IIT Guwahati and TSW

Postgraduate Certificate Program in
Artificial Intelligence & Deep Learning

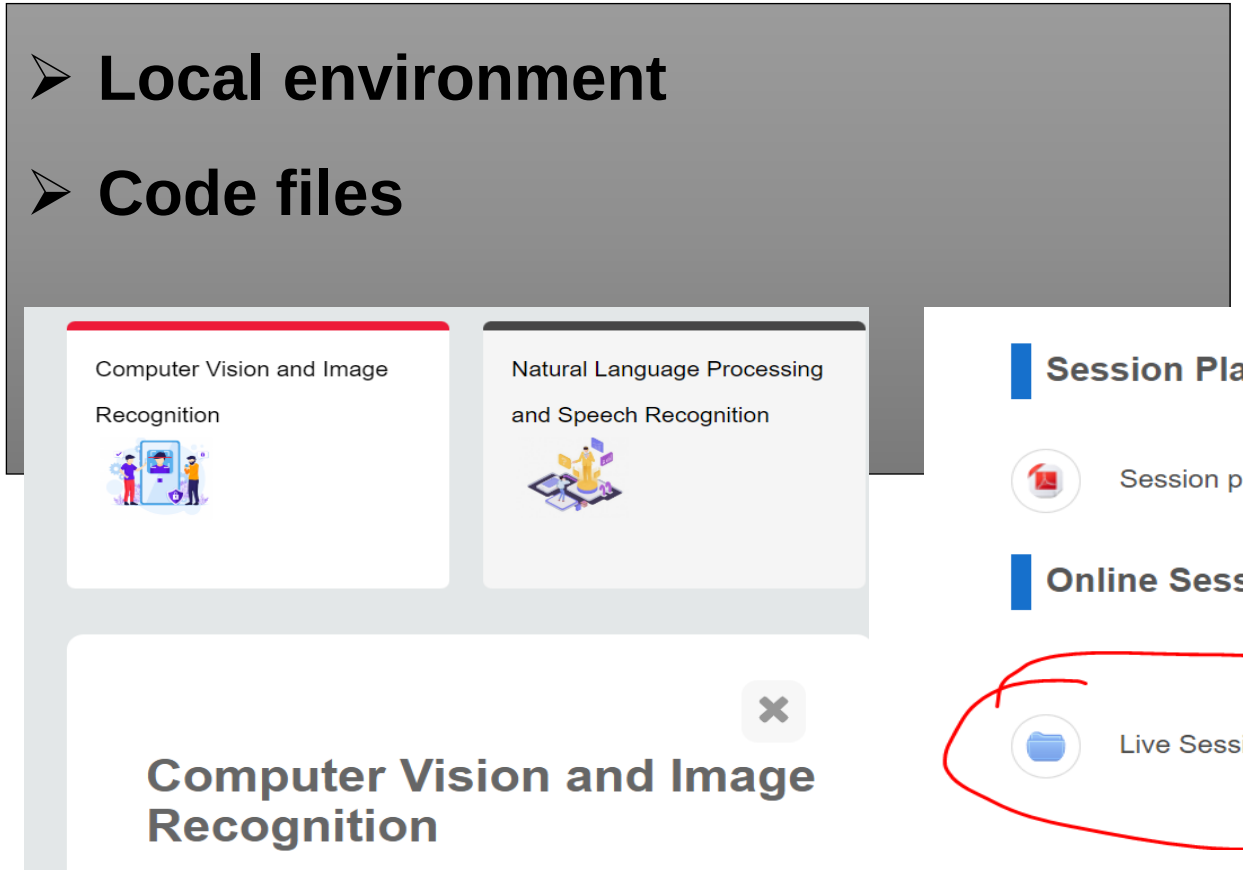
Image Recognition
21st Jan 2023

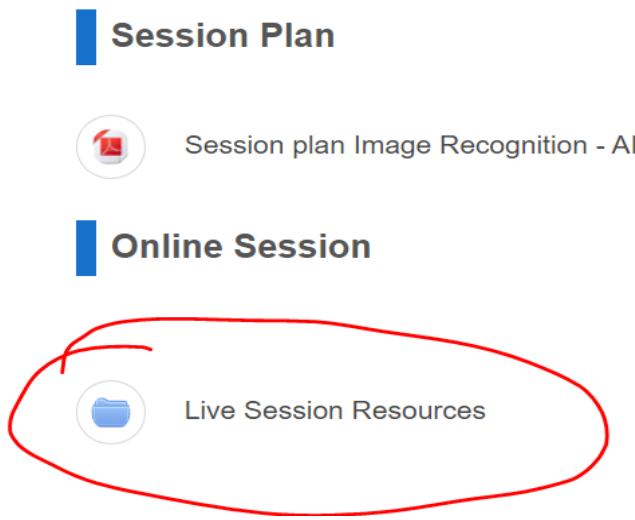
Mohan Silaparasetty

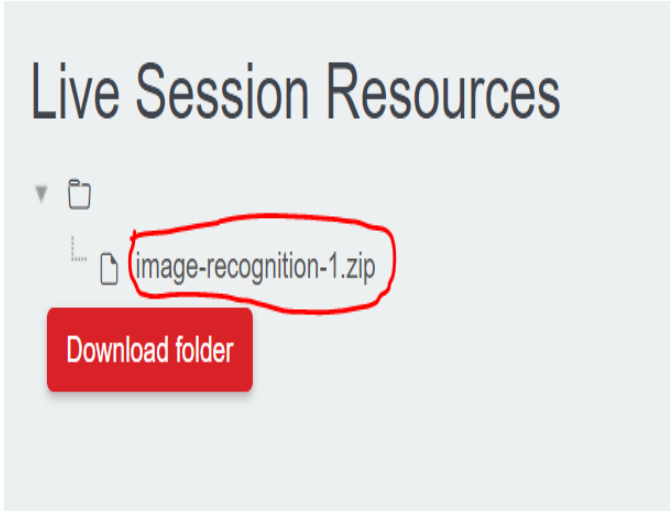
