

# Lecture 1: Motivation and AI History

Viliam Lisý & Branislav Božanský

Artificial Intelligence Center  
Department of Computer Science, Faculty of Electrical Eng.  
Czech Technical University in Prague

[viliam.lisy@fel.cvut.cz](mailto:viliam.lisy@fel.cvut.cz)

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Understand the problems and methods in the field of AI.  
Get broader context of the field

- **Reusable** formal models of decision-making problems
- Basic algorithms solving these problems
- Understand the hypes and limitations
- Understand the relation of AI to ML (CS)
- There is a very long way from a PoC to useful products
- etc.

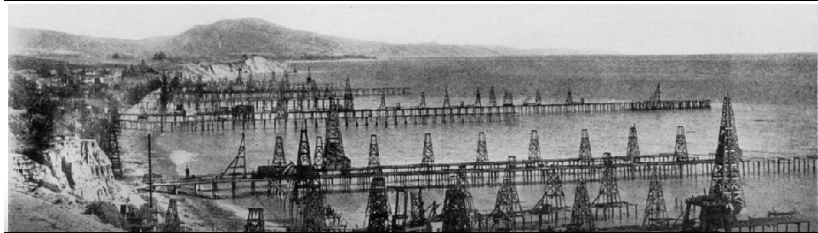
Britannica: Artificial intelligence (AI), the ability of a digital computer or computer-controlled robot to perform tasks commonly associated with intelligent beings.

Merriam-Webster:

- 1 a branch of computer science dealing with the simulation of intelligent behavior in computers
- 2 the capability of a machine to imitate intelligent human behavior

Me: Research field trying to solve problems easy to humans but (so far) difficult for computers - naturally changing a lot in time

## Artificial Intelligence is the Oil of 21 Century



	2016	2017	2020
AI Market size:	\$ 7.8 B	\$ 12.5 B	\$ 46 B



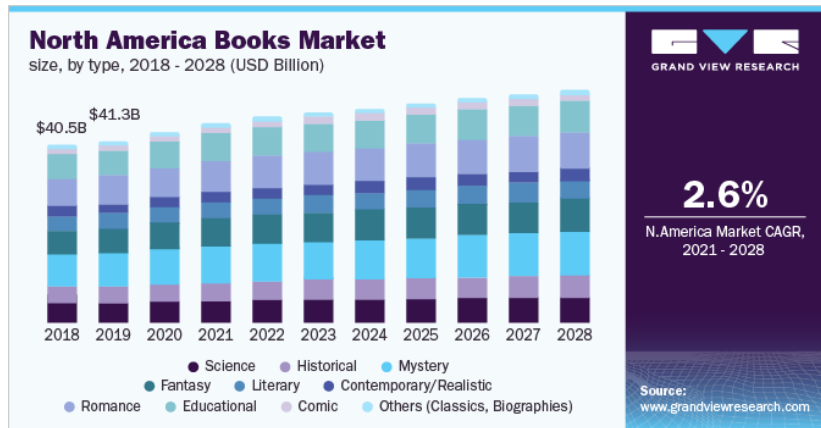
projections for 2028 are around \$700 B  
(original slide by Michal Pěchouček)



## ARTIFICIAL INTELLIGENCE MARKET SIZE, 2021 TO 2030 (USD BILLION)



What do the numbers mean? **Baselines:**



World video games market was  $\approx 184.4$  B, automotive  $\approx 2950$  B in 2022.

Sources:

<https://www.gamesindustry.biz/newzoo-global-games-market-expected-to-decline-43-in-2022>

<https://www.statista.com/statistics/574151/global-automotive-industry-revenue>

If I were to choose a field of study now, it would be AI!

- It is currently one of the most transformative technology.
- AI is replacing jobs. Understanding it makes you the last.
- Very easy to find a job (anywhere).
- Interesting high-tech startup opportunities.

