A Brief History of Computing

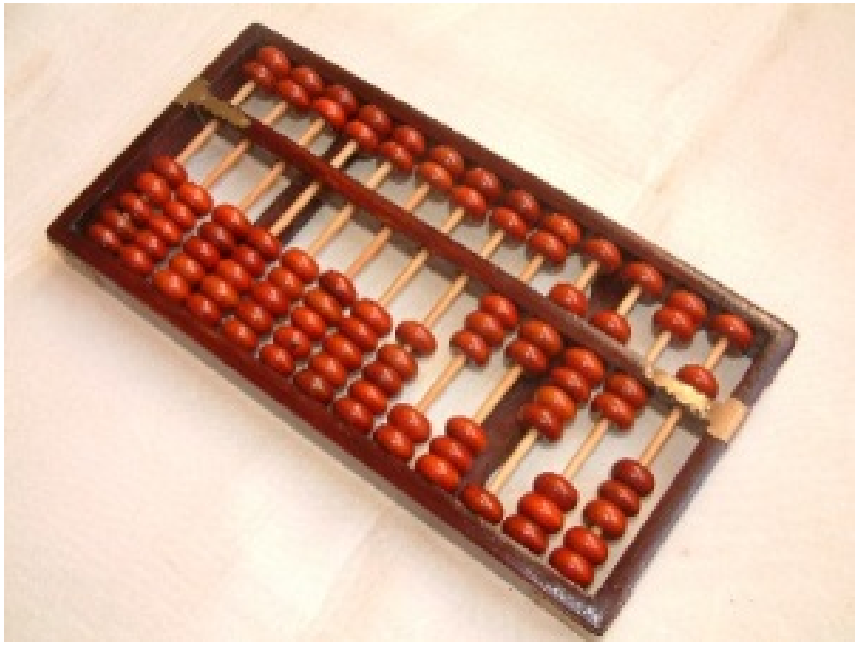
Part I
Ancient History: up to 1930

LASSONDE SCHOOL OF ENGINEERING | YORK UNIVERSITÉ UNIVERSITY | EECS ELECTRICAL ENGINEERING AND COMPUTER SCIENCE

Origins of Digital Computers

- earliest computing devices designed to aid numeric computation

- abacus: first developed in Babylonia, over 5000 years ago and still used today



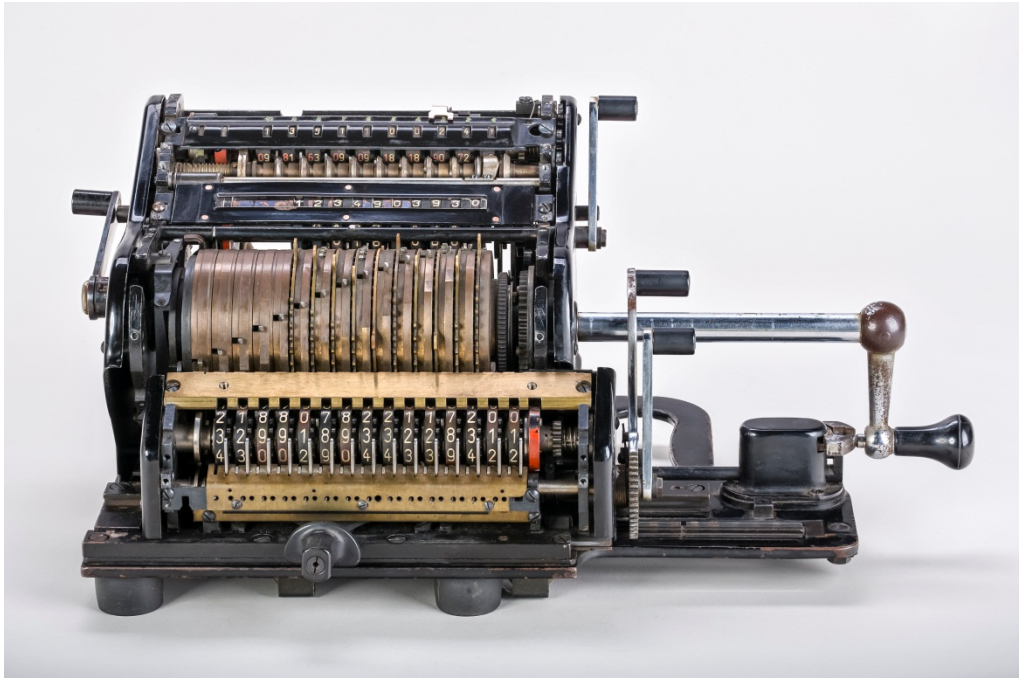
Early Calculating Machines

- William Schickard (1592-1635), mechanical calculator

- Blaise Pascal (1623-1662), decimal calculator, could add and subtract

Early Calculating Machines

- G. W. F. Leibniz (1646-1716), “Stepped Reckoner”, full-featured calculator, (“Leibniz wheel” for multiplication)



Jacquard Loom (1804)

Charles Babbage (1791 – 1871)

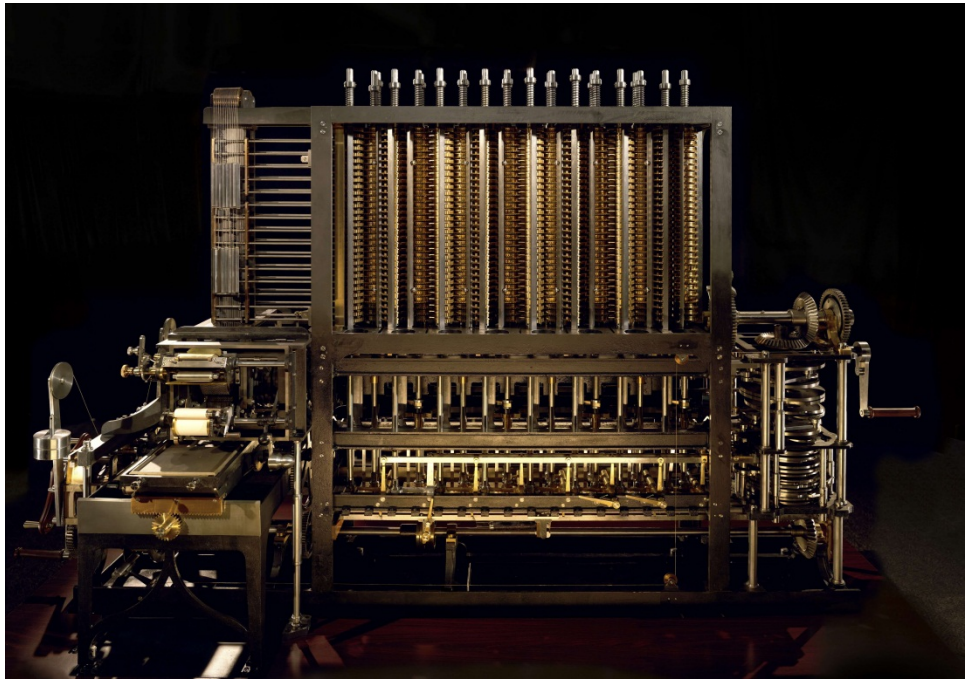
- First true pioneer of modern computing machines
- Designed two calculating machines, neither of which was practical to build
- Difference Engine
- Analytical Engine

Charles Babbage

- Analytic Engine
- Babbage was inspired by Jacquard's use of punch cards to control a (weaving) machine
- Given the technology of the time, it could only be built using rods and gears and powered by STEAM
- It was never built

Babbage's Difference Engine

- Automated both the computation of tables and their printing
- Special-purpose calculating machine
- used the method of differences to calculate polynomials



World's First Programmer

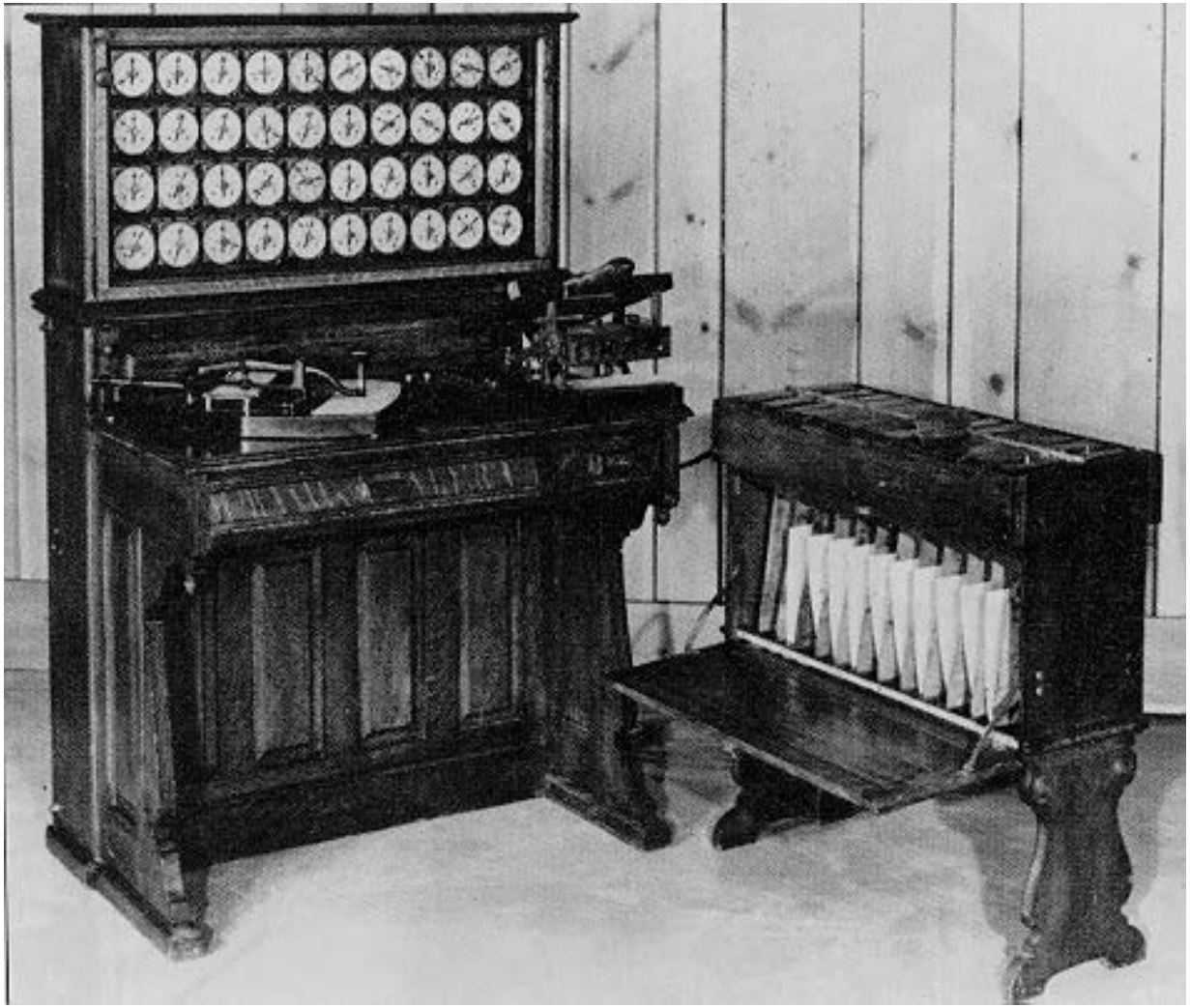
- Ada, daughter of Lord Byron, wrote programs for the Difference Engine, making her the first programmer…

