

# **From Whence Cometh PCs?**

**Lorrin R. Garson**

**OPCUG & PATACS**

**August 18, 2012**

# To Set the Tone...

**Computers are useless. They can only give you answers. Pablo Picasso**

**A picture is worth a thousand words but it takes 3,000 times the disk space. Unknown**

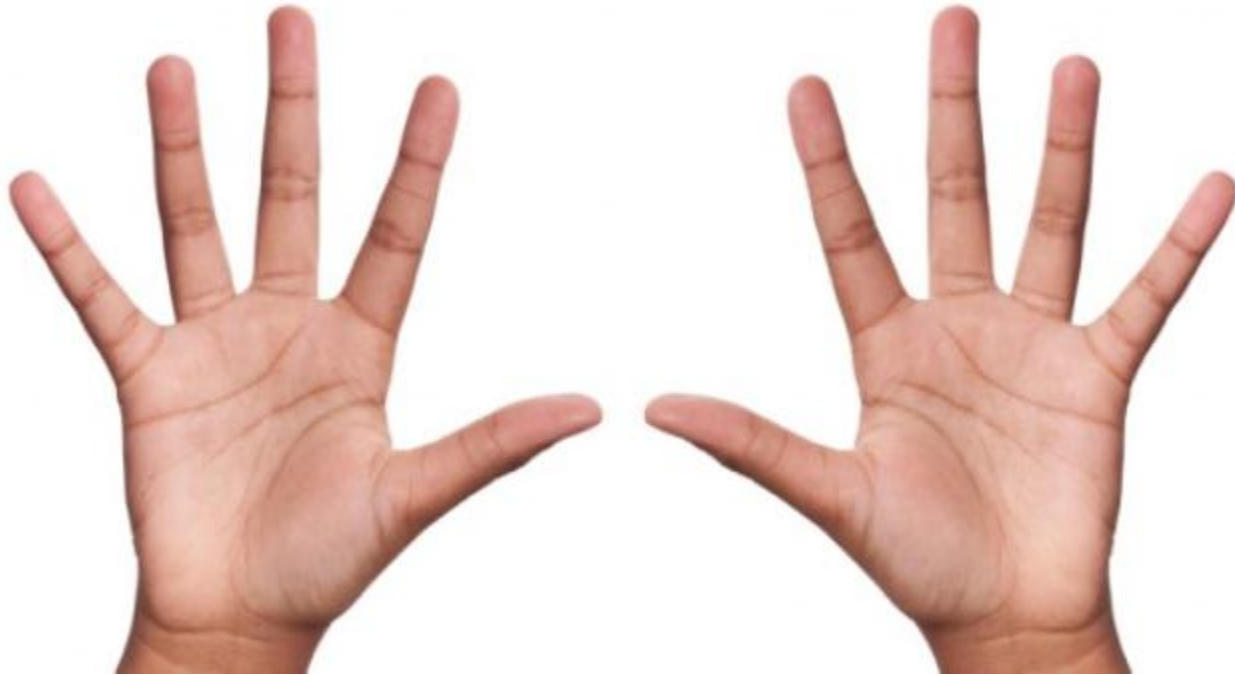
**Applying computer technology is simply finding the right wrench to pound in the correct screw. Unknown**

# Pre-Computer Technology



# The First Computer

Results in the decimal number system (base 10)



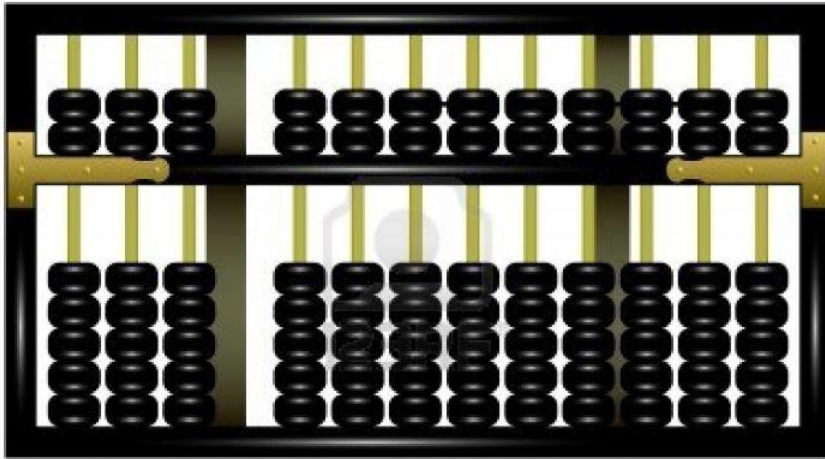


# Oog Meets Saber-Tooth Tiger...

Octal number system (base 8) invented



# Pre-Computer Technology: Abacus



- Mesopotamian (2700—2300 BC)
- Egyptian
- Persian
- Greek
- Roman
- Chinese ←
- Indian
- Japanese
- Russian

# Human Computer




- <math>15^{\text{th}} - 20^{\text{th}}</math> century
- Manually calculated:
  - Financials - commerce
  - Log tables
  - Trigonometric tables
  - Navigation tables**
  - Artillery ballistic tables

**Dryden Flight Research Center 1949  
Edwards, California**

# Pre-Computer Technology: Blaise Pascal's Pascaline



- 1642-1652
- The first calculator...
  - Used in an office
  - To be commercialized
  - To be patented
  - Sold by a distributor
- For detailed information [click here](#) → 



1623–1662



# Pre-Computer Technology: Slide Rule



Edmund Gunter  
(1620?)

Edmund Wingate  
(1624)

William Oughtred  
(1632)

Henry Coggeshall  
(1677)

John Warner  
(1722)

Edward Roberts Everard  
(1755)

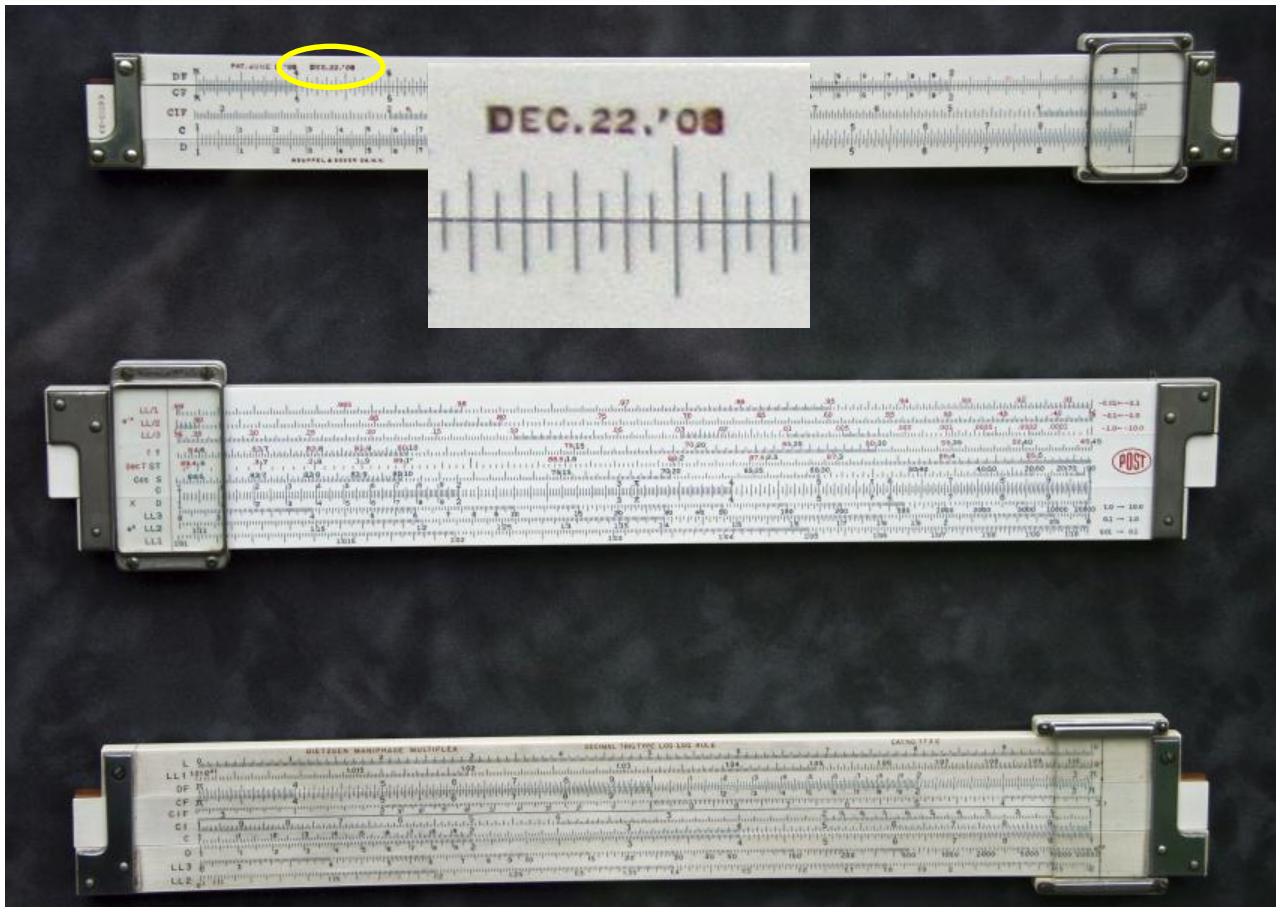
Peter Mark Roget  
(1815)

Nathaniel Bowditch\*  
(1821)

Amédée Mannheim  
(1859)

## Numerous Inventors

# Pre-Computer Technology: Lorrin's Slide Rules

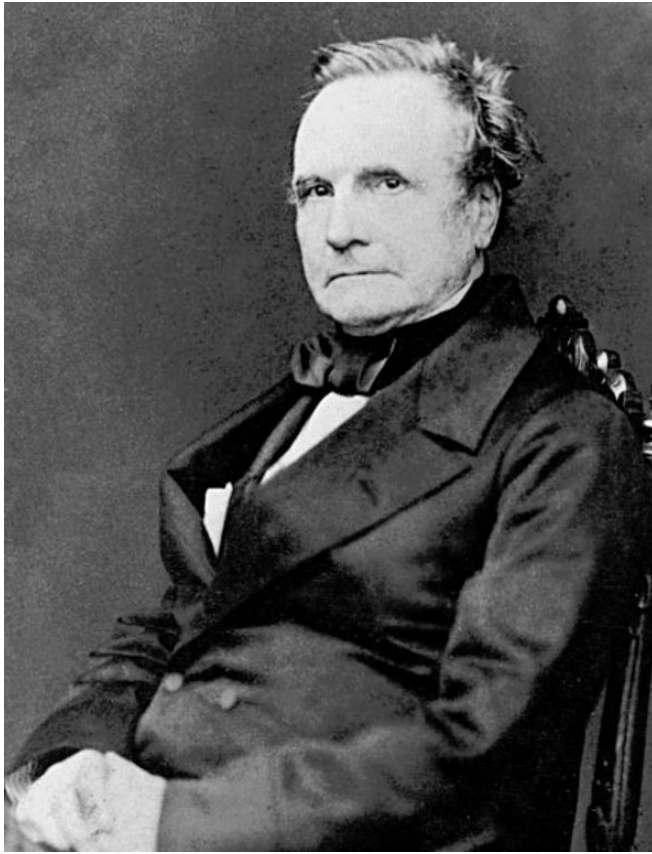


Robert Du Bois  
Keuffel & Esser

Lorrin Garson  
Post

Fred Geiger  
Dietzgen

# Pre-Computer Technology: Charles Babbage

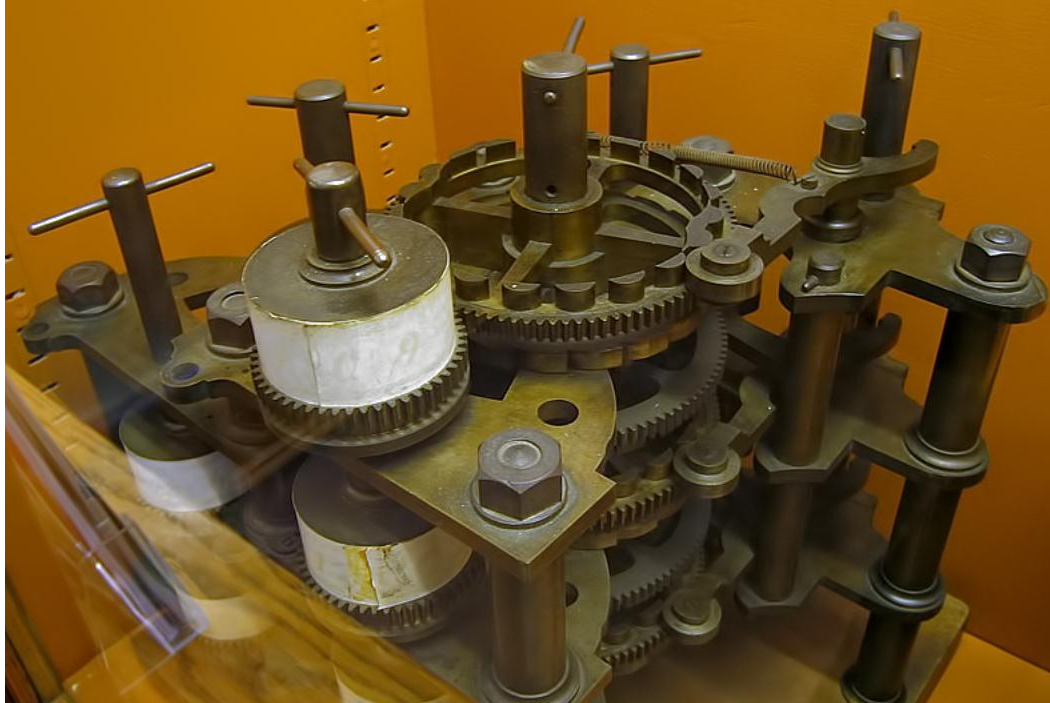


**1791-1871**

- British mathematician, philosopher, inventor and mechanical engineer
- Designed (and almost built) mechanical calculating machines
  - ❑ Difference Engine
  - ❑ Analytical Engine



