

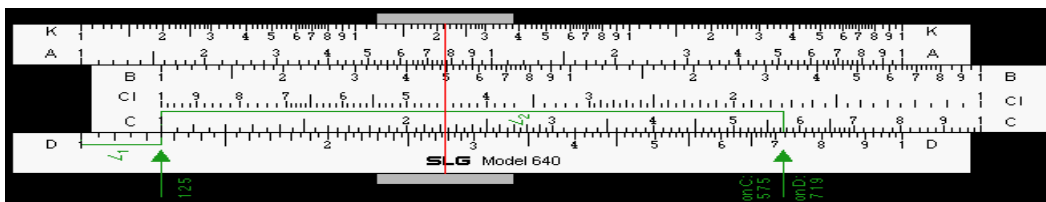
Introduction to Computer Development

The history of computer  began with early mechanical devices from the abacus  (3000 BCE) used for basic arithmetic to Charles Babbage's Analytical Engine (1837 CE) . The 20th century shows rapid advances in computer industry from vacuum tubes , transistors  to the invention of microprocessors that led to a revolution in the digital industry and manufacturing the computers that we use today. The integration of artificial intelligence technologies into computer system and design accelerated advancements significantly, enabling smarter solutions and reshape the industry. Understanding the details of the hardware allows the computer programmer to optimize their work. Below we will explain the timeline  that the computer industry went through.

1- The History of Computer

In 1617 **Napier's bones** built a mechanical device named "**Napier's bones**" for multiplication and division.

Later in 1622 **William Oughtred** invented the **Slide Rule** it's a logarithmic calculator allowed for complex operations like multiplication, division, and roots; this is the **third** improvement from the first computing device (abacus).



In the 17th century, inventor [Wilhelm Schickard](#), [Blaise Pascal](#), and [Gottfried Leibniz](#) laid the foundation for mechanical calculation devices. In 1623 Schickard created the first known calculator, the "Calculating Clock"  capable of adding and

subtracting six-digit numbers with gears rotating wheels and used the carry mechanism between digits, and even ringing a bell 🔔 when the result overflow its six-digit capacity.

Years later in 1642 Blaise Pascal, produced the first practice mechanical calculator named Pascaline device, the machine use gear wheel to represent and manipulate digits (0-9) had a clever carry mechanism addition and subtraction."

Years later Gottfried Leibniz expanded on these ideas in the 1670s with the first four arithmetic operations calculator and invented the binary number system (0 and 1). While in 1713 Jakob Bernoulli discovered theoretical formula to calculate patterns like adding powers of numbers ($1^x + 1/2^x$), which became important in number theory and modern mathematics."

Together, these mechanical and mathematical inventions helped to prepare the world for the computer revolution, that is sparked by Charles Babbage's visionary:

- 1- 🖨 In 1837 Charles Babbage designed the Analytical Engine machine, a mechanical computing machine capable of processing digital data, making it the first true concept of a programmable computer. The Analytical Engine used ten positions variables with discrete digit numbers 0 through 9, much like a mechanical odometer (العداد) in a car.

Charles Babbage's used punched cards to input both instructions and data, he borrowed the idea of punched cards from Jacquard loom (1804 used in clothing industry 🧵).

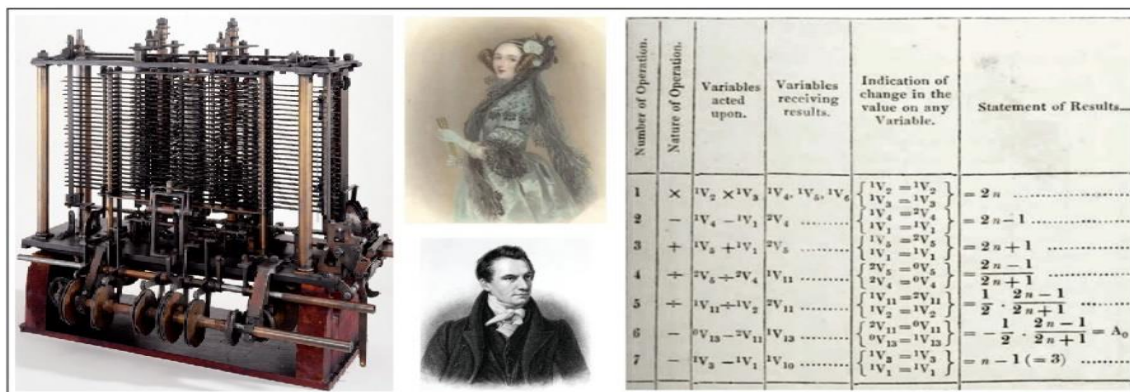
The Analytical Engine used three types of punched

