[2022.01] What is Machine Learning?

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You should be able to answer these questions after reading this document. Important passages are marked with red.

Questions you must be able to answer:

1. What can be AI but not Machine Learning?
2. Is Deep Learning also Machine Learning?
3. What is Regression?
4. What is Classification?
5. What is Supervised Learning?
    a. How do you know whether or not a system has been trained correctly?

Artificial Intelligence

"The study of the modelling of human mental functions by computer programs."—Collins Dictionary

AI is composed of 2 words Artificial and intelligence. Anything which is not natural and created by humans is artificial. Intelligence means ability to understand, reason, plan etc.

So we can say that any code, tech or algorithm that enable machine to mimic, develop or demonstrate the human cognition or behavior is AI.

The concept of AI is very old but it got popularity recently. **But why?**

The reason being earlier we had a very small amount of data to make accurate predictions. But today, there is tremendous increase in the size of the data which is generated every minute and help us to make more accurate predictions. Along with the enormous amount of data, we also have the support of more advanced algorithms, high end computing power and storage that can deal with that huge data size. Examples include Tesla self-driving car, Apple's Siri and many more.

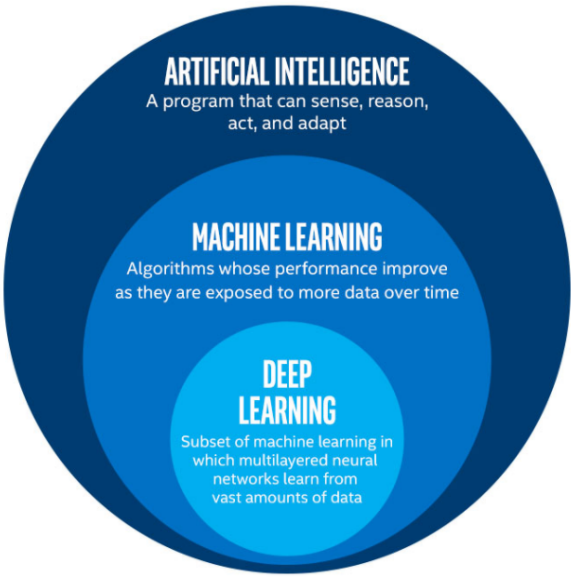
Machine Learning

We have seen what AI is but what were the issues which lead to the introduction of machine learning?

Few reasons were:

In field of Statistics the problem was "How to efficiently train large complex models?" and in Computer Science & AI, the problem was "How to train more robust versions of AI systems?

So because these issues machine learning was introduced.



What is machine learning?

"Machine learning is the *science of getting computers to act without being explicitly programmed."*—*Stanford University*

It's a subset of AI which uses statistical methods to enable machines to improve with experience. It enables a computer to act and take data driven decisions to carry out a certain task. These programs or algorithms are designed in such a way that they can learn and improve over time when exposed to new data.

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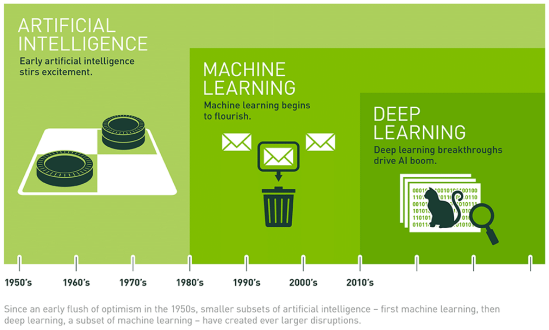
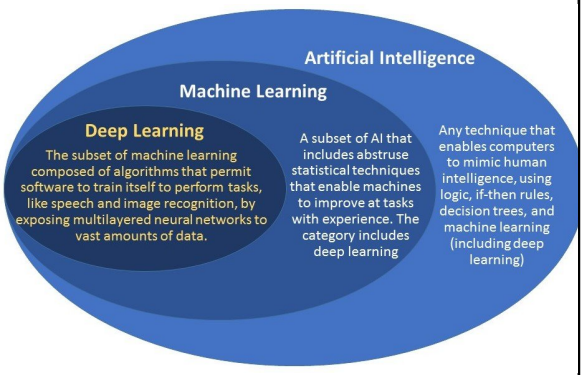
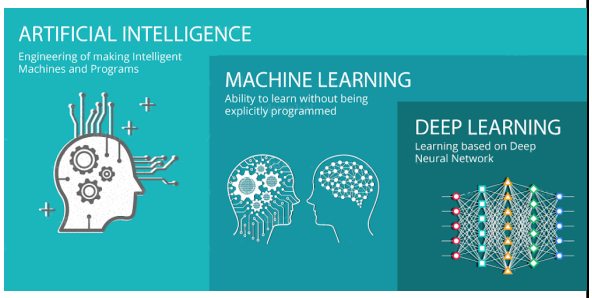
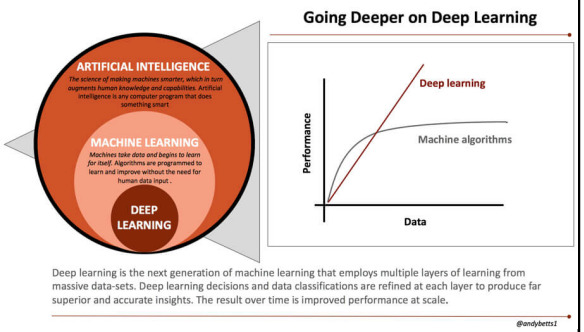
Different interpretations of the relationship between Artificial Intelligence, Machine Learning and Deep Learning