# Pre-Computer Technology: Difference Engine #1



Assembled by Babbage's son after the death of his father using parts found in Babbage's laboratory

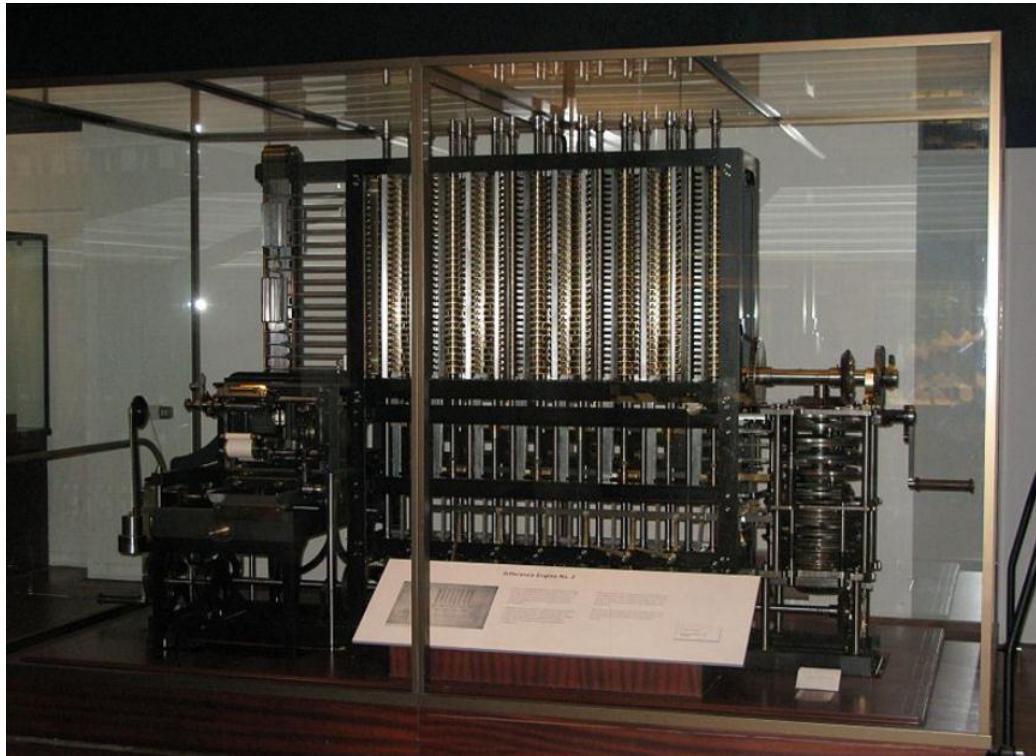
# Pre-Computer Technology: Difference Engine #1



- 2008 The first Difference Engine built
- Constructed from Babbage's plans
- Designed to build log and trig tables using polynomial functions

$$p(x) = 2x^2 - 3x + 2$$

London Science Museum





# Pre-Computer Technology: Analytical Engine



- 1837-1871
- Design for first general-purpose computer
  - Arithmetic logic unit
  - Control flow
  - Conditional branching
  - Loops
  - Memory
  - Used punch cards

# 1815 Flat-Foot Luis Ponders His Toes



Hexadecimal number system (base 16) results

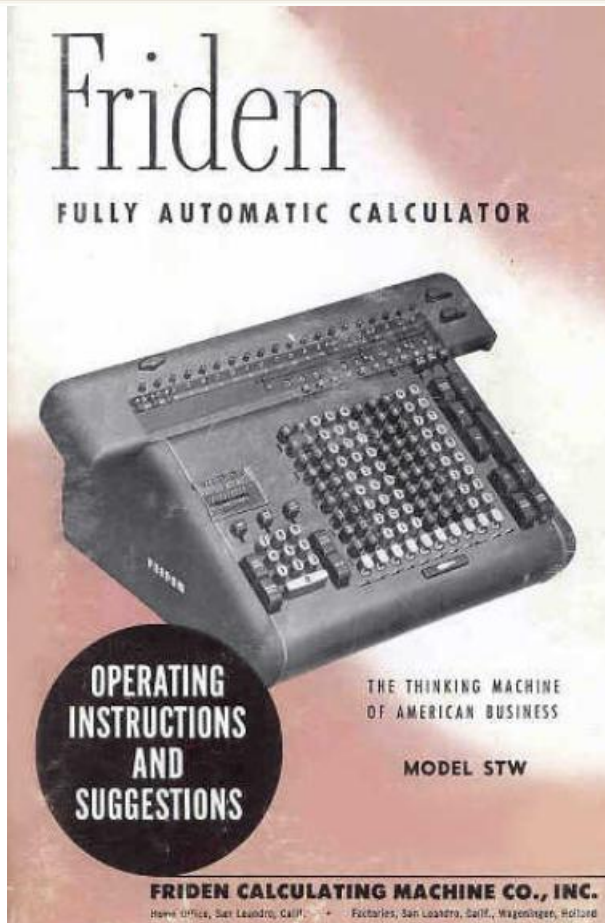
**Early 1920s  
Veterans Bureau office workers com-  
puting bonuses for World War I veterans**



**Burroughs Electric Adding Machines**

# Pre-Computer Technology:

## Friden Model STW-10 Electro-Mechanical Calculator



- 1920s – 1960s
- Largely used in commerce
- Used in science and engineering when greater than 3 figure accuracy needed
- Slow and noisy

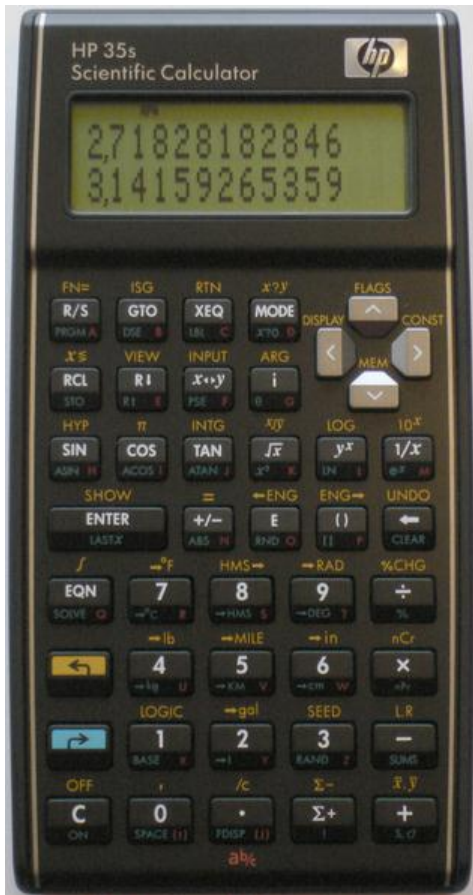
# Pre-PC Technology: Hewlett-Packard “Cal-Tech” Calculator




- 1967
- Four function...
  - Addition
  - Subtraction
  - Multiplication
  - Division
- 12 Decimal places
- Printed output
- Click here →  for details



# Pre-PC Technology: Hewlett-Packard HP-35s Calculator



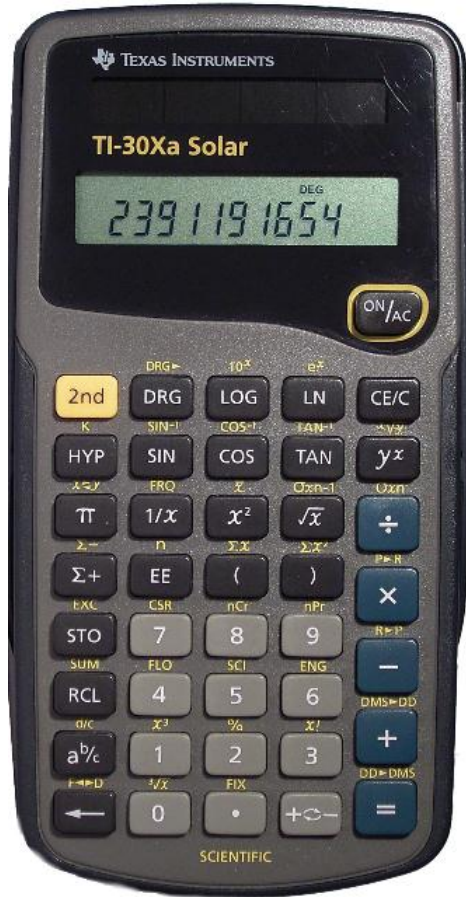
- 1972
- Slide rule killer
- \$395 (\$1,169 in 2012)
- RPN  or Algebraic
- User's Guide: [click here](#) → 

# Pre-PC Technology: Texas Instruments Calculator



- 1976
- TI-30
- \$25 (\$101 in 2012)

# Today — In the Computer Age



- 2012
- TI-30Xa
- \$9.99

# Early Enabling Technologies





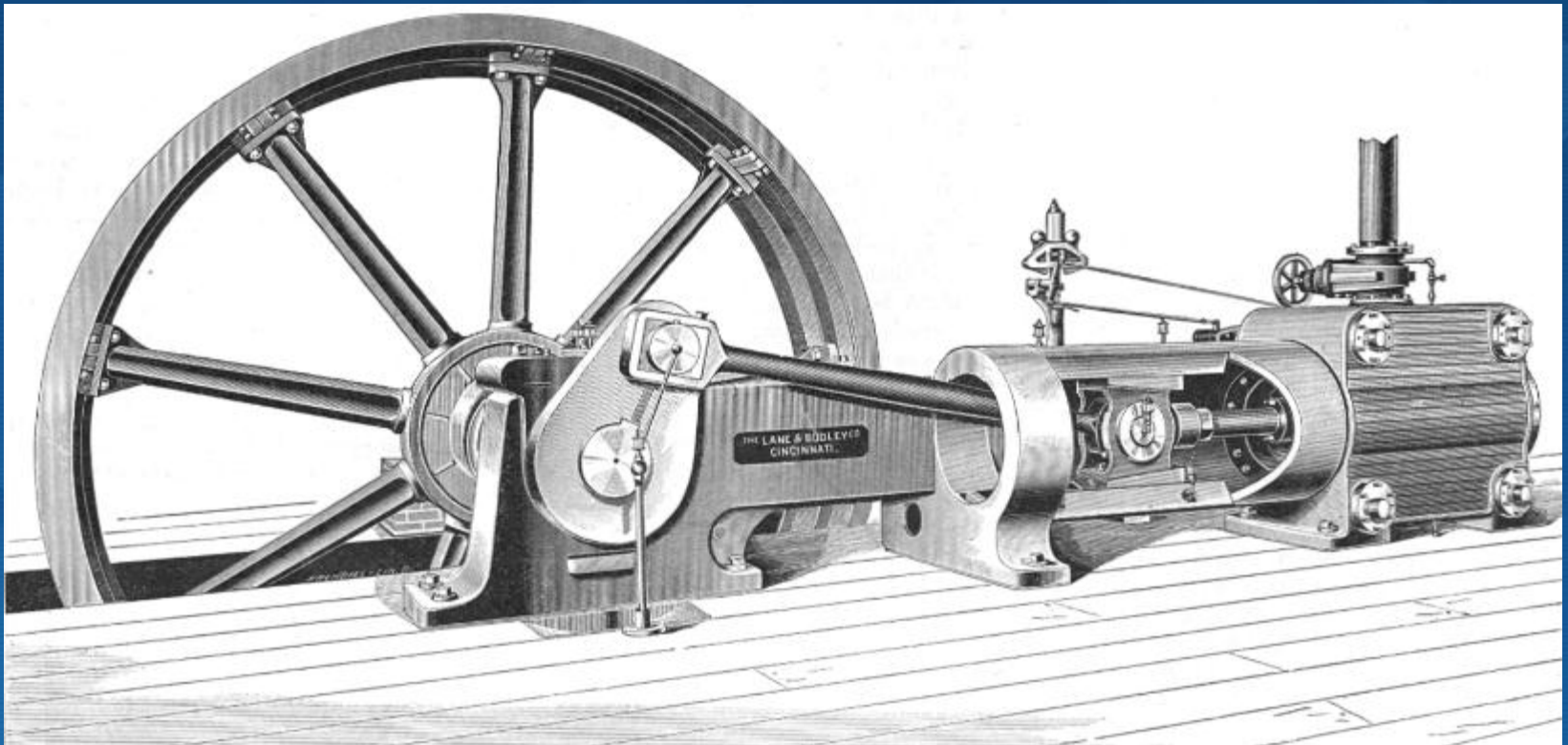
# The Fear of New Technology



"It's a great invention, but it'll probably mean the end of civilization as we know it."



