CS 480

Introduction to Artificial Intelligence

January 13, 2022

Announcements / Reminders

- **Please follow the Week 01 To Do List instructions (will be posted tomorrow)**
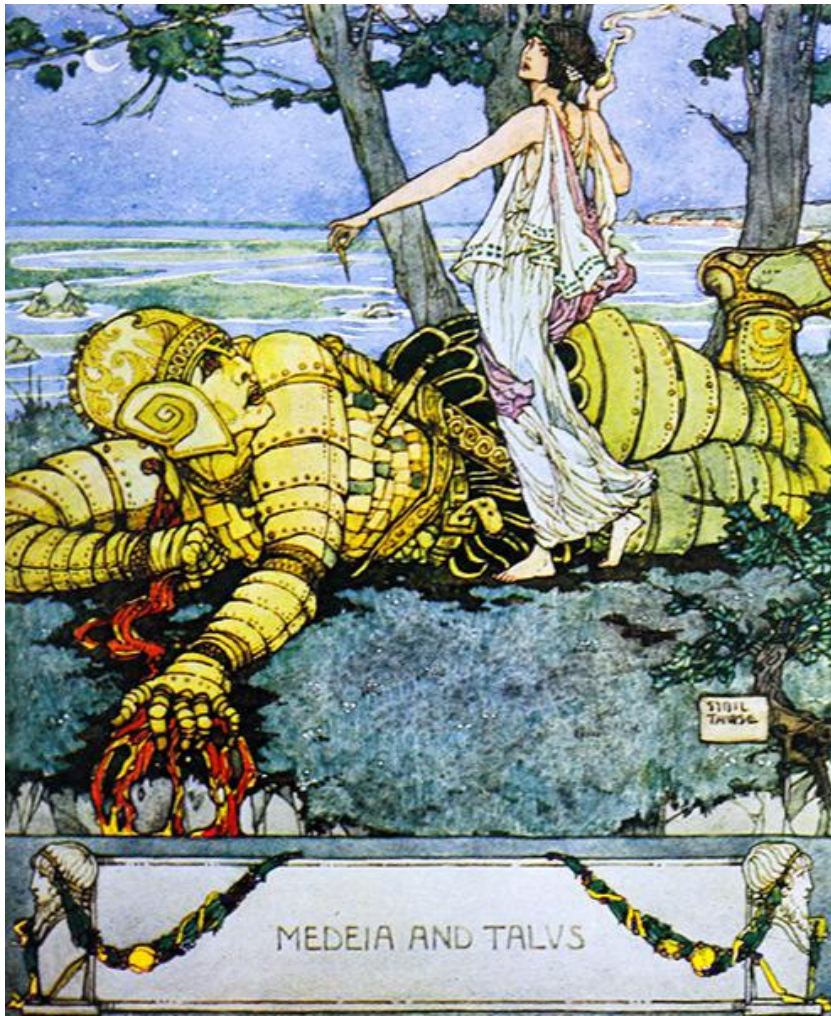
Plan for Today

- **A Quest for Artificial Intelligence**

- **What is Artificial Intelligence?**

- **Intelligent Agents - Introduction (if time permits)**

The quest for
Artificial Intelligence
Selected ideas and artifacts in human history

Talos (around 400 BC)

Source: Thomas Bulfinch - "Stories of Gods and Heroes" (1920)

In Greek mythology, **Talos** was a huge bronze **automaton** whose task was to protect Europa (the mother of King Minos of Crete). Talos was **programmed** to patrol Crete's shores three times a day.
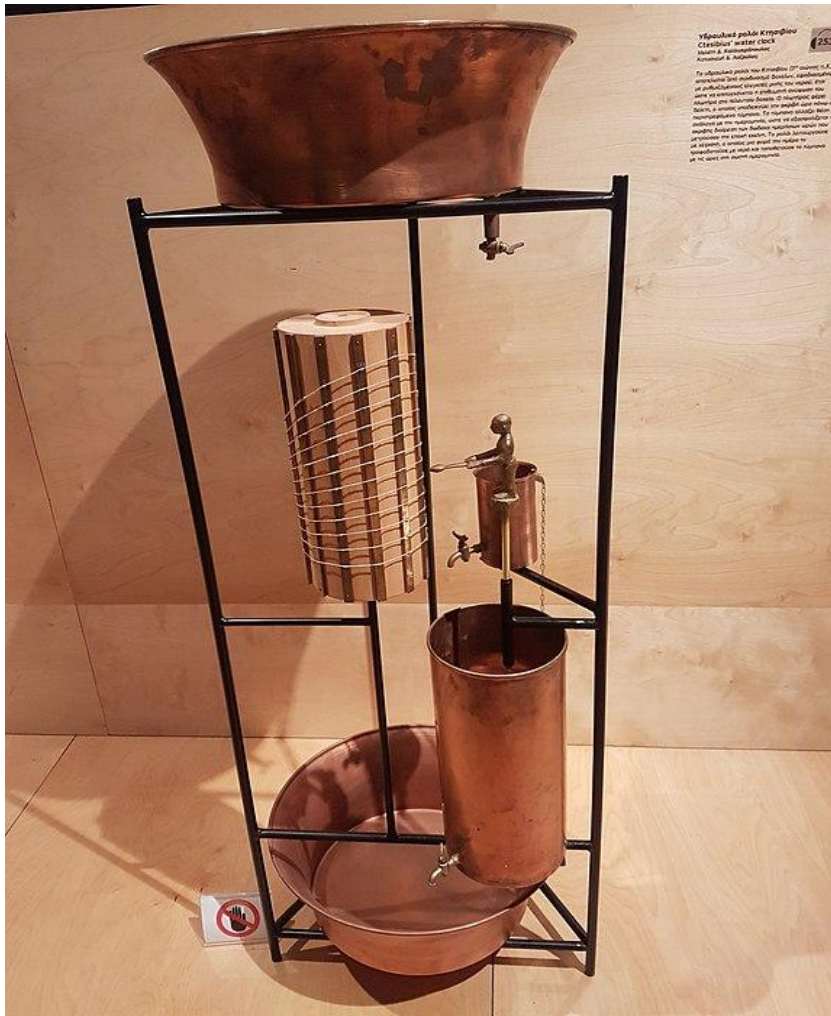
Aristotle's Ideas (around 350 BC)

