INTERNSHIPSTUDIO

Agenda

INTERNSHIPSTUDIO

- A recap- Machine Learning
  - ML case studies
  - Python project ideas
  - ML project ideas
- Deep Learning
  - Diff between ML/AI/DL
  - Artificial Neural Network (ANN)
  - Deep Learning working details
  - Implementing DL
- Resources- Deep Learning

Recap - Machine Learning

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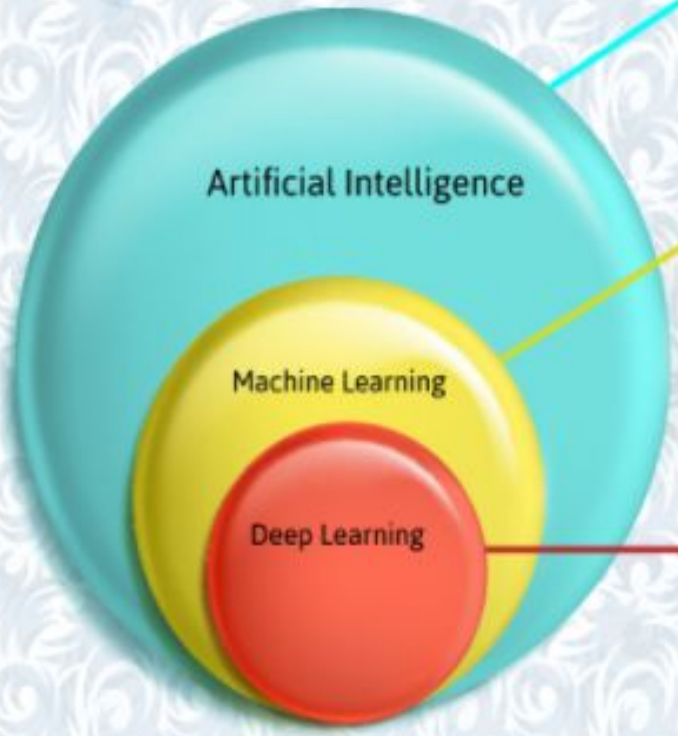
What is Machine Learning?



Artificial Intelligence

The science and engineering of making intelligent machines, especially intelligent computer programs.

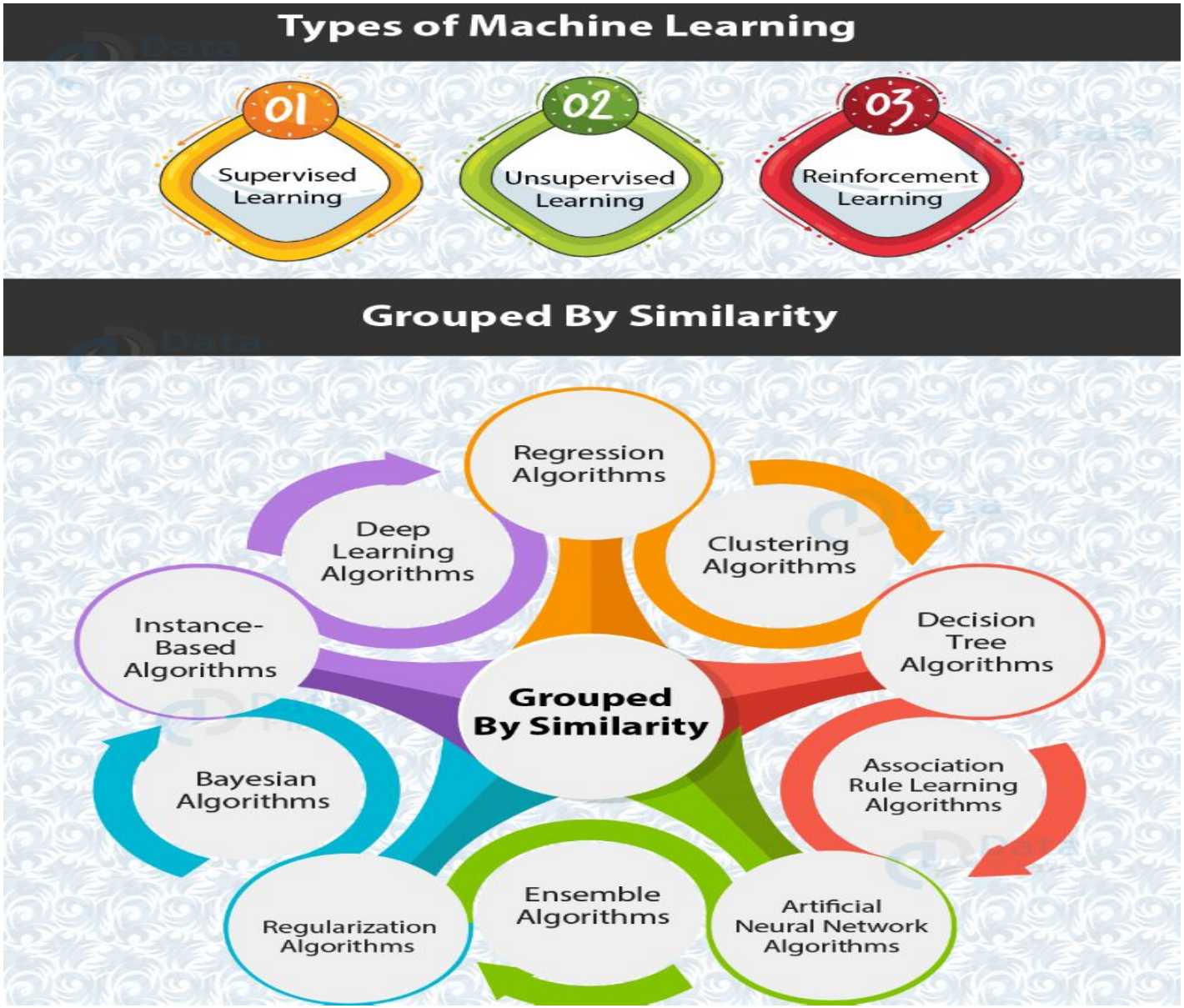
Machine Learning

A subset of AI that provides systems the ability to learn and improve from experience without being explicitly programmed. It deals with algorithms that can look at data to learn from it and make predictions.

Deep Learning

A method of Machine Learning that is based on learning data representations (or feature learning) instead of task-specific algorithms.

Types of Machine Learning



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Applications of Machine Learning

Advantages and Disadvantages

Advantages	Disadvantages
Easily identifies trends and patterns	Data Acquisition
No human intervention needed	Time and Resources
Continuous Improvement	Interpretation of Results
Handling multi-dimensional and multi-variety data	High error-susceptibility
Wide Applications	

Companies Using Python Machine Learning

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Machine Learning case studies

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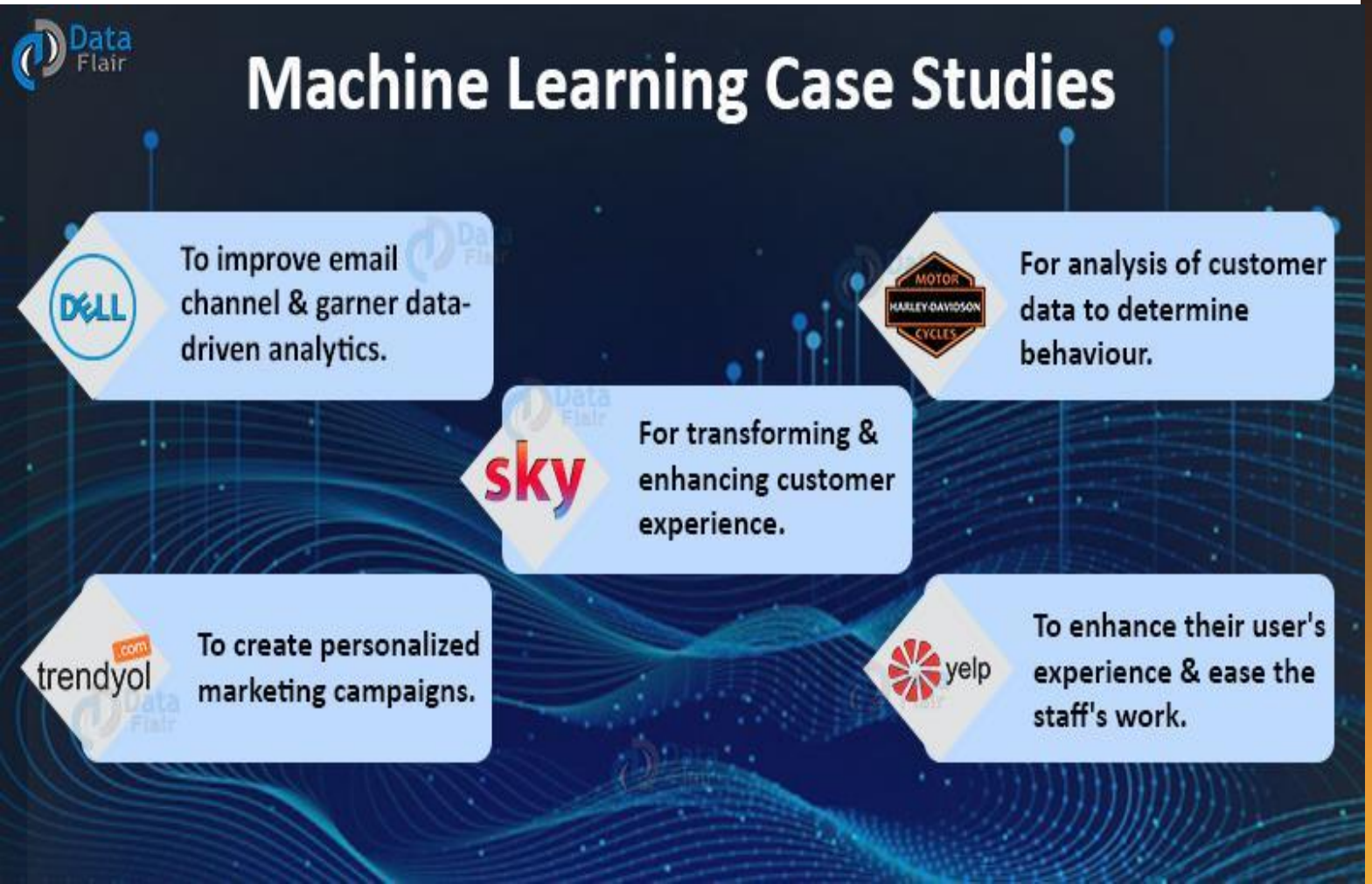
Here are a few real-world case studies on machine learning applications to solve real problems.



Python Project ideas

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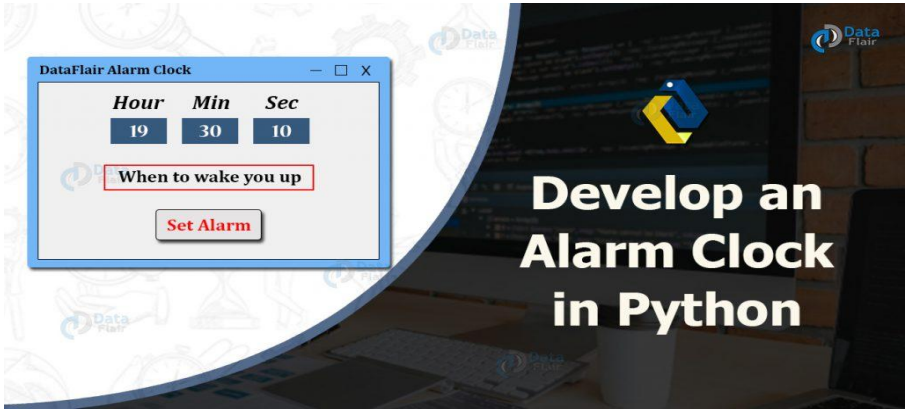
1. Hangman Project in Python
2. Rock Paper Scissor Python Game
3. Dice Rolling Simulator in Python
4. Email Slicer
5. Magic 8 Ball Game
6. Target Practice Game
7. Alarm Clock with GUI
8. Binary Search Algorithm
9. Desktop Notifier App in Python
10. Clickomania Game



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Machine Learning Projects ideas

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Learning through projects is the best investment that you are going to make. These project ideas enable you to grow and enhance your machine learning skills rapidly.

