university
of
tyumen

school
of advanced
studies

Information Technology - basic

Lecture 1
Computer hardware

Fabio Grazioso - *March 2018*

Course introduction

Course info

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- shared google folder: https://goo.gl/SsXpSr

introduction

- bird's-eye view
- several concepts
- have a general idea of many different things
- have the tools to do an in-depth study in the future
- refer to the books
- you don't need to read all the books!

Todays' lecture

Computers

summary of the lecture

- Historical introduction
- Turing Machine
- Computer architecture
- Data representation

Historical introduction

Old mechanical computing devices

Antikythera mechanism

Old mechanical computing devices

Antikythera mechanism

Old mechanical computing devices

Antikythera mechanism

Old mechanical computing devices

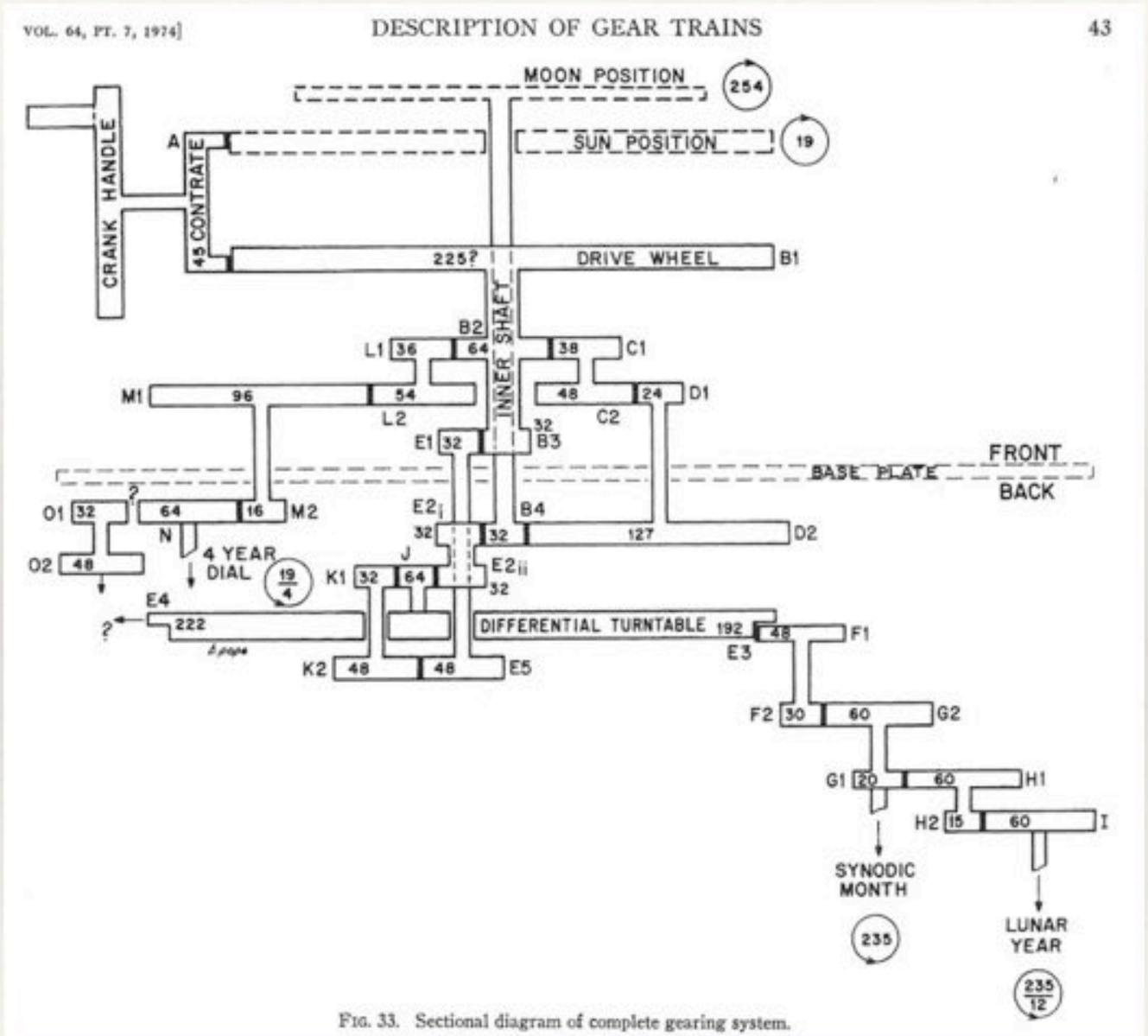


FIG. 33. Sectional diagram of complete gearing system.

Antikythera mechanism

Old mechanical computing devices

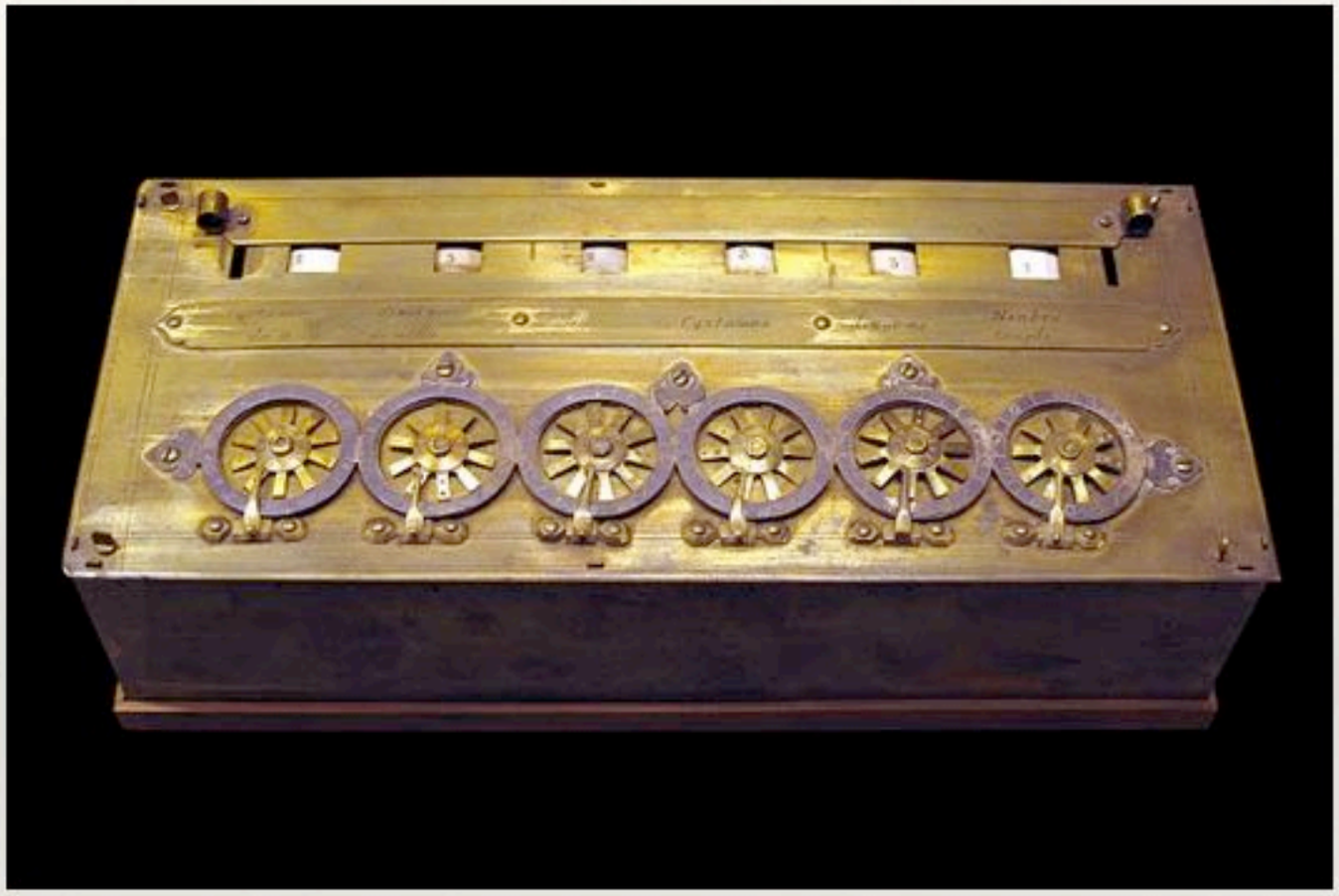
Computer model of the Antikythera Mechanism made by Hublot.

The historic calendar and the Olympiad dial of the Mechanism. Computer model by Hublot, with fonts designed by the Aristotle University of Thessaloniki.