# 19<sup>th</sup> Century Enabling Technologies



Steam replaces human, animal and water power

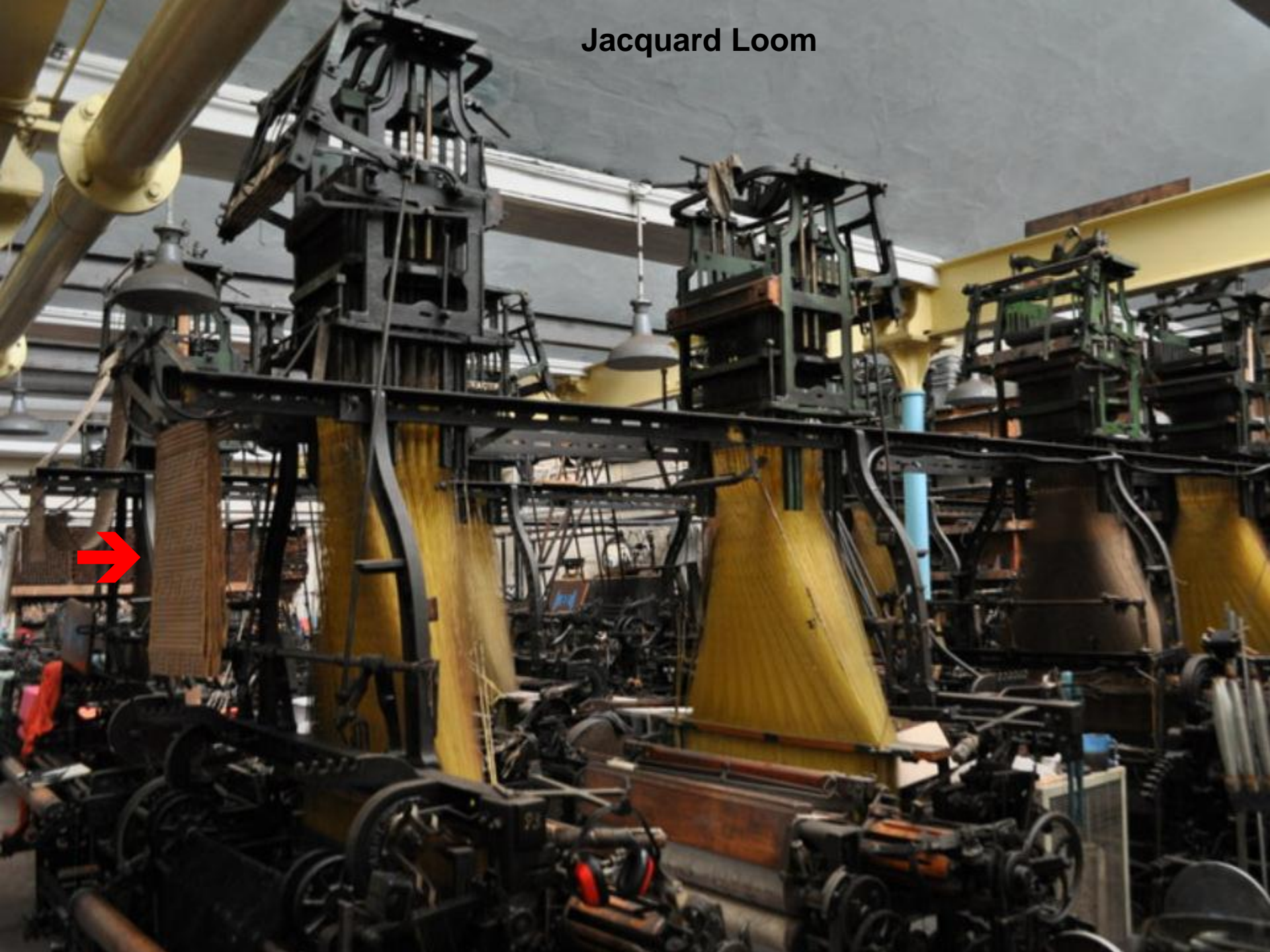
# Pre-Computer Technology: Jacquard's Programmable Textile Loom



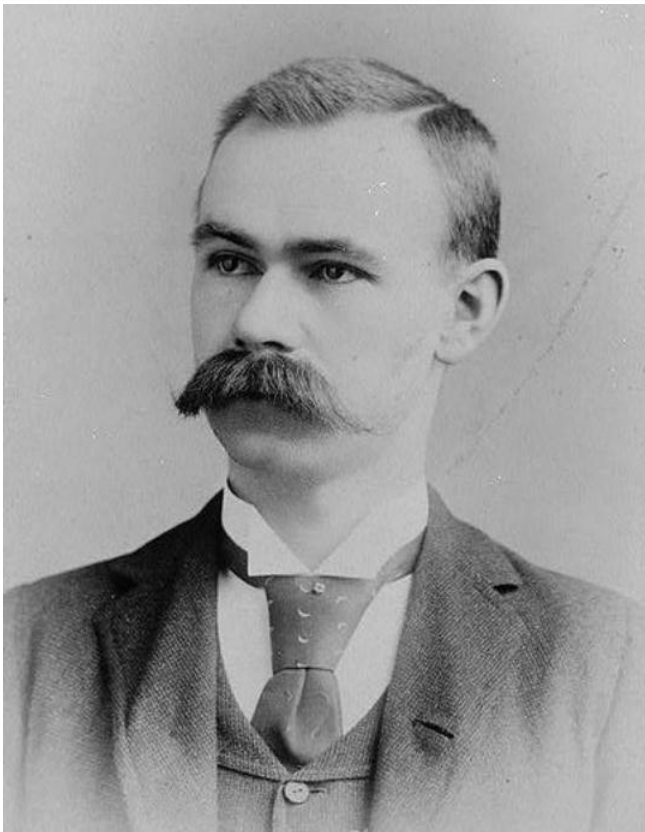
- 1801
- Joseph Marie Jacquard
  - ❑ Bookbinder
  - ❑ Weaver
  - ❑ Inventor
- Loom uses punched cards
- Wove complex patterns of textiles
- In use ~150 years




Jacquard Loom



# Pre-Computer Technology: Herman Hollerith's Tabulating Machine



1860-1929

- Processing U.S. Census Data
  - ❑ 1880 — 8 years to process
  - ❑ 1890 — 1 year to process
- Electromechanical tabulation
- Factory at 31<sup>st</sup> St & C&O Canal, Georgetown
- One of his companies, the Computer-Tabulating-Recording Co., evolved into IBM in 1924. Click here →  for details



# Herman Hollerith's Tabulating Machine



# Hollerith Pantograph (keypunch)



**500 cards/day**

# Pre-Computer Technology: Herman Hollerith's Punch Card



Lx	A	B	C	A	B	C	Lx	Cx	%	Gn	Ad	Ci	Ct	SM	M	HM	WI	A	C	E	F	u	d
Cx	D	E	F	D	E	F	Lx	Cx	%	Sk	Md	Lb	FV	Ox	Ca	X	Tb	B	D	X	a	b	e
Lb	G	H	I	G	H	I	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cx	K	L	M	K	L	M	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Cx	N	O	P	N	O	P	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
LS	Q	R	S	Q	R	S	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Kx	T	U	V	T	U	V	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
RN	W	X	Y	W	X	Y	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
QC	Z	0	1	Z	0	1	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
AV	2	3	4	2	3	4	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
So	5	6	7	5	6	7	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
	8	9	0	8	9	0	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9

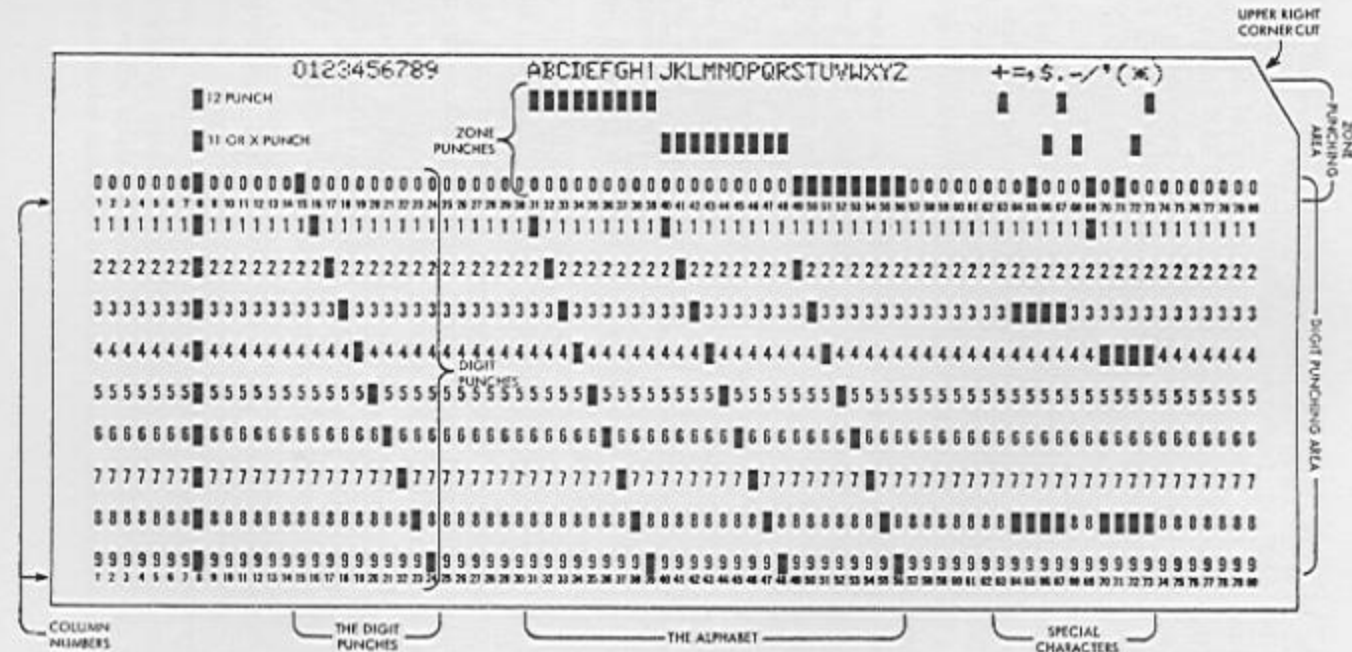
3994

- 12 rows
- 20 columns

# “Modern Day” Punch Card



FIGURE II-1  
A PUNCHCARD AND PUNCHING POSITIONS\*



\* Courtesy of International Business Machines Corporation.



# 20<sup>th</sup> Century Enabling Technologies



# 20<sup>th</sup> Century Enabling Technologies

## Vacuum Tubes



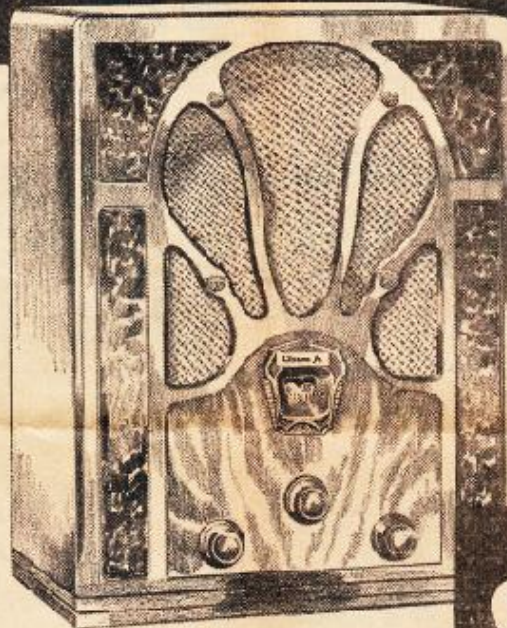
**RCA Triode: Type 808**

- 1904 John Ambrose Fleming invents the diode
- 1906 Robert von Lieben receives a patent for the triode
- 1907 Lee De Forest improves (invents?) the triode
- 1913 AT&T buys De Forest's patent for \$50,000
- 1915 First U.S. coast-to-coast telephone call facilitated by vacuum tube amplifier. \$21/3-min (\$477 in 2012)



Ad from  
1933  
newspaper

# FOUR TUBES ARE NOT ENOUGH!



**Y**OU can't catch ether waves right with only four tubes—it's been tried but never with much success. So the finest radio in the land—the sturdy, full-voiced Clarion Jr.—comes to you with one more tube, with the extra circuit that means real selectivity and sensitivity. When you look at Clarion Jr.'s newer-style cabinet and listen to its last-word "Super-het" performance you marvel that such a radio can be yours for only \$19.95! Call on one of the dealers listed below and discover that miracles still happen!

**5-tube**  
Super-heterodyne  
*Clarion Jr.*

**\$19<sup>95</sup>**  
COMPLETE

**\$352.16**  
**(2012)**

- Moderne Type Cabinet
- Full Super-heterodyne Circuit
- 5 Latest Type Tubes
- 3-Knob Control
- 3-Gang Condenser
- Vernier Dial

OTHER CLARION RADIOS: 6-tube Midget, \$31.95; 8-tube Midget, \$41.95; 10-tube Console, \$52.95; 12-tube Console, \$73.95; 14-tube De Luxe Console, \$129.50. Complete.

