INTRODUCTION TO COMPUTING

- WHAT IS A COMPUTER?

EARLY TOOLS: THE FOUNDATION OF COMPUTING

- The Abacus (c. 2500 BCE): One of the earliest known tools for calculation, the abacus, was developed in Mesopotamia and later used across the ancient world, including by the Greeks, Romans, and Chinese. The abacus allowed users to perform basic arithmetic operations, such as addition and subtraction, using beads that moved along rods.

- The Antikythera Mechanism (c. 100 BCE): Discovered in an ancient Greek shipwreck, this is considered one of the first known analog computers. It was used to predict astronomical positions and eclipses, highlighting the ancient use of mechanical systems for complex calculations.

- **2. THE MECHANICAL ERA: 17TH TO 19TH CENTURY**

- THE MECHANICAL ERA SAW THE DEVELOPMENT OF DEVICES THAT LAID THE GROUNDWORK FOR MODERN COMPUTERS. INNOVATORS BEGAN TO DESIGN AND BUILD MACHINES CAPABLE OF AUTOMATING ARITHMETIC CALCULATIONS, LEADING TO THE FIRST CONCEPTUALIZATIONS OF COMPUTERS.

   PASCAL'S CALCULATOR (1642) INVENTED BY FRENCH MATHEMATICIAN AND PHILOSOPHER **BLAISE PASCAL**, THIS MACHINE COULD ADD AND SUBTRACT, MAKING IT ONE OF THE EARLIEST MECHANICAL CALCULATORS. IT USED A SYSTEM OF GEARS AND DIALS TO PERFORM OPERATIONS.

- **LEIBNIZ'S STEP RECKONER (1673):** GERMAN MATHEMATICIAN **GOTTFRIED WILHELM LEIBNIZ** IMPROVED UPON PASCAL'S INVENTION WITH THE STEP RECKONER, WHICH COULD MULTIPLY AND DIVIDE AS WELL. LEIBNIZ'S DEVICE INTRODUCED BINARY ARITHMETIC, A FOUNDATIONAL CONCEPT FOR DIGITAL COMPUTING.

3. THE ANALYTICAL ENGINE: THE FIRST CONCEPTUAL COMPUTER

- **CHARLES BABBAGE**, AN ENGLISH MATHEMATICIAN, IS OFTEN REGARDED AS THE "FATHER OF THE COMPUTER" DUE TO HIS DESIGN OF THE **ANALYTICAL ENGINE** IN THE 1830S.

- **THE ANALYTICAL ENGINE (1837)**: THIS WAS THE FIRST DESIGN FOR A GENERAL-PURPOSE MECHANICAL COMPUTER. UNLIKE EARLIER MACHINES, THE ANALYTICAL ENGINE WAS NOT LIMITED TO A SINGLE CALCULATION BUT COULD BE PROGRAMMED TO PERFORM A VARIETY OF OPERATIONS. IT HAD FEATURES THAT CLOSELY RESEMBLE MODERN COMPUTERS, SUCH AS:

  - **INPUT/OUTPUT**: DATA WAS ENTERED USING PUNCHED CARDS, AND RESULTS WERE PRINTED OUT.

  - **CONTROL UNIT**: A BASIC SYSTEM TO MANAGE OPERATIONS.

  - **MEMORY**: IT HAD THE CAPACITY TO STORE NUMBERS. UNFORTUNATELY, BABBAGE NEVER COMPLETED A WORKING MODEL OF THE ANALYTICAL ENGINE DUE TO TECHNICAL LIMITATIONS OF THE ERA, BUT HIS VISION INSPIRED FUTURE GENERATIONS OF COMPUTER SCIENTISTS.
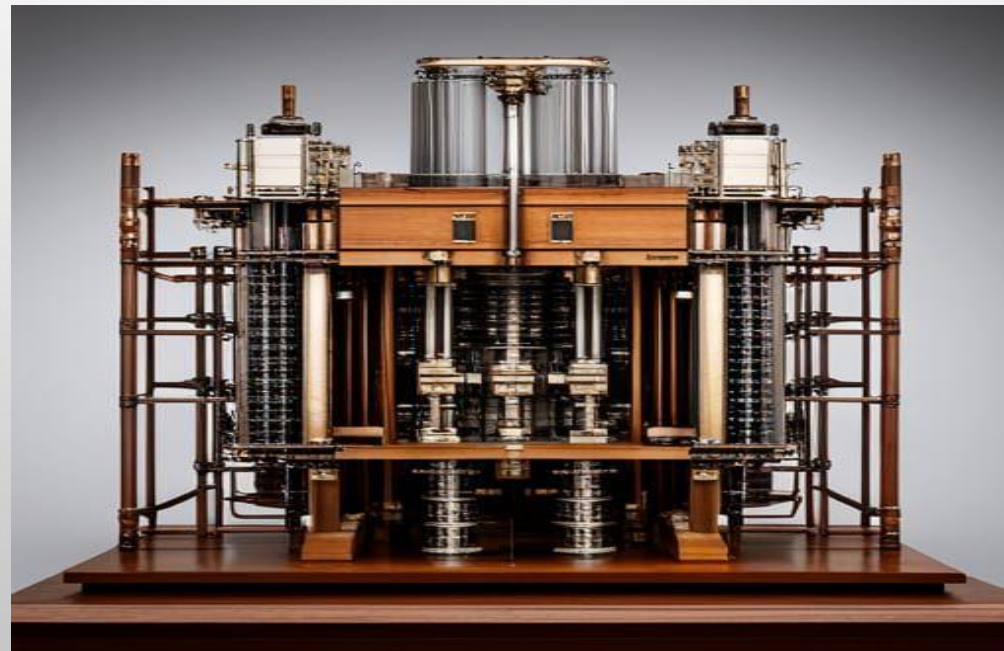
4. THE ELECTROMECHANICAL ERA: EARLY 20TH CENTURY

