

A Brief History Of Computing

1A

The need for computing emerges



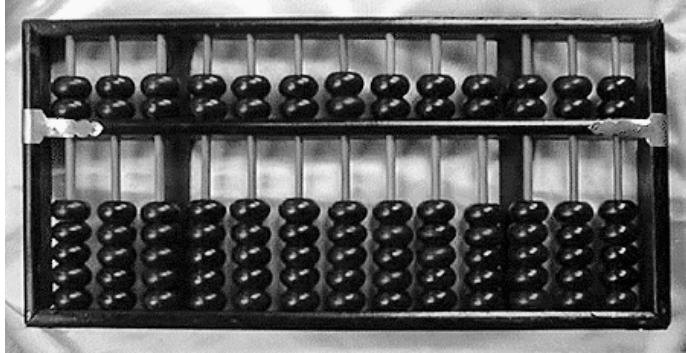
What is computation?



- Computation (n.) - The act or process of computing.
- Computing (n.) - the procedure of calculating; determining something by mathematical or logical methods.
- Computer science (n.) - the branch of engineering science that studies (with the aid of computers) computable processes and structures

Source: www.thefreedictionary.com

The Abacus (Chinese)



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The 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)

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John Napier

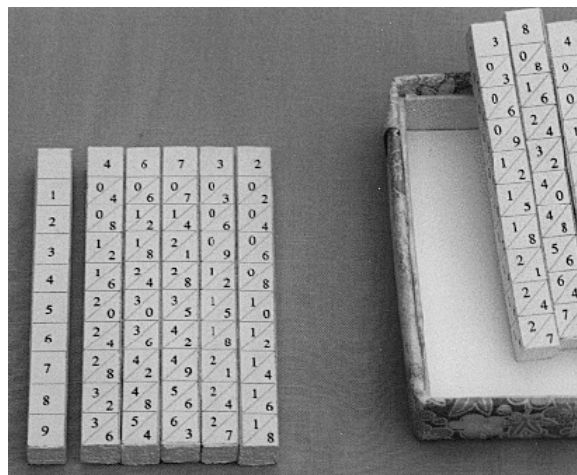


- Scottish mathematician (1550-1617)
- Invented Napier's Bones, used to perform multiplication using only addition.
(http://nrich.maths.org.uk/public/viewer.php?obj_id=1132)
- Napier is also the inventor of logarithms.
- Napier's bones were very successful and were widely used in Europe until mid 1960's.

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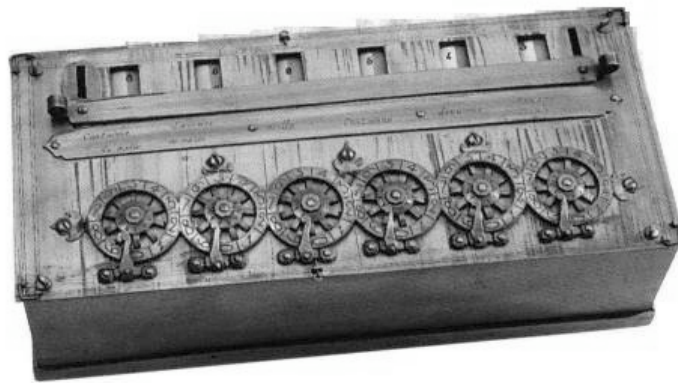
Napier's Bones (1617)



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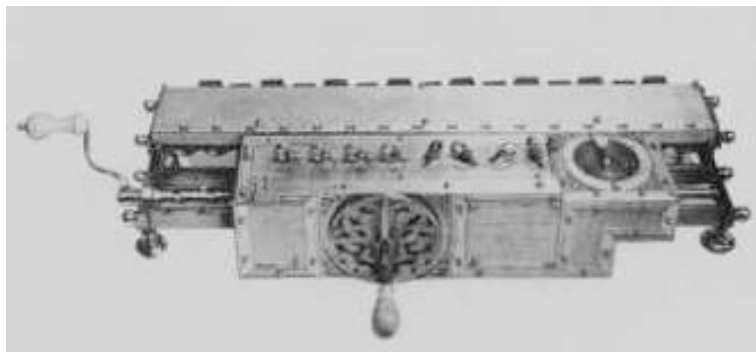
Pascaline (1643)



