

# Introduction to Machine Learning for Healthcare

# Introduction to Machine Learning

- Machine learning algorithms build a model based on sample data(text ,audio , image and video), known as **training data**, in order to make predictions or decisions.
- A Computer program is said to learn from experience(E) with some class of tasks(T) and a Performance measure(P).If its performance at tasks in T as measured by P improves E.

Introduction to ML  
A brief review of ML history

**1950**

The term "machine learning" was coined.



**1960**

First neural networks applied to real world problems (MADALINE).



**1970**

New algorithms (**Backpropagation**) and neural networks (CNN) created.



**2000**

Deep learning accelerated by GPU development.



**1990**

Boosting algorithms discovered to reduce bias.



**1980**

Machine learning and artificial Intelligence took separate paths.



**2017**

Machine learning models in Production.



**2019**

Well financed startups leveraged machine learning.



**Now**

Scientific frontier.



AI winter



# What is Machine learning?

- Algorithm that do the learning without human intervention.
- Learning is done based on examples(data set)
- **Machine learning** is the study of computer algorithms that can improve automatically through **experience** and by the use of **data**.
- It is a part of Artificial Intelligence.

# Feature Extraction and Training



Features:  
1. Color: **Radish/Red**  
2. Type : **Fruit**  
3. Shape  
etc...



Features:  
1. Sky Blue  
2. **Logo**  
3. Shape  
etc...



Features:  
1. **Yellow**  
2. **Fruit**  
3. Shape  
etc...

# Training Data Set and Extracted Features

Colour	Type	Shape
Red	Fruit	Round
Sky Blue	Logo	Round
Yellow	Fruit	Round

1. Colour
2. Type
3. Shape

## ➤ **Supervised learning**

Correct classes of the training data are known(Labelled)

## ➤ **Unsupervised learning**

Correct classes of the training data are **not known(UnLabelled)**

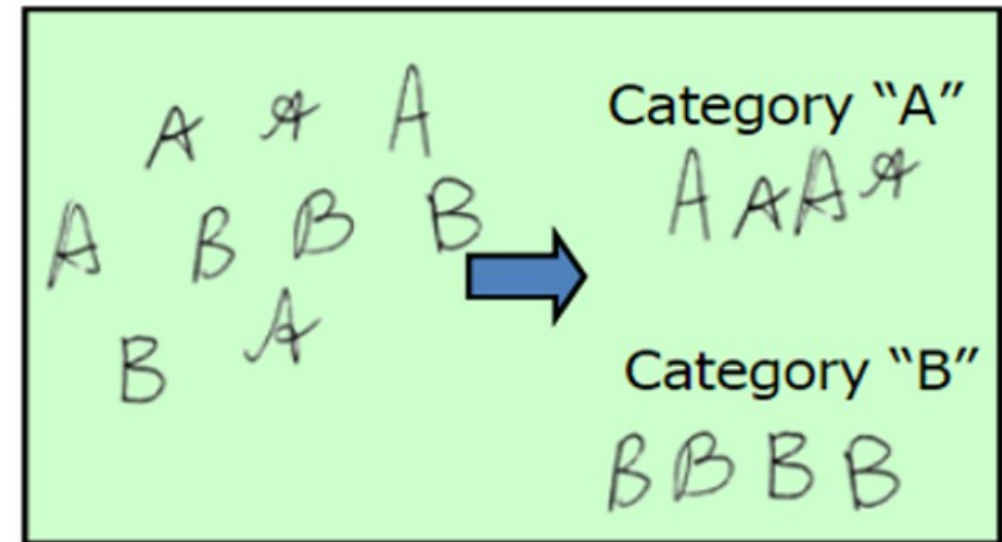
## ➤ **Reinforcement learning**

- ✓ Allows the Machine or Software agent to **learn its behavior based on feedback from the environment.**
- ✓ This behavior can be learned once and for all, or keep on adapting as time goes by.

