UNIT 2: Introduction to Machine learning

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What is Machine Learning

Machine learning: Field of study that gives computers the ability learn without being explicitly programmed.

Arthur Samuel (1959).

Machine Learning is the science (and art) of programming computers so they can *learn from data*.

What is Machine Learning

Well-posed Learning Problem: 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 (1998)

- Experience E : Tens and thousands of games played with itself.
- Task T: Task of playing checkers
- Performance P: probability that wins the game of checkers against some new opponent

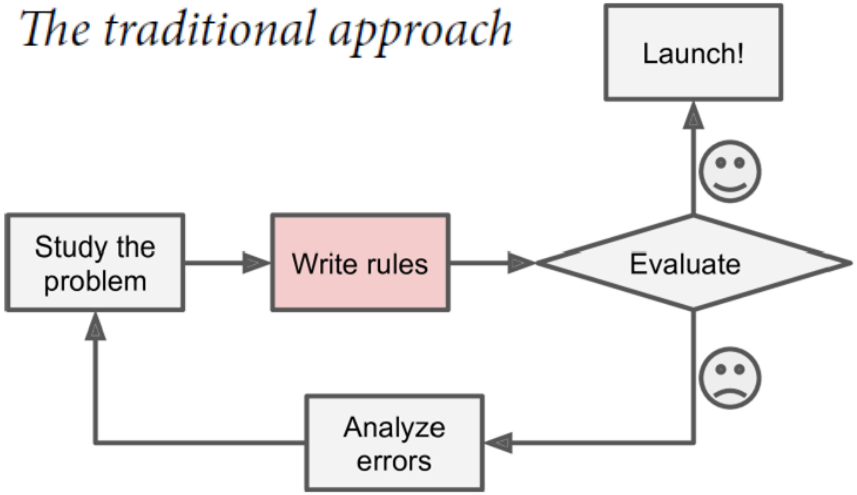
What is Machine Learning

Suppose your email program watches which emails you do or do not mark as spam, and based on that learns how to better filter spam.

- Task T: Classifying image as spam or not
- Experience E : Watching you label email as spam or not
- Performance P: The number of emails correctly classified as spam or not

Why Machine Learning?

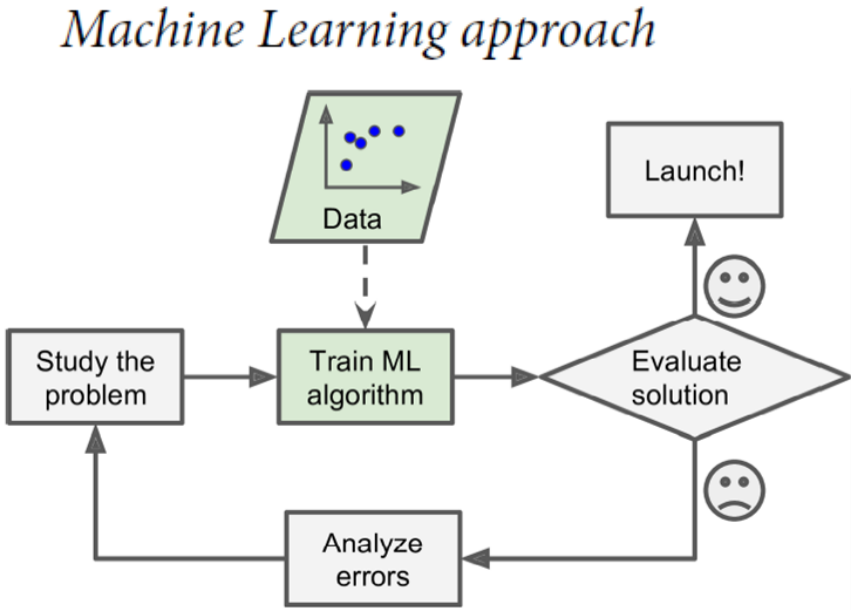
- Use hand coded rules of "if" and "else" decisions to process data or adjust to use input.
- Look at typical spam and words & phrases ("4U", "Credit Card", "free") in subject, some other patterns in senders name and email body
- Write detection algorithms for each of the pattern noticed, flag as spam
- Test and repeat until good enough. Your program may become long list of complex rules.



Source: Hands on Hands-On Machine Learning with Scikit-Learn and tensorflow by Aurélien Géron

Why Machine Learning

In contrast, a spam filter based on Machine Learning techniques automatically learns which words and phrases are good predictors of spam by detecting unusually frequent patterns of words in the spam examples compared to the ham examples



