



Machine Learning for Data Mining

Data Mining and Text Mining (UIC 583 @ Politecnico di Milano)

- ❑ What is Machine Learning?
- ❑ What are the paradigms?
- ❑ Unsupervised Learning
- ❑ Supervised Learning
- ❑ Reinforcement Learning

What is
Machine Learning?

- ❑ “The field of machine learning is concerned with the question of how to construct computer programs that automatically improve with experience.” Tom Mitchell (1997)
- ❑ A 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 .
- ❑ A well-defined learning task is defined by P , T , and E .

- ❑ Task T: playing checkers
- ❑ Artificial Intelligence
 - ▶ Design and implement a computer-based system that exhibit intelligent action
- ❑ Machine Learning
 - ▶ Write a program that can learn how to play
 - ▶ It can learn from examples of previous games, by playing against another opponent, by playing against itself

- ❑ A handwriting recognition learning problem
 - ▶ Task T: recognizing and classifying handwritten words within images
 - ▶ Performance P: percent of words correctly classified
 - ▶ Training experience E: a database of handwritten words with given classification

- ❑ A robot driving learning problem
 - ▶ Task T: driving on public four-lane highways using vision
 - ▶ Performance P: average distance traveled before an error
 - ▶ Training experience E: a sequence of images and steering commands recorded while observing a human driver

Unsupervised Learning



- ❑ Task T: finding interesting groups into data, learning “what normally happens”
- ❑ Performance P: how good, how interesting the groups are
- ❑ Training experience E: raw data
- ❑ Example applications
 - ▶ Customer segmentation in CRM
 - ▶ Color quantization for image compression,
 - ▶ Bioinformatics