Source: https://en.wikipedia.org/wiki/Aristotle

In "Politics" the Greek philosopher Aristotle wrote: "There is only one condition in which we can imagine managers not needing subordinates, and masters not needing slaves. This condition would be that **each instrument could do its own work, at the word of command or by intelligent anticipation** (...)"

Water Clock (around 250 BC)

Source: https://commons.wikimedia.org/wiki/File:Ctesibius%27s_water_clock,_3rd_century_BC,_Alexandria_(reconstruction).jpg
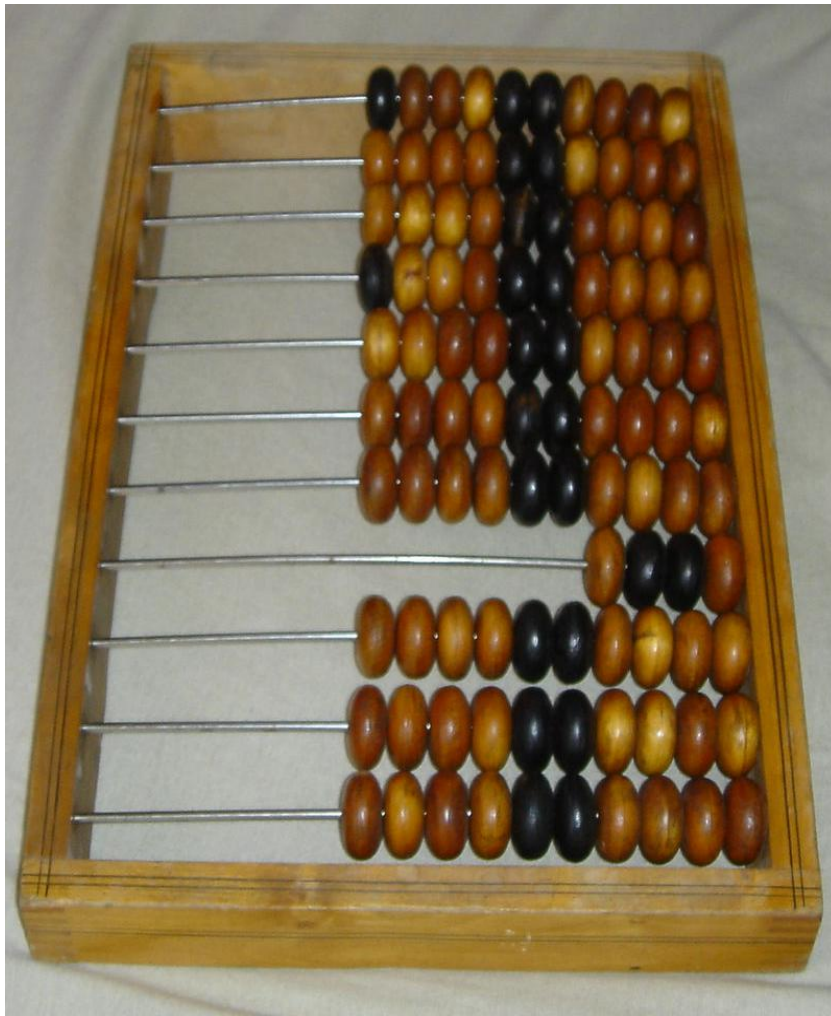
Greek inventor Ktesibios's water clock employed a **regulator in the form of feedback-control** float that maintained constant water flow to measure time. It is an early example of a **self-regulating feedback control system**. **A system capable to respond to changes in its environment**.

Abacus (around 190 BC)

