

CHAPTER 1: INTRODUCTION TO COMPUTER

1.1 What is a Computer?

A **computer** is an electronic machine that performs multiple tasks such as:

- Accepting data
- Processing data
- Producing output
- Storing data for future use

In simple words:

Computer = Input → Process → Output + Storage

Standard Definition

A computer is an electronic device that **retrieves, processes, analyzes data and produces output while storing information for future use.**

1.2 Why is Computer called a Data Processor?

A computer converts **raw data into meaningful information**, hence it is called:

Data Processor

Example:

Raw Data	After Processing (Information)
Marks: 45, 60, 80	Average = 61.6
Daily sales numbers	Total monthly profit

So:

- **Data = Raw facts**
- **Information = Processed useful result**

1.3 Origin of the Word “Computer”

- Derived from Latin word “**Compute**”

- Meaning: **To calculate or count**

Memory Trick:

Compute = Calculate → Computer = Calculator Machine

1.4 Early Purpose of Computer

Initially, computers were invented mainly for:

- ✓ Mathematical calculations
- ✓ Counting large numbers

That's why early computers were just **advanced calculators**

1.5 Hindi Name of Computer

Computer = “**Sanganak**”

1.6 Full Form of COMPUTER

Letter	Meaning
C	Common
O	Operating
M	Machine
P	Purposely
U	Used for
T	Technological
E	Educational
R	Research

Easy Trick:

“Common Operating Machine Purposely Used for Technological & Educational Research”

1.7 Important Personalities

Name	Contribution
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Charles Babbage	Father of Computer
Alan Turing	Father of Modern Computer

Trick to Remember:

Babbage → Basic Computer
Turing → Modern Computing

1.8 First Computers in India

- First computer: **Siddhartha (Youbox wala 🤖)**
- First installed computer: **HEC-2M (1952)** at Indian Statistical Institute, Kolkata

1.9 Computer Literacy

A person is called **computer literate** if:

- ✓ He/she can operate a computer for basic needs

Important Day:

World Computer Literacy Day = 2 December

Started by: **NIIT**

1.10 Information Processing Cycle

This is the **heart of computer working**.

Cycle:

Input → Processing → Output

Stage	Meaning	Example
Input	Entering data	Typing marks
Processing	Calculation	Average calculation
Output	Result	Display average

Sometimes storage is also included.

1.11 Fetch–Decode–Execute Cycle

Computer works internally in 3 steps:

1. **Fetch** → Get instruction
2. **Decode** → Understand instruction
3. **Execute** → Perform action

Trick: FDE = Fetch → Decode → Execute

1.12 Components of Computer System

There are **6 main parts**:

No.	Component	Function
1	CPU	Brain of computer
2	Input Devices	Enter data
3	Output Devices	Show results
4	Memory	Store temporary data
5	Secondary Storage	Store permanently
6	Communication Devices	Data transfer

1.13 Major Functions of Computer

1. Input

- Taking data from user
- Example: Keyboard typing

2. Processing

- Data is processed using programs

3. Output

- Result is shown
- Example: Screen display

4. Storage

- Data is saved

5. Control

- Controls all operations

1.14 Computer Related Terms

DATA

- Raw facts and figures
- Always unprocessed

Example:

- Name, marks, numbers

INFORMATION

- Processed form of data
- Useful for decision making

Example:

- Result: Pass/Fail

1.15 Types of Data

Type	Description	Example
Text	Alphabets	A, B, C
Numerical	Numbers	1, 2, 100
Alphanumeric	Mix of both	A1, B2
Graphical	Images, charts	Graph
Multimedia	Audio + Video	Songs

1.16 Record

Record = Collection of related data

Example:

- Student record = Name + Roll No + Marks

1.17 History of Computer (Beginning)

Abacus

- First calculating device
- Developed in China
- Consists of beads on rods
- Also called **Counting Frame**

Can perform:

- Addition (mainly)

Trick:

Abacus = Beads = Counting

Important Points About Abacus

- Derived from word "**Abax**"
- Wooden rectangular frame
- Basis of modern calculator

Napier's Bones

- Invented in **1611**
- Used for multiplication and division

Modern = Turing

Abacus = First device

After the development of early devices like Abacus and Napier's Bones, several important mechanical and electromechanical devices were invented. These inventions gradually led to the development of modern computers.

