



Machine Learning

Introduced by

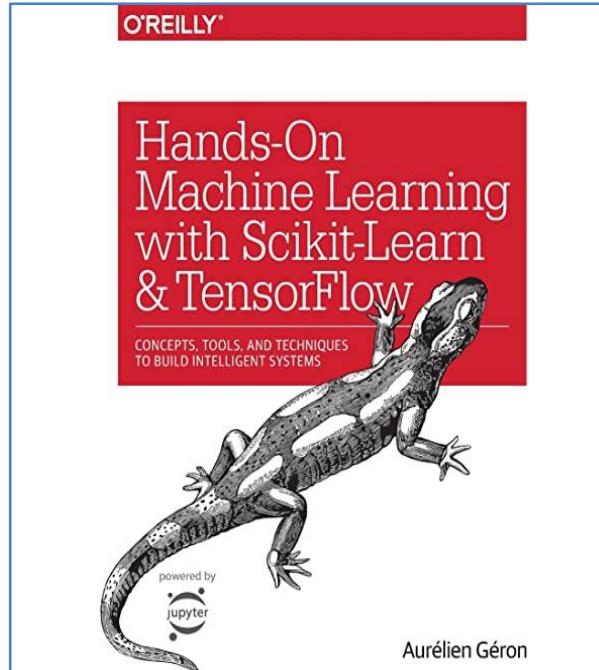
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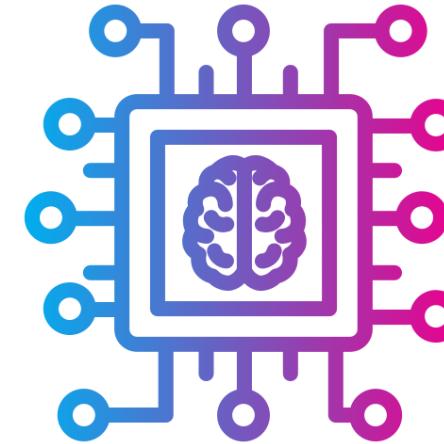


Materials



Aurélien Géron

Introduced by
Dr. Ebtsam Adel





Outline

- Course objectives
- Topics
- Textbooks
- Practical part



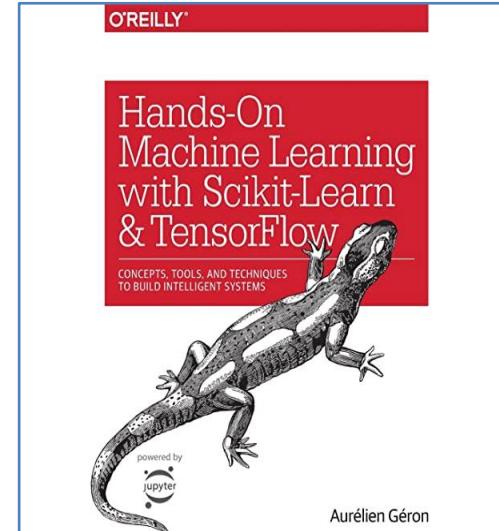
Course objectives

- Provides an introduction to machine learning Definition and examples of machine learning Supervised learning (of classification and regression functions); K-nearest neighbors, decision trees, naïve Bayes, support vector machines, logistic regression, evolutionary algorithms, Bayesian Networks,...
- Provides an introduction to deep neural networks.



Topics

- Ch01_The Machine Learning Landscape
- Ch04_Training Models: linear regression
- Ch05_Support vector machine
- Ch06_decision tress
- Ch07_Ensemble Learning and Random Forests
- Ch08_Dimensionality Reduction
- Ch09_Introduction to Artificial Neural Networks with Keras



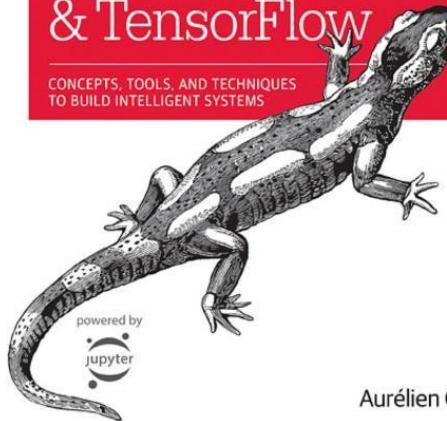


Textbooks

O'REILLY®

Hands-On Machine Learning with Scikit-Learn & TensorFlow

CONCEPTS, TOOLS, AND TECHNIQUES
TO BUILD INTELLIGENT SYSTEMS



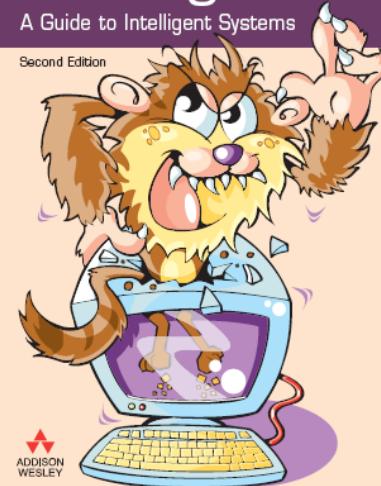
Aurélien Géron

MICHAEL NEGNEVITSKY

Artificial Intelligence

A Guide to Intelligent Systems

Second Edition



ADDISON
WESLEY

http://14.139.161.31/OddSem-0822-1122/Hands-On_Machine_Learning_with_Scikit-Learn-Keras-and-TensorFlow-2nd-Edition-Aurelien-Geron.pdf



Assessment Summary (Grading Policy)

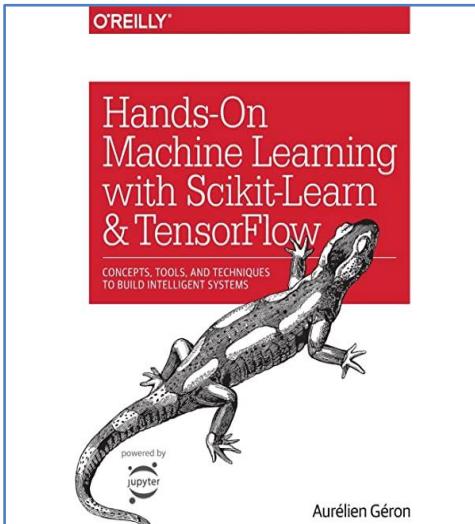
- The Assessment for this subject consists of five components with the following weightings (grading breakdown):

Allocation of Marks	
Midterm examination	20%
Practical exam	20%
Unannounced Quizzes	10%
Final examination	50%
Total	100%