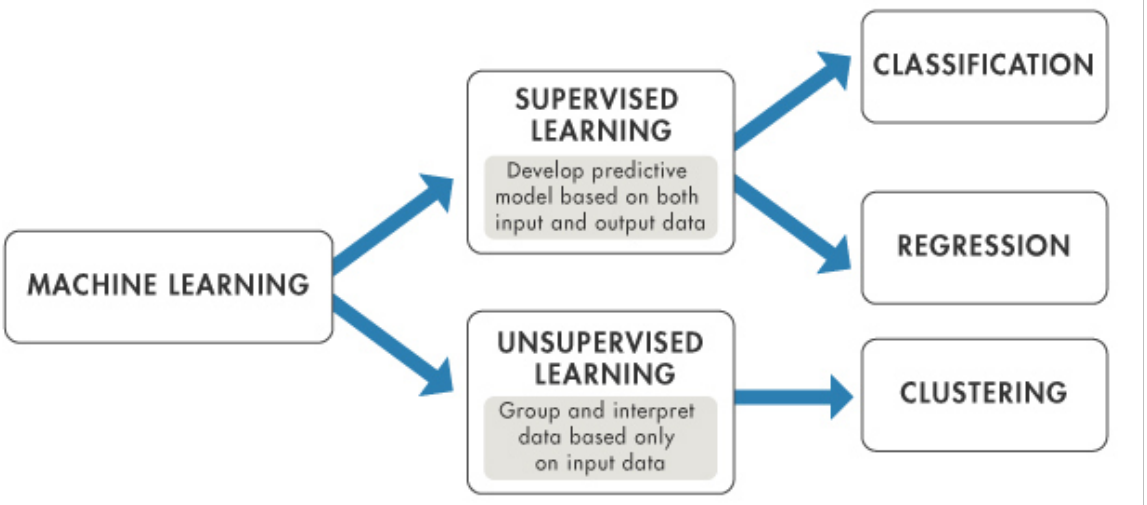




What Is Machine Learning?

Machine learning teaches computers to do what comes naturally to humans: learn from experience. Machine learning algorithms use computational methods to "learn" information directly from data without relying on a predetermined equation as a model. The algorithms adaptively improve their performance as the number of samples available for learning increases.

Machine learning uses two types of techniques: supervised learning, which trains a model on known input and output data so that it can predict future outputs, and unsupervised learning, which finds hidden patterns or intrinsic structures in input data.



Supervised machine learning has the aim to build a model that makes predictions based on evidence in the presence of uncertainty. A supervised learning algorithm takes a known set of input data and known responses to the data (output) and trains a model to generate reasonable predictions for the response to new data. Supervised learning uses classification and regression techniques to develop predictive models.

- ***Classification*** techniques predict categorical responses, for example, whether an email is genuine or spam, or whether a tumor is cancerous or benign. Classification models classify input data into categories. Typical applications include medical imaging, image and speech recognition, and credit scoring.
- ***Regression*** techniques predict continuous responses, for example, changes in temperature or fluctuations in power demand. Typical applications include electricity load forecasting and algorithmic trading.

Fundamentally, classification is about predicting a label and regression is about predicting a quantity. source

Unsupervised learning finds hidden patterns or intrinsic structures in data. It is used to draw inferences from datasets consisting of input data without labeled responses.