1. Iris Flowers Classification Project

Machine Learning Project ideas

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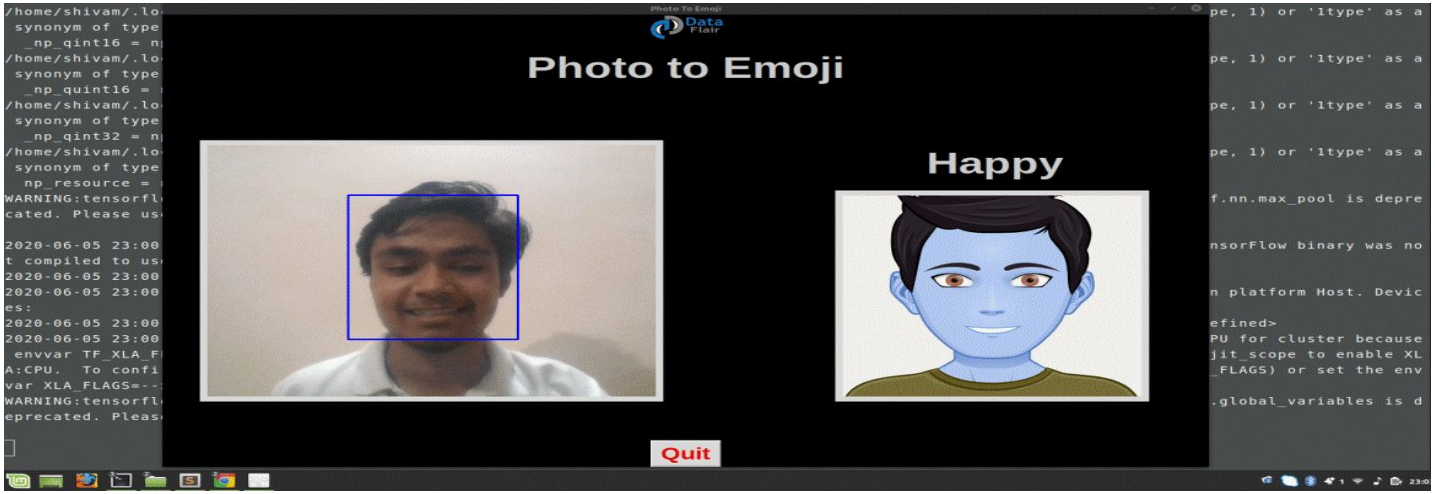
2. Emojify – Create your own emoji with Python



3. Loan Prediction using Machine Learning

Project idea – The idea behind this ML project is to build a model that will classify how much loan the user can take. It is based on the user's marital status, education, number of dependents, and employments. We can build a linear model for this project.

Machine Learning Project ideas

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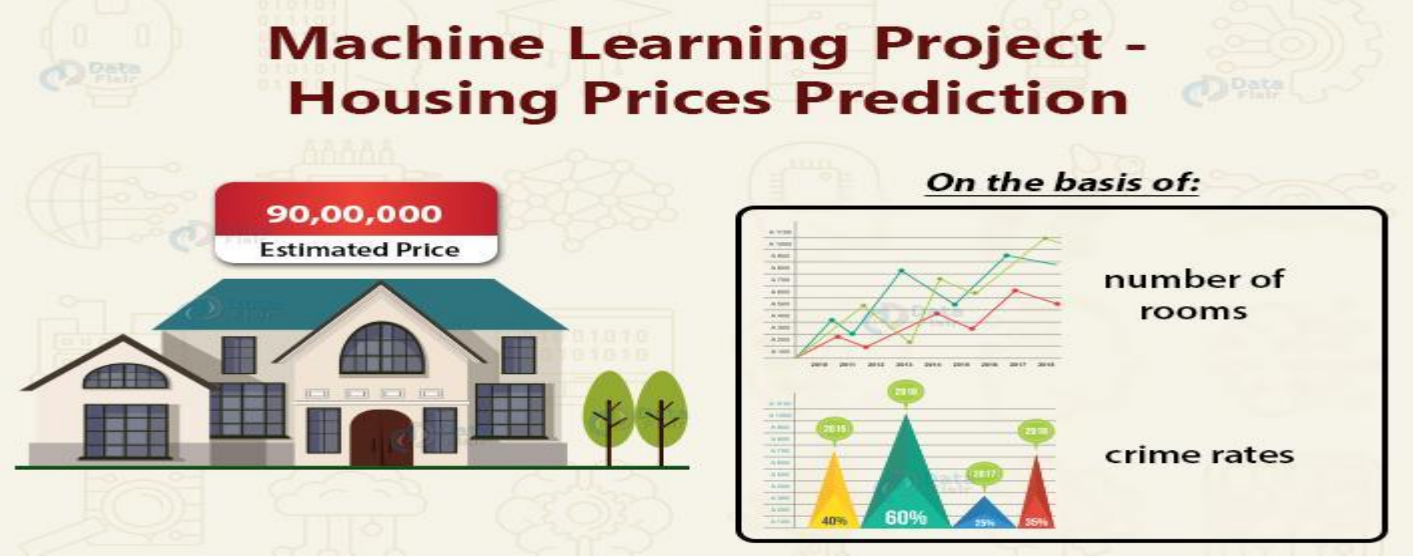
3. Housing Prices Prediction Project



4. MNIST Digit Classification Machine Learning Project

Project idea – The MNIST digit classification python project enables machines to recognize handwritten digits. This project could be very useful for computer vision. Here we will use MNIST datasets to train the model using Convolutional Neural Networks.

Machine Learning Project ideas

5. Stock Price Prediction using Machine Learning
6. Titanic Survival Project
7. Wine Quality Test Project
8. Fake News Detection Project
9. Music Genre Classification Machine Learning Project
10. Bitcoin Price Predictor Project

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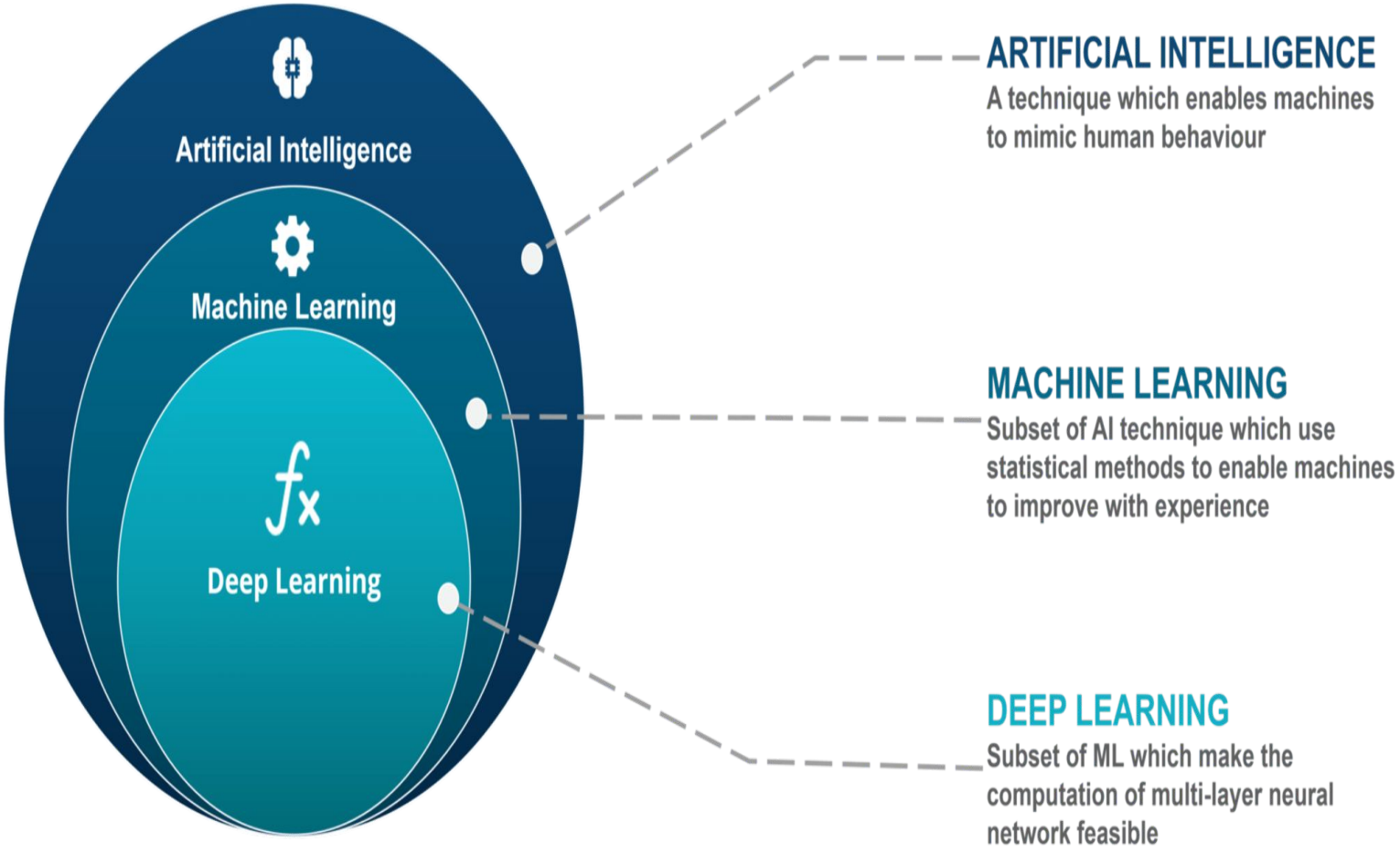
- Summarise different ML algorithms groups?
- Name key applications of ML?
- Advantages & Disadvantages of ML?
- Implement at least 3 project ideas in Python.
- Implement 3 Machine Learning Projects ideas.

ML Vs DL Vs AI



Deep Learning is a subset of **Machine Learning** which is used to achieve **Artificial Intelligence**.

Deep Learning Vs Machine Learning

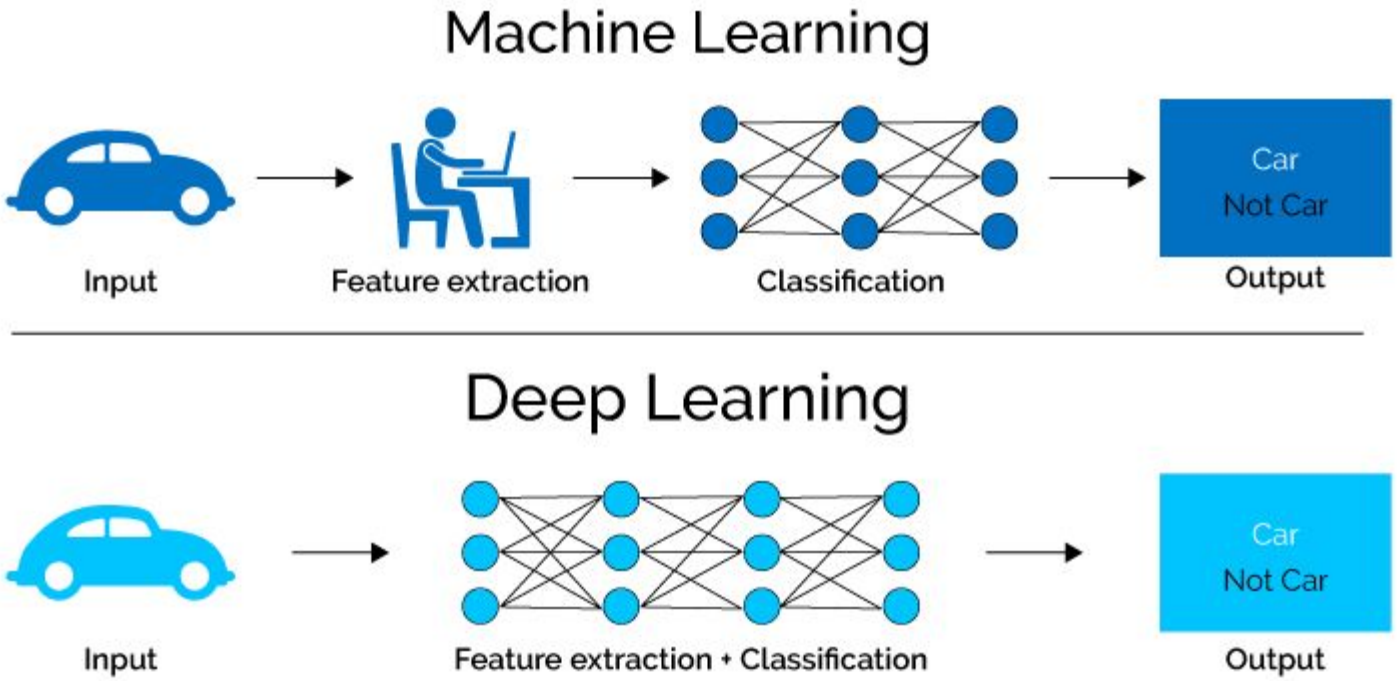
Factors	Deep Learning	Machine Learning
Data Requirement	Requires large data	Can train on lesser data
Accuracy	Provides high accuracy	Gives lesser accuracy
Training Time	Takes longer to train	Takes less time to train
Hardware Dependency	Requires GPU to train properly	Trains on CPU
Hyperparameter Tuning	Can be tuned in various different ways.	Limited tuning capabilities