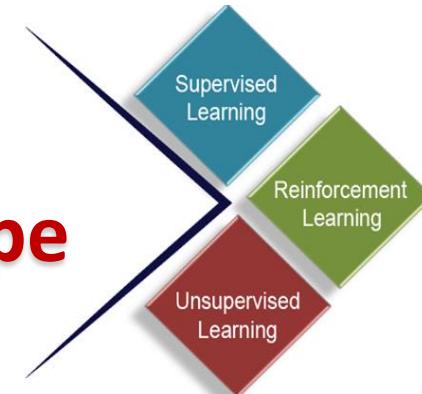


1
chapter

Machine Learning



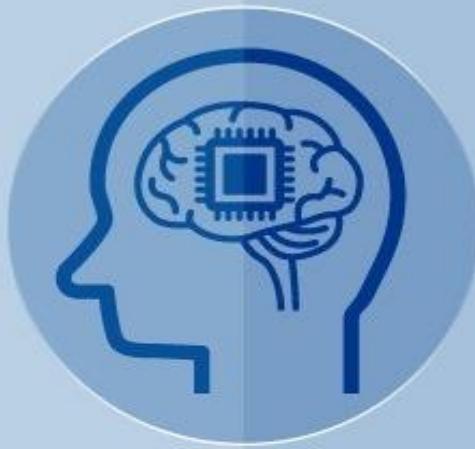
The Machine Learning Landscape



By
Dr. Ebtsam Adel



Artificial Intelligence



Engineering of
making Intelligent
Machines and Programs

1950's

1960's

1970's

1980's

1990's

2000's

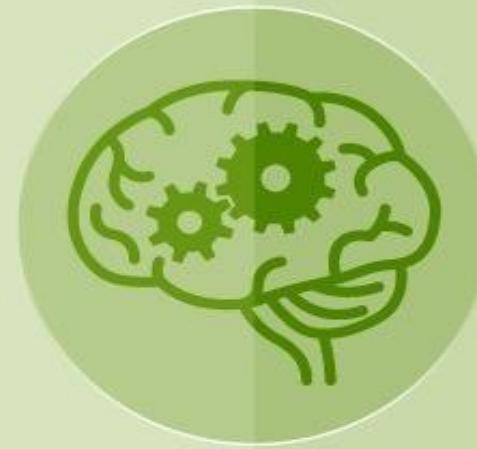
2006's

2010's

2012's

2017's

Machine Learning



Ability to learn
without being explicitly
programmed

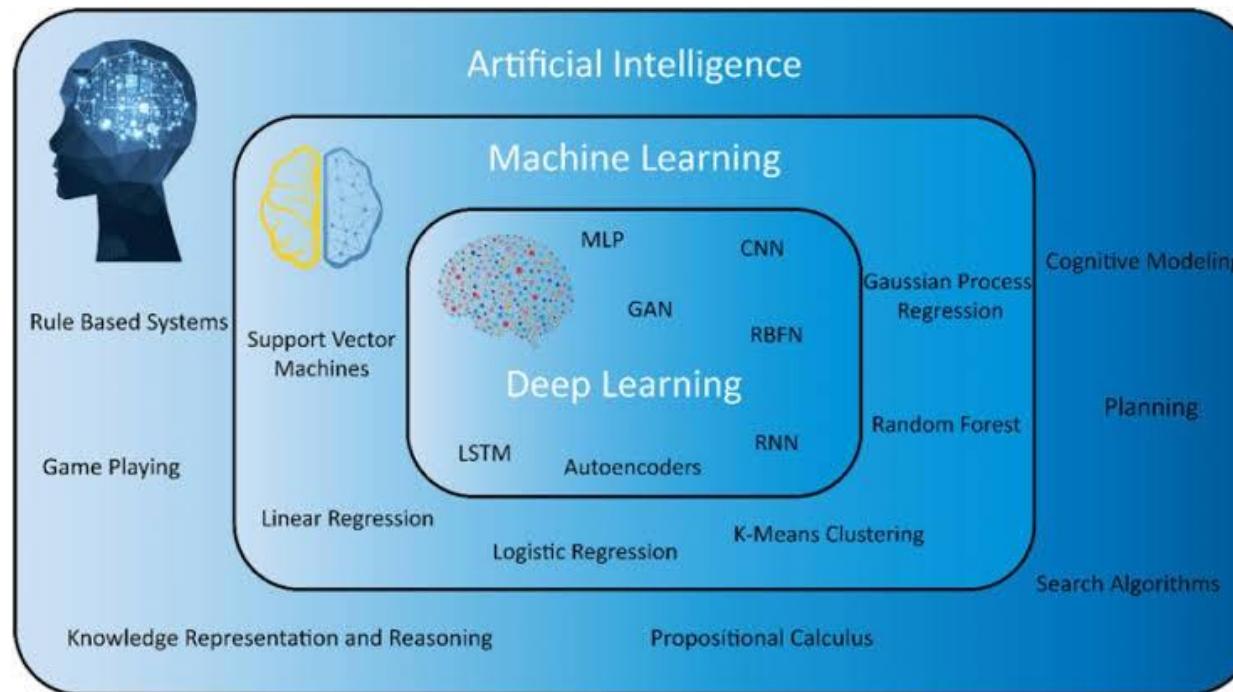
Deep Learning



Learning based on
Deep Neural
Network

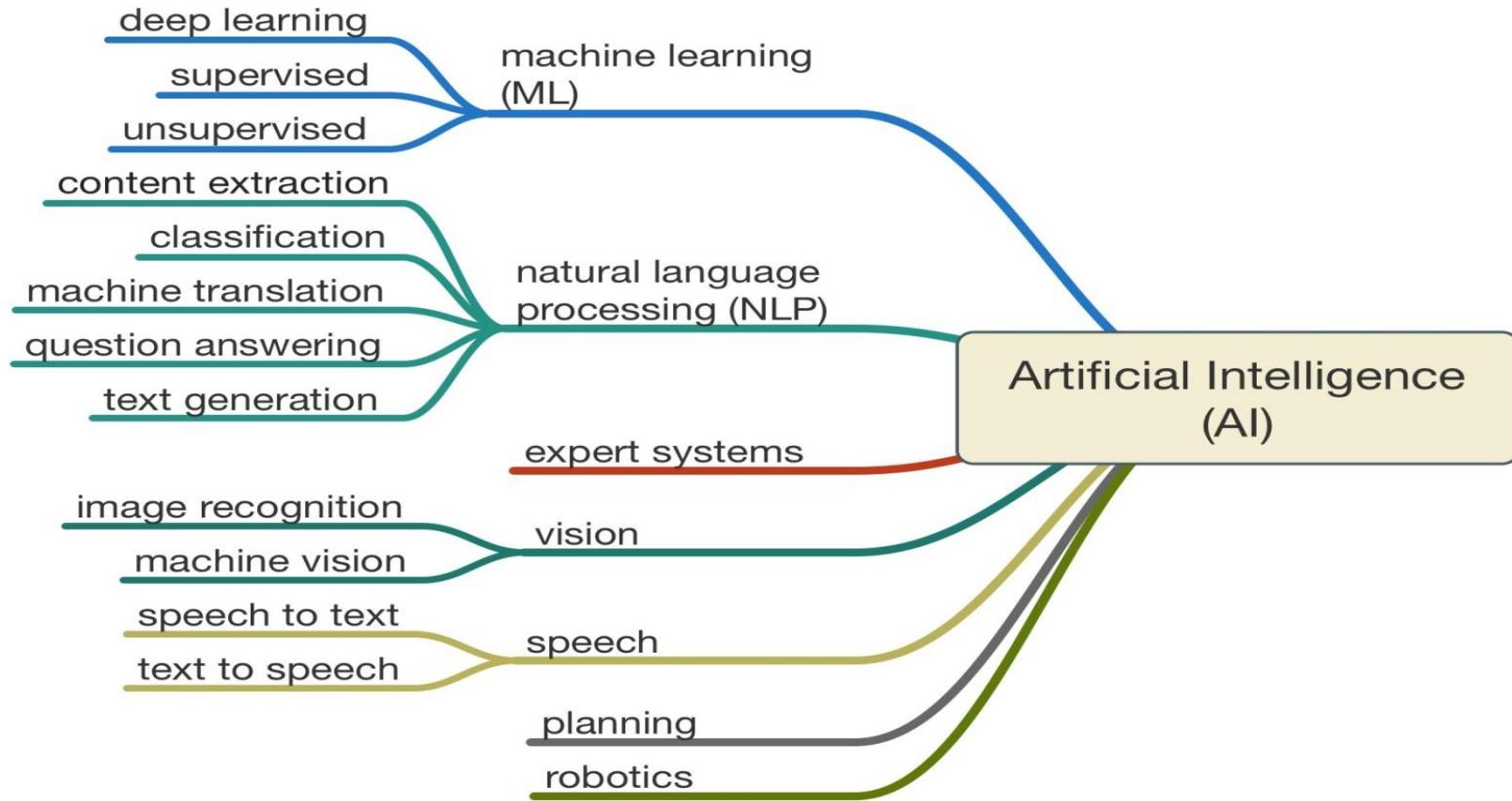


Machine Learning





Machine Learning





Overview

- ❖ What Is Machine Learning?
- ❖ Why Use Machine Learning?
- ❖ Types of Machine Learning Systems
 - Supervised/Unsupervised Learning
 - Batch and Online Learning
 - Instance-Based Versus Model-Based Learning



What is Machine Learning?

- **Machine Learning** is the science (and art) of programming computers so they can **learn from data**.
- **Machine Learning** is the field of study that gives computers the ability to learn **without** being **explicitly programmed**. "Arthur Samuel, 1959"
- 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**. "Tom Mitchell, 1997"



What is Machine Learning?

We can simplify the definition as follows.

Machine Learning is a field that consists of learning algorithms that:

- ❖ Improve their **performance P**
- ❖ At executing some **task T**
- ❖ Over time with **experience E**

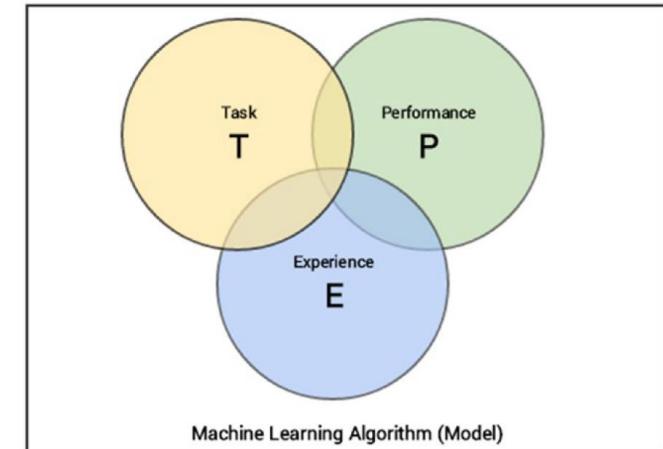


Figure 1-3. Defining the components of a learning algorithm



What is Machine Learning?

Defining the Task, T:

- ✓ Classification or categorization
- ✓ Regression
- ✓ Anomaly detection
- ✓ Translation
- ✓ Clustering or grouping
- ✓ Transcriptions
- ✓



What is Machine Learning?

Defining the Experience, E

- The process of consuming a **dataset** that consists of data samples or data points such that a learning algorithm or model **learns** inherent patterns is defined as the experience, E which is gained by the learning algorithm.
- the idea of a model or algorithm gaining experience usually occurs as an **iterative process**, also known as **training the model**.



What is Machine Learning?

Defining the Performance, P

The performance, P , is usually a **quantitative measure** or **metric** that's used to see how well the algorithm or model is performing the task, T , with experience, E .



Why Use Machine Learning?

Traditional Programming



Machine Learning



Machine learning: how to acquire a model on the basis of data / experience



Why Use Machine Learning?