Supervised learning



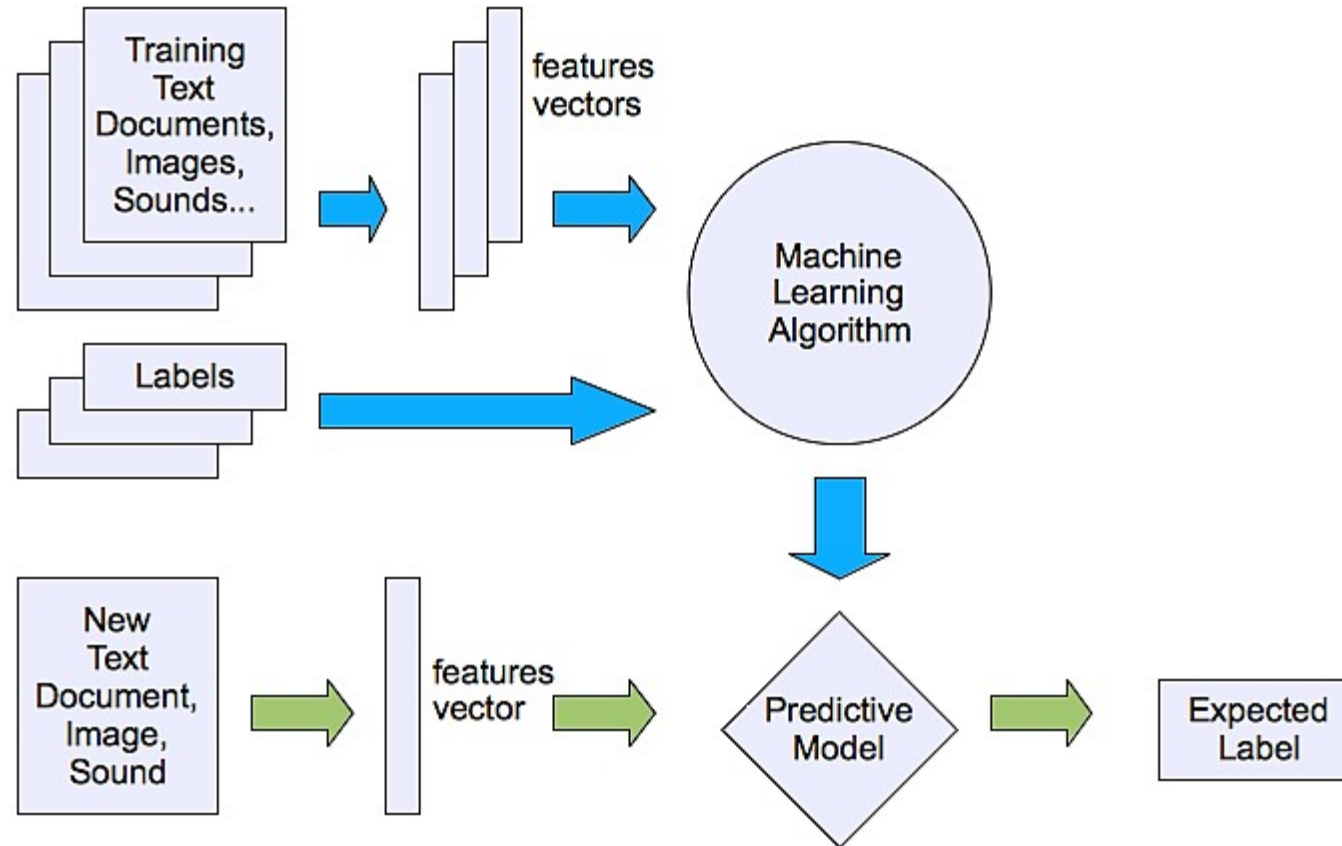
Linear Regression, Naïve Bayes,  
Hidden Markov Models (HMM),  
*K*-nearest neighbours, Decision  
Tree , Random Forest etc.



