Introduction to Machine Learning

Day 0

Welcome to Machine Learning! Today you'll get yourself introduced with the idea of making a computer learn by itself without being explicitly programmed. You'll also see some classifications of Machine Learning problem, mainly:

- Supervised Learning

    - Linear Regression
    - Logistic Regression
    - Linear Discriminant Analysis
    - K-Nearest Neighbors
    - Decision Trees

- Unsupervised Learning

    - K-Means Clustering
    - Principal Component Analysis
    - Anomaly Detection
   - Collaborative filtering and Recommender Systems

- Reinfocement Learning

You can find the relevant materials for today in the links below:

- What Is Machine Learning

- Supervised Learning

- Unsupervised Learning

- Reinforcement Learning

- *Andrew Ng's Full Playlist

Day 1

This day, you'll get to know the most widely used tools for Machine Learning that will speed up your Machine Learning algorithms with the help of cleverly optimized Linear Algebra libraries. This is possible because of a process called "Vectorization" which exploits the benefits of SIMD (Single Intruction Multiple Data) Parallelism, which speeds up your algorithms by a factor of 400-600. Mainly, the tools that you'll be using through this course are:

- Python
  There are some linear algebra libraries of python that you'll get accustomed to throughout this course.

  - SciPy
  - NumPy
  - Matplotlib

- JupyterLab

- Conda

- Examples of Data Visualization using Matplotlib

- Basic Linear Algebra for Machine Learning
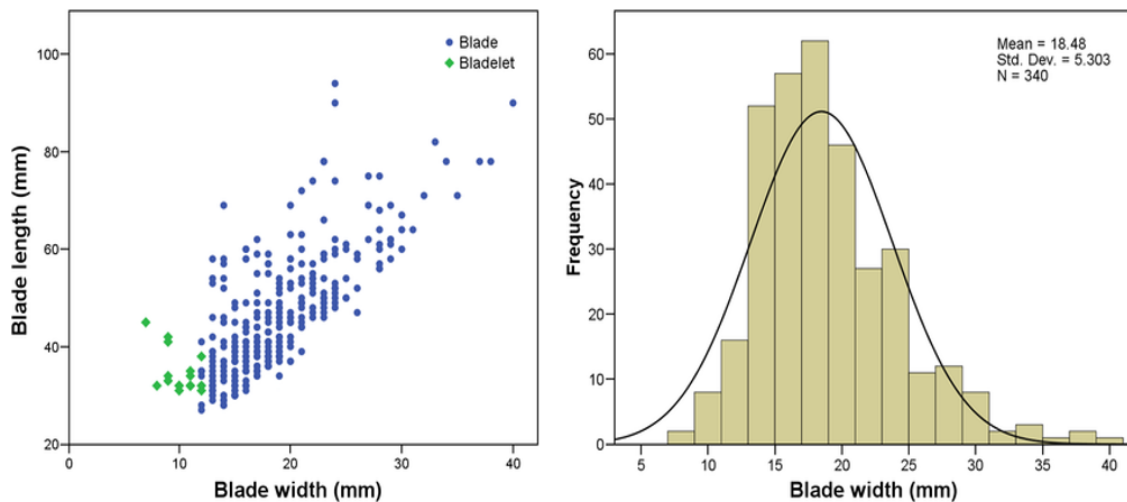
There are some links that you will need to visit frequently while exercising ML algorithms, and these are listed below for your convenience:

