

# A Brief History of Computing

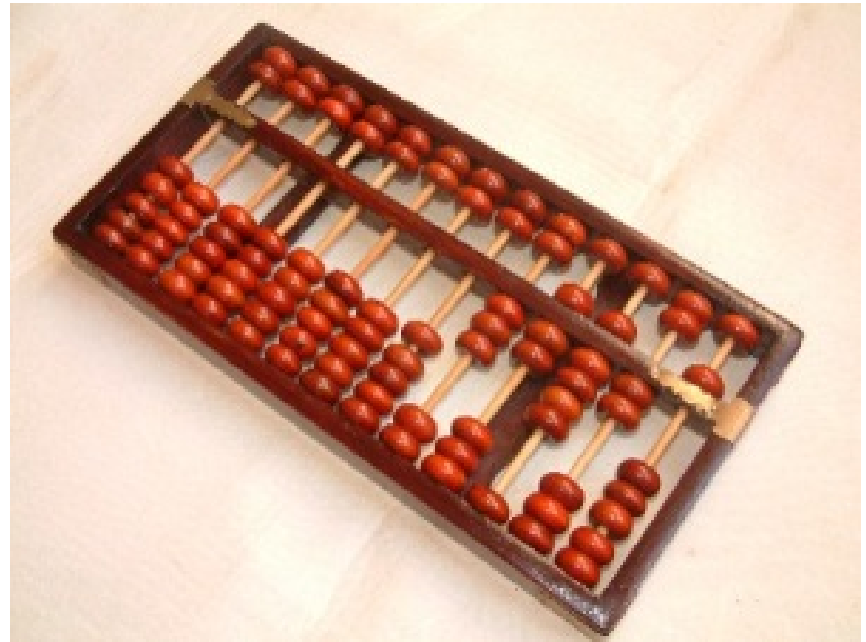
## Part I

Ancient History: up to 1930



# 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

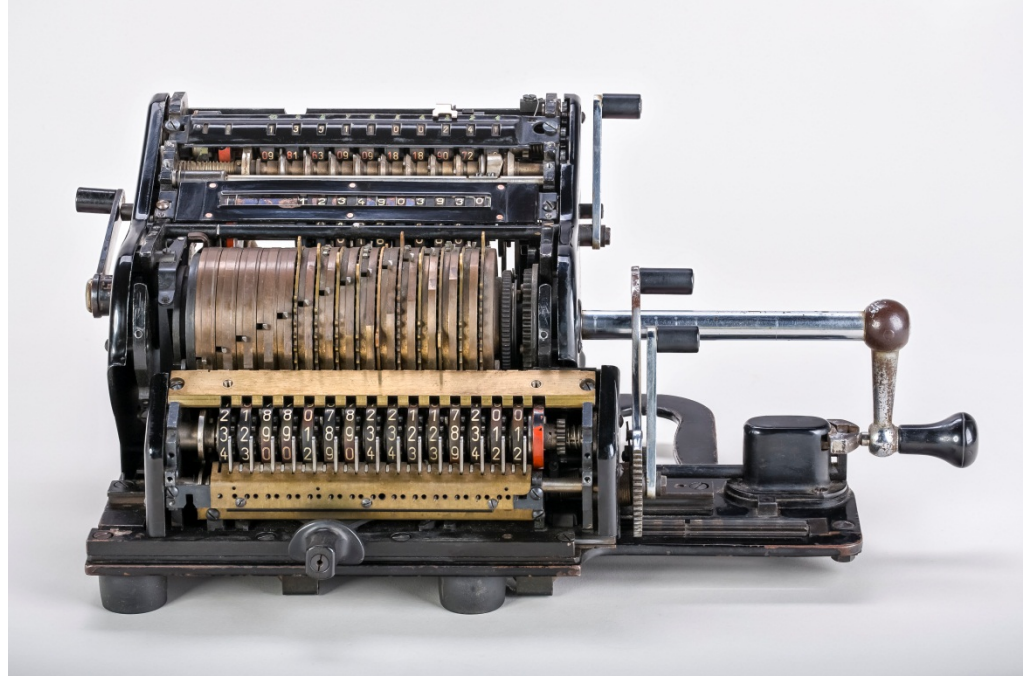


- Blaise Pascal (1623-1662), decimal calculator, could add and subtract



# 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)



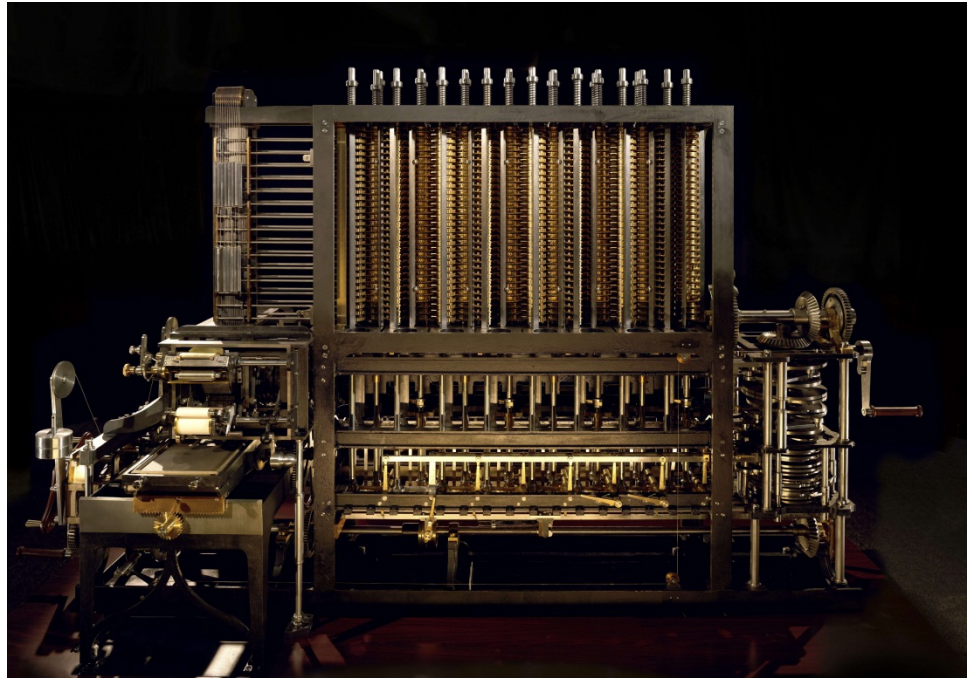
- First true pioneer of modern computing machines
- Designed two calculating machines, neither of which was practical to build
- Difference Engine
- Analytical Engine