Antikythera mechanism

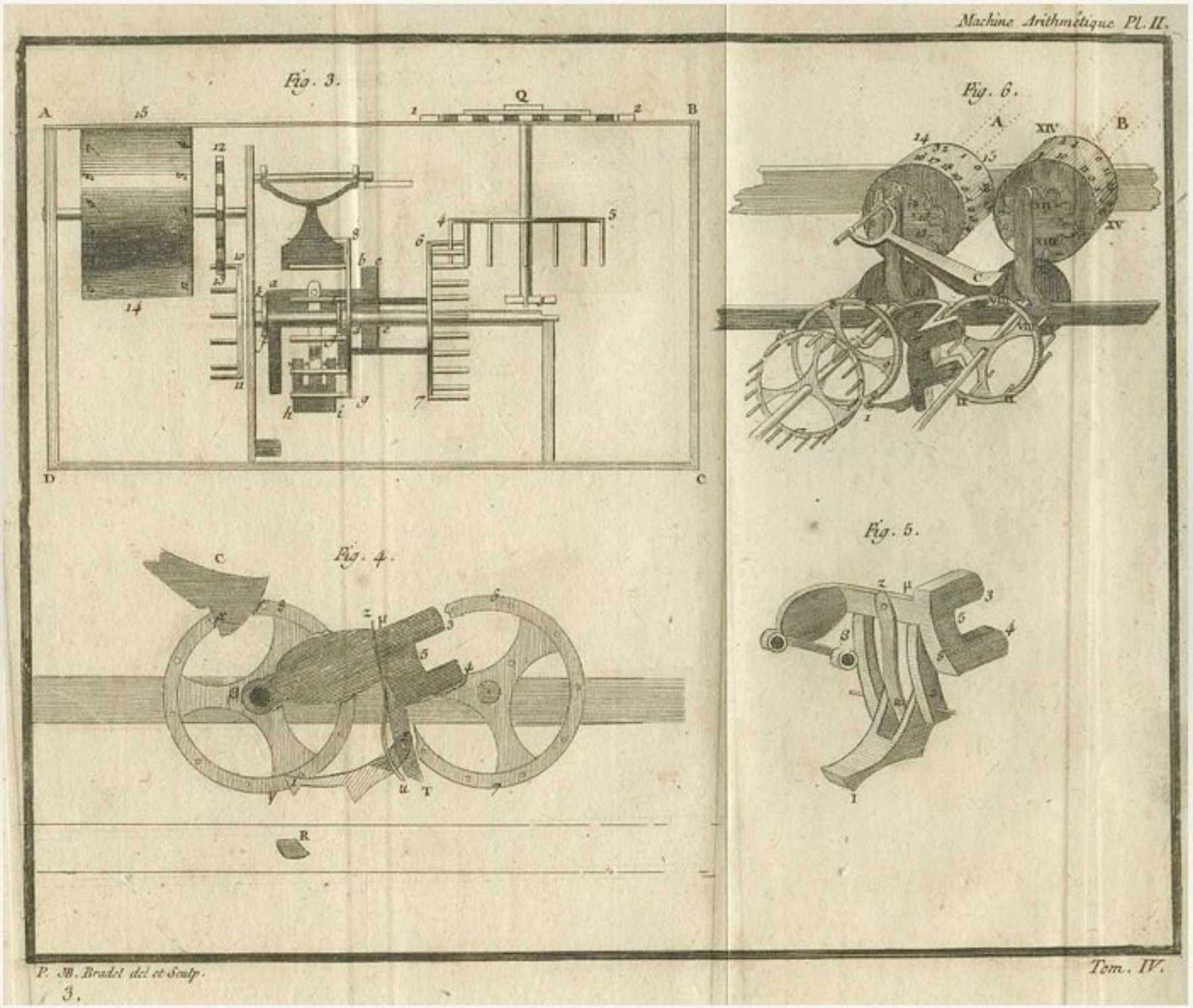
Old mechanical computing devices

Blaise Pascal



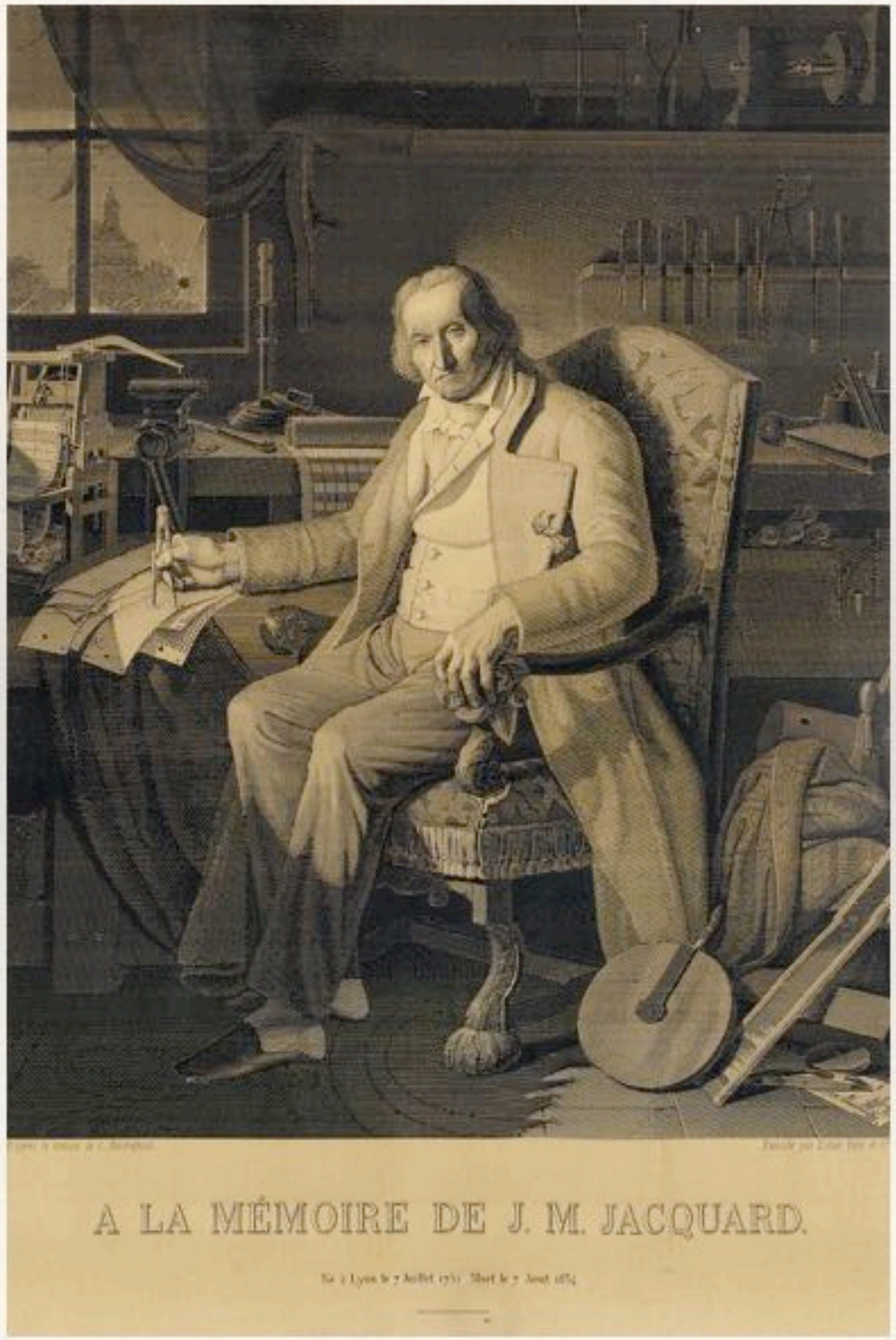
Pascal's calculator

Old mechanical computing devices



Old mechanical computing devices

Joseph Marie Jacquard



Old mechanical computing devices

Jacquard loom

Old mechanical computing devices

Jacquard loom

Old mech g devices

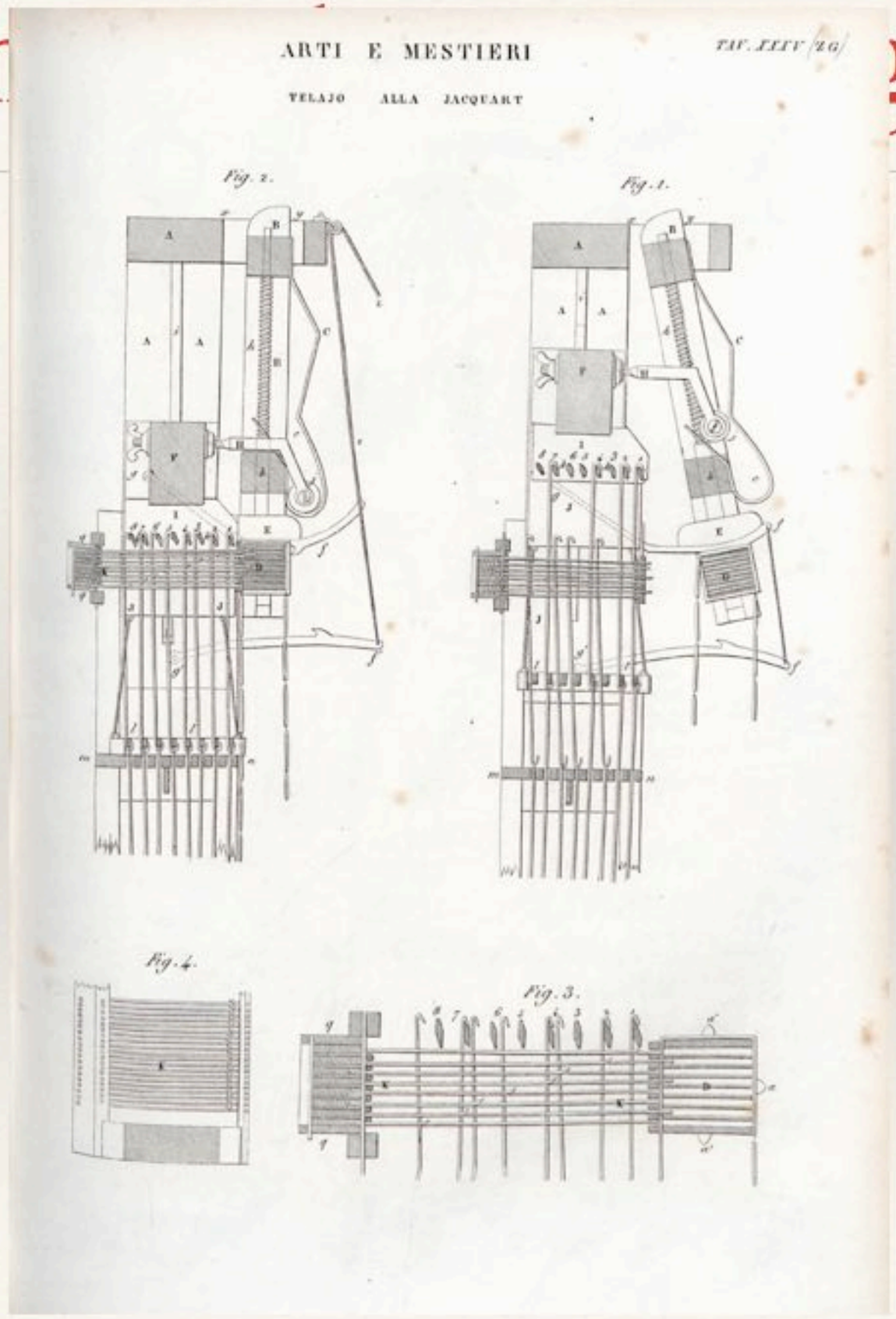

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Fig. 2.

