

Introduction to Artificial Intelligence

Bùi Tiến Lên

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2. What is AI
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Successes of Artificial Intelligence

- Language
- Vision
- Games
- Robotics



Large Language Model

Language

Vision

Games

Robotics

What is AI

Foundations of
AI

History of AI

Course Topics

- Bing Ai based on Large Language Model GPT

The screenshot shows the Microsoft Bing search interface. At the top, there is a navigation bar with the Microsoft Bing logo, a search bar labeled "SEARCH", and a "CHAT" button. A sidebar on the right has a "What is AI?" button. The main content area displays a message from the AI: "Sure thing, I'm ready for a new challenge. What can I do for you now?". Below this, two green checkmarks indicate the AI is searching for "What is AI?" and generating answers. A detailed definition of Artificial Intelligence (AI) follows, mentioning its ability to perform tasks commonly associated with intelligent beings, such as reasoning and learning. An "Explore" button is shown next to an image of a hand interacting with a glowing digital interface. At the bottom, there are links to learn more (1. britannica.com, 2. mckinsey.com, 3. bing.com, 4. en.wikipedia.org), a page number "1 of 20", and a footer with buttons for "Feedback", "Ask me anything...", and other AI-related questions.



Translation

- “The reason Boeing are doing this is to cram more seats in to make their plane more competitive with our products,” said Kevin Keniston, head of passenger comfort at Europe’s Airbus.



- Kevin Keniston, người đứng đầu bộ phận thoải mái của hành khách tại Europe’s Airbus, cho biết: “Lý do Boeing làm điều này là để nhồi nhét thêm ghế để máy bay của họ cạnh tranh hơn với các sản phẩm của chúng tôi.”



Speech Applications

- Cortana
- Siri
- Alexa
- Google Assistance





Sketch2Code

- Sketch2Code is a web-based solution which uses AI to transform a handwritten user interface design from a picture to a valid HTML markup code

The screenshot shows the Sketch2Code interface. On the left, under 'YOUR SKETCH', there is a hand-drawn sketch of a product catalog page. It features a header 'PRODUCT CATALOG' with a search bar. Below are three product cards labeled 'Product 1', 'Product 2', and 'Product 3', each with a price of '\$ 20.15', '\$ 19.50', and '\$ 35.80' respectively, and an 'Add To Cart' button. On the right, under 'YOUR HTML', is the generated HTML code for the same page. The HTML includes the header, a loop to generate product cards for 'Product 1', 'Product 2', and 'Product 3', and the individual product details with their prices and 'Add To Cart' buttons. A green circular icon with a checkmark and the text 'It's done!' is displayed above the generated HTML.

Sketch2Code

Transform any hands-drawn design into a HTML code with AI.

YOUR SKETCH

YOUR HTML

PRODUCT CATALOG

SEARCH

Product 1

Product 2

Product 3

\$ 20.15

\$ 19.50

\$ 35.80

Add To Cart

SEARCH

Product 1

Product 2

Product 3

\$ 20.15

\$ 19.50

\$ 35.80

Add To Cart

Add To Cart

Add To Cart

DOWNLOAD YOUR HTML CODE

PREDICTED OBJECT DETAILS



Auto-captioning

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A person riding a motorcycle on a dirt road.



Two dogs play in the grass.



A skateboarder does a trick on a ramp.



A dog is jumping to catch a frisbee.



A group of young people playing a game of frisbee.



Two hockey players are fighting over the puck.



A little girl in a pink hat is blowing bubbles.



A refrigerator filled with lots of food and drinks.



A herd of elephants walking across a dry grass field.



A close up of a cat laying on a couch.



A red motorcycle parked on the side of the road.



A yellow school bus parked in a parking lot.