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Pro and Cons of using ML

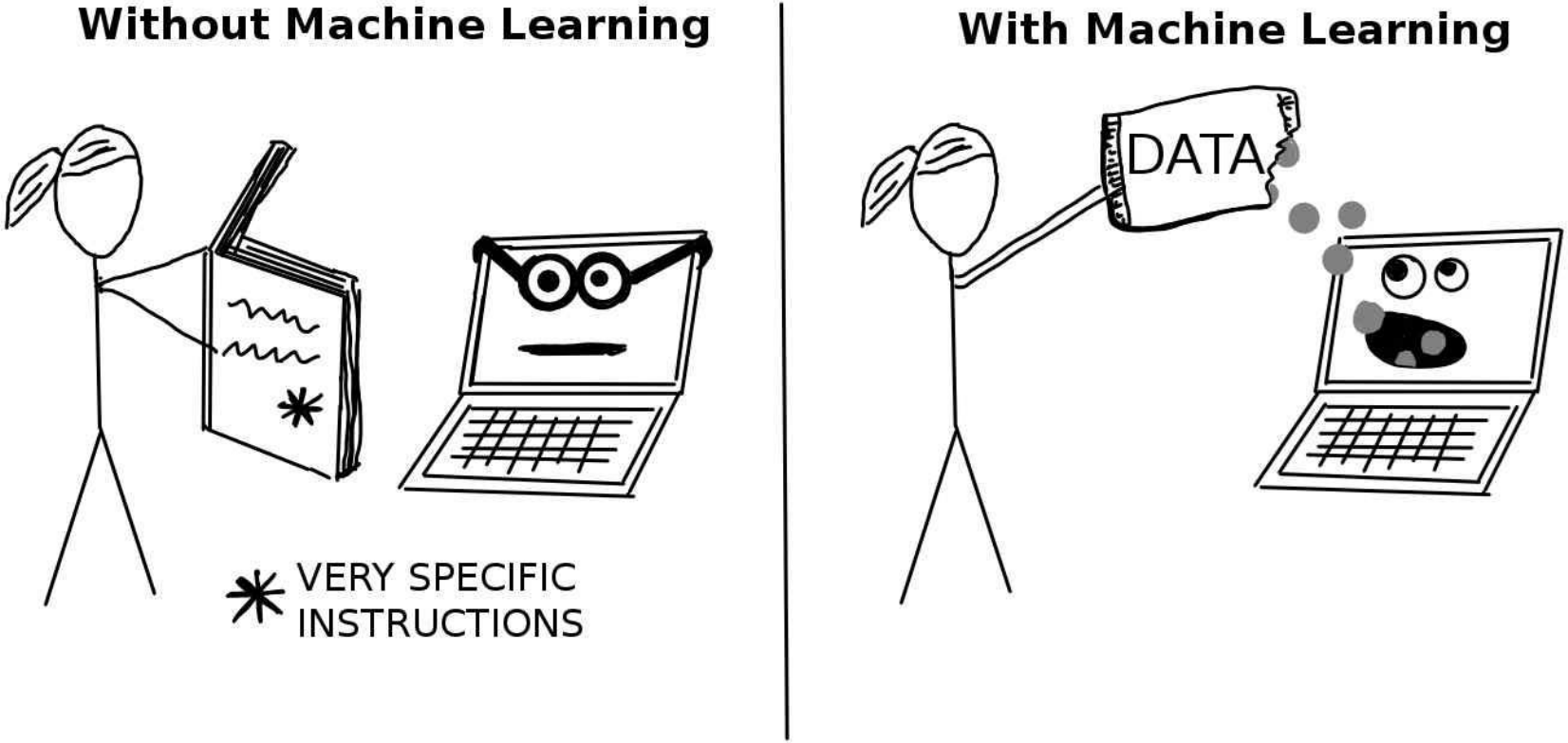
Pros

- Autonomous: Learns automatically from the data
- No need for human subject matter expert to determine the rules
- Superhuman performance is possible for specific tasks (AlphaGo)

Cons

- Needs for data, lots of it
- The relationship learnt is complex and is not easily explained
- Can be easily fooled with "bad data"

