

## HISTORY AND GENERATIONS OF COMPUTING

Modified by: Shailesh Bdr. Pandey, TA, Computer Engineering, Nepal Engineering College

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- **Four basic periods**

Characterized by a principal technology used to solve the **input, processing, output and communication problems** of the time:

1. Premechanical,
2. Mechanical,
3. Electromechanical, and
4. Electronic

### A. The Premechanical Age: 3000 B.C. - 1450 A.D.

1. **Writing and Alphabets--communication.**

1. First humans communicated only through speaking and picture drawings.
2. 3000 B.C., the Sumerians in Mesopotamia (what is today southern Iraq) devised **cuniform**
3. Around 2000 B.C., Phoenicians created symbols
4. The Greeks later adopted the Phoenician alphabet and added vowels; the Romans gave the letters Latin names to create the alphabet we use today.

2. **Paper and Pens--input technologies.**

1. Sumerians' input technology was a stylus that could scratch marks in wet clay.
2. About 2600 B.C., the Egyptians write on the papyrus plant
3. around 100 A.D., the Chinese made paper from rags, on which modern-day papermaking is based.

3. **Books and Libraries: Permanent Storage Devices.**

1. Religious leaders in Mesopotamia kept the earliest "books"
2. The Egyptians kept scrolls
3. Around 600 B.C., the Greeks began to fold sheets of papyrus vertically into leaves and bind them together.

4. **The First Numbering Systems.**

1. Egyptian system:
  - The numbers 1-9 as vertical lines, the number 10 as a U or circle, the number 100 as a coiled rope, and the number 1,000 as a lotus blossom.
2. The first numbering systems similar to those in use today were invented between 100 and 200 A.D. by Hindus in India who created a nine-digit numbering system.
3. Around 875 A.D., the concept of zero was developed.

5. **The First Calculators: The Abacus.**



### B. The Mechanical Age: 1450 - 1840

1. **The First Information Explosion.**

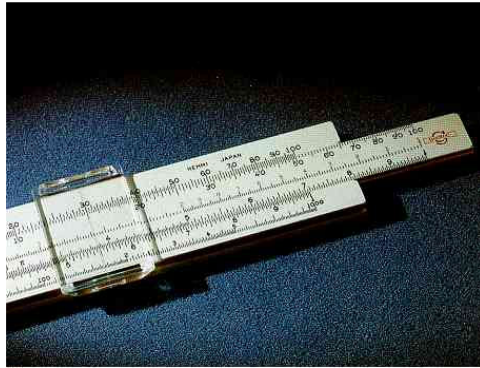
1. Johann Gutenberg (Mainz, Germany)
  - Invented the movable metal-type printing process in 1450.
2. The development of book indexes and the widespread use of page numbers.

2. **The first general purpose "computers"**

- Actually people who held the job title "computer: one who works with numbers."

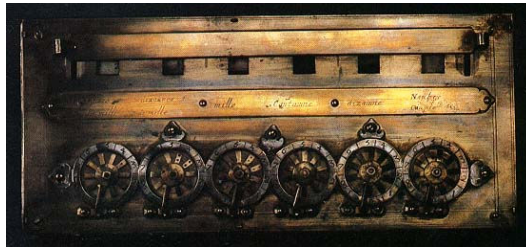
### 3. Slide Rules, the Pascaline and Leibniz's Machine.

- **Slide Rule.**

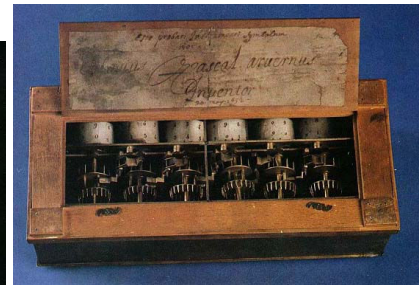


**Early 1600s, William Oughtred**, an English clergyman, invented the slide rule

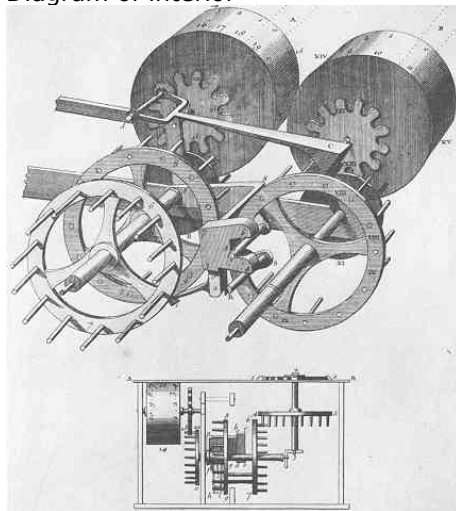
- Early example of an **analog** computer.
- **The Pascaline.** Invented by Blaise Pascal (1623-62).



