

Lecture Notes

Chapter 1

An Overview of Computers and Programming Languages

ECE 111: Introduction to C and C++ Programming

Instructor: Dr. Shayan (Sean) Taheri

Gannon University (GU)





Personal Information

- Name: Shayan (Sean) Taheri.
- Date of Birth: July/28/1991.
- Current Position: Assistant Professor at Gannon University
- Previous Position: Postdoctoral Fellow at University of Florida.
- Ph.D. Degree: Electrical Engineering from the University of Central Florida.
- M.S. Degree: Computer Engineering from the Utah State University.
- University Profile:
<https://www.gannon.edu/FacultyProfiles.aspx?profile=taheri001>



Objectives (1 of 2)

- In this chapter, you will:
 - Learn about different types of computers
 - Explore the hardware and software components of a computer system
 - Learn about the language of a computer
 - Learn about the evolution of programming languages
 - Examine high-level programming languages
 - Discover what a compiler is and what it does



Objectives (2 of 2)

- Examine a C++ program
- Explore how a C++ program is processed
- Learn what an algorithm is and explore problem-solving techniques
- Become aware of structured design and object-oriented design programming methodologies
- Become aware of Standard C++, ANSI/ISO Standard C++, C++11, and C++14



Introduction

- Without software, a computer is useless
- Software is developed with programming languages
 - C++ is a programming language
- C++ is suited for a wide variety of programming tasks



A Brief Overview of the History of Computers (1 of 3)

- Early calculation devices
 - Abacus
 - Pascaline
 - Leibniz device
 - Jacquard's weaving looms
 - Babbage machines: difference and analytic engines
 - Hollerith machine



A Brief Overview of the History of Computers (2 of 3)

- Early computer-like machines
 - Mark I
 - Electronic Numerical Integrator and Calculator (ENIAC)
 - Von Neumann architecture
 - Universal Automatic Computer (UNIVAC)
 - Transistors and microprocessors



A Brief Overview of the History of Computers (3 of 3)

- Categories of computers
 - Mainframe computers
 - Midsize computers
 - Micro computers (personal computers)



Elements of a Computer System

- Two main components
 - Hardware
 - Software



Hardware

- Central processing unit (CPU)
- Main memory (MM) or random access memory (RAM)
- Secondary storage
- Input/output devices



Central Processing Unit and Main Memory (1 of 4)

- Central processing unit
 - Brain of the computer
 - Most expensive piece of hardware
 - Operations
 - Carries out arithmetic and logical operations



Central Processing Unit and Main Memory (2 of 4)

