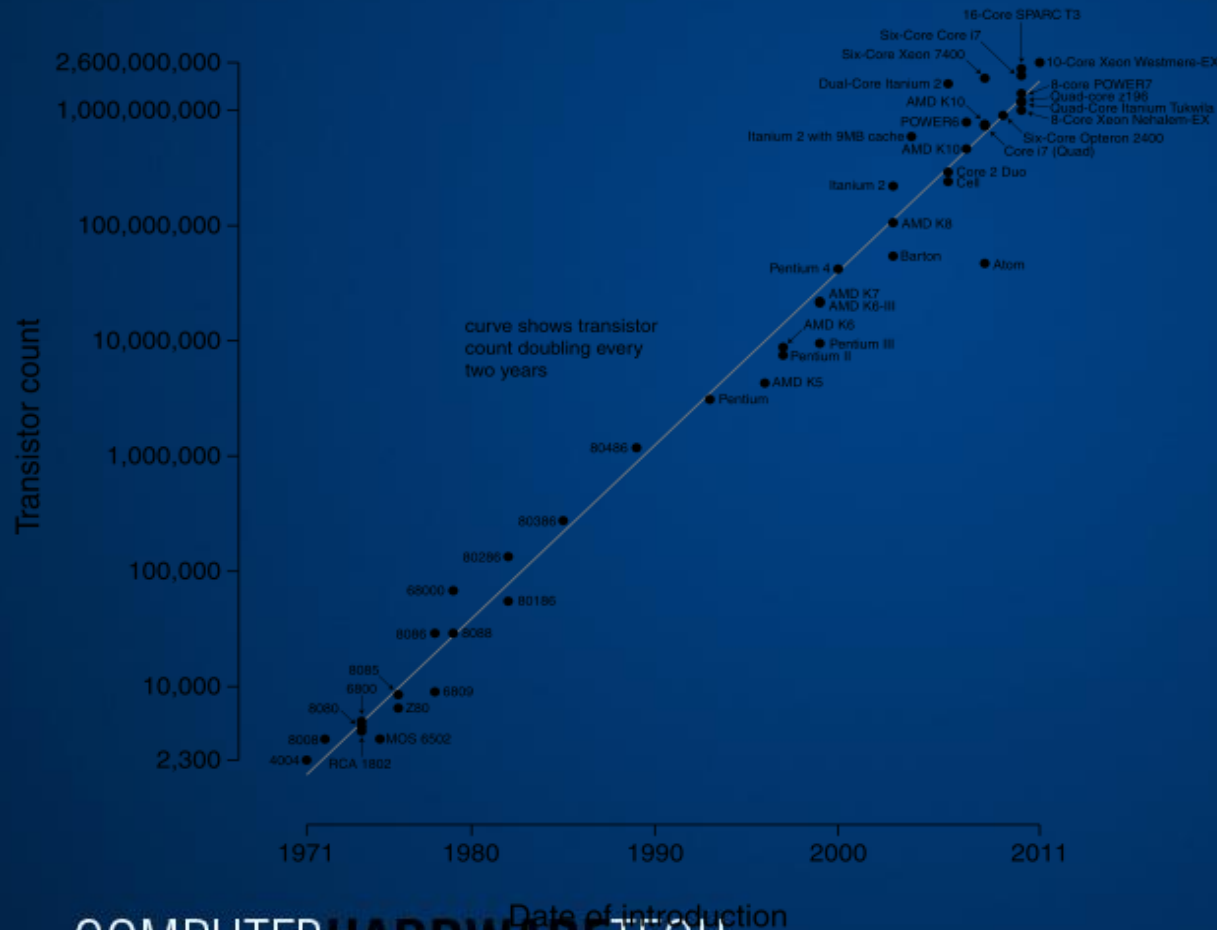# Evolution of computers

Moore's Law

Microprocessor Transistor Counts 1971-2011 & Moore's Law

Moore's law is the observation that "number of transistors per square inch on integrated circuits had doubled every 18months since the integrated circuit was invented".

