

# CSC 222: Computer Organization & Assembly Language

## **2 – Computer Evolution**

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# Outline

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- ▶ Historical Background
- ▶ Classification
- ▶ **References:**
  - ▶ Ch#1, “Computer Organization & Architecture” by Subrata Ghoshal
  - ▶ Ch#1, #2, “Computer Organization & Architecture” by William Stallings



## *Historical Background*

# Mechanical Computers - Calculators

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- ▶ Mechanical calculating machine made by **Pascal** in 1642.
  - ▶ Performs only Addition and Subtraction
  - ▶ 8 digit capacity



- ▶ Mathematician **Leibniz** improved the mechanical calculator.
  - ▶ Also performs Multiplication & Division

## Contd..

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- ▶ **Charles Babbage**, planned two computers:
  - ▶ Differential Engine
  - ▶ Analytical Engine
- ▶ The overall architecture of his analytical engine was very much similar to our modern computers.
- ▶ But he was not able to prepare any working model of either of his design.

## First Generation – Vacuum Tubes

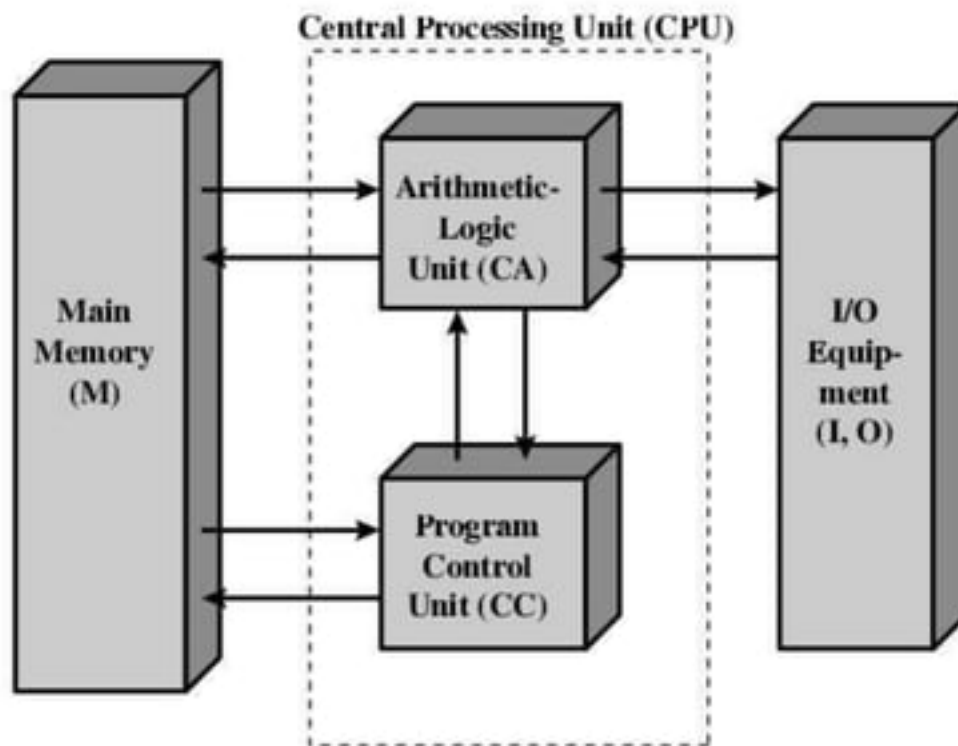
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- ▶ 1945 ~ 1955
- ▶ **ENIAC** (Electronic Numerical Integrator and Computer)
- ▶ Made with vacuum tubes, manual switches, jumper cables for connecting with different sockets.
- ▶ Large, heavy, high power consumption
- ▶ Depended on decimal representation.



# IAS machine – John Von Neumann

- ▶ Concept of stored-program computer
- ▶ Alan Turing



## Contd..

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- ▶ The general structure of the IAS computer consists of:
  - ▶ A main memory, which stores both data and instructions.
  - ▶ An arithmetic-logical unit (ALU) capable of operating on binary data.
  - ▶ A control unit, which interprets the instructions in memory and causes them to be executed.
  - ▶ Input and output (I/O) equipment operated by the control unit.
- ▶ Basic architecture used in this machine is still followed in most of the modern computer.