- Numpy Documentation

- Matplotlib Documentation

- Python Documentation

- JupyterLab Documentation

- Conda Introduction

Day 2

Today you will learn basic Linear Regression and Gradient Descent, as well as some optimization for your learning algorithms including Feature Scaling and Mean Normalization. You'll need to have a brief idea of basic differential calculus for Gradient Descent as a pre-requisite. Using Linear Regression and Gradient Descent, you can fit a linear model on a sample dataset as follows:
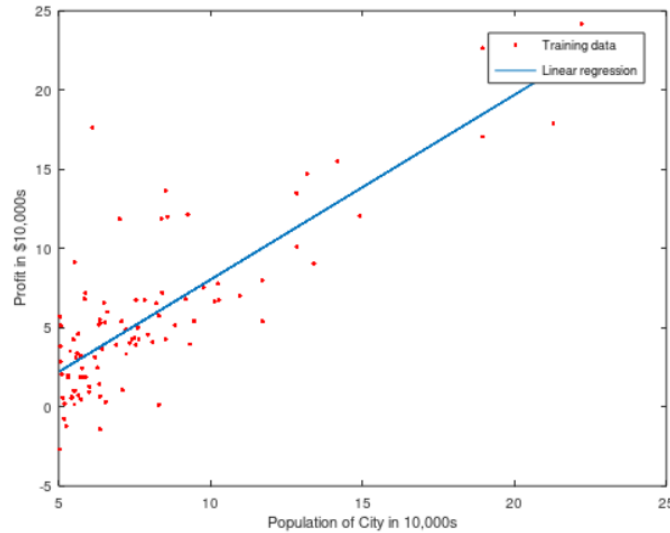

List of relevant information and videos:

- Representing the model

- Squared error cost function

- Feature scaling and Mean normalization

- Gradient Descent

Day 3

Logistic regression is a classification algorithm. Unlike regression algorithms which gives a continuous valued output, classification algorithms provide discrete valued output which can be used for creating decision boundaries and digit recognition.
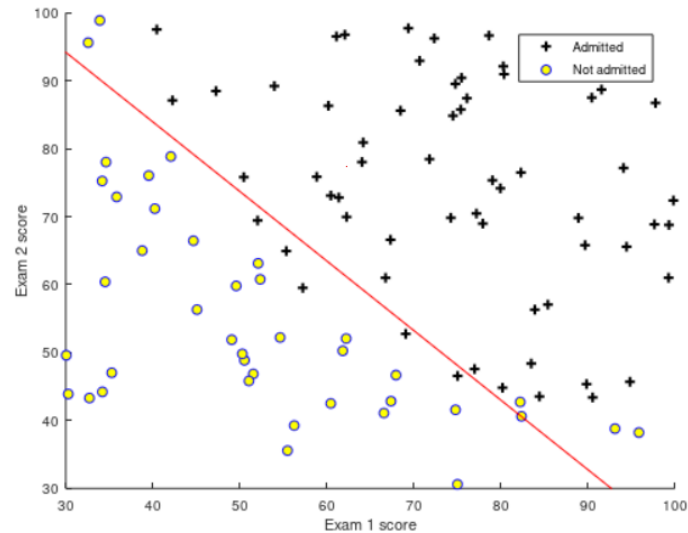

Further optimizing the learning algorithms by using multiple features can be used to find out non-linear decision boundaries.
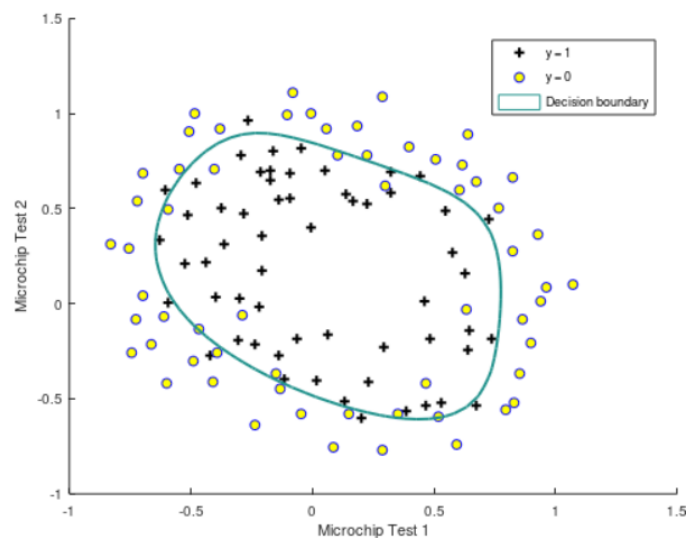
- Logistic Regression concept
- Decision boundary
- Cost function for Logistic regression
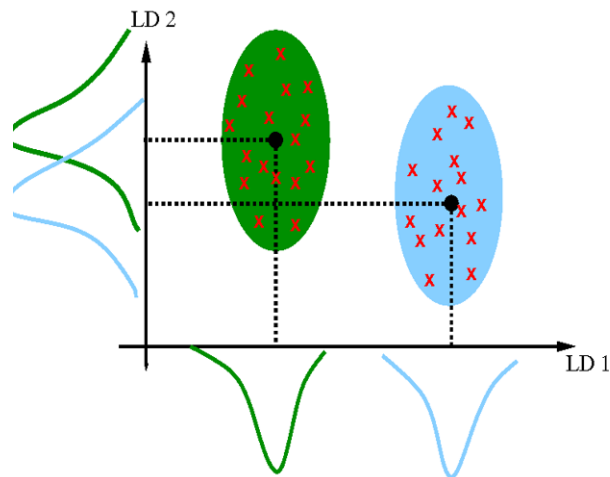- Bias and Variance
- Regularization

