SNS COLLEGE OF ENGINEERING

Kurumbapalayam(Po), Coimbatore – 641 107
Accredited by NAAC-UGC with 'A' Grade
Approved by AICTE, Recognized by UGC & Affiliated to Anna University, Chennai

Department of AI &DS

Course Name – 19AD602 DEEP LEARNING

III Year /VI Semester

Unit 2-DEEP NETWORKS

Topic: CNN

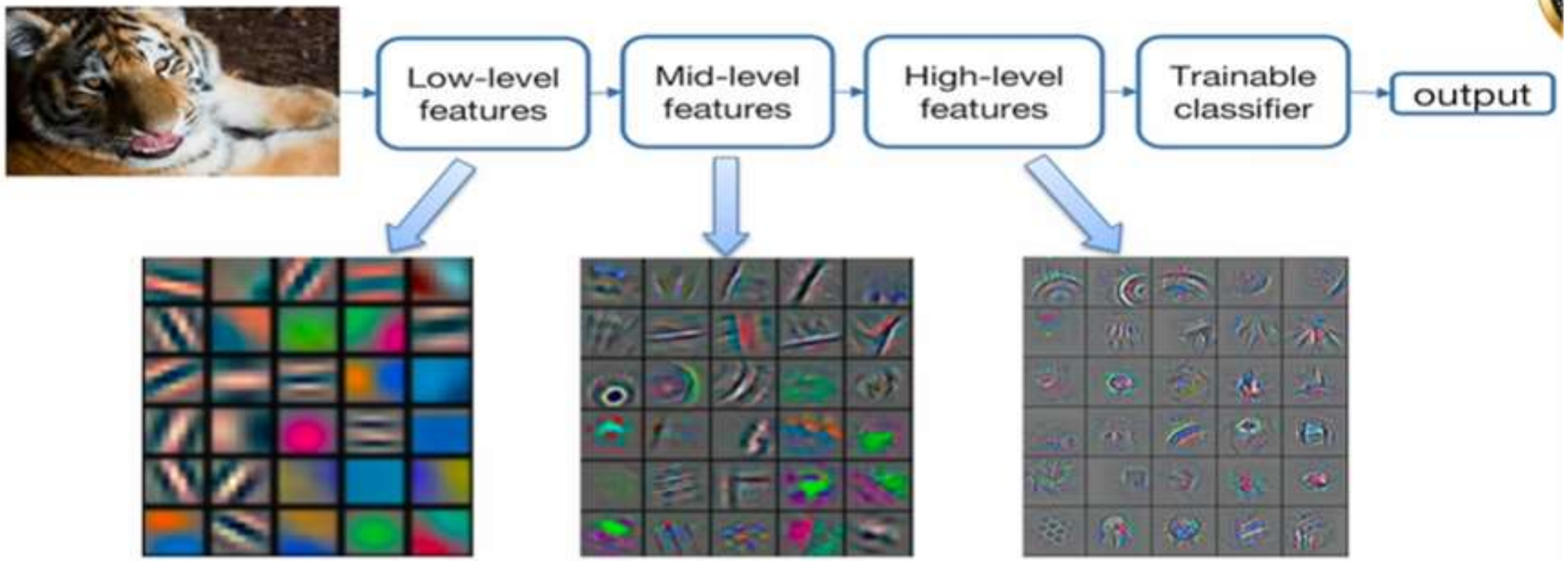
Case Study

An e-commerce company used Convolutional Neural Networks (CNNs) for automatic product categorization based on images. The CNN model improved classification accuracy by 25%, enabling faster and more reliable inventory management. This enhanced user experience by providing better product recommendations.

