1. Introduction

What is Machine Learning?

Input

Prediction Rule

Output

Cat	**1**
Dog	0
Bird	0
Horse	0

Cat	0
Dog	**1**
Bird	0
Horse	0

Cat	0
Dog	0
Bird	0
Horse	**1**

A Rule Based Approach

Concept

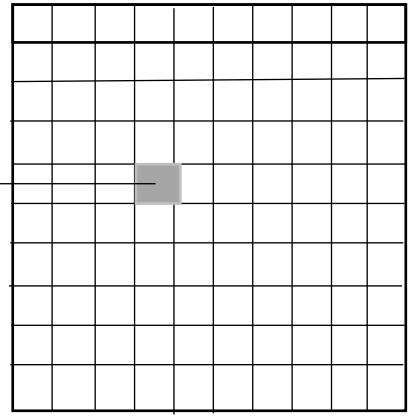
Input

Rules are pre-specified

Classification Rule

Output

Cat	**1**
Dog	0
Bird	0
Horse	0



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```
input data
if condition 1 satisfied
    ...
        if condition n satisfied
            output cat
        else
            output dog
end
```

The Learning Based Approach

Concept

Example 1		Example 2		Example 3		Example 4	
							
Cat	0	Cat	0	**Cat**	**1**	Cat	0
