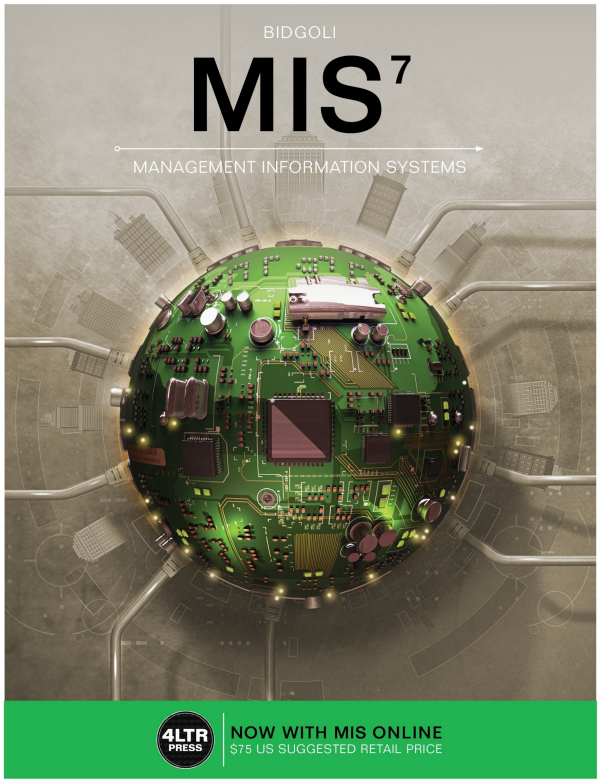
COMP1010 - Week 3 Computers: The Machines Behind Computing

Professor Brian Corbitt
COMP1010 – Computing Fundamentals
University of Newcastle

BIDGOLI

MIS 7



2

COMPUTERS: THE MACHINES BEHIND COMPUTING

LEARNING OUTCOMES

1. Define a computer system, and describe its components
2. Discuss the history of computer hardware and software
3. Explain the factors distinguishing the computing power of computers
4. Summarize computer operations

LEARNING OUTCOMES *(continued)*

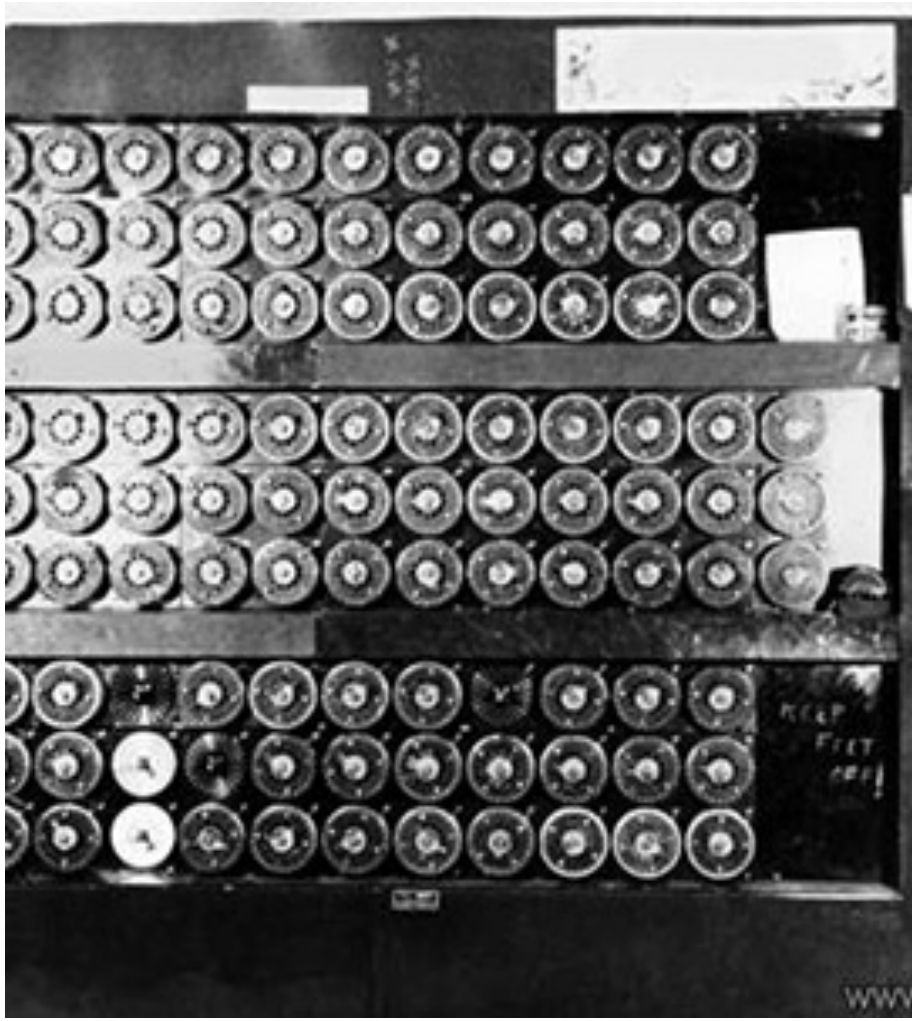
5 Discuss the types of input, output, and memory devices

