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Foundations of web development (420-WA5-AB)

Foundation of computing

Fall 2022

What is a Computer?

What is a computer?

- A computer is an electromechanical device which can be programmed to change (process) information from one form to another.
  - Do exactly as they are told.
  - Digital devices: Understand only two different states (OFF and ON)

Hardware and Software

Concept:

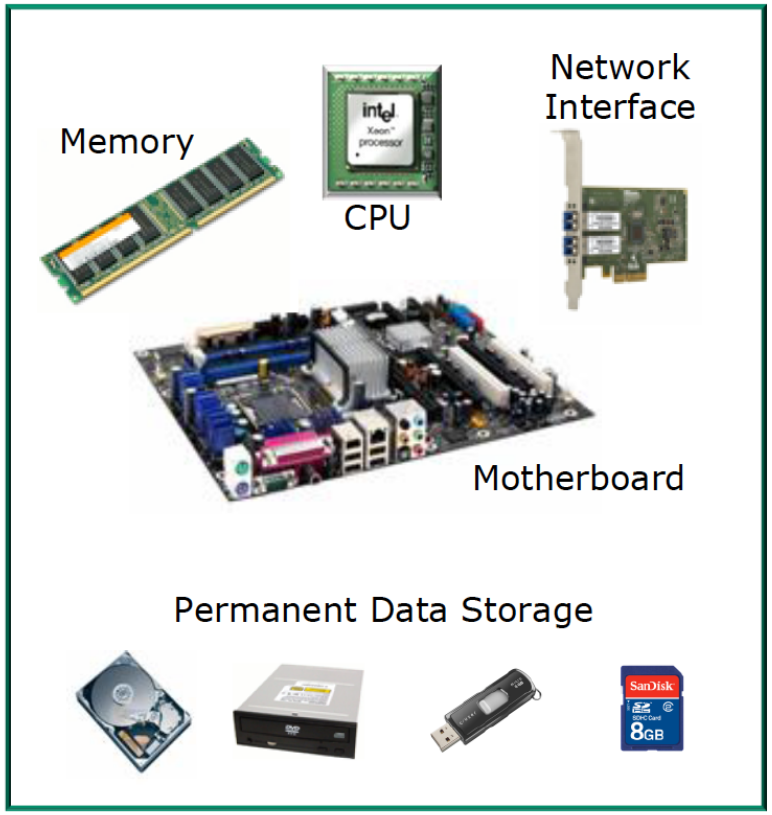
The physical devices that a computer is made of are referred to as the computer's hardware.

The programs that run on a computer are referred to as software.

Source: Logic & Design ()

Computer is Hardware and Software

Hardware

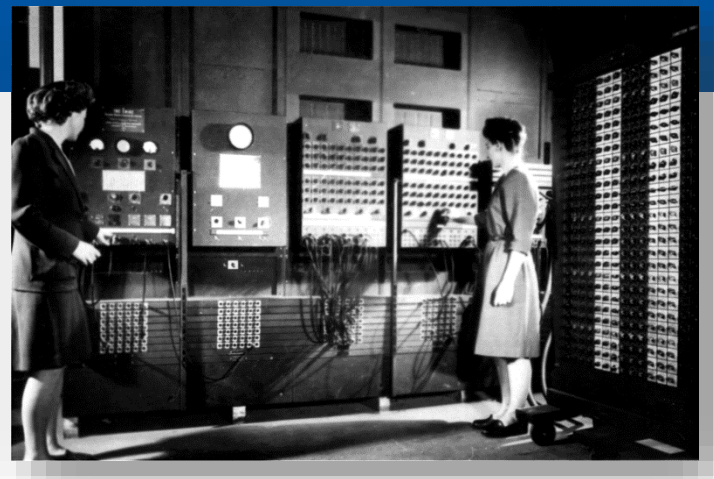


Software

Programs/Apps

Operating System

History Highlight



- 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
- Microprocessor
  - Much smaller
  - Much more powerful