Why deep learning

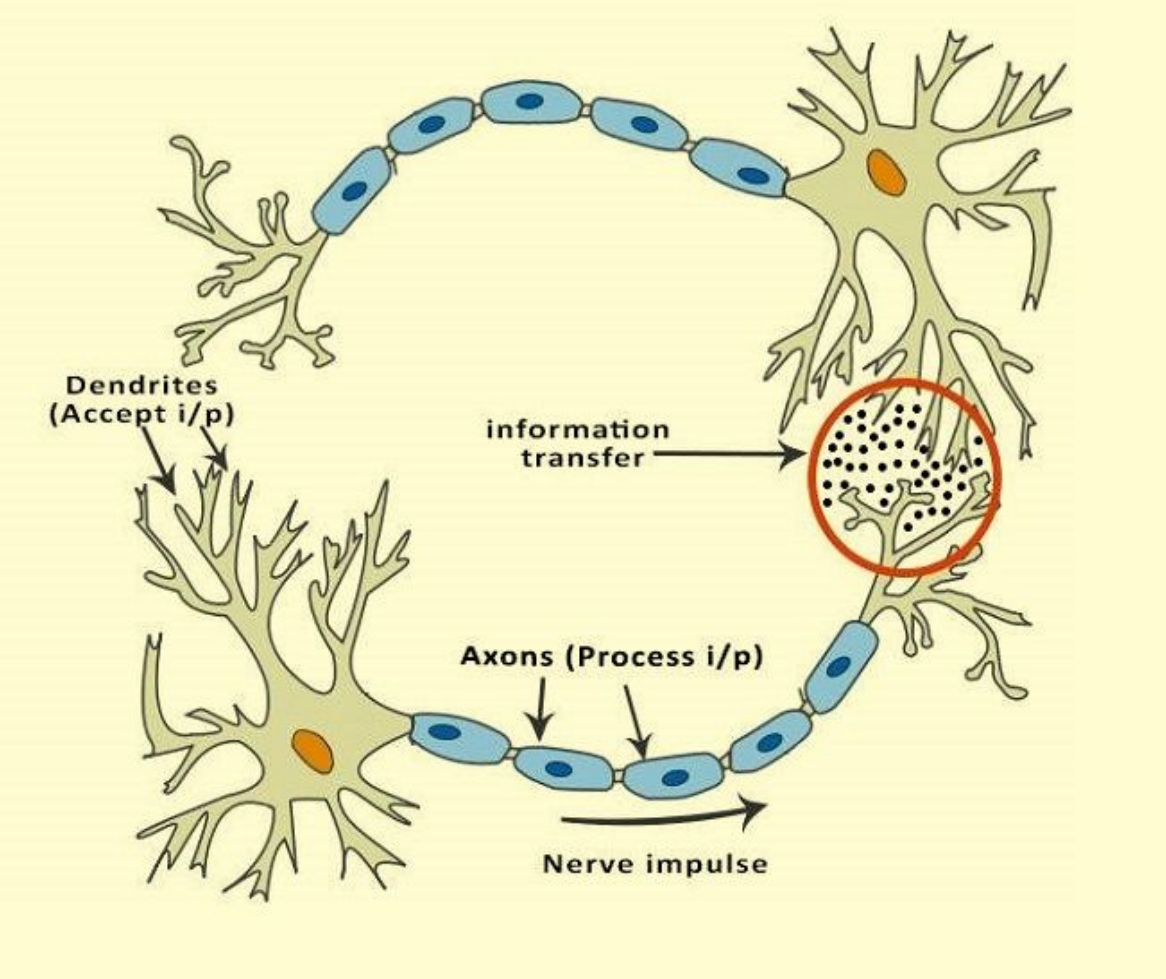
How do data science techniques scale with amount of data?

Deep Learning

- **Deep learning** is an AI function that mimics the workings of the human brain in processing data for use in detecting objects, recognizing speech, translating languages, and making decisions.
- **Deep learning** AI is able to **learn** without human supervision, drawing from data that is both unstructured and unlabeled.



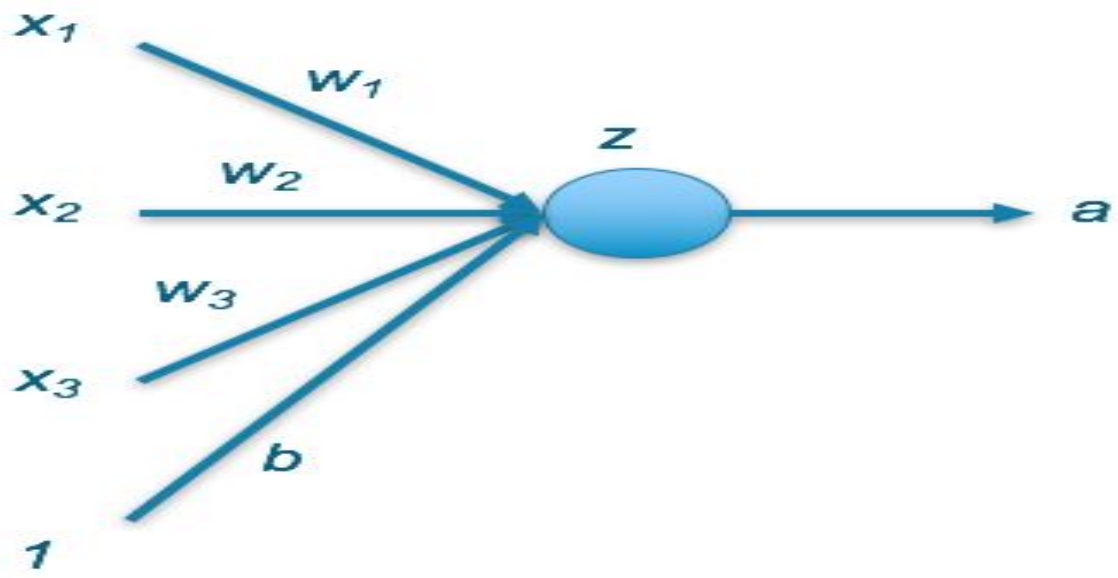
Neurons within the brain



A typical human brain has as many as 10B neurons!

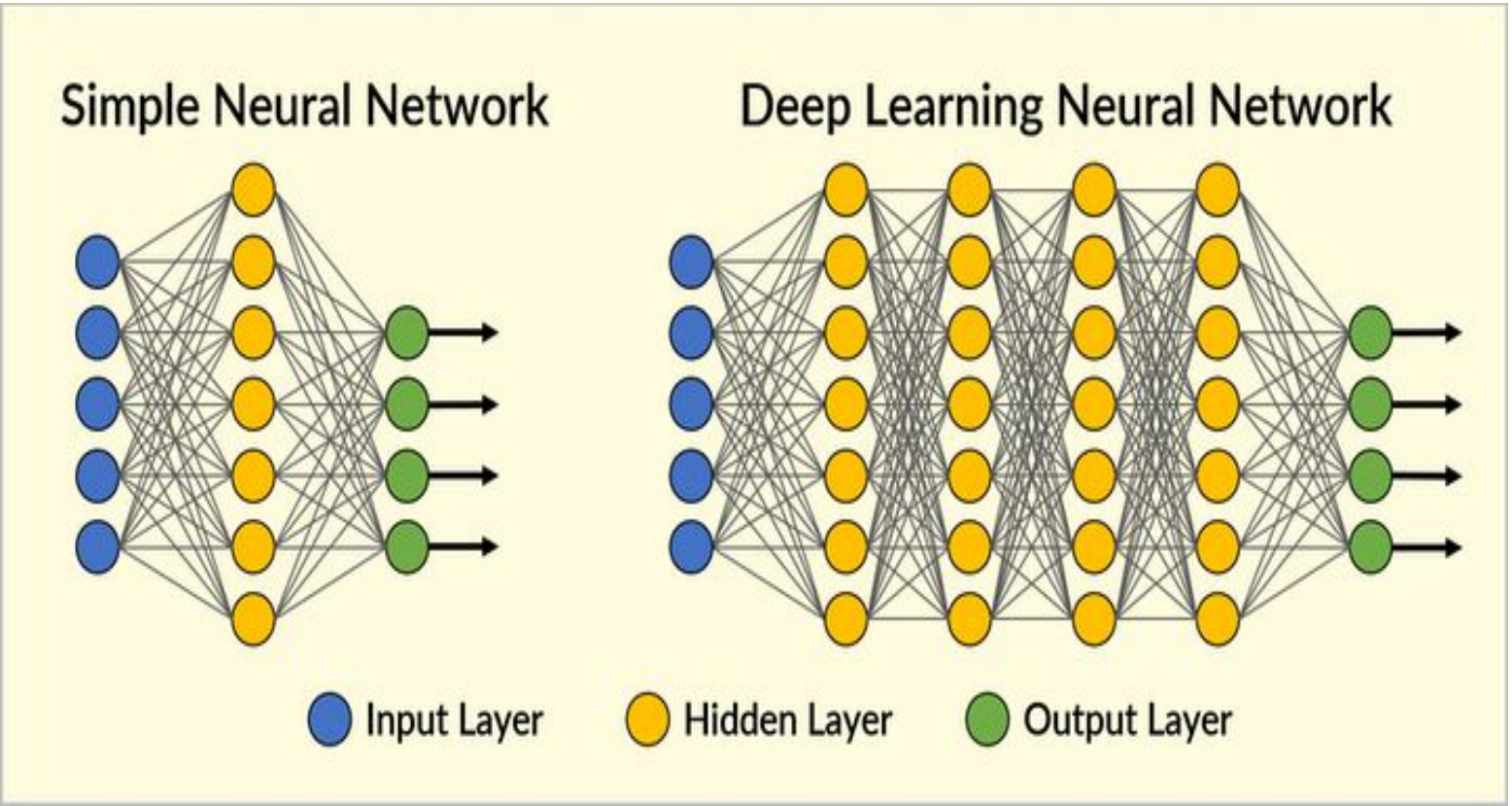
Artificial Neuron

- An artificial neuron (also referred to as a perceptron) is a mathematical function.
- It takes one or more inputs that are multiplied by values called “weights” and added together.
- This value is then passed to a non-linear function, known as an ***activation function***, for neuron’s output.



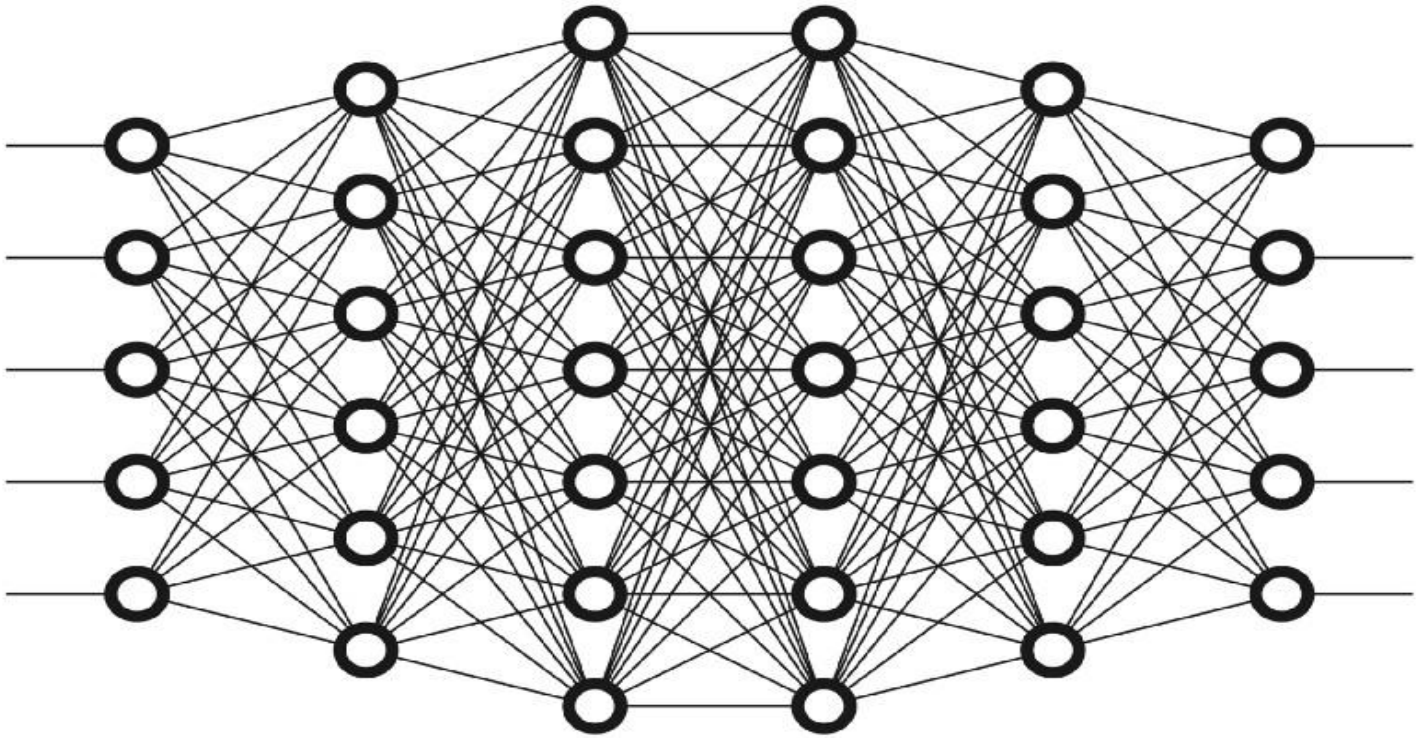
Artificial Neural Network

- Neural networks can learn complex patterns using layers of ***neurons*** which mathematically transform the data
- The layers between the input and output are referred to as "hidden layers"
- A neural network can learn relationships between the features that other algorithms cannot easily discover.

