CM12002
Computer Systems Architecture

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What is a **modern** computer?
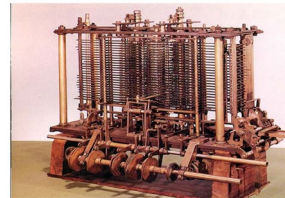
These devices were successful in aiding or replacing hum
However they are not consider computers in the modern

So then what's consider the first modern computer?

What is a modern computer?
A programmable device?

Charles Babbage's Analytical Engine (designed 1837)
First design of a **general-purpose programm**
as Turing-complete (you'll learn in year 2 that it can b
Babbage was never able to complete construction of
and inadequate funding

Watch: http://www.youtube.com/watch?v=QVxbNZV

Ada Lovelace - first world's programmer (Babbage's Analytical Engine)

Lovelace Colloquium:
Encouraging Women in Software
Next one: March 30th 2021 (Lancaster University)
https://bcswomenlovelace.bcs.org/

(1843: you can see the notes she wrote together with her translation of a talk given by Babbage)
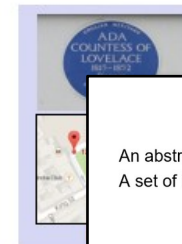
What is a computer?

An abstract machine?
A set of instructions?

Turing Machine – theory of computation

ON COMPUTABLE NUMBERS, WITH AN APPLICATION TO THE ENTSCHEIDUNGSPROBLEM
By A. M. Turing.

Alan Turing 1936

During World War II, Turing worked for the Government Code and Cypher School (GC&CS) at Bletchley Park, Britain's code breaking centre (e.g. Enigma machine)
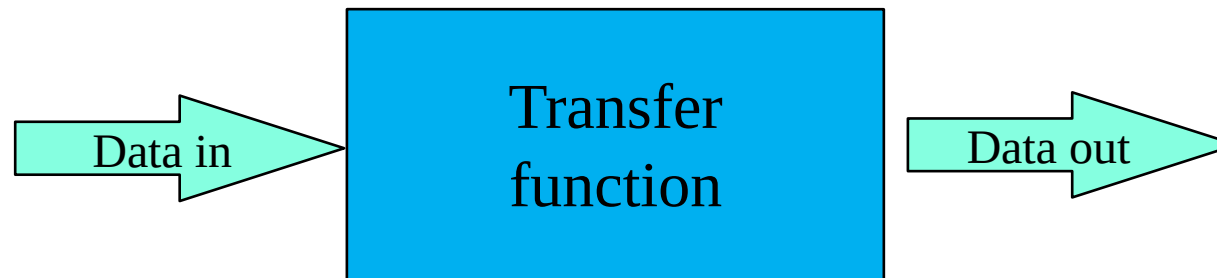
What is a computer?

- Computers are sometimes called *electronic brains*
  which implies intelligence,
- or as *number crunchers*
  which implies that they are used
  only for numeric calculations.

We can think of them most generally as *data processors*:

Data in → **Transfer function** → Data out

Examples of data processing

Data can be of many kinds, for example:

- Process control (sensors and controls)

- Data analysis (usually numeric)

- Word processing (text & fonts)

- Symbolic processing, e.g. $a^2 - b^2 = (a + b)(a - b)$

- Game-playing

- Speech and vision; robotics (sound & images)

- Neural network simulation (cognitive models)

What is a computer?

