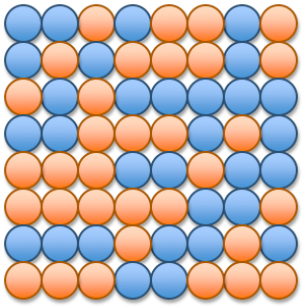
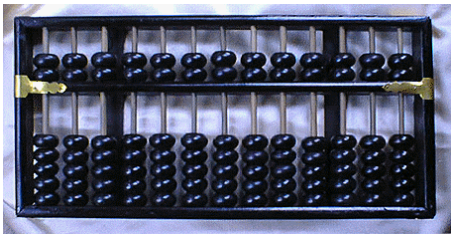


UNIT 1
An Introduction to Computing
The History of Computing

The Abacus

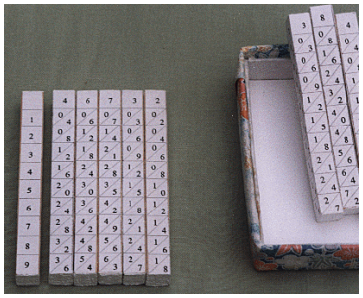


Chinese abacus

- Earliest archaeological evidence of a Greek abacus used around the 5th century BC.
- Earliest documents illustrating the use of the Chinese abacus (suan pan) from the 13th century AD.
- Other abacus forms:
  Soroban (Japan), Choreb (Afghanistan), Schoty (or stchoty) (Russia)

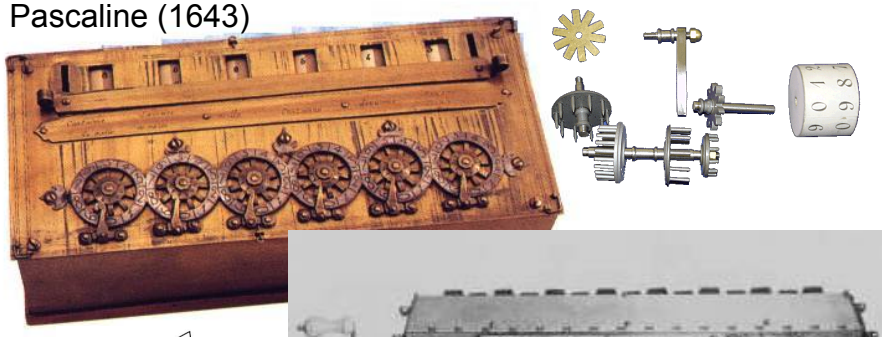
John Napier

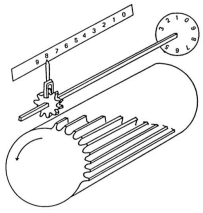
- Scottish mathematician (1550-1617)
- Invented Napier's Bones, used to perform multiplication using only addition.
- Napier is also the inventor of logarithms.
- Napier's bones were very successful and were widely used in Europe until mid 1960's.

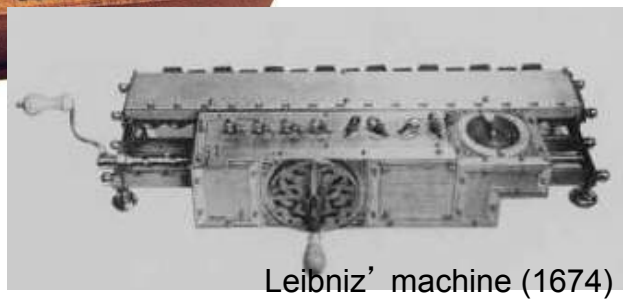


Mechanical Arithmetic Machines

Pascaline (1643)

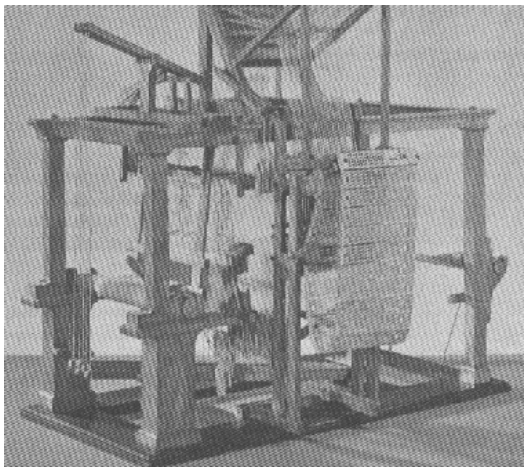






Leibniz' machine (1674)

