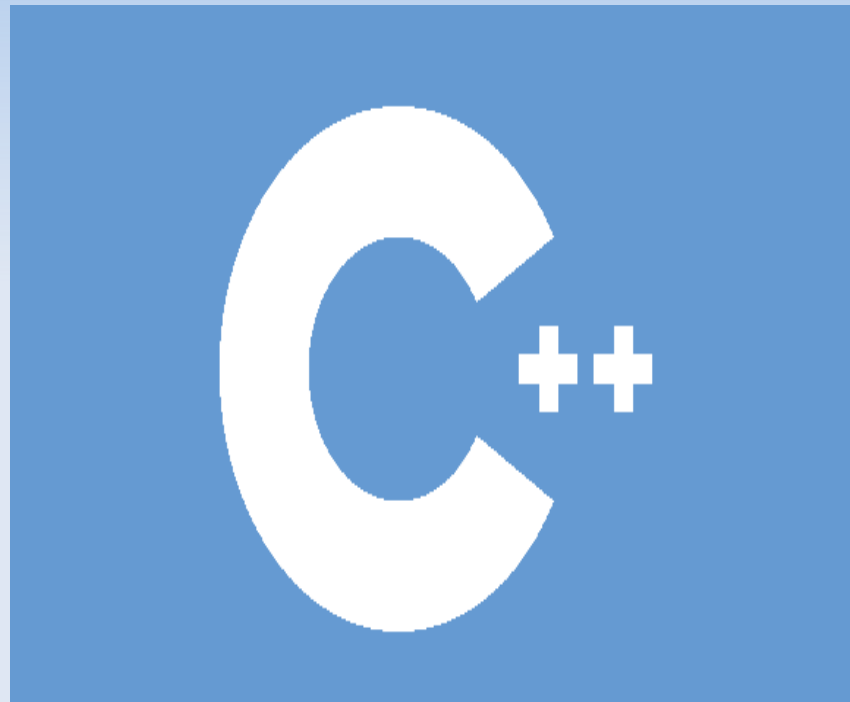


# CS161: Intro to C++

## Chapter 1: An Overview

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# Computer Systems

A computer system is an electronic device capable of performing arithmetic and logical operations.



A computer system has two components:

- hardware: Physical part of system.
- software: Programs which provide logic for doing tasks.

# Elements of a Computer System

- Hardware

- CPU



- Main memory



- Secondary storage (Disks)



- Input/Output devices



- Software

- systems software.