Dog	**1**	Dog	0	Dog	0	Dog	0
Bird	0	Bird	0	Bird	0	**Bird**	**1**
Horse	0	**Horse**	**1**	Horse	0	Horse	0

Learning Algorithm

Classification Rule Set

Classification Rule

Cat	**1**
Dog	0
Bird	0
Horse	0

New Input

New Output

What is machine learning?

Field of study that gives computers the ability to learn without being explicitly programmed.

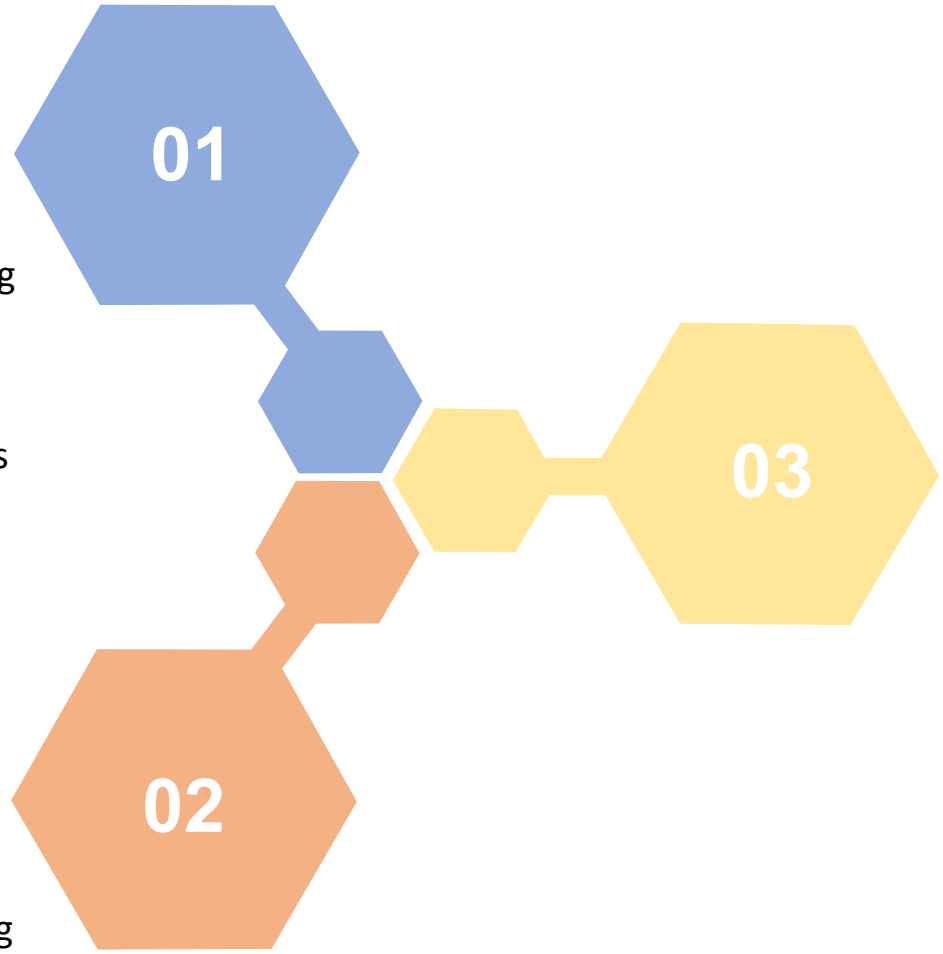
Arthur Samuel (1959)

Rules learnt automatically based on data/experience

Machine Learning Paradigms

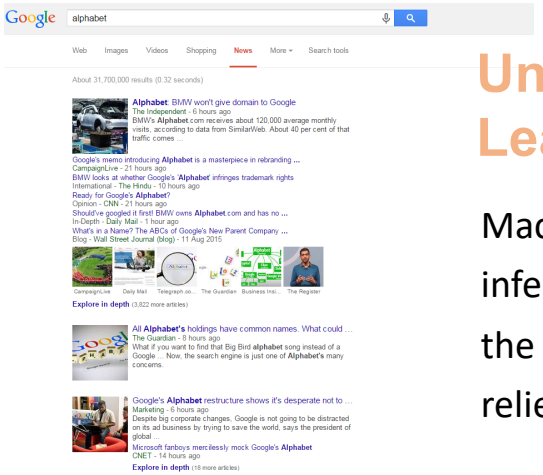
Supervised Learning

Machine learning task of inferring a function describing the relationship between independent and dependent variables in a dataset. It relies on labelled examples