Source: https://en.wikipedia.org/wiki/Abacus

The abacus is an ancient **calculating tool** allowing humans to **perform fast calculations in commerce and engineering**. It consists of rows of movable objects representing digits and **can be considered the ancestor to the computer**.
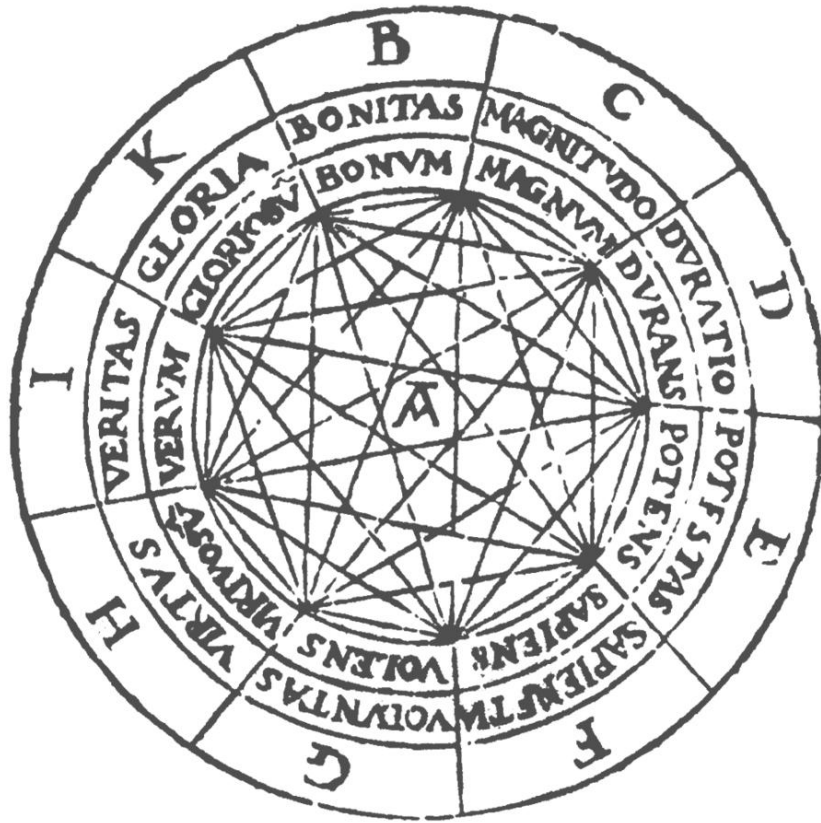
Antikythera (around 125 BC)

Interactive model of Antikythera mechanism. Source: https://www.archaeology.wiki/blog/2017/06/23/new-interactive-model-antikythera-mechanism/

The Antikythera Mechanism is an ancient **geared computing device that was used to calculate astronomical positions**.

Llull's Ars Magna (around 1305)

Catalan philosopher Ramon Llull in his book "Ars Magna". It was an attempt to use logic to **artificially produce new knowledge by generating combinations of elemental truths** (a fixed set of preliminary ideas). Some consider it an **early step towards a "thinking machine"**.

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da Vinci's Knight (around 1495)

Source: https://en.wikipedia.org/wiki/Leonardo%27s_robot

Leonardo da Vinci's **robot** ("automaton knight") designed, and likely constructed, **could stand, sit, raise its visor, and move each arm independently**. It was **operated by a system of pulleys and cables** and was a result of da Vinci's interest in engineering and human anatomy.

Babbage's Difference Engine (1822)

Source: https://www.britannica.com/biography/Charles-Babbage
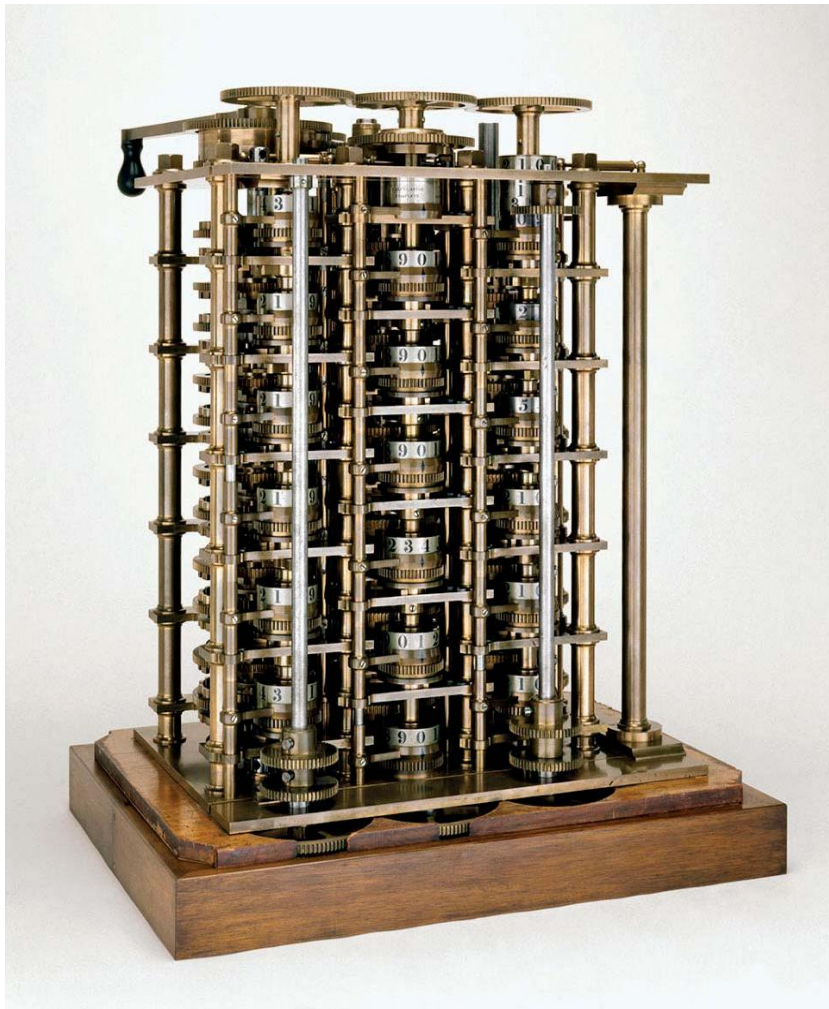
Charles Babbage, an English polymath, is by some considered to be the "**father of the computer**". He designed the **first mechanical computer**, called the **difference engine**, meant to calculate mathematical tables. A functioning difference machine was built in 1991.