- DURING THE EARLY 1900S, INVENTORS BEGAN INTEGRATING ELECTRICAL COMPONENTS INTO MECHANICAL MACHINES, LEADING TO MORE POWERFUL AND EFFICIENT COMPUTING DEVICES.

- **ZUSE'S Z3 (1941)**: GERMAN ENGINEER **KONRAD ZUSE** CREATED THE Z3, THE FIRST FULLY FUNCTIONAL ELECTROMECHANICAL COMPUTER. THE Z3 USED RELAYS (ELECTROMECHANICAL SWITCHES) AND WAS CAPABLE OF PERFORMING BINARY ARITHMETIC AND BASIC LOGICAL OPERATIONS, KEY COMPONENTS OF MODERN COMPUTERS.

- **HARVARD MARK I (1944)**: THIS LARGE-SCALE ELECTROMECHANICAL COMPUTER, DESIGNED BY **HOWARD AIKEN** AND BUILT BY IBM, COULD PERFORM LENGTHY CALCULATIONS AUTOMATICALLY. IT WAS USED BY THE U.S. NAVY DURING WORLD WAR II AND MARKED A SIGNIFICANT LEAP IN COMPUTATIONAL TECHNOLOGY.

5. THE ELECTRONIC ERA: THE DAWN OF MODERN COMPUTING

- THE INTRODUCTION OF FULLY ELECTRONIC COMPONENTS IN THE MID-20TH CENTURY HERALDED THE BIRTH OF THE MODERN COMPUTER. THESE MACHINES NO LONGER RELIED ON MECHANICAL PARTS AND COULD PERFORM CALCULATIONS MUCH FASTER.

- **ENIAC (1945)**: THE **ELECTRONIC NUMERICAL INTEGRATOR AND COMPUTER (ENIAC)** WAS DEVELOPED BY **JOHN MAUCHLY** AND **J. PRESPER ECKERT**, IT USED VACUUM TUBES TO PERFORM CALCULATIONS. ENIAC WAS INITIALLY DESIGNED FOR CALCULATING ARTILLERY FIRING TABLES FOR THE U.S. ARMY BUT QUICKLY BECAME A TOOL FOR A WIDE VARIETY OF APPLICATIONS.

- **TRANSISTORS (1947)**: THE INVENTION OF THE TRANSISTOR AT BELL LABS BY **JOHN BARDEEN**, **WALTER BRATTAIN**, AND **WILLIAM SHOCKLEY** REVOLUTIONIZED COMPUTING. TRANSISTORS REPLACED BULKY AND UNRELIABLE VACUUM TUBES, ENABLING COMPUTERS TO BECOME SMALLER, FASTER, AND MORE ENERGY-EFFICIENT. THIS MARKED THE BEGINNING OF THE SECOND GENERATION OF COMPUTERS.

6. THE AGE OF TRANSISTORS AND INTEGRATED CIRCUITS (1950S–1960S)

With the invention of transistors, computers began to shrink in size and grow in capability. The invention of integrated circuits (ICs) in the 1960s further miniaturized computer components, paving the way for personal computers.

- **Integrated Circuits (ICs)**: **Jack Kilby** of Texas Instruments and **Robert Noyce** of Fairchild Semiconductor independently developed integrated circuits, which allowed multiple transistors to be embedded on a single chip. This advancement dramatically increased the power and efficiency of computers while reducing costs.