Classification (Recognition)



# Supervised learning



# Supervised learning

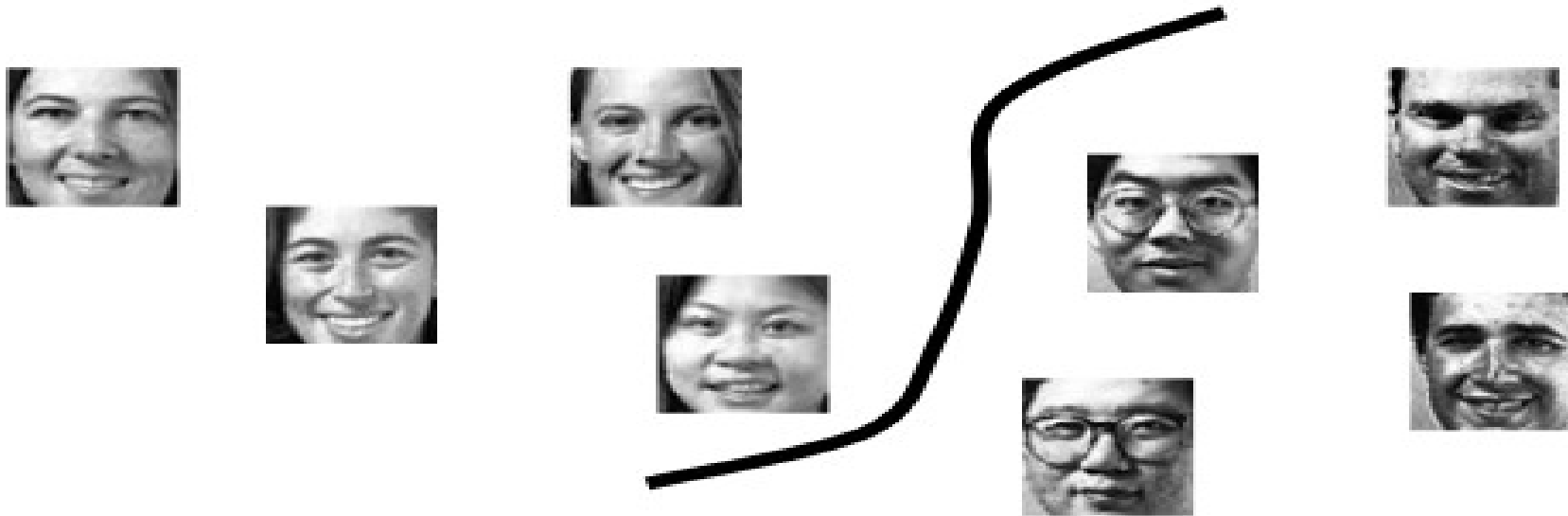
## Labelled data & Multiple Classes



Labelled data



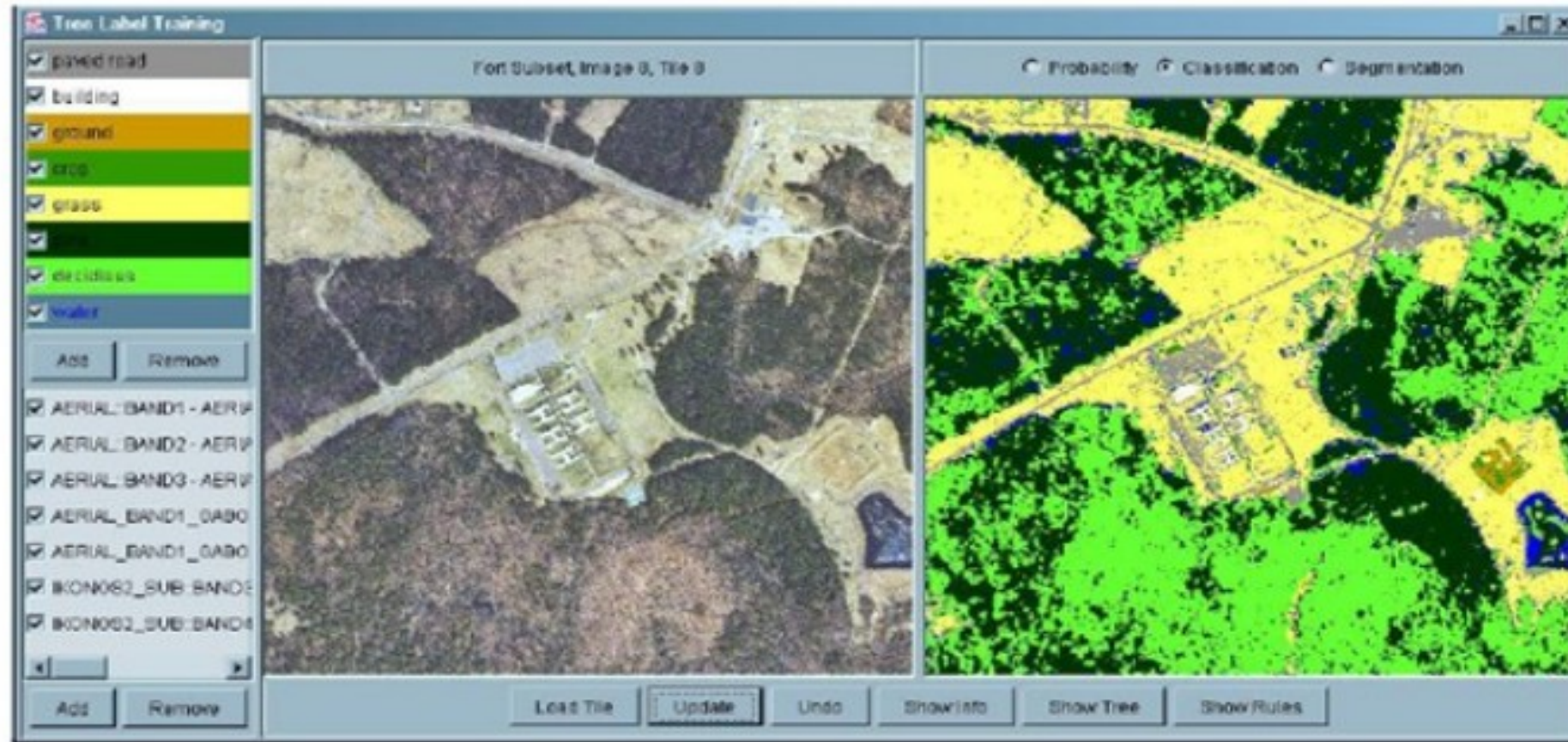
# Gender Classification



Example of balanced classes (i.e., male vs female)

# Land Cover Classification

(from aerial or satellite images)



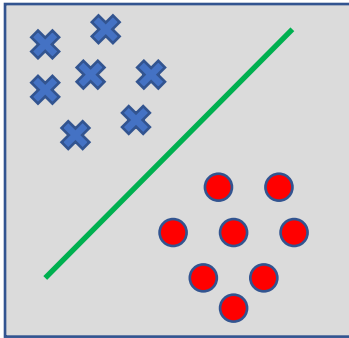


# How does Supervised learning work?

- In case of supervised learning a priori knowledge is required.
- This **priori knowledge** is acquired through **experience**, through **observation**, through **instruction**.
- It can be many in ways and during classification, If we see an **unknown object** then that unknown object has to be put into **known classes**.
- Apply that priori knowledge to recognize or to classify an unknown object.

# Learning techniques

Linear classifier



Techniques:

- Perceptron
- Logistic regression
- Support vector machine (SVM)
- Ada-line
- Multi-layer perceptron (MLP)