The period often quoted as "18 months" is due to Intel executive David House, who predicted that period for a doubling in chip performance (being a combination of the
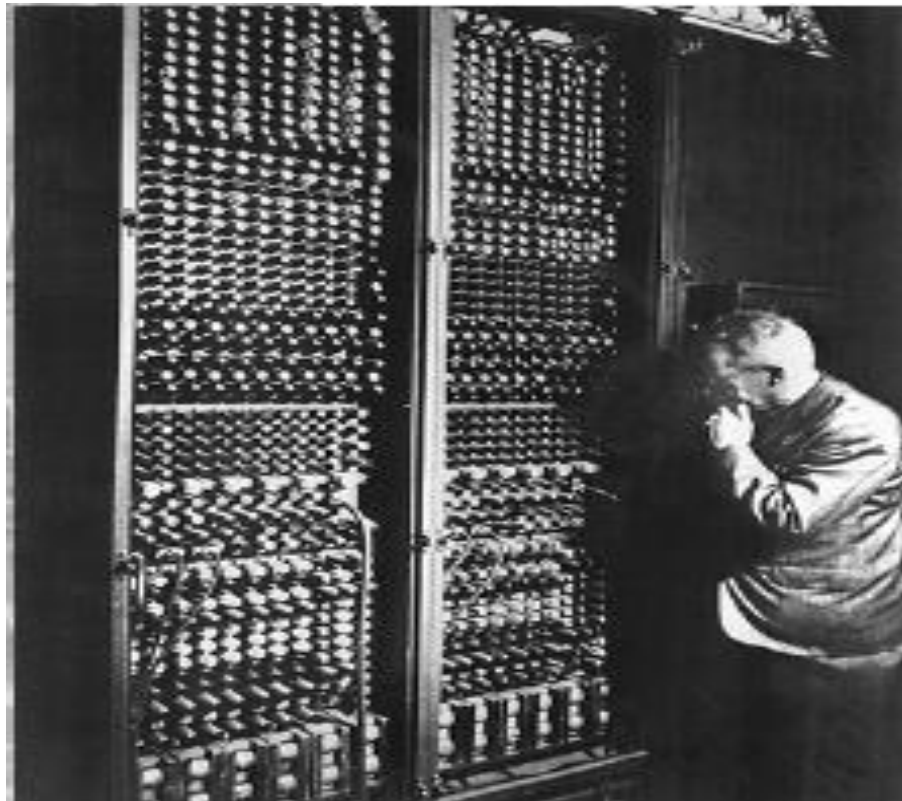
The ENIAC computer required more than 17,000 vacuum tubes to perform ballistic calculations in decimal (base-10) notation. Although vacuum tubes were better than electromechanical relays, the tubes over-heated and needed frequent replacements.

Computers categories

❑ Computers for Individual Users (PC)
- ❑ Desktop Computers
- ❑ Notebook computers
- ❑ Tablet computers
- ❑ Handheld computers
- ❑ Smart phones