The Pascaline (front)  
Diagram of interior

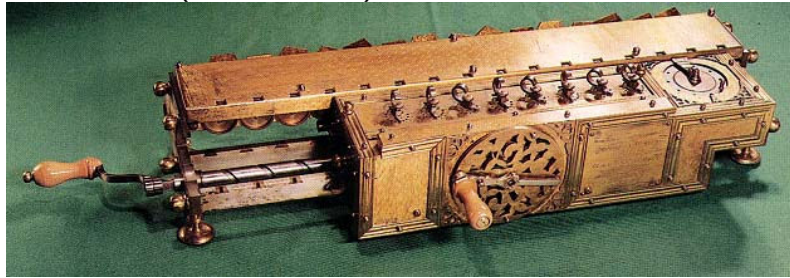


(rear view)



- **One of the first mechanical computing machines**, around 1642.
- **Leibniz's Machine.** Gottfried Wilhelm von Leibniz (1646-1716), German mathematician and philosopher.

The Reckoner (reconstruction)



4. **Babbage's Engines**

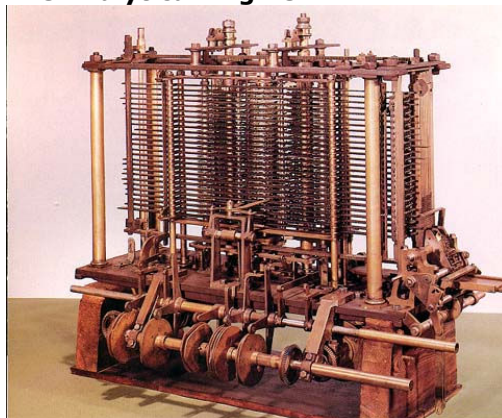
Charles Babbage (1792-1871), eccentric English mathematician

○ **The Difference Engine.**



- Working model created in 1822.
- The "method of differences".

○ **The Analytical Engine.**



Joseph Marie Jacquard's loom.



- Designed during the 1830s
- Parts remarkably similar to modern-day computers.
  - The "store"
  - The "mill"
  - Punch cards.
- Punch card idea picked up by Babbage from **Joseph Marie Jacquard's (1752-1834)** loom.
  - **Introduced in 1801.**
  - **Binary logic**
  - **Fixed program** that would operate in **real time.**
- **Augusta Ada Byron (1815-52).**
- The first programmer

## C. The Electromechanical Age: 1840 - 1940.

**The discovery of ways to harness electricity was the key advance made during this period. Knowledge and information could now be converted into electrical impulses.**

### 1. The Beginnings of Telecommunication.

1. **Voltaic Battery.**
  - Late 18th century.
2. **Telegraph.**
  - Early 1800s.
3. **Morse Code.**
  - Developed in 1835 by Samuel Morse
  - Dots and dashes.
4. **Telephone and Radio.**
  - Alexander Graham Bell.
  - 1876
5. Followed by the discovery that electrical waves travel through space and can produce an effect far from the point at which they originated.
6. These two events led to the invention of the radio
  - Guglielmo Marconi
  - 1894

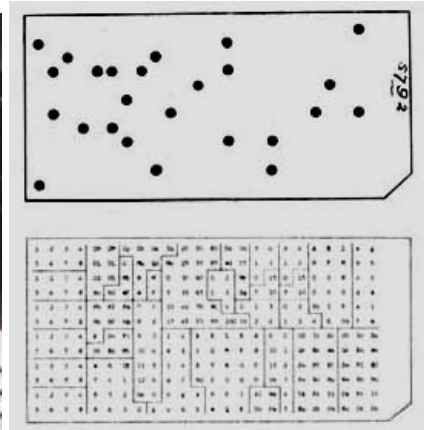
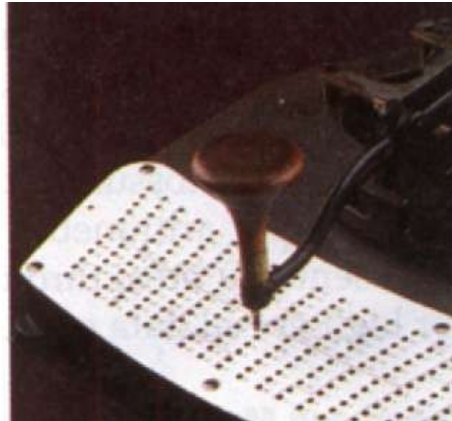
### 2. Electromechanical Computing

1. **Herman Hollerith and IBM.**  
Herman Hollerith (1860-1929) in 1880.

