

Introduction to Computer & its Architecture

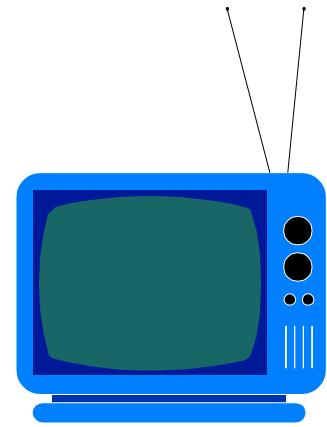
Which one is the computer?



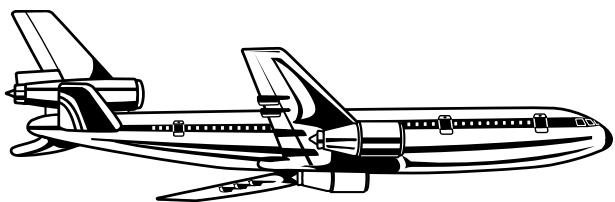
Rock



Calculator



Television



Modern Airplane



Washing Machine



Computer Workstation

Is a rock a computer?



- Does not act or process
- Takes no input and produces no output

- Computers must be able to handle *input* and *output*

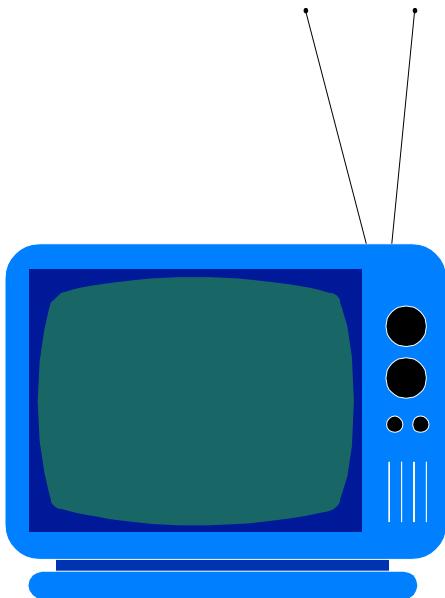
Is a washing machine a computer?



- Input: dirty clothes
- Output: clean clothes
- Does not handle information

- Computers input and output as *information*

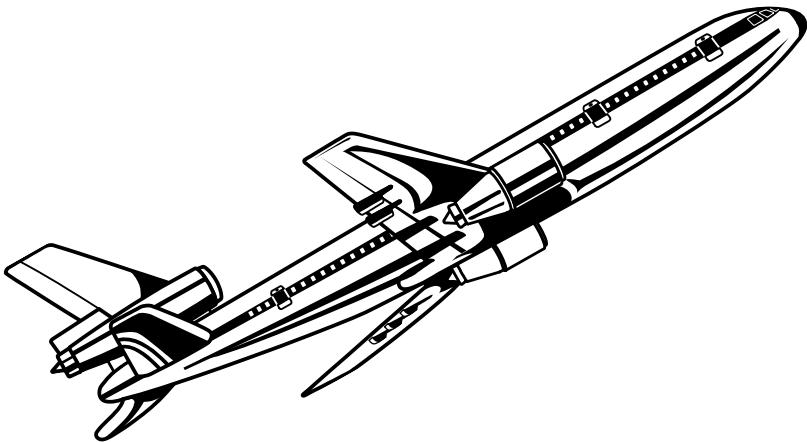
Is a television set a computer?



- Input: information from cables or radio waves
- Output: information as sound and picture
- Does not process information

- Computers *process* information by computing new results and answering queries

Is a modern airplane a computer?



- Input: information from radio waves
- Output: manipulations to the airplane
- Can only handle specific information necessary for flight control
- Computers are *general purpose* because they can perform many different tasks

Is an ordinary calculator a computer?



- Input: numbers and mathematical operations
- Output: answer
- Handles any numeric task
- Cannot remember which buttons are pressed

- Computers are *programmable* so they can remember sequences of operations

Definition of a Computer

- a general purpose,
- programmable,
- information processor
- with input and output



Definition of a Computer

- A computer is an electronic device that performs mathematical and non-mathematical operations with the help of instructions to process the information in order to achieve desired results.
 - Textbook

Characteristics of Computer

1. Speed
2. Accuracy
3. Reliability
4. Diligence
5. Versatility
6. Storage Capability
7. No I.Q
8. No Feelings

...Characteristics of Computer...

Speed...

- Process data at an extremely fast rate
- Work done as enormous speed as compare to human beings
- Speed of Computer is calculated in MHz(MegaHertz) i.e. one million instructions per second.



Accuracy...

- Work with the highest Accuracy
- Accuracy depends upon the "Design of Computer" i.e. instructions and the type of machine being used
- Human Errors are like wrong command, inaccurate data input etc
- GIGO → *Garbage In Garbage Out*
- Error Detecting Techniques



Reliability...

- Measurement of performance of Computer
- perform operation without any failure
- at hardware level, it does not require any human intervention between its processing operations.

...Characteristics of Computer...

Diligence...

- Free from "Tiredness"
- Free from Lack of "Concentration"



Versatility...

- Can perform all kind of job simultaneously
- Can do diverse nature of works like calculations, graphics work, searching etc at the same time



...Characteristics of Computer...

Storage Capability...

- Unlike human being Computer can store huge amount of data
- Loss or Deletion of data is done by User
- The computer memory is small and it can hold only a certain amount of information, therefore the data is stored on storage devices such as magnetic tape or disk.

No IQ...

- Not a thinking machine
- Not Intelligent
- Never does a task as it own
- Follow Human Instructions
- Only perform what it is programmed to do :
nothing more & nothing less

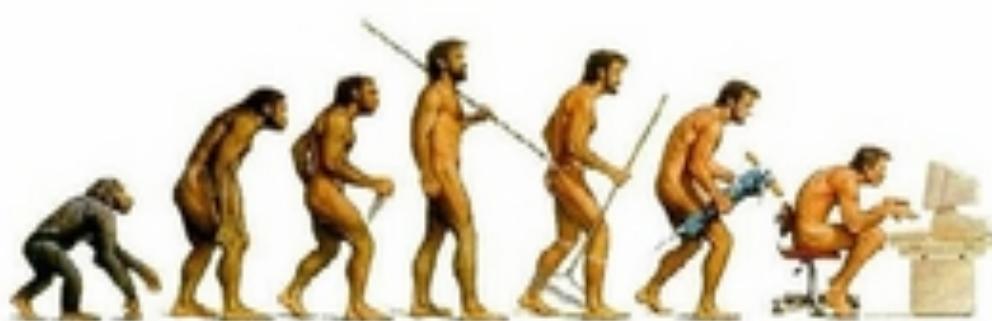


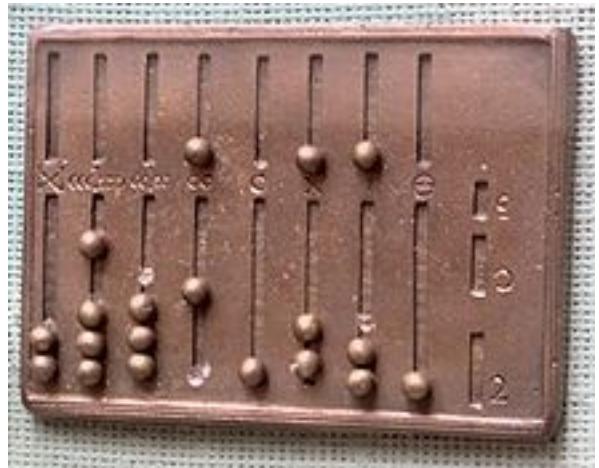
...Characteristics of Computer...

No Feeling...