Napier's Bones Napier's Bones was an early mechanical calculating device invented by **John Napier** in 1611.

Features

- Consisted of rods (called bones)
- Stored digits from 0 to 9
- Used for multiplication, division, addition, and subtraction

Conceptual Importance

Napier also developed the concept of **logarithms**, which simplified complex calculations.

Example

To multiply 23×4 :

- Numbers were arranged on rods
- Results were obtained by reading diagonal values

Memory Technique

Napier → Numbers → Rods → Calculation

Slide Rule

The Slide Rule was developed by **William Oughtred** in 1622.

Working Principle

It is based on logarithmic scales.

Uses

Operation	Explanation
Multiplication	Using sliding scales
Division	Reverse sliding
Squares	Using scale alignment
Cubes	Advanced scale
Square Roots	Scale reading
Trigonometric functions	Special scales

Concept Insight

It was widely used by engineers before electronic calculators.

Limitation

- Requires manual skill
- Accuracy depends on user

Pascal's Calculator (Pascaline)

Invented by **Blaise Pascal** in 1642.

Features

- First mechanical automatic calculator
- Used gears (cogwheels)
- Could perform addition and subtraction

Structure

- Wheels marked from 0 to 9
- Each rotation represented a number

Example

If a wheel moves from 9 to 0, it carries over to the next digit.

Importance

- First step toward automation in calculation

Leibniz Calculator

Developed by **Gottfried Wilhelm Leibniz** in 1671.

Features

- Improved Pascal's calculator
- Could perform multiplication and division
- Introduced stepped drum mechanism

Concept Insight

This machine was more powerful and flexible than Pascal's calculator.

Jacquard Loom

Developed by **Joseph Marie Jacquard** in 1801.

Features

- First programmable mechanical machine
- Used punched cards to control weaving patterns

Importance in Computer History

- Introduced the concept of **programming using punched cards**
- Later used in early computers

Memory Technique

Jacquard → Punched Cards → Programming Concept

Punched Card System

Developed by **Herman Hollerith** in 1890.

Features

- Used hard paper cards with holes
- Stored data in binary form (presence/absence of holes)

Application

- Used in US Census for data processing

Importance

- First large-scale data processing system
- Foundation of input/output systems

Difference Engine

Developed by **Charles Babbage** between 1821–1822.

Features

- First steam-powered mechanical calculator

- Designed to solve mathematical tables

Purpose

- Eliminate human errors in calculations

Importance

- Beginning of automated computing

Analytical Engine

Developed by **Charles Babbage** in 1833.

Features

- First concept of a general-purpose computer
- Included:
 - Input unit
 - Processing unit
 - Output unit
 - Memory

Key Concept

This machine introduced the idea of a **programmable computer**.

First Programmer

Ada Lovelace

- Wrote the first algorithm
- Known as the first software engineer

Concept Insight

Modern computers are based on the Analytical Engine design.

Memory Technique

Analytical Engine = Modern Computer Blueprint

Arithmometer

Invented by **Charles Xavier Thomas de Colmar** in 1820.

Features

- First commercially successful mechanical calculator
- Performed basic arithmetic operations

Census Tabulating Machine

Developed by **Herman Hollerith** in 1890.

Features

- Used punched cards
- Automated census data processing

Importance

- Reduced processing time drastically
- Led to formation of IBM

Transition to Electronic Computers

After mechanical devices, the development moved towards electronic computers.

ABC Computer (1942)

Developed by **John Vincent Atanasoff** and **Clifford Berry**

Features

- First electronic computer
- Used vacuum tubes
- Solved linear equations

Importance

- First step toward digital computing

Mark I (1943)

Developed by **IBM** and **Howard Aiken**

Features

- First electromechanical computer
- Used both electrical and mechanical components

ENIAC (1946)

Developed by **J. Presper Eckert** and **John Mauchly**

Full Form

Electronic Numerical Integrator and Computer

Features

- First general-purpose electronic computer
- Very large and power-consuming

EDVAC (1950)

Developed by **John von Neumann**

Full Form

Electronic Discrete Variable Automatic Computer

Key Concept

- Introduced **stored program concept**

EDSAC (1949)