❑ Computers for Organizations

- ❑ Servers
- ❑ Network servers
- ❑ Mainframe computers
- ❑ Super computers

IBM Servers
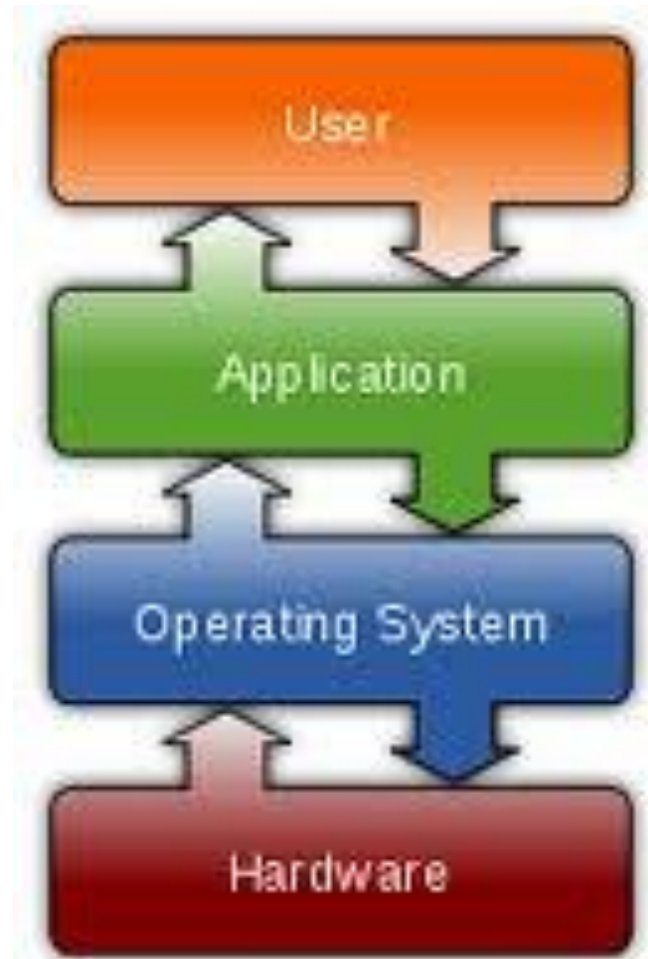
Network Computer

Mainframe IBM

Super Computer

The Blue Gene/P supercomputer at Argonne National Lab runs over 250,000 processors using normal data center air conditioning, grouped in 72 racks/cabinets connected by a high-speed optical network[1]

Computer Components – looking inside

❑ Hardware

❑ Software

❑ Data

Hardware

- ❑ Processor - CPU
- ❑ Memory –
  - ▪ RAM – Random Access Memory
  - ▪ ROM - Read Only Memory

  Memory Size measured in KB, MB, Kb, Mb, GB
- ❑ Input Devices

  Keyboard, mouse, barcode readers , touchscreens, microphone
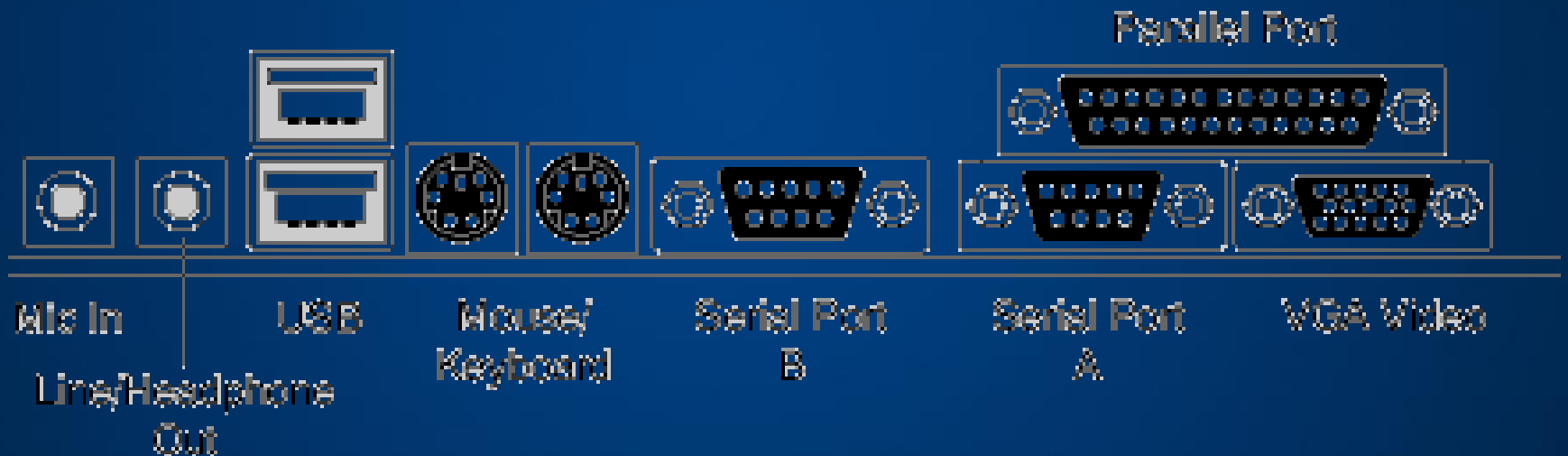- ❑ Output Devices

