

Chapter 1:

Introduction to Computers and Programming

Starting Out with Programming Logic & Design

Third Edition

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1.1 Introduction

- People use computers at...
 - School for writing papers, research, email, online classes, etc.
 - Work for analyzing data, make presentations, business transactions, communicating, control machines, etc.
 - Home for paying bills, shopping online, communicating, playing computer games, etc.

What are some of the ways you use computers?

1.1 Introduction

- **Devices that are computers...**
 - Cell Phones
 - iPods
 - Blackberries
 - Car navigation system (GPS)

Can you think of some other devices that are computers?

1.1 Introduction

- Computers are designed to do any job that their programs tell them to do.
- A program is a set of instructions that a computer follows to perform a task.

For example: Microsoft Word and PowerPoint

- Programs are commonly referred to as software.

What software have you used?

1.1 Introduction

- Programmers or Software Developers are the individuals that create computer software.
- They have the training and skill to design, create, and test computer programs.

What are some of the fields in which computer programs are used?

1.2 Hardware and Software

Concept:

The physical devices that a computer is made of are referred to as the computer's hardware. The programs that run on a computer are referred to as software.

1.2 Hardware and Software

Hardware

- The physical devices that a computer is made of are referred to as the computer's *hardware*.
- A computer is a system of devices that work together.

1.2 Hardware and Software

Hardware

A Computer System consists of:

- Central Processing Unit (CPU)
- Main memory
- Secondary storage
- Input devices
- Output devices

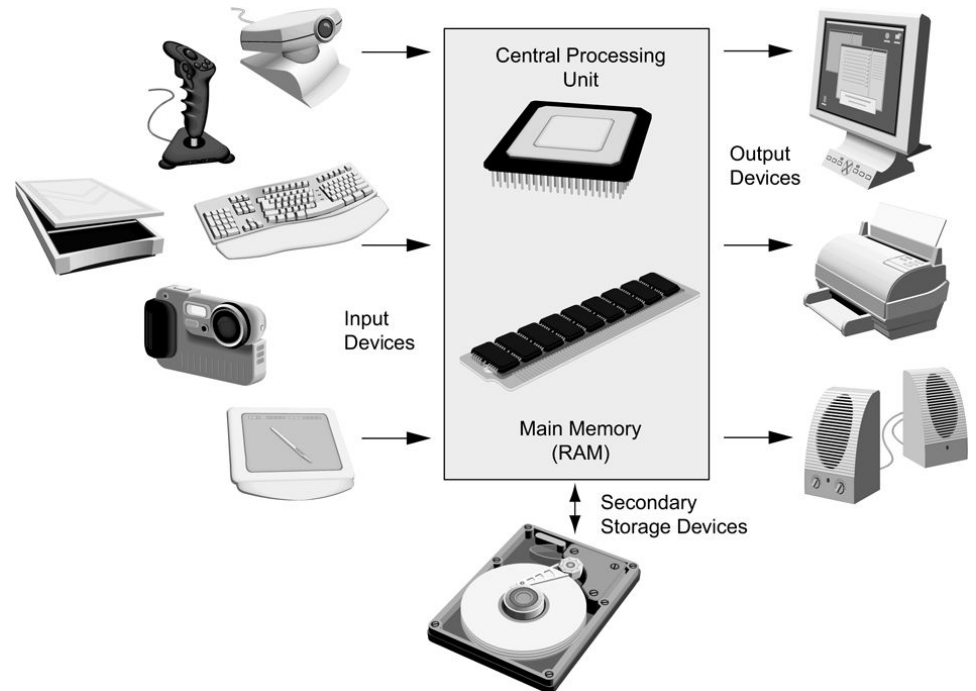


Figure 1-2 Typical components of a computer system

1.2 Hardware and Software

Hardware

Central Processing Unit (CPU)

The CPU is the part of a computer that runs the programs.

Without a CPU a computer cannot run software.

Running or executing a program is the term used when the computer performs the tasks that the program tells it to do.