Census Machine.



Early punch cards.



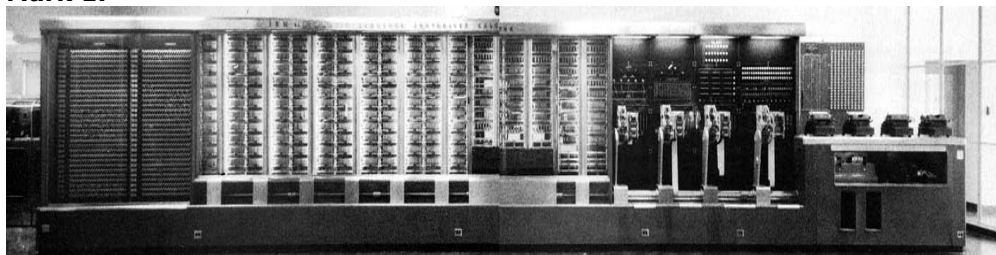
Punch card workers.



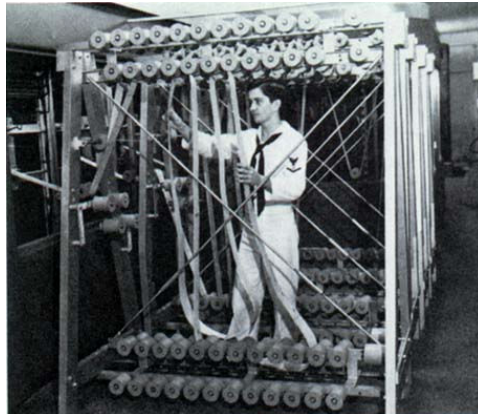
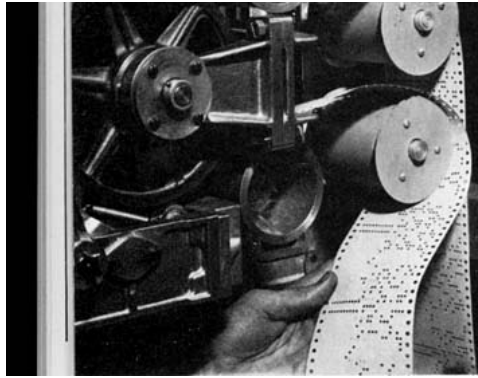
- By 1890
- The **International Business Machines Corporation (IBM)**.
  - Its first logo



## 2. Mark 1.



Paper tape stored data and program instructions.



- Howard Aiken, a Ph.D. student at Harvard University
- Built the Mark I
  - Completed January 1942
  - 8 feet tall, 51 feet long, 2 feet thick, weighed 5 tons, used about 750,000 parts

## D. The Electronic Age: 1940 - Present.

### 1. First Tries.

- Early 1940s
- Electronic vacuum tubes.

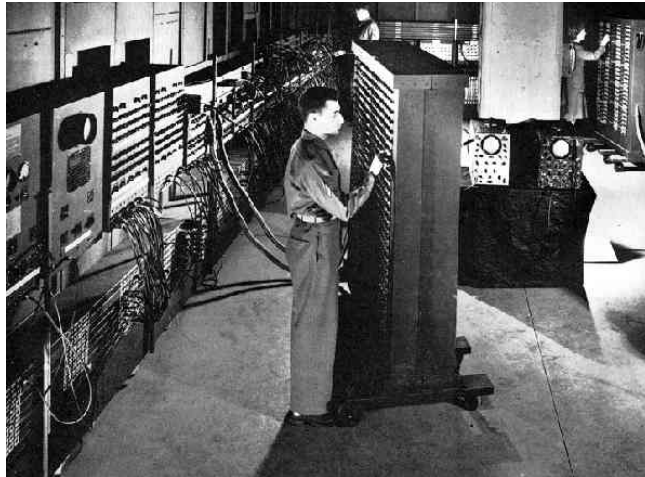
### 2. Eckert and Mauchly.