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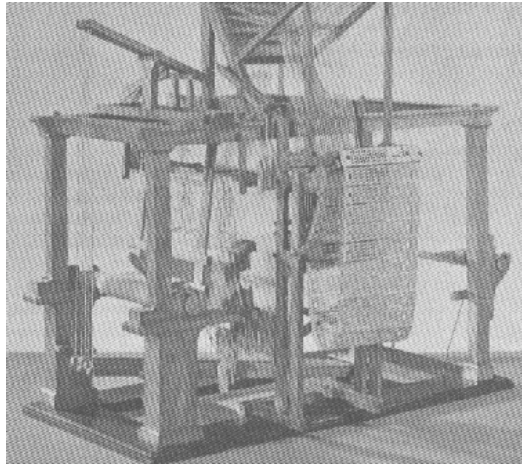
Leibniz' machine (1674)



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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>

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Charles Babbage



- Known as the “(grand)father of computing”
- 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

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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 $\Delta^2 f(x) = 2$)
 - $\Delta f(1) = \Delta f(0) + \Delta^2 f(0) = 2 + 2 = 4$
 $f(1) = f(0) + \Delta f(0) = 1 + 2 = 3$ ($f(1) = 1^2 + 1 + 1 = 3$)
 - $\Delta f(2) = \Delta f(1) + \Delta^2 f(1) = 4 + 2 = 6$
 $f(2) = f(1) + \Delta f(1) = 3 + 4 = 7$ ($f(2) = 2^2 + 2 + 1 = 7$)

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Method of Finite Differences



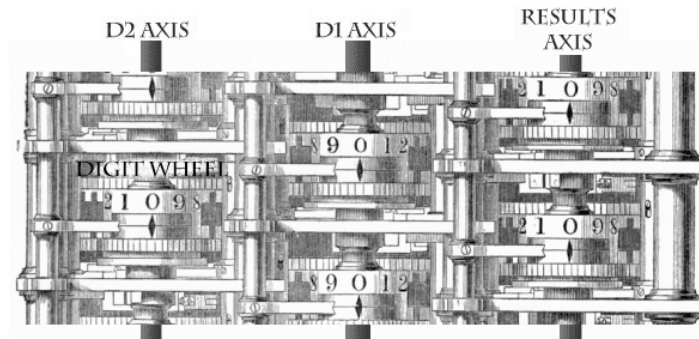
- $f(x) = x^2 + x + 1$
- $\Delta f(x) = 2x + 2$
- $\Delta^2 f(x) = 2$

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

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Babbage's Difference Engine



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

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Babbage's Difference Engine

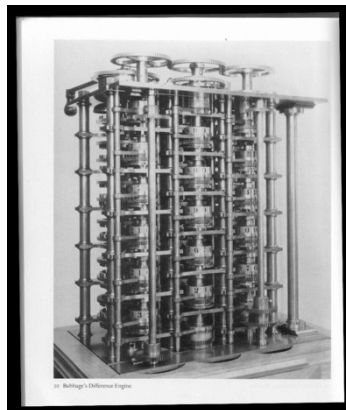
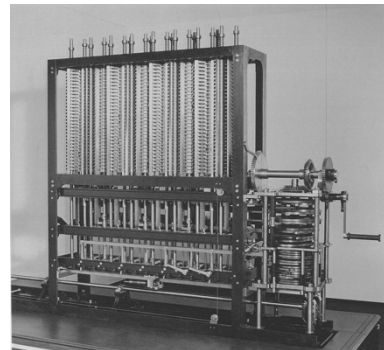


photo of Babbage Difference Engine No. 2
constructed in 1991

Photo of the
1832 Fragment
of a Difference Engine



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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
 - First weaver of coded instructions on punched cards, based on a language that was compatible with the Analytical Engine.

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

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Hollerith's Census Machine

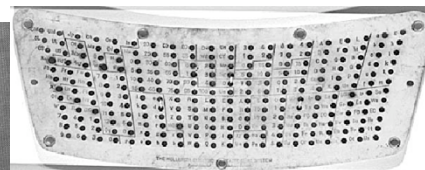
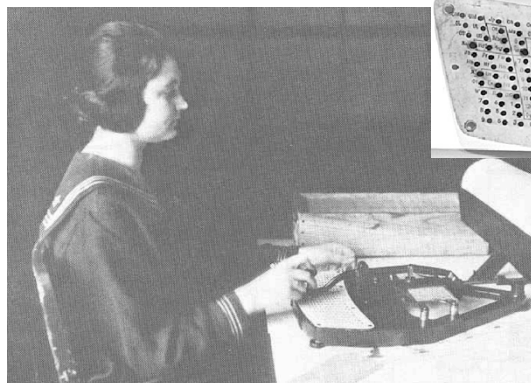