# 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





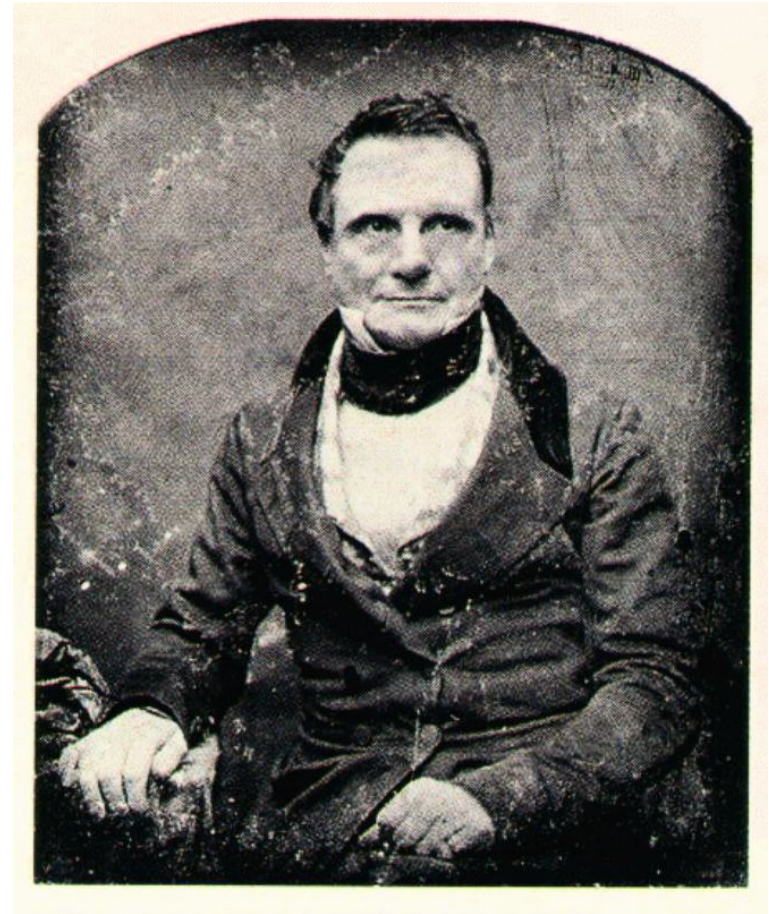
# World's First Programmer

- 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

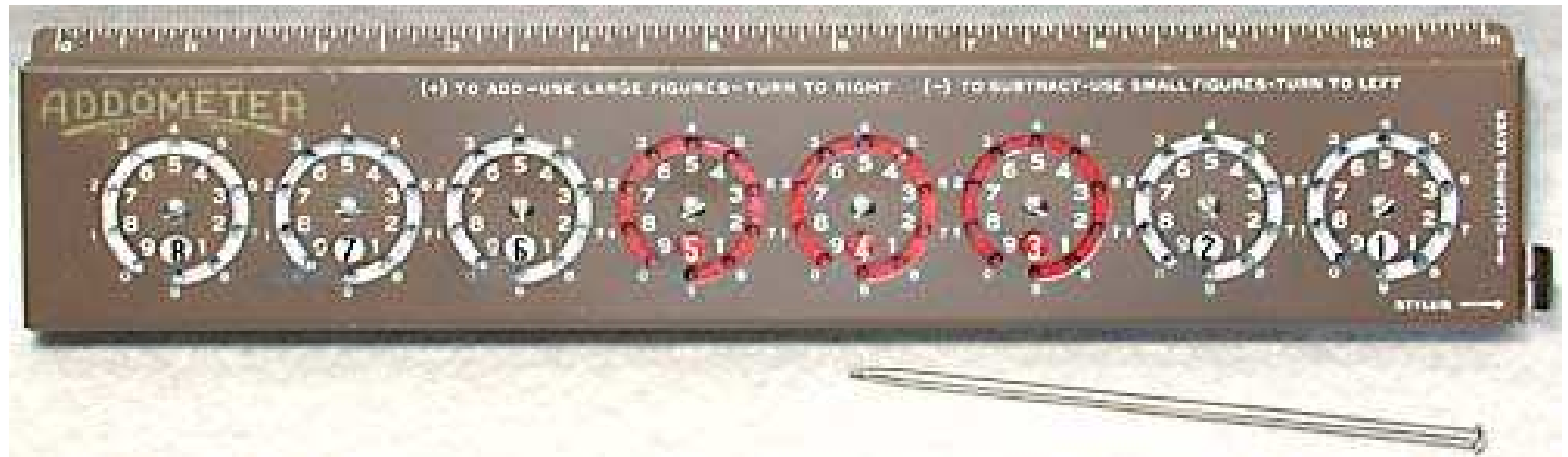




# Hollerith Tabulator



# Early “Pocket” Calculator



# A Brief History of Computing

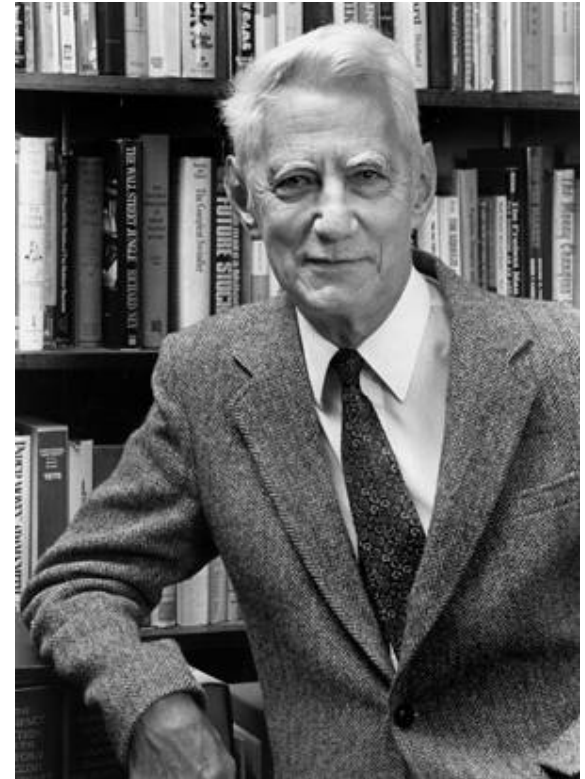
## Part II

### Birth of the Electronic Computer 1930 to 1951

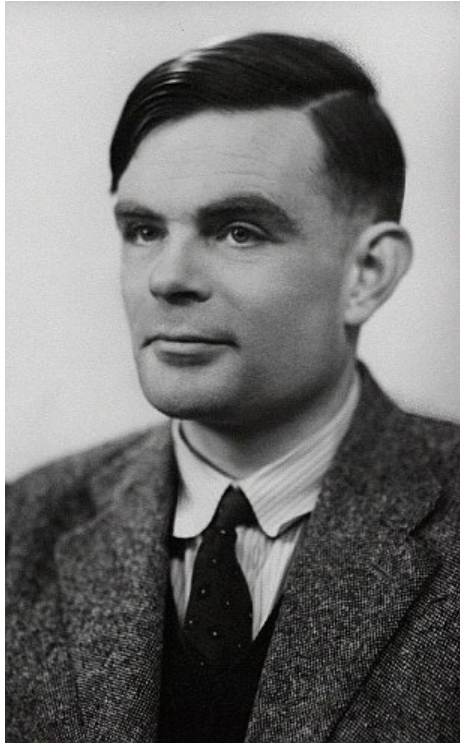


# Claude Shannon (1916 – 2001)

- 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

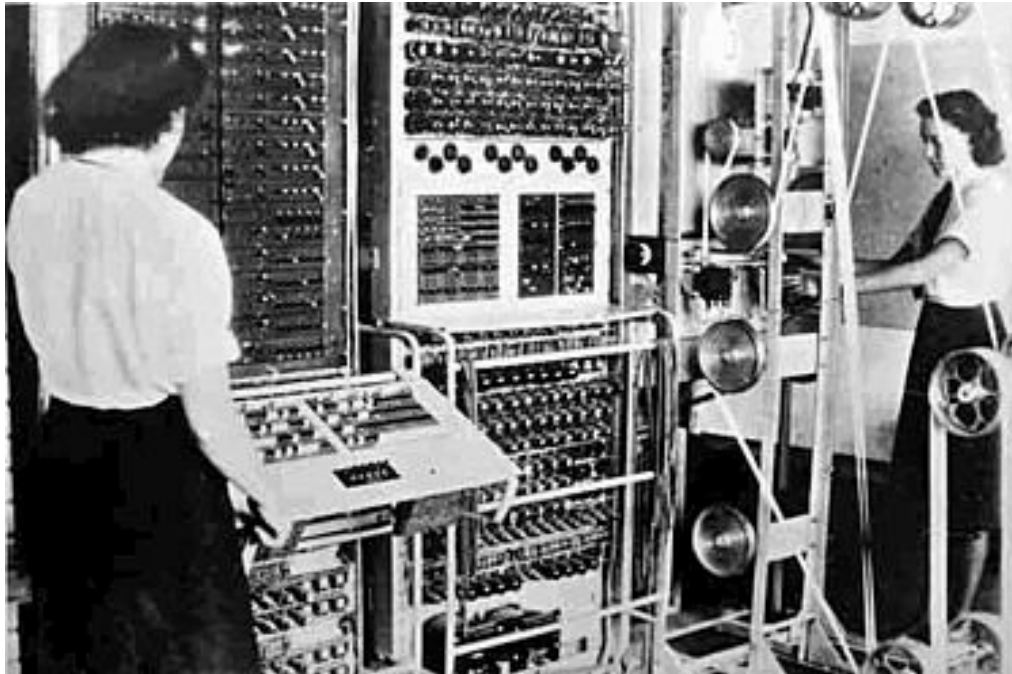