- No taste
- No emotions
- No knowledge

Evolution of the Computer





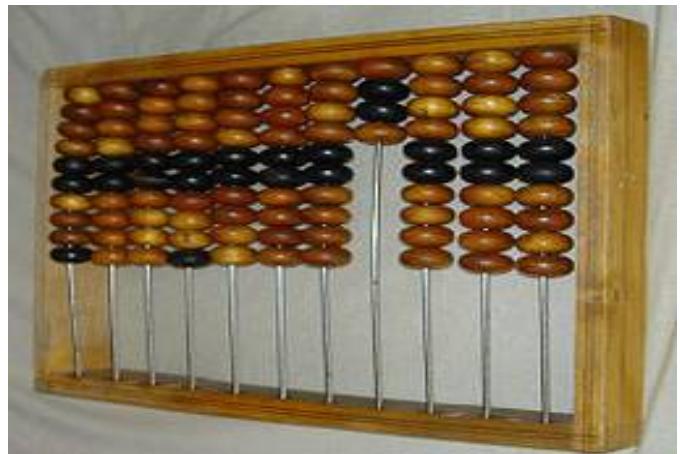
Roman Abacus



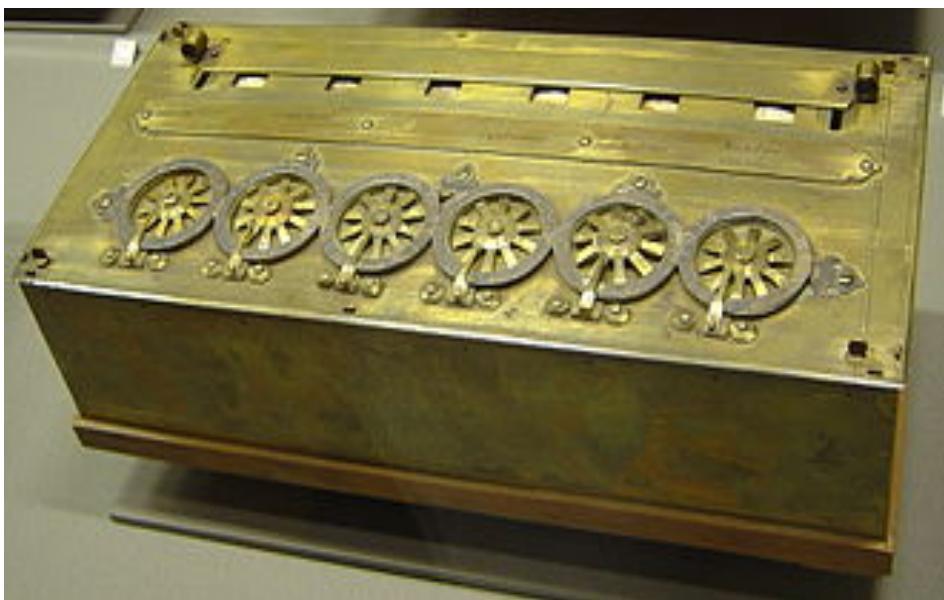
Chinese Abacus



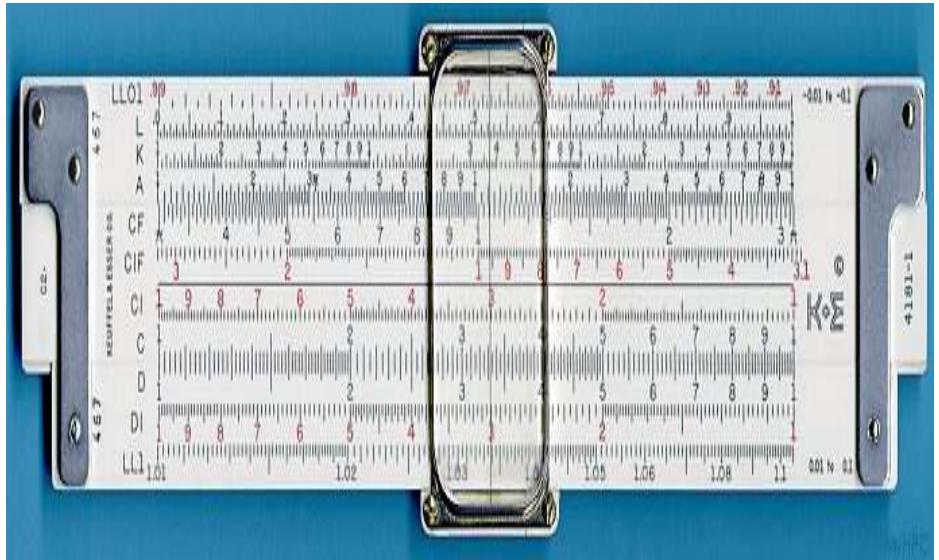
NAPIER'S BONES



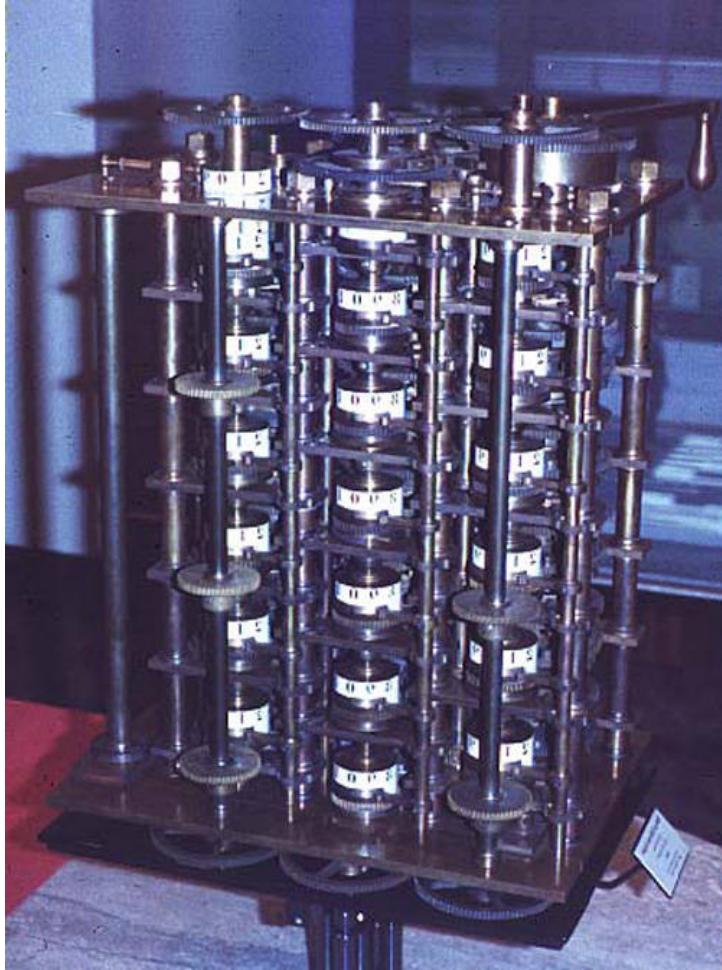
Russian Abacus



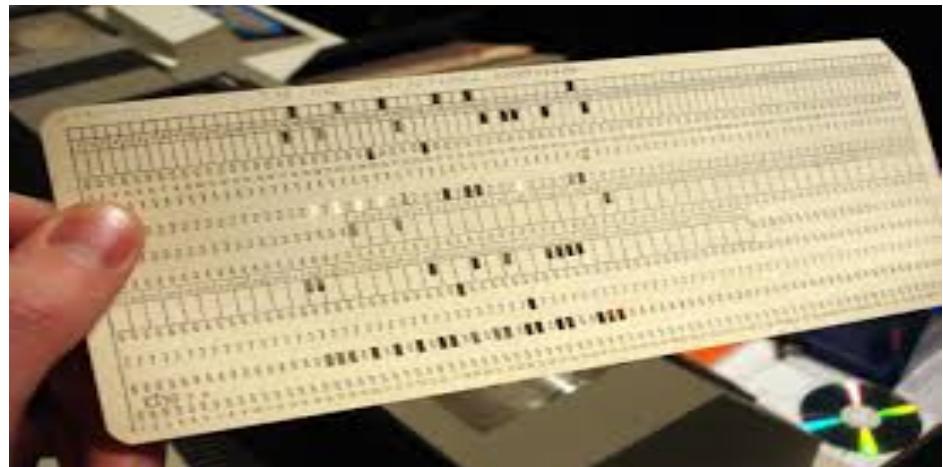
Pascaline



Slide Rule



Difference Engine



Punch Card

Generation of Computer



Generations of Computer

- ❖ ‘Generation’ : stage of technological development or innovation.
- ❖ According to the kind of ‘processor’ installed in a machine, there are five generations of computer

 **The First generation**

 **The Second Generation**

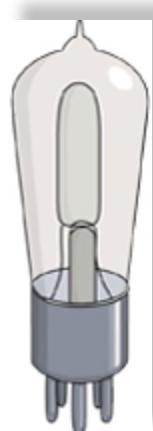
 **The Third Generation**

 **The Fourth Generation**

 **The Fifth Generation**

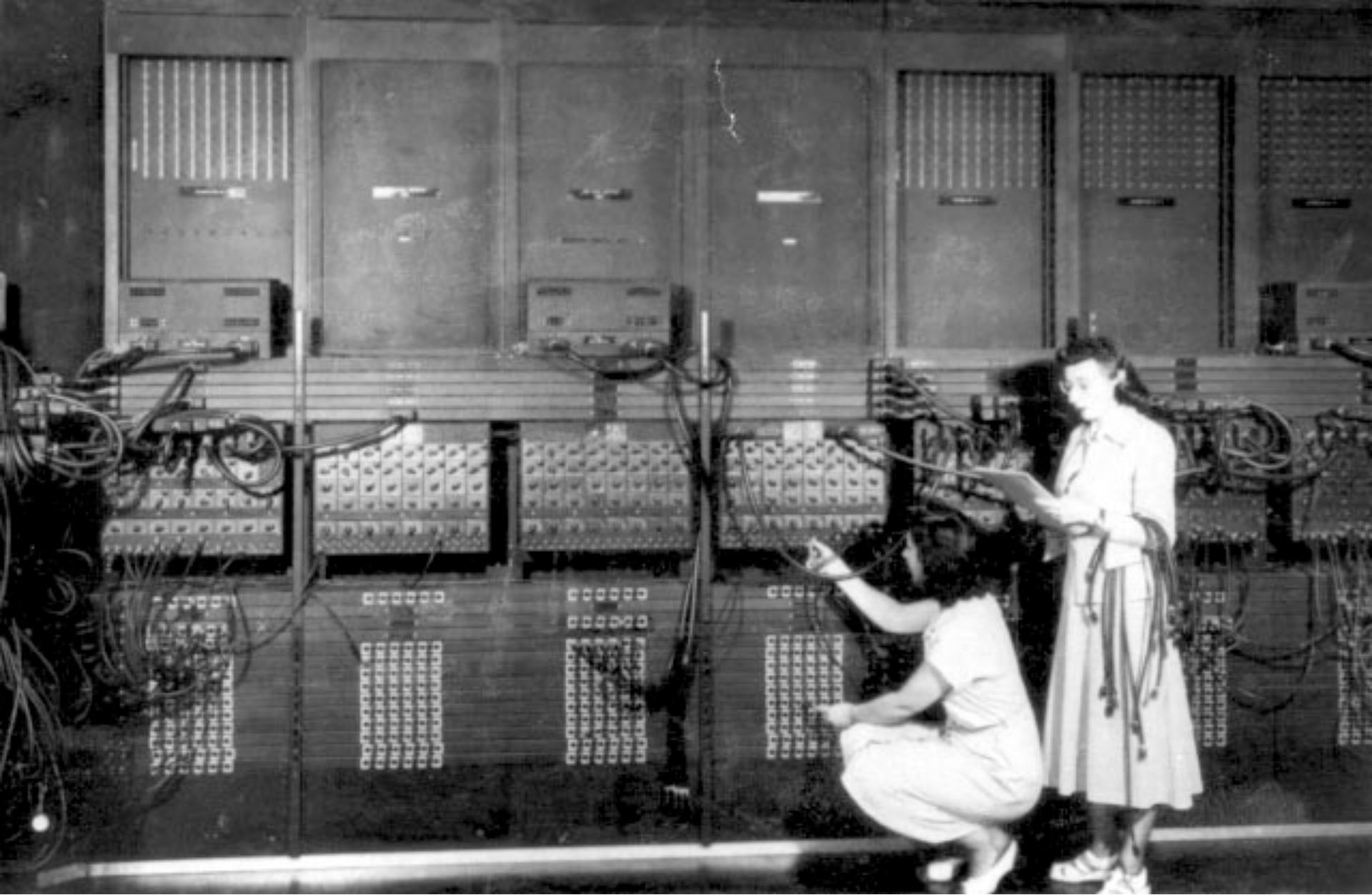
The First Generation

- 1940-1956
- Vacuum Tube
 - Heat
 - Burnout
- Machine language (0/1)
- Magnetic drums memory
- Input
 - Punched cards
- Output
 - Printout



