Machine Learning

-Introduction-

Sang Hyun Park

Robotics Engineering, DGIST

shpark13135@dgist.ac.kr

This course….

- Introduction to machine learning

- Cover the most commonly used machine learning algorithms
  - Supervised learning
  - Unsupervised learning
  - Sequential learning
  - Reinforcement learning

Brief overview

Instructor: Sang Hyun Park

Email: shpark13135@dgist.ac.kr

Phone: 053-785-6222

Room: E5, 409

Brief overview

2017.02- , DGIST

Department of Robotics Engineering
Medical Image & Signal Processing LAB

2008.03-2014.02, Ph.D., Seuol National University

Computer Vision

2014.03-2016.02, PostDoc., University of North Carolina

Medical Image Analysis

2016.03-2017.02, PostDoc., SRI International

Analysis of
Big Neuroimage Data

Brief overview

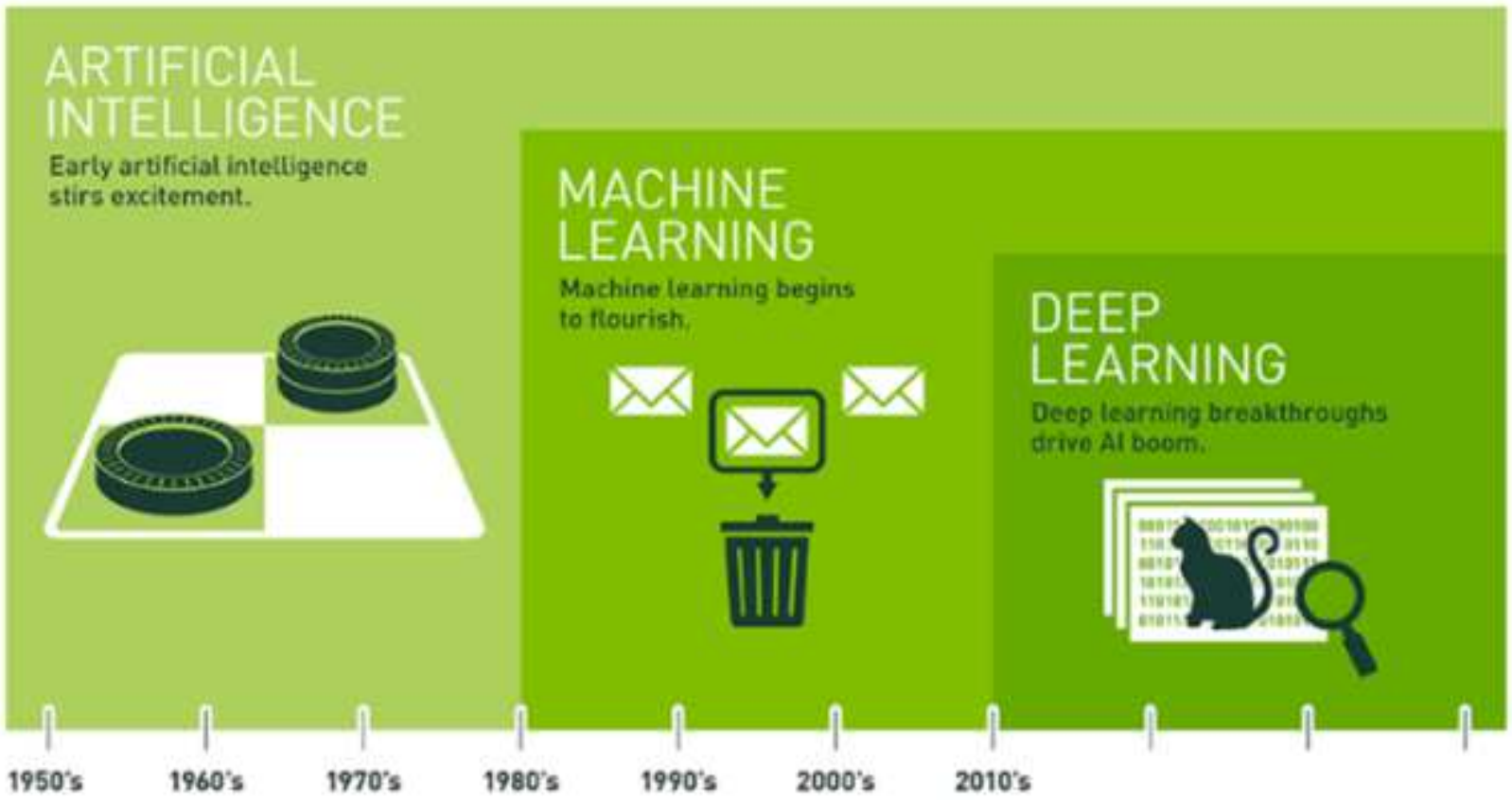
Assignments (40%)

Final exam (40%)

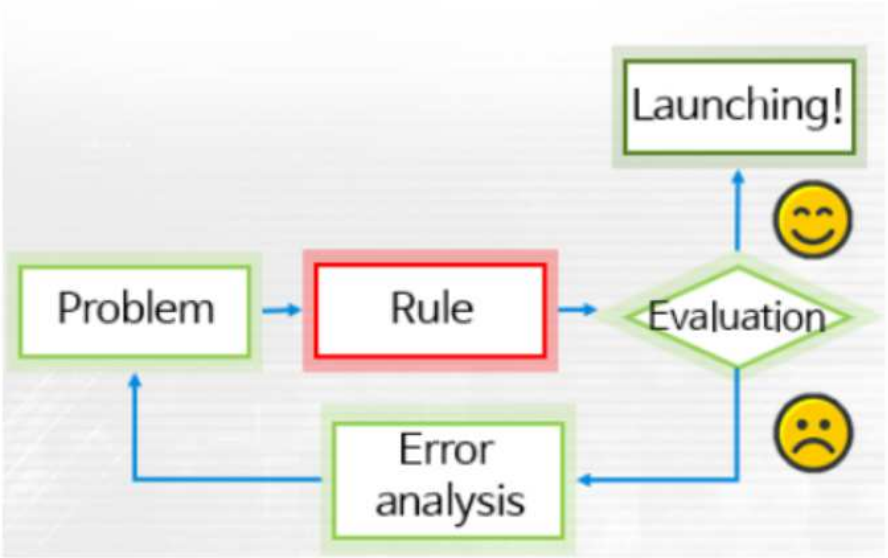
Attendance (20%)

What is Machine Learning?

