

## History

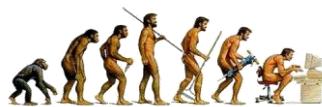


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S1A

- \* Early Mechanical Devices
- \* Analog Computer
- \* Digital Computers
- \* Generations of Computing



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## A Brief History

### Computer => Compute "r"

- Calculation tools
- Used to be a **job description**
- "people" were computers - well into the 1940's

- Came from the need to track planets
  - Initially for Agriculture (seasons) and Navigation
  - Later on for military and political purposes
  - Now... also driven by monetary gain

- Modern Computers developed from a long history of Computing Tools

- The first tools were mechanical
  - Not electronic

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## The Beginning

- ~2400 BC → Abacus (Babylonia - present day Iraq)
  - 5 lower rings represented fingers
  - 2 upper rings represented hands
  - Originally consisted of Sand & Pebbles
  - Laid foundation for positional numbering systems



Photo: Mike Cowlishaw



Photo: Estimer Hilan : ~1914



Photo: Klaus Tenter

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## Mechanical Devices

- ~100 BC - Antikythera mechanism (Greek)
  - Earliest known **Mechanical Analog Computer**
  - Discovered in 1901 in the Antikythera wreck (Off the Greek Island)
  - Salt encrusted metal gears and pointers
  - More than 30 gears - very complex arrangement - emulated the planetary revolutions
  - Capable of tracking the relative positions of all then-known heavenly bodies - and eclipses
  - Nothing close to complexity for 1000 years



Photo: Tilmann Ethimidis



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Photo: Andrew Barclay

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## Computing in the 17<sup>th</sup> Century

- 1610 → Logarithm for Computing
  - John Napier → Scottish
  - Simplify multiplication, Division, Square & Cube Roots
  - Napier's Rods (or Napier's Bones)
    - Rods that could be moved around and placed in specially constructed boards

	7	4	8
1	0	7	6
2	1	4	3
3	2	1	2
4	3	8	2
5	4	5	0
6	5	2	4
7	6	9	6
8	7	6	4
9	8	3	2

Illustration: © Michele Rousseau

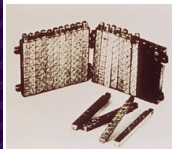


Photo: Courtesy of IBM



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## The 17<sup>th</sup> Century

- 1622 - William Oughtred → Germany
  - Slide rule based on John Napier's work
  - Could calculate **Multiplication, Division, Square Roots, Exponents**
  - Used well into the 20<sup>th</sup> century
    - Replaced by Calculators in the 1970's

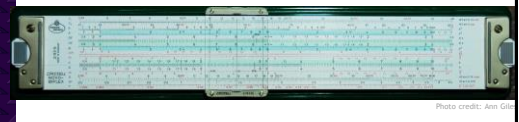


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## Gear Driven Devices

1623 - "Calculating Clock" (Germany)

- Wilhelm Schickard
- **First Discrete Automatic Calculator**
- Could Add/Subtract up to 6-digit numbers
  - Bell warned of overflow
- Constructed with wheels
  - 1-revolution in the units wheel → incremented the tens wheel
- Used by Johannes Kepler for astronomical studies
- Began the "Computer Era"
- Used in modern day odometers



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1642 - "Pascaline" - mechanical adding machine (France)

- Built 50 - weren't that accurate (gears were not accurate)
- Using Gears it each gear revolves 10 times before it increments the next gear



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## Binary Numbering System

1666 - Gottfried Wilhelm von Leibniz (Germany)

- First to advocate use of the **binary number system**
  - fundamental to the operation of modern computers
- Published book: "On the Art of Combination"
  - he thought logic could be expressed in mathematics using binary (a series of true and false propositions) which would be unambiguous compared to natural language.



