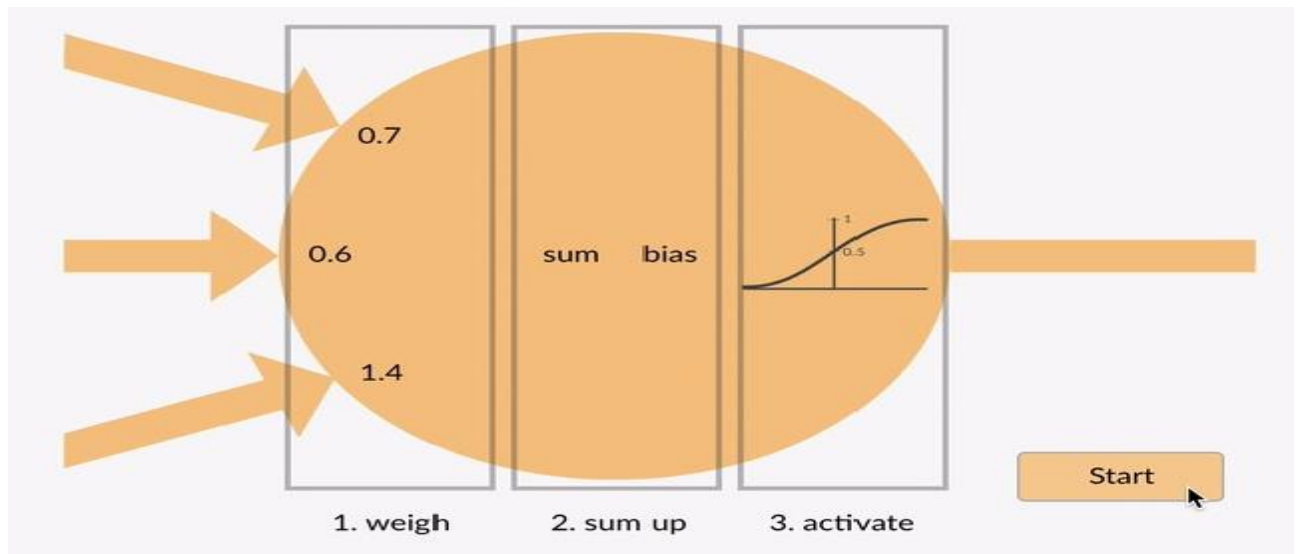


GENERAL

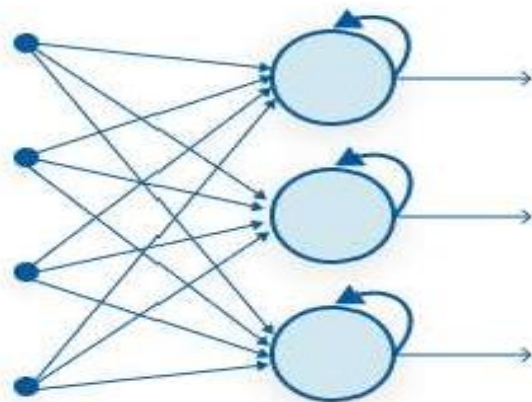
1. **OpenCV** is a library of programming functions mainly aimed at real-time computer vision. OpenCV == opensource + computer vision

	keras	tensorflow	pytorch
overview	Keras is an open source neural network library. It is designed to enable fast experimentation with deep neural networks .	TensorFlow is a library for dataflow programming across a range of tasks. It is a symbolic math library that is used for machine learning applications like neural networks.	PyTorch is an open source machine learning library for Python, based on Torch. It is used for applications such as natural language processing
API	High level API	Both high and low API	Lower level API
speed	Low	high	High speed
Debugging	easy	difficult	Best debugging
dataset	small	large	Large
	Simple readable and concise	Complex and readability	complex

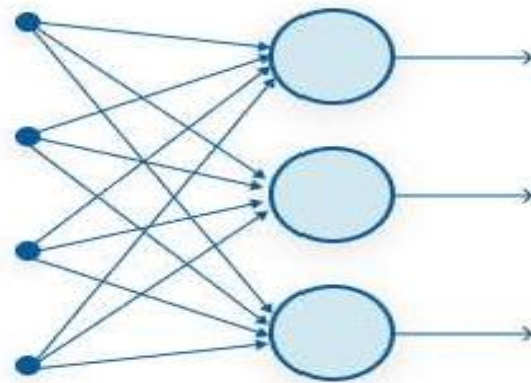
2. **Artificial intelligence** (AI) refers to the simulation of human **intelligence** in machines that are programmed to think like humans and mimic their actions
3. **Machine learning** is an application of artificial **intelligence** (AI) that provides systems the ability to automatically learn and improve from experience without being explicitly programmed. **Machine learning** focuses on the development of computer programs that can access data and use it learn for themselves
4. These are three types of machine learning: **supervised learning**, **unsupervised learning**, and reinforcement learning
5. **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 unlabelled
6. In **deep learning**, a computer model learns to perform classification tasks directly from images, text, or sound. Deep learning models can achieve state-of-the-art accuracy, sometimes exceeding human-level performance. Models are trained by using a large set of labelled data and neural network architectures that contain many layers.
7. Deep Learning models can be used for a variety of complex tasks:
 - Artificial Neural Networks (ANN) for Regression and classification
 - Convolutional Neural Networks (CNN) for Computer Vision
 - Recurrent Neural Networks (RNN) for Time Series analysis
8. The main **difference between deep learning and machine learning** is due to the way data is presented in the system. **Machine learning** algorithms almost always require structured data, while **deep learning** networks rely on layers of ANN (artificial **neural networks**)
9. ANN: Artificial Neural Network, or ANN, is a group of multiple perceptron/neurons at each layer. ANN is also known as a Feed-Forward Neural network because inputs are processed only in the forward direction:
10. As you can see here, ANN consists of 3 layers – Input, Hidden and output. The input layer accepts the inputs, the hidden layer processes the inputs, and the output layer produces the result. Essentially, each layer tries to learn certain weights.