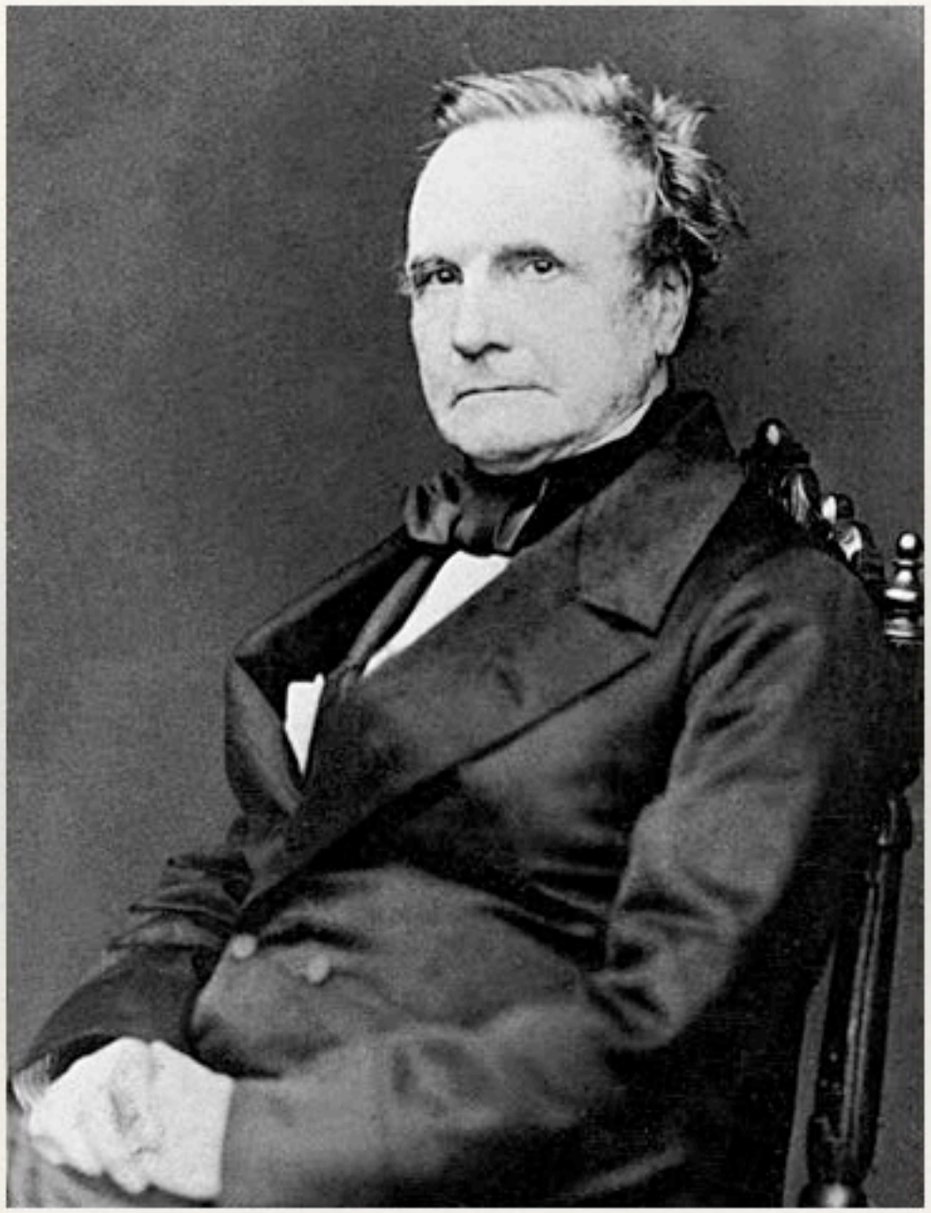
Fig. 1.

Fig. 4.

Fig. 3.