  Monitor, display devices, printers, speakers,
- ❑ Storage (external memory)

  Hard disk, CD, USB /pen drive, SD/micro memo cards, memory tapes, zip drive

Computer interface with IO devices: Ports

Parallel Port

Mic In

Line/Headphone Out

USB

Mouse/ Keyboard

Serial Port B

Serial Port A

VGA Video

Communications and Ports

Computers are connected to external devices via I/O connectors at the back of the computer. Depending on the device being connected and the cable being used, the device may be connected via a serial port (either 9 or 25 pin connector) or via a 25 pin parallel port.

Serial port (DB-9 male)

Serial port (DB-25 male)

Parallel port (DB-25 female)

PS/2 Ports

Desktop computers often have two PS/2 connectors where the keyboard and mouse are attached. The connectors are identical, but often colour coded -- blue is keyboard and green is mouse. In future, PS/2 ports are likely to be replaced by USB.

• VGA Port

A VGA port is used to connect a monitor to a computer. On the back of the computer, should be a female 15-pin connector.
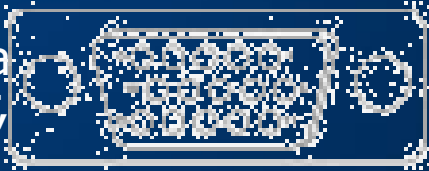
- **USB Ports**

There are two **U**niversal **S**erial **B**us (**USB**) standards, USB 1.1 and USB 2.0. USB connectors and adapters allow the connection of up to 127 peripheral devices. USB 1.1 can transmit data at a rate of 12 Mbps. but USB 2.0 (sometimes called High-speed USB) can transmit at 480 Mbps
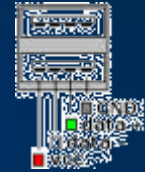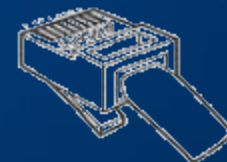
Fire Wire Port
preferred standard for very high speed communications -- the IEEE1394 standard. Data is transferred at speeds of up to 400 Mbps (in IEEE 1394a standard) and 800 Mbps (in IEEE 1394b standard). Fire wire allows up to 63 devices to be connected

Network Connection
A network jack is used to connect a computer's network card to a cable modem or to the network.

RJ-45 8-Wire

Processor interaction with devices

- Device Addressing
    - Memory mapped IO
    - Port mapped IO

- Interrupts

- Device Drivers – OS

Storage= store data

Storage types based on Technology
I. Semiconductor – (IC) – RAM, ROM, Flash
II. Magnetic – HD, Tape, Floppy
III. Optical - CD ROM, DVD ROM

Storage types based on Volatility
1. Volatile
2. Nonvolatile

Storage Types based on computer access
I. Primary – Main memory, RAM and ROM
II. Secondary – Hard disk, CD ROM

Primary Storage

- is also main memory or internal memory – is directly accessible to CPU
- CPU stores instructions and executes in main memory
- Main memory is connected to CPU using memory bus. Memory bus has 2 bus internally – address bus and data bus
- RAM and ROM are main memories. RAM is temporary or volatile data. ROM stores startup program (BIOS) which is permanent and uses non-volatile technology.

Secondary Storage

- Also called as 'auxiliary storage' is memory that is not directly accessible by CPU but a majority of data and programs stored
- All storage that is not required in primary memory is secondary storage
- Normally accessed by CPU using IO channels
- Eg. Hard disk, CD ROM

Volatility

- [Non-volatile memory](#) Will retain the stored information even if it is not constantly supplied with electric power. It is suitable for long-term storage of information.

- [Volatile memory](#) Requires constant power to maintain the stored information. The fastest memory technologies of today are volatile ones generally. Since primary storage is required to be very fast, it predominantly uses volatile memory.
  - Dynamic random-access memory: A form of volatile memory which also requires the stored information to be periodically re-read and re-written, or refreshed, otherwise it would vanish.
  - Static random-access memory A form of volatile memory similar to DRAM with the exception that it never needs to be refreshed as long as power is applied. (It loses its content if power is removed).