Babbage's Legacy

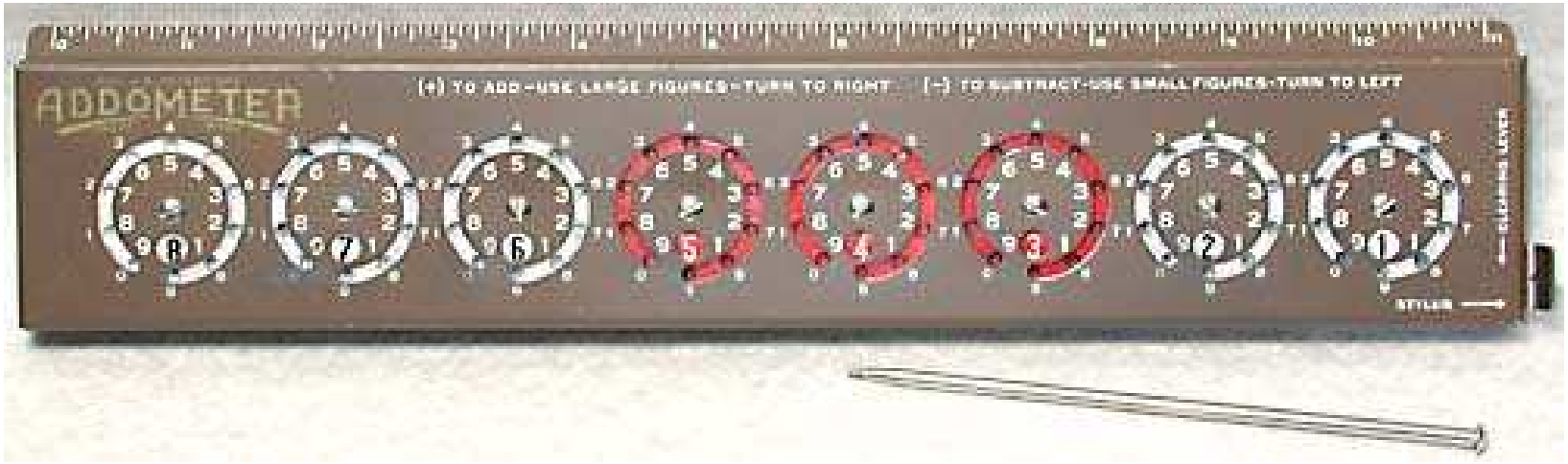
- Designed the first general-purpose digital computing device
- His ideas were way ahead of their times
- First complete Difference Engine was completed in London in 2002. Faithful to the original drawings, it consists of 8,000 parts, weighs 5 tons and is 11 feet long

1880 to 1901: The Birth of the Modern Mechanical Calculator

Hollerith Tabulator



Early “Pocket” Calculator



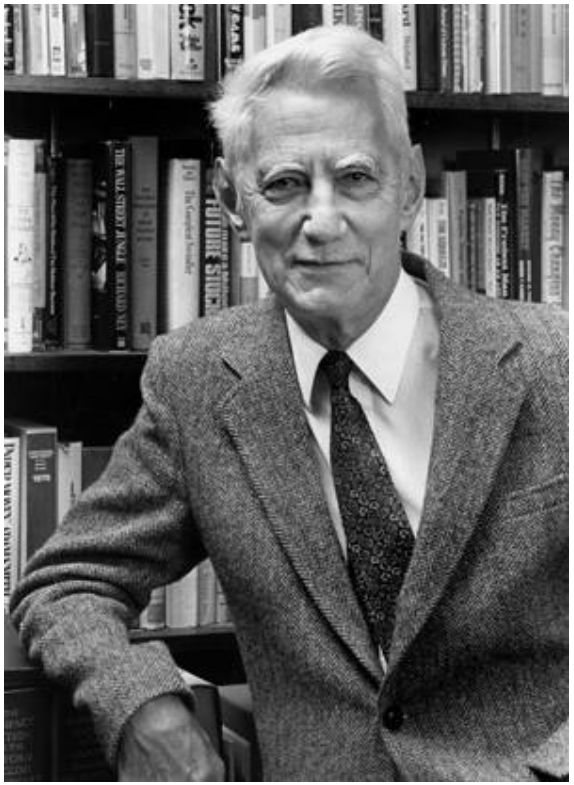
A Brief History of Computing

Part II
Birth of the Electronic Computer
1930 to 1951

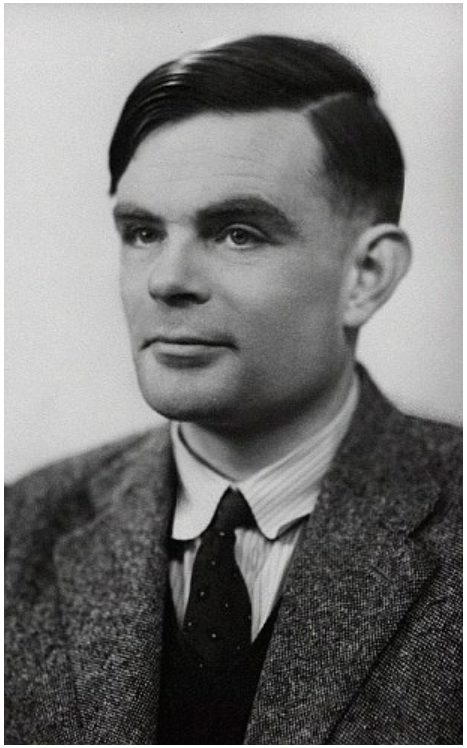
LASSONDE SCHOOL OF ENGINEERING | YORK UNIVERSITÉ UNIVERSITY | EECS ELECTRICAL ENGINEERING AND COMPUTER SCIENCE

Claude Shannon (1916 – 2001)

- In 1937, introduces the concept of binary logic for use in creating digital computing machines
- In 1948 publishes “A mathematical theory of communication” which establishes the principals for encoding information so it might be reliably transmitted electronically
- Considered the Father of the modern information age



Alan Turing (1912 – 1954)

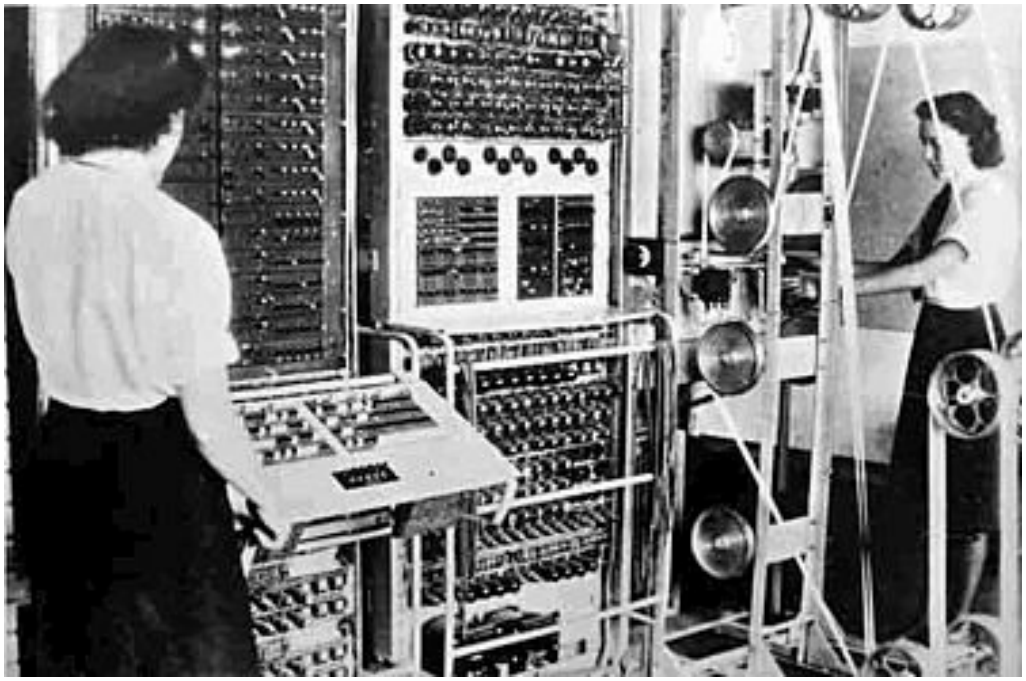


- Led the World War II research group that broke the code for the Enigma machine
- Proposed a simple abstract universal machine model for defining computability – The Turing Machine
- Devised the “Turing Test” for Artificial Intelligence