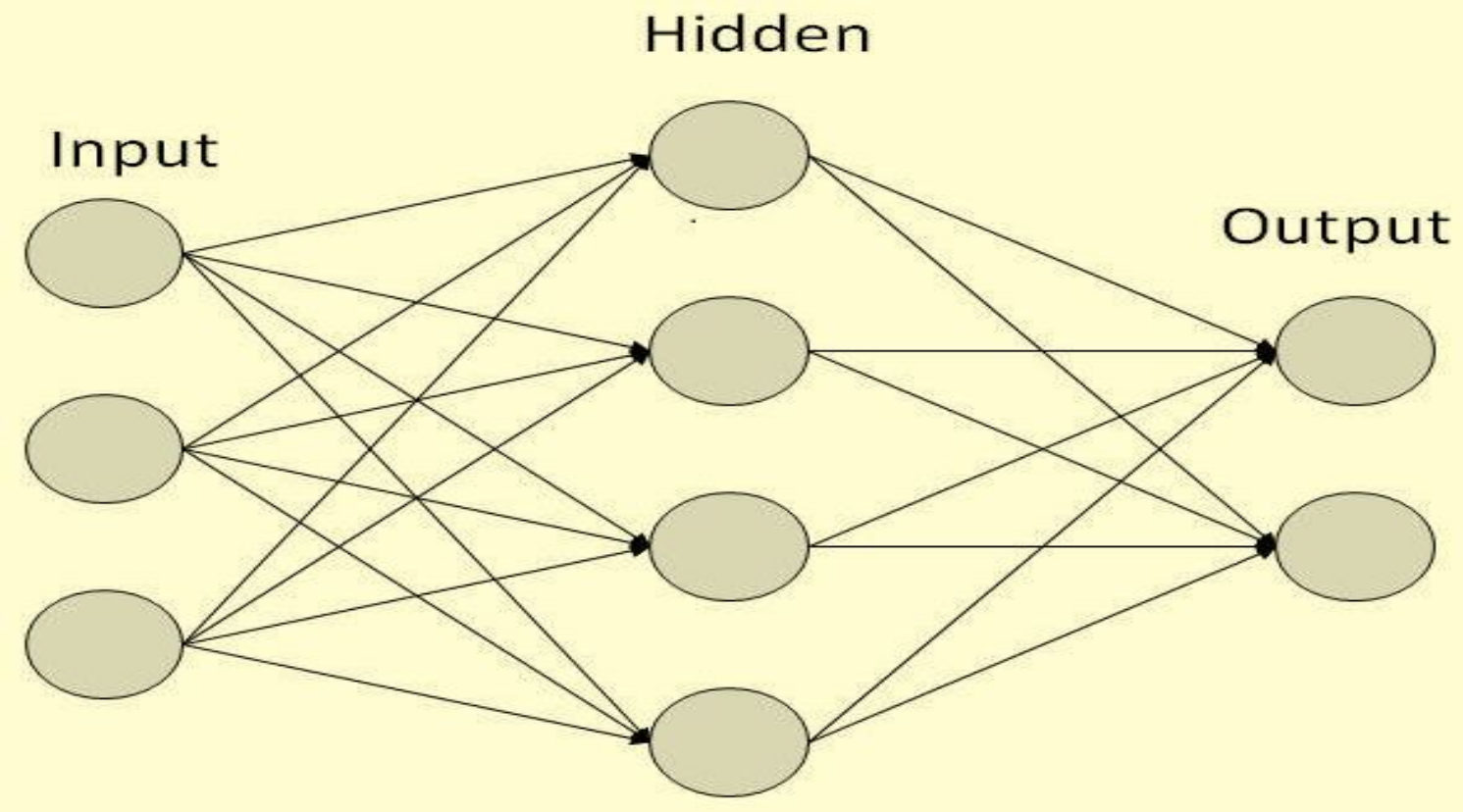


How Deep Learning works?

- The inspiration for deep learning is the way that the human brain filters information. Its purpose is to mimic how the human brain works to create some real magic.
- Deep Learning is a **machine learning** method. It allows us to train an AI to predict outputs, given a set of inputs. Both supervised and unsupervised learning can be used to train the AI.



How do Neural Network works?

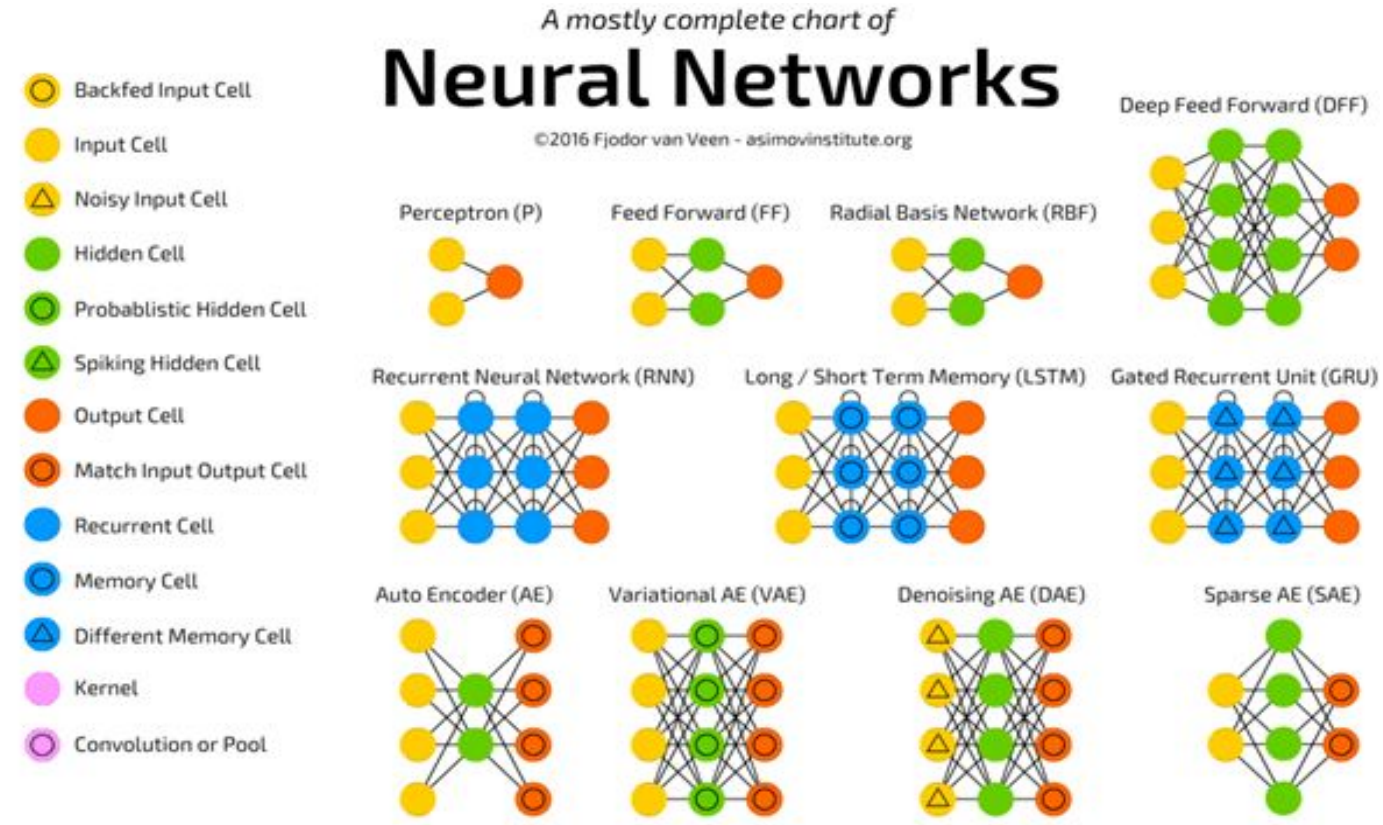


- The leftmost layer in this network is called the input layer, and the neurons within the layer are called *input neurons*.
- The rightmost or *output* layer contains the *output neurons*, or, as in this case, a single output neuron.
- The middle layer is called a *hidden layer*, since the neurons in this layer are neither inputs nor outputs.

Deep Learning Methods

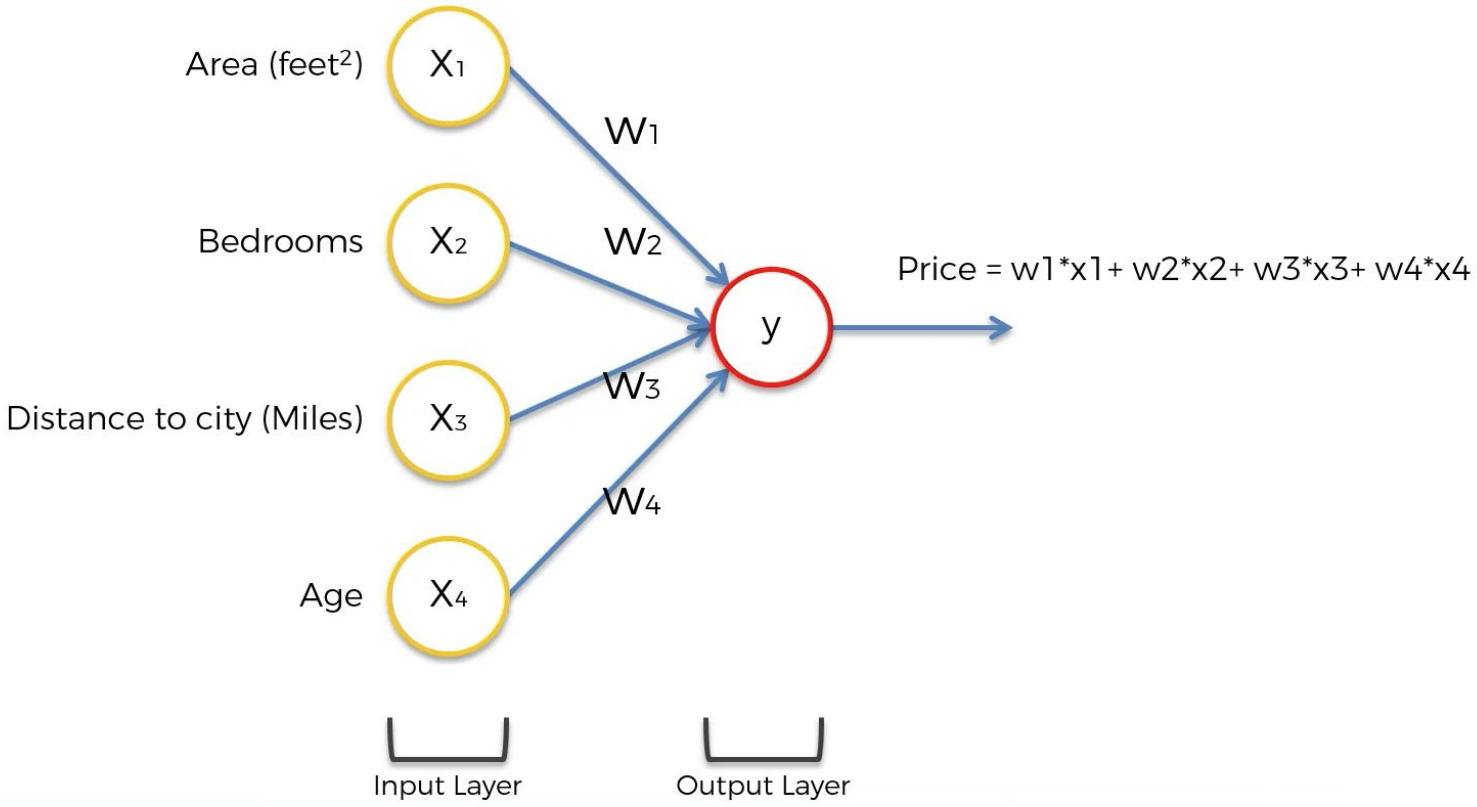
Deep learning then can be defined as neural networks with a large number of parameters and layers in one of four fundamental network architectures:

- Unsupervised Pre-trained Networks
- Convolutional Neural Networks
- Recurrent Neural Networks
- Recursive Neural Networks