# The Enigma Machine

- 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

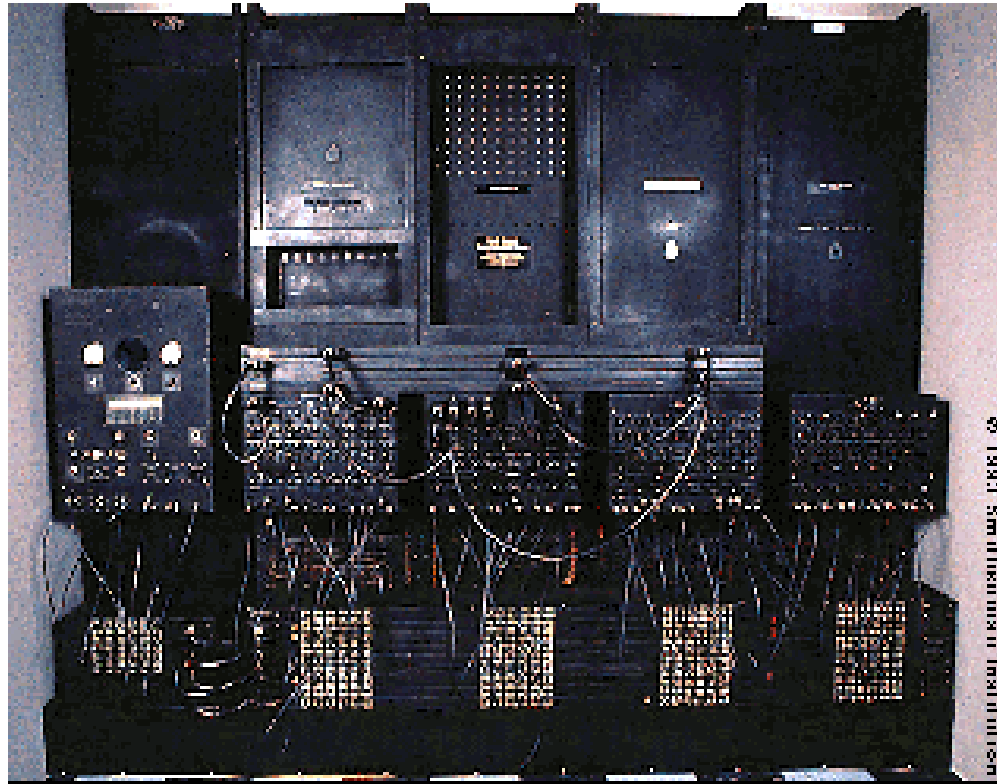
- John W. Mauchly (1907-1980) and J. Presper Eckert (1919-1995) headed the ENIAC team at the Moore School of Engineering, University of Pennsylvania
- ENIAC (Electronic Numerical Integrator And Computer) is the first general-purpose electronic digital computer
- Commissioned by the United States Army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

# ENIAC



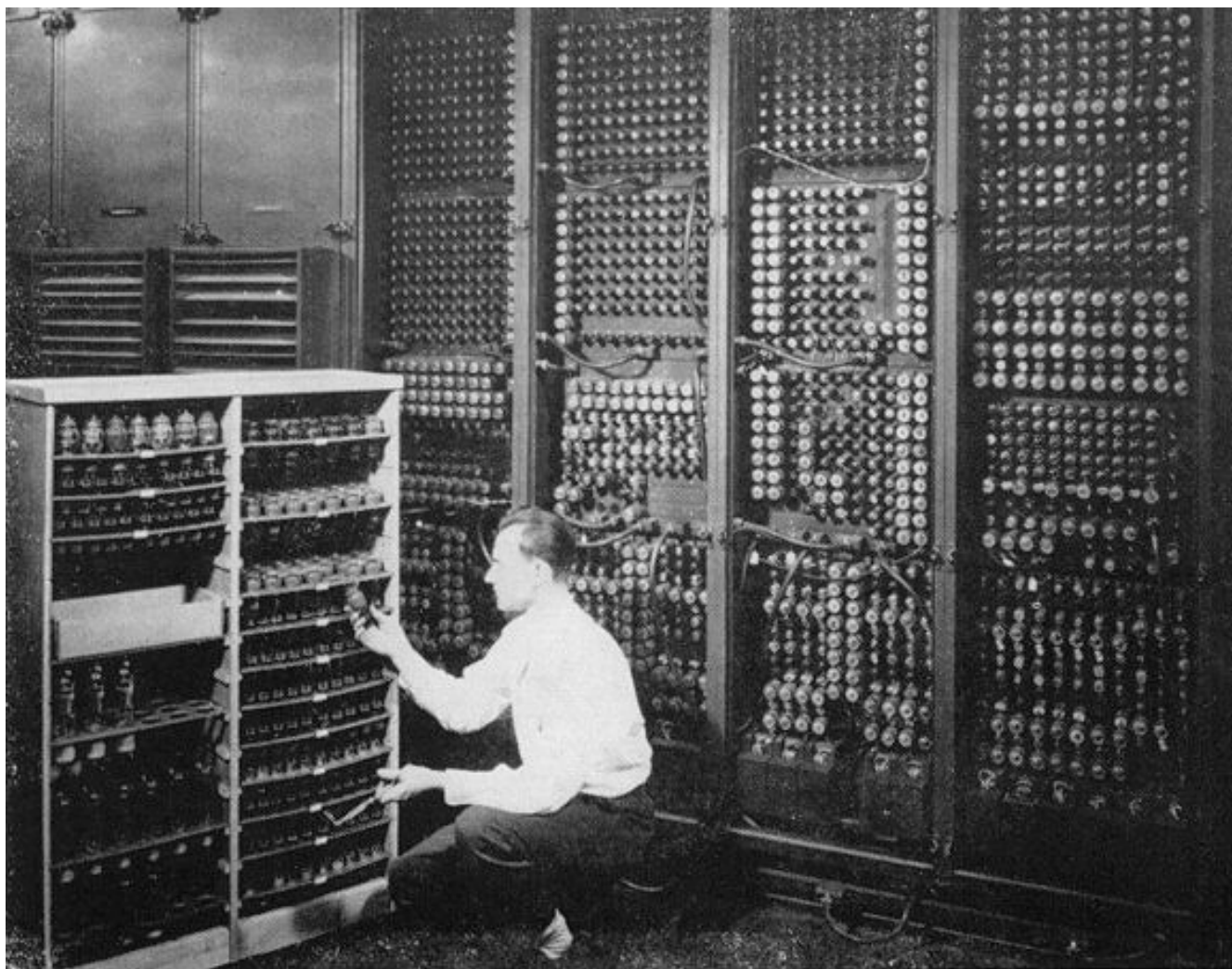
- Noted for massive scale and redundant design
- Decimal internal coding
- Operational in 1946