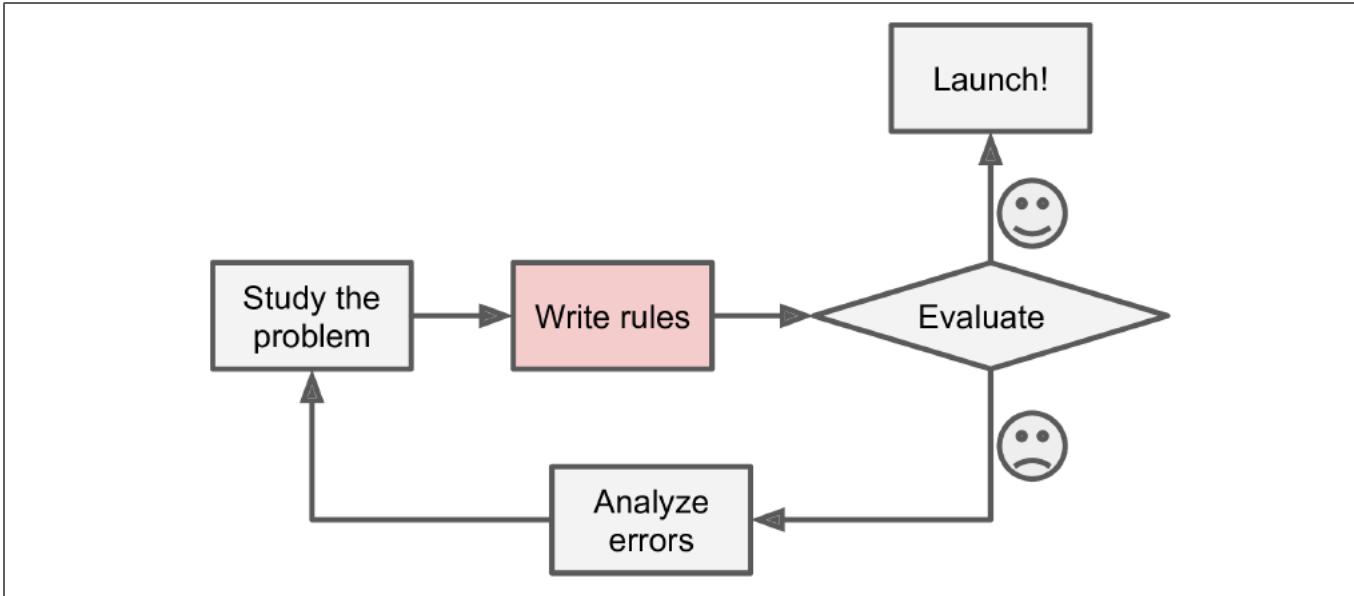


Figure 1-1. The traditional approach



Why Use Machine Learning?

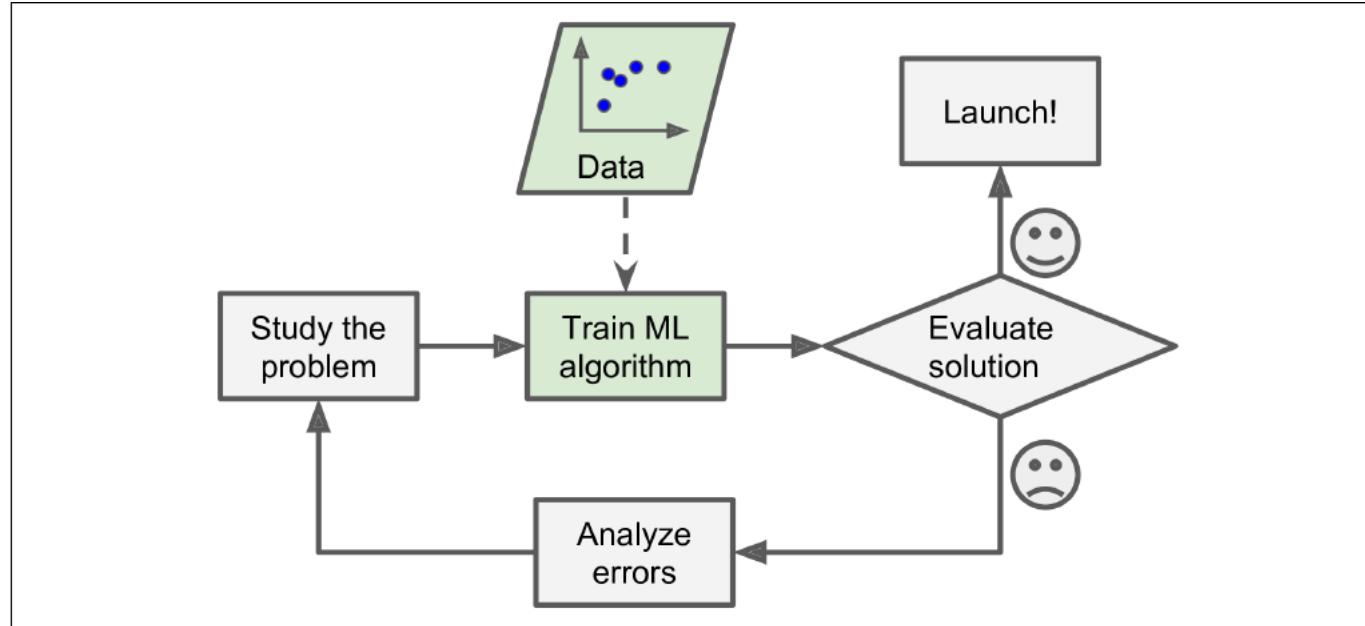


Figure 1-2. Machine Learning approach



Why Use Machine Learning?

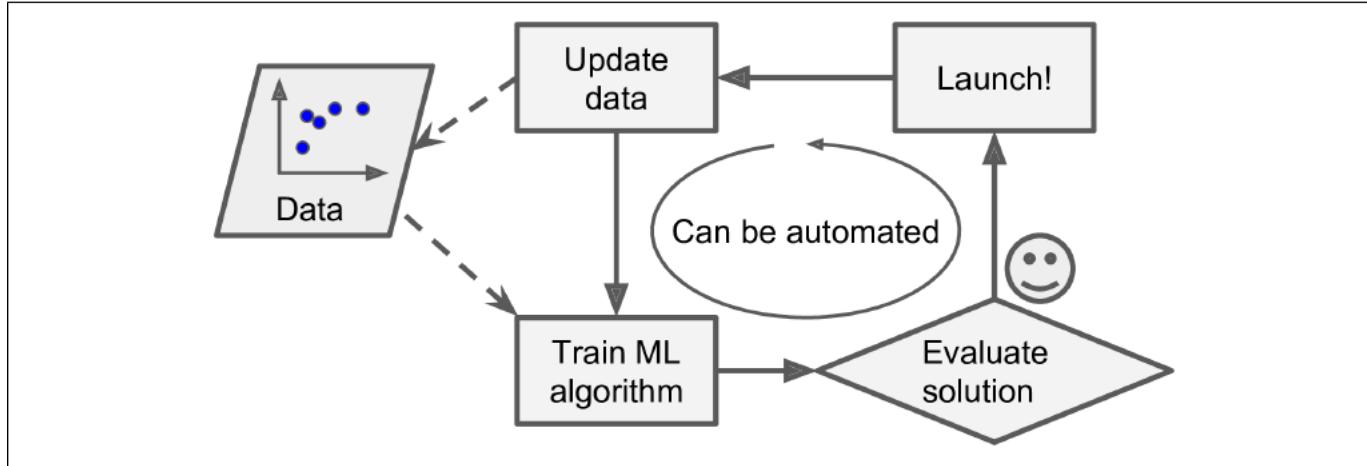


Figure 1-3. Automatically adapting to change



Why Use Machine Learning?

Consider how you would write a **spam filter** using **traditional programming** techniques

- First you would look at what spam typically looks like. You might notice that some words or phrases (such as “**4U**,” “**credit card**,” “**free**,” and “**amazing**”) tend to come up a lot in the subject. Perhaps you would also notice **a few other patterns** in the sender’s name, the email’s body, and so on.
- You would write a detection algorithm for each of the patterns that you noticed, and your program **would flag emails as spam if a number of these patterns are detected**. You would test your program, and repeat steps 1 and 2 until it is good enough.
- **Long list of complex rules!**



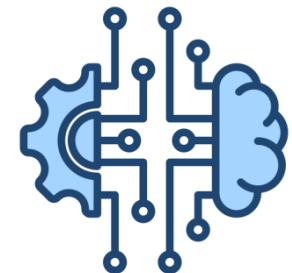
Why Use Machine Learning?

- Moreover, if **spammers** notice that all their emails containing “**4U**” are blocked, they might start writing “**For U**” instead.
- A spam filter using **traditional** programming techniques would need to be updated to flag “**For U**” emails.
- If **spammers keep working** around your spam filter, you will need to **keep writing** new rules forever.



Why Use Machine Learning?

