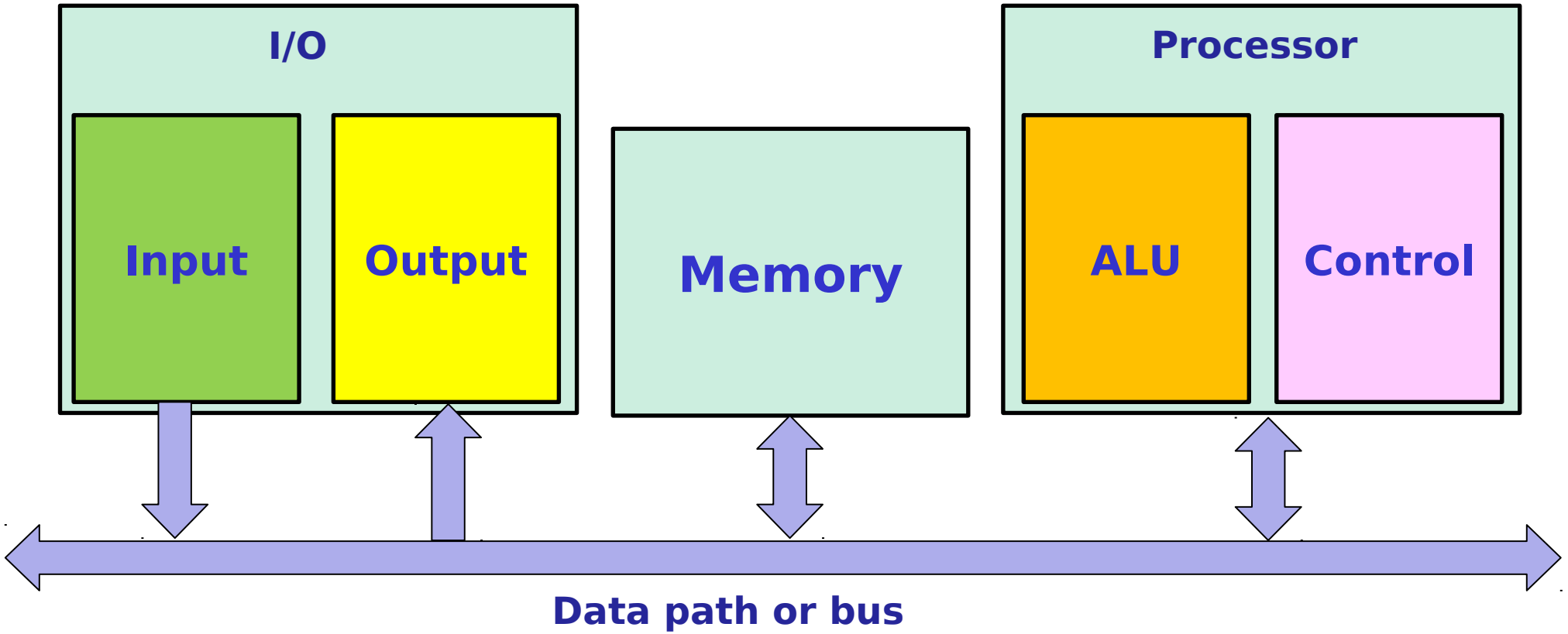
Microarchitecture Level

- **Functional Units**:
  - Input Unit
  - Memory Unit
  - Arithmetic and Logic Unit (ALU)
  - Output Unit
  - Control Unit



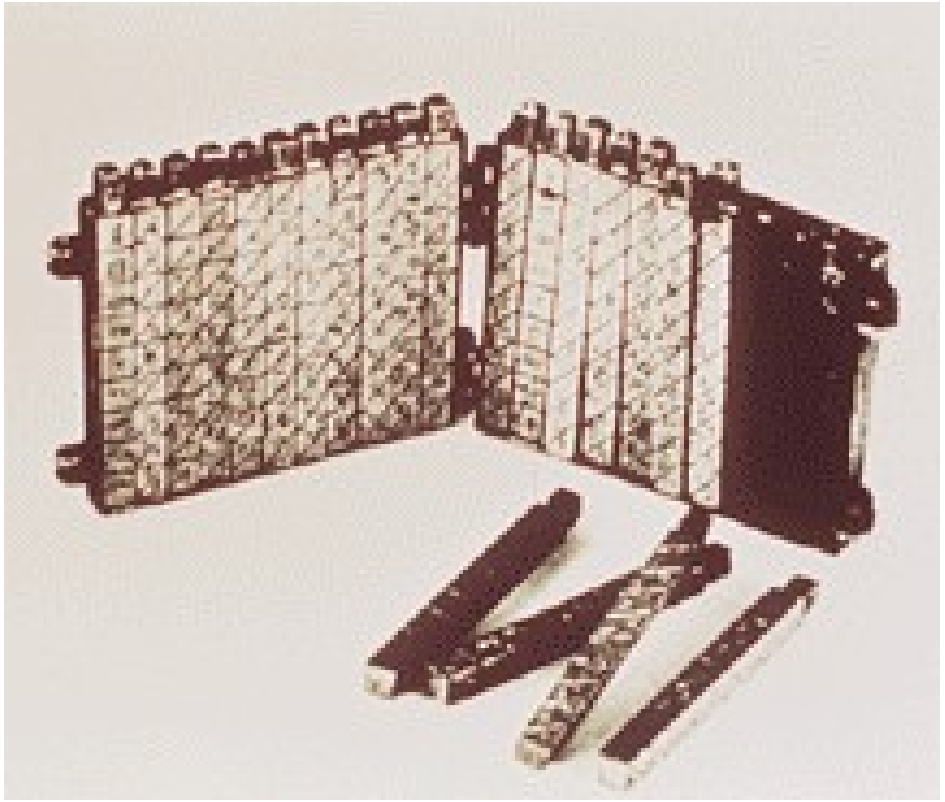
History of computers

CS 204

Abacus

- The abacus is often wrongly attributed to China. In fact, the oldest surviving abacus was used in 300 B.C. by the Babylonians. The abacus is still in use today, principally in the far east.

Napier’s Bones

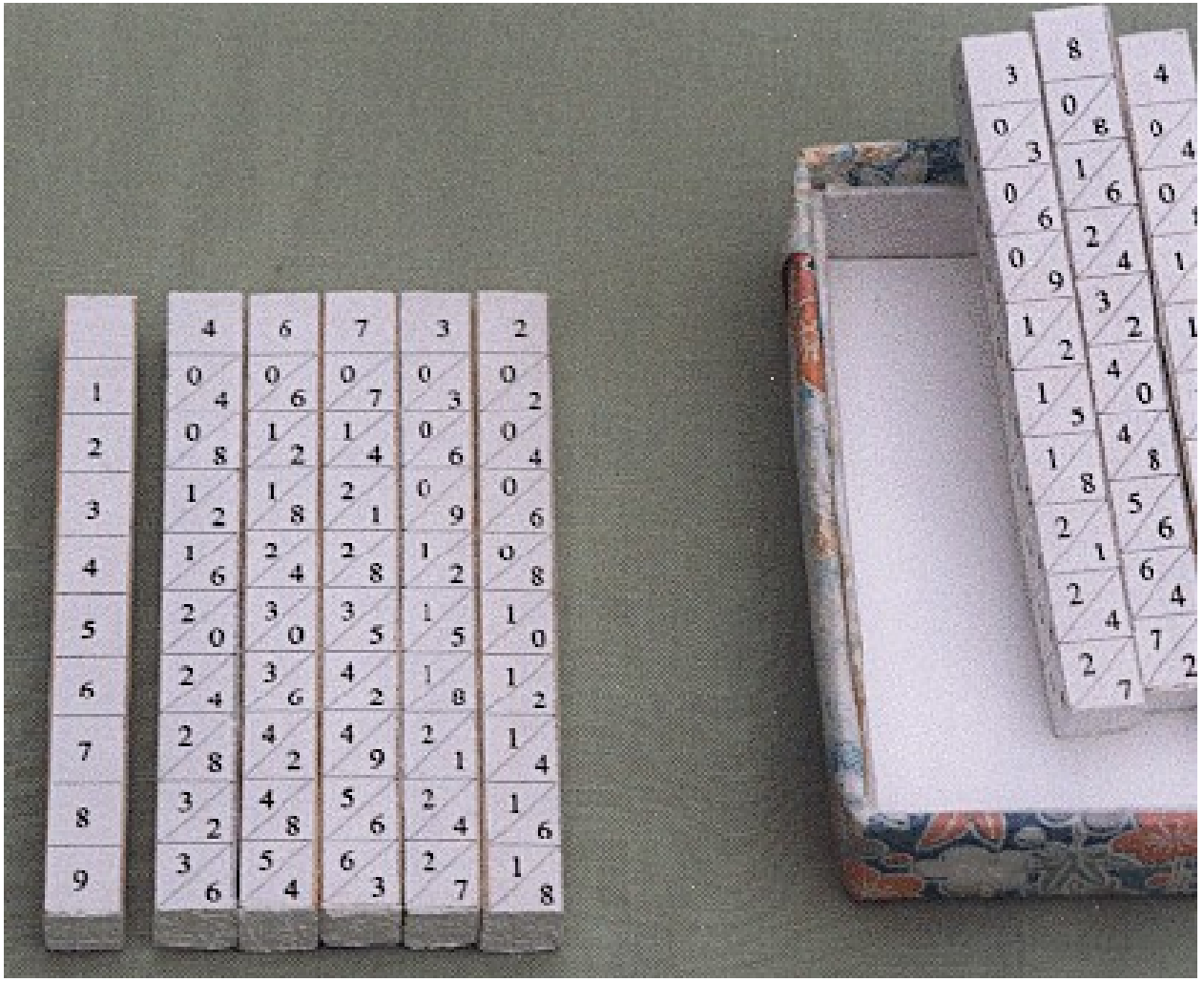


- Napier's bones is a manually-operated calculating device created by John Napier for calculation of products and quotients of numbers.