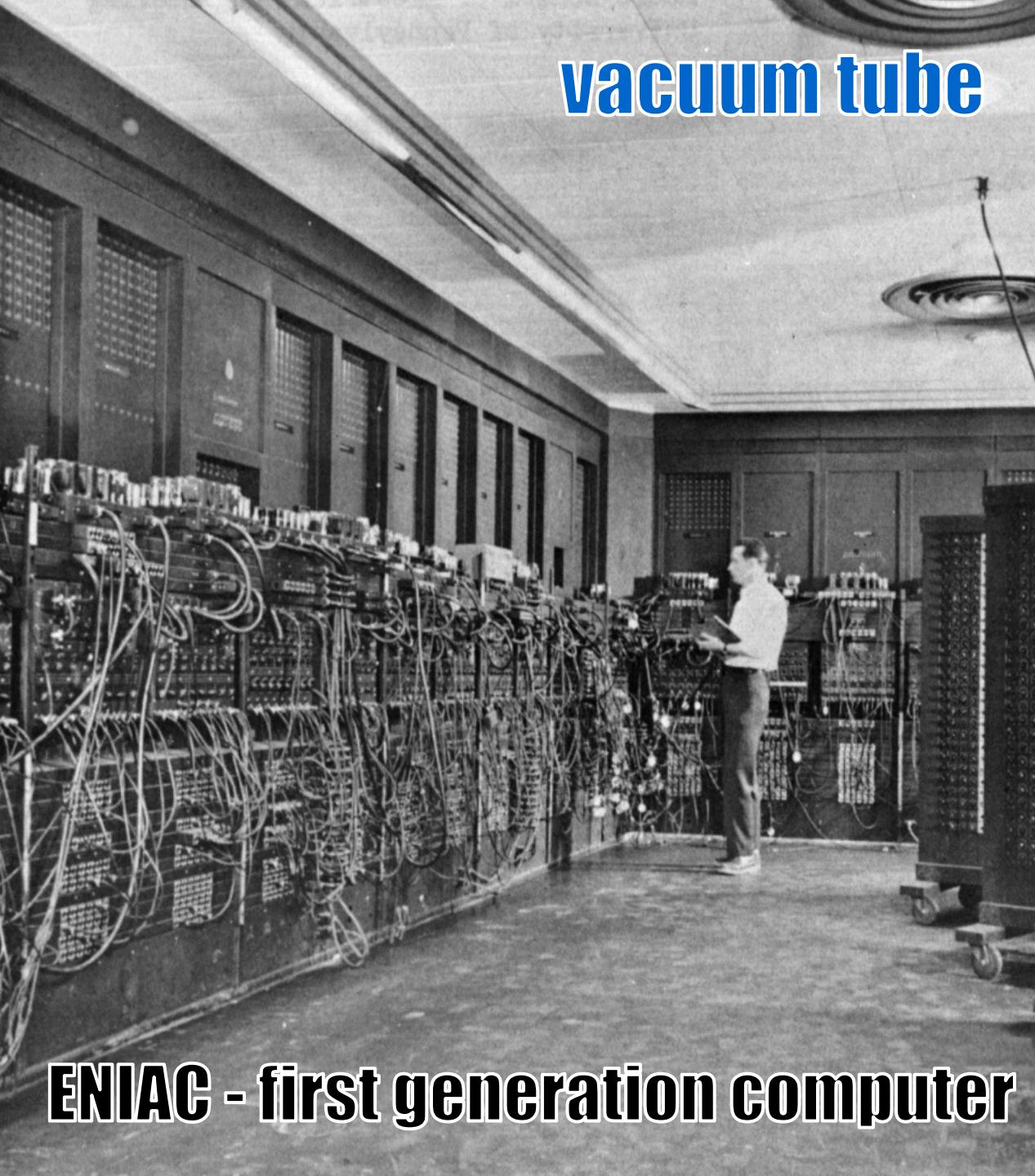
Characteristics of 1st Generation Computers

- Computers big and clumsy
- Electricity consumption is high
- Hardware failure occurred regularly - computers not very reliable
- Large air conditioners was necessary because the computers generated heat
- non-portable, lacked in versatility & speed
 - *Batch processing (one problem at a time)*



programming - machine language

vacuum tube

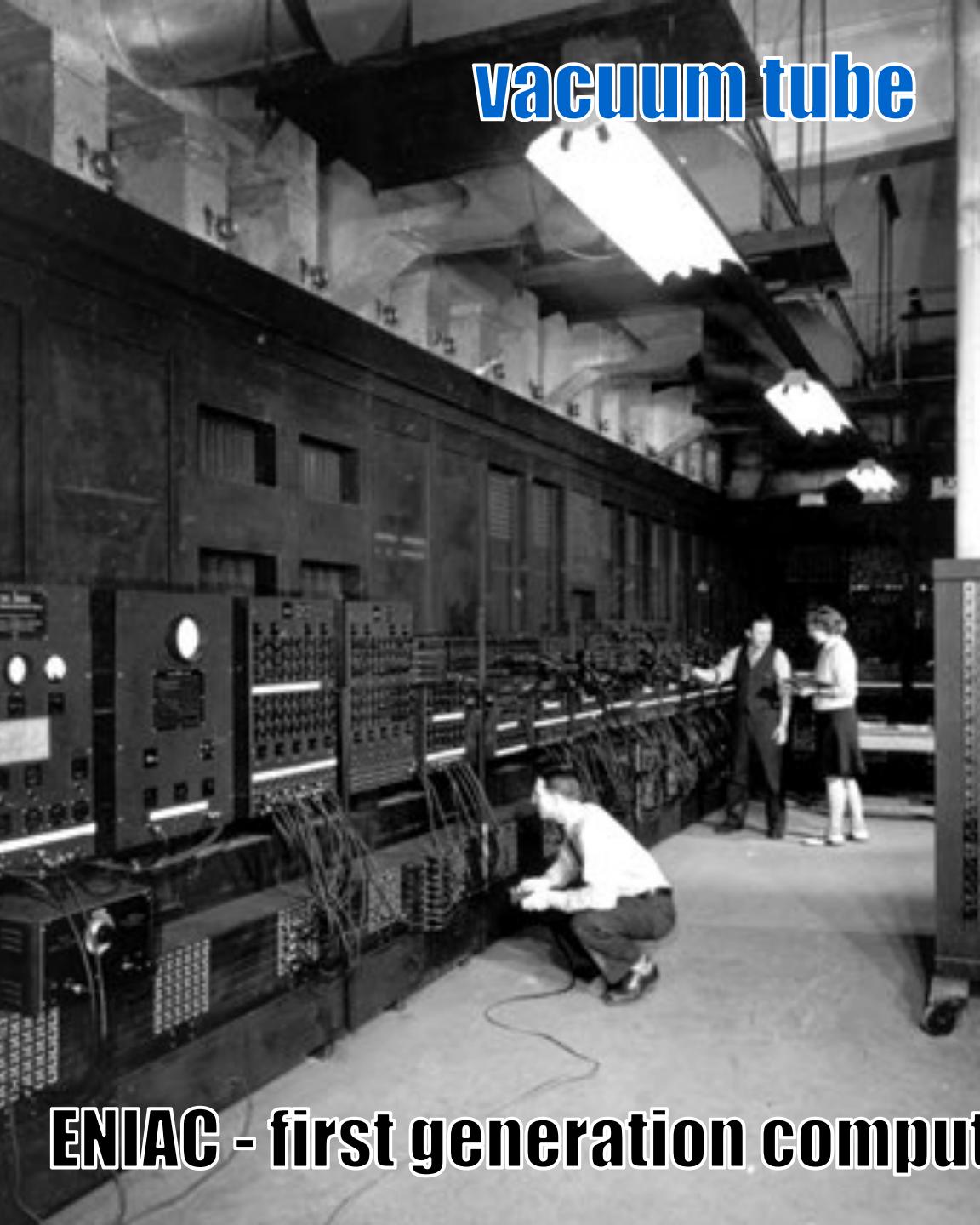


ENIAC - first generation computer



1940-1956

vacuum tube



ENIAC - first generation computer



1940-1956

The Second Generation

- 1956-1963
- Transistor
 - > Smaller
 - > Less heat
 - > Faster
 - > More reliable
- Storage
 - > Magnetic cores – primary memory
 - > Magnetic disks – secondary memory
- Programming languages
 - > Assembly language (mnemonics)
 - > FORTRAN (1954)
 - > COBOL(1959)
- > Input: Punched card
- > Output: Printout

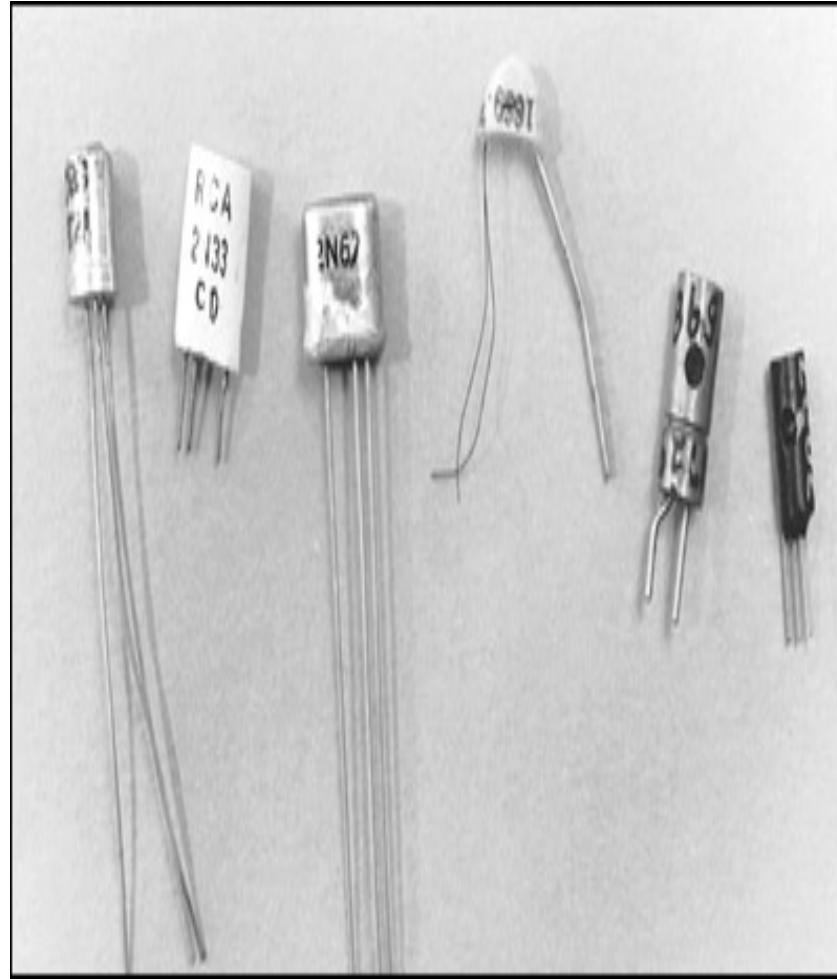
*Used primarily by business,
university, government*