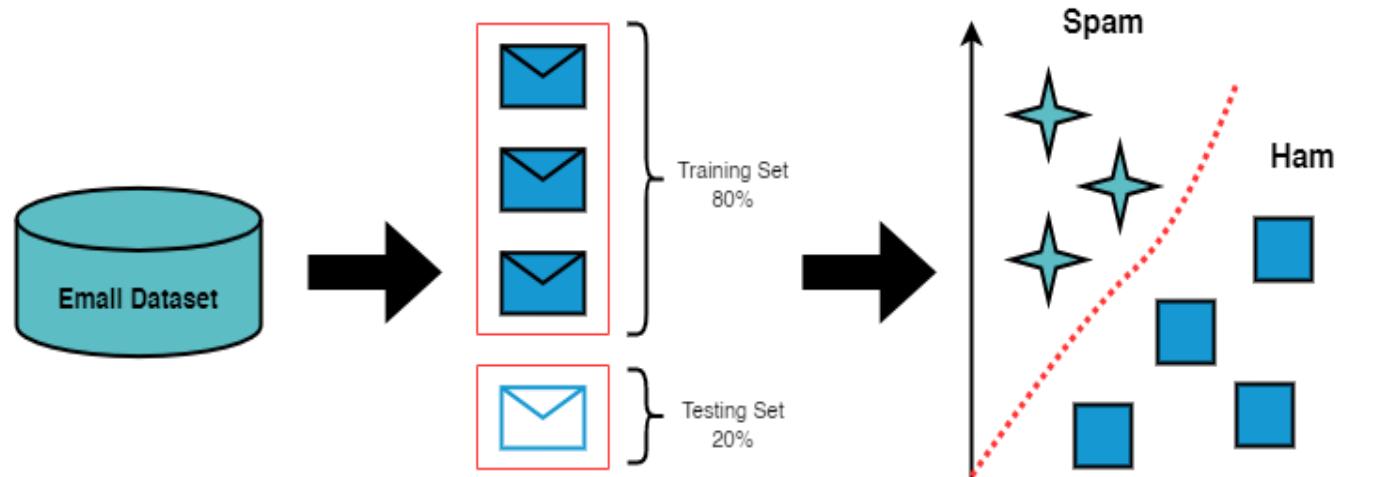
- Another area where Machine Learning shines is for problems that either are **too complex** for traditional approaches or have no known algorithm. For example, consider **speech recognition**.
- Applying ML techniques to dig **into large amounts of data** can help discover patterns that were not immediately apparent. This is called *data mining*.





Why Use Machine Learning?

- In contrast, a spam filter based on **Machine Learning** techniques **automatically** notices that “For U” has become **unusually frequent** in spam flagged by users, and it starts flagging them without your intervention.



Instance Gathering

Training and Testing

Classification



Why Use Machine Learning?

To summarize, Machine Learning is great for:

- Problems for which existing solutions require a lot of hand-tuning or **long lists of rules**: one Machine Learning algorithm can often simplify code and perform better.
- **Complex problems** for which there is no good solution at all using a traditional approach: the best Machine Learning techniques can find a solution.
- **Changed environments**: a Machine Learning system can adapt to **new data**.
- Getting insights about complex problems and **large amounts of data**.



Machine learning algorithms

Some of the machine learning algorithms are:

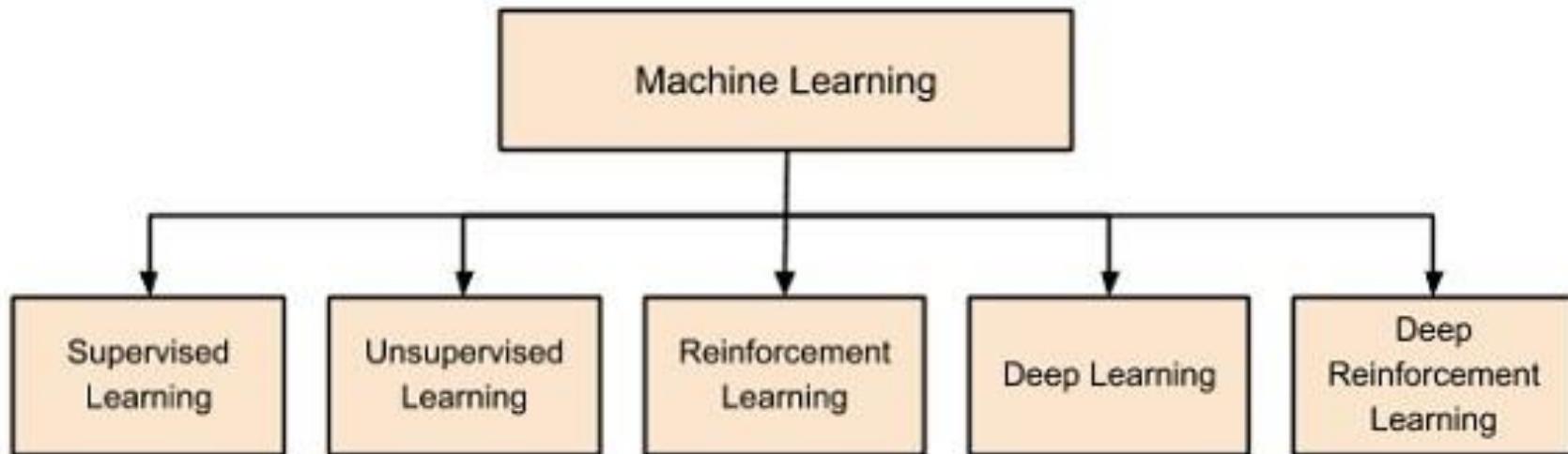
- Random Forests
- Decision trees
- Linear Regression
- Logistic Regression
- Support Vector Machines (SVMs)
- K-nearest neighbors
- naïve Bayes
-

