A Brief

History of Computer Science

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History of Computing Machines

The Word "Computer"

- The word "computer" was first used in 1613 meaning any **person** performing calculations.

- The calculations of this period required years of training in mathematics and was expensive to perform (i.e. labor-intensive).

"Hidden Figures" movie

Modern Definition of "Computer"

- A programmable machine

- A machine that manipulates data according to a list of instructions

- Any device which aids humans in performing various kinds of computations or calculations
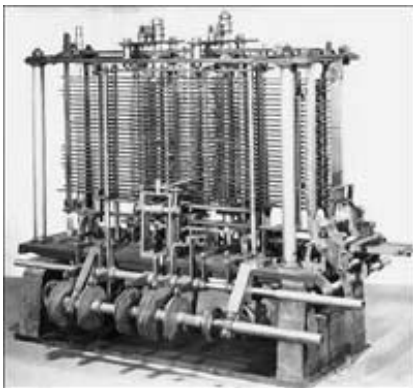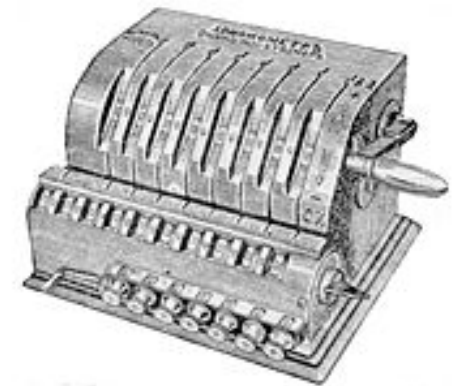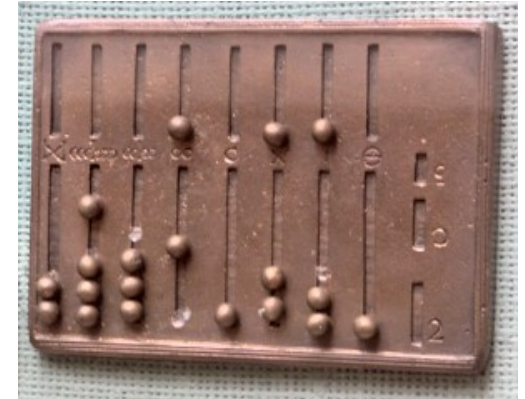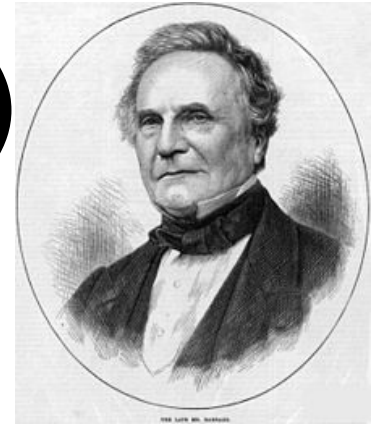

Analytic Engine

Monroe

Wang 2200

Computing Devices

Roman Abacus

- Abacus (2400 BCE) - performed basic arithmetic operations

- Slide Rule (1622) - performed multiplication & division, logarithms, and trigonometry

- Arithmometer (1820) - first reliable and commercially successful mechanical calculating machine

Charles Babbage (1791-1871)

- Designed and built a **Difference Engine** (1822) to tabulate polynomial functions. It was the first mechanical computer.

- Proposed the **Analytical Engine** (1837). The design is recognized as the **first general-purpose computer**. Babbage never built it.