Boolean Algebra (1854)

Source: https://en.wikipedia.org/wiki/George_Boole

George Boole, an English mathematician, was interested in "investigating the **fundamental laws of those operations of the mind by which reasoning is performed**". He tried to **reduce logic to a simple algebra of two values, 0 and 1 (false and true), and three basic operations: and, or, and not**. Modern electronics and computers are based on it,

# Artificial Neural Network (1943)

Hidden
Input
Output
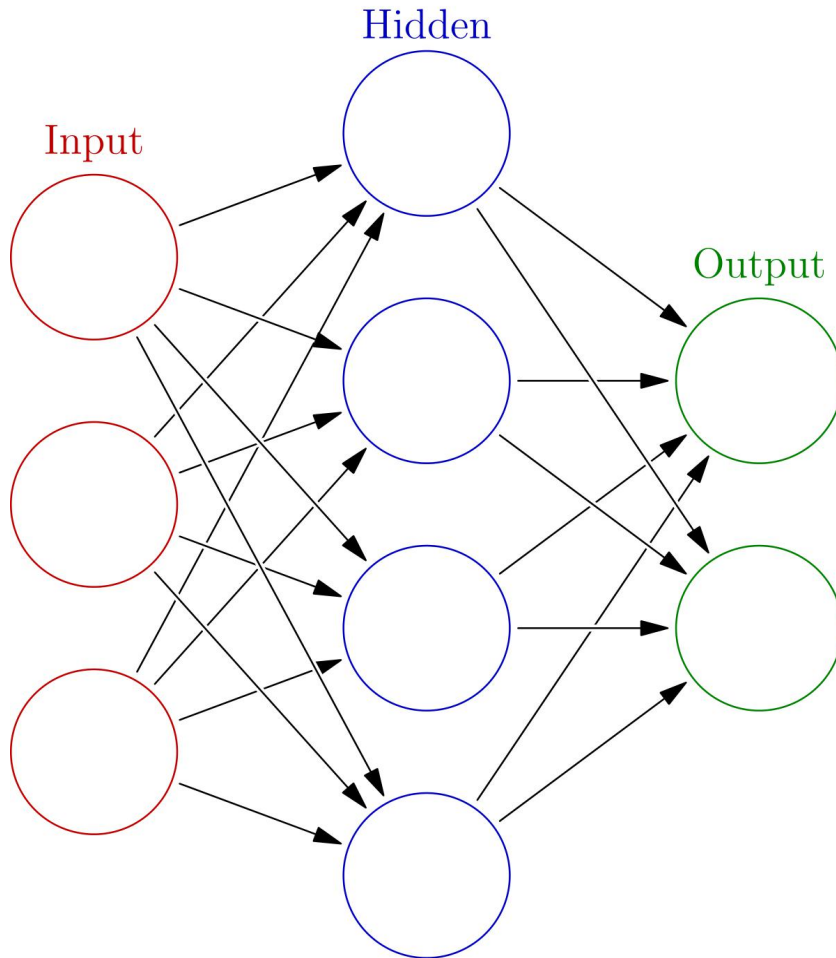
First computational models of an **Artificial Neural Network** (loosely inspired by biological neural networks) were proposed by Warren McCulloch and Walter Pitts in 1943. Their ideas are a **key component of modern day machine and deep learning**.

Source:
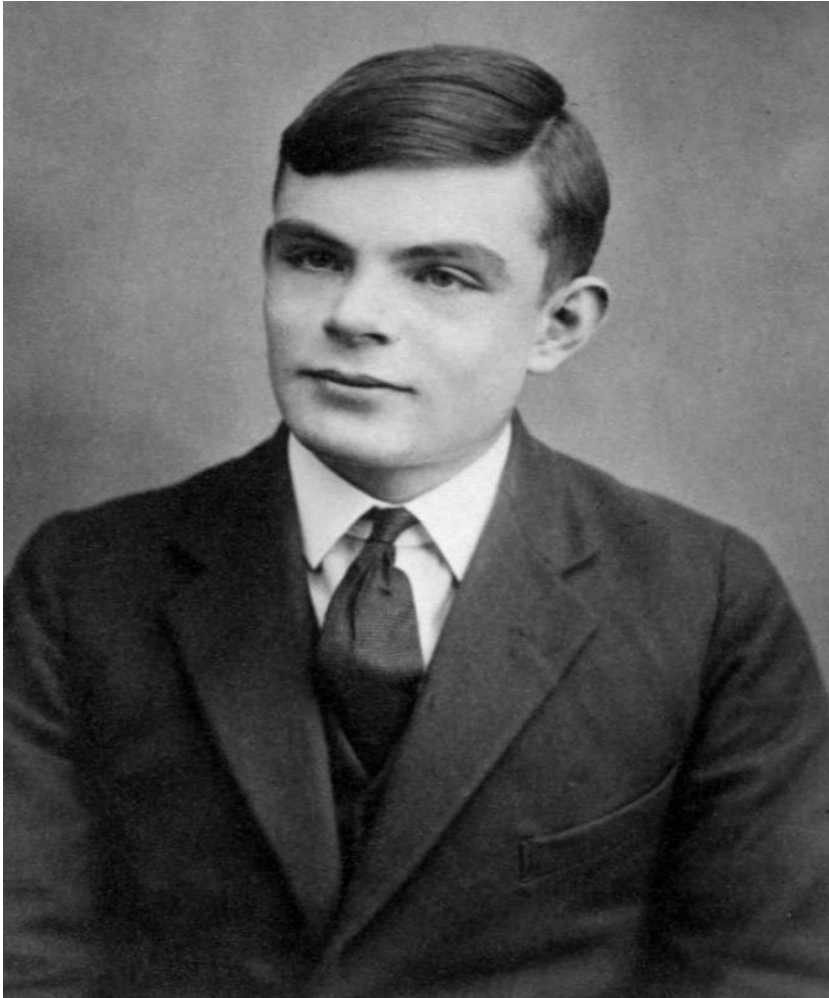*https://en.wikipedia.org/wiki/Artificial_neural_network*