Developed by **Maurice Wilkes**

Full Form

Electronic Delay Storage Automatic Calculator

Importance

- First stored-program computer

UNIVAC

Full Form:
Universal Automatic Computer

Importance

- First commercial computer
- Used for business and government purposes

Stored Program Concept

Proposed by **John von Neumann**

Concept

- Data and instructions are stored in the same memory

Importance

- Basis of modern computer architecture

Memory Technique

Single Memory → Data + Program

Summary Table of Historical Devices

Device	Year	Inventor	Importance
Napier's Bones	1611	John Napier	Logarithmic calculation
Slide Rule	1622	William Oughtred	Logarithmic operations
Pascaline	1642	Blaise Pascal	First mechanical calculator
Leibniz Calculator	1671	Leibniz	Advanced calculations
Jacquard Loom	1801	Jacquard	Punched card concept
Difference Engine	1822	Babbage	Automatic calculation
Analytical Engine	1833	Babbage	First computer concept
ABC	1942	Atanasoff & Berry	First electronic computer
ENIAC	1946	Eckert & Mauchly	First general-purpose computer

1.17 History of Computer

The history of computers is not a sudden development but a **gradual evolution over centuries**. It reflects humanity's continuous effort to reduce manual calculation, minimize errors, and increase speed and efficiency.

The development can be understood in **four major stages**:

Stage	Description
Manual Stage	Human-based calculations
Mechanical Stage	Machines with gears and rods
Electromechanical Stage	Combination of electrical and mechanical parts
Electronic Stage	Fully electronic computers

1.17.1 Napier's Bones – Beginning of Advanced Calculation

Invented by **John Napier** in 1611.

Detailed Structure

Napier's Bones consisted of:

- Rectangular rods (bones)
- Each rod represented digits from 0–9
- Numbers were arranged in a specific pattern

Working Principle

The device used **diagonal arrangements** of numbers to perform multiplication and division.

Example (Conceptual)

To multiply 23×4 :

- Select rods for 2 and 3
- Align them side by side
- Read diagonal values to get the result

Conceptual Importance

- Introduced the use of **logarithms**
- Reduced complex multiplication into simpler addition

Deep Insight

Napier's work laid the mathematical foundation for later computing devices such as slide rules and logarithmic tables.

1.17.2 Slide Rule – Analog Computing Device

Developed by **William Oughtred** in 1622.

Fundamental Principle

Based on **logarithmic scales**, where:

- Addition of lengths = Multiplication of numbers

Detailed Uses

Function	How it Works
Multiplication	Sliding scales align values
Division	Reverse alignment
Square	Using squared scale
Cube	Using cubic scale
Trigonometry	Special scales

Real-Life Application

Before electronic calculators, engineers used slide rules to:

- Design bridges
- Calculate distances
- Solve physics equations

Limitations

- Accuracy depends on user skill
- Not suitable for very precise calculations

Conceptual Importance

It represents the transition from **mechanical to analog computation**.

1.17.3 Pascal's Calculator – First Automatic Machine

Invented by **Blaise Pascal** in 1642.

Internal Mechanism

- Consisted of **gears and wheels**
- Each wheel represented digits (0–9)
- Automatic carry mechanism was introduced

Working Example

If a wheel moves from 9 to 0:

- It automatically increments the next wheel (carry operation)

Operations

- Addition
- Subtraction

Deep Insight

This was the first machine to:

- Perform calculations automatically
- Reduce human effort significantly

Limitation

- Could not perform multiplication and division directly

1.17.4 Leibniz Calculator – Advancement in Mechanical Computing

Developed by **Gottfried Wilhelm Leibniz** in 1671.

Key Innovation

- Introduced **Stepped Drum Mechanism**

Capabilities

- Addition

- Subtraction
- Multiplication
- Division

Conceptual Advancement

Leibniz's machine improved Pascal's design and brought computing closer to modern capabilities.

Deep Insight

Leibniz also proposed the idea of **binary number system**, which is the foundation of modern computers.

1.17.5 Jacquard Loom – Birth of Programming Concept

Developed by **Joseph Marie Jacquard** in 1801.

Working Mechanism

- Used **punched cards** to control weaving patterns
- Each card contained holes representing instructions

Conceptual Breakthrough

This was the first time:

- Instructions were stored externally
- Machines followed predefined instructions

Importance in Computing

- Introduced the concept of **programming**
- Inspired early computer input systems

Deep Understanding

Each punched card can be compared to:

- A line of code in modern programming

1.17.6 Punched Card System – Data Storage Revolution

Developed by **Herman Hollerith** in 1890.