Hardware Components

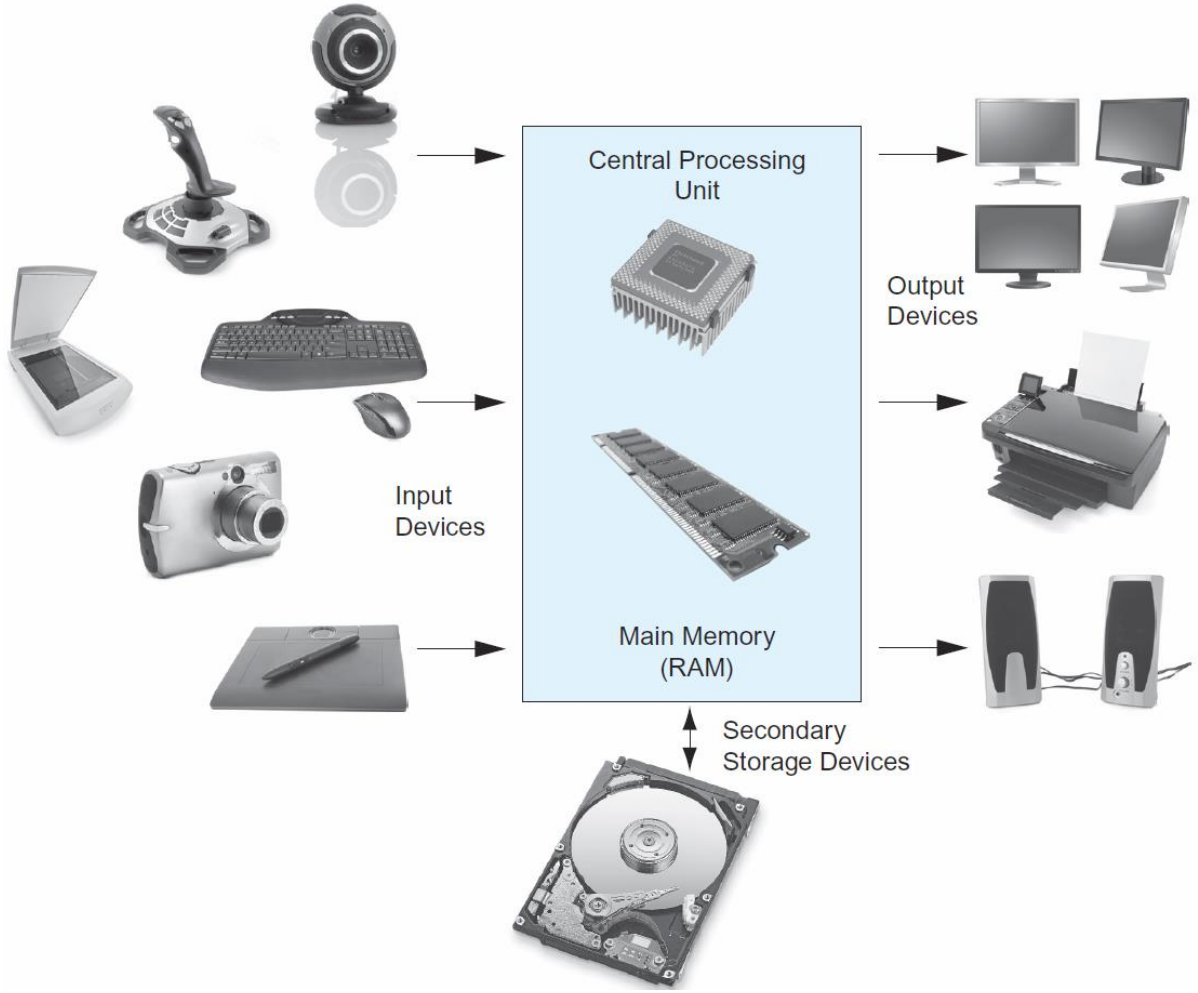
- The physical devices that a computer is made of are referred to as the computer's ***hardware.***

- A computer is a system of devices that work together.

Hardware Components (cont.)