#### 1. The First High-Speed, General-Purpose Computer Using Vacuum Tubes:

#### Electronic Numerical Integrator and Computer (ENIAC)

The ENIAC team (Feb 14, 1946). Left to right: J. Presper Eckert, Jr.; John Grist Brainerd; Sam Feltman; Herman H. Goldstine; John W. Mauchly; Harold Pender; Major General G. L. Barnes; Colonel Paul N. Gillon.



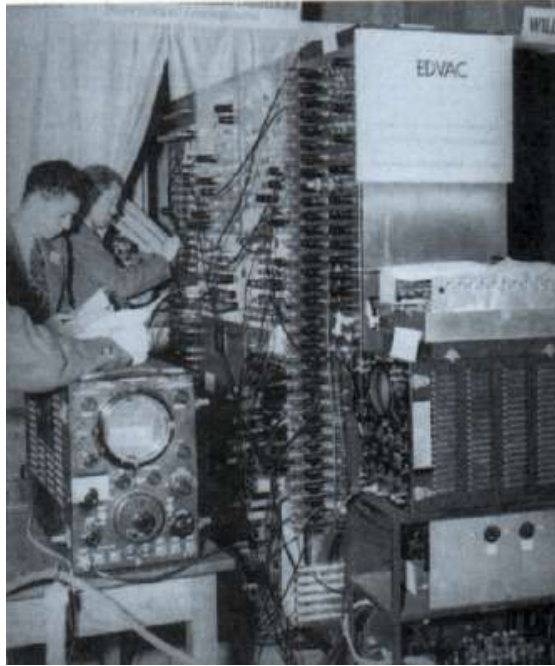


Rear view (note vacuum tubes).

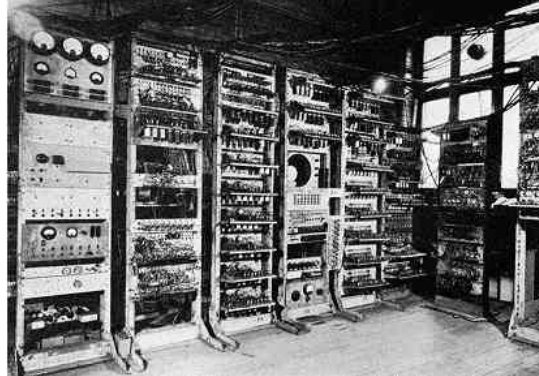


- **Electronic Numerical Integrator and Computer (ENIAC)**
  - 1946.
  - Used vacuum tubes (not mechanical devices) to do its calculations.
    - Hence, first **electronic** computer.
  - Developers John Mauchly, a physicist, and J. Prosper Eckert, an electrical engineer
    - The Moore School of Electrical Engineering at the University of Pennsylvania
  - Funded by the U.S. Army.
  - But it could not *store* its programs (its set of instructions)

## 2. The First Stored-Program Computer(s)



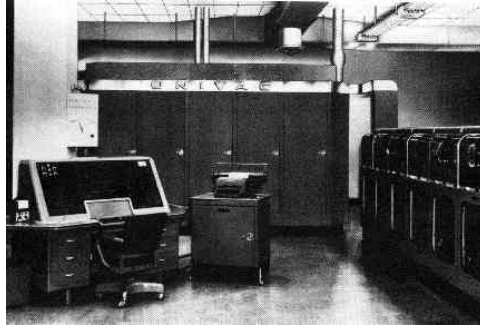
The Manchester University Mark I (prototype).



- Early 1940s, Mauchly and Eckert began to design the **EDVAC - the Electronic Discreet Variable Computer**.
- John von Neumann's influential report in June 1945:
  - "The Report on the EDVAC"
- British scientists used this report *and outpaced the Americans*.
  - Max Newman headed up the effort at Manchester University
    - Where the **Manchester Mark I** went into operation in June 1948--**becoming the first stored-program computer**.
  - Maurice Wilkes, a British scientist at Cambridge University, completed the **EDSAC (Electronic Delay Storage Automatic Calculator)** in 1949--two years before EDVAC was finished.
    - Thus, EDSAC became the first stored-program computer in general use (i.e., not a prototype).