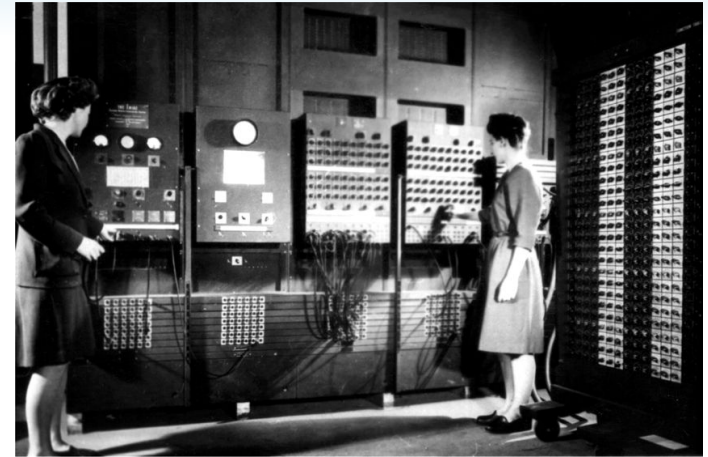
1.2 Hardware and Software

Hardware

ENIAC

- World's first programmable computer
- Built in 1945
- Designed to calculate artillery ballistic tables for the U.S. Army
- CPU was 8 feet tall, 100 feet long, and weighed 30 tons

Figure 1-3 The ENIAC computer
(courtesy of U.S. Army Historic Computer Images)



Microprocessor

- Much smaller
- Much more powerful

Figure 1-4
A lab technician holds a modern microprocessor
(photo courtesy of Intel Corporation)



1.2 Hardware and Software

Main Memory

- Considered the computer's work area
- Computer stores the program that is running as well as the data
- Commonly known as the *random-access memory (RAM)*
- Data is quickly accessed
- RAM is a volatile type of memory
- Used for temporary storage
- RAM is erased when computer is turned off

1.2 Hardware and Software

Secondary Storage Devices

- Type of memory that can hold data for long periods of time.
- Programs and important data are stored in secondary storage
- **Disk drive** is a common type of secondary storage
 - Data is stored by magnetically encoding it onto a circular disk
 - Most computers have an internal disk drive
 - Some have external disk drives; they are used to create backup copies
- **Floppy drives** record data onto a small floppy disk
 - Holds only a small amount of data
 - Slow to access data
 - Can be unreliable

1.2 Hardware and Software

Secondary Storage Devices

- **USB drives** are small devices that plug into the computer's universal serial bus (USB) port
 - It does not contain a disk
 - The data is stored on flash memory
 - Also known as memory sticks and flash drives
 - Inexpensive, reliable, and small
- **Optical devices (CD or DVD)**
 - Data is encoded as a series of pits on the disc's surface
 - Uses laser to encode the data
 - Holds large amounts of data
 - Good medium for creating backups

1.2 Hardware and Software

Input Devices

- Any data the computer collects from people and from other devices is called input.
- The hardware component that collects the data is called an input device.
- Common input devices are:
 - Keyboard
 - Mouse
 - Scanner
 - Microphone
 - Digital camera

Can you think of any other input devices?

1.2 Hardware and Software

Output Devices

- Any data the computer produces for people or for other devices is called output.
- The hardware component that formats and presents the data is called an output device.
- Common output devices are:
 - monitor
 - printer

Can you think of any other output devices?

1.2 Hardware and Software

Software

- Everything a computer does is controlled by software.
- Two categories of software:
 - System software
 - Application software

1.2 Hardware and Software

System Software

- Programs that control and manage the basic operations of a computer are referred to as system software.
- Includes the following types:
 - Operating System controls the internal operations of the computer's hardware and manages all of the devices connected to the computer.
 - Utility Programs perform a specialized task that enhances the computer's operation or safeguards data.
 - Software Developments Tools are programs that are used to create, modify, and test software.

1.2 Hardware and Software

Application Software

- Programs that people normally spend most of their time running on their computers performing everyday tasks are referred to as *application software*.
- For example:
 - Word processing
 - Spreadsheet
 - Database
 - Presentation

Can you think of any other application software?