ENIAC (1946)
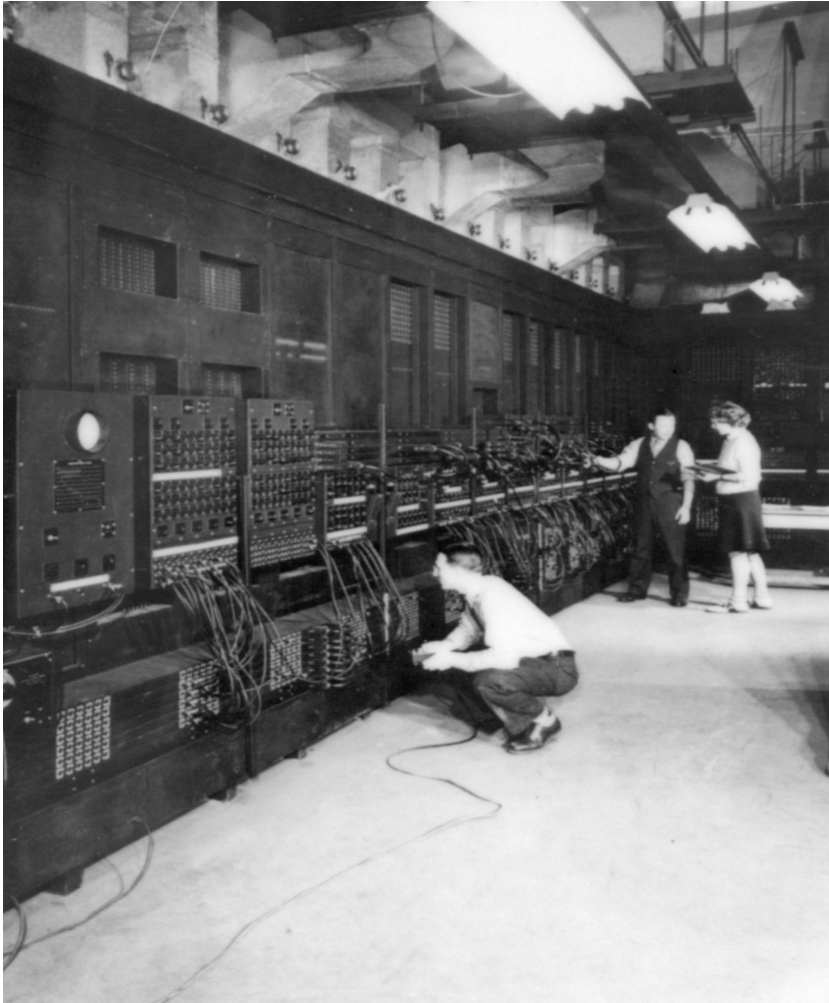
ENIAC (Electronic Numerical Integrator and Computer) was **the first programmable, electronic, general-purpose digital computer**. It was designed to calculate US Army artillery firing tables, but its first important application was in the design of the hydrogen bomb.

Turing Test (1950)

Source: https://en.wikipedia.org/wiki/Alan_Turing

In 1950, English computer scientists **Alan Turing suggested that if a computer behaves the same way as a human, we might as well call it intelligent**. A Turing Test is a test where a machine and human respond, in text, to typed questions of human judges who cannot see who is responding.

Darthmouth AI Workshop (1956)