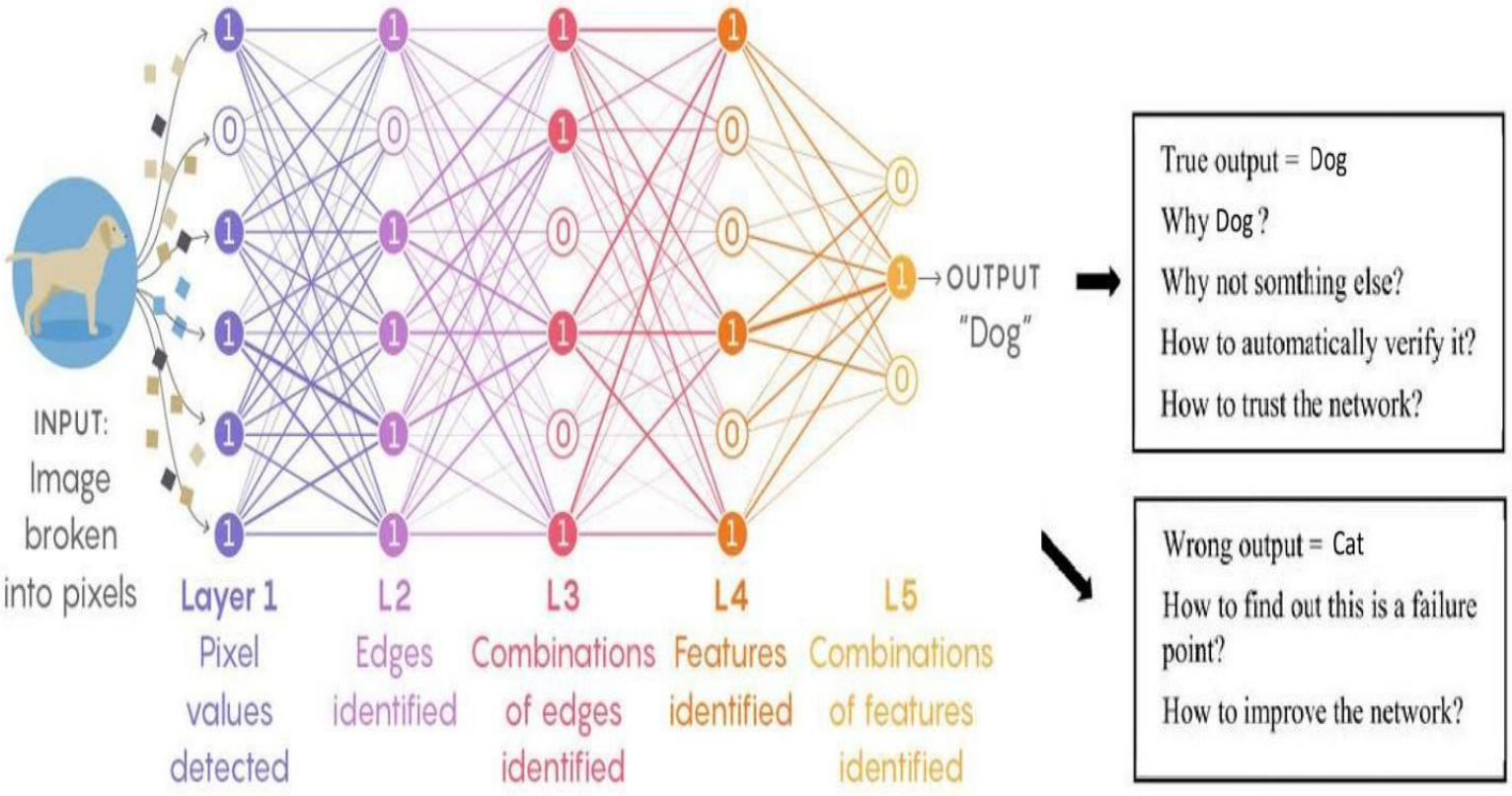


The Most Basic Form of a Neural Network

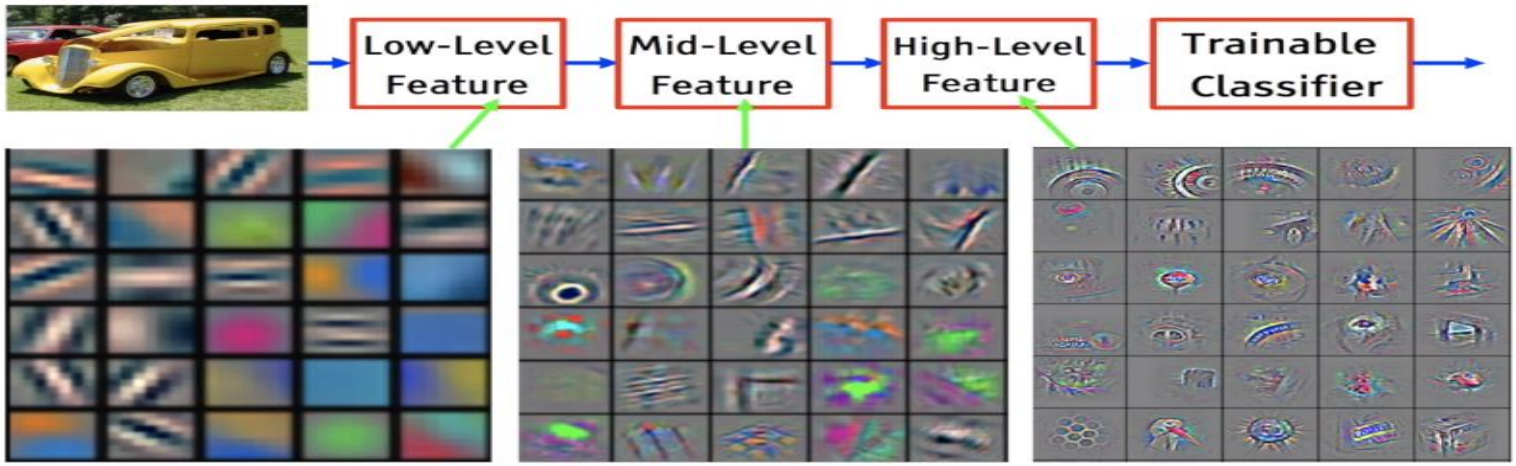
- In this a neural network only has two layers - the input layer and the output layer. The output layer is the component of the neural net that actually makes predictions.
- For example, if you wanted to make predictions using a simple weighted sum (also called linear regression) model..



Identifying a Dog



Capturing information



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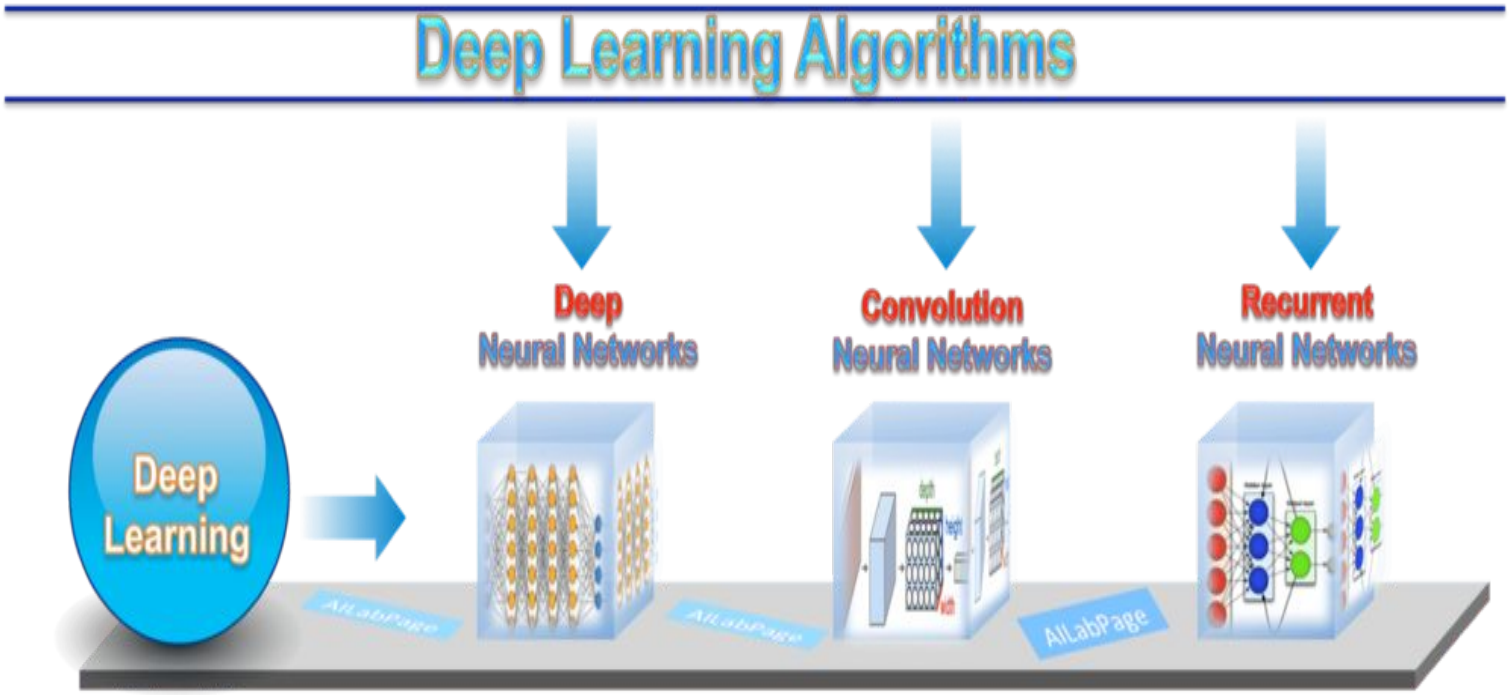
DL types and usages



A method for applying simple mathematical function to Data (Voice, Text, Images or Videos).

It learns high level features by detecting complex interaction

For improved traditional algorithms

Used for

Fraud detection by identifying complex patterns in finance

Identify defects based on deeper anomaly detection for manufacturing

For processing images

Used for

Images, Healthcare, Satellite images (Maps), Retails for in store traffic by video processing, insurance and automotive

For sequenced data

Used for

Customer Services, Social media posts, Photo captioning, Predicting customer behavior based via time series and recommendation systems

INTERNSHIPSTUDIO

- What is Deep Learning?
- What is the use of Deep Learning?
- What are Neural Networks?
- What is an Activation Function?
- What are the applications of Deep Learning?

Deep Learning

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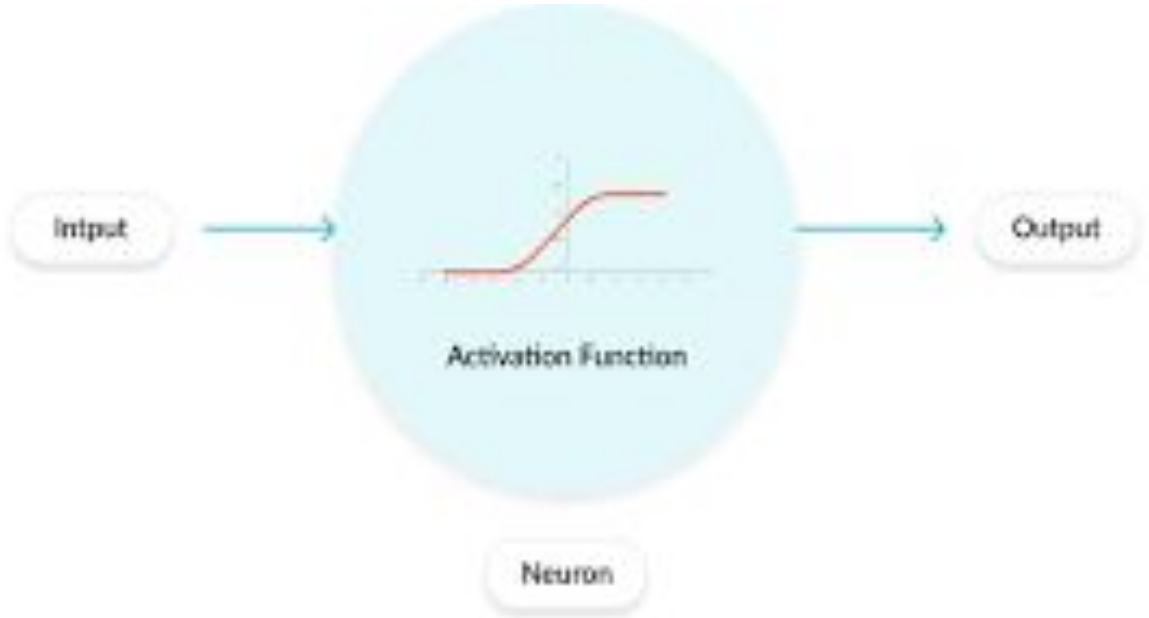
Why Do We Need Activation Functions?



- In neural networks to make neuron intelligent on activation process is needed i.e. when to get activated & when not to.
- A perceptron is either 0 or 1 we need a smoother function that progressively changes from 0 to 1 with no discontinuity.

What is an Activation Function?

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An activation function is a non-linear function applied by a neuron to introduce non-linear properties in the network.

- A relationship is linear if a change in the first variable corresponds to a constant change in the second variable.
- A non-linear relationship means that a change in the first variable doesn't necessarily correspond with a constant change in the second. However, they may impact each other but it appears to be unpredictable.

Linear function

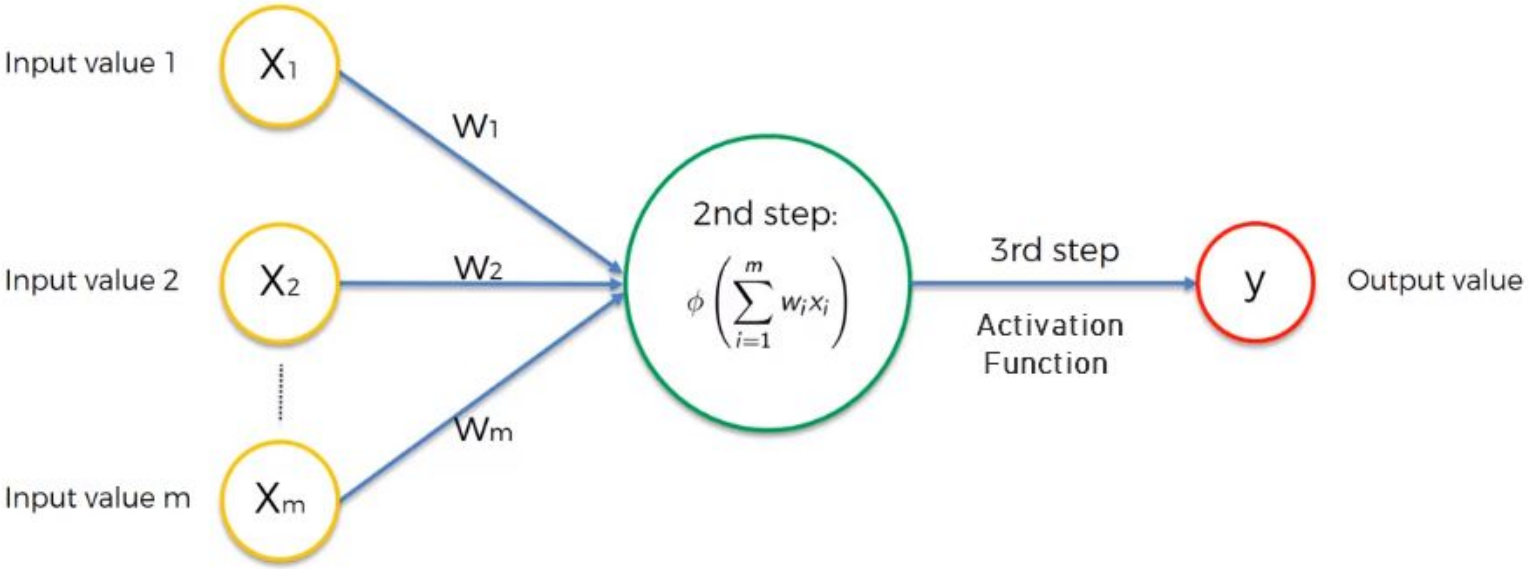
Non-linear function

Activation Function- Working

- What an artificial neuron do is to calculate a weighted sum of its input, adds a bias and then decides whether it should be "fired" or not.

$$Y = \sum(weight * input) + bias$$

- Considering the neuron of the figure above, the value of Y can be anything ranging from -inf to +inf. The neuron really doesn't know the bounds of the value. How do we decide whether the neuron should fire or not? We use activatioin functions for this purpose. To check the Y value produced by a neuron and decide whether outside connections should consider this neuron as fired or not.