The Second Generation

- Computers became smaller
- Generate less heat
- Electricity consumption lower
- More reliable - less prone to hardware failure
- Better portability
- Assembly language used to program computers – programming became more time efficient

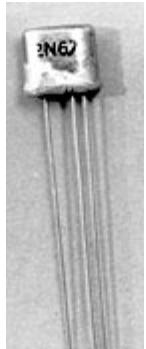
transistor



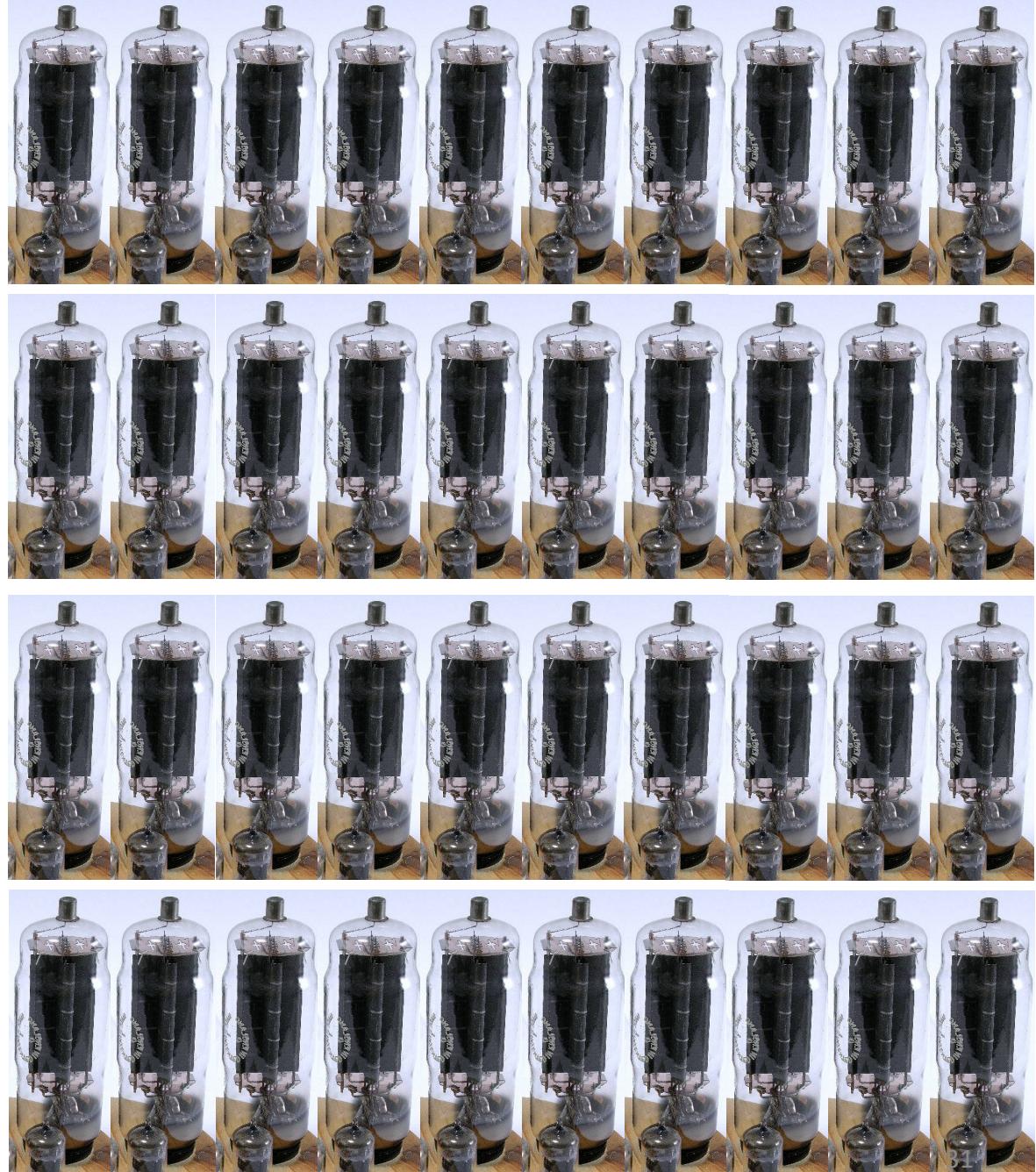
second generation computer

1956-1963

1



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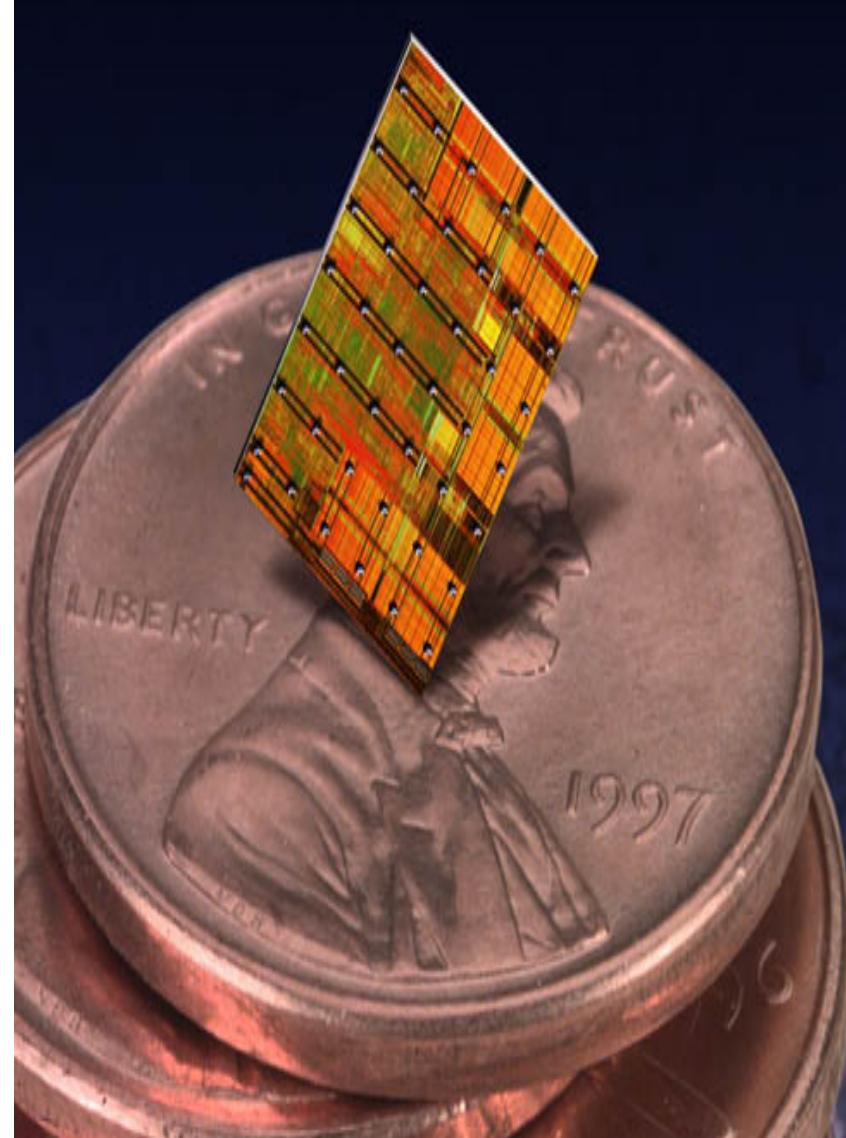
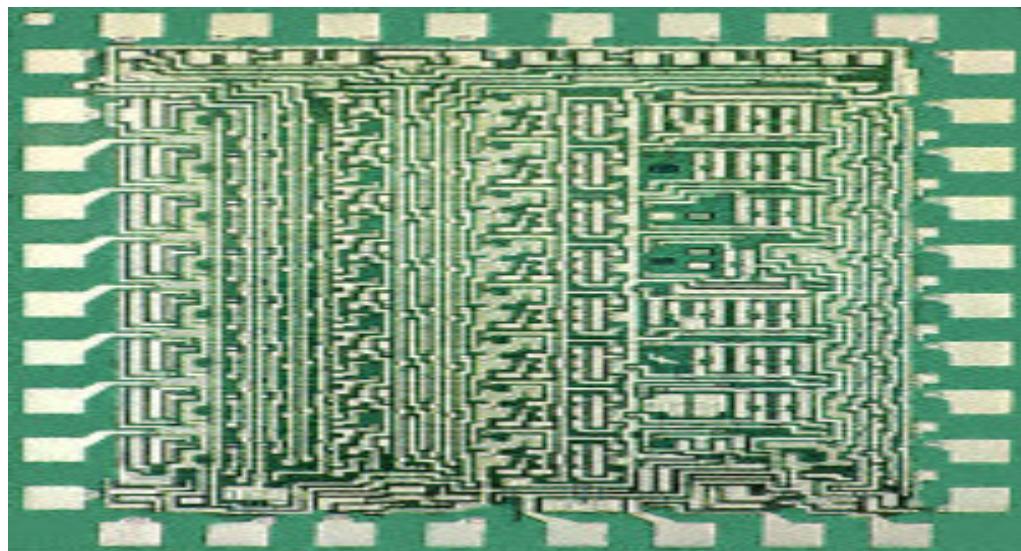
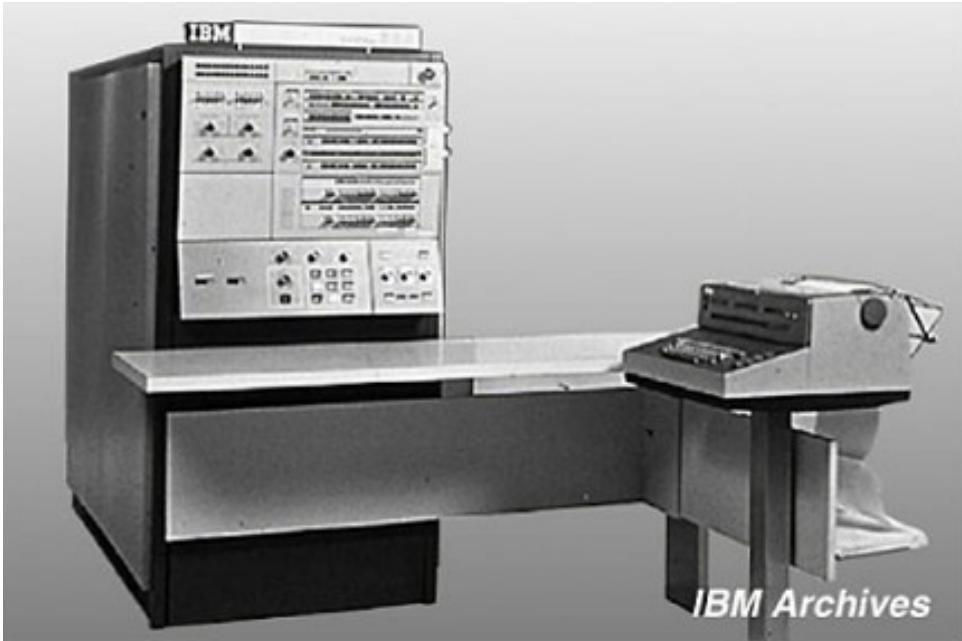