RRN: A looping constraint on the hidden layer of ANN turns to RNN.



Recurrent Neural Network



Feed-Forward Neural Network

KERAS MODELS

Sequential

The core idea of **Sequential API** is simply arranging the Keras layers in a sequential order and so, it is called Sequential API. Most of the ANN also has layers in sequential order and the data flows from one layer to another layer in the given order until the data finally reaches the output layer.

Convolution2D

In image processing kernel is a convolution matrix or masks which can be used for blurring, sharpening, embossing, edge detection, and more by doing a convolution between a kernel and an image

Conv2D parameter is the numbers of filters that convolutional layers will learn from.

It is an integer value and also determines the number of output filters in the convolution.

Here we are learning a total of 32 filters and then we use Max Pooling to reduce the spatial dimensions of the output volume.

As far as choosing the appropriate value for no. of filters, it is always recommended to use powers of 2 as the values.

It is an integer or tuple/list of 2 integers, specifying the height and width of the 2D convolution window.

This parameter must be an odd integer.

The activation parameter to the Conv2D class is simply a convenience parameter which allows you to supply a string, which specifies the name of the activation function you want to apply after performing the convolution.

MaxPooling2D **layer** is used to add the pooling **layers**. **Flatten** is the **function** that converts the pooled feature map to a single column that is passed to the fully connected **layer**. Dense adds the fully connected **layer** to the neural network.

SoftMax function

The axis argument sets which axis of the input the function is applied along. **SoftMax** is often used as the activation for the last layer of a classification network because the result could be interpreted as a probability distribution.

The **SoftMax** of each vector x is computed as $\exp(x) / \text{tf}$

Optimizer

In machine learning, **Optimization** is an important process which optimize the input weights by comparing the prediction and the loss function. Keras provides quite a few optimizers as a module, *optimizers*

Loss

In machine learning, **Loss** function is used to find error or deviation in the learning process. Keras requires loss function during model compilation process

Metrics

In machine learning, **Metrics** is used to evaluate the performance of your model. It is similar to loss function, but not used in training process. Keras provides quite a few metrics as a module

ImageDataGenerator

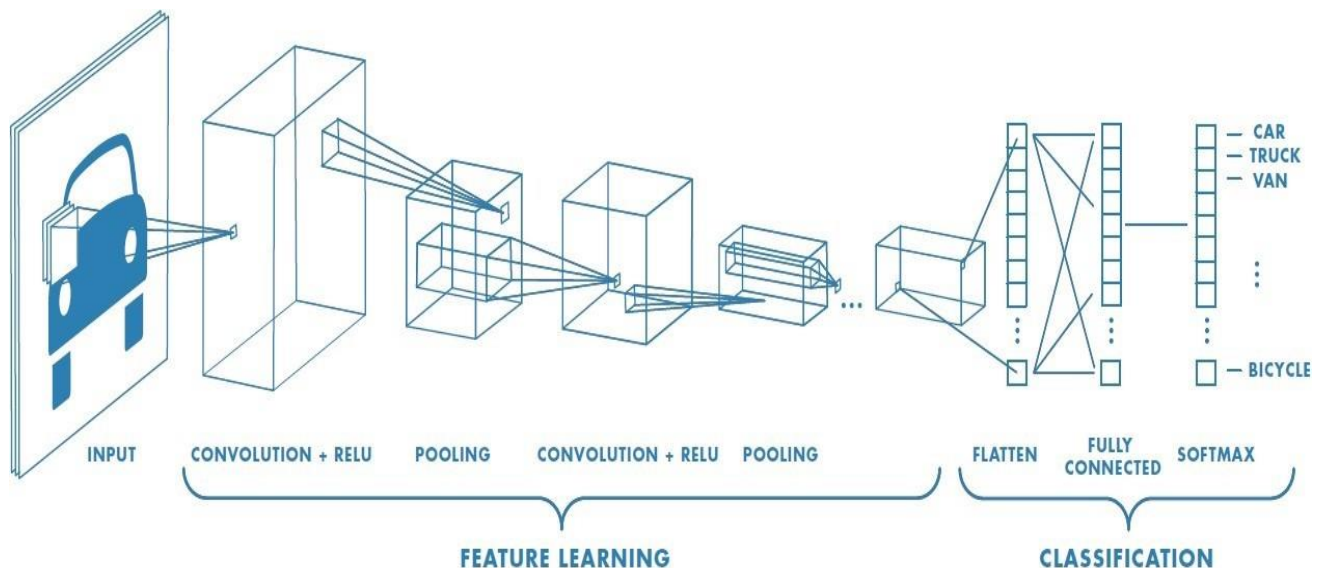
class as “intercepting” the original data, randomly transforming it, and then returning it to the neural network for training