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1847 - George Boole



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- Published: "The Mathematical Analysis of Logic"
  - ▶ System of linguistic algebra based on the binary numbering system we call that **Boolean Algebra**
- Believe, like Leibniz, that logic was mathematical not philosophical
- Hardware is based on Boolean Algebra
- Extensively used in programming

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

- 1801 - Automatic loom (controlled by punch cards)
  - Joseph-Marie Jacquard → Frenchman
  - Automatically controlled the warp and weft threads on a silk loom by recording patterns of holes in a string of cards
  - This was the start of "punch cards"



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## Charles Babbage



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The Father of Computing

- 2 Major Contributions

- Difference Engine
- Analytical Machine

- Difference Engine (1822)

- Needed accurate tables
- First Mechanical Computer
- Capable of calculating polynomials
- Could calculate differences with 30 digit numbers

- Revised in 1847 - "Difference Engine 2"

- 2002 - Complete machine built (London)
  - 8,000 parts
  - 2 tons,
  - 11 feet long



Photo: Martin Wichary Resized and cropped

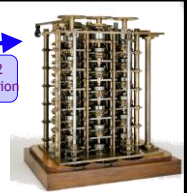


Photo: Science Museum, London



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## Charles Babbage (2)

Analytical Machine

- Scrapped the Difference Machine
- The First Programmable Computer
  - Could handle conditional jumps
  - Parallel processing
- Used Punch Cards from Jacquard's Loom to program computers
  - Used as input for a program and data
  - These were "Read-only memory"
  - Was proposed to handle parallel computing
- Employed concepts of the "Store" (memory) & "Mill" (CPU) - terms from Jacquard
- Would have been > 13 ft tall by 20 ft wide
- Powered by steam engines
- Partially completed



Photo: Karoly Larentzy Resized & Cropped



Analytical Engine Mill  
Photo: CG - Martin Wichary

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## Ada Byron Lovelace

First Computer Programmer



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- Daughter of famous poet Lord Byron

- Educated in Math

- Friend of Charles Babbage

- Described programs that would work on Babbage's Analytical Engine

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## Herman Hollerith

Hollerith's desk - Electronic Tabulating Machine

- Need for accounting in the 1890 census
  - (the 1880 took 7.5 years - must be complete in 10 years)
- Used punch cards
  - Used a card reader which sensed the holes in the cards
  - Made them read/write capable
- Gear driven mechanism
  - These would count and display on a large wall of dial indicators
  - Electro-mechanical
- His company would become IBM



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## Punch Cards

- used in computers through the 70's & 80s

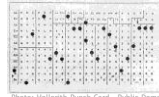


Photo: Hollerith Punch Card - Public Domain



Photo: IBM Punch Card - Public Domain



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Photo: National Archives storage of Punch Cards - Public Domain

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## Atanasoff-Berry Computer



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- John Atanasoff & Cliff Berry
- Iowa State U in 1939
- First digital-electronic computer
  - Designed to solve linear equations
- Utilized many new technologies
  - First machine to store data as a charge on a capacitor
    - Which is how computers store information in their main memory today.
  - binary system of arithmetic
  - parallel processing
  - regenerative memory
    - separation of memory & computing functions.
- Influenced the ENIAC



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## Mauchly & Eckert

ENIAC (Electronic Numerical Integrator And Calculator)

- 1946 → Developed for the Military
- Based on Atanasoff's Work
- Calculated Firing Tables
- Not "published" until well after the war
  - 17,468 vacuum tubes
  - 70,000 resistors
  - 10,000 capacitors
  - 1,500 relays
  - 6,000 manual switches
  - 1800 square feet of floor space
    - weighed 30 tons

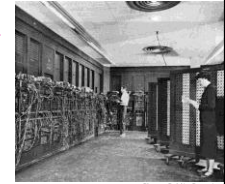


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UNIVAC (UNIVersal Automatic Computer)

- 1951 → Developed for the census bureau (baby boomers)
- 1952 → successfully predicted the outcome of the Eisenhower-Stevenson election
  - Used magnetic tape → much faster than IBM's punch cards

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## Alan Turing



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1939 - Bletchley Park

- Father of Artificial Intelligence
  - "Sometimes it is the people no one can imagine anything of who do the things no one can imagine." - Alan Turing
- Developed the Bombe
  - Broke the German Enigma code
  - Estimated to have ended WWII 2 years early - others argue the British would have lost...
- Developed the Colossus
- Key in the development of cryptography and artificial intelligence



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## Grace Hopper

- Developed the first "compiler" for high level languages - 1952



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- Worked with Mauchly and Eckert on the UNIVAC I
- "FLOW-MATIC"
  - Developed into "COBOL (Common Oriented Business Language)"
- High-level languages are more understandable by people than computers
  - Use English-based instructions
- The compiler is a program to convert them to a language the computer can understand
- Compilers translate the high-level into binary

- Found the First "computer bug"
  - A "moth" blocking the reading holes in paper tape



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- Coined the term "debugging"
  - Which means to remove errors

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