Day 4

More supervised learning algorithms will give you a brief overview of Linear Discriminant Analysis, K-Nearest Neighbors and Decision trees.
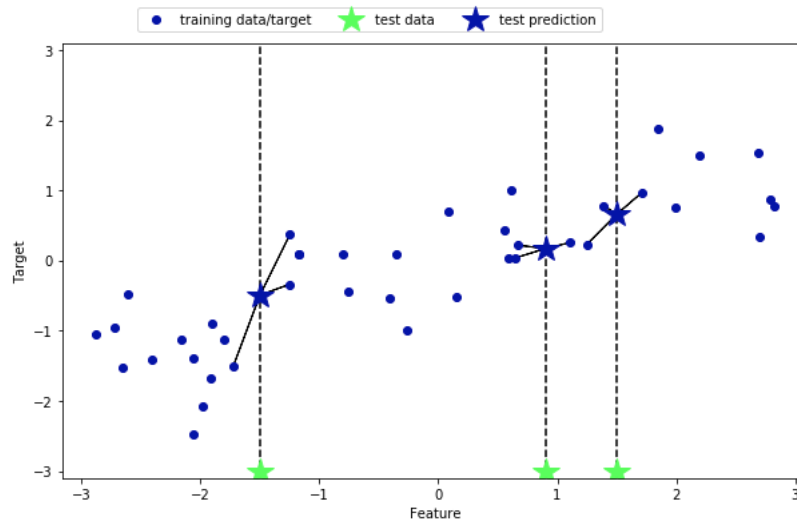

K-Nearest Neighbors

- K-Nearest Neighbors

- Linear Discriminant Analysis

- Decision Trees

Day 5

Measuring the performance of a learning algorithm is undoubtedly the most crucial part of a Machine Learning project. Using Matplotlib, learning curves can be plotted and be checked against overfitting or underfitting problems. Regularization can be addressed to tackle these issues. Exploiting the benefits of real-valued performance measurement and error metrics such as: Precision, Recall and F1 Score, we can further extract out the best result of our Machine Learning project by choosing the best parameters and learning algorithm.
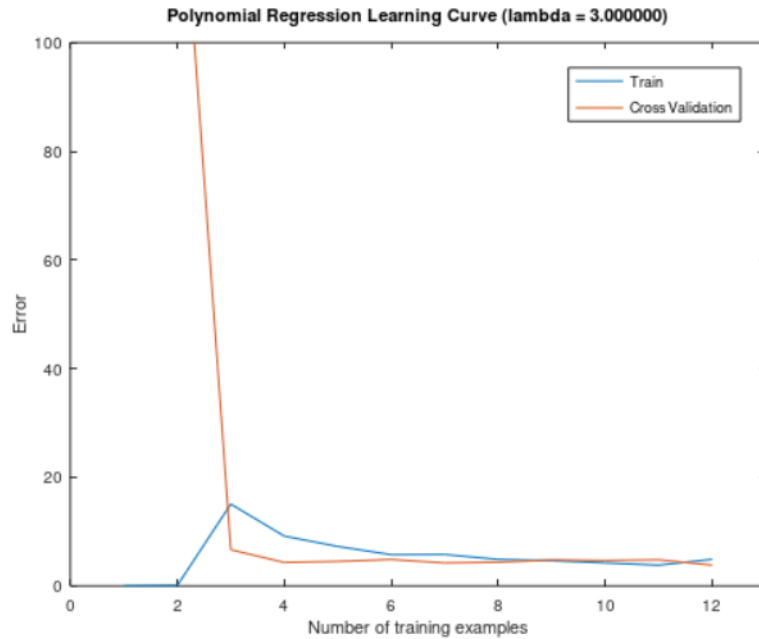