Reinforcement Learning

It is concerned with how software agents ought to take actions in an environment so as to maximize some cumulative reward.

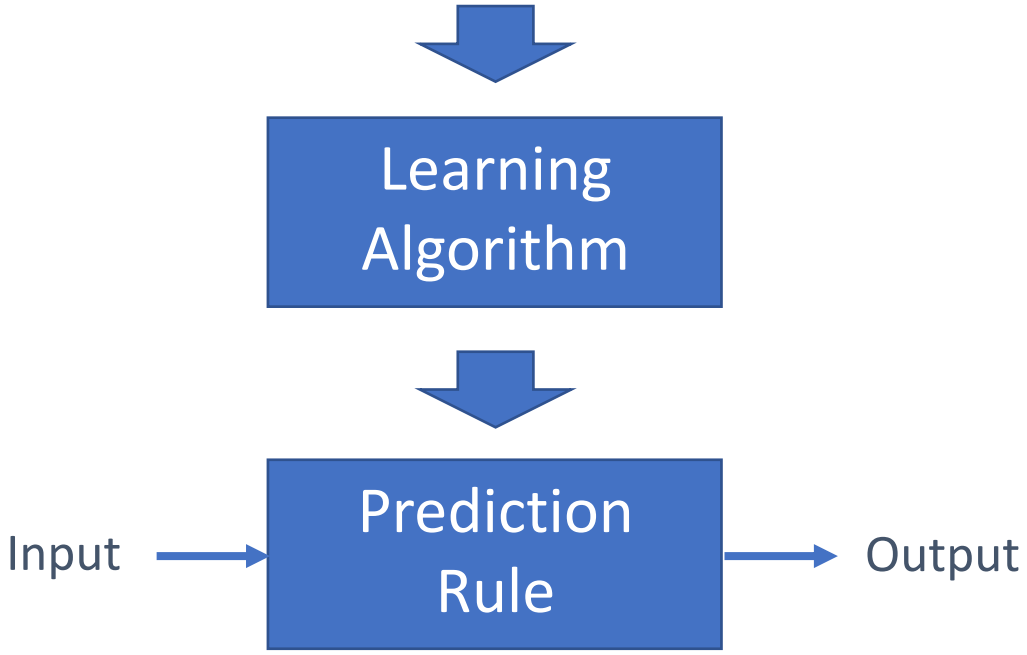


Unsupervised Learning

Machine learning task of inferring a function describing the structure of a dataset. It relies on unlabelled data.

Supervised Learning

Example 1		Example 2		Example 3		Example 4		Example 5		Example 6	
											
Cat	**1**	Cat	0	Cat	0	**Cat**	**1**	Cat	0	Cat	0
Dog	0	**Dog**	**1**	Dog	0	Dog	0	Dog	0	Dog	0
Bird	0	Bird	0	Bird	0	Bird	0	**Bird**	**1**	**Bird**	**1**