John Napier invented logarithms, which are a technology that allows multiplication to be performed via addition. The magic ingredient is the logarithm of each operand, which was originally obtained from a printed table

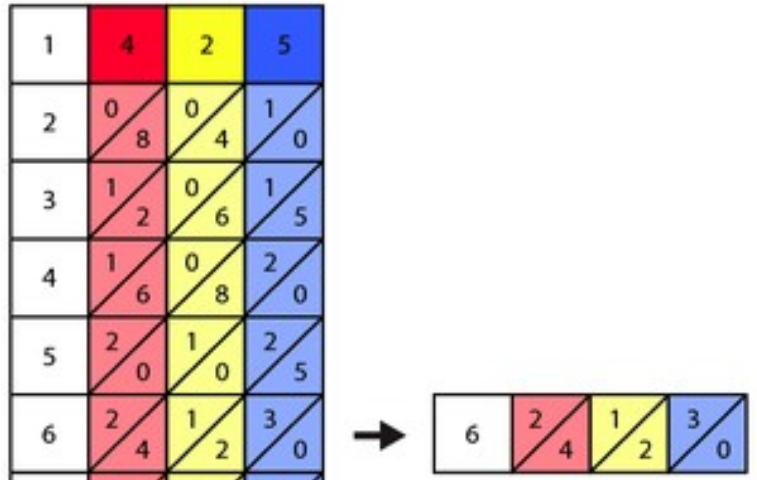
Napier published his version in 1617 in

Napier’s Bones



Napier’s Bones

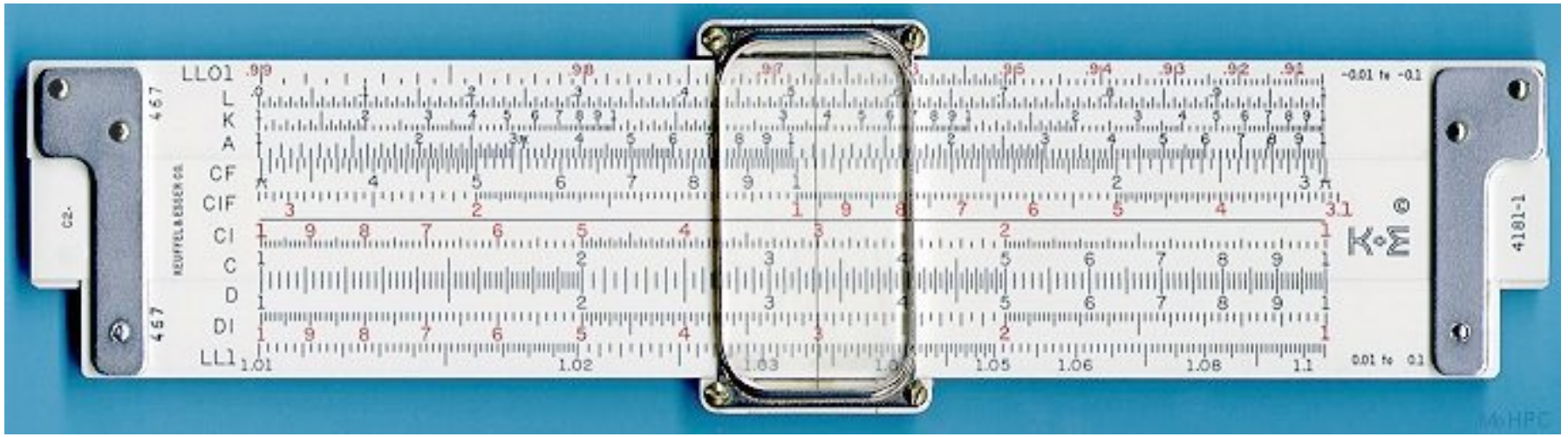
1	4	2	5
2	0/8	0/4	1/0
3	1/2	0/6	1/5
4	1/6	0/8	2/0
5	2/0	1/0	2/5
6	2/4	1/2	3/0
7	2/8	1/4	3/5
8	3/2	1/6	4/0
9	3/6	1/8	4/5



6	2/4 + 1/2 + 3/0		
= 2	= 5	= 5	= 0

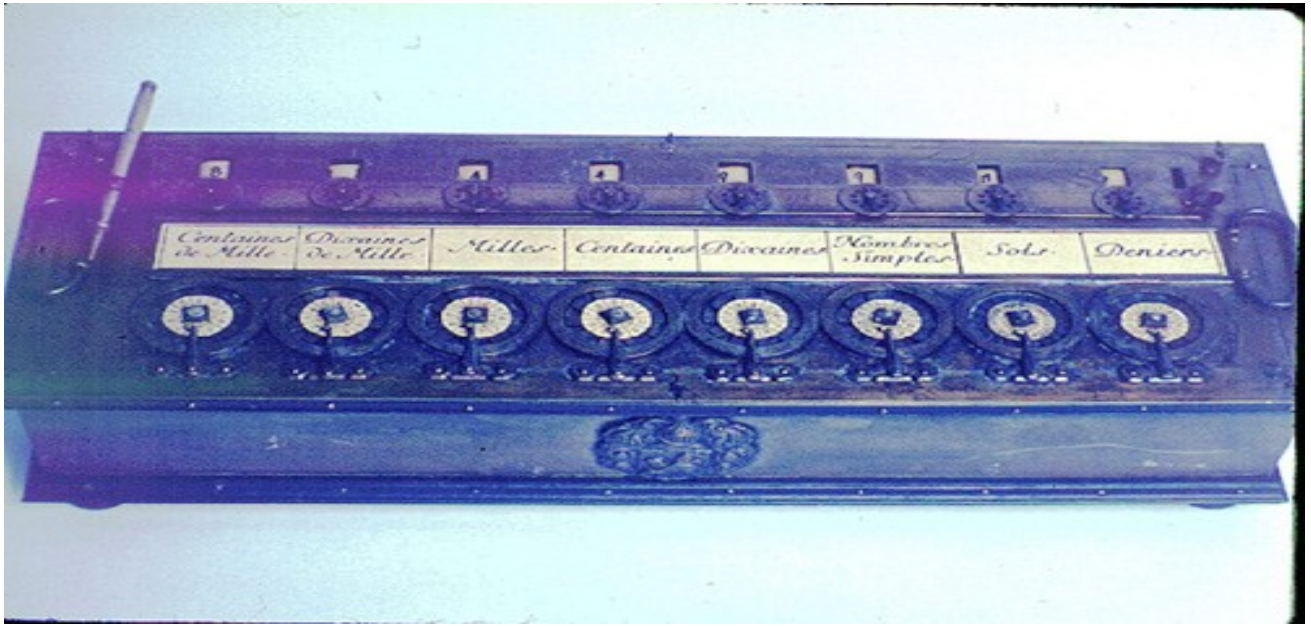
Slide Rule

- Napier's invention led directly to the ***slide rule***, first built in England in 1632 and still in use in the 1960's by the NASA engineers of the Mercury, Gemini, and Apollo programs which landed men on the moon.



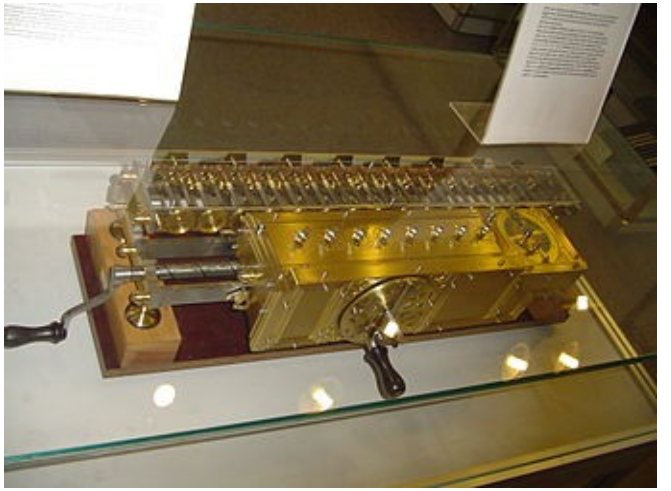
Blaise Pascal

- Also called Arithmetic Machine the first calculator or adding machine to be produced in any quantity and actually used.
- In 1642 Blaise Pascal at age 19, invented the ***Pascaline*** as an aid for his father who was a tax collector.
- The devices weren't that accurate (at that time it was not possible to fabricate gears with the required precision).
- Odometer portion of a car's speedometer used the very same mechanism as the Pascaline to increment the next wheel after each full revolution of the prior wheel.



Leibniz

- Just a few years after Pascal, the German Gottfried Wilhelm Leibniz (co-inventor with Newton of calculus)
- four-function (addition, subtraction, multiplication, and division) calculator that he called the stepped reckoner because, instead of gears, it employed fluted drums having ten flutes arranged around their circumference in a stair-step fashion.
- Although the stepped reckoner employed the decimal number system (each drum had 10 flutes),
- Leibniz was the first to advocate use of the binary number system which is fundamental to the operation of modern computers.



Replica of Leibniz's stepped reckoner in the Deutsches Museum.

Charle’s Babbage

- By 1822 the English mathematician ***Charles Babbage*** was proposing a steam driven calculating machine the size of a room, which he called the ***Difference Engine***.

Difference Engine

- This machine would be able to compute tables of numbers, such as logarithm tables.
- Construction of Babbage's Difference Engine proved exceedingly difficult and the project soon became the most expensive government funded project up to that point in English history.
- Ten years later the device was still nowhere near complete, acrimony abounded between all involved, and funding dried up. **The device was never finished.**

Babbage-Analytic Engine

- Babbage was not deterred, and by then was on to his next brainstorm, which he called the ***Analytic Engine***.
- This device, large as a house and powered by 6 steam engines,
- It was programmable

Babbage-Analytic Engine

- Babbage realized that punched paper could be employed as a storage mechanism, holding computed numbers for future reference.

- Babbage called the two main parts of his Analytic Engine the "Store" and the "Mill", as both terms are used in the weaving industry.

- The Store was where numbers were held and the Mill was where they were "woven" into new results.

- In a modern computer these same parts are called the ***memory unit*** and the ***central processing unit*** (CPU).

Ada Byron (First computer Programmer)

- Babbage befriended ***Ada Byron***, the daughter of the famous poet Lord Byron
- Though she was only 19, she was fascinated by Babbage's ideas
- She began fashioning programs for the Analytic Engine, although still unbuilt.
- The Analytic Engine remained unbuilt (the British government refused to get involved with this one) but Ada earned her spot in history as the first computer programmer.
- Ada invented the subroutine and was the first to recognize the importance of looping.

US Census

- The next breakthrough occurred in America. The U.S. Constitution states that a census should be taken of all U.S. citizens every 10 years in order to determine the representation of the states in Congress.

- While the very first census of 1790 had only required 9 months, by 1880 the U.S. population had grown so much that the count for the 1880 census took 7.5 years. Automation was clearly needed for the next census.

- The census bureau offered a prize for an inventor to help with the 1890 census and this prize was won by Herman Hollerith,

Hollerith Desk

Hollerith Desk

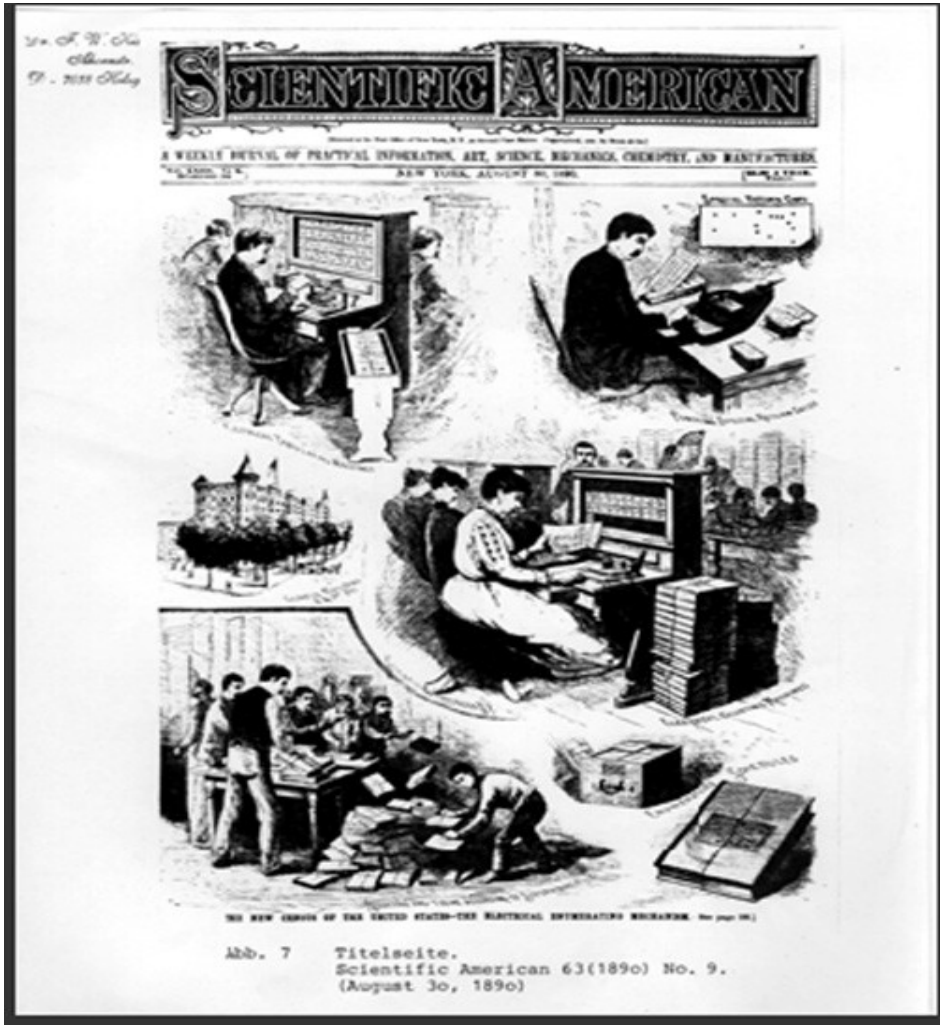
- Hollerith's technique was successful and the 1890 census was completed in only 3 years at a savings of 5 million dollars.

