Deep Learning/Machine Learning/Artificial Intelligence

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Sources for Slides

- I have used materials from
  `https://skymind.ai/wiki/ai-vs-machine-learning-vs-deep-learning`
  for the overview of artificial intelligence.

Outline

Artificial intelligence/machine learning/deep learning

DL/ML/AI

- You can think of deep learning, machine learning and artificial intelligence as a set of Russian dolls nested within each other.
- Deep learning is a subset of machine learning, and machine learning is a subset of AI, which is an umbrella term for any computer program that does something smart.
- In other words, all machine learning is AI, but not all AI is machine learning, and so forth.

Artificial intelligence

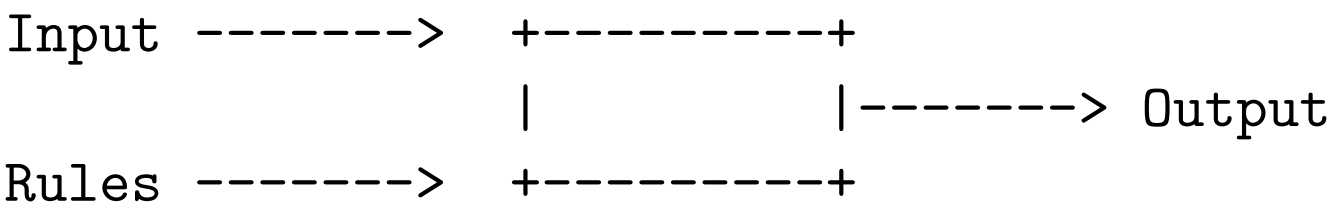
- John McCarthy, one of the founders of artificial intelligence, defined it as "the science and engineering of making intelligent machines."
  `https://en.wikipedia.org/wiki/John_McCarthy_(computer_scientist)`
- Here are a few other definitions of artificial intelligence:
- A branch of computer science dealing with the simulation of intelligent behavior in computers.
- The capability of a machine to imitate intelligent human behavior.
- A computer system able to perform tasks that normally require human intelligence, such as visual perception, speech recognition, decision-making, and translation between languages.

Symbolic AI/GOFAI

- Symbolic artificial intelligence is the term for the collection of all methods in artificial intelligence research that are based on high-level "symbolic" (human-readable) representations of problems, logic and search.
- Symbolic artificial intelligence is often called GOFAI ("Good Old-Fashioned Artificial Intelligence").
- The programming language Prolog is an example of symbolic artificial intelligence
  `https://en.wikipedia.org/wiki/Prolog`.
  `https://swish.swi-prolog.org/example/queens.pl`

Symbolic AI/GOFAI

Roughly speaking, symbolic AI operates like this:



Machine learning

- In 1959, Arthur Samuel, coined the machine learning and defined it as a "field of study that gives computers the ability to learn without being explicitly programmed." `https://en.wikipedia.org/wiki/Arthur_Samuel`
- Machine-learning programs, in a sense, adjust themselves in response to the data they're exposed to (like a child that is born knowing nothing adjusts its understanding of the world in response to experience).

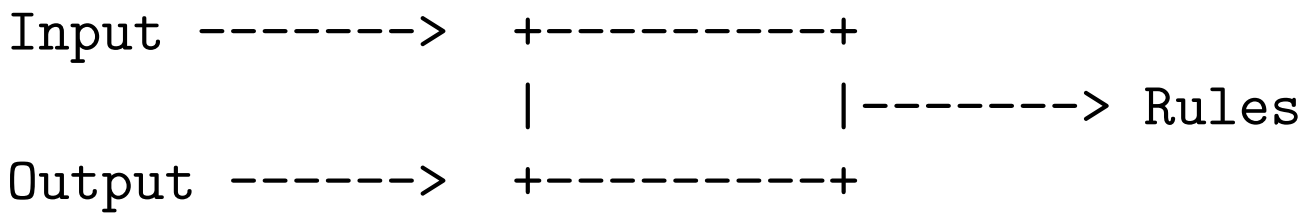
Machine learning

- Machine learning is dynamic and does not require human intervention to make certain changes.
- That makes it less brittle, and less reliant on human experts.
- Tom Mitchell provided a widely quoated, more formal definition of the algorithms studies in the machine learning field:

  A computer program is said to learn from experience E with respect to some class of tasks T and performance measure P if its performance at tasks in T, as measured by P, improves with experience E.

Machine learning

- One aspect that separates machine learning from symbolic AI is its ability to modify itself when exposed to more data.
- Instead of coding up rules that transform the input to output, a machine learning system comes up with the rules itself.



- The learned rules can then be used to predict outputs for new unseen inputs.
- We will make this more precise, especially in the context of supervised learning.

Combining two AI approaches

- One may think that symbolic AI (GOFAI) is somewhat "boring", while machine learning (in particular, deep learning) is "cool."
- This is not the case. For instance, the recent research paperstries to combine both approaches:

  `https://arxiv.org/pdf/1904.12584.pdf`

  Here is a short description of the main ideas in MIT Technology Review:

  `https://www.technologyreview.com/s/613270/`

  `two-rival-ai-approaches-combine-to-let-machines-learn-about-the-world-like-a-child/`

Overview

- This concludes the high-level overview of artificial intelligence.
- Let's look at the three times of machine learning in more detail.