Horse	0	Horse	0	**Horse**	**1**	Horse	0	Horse	0	Horse	0



Concept

The task of inferring a function describing the relationship between independent and dependent variables in a dataset (based on labelled examples)

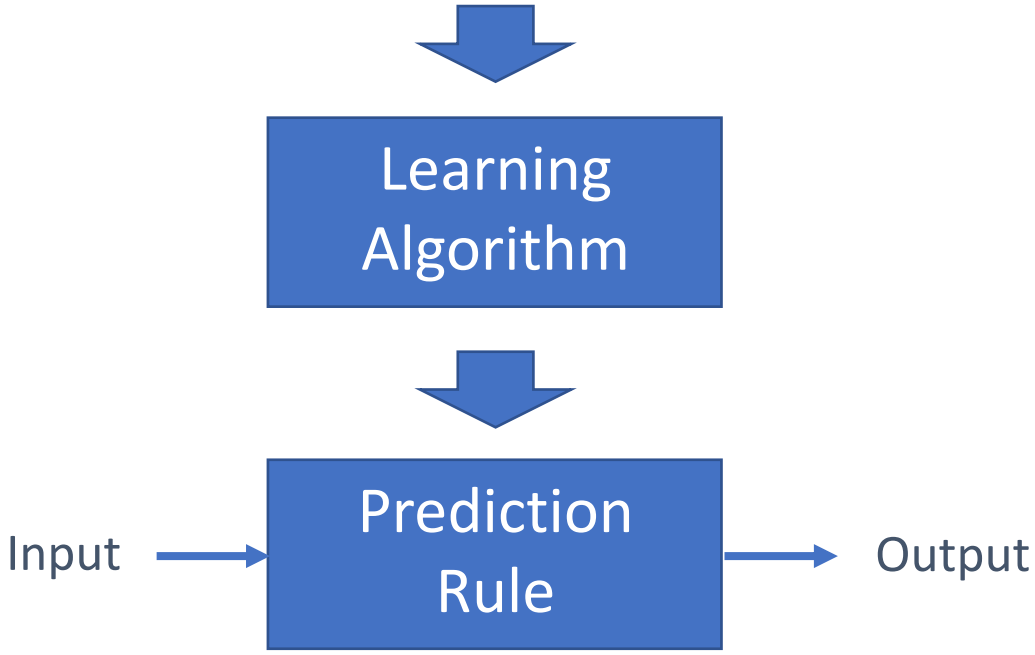
Applications

Supervised learning can be used to solve various tasks:

- Classification tasks
- Regression tasks
- Forecasting tasks
- Recommender systems
- Anomaly detection tasks

Variant: Semi-Supervised Learning

Example 1	Example 2	Example 3	Example 4	Example 5	Example 6
					
Cat 1 Dog 0 Bird 0 Horse 0		Cat 0 Dog 0 Bird 0 **Horse 1**			Cat 0 Dog 0 **Bird 1** Horse 0



Examples: Supervised Learning