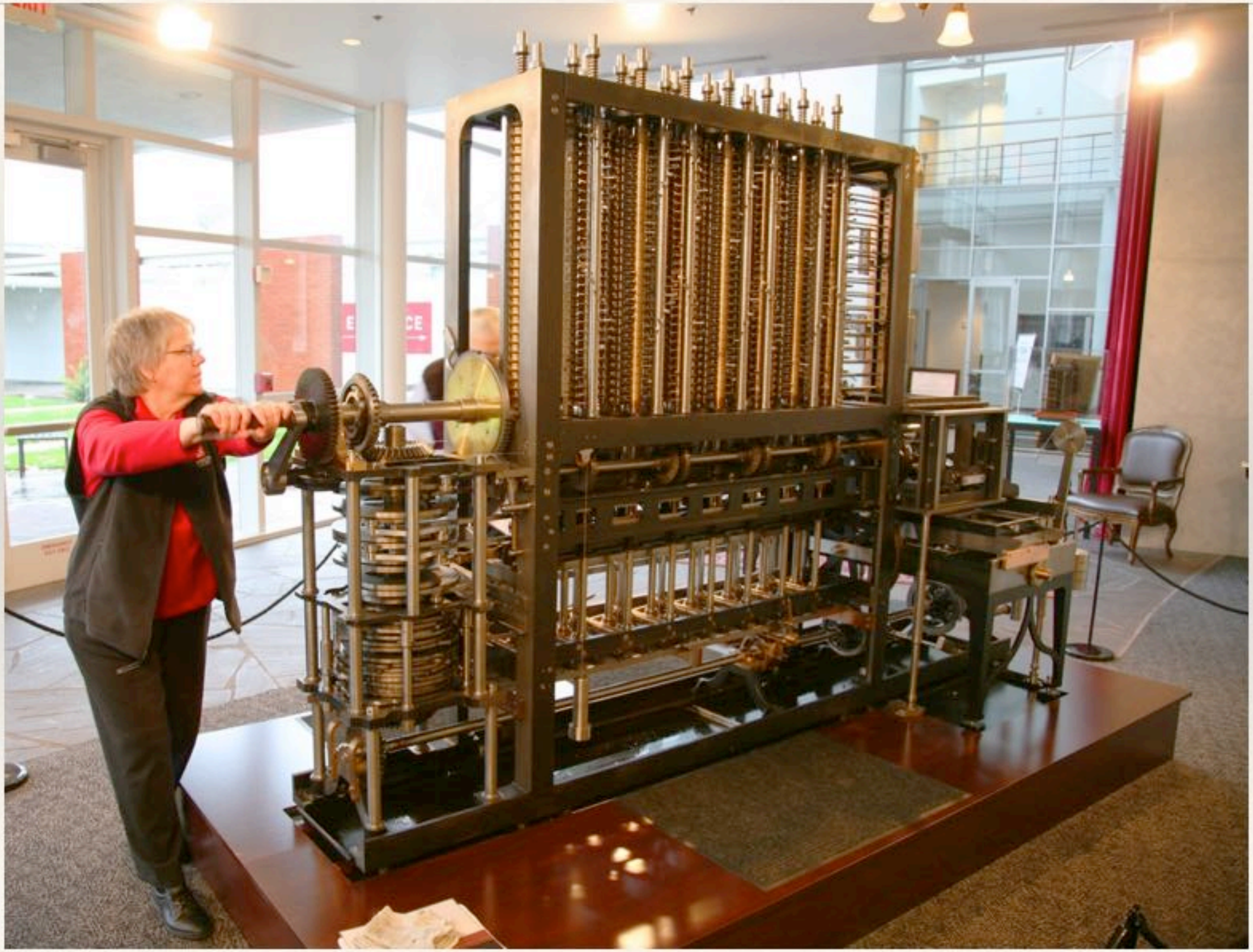
Jacquard loom

Old mechanical computing devices



Charles Babbage

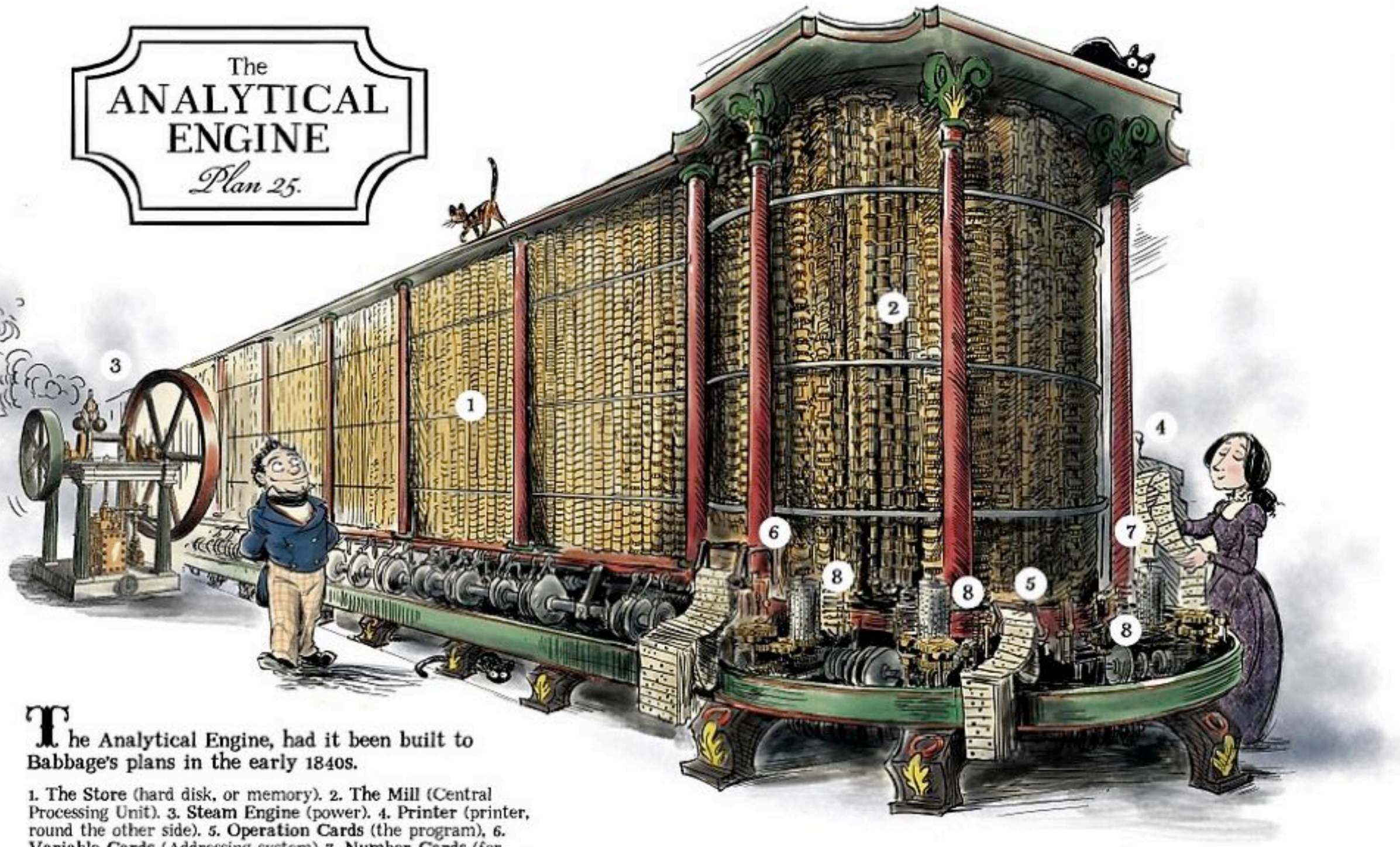
Old mechanical computing devices



Old mechanical computing devices

The ANALYTICAL ENGINE

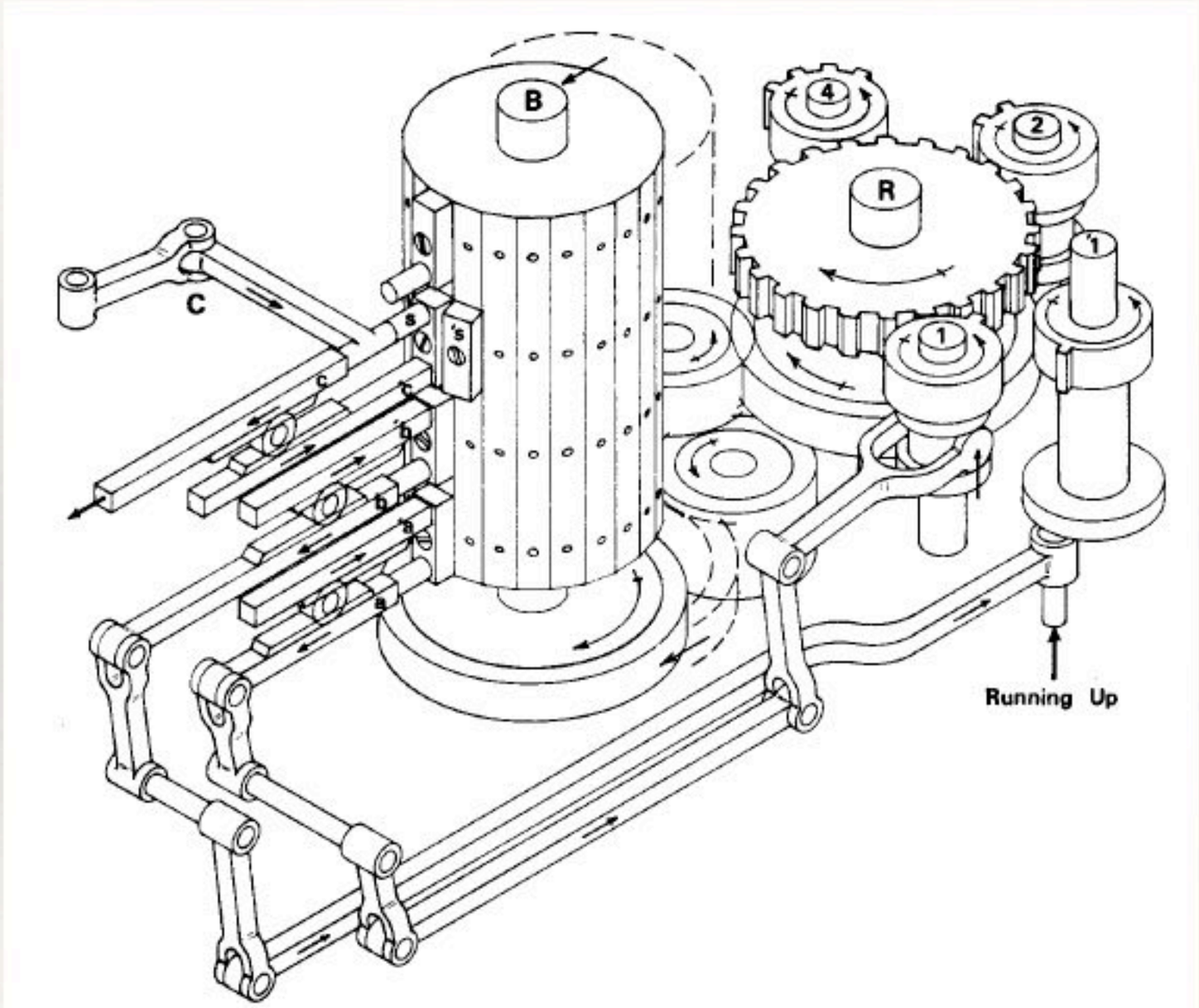
Plan 25.



The Analytical Engine, had it been built to Babbage's plans in the early 1840s.

1. **The Store** (hard disk, or memory). 2. **The Mill** (Central Processing Unit). 3. **Steam Engine** (power). 4. **Printer** (printer, round the other side). 5. **Operation Cards** (the program). 6. **Variable Cards** (Addressing system) 7. **Number Cards** (for entering numbers). 8. **The Barrel Controllers** (microprograms).

Old mechanical computing devices



difference engine - detail

programming is for women!

Ada Lovelace

Augusta Ada King-Noel, Countess of Lovelace

programming is for women!

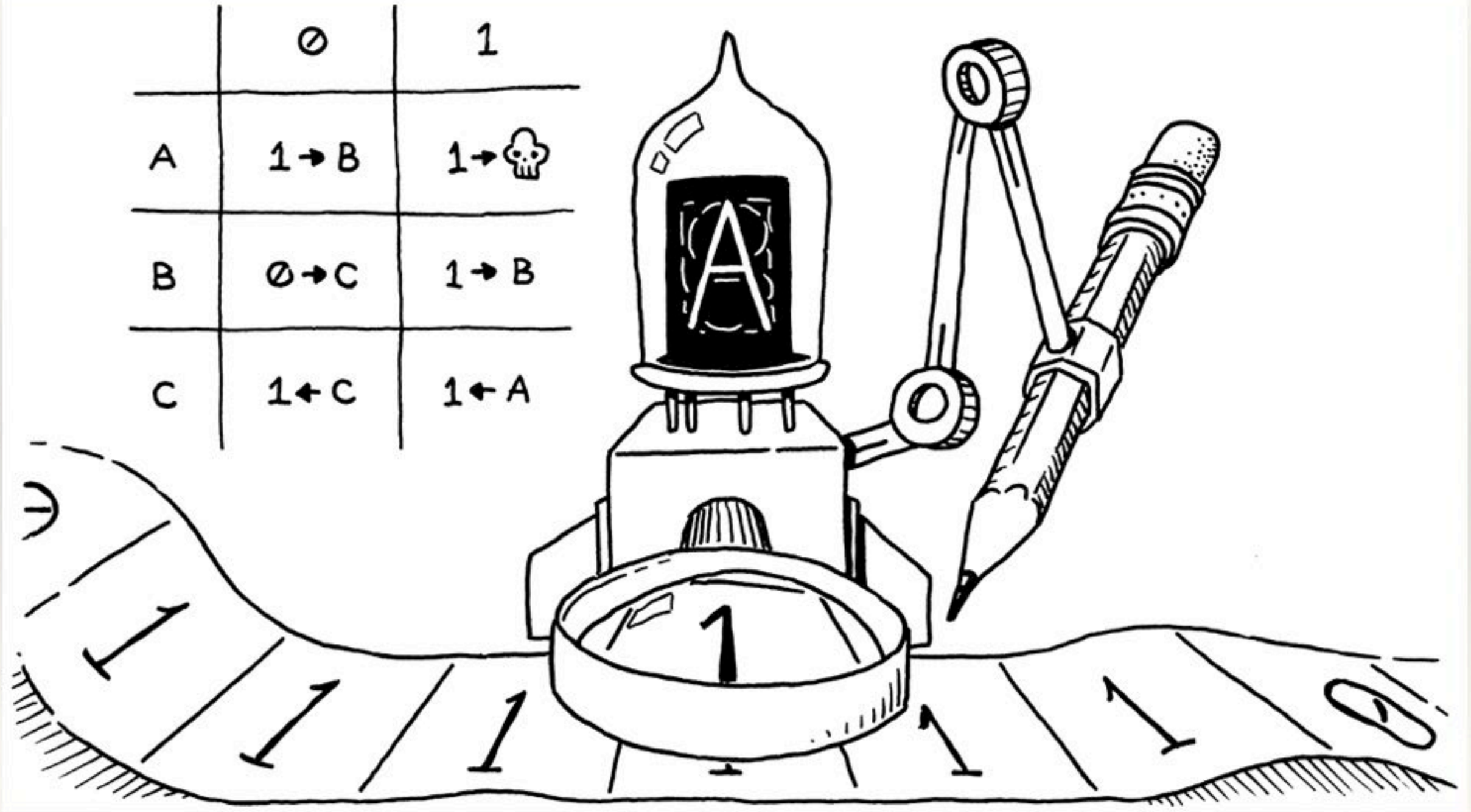
Grace Brewster Murray Hopper

programming is for women!

Grace Brewster Murray Hopper

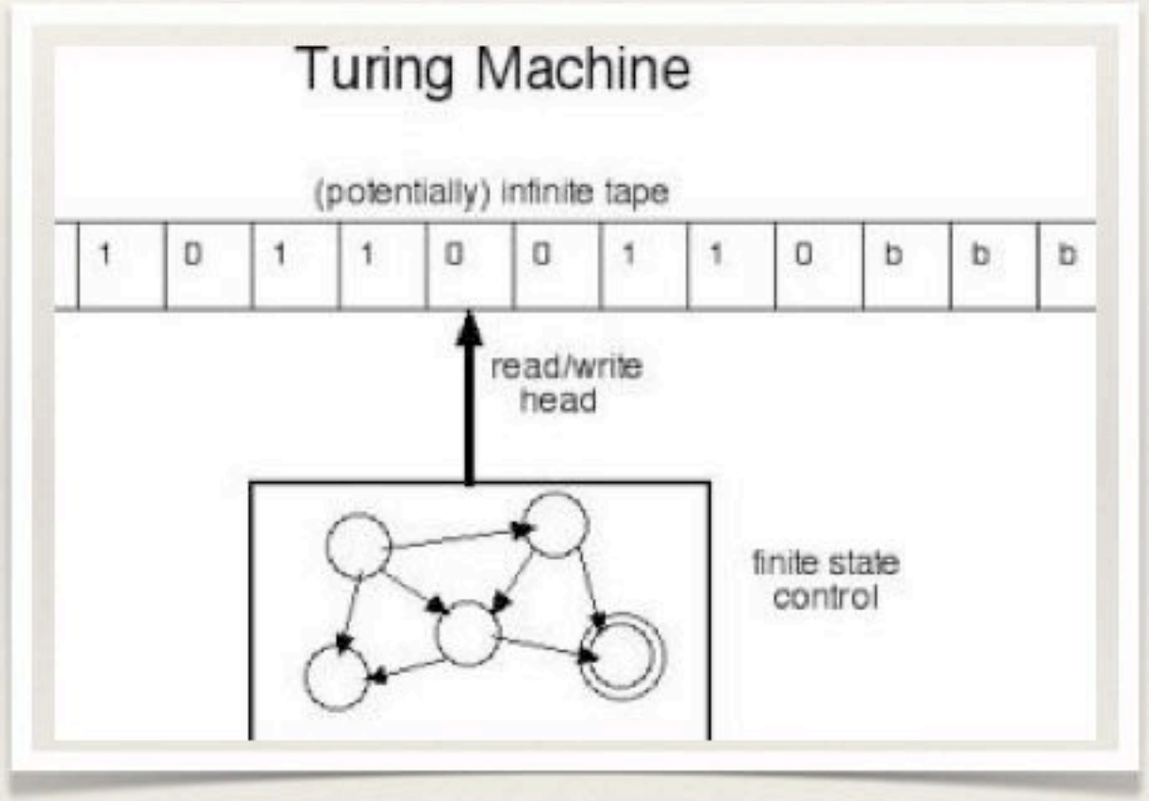
Foundational concepts

The Turing machine



The Turing machine

- an infinite tape
  - divided in discrete cells
- a read/write head
- a finite-state control unit