THE TIMES OF INDIA GROUP

Quick house keeping

- Local environment
- Code files



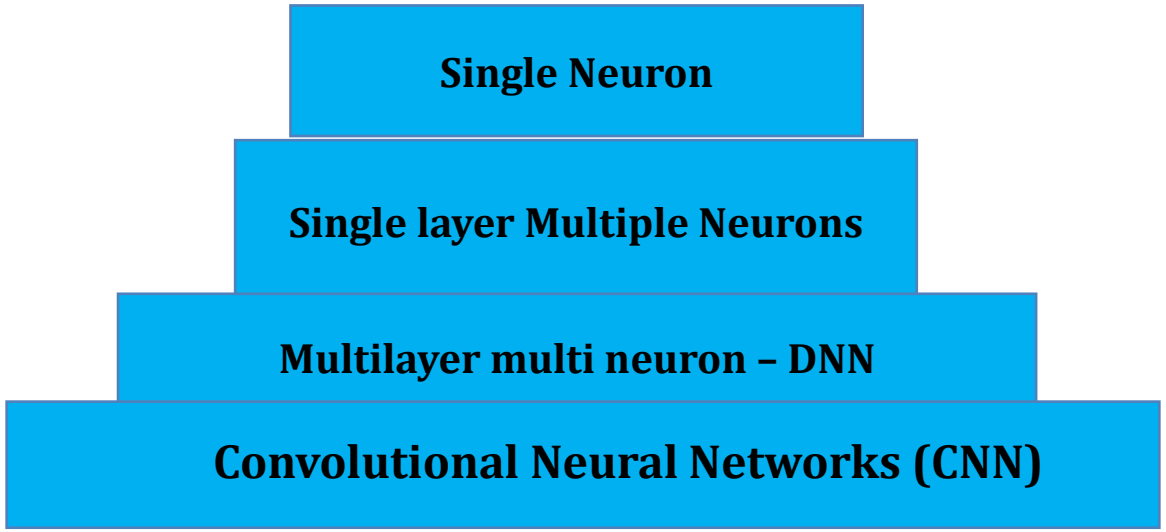




Today's AGENDA

- **What is Image Recognition?**
- Recap of regular DNN and CNN
- MNIST with CNN
- Cat/Dog – Binary classification