Normal Computer vs Machine Learning



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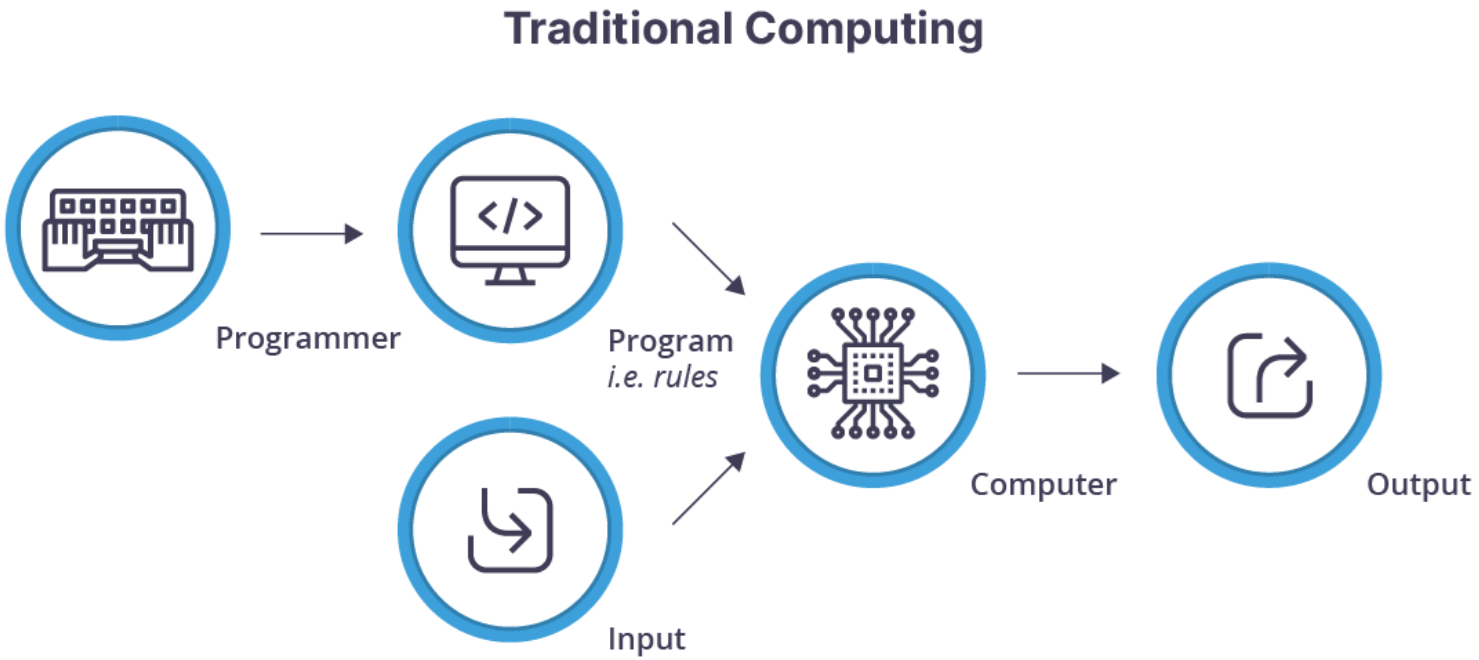
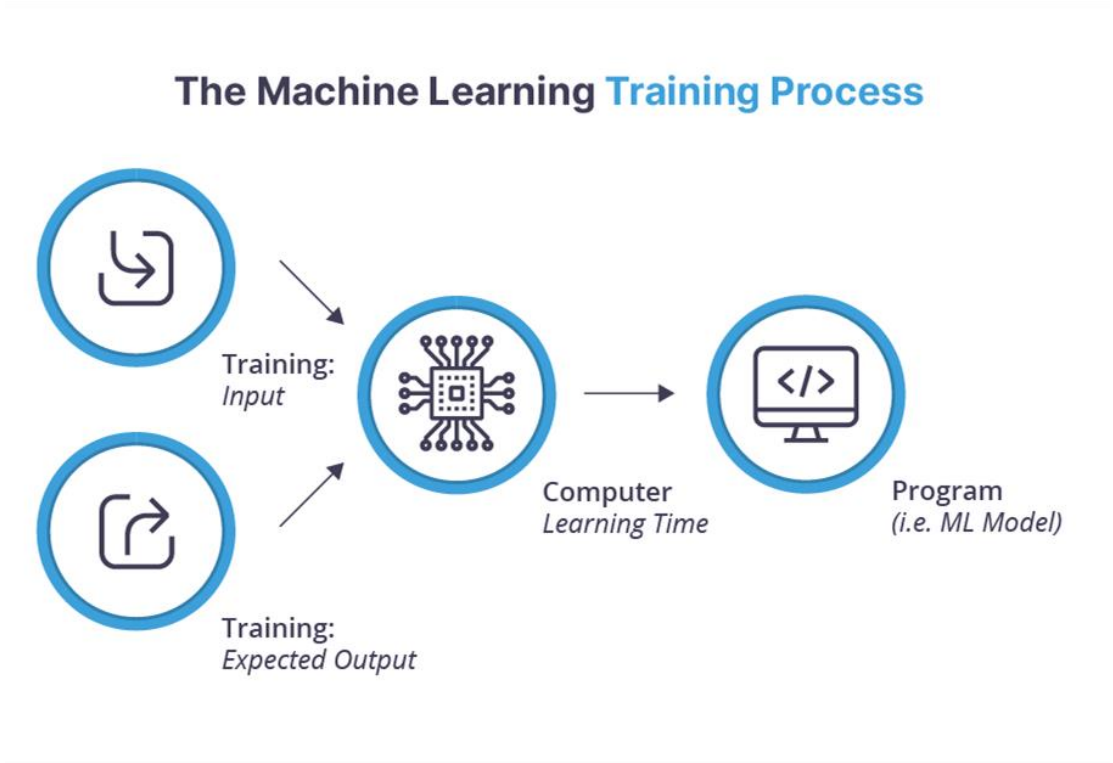
Normal Computer vs Machine Learning