Sipser p165

The Turing machine

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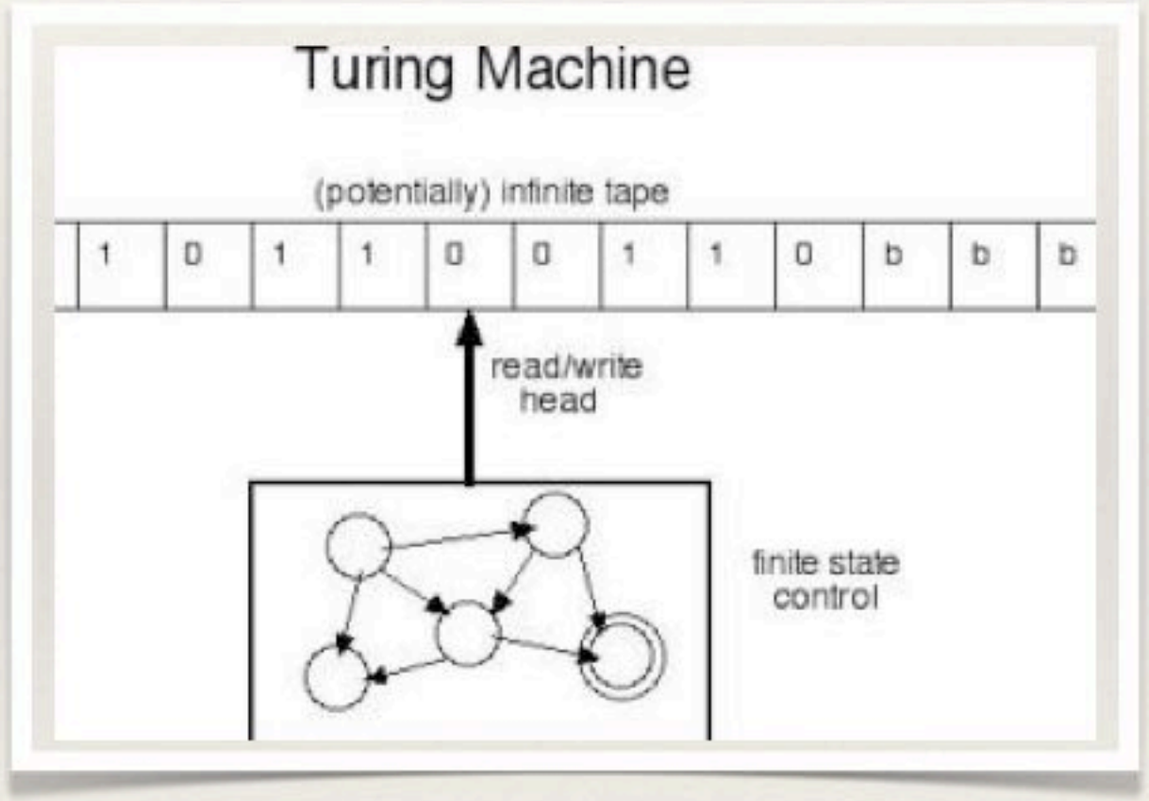

Sipser p165

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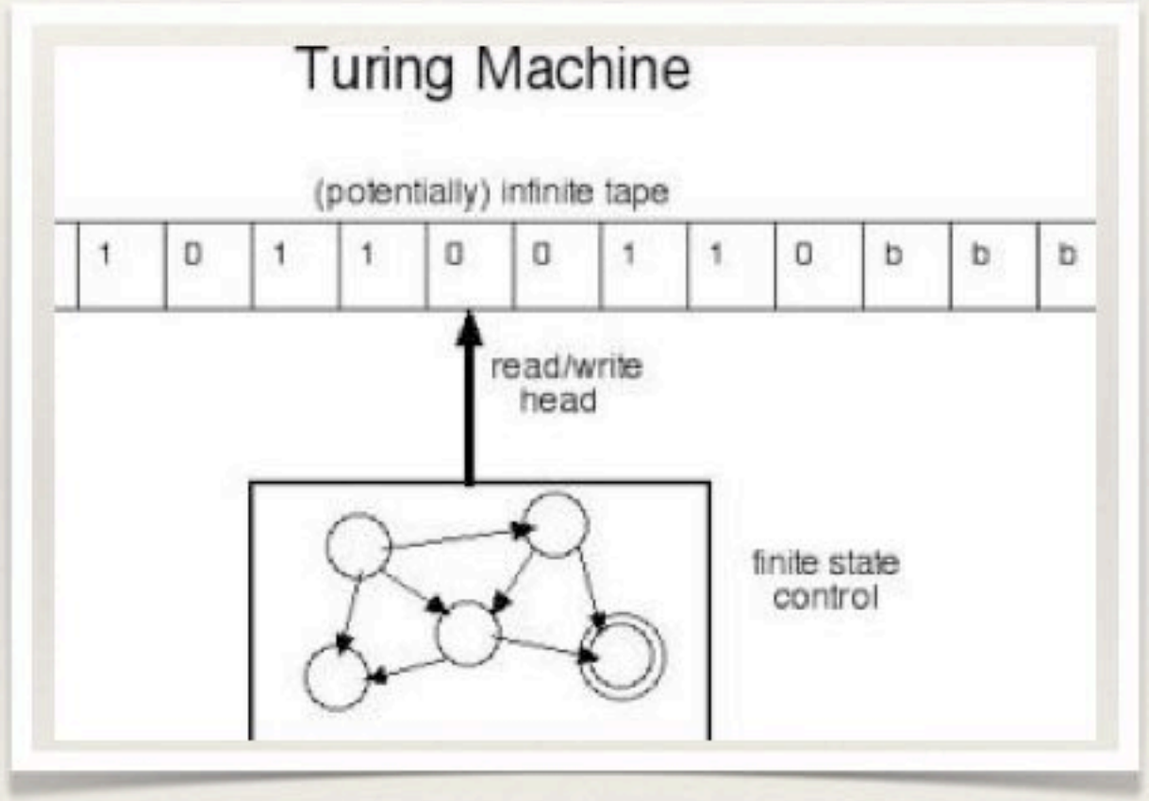


Sipser p165

The Turing machine

- a finite-state control unit

DEFINITION 1.5

A ***finite automaton*** is a 5-tuple $(Q, \Sigma, \delta, q_0, F)$, where

1. Q is a finite set called the ***states***,
2. Σ is a finite set called the ***alphabet***,
3. $\delta: Q \times \Sigma \longrightarrow Q$ is the ***transition function***,[1]
4. $q_0 \in Q$ is the ***start state***, and
5. $F \subseteq Q$ is the ***set of accept states***.[2]

Sipser p35

Church-Turing conjecture

«Anything that can be computed at all can be computed by a Turing machine.»

«A function on the natural numbers is computable by a human being following an algorithm, ignoring resource limitations, if and only if it is computable by a Turing machine.»

«The intuitive concept of *algorithm* and the rigorous definition of Turing machine are equivalent»

Sipser p183

human computers

Harvard_computers 1890

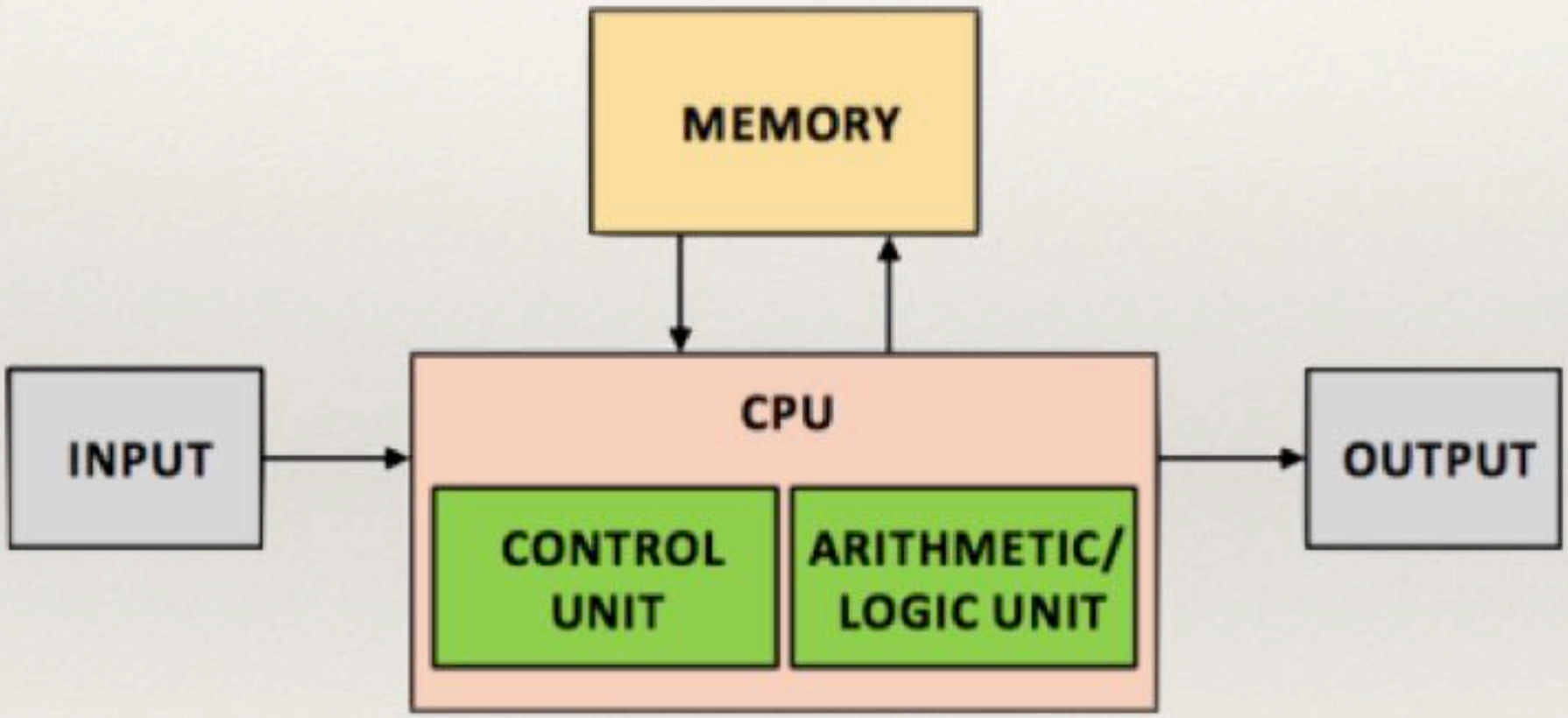
human computers

Harvard College Observatory 1913

human computers

NACA High Speed Flight Station "Computer Room" (1949)