  Is BIOS volatile or nonvolatile ?

Storage Device characteristics

- Volatility - *Volatile or non-volatile*

- Accessibility – *Sequential access or random access*

- Addressability – *memory or file addressable*

- Capacity – *size and density*

- Latency - *Time taken to access data from particular location*

COMPUTER**HARDWARE**TECH   DAVIE**BALMADRID**MIT
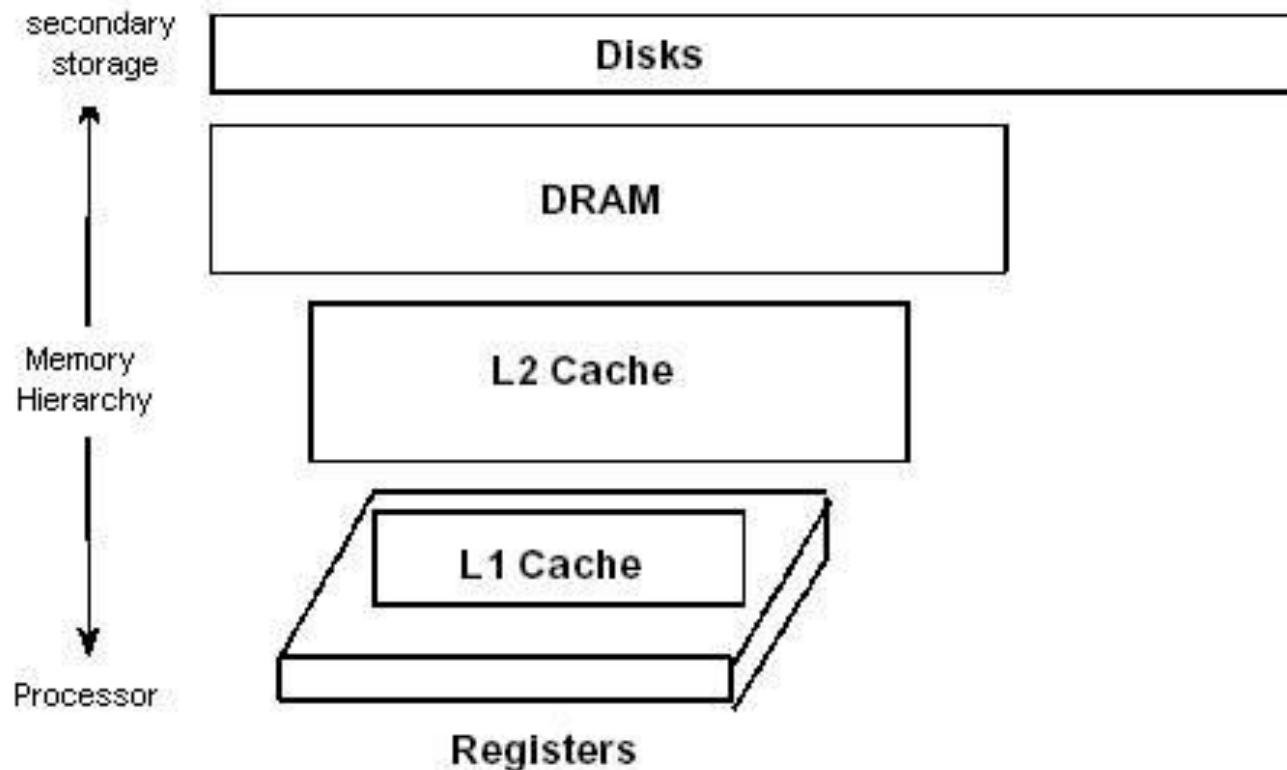
Key Terms

- RAM
- ROM
- Cache
- Virtual Memory
- Volatile and non-Volatile memory

CENTRAL PROCESSING UNIT (CPU)

- The central processing unit (CPU) is the portion of a computer system that carries out the instructions of a computer program, and is the primary element carrying out the computer's functions.