What is done so far



Two main areas of AI

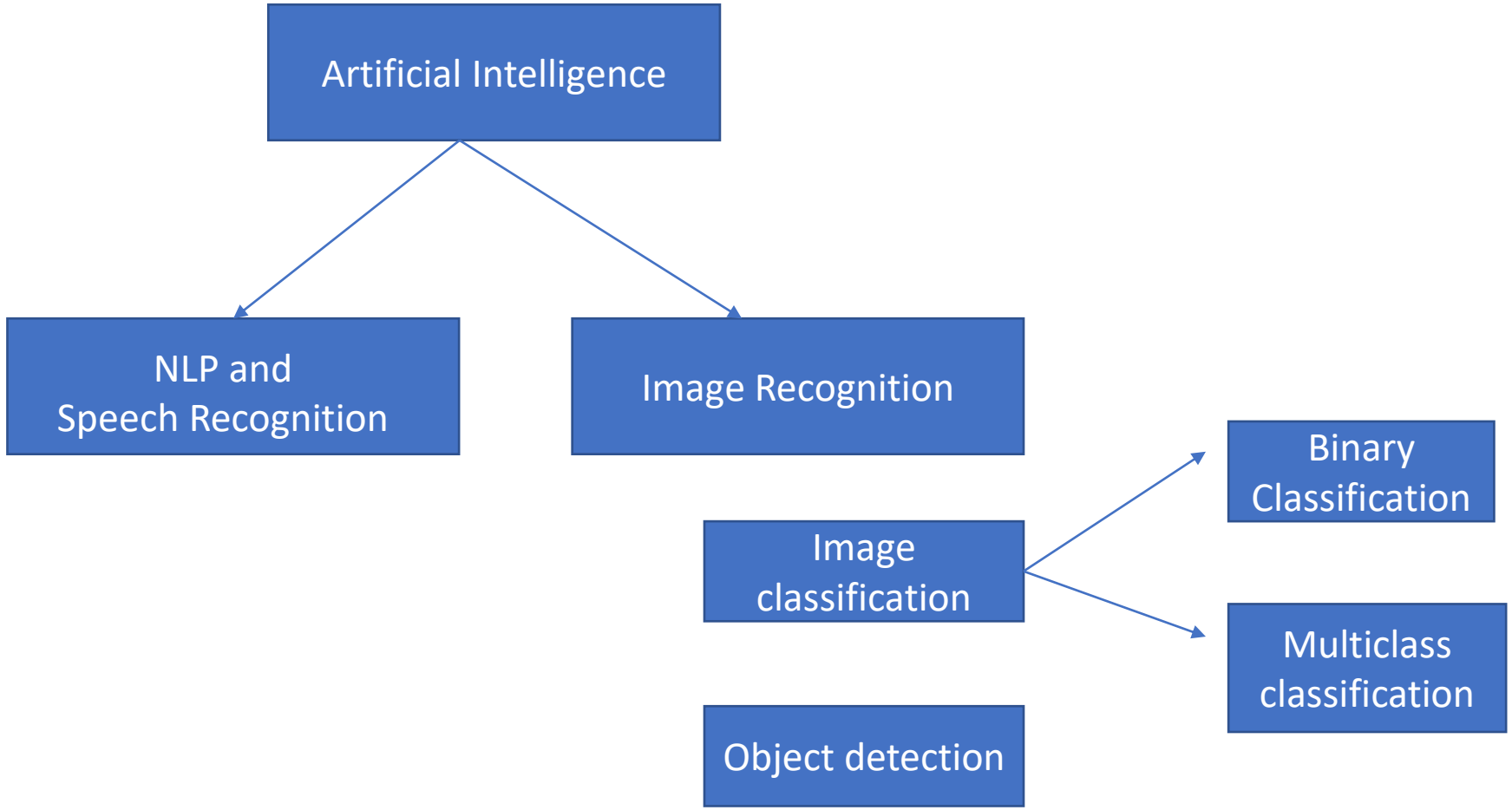


Image classification

- Demo
- Pre-requisites
  - Keras
  - Classification
    - Binary
    - Multiclass
  - Multilayer neural networks