Jacquard's Loom (1805)



Developed by
Joseph-Marie Jacquard.
The loom was controlled
by a loop of punched cards.
Holes in the punched cards
determined how the
knitting proceeded, yielding
very complex weaves
at a much faster rate.

from
Columbia University
Computing History
http://www.columbia.edu/
acis/history/jacquard.html

Charles Babbage

- Mathematician, industrialist, philosopher, politician
- Difference Engine (1822)
  - Babbage's first computational machine was based on the method of finite differences.
  - He only built a small prototype.
- Analytical Engine (1834-1836)
  - Babbage's more general "computer"
  - Never built, but its design is considered to be the foundation of modern computing.

Difference Engine:
How it works: Method of Finite Differences

- $f(x) = x^2 + x + 1$
- First order difference $\Delta f(x)$
  $= f(x+1) - f(x) = (x+1)^2 + (x+1) + 1 - (x^2 + x + 1) = 2x + 2$
- Second order difference $\Delta^2 f(x)$
  $= \Delta f(x+1) - \Delta f(x) = 2(x+1) + 2 - (2x + 2) = 2$
- Given: $f(0) = 1$, $\Delta f(0) = 2$, $\Delta^2 f(0) = 2$(note: all $\Delta^2 f(x) = 2$)
  - $\Delta f(1) = \Delta f(0) + \Delta^2 f(0) = 2 + 2 = 4$
    $f(1) = f(0) + \Delta f(0) = 1 + 2 = 3$ $(f(1) = 1^2 + 1 + 1 = 3)$
  - $\Delta f(2) = \Delta f(1) + \Delta^2 f(1) = 4 + 2 = 6$
    $f(2) = f(1) + \Delta f(1) = 3 + 4 = 7$ $(f(2) = 2^2 + 2 + 1 = 7)$

Method of Finite Differences

- $f(x) = x^2 + x + 1$
- $\Delta f(x) = 2x + 2$
- $\Delta^2 f(x) = 2$

x	$\Delta^2 f(x)$	$\Delta f(x)$	$f(x)$
0	2	2	1
1	2	4	3
2	2	6	7
3	2	8	13

Method of Finite Differences

- $f(x) = 4x^2 + 9$
- $\Delta f(x) = f(x+1) - f(x) =$
- $\Delta^2 f(x) = \Delta f(x+1) - \Delta f(x) =$

x	$\Delta^2 f(x)$	$\Delta f(x)$	$f(x)$
0			
1			
2			
3			

Babbage's Difference Engine

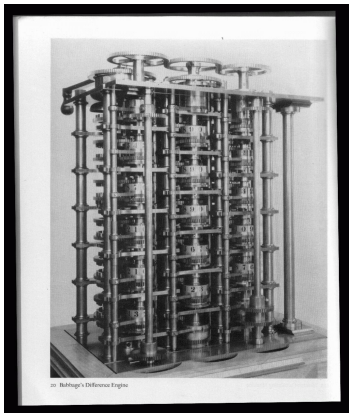


Photo of the
1832 Fragment
of a Difference Engine

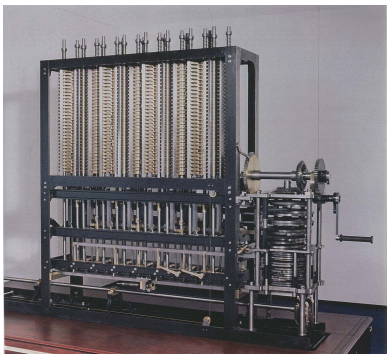
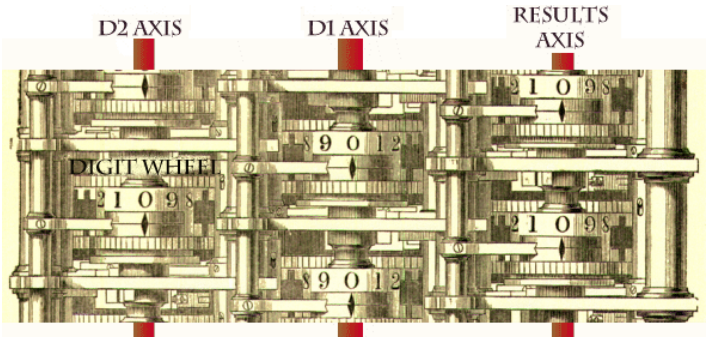