- ***Clustering*** is the most common unsupervised learning technique. It is used for exploratory data analysis to find hidden patterns or groupings in data. Applications for clustering include gene sequence analysis, market research, and object recognition.

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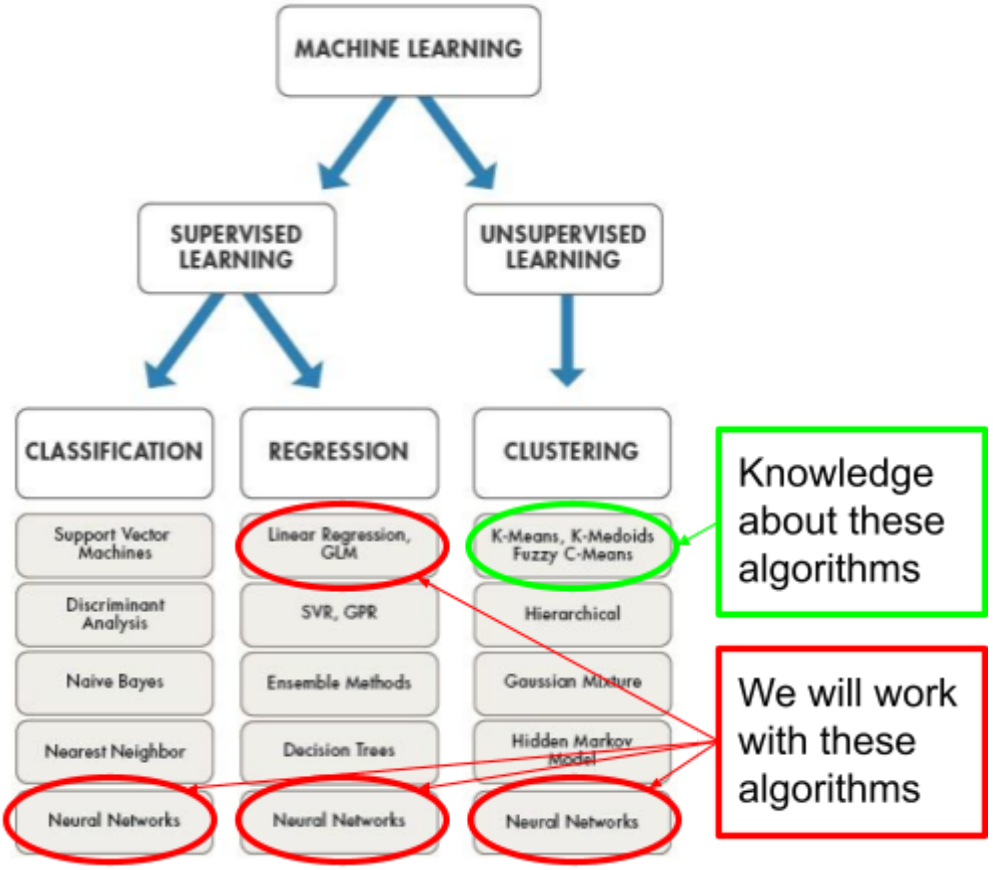
Selecting the Right Algorithm

Choosing the right algorithm can seem overwhelming—there are dozens of supervised and unsupervised machine learning algorithms, and each takes a different approach to learning. There is no best method or one size fits all. Finding the right algorithm is partly based on trial and error—even highly experienced data scientists cannot tell whether an algorithm will work without trying it out. Highly flexible models tend to overfit data by modeling minor variations that could be noise. Simple models are easier to interpret but might have lower accuracy. Therefore, choosing the right algorithm requires trading off one benefit against another, including model speed, accuracy, and complexity. Trial and error is at the core of machine learning—if one approach or algorithm does not work, you try another. MATLAB® provides tools to help you try out a variety of machine learning models and choose the best.



To find **MATLAB** apps and functions to help you solve machine learning tasks, consult the following table. Some machine learning tasks are made easier by using apps, and others use command-line features.
source

P.S: This picture is taken from Matlab, and shows what apps / methods they have, there are preferably more if you look at other tools. This image is included only to give an overview of the subject. We need an overview (even if it does not include everything) that gives us a sense of where we are, when working with a particular algorithm.

P.S: Also note that all 3 (Classification, Regression and Clustering) can be solved using Neural Networks.