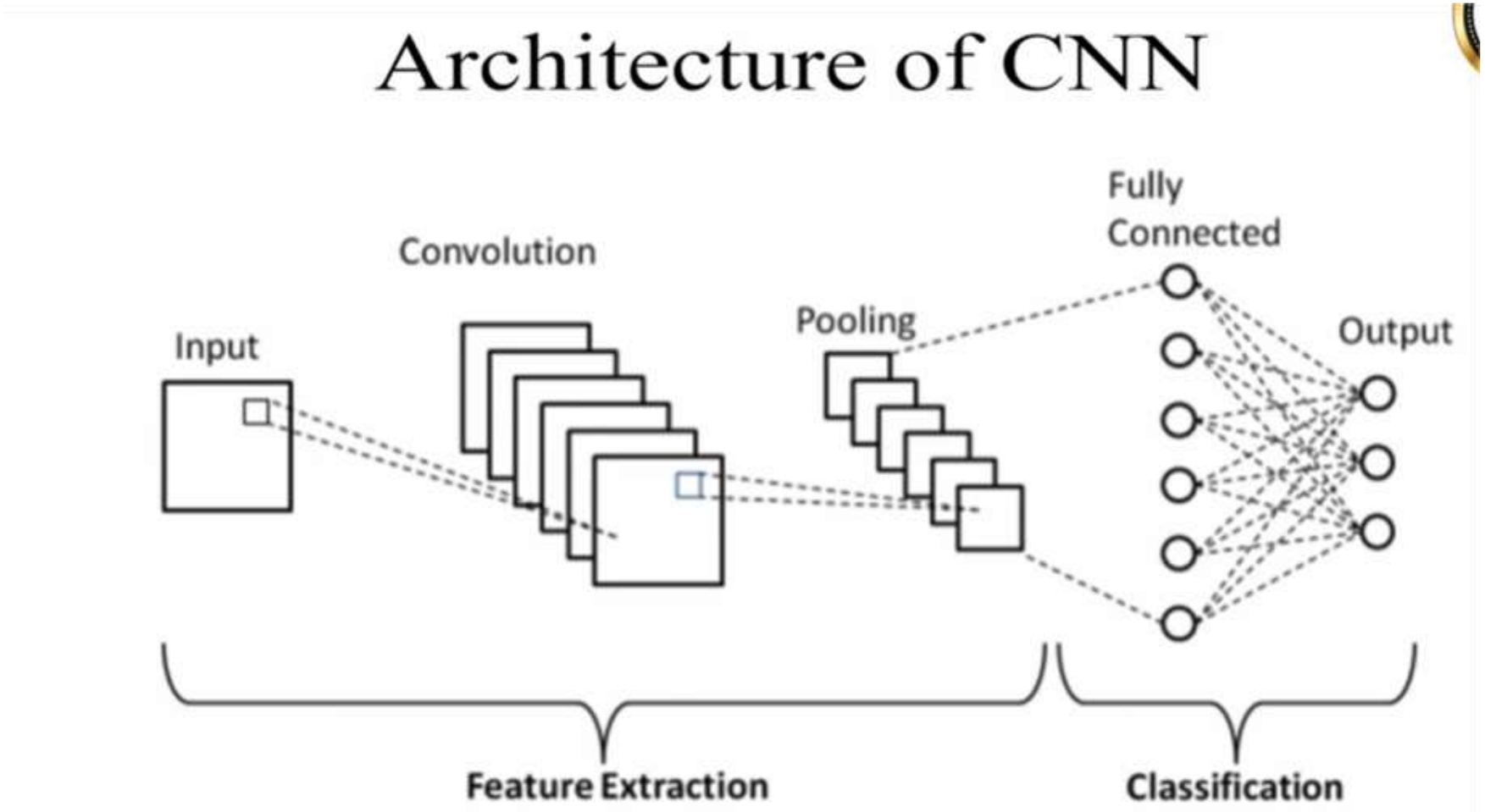
Convolutional Neural Network

- Convolutional neural networks (CNN) is a special architecture of artificial neural networks, proposed by Yann LeCun in 1988.
- CNN uses some features of the visual cortex. One of the most popular uses of this architecture is image classification.
- For example:
  - Amazon uses for generating product recommendations
  - Google uses for search through among user's photos.