Describes without errors

Describes with minor errors

Somewhat related to the image

Unrelated to the image

Vinyals et al., 2015



Text-to-Image

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OpenAI's DALL-E

- **TEXT PROMPT:**

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

- **AI-GENERATED IMAGES:**





Detection and Segmentation



P. O. Pinheiro, T. Y. Lin, R. Collobert, and P. Dollar. Learning to refine object segments, ECCV, 2016



Face recognition

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Image generation

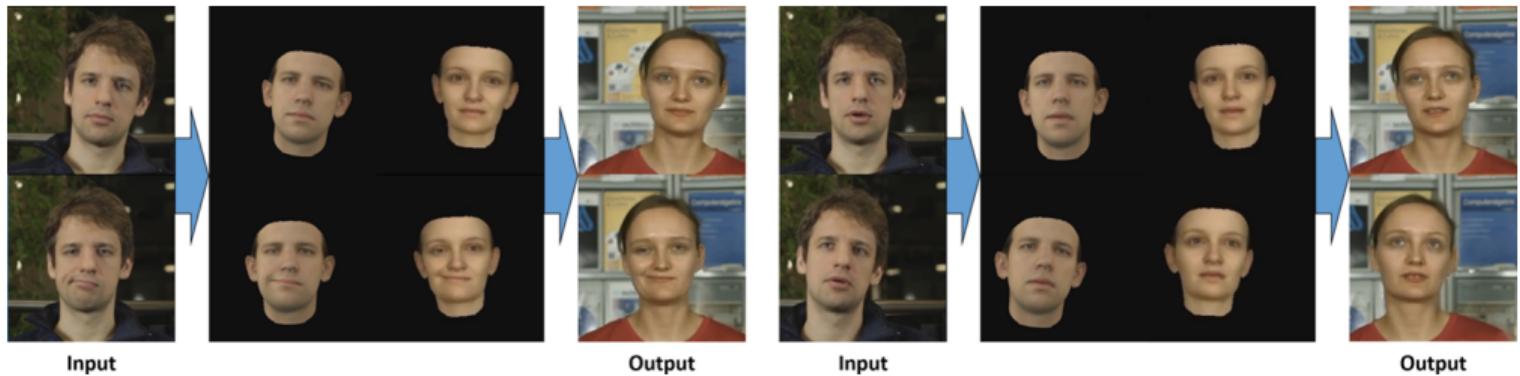
- Faces: 1024x1024 resolution, CelebA-HQ dataset



T. Karras, T. Aila, S. Laine, and J. Lehtinen, Progressive Growing of GANs for Improved Quality, Stability, and Variation, ICLR 2018



DeepFakes

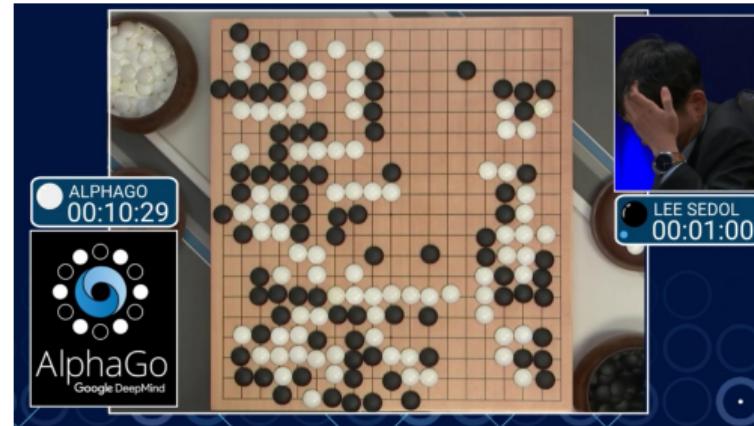


H. Kim et al., Deep video portraits, SIGGRAPH, 2018



Games

- **2013:** DeepMind uses deep reinforcement learning to beat humans at some Atari games
- **2016:** DeepMind's AlphaGo system beats Go grandmaster Lee Sedol 4-1
- **2017:** AlphaZero learns to play Go and chess from scratch
- **2019:** DeepMind's StarCraft 2 AI is better than 99.8 percent of all human players





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Self-driving cars





What is AI



Intelligence vs. Artificial Intelligence

Concept 1

- **Intelligence** includes the capacity for logic, understanding, learning, reasoning, creativity, and problem solving, etc.
- **Artificial intelligence (AI)** attempts not just to **understand** (scientific goal) but also to **build** (engineering goal) intelligent entities.