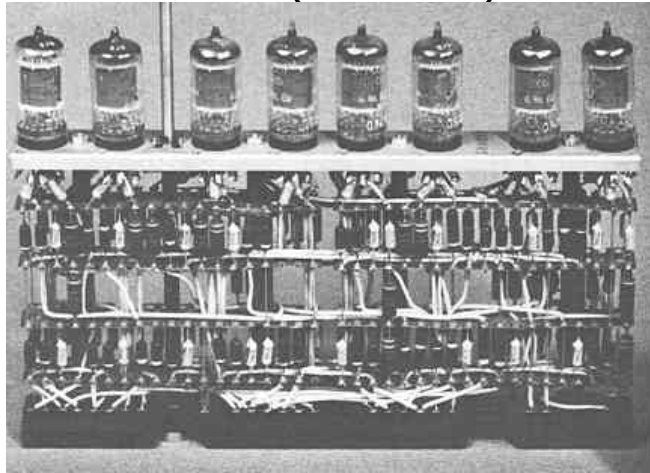
3. **The First General-Purpose Computer for Commercial Use: Universal Automatic Computer (UNIVAC).**



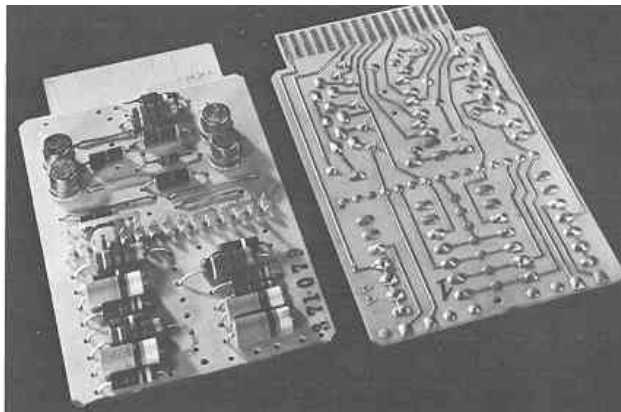
- Late 1940s, Eckert and Mauchly began the development of a computer called **UNIVAC (Universal Automatic Computer)**
  - Remington Rand.
  - First UNIVAC delivered to Census Bureau in 1951.
- **But**, a machine called LEO (Lyons Electronic Office) went into action a few months before UNIVAC and became the world's **first commercial computer**.

