

Gateway to Computer Science

Computer Science is the study and application of computation and information. The main tool used in computer science is the computer.

The computer can store and process information. The parts that exist within a computer fall under two general categories: hardware and software. Hardware is the tangible components of a computer. Examples of hardware include: motherboards, storage devices, and processing units. The second category is software. Software is the information that is stored in the computer's hardware.

There are two main types of software: programs and data. A program is a set of instructions to be performed by a computer's hardware. Data is any information that gets processed by a computer's hardware on behalf of a program. Examples of popular programs include: Google Chrome, Microsoft Windows, Adobe Photoshop, and Steam. Examples of popular data formats include: JPEG images, MP3 audio, MP4 video, and PDF documents.

A computer organizes software into a file system. A file system is composed of files and directories. Files can store programs or data, and directories can store files and other directories, forming a hierarchy. File systems are commonly found on disk drives, solid state drives, and flash drives.

It is important to know that while the computer's hardware ultimately performs all actions, these actions are guided by programs. Everything that you do on a computer requires that you interact with a program. Accessing files from the file system requires that we use a program to do so. If you want to browse the web, you must use a type of program known as a web browser. If you want to type an essay, you would use a type of program known as a word processor.

There are certain functions that are commonly used by all programs on the computer. These functions are provided by a special program known as the operating system. The operating system instructs the computer's hardware to perform certain actions on behalf of all other programs. These actions may include: memory allocation, file system access, graphics control, and network communication. Operating systems also control which programs are running at any given time. Popular operating systems include: Linux, Mac OS X, and Microsoft Windows.

A major activity in computer science is computer programming. We usually program a computer by creating a computer program and having the computer's hardware execute it. To create a computer program, you must type out a set of statements that conform to a particular syntax or set of rules, the syntax that you use to type these instructions is known as a programming language. There are many different programming languages, each having their strengths and weaknesses. The language that we will use is C++.

A set of statements expressed in a particular programming language is referred to as the source code of a program. Typing out the source code for a program can be done using any basic text editing program. This source code, however, is not ready to be executed by a computer until it has been converted into a computer program. To convert source code into a computer program, we use a special program known as a compiler.

After source code has been compiled into a program, it is quite common that the new program is found to be defective in some way. A defect existing in a computer program is known as a bug. The process of removing bugs from a program is called debugging. There are special programs called debuggers which help programmers monitor the internal state of a program as it gets executed.

While a text editor and compiler is all that's necessary to create a program, some programmers like to use Integrated Development Environments (IDE). An IDE combines the functionality of a text editor, compiler, and debugger in order to make the computer programmer's life easier and more productive. Ironically, IDEs are fairly complicated to learn and it is best if the new programmer avoids using them right away.

Many of the programs that you will create will be interactive programs, meaning that they require user input to operate. The means of how a program allows a user to interact with it is called an interface. There are two popular forms of interfaces: command-line interface (CLI) and graphical user interface (GUI). A GUI uses buttons, text boxes, scrollbars, and other graphical elements for user-program interaction. For programs that present themselves through a CLI, the user is required to type line-by-line statements known as commands in order to interact with the program. CLI is often preferred by more advanced computer users since they provide a greater means of program control. CLI programs are also easier to create than GUI programs and many useful programming tools exist as CLI programs.

Perhaps the most important CLI program is the command-line interpreter, or CLI shell. While most operating systems today allow users to interact with them through a GUI, they also provide an alternative way to do it through a command-line interface. The CLI shell allows you to perform operating system-related functions through a CLI. Common operations that can be performed in a CLI shell include: deleting files, moving files, copying files, creating directories, running CLI programs, stopping running programs, and compiling source code into programs.

There are different ways for you to access the command-line interface shell depending on your operating system. For Linux and Mac OS X, this program can be accessed through an application known as the Terminal. For Windows, the CLI shell can be accessed through the Command Prompt. Learning how to program is best done by using the Linux operating system. The school of Computer Science and Engineering provides computer labs that include Linux and we will base much of our instruction on the programming tools provided by it.

The first program that you will create will display one message. Here is it's source code:

```
#include <iostream>

int main()
{
    std::cout << "Hello world!\n";
    return 0;
}
```

This source code is in the C++ programming language. Do not be afraid if you do not understand it's syntax at first, you will learn what these symbols mean through study and most importantly: hands-on practice.

To convert this source code into a program follow these steps on Linux:

1. Save this source code into a file named *hello.cpp* and place this file into your *Documents* directory
2. Open the terminal program

3. Type `cd Documents` and press enter
4. Type `g++ hello.cpp` and press enter
5. The program has now been created and saved into a file named *a.out*
6. To execute this program, type `./a.out` and press enter

The commands that you typed to compile and run your first program is in a language known as Bash. Bash is the name of the CLI shell and command language used on most Linux operating systems. From now on, we will use C++ as our programming language and Bash for our CLI shell.

We will not always provide the source code and shell commands, you will eventually have to know which codes to type into the computer yourself.

– *Mark Swoope*
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