Classification

Predict the class of an item given various examples

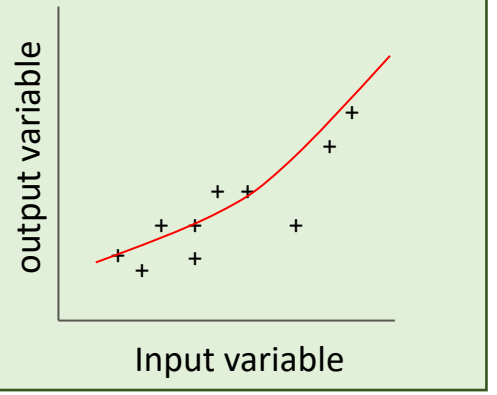
Example:

Classification of tumors as benign or malign based on:

- appearance (feature 1)
- tumor size (feature 2)

Regression

Predict the value of a variable given other variables.

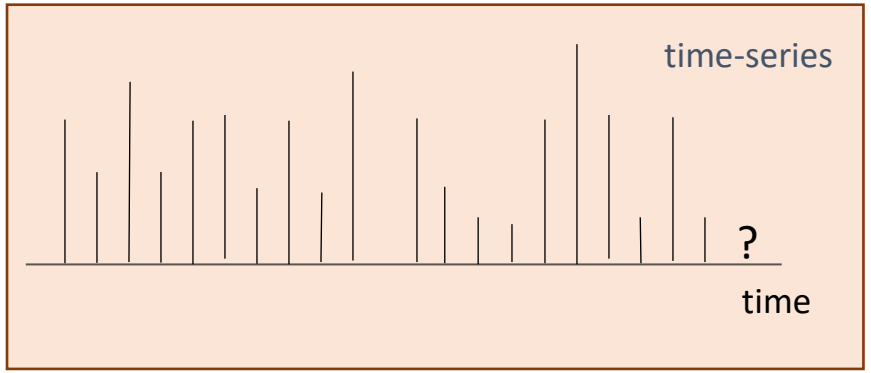


Example:

Prediction of a car's price (output variable) based on the car's mileage (input variable)

Forecasting

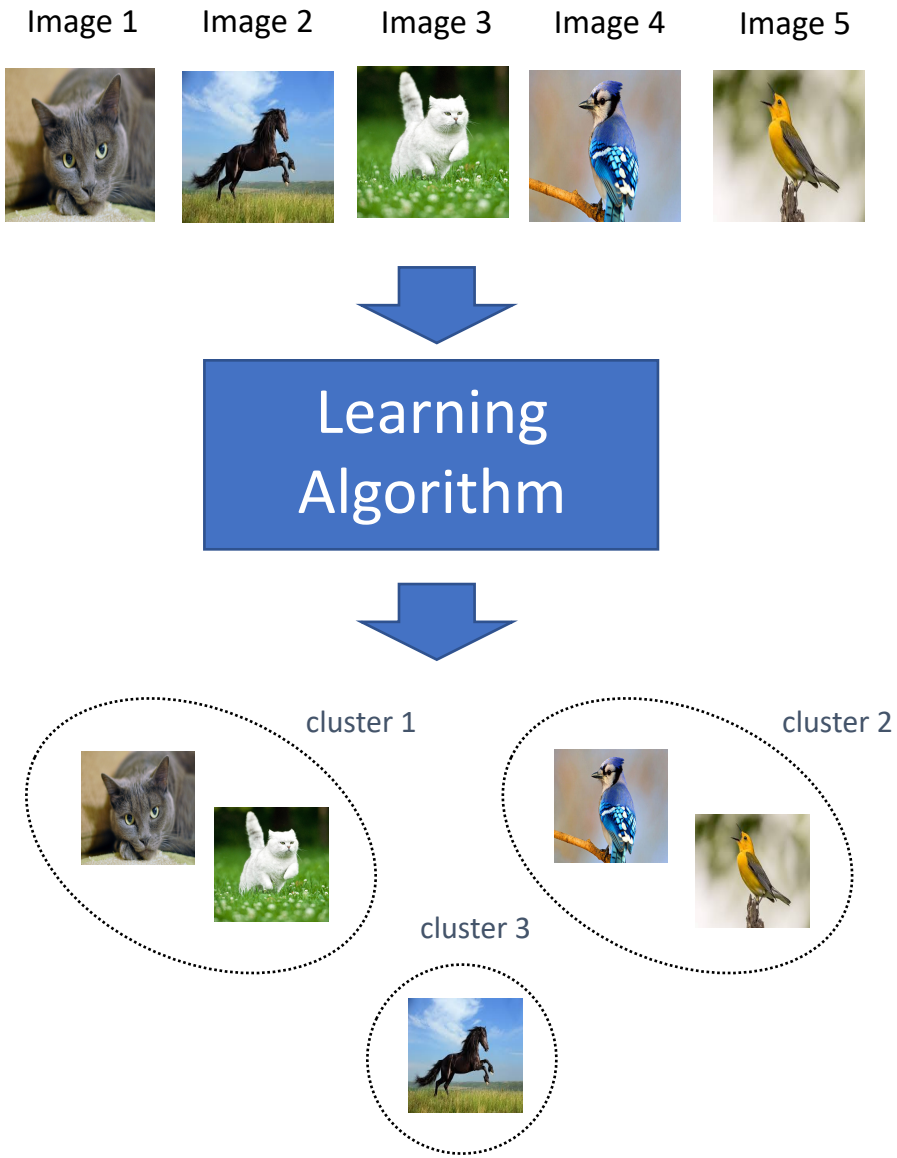
Predict future values given past ones



Example:

Prediction of tomorrow's stock value based on the previous stock values.

Unsupervised Learning