- **Augusta Ada Byron** assisted Babbage and wrote programs for the Analytical Engine. She is recognized for being the **first "programmer"**.
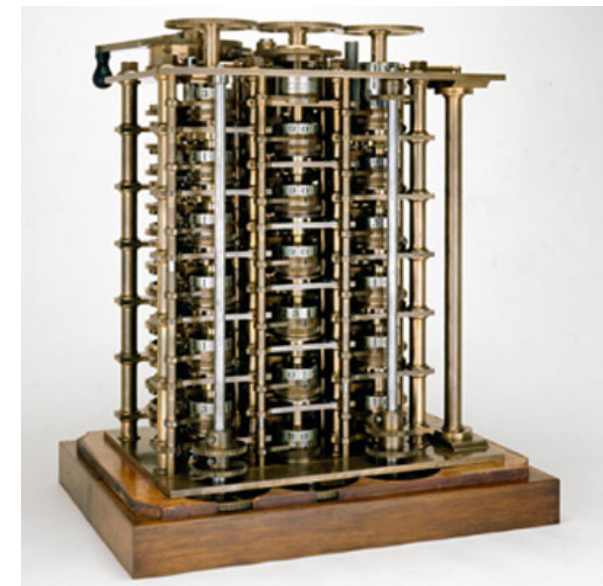
Difference Engine

Von Neumann Architecture

- A computer architecture proposed by physicist and mathematician John von Neumann in 1945.

- Previous computers were hard-wired with one program to solve one problem. Von Neumann's computer could load and execute different programs to solve different problems.

- It is the basic computer architecture still used today.
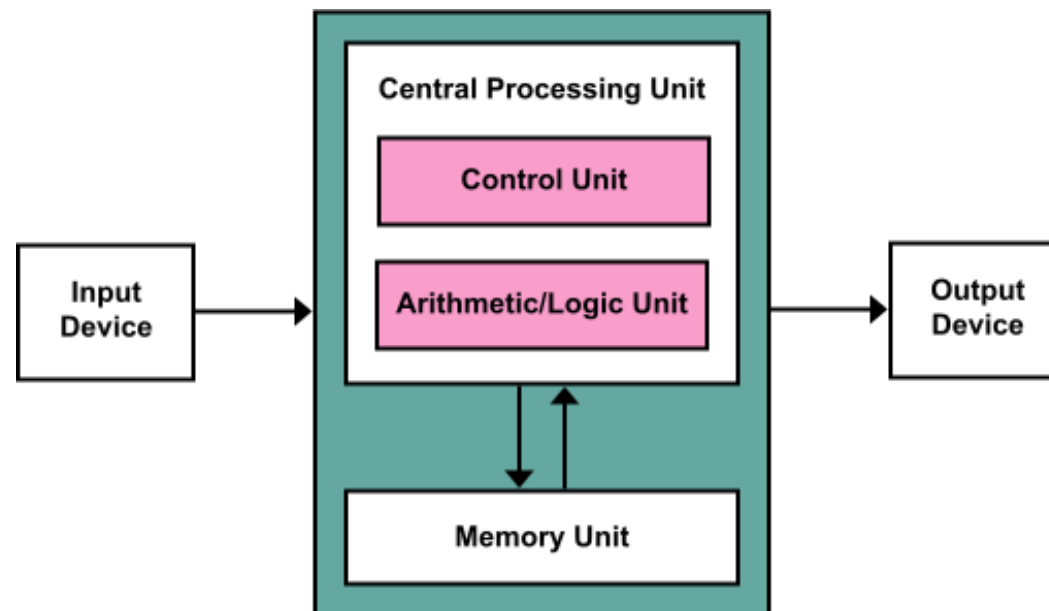
# The First Modern Computers

Harvard Mark I (1943)

- the first electro-mechanical computer

ENIAC

Computer Generations

- **First Generation** (1946-1958) - vacuum tubes and magnetic drums for memory, low level machine language

- **Second Generation** (1959-1964) - small transistors replaced vacuum tubes, faster and cheaper, energy-efficient and more reliable