# ENIAC



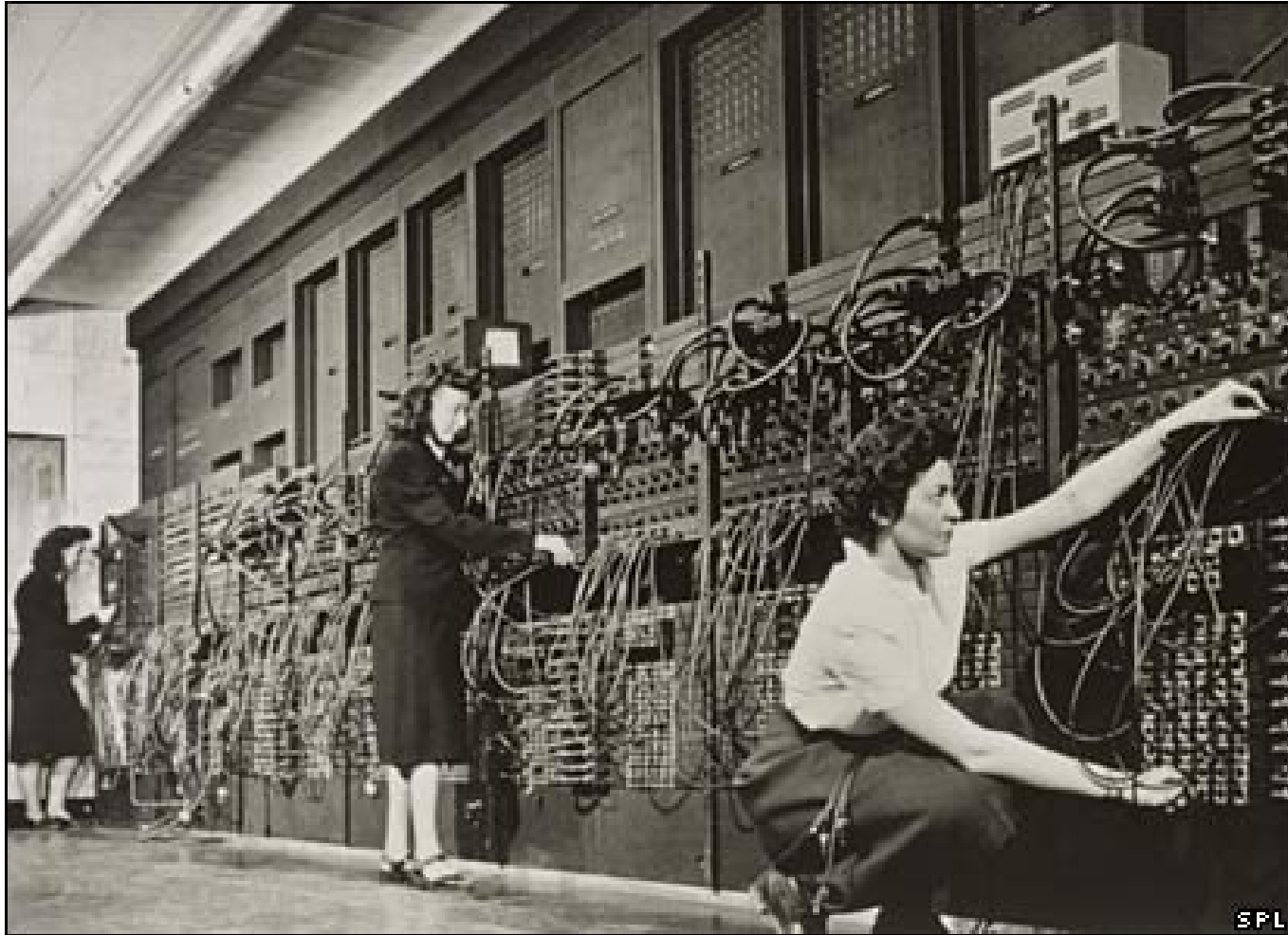
- manual programming of boards, switches and “function table”