A digital device?
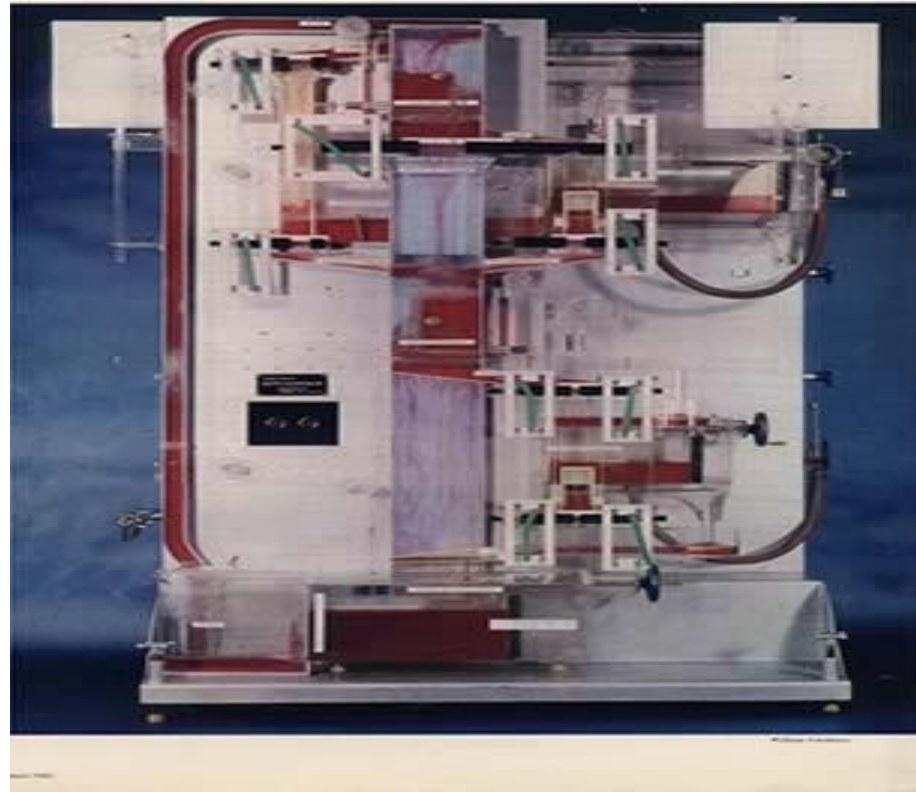
MONIAC (1949, London LSE/New Zealand): An **analogue** computer which used fluidic* logic to model the workings of an economy.

* https://www.youtube.com/watch?v=rAZavOcEnLg and https://www.youtube.com/watch?v=rVOhYROKeu4

Analogue computing

Analogue methods

Use continuously variable *analogues*, such as the rotation of a shaft, or electrical current and voltage, to represent parameters.

The analogues are totally ***precise*** representations, but the systems are ***inaccurate*** because the analogues cannot be exactly measured (or manipulated).

Digital computing

Digital methods

- *Discretized* representations are used to hold and manipulate parameters. The representation is **imprecise** because it is quantized, but **totally accurate** at any given level of quantization.

- Compare: 0 1 2 3 then 1.3 1.4 1.5 then 1.46 1.47 1.48 and so on.

- Extra digits increase the precision, but at a given precision, the representations and the arithmetic are totally accurate. Thus 1.2 + 2.5 is exactly 3.7, to one decimal place.

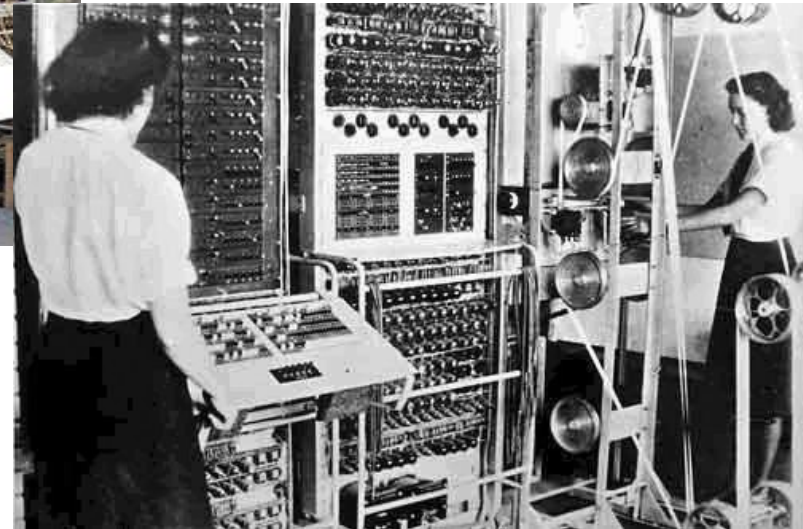- We shall henceforth be concerned wholly with digital computing and digital computers.
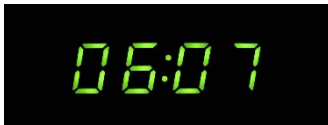
What is a computer?