https://feedzai.com/blog/how-machine-learning-works/

Normal Computer vs Machine Learning



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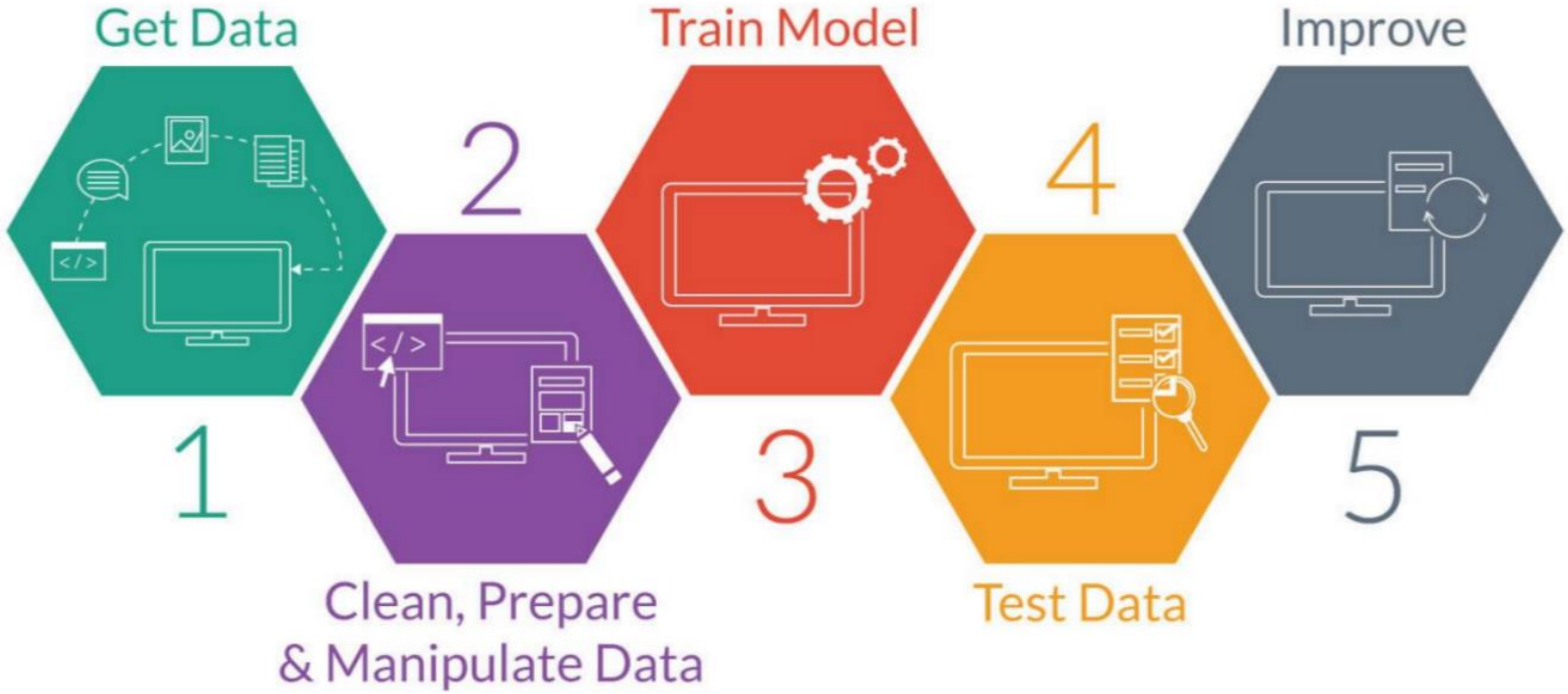
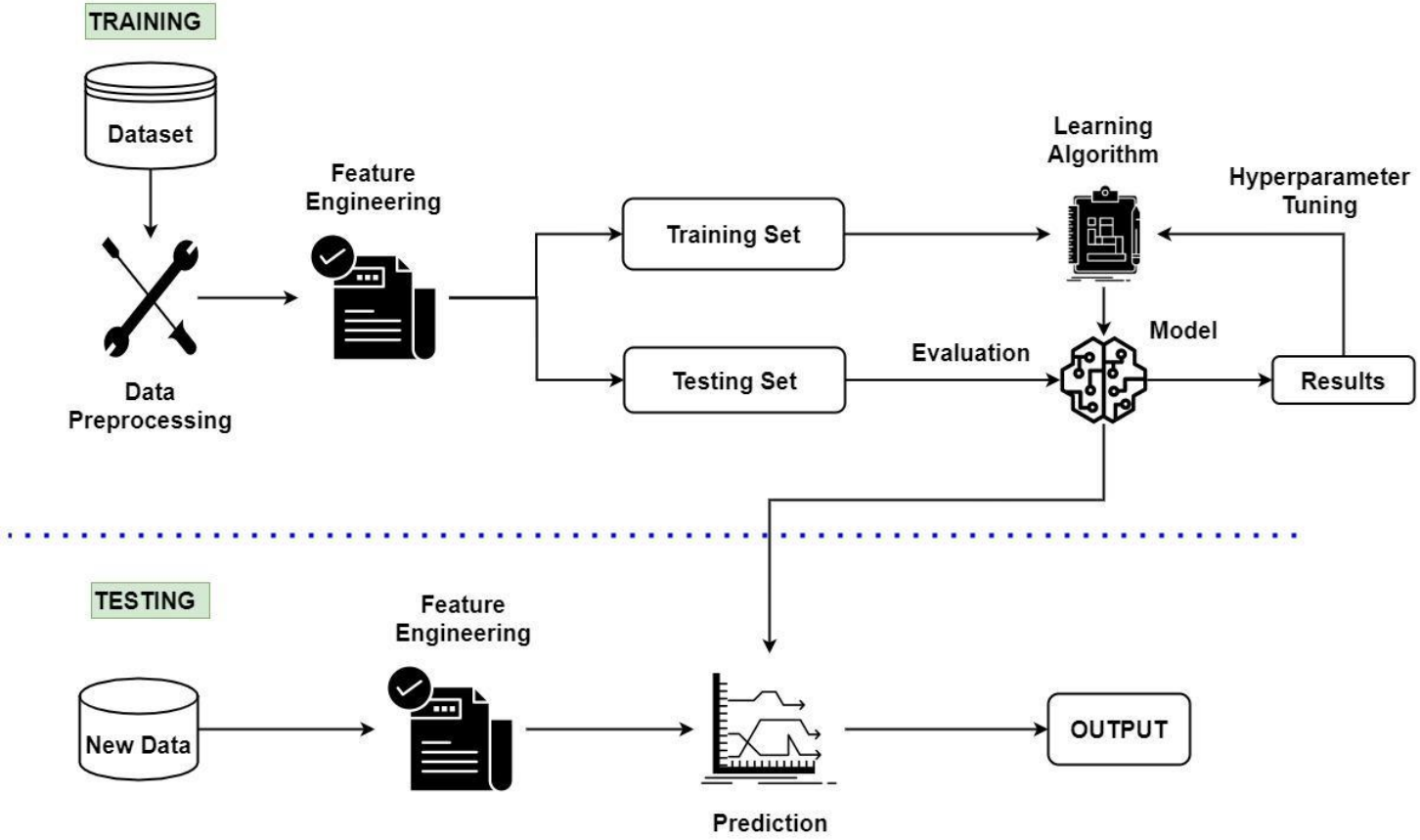
Machine Learning Workflow