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The Third Generation

- ◎ 1964- Early 1970
 - ◎ Integrated Circuit
 - > Electronic circuit on small silicon chip
 - > Transistors and resistors fabricated on it
 - > Reliability
 - > Compactness
 - > Low cost
 - > Inexpensive – mass-produced
1. **Computers smaller, faster and more reliable**
 2. **Power consumption lower**
 3. **High-level languages appeared**





integrated circuit

third generation computer

1964-1970

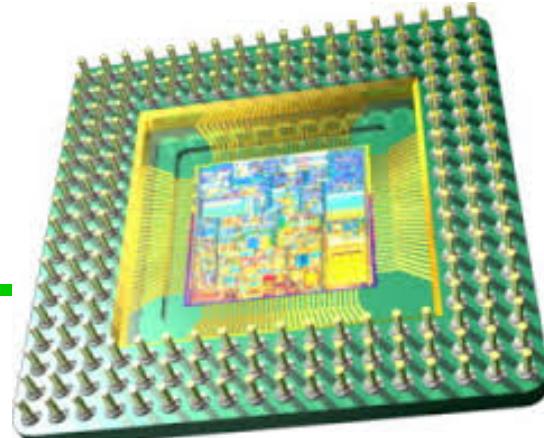
The Third Generation

- Easily portable and more reliable
- Instead of punched cards and printout, for interaction with computer keyboard and monitors were used
- Size of computer was smaller compared to previous generation
- Commercial production become easier and cheaper

The Fourth Generation

- Early 1970s – Till Date
- Microprocessor
 - > General-purpose processor on a chip
 - > All the components of a computer are on a chip
- Explosive growth
 - > Digital watches
 - > Pocket calculators
 - > Personal computers
 - > Cars
 - > Copy machines
 - > Television sets

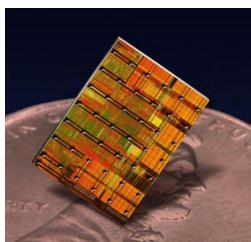
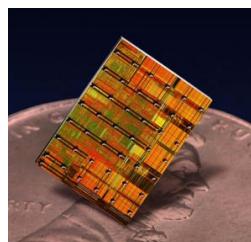
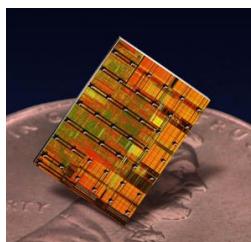
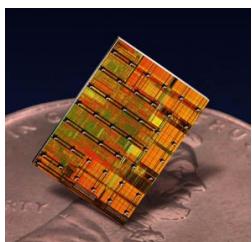
- Integrated circuits, smaller and faster
- Micro computer series such as IBM and APPLE developed
- Portable computers developed
- Great development in data communication
- Different types of secondary memory with high storage capacity and fast access developed



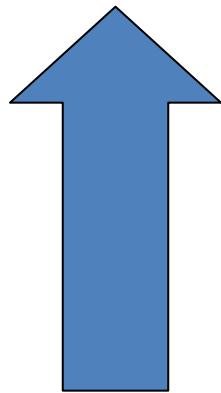
The Fourth Generation

- Large Scale Integration (LSI): thousand of transistors are constructed on small chip
- Very Large Scale Integration (VLSI): hundreds of thousands of components on single chip
- Ultra – Large Scale Integration (ULSI): millions of components on single chip

1000



1



The Fourth Generation

- Powerful, compact, reliable and affordable – personal computer (PC)
- Faster random access main memory
- Hard disk became economical, smaller and bigger in capacity
- Cheapest among all the other generation
- Hardware failure is negligible, so minimum maintenance required
- Generate negligible amount of heat, hence do not required air conditioning
- Interconnection with computer leads to better resource sharing and communication, also developed pointing devices
- Disadvantage: Required complex and sophisticated technology for manufacturing of CPU and the other components.

The Fifth Generation

- Still in development stage
- Use Super Large Scale Integrated (SLSI) chips
- Artificial Intelligence
- Knowledge based problem solving techniques
- Input and Output:
Graphical image and natural language
- Perform multiple simultaneous instructions



microprocessor

fifth generation computer

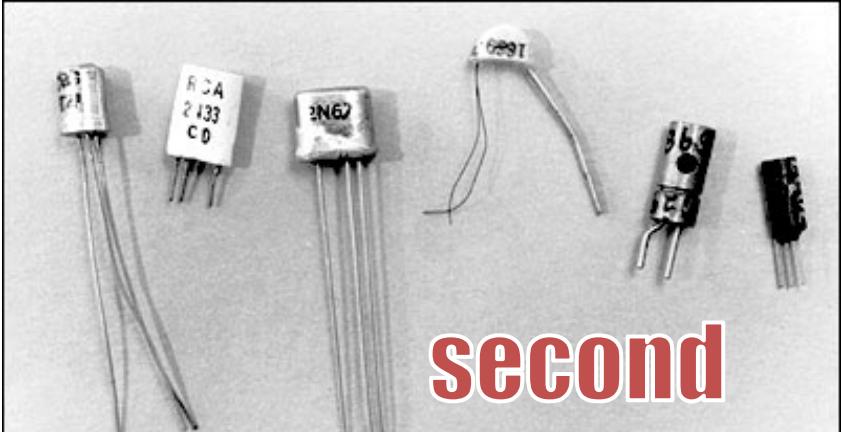
1989 - today

first

vacuum tube

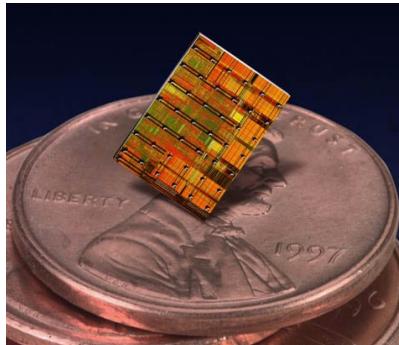


fourth
microprocessor



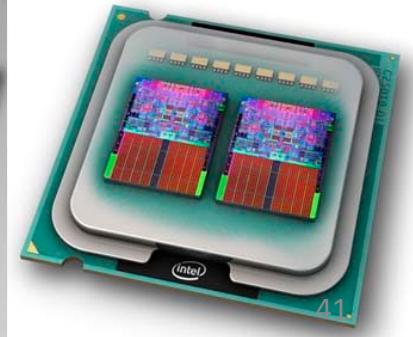
second

transistor

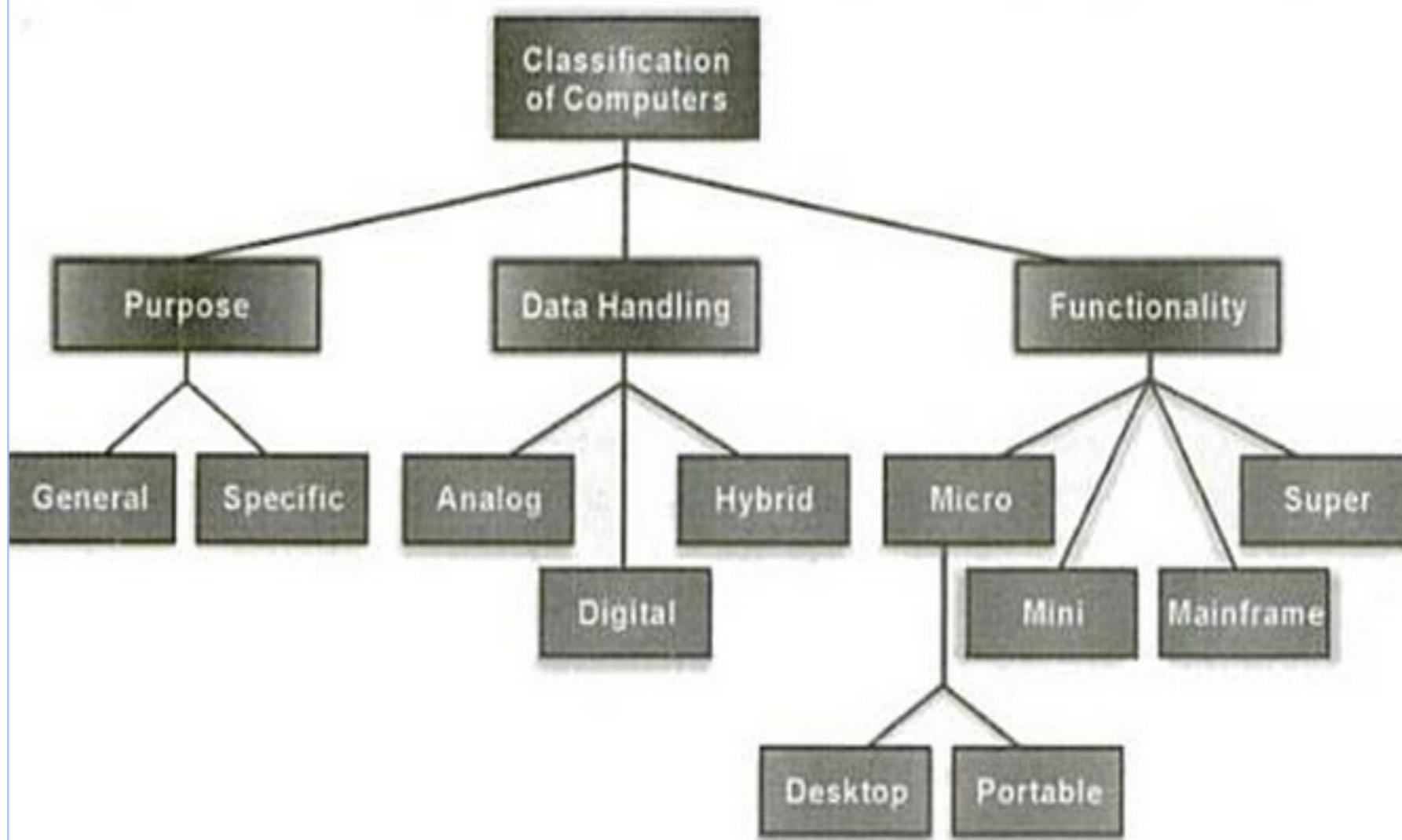


third

integrated circuit



Classification of Computers



I. ACCORDING TO FUNCTION OR PURPOSE

1. **SPECIAL PURPOSE COMPUTER** is a computer that is designed to operate on a restricted class of problems. It is dedicated to one function only.