- **Third Generation** (1965-1970) - one integrated circuit replaced hundreds of transistors, again smaller, cheaper, faster
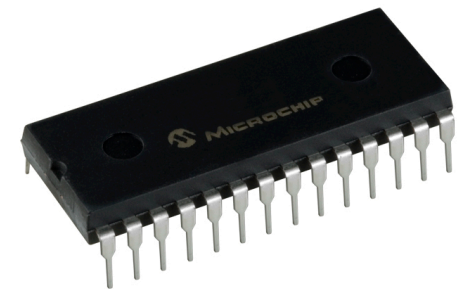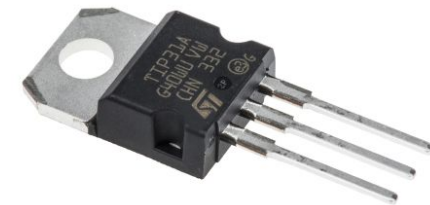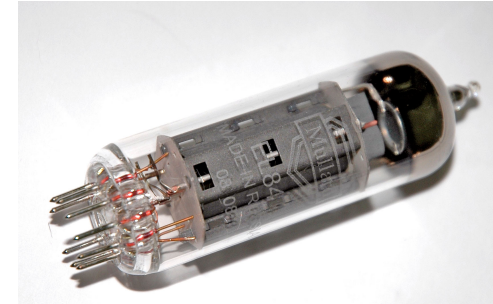
Computer Generations (cont.)
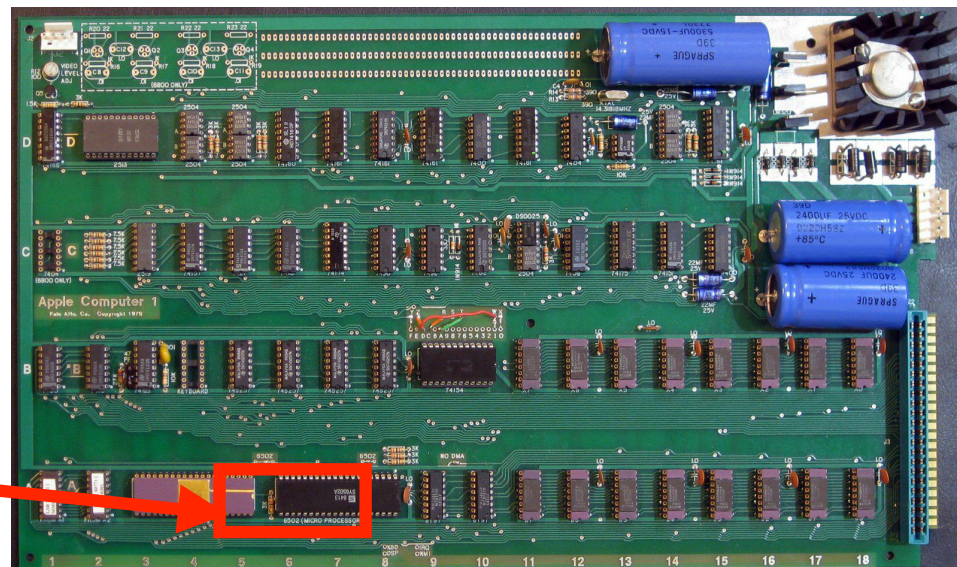
- **Fourth Generation** (1971-today) - the microprocessor
  - the microprocessor fit thousands of integrated circuits into a small package
  - small microprocessor-based computers could be built and linked together to form networks
  - computing power increased and saw the development of GUIs, the mouse, and handheld devices

Apple 1 Mother Board (1976)

Microprocessor

Computer Generations (cont.)

- **Fifth Generation** (today)
  - based on Artificial Intelligence (AI)
  - use parallel processing and superconductors
  - responds to natural language and capable of learning and organizing

iPhone X

IBM's Blue Gene/P massively parallel supercomputer

History of Algorithms
and
Theoretical Computer Science

History of Algorithms

- Algorithms were derived from algebra developed in the 7th century by Indian mathematician Brahmagupta

- In 825, a Persian mathematician, Al-Kwarizmi, wrote a book that spawned Hindu-Arabic numerals and algorithms into Europe

- In the 12th century, the book was translated to Latin and introduced a more formal concept of an algorithm

- Today, programs are the manifestation of algorithms in machine language

A GUIDE TO THE MEDICAL DIAGNOSTIC AND TREATMENT ALGORITHM USED BY IBM's WATSON COMPUTER SYSTEM

Binary Logic

- The **binary system** (0's & 1's) was invented in the 3rd century by the Indian mathematician Pingala.