CNN

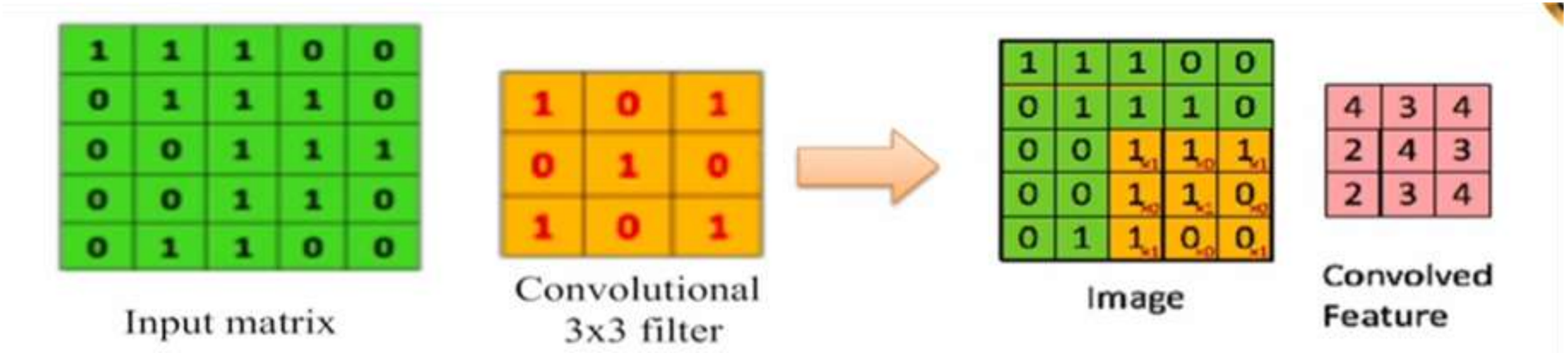


- Each module in Deep Learning transforms its input representation into a higher-level one, in a way similar to human cortex.


Architecture of CNN
Fully
Connected
Convolution
Pooling
Input
Output
Feature Extraction
Classification

CONVOLUTION LAYER

- **The Convolution layer** is always the first.
- The image (matrix with pixel values) is entered into it. Imagine that the reading of the input matrix begins at the top left of image.
- Next, a smaller matrix there, which is called a **filter** is selected .
- Then the filter produces convolution by multiply its values by the original pixel values and all these multiplications are summed up.



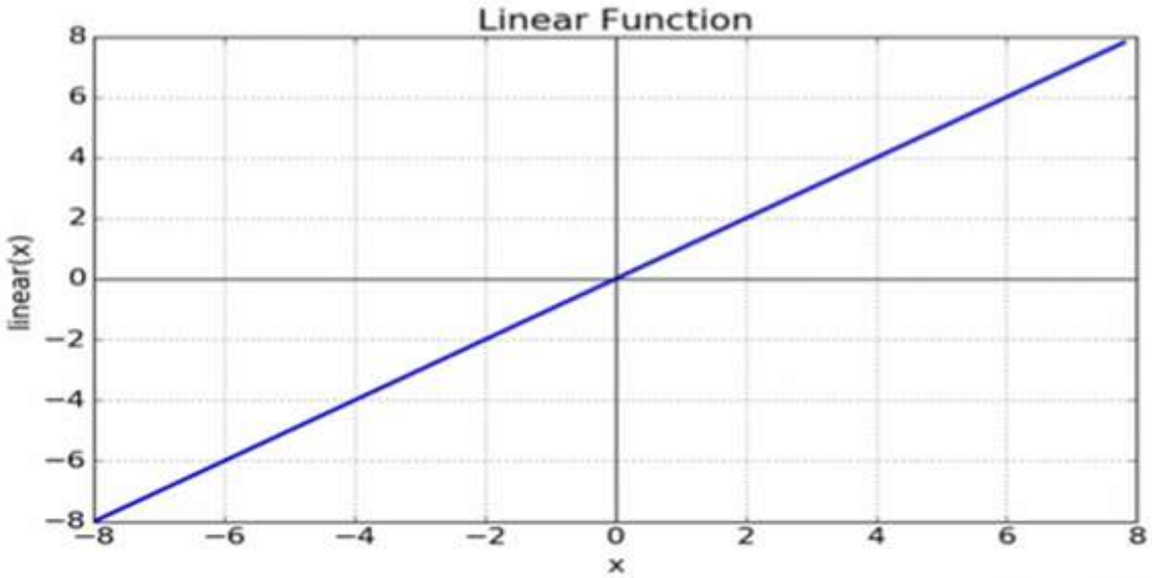
After passing the filter across all positions, a matrix is obtained, but smaller then a input matrix.

ACTIVATION FUNCTION

- The Activation Functions is used to determine the output of neural network like yes or no. It maps the resulting values in between 0 to 1 or -1 to 1 etc. (depending upon the function).
- It can be basically divided into 2 types-
  - Linear Activation Function
  - Non-linear Activation Functions

Linear Activation Function

The function is a line or linear. Therefore, the output of the functions will not be confined between any range.