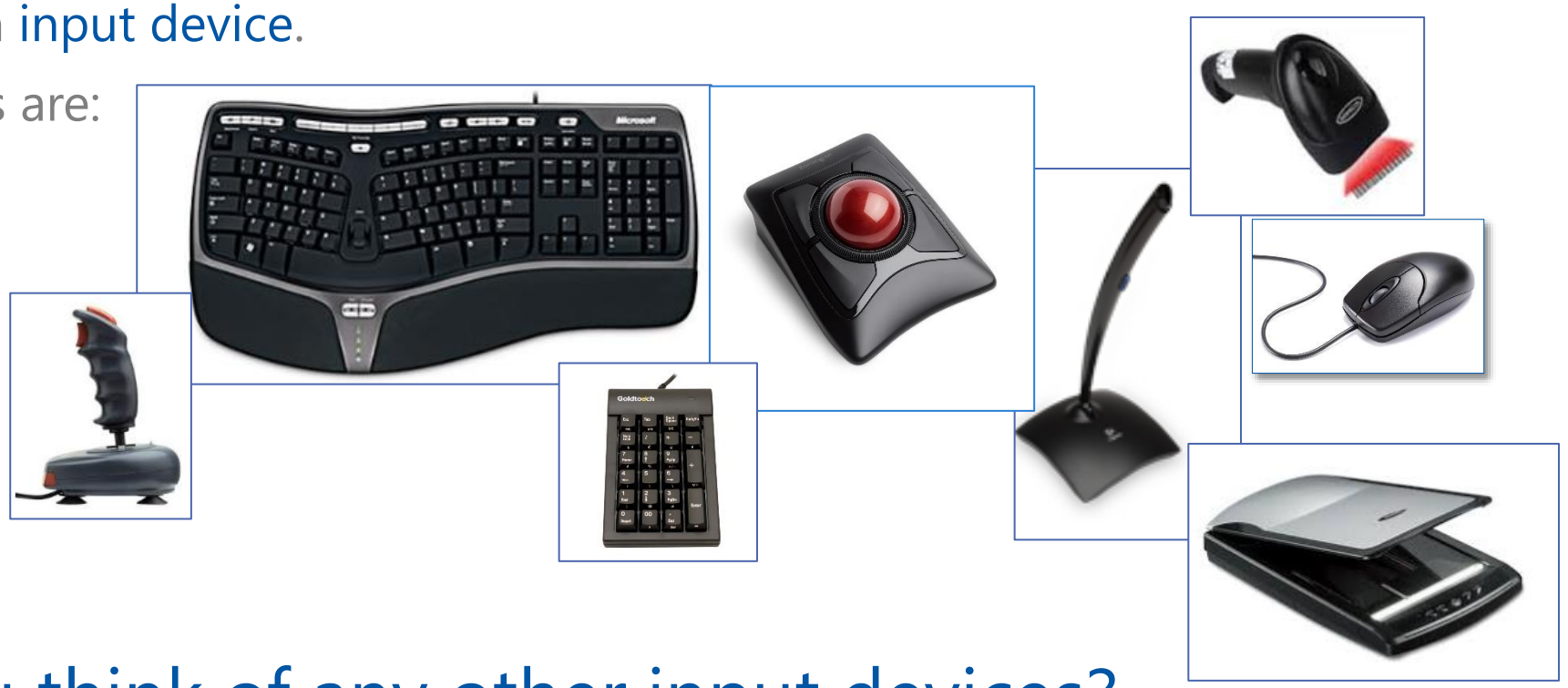
A Computer System consists of:

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



Hardware Components: Input Devices

- Any data the computer collects from users and from other devices is called input.
- The hardware component that allows a computer to accept data and instructions from a user is called an input device.
- Common input devices are:
  - Keyboard
  - Mouse
  - Touch screen
  - Scanner
  - Microphone
  - Digital camera



Can you think of any other input devices?

Hardware Components: CPU

- Central Processing Unit (CPU)
  - The CPU is the part of a computer that runs the programs.
  - Often referred to as the processor.
  - 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.

Hardware Components: 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)
- Features:
  - Data is quickly accessed
  - Used for temporary storage
  - RAM is a volatile type of memory.
  - RAM is erased when computer is turned off.

Hardware Components: Read-Only Memory (ROM)

- A computer can read the contents of ROM, but it cannot change its contents, or store additional data there.
- ROM is nonvolatile. It does not lose its contents, even when the computer's power is turned off.
- ROM is typically used to store programs that are important for the system's operation.
  - For example, the computer's startup program, which is executed each time the computer is started.

Hardware Components: 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.
- Solid-State drives are becoming increasingly popular
  - Does not contain a disk. Instead, it stores data in solid-state memory.
  - No moving parts.
  - Operates faster than a traditional disk drive.

Hardware Components: Secondary Storage Devices (II)

- USB drives
  - It does not contain a disk.
  - The data is stored on flash memory.
  - Inexpensive, reliable, and small.
- Optical devices (CD or DVD)
  - Data is encoded as a series of pits on the disc's surface using laser.
  - Holds large amounts of data.
  - Good medium for creating backups.
- Cloud Storage
  - When you store data in the cloud, you are storing it on a remote server via the internet, or via a company's private network.
  - You can access it from many different devices, and from any location where you have a network connection.
  - Can also be used to backup important data that is stored on a computer's disk.

Output Devices

Output devices present information to the user from a computer.

- Monitors
- Projectors
- Printers
- Speakers
- Headphones

Can you think of any other output devices?

Software

- The programs (instructions) that tell the computer (the hardware) what to do.
- Everything a computer does is controlled by software.
- Software can be categorized into the following:
  - System Software
  - Application Software

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 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.