First Generation of Digital Computers
### Valves/Vacuum tubes

The "Colossus" at Bletchley Park (1943) - world's
first electronic digital computer that was
programmable (but dedicated to **code
breaking**, so <u>not general purpose</u>).

The existence of the Colossus machines was kept secret until the mid-1970s (a rebuild of
Colossus is on display at the National Museum of Computing at Bletchley Park)

What is a computer?

A fully general ("Turing Complete") device?
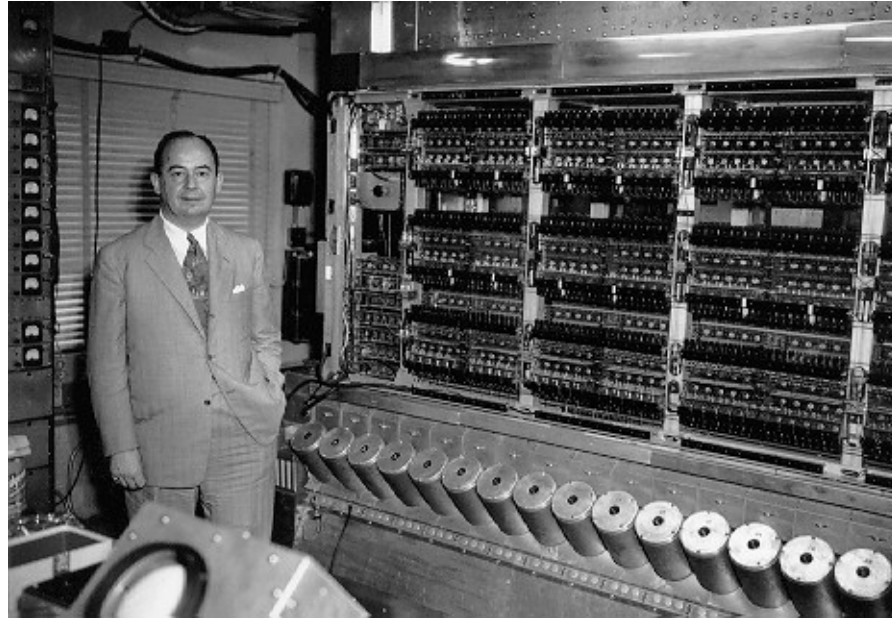
John von Neumann and ENIAC (1946)

ENIAC: electronic digital computer that was **programmable AND general purpose**.

(Turing complete: can be adapted to simulate the logic of any computer algorithm)

IEEE John von Neumann Medal:

For outstanding achievements in computer-related science and technology
https://www.ieee.org/about/awards/bios/vonneumann_recipients.html

Issues with 1st generation digital computers

- Vacuum tube technology

- Generated a lot of heat (need of AC)

- Unreliable

- Very costly

- Supported machine language only

- Slow input and output devices

- Huge size

- Non-portable

- Consumed a lot of electricity

Examples:
- ENIAC
- EDVAC
- UNIVAC
- IBM-701
- IBM-650

From https://www.tutorialspoint.com/computer_fundamentals/

"I think there is a world market
for maybe five computers."

Thomas J. Watson, president of IBM (1943)
(probably an incorrect attribution)

"Prediction is very difficult,
especially about the future."

Niels Bohr – physicist, atomic model, Nobel Prize 1922