The Enigma Machine

- Invented in 1918, it was the most sophisticated code system of its day, and a priority for the Allies to break it as the Germans believed it was unbreakable

Alan Turing and his Colossus



- constructed an electronic computing machine in 1943 to help decrypt German coded messages

IBM Harvard Mark I (1944)

- IBM Automatic Sequence Controlled Calculator, installed at Harvard University in 1944. It was 51 feet long, weighed 5 tons and has 750,000 parts including 72 accumulators and 60 sets of rotary switches

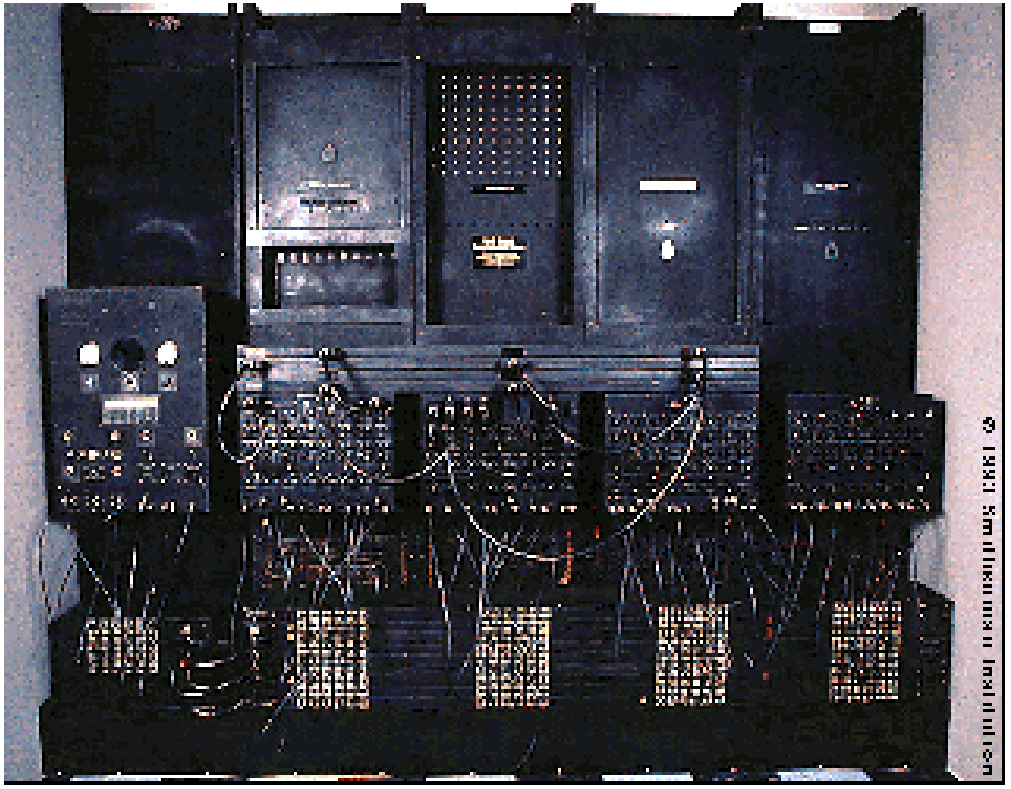
Mauchly and Eckert

- John W. Mauchly (1907-1980) and J. Presper Eckert (1919-1995) headed the ENIAC team at the Moore School of Engineering, University of Pennsylvania
- ENIAC (Electronic Numerical Integrator And Computer) is the first general-purpose electronic digital computer
- Commissioned by the United States Army for computing ballistic firing tables

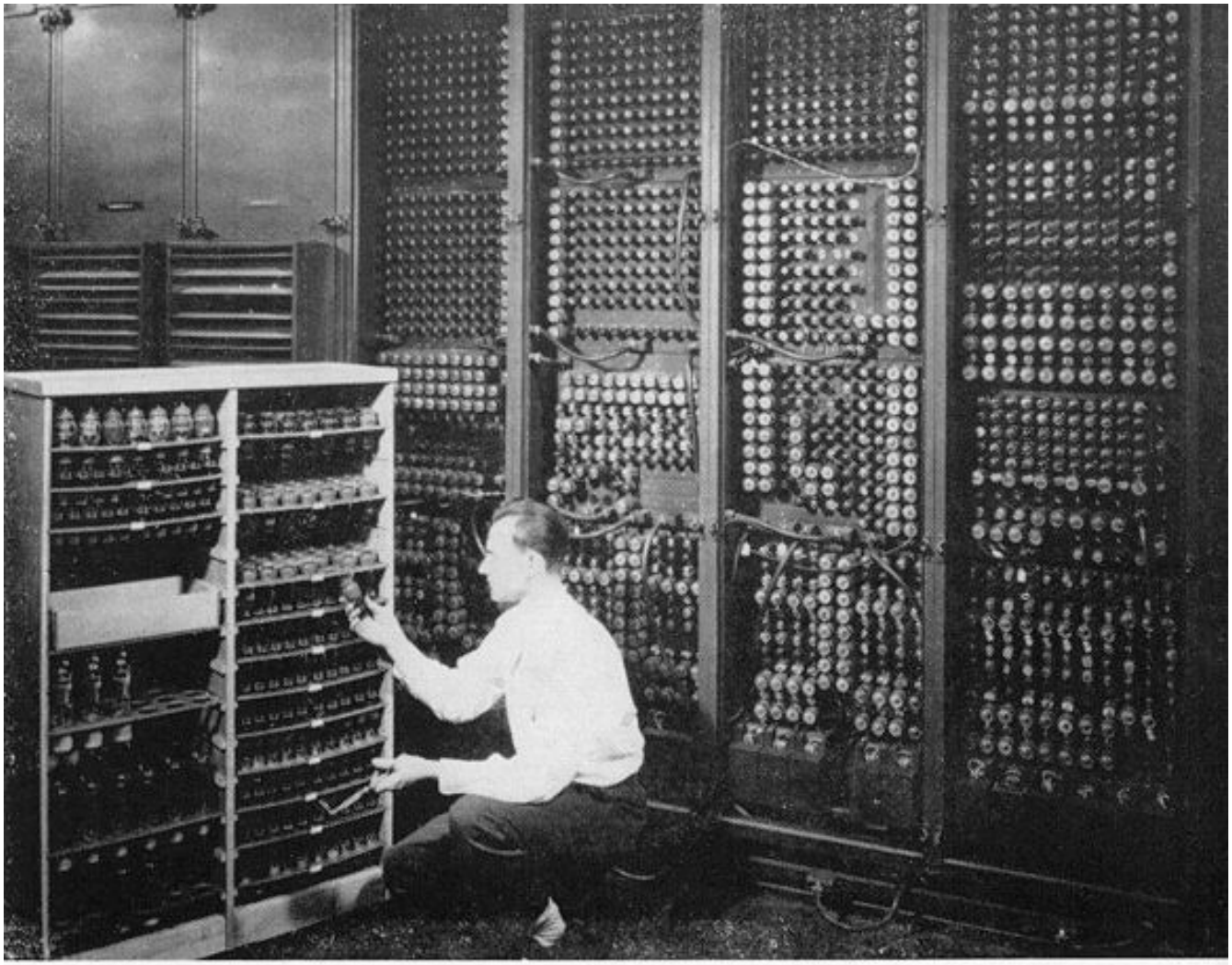
ENIAC

- Noted for massive scale and redundant design
- Decimal internal coding
- Operational in 1946