IBM

- Hollerith built a company, the Tabulating Machine Company which, after a few buyouts, eventually became International Business Machines, known today as ***IBM***.

Hollerith's Innovation

- By using punch cards, Hollerith created a way to store and retrieve information.
- This was the first type of read and write technology



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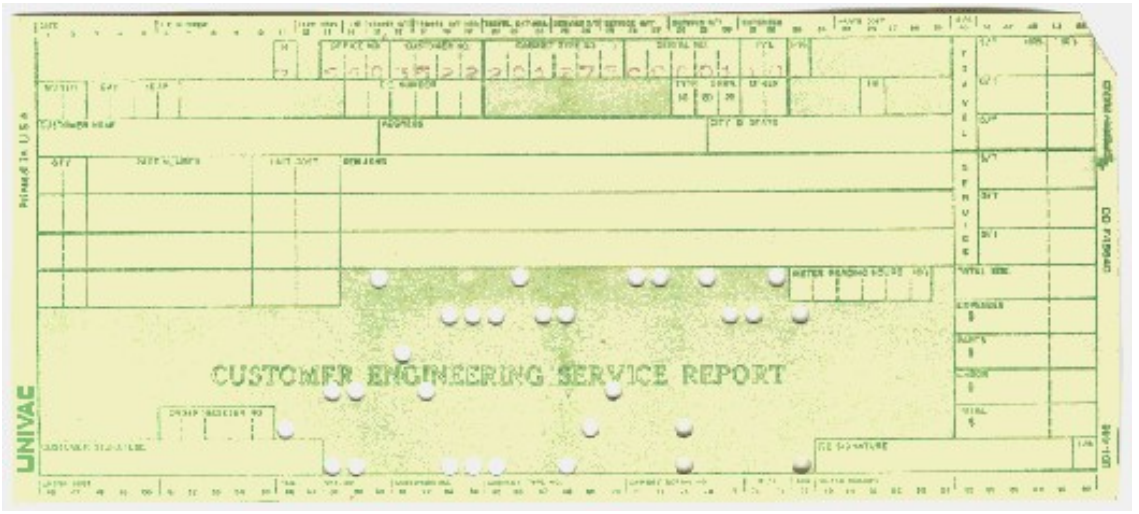
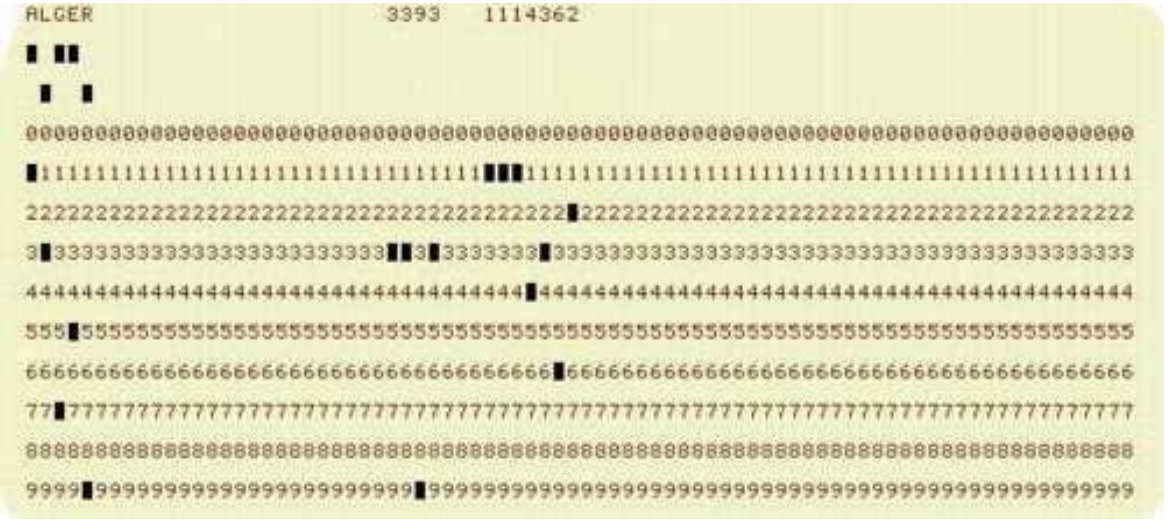
Scientific American 63(189o) No. 9.
(August 3o, 189o)

Examples of Punch Cards



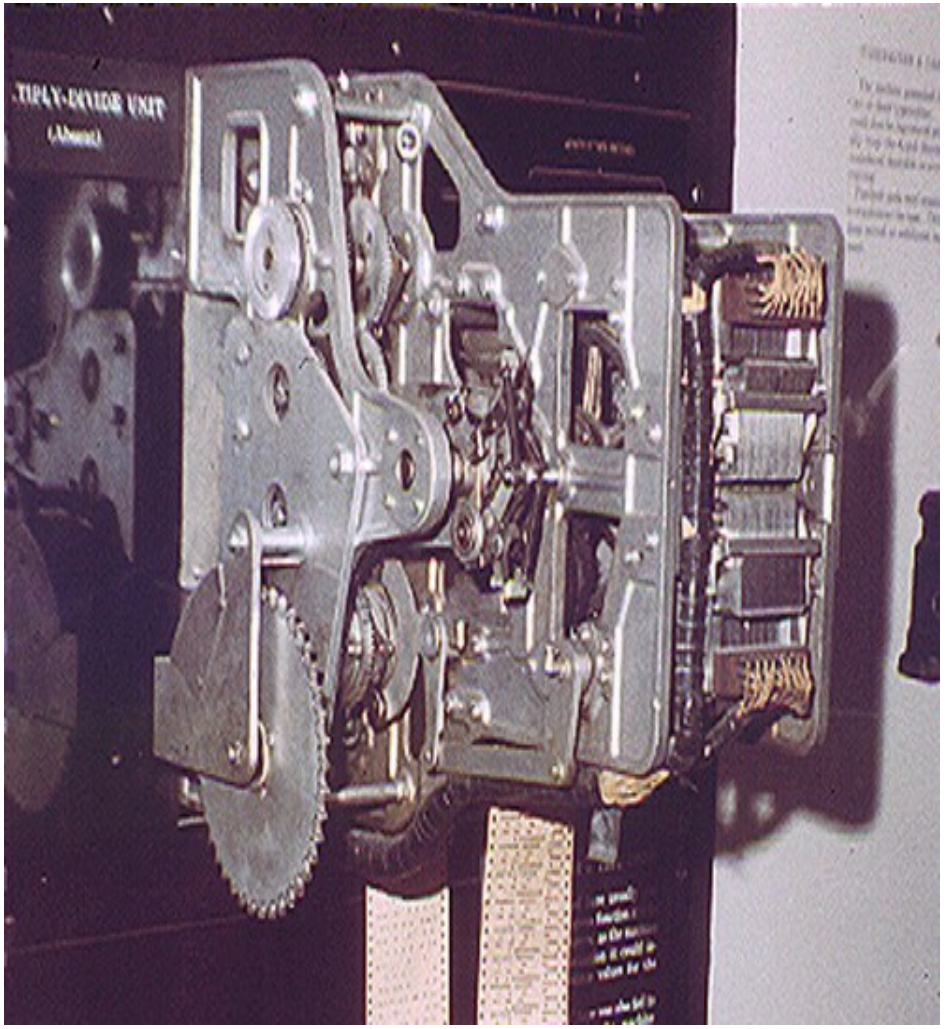


US Military

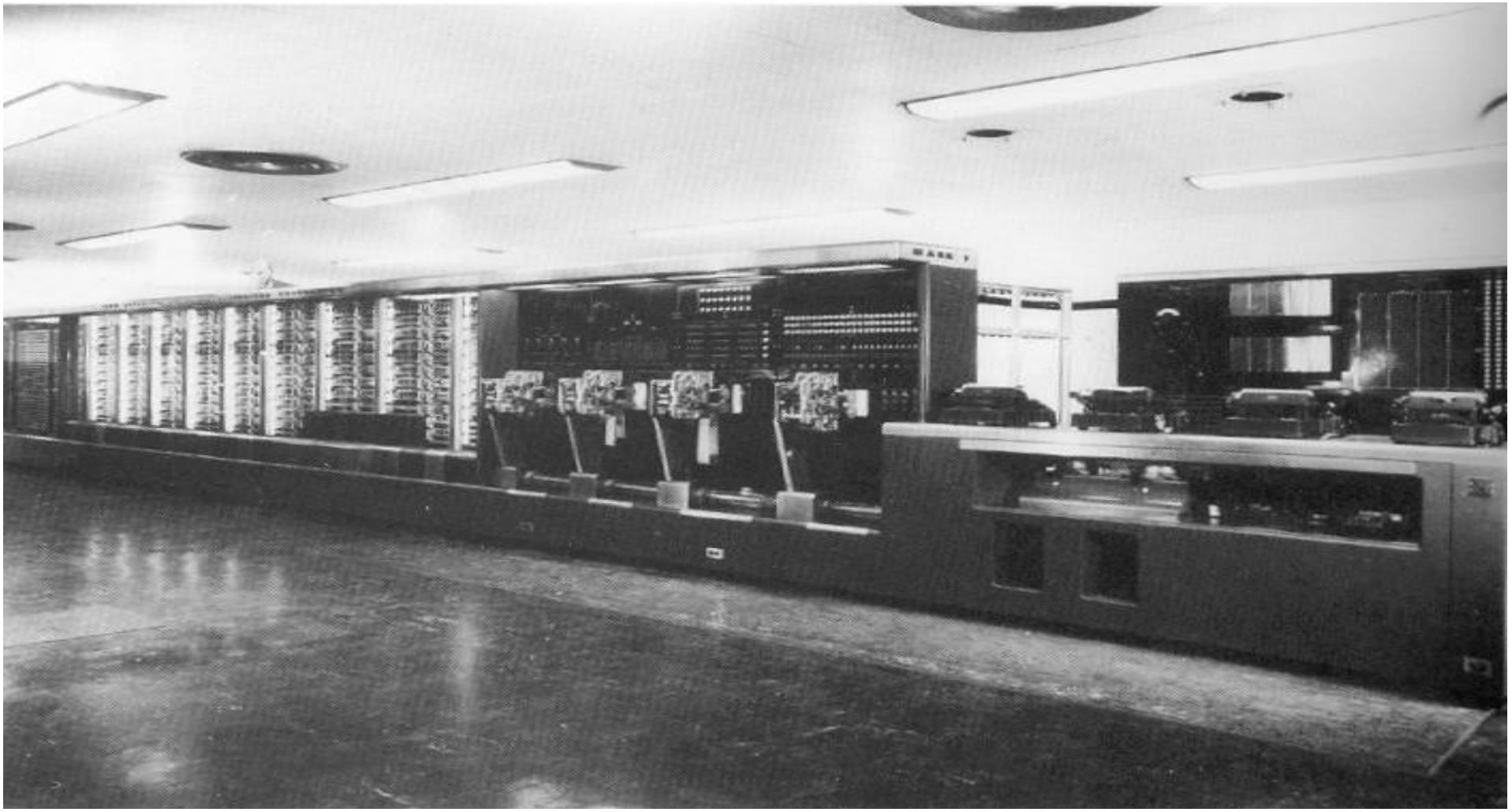
- The U.S. military desired a mechanical calculator more optimized for scientific computation.
- By World War II the U.S. had battleships that could lob shells weighing as much as a small car over distances up to 25 miles.
- Physicists could write the equations that described how atmospheric drag, wind, gravity, muzzle velocity, etc. would determine the trajectory of the shell, but solving such equations was extremely laborious.