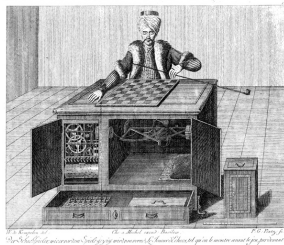
# Why is it important to know AI history

- 1 what is already possible / known and what not
- 2 when did the well-known results happen
- 3 hypes vs. actual progress
- 4 time from flashy prototypes in media to practice
- 5 motivate seemingly redundant lectures in this course
- 6 not to be embarrassed by lack of general knowledge
  - Turing test, Deep blue, AI winter, superintelligence, etc.

long BC: Golem

1495 Leonardo's **mechanical knight**

Armor performing human-like motions through pulleys and cables



1770 **Mechanical turk**

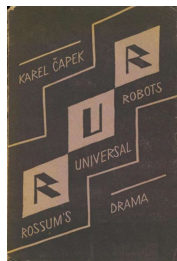
Fake chess automaton

1914 First actual **chess-playing machine**

Endgame of rook+king vs. king

1921 RUR

Origin of the word “robot”

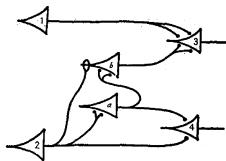
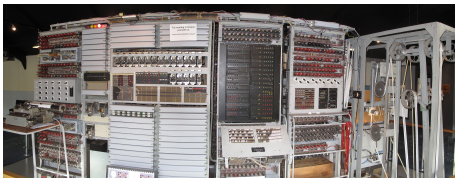


1941 First electronic computers

Z3, AtanasoffBerry, Colossus

1943 McCulloch&Pitts create the first model of artificial neurons

1945 Alan Turing states that computers could play chess



1950 Turing wrote the [first chess program](#).

1950 Claude Shannon published the first paper on computer chess.

1950 Turing proposed the **Turing test**.

1956 [Logic Theorist](#): Reasoning as heuristic search

Eventually proved 38 of the first 52 theorems in chapter 2 of the Principia Mathematica

1956 Dartmouth workshop

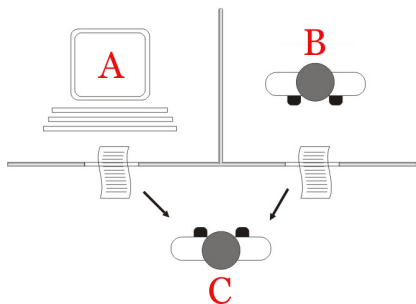
Formalization of the question: **Can machines think?**

The first variant was proposed in 1948 using Chess. Can a computer be programmed to be indistinguishable from a bad chess player?

## Official publication

A. M. Turing (1950): [Computing Machinery and Intelligence](#).  
MIND a Quaterly Review of Psychology and Philosophy, Vol. 59,  
No. 236., pp 433–460.





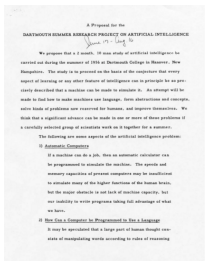
- Separates physical and intellectual capabilities
- Turing proposed variants
  - An interrogator distinguishes between a human and a machine
  - She distinguishes whether the subjects is a human or a machine
  - (1952) A whole jury serves as the interrogator
- The paper rebuts some of the main objections



CAPTCHA: Completely Automatic Public Turing tests to tell Computers and Humans Apart



# 1956: Dartmouth workshop on “artificial intelligence”



The **proposal** from 1955 used the term “artificial intelligence”.

- “We propose that a 2 month, 10 man study of artificial” ...
- Main topics:
  - Automatic computers
  - Theory of the size of a calculation
  - How can a computer be programmed to use a language
  - Self-improvement
  - Neuron nets
  - Abstractions
  - Randomness and Creativity

Considered to be the founding event of AI as a research field.

- 1961 Unimate, the first industrial robot for General Motors assembly line ([video](#))
- 1965 I.J. Good writes in “Speculations Concerning the First Ultraintelligent Machine” that the first ultraintelligent machine is the last invention that man need ever make, provided that the machine is docile enough to tell us how to keep it under control.”
- 1966 Eliza
- 1966 Shakey the robot

# 1966: Eliza

Weizenbaum, J. (1966). ELIZA – a computer program for the study of natural language communication between man and machine. Communications of the ACM, 9(1), 36-45.

Shows that a computer can hold a natural language conversation.

Based on pattern matching with minimal permanent state.

identifies keywords, discovers a minimal context, chooses a **transformation rule**, generic response if no keywords

Most famous set of conversation rules simulated a psychologist.