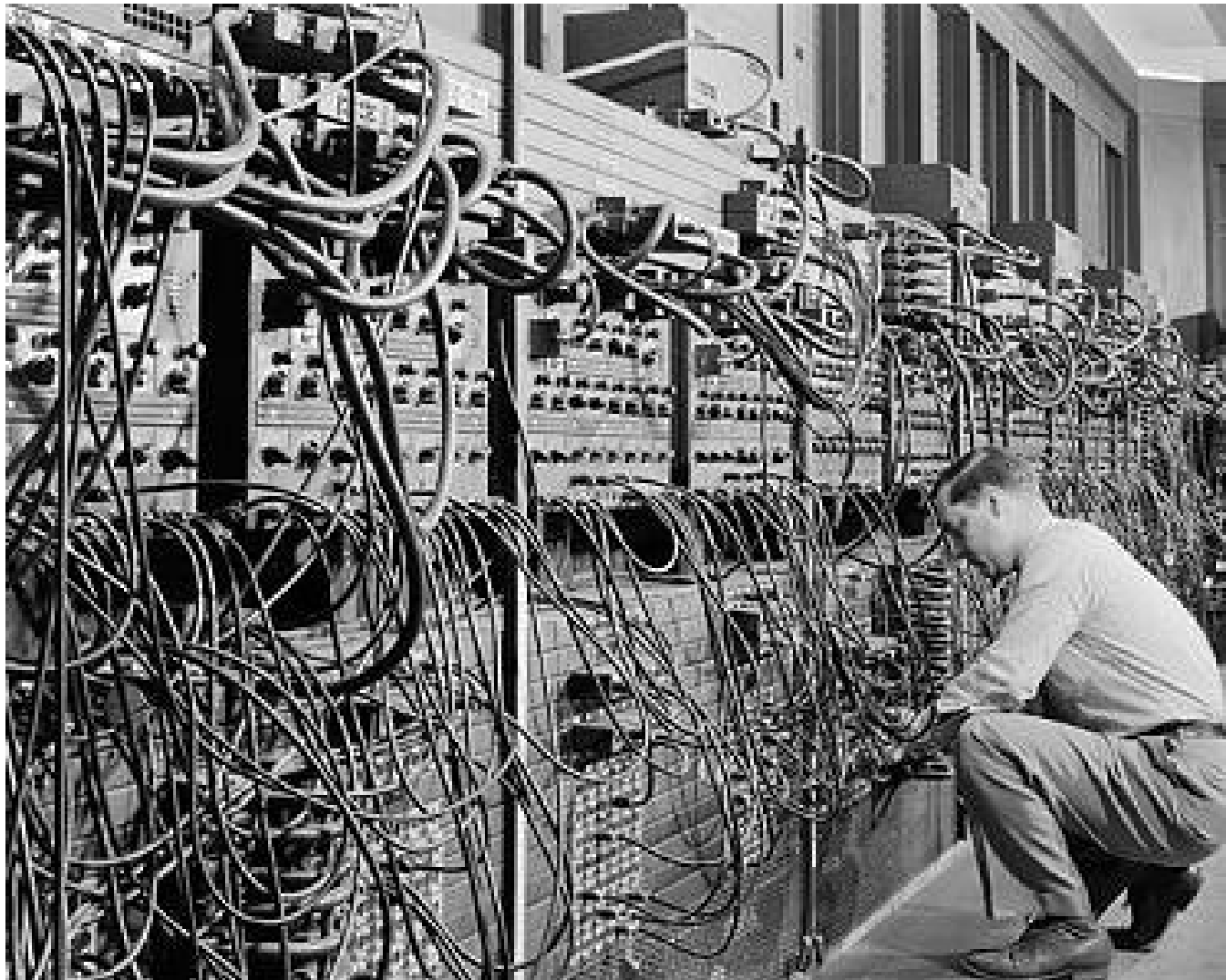


Replacing a bad tube meant checking among ENIAC's 19,000 possibilities.

Early Computer Programming was slow,  
tedious and repetitious





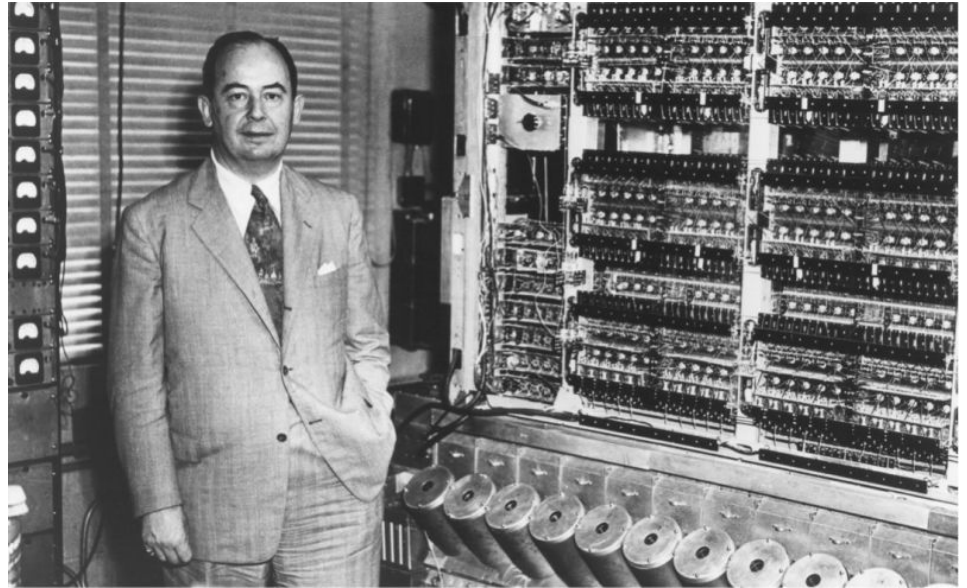


# John Von Neumann (1903 – 1954)

- 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



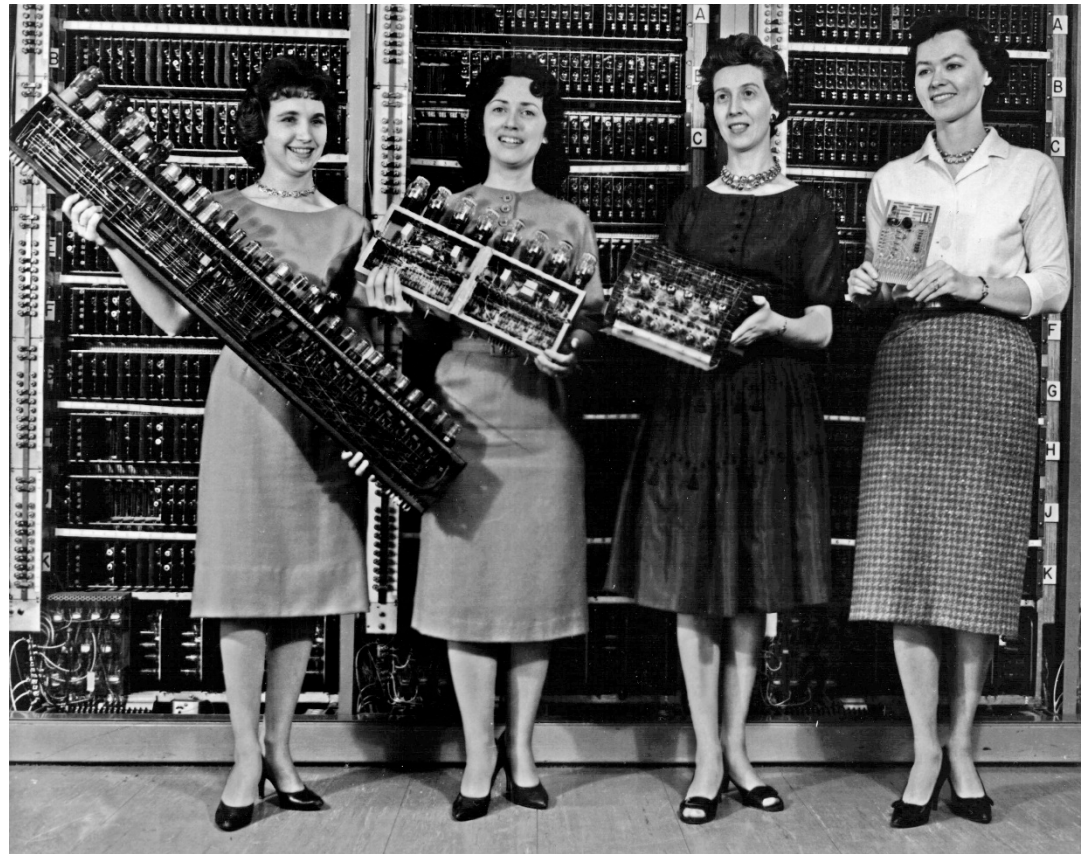
# Univac I



- 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 20<sup>th</sup> 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”

A black and silver portable transistor radio with a large circular speaker grille and two control knobs on top.

A small inset showing a radio with a handle that can be locked in either a carrying position or a standing position.

Dual Lock Handle—  
for carrying—for standing

A small inset showing a coiled earphone with a plug that fits into the radio's earphone jack.

Optional plug-in earphone for  
private listening enjoyment

A rectangular transistor radio with a large circular speaker grille and a tuning dial on top.

**This Is a  
Transistor**

A small circular inset showing a tiny transistor component, much smaller than a vacuum tube.

This tiny miracle does everything  
a vacuum tube does in a space  
smaller than fingernail.

A small inset showing the Regency radio with a hearing-aid battery attached to its side.

The Regency radio with its tiny  
transistors needs only this one  
small 22½ volt hearing-aid bat-  
tery for reception range equal to  
portable radios 3 to 5 times its  
size. Low in cost—long in life.  
Snap-in and snap-out installa-  
tion.

