Introduction of Machine Learning

CSCI/DSCI 575 Advanced Machine Learning

Department of Computer Science
Colorado School of Mines

What is *learning*?

Image source: Magnetic Speaking

What is *learning*?

- What if you don't know much about the environment when you start or if the environment changes?
  - We are sending a robot to Mars but we do not know the coefficient of friction of the dust on the Martian surface.
  - The scientists know a lot about the world dynamics but they have to leave a free parameter representing this coefficient of friction.

- Part of the job of learning by the intelligent system is to use sequences of percepts to estimate the missing details in the world dynamics.

- Learning is not very different from perception, they both find out about the world based on experience.
  - Perception = short time scale (example: where am I?)
  - Learning = long time scale (example: what is the coefficient of friction?)

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What is *learning*?

- "Learning is constructing or modifying representations of what is being experienced." — Ryszard Michalski
- "Learning denotes changes in a system that ... enable a system to do the same task more efficiently the next time." — Herbert Simon
- "Learning is making useful changes in our minds." — Marvin Minsky

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What is *machine learning*?

Machine Learning

Machine learning is defined as a set of methods that can automatically detect patterns in data, and then use the uncovered patterns to predict future data, or to perform other kinds of decision making under uncertainty (such as planning how to collect more data!).

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What is machine learning?

Study of algorithms that, for a well defined learning task $\langle P, T, E \rangle$,

- improve their performance P,
- at some task T,
- with experience E.

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Why machine learning?

Image source: eLearning Industry

Why machine learning? — detecting objects in images

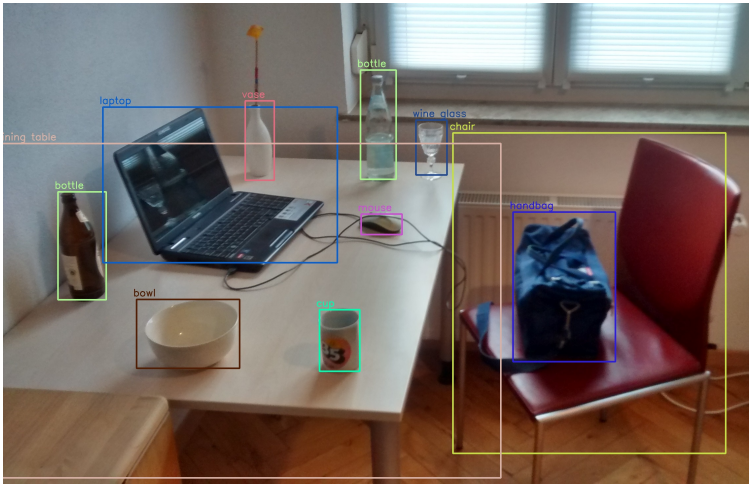

Image source: Wikipedia

Why machine learning? — speech recognition

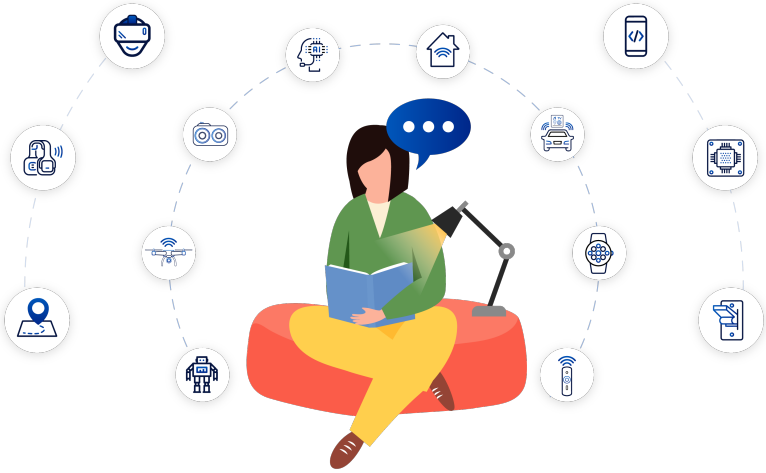

Image source: fluent.ai

Why machine learning? — classifying text documents

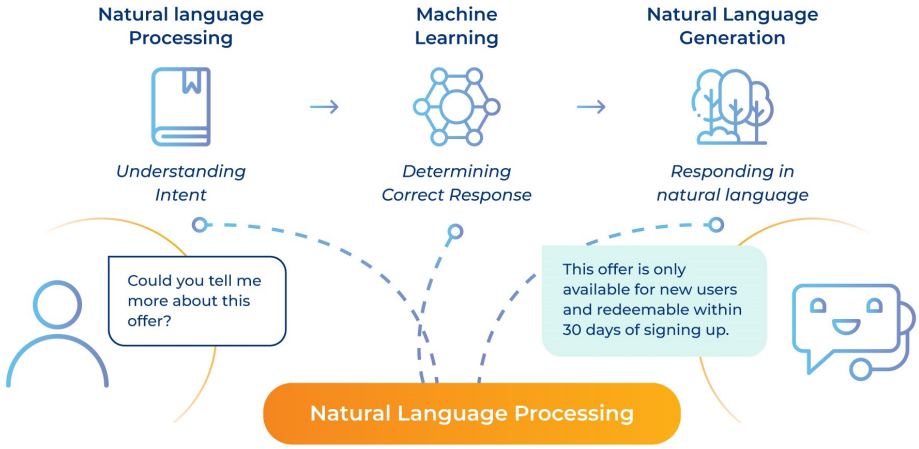

Image source: Search Unify

Why machine learning? — medical diagnosis

Image source: Bold Business

Why machine learning? — computer games

Image source: Robotics and Automation News

Image source: IEEE Spectrum

Why machine learning? — solving difficult problems in our daily lives

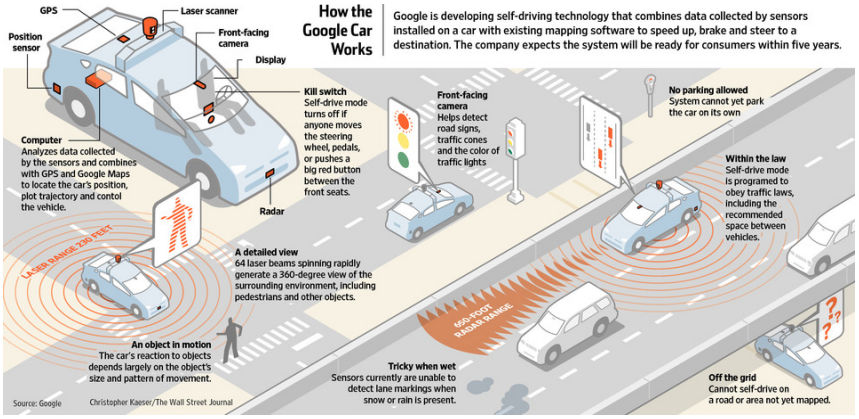

Image source: The Wall Street Journal

Why machine learning?

We are entering the era of big data. This deluge of data calls for automated methods of data analysis, which is what **machine learning** provides.

- There are about 1 trillion web pages;
- one hour of video is uploaded to YouTube every second, amounting to 10 years of content every day;
- the genomes of 1000s of people, each of which has a length of 3.8×10^9 base pairs, have been sequenced by various labs;
- Walmart handles more than 1M transactions per hour and has databases containing more than 2.5 petabytes (2.5×10^{15}) of information.
- ...

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