Structure

- Cards made of stiff paper
- Holes represented binary data (1 and 0)

Application

- Used in US Census processing
- Reduced processing time from years to months

Conceptual Importance

- First large-scale data processing system
- Introduced **input, output, and storage integration**

Deep Insight

Punched cards were used in computers until the 1970s.

1.17.7 Difference Engine – Beginning of Automation

Developed by **Charles Babbage** (1821–1822)

Purpose

- To compute mathematical tables automatically

Mechanism

- Based on **finite difference method**
- Used mechanical gears

Importance

- Eliminated human calculation errors
- First automatic mechanical calculator

1.17.8 Analytical Engine – Foundation of Modern Computer

Developed by **Charles Babbage** in 1833.

Components (Very Important)

Component	Modern Equivalent
Store	Memory

Mill	CPU
Input	Input devices
Output	Output devices

Key Features

- Programmable machine
- Used punched cards
- Had memory and processing unit

First Programmer

Ada Lovelace

- Wrote the first algorithm
- Understood machine capability beyond calculation

Deep Concept

This machine had all the basic components of modern computers.

Very Important Insight

Modern computers are direct descendants of the Analytical Engine.

1.17.9 Arithmometer – Commercial Calculator

Invented by **Charles Xavier Thomas de Colmar**

Features

- First commercially successful calculator
- Used in offices and businesses

1.17.10 Transition to Electronic Computers

Mechanical limitations led to:

- Slow speed
- High error rate
- Physical wear and tear

This led to the development of electronic computers.

1.17.11 ABC Computer (1942)

Developed by **John Vincent Atanasoff** and **Clifford Berry**

Features

- First electronic computer
- Used vacuum tubes
- Solved algebraic equations

Importance

- Beginning of digital electronics

1.17.12 Mark I (1943)

Developed by IBM and **Howard Aiken**

Features

- Electromechanical
- Automatic sequence control

1.17.13 ENIAC (1946)

Developed by **J. Presper Eckert** and **John Mauchly**

Features

- First general-purpose electronic computer
- Used thousands of vacuum tubes

Limitation

- Consumed huge electricity
- Generated heat

1.17.14 EDVAC and Stored Program Concept

Developed by **John von Neumann**

Core Idea

- Data and instructions stored in same memory

Importance

- Foundation of modern computer architecture

1.17.15 EDSAC (1949)

Developed by **Maurice Wilkes**

Importance

- First practical stored-program computer

1.17.16 UNIVAC

Full Form

Universal Automatic Computer

Importance

- First commercial computer
- Used in business, government, and census

1.17.0 Conceptual Introduction: Why Computers Were Invented

Before understanding each machine, it is important to understand **why computers evolved**.

Human beings faced three major problems:

1. **Slow Calculation Speed**
2. **High Chances of Error**
3. **Difficulty in Handling Large Data**

To solve these problems, humans gradually developed machines.

1.17.1 Evolution Stages of Computer

The development of computers did not happen suddenly. It evolved step by step.

Stage	Nature	Key Feature
Manual Stage	Human-based	Fingers, memory

Mechanical Stage	Machines	Gears, rods
Electromechanical Stage	Mixed	Electrical + mechanical
Electronic Stage	Modern	Fully electronic

Deep Concept

Each stage solved the limitations of the previous stage:

- Manual → Slow
- Mechanical → Limited capability
- Electromechanical → Semi-automatic
- Electronic → Fast and accurate

1.17.2 MECHANICAL ERA (DETAILED ANALYSIS)

This era includes machines that used **physical components like gears, rods, and wheels**.

Napier's Bones (1611)

Invented by **John Napier**

Structural Design

- Set of rods (called bones)
- Each rod had numbers arranged diagonally
- Represented multiplication tables

Working Mechanism (Step-by-Step Concept)

1. Select rods corresponding to numbers
2. Align rods side by side
3. Read diagonals to get results

Example (Conceptual Understanding)

Multiply 23×4 :

- Take rods for 2 and 3
- Read 4th row
- Combine diagonal values

Deep Mathematical Concept

- Based on **logarithmic principles**
- Converts multiplication into addition

Importance

- First device to reduce calculation complexity
- Foundation for future computational mathematics

Slide Rule (1622)

Developed by **William Oughtred**

Core Principle

Based on:
 $\text{Log}(a \times b) = \text{Log}(a) + \text{Log}(b)$

Thus:
 Multiplication becomes addition of distances.

