CS412
# Machine Learning
Introduction
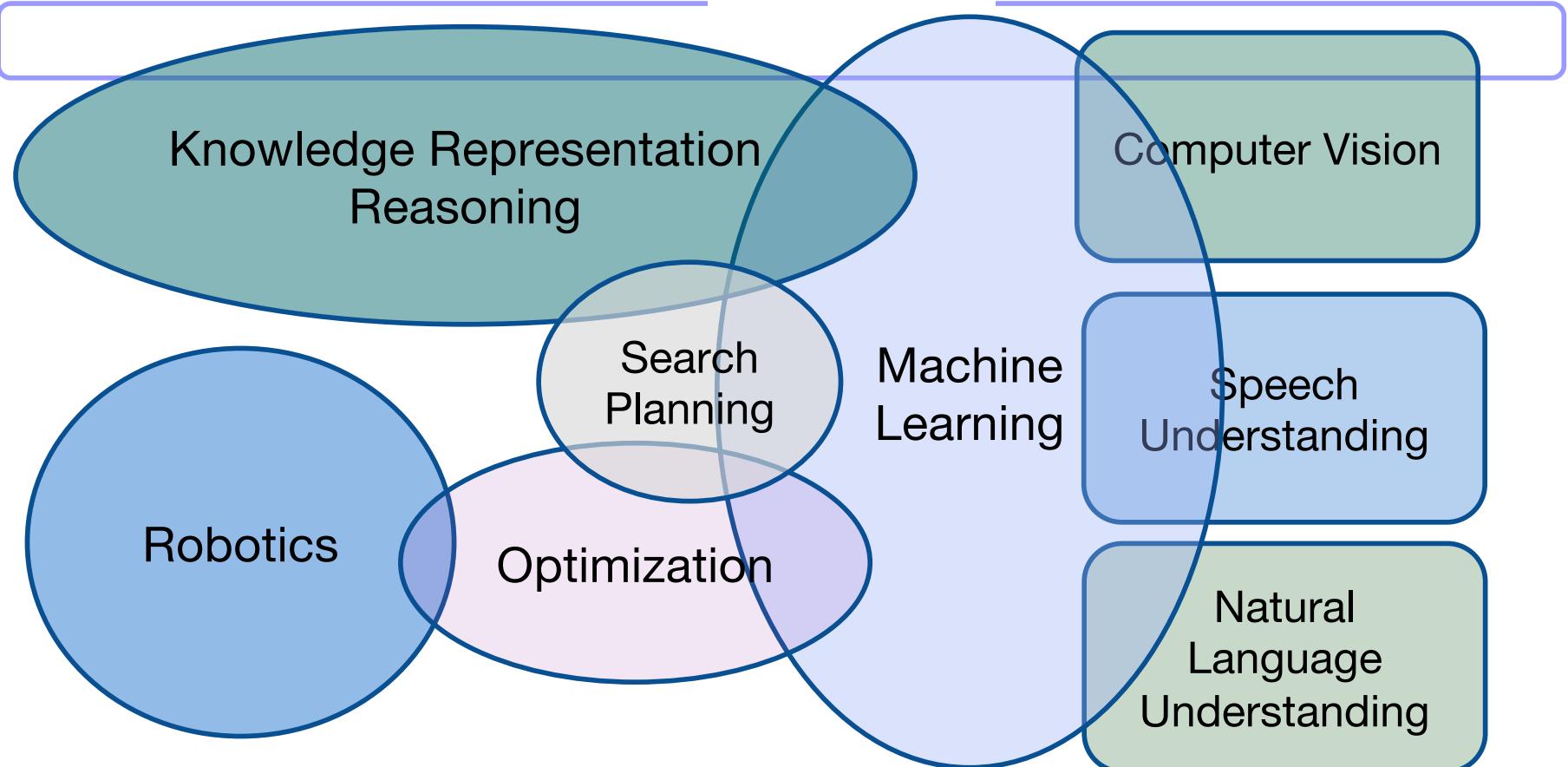
Berrin Yanikoglu

Sabancı Üniversitesi

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- We covered the course expectations in the first 20 min or so of the lecture.

