Some History

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Jacquard loom - Introduced 1801
Charles Babbage’s “engines” - Designed early to mid 1800s (mechanical)
Need to tabulate polynomial functions
  E.g., for trig tables
Concept proposed in 1822
  "Note on the application of machinery to the computation of astronomical and mathematical tables"
  Project terminated due to cost overruns
Analytical Engine described in 1837
Difference Engine #2 designed 1847-49
Crank-powered
Evaluates degree 7 polynomials
Prints the results (or makes plates)
The Babbage Engine

- 8000 parts
- 5 tons
- 11'
Ada Lovelace - Babbage's collaborator

**The Analytical Engine**

Lovelace's program turned a complex formula into simple calculations that could be encoded on punched cards and fed into Charles Babbage's Analytical Engine, a mechanical computer that he designed but never built. She published it in 1843, a century before the modern computer age.

\[
\frac{x}{e^x - 1} = \frac{1}{1 + \frac{x}{2} + \frac{x^2}{2 \cdot 3} + \frac{x^3}{2 \cdot 3 \cdot 4} + \&c.}
\]

**A Universal Computer**

Lovelace did more than write the first computer program. She was also the first person to realise that a general purpose computer could do anything, given the right data and instructions.

"The Analytical Engine weaves algebraic patterns just as the Jacquard loom weaves flowers and leaves."

"Supposing, for instance, that the fundamental relations of pitched sounds in the science of harmony and of musical composition were susceptible of such expression and adaptations, the engine might compose elaborate and scientific pieces of music of any degree of complexity or extent."

Augusta Ada King, Countess of Lovelace
Born: 10 December 1815
Died: 27 November 1852
IBM/Harvard Mark I - Built early 1940s (electromechanical)

765,000 electromechanical components (switches, relays, rotating shafts, clutches)
500 miles of wire
Powered by a 5 hp electric motor
Program executed from punched paper tape

8' (h) x 2' (d) x 51' (linear)
5 tons

3 additions or subtractions per second
Multiply: 6 seconds
Divide: 15 seconds
RADM Grace Murray Hopper - one of the 3 original programmers of the Mark I

Invented the first compiler
Key role in development of the COBOL programming language
RADM Grace Murray Hopper - one of the 3 original programmers of the Mark I

Had a destroyer named for her (USS Hopper)

Found the first bug!

- 17,468 vacuum tubes
- 7,200 crystal diodes,
- 1,500 relays

- 8.5’ (h) x 3’ (d) x 80’ (linear)
- 30 tons
- 150 kW of power

- 5,000 additions or subtractions per second
- 385 multiplications per second
- 40 divisions per second

 (~2,000x as fast as the Mark I)
IAS machine: von Neumann - Built 1945-51

1024 40-bit words of memory implemented using 40 Williams cathode ray tubes

A stored program machine
The transistor - 1947

- William Shockley, Walter Brattain and John Bardeen, Bell Labs
The integrated circuit - 1958

- Jack Kilby, Texas Instruments, and Bob Noyce, Fairchild Semiconductor Corporation
Moore’s Law and exponential progress - 1965-today

Gordon Moore
iPhone 6

Something like 8,000,000,000 operations per second
(~1M-2Mx ENIAC)

And it’s considerably smaller, lighter, and less power-hungry:
8.5’ (h) x 3’ (d) x 80’ (linear)
30 tons
150 kW of power
Computer History Museum - Mountain View CA
Living Computer Museum - Seattle WA

The Living Computer Museum collection presents the meaningful milestones in the evolution of computers and how people use them. The collection was assembled by Microsoft co-founder Paul G. Allen as a way to preserve the history that put him and Bill Gates on the path to founding the company.

Address:
2245 1st Ave S
Seattle, WA 98134
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YOU HAD TO LOVE IT

Your $400 bought you bags of parts. If you were good with a soldering iron, you might end up with a functioning computer.

You programmed the Altair by entering the ones and zeros of machine language on the row of toggle switches across the front. It could take several minutes to enter the instructions necessary to add 2 plus 2.

A single illuminated LED in the row of lights represented your answer in binary: 100. Better known as 4.

People bought the Altair regardless of its limitations, excited by the idea of finally, at last, owning a computer.

THE ALTAIR AND BASIC WERE THE RIGHT COMBINATION

Paul Allen used the Altair in 1974. Using its BASIC language, he programmed the 8080, he and Allen's machine language for the Altair, and Allen's Altair BASIC.

These were the two key elements:

- Allen and his Altair BASIC.
- Gates and Allen using it in a computer.

These two things, one leads to the other, and you have your own computer and a program.