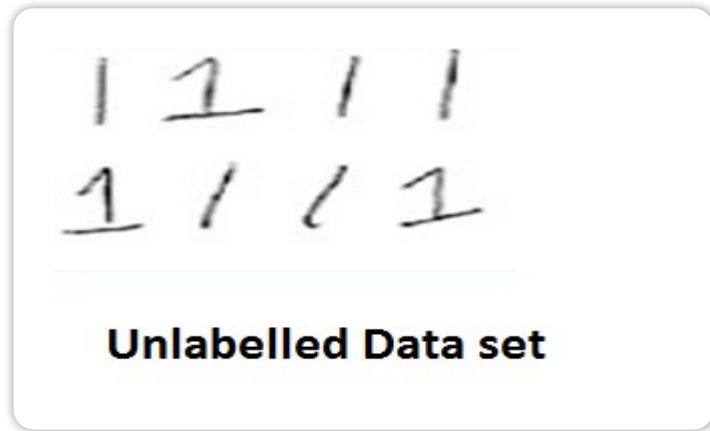
# Unsupervised learning

- A mixture of all different objects.
- From this mixture we have to separate the objects into 2

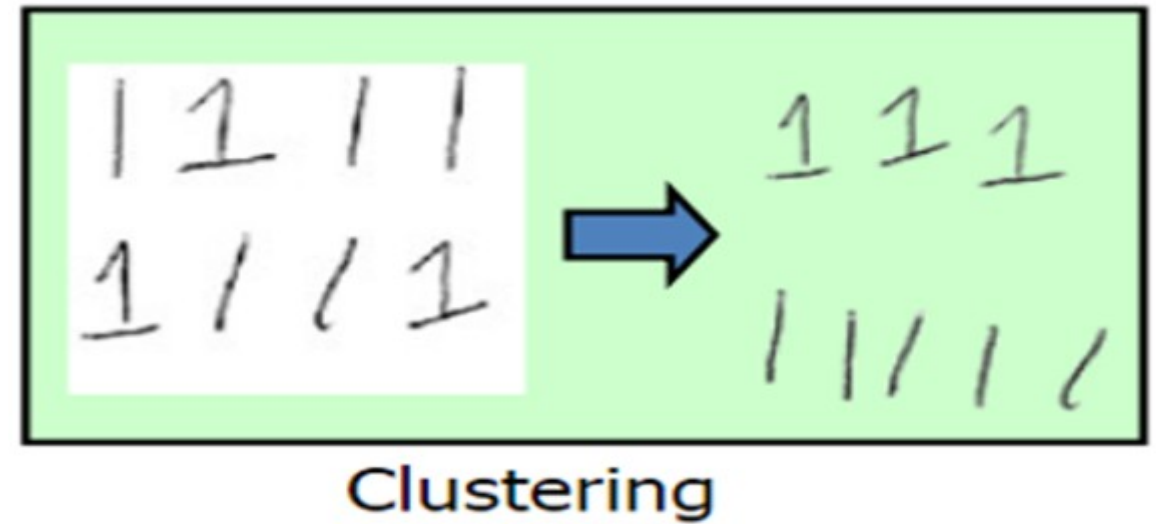


Unlabelled data



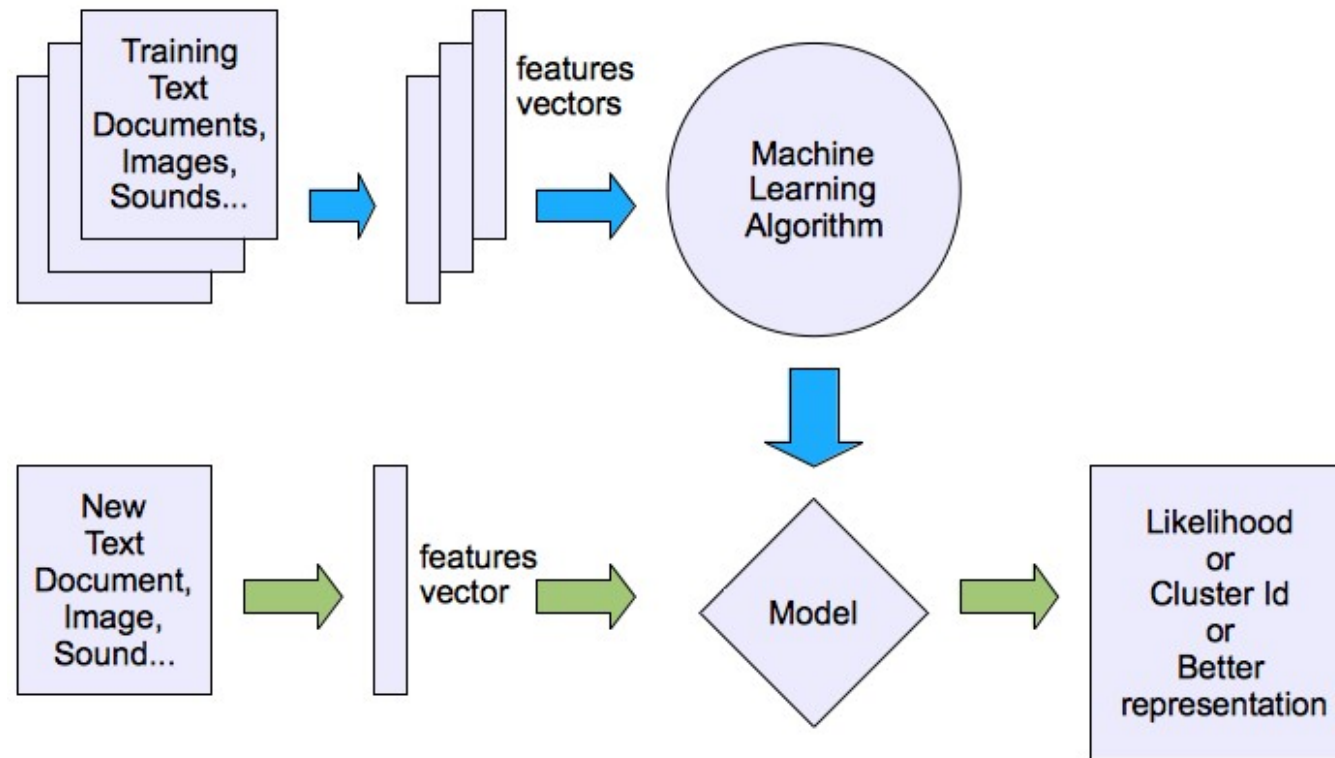


K-means clustering, Gaussian mixture model (GMM), Principal component analysis (PCA) and etc