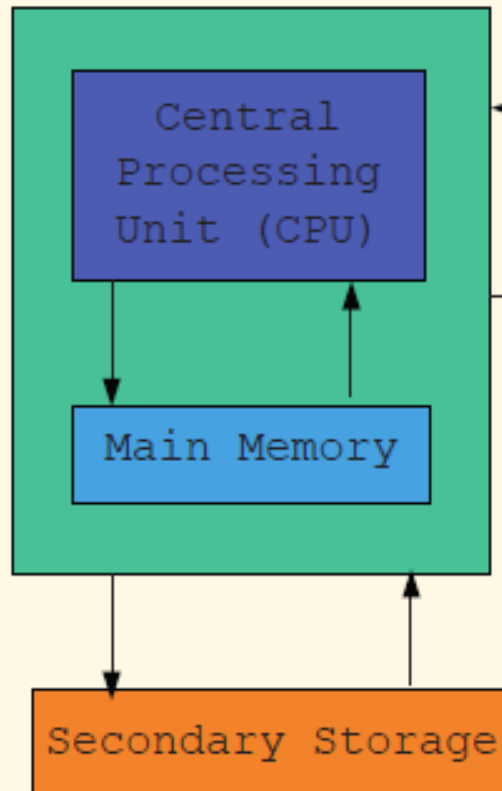
- Application software



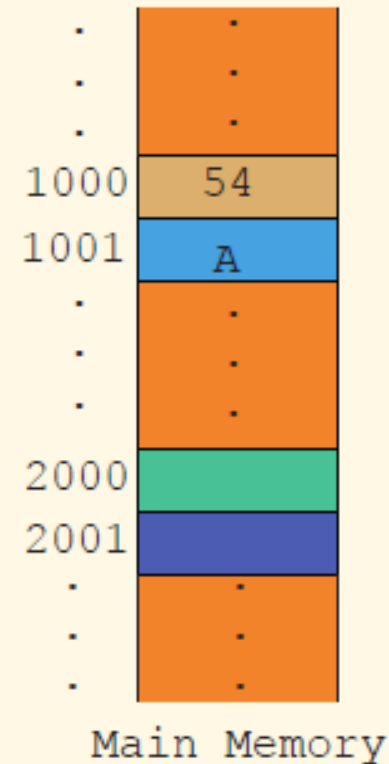
# How a Computer System Works

- When computer is turned on, operating system software is run.
- Operating system handles the running of application programs on your system.
- When a program is executed, the operating system:
  - Sets aside a portion of main memory to store the instructions and data for the program.
  - Sends one instruction at a time to the CPU to execute.

# Central Processing Unit and Main Memory



(a)



(b)

# Binary numbers and binary code

**Binary code (binary number):** a sequence of binary digits.

**Binary digit** is represented by either a 0 or a 1.

Example: 101101100011000111000...

In hardware this is a series of transistors that act as electrical on/off switches:

switch is on equals 1.

switch is off equals 0.

# Binary Code Measurements

- **Byte**: A sequence of eight bits:

**10011001**

- **Kilobyte (KB)**:

$2^{10}$  bytes = 1024 bytes

- **Megabyte (MB)**:

$2^{20}$  bytes = 1,048,576 bytes

- **Gigabyte(GB)**:

$2^{30}$  bytes = 1,073,741,824 bytes

# Representation of Characters

- A computer only understands numerical data.
- But we also need to deal with non-numerical data, such as letters, symbols, etc.
- To represent non-numerical data, we need to use a numerical code.



# Representation of Characters

- Two most common codes in use today:
- **ASCII** (American Standard Code for Information Interchange)
  - 128 characters. Examples are:
    - A is encoded as 1000001 (66th character)
    - 3 is encoded as 0110011
- **Unicode**
  - 65536 characters
  - Two bytes are needed to store a character

# Machine Language

- This is the language the computer actually understands. All code in other languages need to be translated into machine code.
- It is hardware-based code but represented by binary code (1's and 0's).

# Machine Language Example

- To calculate  $\text{wages} = \text{rate} * \text{hours}$  in machine language:

100100 010001      //Load

100110 010010      //Multiply

100010 010011      //Store

# Assembly Language

- Assembly language instructions are mnemonic:
  - They can be easily remembered and understood by humans.
- Assembler: translates a program written in assembly language into machine language

# Assembly Language Example

- Using assembly language instructions,  
 $\text{wages} = \text{rate} \cdot \text{hours}$  can be written as:

LOAD rate

MULT hour

STOR wages

# High-Level Languages

- High-level languages include Basic, FORTRAN, COBOL, Pascal, C, C++, C#, and Java.
- Compiler: translates a program written in a high-level language into machine language.
- The equation  $\text{wages} = \text{rate} \cdot \text{hours}$  can be written in C++ as:  
`wages = rate * hours;`

# ANSI/ISO Standard C++

- C++ evolved from C (1969).
- C++ designed by Bjarne Stroustrup at Bell Laboratories in early 1980s
- C++ programs were not always portable from one compiler to another (still aren't completely today).
- In mid-1998, ANSI/ISO C++ language standards were approved
- Second standard called C++11 approved in 2011
- There have been 'upgrades' to the language in 2014 and 2017.

# C++ Program Example

```
#include <iostream>
using namespace std;
int main()
{
    cout << "My first C++ program." << endl;
    return 0;
}
```

## **Sample Run:**

My first C++ program.



# Steps to Creating a C++ Program

- 1) Write the C++ code. (more on this later)
- 2) Compile the code.
- 3) Link it to any included libraries.
- 4) Run code (load it into memory and execute)

# IDE: Integrated Development Environment

- In order to write the code, you will need make sure the code is written a ASCII standard text file. The compiler won't understand any other type of file.
  - However, in Windows/MacOSX, most word processors and text editors don't use standard ASCII text format. **So don't use these for writing code.**
- Use of an IDE, like Visual Studio,
  - It uses ASCII standard text format.
  - It also helps the creating of software by 'integrating' all steps into one environment.