Mark I

- The machine weighed 5 tons, incorporated 500 miles of wire, was 8 feet tall and 51 feet long, and had a 50 ft rotating shaft running its length, turned by a 5 horsepower electric motor.
- The Mark I ran non-stop for 15 years, sounding like a roomful of ladies knitting.

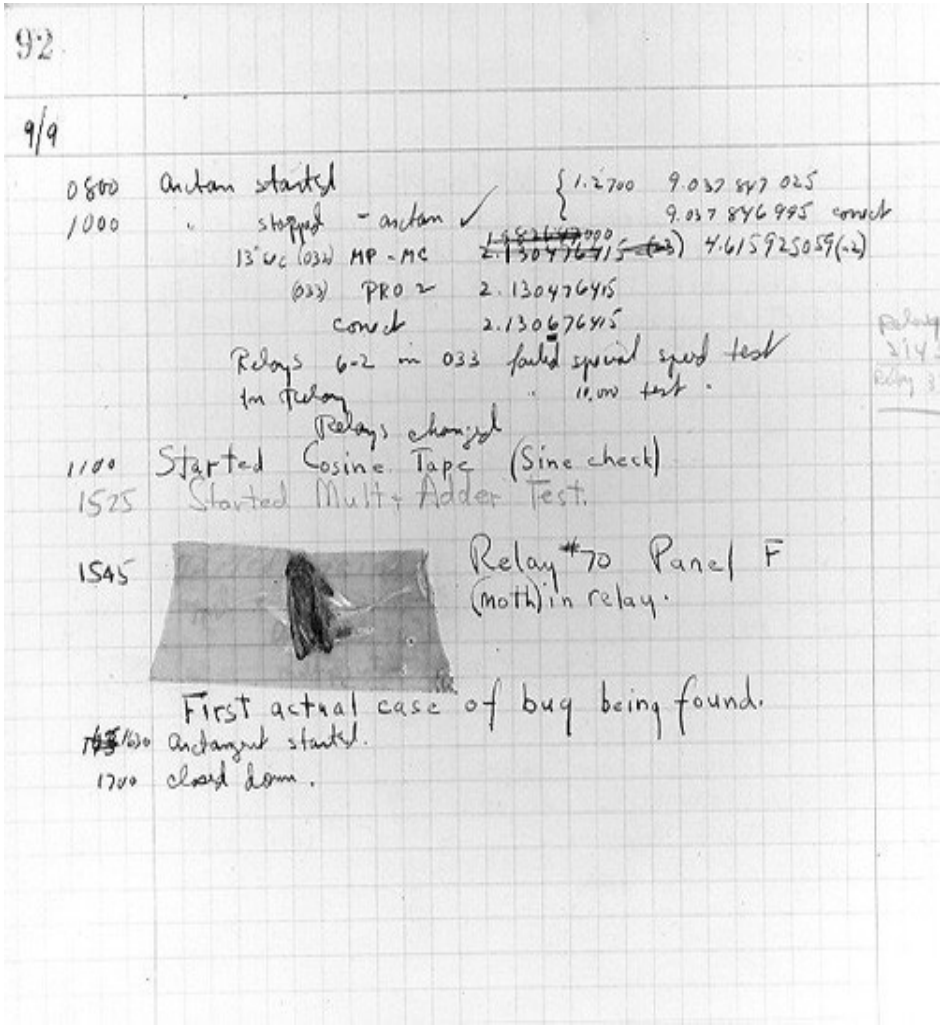


Mark I



The First Bug

- One of the primary programmers for the Mark I was a woman, ***Grace Hopper***.
- Hopper found the first computer "bug": a dead moth that had gotten into the Mark I
- The word "bug" had been used to describe a defect since at least 1889 but Hopper is credited with coining the word "debugging" to describe the work to eliminate program faults.



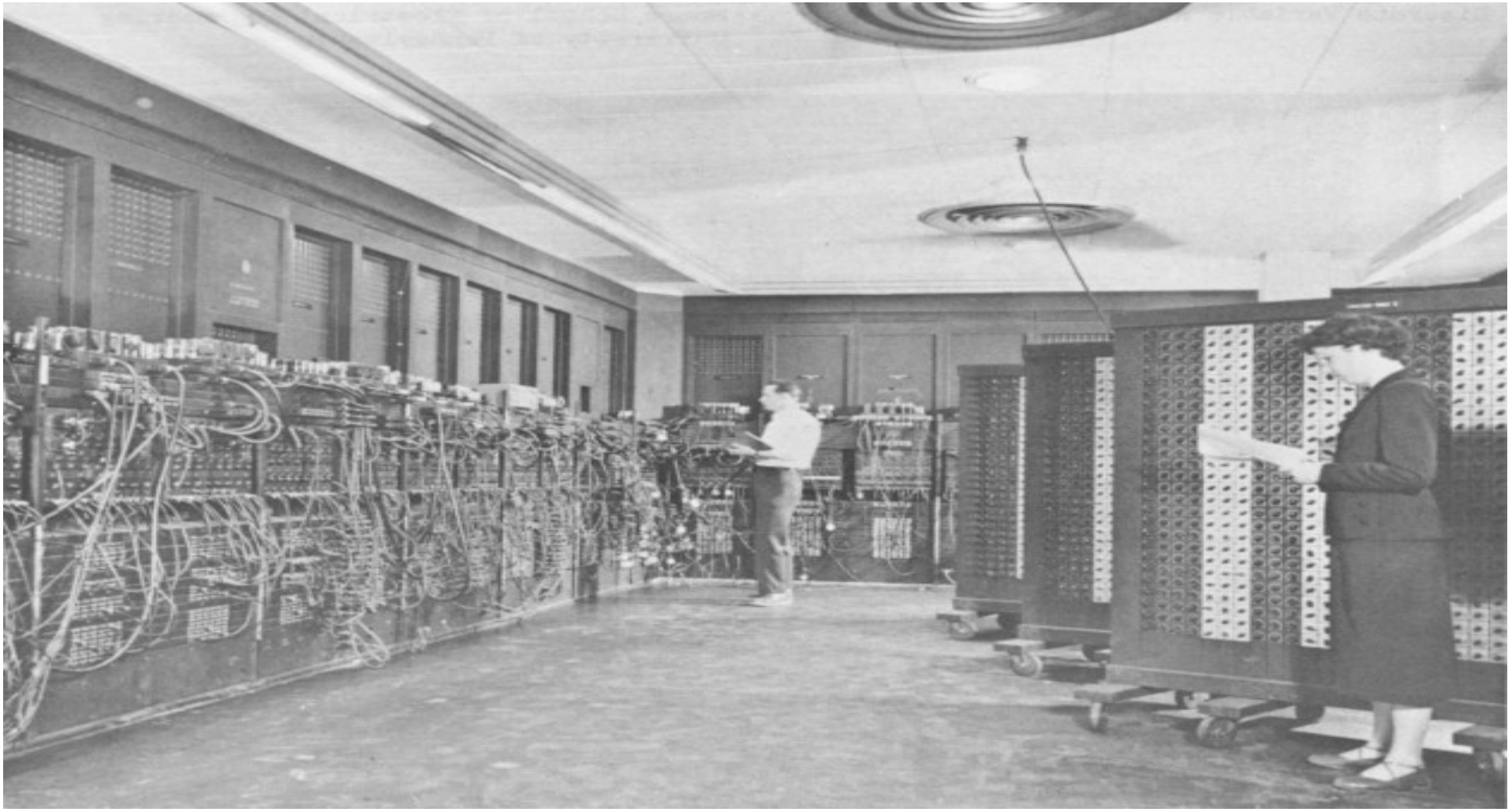
First Generation Computers

- The first electronic computer was designed at Iowa State between 1939-1942
- The Atanasoff-Berry Computer used the binary system(1’s and 0’s).
- Contained vacuum tubes and stored numbers for calculations by burning holes in paper

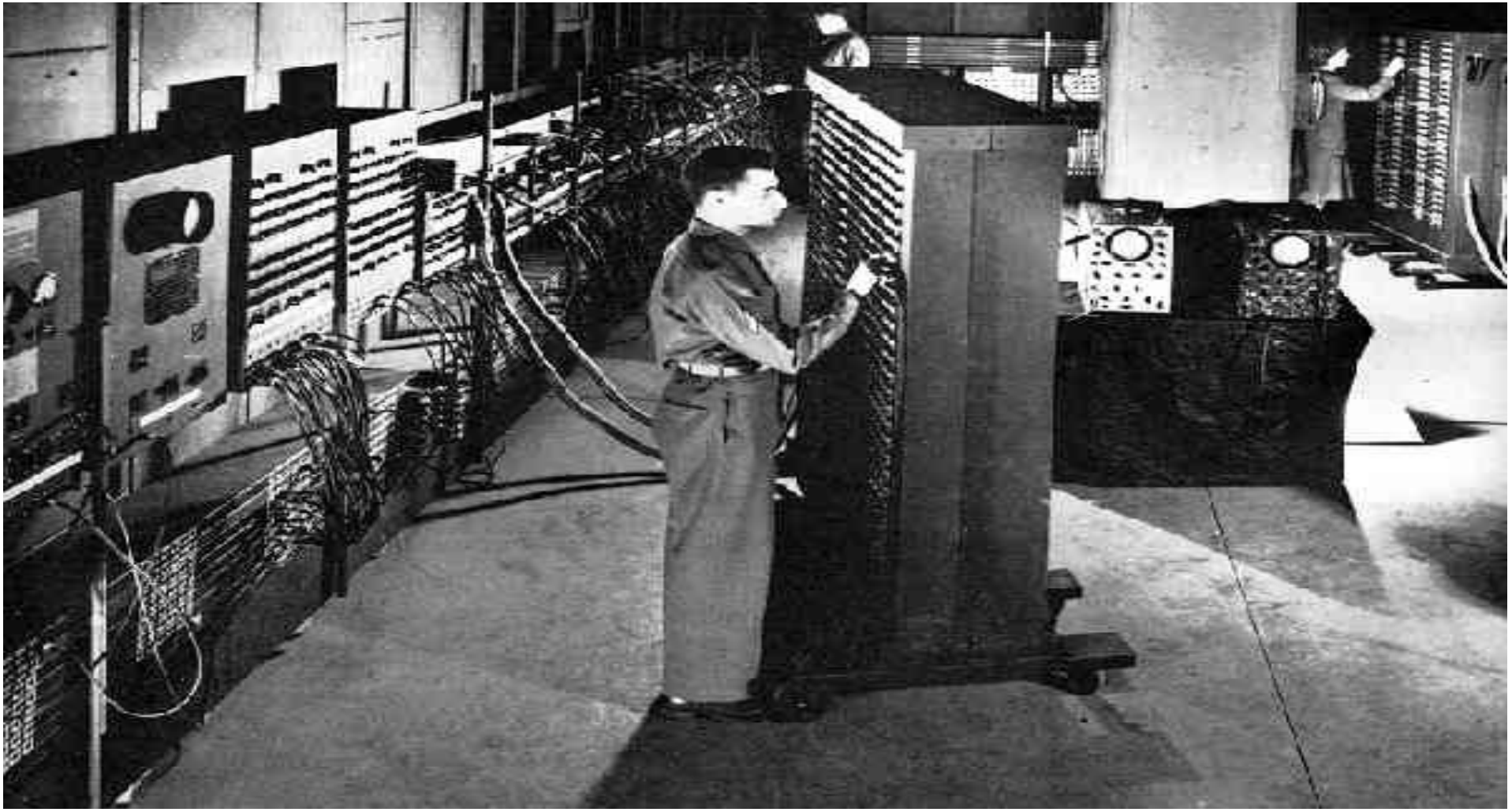
Eniac

- The title of forefather of today's all-electronic digital computers is usually awarded to ***ENIAC***, which stood for Electronic Numerical Integrator and Calculator.
- ENIAC was built at the University of Pennsylvania between 1943 and 1945 by two professors, ***John Mauchly*** and the 24 year old ***J. Presper Eckert***, who got funding from the war department after promising they could build a machine that would replace all the "computers"
- ENIAC filled a 20 by 40 foot room, weighed 30 tons, and used more than 18,000 vacuum tubes.