Artificial Intelligent vs Machine Learning



What is Machine Learning?



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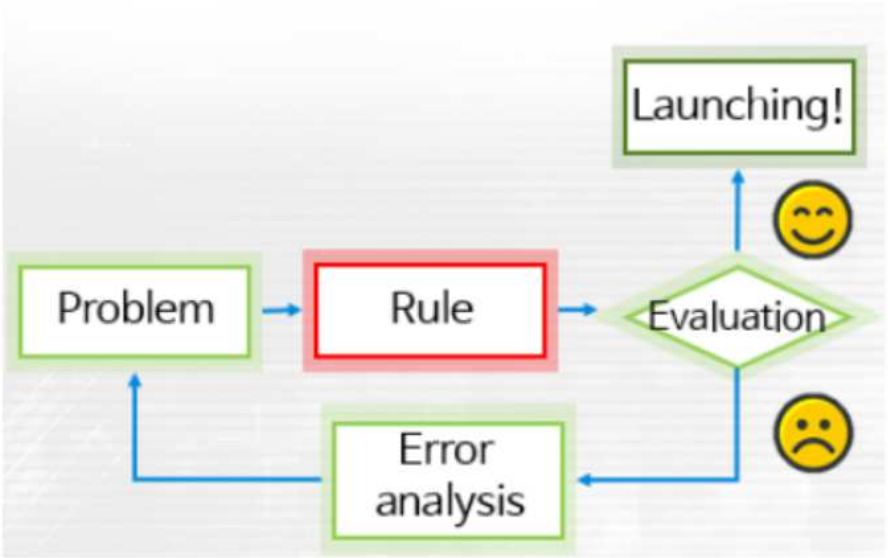
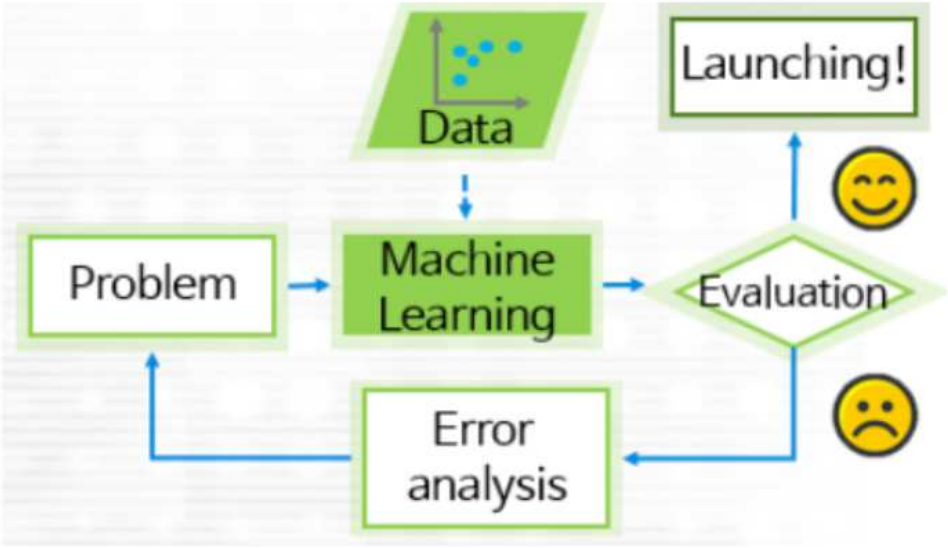




Contents in this course

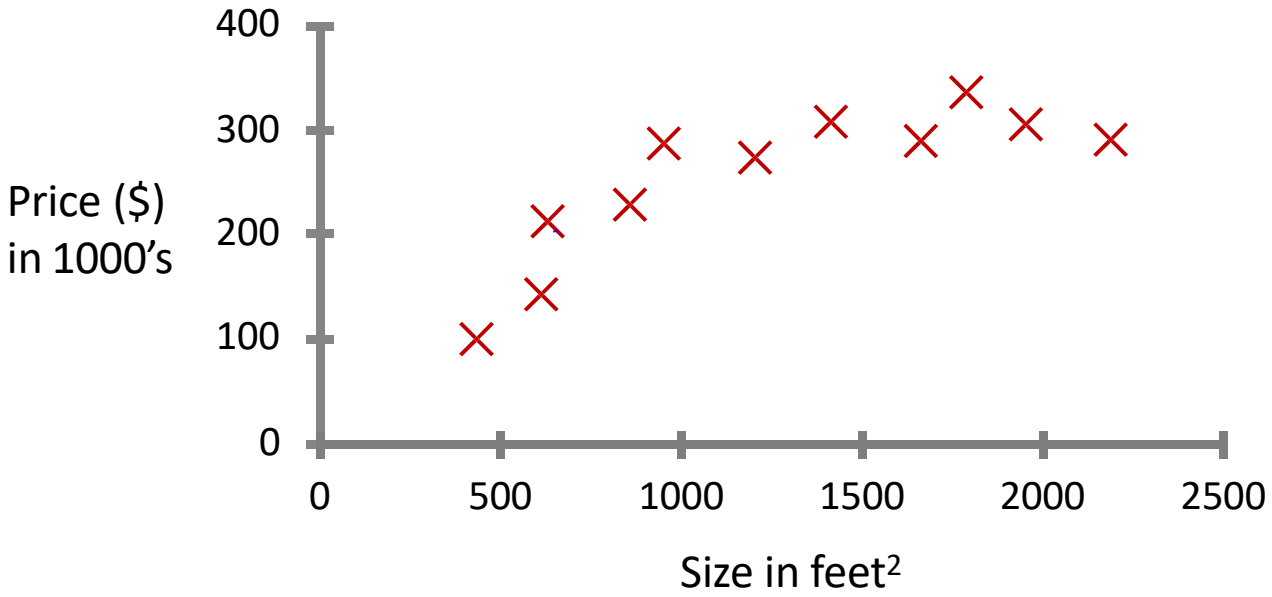
- Supervised Learning
- Unsupervised Learning
- Sequential learning - Hidden Markov Model
- Reinforcement Learning

Contents in this course

- Supervised Learning
  - Linear regression
  - Logistic regression
  - Neural network
  - Support vector machine
  - Ensemble learning, Adaboost
  - Decision Tree, Random Forest
- Unsupervised Learning
  - Clustering
  - EM algorithm
  - Auto-encoder
  - Principal component analysis
  - Collaborate filtering
  - Semi-supervised learning
- Sequential learning - Hidden Markov Model
- Reinforcement Learning