ENIAC

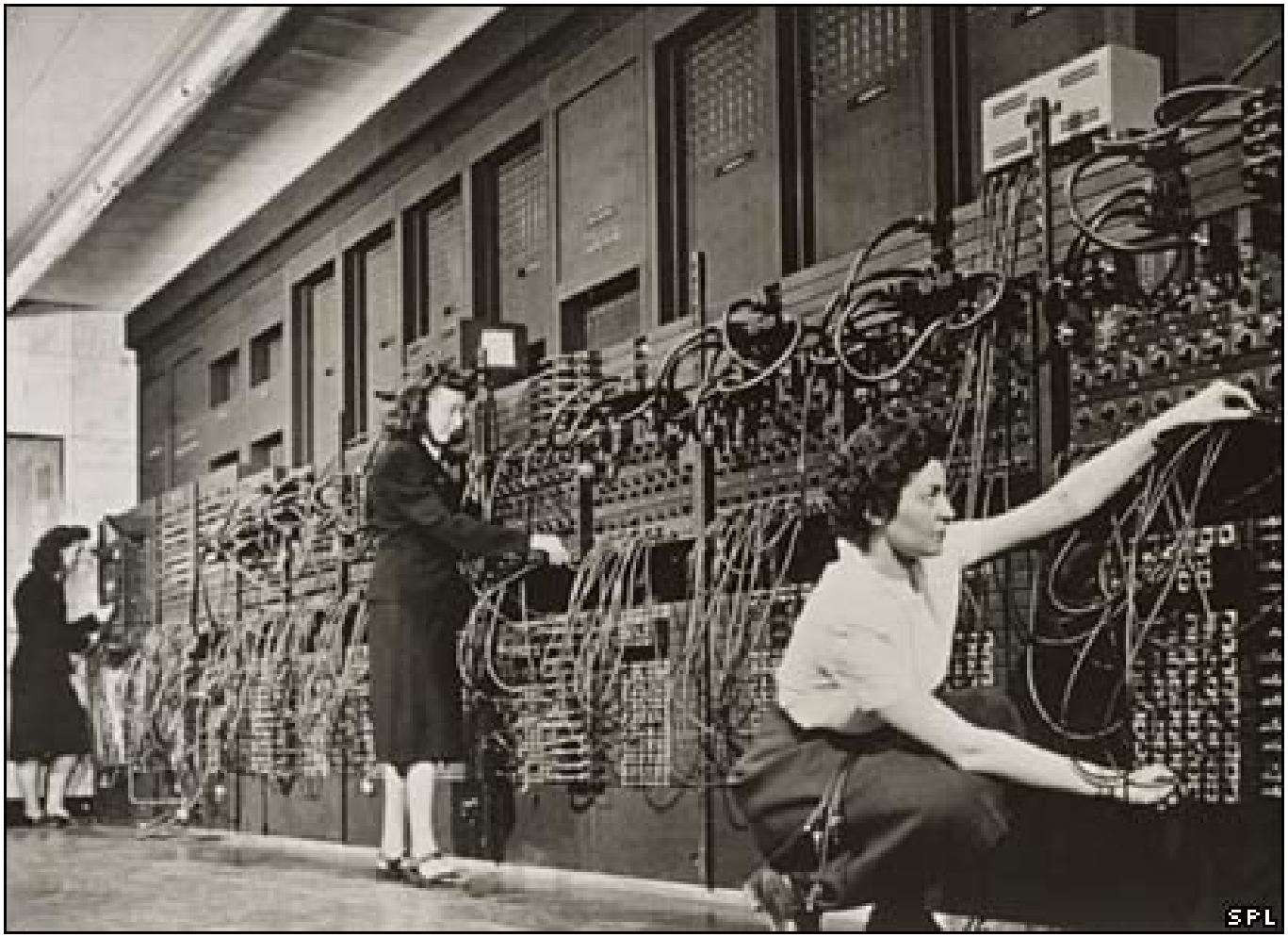


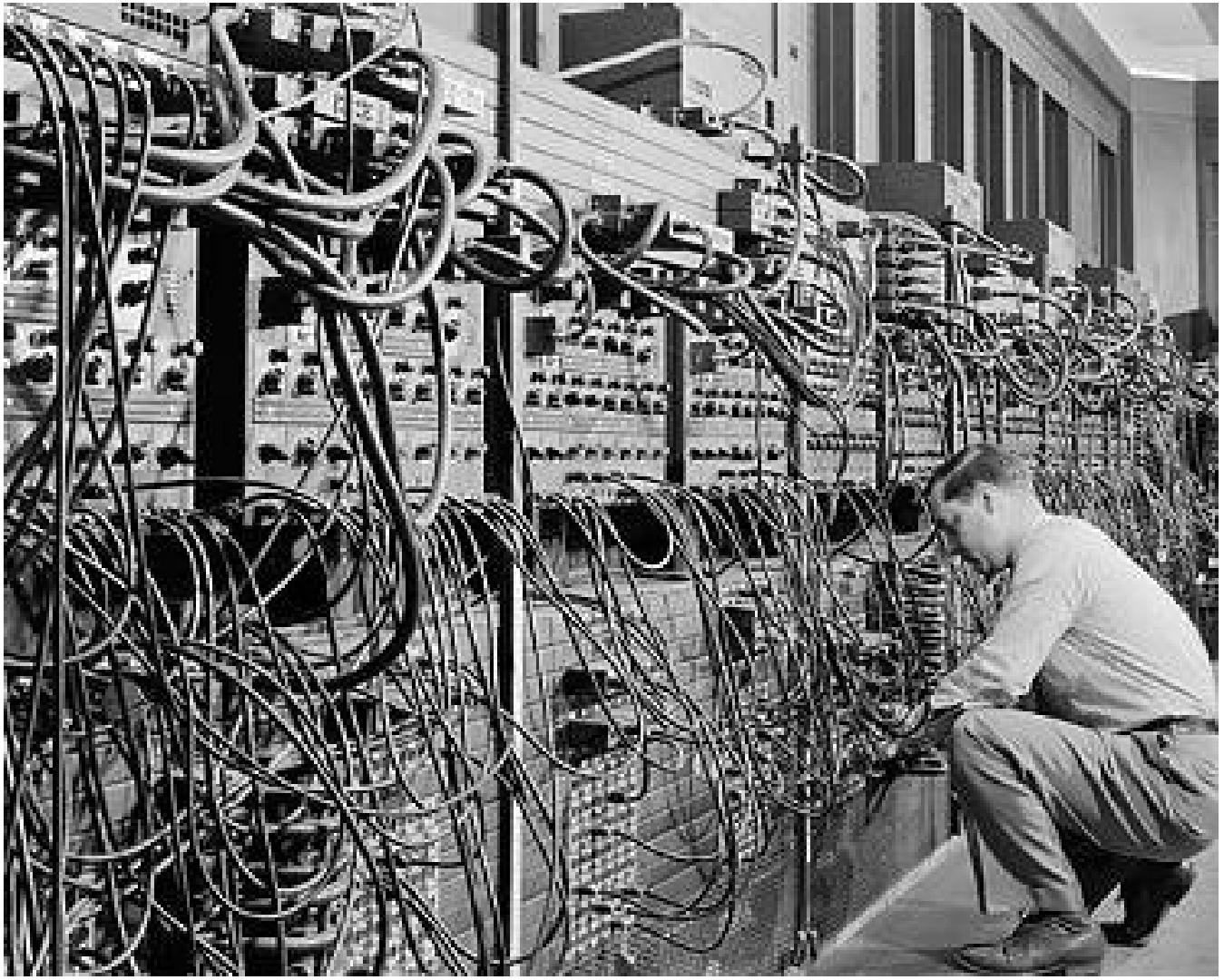
- manual progtamming of boards, switches and “function table”



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

Early Computer Programming was slow, tedious and repetitious



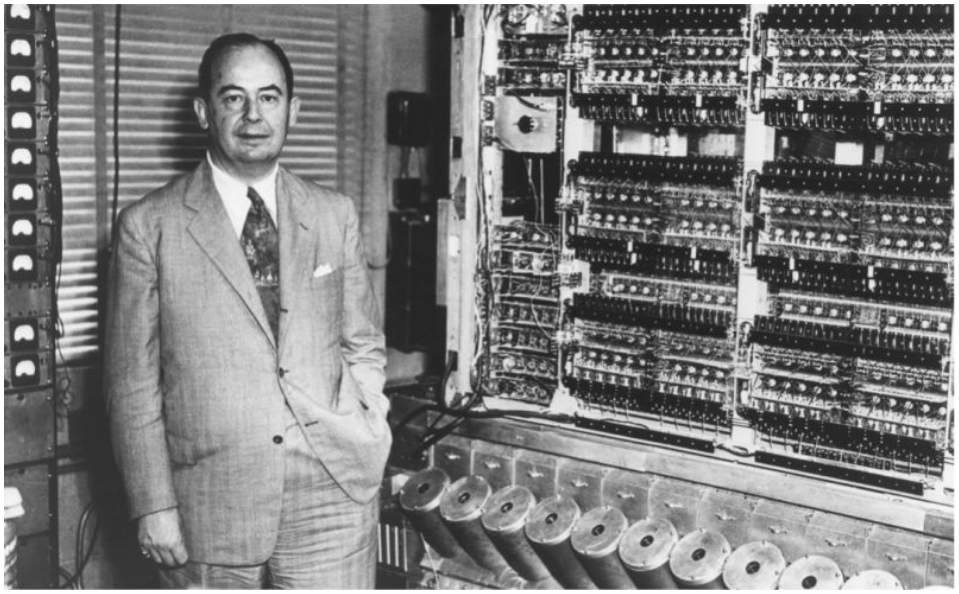


John Von Neumann (1903 – 1954)

- Visits the Moore School in 1944
- Prepares a draft report for an automatic programmable device (later called EDVAC)
- Comes up with the “stored program” concept
- Publishes ideas (with Goldstine and Burks) in 1946
- Designs the IAS (Institute for Advanced Studies) machine which becomes operational in 1951

Von Neumann Architecture

- “stored program”
- Binary internal coding
- CPU-Memory-I/O organization
- “fetch-decode-execute” instruction cycle