ROI

RoI (Region of Interest) is a proposed region from the original image. We’re not going to describe how to extract those regions because there are multiple methods to do only that. The only thing we should know right now is there are multiple regions like that

CNN

1. In neural networks, Convolutional neural network (ConvNets or CNNs) is one of the main categories to do images recognition, images classifications. Objects detections, recognition faces etc., are some of the areas where CNNs are widely used.
2. CNN image classifications takes an input image, process it and classify it under certain categories (Eg., Dog, Cat, Tiger, Lion). Computers sees an input image as array of pixels and it depends on the image resolution. Based on the image resolution, it will see $h \times w \times d$ (h = Height, w = Width, d = Dimension). Eg., An image of $6 \times 6 \times 3$ array of matrix of RGB (3 refers to RGB values) and an image of $4 \times 4 \times 1$ array of matrix of grayscale image.



3. Technically, deep learning CNN models to train and test, each input image will pass it through a series of convolution layers with filters (Kernels), Pooling, fully connected layers (FC) and apply Softmax function to classify an object with probabilistic values between 0 and 1. The below figure is a complete flow of CNN to process an input image and classifies the objects based on values
4. Convolution is the first layer to extract features from an input image. It is a mathematical operation that takes two inputs such as image matrix and a filter or kernel.
5. Then the convolution of 5 x 5 image matrix multiplies with 3 x 3 filter matrix which is called **"Feature Map"** as output shown in below. Convolution of an image with different filters can perform operations such as edge detection, blur and sharpen by applying filters

1	1	1	0	0
0	1	1	1	0
0	0	1	1	1
0	0	1	1	0
0	1	1	0	0

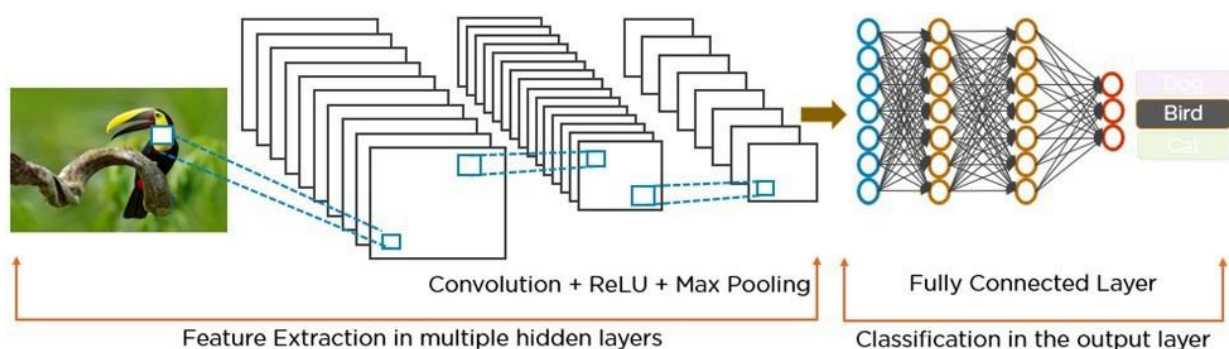
5 x 5 – Image Matrix



1	0	1
0	1	0
1	0	1

3 x 3 – Filter Matrix

6. Examples figure of CNN:



Running of code

- Keras used for build code anaconda used code open in spyder
- 3 parts collect data ,train and predict

Code running

Collect data

1. Categories- Mode train,image count
2. Put hand show sign and press the corresponding label to the keyboard
3. The image will get saved in folder data/test data/train data
4. CV2 is webcam object
5. Defined coordinate and size of ROI.Resizing in 64*64
6. Convert in b/w by cvtcolor function.Thresholding the colour 120-255->1 otherwise 0
7. Intuupt check keyboard value and save it in correct directory esc will close window

Creating CNN

1. Sequential class used to initialise classifier object and add layers
2. 32 filter size defines ,input shape size of roi
3. Layers will be in 2d array we need to convert in 1 d array using flatten function
4. Adding layer using dense function 128 will be number of neurons
5. Last layer will be output layer having number of units =6 which is number of directories softmax is used for classification

Training data

1. Take images and take it to neural networks
2. Steps per epoch will be number will be number of images in training set
3. Models and weights will be saved as json file

Predict

1. Import library, import model, load weight in model
2. Inside while we draw rectangle to take data from rectangle and recycle it and convert it to b/w
3. And threshold resize in 64,64,1
4. Then sorting the prediction and showing result