The von Neumann architecture

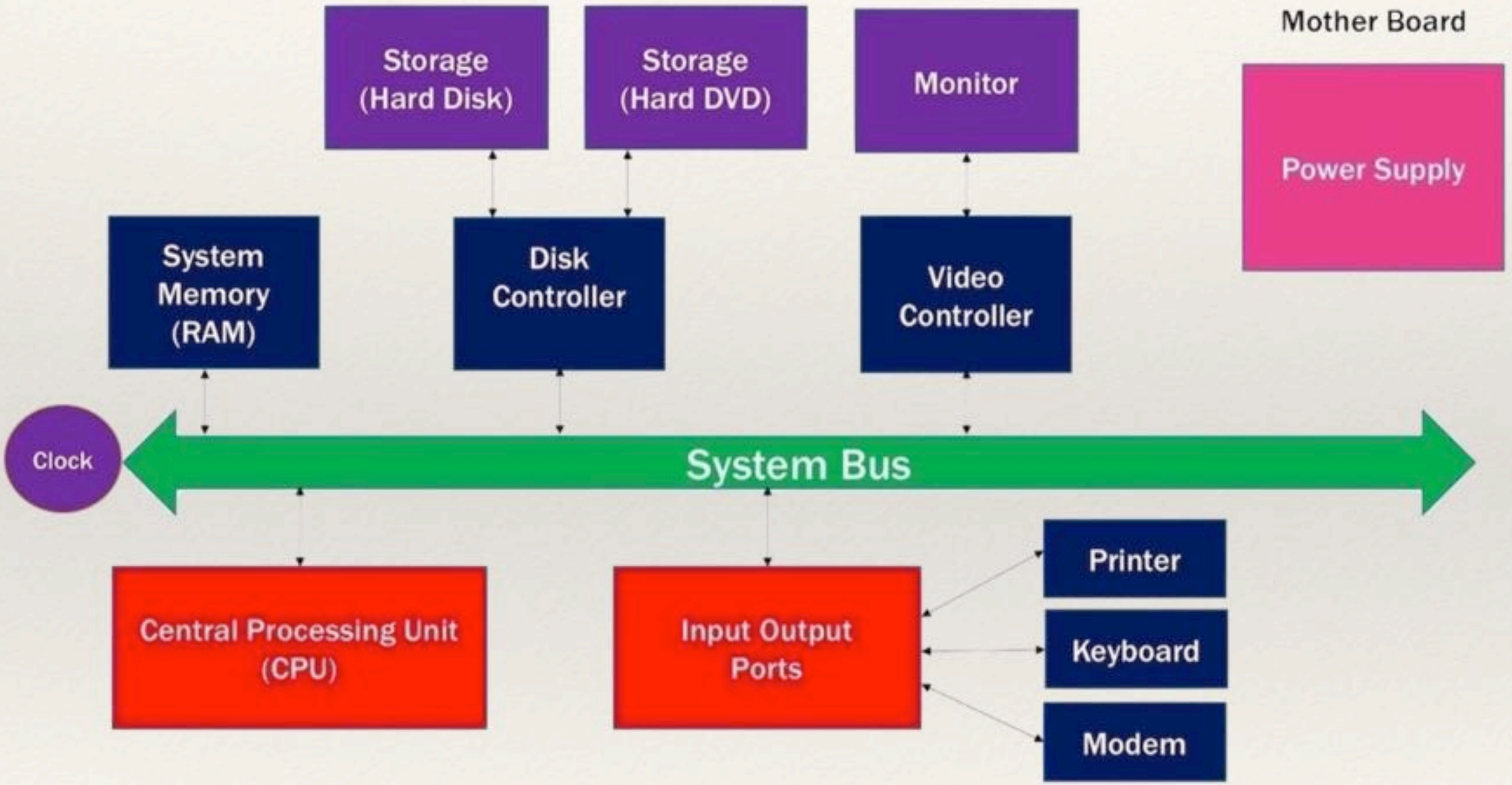


Computer hardware

- System unit
  - motherboard
    - CPU
    - cooling unit for the CPU
    - Possibly extra processors (for instance, for graphics)
    - Memory chips for RAM, ROM
    - Connectors for peripherals (sometimes known as ports)
    - Expansion slots for other peripheral device cards
    - ROM BIOS for booting and basic input and output instructions
    - Power supply connector
  - Disk drives
  - Fan units
  - Power supply
- A monitor
- A keyboard and a pointing device (mouse, track point, track ball)
- Speakers (optional)