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Design criteria for multilayer classification models

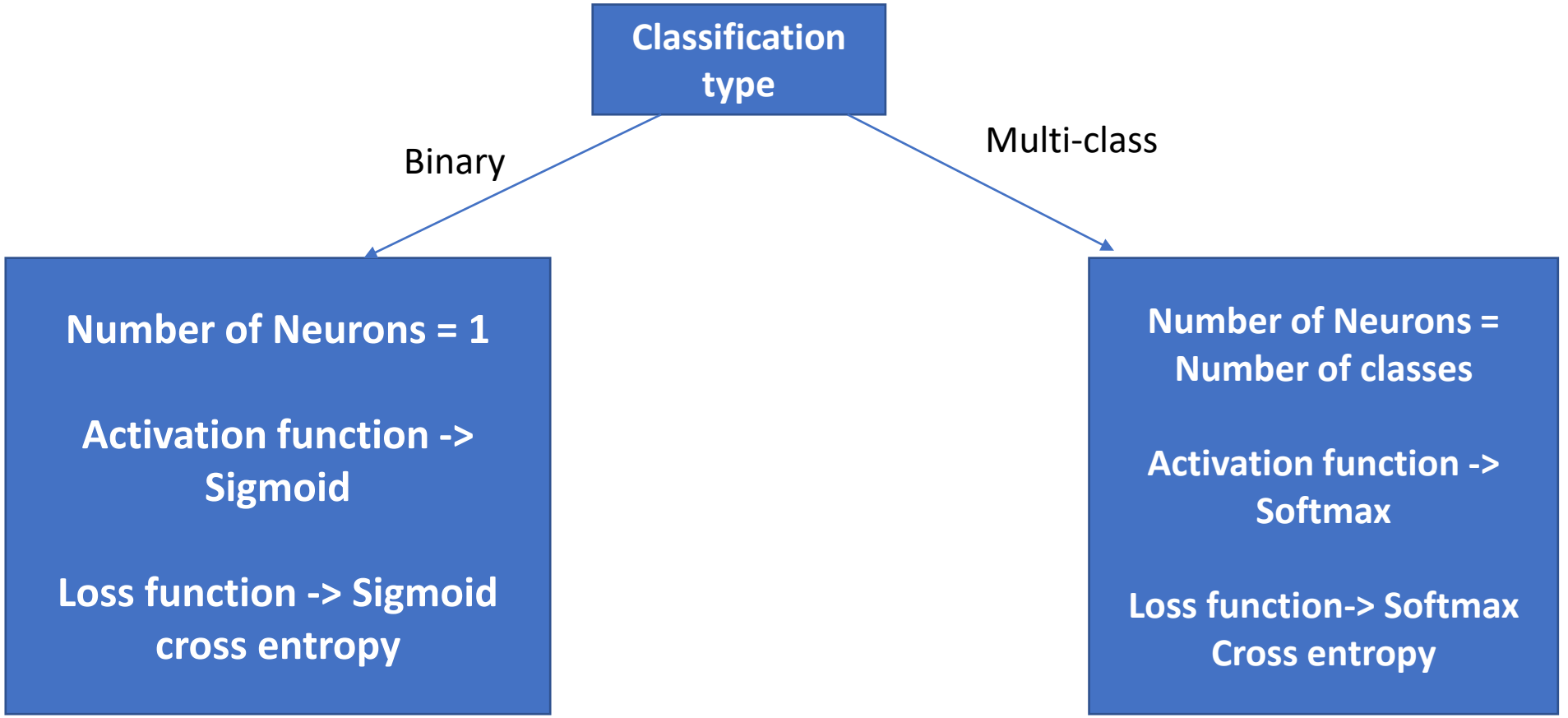
How many hidden layers?
Which activation function at different layers?
Last layer/Classification layer

Which activation function at different layers?