A Brief History of Computing

Part III
Age of the Mainframe
1951 to 1970

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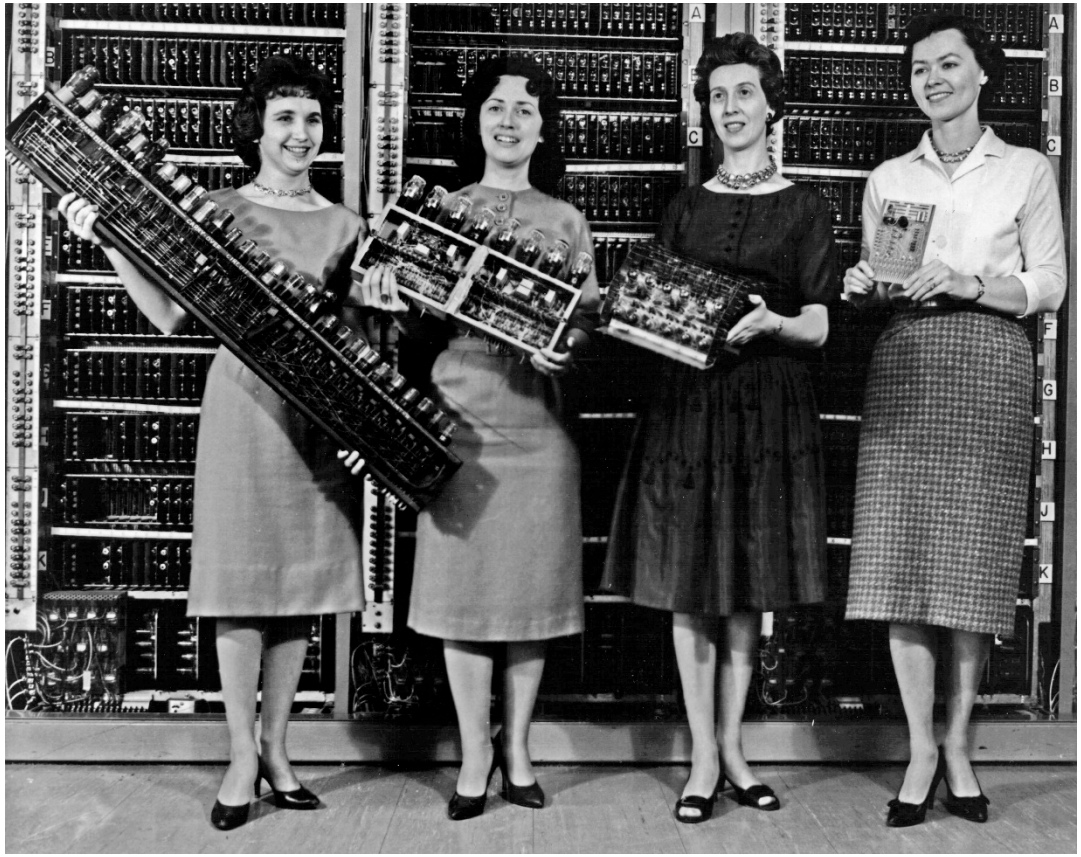
Univac I

- First commercial general-purpose computer
- Delivered in 1951
- Used to forecast the 1952 United States presidential election

Starting in the 1950s, computers got smaller over time

- Four generations of vacuum tube computer circuits, showing the reduction in size during the 1950s



Grace Murray Hopper (1906 – 1992)

- First real “computer scientist”.
- Created first Compiler because she was tired of writing “machine code” by hand. Greatly improved programming speed and efficiency.

The transistor

"The most important invention of the 20th century…"

- Invented by Shockley, Bardeen & Brattain in 1947 at Bell Labs
- Replaced vacuum tubes, which were bulky

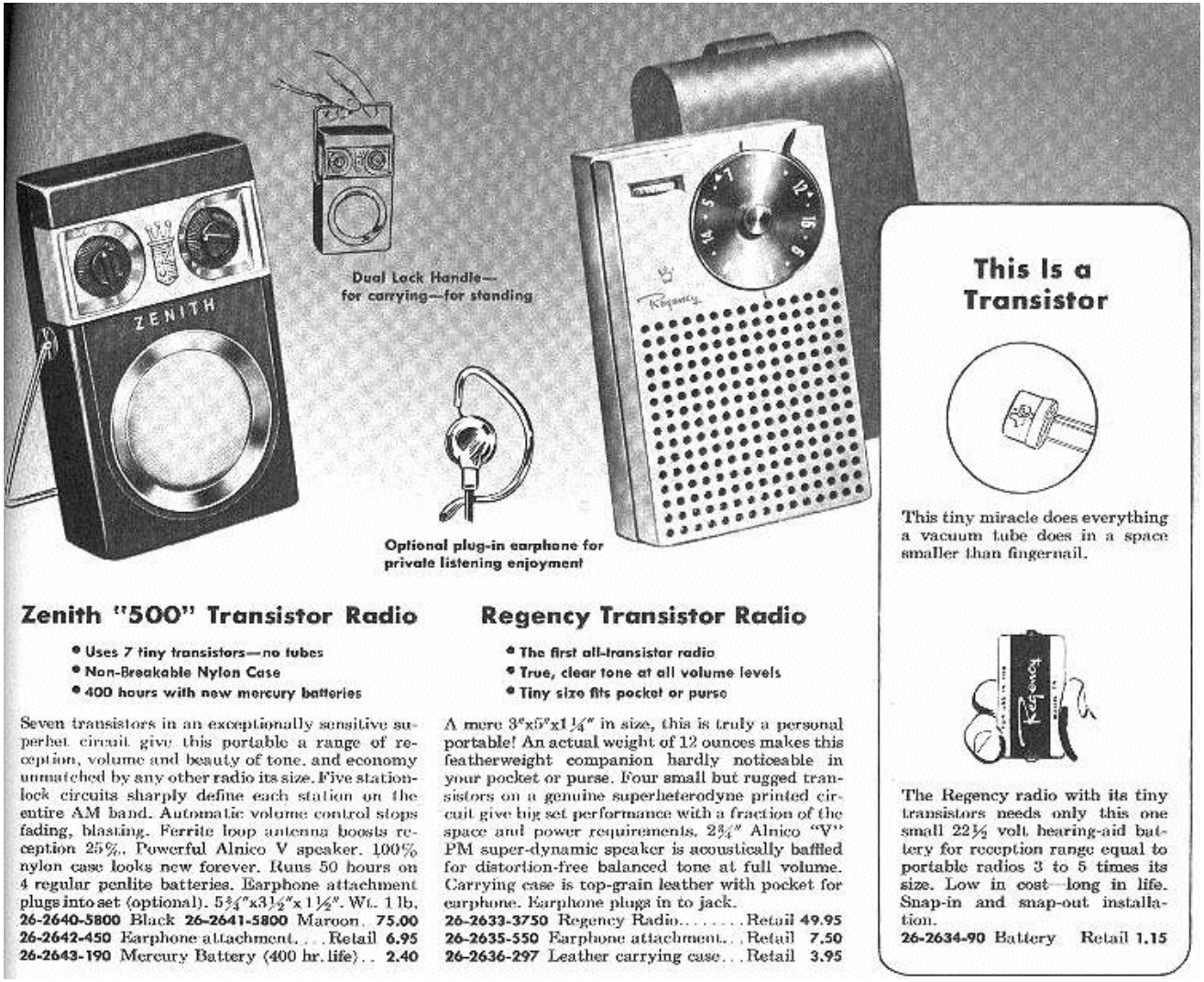
- Invented by Jack Kilby in 1958
- Allowed placement of many transistors onto a small surface

- This enabled computers and other electronic devices to become smaller and cheaper to build and maintain

A hearing aid

- The first device built with transistors, in 1953
- Zenith Royal-T “tubeless” hearing aid
- A prehistoric iPod ☺

Followed by the “transistor radio”



Zenith "500" Transistor Radio

- Uses 7 tiny transistors—no tubes
- Non-Breakable Nylon Case
- 400 hours with new mercury batteries

Seven transistors in an exceptionally sensitive superhet circuit give this portable a range of reception, volume and beauty of tone, and economy unmatched by any other radio its size. Five station-lock circuits sharply define each station on the entire AM band. Automatic volume control stops fading, blasting. Ferrite loop antenna boosts reception 25%. Powerful Alnico V speaker. 100% nylon case looks new forever. Runs 50 hours on 4 regular penlite batteries. Earphone attachment plugs into set (optional). 5¾"x3½"x1½". Wt. 1 lb.

26-2640-5800 Black **26-2641-5800** Maroon. **75.00**
26-2642-450 Earphone attachment. . . Retail **6.95**
26-2643-190 Mercury Battery (400 hr. life) . . **2.40**

Regency Transistor Radio

- The first all-transistor radio
- True, clear tone at all volume levels
- Tiny size fits pocket or purse

A mere 3"x5"x1¼" in size, this is truly a personal portable! An actual weight of 12 ounces makes this featherweight companion hardly noticeable in your pocket or purse. Four small but rugged transistors on a genuine superheterodyne printed circuit give big set performance with a fraction of the space and power requirements. 2¾" Alnico "V" PM super-dynamic speaker is acoustically baffled for distortion-free balanced tone at full volume. Carrying case is top-grain leather with pocket for earphone. Earphone plugs in to jack.

26-2633-3750 Regency Radio. . . . . Retail **49.95**
26-2635-550 Earphone attachment. . . Retail **7.50**
26-2636-297 Leather carrying case. . . Retail **3.95**

The Integrated Circuit (IC)

- Invented by Jack Kilby at Texas Instruments in 1957.
- Enabled many transistors to be grouped into a single package.
- Lowered cost and decreased space compared to using individual transistors.
- First commercial use of the IC was in a pocket calculator in 1961.
- Today exceeding 10 billion transistors in a single package of approximately 25 square centimetres.
- Still the building blocks for all electronics today.

jack Kilby and his “children”