Learning Curve

Useful links and materials:

- Learning Curves

- Error Metrics

- F1 Score

Day 6

Just using a logistic regression classifier to plot decision boundaries often fails to keep a large margin between the different classes, and this is where Large Margin Classifiers come into play. Support Vector Machines is undoubtedly one of the most widely used algorithm to address this issue. Using a suitable Kernel, a margin between different classes can be maintained in order to further improve the performance of your learning algorithms, and the best part is that you don't even have to implement any of these SVM algorithms by yourself. All these algorithms are neatly packed in your python libraries which you can apply using just a few lines of code!
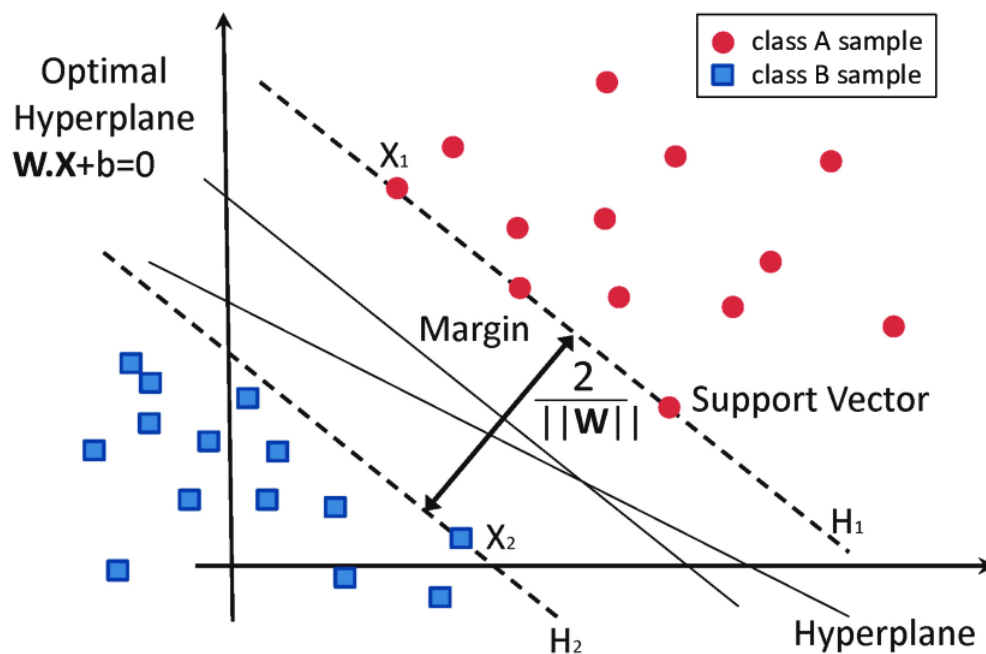
Support Vector Machine

Useful links and materials:

- Large Margin Intuition

- SVM explained

- Kernels

- SVM with Python [Warning: Long Video]

