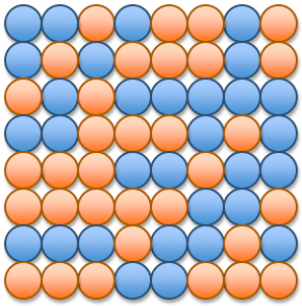
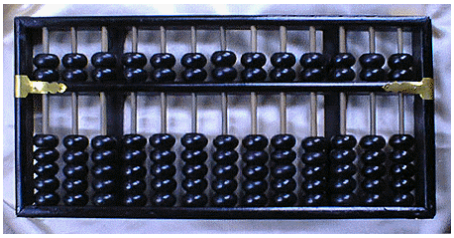


UNIT 1A
A Brief History Of Computing

Pre-Electronic Computing (up to the 1940's)

The Abacus

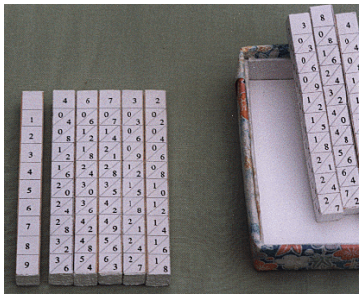


Chinese abacus

- 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)

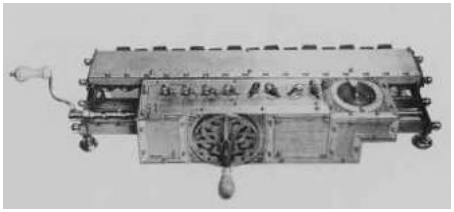
John Napier

- 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.



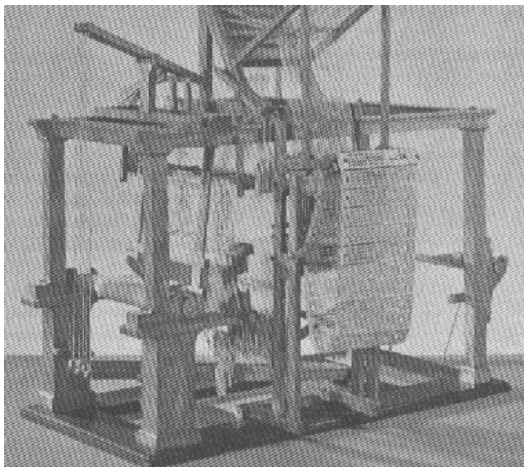
Mechanical Arithmetic Machines

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.
- Analytical Engine (1834-1836)
  - Babbage's more general "computer"
  - Never built, but its design is considered to be the foundation of modern computing

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

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

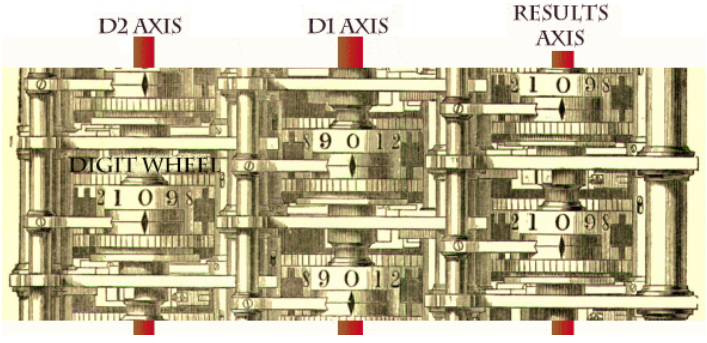
x	$\Delta^2 f(x)$	$\Delta f(x)$	$f(x)$
0	2	2	1
1	2	4	3
2	2	6	7
3	2	8	13

Method of Finite Differences

- $f(x) = 15x^2 + 110$
- $\Delta f(x) = f(x+1) - f(x) =$
- $\Delta^2 f(x) = \Delta f(x+1) - \Delta f(x) =$