Types of Activation functions

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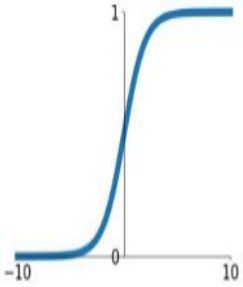
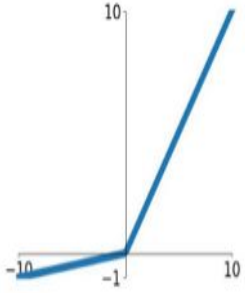
Sigmoid

$$\sigma(x) = \frac{1}{1+e^{-x}}$$



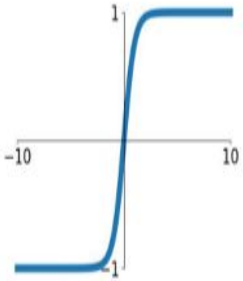
Leaky ReLU

$$\max(0.1x, x)$$



tanh

$$\tanh(x)$$



Maxout

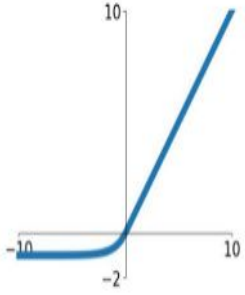
$$\max(w_1^T x + b_1, w_2^T x + b_2)$$

ReLU

$$\max(0, x)$$

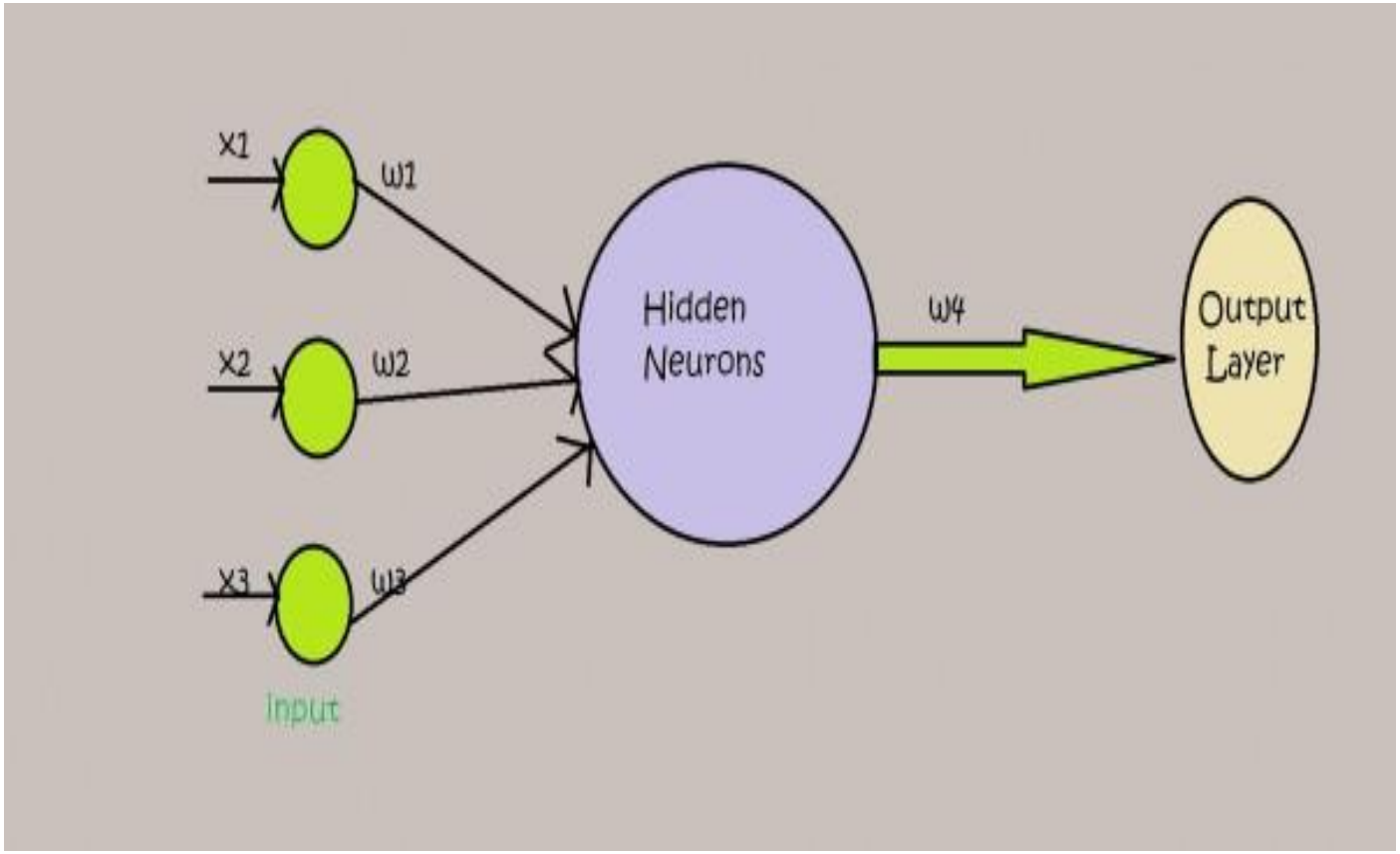
ELU

$$\begin{cases} x & x \geq 0 \\ \alpha(e^x - 1) & x < 0 \end{cases}$$



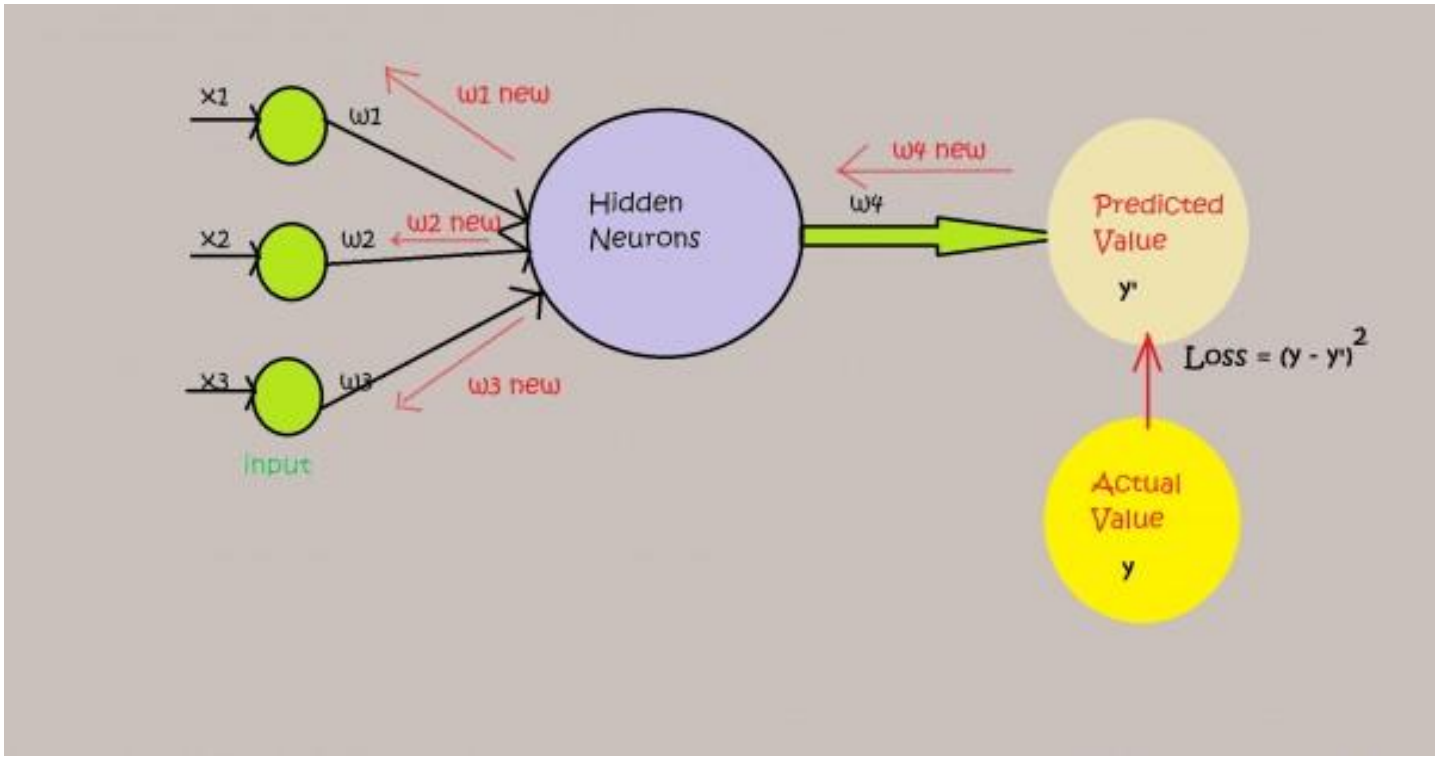
Forward Propagation

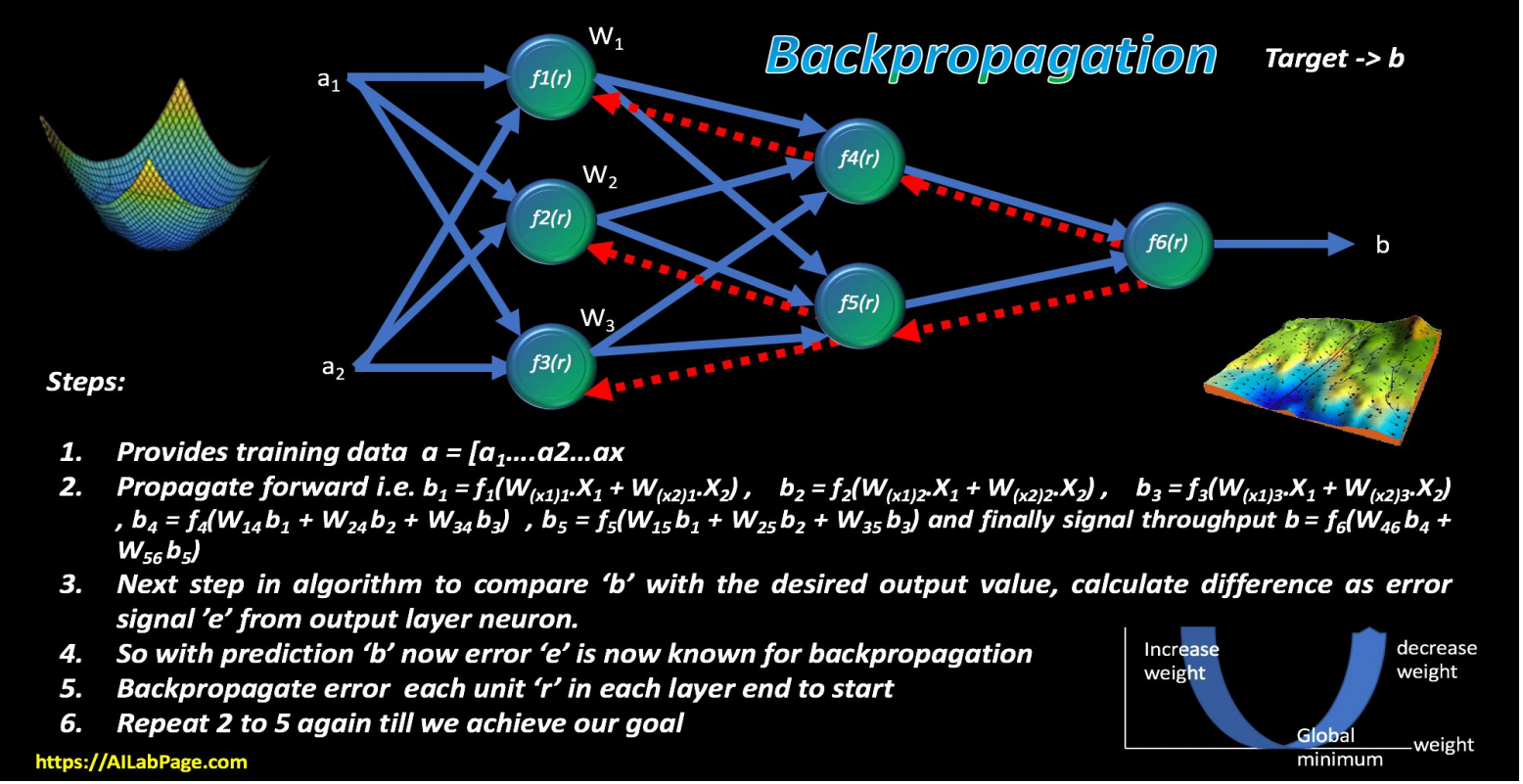
In feed forward network, the information moves in only one direction, forward, from the input nodes, through the hidden nodes (if any) and to the output nodes. There are no cycles or loops in the network.