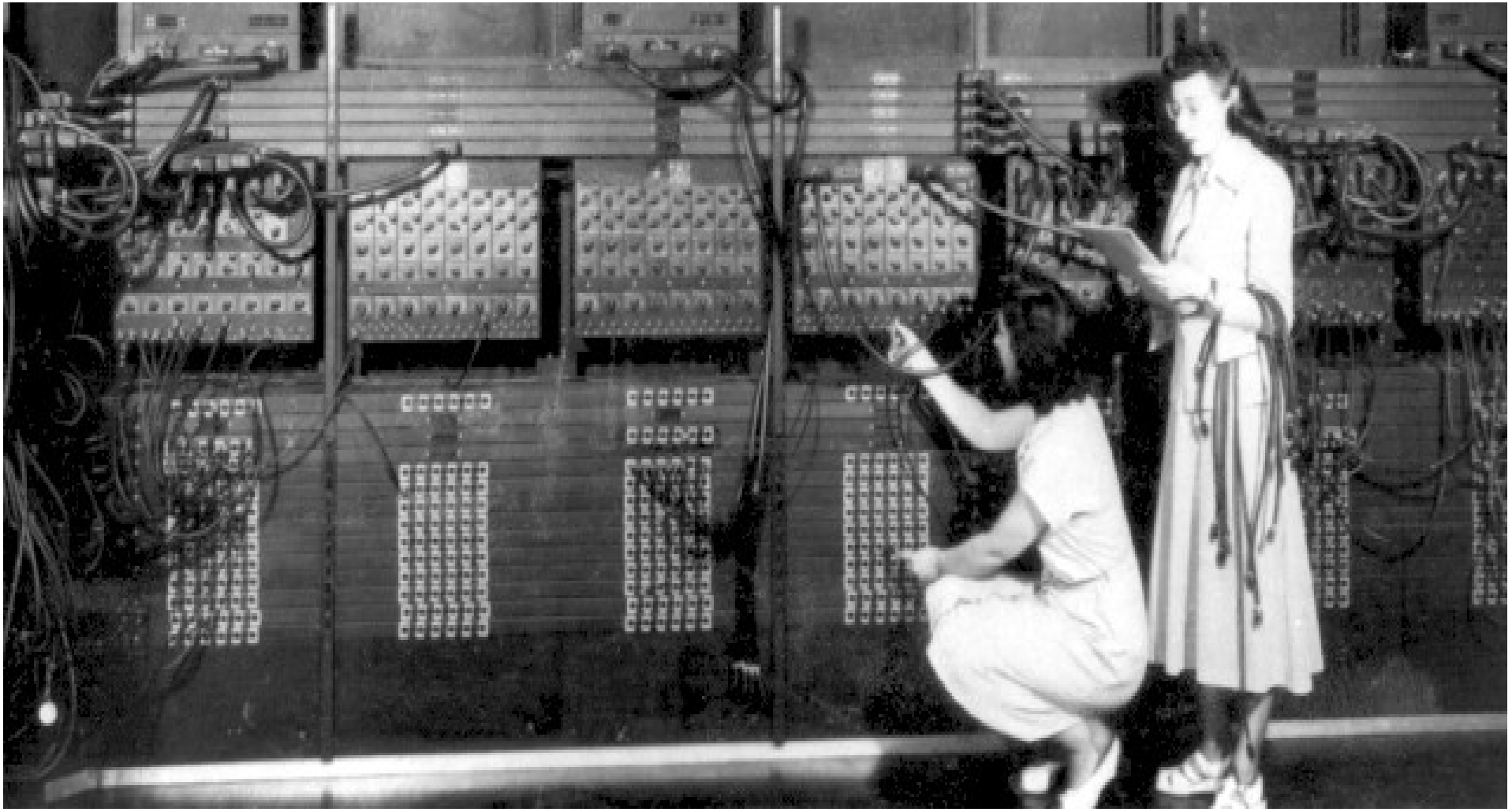
ENIAC



ENIAC



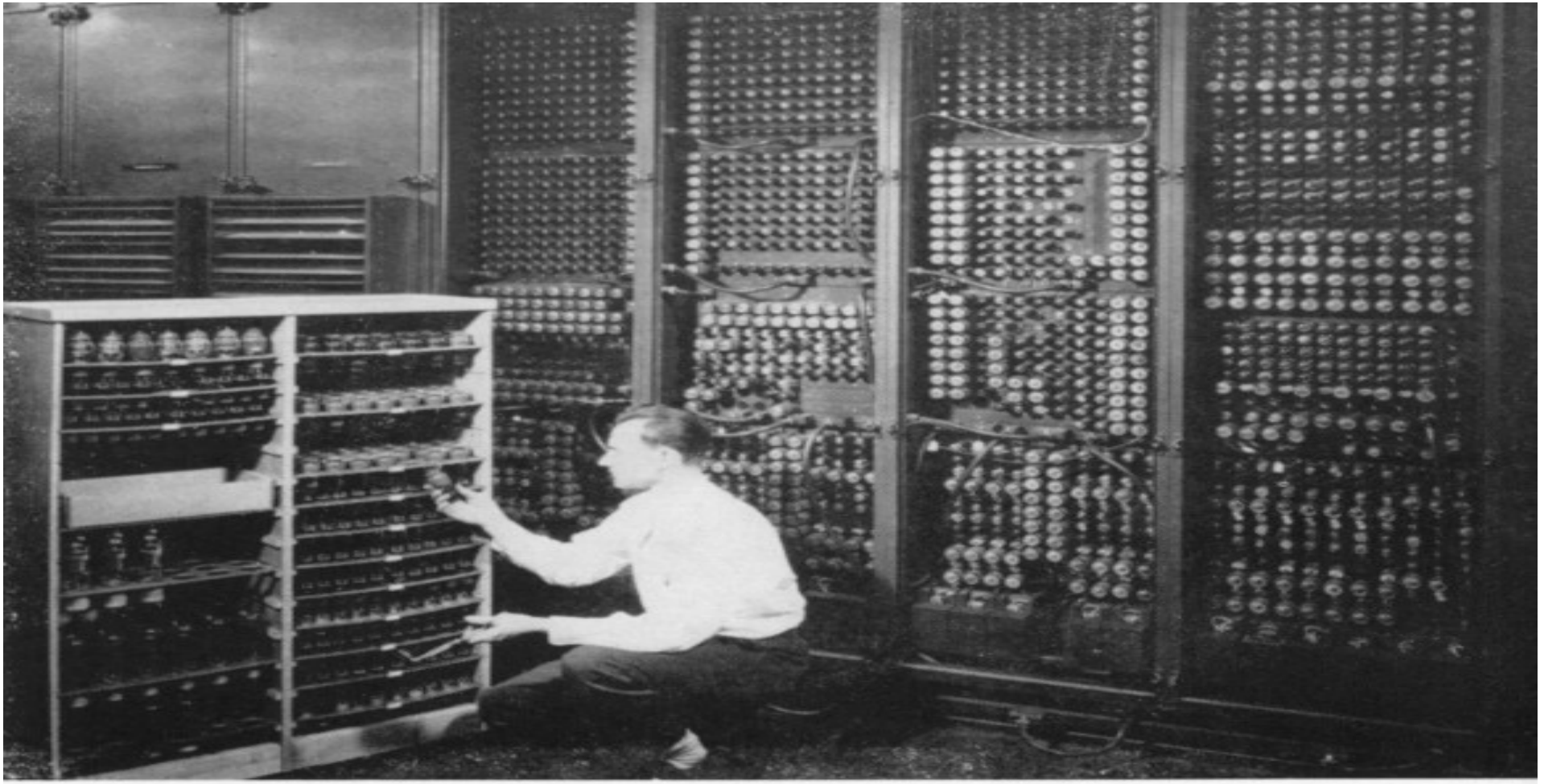
Programming the ENIAC



Problems with the ENIAC

- The ENIAC used 18,000 vacuum tubes to hold a charge
- Vacuum tubes were so notoriously unreliable

Replacing a vacuum tube



Replacing a bad tube meant checking among ENIAC's 19,000 possibilities.

The Stored Program Computer

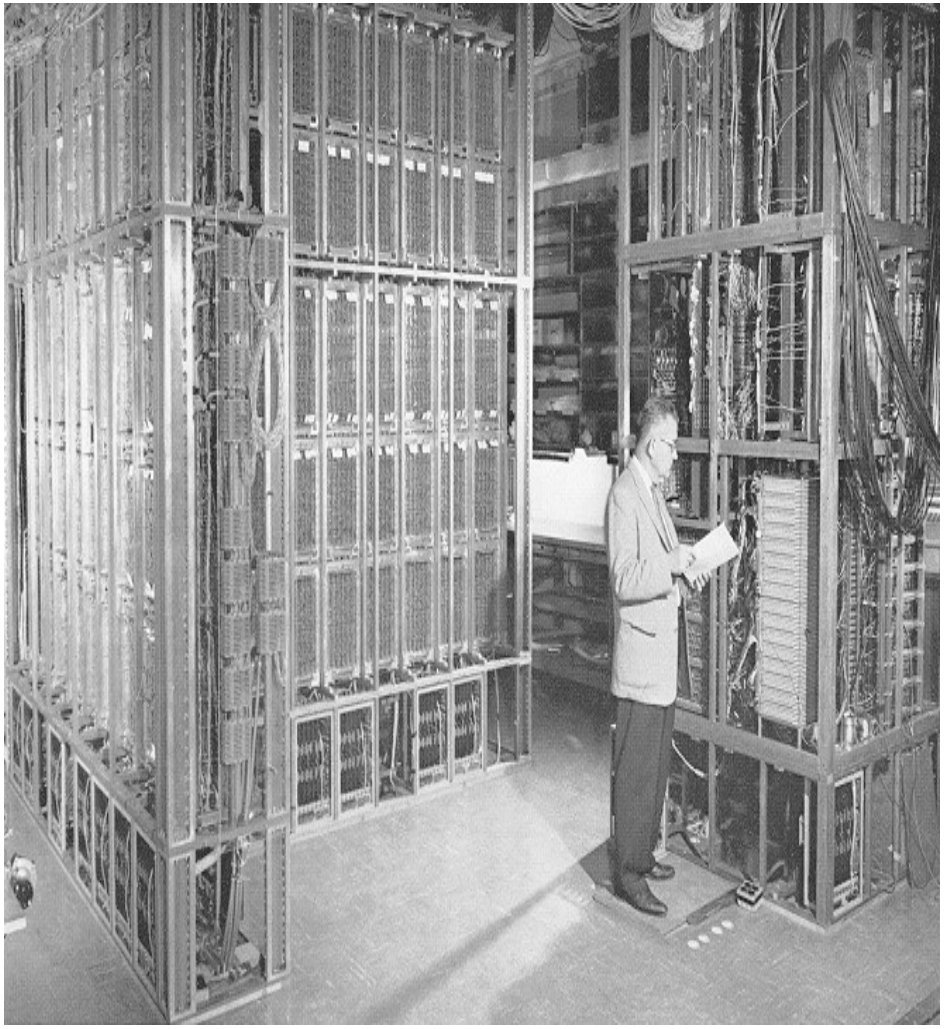
- In 1945 John von Neumann presented his idea of a computer that would store computer instructions in a CPU
- The CPU(Central Processing Unit) consisted of elements that would control the computer electronically