John McCarthy, who coined the term AI. Source: https://en.wikipedia.org/wiki/John_McCarthy_(computer_sci entist)
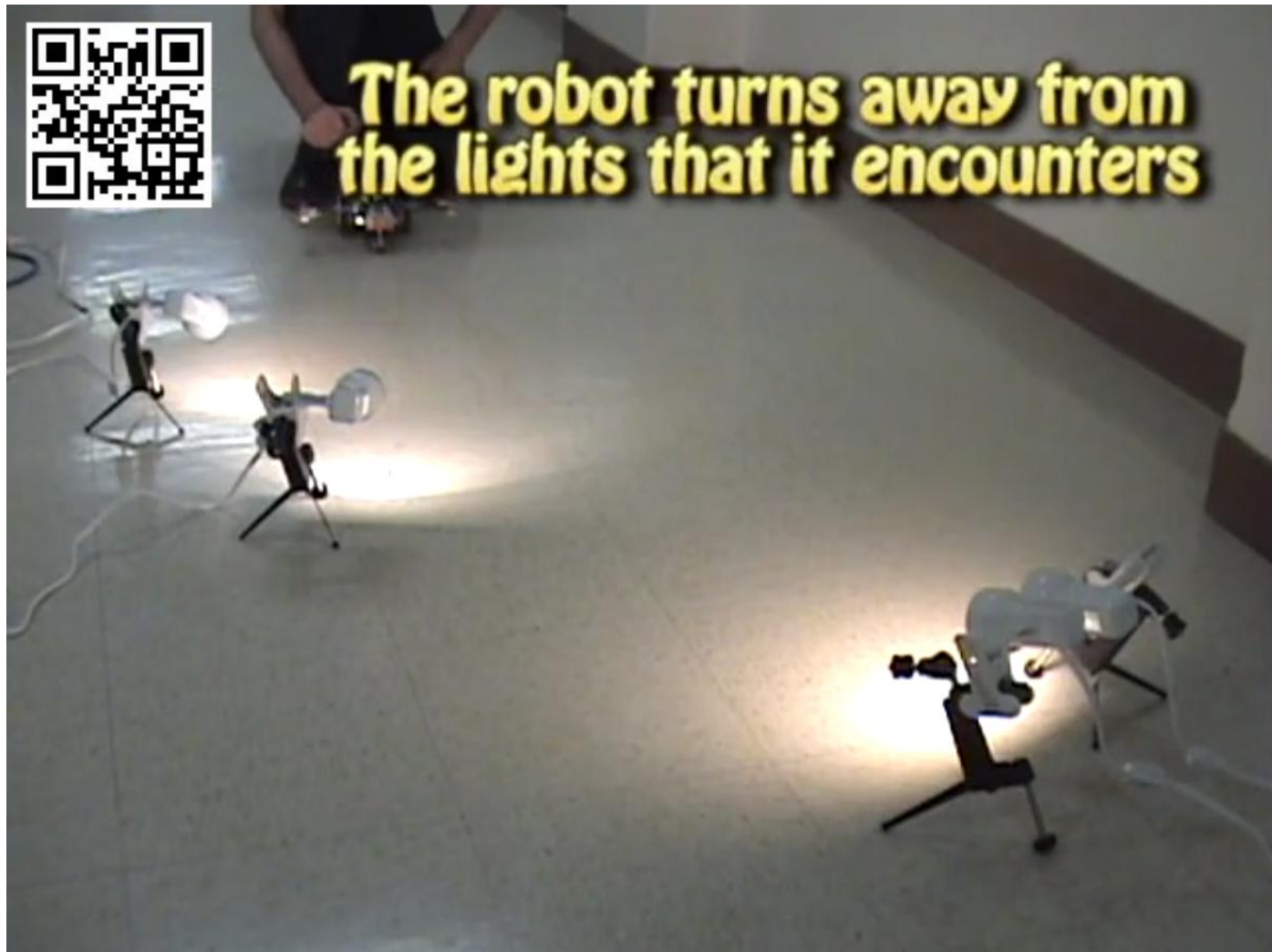
The Darthmouth Summer Research Project on Artificial Intelligence was the **first AI-related conference** and where the term **Artificial Intelligence** was coined.

Have you noticed any key themes?

Is this intelligence?

The robot turns away from the lights that it encounters
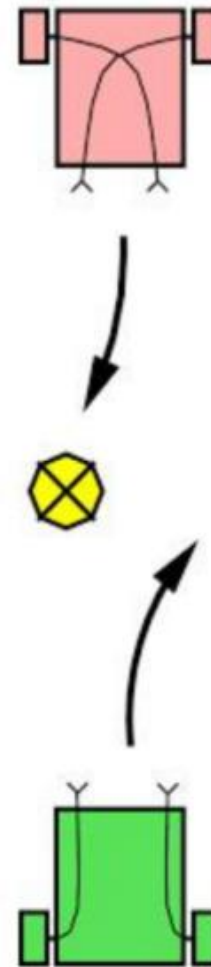
Source: https://www.youtube.com/watch?v=yUVcI5Pw2o4

Braitenberg's Vehicles
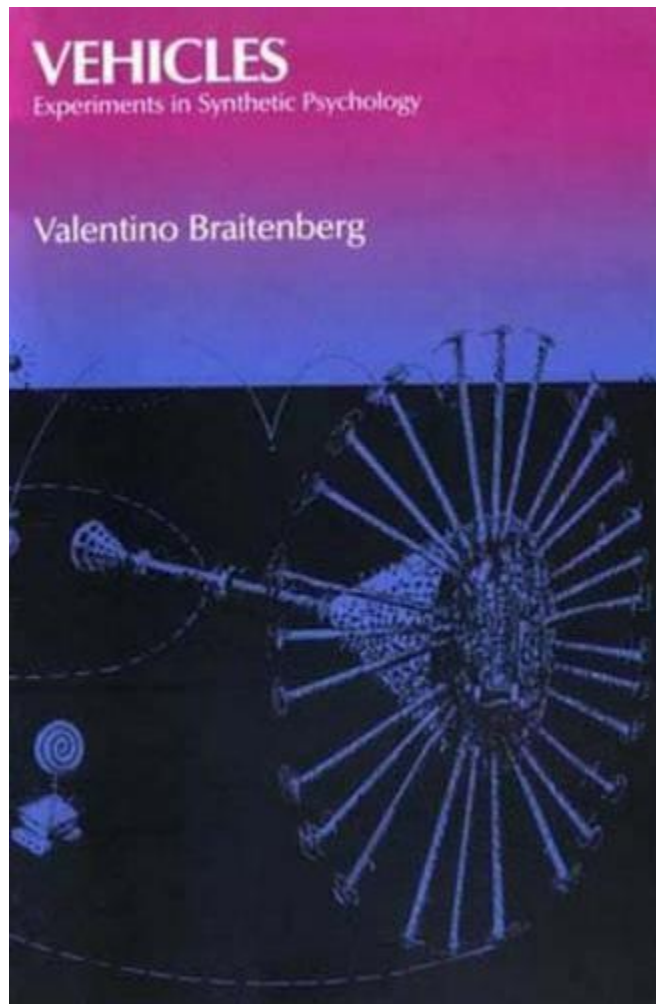
Valentino Braitenberg - "Vehicles. Experiments in Synthetic Psychology" (The MIT Press)

What is Artificial Intelligence?