photo of Babbage Difference Engine No. 2
constructed in 1991

Babbage's Difference Engine



http://www.culture.com.au/brain_proj/CONTENT/BABBAGE.HTM

Ada Lovelace

- 1815-1852
- Daughter of poet Lord Byron
- Translated Menabrea's *Sketch of the Analytical Engine* to English
  - Quadrupled its length by adding lengthy notes and detailed mathematical explanations
- Referred to as the world's first programmer
  - Described how the machine might be configured (programmed) to solve a variety of problems.

Herman Hollerith
& The Hollerith Census Machine

- 1880 U.S. Census
  - The amount of data that needed to be analyzed was growing so quickly due to immigration
  - Required almost a decade to compute 1880 Census
- In 1882, Hollerith investigated a suggestion by Dr. John Shaw Billings, head of the division of Vital Statistics for the Census Bureau
  - "There ought to be some mechanical way of [tabulating Census data], something on the principle of the Jacquard loom, whereby holes in a card regulate the pattern to be woven."

Hollerith's Census Machine

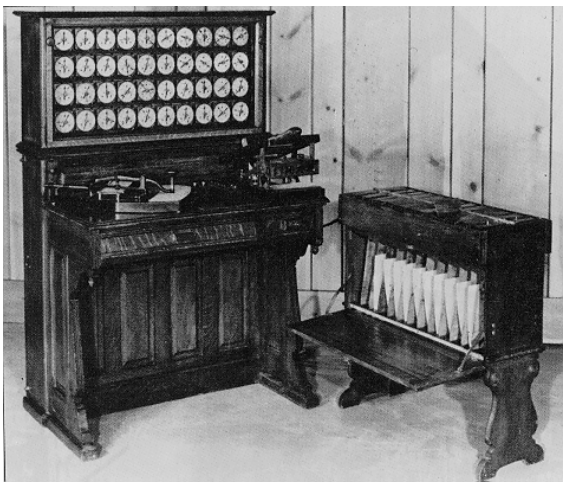


Photo: IBM

Hollerith's Census Machine

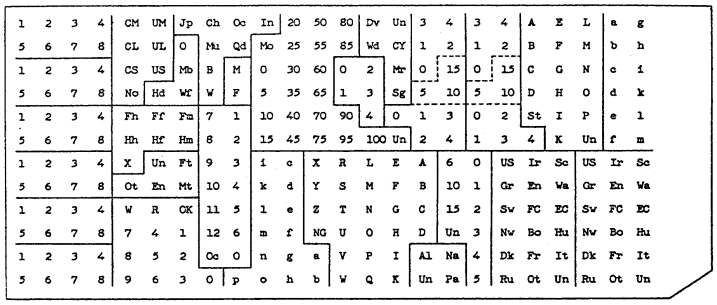


Photo of a punch card for the Hollerith machine, from *John McPherson, Computer Engineer*, an oral history conducted in 1992 by William Aspray, IEEE History Center, Rutgers University, New Brunswick, NJ, USA.

