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INTRO TO ARTIFICIAL INTELLIGENCE

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Hamid RezaTofighi

AlphaGo vs. Lee Sedol (2016)

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Scene from AlphaGo documentary,
<https://www.youtube.com/watch?v=WXuK6gekU1Y>

Progress in self-driving cars



Testing of Cruise autonomous vehicle, by Dllu

[https://en.wikipedia.org/wiki/Cruise_\(autonomous_vehicle\)#/media/File:Cruise_Automation_Bolt_EV_third_generation_in_San_Francisco.jpg](https://en.wikipedia.org/wiki/Cruise_(autonomous_vehicle)#/media/File:Cruise_Automation_Bolt_EV_third_generation_in_San_Francisco.jpg)

Amazon Go: A “just walk out” store



<https://www.youtube.com/watch?v=zdbumR6Bhd8>

Artificial Intelligence becoming mainstream

- Industrial Revolution → major increase in manufacturing productivity
- AI Revolution → promises major increase in knowledge work productivity

Currently AI research is receiving significant attention and investment,

Estimated 133 million new jobs globally by 2022 (Dwyer et al. 2019)

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However, we have seen 'AI winters' before...

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Goals of the field of AI research

- Understand what intelligence is, and
- Build intelligent systems

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What is intelligence?

Ingredients of an intelligent entity:

- Communication
- Internal knowledge, memory
- World knowledge, model of the world
- Intentions, and plans to achieve them
- Creativity

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Definitions of AI

- “[The automation of] activities that we associate with human thinking, activities such as decision-making, problem solving, learning...” (Bellman, 1978)

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- “The study of computations that make it possible to perceive, reason, and act.” (Winston, 1992)

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- “The study of how to make computers do things at which, at the moment, people are better.” (Rich and Knight, 1991)

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Nuances in definition of AI

- Human ideal:

- ▶ Thinking humanly
- ▶ Acting humanly

- Rational ideal:

- ▶ Thinking rationally
- ▶ Acting rationally

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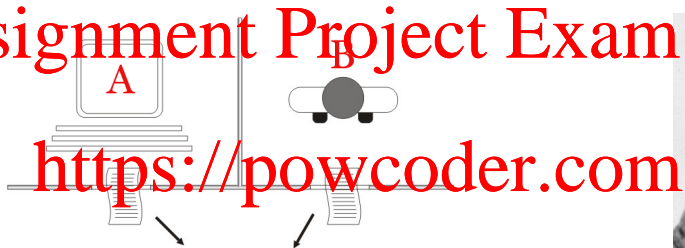
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Acting humanly: Turing test (1950)

Judge C uses written responses to questions to decide whether A or B is the computer

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Requires knowledge, reasoning, language, learning
By definition an empirical test to judge success

Turing test, A read



The screenshot shows a web browser displaying the Stanford Encyclopedia of Philosophy entry for 'The Turing Test'. The browser's address bar shows the URL 'plato.stanford.edu/entries/turing-test/'. The page features the SEP logo and navigation links: 'Browse', 'About', and 'Support SEP'. A search bar is located on the right. On the left side of the article, there is a sidebar with links: 'Entry Contents', 'Bibliography', 'Academic Tools', 'Friends PDF Preview', 'Author and Citation Info', and 'Back to Top'. The main title of the article is 'The Turing Test', with a subtitle indicating it was first published on Wed Apr 9, 2003, and had a substantive revision on Tue Aug 18, 2020. The introductory paragraph discusses the phrase 'The Turing Test' as a proposal made by Turing (1950) for dealing with the question of whether machines can think. The text is partially obscured by large red watermarks.

← → ↻ 🏠 plato.stanford.edu/entries/turing-test/ ☆ ⚙️ ☰

 Stanford Encyclopedia of Philosophy

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The Turing Test

First published Wed Apr 9, 2003; substantive revision Tue Aug 18, 2020

The phrase “The Turing Test” is most properly used to refer to a proposal made by Turing (1950) as a way of dealing with the question whether machines can think. According to Turing, the question whether machines can think is itself “too meaningless” to deserve discussion. (442) However, if we consider the more precise – and somehow related – question whether a digital computer can do well in a certain kind of game that Turing describes (“The Imitation Game”), then—at least in Turing’s eyes—we do have a question that admits of precise discussion. Moreover, as we shall see, Turing himself thought that it would not be too long before we did have digital computers that could “do well” in the Imitation Game.

<https://plato.stanford.edu/entries/turing-test/>

Acting rationally

Rational behaviour: always doing the *best* thing

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Acting rationally

Rational behaviour: always doing the *best* thing

Where *best* means "that which maximizes the expected performance on the goal, given all available information."

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Acting rationally

Rational behaviour: always doing the *best* thing

Where *best* means: that which maximizes the expected performance on the goal, given all available information.

Limits on rational behavior: CPU time, memory capacity

Bounded rationality: do the best possible under given resources

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Acting rationally

Rational behaviour: always doing the *best* thing

Where *best* means: that which maximizes the expected performance on the goal, given all available information.

