

NEURAL NETWORKS

ML vs. DL:

Machine Learning - used for processing CSV, Excel files.

Deep Learning - used for processing images or videos.

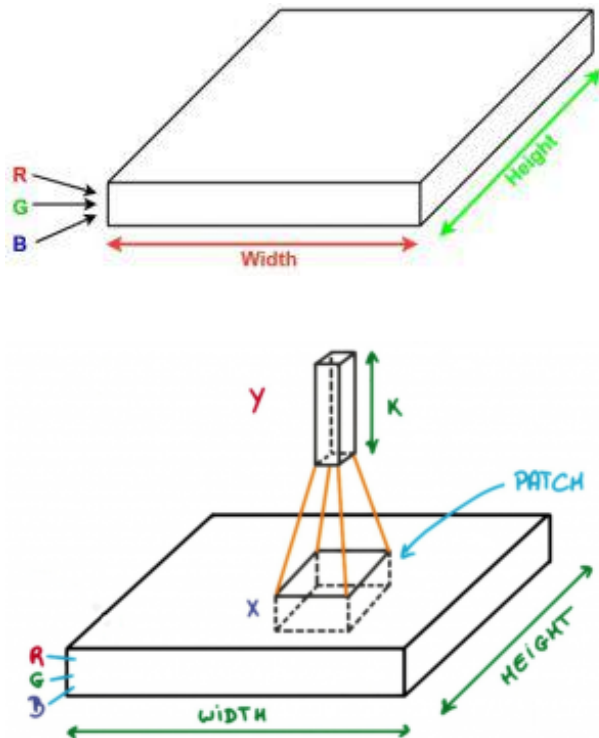
What is a Neural Network? ML models that mimic function of the human brain.

- consist interconnected nodes or neurons → process data, enable pattern recog.

Convolutional Neural Network: → designed to extract features from grid-like datasets. (useful for visual datasets i.e. img, vids)

→ widely used for CV (Computer Vision)

→ all layers (i/p, convolutional, max pooling, dense, o/p) share parameters (length, width, RGB channels)



Channels: parameters used by a colour model to represent colour i.e. the no. of numbers used to describe the colour of a pixel. (RGB, CMYK, HSV, YIQ)

Convolution: sliding a kernel/filter ($i \times j$ matrix of values) over all $i \times j$ sized patches of an image to obtain a new vertical matrix of values representing said image.

→ **convolution is literally just the dot product of 2 matrices summed along its diagonals.**

Key Components:

i. Convolutional Layers: convolute images to detect features such as edges, textured and other pattern; preserve the spatial relationship between pixels.

ii. Pooling Layers: downsample the dimensions of i/p, reduce computational

capacity and no. of parameters.

iii. Activation Functions: basically a set threshold that directs neuron activation. they introduce non-linearity to the model; decides whether a neuron should be activated by calculating the weighted sum of inputs and adding a bias term. (e.g.: ReLU, Sigmoid, or Tanh)

Why is non-linearity so important? Imagine you want to classify apples and bananas based on their shape and color.

- ★ If we use a linear function, it can only separate them using a straight line.
- ★ But real-world data is often more complex (e.g., overlapping colors, different lighting).
- ★ By adding a non-linear activation function, the network can create curved decision boundaries to separate them correctly.

iv. Fully Connected Layers: responsible for predictive decision making based on features learnt from previous layers. they permute and combine every neuron in 2 consecutive layers.