–
  was published in 1892.
– Total population of the U.S.: 62,622,250

Hollerith's Census Machine

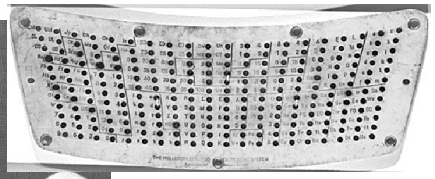
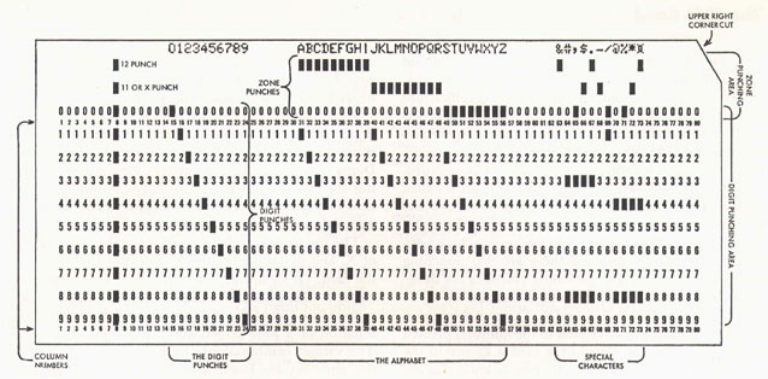


Photo of Pantographic Card Punch plate: from US Library of Congress

Photo from 1920 Census: Austrian, Geoffrey, *Herman Hollerith: Forgotten Giant of Information Processing*, Columbia University Press (1982).

The Birth of IBM



An IBM punch card used from 1928 until the 1970s.

- Hollerith forms the Tabulating Machine Company in 1896 which eventually becomes IBM in 1924 through a merger and several name changes.

ENIAC

Electronic Numerical Integrator and Computer

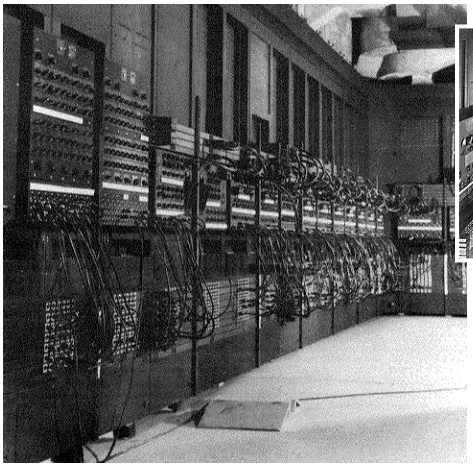
- Collaboration between Moore School of Electrical Engineering at the University of Pennsylvania and the Ballistic Research Laboratory in Aberdeen, MD
  - Designed by John W. Mauchley and J. Presper Eckert

from www.computer.org

- In 1943, the Ordinance Dept. signs a contract for UPenn to develop an electronic computer to solve differential equations for ballistic trajectories
- Constructed completed in the fall of 1945 after WWII ends, and dedicated in February 1946.

ENIAC

Electronic Numerical Integrator and Computer



(Virginia Tech – History of Computing)

UNIVAC and the First Compiled Programming Language

J. Presper Eckert and Walter Cronkite (CBS) next to the UNIVAC in 1952
(Center for the Study of Technology and Society)

- UNIVAC I
  - Built by Remington Rand to compute 1950 U.S. census but completed in 1951
  - Used to predict the winner of the 1952 U.S. Presidential Election based on ~3.4M votes
- A-0 was a programming language for the UNIVAC I or II
- A-0 was the first language for which a compiler was developed, produced by a team led by Admiral Grace Hopper.
  - the premier conference for women in computing is named after Grace Hopper

Admiral Grace Hopper

The Integrated Circuit

- The Cold War and the Space Race led to many advancements in the 1950s and 1960s including miniaturization and automation.
- Robert Noyce and Jack Kilby are credited with the invention of the integrated circuit (IC) or microchip.
  - Kilby wins Nobel Prize in Physics in 2000.
  - Robert Noyce co-founded Intel in 1968.
- By the mid 1970s, ICs contained tens of thousands of transistors per chip.
  - In 1970, Intel created the 1103--the first generally available DRAM (Dynamic Random Access Memory) chip.

Units of Memory

• Byte	B	8 bits (8b)		
• Kilobyte	KB	1024 B	= 2^{10} bytes	≈ 10^3 bytes
• Megabyte	MB	1024 KB	= 2^{20} bytes	≈ 10^6 bytes
• Gigabyte	GB	1024 MB	= 2^{30} bytes	≈ 10^9 bytes
• Terabyte	TB	1024 GB	= 2^{40} bytes	≈ 10^{12} bytes
• Petabyte	PB	1024 TB	= 2^{50} bytes	≈ 10^{15} bytes

- How many bytes can be stored in a 4GB flash drive?
- How many bytes/second is a 16Mbps cable modem connection?