6 Explain how computers are classified

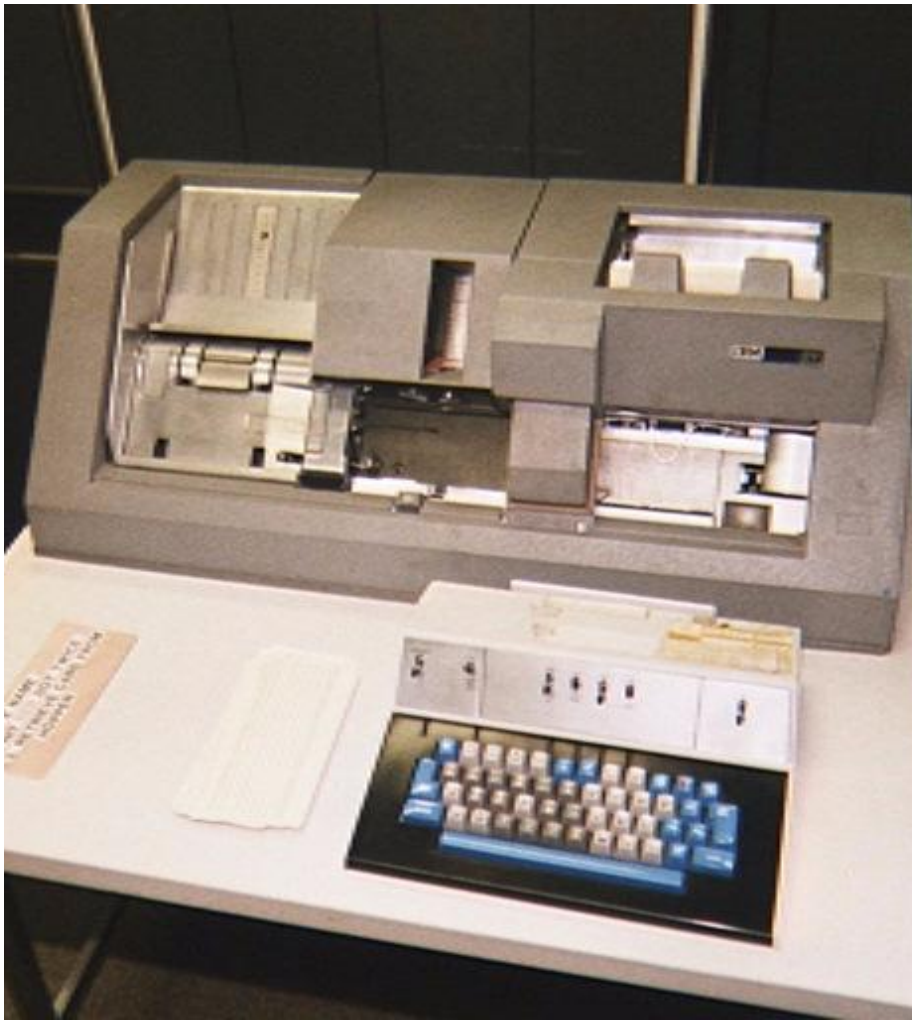
7 Describe the two major types of software