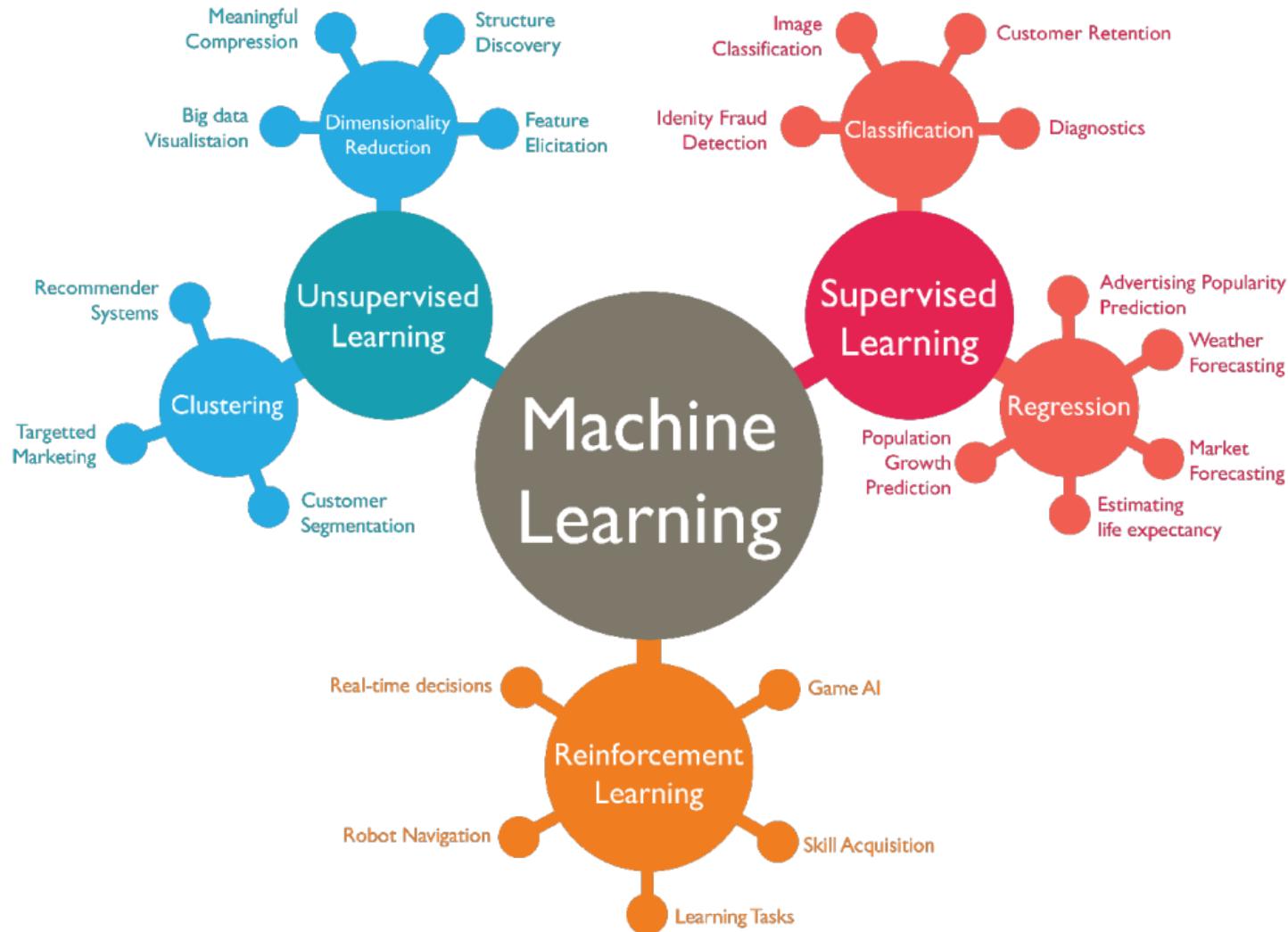


Types of Machine Learning

Types of Machine Learning

Types of Machine Learning







Types of Machine Learning

Whether or not they are trained with human supervision



Types of Machine Learning

There are three types of machine learning

□ **Supervised learning**

- Data and corresponding **labels** are given

□ **Unsupervised learning**

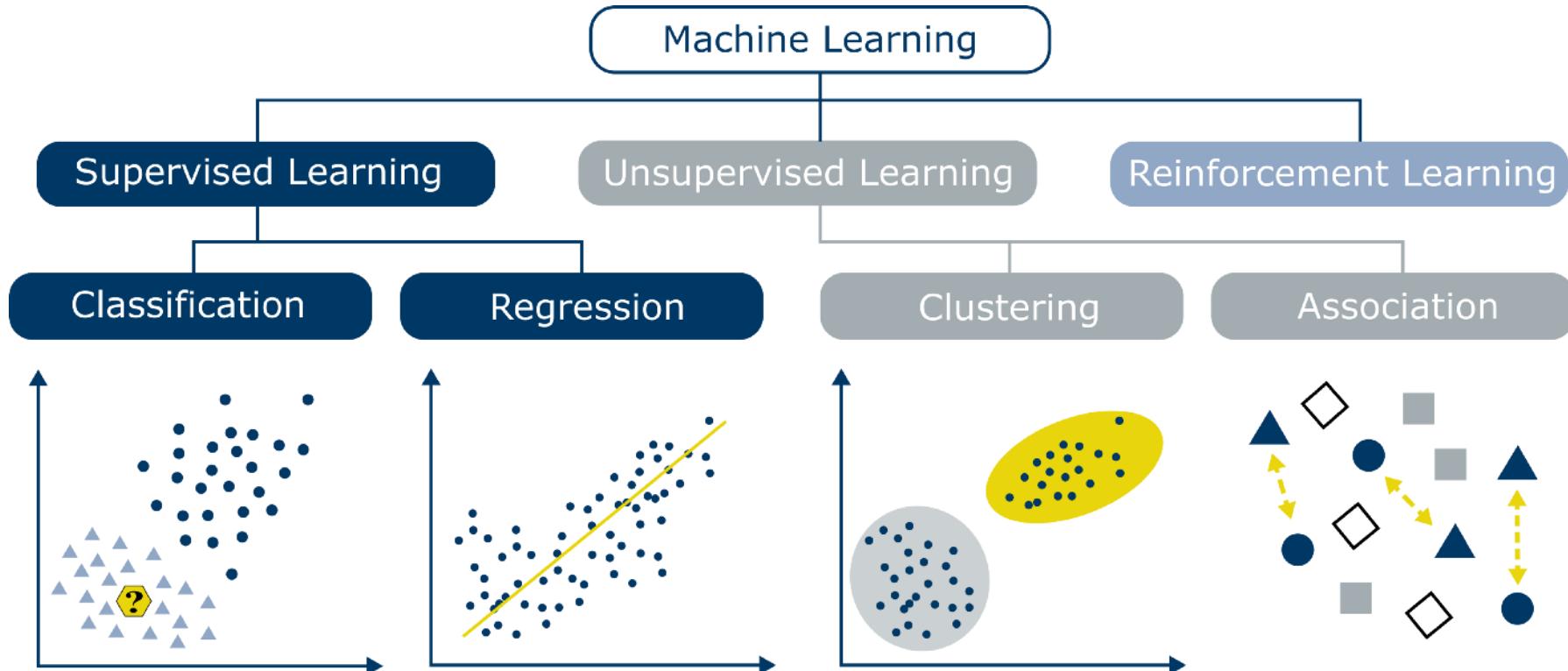
- Only data is given, **no labels** provided

□ **Reinforcement learning**

- An agent interacting with the world makes **observations**, takes actions, and is rewarded “مكافأة” or punished “يعاقب”; it should learn to choose actions in such a way as to obtain a lot of **reward**

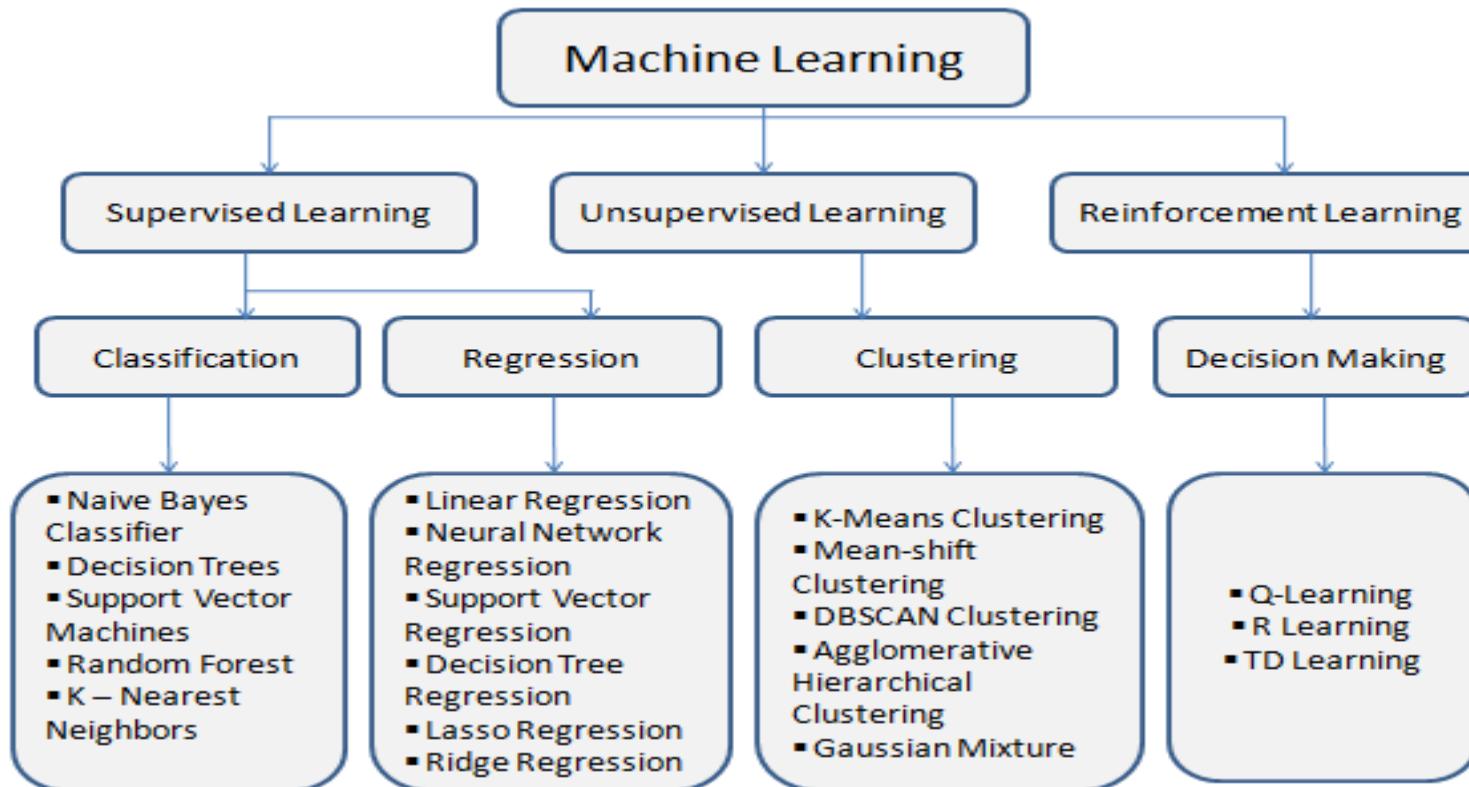


Types of Machine Learning





Types of Machine Learning





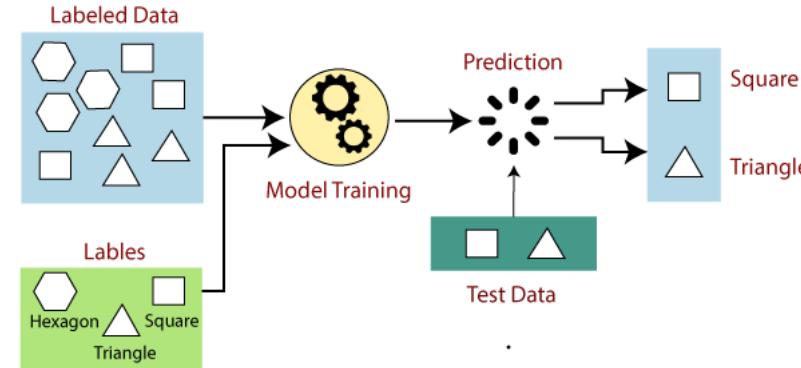
Supervised Learning



Types of Machine Learning- Supervised Learning

Supervised Learning

- **Supervised** learning is similar to **training a child** to walk. You will hold the child's hand, show him how to take his foot forward, walk yourself for a demonstration and so on, until the child learns to walk on his own.
- In **supervised learning**, the training data you feed to the algorithm includes the **desired solutions**, called **labels**.