Regression

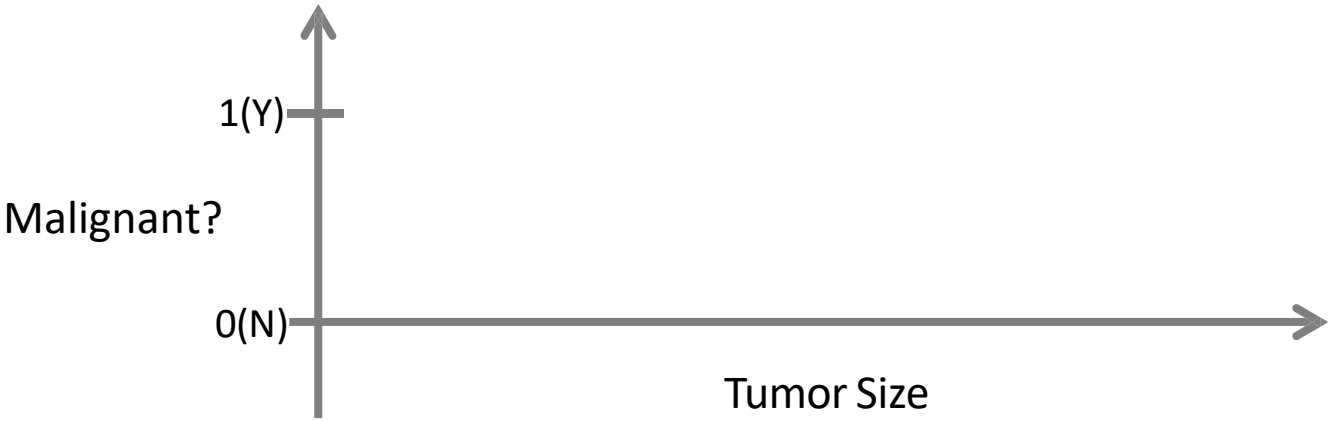
Housing price prediction



Regression: Predict continuous valued output (price)

Classification

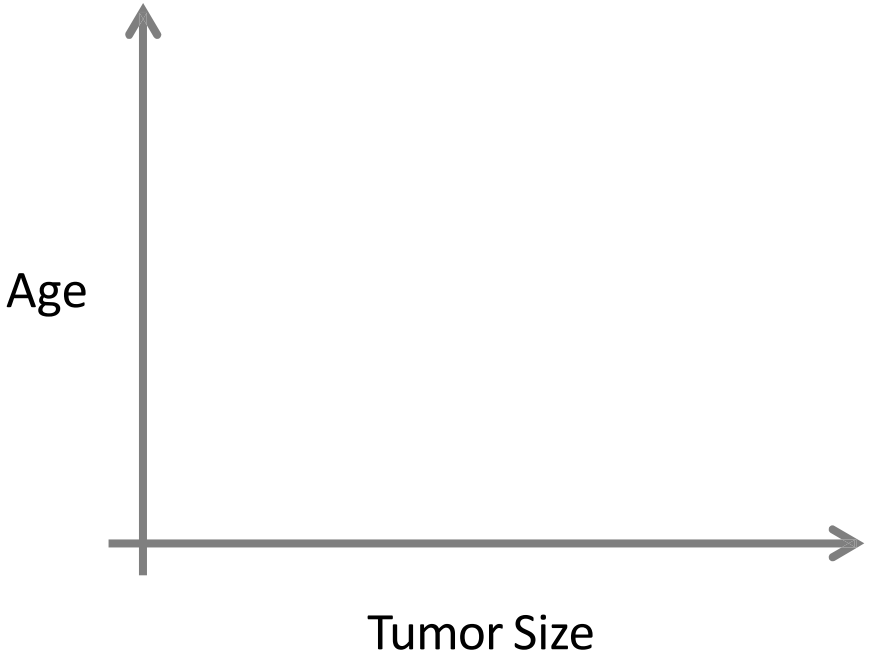
Breast cancer (malignant, benign)



<u>Classification</u>

Discrete valued output (0 or 1)

Classification



- Clump Thickness
- Uniformity of Cell Size
- Uniformity of Cell Shape

...