source https://upxacademy.com/introduction-machine-learning/

Machine Learning Workflow



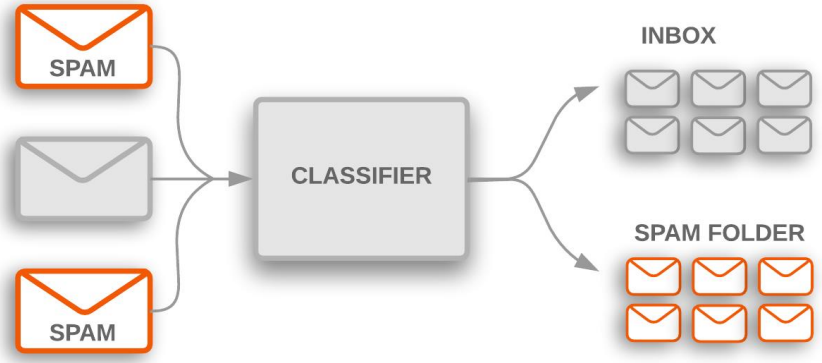
Types of Machine Learning Algorithms

1. Supervised Learning:

- Machine learning algorithms that learn from input/output pairs are called supervised learning algorithms.

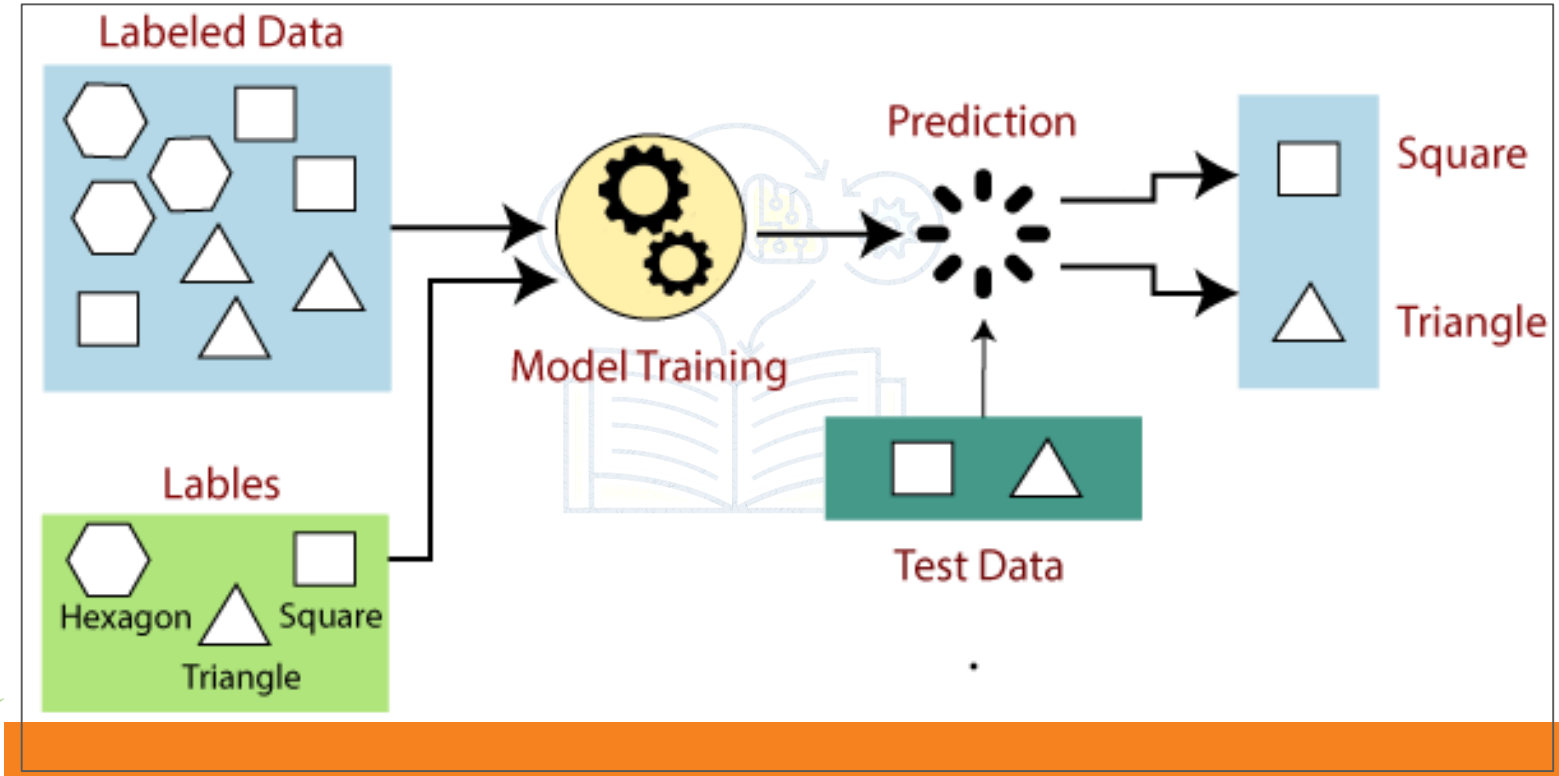
- "teacher" provides supervision to the algorithms in the form of the desired output for each example that they learn from.