**SAMPSON ELECTRIC COMPANY**

Ad from  
1933  
newspaper

14-tube De Luxe Console, \$129.50



\$2,285.95 in 2012



# 20<sup>th</sup> Century Enabling Technologies

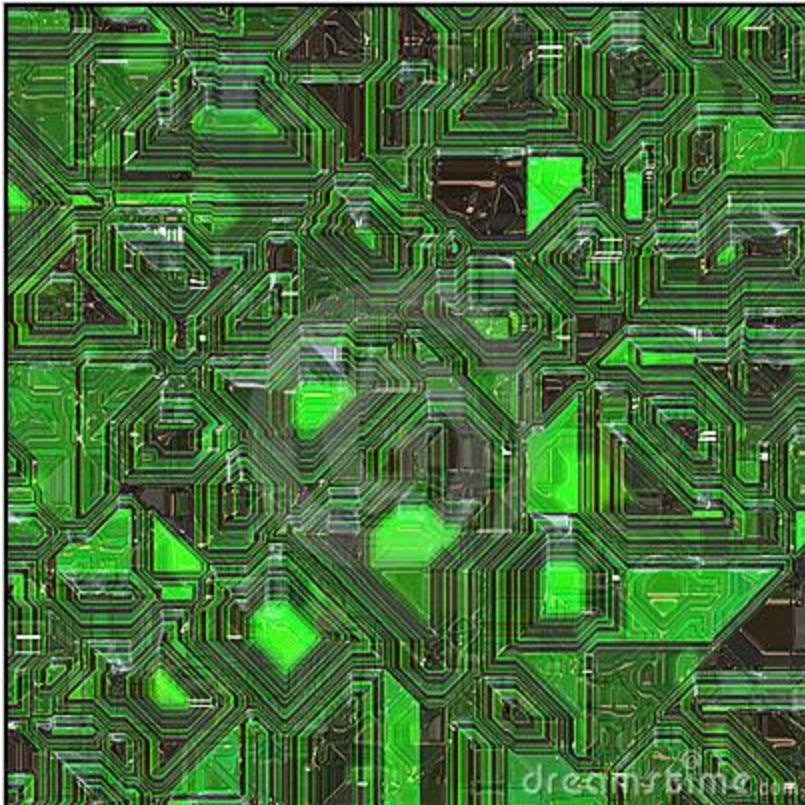
## Transistors





- 1947
- Invented by John Bardeen, William Shockley and Walter Brattain at Bell Labs\*
- 1956 Nobel Prize in physics 
- Click here →  for information on the transistor

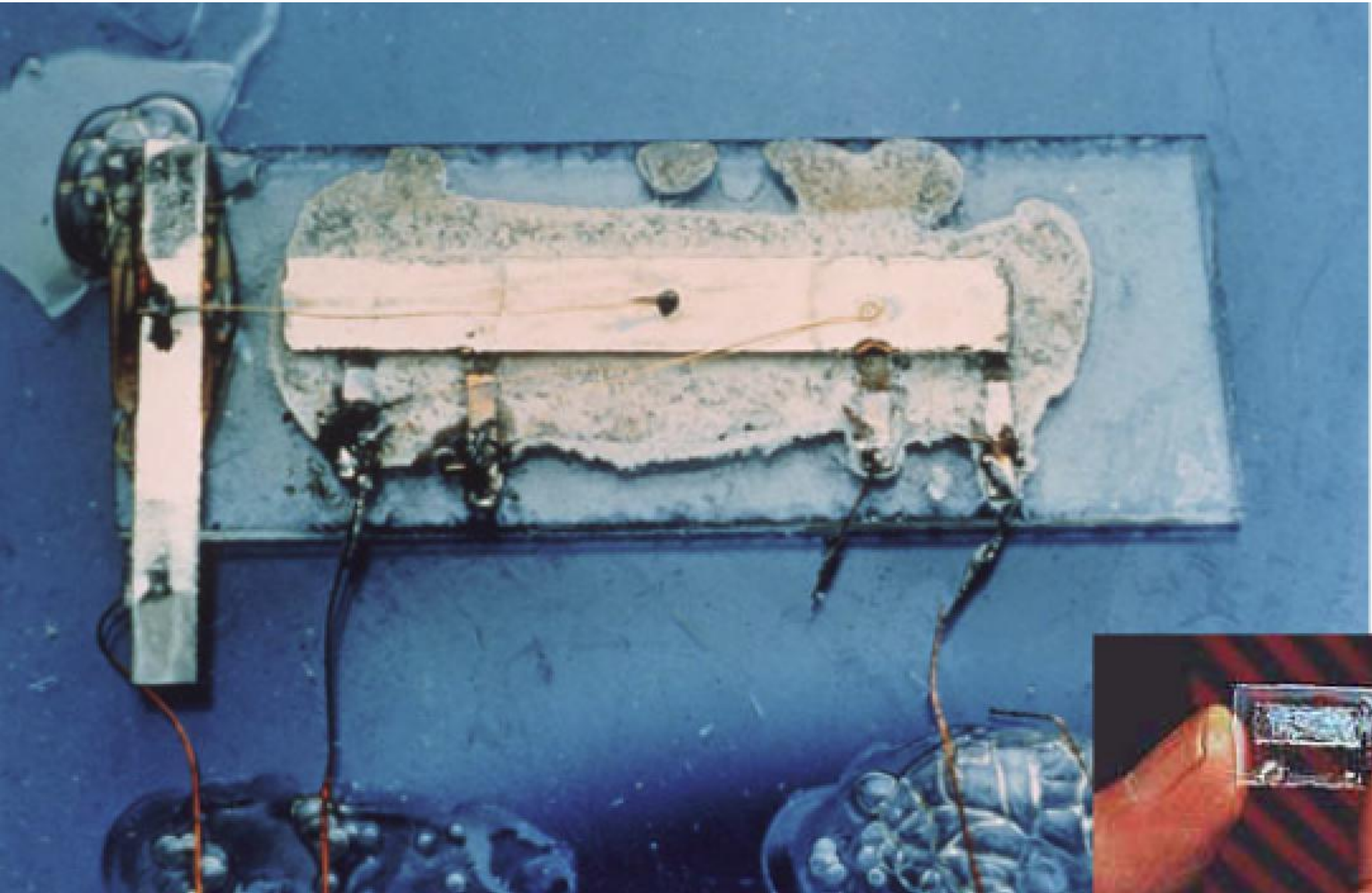
# 20<sup>th</sup> Century Enabling Technologies

## Integrated Circuits



- 1958
- Invented by Jack Kilby at Texas Instruments
- An electronic circuit manufactured by lithography  
Click here →  for details
- Kilby received the 2000 Nobel Prize in Physics 

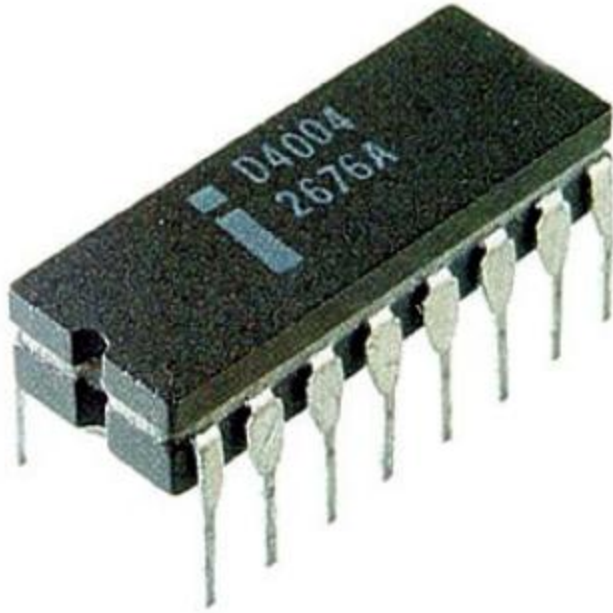
# Jack Kilby's Original Integrated Circuit





# 20<sup>th</sup> Century Enabling Technologies

## Microprocessors



**Intel 4004**

- 1971 Intel 4004, 4-bit
- 1972 Intel 8008, 8-bit
- 1974 Intel 8080, 8-bit
- 1975 National Semiconductor PACE, 16-bit
- 1979 Motorola MC68000, 32-bit
- 2003 Advanced Micro Devices AMD64, 64-bit
- 2005 Multicore processors for workstations and servers





# Types of Computers

Supercomputers

Servers

Minicomputers

Workstations

Laptops

Netbooks

Tablets

E-Book Readers

Game Consoles

Embedded Computers

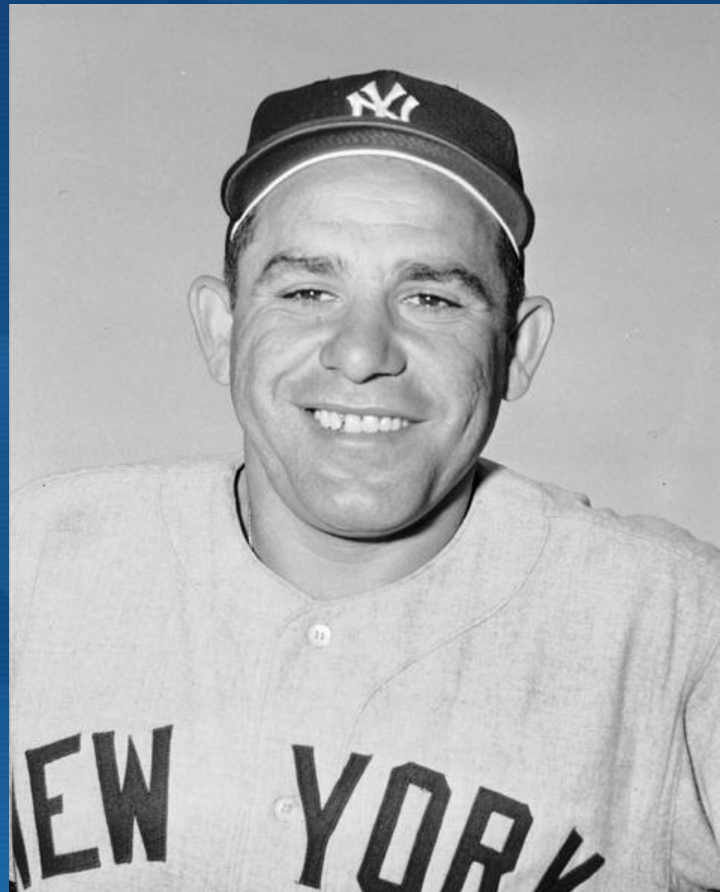
Smartphones

PDA's

PCs

Computers

# Predicting the Future



**“It's tough to make predictions,  
especially about the future.”**

**Yogi Berra, 1925–  
Baseball Player  
Philosopher  
“Malaprop-er”**

# Predicting the Future



**“I think there is a world market for maybe five computers.” (1943)**

**Thomas J. Watson, Sr., 1874-1956  
Chairman & CEO of IBM**



# Troublesome Public Relations

- **Deutsche Hollerith Maschinen Gesellschaft (GmbH)**
- **DEHOMAG**
- **IBM owned 90%**



**Tom Watson, Sr. meets with Adolf Hitler, July 1937**

Watson's controversial meeting with Hitler came shortly before he received a medal for "Service to the Reich" for providing tabulating equipment. Watson later returned the medal.