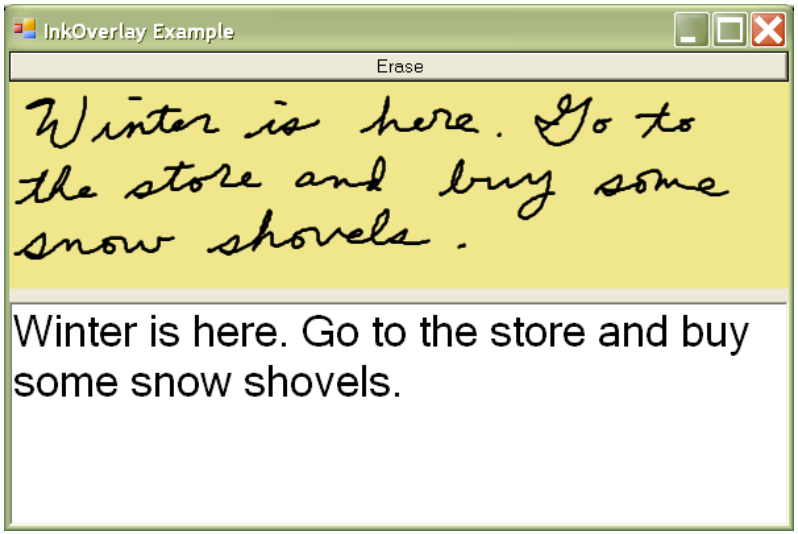
Classification

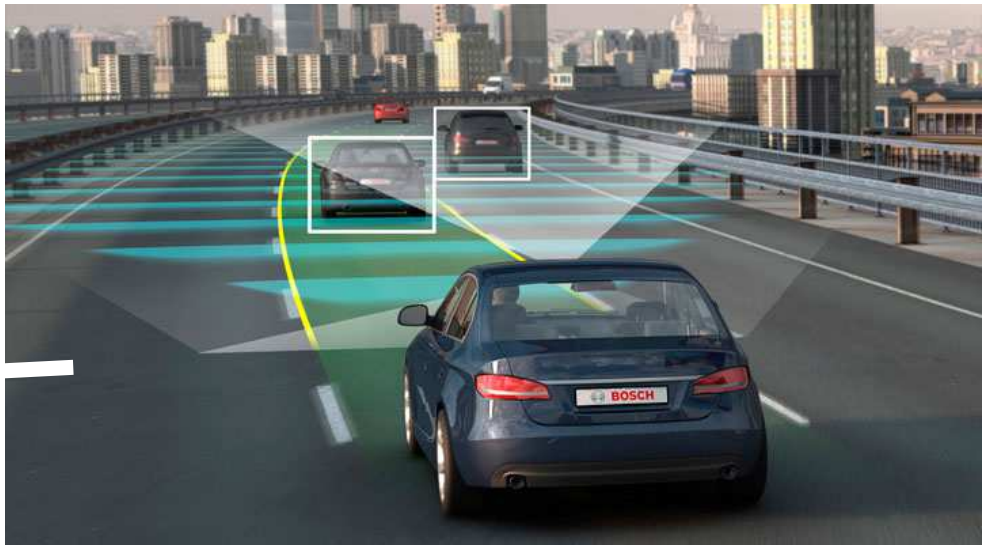
- Logistic Regression
- Neural Network
- Support Vector Machine
- Decision Tree

Supervised learning: Applications

- Automated system

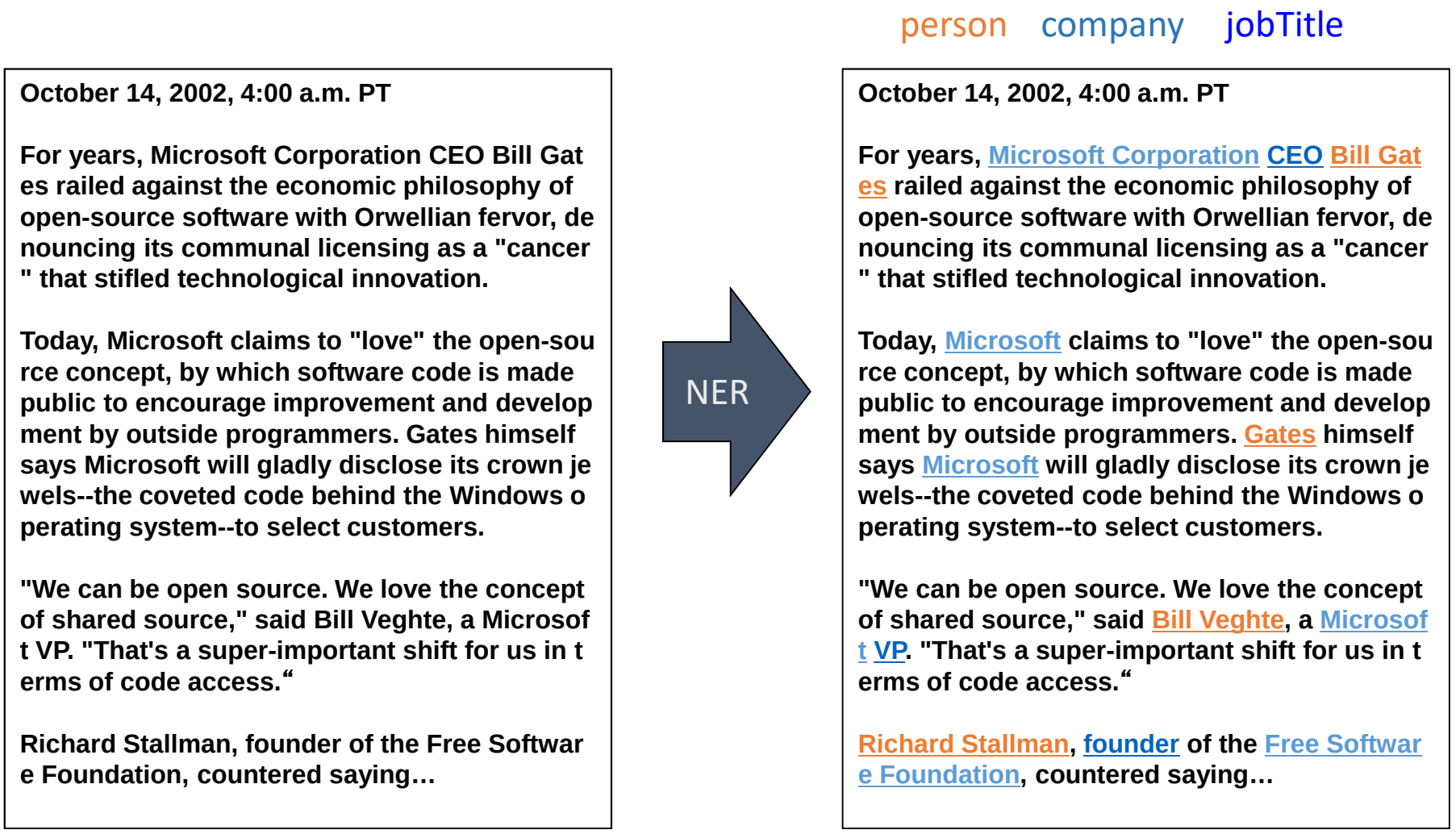
  E.g., Autonomous helicopter, handwriting recognition, most of Natural Language Processing (NLP), Computer Vision.