Equation: f(x)=x

Range: -∞ to +∞

Non-linear Activation Functions

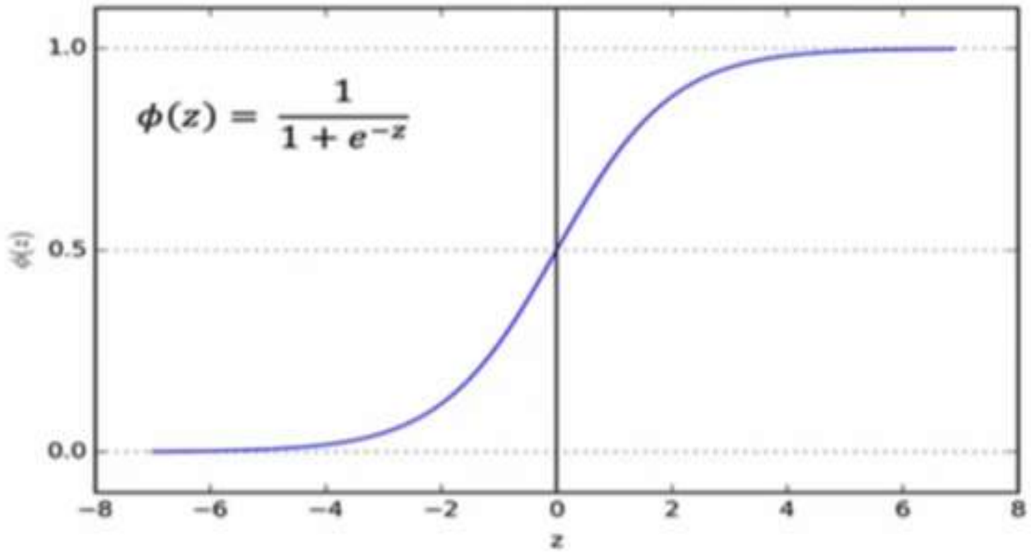
- The Nonlinear Activation Functions are the most used activation functions.

It makes it easy for the model to generalize or adapt with variety of data and to differentiate between the output.

- The Nonlinear Activation Functions are mainly divided on the basis of their **range or curves**.
  - –Sigmoid
  - –Tanh
  - –ReLU
  - –Leaky ReLU

SIGMOID

- It is also known as Logistic Activation Function
- The main reason why we use sigmoid function is because it exists between **(0 to 1).** Therefore, it is especially used for models where we have to **predict the probability** as an output.
- Since probability of anything exists only between the range of **0 and 1,** sigmoid is the right choice.
- The function is **differentiable**.That means, we can find the slope of the sigmoid curve at any two points.

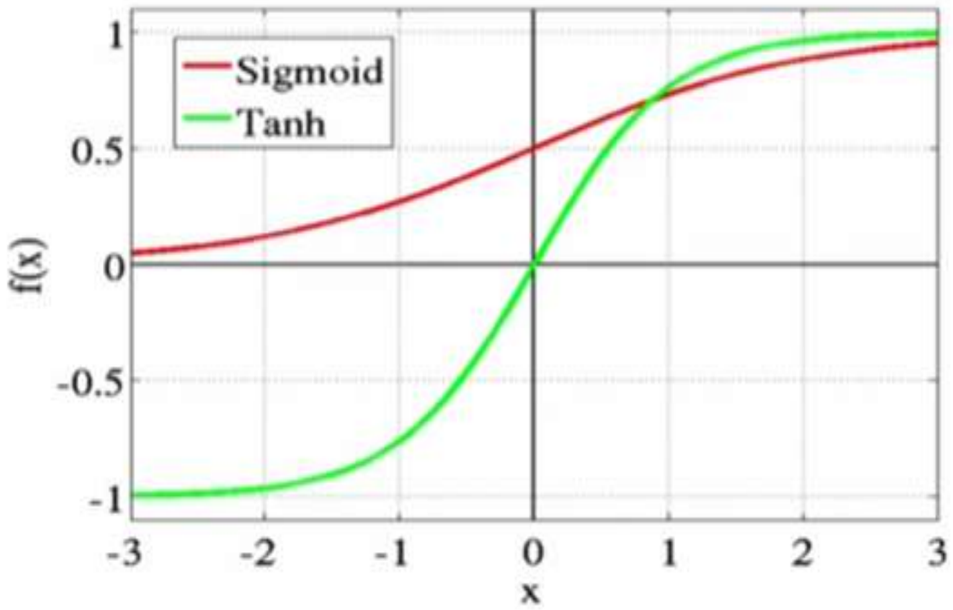


The **softmax function** is a more generalized logistic activation function which is used for multiclass classification.