- The algorithm is able to create an output for an input it has never seen before without any help from a human.



Types of Machine Learning Algorithms

1. Supervised Learning:



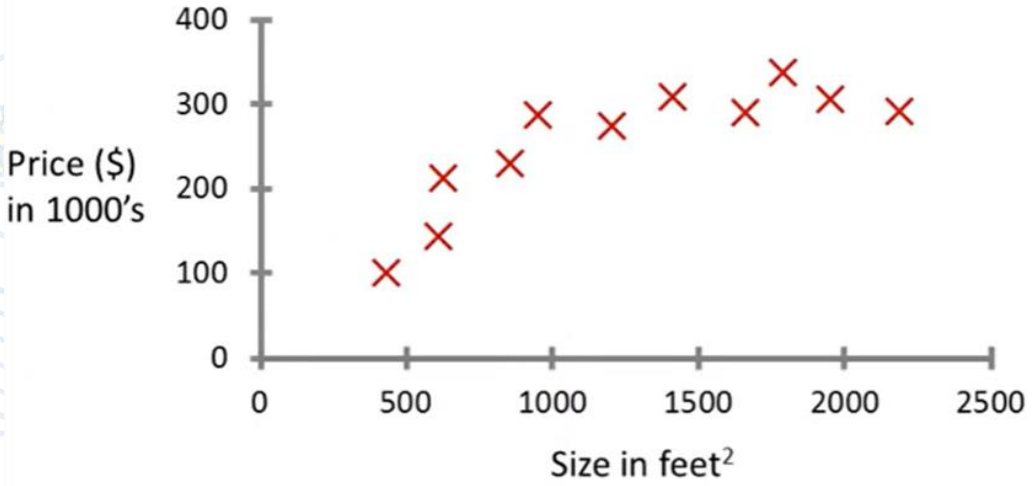
Types of Machine Learning Algorithms

1. Supervised Learning:

Examples of supervised Machine Learning task include;

A Typical task is to predict a *target* numeric value (Regression)

- Housing price prediction
- Predicting price of car given set of features (mileage, brand etc) called predictors.

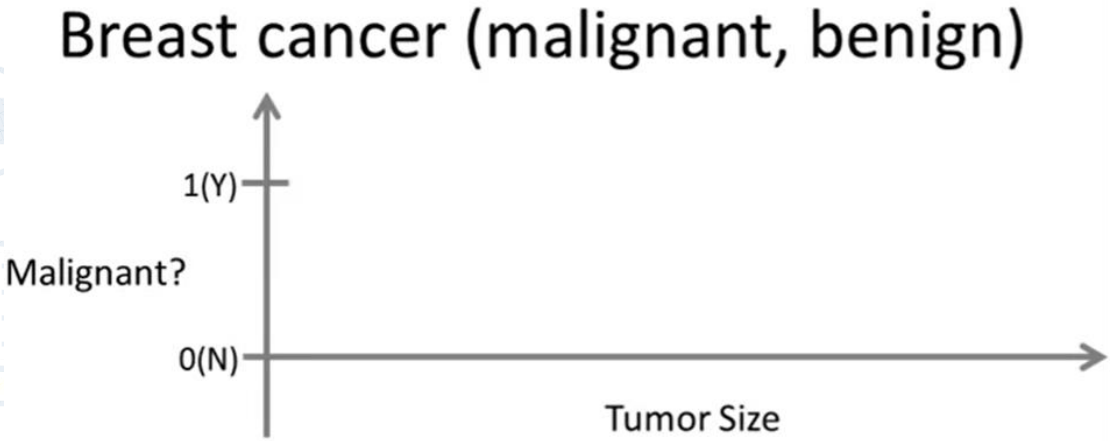


Types of Machine Learning Algorithms

1. Supervised Learning:

Another typical supervised learning task is *classification*.

- Determining whether a tumor is benign based on a medical image
- Handwriting recognition
- Detecting fraudulent activity in credit card transactions



Types of Machine Learning Algorithms

You're running a company, and you want to develop learning algorithms to address each of two problems.

Problem 1: You have a large inventory of identical items. You want to predict how many of these items will sell over the next 3 months.
Problem 2: You'd like software to examine individual customer accounts, and for each account decide if it has been hacked/compromised.

Should you treat these as classification or as regression problems?

- ◯ Treat both as classification problems.
- ◯ Treat problem 1 as a classification problem, problem 2 as a regression problem.
- ◯ Treat problem 1 as a regression problem, problem 2 as a classification problem.
- ◯ Treat both as regression problems.

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enjoy algorithms

Regression

What will be the temperature tomorrow?

Fahrenheit

Classification

Will it be hot or cold tomorrow?