# Unsupervised learning

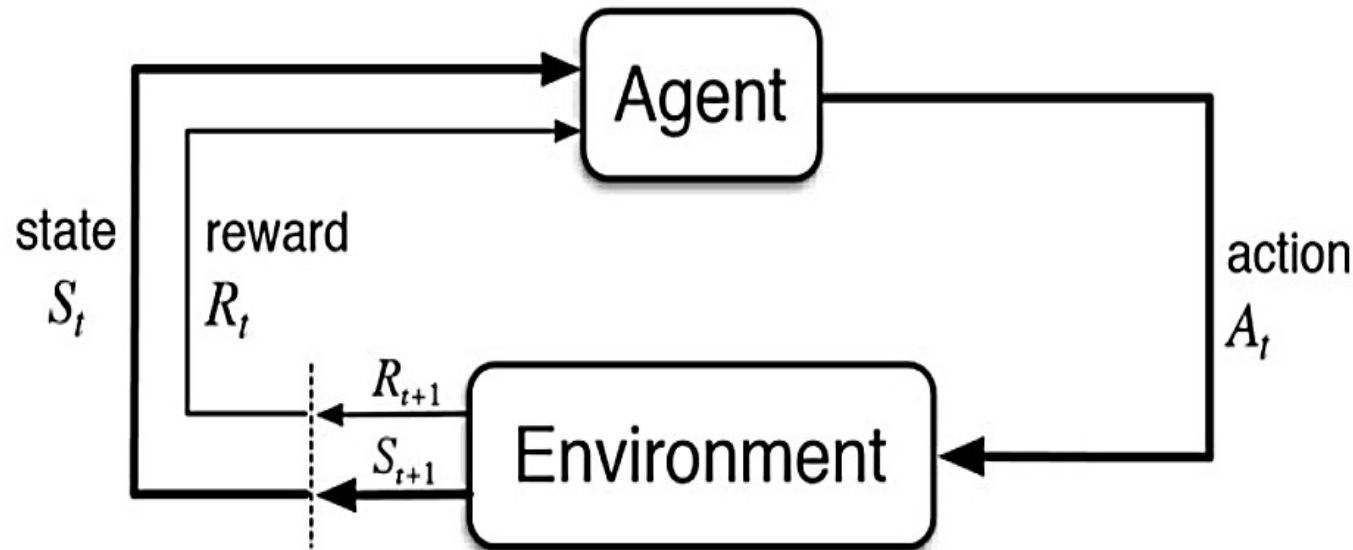


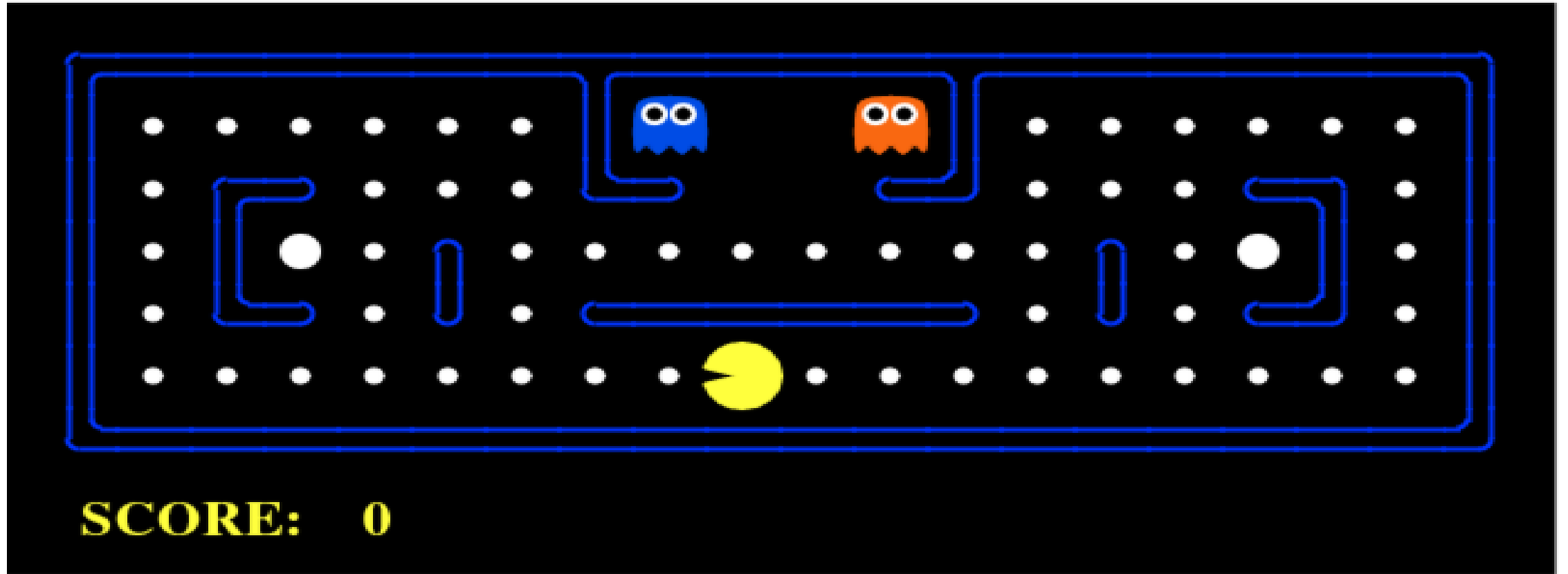
# Learning techniques

- Unsupervised learning categories and techniques
  - **Clustering**
    - K-means clustering
    - Spectral clustering
  - **Density Estimation**
    - Gaussian mixture model (GMM)
    - Graphical models
  - **Dimensionality reduction**
    - Principal component analysis (PCA)
    - Factor analysis