8 List the generations of computer languages

A brief visual history of computers



A brief visual history of computers



A brief visual history of computers

Today’s computers

Today’s computers

Supercomputers

Defining a Computer

- Machine that:
  - *Accepts data as input*
  - *Processes data without human intervention using stored instructions*
  - *Outputs information*
- Program
  - *Step-by-step directions for performing a specific task*
  - *Written in a language the computer can understand*

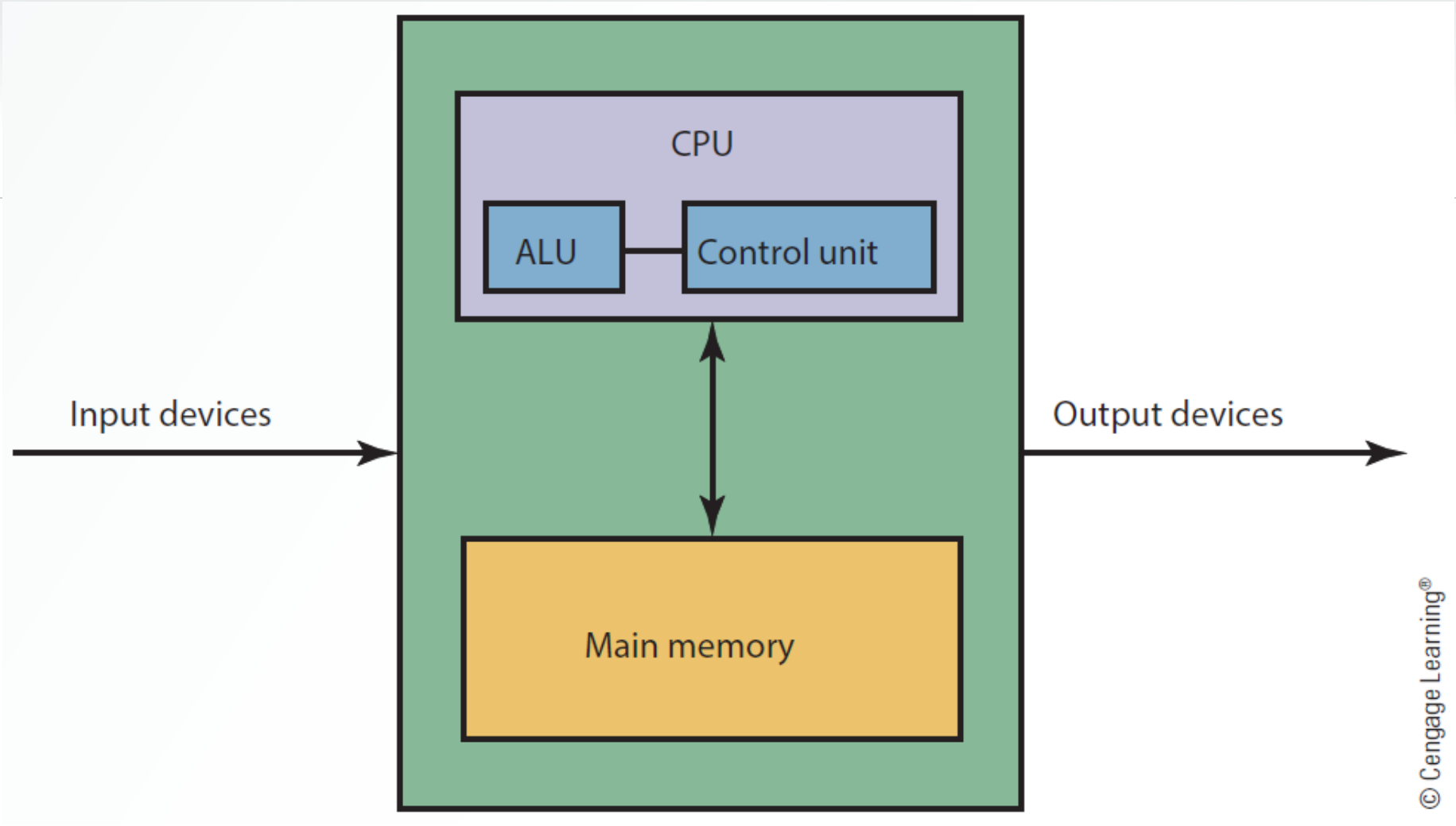
Defining a Computer

- GIGO
  - *Rule stating that, if data is erroneous, the information provided by the computer is also erroneous*
  - *Referred as garbage in, garbage out*

Defining a Computer

- Writing a computer program requires:
  - *Identifying the objective and method of achieving the objective*
  - *Selecting the right language*
    - Depends on the problem being solved and the type of computer being used
- A program is also called a source code
  - *Source code must be translated into object code consisting of binary 0s and 1s*