- Please read the syllabus in Sucourse

Machine Learning in Perspective

AI Components

Perceiving the World: Computer Vision

An intelligent computer must be able to recognize its surrounding environment and adapt to changes in it. To do this it must be able to "see" and "hear" what's going on.
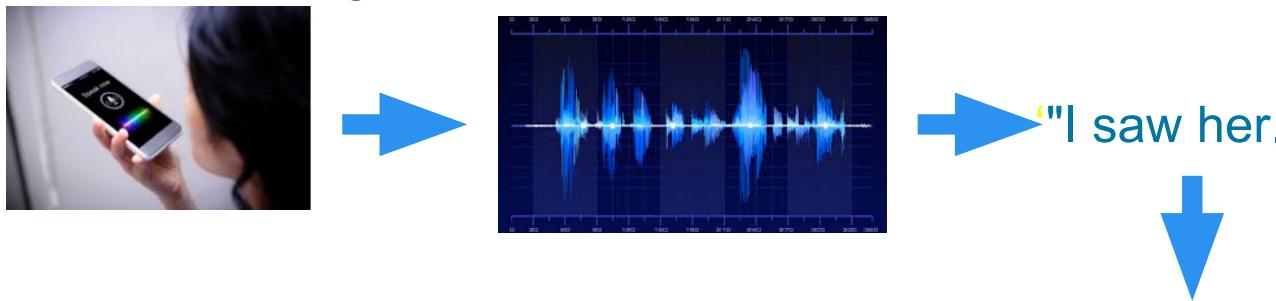
Computer vision is the capability of a computer to mimic the ways that human brains process and interpret light waves to produce a model of reality. Though it's very easy for people to do that, it's very difficult for computers to do build and update their models

AI Components: Perception
Speech and Natural Language Understanding

- **Speech understanding**: Converting a given speech signal into transcribed text.

- **Natural language understanding**: Understanding what is meant in a given transcribed text.

"I saw her."

" I saw (Ayşe). "

AI Components:
Search Algorithms

- Finding solutions to puzzles/problems by considering alternatives in a systematic way

- Time and space complexity

- Foundation of Game Playing

  Adversarial search
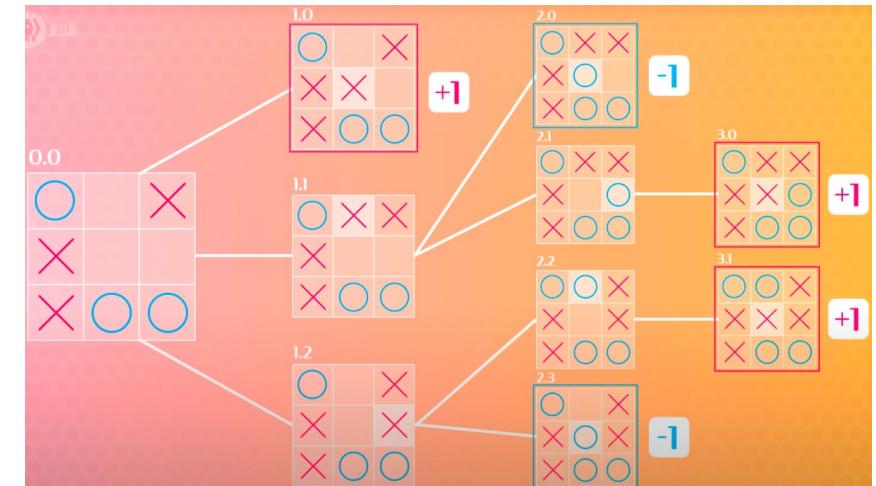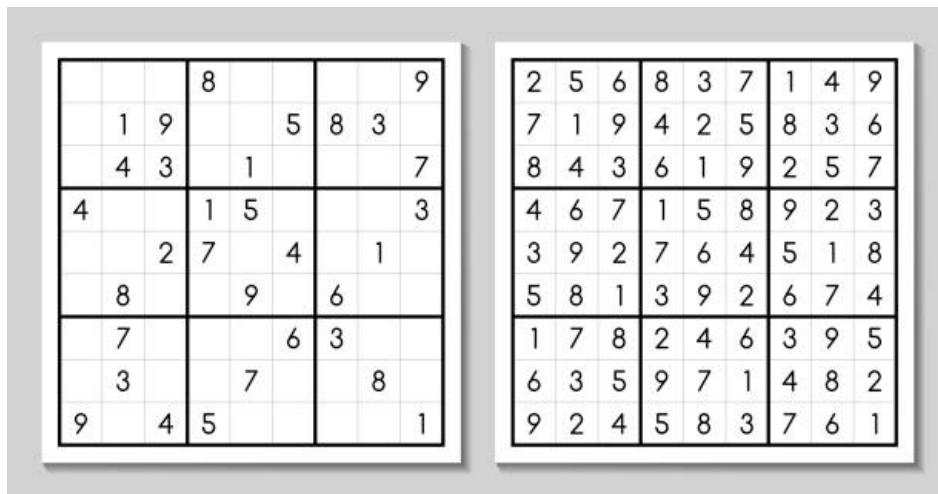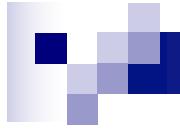
Image: Morioh.com