Concept

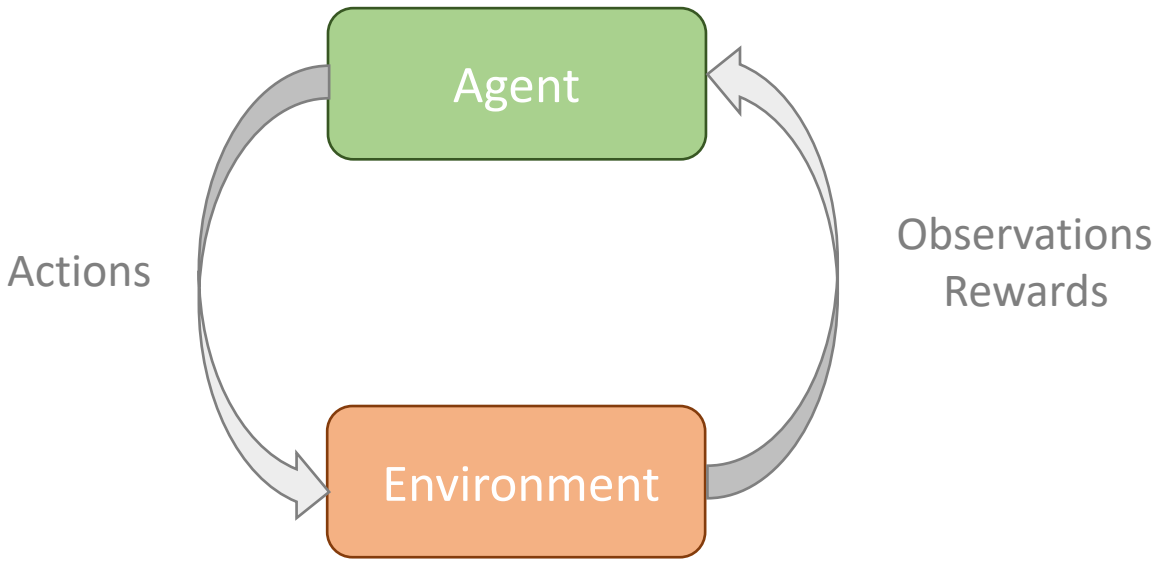
The task of inferring a function describing the structure of a dataset (based on unlabelled data).

Examples

Examples of unsupervised learning tasks include:

- Clustering tasks
- Dimensionality reduction tasks
- Recommender systems
- Anomaly detection tasks

Reinforcement Learning



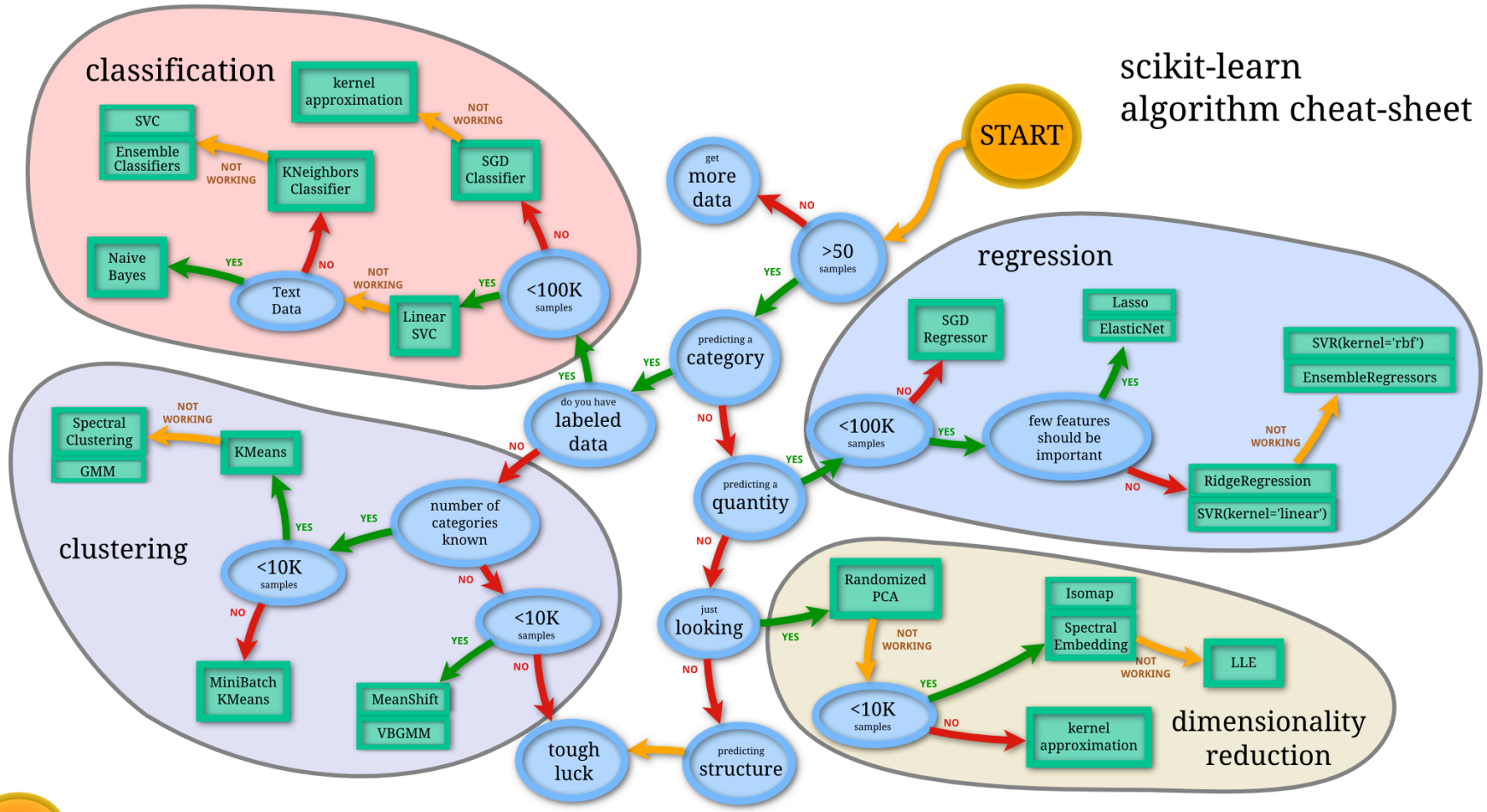
Concept

Reinforcement learning represents an agent's attempt to approximate the environment's function, in order to determine the agent's actions on the black-box environment that maximize the agent's rewards

Applications