- **Operation cards** for instructions
- **Variable cards** for memory access
- **Number cards** for constants



The machine components similar to modern computers  include: a memory (“store”), a processor (“mill”), input/output systems included a printer  and curve plotter  it also supported loops and conditional branching. **The machine used gears and levers to perform calculations, (not electricity or digital logic) and powered by a steam engine. The machine was *never* built in his lifetime, but the design laid the foundation for of a general-purpose computer including your modern phone and laptop.**

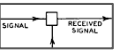
- 2-  **In 1843 Lady Ada Lovelace** translated Babbage’s design and wrote her famous notes (Note G), she created what is considered the first published **algorithm** : a step-by-step method for the Analytical Engine to compute Bernoulli numbers. Her notes focused on **programming a mechanical machine showing** how a machine could follow instructions, use memory, loops, and variables, **making her the world’s first computer programmer.** Ada imagined computers as creative tools, doing more than just math such as creating art a century before it became reality.

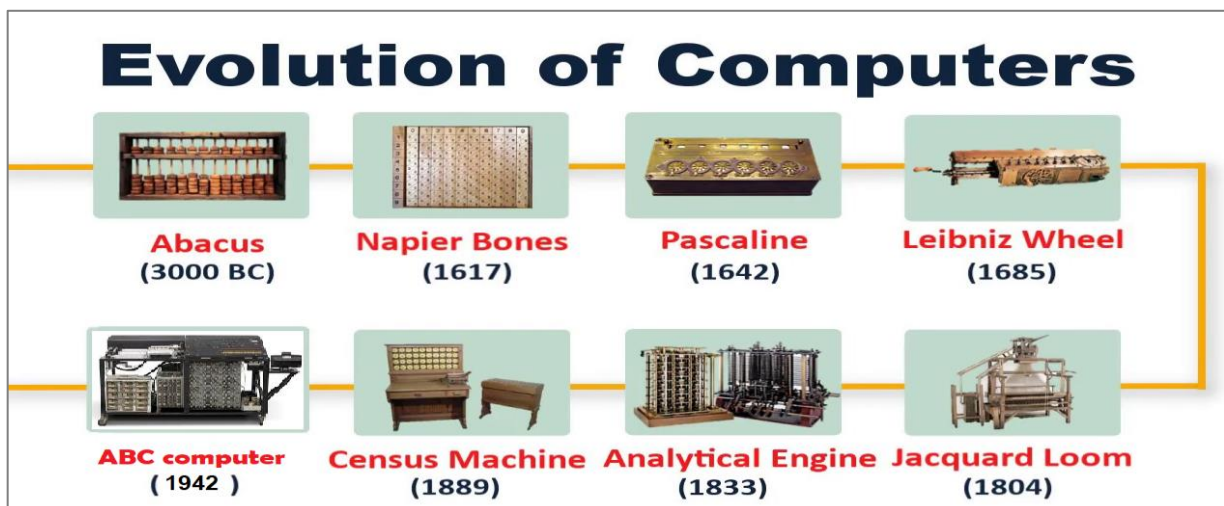


Number of Operation.	Nature of Operation.	Variables acted upon.	Variables receiving results.	Indication of change in the value on any Variable.	Statement of Results.
1	$\times$	$1V_2 \times 1V_3$	$1V_4, 1V_5, 1V_6$	$1V_2 = 1V_2$ $1V_3 = 1V_3$ $1V_4 = 1V_4$ $1V_5 = 1V_5$ $1V_6 = 1V_6$	$= 2n$
2	$-$	$1V_4 - 1V_1$	$2V_4$	$1V_4 = 1V_4$ $1V_5 = 1V_5$ $1V_6 = 1V_6$	$= 2n - 1$
3	$+$	$1V_5 + 1V_1$	$2V_5$	$1V_5 = 1V_5$ $1V_6 = 1V_6$	$= 2n + 1$
4	$+$	$2V_5 + 2V_4$	$1V_{11}$	$2V_5 = 2V_5$ $2V_4 = 2V_4$	$= 2n - 1$ $= 2n + 1$
5	$+$	$1V_{11} + 1V_2$	$2V_{11}$	$1V_{11} = 1V_{11}$ $1V_2 = 1V_2$	$= 1 \cdot 2n - 1$ $= 2 \cdot 2n + 1$