ReLU – in all intermediate layers

Last layer – Sigmoid or Softmax

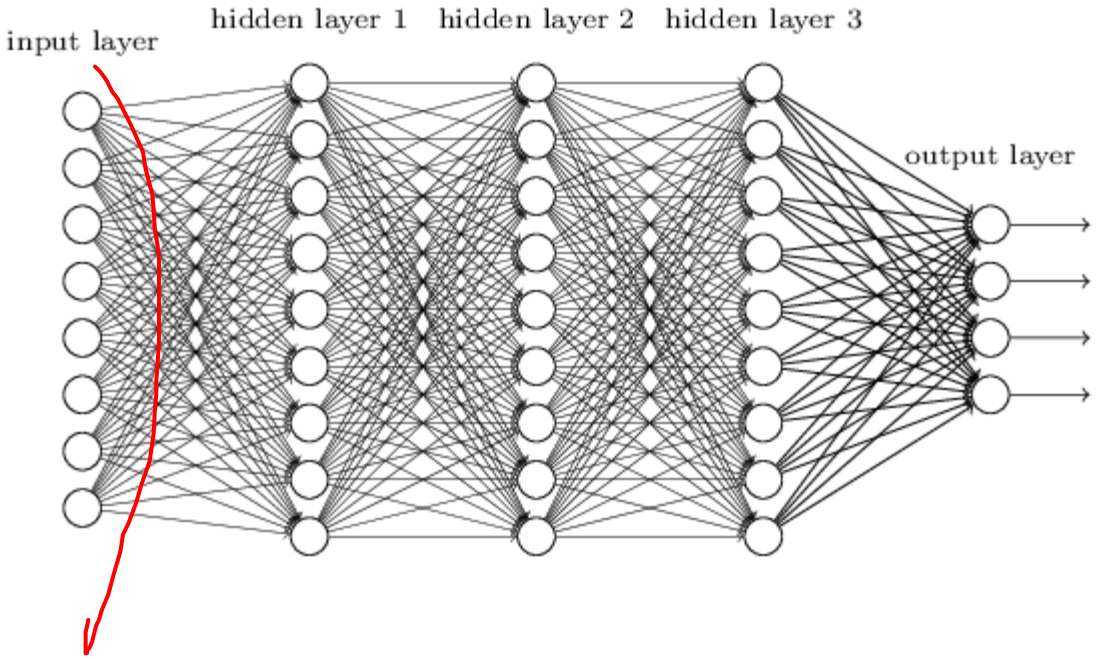
Last layer/Classification layer



CNN- Convolutional Neural Networks

Difference between DNN and CNN

- In an DNN, each neuron in the network is connected to every other neuron in the adjacent hidden layers.



- In a CNN, each neuron in the hidden layer is connected to a small region of the input neurons.