Types of Machine Learning- Supervised Learning

Here are some of the most important **supervised learning algorithms**:

- k-Nearest Neighbors
- Linear Regression
- Logistic Regression
- Support Vector Machines (SVMs)
- Decision Trees and Random Forests
- Neural networks



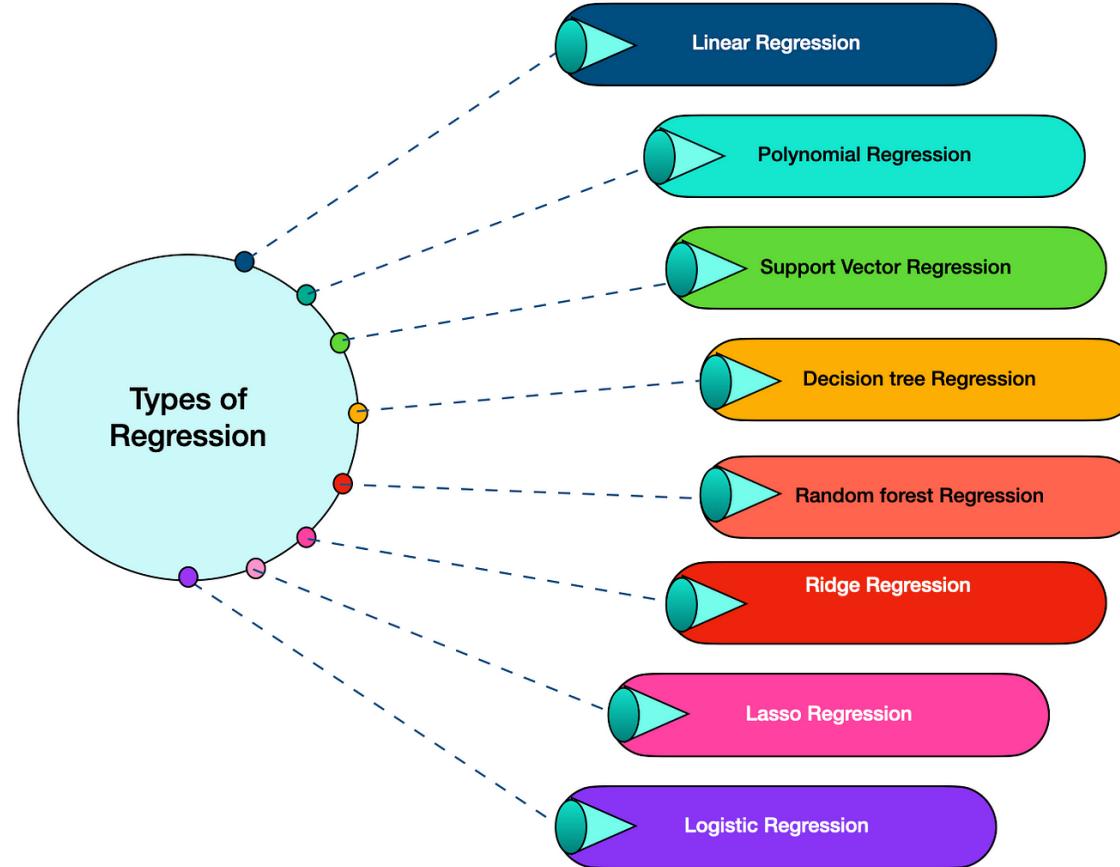
Types of Machine Learning- Supervised Learning

Supervised Learning

- **Regression:** Similarly, in the case of supervised learning, you give concrete known examples to the computer. You say that for given feature value x_1 the output is y_1 , for x_2 it is y_2 , for x_3 it is y_3 , and so on. Based on this data, you let the computer figure out an **relationship** between x and y .
- **Classification:** You may also use machine learning techniques for classification problems. In classification problems, you **classify objects** of similar nature into a single **group**.



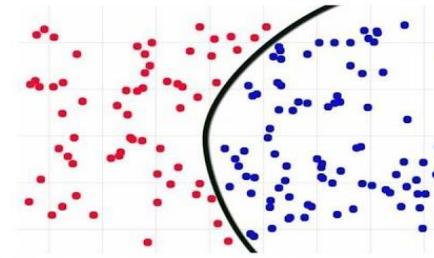
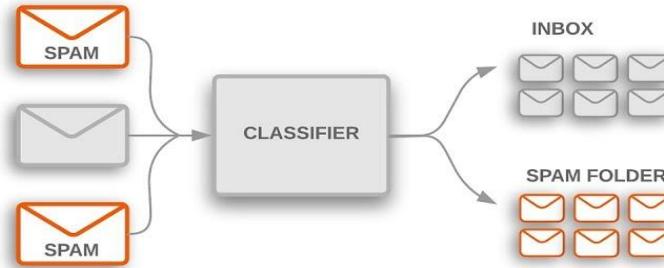
Types of Machine Learning - Regression





Types of Machine Learning - Classification

What is Classification

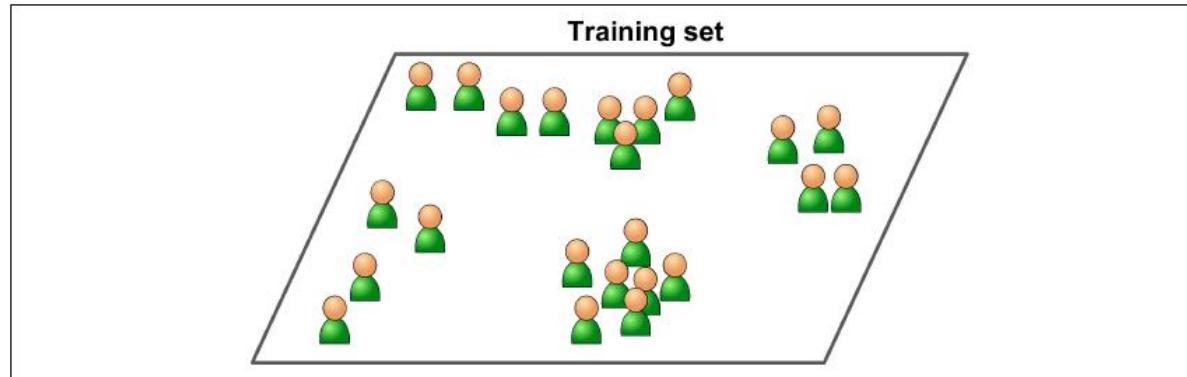




UnSupervised Learning

Types of Machine Learning- UnSupervised Learning

- In **unsupervised learning**, you might guess, the training data is **unlabeled**. The system tries to learn **without a teacher**.
- The **unsupervised** learning has shown a great success in many modern AI applications, such as **face detection**, **object detection**, and so on.



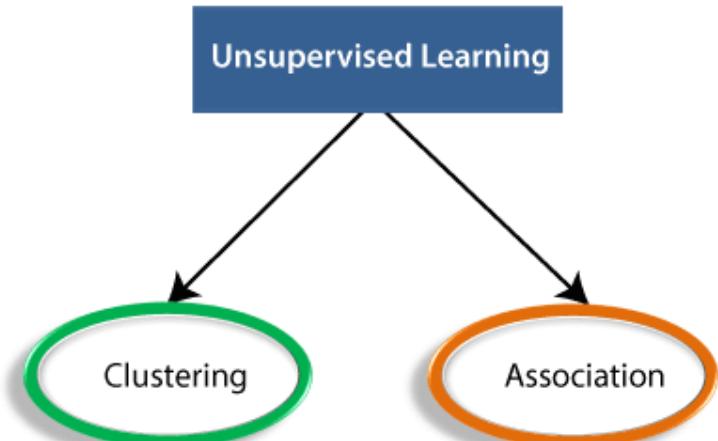
Clustering

Figure 1-7. An unlabeled training set for unsupervised learning

Types of Machine Learning- UnSupervised Learning

In **unsupervised** learning, we don't have a predetermined result. The machine tries to find useful insights from the **huge amount of data**. It can be further classifieds into two categories of algorithms:

- **Clustering**
- **Association**



Types of Machine Learning - Clustering

- You may want to run a **clustering** algorithm to try to **detect groups of similar visitors**.