Tanh

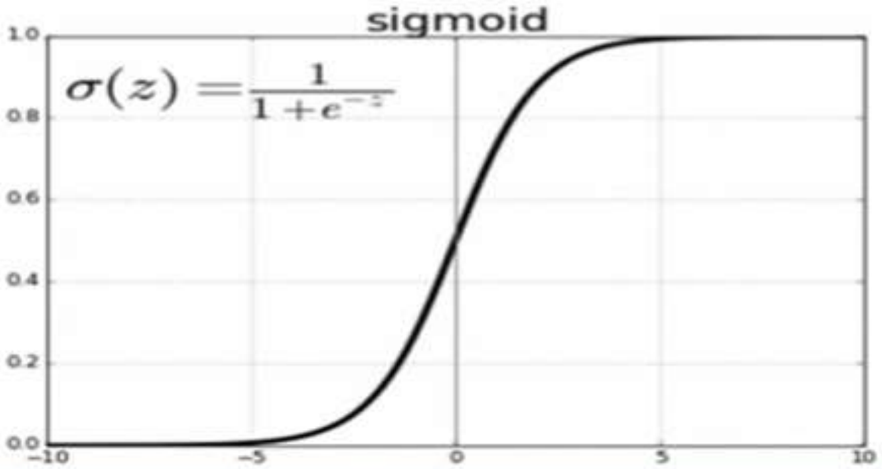
- Hyperbolic Tangent (Tanh) is also like logistic sigmoid but better. The range of the tanh function is from (-1 to 1). tanh is also sigmoidal
- The advantage is that the negative inputs will be mapped strongly negative and the zero inputs will be mapped near zero in the tanh graph.

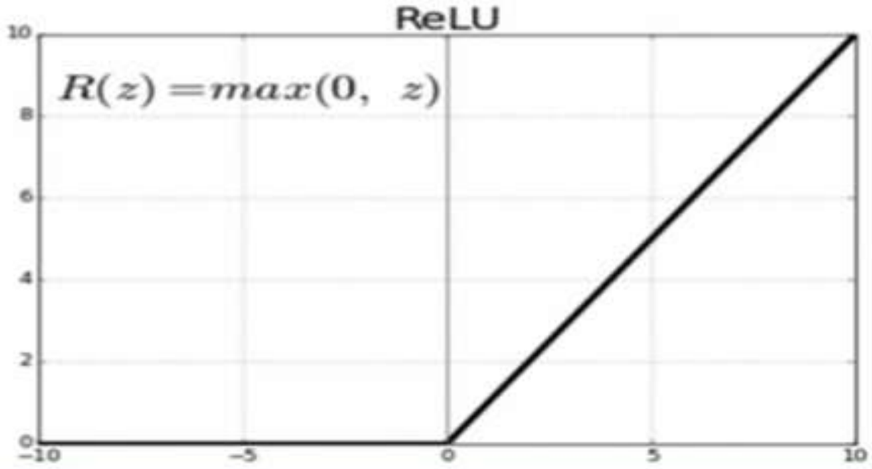
- The tanh function is mainly used classification between two classes.



ReLU (Rectified Linear Unit)

- The ReLU is the most used activation function in the world right now. Since, it is used in almost all the convolutional neural networks or deep learning.