- **Mainframes and Minicomputers**

7. THE PERSONAL COMPUTER REVOLUTION (1970S–1980S)

- THE 1970S AND 80S SAW THE ADVENT OF PERSONAL COMPUTING, BRINGING COMPUTERS OUT OF RESEARCH LABS AND INTO HOMES, SCHOOLS, AND SMALL BUSINESSES.

- **APPLE I AND II (1976, 1977): STEVE JOBS** AND **STEVE WOZNIAK** FOUNDED APPLE AND DEVELOPED THE APPLE I AND LATER THE APPLE II, WHICH BECAME ONE OF THE FIRST COMMERCIALLY SUCCESSFUL PERSONAL COMPUTERS.

- **IBM PERSONAL COMPUTER (1981):** IBM INTRODUCED ITS OWN PERSONAL COMPUTER, THE IBM PC, IN 1981. THIS MACHINE SET STANDARDS FOR PERSONAL COMPUTERS, INCLUDING THE USE OF MICROSOFT'S MS-DOS OPERATING SYSTEM.

- **GRAPHICAL USER INTERFACE (GUI):** IN 1984, APPLE INTRODUCED THE **MACINTOSH,** THE FIRST COMMERCIALLY SUCCESSFUL COMPUTER WITH A **GRAPHICAL USER INTERFACE (GUI).** INSTEAD OF TYPING COMMANDS, USERS COULD INTERACT WITH THE COMPUTER USING WINDOWS, ICONS, AND A MOUSE, MAKING COMPUTERS MORE USER-FRIENDLY AND ACCESSIBLE.

8. THE MODERN ERA: COMPUTING TODAY

- TODAY'S COMPUTING LANDSCAPE IS CHARACTERIZED BY EXPONENTIAL GROWTH IN POWER AND DIVERSITY OF APPLICATIONS, RANGING FROM MOBILE DEVICES TO CLOUD COMPUTING.

- **SMARTPHONES**.

- **CLOUD COMPUTING**

- **ARTIFICIAL INTELLIGENCE (AI)**

- **QUANTUM COMPUTING**

THREE MAJOR COMPONENTS OF A COMPUTER

- ■ HARDWARE IS THE TANGIBLE OR PHYSICAL PART OF A COMPUTER SYSTEM.

- ■ SOFTWARE IS THE NON-TANGIBLE PART THAT TELLS THE COMPUTER HOW TO DO ITS JOB.

- ■ LIVEWARE REFER TO PEOPLE WHO USE AND OPERATE THE COMPUTER SYSTEM, WRITE COMPUTER PROGRAMS, AND ANALYZE AND DESIGN THE INFORMATION SYSTEM.

1. HARDWARE COMPONENTS

- HARDWARE REFERS TO THE PHYSICAL COMPONENTS OF A COMPUTER THAT CAN BE SEEN AND TOUCHED. THESE COMPONENTS WORK TOGETHER TO PROCESS DATA AND PERFORM TASKS.

- **A. CENTRAL PROCESSING UNIT (CPU)**

- **FUNCTION**: THE CPU IS OFTEN REFERRED TO AS THE "BRAIN" OF THE COMPUTER. IT IS RESPONSIBLE FOR INTERPRETING AND EXECUTING MOST OF THE COMMANDS FROM THE COMPUTER'S HARDWARE AND SOFTWARE.

- **COMPONENTS**:
    - **CONTROL UNIT (CU)**: DIRECTS THE OPERATION OF THE PROCESSOR. IT TELLS THE COMPUTER'S MEMORY, ALU (ARITHMETIC LOGIC UNIT), AND INPUT/OUTPUT DEVICES HOW TO RESPOND TO A PROGRAM'S INSTRUCTIONS.
    - **ARITHMETIC LOGIC UNIT (ALU)**: PERFORMS ALL ARITHMETIC AND LOGIC OPERATIONS, SUCH AS ADDITION, SUBTRACTION, AND COMPARISONS.
    - **REGISTERS**: SMALL, HIGH-SPEED STORAGE LOCATIONS THAT TEMPORARILY HOLD DATA AND INSTRUCTIONS DURING PROCESSING.

b. Memory (RAM - Random Access Memory)

•**Function**: RAM is the temporary storage that the CPU uses to store data that is actively being used or processed. It is volatile, meaning

 that all data is lost when the computer is turned off.

•**Importance**: The amount of RAM influences the computer's ability to run multiple applications simultaneously.

•More RAM generally results in faster performance, especially in multitasking environments.

c. Storage (Hard Disk Drive/SSD)

• **Hard Disk Drive (HDD)**: A traditional storage device that uses magnetic disks to store data. It has a larger capacity compared to SSDs but is slower because it relies on spinning disks.