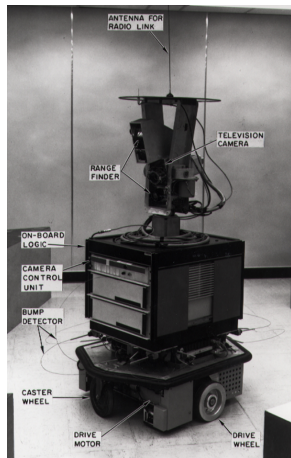
(0 YOU 0 ME) => (WHAT MAKES YOU THINK I 3 YOU)

```
Men are all alike.
IN WHAT WAY?
They're always bugging us about something or other.
CAN YOU THINK OF A SPECIFIC EXAMPLE?
Well, my boyfriend made me come here.
YOUR BOYFRIEND MADE YOU COME HERE?
He says I'm depressed much of the time.
I AM SORRY TO HEAR YOU ARE DEPRESSED.
It's true. I am unhappy.
DO YOU THINK COMING HERE WILL HELP YOU NOT TO BE UNHAPPY.
I need some help, that much seems certain.
WHAT WOULD IT MEAN TO YOU IF YOU GOT SOME HELP?
Perhaps I could learn to get along with my mother.
TELL ME MORE ABOUT YOUR FAMILY.
My mother takes care of me.
WHO ELSE IN YOUR FAMILY TAKES CARE OF YOU?
My father.
YOUR FATHER?
You are like my father in some ways.
WHAT RESEMBLANCE DO YOU SEE?
You are not very aggressive
but I think you don't want me to notice that.
WHAT MAKES YOU THINK I AM NOT VERY AGGRESSIVE?
You don't argue with me.
WHY DO YOU THINK I DON'T ARGUE WITH YOU?
You are afraid of me.
DOES IT PLEASE YOU TO BELIEVE I AM AFRAID OF YOU?
My father is afraid of everybody.
WHAT ELSE COMES TO YOUR MIND WHEN YOU THINK OF YOUR FATHER?
Bullies.
DOES THAT HAVE ANYTHING TO DO WITH THE FACT
THAT YOUR BOYFRIEND MADE YOU COME HERE?
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General-purpose mobile robot developed at Standord Research Institute

Combined navigation, computer vision, natural language processing, etc.

Programmed primarily in **Lisp**. General purpose planning using **STRIPS**. The project also introduced the **A\*** algorithm and generalized Hough transform.

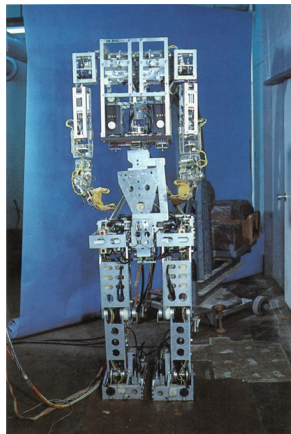


1972 WABOT-1, humanoid made in Japan  
Could walk, communicate in Japanese, grip and transport objects

1972 MYCIN, an expert system to identify the source of infection and recommend antibiotics

- Written in Lisp by Edward Shortliffe
- Knowledge base of  $\sim 600$  rules
- “Fuzzy logic” evidence aggregation
- acceptability rating of 65% from a panel of specialist (humans achieved 42.5% – 62.5%)

**AI adaptation is not only about performance**





# 1974-1980: The First AI Winter

Large drop of funding and interest in AI

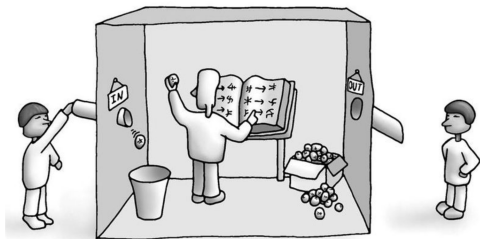
- Initial hype did not deliver impactful applications
- UK funding cut due to Lighthill report

”In no part of the field have the discoveries made so far produced the major impact that was then promised”
- DARPA focussed on “mission-oriented direct research”
- Negative results of Minsky & Papert on perceptrons decreased popularity of connectionism



# 1980: Chinese room argument

**Strong AI:** a computer is a mind, which can literally understand  
**Weak AI:** it simulates thoughts and only seem to understand



Source: Wikicomms

Searle argues against the possibility of strong AI.

Searle, John. 1980a. Minds, Brains, and Programs.  
Behavioral and Brain Sciences 3, 417-424.

- 1980 XCON, expert system selecting computer components
  - Saved millions of dollars annually in deployment
- 1980 WABOT-2, robot musician reads score and plays el. organ
- 1981 \$850 million Japanese “Fifth Generation Computer” project
  - Supercomputer focused on parallel logical programming for AI
- 1986 Driverless van drives 55 mph on empty streets of Bavaria
  - Driving in public traffic since 1992, 1000s kms on highways
  - Few other similar projects around the same time
- 1988 Judea Pearl invented Bayesian networks
  - Turing Award in 2011
- 1989 recognising handwritten ZIP codes
  - Yann LeCun et al. at AT&T using Neural Networks

# 1987-1993: The Second AI Winter

Large drop of funding and interest in AI

- The expert systems did not meet the expectations, they were too expensive to maintain