Day 7

Unsupervised Learning Algorithms are used to find patterns/structures in a given dataset. The term 'Unsupervised' is used because we don't have to use any labeled training examples as we had to in Supervised Algorithms. You will be able to analyze clusters in datasets by successfully implementing the very popular K-Means Clustering algorithm. You will also learn to compress an image from 24-bit to 16-bit representation by using the Principal Component Analysis algorithm, which will also help you with data compression.
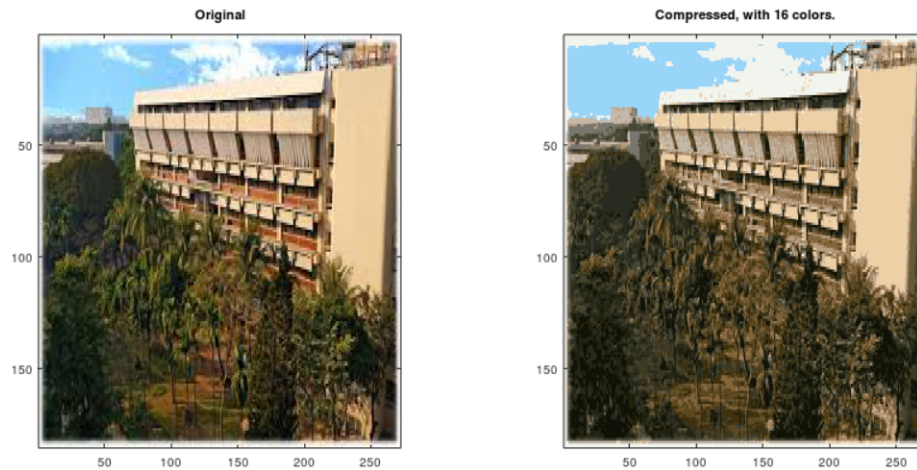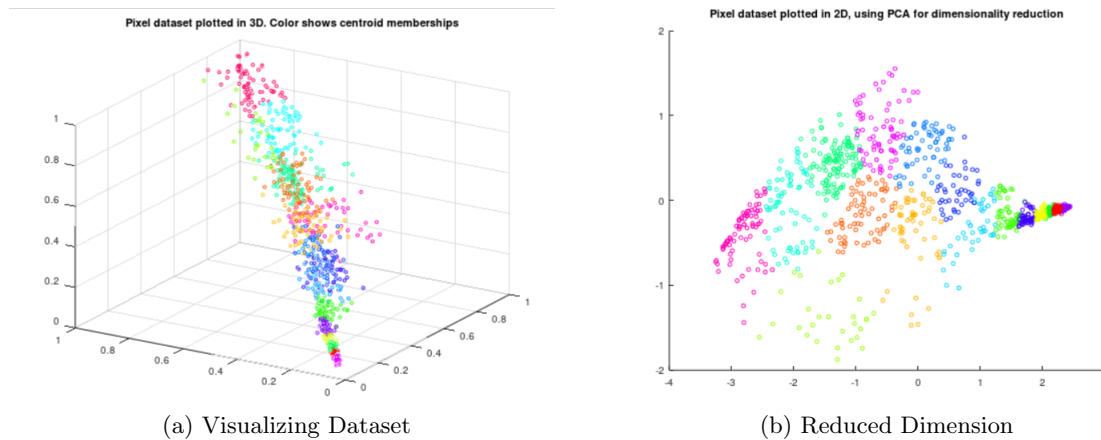

Image compression

(a) Visualizing Dataset   (b) Reduced Dimension

Principal Component Analysis

Useful links and materials:

- K-Means Clustering
- Principal Component Analysis-1
- Principal Component Analysis-2

Day 8

You will learn how to detect anomalies in your system and this type of unsupervised learning is used in fraud detection, manufacturing aircraft engines, monitoring machines in data center and so on. Carefully chosen features will help your algorithms ouput the best prediction and using Gaussian Distribution, you can implement the Anomaly Detection algorithm by yourself.
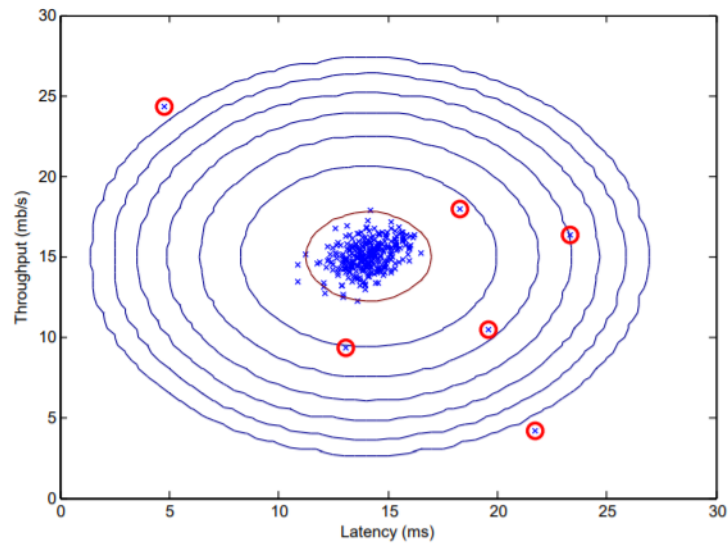