The Stored Program Computer

- The EDVAC (Electronic discrete variable automatic computer), EDSAC(Electronic Delay Storage Automatic Calculator) and UNIVAC were the first computers to use the stored program concept

Edvac

- It took days to change ENIAC's program.
- Eckert and Mauchly's next teamed up with the mathematician ***John von Neumann*** to design ***EDVAC***, which pioneered the ***stored program***.
- After **ENIAC** and **EDVAC** came other computers with humorous names such as **ILLIAC, JOHNNIAC**, and, of course, **MANIAC**



Second Generation Computers

- In 1947, the transistor was invented
- The transistor made computers smaller, less expensive and increased calculating speeds.
- Second generation computers also saw a new way of storing data
- Punch cards were replaced with magnetic tapes and reel to reel machines

Univac

- The ***UNIVAC*** computer was the first commercial (mass produced) computer.
- In the 50's, UNIVAC (a contraction of "Universal Automatic Computer") was the household word for "computer"

- UNIVAC was also the first computer to employ magnetic tape.

Third Generation Computers

- Transistors were replaced by integrated circuits(IC)
- One IC could replace hundreds of transistors
- This made computers even smaller and faster.

Fourth Generation Computers

- In 1970 the Intel Corporation invented the Microprocessor:an entire CPU on one chip
- This led to microcomputers-computers on a desk

Computer Programming in the ’70’s

- computer programming in the 1970's, are called ***mainframe computers***, such as the IBM 7090 (shown below), IBM 360, or IBM 370.

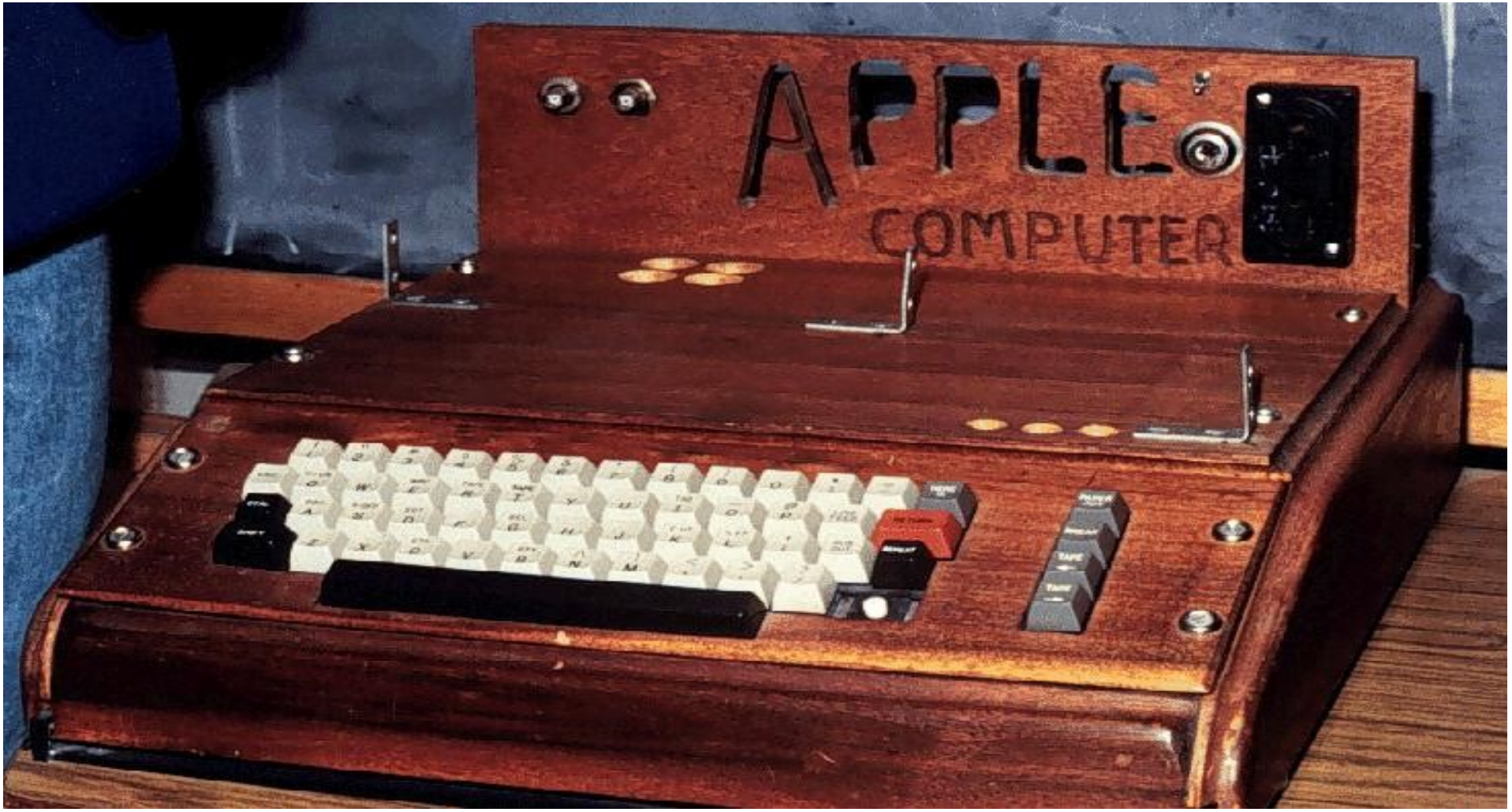
Punch Cards

- University students in the 1970's bought blank cards a linear foot at a time from the university bookstore.
- Each card could hold only 1 program statement.
- To submit your program to the mainframe, you placed your stack of cards in the hopper of a card reader.
- Your program would be run whenever the computer made it that far.
- You often submitted your deck and then went to dinner or to bed and came back later hoping to see a successful printout showing your results

Programming

- By the 1990's a university student would typically own his own computer and have exclusive use of it in his dorm room.

Apple 1 Computer - 1976



The IBM PC

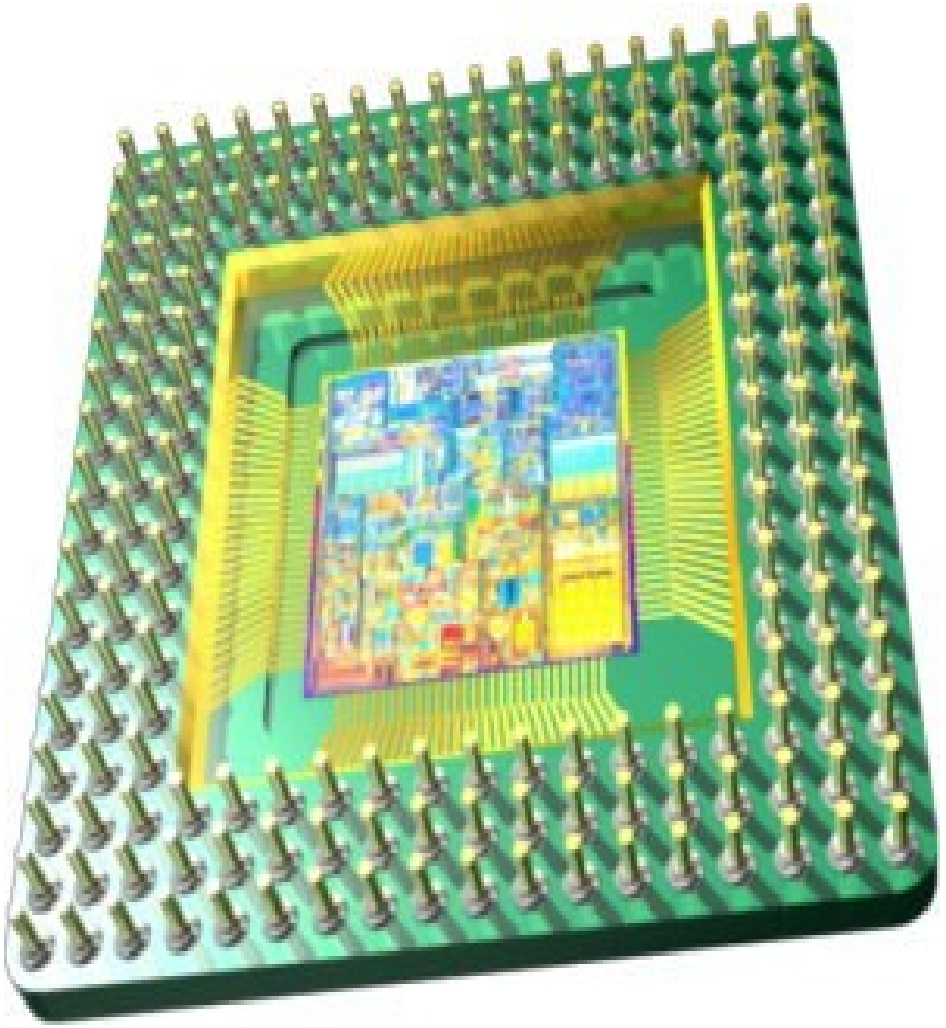
Commodore 64

Apple Macintosh

The Amiga

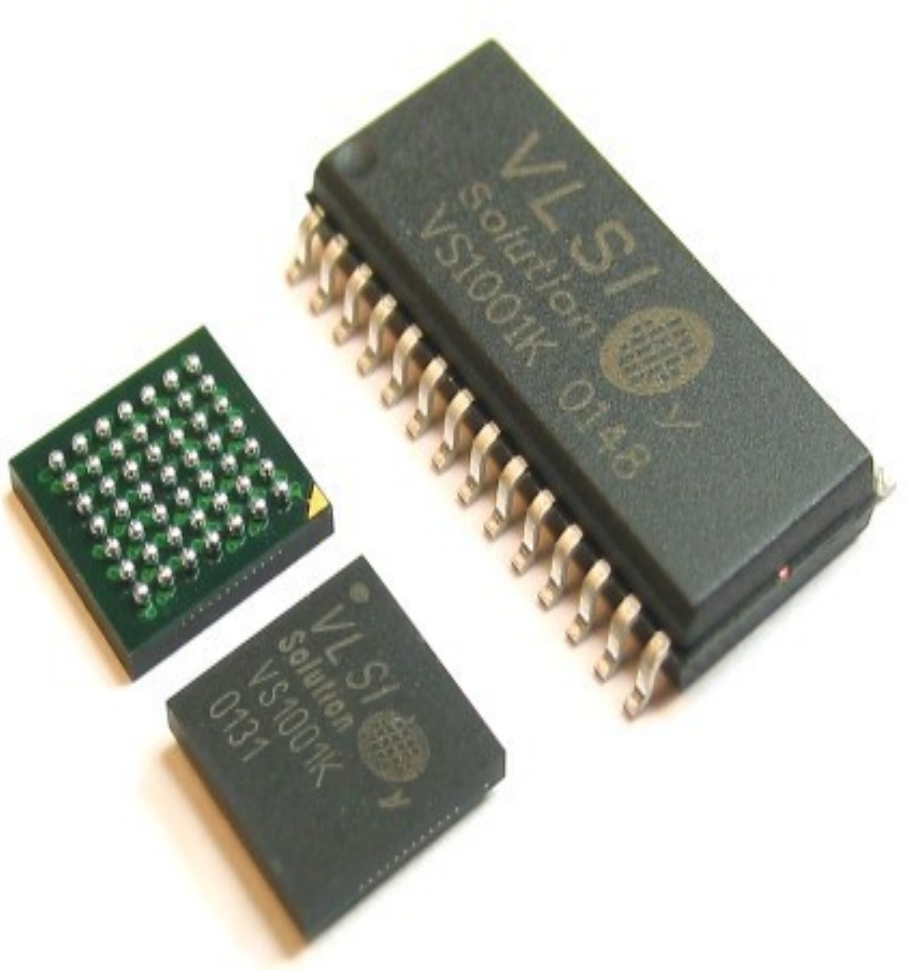
Microprocessor

- This transformation was a result of the invention of the ***microprocessor***.
- A microprocessor (uP) is a computer that is fabricated on an integrated circuit (IC).
- Computers had been around for 20 years before the first microprocessor was developed at ***Intel*** in 1971.



