Specification (1)

- ▶ Specify the type of the data to be printed

```
1      int a = 45;  
2      printf("The value is %d\n", a);
```

- ▶ This will print the following:
The value is 45
- ▶ Each formatting specification must be matched by a parameter
- ▶ To specify wrong control strings is another common error in C programs

Formatting Specification (2)

Formatting specification starts with a % character

Conversion	Meaning
%c	Single character
%d or %i	Signed decimal integer
%f	Floating point (decimal notation)
%e	Floating point (exponential notation)
%lf	Double (decimal notation)
%s	String
%%	print the percent sign itself
%p	print address of pointer