Exhibit 2.1 The Building Blocks of a Computer



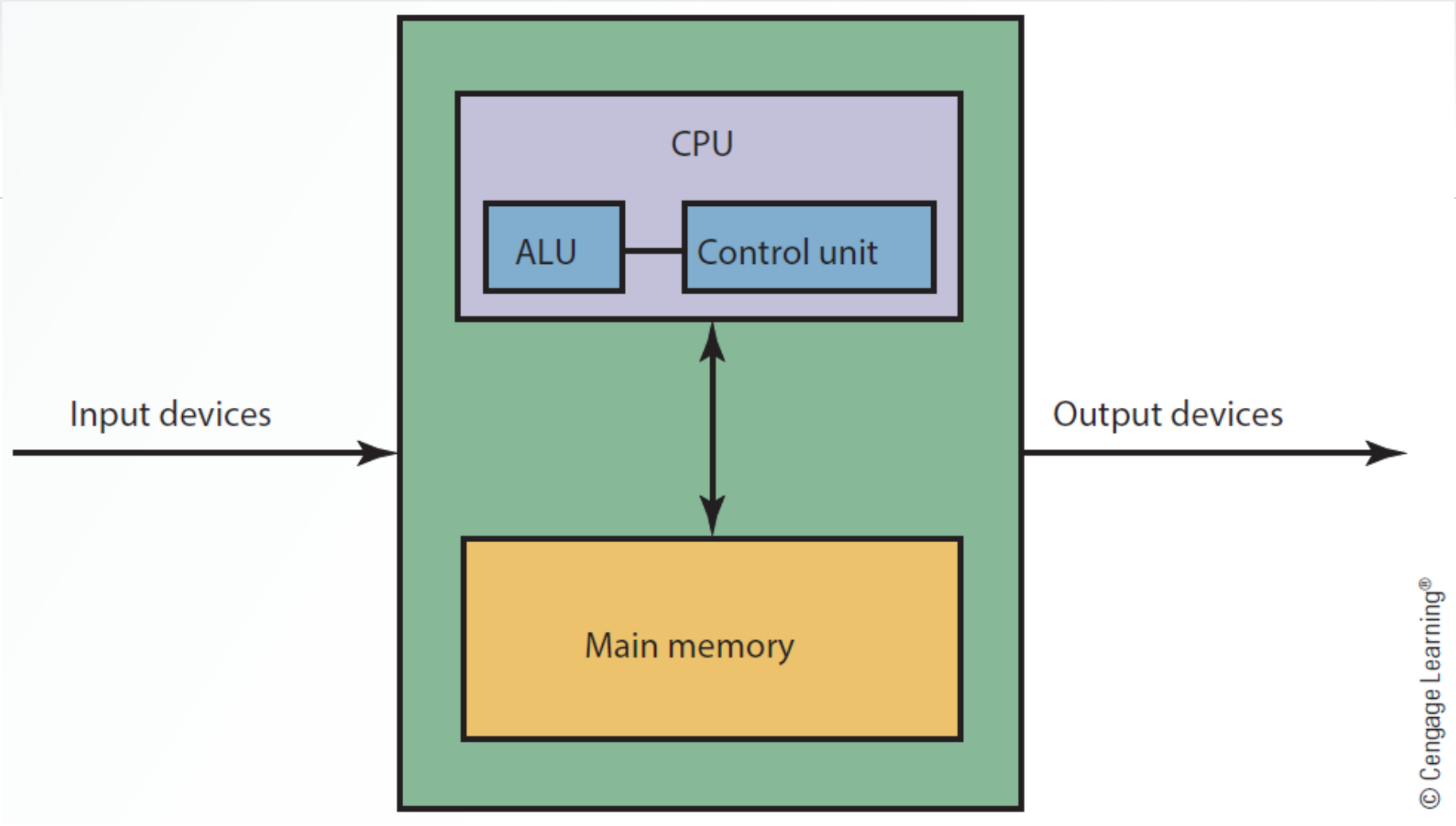
Components of a Computer System

- Hardware components
  - *Physical devices: Keyboards, monitors, and processing units*
- Software components
  - *Programs written in computer languages*

Components of a Computer System

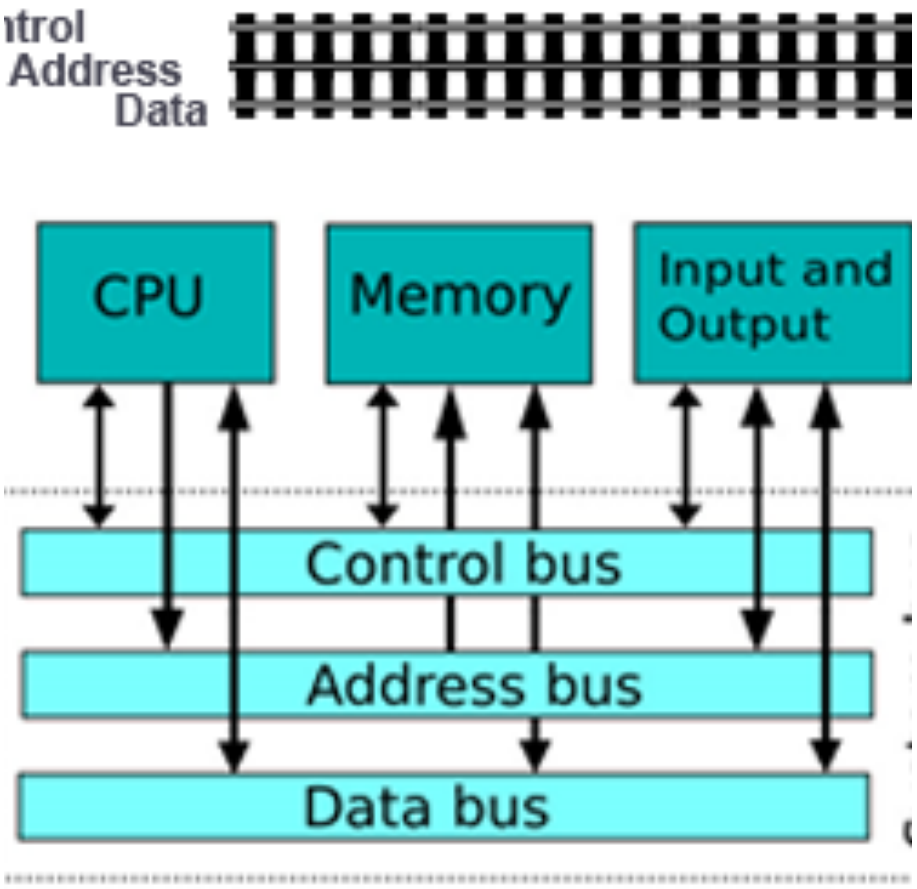
- **Central processing unit (CPU)**: Heart of a computer, consisting of:
  - ***Arithmetic logic unit (ALU)**: Performs arithmetic operations (+, –, *, /) and comparison or relational operations (<, >, =)*
  - ***Control unit**: Instructs the computer which device to read or send output to*
- Computers can either have a single processor or multiprocessors
  - *Multiprocessing: Use of two or more CPUs in a single computer system*