# First Computer by IBM

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- ▶ First series Named as 701
  - ▶ 1953
  - ▶ 36-bit word machine, with 2,048 words of memory.
  - ▶ Intended primarily for scientific applications
- ▶ Later introduced 704 with improved computing power and memory size.
  - ▶ had a number of hardware features that suited it to business applications
- ▶ These were the first of a long series of 700/7000 computers that established IBM as the overwhelmingly dominant computer manufacturer.

## 2<sup>nd</sup> Generation - Transistors

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- ▶ Vacuum tubes replaced by Transistors.
- ▶ Transistor is a solid-state device, made from silicon, invented at Bell Labs in 1947.
- ▶ It is smaller, cheaper, and dissipates less heat than a vacuum tube.
- ▶ As a result, size reduced and efficiency increased.
- ▶ **Programmed Data Processor-1 (PDP-1)**
  - ▶ First minicomputer
  - ▶ Series: PDP-8, PDP-11
- ▶ Another superb machine of this era is 6600 from Control Data Corporation (CDC), designed by Cray.
  - ▶ Parallel Processing with multiple processors

## 3<sup>rd</sup> Generation – Integrated Circuits

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- ▶ In 1958 came the achievement that revolutionized electronics and started the era of microelectronics: *the invention of the integrated circuit*.
  - ▶ Small Scale Integration (**SSI**)
- ▶ The two most important members of this generation are:
  - ▶ the IBM System/360 and
  - ▶ the DEC PDP-8
- ▶ Throughput increased
- ▶ Price reduced

## Next Generations

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- ▶ Large Scale Integration (**LSI**) – 4<sup>th</sup> Generation
- ▶ Very Large Scale Integration (**VLSI**) – 5<sup>th</sup> Generation
- ▶ Ultra Large Scale Integration (**ULSI**) – 6<sup>th</sup> Generation
  
- ▶ Powerful Operating Systems

# Microprocessor

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- ▶ **Microprocessor** is an electronic circuit that functions as the central processing unit (CPU) of a computer, providing computational control.
- ▶ Early computers had many separate chips for the different portions of a computer system
- ▶ First microprocessors placed control, registers, arithmetic logic unit in one integrated circuit (one chip).



# Intel Microprocessors

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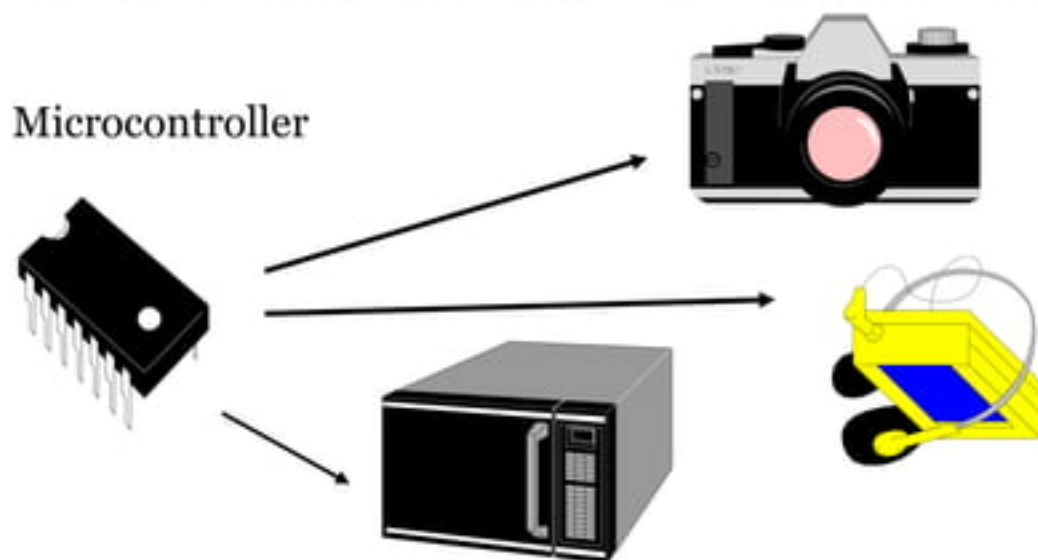
- ▶ **Intel** introduced first microprocessor (**Intel 4004**) in early 1974.
- ▶ Intel microprocessor series
  - ▶ 8080, 8086, 80286, 80386, 80486
  - ▶ **Pentium Series:**
    - ▶ Pentium Pro, Pentium II, Pentium III, Pentium 4
    - ▶ Allow multiple instructions to execute in parallel
  - ▶ **Intel Core**
    - ▶ More than one processors on a single chip
    - ▶ Different microarchitecture
    - ▶ Dual Core , Core 2 Duo
    - ▶ Intel Core i3, Intel Core i5, Intel Core i7