How Time Flies…

Definitely not to scale

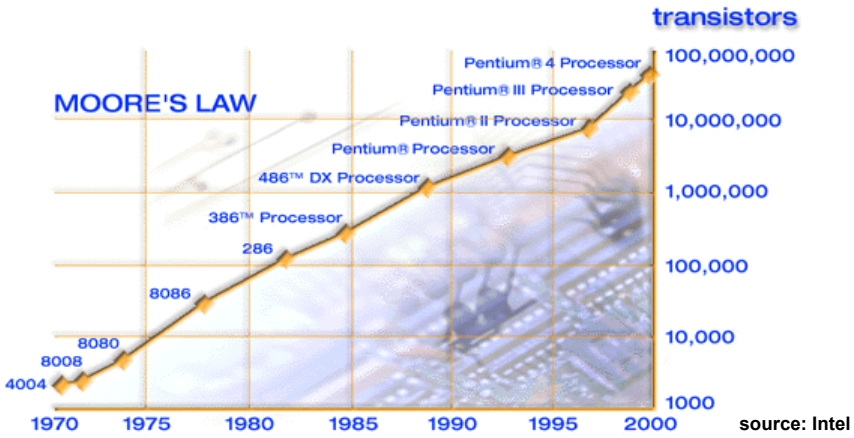
Commodore 64 (1982)
40cm X 22 cm X 8 cm
64KB of IC memory
$595

MicroSD Card (2017)
15mm X 11mm X 1mm
32GB of flash memory
$14 (includes adapter!)

Moore's Law

- Gordon Moore co-founded Intel Corporation in 1968.
- Famous for his prediction on the growth of the semiconductor industry: Moore's Law
  - An empirical observation stating in effect that the complexity of integrated circuits doubles every 24 months. ("complexity" generally means number of transistors on a chip)

Moore's Law



Computer Get Smaller

- IBM System 360 (mainframe) – 60's
- PDP-8 (minicomputer) – 70's
- Personal computers: 70's-80's
  - ALTAIR 8800
  - Apple II
  - IBM PC
  - Apple MacIntosh
  - Many IBM clones... (into the 90's, 00's)
- Tablets and Smart Phones

The GUI

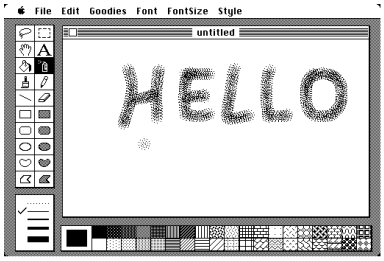
Graphical User Interface

- Concept born at SRI in the early 1960s
- Major development at Xerox PARC in late 70s
- Apple Macintosh, founded by Steve Jobs and his friend Steve Wozniak, introduced in 1984 with full GUI operating system
- Microsoft is founded by Bill Gates and Paul G. Allen with sales of Microsoft BASIC
  - develops its own window-based operating system soon afterwards based on Apple's design… many lawsuits follow
- Even IBM jumps into the fray with OS/2

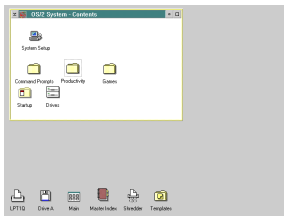



The GUI

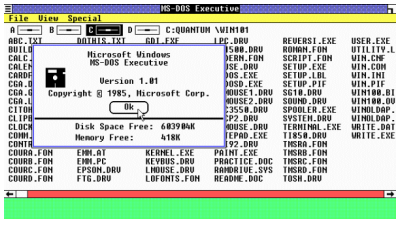
Graphical User Interface



Macintosh OS



IBM
OS/2



Microsoft Windows 1.0

More History to Come...

- Alan Turing
  - Computability
  - Enigma machine (encryption)
  - Artificial Intelligence
- The birth of the Internet and the World Wide Web

Alan Turing

Tim Berners-Lee
(inventor of WWW)