Examples: ATM Machine, Washing Machine, Cash Registers etc.



2. **GENERAL PURPOSE COMPUTER** is a computer that can be programmed to do many different kinds of tasks, rather than one that is limited by design to a specific task. Most computers are general purpose, and can have software installed for many different uses. Lack in speed and efficiency

Examples: Desktop computer, Laptop Computer



II. ACCORDING TO THE TYPE OF DATA HANDLED

1. ANALOG COMPUTERS.

were the first type to be produced. They measure continuous variable, physical quantities such as electrical potential, fluid pressure, mechanical motion etc.

Do not deal with numbers. Measure continuous physical magnitudes.(temperature, pressure)

Give approximate results, very fast and less accurate

Examples:

[Speedometer of a Car](#), [Seismometer](#), [Gasoline Pump](#)



2. *DIGITAL COMPUTERS.*

- handle information that can be counted. Uses digital circuits and are designed to operate on two states, namely bits 0 and 1.
- These bits can be combined to denote information such as numbers, letters, graphics, images and program instructions.
- Digital computers are suitable for complex computation and have higher processing speeds. They are programmable.
- Very accurate

Examples:

Desktop Computers, Laptops, smart phones etc



3. HYBRID COMPUTERS

- is a combination of both analog and digital computer. Can handle both analog and digital data.
- A hybrid computer combines the best characteristics of both the analog and digital computer. It can accept data in both analog and digital form



Application areas such as manufacturing, transportation, power systems and others

1. MICROCOMPUTERS

A microcomputer is a small, low cost computer with a **microprocessor** as its central processing unit. They are physically small compared to mainframe and minicomputers. Many microcomputers (when equipped with a keyboard and screen for input and output) are also personal computers (in the generic sense).

Classification within this category includes:

- Desktop
- Workstations
- Laptop
- Handheld
- Embedded computers

DESKTOP COMPUTERS

are the most common type of personal computer and are designed to fit conveniently on the surface of a desk or workspace. Desktop computers have separate display screens, keyboards, internal hard disk storage and other peripheral devices.

A **workstation** is simply a desktop computer that has a more powerful processor, additional memory and enhanced capabilities for performing a special group of task, such as 3D Graphics or game development.



LAPTOP COMPUTER

- also called a **notebook**, is a personal computer for mobile use.
- A laptop integrates most of the typical components of a desktop computer, including a display, a keyboard, a pointing device (touchpad or trackpad) and speakers into a single unit.
- Powered via an AC adapter, and can be used away from an outlet using a rechargeable battery.

Classification:

- ✓ **Desktop replacements**
- ✓ **Subnotebook**
- ✓ **Notebook**
- ✓ **Tablet PC**



□ Handheld Computer

mobile device (also known as a **handheld device**, **handheld computer** or simply **handheld**) is a small, hand-held computing device, typically having a display screen with touch input and/or a small keyboard.

Typical handhelds:

- Information appliance
- Smart phone/Mobile Phone
 - Personal digital assistant (PDA)
- Personal Communicator



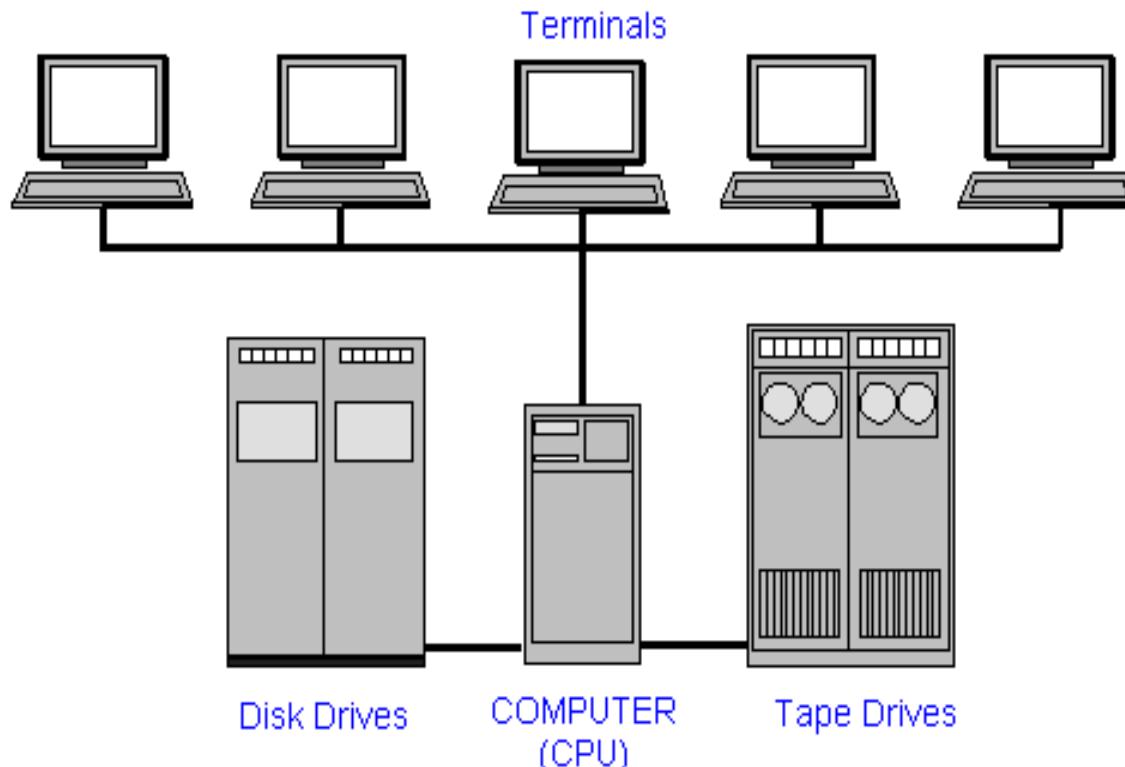
EMBEDDED COMPUTERS

- ✓ “Computers on a chip”. A microprocessor or a microcontroller, which is programmed to perform a small number of tasks.
- ✓ are the “brains” behind many everyday mechanisms, such as wireless devices, cars, climate control systems, traffic signals, and washing machines, ticket machines at the subway, cameras, airplanes, cars, sewing machines, clocks, etc.
- ✓ The software written for many embedded systems is called **firmware**. Firmware is software that is embedded in hardware devices, e.g. in one or more ROM or Flash memory IC chips.



2. MINI COMPUTERS.

- Minicomputers are mid-range computers whose size, speed and capabilities lie somewhere, between those of a mainframe and a microcomputer.
- A minicomputer is a class of multi-user computers that lies in the middle range of the computing spectrum, in between the largest multi-user systems (mainframe computers) and the smallest single-user systems (microcomputers or personal computers).
- It is capable of supporting 4 to 200 users simultaneously. EX Network Server



3. MAINFRAME COMPUTERS

- Powerful computers used mainly by large organizations for critical applications, typically bulk data processing such as online transaction processing system, extensive data storage and retrieval.
- Most of the mainframe computers have the capacities to host multiple operating systems and can handle hundreds of users (can serve up to 50,000 users simultaneously)



4. SUPER COMPUTERS

- Fastest, costliest and most powerful. Generally operate at 4 to 10 times faster than the mainframe.
- designed to work on a single problem at a time.
- Supercomputers are used for highly calculation-intensive tasks such as problems including quantum physics, weather forecasting, climate research, molecular modeling, physical simulations, aircraft and spacecraft designing, encrypting & decoding sensitive intelligence information

Deep Blue computer play a chess game against Garry Kasparov in 1997, it is an IBM supercomputer that uses scalable parallel processing to solve complex problems. Deep Blue uses 256 processors working together to calculate between 50 and 100 billion chess moves in under three minutes.



Applications of COMPUTER

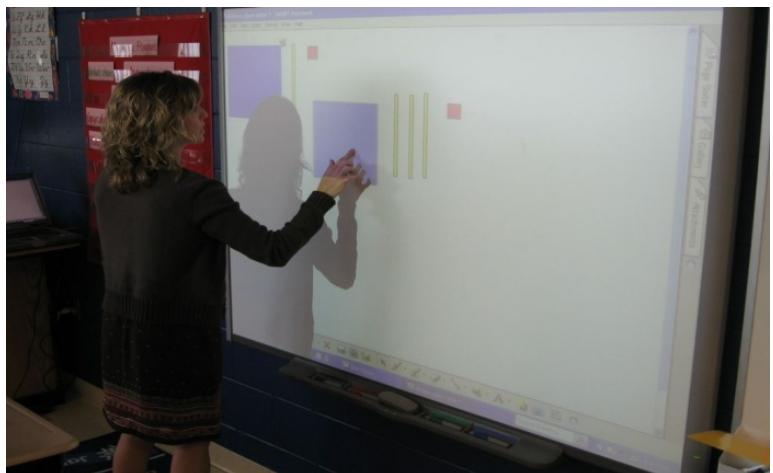
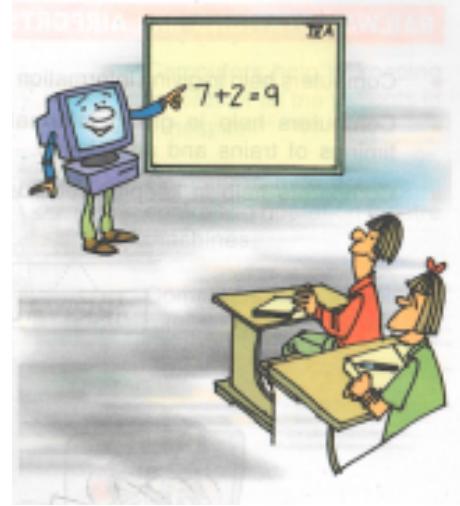
Uses of computer in e - commerce