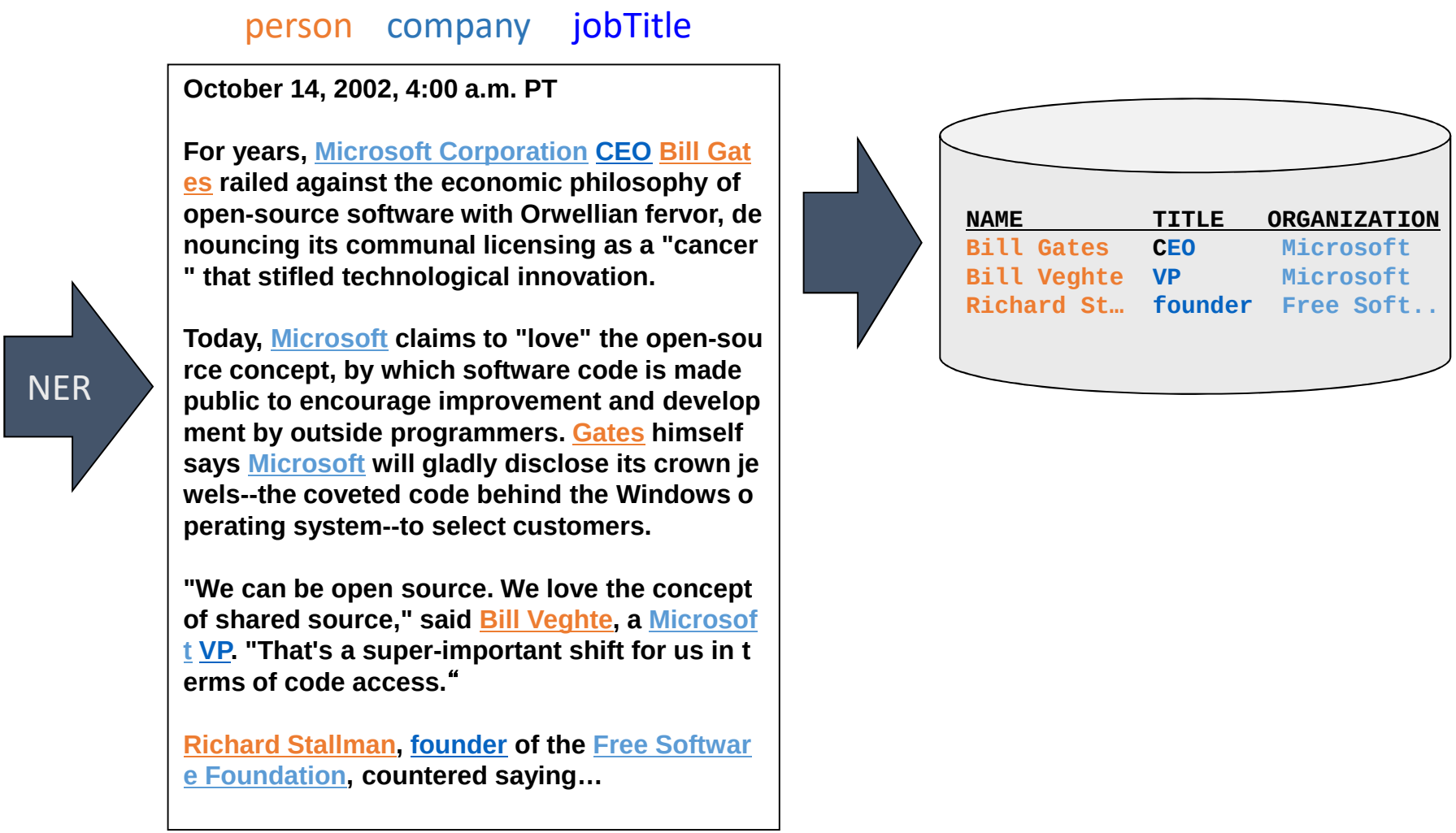


Sequential Learning

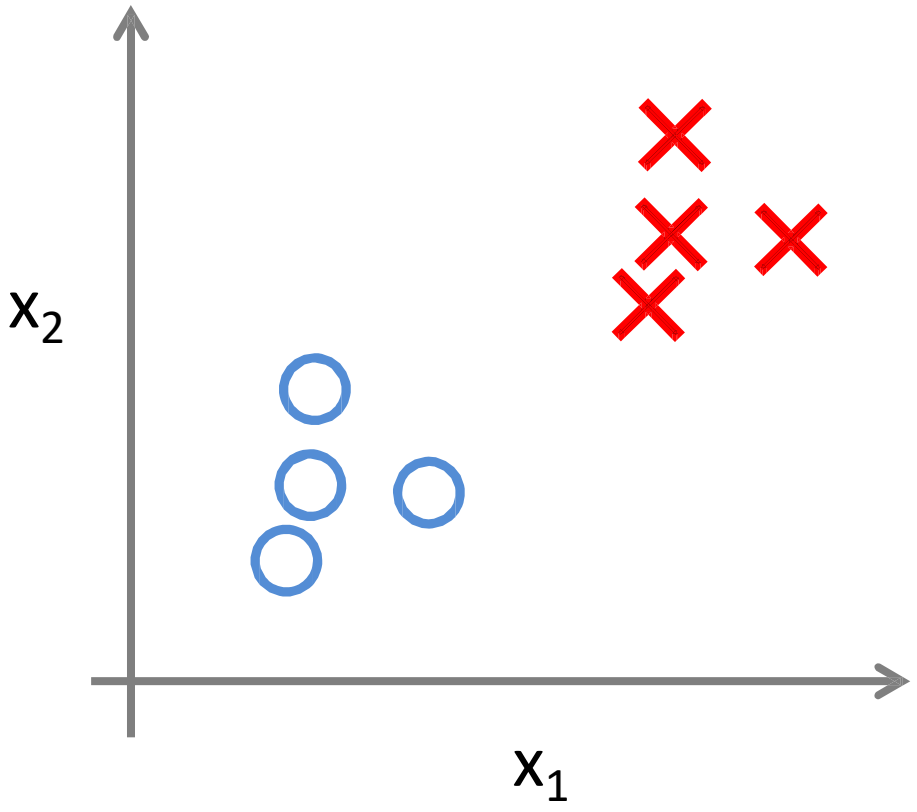
- Named Entity Recognition (NER)