Fahrenheit

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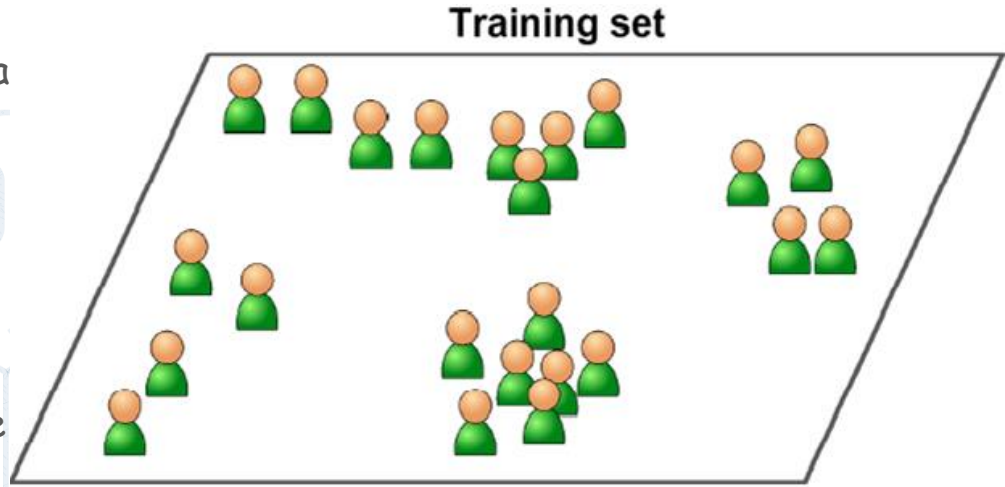
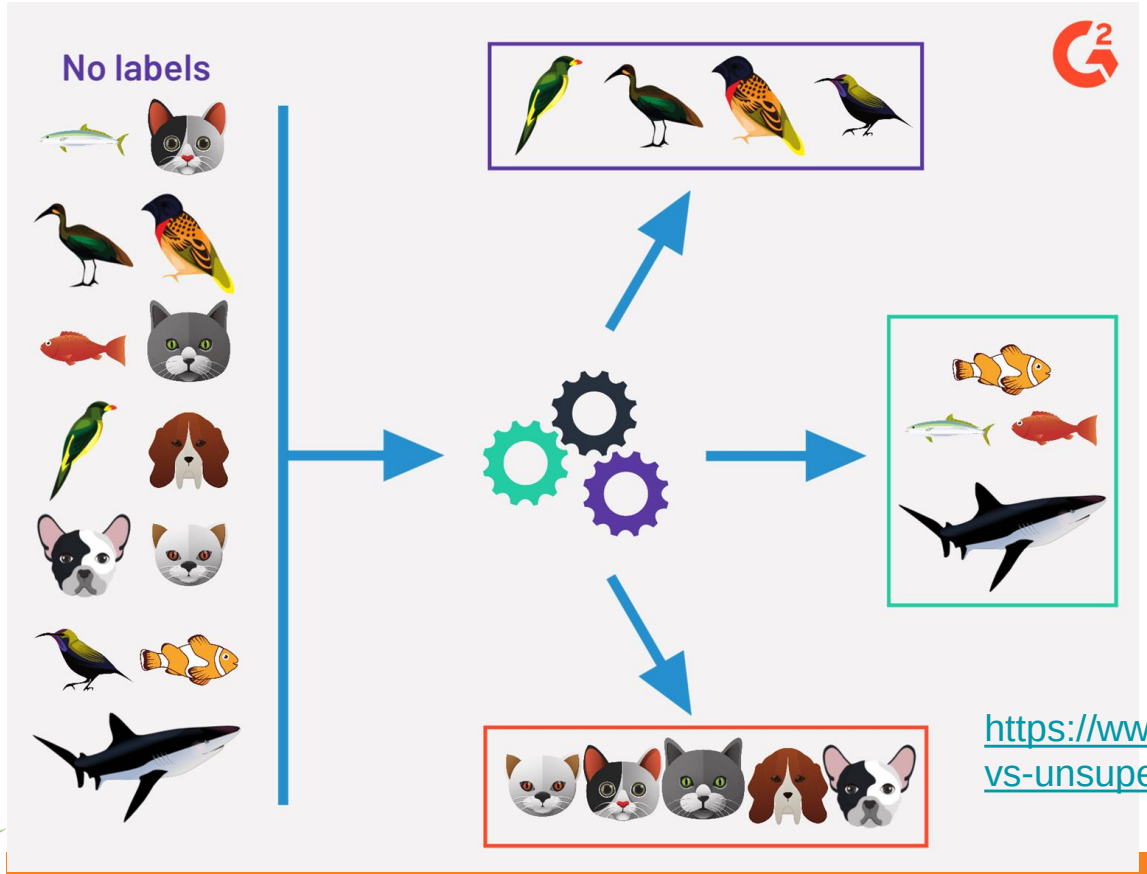
Types of Machine Learning Algorithms

2. Unsupervised Learning:

- In unsupervised learning, only the input data is known, and no known output data is given to the algorithm
- the training data is unlabelled, the system tries to learn without a teacher
- While there are many successful applications of these methods, they are usually harder to understand and evaluate