Backward Propagation

- Backpropagation is a widely used algorithm in training feedforward neural networks for supervised learning.
- Firstly it propagates in forward direction and gives the predicted output.
- Then, we check the difference between the predicted output and actual output.
- In order to minimize this loss we will back propagate and update our weights.





- ***Set inputs and desired outputs*** – Choose inputs and set the desired outputs
- ***Set random weights*** – This is needed for manipulating the output values.
- ***Calculating the error*** – Calculating error helps to check how far is the required output from the actual. How good/bad is the model output from the actual output.
- ***Minimising the error*** – Now at this step, we need to check the error rate for its minimization
- ***Updating the parameters*** – In case the error has a huge gap then, change/update the parameters i.e. weights and biases to reduce it. Repeating this check and update process until error gets minimised is the motive here.
- ***Model readiness for a prediction*** – After the last step, we get our error optimised and, we can now test our output with some testing inputs.

Forward Propagation Steps

Input -

- 1. The features of your data is passed through input layer at first.
- 2. Firstly some weights are assigned to each input features. In this diagram, x1, x2, x3 are input features.

Hidden Neurons

- 3. Then, the information is passed through all the neurons in the hidden layer.
- 4. Then, they the input features are multiplied with their respective weights and added together along with a bias to get a value

  y = x1*w1 + x2*w2 + x3*w3 + bias

- This function is multiplied with output weight w4 and passed to

Activation function

- 5. This value is passed to activation function so that only required activation functions can get activated as per the passed threshold values.

  z = y*w4 = Activation(z)

Output

- 6. Finally, after the pre processing is done in hidden neurons, we get the output depending on number of classes.

LIMITATIONS - Using FF propagation we cant update our weights. Since, initial weights are generally randomly initialized so they will most likely give huge losses.

- We need to minimize this loss such that our predicted values are closer to actual values. Therefore, another technique came into play later on known as back propagation in which we go back and update the weights for minimizing the cost functions.

Backward Propagation Steps

INPUT LAYER

1. Firstly some weights are assigned to each input features. In this diagram, x1, x2, x3 are input features.
2. Then, the information is passed through all the neurons in the hidden layer.

PRE PROCESSING IN HIDDEN LAYER

3. Then, they the input features are multiplied with their respective weights and added together along with a bias to get a value

    y = x1*w1 + x2*w2 + x3*w3 + bias

4. This function is multiplied with output weight w4 and passed to activation function in the hidden layer. It activates only required activation functions can get activated as per the passed threshold values.

    z = y*w4 = Activation(z)

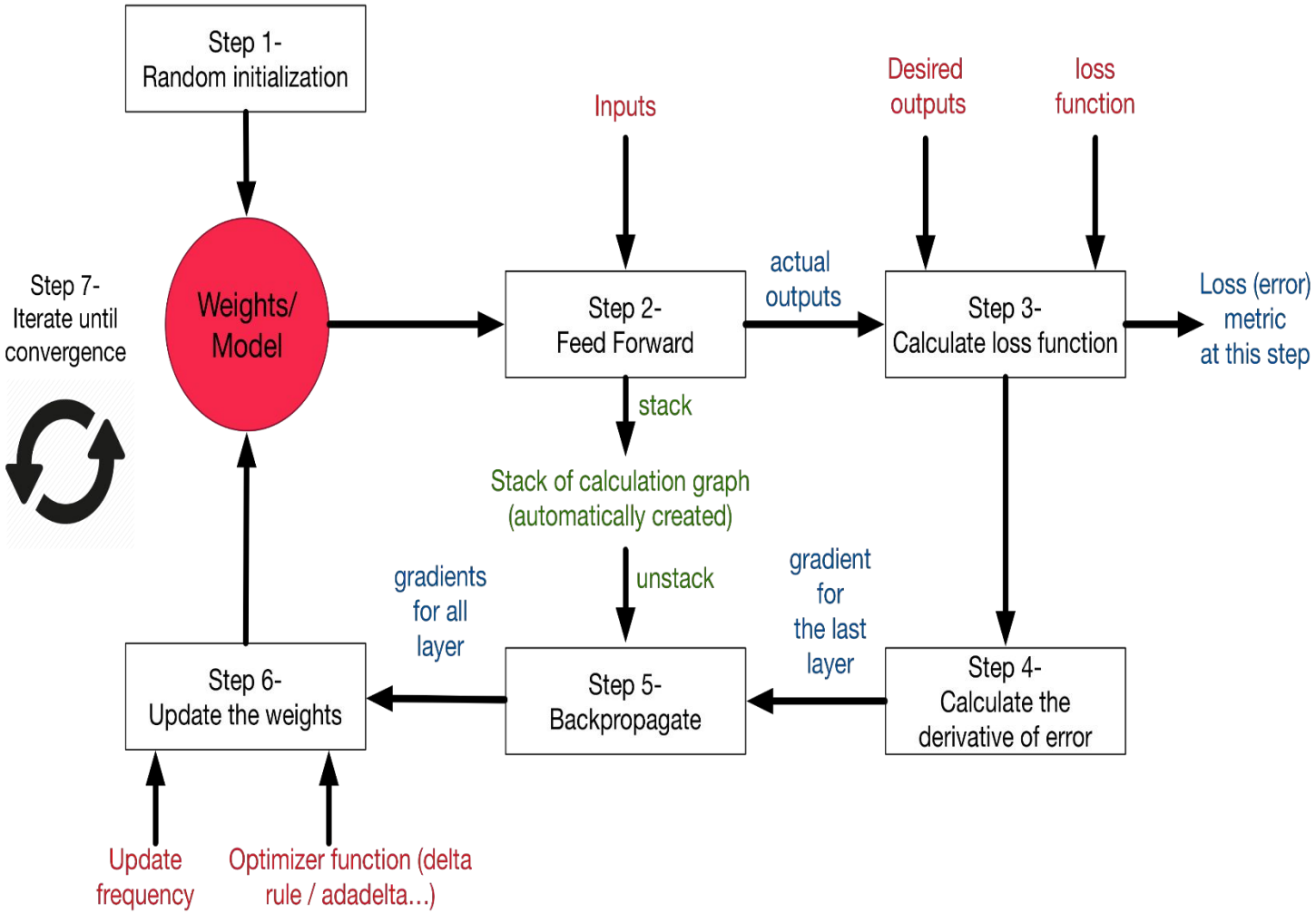
CALCULATING LOSS FUNCTION

5. Then loss value is calculated using square of difference of actual and predicted output.

    Loss = (y - y') square

6. We do square so that in case we get negative value it becomes positive.

Learning steps- Neural Networks



Learning steps- Neural Networks

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- Why we need an activation function?
- What is Forward Propagation?
- What is Backward Propagation?
- What are different types of activation function?

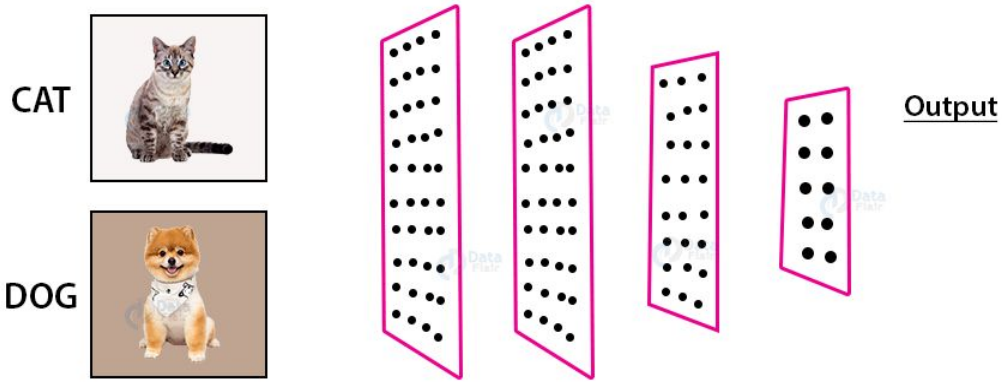
Deep Learning Project Ideas

INTERNSHIPSTUDIO

1. Predict Next Sequence

The very basic project that you can build is to predict the next digit in a sequence. Create a sequence like a list of odd numbers and then build a model and train it to predict the next digit in the sequence. A simple neural network with 2 layers would be sufficient to build the model.

2. Cats vs Dogs



Deep Learning Project ideas

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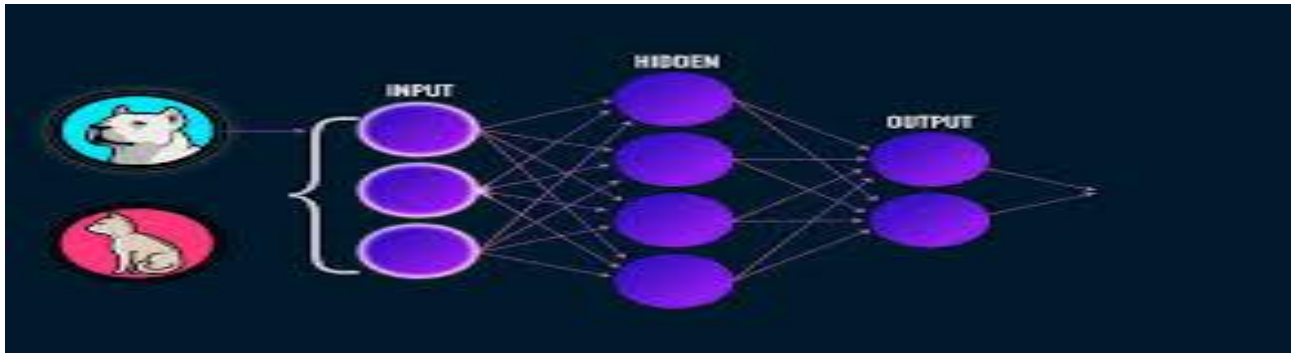
3. Build your Own Neural Net from Scratch



4. Image Classification with CIFAR-10 Dataset

Deep Learning Project ideas

5. Human Face Detection

6. Dog’s Breed Identification

7. Gender and Age Detection

8. Driver Drowsiness Detection

9. Language Translator

Computer Vision Project ideas

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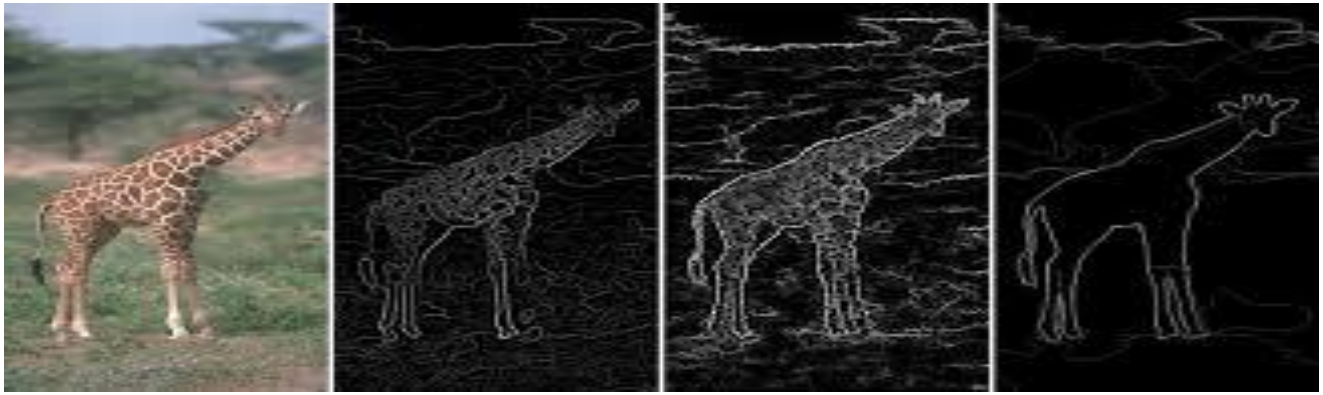
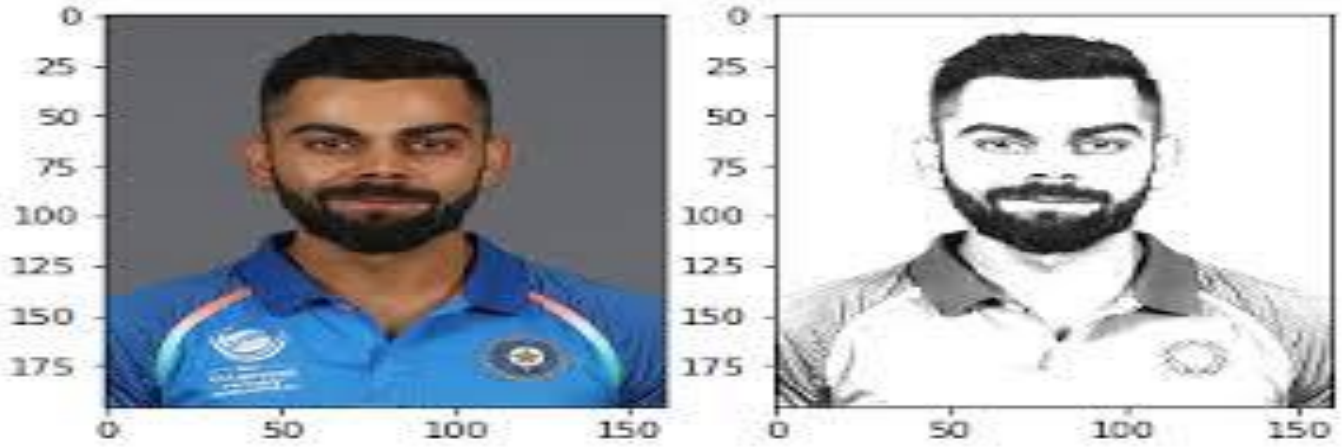
1. Edge Detection