6	$-$	$2V_{11} - 2V_{11}$	$1V_{13}$	$2V_{11} = 2V_{11}$ $2V_{13} = 1V_{13}$	$= - \frac{1}{2} \cdot 2n - 1 = A_0$
7	$-$	$1V_3 - 1V_1$	$1V_{10}$	$1V_3 = 1V_3$ $1V_1 = 1V_1$	$= n - 1 (= 3)$

Charles Babbage’s machine and Lady Ada Lovelace Notes on writing algorithm

- 3-  **In 1847 George Boole** developed a mathematical system of logic, operating on binary variables that is now known as **Boolean logic**. Each of Boole’s variables could be TRUE or FALSE. Involve logical operations like AND, OR, NOT.

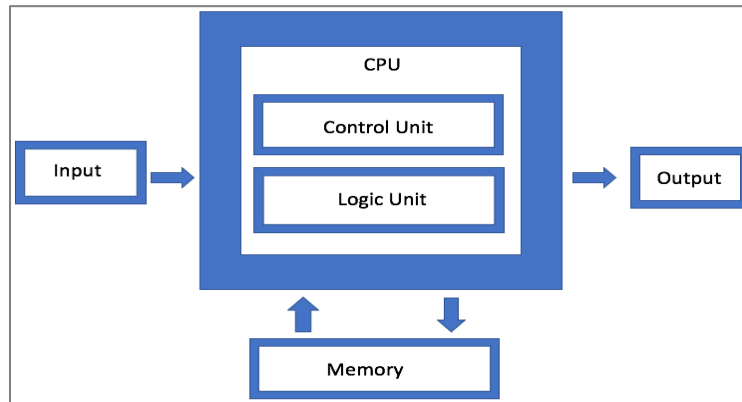
- 4-  **In the 1930s Claude Shannon**, used logic in engineering real machine. He treated electrical switches (on/off) as binary values (1/0), just like **Boole's** logic and proved that **logical operations** like AND, OR, and NOT could be directly mapped to **relay circuits**  this method later laid to programming logic that is used in building the earliest digital computers
- 5-  **In 1942 Atanasoff and Berry** invented the **first** electronic digital **Computer** known as **ABC**, they used vacuum tubes to perform logical operations on binary values and control and arithmetic calculations electronically they used memory capacitors, and punched cards as input/output units.
- 6-  **In 1946 Eckert and Mauchly**, completed the **first general-purpose electronic digital computer called ENIAC** (Electronic Numerical Integrator and Computer), their work took the concept of **digital computing from the laboratory into industry**.



7- **Von Neumann Architecture:**

In 1945 John von Neumann's joined the ENIAC team and began working on its successor, the EDVAC. He introduced the concept of the stored-program architecture, where both data and instructions are stored in the same memory, a revolutionary idea

at the time. This architecture became known as the **von Neumann architecture**, making the foundation of programmable digital machines and it's still the foundation of most computers today.