*IBM and the Holocaust* by Edwin Black  
*Nazi Nexus* by Edwin Black

# A Selection of Historical Computers



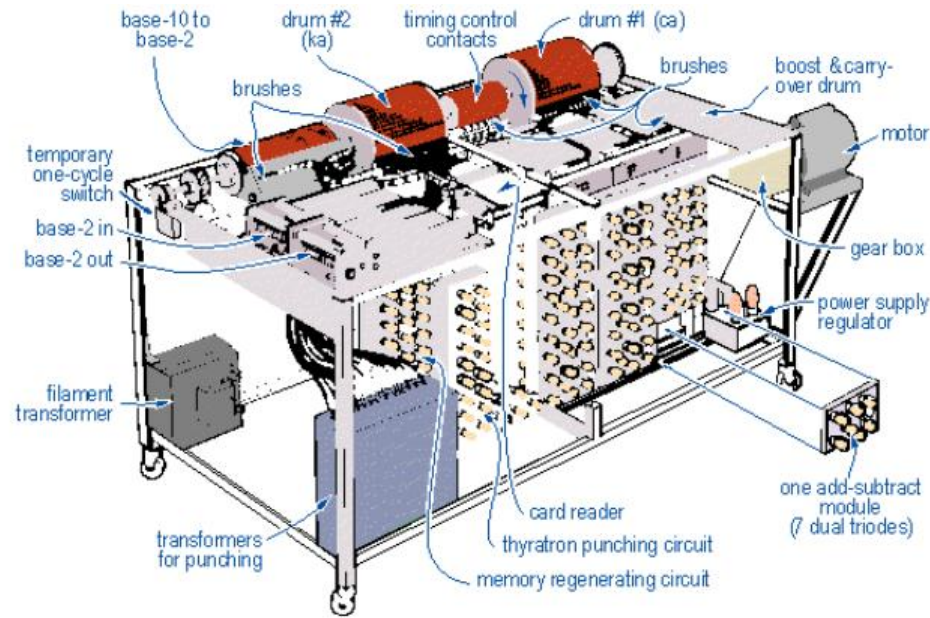
Two 54-minute videos on history of computers  

# Generations of Computers



- 1<sup>st</sup> Generation (1946-1958). The Vacuum tube years
- 2<sup>nd</sup> Generation (1959-1964). Era of the transistor
- 3<sup>rd</sup> Generation (1965-1970). Era of integrated circuits
- 4<sup>th</sup> Generation (1971-today). The microprocessor

# Atanasoff–Berry Computer (ABC)



Click here →  for a 11 min video

$$4x + y = 17$$

$$2x + y = 9$$

- Conceived 1937; tested 1942
- John Atanasoff & Clifford Berry at Iowa State University
- 280 triode vacuum tubes
- 700 lbs
- Used binary digits
- Performed calculations electronically
- Computation and memory separate
- Specific purpose machine: solution to simultaneous linear equations



# Konrad Zuse

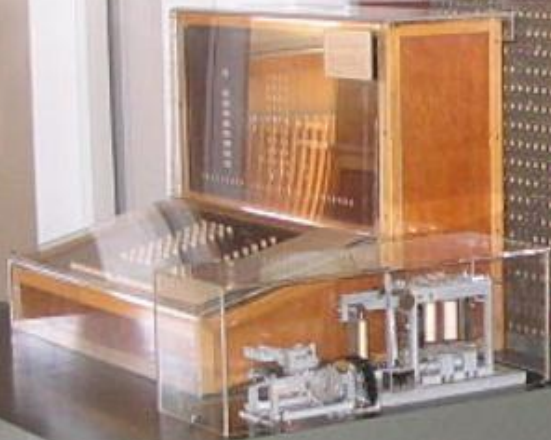


**1910-1995**

- 1941 The first programmable, automatic computer
- Zuse Z3 computer
  - ❑ Programmable
  - ❑ 2,000 relays
  - ❑ 22 bit word length
  - ❑ 5-10 Hz clock speed
  - ❑ Program code and data stored on punched film
- Statistical analysis of wing flutter for the Luftwaffe
- Zuse models from Z1 to Z43
- Founded company Zuse KG (sold to Siemens in 1967)

**Zuse Z3 Replica  
Deutsches Museum  
München**

Z3: Eine bahnbrechende  
programmierbare Rechenmaschine



# Alan Turing



**1912-1954**

- British mathematician, logician, cryptanalyst and computer scientist
- The father of computer science and artificial intelligence
- During World War 2, attacked codes of:
  - Germany (Enigma)
  - Japan
  - Italy



# German Enigma



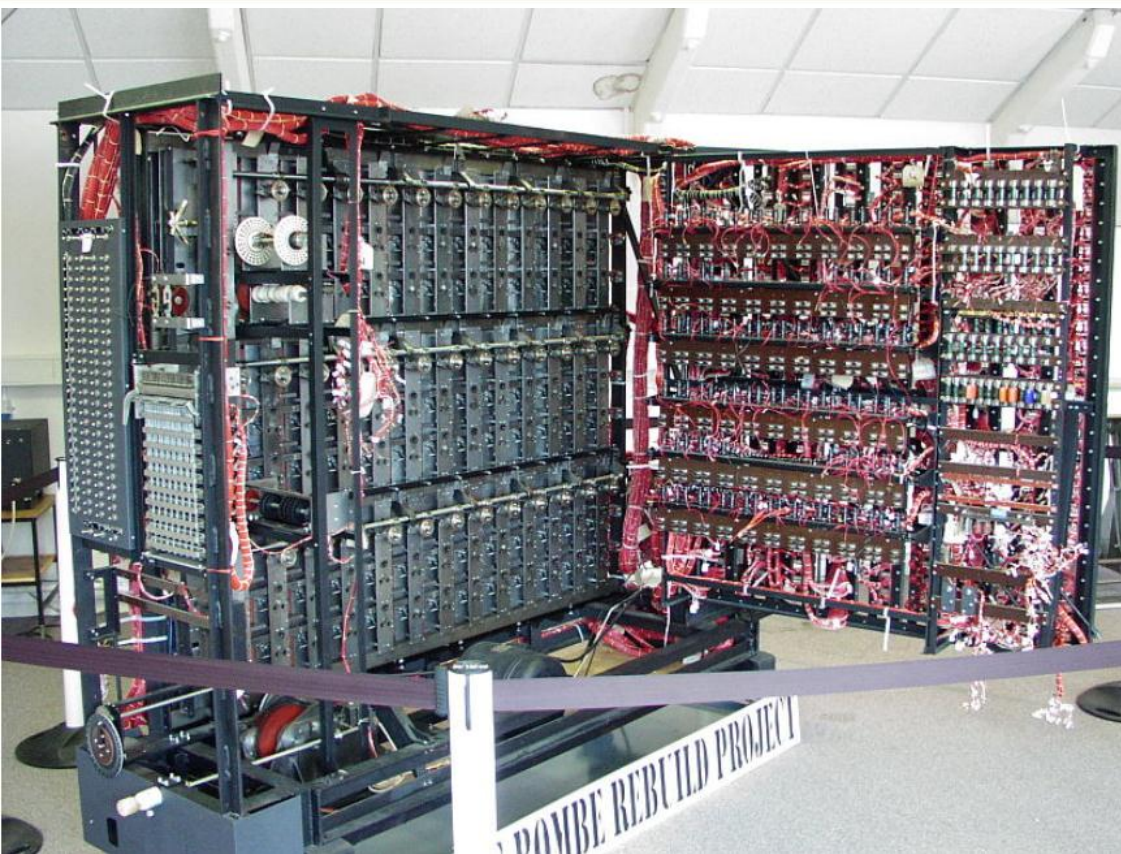
- Developed 1918-1919
- Used in commerce 1920s
- Used by German military 1926 to 1945
- Quite secure if used properly
- Click here →   for more information



Replica



# Turing-Welchman Bombe



Replica

- Operational March 18, 1940
- Named after Polish bomba kryptologiczna
- Used to decipher German Kriegsmarine Enigma messages

# The Italian Codes

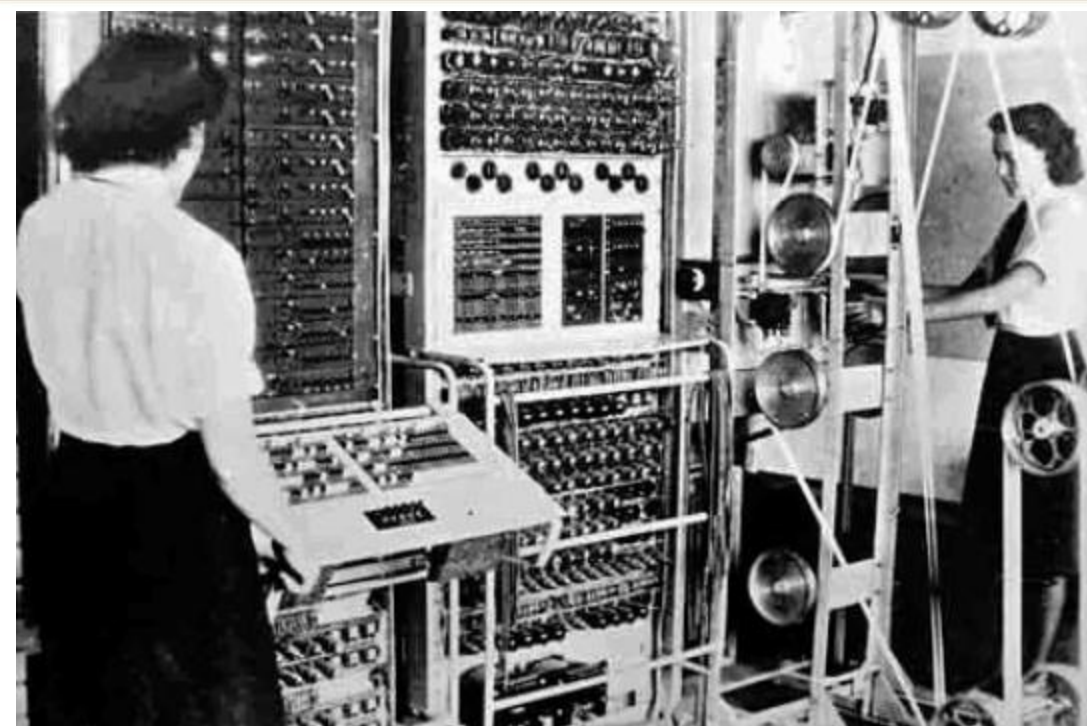
(How tough can it be?)

Cracking the Italian codes was something you did at the pub over a beer. It was both relaxing and enjoyable...

Peter Hilton

WW2 British codebreaker

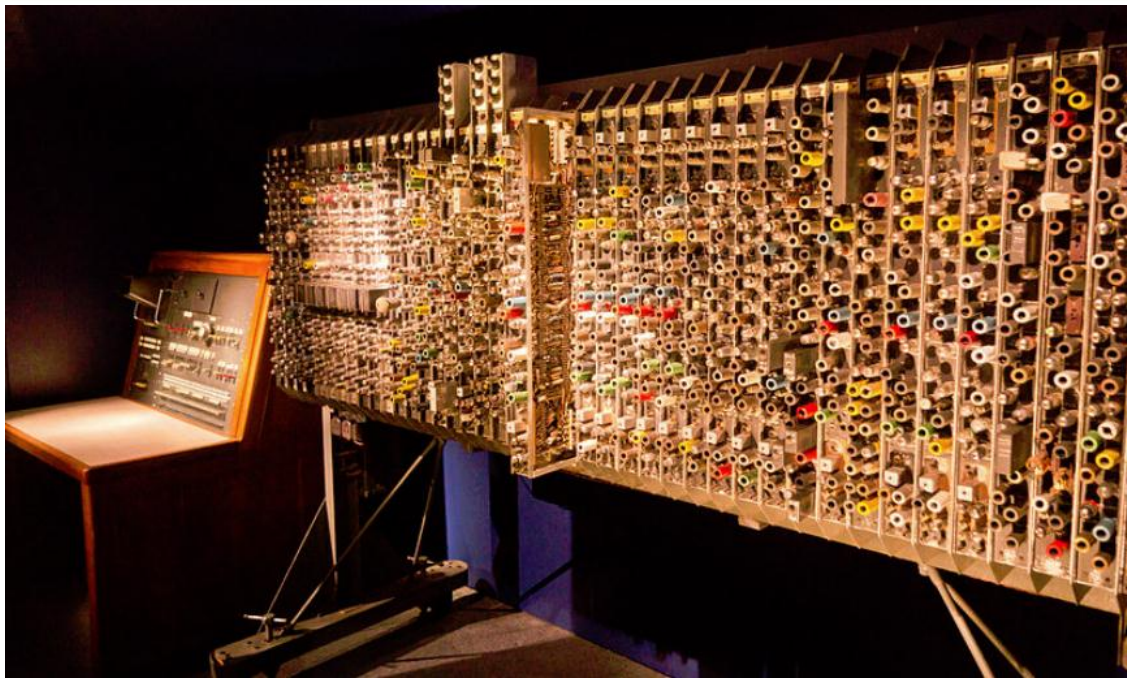
# British Colossus



**Colossus Mark 2 Computer**

- Operational 1944
- First electronic, digital, programmable computer
- Designed by Tommy Flowers 
- Used to decrypt German Lorenz encrypted messages (12 rotor)

# ACE—Automatic Computing Engine



**Pilot ACE**

- 1946
- Designed by Alan Turing
- Early (first?) stored-program computer
- National Physical Laboratory (England)
- Used by Dorothy Hodgkin\* (structures of vitamin B12 and insulin)

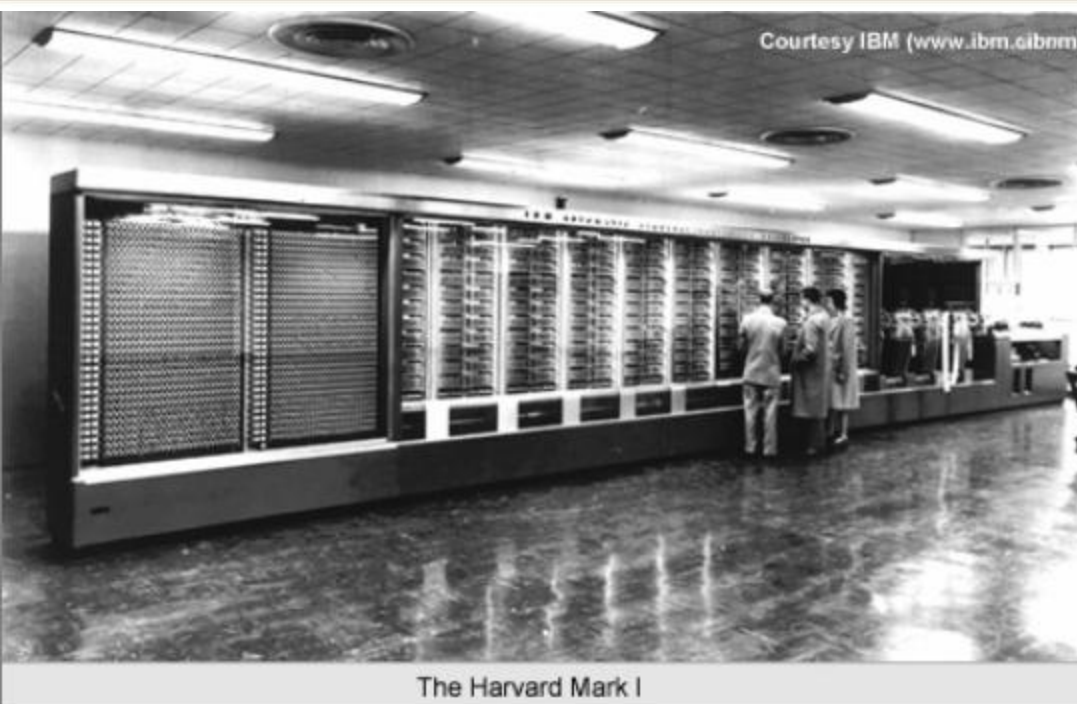
Click here →  for the structure of insulin