- ❖ electronic mail
- ❖ video conferencing
- ❖ electronic shopping
- ❖ electronic banking



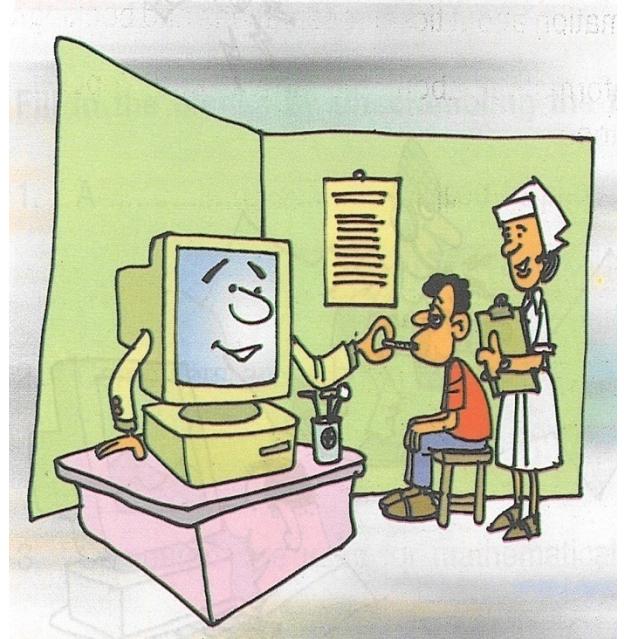
Education

- Better study moods
- most understandable and easier
- internet facility provides a lot of information from any corner of the world

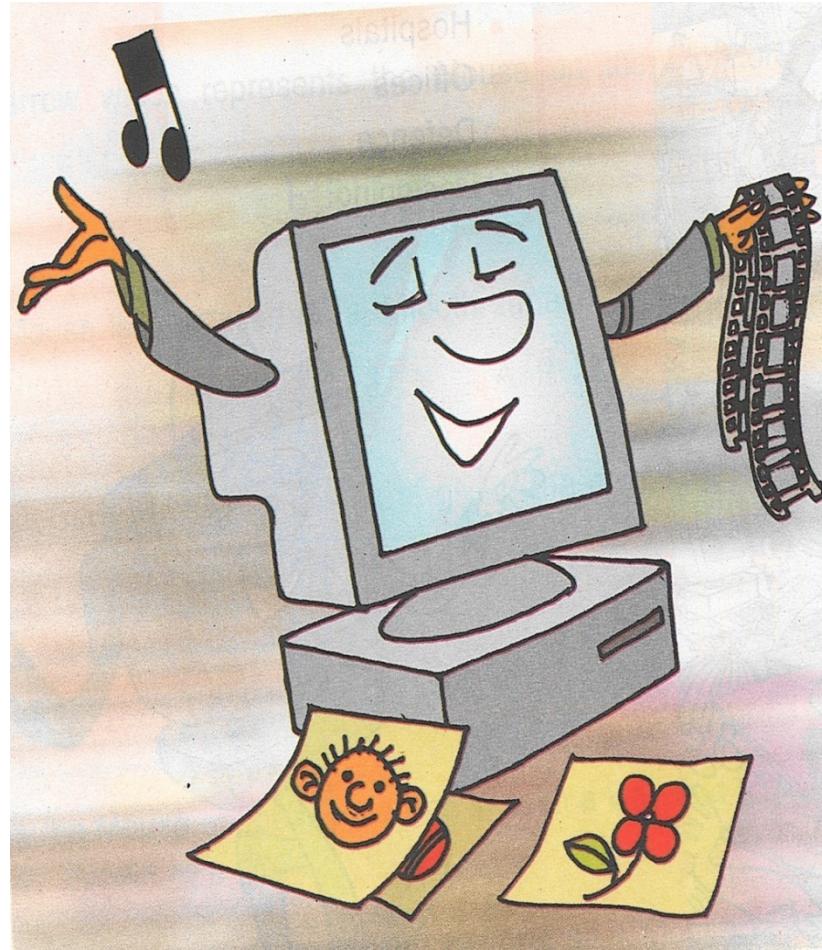


Medicine & Health care

- Patient monitoring
- patient records
- diagnosis
- hospital administration
- medical history records
- life support system



Entertainment



Engineering/Architecture/Manufacture

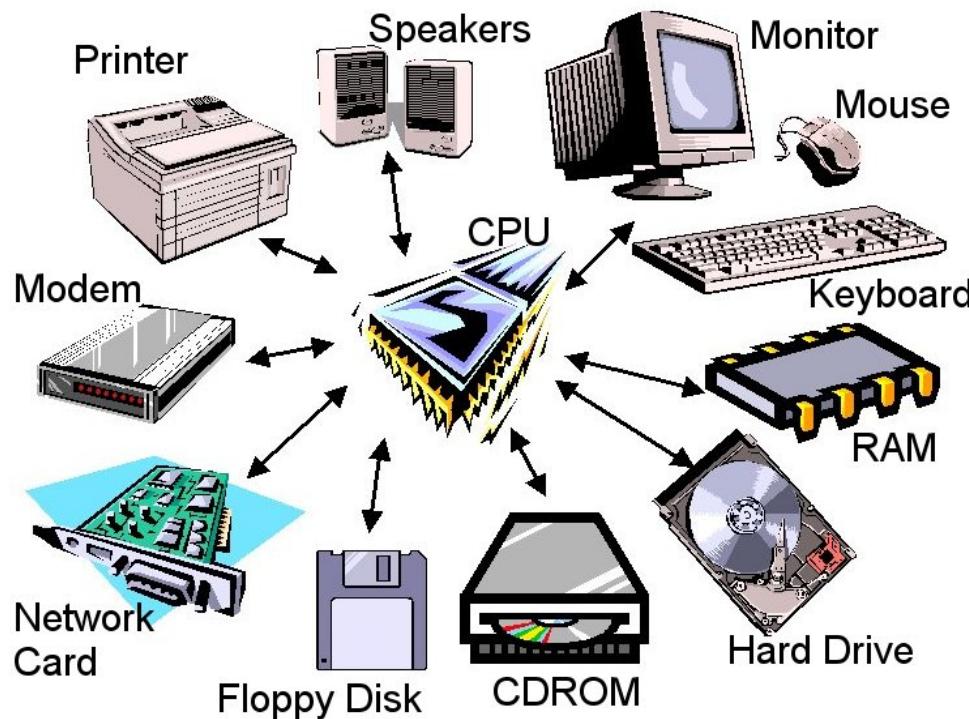


and many others ...

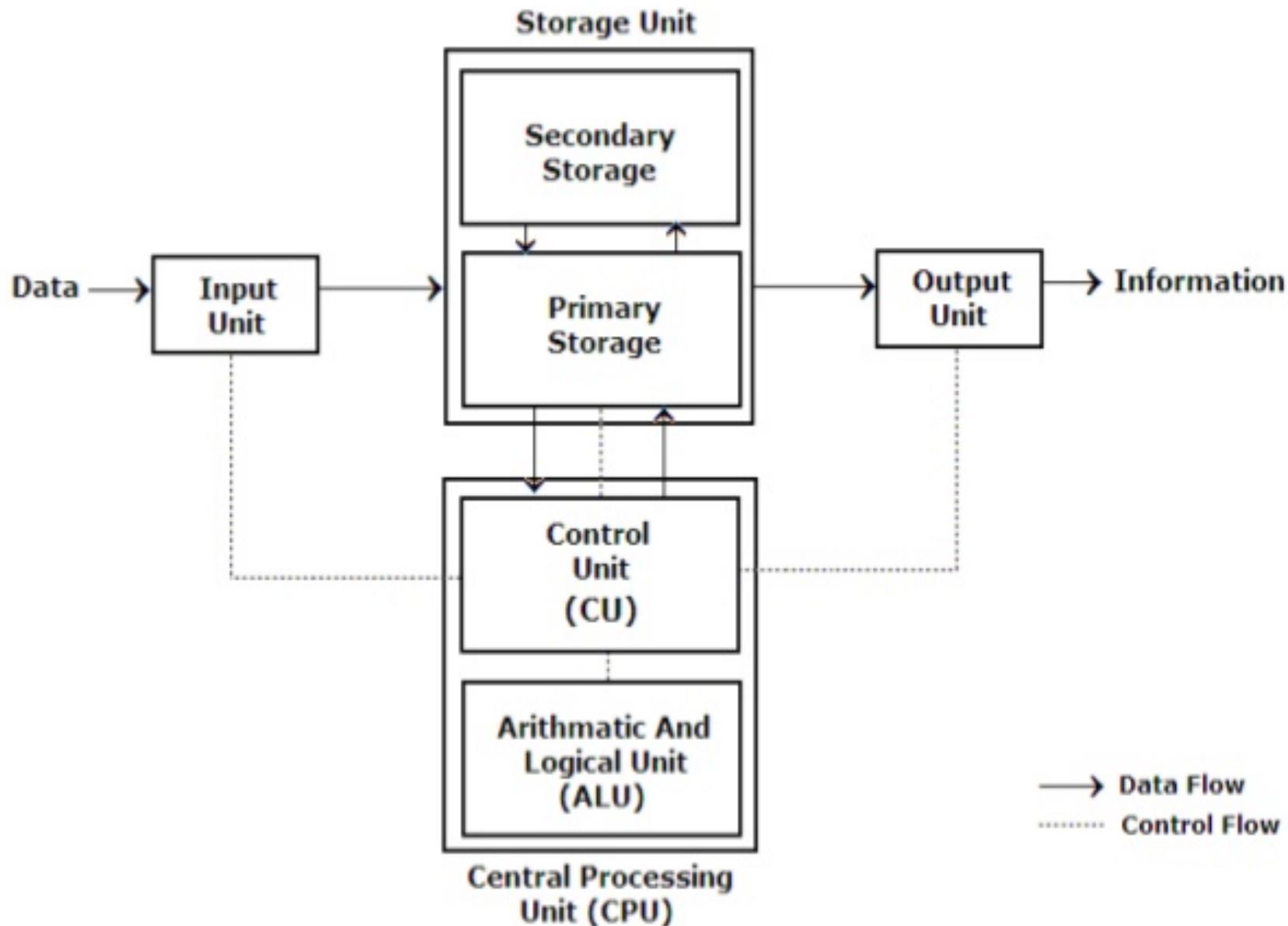


Component Interaction

The CPU controls all of the other resources within the system, in order to accomplish a task.