Photo of Pantographic Card Punch plate: from US Library of Congress

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

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Hollerith's Census Machine



1	2	3	4	GM	Um	Jp	Ch	Oe	In	20	50	80	Dv	Un	3	4	3	4	A	E	L	a	g
5	6	7	8	CL	UL	O	Na	Qs	Mo	25	55	85	Wd	CY	1	2	1	2	B	F	M	b	h
1	2	3	4	CS	US	Mb	B	M	0	30	60	0	2	Me	0	15	0	15	C	G	N	e	i
5	6	7	8	No	Hd	Wc	W	F	5	35	65	1	3	Se	5	10	5	10	D	H	O	d	x
1	2	3	4	Fh	Ff	Fz	7	1	10	40	70	90	4	0	1	3	0	2	St	I	P	e	l
5	6	7	8	Jh	Hf	Hm	8	2	15	45	75	95	100	Un	2	4	1	3	4	X	Un	f	m
1	2	3	4	X	Un	Ft	9	3	1	o	X	R	L	E	A	6	0	US	Ir	So	US	Ir	So
5	6	7	8	Ot	Zn	Mt	10	4	x	d	Y	S	M	F	B	10	1	Gr	Zn	Wa	Gr	Zn	Wa
1	2	3	4	V	R	GK	11	5	1	e	Z	T	N	G	C	15	2	Sw	FC	EG	Sw	FC	EG
5	6	7	8	7	4	1	12	6	m	f	NG	U	O	H	D	Un	3	Nv	Bo	Hu	Nv	Bo	Hu
1	2	3	4	8	5	2	Oe	0	n	g	a	V	P	I	Al	Na	4	Dk	Fr	It	Dk	Fr	It
5	6	7	8	9	6	3	0	p	o	h	b	V	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 vs. the expected 2 years if counted by hand.
- Total population of the U.S.: 62,622,250

The Birth of IBM

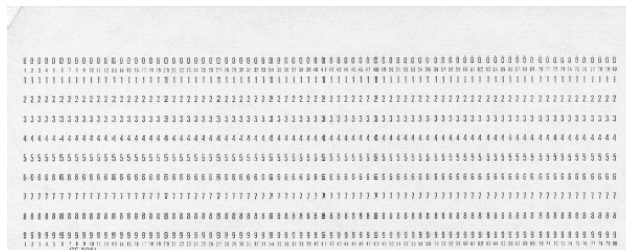


Photo of a modern punch card used from 1928 until the 1970s.

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

Differential Analyzer

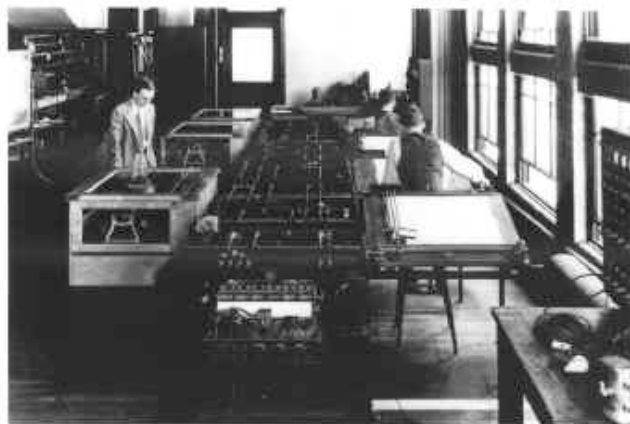


- Designed by Vannevar Bush starting in the 1920s and completed in the early 1930s.
- Rockefeller Differential Analyzer completed in 1942 at MIT
 - Massive machine
 - 100-ton machine
 - 2000 vacuum tubes
 - 150 motors
 - Fell into secrecy during World War II
 - Emerging after WWII, the Differential Analyzer was already obsolete, being replaced by digital computers like ENIAC

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Differential Analyzer



The Differential Analyzer
(MIT Museum)

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Harvard Mark I

IBM Automatic Sequence Controlled Calculator



- Developed by Howard Aiken
 - IBM funded the construction under the permission of Thomas J. Watson, head of IBM
- Constructed out of switches, relays, rotating shafts and clutches
- Sounded like a “roomful of ladies knitting”
- Contained more than 750,000 components
 - over 50 feet long
 - 8 feet tall
 - weighed approximately 5 tons



Aiken

Harvard Mark I

IBM Automatic Sequence Controlled Calculator



Harvard Mark I
(IBM Archives)

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