Types of Machine Learning Algorithms



https://www.g2.com/articles/supervised-vs-unsupervised-learning

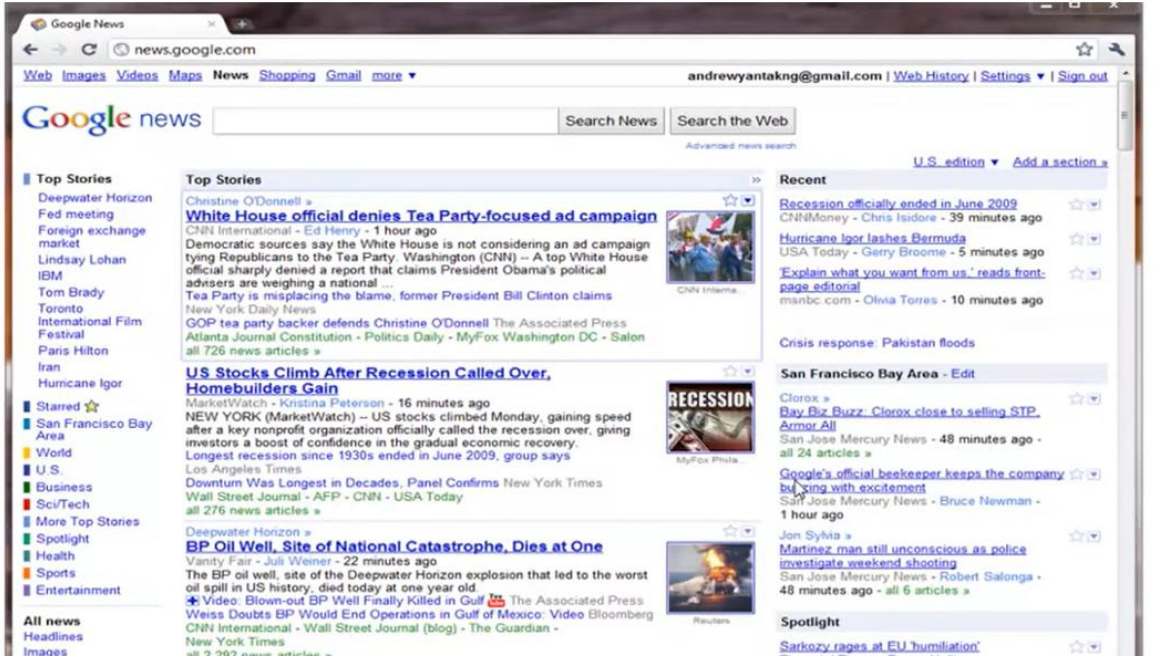
Types of Machine Learning Algorithms

2. Unsupervised Learning:

Examples of unsupervised learning;

- Identifying topics in a set of blog posts

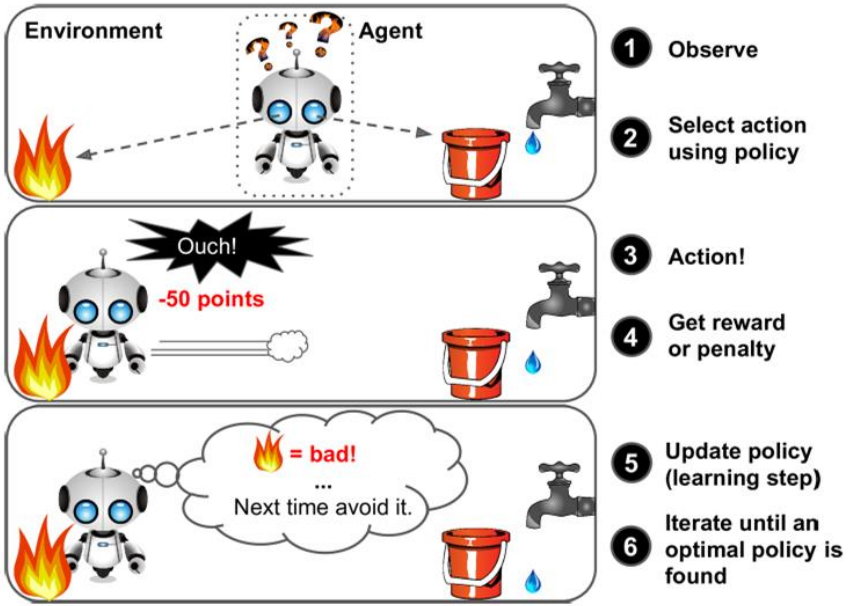
- Segmenting customers into groups with similar preferences



Types of Machine Learning Algorithms

3. 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 (or penalties in the form of negative rewards.
- It must then learn by itself what is the best strategy, called a *policy*, to get the most reward over time. A policy defines what action the agent should choose when it is in a given situation.



Types of Machine Learning Algorithms

3. Reinforcement Learning:

- For example, many robots implement Reinforcement Learning algorithms to learn how to walk.

- DeepMind's AlphaGo program is also a good example of Reinforcement Learning: it beat the world champion Lee Sedol at the game of Go.

- It learned its winning policy by analyzing millions of games, and then playing many games against itself

Tools for AI and ML

Machine Learning Framework

- Tensorflow
- Orange
- Keras

Research Publications

- Arxiv

Open source repositories:

- GitHub

- Scikit-learn

- scikit-learn is an open source project. It contains a number of state-of-the-art machine learning algorithms, as well as comprehensive documentation about each algorithm. scikit-learn is a very popular tool, and the most prominent Python library for machine learning.

THANK YOU ☺