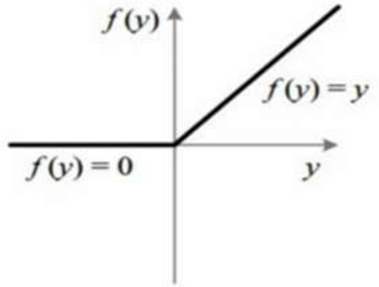


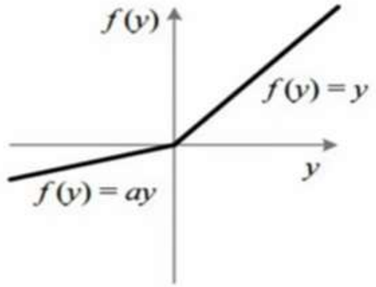


- That means any negative input given to the ReLU activation function turns the value into zero immediately in the graph, which in turns affects the resulting graph by not mapping the negative values appropriately.
- This problem is known as Dying ReLU problem.

LEAKY ReLU

- It is an attempt to solve the dying ReLU problem.
- The leak helps to increase the range of the ReLU function. Usually, the value of a is 0.01 or so.



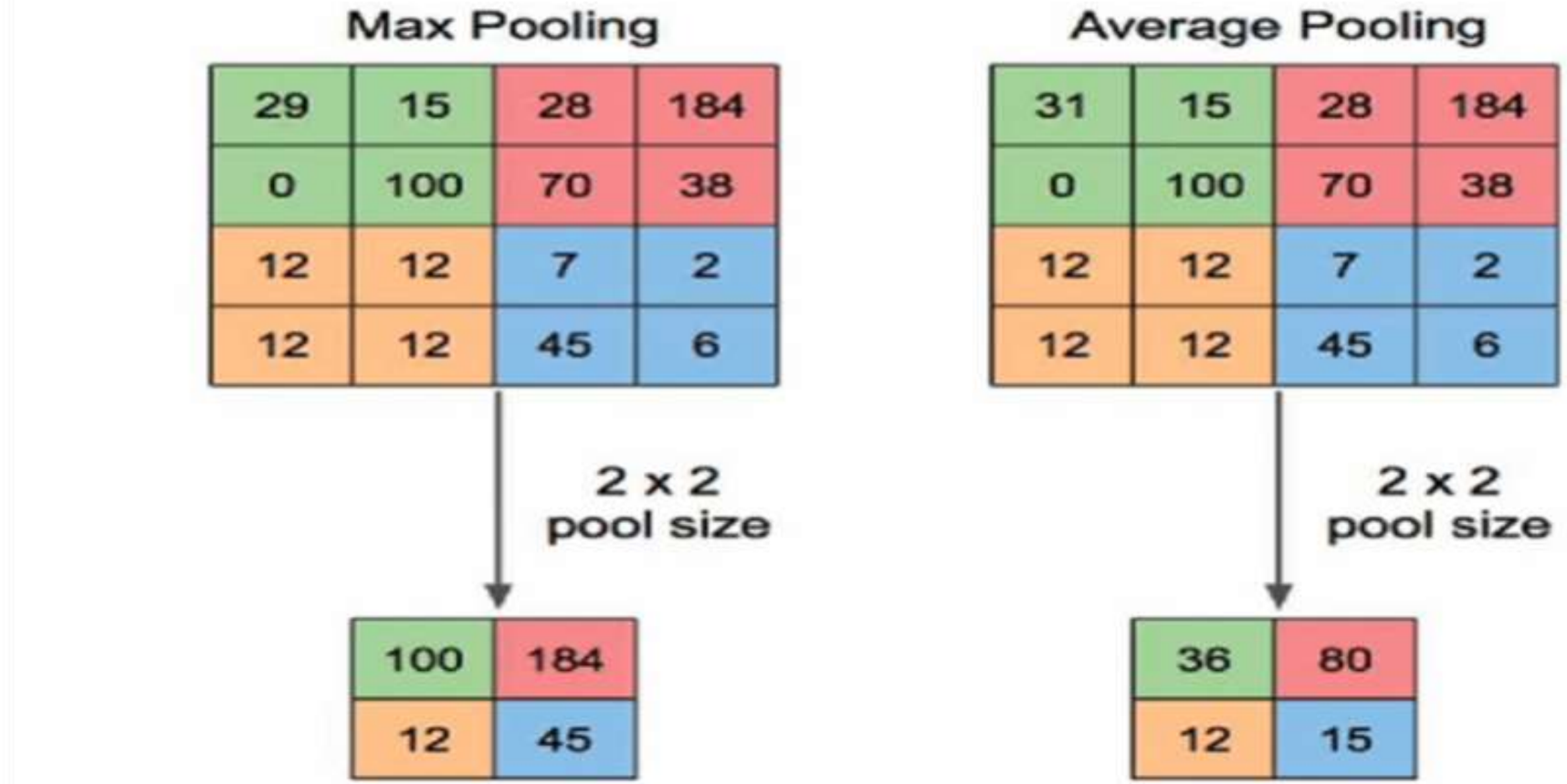


POOLING LAYER

- Pooling layers are used to reduce the dimensions of the feature maps.
- Thus, it reduces the number of parameters to learn and the amount of computation performed in the network.
- The pooling layer summarizes the features present in a region of the feature map generated by a convolution layer.

Types of Pooling