The field of Artificial Intelligence

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Course Topics

- AI is one of the newest fields in science and engineering.
 - Work started in earnest soon after World War II, and the name itself was coined at a conference at Dartmouth College in 1956.
- AI research aims to build intelligent entities that are capable of simulating humans in different aspects.
 - Thinking: learning, planning, knowledge refinement
 - Perception: see, hear, feel, etc.
 - Communication in natural languages
 - Manipulation and moving objects



What is AI

Thinking Humanly

"The exciting new effort to make computers think ... machines with minds, in the full and literal sense." (Haugeland, 1985)

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

Thinking rationally

"The study of mental faculties through the use of computational models." (Charniak and McDermott, 1985)

"The study of the computations that make it possible to perceive, reason, and act." (Winston, 1992)

Acting Humanly

"The art of creating machines that perform functions that require intelligence when performed by people." (Kurzweil, 1990)

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

Acting rationally

"Computational Intelligence is the study of the design of intelligent agents." (Poole et al., 1998)

"AI ...is concerned with intelligent behavior in artifacts." (Nilsson, 1998)

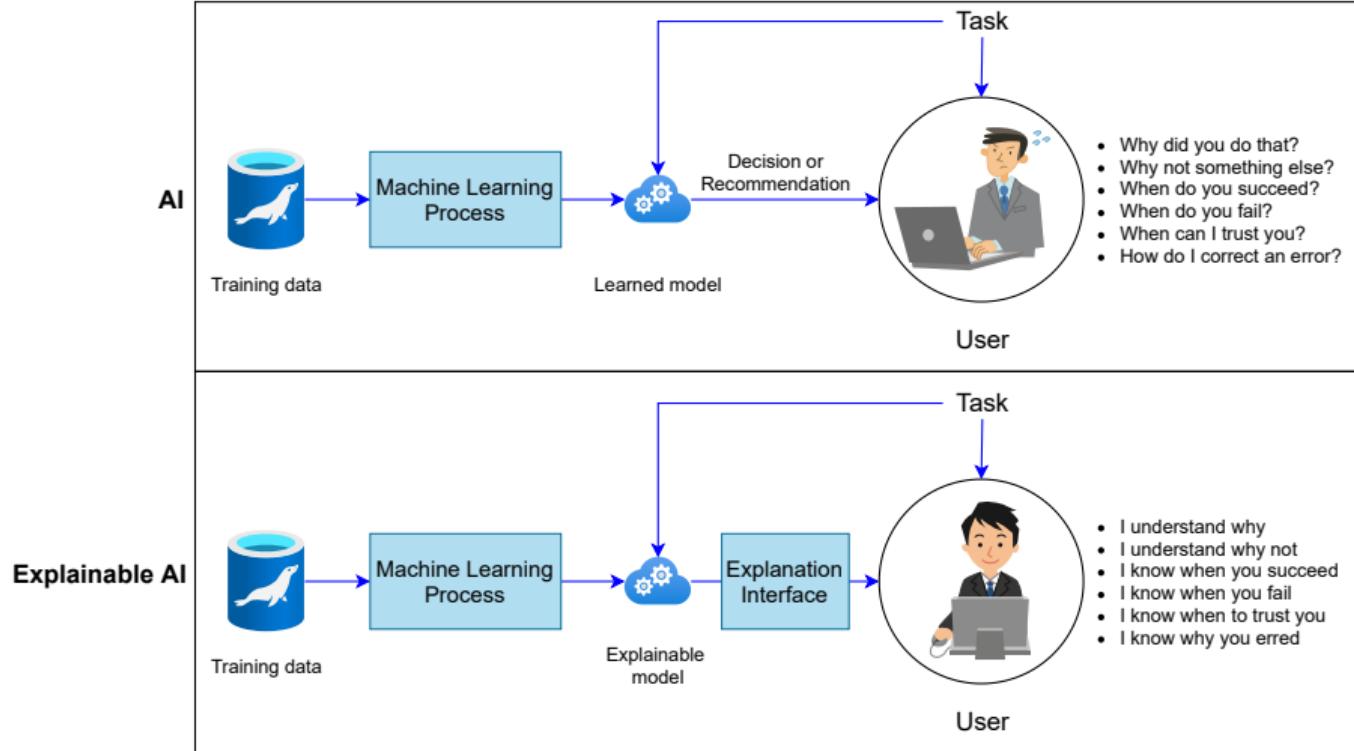


What is AI (cont.)