Limits on rational behavior: CPU time, memory capacity

Bounded rationality: do the best possible under given resources

This unit covers algorithms that target *rational* behaviour

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Nuances in the path to AI

- 'Strong' AI

- ▶ Build a machine that is actually thinking
- ▶ Top-down philosophical perspective: does my program think?
- ▶ Create general strategy to intelligence
 - ▶ One program that can do any task.

- 'Weak' AI

- ▶ Build a machine that acts as if it were intelligent
- ▶ Like a submarine acts *as if* it can swim
- ▶ Bottom-up, goal-driven perspective: does my program work?
- ▶ Create domain-specific strategies:
 - ▶ a chess program,
 - ▶ a train scheduling program,
 - ▶ a language translation program,
 - ▶ an image classification program

Nuances in the path to AI

- 'Strong' AI

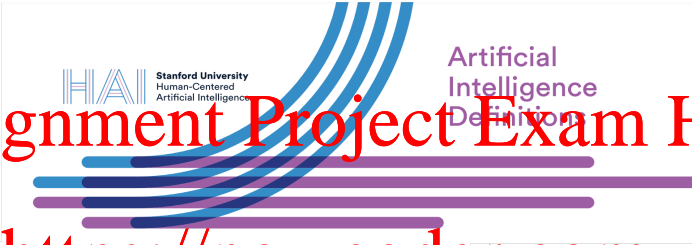
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- 'Weak' AI

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More AI Definitions

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Artificial Intelligence Definitions

Intelligence is the ability to learn and perform suitable techniques to solve problem and make good decisions to the context in an uncertain ever-varying world. A fully pre-programmed factory robot is flexible, accurate, and consistent but not intelligent.

Artificial Intelligence (AI), a term coined by emeritus Stanford Professor John McCarthy in 1955, was defined by him as “the science and engineering of making intelligent machines”. Much research has humans program machines to behave like a clever boy, like playing chess, but, today, when has the machine that can learn at least some what like human beings do.

Autonomous systems can independently plan and decide sequences of steps to achieve a specified goal without micro-management. A hospital delivery robot must autonomously navigate busy corridors to succeed in its task. In AI, autonomy doesn’t have the sense of being self-governing common in politics or biology.

Machine learning (ML) is the part of Artificial Intelligence that aims to improve their perception, knowledge, thinking, or actions based on experience or data. For this, ML draws from computer science, statistics, psychology, neuroscience, economics and control theory.

In **supervised learning**, a computer learns to predict human-given labels, such as dog breed based on labeled dog pictures; **unsupervised learning** does not require labels, sometimes making its own prediction task, such as trying to predict each successive word in a sentence; **reinforcement learning** lets an agent learn action sequences that optimize its total rewards, such as winning games, without explicit examples of good techniques, enabling autonomy.

Deep Learning is the use of large multi-layer (artificial) neural networks that compute with continuous (real number) representations, a little like the hierarchically organized neurons in human brains. It is currently the most successful ML approach, usable for all types of ML, with better generalization from small data and better scaling to big data and compute budgets.

Algorithm is the precise steps to take, such as a person writes, in a computer program. AI systems contain algorithms, but often just for a few parts like a learning or reward calculation method. Much of their behavior emerges via learning from data or experience, a sea change in system design that Stanford alumnus Andrej Karpathy dubbed **Software 2.0**.

Narrow AI is intelligent systems for one particular thing, e.g., **speech** or **facial recognition**.

Human-level AI or **Artificial General Intelligence (AGI)**, seeks to build an intelligent control system in machines. It is needed for effective **social chatbots** or **human-robot interaction**.

Human-Centered Artificial Intelligence is AI that seeks to augment the abilities of, address the societal needs of, and draw inspiration from human beings. It researches and builds effective partners and tools for people, such as a robot helper and companion for the elderly.

Text by Professor Christopher Manning, September 2020



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AI Definitions by Prof. Christopher Manning from Stanford University Human-Centered AI. shorturl.at/cqrJZ

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Problems and approaches in **designing intelligent software**

Examples

- Abstracting problems to allow solving them
 - ▶ Representing states of the world, properties of environments (PEAS)

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Scope of FIT3080

Problems and approaches in **designing intelligent software**

Examples

- Abstracting problems to allow solving them
- Finding the best sequence of decisions to take
 - ▶ Search algorithms (A*), planning algorithms (value iteration)

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Scope of FIT3080

Problems and approaches in **designing intelligent software**

Examples

- Abstracting problems to allow solving them
- Finding the best sequence of decisions to take
- Learning how to perform well in an unknown environment
 - ▶ Reinforcement learning algorithms (Q-learning, Deep Q-Networks)

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Scope of FIT3080

Problems and approaches in **designing intelligent software**

Examples

- Abstracting problems to allow solving them
- Finding the best sequence of decisions to take
- Learning how to perform well in an unknown environment
- Reasoning about information to derive new knowledge
 - ▶ Logic and probabilistic (Bayesian) reasoning

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Scope of FIT3080

Problems and approaches in **designing intelligent software**

Examples

- Abstracting problems to allow solving them
- Finding the best sequence of decisions to take
- Learning how to perform well in an unknown environment
- Reasoning about information to derive new knowledge
- Generalizing to unseen data from historic examples
 - ▶ Principles of machine learning