- **Binary logic** was formally developed in the 1700's by Gottfried Leibniz (who invented Calculus with Newton). Here zeros and ones take on false and true values.

- George Boole refined the process in the 1800's and published *Boolean Algebra*.

Formal Boolean Algebra

Problem 1 [STONE] One of the important occur in traditional mathematical structures concerns r

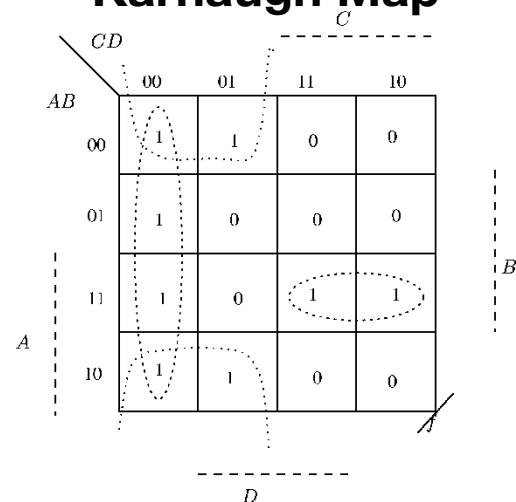(a) If $B, \vee, \wedge, ', 0, 1$ is a Boolean algebra, define

$$x + y \text{ as } (x \wedge y') \vee (x' \wedge y) \qquad \text{(the symm}$$

$$x \times y \text{ as } x \wedge y.$$

Show that $B, +, \times, 0, 1$ is a Boolean ring (i.e.

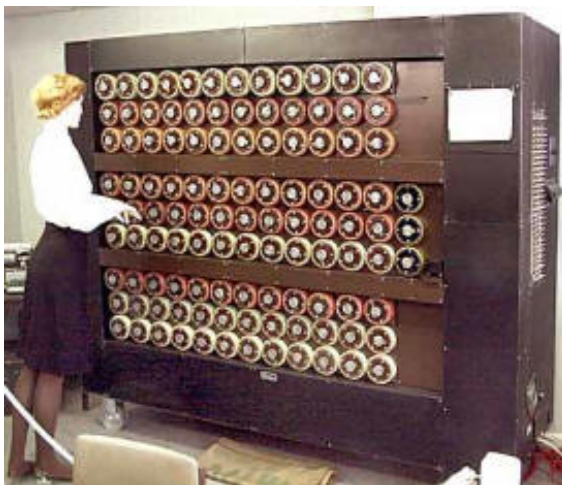(b) If $R, +, \times, 0, 1$ is a Boolean ring, define

Karnaugh Map

Alan Turing (1912-1954)

- A British theoretical mathematician who is recognized as the "Father of Computer Science".

- Developed the conceptual "Turing Machine", a basic abstract symbol manipulating device used to simulate the logic of any computer that could be constructed.

Bombe Computer

During WWII, Turing developed an algorithm that broke the German's secret Enigma cipher. The "Bombe" computer was built specifically to perform Turing's algorithm.

Now What?

Since Turing, modern Computer Science has expanded into theoretical and applied sciences

Theoretical Computer Science

- Theory of Computation

- Information and Coding Theory

- Algorithms and Data Structures*

Applied Computer Science

- Artificial Intelligence

- Computer Architecture and Engineering

- Computer Performance*

- Computer Graphics*

- Computer Cryptology

- Computer Networks

- Databases*

- Software Engineering*

* topics in APCS A

And What About Programming?

- Programming is how we realize the theoretical and abstract algorithms, designs and architectures into practical, real-world terms.

- Programming languages are tools to express this realization.

- Different applications require different languages.