2- Developing Generation of Modern Computer

During (1900 to 1946) scientists (mathematics, physics, chemistry and engineering) worked on developing theories and building mathematical models, until manufacture the first practical general purpose digital computer ENIAC, scientists continue developing computer devices until the 1970s where the industry of computers moves from labs and governments into businesses, universities, and research centers. By the 1980s, personal computers became common. The period from (1946 to 1970) show the important progress on 5 generation as explained in the next figure:



 The **First generation (1946-1959)**: computers such as ENAC, EDVAC, Univac and IBM650 were built between 1945 and 1955, designed used **vacuum tubes** , as the primary electronic component

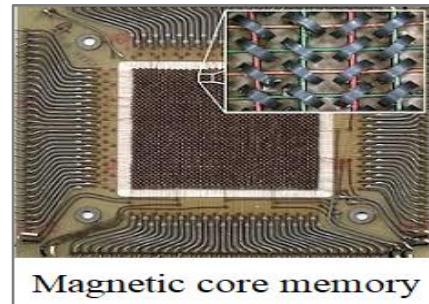
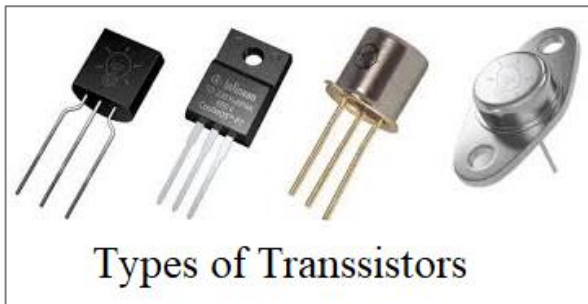
- The main memory was the magnetic tape
- Punching card and paper tapes used for input /output.
- Used machine language, which is binary code directly understood by the computer.
- The computers called mainframe and were very large and expensive mainly found in large centers.



 The **Second generation (1959-1965)**:

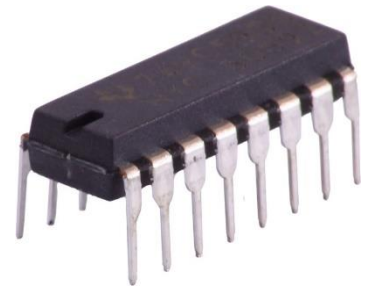
This generation marked a major turning point in the history of computing, replaced **vacuum tubes**  with **transistors**. In 1947 the **transistor** invented at **Bell Labs**, transistor made of semiconductor material with open and close circuit. Computers developed using transistor after 1955. This generation characteristics:

- Used **transistors** made the computers smaller, faster, and more reliable
- Introduce the CPU, **magnetic core** and magnetic tape for memory, the input /output used punching cards and magnetic tape.
- Introduced assembly language, used mnemonics (symbolic representations) to make programming easier than using machine (binary) code
- Used programming languages as FORTRAN and COBOL.
- The computers still large and expensive, but they were smaller and more accessible to businesses and universities.
- The produced computer are the IBM 1401, UNIVAC 1107, and DEC PDP-1



Third generation computers (1964-1971)

Computers in the **1960s** upgraded to **integrated circuits (ICs)** marked another major leap in the history of computing. Integrated Circuit invented in **1958** by **Jack Kilby and Robert Noyce**, known as silicon chips. Each chip contains many tiny electronic parts, like transistors, registers, and capacitors, all on a thin piece of silicon. Using thousands and millions of transistors placed on single chip, made computers much faster and more computation capability.



- In this generation a magnetic tape and magnetic disk are used for secondary memory and a **magnetic core** for main memory.
- Magnetic tape, keyboard, monitor, printer used for input/output.
- Graphical user interfaces (GUIs), which made it easier for users to interact with the computer using a mouse and keyboard
- Used operating systems, which made it easier for users to interact with the computer and perform multiple tasks simultaneously.
- High programming language BASIC where commonly used.
- The computers were mini and smaller than the mainframe marked the beginning of the personal computing.

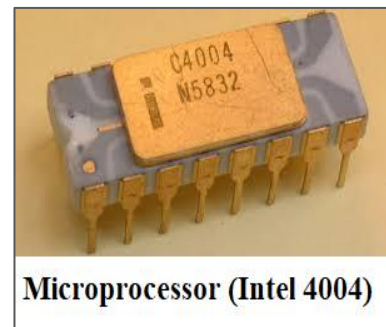
- Example third generation computers IBM 360 and UNIVAC 1108. In this generation the used

Fourth generation from (1971 to 1985)

The **microprocessor** was invented in the **4th generation** of computers. This generation developed using the technology of **Very-large-scale integration** (**VLSI** has thousands of transistors on a single microchip).