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

Babbage's Difference Engine



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

Babbage's Difference Engine

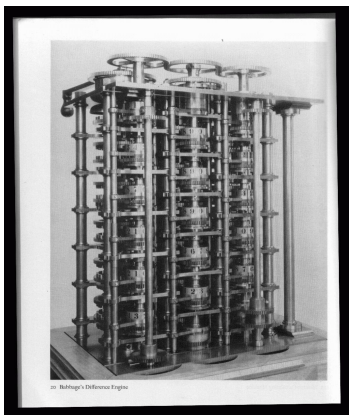


Photo of the
1832 Fragment
of a Difference Engine

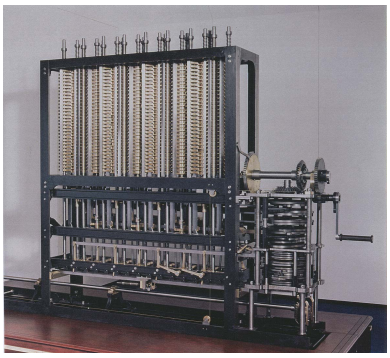


photo of Babbage Difference Engine No. 2
constructed in 1991

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

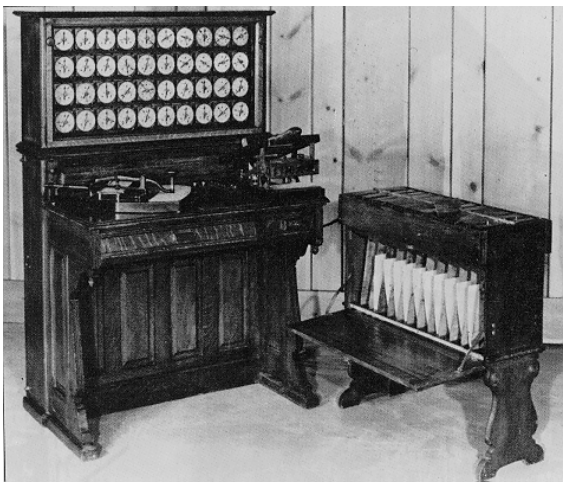


Photo: IBM

Hollerith's Census Machine

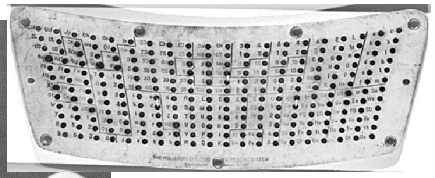
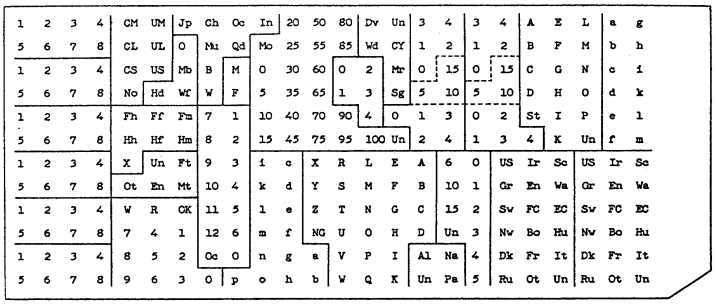


Photo of Pantographic Card Punch plate: from US Library of Congress

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

Hollerith's Census Machine

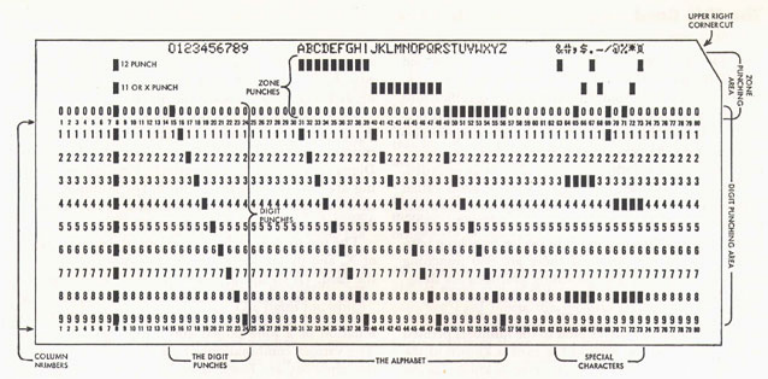


1	2	3	4	CM	UM	Jp	Ch	Oc	In	20	50	80	Dv	Un	3	4	3	4	A	E	L	a	g
5	6	7	8	CL	UL	O	Mu	Qd	Mo	25	55	85	Wd	CY	1	2	1	2	B	F	M	b	h
1	2	3	4	CS	US	Mb	B	M	O	30	60	O	2	Mr	O	15	O	15	C	G	N	c	i
5	6	7	8	No	Hd	Wr	W	F	5	35	65	1	3	Sg	5	10	5	10	D	H	O	d	k
1	2	3	4	Fh	Ff	Fm	7	1	10	40	70	90	4	O	1	3	O	2	St	I	P	e	l
5	6	7	8	Hh	Hf	Hm	8	2	15	45	75	95	100	Un	2	4	1	3	4	K	Un	f	m
1	2	3	4	X	Un	Ft	9	3	i	c	X	R	L	E	A	6	O	US	Ir	Sc	US	Ir	Sc
5	6	7	8	Ot	En	Mt	10	4	k	d	Y	S	M	F	B	10	1	Gr	En	Wa	Gr	En	Wa
1	2	3	4	W	R	CK	11	5	l	e	Z	T	N	G	C	15	2	Sw	FC	EC	Sw	FC	EC
5	6	7	8	7	4	1	12	6	m	f	NG	U	O	H	D	Un	3	Nw	Bo	Hu	Nw	Bo	Hu
1	2	3	4	8	5	2	Oc	O	n	g	a	V	P	I	Al	Na	4	Dk	Fr	It	Dk	Fr	It
5	6	7	8	9	6	3	O	p	o	h	b	W	Q	K	Un	Pa	5	Ru	Ot	Un	Ru	Ot	Un

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.

- The entire 1890 census data was processed in 3 months and complete 1890 data was published in 1892.
- Total population of the U.S.: 62,622,250

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.

Harvard Mark I

IBM Automatic Sequence Controlled Calculator

- Developed by Howard Aiken
- Contained more than 750,000 components
  - over 50 feet long
  - 8 feet tall
  - weighed ~5 tons
- Sounded like a "roomful of ladies knitting"

Harvard Mark I
(IBM Archives)

Aiken

In 1947, how many electronic digital computers did Aiken predict would be required to satisfy the computing needs of the entire U.S.?