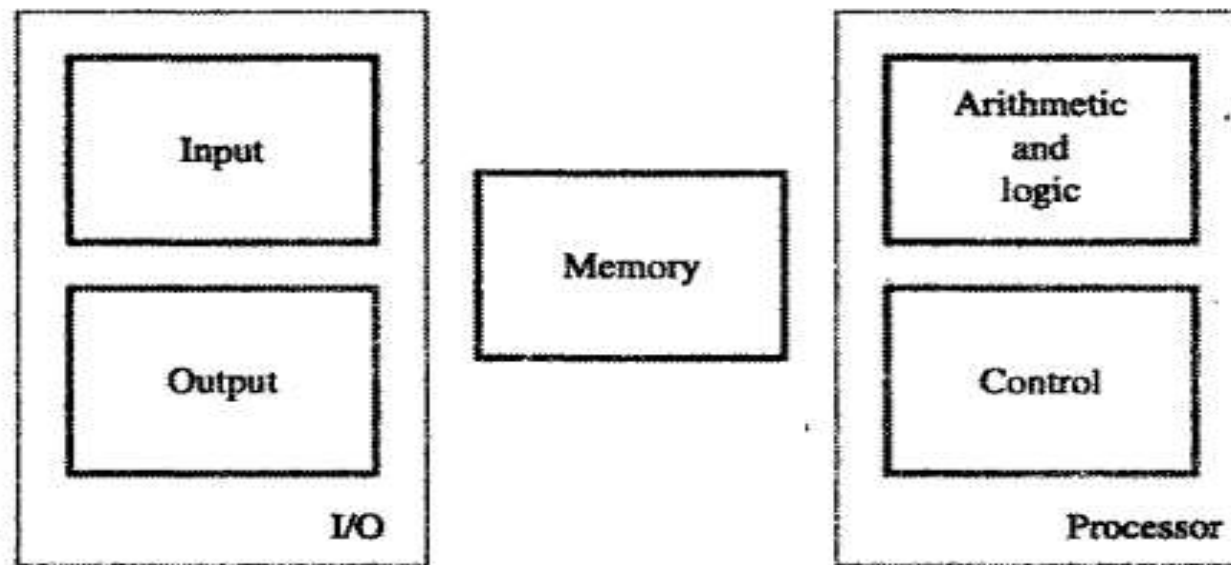


# Key components of a computer

- Underlying hardware in any computer performs the same basic functions: **inputting data, outputting data, processing data** and **storing data**.
- **Five components of a computer** that perform the tasks of inputting, outputting, processing, and storing data.