A microprocessor is a chip contains the central processing unit (CPU) of a computer, making it possible to build smaller, less expensive, more powerful and portable. The **first** commercially microprocessor was the **Intel 4004**, released in 1971. It was a 4-bit central processing unit (CPU) designed for a Japanese calculator manufacturer. The 4004's architecture paved the way for the development of general-purpose computers and revolutionized the field of electronics.



Microprocessor (Intel 4004)

The main leap of **4th generation**:

- Based on **Very-large-scale integration (VLSI)** and **microprocessors**.
- Semiconductor memory such as **RAM, ROM**, used for memory storage.
- Introduced Input/output devices such as pointing devices, optical scanning, keyboard, monitor, printer, etc.
- This era brought in key technologies such as:
 - **Multiprogramming**
 - **Multiprocessing**
 - **Time-sharing**

- **High operating speed**
- **Virtual memory**
- Computers became more widely used, with the rise of **Personal computers** such as **STAR 1000 (1974), Apple II (1977), IBM PC (1981)**
- Development computer networks, Distributed Systems and the Internet.

Fifth Generation (1980 – present)

This generation of computers, started around 1980, built based on artificial intelligence, use the **Ultra Large-Scale Integration (ULSI)** technology and parallel processing method (ULSI has millions of transistors on a single microchip and the **Parallel** processing method, uses two or more microprocessors to run tasks simultaneously). This characterized by:

- This generation has faster processing speeds, improved storage capacity increased computing power.
- The development of artificial intelligence (AI) technology and expert systems.
- Ability to understand natural language processing and interact with users in a more human-like manner, making computer easier to use.
- The development of the graphical user interface (GUI) also made computers more accessible and user-friendly

Modern Era (2000s–present):

Computers are Desktops, laptops, tablets, Mobile computing  , cloud services, artificial intelligence, and the Internet of Things (IoT) continue to expand the computer industry's reach.

5 Generations of Computers		
Generations	Time-Period	Technology Used
1st Generation	1940 – 1956	Vacuum Tube
2nd Generation	1956 – 1963	Transistor
3rd Generation	1964 – 1971	Integrated Circuit
4th Generation	1971 – 1985	VLSI - Microprocessor
5th Generation	1985 – Future	ULSI - Artificial Intelligence

3-Types of Computers

Computer types range from powerful supercomputers for complex tasks to tiny embedded systems built for specific functions. Each type is designed in different:

Size , Functionality , Purpose , Performance, Data Handling , applications

All digital computer carries out main **functions** which are input/output, store/process data, and execute instructions. The following is an overview of the common computer types

 **Mainframe:** A powerful multi-user computer capable of supporting many hundreds or thousands of users simultaneously. Used in airline reservation systems and banks.



 **Supercomputer:** An extremely fast computer that can perform hundreds of millions of instructions per second. Used in:

Space exploration , Weather modeling  and AI training.

 **Server Computers** are computers that combine data and programs. applications are stored and shared on the server computer. Such computer does not solve big problem like a supercomputer but it solves many smaller ones, such as send information (). Example server computers:

Web Server, Database Servers, File Servers and Mail Servers 

 **Workstation:** A powerful, single-user computer. It's like a personal computer, but it has a more powerful microprocessor and high quality monitor. example

Computer Aided Desing (CAD), 3D video editing and Scientific Simulation 

 **Embedded Computers:** Description: Embedded computers are specialized computers that are designed to perform specific tasks and are often built into other devices. Example:

Smartphones  Smart TVs, Game consoles  Medical services 

 **Personal computer:** A small, single-user computer based on a microprocessor. In addition to the microprocessor, a personal computer has a keyboard for entering data, a monitor for displaying information, and a storage device for saving data. **Examples:** Desktop PCs , Laptops, Tablets,



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3- *Assembly Language Step by Step*, Jeff Duntemann, 1992 by John Wiley & Sons, Inc.

4- www.emu8086.co