2. Photo Sketching



Computer Vision Project ideas

3. Detecting Contours

4. Collage Mosaic Generator

Computer Vision Project ideas

INTERNSHIPSTUDIO

5. Barcode and QR Code Scanner

6. Face Detection

Classification of MNIST dataset with CNN

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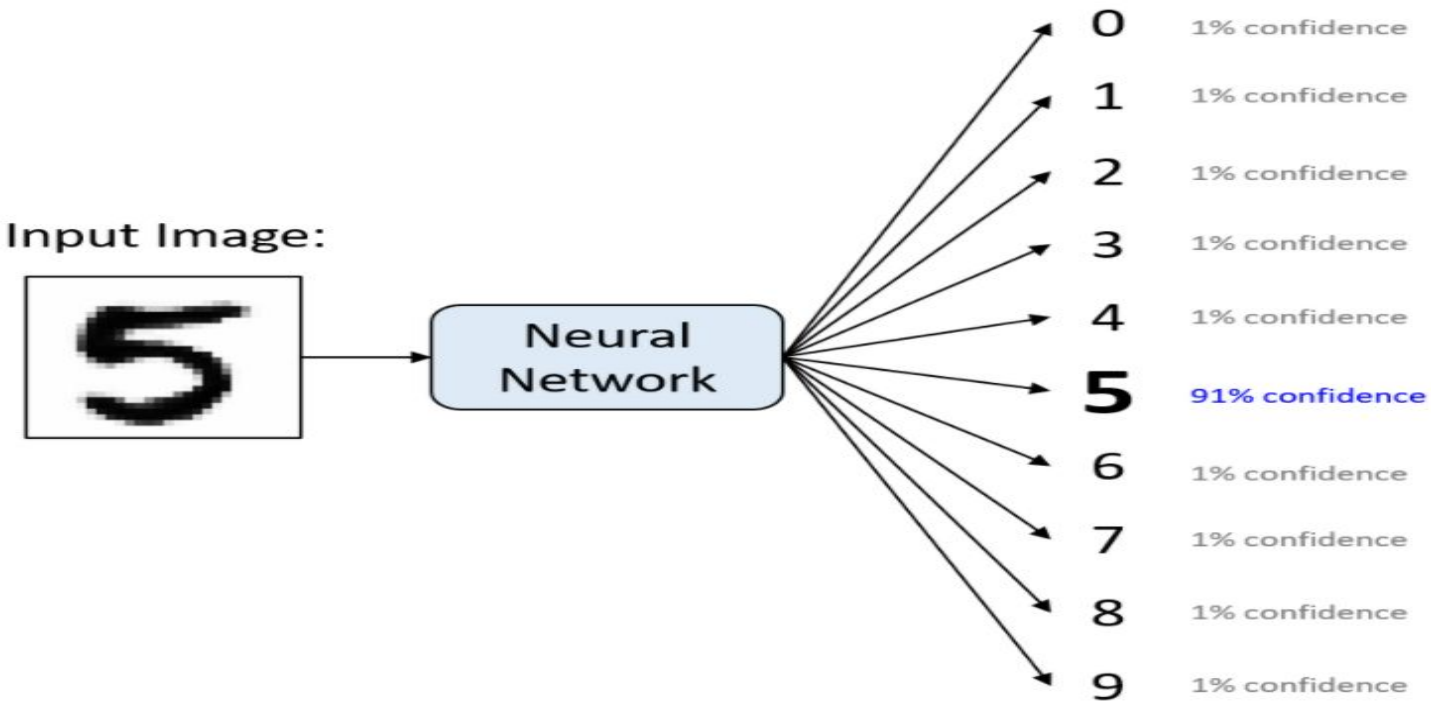
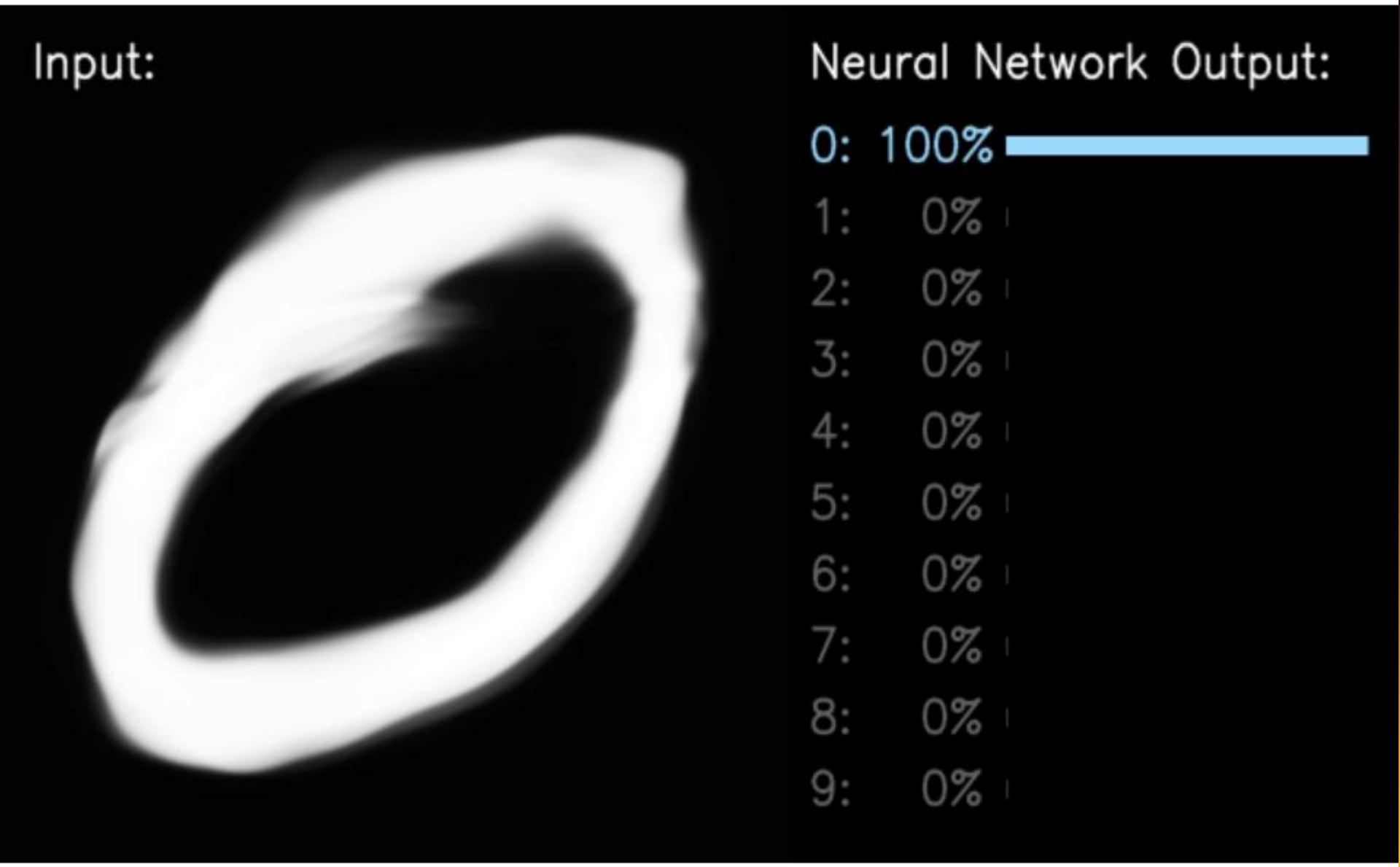
Let's build a convolutional neural network (CNN) classifier to classify images of handwritten digits in the MNIST dataset with a twist where we test our classifier on high-resolution hand-written digits from outside the dataset.

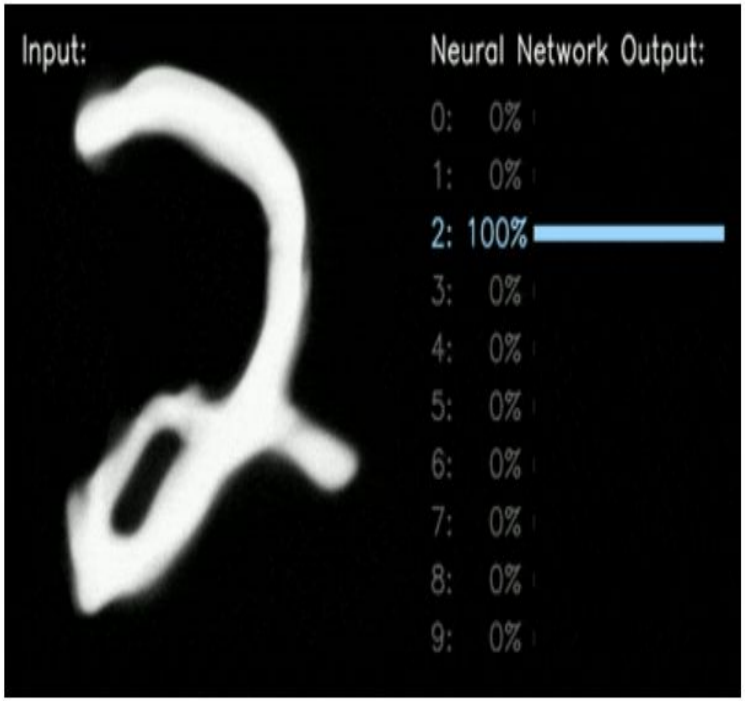


Making Predictions



Making Predictions

The above shows the prediction of the network by choosing the neuron with the highest output. While the output layer values add 1 to one, these do not reflect well-calibrated measures of "uncertainty". Often, the network is overly confident about the top choice that does not reflect a learned measure of probability. If everything ran correctly you should get an animation like this:



How to Become a Data Scientist

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STEP 2

Fulfil Data Science Prerequisites

Technical Skills

- Mathematics and Statistics, Computer Science, and Engineering
- Languages like Python and Scala
- SQL and NoSQL databases
- Machine Learning techniques and algorithms
- Experience with Big Data and its tools
- Analytical tools like SAS and/or R

Non-technical Skills

- Exceptional curiosity
- Business acumen and domain knowledge
- Excellent communication skills

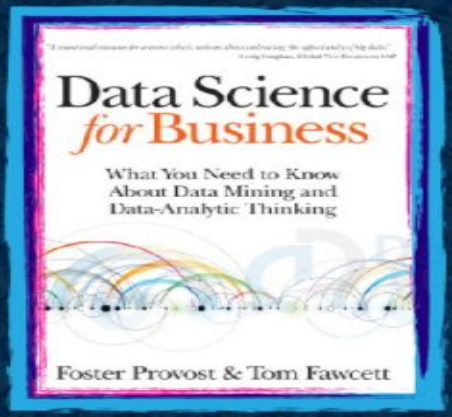
A good Data Scientist

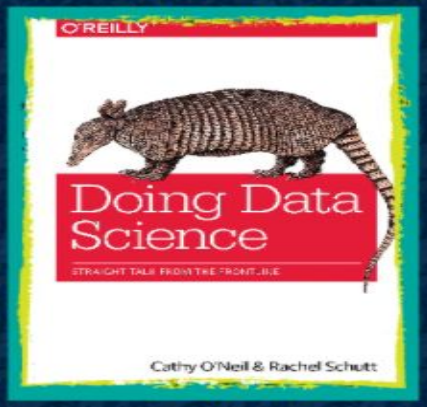
- Has experience with data visualization tools like Tableau, QlikView, and D3.js
- Is proficient in using Big Data tools like Hadoop and Spark
- Portrays dexterity in languages like Python and Scala
- Is experienced in common stats tools like R, NumPy, and MATLAB
- Has expertise in SQL and NoSQL databases like MongoDB and Cassandra

INTERNSHIPSTUDIO

STEP 3

Read the Best Books for Data Science





STEP 4

Go for Data Science Certifications

- Principal Data Scientist - DASCA
- SAS Certified Data Scientist
- Cloudera Certified Professional (CCP) Data Science Certificate
- IBM Data Science Professional Certificate
- EMC Proven Professional Data Scientist Associate (EMCDSA)
- Microsoft Professional Program Certificate in Data Science

STEP 5

Apply for Jobs

INTERNSHIPSTUDIO

Responsibilities of a Data Scientist

- Perform exploratory data analysis
- Process, cleanse, and verify the integrity of data
- Identify trends in data and make predictions
- Generate insights using Machine Learning techniques

Applications of Data Science

- Recommendation engines
- Automating risk management
- Real-time & Predictive analytics
- Personalized marketing
- Clickstream analysis
- Customer behavior analytics