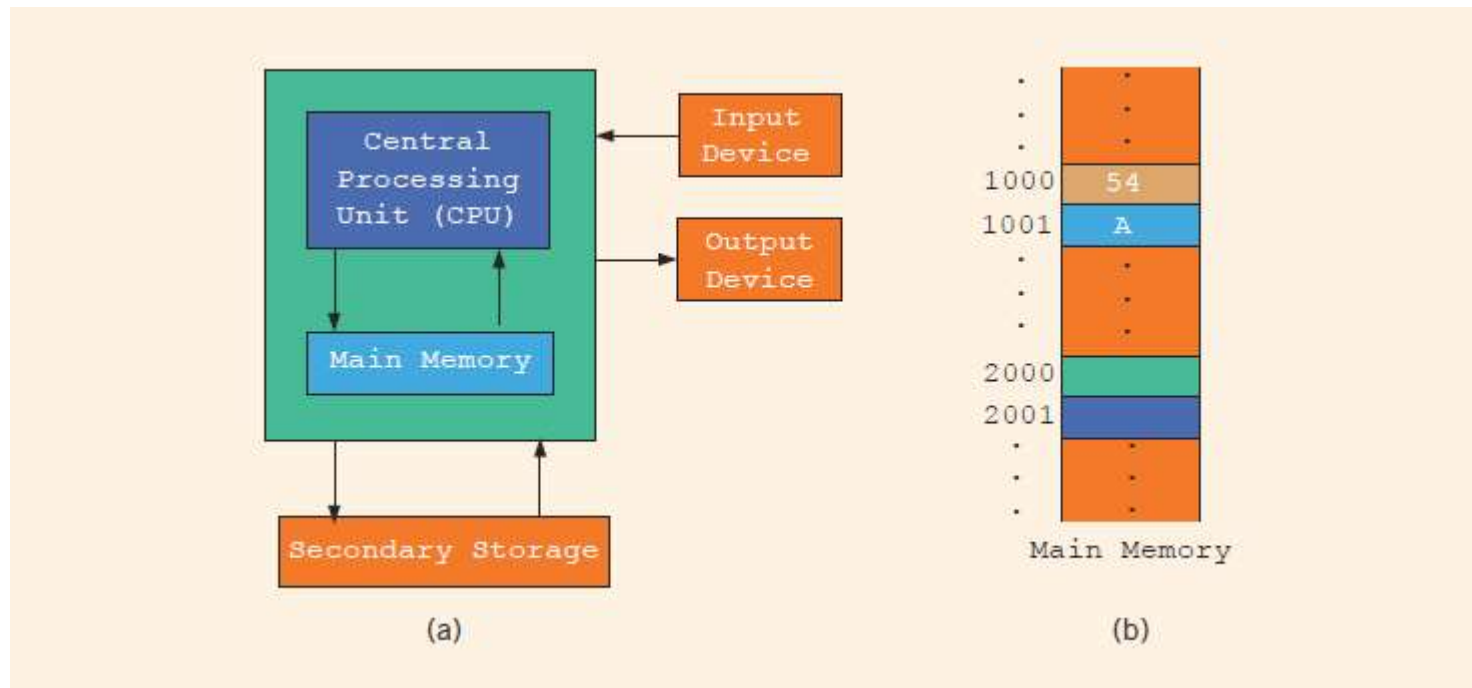


FIGURE 1-1 Hardware components of a computer and main memory



Central Processing Unit and Main Memory (3 of 4)

- Random access memory (or main memory) is directly connected to the CPU
- All programs must be loaded into main memory before they can be executed
- All data must be brought into main memory before it can be manipulated
- When computer power is turned off, everything in main memory is lost



Central Processing Unit and Main Memory (4 of 4)

- Main memory is an ordered sequence of memory cells
 - Each cell has a unique location in main memory, called the address of the cell
- Each cell can contain either a programming instruction or data



Secondary Storage

- Secondary storage: device that stores information permanently
- Examples of secondary storage
 - Hard disks
 - Flash drives
 - CD-ROMs



Input/Output Devices

- Input devices feed data and programs into computers
 - Keyboard
 - Mouse
 - Scanner
 - Camera
 - Secondary storage
- Output devices display results
 - Monitor
 - Printer
 - Secondary storage



Software

- Software are programs written to perform specific tasks
- System programs control the computer
 - Operating system monitors the overall activity of the computer and provides services such as:
 - Memory management
 - Input/output activities
 - Storage management
- Application programs perform a specific task
 - Word processors
 - Spreadsheets
 - Games



The Language of a Computer (1 of 4)

- Analog signals: continuously varying continuous wave forms
- Digital signals: sequences of 0s and 1s
- Machine language: language of a computer
 - A sequence of 0s and 1s
- Binary digit (bit): the digit 0 or 1
- Binary code (binary number): a sequence of 0s and 1s



The Language of a Computer (2 of 4)

- Byte: a sequence of eight bits
- Kilobyte (KB): 2^{10} bytes = 1024 bytes
- ASCII (American Standard Code for Information Interchange)
 - 128 characters
 - **A** is encoded as 1000001 (66th character)
 - The character **3** is encoded as 0110011 (51st character)
- Number systems
 - The decimal system (base 10) is used in our daily life
 - The computer uses the binary (or base 2) number system



The Language of a Computer (3 of 4)

TABLE 1-1 Binary Units

Unit	Symbol	Bits/Bytes
Byte		8 bits
Kilobyte	KB	2^{10} bytes = 1024 bytes
Megabyte	MB	10^{24} KB = 2^{10} KB = 2^{20} bytes = 1,048,576 bytes
Gigabyte	GB	10^{24} MB = 2^{10} MB = 2^{30} bytes = 1,073,741,824 bytes
Terabyte	TB	10^{24} GB = 2^{10} GB = 2^{40} bytes = 1,099,511,627,776 bytes
Petabyte	PB	10^{24} TB = 2^{10} TB = 2^{50} bytes = 1,125,899,906,842,624 bytes
Exabyte	EB	10^{24} PB = 2^{10} PB = 2^{60} bytes = 1,152,921,504,606,846,976 bytes
Zettabyte	ZB	10^{24} EB = 2^{10} EB = 270 bytes = 1,180,591,620,717,411,303,424 bytes



The Language of a Computer (4 of 4)

- Unicode is another coding scheme
 - 65,536 characters
 - Two bytes (16 bits) to store a character



The Evolution of Programming Languages (1 of 3)

- Early computers were programmed in machine language
- To calculate wages = rate * hours in machine language:

```
100100 010001    //Load
100110 010010    //Multiply
100010 010011    //Store
```



The Evolution of Programming Languages (2 of 3)

- Assembly language instructions are mnemonic
 - Instructions are written in an easy-to-remember form
- An assembler translates a program written in assembly language into machine language
- Using assembly language instructions, **wages = rate * hours** can be written as:

LOAD rate

MULT hours

STOR wages