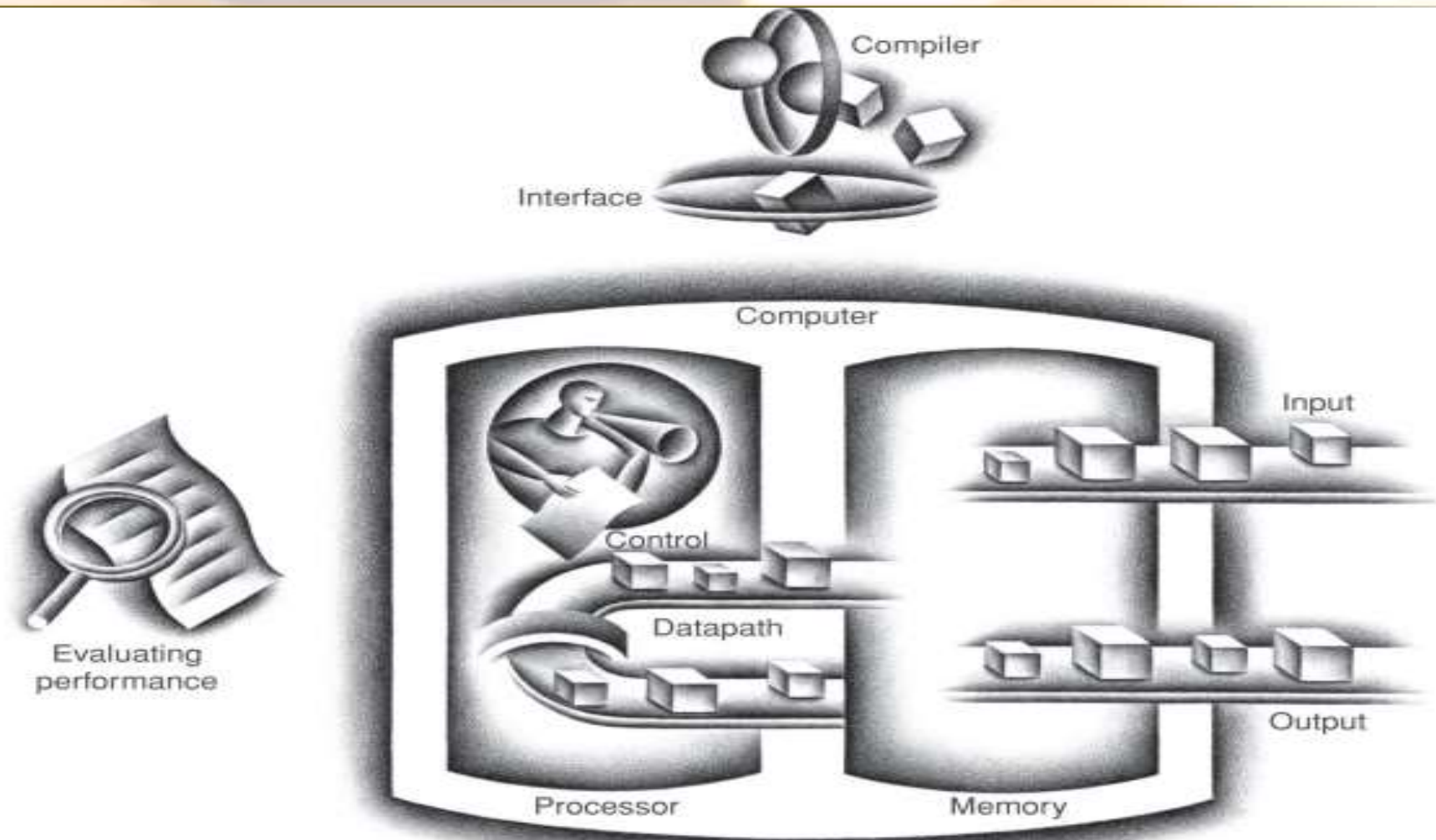
**Figure 3** Basic functional units of a computer.

[Hamacher, Vranesic & Zaky, "Computer Organization" (5th Ed), McGraw Hill]

# Key components of a computer

- The five classic components of a computer are **input, output, memory, datapath,** and **control,** with the last two sometimes combined and called the **processor.**
- Figure 4 shows the **standard organization** of a computer. This organization is **independent of hardware technology:** you can place every piece of every computer, past and present, into one of these five categories.

# Key components of a computer



**FIGURE 4: The organization of a computer, showing the five classic components.** The processor gets instructions and data from memory. Input writes data to memory, and output reads data from memory. Control sends the signals that determine the operations of the datapath, memory, input, and output.

# Key components of a computer

- Two **key components** of computers are **input devices**, such as the microphone, and **output devices**, such as the speaker.
- As the names suggest, **input feeds the computer**, and **output is the result of computation sent to the user**.
- Some devices, such as wireless networks, **provide both input and output** to the computer.

# Key components of a computer

- The most fascinating I/O device is probably the **graphics display**. Most personal mobile devices use **liquid crystal displays (LCDs)** to get a thin, low-power display.
- Most LCD displays use an **active matrix** that has a tiny transistor switch at each pixel to precisely **control current and make sharper images**.
- The image is composed of a matrix of picture elements, or **pixels**, which can be represented as a matrix of bits, called a **bit map**.