- Drop of market for specialized AI HW as general purpose HW became more powerful
- High expectations / promises of many startups failed



- 1990 Brooks: "Elephants Dont Play Chess"  
Fast reactive behaviours for AI rather than hard symbolic manipulation
- 1995 A.L.I.C.E., chatbot with large data samples from the internet
- 1997 DeepBlue beats Kasparov  
Parallel Alpha-Beta search, evaluation function tuned on grandmaster games, openings database, endgames
- 1999 AIBO



- 2002 i-Robot Roomba, commercially successful robotic vacuum cleaner
- 2004 DARPA Grand Challenge: No one finished the 150 miles in a desert
- 2005 DARPA Grand Challenge: Multiple successful teams
  - Continued with few more challenges
- 2009 Google develops driverless car (2014 passed Nevada's test)



2011 Watson

2011 Siri

2015 DQN in Atari games

Reinforcement learning + Deep Learning

2015 AlphaGo

Monte Carlo tree search + Deep Learning

2017 DeepStack

CFR + Deep Learning

2018 BERT followed by other language models

Big Data + Deep Learning

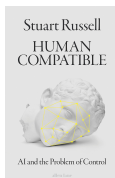
2019 AlphaStar

Game Theory + RL + Deep Learning



Open Letter on Artificial Intelligence (2015): Stephen Hawking, Elon Musk, Russell, Norvig, Hassabis, Wozniak et al.

Argues to focus on maximizing societal benefits of AI, e.g., Law and Liability, Ethics, Autonomous Weapons, Privacy, Verification, Control, etc.



**Bias in AI:** Amount of care in US hospitals, recidivism prediction, Amazon's hiring, gender stereotypes in language models, etc.



Predicting protein 3D shape from genetic sequence.

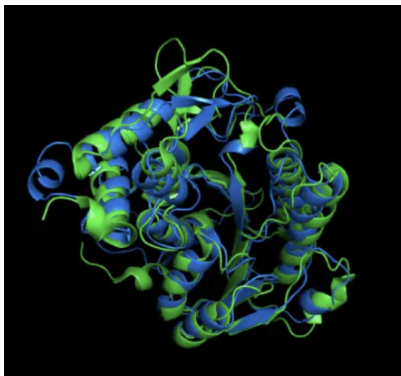
Important for

- understanding biological processes
- creating new drugs

Released publicly in 2021

Long-standing challenge

[More details](#)



System for generating images from textual description trained from text-image pairs

“an armchair in the shape of an avocado”



“an illustration of a baby daikon radish in a tutu walking a dog”




<https://openai.com/blog/dall-e/>



“Large Language Model” fine-tuned using “Reinforcement Learning from Human Feedback”

Released on Nov 30,  
reached 1M users on Dec 4.

Alternatives exist  
(e.g., Claude, Bard)

 What should I tell college students in the first class of "Introduction to AI" about ChatGPT?



As a language model trained by OpenAI, ChatGPT is an example of a technology that uses artificial intelligence (AI) to generate human-like responses to text-based inputs.  

ChatGPT is a powerful tool that can be used for a wide range of applications, from chatbots and personal assistants to language translation and content creation. It is based on a deep learning architecture that uses a large amount of text data to learn patterns and relationships in language and generate text that is similar to human-written text.

In the context of an "Introduction to AI" course, ChatGPT can be used as an example of how deep learning algorithms can be used to generate human-like responses to text-based inputs. You can also discuss some of the limitations and challenges of this technology, such as the potential for bias and the need for large amounts of data to train the model.

Overall, introducing ChatGPT in an "Introduction to AI" course can help students understand some of the practical applications of AI and the types of problems that AI can help solve.

<https://openai.com/blog/chatgpt/>

AI history revolves around clear milestones.

Proof of concept is far from a viable product.

The key ideas behind many recent breakthroughs are quite old.

Hypes come and go. LLMs might be another one.

Deep Learning is great, but usually **not enough**.

AI safety concerns are as old as the field.

Better save than sorry.