1.3 How Computers Store Data

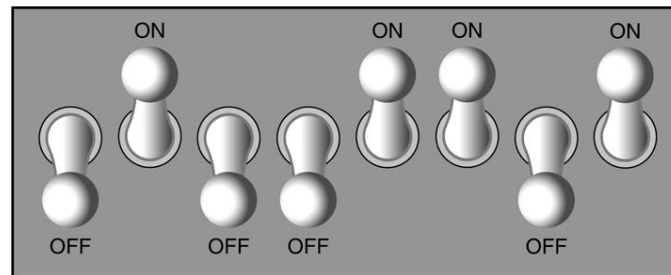
Concept:

All data that is stored in a computer is converted to sequences of 0s and 1s.

1.3 How Computers Store Data

- A computer's memory is divided into tiny storage locations known as bytes
- One byte represents one number
- A byte is divided into eight smaller storage locations known as bits (*binary digits*)
- Bits are tiny electrical components that can hold either a positive or a negative charge.
- A positive charge is similar to a switch in the *on* position
- A negative charge is similar to a switch in the *off* position

Figure 1-6 Think of a byte as eight switches

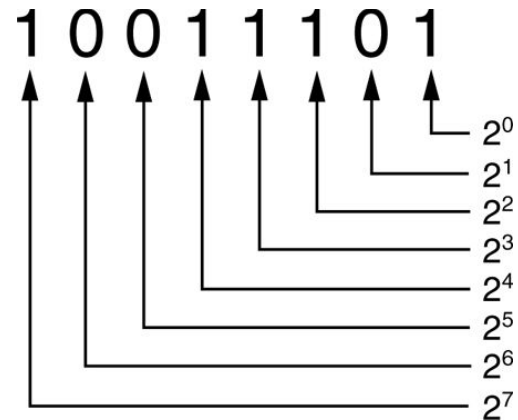


1.3 How Computers Store Data

Storing Numbers

- The positive charge or the *on* position is represented by the digit 1
- The negative charge or the *off* position is represented by the digit 0
- This corresponds to the binary numbering system where all numeric values are written as a sequence of 0s and 1s
- Each digit in a binary number has a value assigned to it

Figure 1-8 The values of binary digits as powers of 2



1.3 How Computers Store Data

Storing Numbers

For example:

Figure 1-10 Determining the value of 10011101

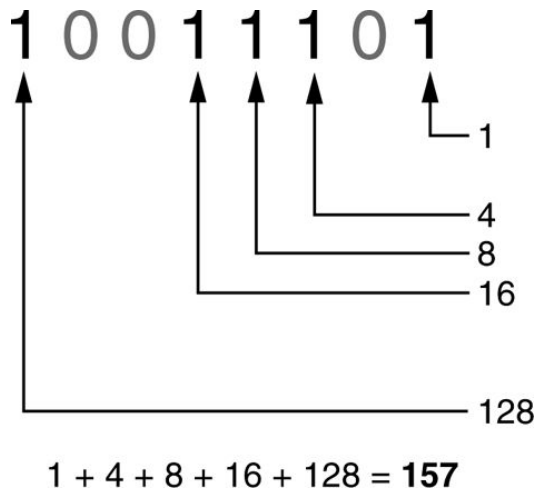
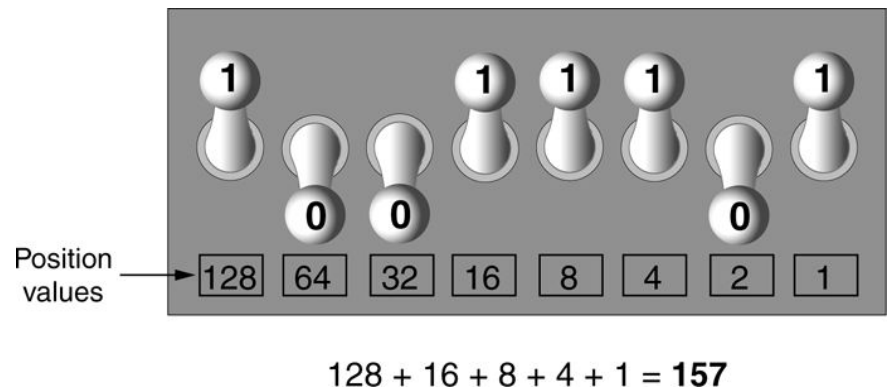