- The form, design and implementation of CPUs have changed dramatically since the earliest examples, but their fundamental operation remains much the same.

Components of CPU

1. ALU – Arithmetic Logic Unit
2. Registers
3. Control Unit
4. RAM
5. Buses
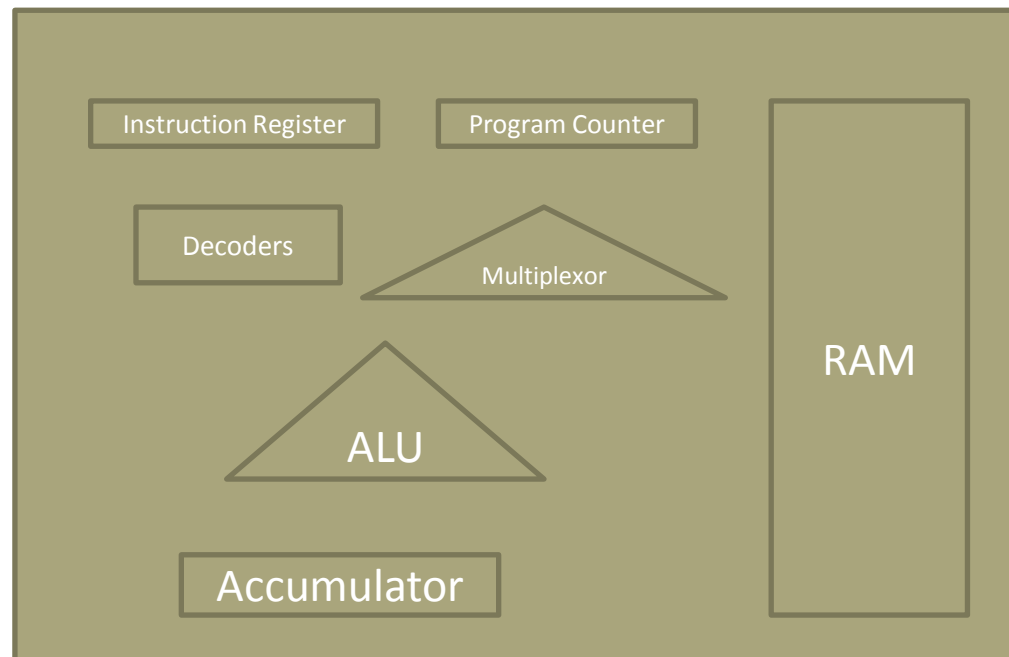
Registers

- ✓ Registers are memory that are present within CPU and can be accessed very quickly
- ✓ It's content can be easily and more quickly accessed than storage available elsewhere.
- ✓ Examples include the instruction register, flag register, the program counter and the accumulator.

Control Unit

- A Control Unit is part of the machinery that controls its operation.

- It Co-ordinates the input and output devices of a computer system.

ALU

- **ALU** stands for **A**rithmetic **L**ogic **U**nit.

- is a digital circuit that performs arithmetic and logical operations.