Anomaly Detection
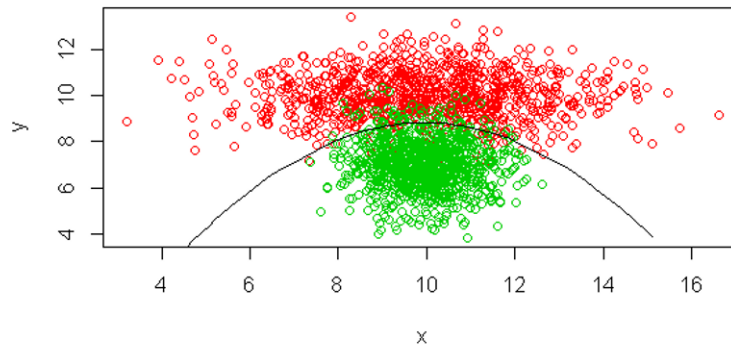
Gaussian Naive Bayes

Useful links and materials:

- Gaussian Distribution
- Anomaly Detection algorithm

Day 9

Ever wondered how YouTube is able to accurately predict the videos that you are most likely to watch? Every time you watch a video, YouTube's Recommender System keeps track of your watch history. By analyzing your past videos, a recommender system can accurately predict what types of videos you will prefer and what types of videos you will not likely watch. The next time you go to YouTube, you will see your homepage flooded with recommendations, and most of those are bang on! These sorts of Recommender Systems work based on Collaborative Filtering and are widely used in online e-commerce services like Amazon, Daraz and Foodpanda, which contributes a substantial amount to their revenue. You will learn how to build a recommender system and based on the type of a certain content, you will be able to predict whether that content is going to be a major hit or barely draw the attention of customers.
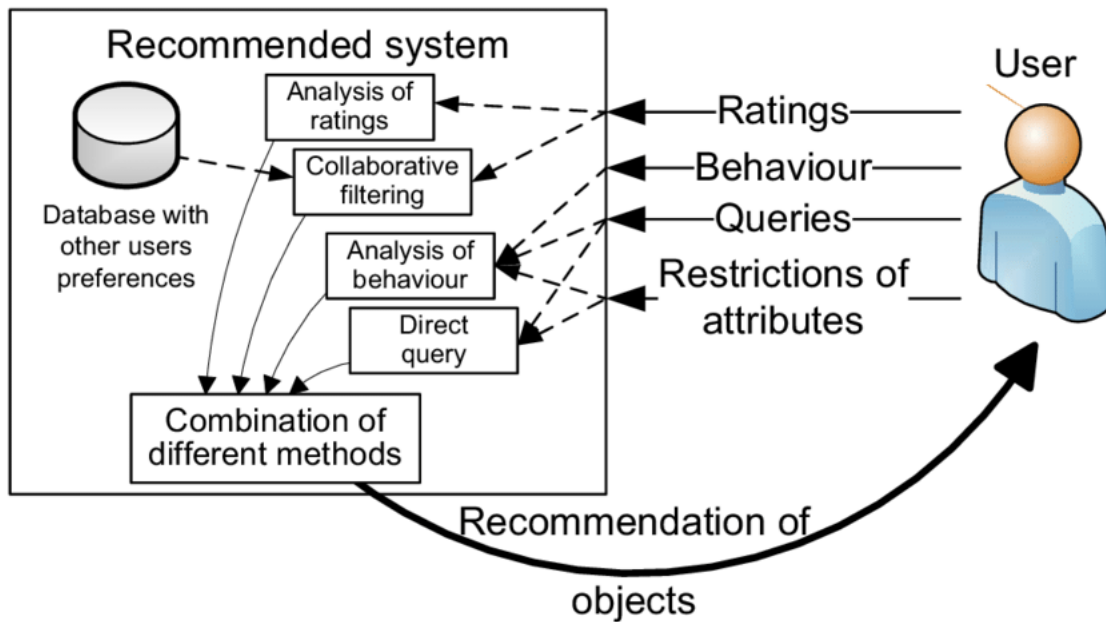
Recommender Systems flow-chart