Figure 1-11 The bit pattern for 157

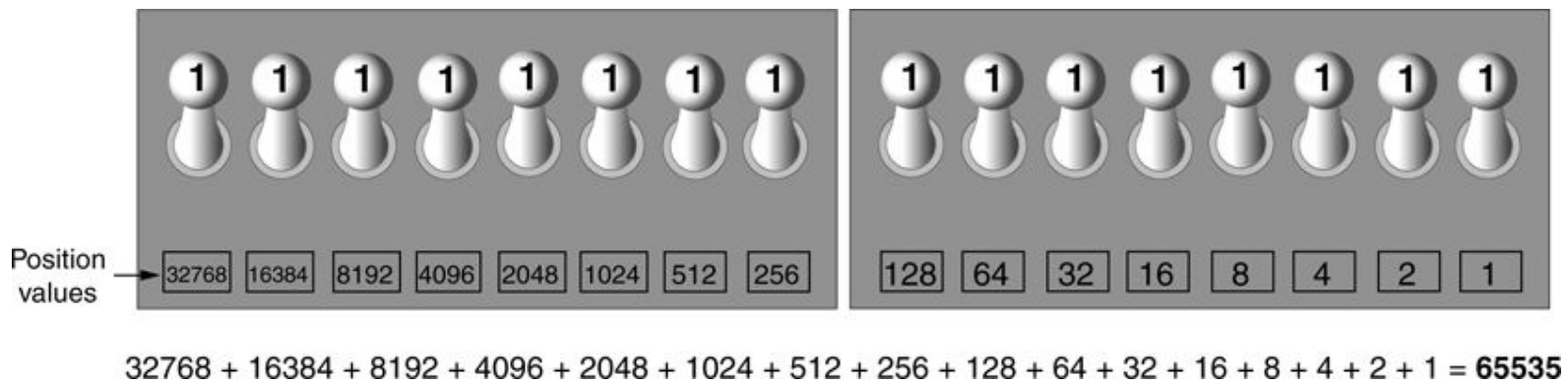


1.3 How Computers Store Data

Storing Numbers

- The largest value that can be stored in a byte with eight bits is 255
- Two bytes are used for larger numbers; maximum value is 65535

Figure 1-12 Two bytes used for a large number

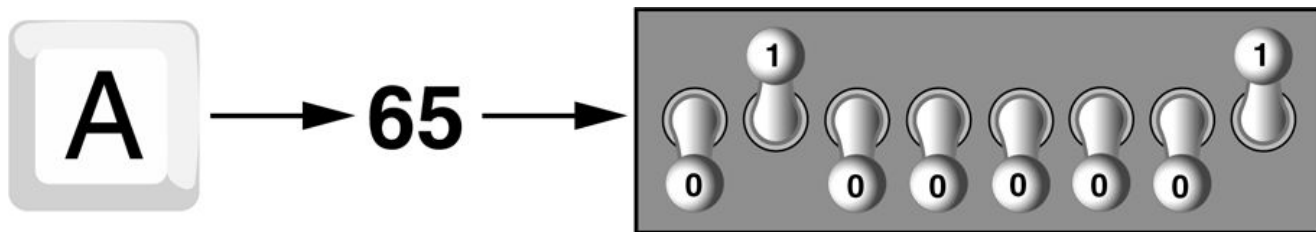


1.3 How Computers Store Data

Storing Characters

- Characters are stored in the computer's memory as binary number
- *ASCII (American Standard Code for Information Interchange)* is a coding scheme

Figure 1-13 The letter A is stored in memory as the number 65



1.3 How Computers Store Data

Storing Characters

- ASCII is a set of 128 numeric codes
- ASCII is limited
- Unicode is an extensive encoding scheme
 - It is compatible with ASCII
 - It represents characters for many languages in the world

1.3 How Computers Store Data

Advanced Number Storage

- Binary numbering system can be used to represent only integer numbers
- Negative numbers are encoded using *two's complement*
- Real numbers are encoded using *floating-point notation*

1.3 How Computers Store Data

Other Types of Data

- *Digital data* is data that is stored in binary
- A *digital device* is any device that works with binary data
- Digital images are composed of tiny dots of color known as *pixels (picture elements)*
- Digital sound is broken into small pieces known as *samples*

1.4 How a Program Works

Concept:

A computer's CPU can only understand instructions that are written in machine language. Because people find it very difficult to write entire programs in machine language, other programming languages have been invented.