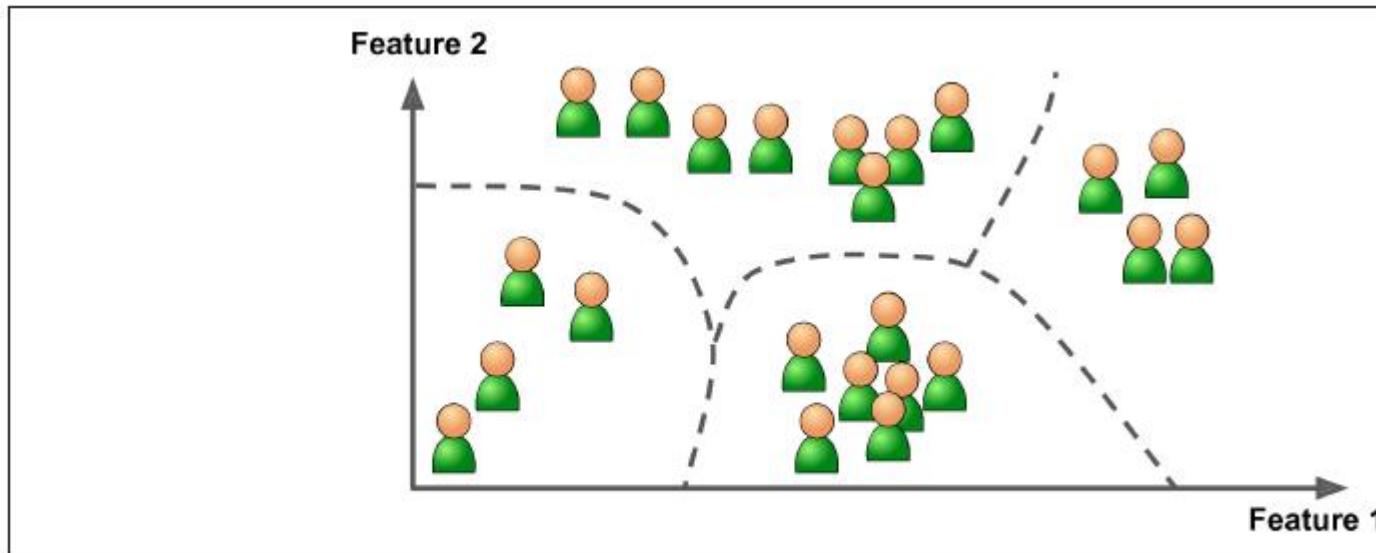
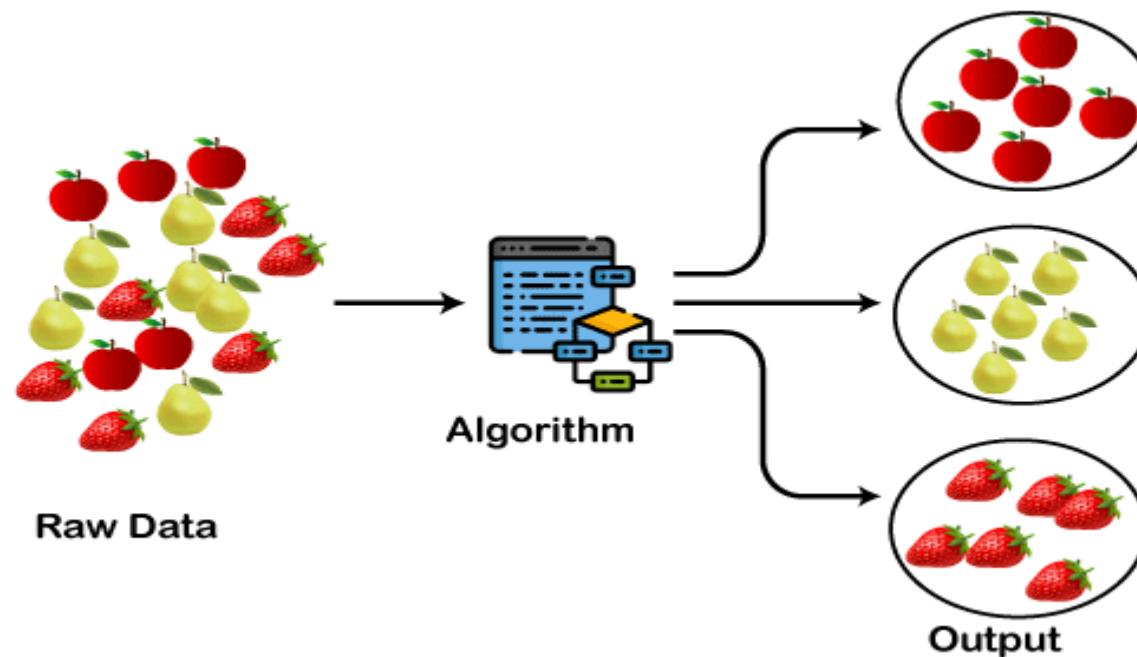


Figure 1-8. Clustering



Types of Machine Learning - Clustering

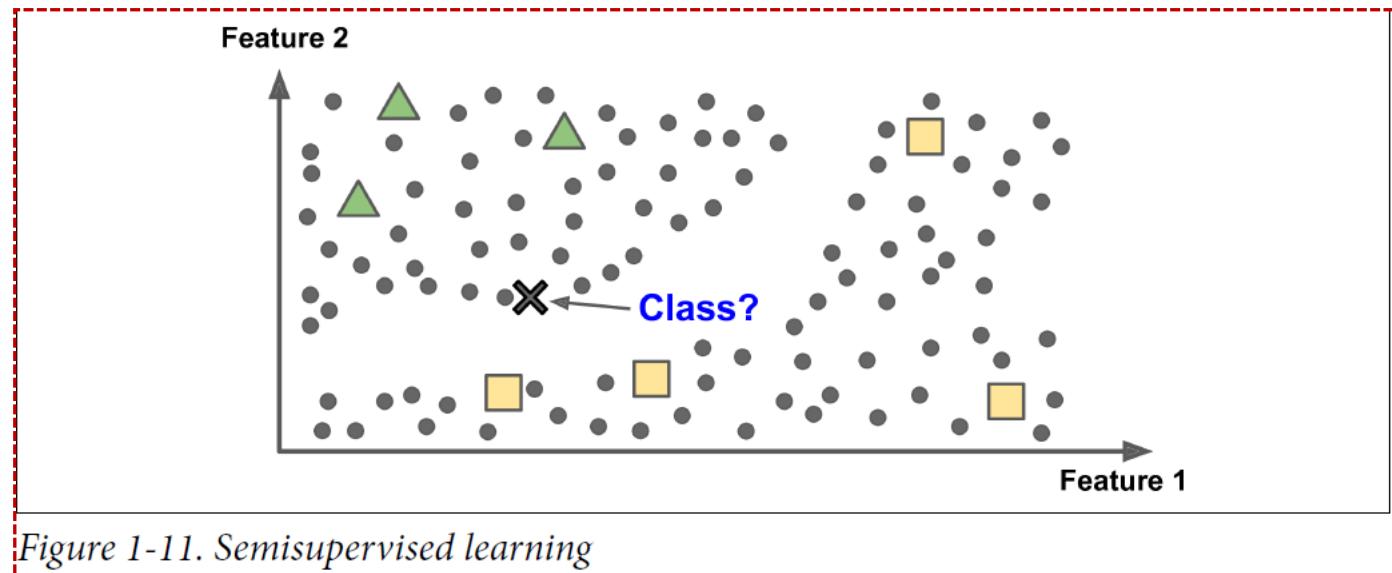




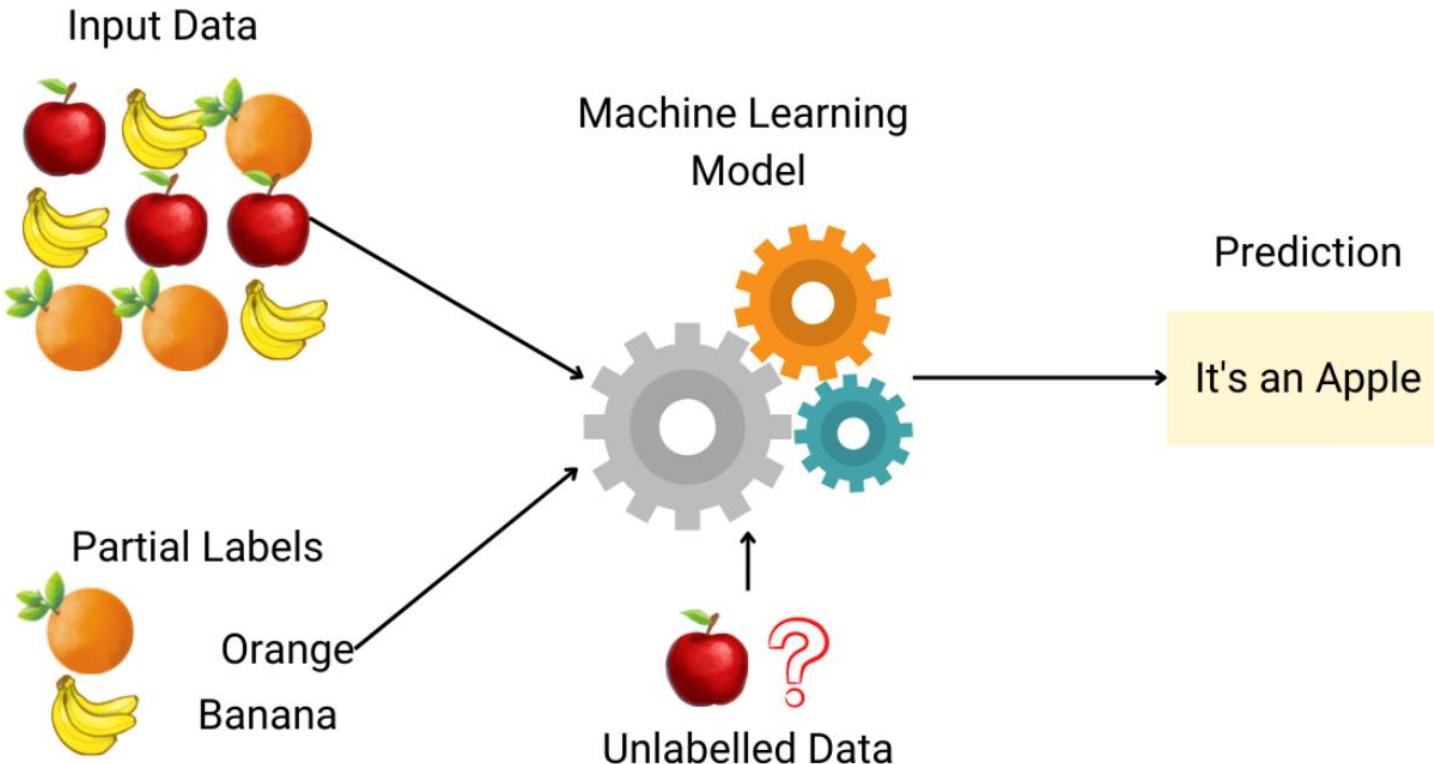
Semi supervised Learning

Types of Machine Learning- Semisupervised Learning

- Some algorithms can deal with **partially labeled** training data, usually a lot of **unlabeled data** and a little bit of labeled data. This is called **Semisupervised learning**.