Sequential Learning

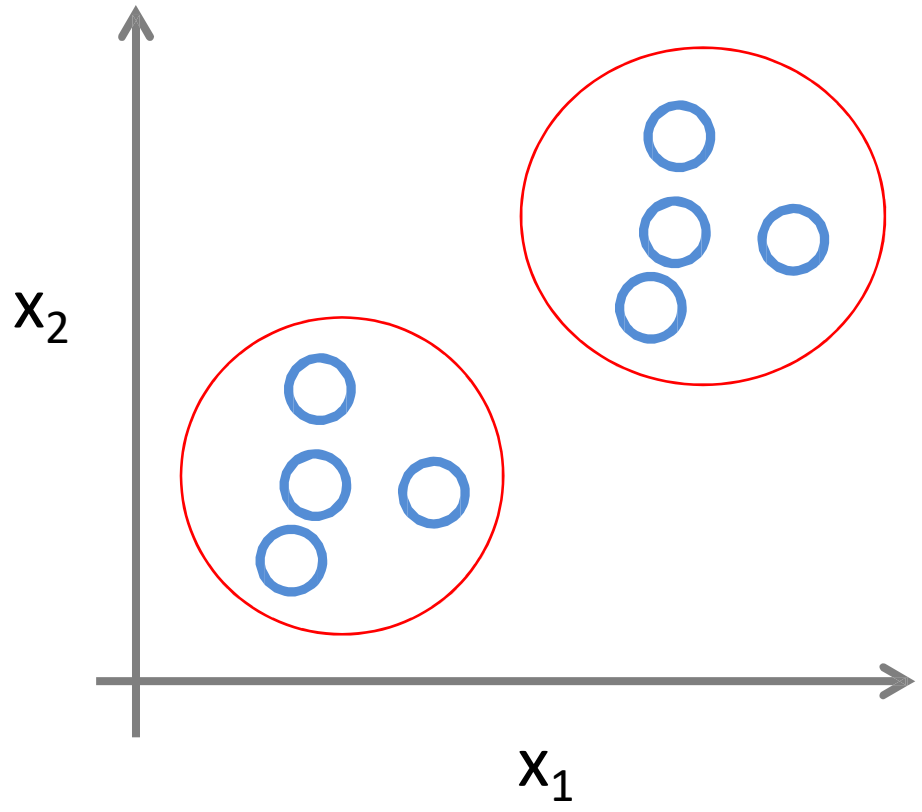


Unsupervised Learning



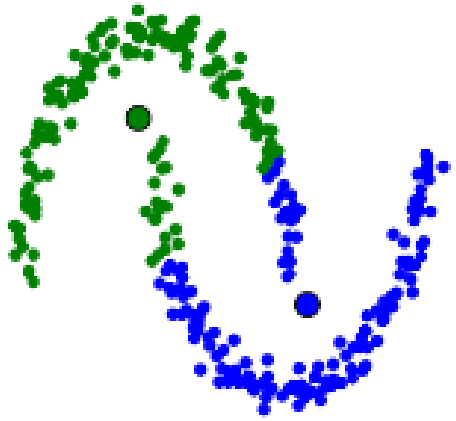
Supervised Learning

Unsupervised Learning

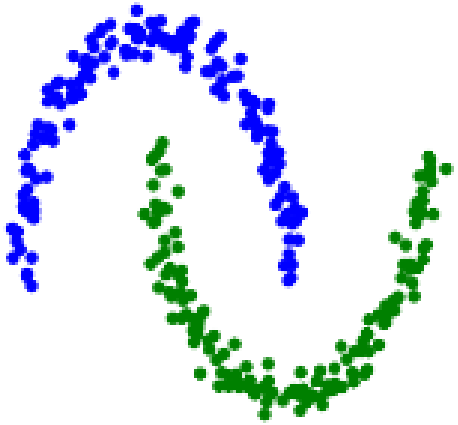


Unsupervised Learning

Unsupervised Learning

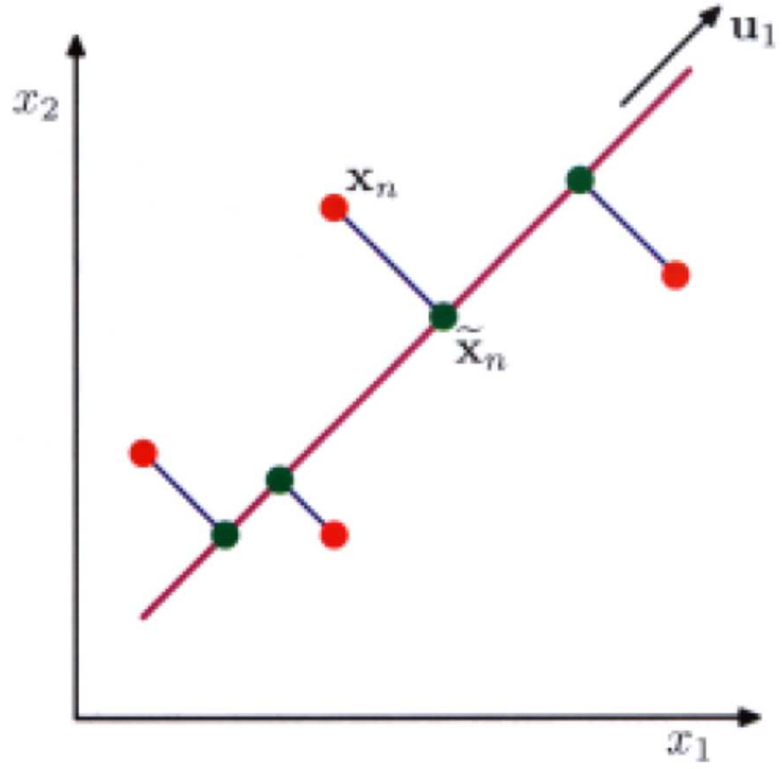


K-means clustering



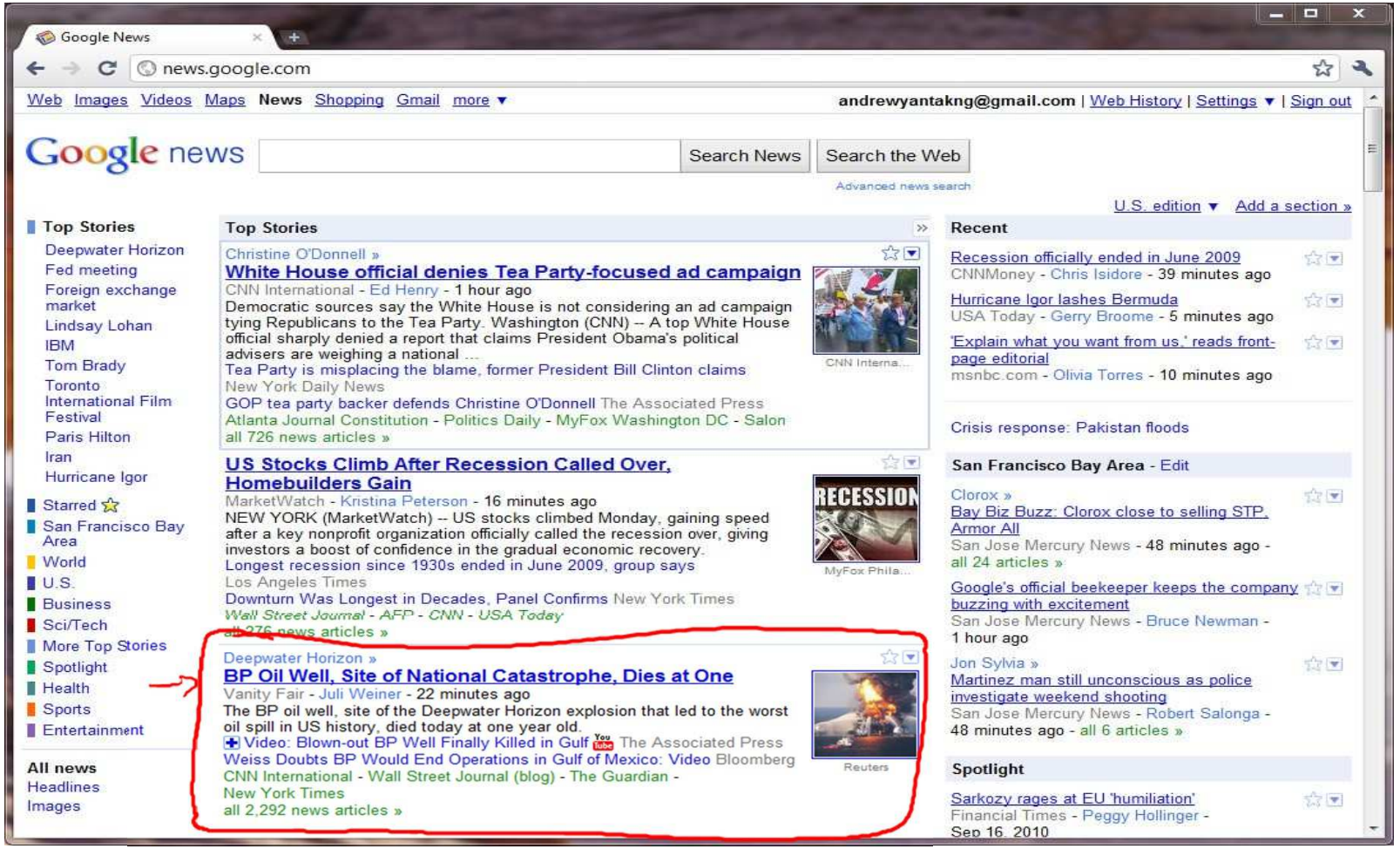
Spectral clustering

Unsupervised Learning

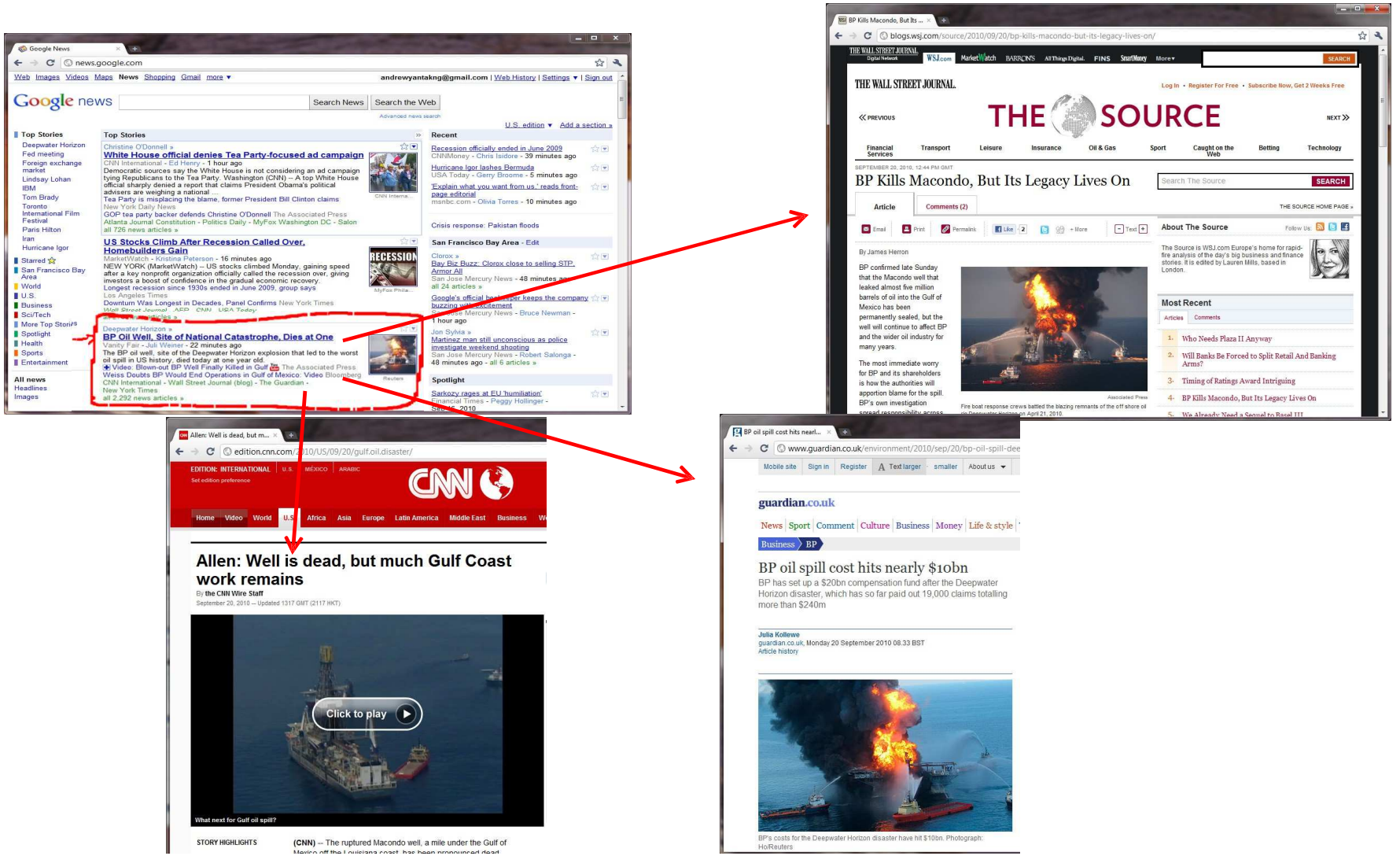


Seek a space of lower dimensionality

Unsupervised Learning



Unsupervised Learning



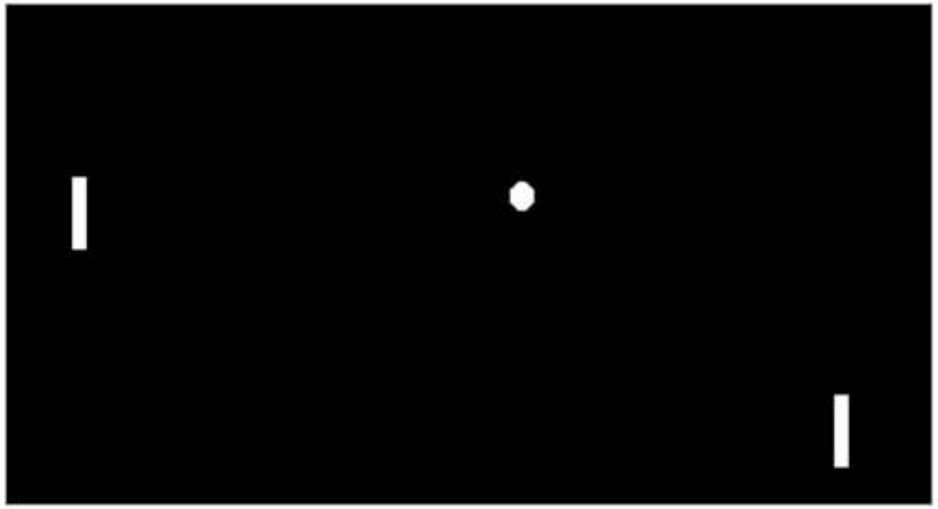
Machine learning: Applications

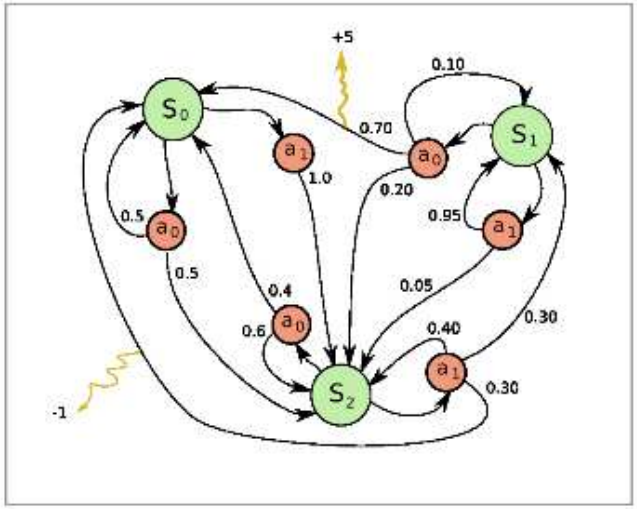