Fox p13

Computer hardware



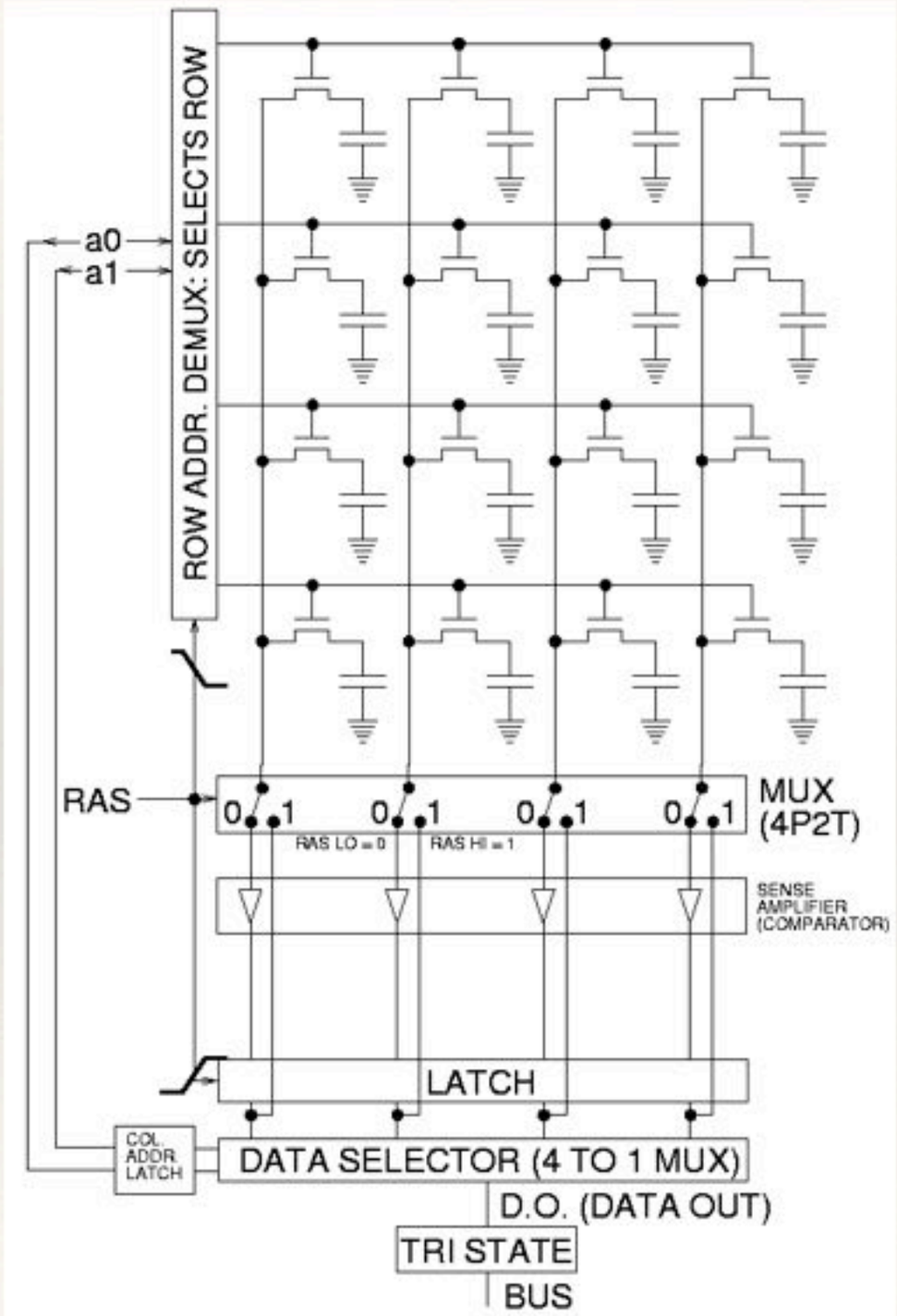
Frick p13

Computer representation of data

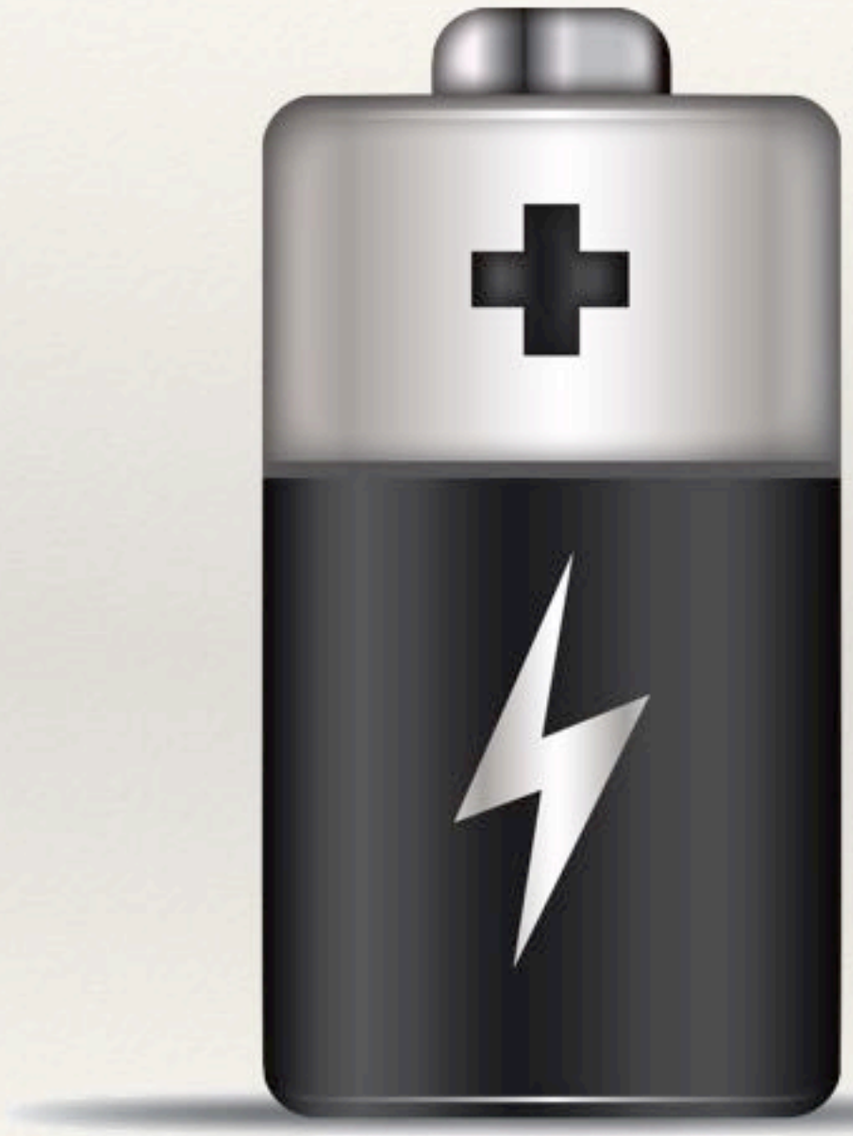
binary numbers

0 0 1 1 1 0 1 0

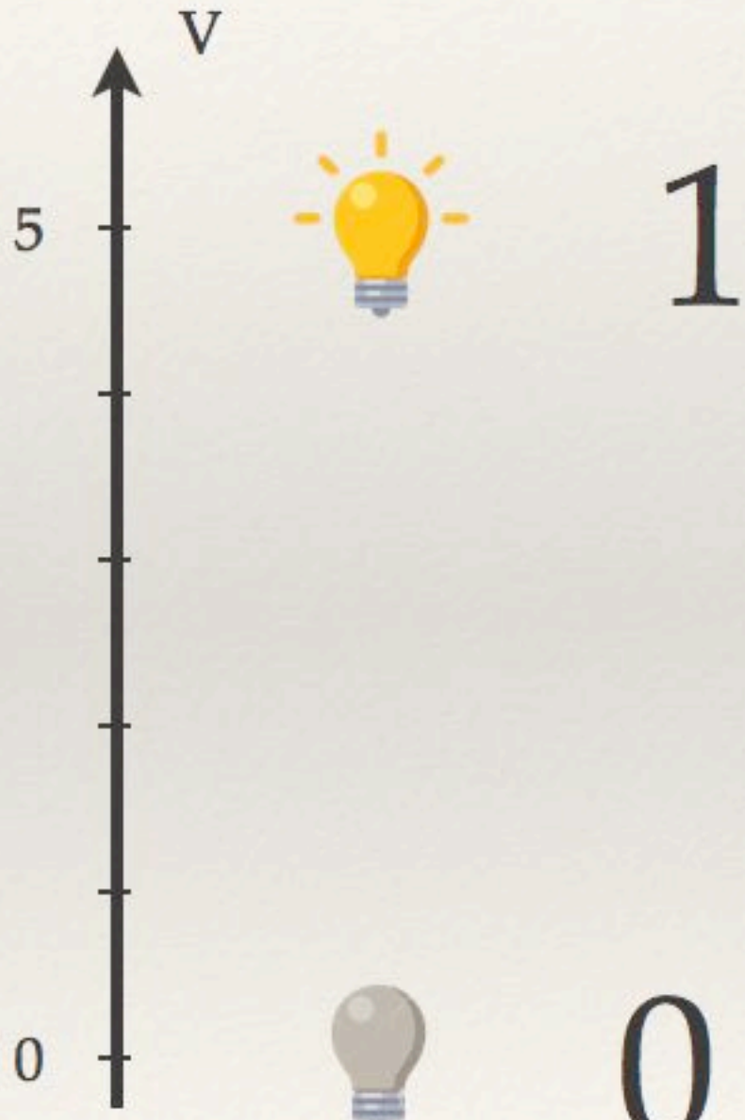
binary numbers storage



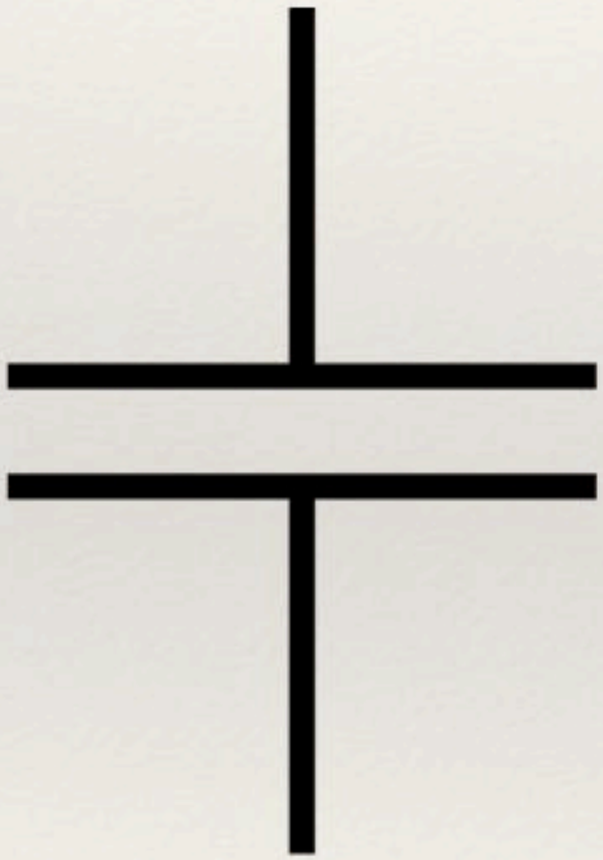
binary numbers storage

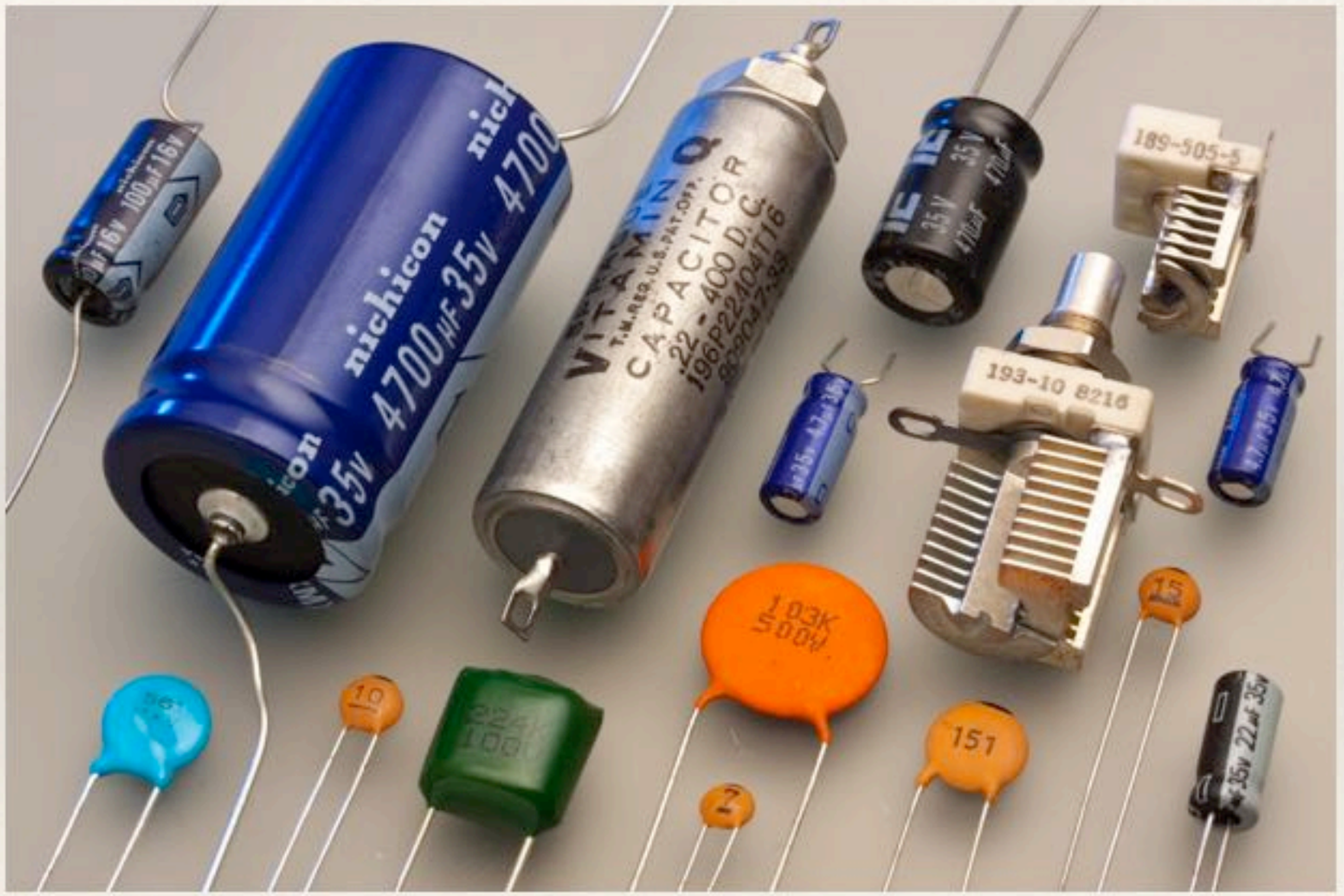


binary numbers storage



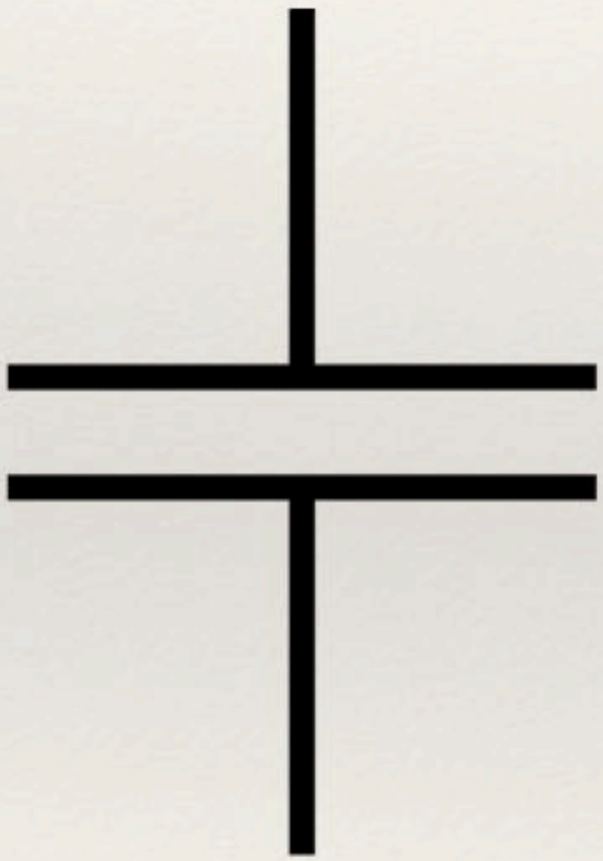