26-2634-90 Battery    Retail 1.15

**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 superbet 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). 5¼"x3½"x1½". Wt. 1 lb. 26-2640-5800 Black 26-2641-5800 Maroon. Retail 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. 2¼" 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

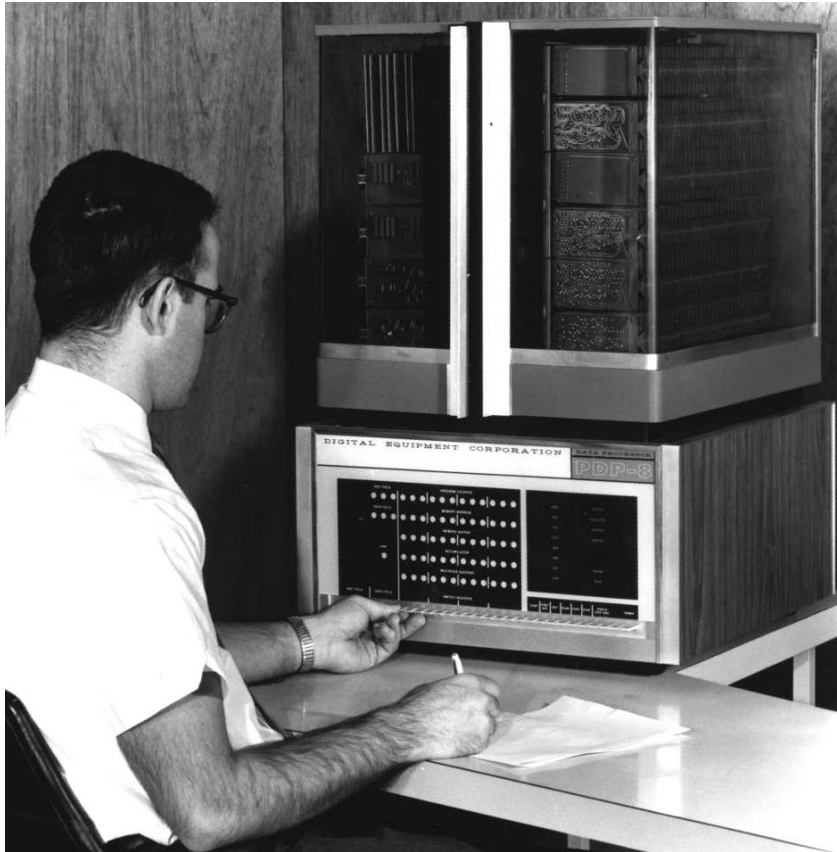


# Gordon Bell: the “Minicomputer” Digital Equipment Corporation (DEC)



- 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

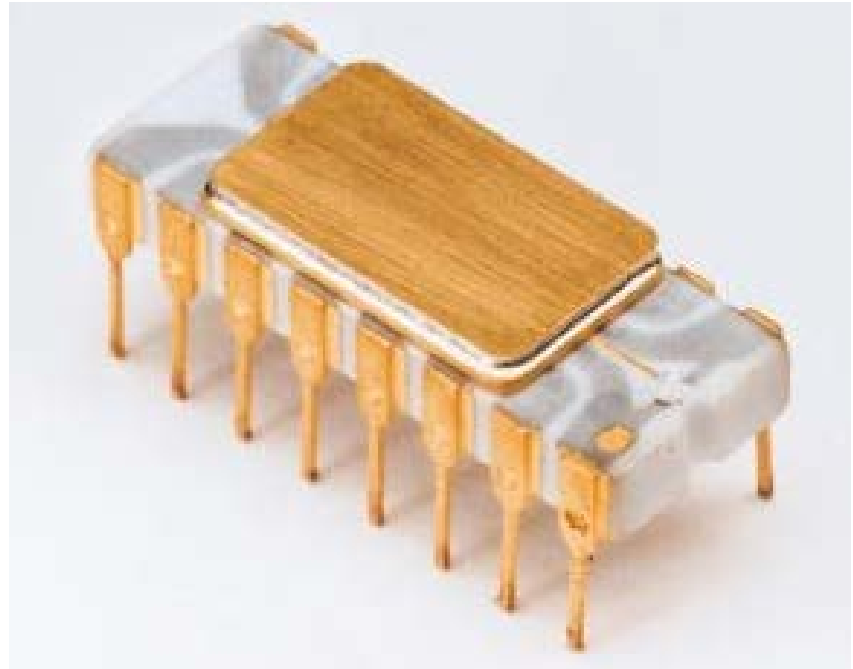
# A Brief History of Computing

## Part IV Age of the Personal Computer after 1970



# 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





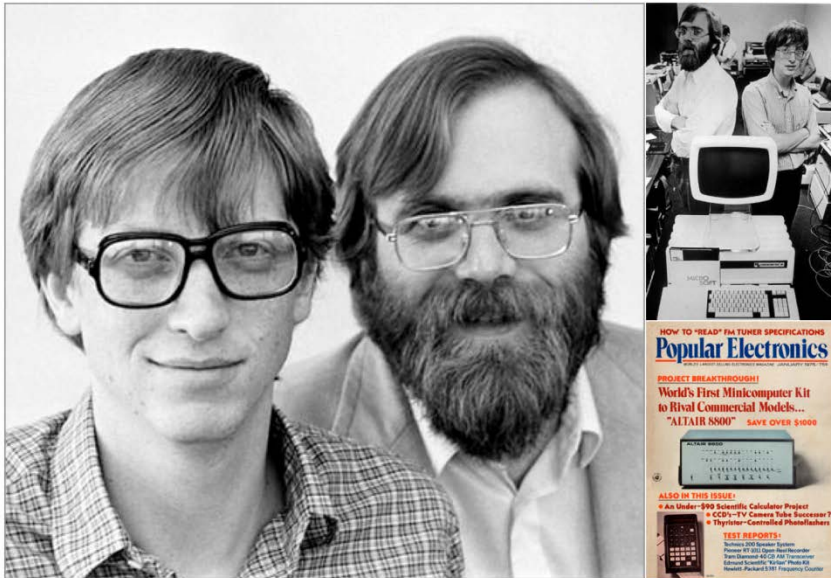
# Altair 8080

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.