\* Nobel Prize in Chemistry, 1964





# Harvard Mark 1



- 1944
- Designed by Howard Aiken & Grace Hopper
- Built by IBM 
- 760,000 components
- U.S. Navy Bureau of Ships
- Gunnery and ballistic calculations
- 23 decimal places

# Admiral Grace Hopper



- AKA “Amazing Grace”
- Computer scientist and U.S. Navy officer (41 years service)
- One of first Harvard Mark I programmers
- Developed first compiler for a computer language
- Conceptualized machine-independent programming (lead to COBOL)
- Coined “computer bug” 

1906 - 1992


# The Original Computer Bug

92.  
9/9

0800 Antan started  
1000 " stopped - antan ✓

13<sup>00</sup> MC (033) MP - MC  $\left\{ \begin{array}{l} 1.2700 \quad 9.037847025 \\ 1.30476415 \quad 9.037846995 \text{ correct} \\ 2.130476415 \quad 4.615925059(-2) \\ 2.130676415 \end{array} \right.$

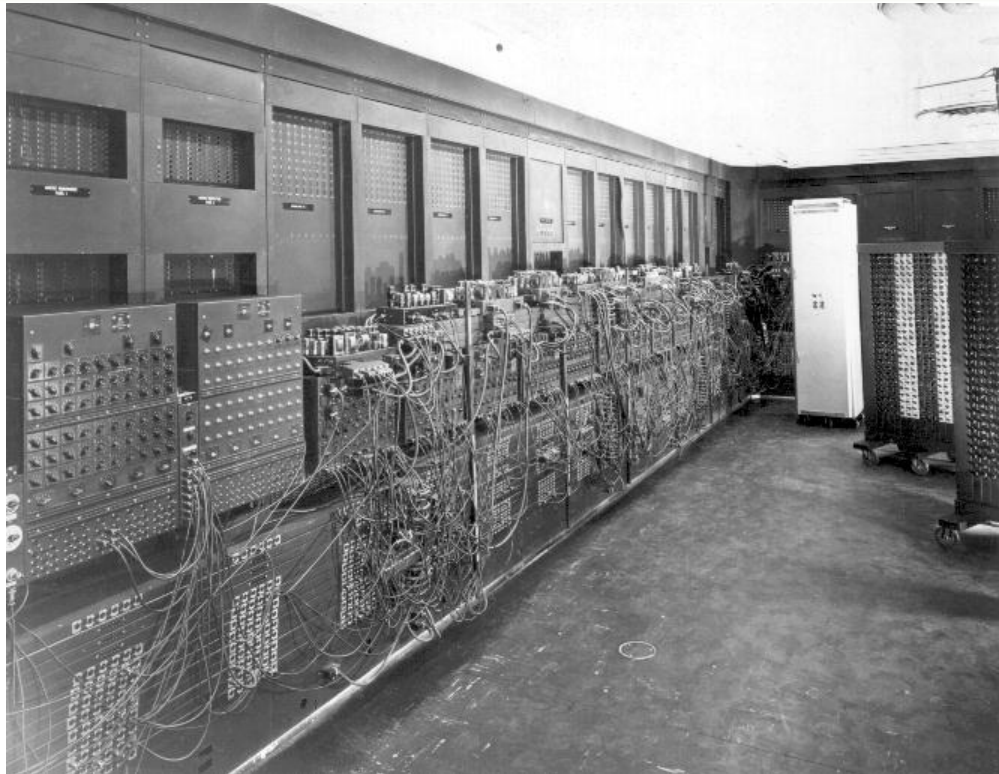
(033) PRO 2  
convd  
Relays 6-2 in 033 failed special speed test  
in relay  
Relays changed  
1100 Started Cosine Tape (Sine check)  
1525 Started Mult + Add

1545  Relay #70 Panel F  
(moth) in relay.

1630 Antan started.  
1700 closed down.

First actual case

# ENIAC



- 1946
- Designed by John Mauchly & J. Presper Eckert (University of Pennsylvania)
- Used at Aberdeen Proving Ground 1947-1955
- General purpose computer
- Calculating ballistic tables



# Back panel of ENIAC computer (17,468 vacuum tubes)



# The Future of Computers

Computers in the future may have only 1,000 vacuum tubes and perhaps only weigh 1 1/2 tons.  
Popular Mechanics (1949)

# IBM and the Seven Dwarfs



1. IBM
2. Burroughs
3. UNIVAC
4. NCR
5. Control Data
6. Honeywell
7. General Electric
8. RCA

The 1950s going forward...

# IBM Mainframes: 1950s – 1960s



- **1401 Data Processing System**

- 1401 (1959) \*
- 1410 (1960) \*
- 1440 (1962) \*
- 1460 (1963)

- **1620 Data Processing System**

- 1620 (1959) \*
- 1620 Model II (1963)

- **7000 Data Processing System Series**

- 7090 (1958) \*
- 7030 (1960) \*
- 7040 (1961)
- 7044 (1961)
- 7094 (1962) \*
- 7094-II (1963)
- 7070 (1958)
- 7080 (1960)
- 7074 (1960)
- 7072 (1961)
- 7010 (1962)



# IBM Mainframes: 1960s (cont.)



- **System/360 Series (1964)**

- Model 20 (1964) IBM 2020 processing unit
- Model 40 (1964)\* IBM 2040 processing unit
- Model 30 (1964)\* IBM 2030 processing unit
- Model 50 (1964)\* IBM 2050 processing unit
- Model 60 (1964) IBM 2060 processing unit
- Model 62 (1964) IBM 2062 processing unit
- Model 70 (1964) IBM 2070 processing unit
- Model 92 (1964) IBM 2092 processing unit
- Model 44 (1965)\* IBM 2044 processing unit
- Model 57 (1965) IBM 2057 processing unit
- Model 65 (1965) IBM 2065 processing unit
- Model 67 (1965) IBM 2067 processing unit
- Model 75 (1965)\* IBM 2075 processing unit
- Model 91 (1966)\* IBM 2091 processing unit
- Model 25 (1968)\* IBM 2025 processing unit
- Model 85 (1968) IBM 2085 processing unit
- Model 95\* (Offered on special government contract & shipped 2/68)
- Model 195 (1969)\* IBM 2195 processing unit
- Model 22 (1971)\* IBM 2022 processing unit

# IBM Mainframes: 1970s



## • System/370 Series (1970)

- Model 155 (1970)\* IBM 3155 processing unit
- Model 165 (1970)\* IBM 3165 processing unit
- Model 145 (1970)\* IBM 3145 processing unit
- Model 135 (1971)\* IBM 3135 processing unit
- Model 195 (1970)\* IBM 3195 processing unit
- Model 158 (1972)\* IBM 3158 processing unit
- Model 168 (1972)\* IBM 3168 processing unit
- Model 125 (1972)\* IBM 3125 processing unit
- Model 115 (1973)\* IBM 3115 processing unit
- Model 115-2 (1975)
- Model 125-2 (1975)
- Model 158-3 (1976) IBM 3158-3 processing unit
- Model 168-3 (1976) IBM 3168-3 processing unit
- Model 135-3 (1976) IBM 3135-3 processing unit
- Model 145-3 (1976) IBM 3145-3 processing unit
- Model 138 (1976)\* IBM 3138 processing unit
- Model 148 (1976)\* IBM 3148 processing unit
- Model 158-AP (1976) Attached processor

## • System/370 Compatible - 3031 Processor Complex (1977)

- 3031 (1977)\* Models 1-6
- 3031 (1978) Models A2-A6 (attached processors)
- 3031 (1979) Models 7, 8, A7 & A8

## • System/370 Compatible - 3032 Processor Complex (1977)

- 3032 (1977)\* Models 2, 4 & 6
- 3032 (1979) Model 8

## • System/370 Compatible - 3033 Processor Complex\* (1977)

- 3033U (1977) Uniprocessor models 1, 4, 6 & 8
- 3033MP (1978) Multiprocessor models 4, 6 & 8
- 3033 (1978) Models U12 & U16 and M12 & M16
- 3033 (1979) Attached processor models 4, 8, 12 & 16
- 3033N (1979) Models N4 & N8
- 3033S (1980) Models S4 & S8 and U24 and A24
- 3033N (1980) Models N4, N8, N12 & N16
- 3033 (1981) Models S4 & S8
- 3033 (1981) Models S12 & S16

## • 4300 Processing Systems (1979)

- 4331 (1979)\* Models I1 & J1
- 4341 (1979)\* Models K1 & L1

# IBM Mainframes: 1980s



- 4331 (1980) Models J2, K2, KJ2 & L2
- 4341 (1980) Models K2, L2 & M2
- 4321 (1981) Model J11

- 4331-2 (1981)
- 4331 (1981) Models J11 & K11
- 4341 (1981) Models N2 & P2
- 4341 (1981) Models K10, L10, K11, L11 & M11
- 4341 (1982) Model Groups 9 & 12
- 4361 (1983)\* Model Groups 4 & 5
- 4381 (1983)\* Model Groups 1 & 2
- 4361 (1984) Models N4 & N5
- 4381 (1984)\* Model Group 3 (M3, P3, Q3 & R3)
- 4381 (1984) Models Q2 & R2
- 4381 (1986) Model Groups 11 - 14
- 4381 (1987) Model Groups 21 - 24
- 4381E (1988) Models 91E & 92E
- ES/4381 (1989) Entry level models

## • System/370 Compatible - 3081 Processor Complex (1980)

- 3081 (1980)\* Models D16, D24 & D32
- 3081K (1981) Models K16, K24 & K32
- 3081 (1982) Models GG16, G24 & G32
- 3081 (1983) Models G48 & K48

## • System/370 Compatible - 3083 Processor Complex (1982)

- 3083 (1982)\* Models E8, E16, B8, B16, B23, B32, J8, J16, J24 & J32
- 3083E (1983) Models E24 & E32
- 3083CX (1984) Models CX0, CX1 - CX3

## • System/370 Compatible - 3084 Processor Complex (1982)

- 3084 (1982)\* Models Q32, Q48 & Q64
- 3084 (1983) Model Q96
- 3084X (1984)

## • System/370 Compatible - 3090 Processor Series (1985)

- 3090 (1985)\* Models 200 & 400
- 3090 (1986) Models 150 & 180
- 3090E (1987) Models 150E, 180E, 200E, 300E, 400E & 600E
- 3090 (1987) Model 120E
- ES/3090 (1988) Model 600S
- 3090E (1988) Models 280E & 500E
- ES/3090 (1989) Multiprocessor and entry level models

# IBM Mainframes: 1990s



- **System/390 Series (1990)**

- ES/9000 (1990)\* 18 models
- ES/9000 (1991) Seven models
- ES/9000 (1992) Two entry-level models
- ES/9000 (1993) 18 new models including Model 982
- (1994) Parallel Sysplex and Parallel Query Server
- ES/9000 (1994) Model 9X2
- ES/9000 (1994) Five air-cooled processor
- (1994)\* Six models of S/390 Parallel Enterprise Server
- (1995) 12 models of the S/390 Parallel Enterprise Server
- (1996) Third generation (G3) of S/390 Parallel Enterprise Server
- (1996) Multiprise 2000
- (1997)\* S/390 Parallel Enterprise Server G4
- (1998)\* S/390 Parallel Enterprise Server G5
- (1999)\* S/390 Parallel Enterprise Server G6
- (1999)\* Multiprise 3000



# IBM Mainframes: 2000s




- **IBM eServer zSeries (2000)**

- (2000)\* 900
- (2002)\* 800
- (2003)\* 990

# IBM Mainframes: z990



- 2003-present
- 32 processors
- z/OS operating system
- 256 GB memory
- 9,000 MIPS
- Clusters up to 64 (?) machines
- Click here →  for a technical guide

# Modern Mainframes: 2000s



Modern mainframes are defined by:

- Redundant internal engineering, high availability
- Backward compatibility with older software
- Host multiple operating systems
- Handle very high volume of input/output
- Fault tolerant computing