Systems that think like humans	Systems that think rationally
Systems that act like humans	Systems that act rationally



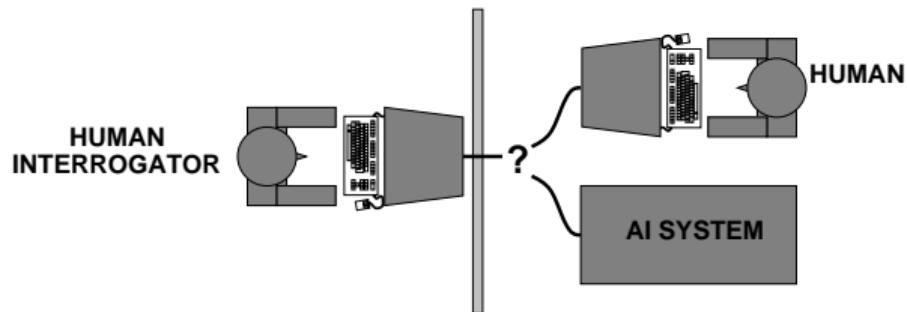
The Explainable Artificial Intelligence





Acting humanly

- The Turing Test approach
- Turing (1950) “Computing machinery and intelligence”
 - “Can machines think?” → “Can machines behave intelligently?”
 - Operational test for intelligent behavior: the **Imitation Game**. A *computer passes the test if a human interrogator, after posing some written questions, cannot tell whether the written responses come from a person or from a computer*
- Problem: Turing test is not *reproducible, constructive, or amenable to mathematical analysis*





Thinking humanly

- The cognitive modeling approach
- Requires scientific theories of internal activities of the brain to get inside the actual workings of human minds
 - What level of abstraction? “**Knowledge**” or “**circuits**”?
- How to validate?
 - Predicting and testing behavior of human subjects (top-down) or
 - Direct identification from neurological data (bottom-up)
- These approaches (**Cognitive Science** and **Cognitive Neuroscience**) are now distinct from AI
 - Share that the available theories but do not explain anything resembling human intelligence.
 - All share a principal direction.



Thinking rationally

- The “laws of thought” approach
- “Right thinking” is irrefutable reasoning processes
- Based on **logic**: *notation* and *rules of derivation* for thoughts; may or may not have proceeded to the idea of mechanization
- Problems:
 - Not all intelligent behavior is mediated by logical deliberation
 - Solving a problem “in principle” is different from solving it in practice



Acting rationally

- The rational agent approach
- **Rational behavior** is doing the **right thing**
 - The **right thing** which is expected to maximize goal achievement, given the available information
 - Doesn't necessarily involve thinking – e.g., blinking reflex – but thinking should be in the service of rational action
- An **agent** is an entity that perceives and acts. Abstractly, an agent is a function from percept histories to actions

$$f : \mathcal{P}^* \rightarrow \mathcal{A}$$



Foundations of AI



Disciplines to contribute ideas, viewpoints, and techniques to AI





Disciplines to contribute ideas, viewpoints, and techniques to AI (cont.)

Field	Description
Philosophy	Logic, methods of reasoning, mind as physical system, foundations of learning, language, rationality
Mathematics	Formal representation and proof, algorithms, computation, (un)decidability, (in)tractability, probability
Economics	Utility, decision theory, rational economic agents
Neuroscience	Neurons as information processing units
Psychology	How do people behave, perceive, process information, represent knowledge.
Computer Engineering	Building fast computers
Control theory and cybernetics	Design systems that maximize an objective function over time
Linguistic	Knowledge representation, grammar



History of AI



A brief history of AI

- 1940 – 1950: Early days
 - 1943: McCulloch & Pitts: Boolean circuit model of brain
 - 1950: Turing's "Computing Machinery and Intelligence"
- 1950 – 1970: Excitement: Look, Ma, no hands
 - 1950s: Early AI programs, including Samuel's checkers program, Newell & Simon's Logic Theorist, Gelernter's Geometry Engine
 - 1956: Dartmouth meeting: "Artificial Intelligence" adopted
 - 1965: Robinson's complete algorithm for logical reasoning
- 1970 – 1990: Knowledge-based approaches
 - 1969 – 1980: Early development of knowledge-based systems
 - 1980 – 1988: Expert systems industry booms
 - 1988 – 1993: Expert systems industry busts: "AI Winter"