AIMA Textbook Definition

Artificial Intelligence:

The field of artificial intelligence, or AI, is concerned with not just understanding but also **building intelligent entities** - **machines that can compute how to act effectively and safely in a wide variety of novel situations**.

Oxford English Dictionary Definition

Artificial Intelligence:

The theory and development of **computer systems** able to perform **tasks normally requiring human intelligence**, such as visual perception, speech recognition, decision-making, and translation between languages.

IBM Website Definition

Artificial Intelligence:

Artificial intelligence leverages **computers** and **machines** to **mimic the problem-solving and decision-making capabilities of the human mind**.

Source: https://www.ibm.com/cloud/learn/what-is-artificial-intelligence

But what is Intelligence?

Oxford English Dictionary Definition

Intelligence:

The ability to **learn**, **understand** and **think in a logical way about things**; the ability to **do this well**.

Source: https://www.oxfordlearnersdictionaries.com/us/definition/american_english/intelligence

R. J. Sternberg Definition

Intelligence according to R. J. Sternberg:
Intelligence is the **cognitive ability** of an individual to **learn from experience**, to **reason well**, to **remember important information**, and to **cope with the demands of daily living**.

Source: R. J. Sternberg- "In Search of the Human Mind" (1994). pp 395-396

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Further questions:

How do you decide if someone or something is intelligent?

Are animals intelligent?

If animals are intelligent, how do you measure their intelligence?

Are we the most intelligent beings?

Turing Test

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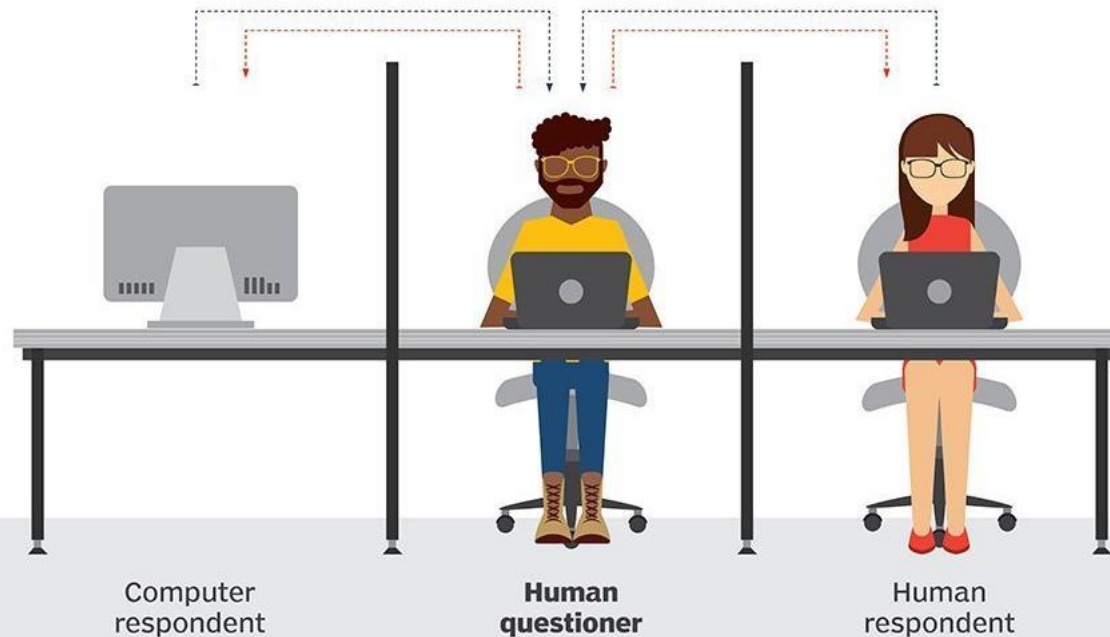
What questions would you suggest for a Turing test?

(we'll make it a Blackboard discussion)

Narrow / Strong / Super AI

Narrow / Weak AI:

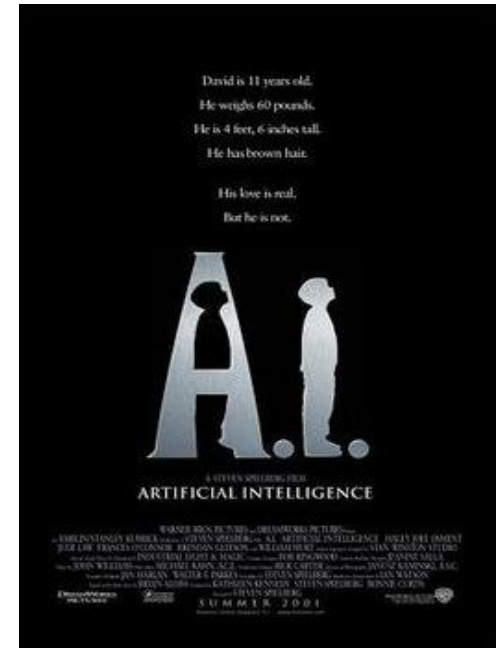AI solutions programmed / dedicated to solve specific, "narrow" problems.