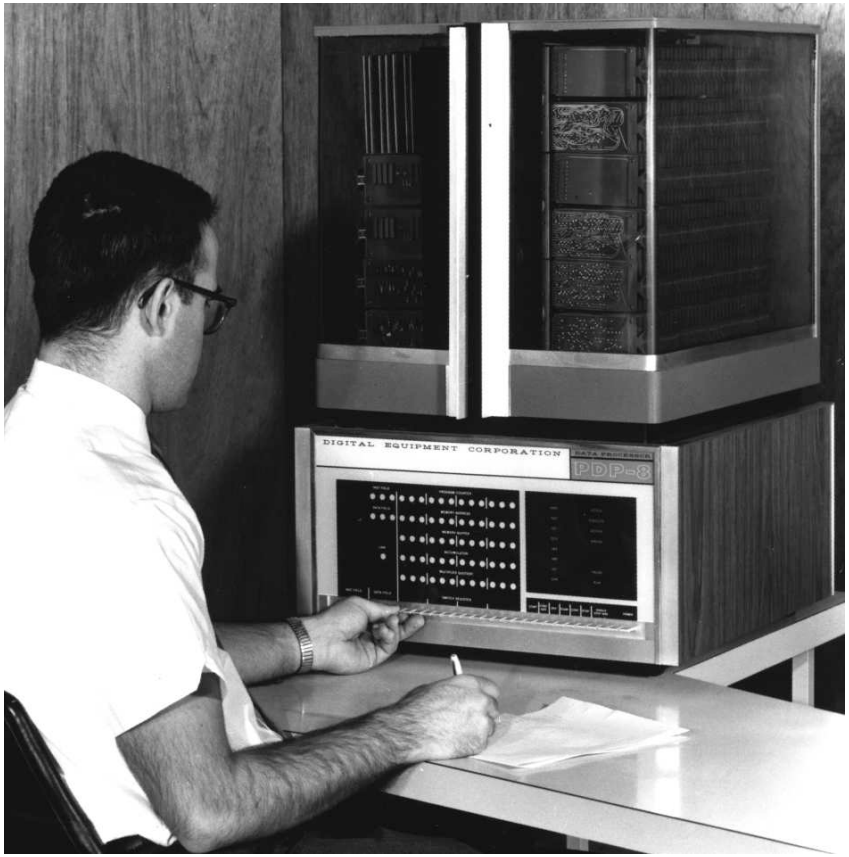
1960s: IBM System/360

- Introduced in 1964
- Family of computers, with compatible architecture, covering a wide price range
- Established the standard for mainframes for a decade and beyond

Gordon Bell: the “Minicomputer” Digital Equipment Corporation (DEC)

- Developed first “mini” computers, 1960-83
- Brought computing to small business
- Created major competition for IBM, Univac, who only built mainframes
- Made Boston area first “silicon valley”

DEC PDP series



- Offered mainframe performance at a fraction of the cost
- PDP-8 introduced at $20,000 vs. $1M for a mainframe (early 1960s dollars)

Specialized Supercomputers

- First developed in the late 1970s
- High-performance systems used for scientific applications (weather forecasting, code breaking)
- Advanced special purpose designs
- Cray Research, Control Data, NEC, IBM and others

Supercomputers Today: IBM Blue Gene Supercomputer

Used for hydrodynamics, quantum chemistry, molecular dynamics, climate modeling and financial modeling

A Brief History of Computing

Part IV
Age of the Personal Computer after 1970

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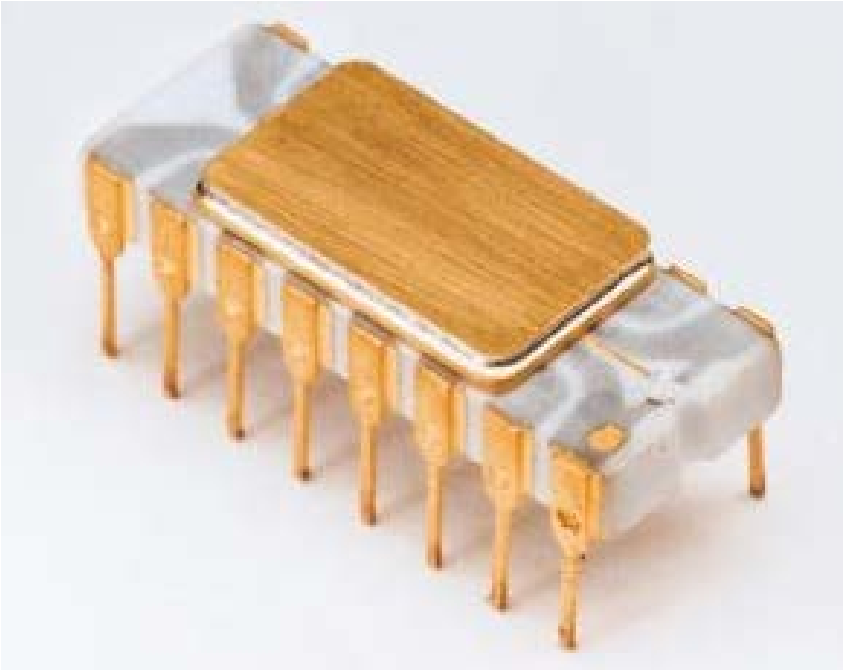
Intel 4004 Microprocessor - 1971

- First commercially available microprocessor – first used in a programmable calculator
- Made the personal computer possible
- Contained 2300 transistors and ran at 100 kHz



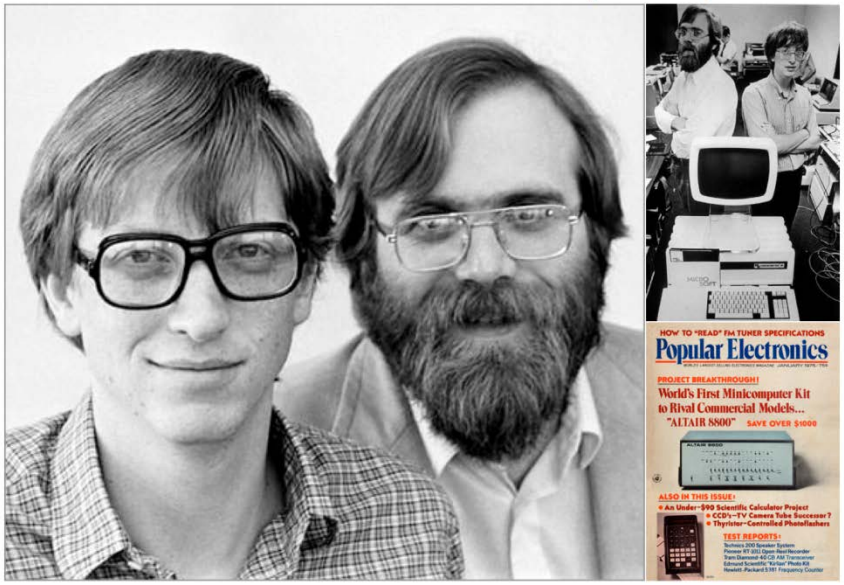
Desktop and Portable Computers 1975 and later

- use microprocessors
- all-in-one designs, performance/price tradeoffs
- aimed at mass audience
- personal computers
- workstations

Altair 8080
first kit micro computer (1975)

The beginning of Microsoft

April 4, 1975:
Bill Gates & Paul Allen form "Micro-soft" partnership

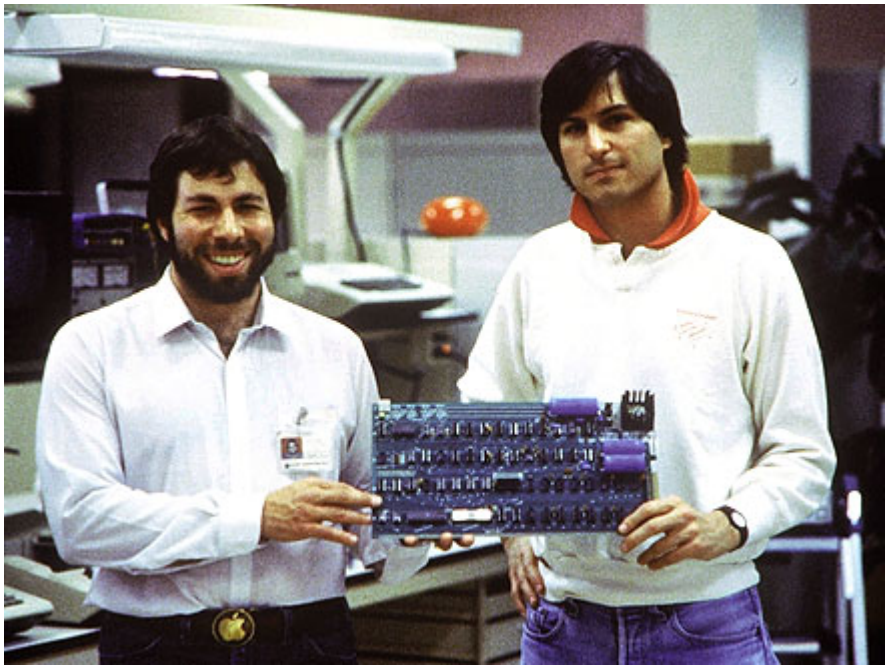


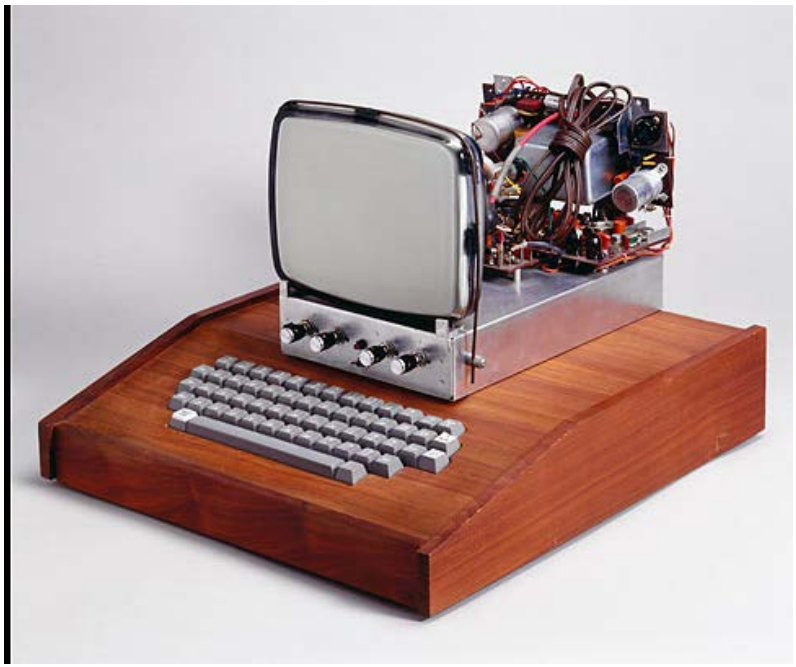
In 1975 Bill Gates and Paul Allen approached Ed Roberts of MITS, the company that developed the Altair, and promised to deliver a BASIC compiler. They did so, and from that sale, Microsoft was born.