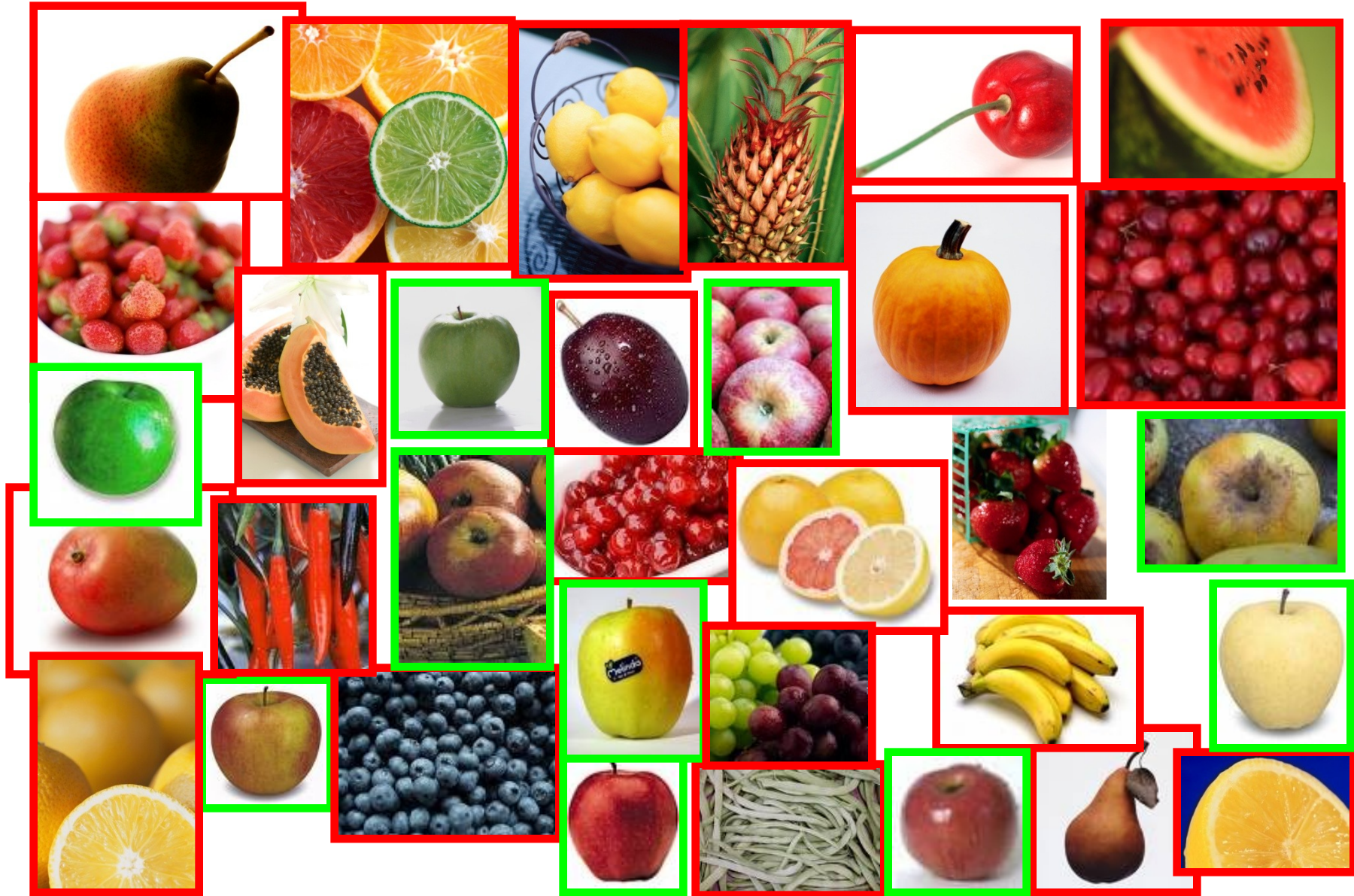
Supervised Learning

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What is an apple?

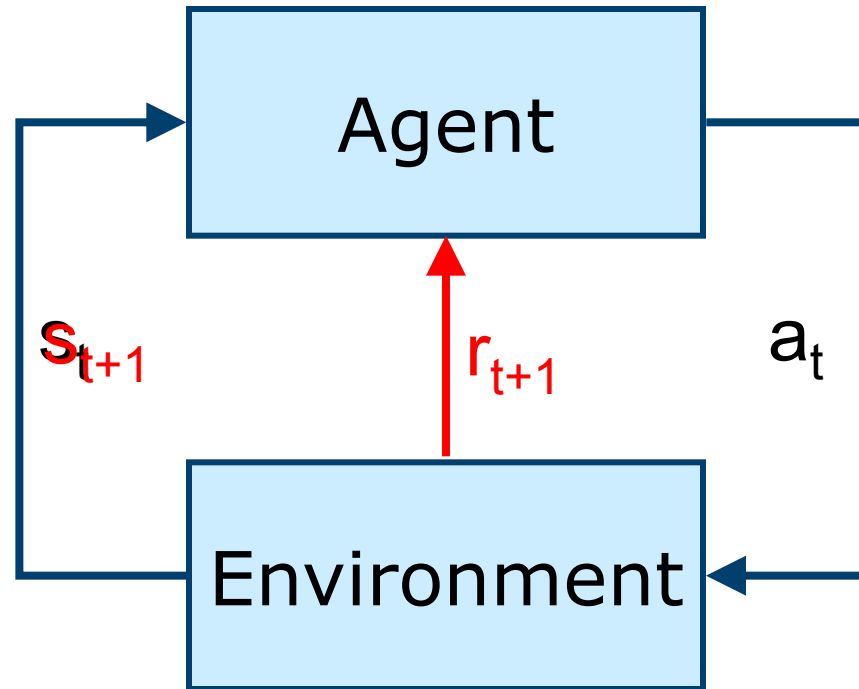
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- ❑ Training experience E : examples labeled by a supervisor
- ❑ Task T : to extract a description of a concept from the data.
Use the description to predict the output for future examples
- ❑ Performance P : how accurate the description is
- ❑ Example applications
 - ▶ Credit approval
 - ▶ Target marketing
 - ▶ Medical diagnosis
 - ▶ Fraud detection

Reinforcement Learning



- ❑ The agent learn through trial-and-error interactions
- ❑ The goal is to maximize the amount of reward received from the environment
- ❑ Compute a value function $Q(s_t, a_t)$ mapping state-action pairs into expected future payoffs

- ❑ Training experience E : online interactions with the environment
- ❑ Task T : collect as much reward as possible
- ❑ Performance P : the amount of reward
- ❑ Example applications
 - ▶ Robot learning
 - ▶ Games
 - ▶ Multiagent learning

Data Mining & Machine Learning

□ Applications

- ▶ Agents
- ▶ Data Mining
- ▶ Robotics
- ▶ ...

□ Paradigms

- ▶ Unsupervised Learning
- ▶ Supervised Learning
- ▶ Reinforcement Learning
- ▶ ...

□ Algorithms

- ▶ Clustering
- ▶ Association Rules
- ▶ Decision trees
- ▶ ...

- ❑ Machine learning algorithms acquire structural descriptions from examples
- ❑ Structural descriptions represent patterns explicitly
 - ▶ They can be used to predict outcomes in new situations
 - ▶ They can be used to understand and explain how predictions are derived
- ❑ Unsupervised learning
 - ▶ Clustering
 - ▶ Association rules
- ❑ Supervised learning
 - ▶ Decision trees
 - ▶ Decision rules
 - ▶ Bayesian classifiers