General / Strong AI:

AI that matches humans.

Super AI:

AI that surpasses human intelligence.

Strong AI (As Seen on TV!):

Weak AI:
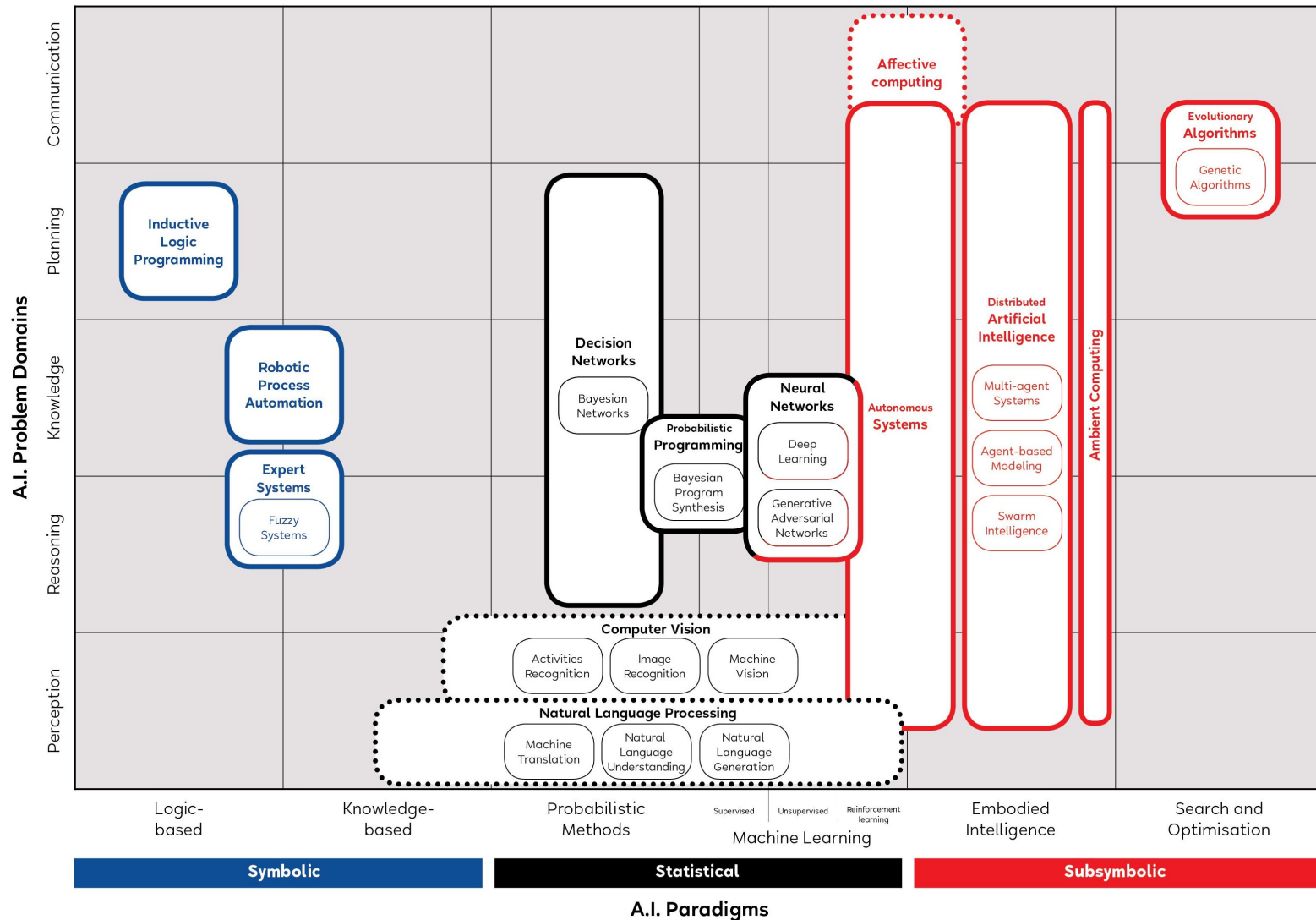
Well… currently available AI

AI Progress - Games Perspective

AI wins (with champions in most cases):

- **Checkers: 1994**
- **Othello / reversi: 1997**
- **Chess: 1997**
- **Scrabble: 2006**
- **Jeopardy: 2011**
- **Go: 2016**
- **Shogi: 2017**
- **Two-player no-limit hold'em poker: 2017**
- **Starcraft: 2019 [not with best players]**

What was needed to win?

AI Knowledge Map

Source:https://francesco-ai.medium.com/ai-knowledge-map-how-to-classify-ai-technologies-6c073b969020

Identyfing Problems Suitable for AI

Most AI problems will exhibit the following three characteristics:

- tend to be large,

- computationally complex and cannot be solved by a straightforward algorithm,

- tend to require a significant amount of human expertise to be solved

Solving Problems: A Structure

Pre-conditions

INPUT(S)

PROCESS

A SEQUENCE of steps

(in our case usually programming language commands)

OUTPUT(S)

Post-conditions