Types of Machine Learning- Semi supervised Learning





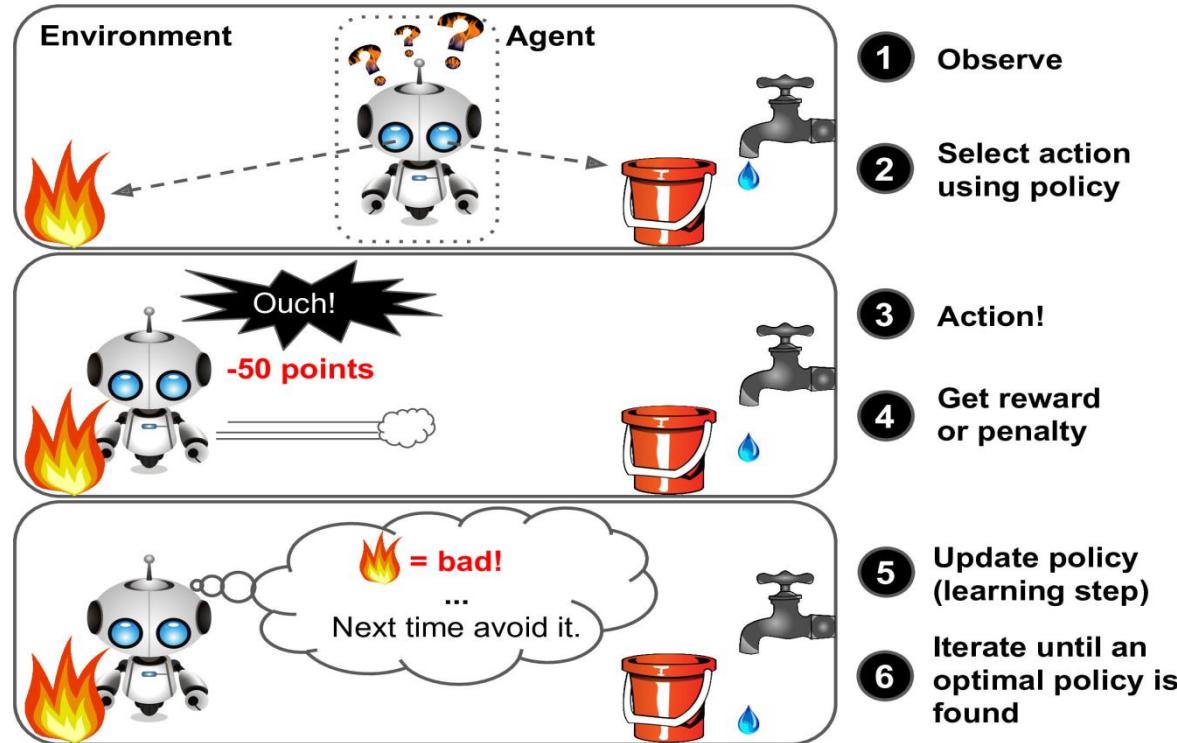
Reinforcement Learning (Robots)

Types of Machine Learning- Reinforcement Learning

Reinforcement Learning

Reinforcement Learning is a very different beast. The learning system, called an *agent* in this context, can **observe** the environment, select and perform actions, and get **rewards** in return

Reinforcement learning





Types of Machine Learning

Whether or not they can learn incrementally on the fly:
online versus batch learning



Types of Machine Learning- Batch

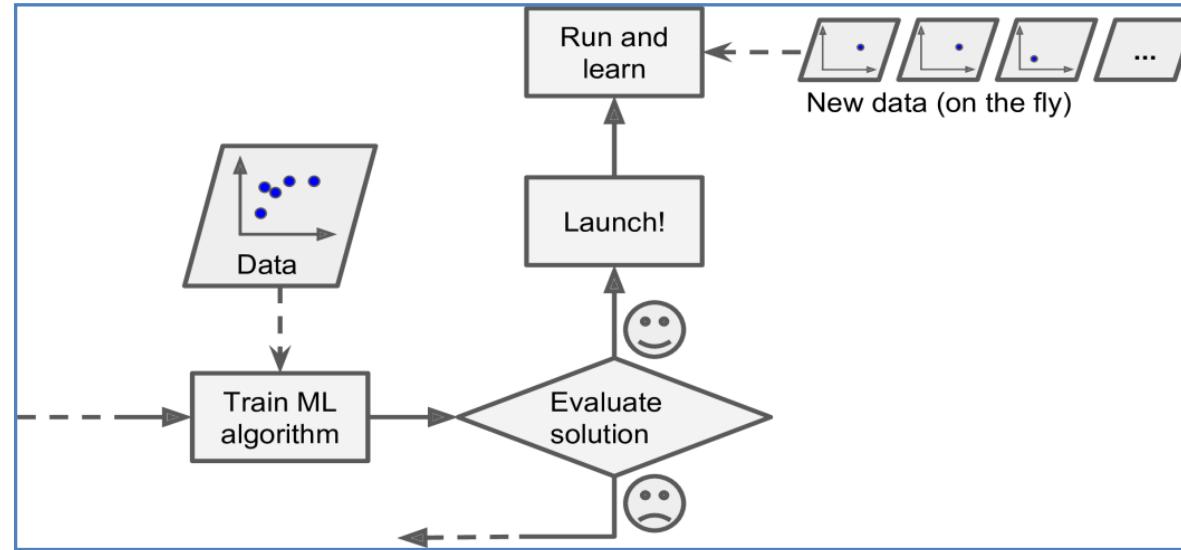
❖ **Batch**

- the system is incapable of learning **incrementally**
 - it must be trained using all the available data.
 - Called **offline learning**.
-
- If you want a batch learning system to know about new data (such as **a new type of spam**), you need to train a new version of the system from scratch on the full dataset (not just the new data, but also the old data), then stop the old system and replace it with the new one.

Types of Machine Learning- Online

Online learning

- you train the system **incrementally** by feeding it data instances sequentially, either **individually** or by small groups called **mini-batches**.





Types of Machine Learning

instance-based versus model-based learning



Types of Machine Learning- instance-based

Instance-based learning

- Possibly the most trivial form of learning is simply to learn by heart.
- If you were to create a spam filter this way, it would just flag all emails that are identical to emails that have already been flagged by users—not the worst solution, but certainly not the best.



Types of Machine Learning- instance-based

- ❑ Instead of just flagging emails that are **identical** to known spam emails, your spam filter could be programmed to also flag emails that are very similar to known spam emails. This requires a **measure of similarity** between two emails.
- ❑ A (very basic) similarity measure between two emails could be to **count the number of words** they have in common. The system would flag an email as spam if it has many words in common with a known spam email.

Types of Machine Learning- instance-based

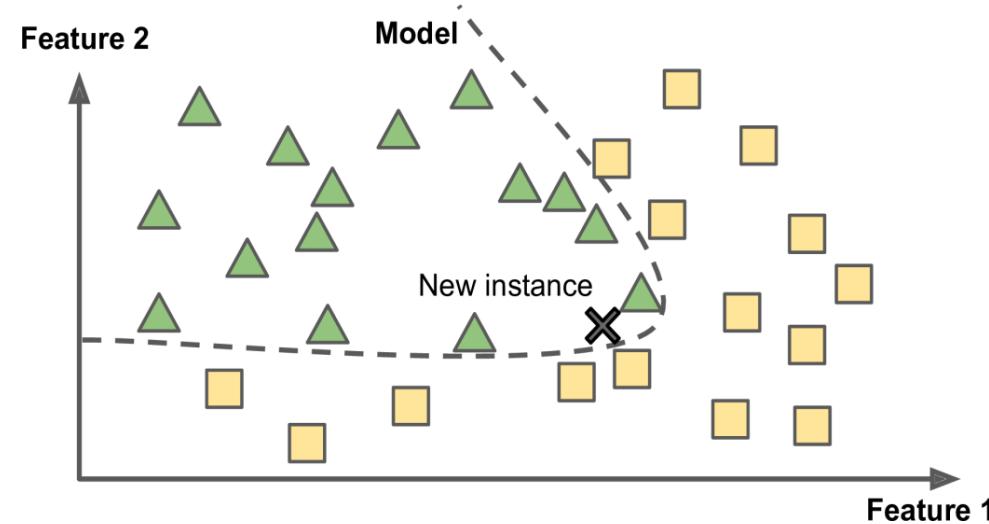


K Nearest Neighbor (KNN)

Types of Machine Learning- model-based

Model-based learning

- ❑ Another way to **generalize** from a set of examples is to build a **model** of these examples, then use that model to make **predictions**.





Practical Part



Practical part

Setting Up a Python Environment:

- Install Python and the necessary libraries individually.
- Use a pre-packaged Python distribution that comes with necessary libraries, i.e. Anaconda.

Installing Libraries

- The basic syntax to install a package from Python Package Index (PyPI) using pip is as follows:

```
-pip install required_package
```



Practical part

Some popular Python machine learning libraries are as follows –

- [NumPy](#)
- [Pandas](#)
- [SciPy](#)
- [Scikit-learn](#)
- [TensorFlow](#)
- [Keras](#)
- [Matplotlib](#)
- [OpenCV](#)
-



Thank You!

Any questions?