1.4 How a Program Works

- CPU is the most important component in a computer
- CPU is not a brain
- CPU is not smart
- CPU is an electronic device that is designed to do specific things.

1.4 How a Program Works

CPU is designed to perform the following operations:

- Read a piece of data from main memory
- Adding two numbers
- Subtracting one number from another number
- Multiplying two numbers
- Dividing one number by another number
- Moving a piece of data from one memory location to another
- Determining whether one value is equal to another value

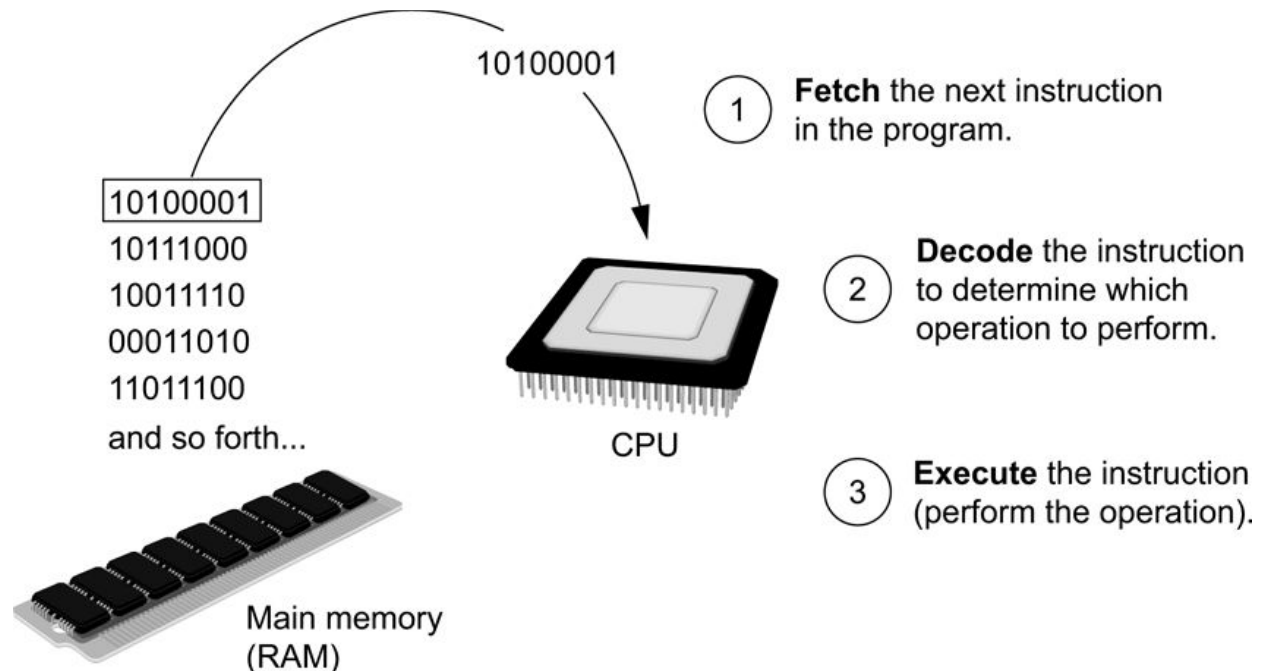
1.4 How a Program Works

- CPU only understands instructions written in *machine language*
- Machine language instructions are written in 1s and 0s
- The entire set of instructions that a CPU can execute is known as the CPU's *instruction set*
- Each brand of microprocessors (Intel, AMD, and Motorola) has a unique instruction set