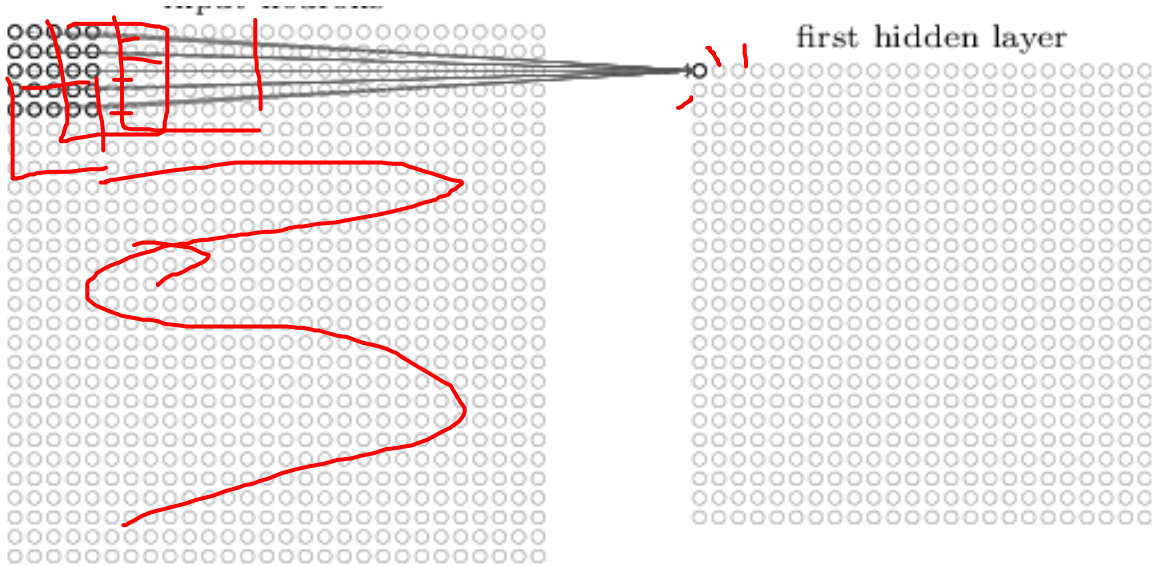
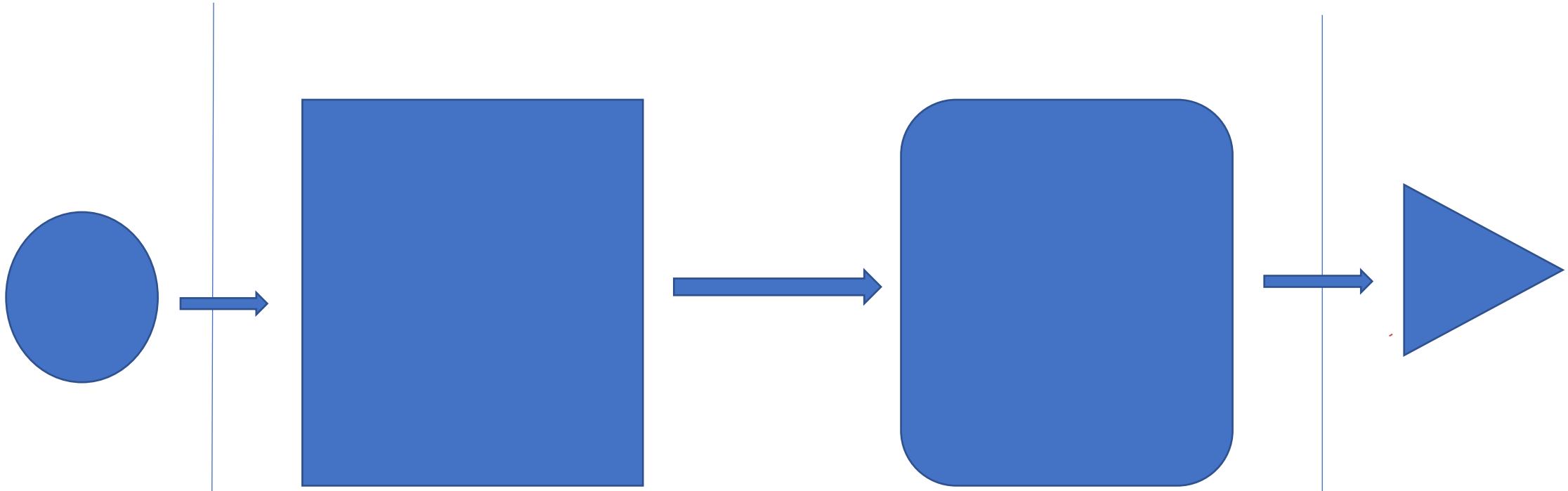