• **Solid-State Drive (SSD)**: An advanced storage device that uses flash memory to store data. It has no moving parts and is much faster than an HDD in terms of data access and boot-up times.

• **Function**: Both HDDs and SSDs are used for long-term storage of operating systems, applications, and personal files.

• Data stored here is non-volatile, meaning it is retained even after the computer is powered down.
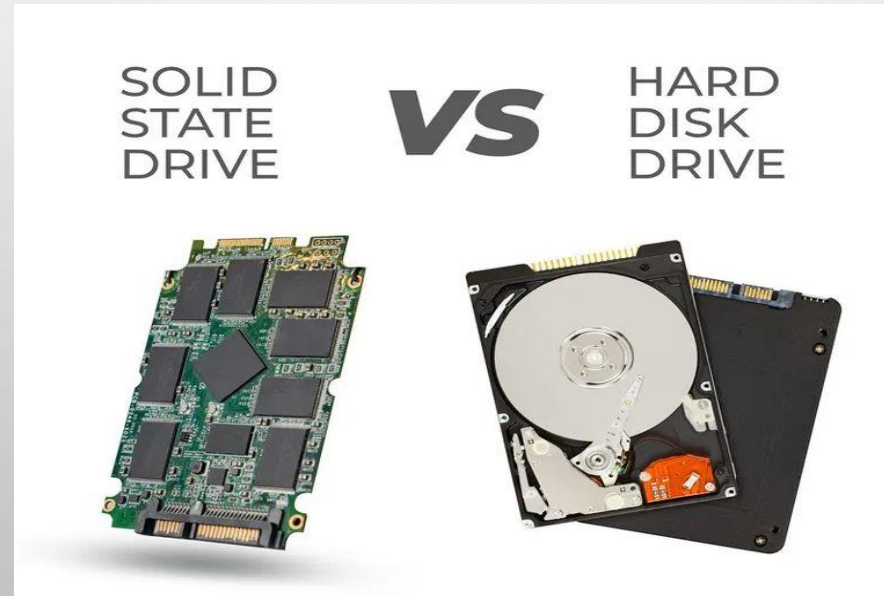
d. Motherboard

Function: The motherboard is the primary circuit board that houses the CPU, memory, and other components. It facilitates communication between all the different hardware components of the computer.

•**Features**:

   •**Bus**: A communication system that transfers data between components.

   •**Chipsets**: Manage data flow between the CPU, memory, and other peripherals.

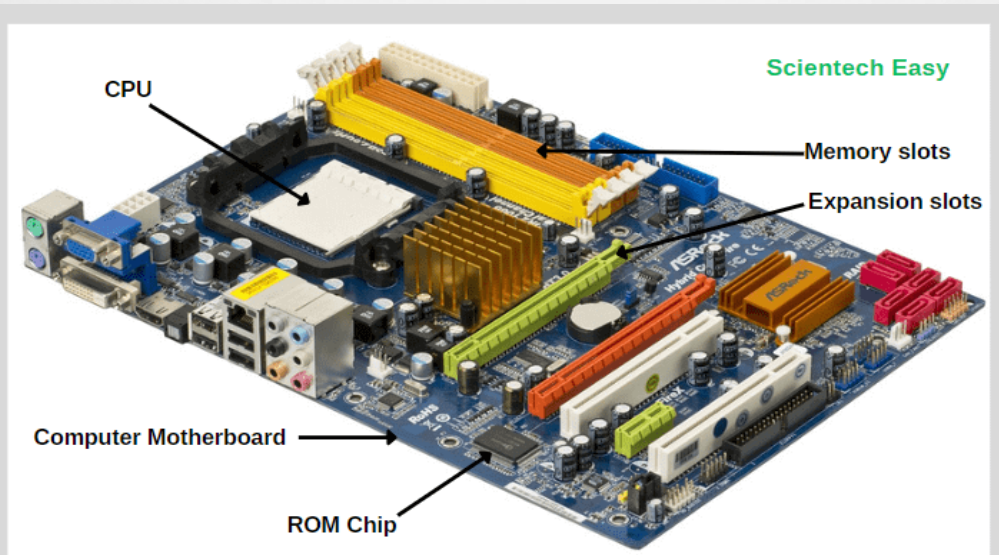   •**Expansion Slots**: Allow the installation of additional components, like graphics cards or network cards.

Fig: A typical Motherboard in a computer system

e. Power Supply Unit (PSU)

•**Function**: The PSU converts electricity from an AC outlet into the low-voltage DC power needed by the internal components of the computer.

•**Importance**: A reliable PSU is essential for the stability of the computer. An underpowered or faulty PSU can cause system instability or damage components.