# Minicomputers

Apollo Computer

DEC/Digital

Data General

Hewlett-Packard

IBM

NCR

Prime Computer

Sun

Wang



DEC PDP-11



# Minicomputers



- Evolved in the mid-1960s
- Much less expensive than IBM mainframes and mid-size computers
- Priced at < \$25,000 (\$147,859 in 2012)
- Input/output device such as a teleprinter
- Minimum 4K memory
- Capable of running programs in a higher level language such as Fortran, COBOL or Basic

# The Future of Computers

**There is no reason why anyone would want a computer in the home.**

Ken Olson (1977)

Founder & CEO Digital Equipment Corporation (DEC)

**In June 1998 DEC was acquired by Compaq, which Merged with Hewlett-Packard in May 2002**

# Alpha Microsystems



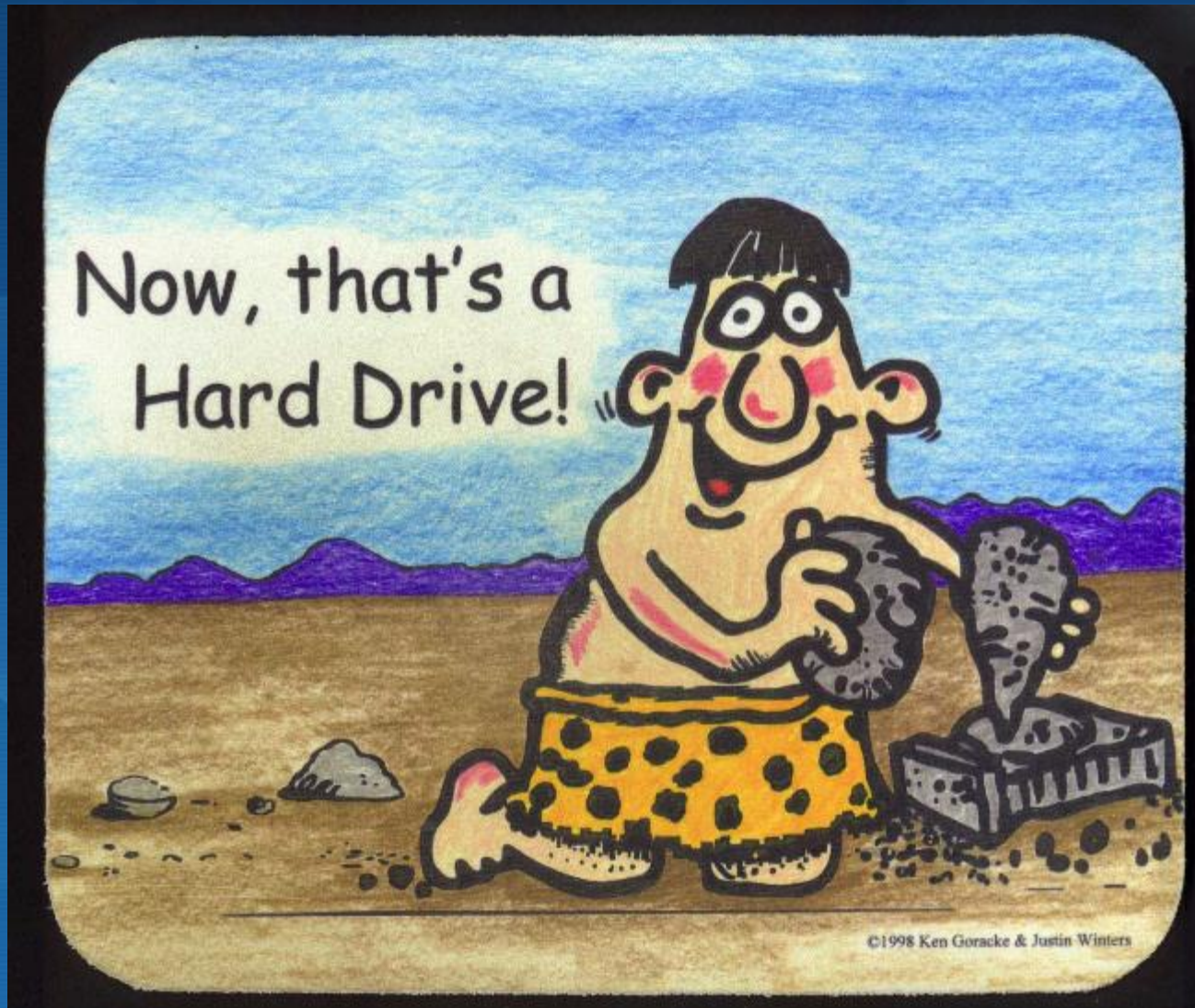
Alpha Microsystems still exists

see 

- 1977
- Minicomputer, multiuser, multitasking
- S-100 bus
- Western Digital WD16 CPU, 3.3 MHz
- AMOS operating system\*
- Alpha- BASIC, FORTRAN, LISP, PASCAL, C
- Vertical markets: medicine, dentistry, pharmacy, law, etc.

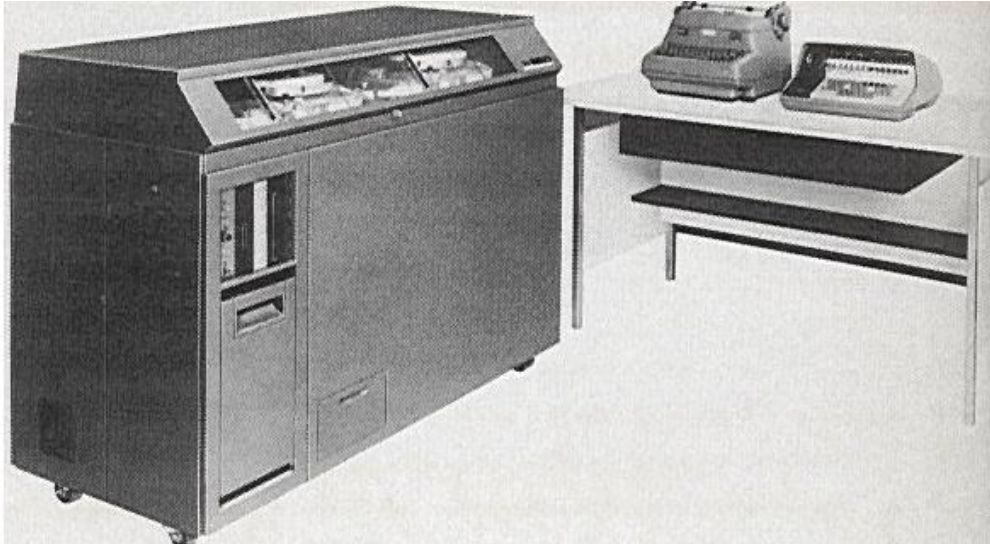
\*Similar to DEC PDP-11

# A Selection of Historical PCs





# IBM 610



- 1957
- First “personal computer”
- Designed to be used by one person
- Price: \$55,000 (\$449,156 in 2012)

# Kenback-1



- 1971
- The first PC (?)
- \$750 (\$4,250 in 2012)
- TTL chips for CPU 
- 8-bit architecture
- 256 bytes memory
- 1 MHz clock speed

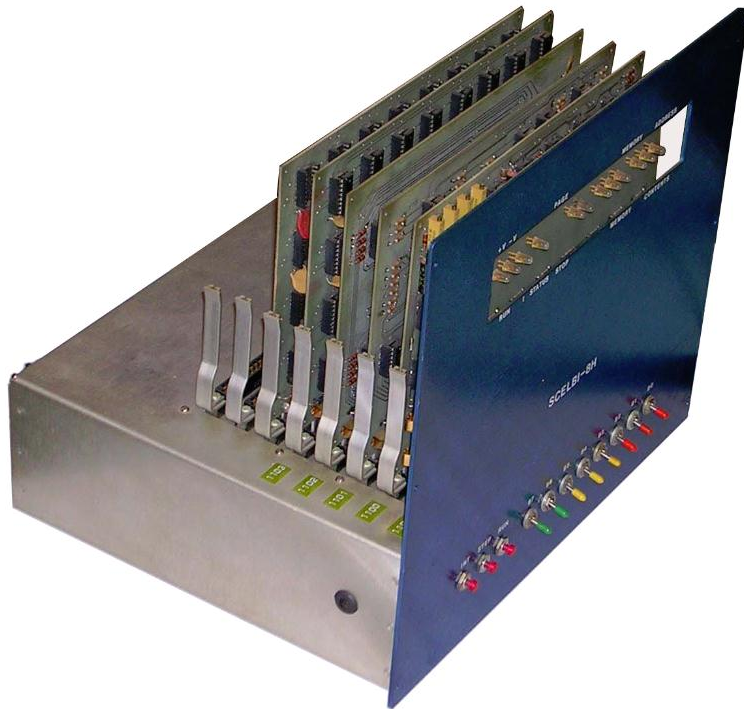
**\*TTL = Transistor-transistor logic circuit**

# Xerox Alto



- 1973
- First GUI
- First mouse
- From Xerox Parc
- Not a commercial product
- Thousands built and used internally

# SCELBI-8



- 1974
- First microprocessor based hobbyist PC
- \$500 (\$2,330 in 2012)
- 1 KB RAM
- Intel 8008 CPU



# MITS Altair 8800



- 1975
- First S-100 bus machine\*
- First widely popular PC
- \$439 as kit (\$1,870 in 2012)
- \$621 assembled (\$2,650 in 2012)
- 1K or 2K or 4KB RAM
- Intel 8080 CPU
- CP/M operating system
- 8-in floppy disk drive

\*AKA The “Altair bus” which was widely copied

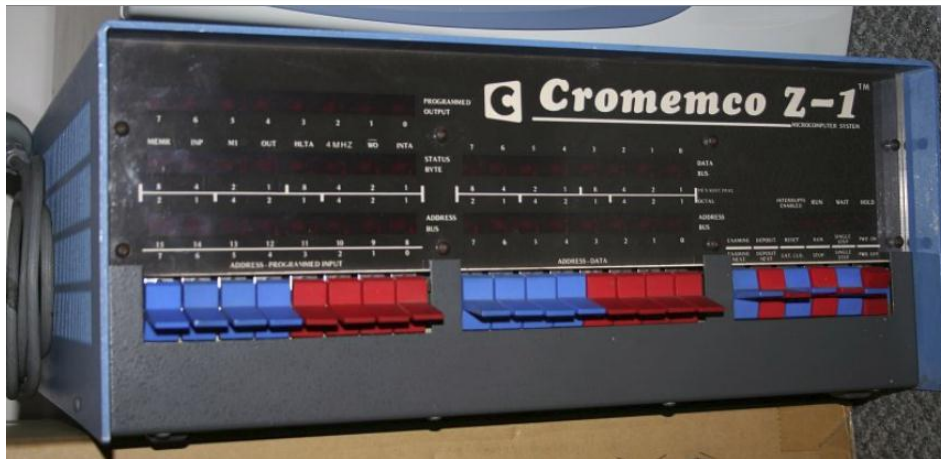


# IMSAI 8080



- 1975
- \$400+ as kit (\$1,700 in 2012)
- \$600+ assembled (\$2,560 in 2012)
- 64 K memory
- 2 MHz clock speed
- CP/M operating system & others
- 8 or 5¼-in floppy disk drive
- ~18,000 produced 1975-78

# Cromemco Z-1



- 1976
- 8K memory
- Z80 CPU
- CDOS operating system (CP/M-like); later UNIX
- Produced ~ dozen models
- Company survives as Cromemco AG (Switzerland)

# Apple I



Designed & built by Steve Wozniak  
Steve Jobs suggested selling them

Apple 1	
<b>Introduced:</b>	March 1976
<b>Released:</b>	July 1976
<b>Price:</b>	US \$666.66 w/4K RAM
<b>How many?</b>	about 200 total
<b>CPU:</b>	MOS 6502, 1.0 MHz
<b>RAM:</b>	4K, 65K max
<b>Display:</b>	monochrome 280 X 192, 40 X 24 text
<b>Keyboard:</b>	not included.
<b>Ports:</b>	composite video output keyboard interface one vertical expansion slot
<b>Storage:</b>	cassette interface available
<b>OS:</b>	firmware in ROM (HEX) Apple BASIC on cassette

**\$2,684 in 2012**



# First Apple Manufacturing Plant



2066 Crist Drive, Los Altos, California  
(Google Earth)

2066

# Homebrew Computer Club

## Palo Alto, California



- Instrumental in creating the technological culture of Silicon Valley
- First meeting March 1975
- Focus of meetings on Altair 8800 and other technical topics
- Members include:
  - ❑ John Draper — (AKA Captain Crunch), software developer
  - ❑ Bill Gates — Microsoft, Inc.
  - ❑ Steve Jobs & Steve Wozniak — Apple, Inc.
  - ❑ Jerry Lawson — founder Videosoft (game developer)
  - ❑ Bob Marsh — Sol-20 computer
  - ❑ Adam Osborne & Lee Felsenstein — Osborne 1 computer

# Sol-20



- 1976
- First integrated machine with keyboard
- \$995 as a kit (\$4,012 today)
- 4 to 32 K memory
- Intel 8080 CPU
- 2 MHz clock speed
- CP/M operating system
- ~10,000 produced 1977-79