# Microcontrollers

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- ▶ Microcontrollers integrate all of the components (control, memory, I/O) of a computer system into one integrated circuit.
- ▶ Microcontrollers are intended to be single chip solutions for systems requiring low to moderate processing power.



# Microprocessor vs. Microcontroller

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## **Microprocessor**

- ▶ CPU is stand-alone, RAM, ROM, I/O, timer are separate
- ▶ designer can decide on the amount of ROM, RAM and I/O ports.
- ▶ general-purpose

## **Microcontroller**

- ▶ CPU, RAM, ROM, I/O and timer are all on a single chip
- ▶ fix amount of on-chip ROM, RAM, I/O ports
- ▶ single-purpose



# Computer Generations - Summary

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Generation	Approximate Dates	Technology	Typical Speed (operations per second)
1	1946 – 1957	Vacuum Tube	40,000
2	1958 – 1964	Transistors	200,000
3	1965 – 1971	Small & medium scale integration	1,000,000
4	1972 – 1977	Large scale integration	10,000,000
5	1978 – 1991	Very large scale integration	100,000,000
6	1991 –	Ultra large scale integration	1,000,000,000



# Classification

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- ▶ According to attributes like price, performance, power consumption etc.
- ▶ Classification according to usage:
  - ▶ Embedded systems
  - ▶ Personal Computers
  - ▶ Work stations
  - ▶ Servers
  - ▶ Mainframes
  - ▶ Supercomputer

# Embedded System

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- ▶ An embedded product uses a microprocessor or microcontroller to do one task only.
- ▶ Embedded systems are typically designed to meet real time constraints.
- ▶ In an embedded system, there is only one application software that is typically burned into ROM.
- ▶ **Example:** printer, video game player, cell phones, washing machines, fax machines etc

# Personal Computers

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- ▶ Desktops, laptops etc.
- ▶ Capable of executing user's software
- ▶ Extensive user interaction
- ▶ Single user system

## Workstations

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- ▶ Also, single user systems
- ▶ More powerful with faster processor, larger memory area, better graphics capability and may be networked.

# Servers

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- ▶ Different in disc space, memory size, network communication speed vary.
- ▶ Equipped with multiple processors for faster response against requests of data communication.
- ▶ Helps provide network services.



# Mainframes

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- ▶ Used primarily by corporate and governmental organizations for critical applications, bulk data processing such as census, industry and consumer statistics, enterprise resource planning, and transaction processing.
  - ▶ Enormous amount of storage space.
  - ▶ Much more I/O lines
  - ▶ Large size





# Supercomputer

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- ▶ Used in the field of Computational Science
- ▶ Speed of calculation (nanoseconds).
- ▶ used for a wide range of computationally intensive tasks in various fields like:
  - ▶ Weather forecasting,
  - ▶ Molecular modeling (computing the structures and properties of chemical compounds, biological macromolecules, polymers, and crystals),
  - ▶ and physical simulations (such as simulations of the early moments of the universe, airplane and spacecraft aerodynamics, the detonation of nuclear weapons, and nuclear fusion).
  - ▶ Throughout their history, they have been essential in the field of cryptanalysis

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- ▶ The fastest supercomputer currently in use in Pakistan is developed and hosted by the National University of Sciences and Technology at its modeling and simulation research centre.
- ▶ In 2004, CIIT built a cluster-based supercomputer for research purposes.