Exhibit 2.1 The Building Blocks of a Computer



Components of a Computer System

- **Bus**: Link between devices connected to the computer
  - Exists as parallel or serial, internal (local) or external



What is computer Bus

In the computer Bus is the set of physical connection in between cables and printed circuits. It is sheared by different hardware component in order to communicate each other. It reduces the pathway between different component. Sometimes it is called the data highway.

Components of a Computer System

- **Disk drive**: Peripheral device for recording, storing, and retrieving information

Components of a Computer System

- **Disk drive**: Peripheral device for recording, storing, and retrieving information **and they are changing fast**

Components of a Computer System

- **Disk drive**: Peripheral device for recording, storing, and retrieving information **and they are changing fast**

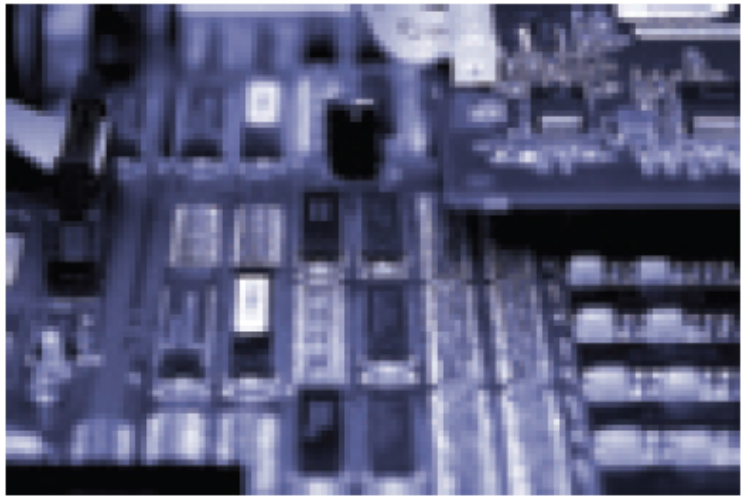
Components of a Computer System

- **CPU case**: Enclosure containing the computer's main components
  - *Referred to as computer chassis or tower*
- **Motherboard**: Circuit board containing connectors for attaching additional boards

Exhibit 2.2 Components of a Computer System

© Avera/Shutterstock.com

© Ps-42/Shutterstock.com



© Henrik Lehnerer/ Shutterstock.com

History of Computer Hardware and Software

- First-generation computers used vacuum tube technology in the 1940s
  - *Size was bulky and unreliable*
  - *Generated excessive heat*
  - *Programming was difficult*
- Second-generation computers used transistors
  - *Speed was faster, and more reliable*
  - *Easier to program and maintain*

Table 2.1 Hardware Generations

Generation	Date	Major technologies	Example
First	1946–1956	Vacuum tube	ENIAC
Second	1957–1963	Transistors	IBM 7094, 1401
Third	1964–1970	Integrated circuits, remote data entry, telecommunications	IBM 360, 370
Fourth	1971–1992	Miniaturization, VLSI, personal computers, optical discs	Cray XMP, Cray II
Fifth	1993–present	Parallel processing, gallium arsenide chips, optical technologies	IBM System zEnterprise EC12