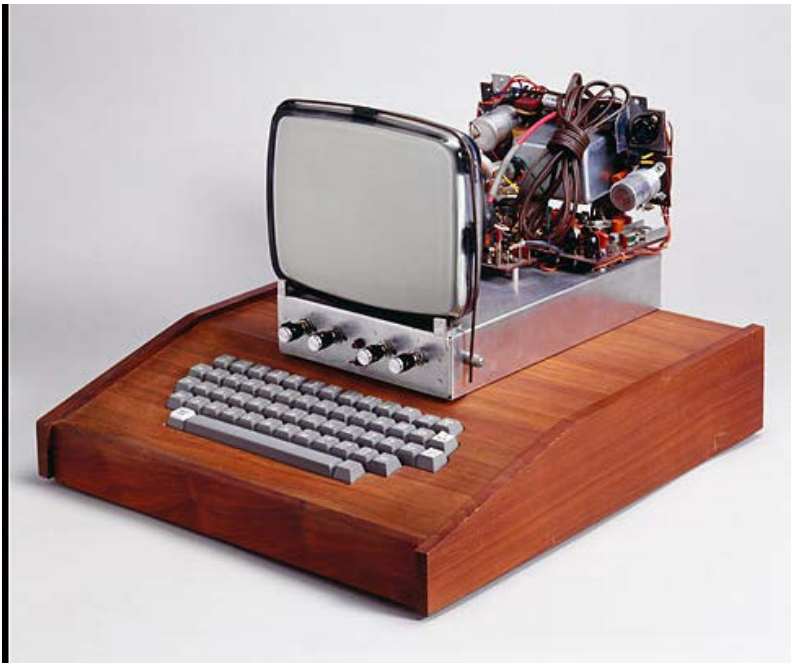
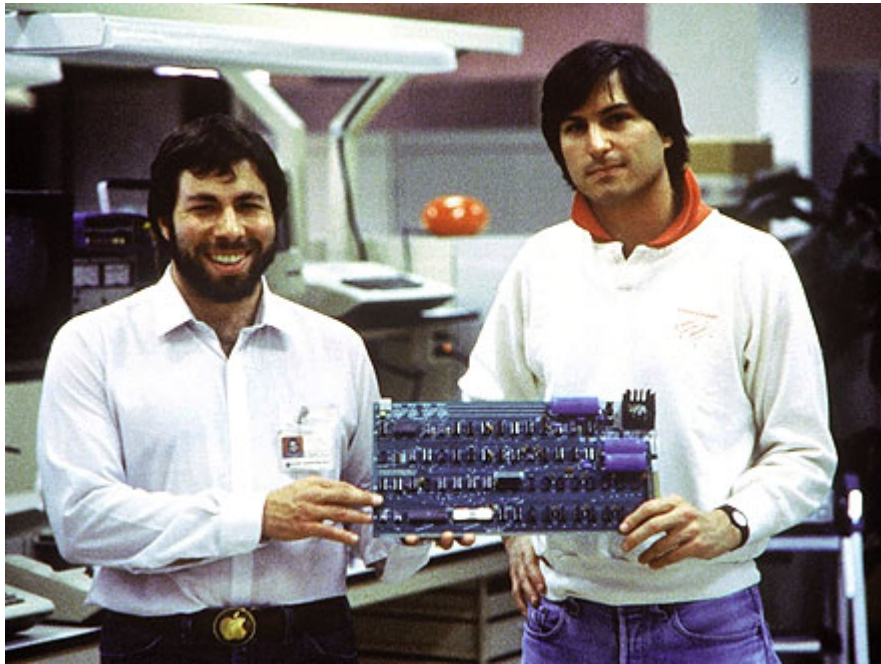


Microsoft Corporation, 1978

[ownposters.com](http://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 concept was WYSIWYG (What You See Is What You Get).

# Xerox Star (1981)



# Xerox Star GUI

**XEROX 6085 Workstation**

**User Interface Design**

To make it easy to compose text and graphics, to do electronic filing, printing, and mailing all at the same workstation, requires a revolutionary user interface design.

**Bit-map display** - Each of the pictures on the 14" screen is mapped to a bit in memory; that, similarly, complex images can be displayed. The 6085 displays all text and graphics as they will be printed. In addition, familiar office objects such as documents, folders, file drawers and bookshelves are portrayed as recognizable images.

**The mouse** - A unique pointing device that allows the user to quickly select any text, graphic or other object on the display.

**See and Point**

All functions are visible to the user on the keyboard or on the screen. The user does filing and retrieval by selecting them with the mouse and touching the appropriate COMB, DELTA or FUNCTIONAL command keys. Text and graphics are edited with the same keys.

**Shorter Production Times**

Experience at Xerox with prototype work stations has shown shorter production times and that lower costs, as a function of the percentage of use of the workstation. The following equation can be used to express this:

**Table 1: Percentages of Use of Methods**

Year	See and Point	Other
1978	65.2	34.8
1980	45.1	54.9
1982	41	59
1984	30	70
1986	10	90
1988	5	95

**Activity under the old and the new**

Figure 1: Data from Table 1 above

**Figure 2: Data from Table 1 above**

**Workstation users percentage**

Table 1 and illustrated in Figure 2 (00% users are likely to do no composition and layout, neither printing and distribution).

**Text and Graphics**

To explain typesetting, the 6085 offers a choice of type fonts and sizes, from 4 point to 36 point. Here is a sample of 12 point text. Here is a sample of 18 point text. Here is a sample of 24 point text. Here is a sample of 36 point text.

**Desktop Icons:**

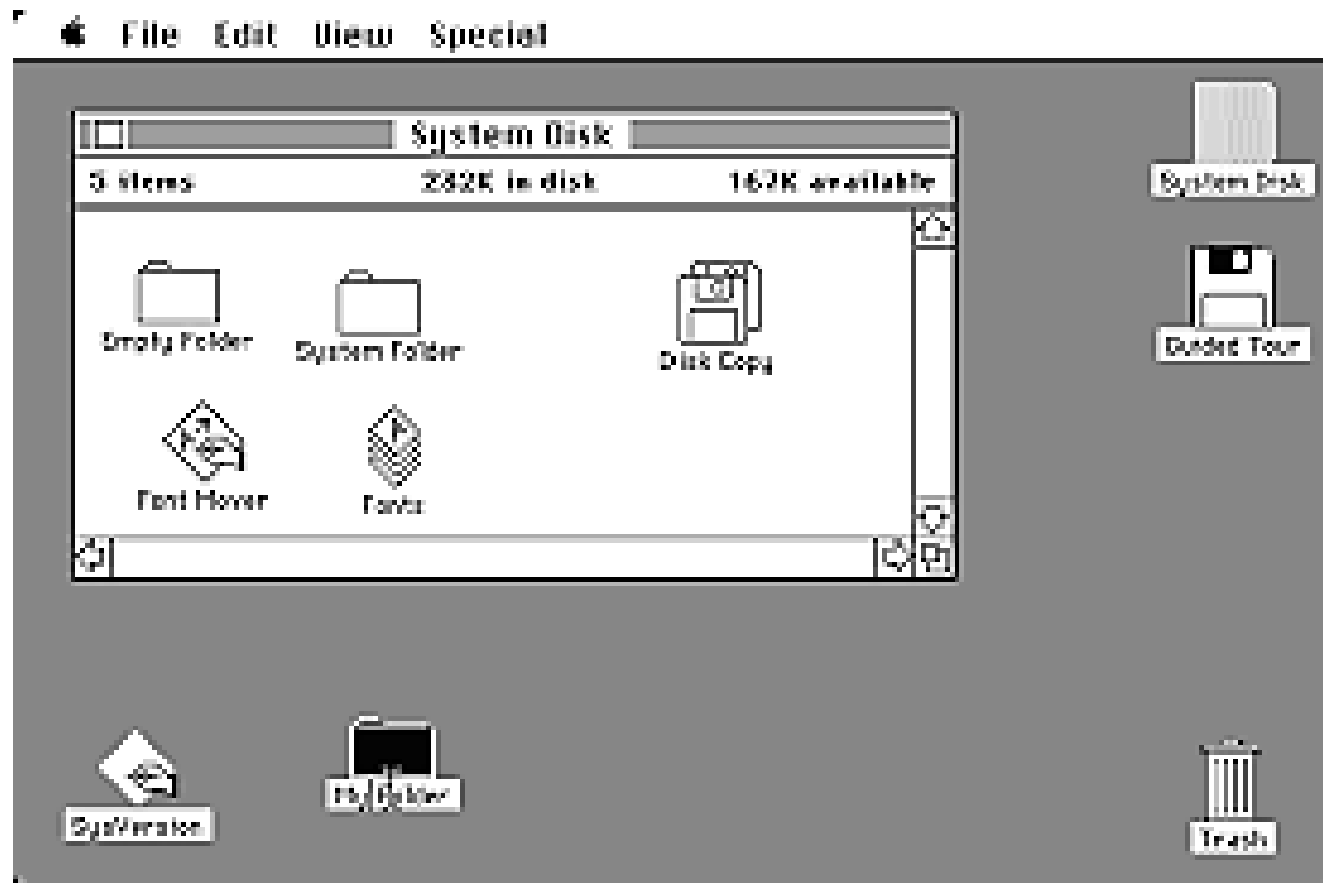
- 9:27:28 10-25-88 N.H.
- Local
- My Job
- On Board
- Mail Merge
- Mail from Ken
- Calendar
- Calc
- Loader
- Blank User Disk
- Empty Diskette
- Blank Record File
- Blank Document
- Blank Folder
- Blank Illustration
- Blank Curve
- Blank Book
- Sample File
- Blank Reference
- Blank Worksheet
- Blank Directory