Microsoft Corporation, 1978
ownposters.com
Would you invest?

Steve Wozniak and Steve Jobs with the First Apple Computer (1976)

Developed in the family garage





Radio Shack TRS-80 (1978)

- first plug and play personal computer available at retail
- programmed in BASIC
- very successful
- very affordable
- limited commercial software
- created a cottage industry

Apple II (1978)

- first commercially available Apple
- initially sold to Wall St. bankers who wanted the spreadsheet program called Visicalc, which ran on the Apple II
- put Apple on the map.

Osborne I (1981)

- First “portable” personal computer
- Came with lots of bundled software
- Only weighed around 20 kilos and sold for $1795
- Notice the huge 5 inch (13 cm) screen!

IBM PC (1982)

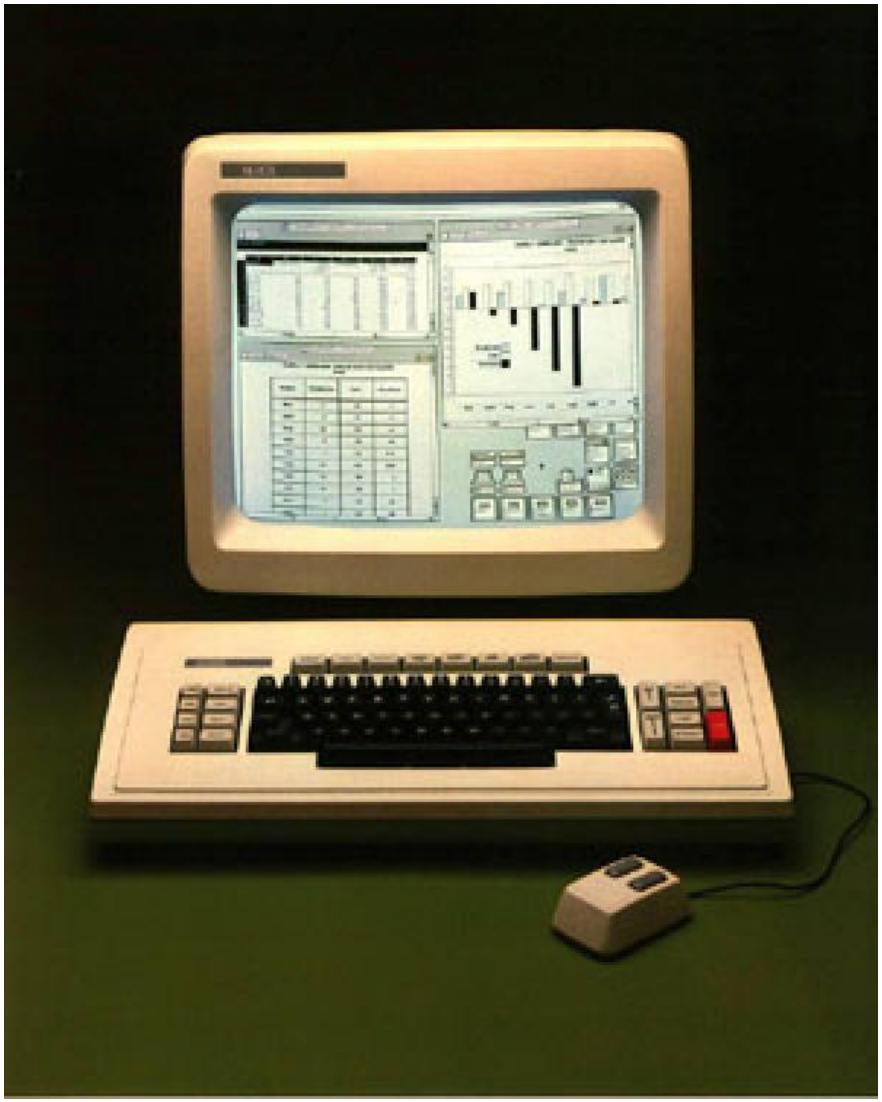
- IBM's first personal computer
- significant shift for IBM
- open architecture
- established a new standard – legitimized the personal computer
- Operating System supplied by Microsoft

Xerox
the Computer Company that Wasn't

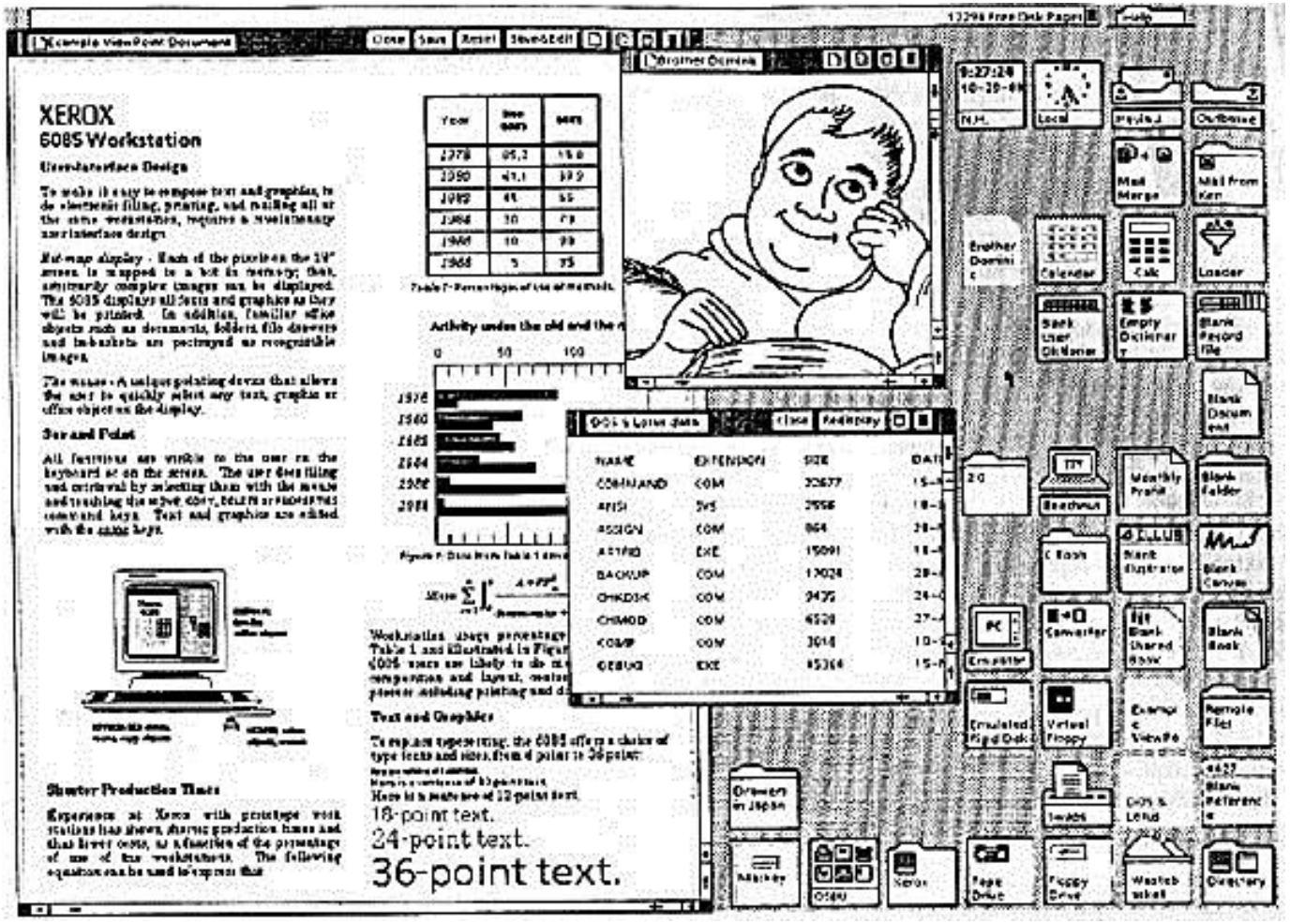
- Many innovations that became part of the Personal Computer were invented at Xerox PARC (Palo Alto Research Centre).

- Xerox was never able to successfully exploit those innovations that included the mouse, graphic user interface and the cancept was WYSIWYG (What You See Is What You Get).