Buses

- A bus is a subsystem that transfers data between computer components
- The buses are the information highway for the CPU.
- They are bundles of tiny wires that carry data between components.
- The three most important buses are the
  - address bus,
  - data bus
  - control buses.
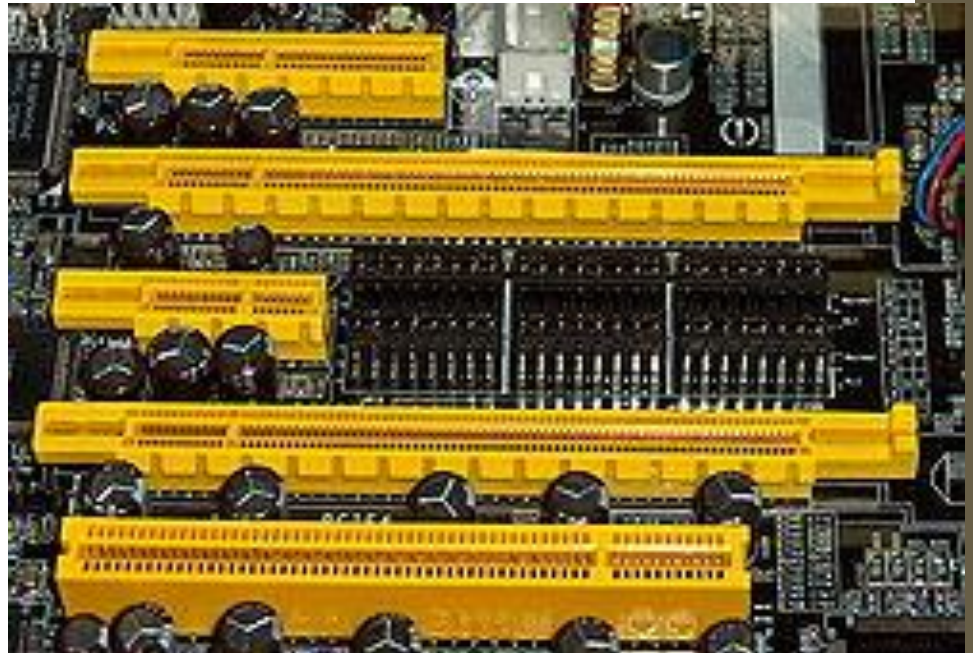
Von Neumann architecture

Primary Memory

Input Units	CPU (Central Processing Unit)	Output Units
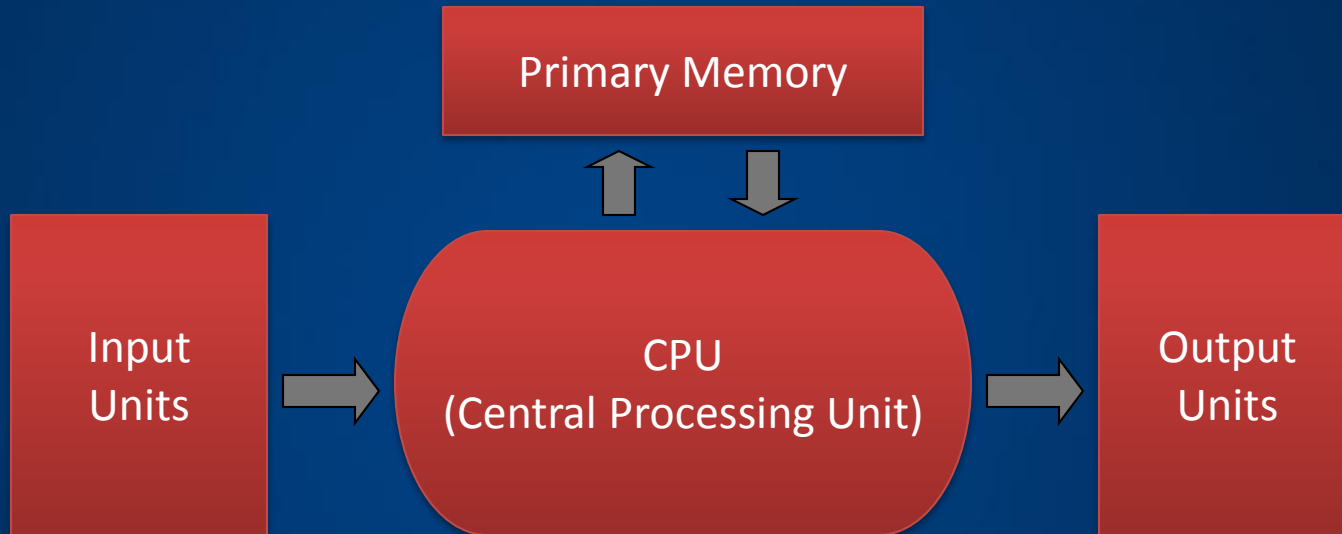
- Programs and data are stored in the same memory: primary memory.
- The computer can only perform one instruction at a time.
- Most of modern and general purpose computers/desktops follow this architecture.