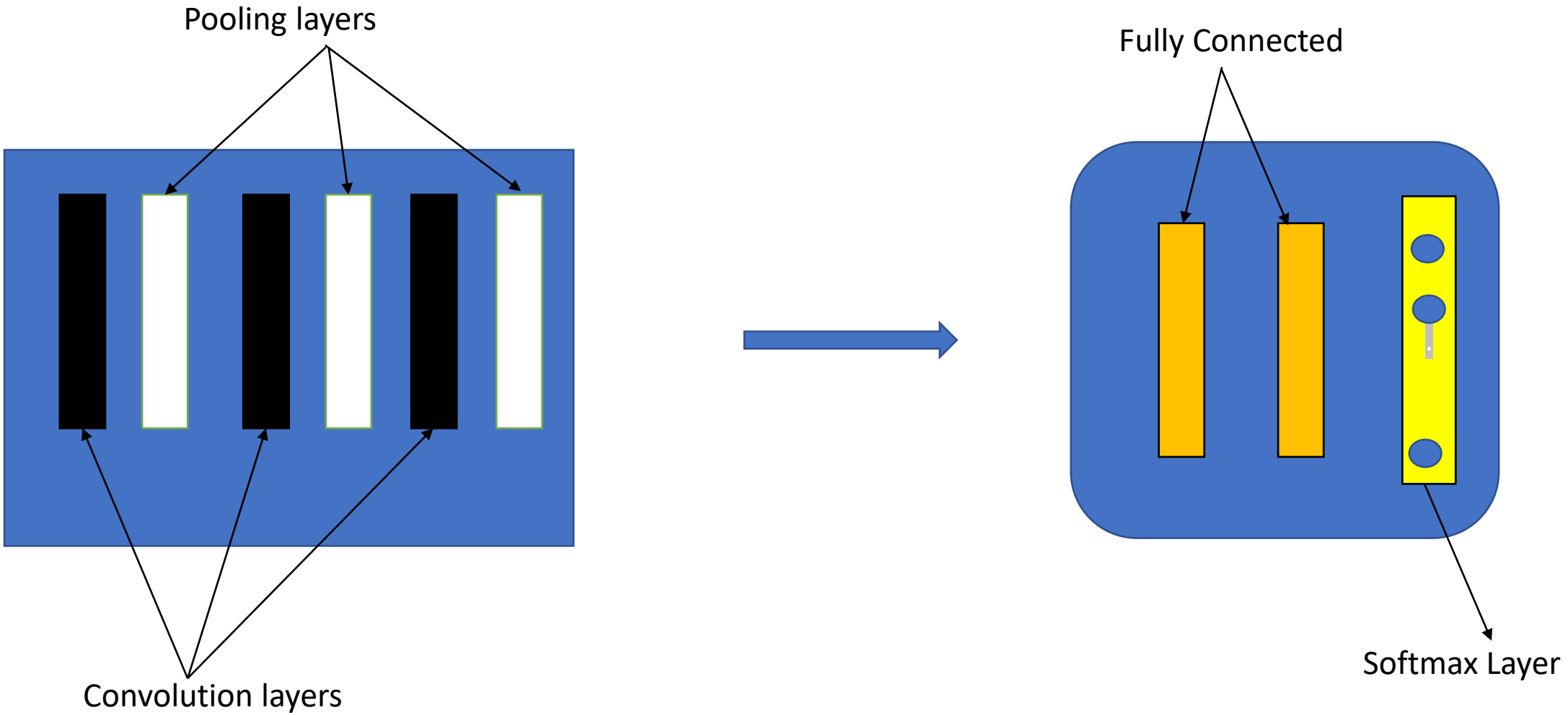
Image Source : "Neural Networks and Deep Learning" by Micheal Nielson