## Touchscreen

- While PCs also use LCD displays, the tablets and smartphones of the PostPC era have replaced the keyboard and mouse with **touch sensitive displays**, which has the wonderful user interface advantage of **users pointing directly what they are interested in rather than indirectly with a mouse**.

# Key components of a computer

- **I/O devices** includes a capacitive multitouch LCD display, front facing camera, rear facing camera, microphone, headphone jack, speakers, accelerometer, gyroscope, Wi-Fi network, and Bluetooth network.
- The datapath, control, and memory are a tiny portion of the components.
- **Integrated circuit**(also called a **chip**): A device combining dozens to millions of transistors.
- **Central processor unit** (CPU) (also called **processor**): The active part of the computer, which contains the **datapath** and **control** and which adds numbers, tests numbers, signals I/O devices to activate and so on.

# Key components of a computer

- **Datapath and control**, the respective **brawn** (physical strength) and **brain** of the processor.
- **Datapath**: The component of the processor that performs **arithmetic operations**.
- **Control**: The component of the processor that commands the datapath, memory and I/O devices according to the **instructions** of the program.
- **Memory**: The storage area in which **programs are kept** when they are running and that **contains the data** needed by the running programs.
- **Dynamic random access memory** (DRAM): Memory built as an integrated circuit; it provides random access to any location. Access times are 50 nanoseconds.

(In **contrast to sequential access memories**, such as magnetic tapes, the RAM portion of the term DRAM means that **memory accesses take basically the same amount of time** no matter what portion of the memory is read.)



# Key components of a computer

- Inside the processor is another type of memory, **cache memory**.
- **Cache** memory consists of a **small, fast memory** that acts as a buffer for the DRAM memory.
- Cache is built using a different memory technology, **static random access memory** (SRAM). SRAM is faster but **less dense, and hence more expensive**, than DRAM. (SRAM and DRAM are two layers of the memory hierarchy).



# Key components of a computer

- **Instruction set architecture**(also called **architecture**): An abstract **interface** between the hardware and the lowest level software that **encompasses all the information necessary to write a machine language program** that will run correctly, including instructions, registers, memory access, I/O and so on.
- **Application binary interface**(ABI): The **user portion of the instruction set plus the operating system interfaces** used by application programmers. It defines a **standard for binary portability** across computers.
- **Implementation**: Hardware that obeys the architecture abstraction.
- Both hardware and software consist of **hierarchical layers using abstraction**, with each lower layer hiding details from the level above

# Key components of a computer

- **Volatile memory:** Storage, such as **DRAM**, that retains data only if it is receiving power.
- **Nonvolatile memory:** A form of memory that retains data even in the absence of a power source and that is used to store programs between runs. A **DVD** disk is nonvolatile.
- To distinguish between the volatile memory used to **hold data and programs while they are running** and nonvolatile memory used **to store data and programs** between runs, the term **main memory or primary memory** is used for the former, and **secondary memory** for the latter.
- **Secondary memory** forms the next lower layer of the memory hierarchy. Eg:- magnetic disks
- Personal Mobile Devices use **flash memory**, a nonvolatile semiconductor memory, instead of disks.

# Key components of a computer

## Computer networks

- Networks are the **backbone** of current computer systems.
- Networked computers have several major **advantages**:
  - **Communication**: Information is exchanged between computers at high speeds.
  - **Resource sharing**: Rather than each computer having its own I/O devices, computers on the network can share I/O devices.
  - **Nonlocal access**: By connecting computers over long distances, users need not be near the computer they are using.
- Most popular type of network is **Ethernet**.
- **Local area network** (LAN): A network designed to carry data within a geographically confined area, typically within a single building.
- **Wide area network** (WAN): A network extended over hundreds of kilometers that can span a continent.