AI Components: Perception
Knowledge Representation and Logic

"You will have fever and body ache in Flu"

Flu ⇒ Fever BodyAche

"Patient has fever, but no body ache"

Fever ∧ ¬BodyAche.

⇒ Not Flu

AI Components:
Robotics

Honda Asimo

Harvard U.'s Insect Bot

Kuri

Samsung Bot Care

SwagBot - Sydney University
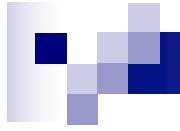
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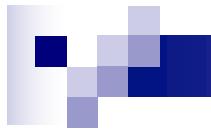
https://www.pocket-lint.com/gadgets/news/...

What is Machine Learning?

What is learning?

It is very difficult to pin down what learning is. As our programs/agents/robots start doing more and more things, we do not find them intelligent anymore.
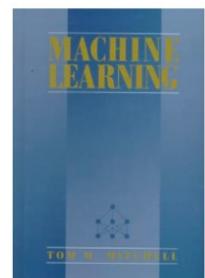
Some definitions from famous people in CS/AI history:

- "Learning denotes changes in a system that ... enable a system to do the same task more efficiently the next time." –Herbert Simon

- "Learning is any process by which a system improves performance from experience." –Herbert Simon

- "Learning is constructing or modifying representations of what is being experienced." –Ryszard Michalski

- "Learning is making useful changes in our minds." –Marvin Minsky

- **Arthur Samuel (1959) :**
  - Field of study that gives computers the ability to learn without being explicitly programmed.

- **Tom Mitchell (1998) :**
  - **Formally:** A computer program is said to learn from experience **E** with respect to some task T and some performance measure on T, as measured by P improves with experience **E.**
  - **Informally:** *Algorithms* that improve on some *task* with *experience*

Tom Mitchell, 1997

Chair of ML Department at CMU

- *A computer program is said to learn from experience E with respect to some task T and some performance measure P, if its performance on T, as measured by P, improves with experience E.*

- Task T

  Classify mail as Spam/NotSpam

- Experience E

  Sample emails with human tagged labels as Spam/NotSpam

- Performance P

  Accuracy…

- *A computer program is said to learn from experience E with respect to some task T and some performance measure P, if its performance on T, as measured by P, improves with experience E.*

- Task T

  Play chess

- Experience E

  Play against a human expert or against another computer…

- Performance P

  % of games won in a tournament

- *A computer program is said to learn from experience E with respect to some task T and some performance measure P, if its performance on T, as measured by P, improves with experience E.*

- Task T

  Predict whether the stock price will increase/decrease
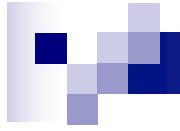
  Predict tomorrow`s stock price for a company

- Experience E
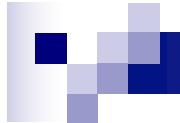
  Historical stock market and associated data

- Performance P

  Accuracy in prediction

Why Learn?

Why learn?

- Develop **systems that are too difficult/expensive to construct manually** because they require specific detailed skills or knowledge tuned to a specific task

  Large, complex AI systems cannot be completely derived by hand and require dynamic updating to incorporate new information.

- Build software **agents that can adapt** to their users or to other software agents or to changing environments

  Mars robot

- **Discover new things** that were previously unknown to humans

  Examples: data mining, scientific discovery