Factors Affecting the Power of Computers

Speed

Accuracy

Storage and retrieval capabilities

Speed and Accuracy

- Computer speed is measured as the number of instructions performed per fractions of a second
  - *Millisecond: 1/1000 of a second*
  - *Microsecond: 1/1,000,000 of a second*
  - *Nanosecond: 1/1,000,000,000 of a second*
  - *Picosecond: 1/1,000,000,000,000 of a second*
- Degree of accuracy is extremely important for many computer applications

Storage and Retrieval

- Storage: Saving data in computer memory
- Retrieval: Accessing data from memory
- Data is stored in bits
- American Standard Code for Information Interchange (ASCII)
  - *Data code for text files, PC applications, and the Internet*
  - *Defines up to 128 characters*

Table 2.3 Storage Measurements (Approximations)

1 bit	A single value of 0 or 1
8 bits	1 byte or character
2^{10} bytes	1000 bytes, or 1 kilobyte (KB)
2^{20} bytes	1,000,000 bytes, or 1 megabyte (MB)
2^{30} bytes	1,000,000,000 bytes, or 1 gigabyte (GB)
2^{40} bytes	1,000,000,000,000 bytes, or 1 terabyte (TB)
2^{50} bytes	1,000,000,000,000,000 bytes, or 1 petabyte (PB)
2^{60} bytes	1,000,000,000,000,000,000 bytes, or 1 exabyte (EB)

Input Devices

- Send data and information to the computer
  - Keyboard, mouse, touch screen, light pen, trackball, and data tablet
  - Barcode reader, optical character reader (OCR), magnetic ink character recognition (MICR) system, and optical mark recognition (OMR) system

MICR

Magnetic Ink Character Recognition

Output Devices

- Capable of representing information from a computer
  - *Form of this output might be visual, audio, or digital*
- Displays output in the forms of soft copy and hard copy
- Plotters: Converts output to graphics
- Voice synthesizers: Converts output to voice

Memory Devices

- **Main memory**: Stores data and is volatile
  - *Volatile: Contents are lost when electrical power is turned off*
- **Secondary memory**
  - *Nonvolatile*
  - *Holds data when the computer is off or during course of a program's operation*
  - *Serves as archival storage*

Main Memory Devices

- Semiconductor chips made of silicon
  - *Can be volatile or nonvolatile*
- **Random access memory (RAM)**: Is a volatile memory, in which data can be read from and written to
  - *Known as read-write memory*
  - ***Cache RAM**: Stores recently accessed memory*
    - Resides on the processor as memory access from main RAM storage takes several clock cycles

Main Memory Devices

- **Read only memory (ROM)**: Is nonvolatile
  - Data cannot be written to it
  - Includes BIOS information and the computer system's clock
  - Types
    - Programmable read-only memory (PROM)
    - Erasable programmable read-only memory (EPROM)

- **BIOS** (basic input/output system) is the program a personal computer's microprocessor uses to get the computer system started after you turn it on. It also manages data flow between the computer's operating system and attached devices such as the hard disk, video adapter, keyboard, mouse and printer.

Secondary Memory Devices

Magnetic disks

- Made of mylar or metal
- Used for random-access processing

Magnetic tape

- Made of a plastic material
- Stores data sequentially

Optical discs

- Use laser beams to access and store data
- CD-ROM, WORM, DVD

Secondary Memory Devices

- Includes hard disk, USB flash drive, memory card
- **Redundant array of independent disks (RAID) system**
  - *Collection of disk drives used for fault tolerance and improved performance*
  - *Found in large network systems*

Secondary Memory Devices

- **Cloud storage**
  - *Used for online storage and backup*
  - *Involves multiple virtual servers that are hosted by third parties*
  - *Customers buy or lease storage space from third parties based on their current or future needs*

Table 2.4 Capacity of Secondary Memory Devices

Device	Storage capacity
Memory stick	16 GB
Hard disk	2 TB
CD-ROM, CD-R, CD-RW	800 MB
DVD-ROM, DVD-R, DVD-RW	4.7 GB or more
Blu-Ray (latest generation optical disc)	Up to 25 GB on a single-layer disc and 50 GB on a dual-layer disc