# Apple Macintosh (1984)

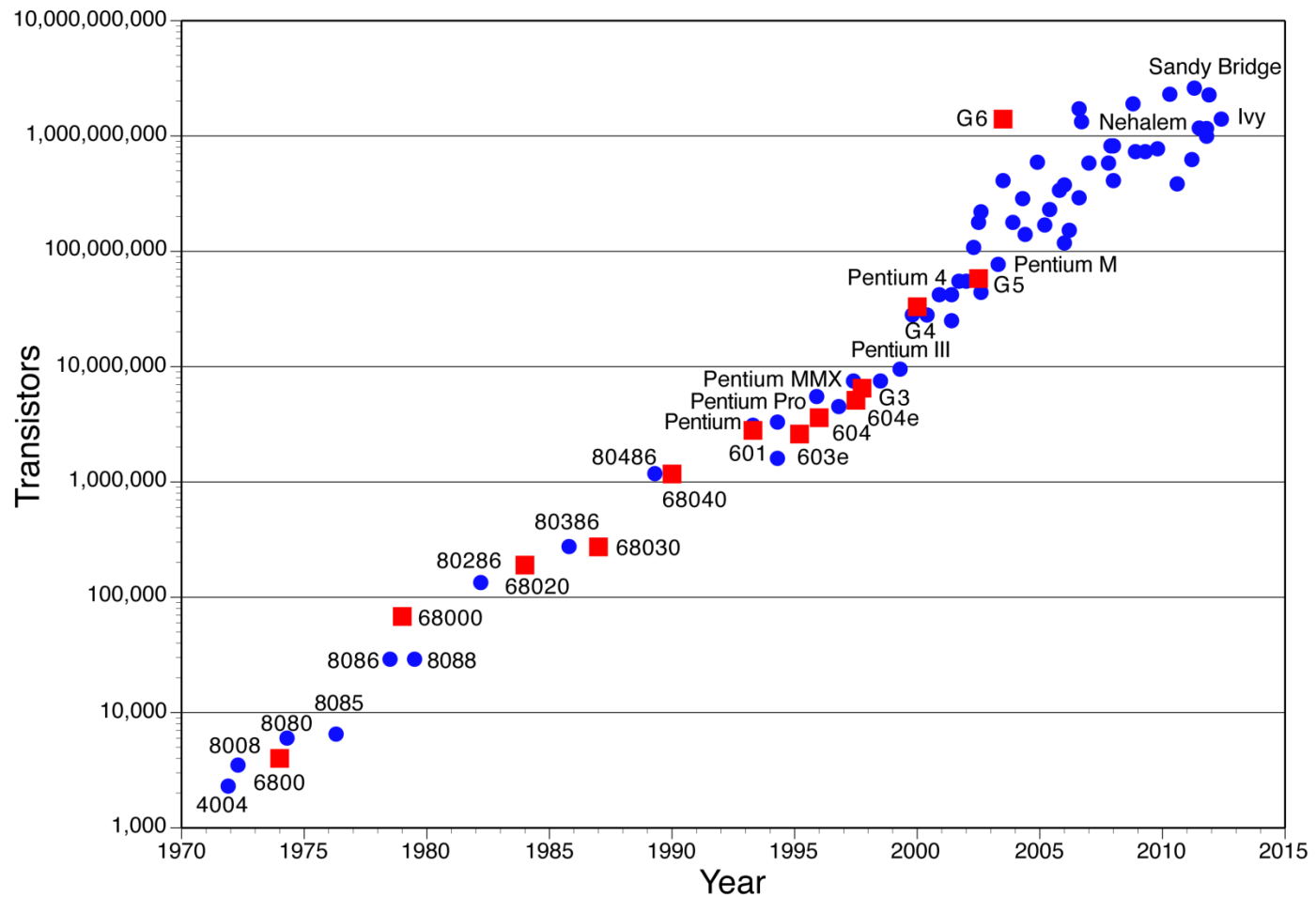
- second Personal computer with GUI interface
- adapted from the work done at Xerox
- designed to be a computer appliance for “Real People”
- introduced at the 1984 Superbowl



# The GUI has arrived!



# Moore's Law in action





# Today's Price/Performance

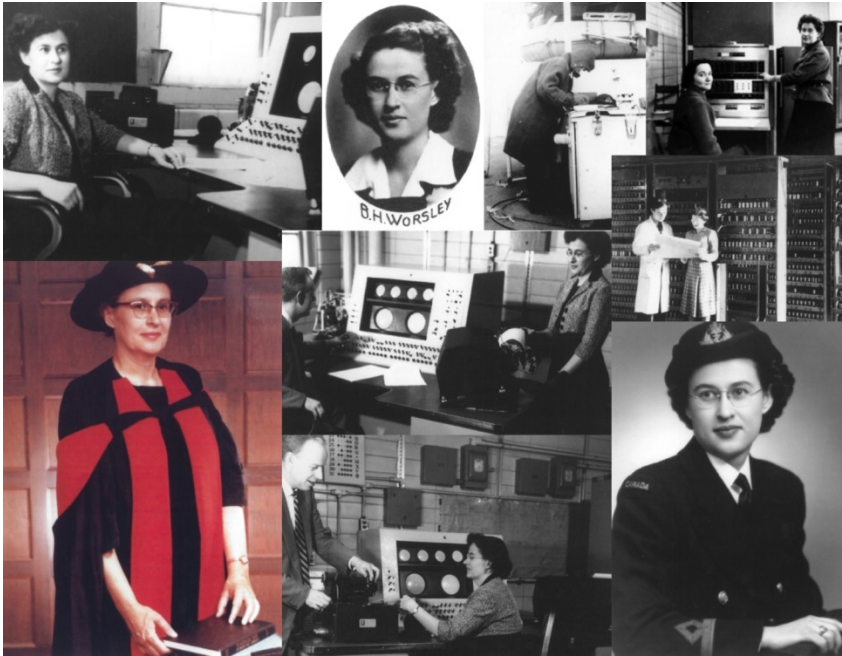
- Over 3 billion operations per second costs less than \$300
- Memory is measured in Gigabytes... not Megabytes or Kilobytes
- Secondary Storage is Terabytes, soon to be Petabytes
- Communication speeds measured in Megabits or Gigabits per second, not Kilobits

And so it continues

# Web Resources for Computing History

- [www.computerhistory.org](http://www.computerhistory.org)
- [waxy.org/2008/06/the\\_machine\\_that\\_changed\\_the\\_world](http://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