## Reinforcement learning

- **Environment:** Physical world in which the agent operates
- **State:** Current situation of the agent
- **Reward:** Feedback from the environment



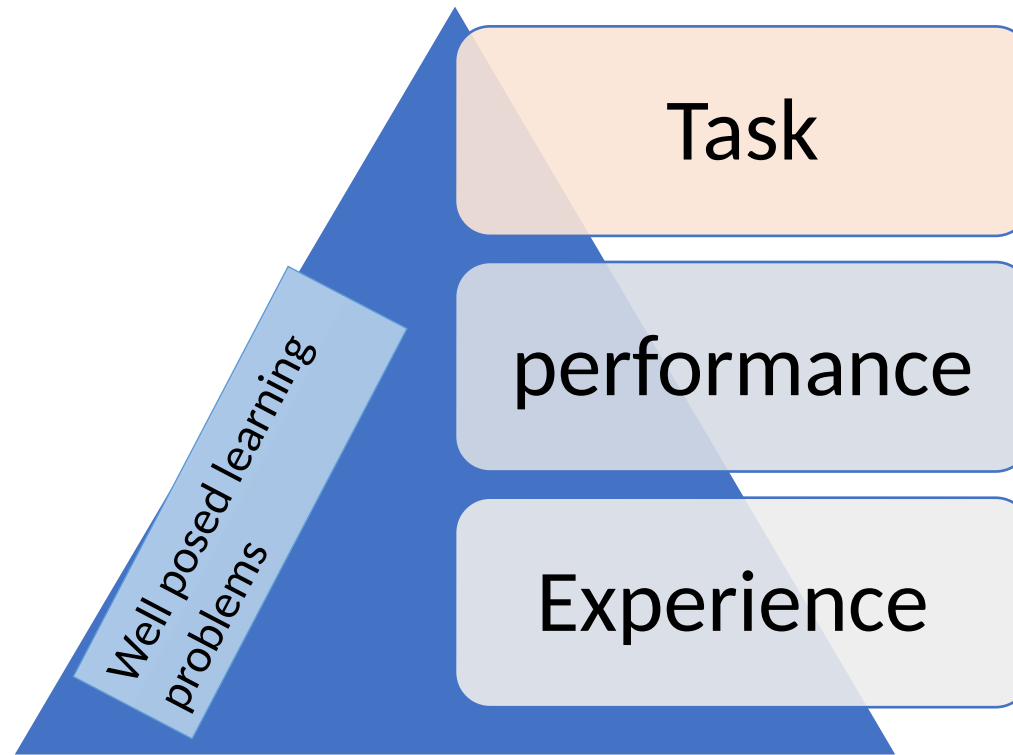


Source:<https://www.kdnuggets.com/2018/03/5-things-reinforcement-learning.html>

# Reinforcement learning (RL)

- It is concerned with how [software agents](#) ought to take [actions](#) in an *environment*.
- The problem, due to its generality, is studied in many other disciplines, such as
- Algorithm learn to react with environment.
- ✓ [simulation-based optimization](#)
- ✓ [multi-agent systems](#)
- ✓ [swarm intelligence](#)
- ✓ [statistics](#)
- ✓ [genetic algorithms](#)
- ✓ [game theory](#)
- In the operations research and control literature, reinforcement learning is called *approximate dynamic programming*, or *neuro-dynamic programming*

# Learning problem



# A handwritten recognition learning problem

- Task(T) : recognizing and classifying handwritten words within images.
- Performance measure (P) : percent of words correctly classified.
- Experience(E) : A database of handwritten words with given classifications.

# A robot driving learning problem

- Task(T) : driving on public four lane highways using vision sensors.
- Performance measure (P) : average distance travelled before an error(as judged by human).
- Experience(E) : A sequence of images and steering commands recorded while observing a human driver.



# Applications of Machine learning

- Health care
- Education
- Financial modeling
- Computer vision
- Speech recognition
- Natural language processing
- Robot control etc.

***Several domain specific areas are emerging...***