Xerox Star (1981)



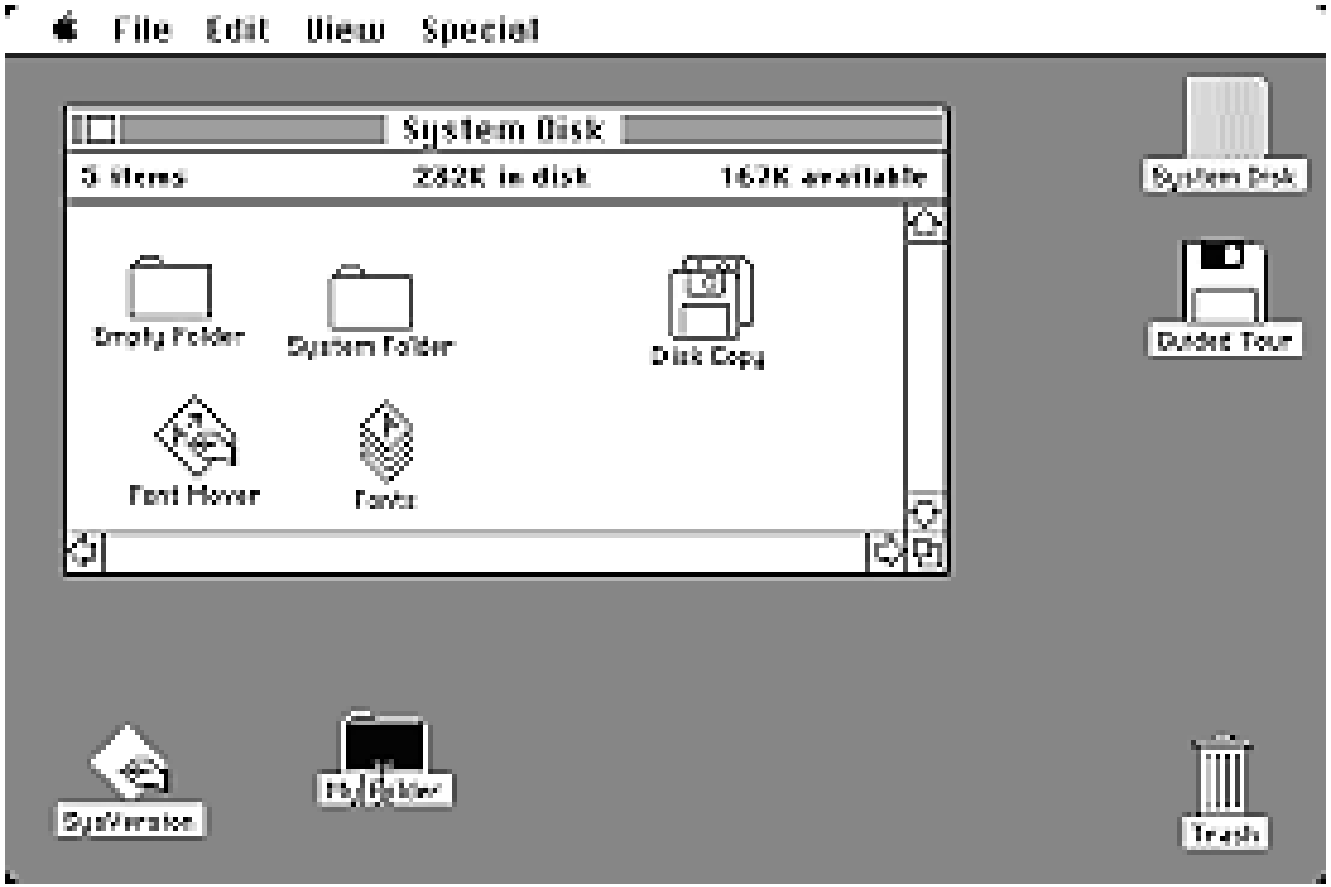
Xerox Star GUI



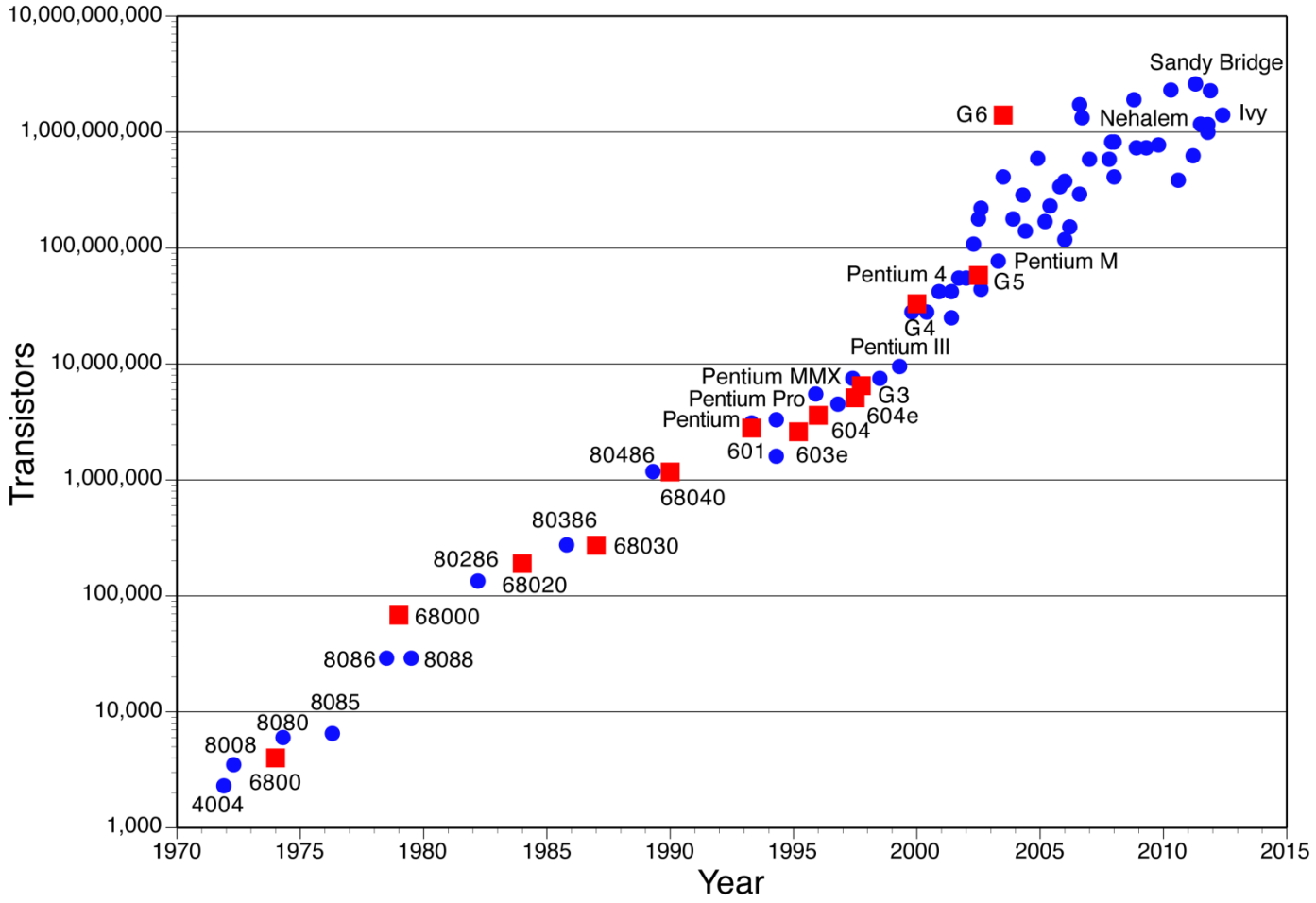
Apple MacIntosh (1984)

- second Personal computer with GUI interface
- adapted from the work done at Xerox
- designed to be a computer appliance for “Real People”
- introduced at the 1984 Superbowl

The GUI has arrived!



Moore's Law in action



Today's Price/Performance

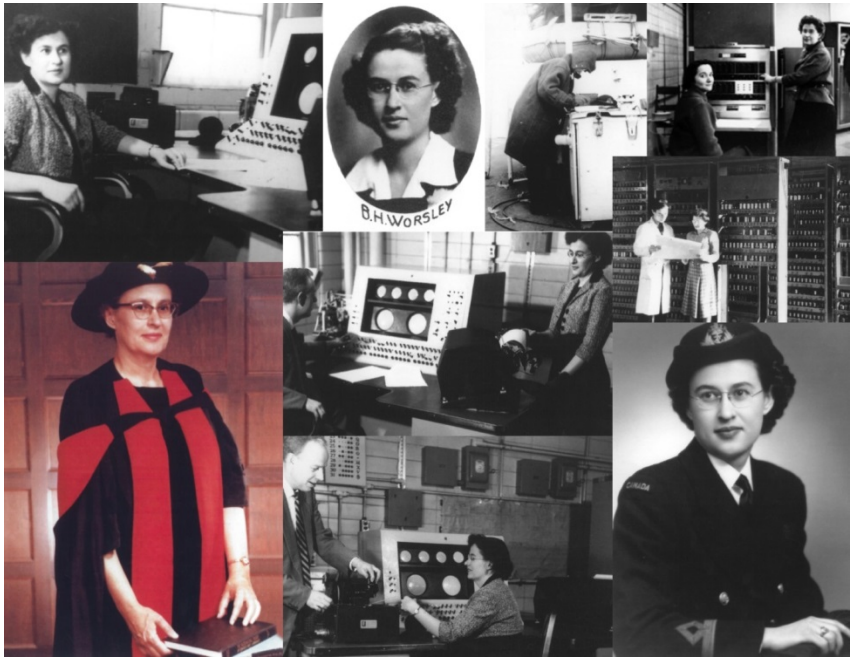
- Over 3 billion operations per second costs less than $300
- Memory is measured in Gigabytes… not Megabytes or Kilobytes
- Secondary Storage is Terabytes, soon to be Petabytes
- Communication speeds measured in Megabits or Gigabits per second, not Kilobits

And so it continues

Web Resources for Computing History

- www.computerhistory.org
- waxy.org/2008/06/the_machine_that_changed_the_world
- Google any name or term and see what comes up, especially wikipedia entries

Beatrice Helen Worsley (1921-1972)



- First female computer scientist in Canada
- Ph.D. from University of Cambridge, Alan Turing was an advisor
- Joined University of Toronto Computation Centre in 1948
- Co-wrote first compiler for Ferranti Mark 1, Canada's first electronic computer