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
  - Texting
  - Having Fun

Can you think of any other application software?

Data Representation in Computers

How Computers Store Data

Concept:

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

How Computers Store Data

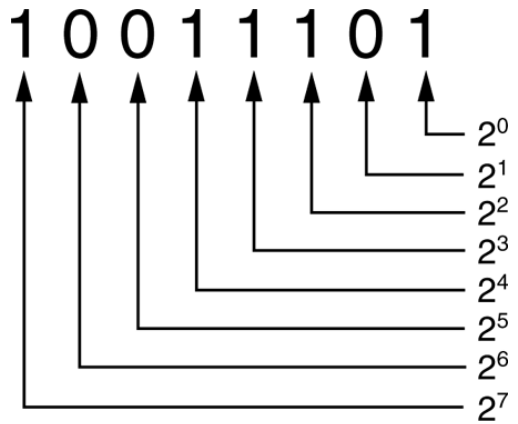
- A computer's memory is divided into tiny storage locations known as bytes.
  - One byte represents one number
  - A byte is divided into eight smaller storage locations known as bits (binary digits)

- 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 → 1
  - A negative charge is similar to a switch in the off position → 0

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

- Binary Numbers: corresponds to the binary numbering system where all numeric values are written as a sequence of 0s and 1s



Converting: Decimal Number to Binary

- Remember each number is one byte (or combination or bytes)

2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
128	64	32	16	8	4	2	1

Converting Decimal Number to Binary

1. Divide a given decimal number by 2 using long division.
   - Binary numbers are 2-base numbers (they have only 2 values 0 & 1)
   - Decimal numbers are 10-base numbers (they have 10 values)
2. Note down the outcome and remainder of the division on the side.
3. Repeat steps 1 and 2 on the outcome until the outcome becomes zero.
4. The binary number will the series of the remainders in the step 2.

Demo: Converting Decimal Number to Binary

- Covert 25 to binary.

Division:

Steps	Outcome	Remainder
1	25 / 2	1
2	12 / 2	0
3	6 / 2	0
4	3 / 2	1
5	1 / 2	1
Stop	0	

$$(25)_{10} = (11001)_2$$

Exercise: Converting Decimal Number to Binary

- Covert 107 to binary.

	107	
$(107)_{10} = (\quad)_2$		

Exercises:

- Convert the following into binary:

- 10
- 64
- 128
- 146
- 300

Demo: Converting: Binary to Decimal

1. Number the binary number digits
   - Right to left.
   - Starting from 0.
2. Find the power 2 value for each available digits.
3. Add only the numbers that have 1 in the binary digit.

Binary Number	1	1	0	0	1
Step 1	4	3	2	1	0
Step 2	2^4	2^3	2^2	2^1	2^0
	16	8	4	2	1
Step 3	16 + 8 + 1 = 25				

Exercises:

- Convert the following binary numbers to decimal:

1001

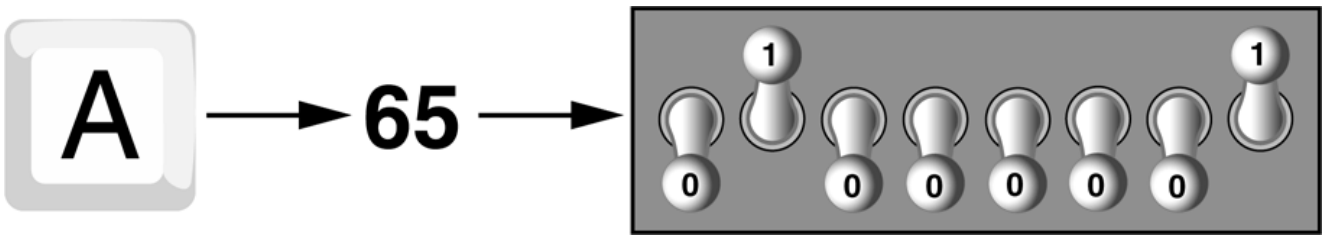
1101101

1000001

1111111

Storing Characters

- Characters are stored in the computer's memory as binary number.
- ASCII (American Standard Code for Information Interchange) is a coding scheme
- Unicode is an extensive encoding scheme
  - It is compatible with ASCII
  - It represents characters for many languages in the world



Advanced Number Storage

- Binary numbering system can be used to represent only integer numbers.

- Specific Binary Formats:
  - Negative numbers are encoded using *two's complement*.
  - Real numbers are encoded using *floating-point notation*.

- Conclusion: all data must be stored in binary format so the computer can understand it and process it.

Q & A