# Commodore Pet 2001



- 1977
- First fully integrated “Appliance” computer
- MOS Technology 6502 CPU
- \$995 as a kit (\$4,012 today)
- 4, 8, 16, 32 K memory
- BASIC in ROM operating system
- Several ports
- 1 MHz clock speed



# TRS 80 Model 1



2012—35<sup>th</sup> Anniversary

For more information

click here →  & here 

- 1977
- Very popular and successful machine
- Zilog Z80 CPU
- \$600 (\$2,270 today)
- 32 or 64 K memory
- BASIC language (3 versions)
- TRS-DOS operating system (and others)
- 1 MHz clock speed

# Apple II Series



1977 to 1988

- Apple II
- Apple II Plus
- Apple II Europlus and J-Plus
- Apple IIe
- Apple IIc
- Apple IIGS
- Apple IIc Plus
- Apple IIe Card

Succeeded by Apple Macintosh in 1984

# Atari 400



- 1979 to 1992
- Atari 400, 800, XL and XE
- Two 400/800 models named after two attractive secretaries
  - ❑ Colleen—the computer
  - ❑ Candy—the game machine
- Sales of 4 million units

# Apple III



- It was a bomb!**
- 1980 to 1984
  - A business oriented PC
  - Many stability issues and numerous recalls
  - A failure in the market, selling 65,000-75,000 units



# Osborne 1



- 1981
- First portable at 23.5 lbs. (“Luggable”)
- \$1,795 (\$4,530 in 2012)
- A commercial success — victim to the “Osborne Effect”, i.e., premature announcement of new models that kills sales of current products
- Bankruptcy 1983

# A Good Selection of Software (Osborne Computers)

Program Name	Version	Published by	Program Type	Date	Part Number	Number of Disks
CBASIC2		Digital Research	Language compiler	1979		
MBasic		Microsoft	Language interpreter		301002-02D	1
Colossal Cave			Game			
Deadline		Infocom	Game			2
dBase II		Ashton-Tate	Database			
dBase II Tutor		Ashton Tate	Training for database			6
Nominal Ledger	2.7	PeachTree Software	Business Software	1983	2X09200-04	2
Purchase Ledger	2.7	PeachTree Software	Business Software	1983	2X09200-04	2
Sales Ledger	2.7	PeachTree Software	Business Software	1983	2X09200-04	2
SuperCalc		Sorcim	Spreadsheet	1981	301002-03	1
Wordstar	2.26	MicroPro	Word processor			1

# Apple Lisa



One month after the Lisa is discontinued Steve Jobs leaves Apple to form the NeXT Computer company

## Tim Berners-Lee at CERN (a sidebar)



1955–

- 1990-1991
- NeXT computer used for:
  - First Web server
  - Developing first Web browser named “WorldWideWeb”
  - Defined URL
  - Defined HTML
  - Defined HTTP
- In collaboration with Robert Cailliau



# Epson HX-20



See  for manuals

- 1981
- First portable notebook computer (3.5 lbs.)
- \$795 (\$2,000 in 2012)
- Full keyboard
- Ni/Cd batteries
- 120 x 32-pixel LCD monitor (20 characters, 4 lines)
- Printer
- BASIC interpreter

# IBM PC 5150



- 1981–IBM gets into the PC business
- PC line 1981-1987
- Intel 8088 CPU (4.77 MHz)
- Optional 8087 floating-point coprocessor
- 16 to 256 KB RAM
- BASIC (licensed from Microsoft)

# The IBM PC Line (1981-1987)

Model name	Model #	Introduced	CPU	Features
PC	5150	August 1981	8088	Floppy disk or cassette <sup>[15]</sup> system
	5160	March 1983	8088	First IBM PC to come with an internal hard drive as standard.
XT/370	5160/388	October 1983	8088	5160 with XT/370 Option Kit and 3277 Emulation Adapter
3270 PC	5271	October 1983	8088	With 3270 terminal emulation, 20 Function Key Keyboard
PCjr	4860	November 1983	8088	Floppy-based home computer, Infrared Keyboard
Portable	5155	February 1984	8088	Floppy-based portable
AT	5170	August 1984	80286	Faster Processor, Faster System Bus (6 MHz, later 8 MHz, vs 4.77 MHz), Jump over Configuration, Real Time Clock
AT/370	5170/599	October 1984	80286	5170 with AT/370 Option Kit and 3277 Emulation Adapter
3270 AT	5281	June 1985 <sup>[16]</sup>	80286	With 3270 terminal emulation
Convertible	5140	April 1986	8088	Microfloppy laptop portable
XT 286	5162	September 1986	80286	Slow hard disk, but zero wait state memory on the motherboard. This 6 MHz machine was actually faster than the 8 MHz ATs (when using planar memory) because of the zero wait states

Software backwards compatible

# **IBM sells PC Line to Lenova (December 2004)**

**IBM sells its PC division to China-based Lenovo Group and take a minority stake in a deal valued at \$1.75 billion (\$2.13 billion in 2012)**



# Commodore 64



- 1982-1994
- Most sold PC ever (~20 million\*)
- \$595 (\$1,410 in 2012)
- KERNAL, GEOS & other OSs; 1 MHz
- 64 KB RAM
- BASIC language

\*Estimates range from 12-30 million

# Apple Macintosh



- 1984
- AKA “The Mac”
- \$2,495 (\$5,510 in 2012)
- Mac OS 1 through 3.2\*
- 128 KB RAM
- Motorola 68000 CPU; 4, 6, 8, 10, 12.5, 25 & 50 MHz

\*Called simply “System Software; for more information see 

# “Macs”



## 128

- Macintosh 128K
- Macintosh 512K
- Macintosh 512Ke
- Macintosh Plus



## Lisa

- Macintosh XL<sup>[1]</sup>



## SE

- Macintosh SE
- Macintosh SE FDHD
- Macintosh SE/30



## Classic

- Macintosh Classic
- Macintosh Classic II



## Color Classic

- Mac. Color Classic
- Mac. Color Classic II



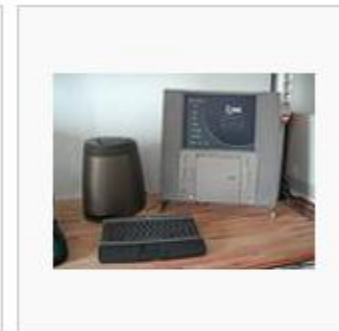
## LC 500 series

- Macintosh LC 520
- Macintosh LC 550
- Macintosh LC 575
- Macintosh LC 580
- Macintosh TV<sup>[2]</sup>



## Power Macintosh 5000 series

- Power Mac 5200
- Power Mac 5300
- Power Mac 5400
- Power Mac 5500



## 20th Anniversary Mac.

- 20th Anniversary Mac.

# “Macs” (cont.)



**Power Macintosh G3 AIO**

- Power Mac G3 AIO



**iMac<sup>[3]</sup>**

- iMac G3
- iMac G3 (slot loading)<sup>[4]</sup>



**iMac (flat panel)**

- iMac G4<sup>[5]</sup>



**eMac**

- eMac



**iMac G5<sup>[6]</sup>**

- iMac G5
- iMac G5 (Ambient Light Sensor)



**iMac with iSight<sup>[7]</sup>**

- iMac G5 (iSight)
- iMac Core
- iMac Core 2



**Aluminum iMac<sup>[8]</sup>**

- iMac Core 2
- iMac Core i5
- iMac Core i7

# “Big Macs”



## Quadra 900

- Macintosh Quadra 900
- Macintosh Quadra 950
- Workgroup Server 95
- Workgroup Server 9150<sup>[13]</sup>



## Quadra 800

- Macintosh Quadra 800
- Mac Quadra 840AV
- Workgroup Server 80
- Power Mac 8100
- Power Mac 8200
- Power Mac 8500



## Power Mac 9500<sup>[14]</sup>

- Power Mac 9500



## Performa 6400

- Power Mac 6400
- Power Mac 6500



## Power Macintosh 9600

- Power Mac 8600
- Power Mac 9600



## Power Mac G3 MT<sup>[15]</sup>

- Power Mac G3 MT



## Power Mac G3 B&W

- Power Mac G3 B&W



## Power Mac G4 Original

- Power Mac G4 "PCI Graphics"
- Power Mac G4 "AGP Graphics"
- Power Mac G4 "Gigabit Ethernet"



# Top 10 Computer Manufacturers— Worldwide\*



1. Hewlett-Packard
2. Acer
3. Dell
4. Lenovo
5. Toshiba
6. IBM
7. Fujitsu
8. NEC
9. Apple
10. Gateway (subsidiary of Acer)

# Apple in 3<sup>rd</sup> Place Among U.S. Mfg\*

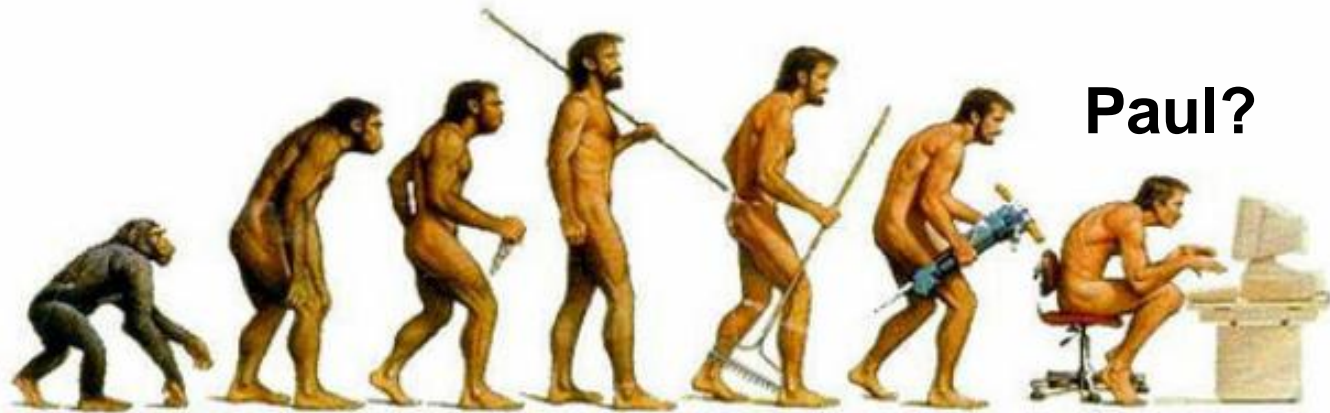


Company	1Q12 Shipments	1Q12 Market Share (%)	1Q11 Shipments	1Q11 Market Share (%)	1Q12-1Q11 Growth (%)
HP	4,494	29.0	4,213	26.2	6.6
Dell	3,460	22.3	3,588	22.3	-3.6
Apple	1,641	10.6	1,580	9.8	3.8
Acer	1,418	9.1	1,913	11.9	-25.9
Toshiba	1,350	8.7	1,670	10.4	-19.2
Others	3,158	20.3	3,126	19.4	1.0
<b>Total</b>	<b>15,520</b>	<b>100.0</b>	<b>16,091</b>	<b>100.0</b>	<b>-3.5</b>

*Gartner's Preliminary U.S. PC Vendor Unit Shipment Estimates for 1Q12 (Thousands of Units)*



# Things have evolved...



**Paul?**

# ...into the typical user!



# **Users We Have All Met...**

**And bring me a hard copy of the Internet so I can do some serious surfing. Scott Adams**

**Back up my hard disk? I can't find the reverse switch! Unknown**

**The cup holder in my laptop is broken! Unknown**



# The Price of Computers

The newest computer, 16-bit,  
with high-tech monitor...  
including mouse.



It is not worth it—in six  
months it will cost you  
half as much!



## 3 TB Disk Drive



- 2012
- Price \$162.99\*
- Storage cost:
  - ❑ \$54.33 per TB
  - ❑ \$0.05433 per GB
  - ❑ \$0.0000543 per MB ( $5.43 \times 10^{-5}$ )
- 3 TB will hold 1 million photos (3 MB each)

\*Western Digital Caviar Green, 3 TB, SATA III, 64 MB Cache. Amazon.com

## 75 MB Disk Drive—for Alpha Microsystem



- 1979
- \$12,500 (\$39,500 in 2012)
- Storage cost (2012 dollars):
  - ❑ \$526.67 per MB\* ←
  - ❑ \$526,666.67 per GB
- 75 MB drive will hold 25 photos (3 MB each)

**\*In 1979, 3TB storage have would cost: \$1.58 billion**

\*In 2012: \$0.0000543 per MB ( $5.43 \times 10^{-5}$ ) ←

# Imagine

**If the price of cars had followed  
the price of disk drives...**



**2012 Mercedes-Benz SL63 AMG Roadster**

**2012 Price: \$170,000**

**1979 Price: \$54,000**

**\$1.75**

**If cars had paralleled the price of disk drives,  
how much would this car cost today?**



**But Wait...**

# Yesterday Only!

## 3 for \$5.00

**CONDITIONS:** Only good in the U.S.A. and Greenland. Offer valid until August 17, 2012. No more than six cars per customer. Fleet purchases available at further discounts. Maximum allowed for trade-in on your vehicle in excellent condition is 1¢. A full tank of gasoline for each vehicle purchased is an additional \$263. Does not include applicable taxes, license fees, transportation from Stuttgart, or insurance. Offer invalid where illegal.

**Paul?**



**Thanks**

**for**

**your**

**Attention!**