Robotics, industrial automation, education and training, health and medicine, media and advertising, finance

The Machine Learning Landscape

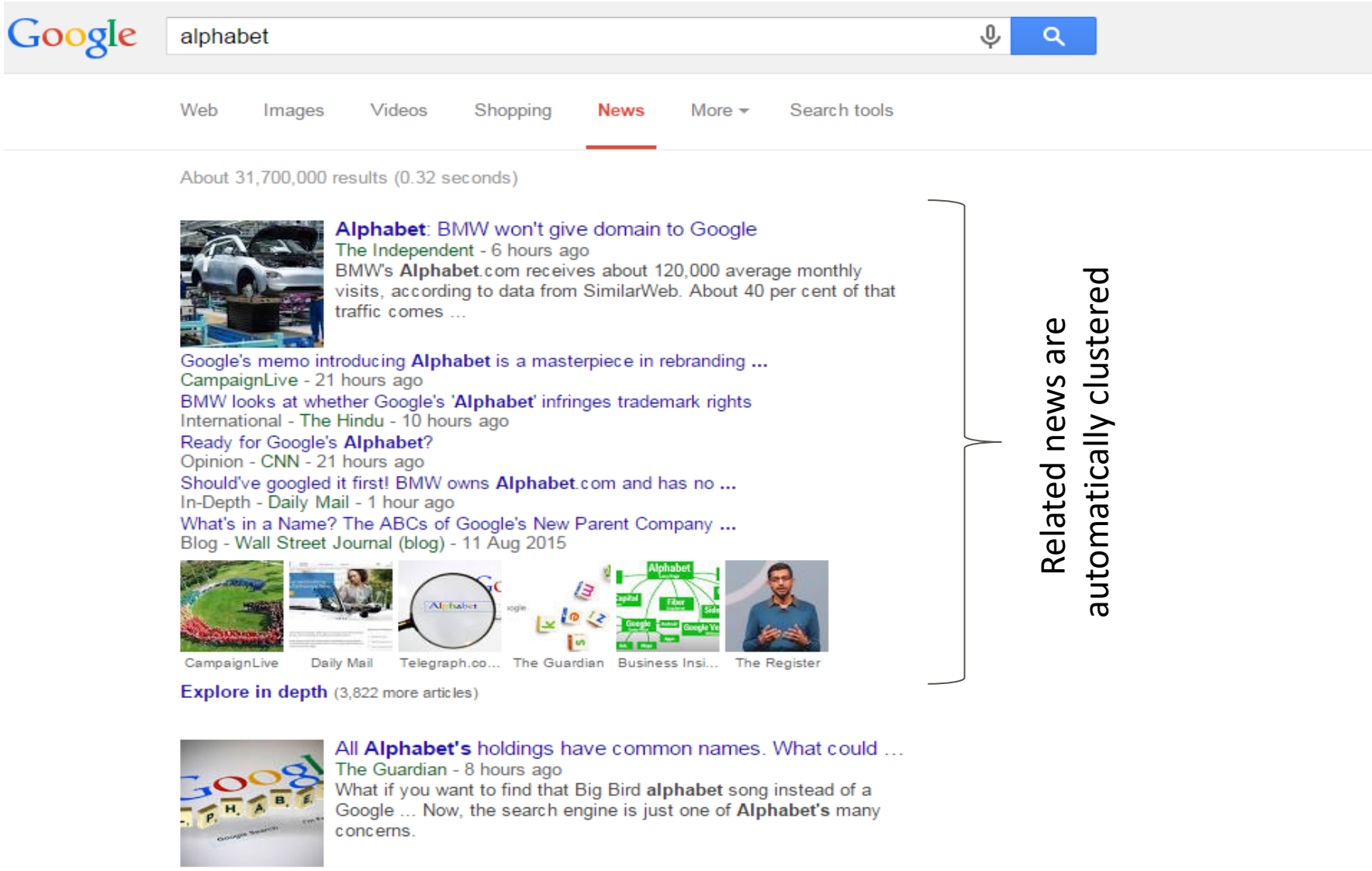


Note: There is also now state-of-the-art approaches such as deep learning and deep reinforcement learning

Back

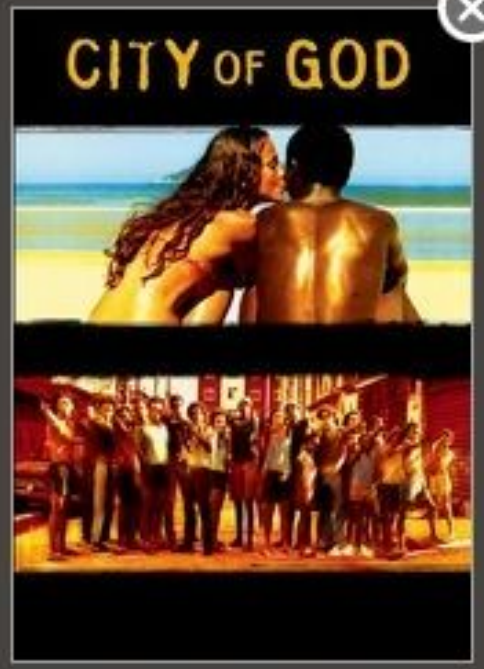
https://scikit-learn.org/stable/tutorial/machine_learning_map/index.html

Machine Learning: Real-World Examples



NETFLIX Home Just for Kids Genres Suggestions for You

Rate what you've seen to discover suggestions for you



Haven't Seen It

Haven't Seen It

Haven't Seen It

Action & Adventure

Machine Learning: Real-World Examples

The Machine Learning Process