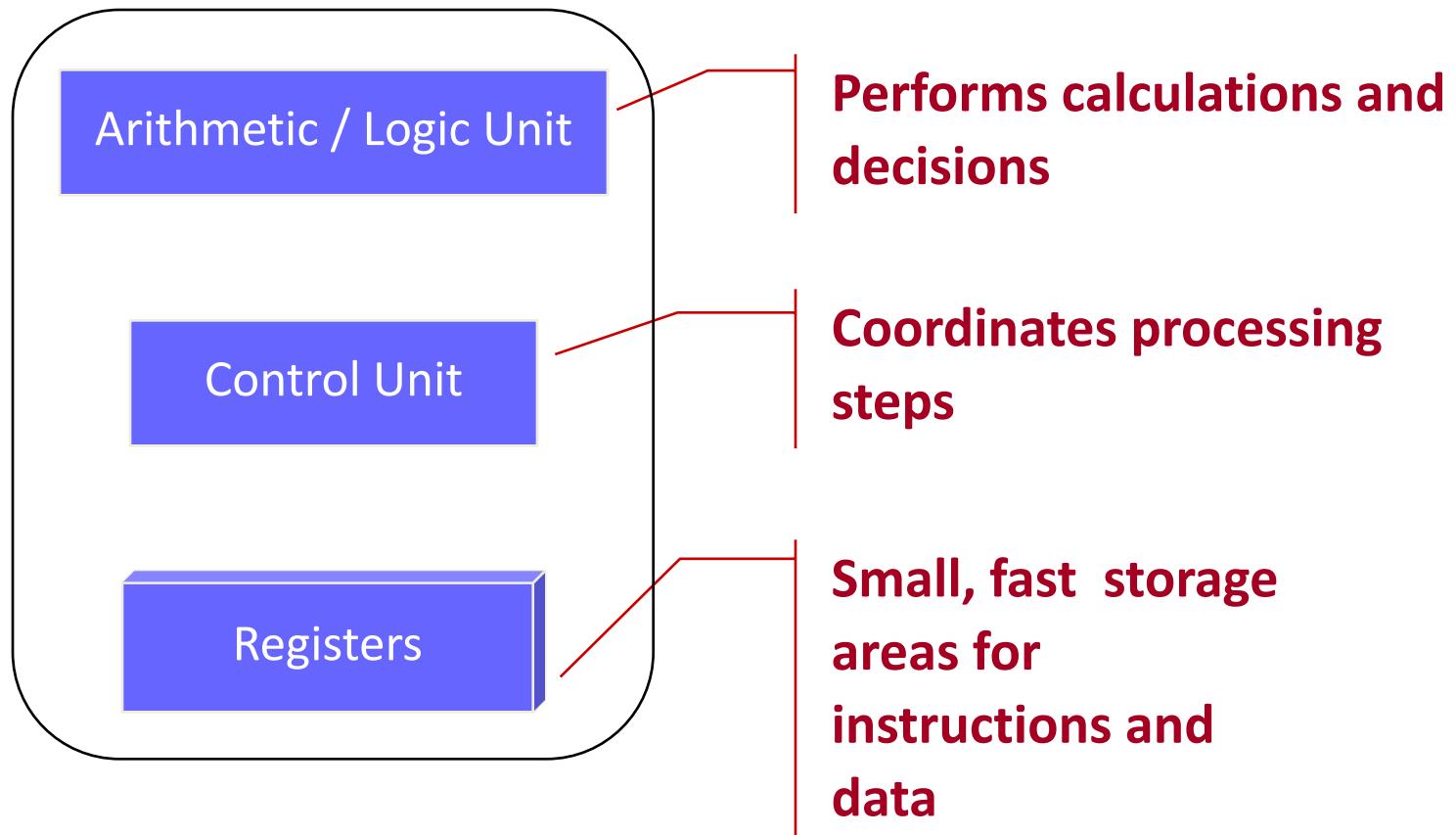
Block diagram of computer



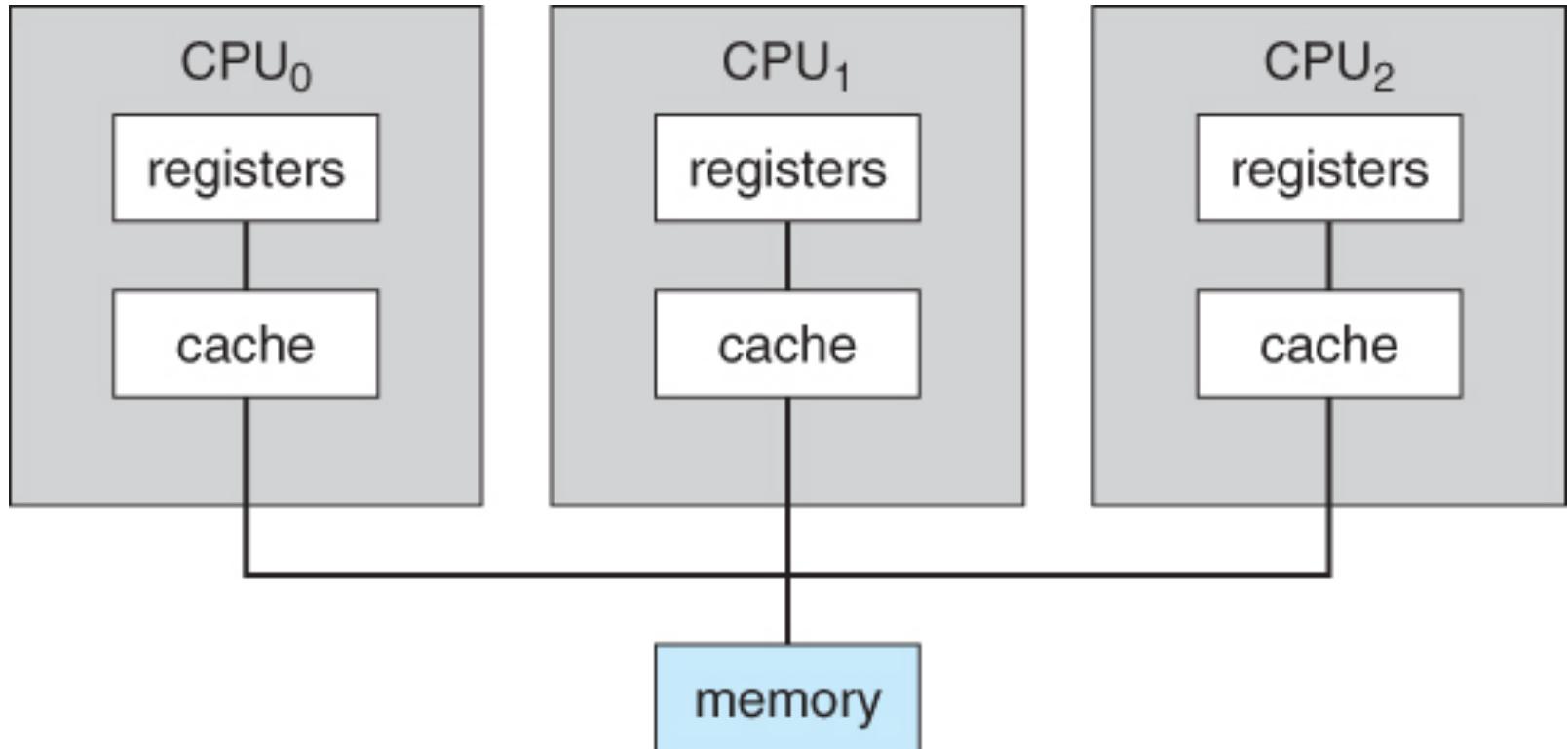
The CPU

- The **CPU** is a silicon chip that contains millions of tiny electrical components.
- The **CPU's** three main parts are:
 - Control Unit
 - Arithmetic Logic Unit (ALU)
 - Registers

Central Processing Unit (CPU)



Multiprocessor systems

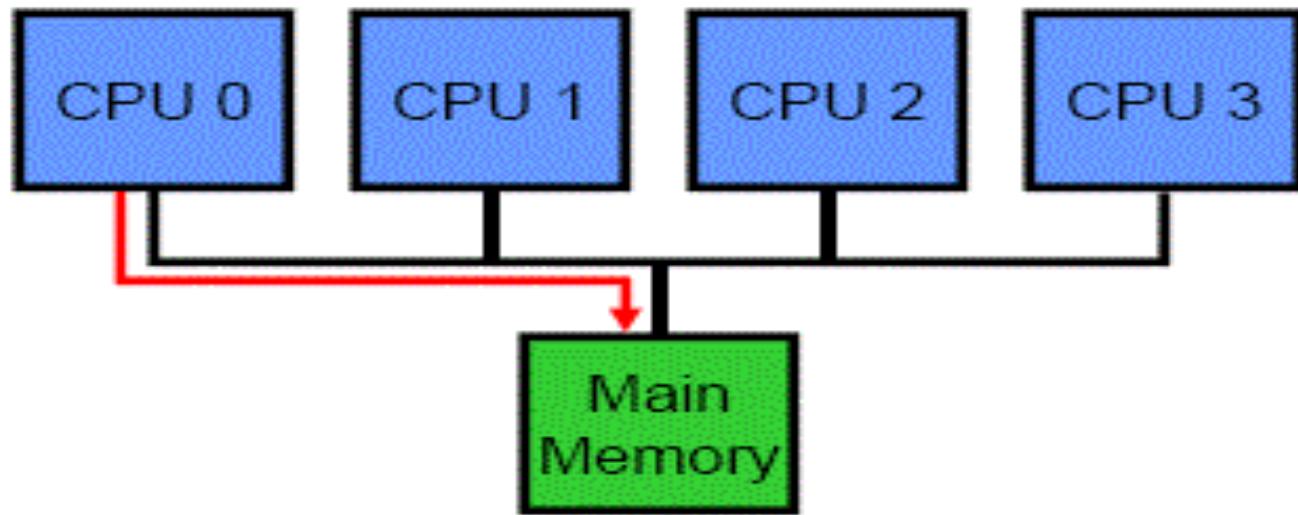


- A computer system which includes only one processor is called a single-processor system.
- Computer system that include more than one processor are called multiprocessor systems.

Multiprocessor systems

- Two popular architectural approaches for building multiprocessor computer systems are:
 - Symmetric Shared Memory Multiprocessor
 - Asymmetric Shared Memory Multiprocessor

Symmetric MultiProcessor



- Common pool of memory connected with high speed bus
- All processor can access all these memory

Asymmetric Multiprocessor

- One processor act as a controller termed as *master processor*, which controls memory unit and other processors.
- Rest of the processor are termed as *slave processor*
- The master has access to whole memory *but* Slave has access to limited memory