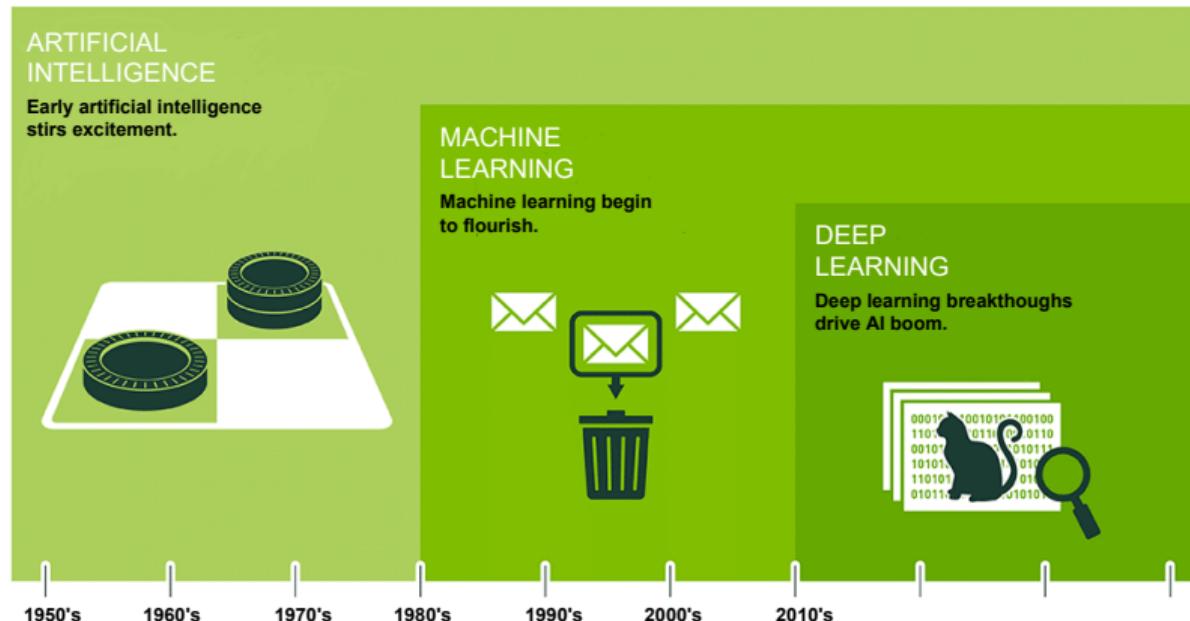


A brief history of AI (cont.)

- 1990 – 2010: Statistical approaches
 - Resurgence of probability, focus on uncertainty
 - General increase in technical depth
 - Agents and learning systems... “AI Spring”?
- 2010 – present: Deep learning and where are we now?



A brief history of AI (cont.)





Course Topics



Solving problems by searching

- **Search** is the fundamental technique of AI.
 - Possible answers, decisions or courses of action are structured into an abstract space, which we then search.
 - Search is either “uninformed” or “informed”
 - **Uninformed**: we move through the space without worrying about what is coming next, but recognizing the answer if we see it
 - **Informed**: we guess what is ahead, and use that information to decide where to look next.
 - We may want to search for the first answer that satisfies our goal, or keep searching until we find the best answer.



Knowledge and reasoning

- The second most important concept in AI
- If we are going to act rationally in our environment, then we must have some way of describing that environment and drawing inferences from that representation.
 - How do we describe what we know about the world?
 - How do we describe it concisely?
 - How do we describe it so that we can get hold of the right piece of knowledge when we need it?
 - How do we generate new pieces of knowledge?
 - How do we deal with **uncertain knowledge**?



Machine learning

- If a system is going to act truly appropriately, then it must be able to **change its actions in the light of experience.**
 - How do we generate new facts from old?
 - How do we generate new concepts?
 - How do we learn to distinguish different situations in new environments?



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