Detailed Functional Table

Operation	Method
Multiplication	Add distances
Division	Subtract distances
Square	Use square scale
Cube	Use cube scale
Trigonometry	Special scales

Engineering Example

Engineers used slide rules for:

- Bridge design
- Aeronautics calculations
- Physics problems

Deep Insight

This is an **analog computer**, not digital.

Limitation

- Not exact
- Requires expertise

Pascal's Calculator (1642)

Invented by **Blaise Pascal**

Mechanical Structure

- Interconnected wheels
- Each wheel = 1 digit (0–9)
- Gear mechanism

Key Innovation

Automatic Carry System

Working Logic

If digit exceeds 9:

- It resets to 0
- Carries 1 to next wheel

Example

999 + 1:

- All wheels rotate → 000
- Carry propagates → 1000

Importance

- First automatic mechanical calculator
- Reduced manual intervention

Limitation

- Only addition and subtraction

Leibniz Calculator (1671)

Developed by **Gottfried Wilhelm Leibniz**

Key Innovation

Stepped Drum Mechanism

Capabilities

- Addition
- Subtraction
- Multiplication
- Division

Deep Concept

Leibniz also introduced:

Binary Number System (0 and 1)

Importance

Binary system is the **foundation of modern computers**.

Jacquard Loom (1801)

Developed by **Joseph Marie Jacquard**

Working Mechanism

- Used punched cards
- Each card contained pattern instructions

Conceptual Breakthrough

- First programmable machine
- Instructions stored externally

Deep Understanding

Each punched card = Instruction set

Connection to Modern Computing

- Similar to programming code
- Inspired computer input methods

Punched Card System (1890)

Developed by **Herman Hollerith**

Structure

- Hard paper card
- Holes represent binary data

Working Concept

- Hole = 1
- No hole = 0

Application

- US Census processing

Impact

- Reduced processing time drastically
- Introduced automated data handling

Deep Insight

This system introduced:

- Input
- Output
- Storage

Difference Engine (1822)

Developed by **Charles Babbage**

Core Principle

Based on:
Finite Difference Method

Purpose

- Solve polynomial equations
- Generate mathematical tables

Importance

- Eliminated human errors
- First automatic calculating machine

Analytical Engine (1833) – MOST IMPORTANT

Developed by **Charles Babbage**

Complete Structure

Component	Function	Modern Equivalent
Store	Data storage	Memory
Mill	Processing	CPU
Input	Data entry	Keyboard
Output	Result display	Monitor

Key Features

- Programmable
- Stored data
- Performed calculations
- Used punched cards

First Programmer

Ada Lovelace

Deep Conceptual Insight

This machine had:

- Input unit
- Processing unit
- Output unit
- Memory

These are exactly the components of modern computers.

Critical Understanding

Modern computers are **direct implementation of Analytical Engine concept.**

Arithmometer

Invented by **Charles Xavier Thomas de Colmar**

Importance

- First commercially used calculator
- Used in offices

1.17.3 TRANSITION TO ELECTRONIC ERA

Mechanical machines had limitations:

- Slow speed
- Mechanical wear and tear
- Limited complexity

This led to the development of **electronic computers.**

ABC Computer (1942)

Developed by **John Vincent Atanasoff** and **Clifford Berry**

Features

- First electronic computer
- Used vacuum tubes

- Solved linear equations

Deep Insight

Marked the beginning of **digital computing**.

Mark I (1943)

Developed by IBM and **Howard Aiken**

Nature

Electromechanical

Importance

- Bridge between mechanical and electronic era

ENIAC (1946)

Developed by **J. Presper Eckert** and **John Mauchly**

Features

- First general-purpose electronic computer
- Used vacuum tubes

Limitations

- Very large
- High power consumption

EDVAC and Stored Program Concept

Proposed by **John von Neumann**

Core Principle

- Data + Instructions stored in same memory

Importance

- Foundation of modern computer architecture

EDSAC (1949)

Developed by **Maurice Wilkes**

Importance

- First practical stored-program computer

UNIVAC

Full Form:
Universal Automatic Computer

Importance

- First commercial computer
- Used in business and government