1.4 How a Program Works

- **Fetch-decode-execute cycle** is the term used when the CPU executes the instructions in a program.
- The cycle consists of three steps:
 - Fetch
 - Decode
 - Execute

Figure 1-16
The
fetch-decode-execute
cycle



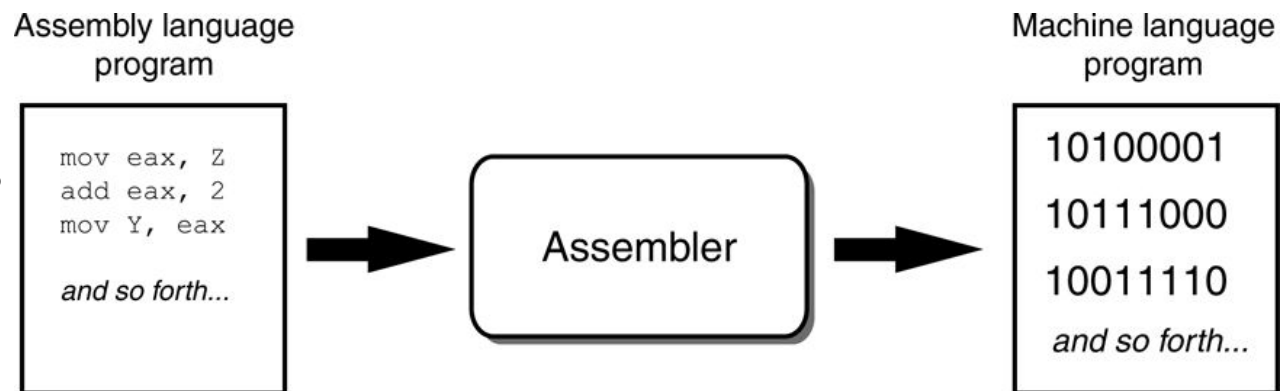
1.4 How a Program Works

From Machine Language to Assembly Language

- Computers only understand machine language
- Machine language is difficult to write
- Assembly language uses short words that are known as mnemonics
- Assembler is used to translate an assembly language program to machine language

Figure 1-17

An assembler translates an assembly language program to a machine language program



1.4 How a Program Works

High-Level Languages

- Assembly language is referred to as a low-level language
- High-level languages allow you to create powerful and complex programs without knowing how the CPU works, using words that are easy to understand.

For example:

Java, C++, Python, Visual Basic, C#, Ada, Fortran

Do you know of any other
high-level computer programming
languages?

1.4 How a Program Works

Key Words, Operators, and Syntax: an Overview

- Key words or reserved words have specific meaning and purpose in the programming language
- Operators perform various operations on data
- Syntax is a set of rules that must be strictly followed when writing a program
- Statements are individual instructions written in a programming language