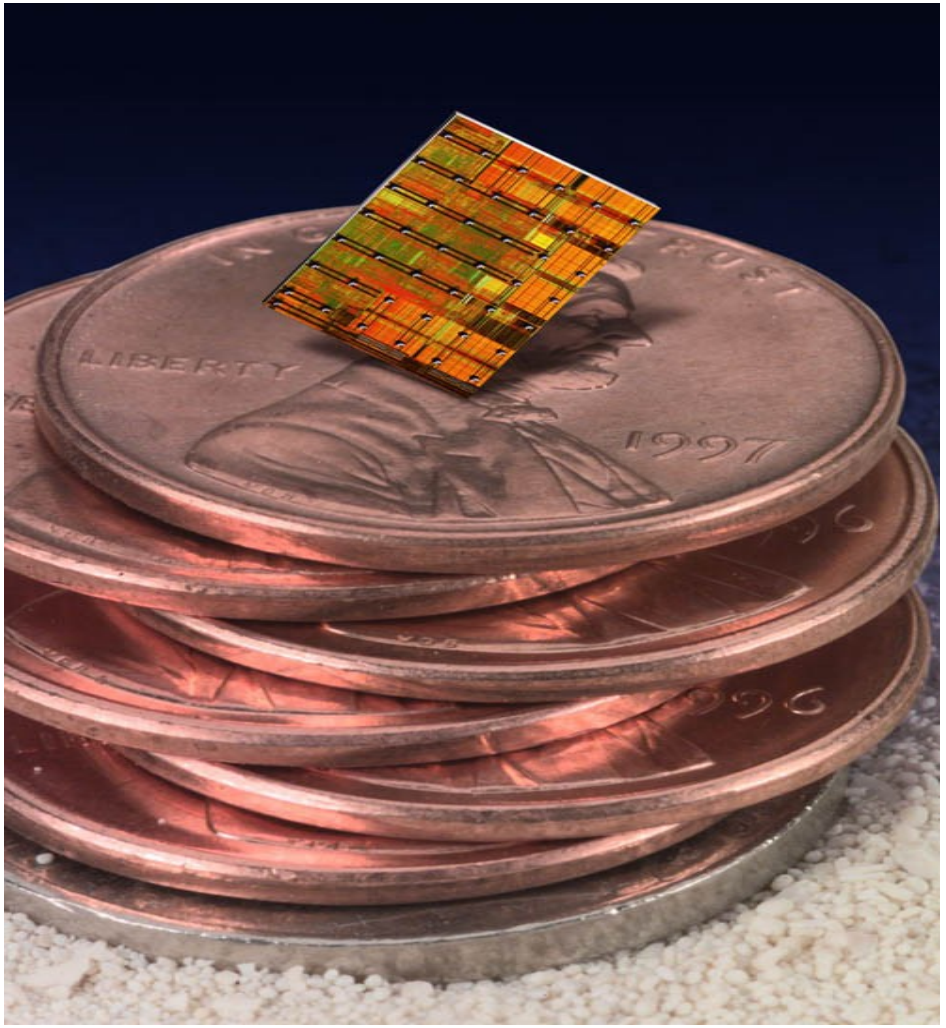
Microprocessor

- The micro in the name microprocessor refers to the physical size.
- Intel didn't invent the electronic computer, but they were the first to succeed in cramming an entire computer on a single ***chip*** (IC)



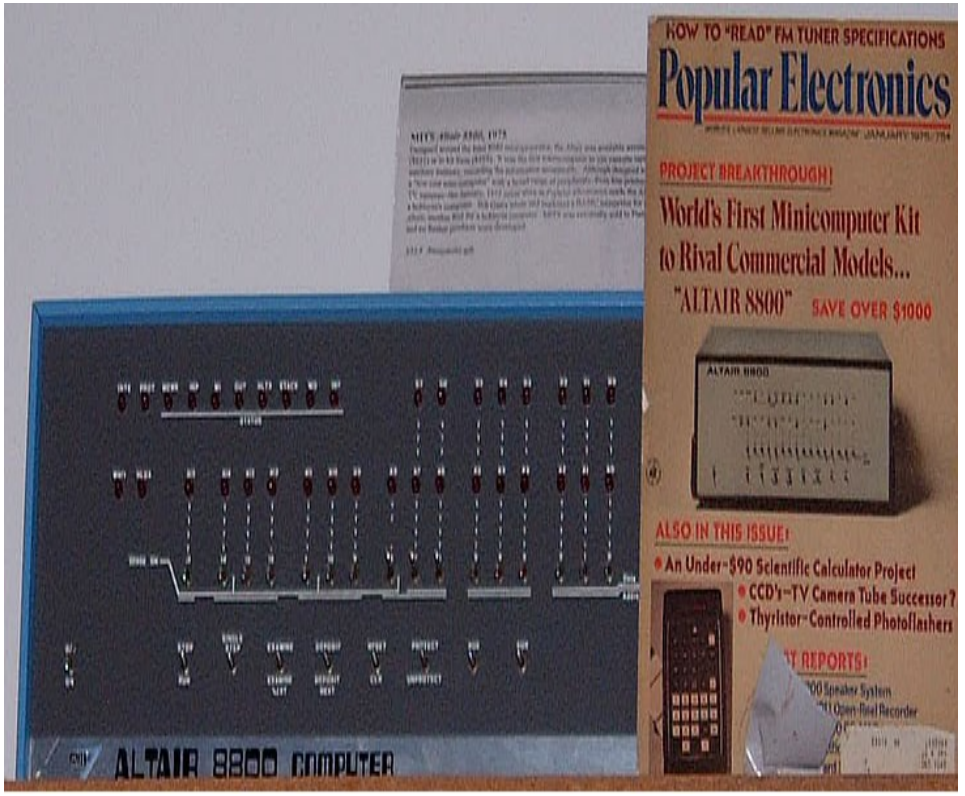
Integrated Circuits

- The ***microelectronics revolution*** is what allowed the amount of hand-crafted wiring seen in the prior photo to be mass-produced as an ***integrated circuit*** which is a small sliver of silicon the size of your thumbnail