- **Max pooling**: reports the maximum output within a rectangular neighborhood.
- **Min pooling**: reports the minimum output within the neighborhood.
- **Average pooling**: reports the average output of a rectangular neighborhood.

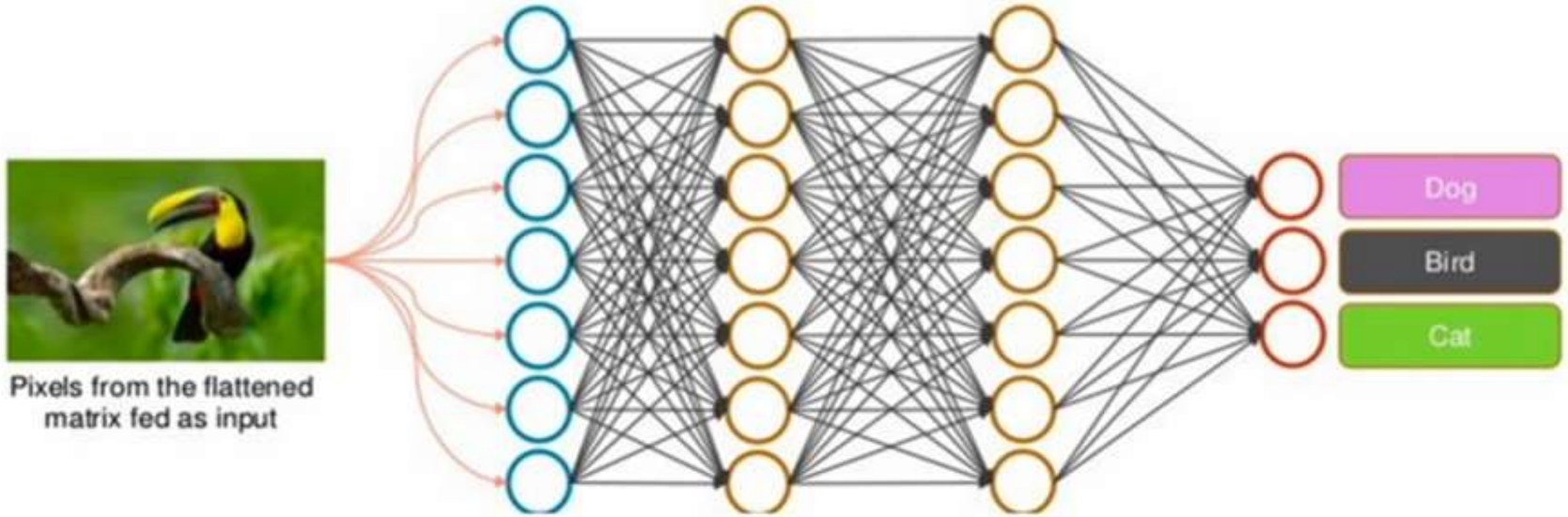

Max Pooling
29 15 28 184
0 100 70 38
12 12 7 2
12 12 45 6
2 x 2
pool size
100 184
12 45
Average Pooling
31 15 28 184
0 100 70 38
12 12 7 2
12 12 45 6
2 x 2
pool size
36 80
12 15

FLATTENING

- It is a process of converting all the arrays from pooled featured map into a single long linear continuous vector.

FULLY CONNECTED LAYERS

- The flattened matrix is fed as input for the fully connected layer to classify the image.



Activity

Train a CNN to classify images of animals (e.g., cats and dogs) and evaluate its performance on a test set. Observe how the CNN’s convolutional layers automatically extract features like edges and patterns to make accurate predictions.

THANK YOU