### 3. The Four Generations of Digital Computing.

#### 0. The First Generation (1951 to 1958).



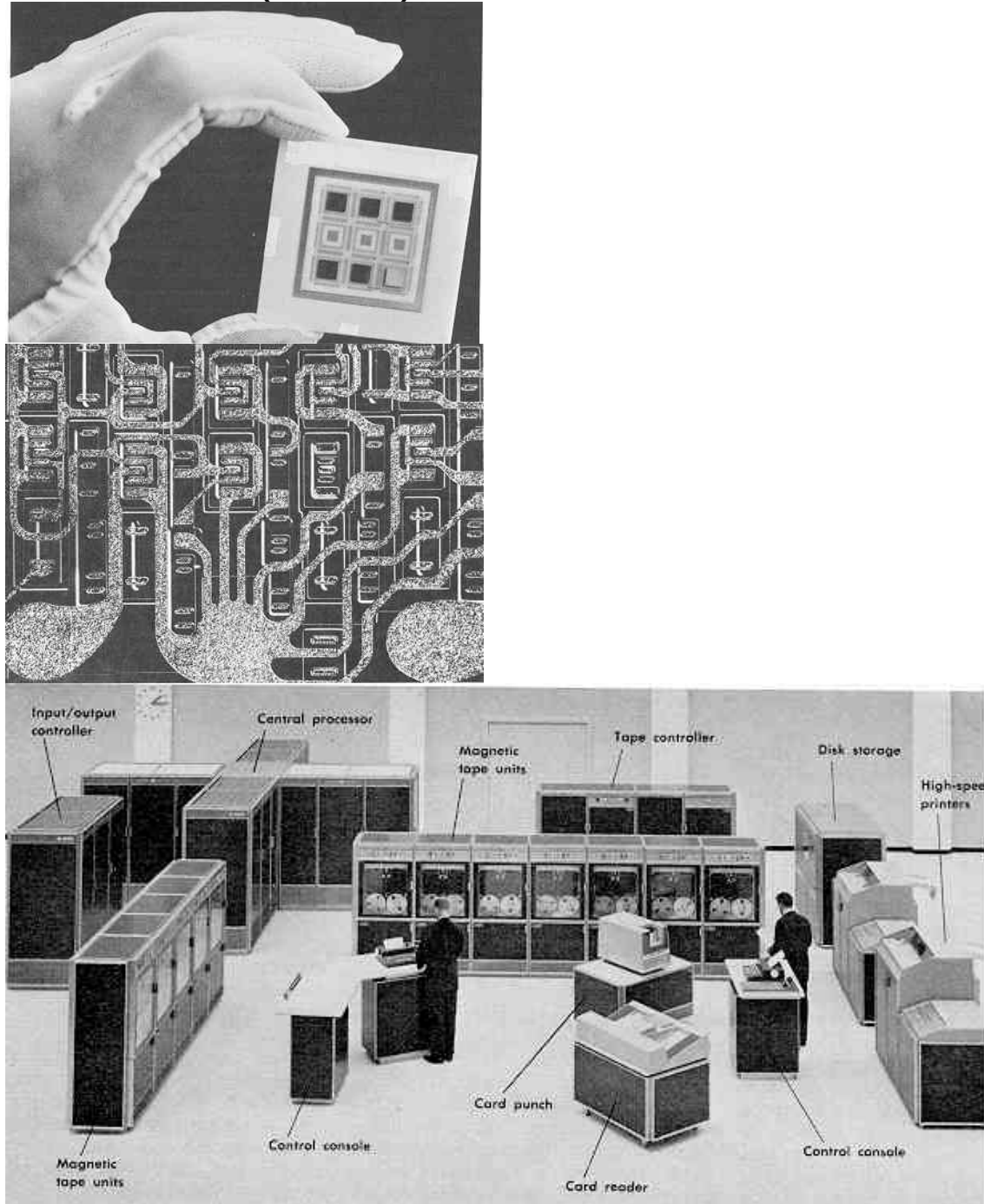
1. Vacuum tubes as their main logic elements.
2. Punch cards to input and *externally* store data.
3. Rotating magnetic drums for *internal* storage of data and programs
  - Programs written in
    - Machine language
    - Assembly language
      - Requires **a compiler**.



#### 1. The Second Generation (1959-1963).

0. Vacuum tubes replaced by **transistors** as main logic element.
  - AT&T's Bell Laboratories, in the 1940s
  - Crystalline mineral materials called **semiconductors** could be used in the design of a device called a **transistor**
1. Magnetic tape and disks began to replace punched cards as external storage devices.
2. Magnetic cores (very small donut-shaped magnets that could be polarized in one of two directions to represent data) strung on wire within the computer became the primary internal storage technology.
  - High-level programming languages
    - E.g., FORTRAN and COBOL

## 2. The Third Generation (1964-1979).



0. Individual transistors were replaced by **integrated circuits**.
1. Magnetic tape and disks *completely* replace punch cards as external storage devices.
2. Magnetic core *internal* memories began to give way to a new form, metal oxide semiconductor (MOS) memory, which, like integrated circuits, used silicon-backed chips.
  - **Operating systems**
  - Advanced programming languages like BASIC developed.
    - Which is where Bill Gates and Microsoft got their start in 1975.

## 3. The Fourth Generation (1979- Present).

0. Large-scale and very large-scale integrated circuits (LSIs and VLSICs)
1. Microprocessors that contained memory, logic, and control circuits (an entire **CPU = Central Processing Unit**) on a single chip.

- Which allowed for home-use **personal computers or PCs**, like the Apple (II and Mac) and IBM PC.
  - Apple II released to public in 1977, by Stephen Wozniak and Steven Jobs.
    - Initially sold for \$1,195 (without a monitor); had 16k RAM.
  - First Apple Mac released in 1984.
  - IBM PC introduced in 1981.
    - Debuts with **MS-DOS (Microsoft Disk Operating System)**
- Fourth generation language software products
  - E.g., Visicalc, Lotus 1-2-3, dBase, Microsoft Word, and many others.
  - **Graphical User Interfaces (GUI)** for PCs arrive in early 1980s
    - **MS Windows** debuts in 1983, but is quite a clunker.
      - Windows wouldn't take off until version 3 was released in 1990



Apple's GUI (on the first Mac) debuts in 1984.

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