Useful materials and links:

- Content Based Recommendation
- Collaborative Filtering Algorithm

Day 10

Now you'll apply Machine Learning to your own projects and datasets! Open up your JupyterLab, download some datasets from Kaggle and you're ready to go! Apply your skills and find out what you can do. You can deploy and train your models on IBM Watson, which is a great way to harness GPU power from IBM.

Day 11

Congratulations! Now you can add Machine Learning skills to your CV with confidence! On this last day, you will get some advice for applying Machine Learning problems, get a brief overview of Deep Learning and you'll be handed project ideas for applying Machine Learning. Deep Learning is now a very promising field which mimics the learning process of our biological brains, and using such learning methods people are able to train Neural Networks to autonomously drive cars, recognize faces of different people and more interestingly, use Neural Networks on homomorphic encryption.
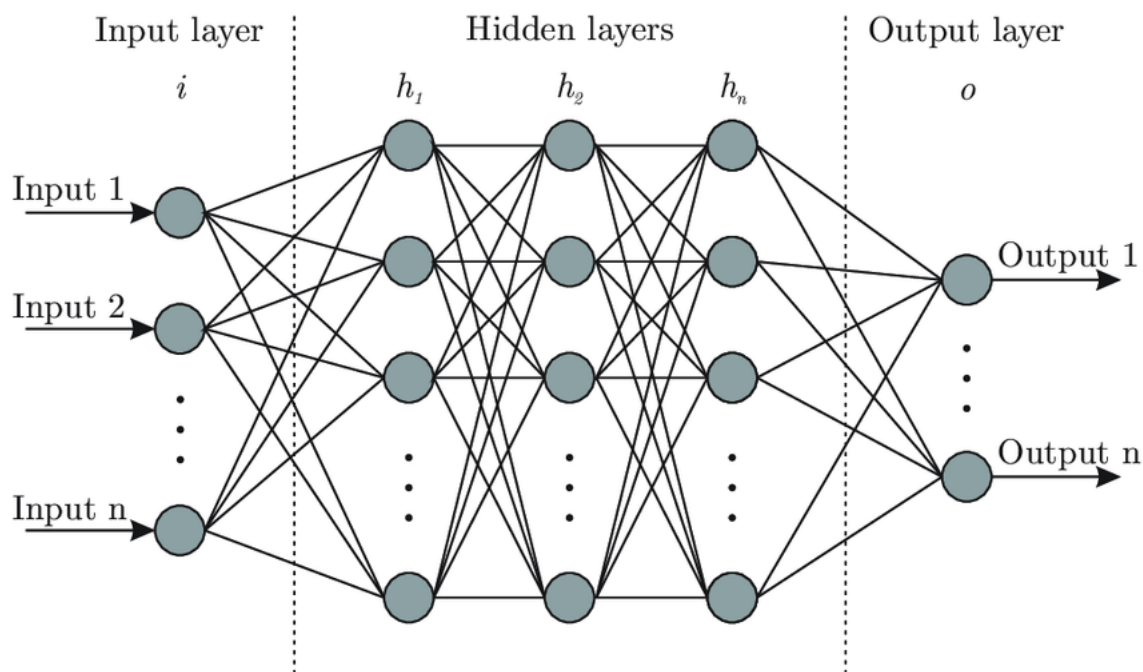
Neural Network Basic Architecture

You can find interesting applications of AI and Deep Learning on this amazing channel named "Two Minute Papers". The recent release of OpenAI GPT-3 shows the true power of deep neural networks. Be sure to check that out here. Best of luck for your future endeavors!