History
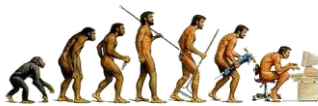
Photo: Public Domain

CS1A

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

Photo: CC - pixabay

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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: Eistner Hilton : ~1914   Photo: Klaus Tent

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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: Tilemahos Efthimiadis   Photo: Andrew Barclay

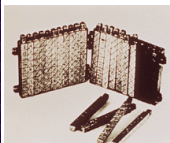(c) Michele Rousseau   History of CS   4

The 17th 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

Illustration: © Michele Rousseau

Photo: Courtesy of IBM   Photo: PD – ComputerScienceLab.com   Photo: CC-SA – Stephen C Dickenson

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The 17th Century

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

Photo credit: Ann Giles

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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.

Photo: Public Domain

1847 - George Boole

- ☀ 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

Photo: Public Domain

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Charles Babbage

Photo : Public Domain

The Father of Computing   1822 Version

- 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

Photo: Science Museum, London

  - Revised in 1847 – "Difference Engine 2"
  - 2002 – Complete machine built (London)
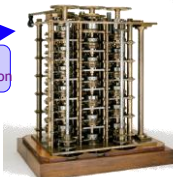   - 8,000 parts
    - 2 tons,
    - 11 feet long

Photo:"Marcin Wichary Resized and cropped

Photo: Marcin Wichary Resized and cropped

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Charles Babbage (2)

Analytical Machine

- Scrapped the Difference Machine
- The First Programmable Computer
  - Could handle conditional jumps
  - Parallel processing

Photo: Karoly Lorentey Resized & Cropped

  - 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

Analytical Engine Mill
Photo: CC – Marcin Wichary

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Ada Byron Lovelace

First Computer Programmer

- ☀ Daughter of famous poet Lord Byron
- ☀ Educated in Math
- ☀ Friend of Charles Babbage
- ☀ Described programs that would work on Babbage's Analytical Engine

Photo: 1840 Portrait - Public Domain

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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

Photo: Public Domain

Photo: Public Domain

Photo: (CC) Adam Schuster - Resized

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

punch cards
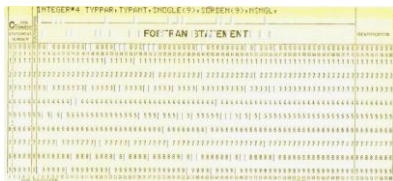
Photo: Public Domain

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Atanasoff-Berry Computer

"I have always taken the position that there is enough credit for everyone in the invention and development of the electronic computer." - John Atanasoff

Photo: Public Domain

- 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   Photo: Public Domain
  - 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

(c) Michele Rousseau   History of CS   Photo: Public Domain   13

Mauchly & Ekert

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
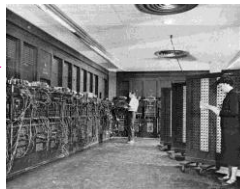   → weighed 30 tons

Photo: Public Domain

- 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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Turing

- 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*

Photo: Public Domain

- 1939 - Bletchley Park
- Developed the Bombe
  - Broke the German Enigma code
  - Estimated to have ended WWII 2 years early – others argue the British would have lost...
- Key in the development of cryptography and artificial intelligence

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Grace Hopper

☀ Developed the first "compiler" for high level languages – 1952

▫ Worked with Mauchley 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

Photo: Public Domain

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

☀ Coined the term "debugging"
  ▶ Which means to remove errors

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Photo: Public Domain

Generations of Computers

○ Consumers perspective based on
  • Size (smaller)
  • Speed (faster)
  • Cost (cheaper)

○ Computer scientists characterize the differences based on major technological development.
  • These advances result in the properties that consumers see.

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First-Generation

1940-1956:
  • Vacuum tubes – Circuitry
    ▫ Invented by John Ambrose Fleming (1904)
  • Magnetic drums – Memory
  • Large systems – took up entire rooms
  • Expensive to operate
  • Not energy efficient
    ▫ Ran Hot
  • Input – paper tape, punch cards
  • Output – displayed on paper

Photo: Marcin Wichary

○ Examples: ENIAC & COLLOSSUS

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Photo: Rony B Chandro

Second Generation

- Transistors – Replace Vacuum Tubes for circuitry
  - Invented in 1947, by Bardeen, Schockley, & Brattain
    - not widely used until the late 50's
  - Smaller, faster, & cheaper than vacuum tubes
  - More energy-efficient
  - More reliable
  - ☀Still hot → would damage computer
  - ☀Input: Punched cards
  - ☀Output: Printouts
  - ☀High-level programming languages (COBOL/FORTRAN)
  - ☀Instructions stored in memory (not magnetic drums)

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Third Generation

1964 – 1971: Integrated circuit
  - ☀Invented 1952 by Jacobi
  - ☀Couldn't be produced until 1958
  - ☀Kilby, Lehnovic, & Noyce
  - ☀miniature transistors placed on silicon chips called semiconductors
  - ☀Faster

Photo: Public Domain

- ☀ Interfaces: Keyboards and monitors
- ☀ Could run many different applications at one time.
- ☀ Central program monitored memory
- ☀ Started moving to mass audience

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Fourth Generation

1971-Present – Microprocessors
  - 1971 - Invented by Ted off at Intel
  - Thousands of Integrated circuits on a silicon chip
  - Much smaller
    - Filled a room in 1ˢᵗ gen
    - 4ᵗʰ gen fits in the palm of the hand
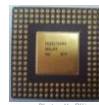 - CPU, Memory, I/O Controls – one 1 chip

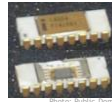Photo: M. Olivando

- 1981 – IBM introduced its first PC for home user
- 1984 – Apple introduced the Macintosh
  - 1964 – the mouse by Doug Englebart
  - 1973 – Xerox PARC invented he Alto (GUI)
- Networked computers
- Graphical user interfaces during this gen
- Interface with mouse & handheld devices

Photo: SRI International

Photo: Alexander

Michele Rousseau   History of CS   Photo: Ruben de 21

Fifth Generation

○ Present & Beyond
- Based on Artificial intelligence
- Self-learning / self-modifying
- Parallel processors
- Voice recognition
- New ways of interacting (gesture-based)

- Goal:
  - to develop devices that better support the process
  - Ubiquitous
  - Capable of learning and self-organization
  - Still… smaller, cheaper, faster