1.4 How a Program Works

Compilers and Interpreters

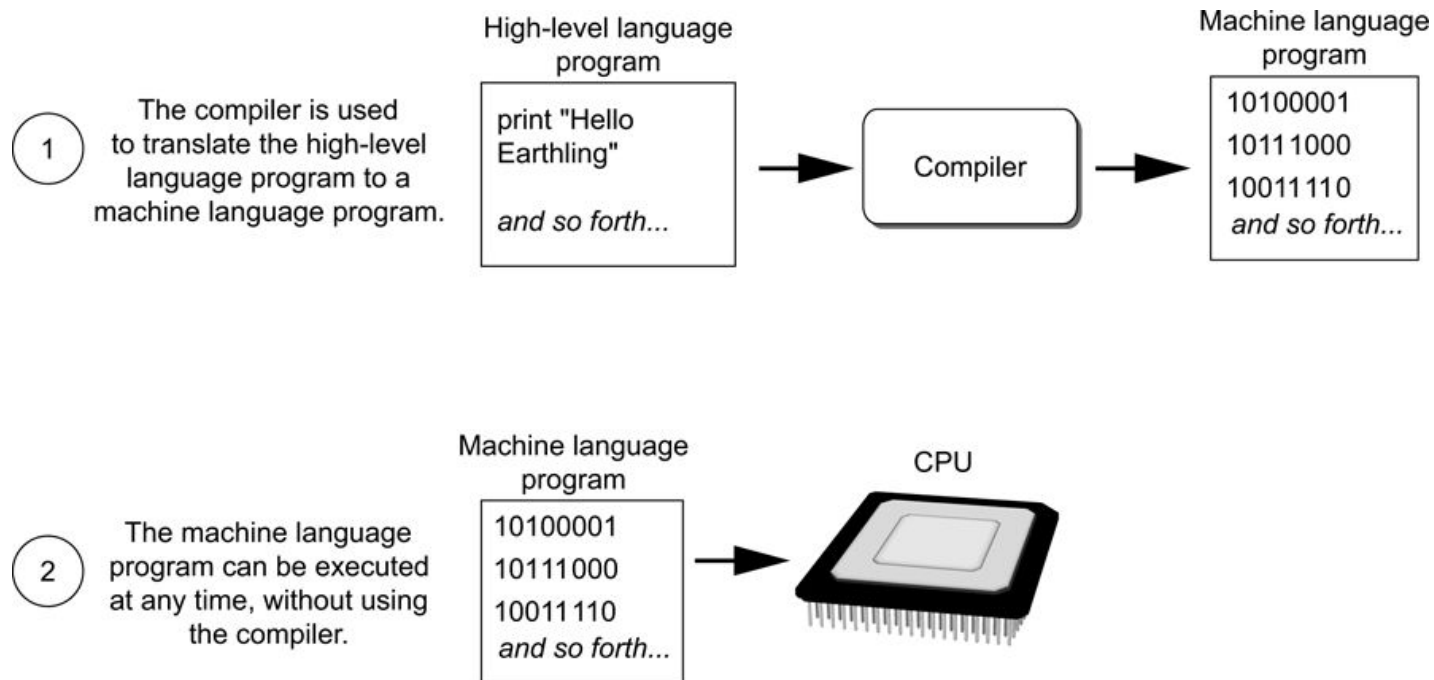
- The statements written in a high-level language are called source code or simply code
- Source code is translated to machine language using a compiler or an interpreter
- Syntax error is a mistake such as a:
 - Misspelled word
 - Missing punctuation character
 - Incorrect use of an operator

1.4 How a Program Works

Compilers and Interpreters

• **Compiler** is a program that translates a high-level language program into a separate machine language program

Figure 1-18 Compiling a high-level program and executing it

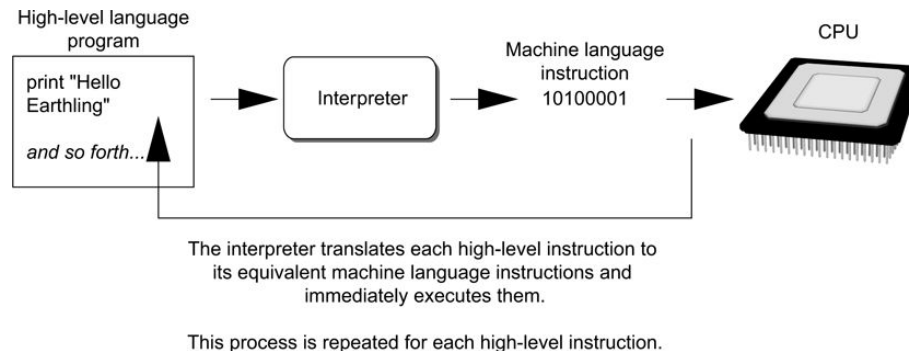


1.4 How a Program Works

Compilers and Interpreters

- An ***interpreter*** is a program that both translates and executes the instructions in a high-level language program

Figure 1-19 Executing a high-level program with an interpreter



1.5 Types of Software

Programs generally fit into one of two categories

- System software

- The set of programs that control or enhance the operation of a computer such as an Operating System, Utility Programs, or Software Development Tools.

- Application software

- Programs that make a computer useful for every day tasks such as Microsoft Word, email programs, and Web browsers.