- Self-customizing programs

  E.g., Amazon, Netflix product recommendations

Reinforcement Learning

Atari Game Example

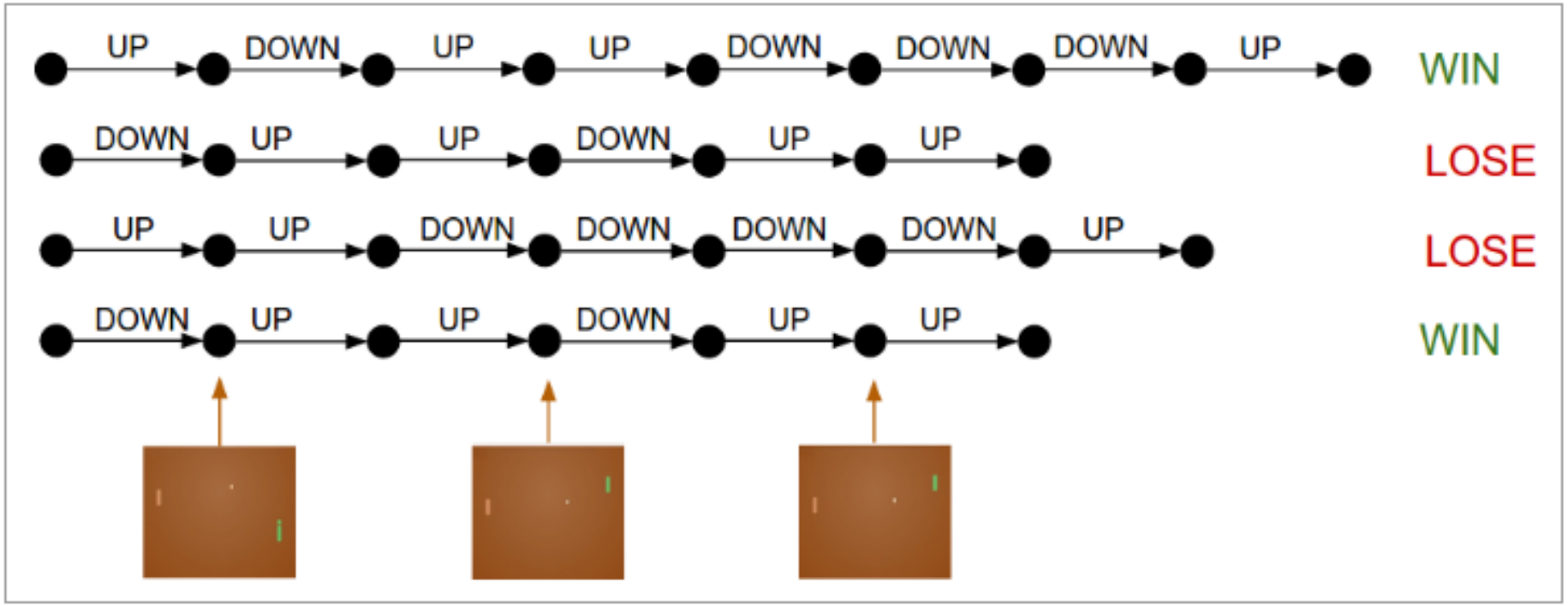




Left: The game of Pong. Right: Pong is a special case of a Markov Decision Process (MDP): A graph where each node is a particular game state and each edge is a possible (in general probabilistic) transition. Each edge also gives a reward, and the goal is to compute the optimal way of acting in any state to maximize rewards.

[http://karpathy.github.io/2016/05/31/rl/]

Reinforcement Learning



Cartoon diagram of 4 games. Each black circle is some game state (three example states are visualized on the bottom), and each arrow is a transition, annotated with the action that was sampled. In this case we won 2 games and lost 2 games. With Policy Gradients we would take the two games we won and slightly encourage every single action we made in that episode. Conversely, we would also take the two games we lost and slightly discourage every single action we made in that episode.

Summary

- Artificial intelligent
- Machine learning
- Datamining
- Supervised learning
- Unsupervised learning
- Sequential learning
- Reinforcement learning

References

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