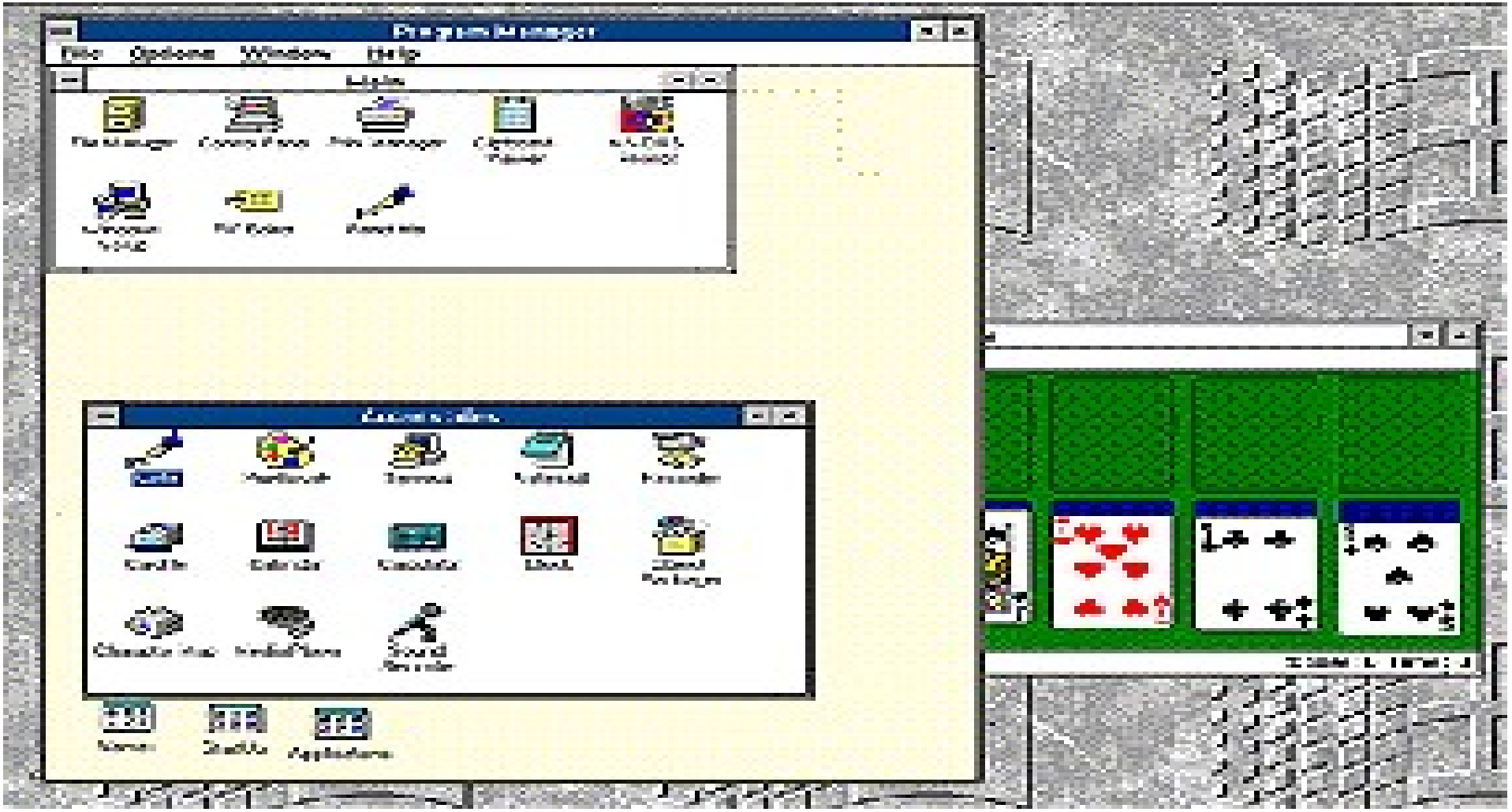


Integrated Circuits

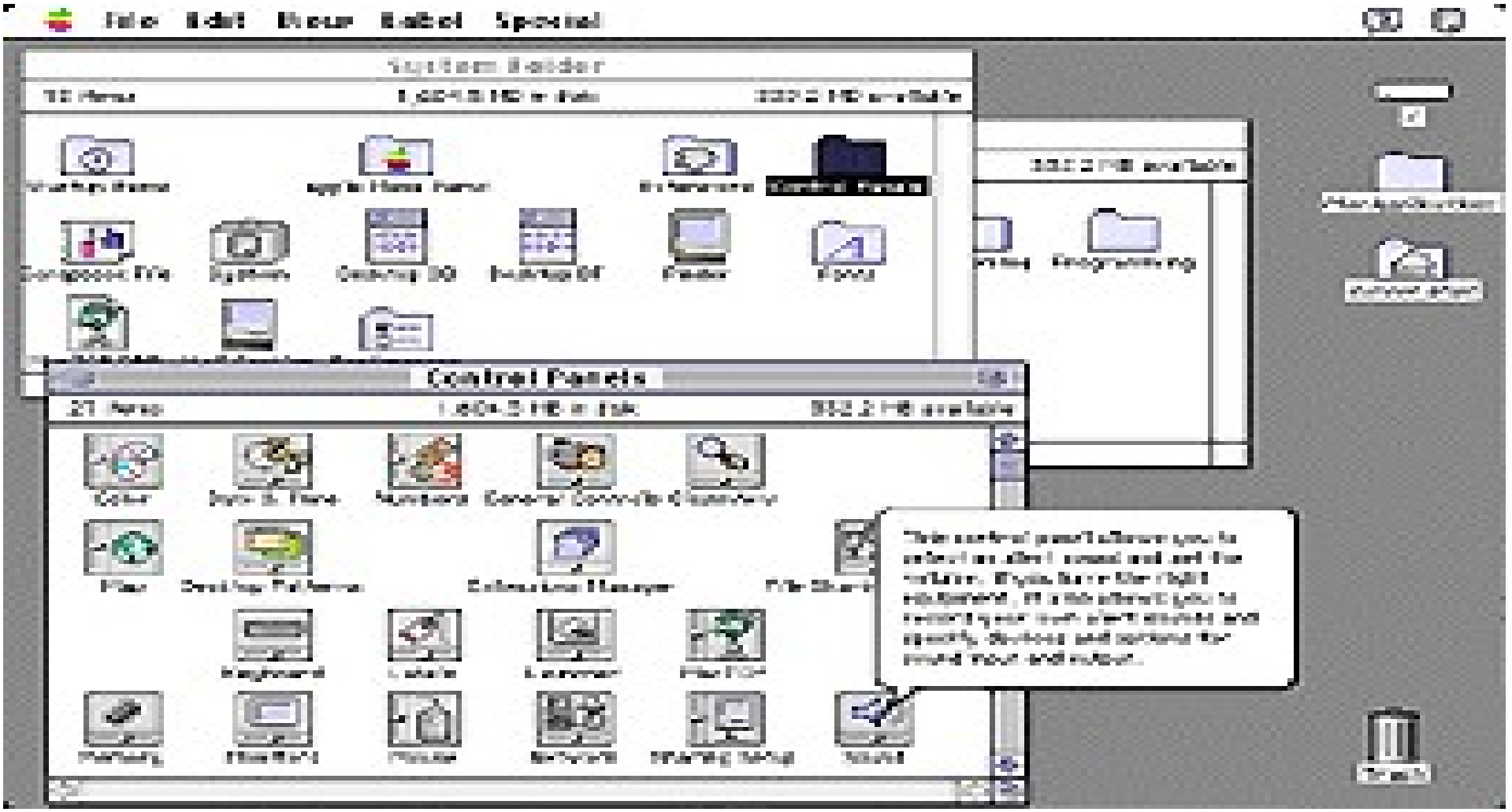
- Integrated circuits and microprocessors allowed computers to be faster
- This led to a new age of computers
- The first home-brew computers is called the ALTAIR 8800



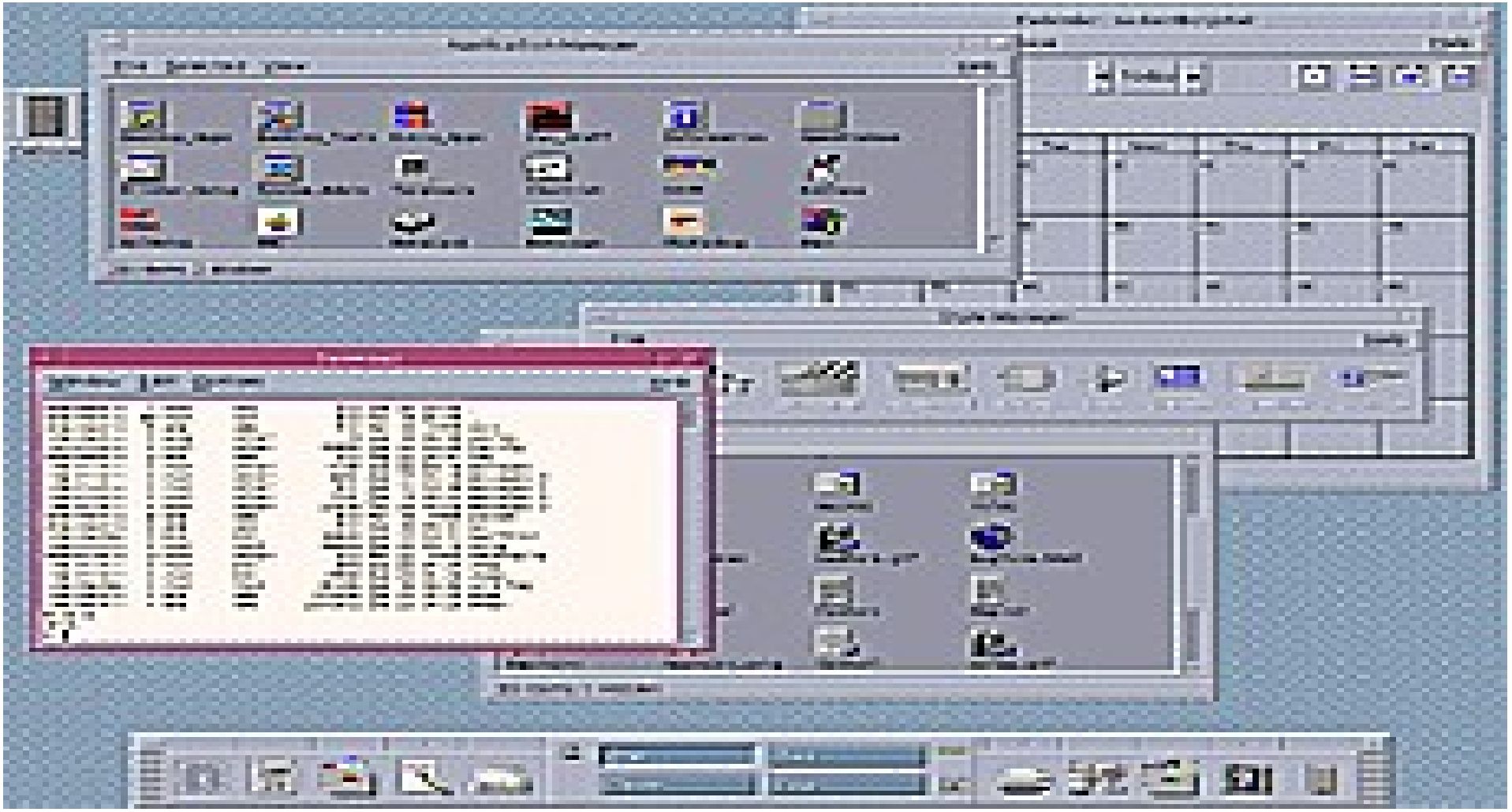
Windows 3



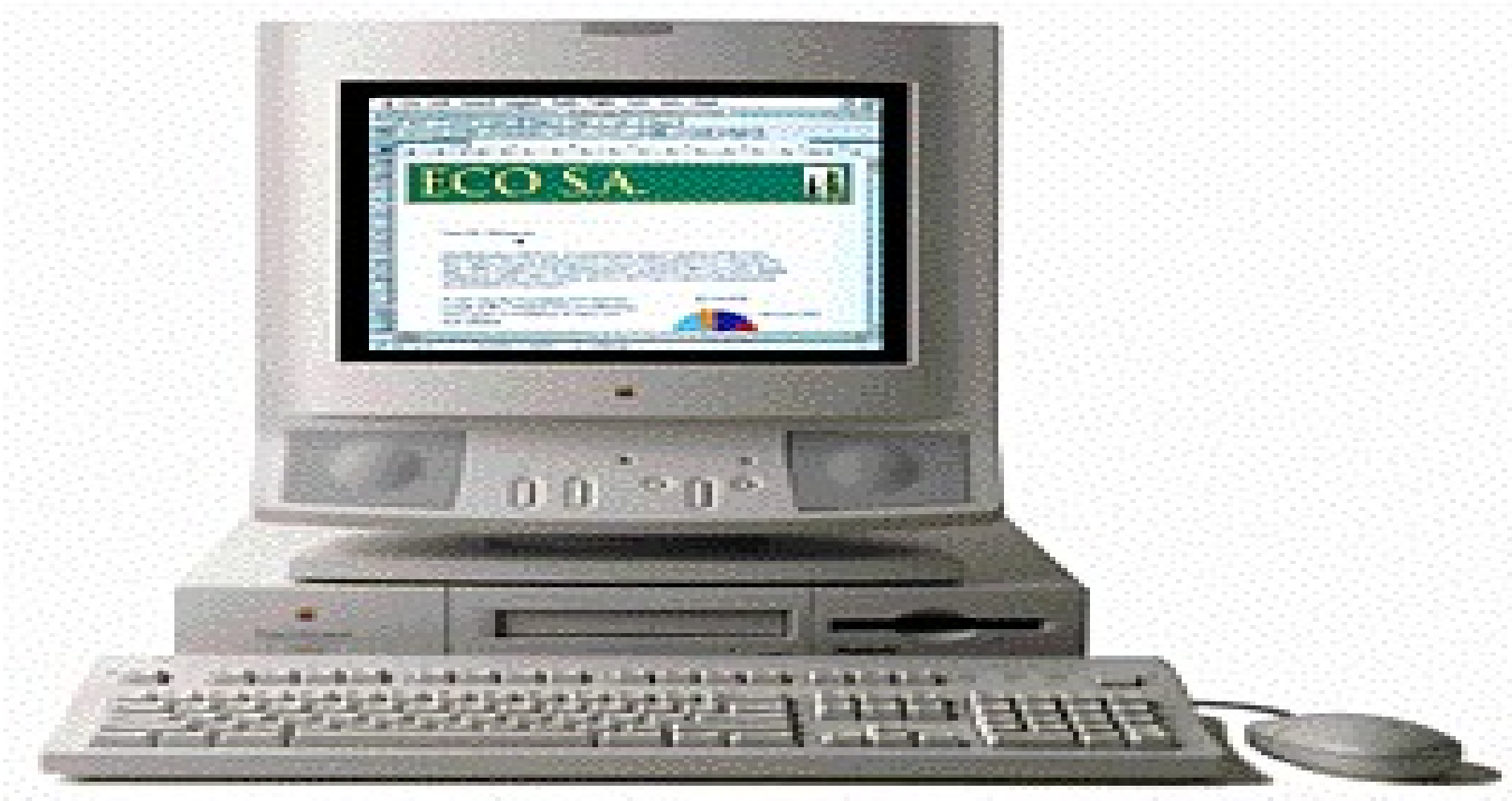
Macintosh System 7



Standard UNIX



PowerPC



Windows 95

References

- Most of the information for this power point was obtained from the following web page:
- http://www.computersciencelab.com/ComputerHistory/History.htm