binary numbers storage

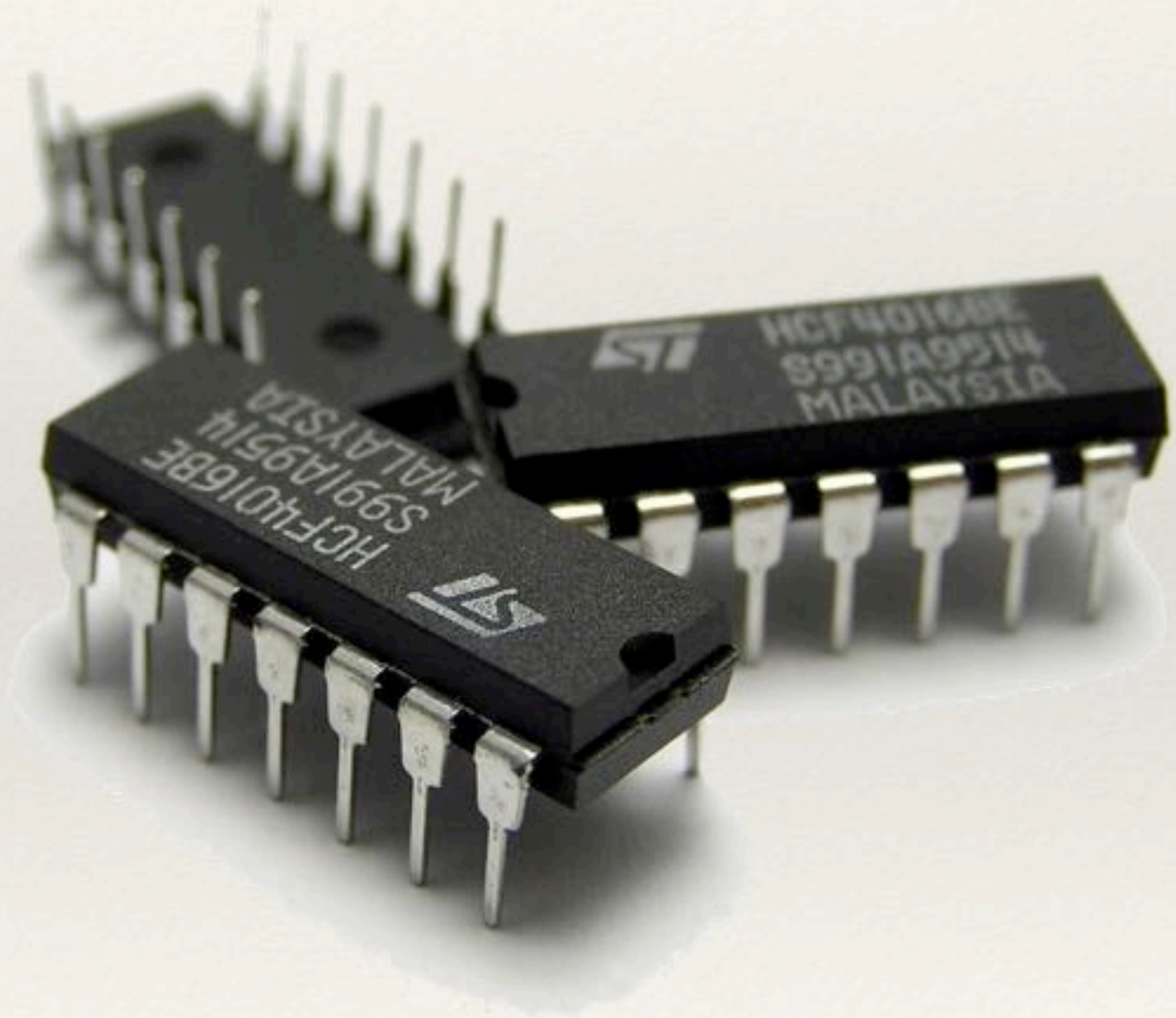




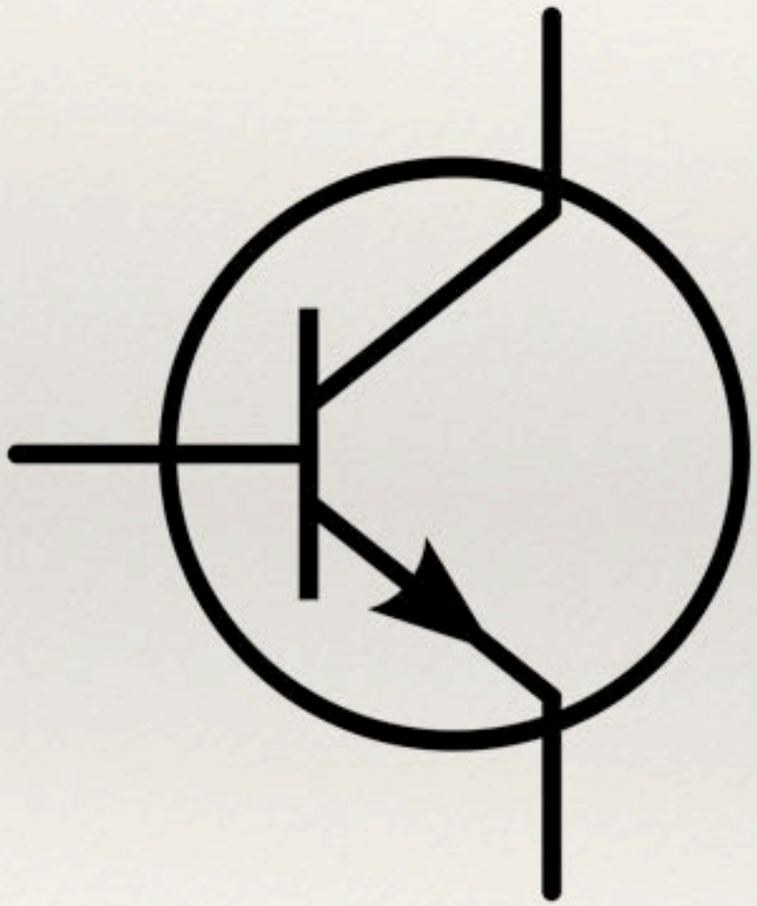
capacitor

binary numbers storage

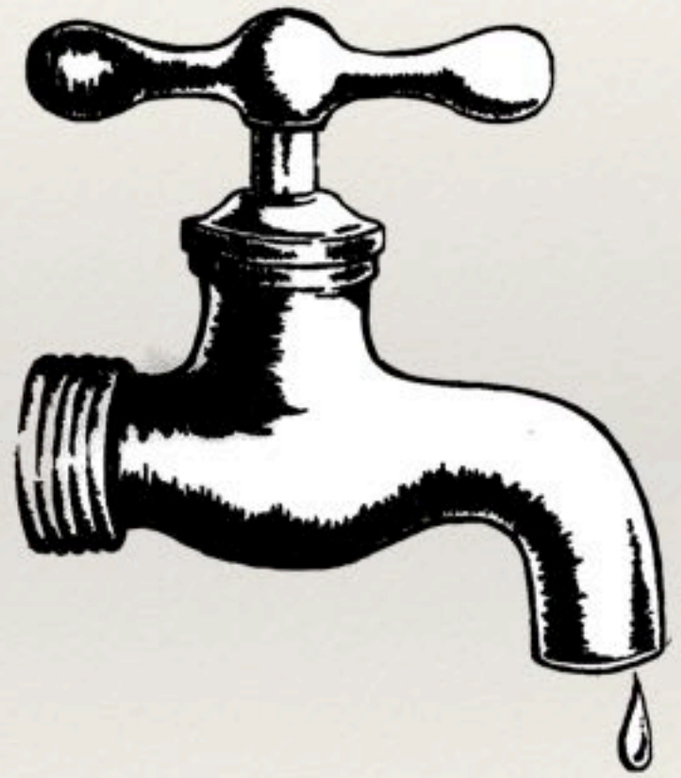




binary numbers storage



transistor



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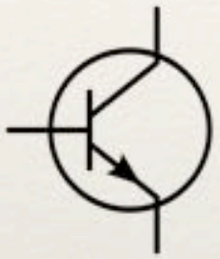

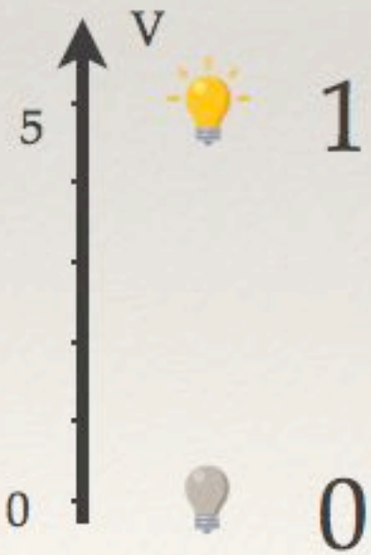

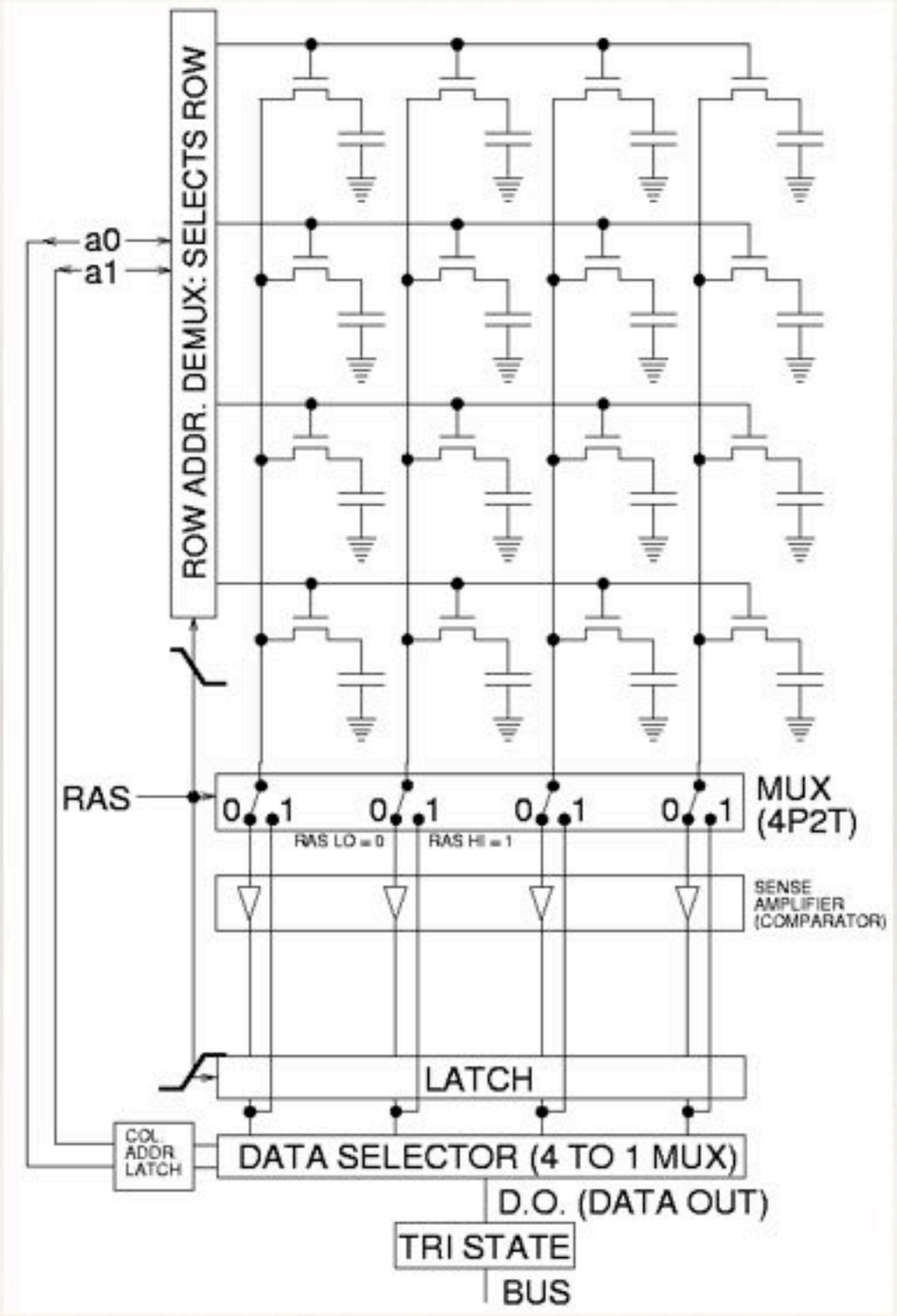

binary numbers transmission