© Cengage Learning®

Storage Area Networks and Network-Attached Storage

- **Storage area network (SAN)**
  - *Dedicated high-speed network consisting of both hardware and software*
  - *Used to connect and manage shared storage devices*
    - Disk arrays, tape libraries, and optical storage devices
- **Network-attached storage (NAS)**
  - *Network-connected computer dedicated to provide file-based data storage services to other network devices*

Classes of Computers

- Vary in terms of cost, amount of memory, speed, and sophistication
- Types
  - *Subnotebooks and notebooks*
  - *Personal and minicomputers*
  - *Mainframes*
  - *Supercomputers*

Server Platforms: An Overview

- **Server**
  - *Computer and all the software for managing network resources and offering services to a network*
- Available server platforms
  - *Application, database, disk, fax, file, mail, print, remote access servers (RAS), and Web servers*

What is Software?

- Programs that run a computer system
- Classification
  - *System software: Works in the background and takes care of tasks such as deleting waste files*
  - *Application software: Performs specialized tasks*

Operating System

- Set of programs for controlling and managing computer hardware and software
- Provides an interface between a computer and the user
- Increases computer efficiency by helping users share computer resources and performing repetitive tasks for users

Operating System Software

- Consists of control programs to manage hardware and resources by performing:
  - *Job management*
  - *Resource allocation*
  - *Data management*
  - *Communication*
- Supervisor program: Responsible for controlling all other programs in the OS
  - *Known as the kernel*

Application Software

- Commercial software or software developed in-house, used to perform variety of tasks on a personal computer
  - *Word processing*
  - *Spreadsheet and database*
  - *Presentation and graphics*
  - *Desktop publishing*
  - *Financial planning and accounting*
  - *Project management*
  - *Computer-aided design (CAD)*

Computer Languages

- **Machine language**
  - *First generation of computer languages*
  - *Consists of a series of 0 s and 1 s representing data or instructions representing data or instructions*
  - *Dependent on the machine*
  - *Time consuming to write a program*

Computer Languages

- **Assembly language**
  - *Second generation of computer languages*
  - *Machine dependent, though a higher-level language than machine language*
  - *Uses a series of short codes, or mnemonics, to represent data or instructions*

Computer Languages

- **High-level languages**
  - *Part of the third-generation of computer languages*
  - *Machine independent and self documenting*
  - *Used for Web development and Internet applications*
- **Fourth generation languages (4GLs)**
  - *Use macro codes that can take the place of several lines of programming*
  - *Commands are powerful and easy to learn*

Computer Languages

- **Fifth-generation languages (5GLs)**
  - *Use artificial intelligence technologies*
    - Knowledge-based systems, natural language processing (NLP), visual programming, and a graphical approach to programming
  - *Designed to facilitate natural conversations between an individual and the computer*

KEY TERMS

- Application software
- Arithmetic logic unit (ALU)
- Assembly language
- Bus
- Cache RAM
- Central processing unit (CPU)
- Cloud storage
- Computer

KEY TERMS

- Control unit
- CPU case
- Disk drive
- Fifth-generation languages (5GLs)
- Fourth-generation languages (4gGLs)
- High-level languages
- Input devices
- Machine language

KEY TERMS

- Magnetic disk
- Magnetic tape
- Main memory
- Motherboard
- Network attached storage (NAS)
- Operating system (OS)
- Optical discs

KEY TERMS

- Output devices
- Random access memory (RAM)
- Read-only memory (ROM)
- Redundant array of independent disks (RAID)
- Secondary memory
- Server
- Storage area network (SAN)

SUMMARY

- Computers perform arithmetic, logical, and storage and retrieval operations
- To process data a computer requires input, output, and memory devices
- Software is all the programs that run a computer system
- Computer languages include machine, assembly, high-level, fourth- and fifth-generation languages