CNN Architecture Template



CNN

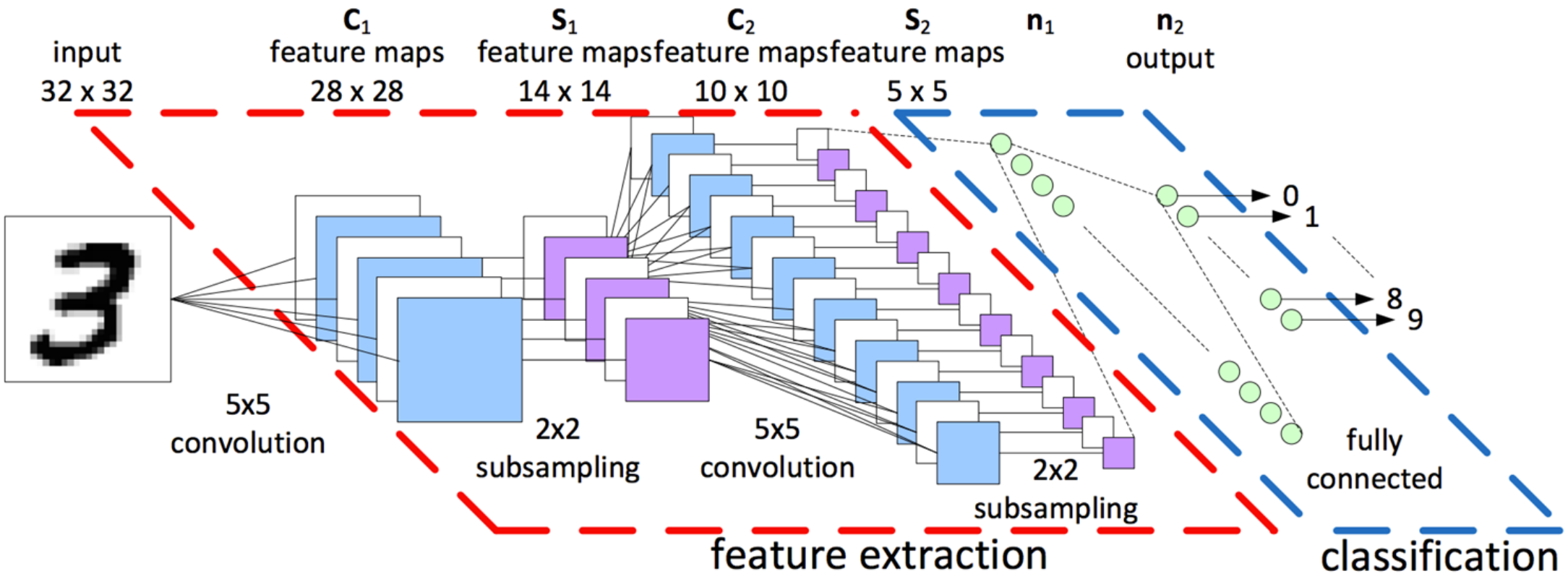
CNN Architecture Template



Block of Feature Extraction layers

Block of Classification layers

Example 1 – LeNet CNN Architecture



Process of Convolution

EXAMPLE

- How many pairs of layers – conv+pooling

Parameters for each layer:

- Number of filters/kernels: e.g. 16
- Size of the filter: e.g. 3x3
- Stride: default = 1

81	2	209	44	71	58
24	56	108	98	12	112
91	0	189	65	79	232
12	0	0	5	1	71
2	32	23	58	8	209
49	98	81	112	54	9

Input layer

0	1	1
1	0	0
1	0	1

Filter/Kernel

(Weighted matrix)

515			

Output

Process of Convolution (Contd.)

EXAMPLE

- As the filter/kernel is slid across the input layer, the convolved layer is obtained by adding the values obtained by element wise multiplication of the weight matrix.

81	2	209	44	71	58
24	56	108	98	12	112
91	0	189	65	79	232
12	0	0	5	1	71
2	32	23	58	8	209
49	98	81	112	54	9

Input layer

0	1	1
1	0	0
1	0	1

Filter/Kernel

(Weighted matrix)

515			

Output

- For example, when the weighted matrix starts from the top left corner of the input layer, the output value is calculated as:

$$(81x0+2x1+209x1)+(24x1+56x0+108X0)+(91x1+0x0+189x1) = 515$$

Process of Convolution (Contd.)

EXAMPLE

- The filter then moves by 1 pixel to the next receptive field and the process is repeated. The output layer obtained after the filter slides over the entire image would be a 4X4 matrix.
- This is called an **activation map/ feature map**.

81	2	209	44	71	58
24	56	108	98	12	112
91	0	189	65	79	232
12	0	0	5	1	71
2	32	23	58	8	209
49	98	81	112	54	9

Input layer

0	1	1
1	0	0
1	0	1

Filter/Kernel

(Weighted matrix)

515	374		

Output

(Activation/Feature Map)

- The distance between two consecutive receptive fields is called the **stride**.
- In this example stride is 1 since the receptive field was moved by 1 pixel at a time.

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Today's AGENDA

- **Recap**
- Cat/Dog – Binary classification
- Save/Restore models
- Cifar Multiclass classification
- Pre-trained models

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