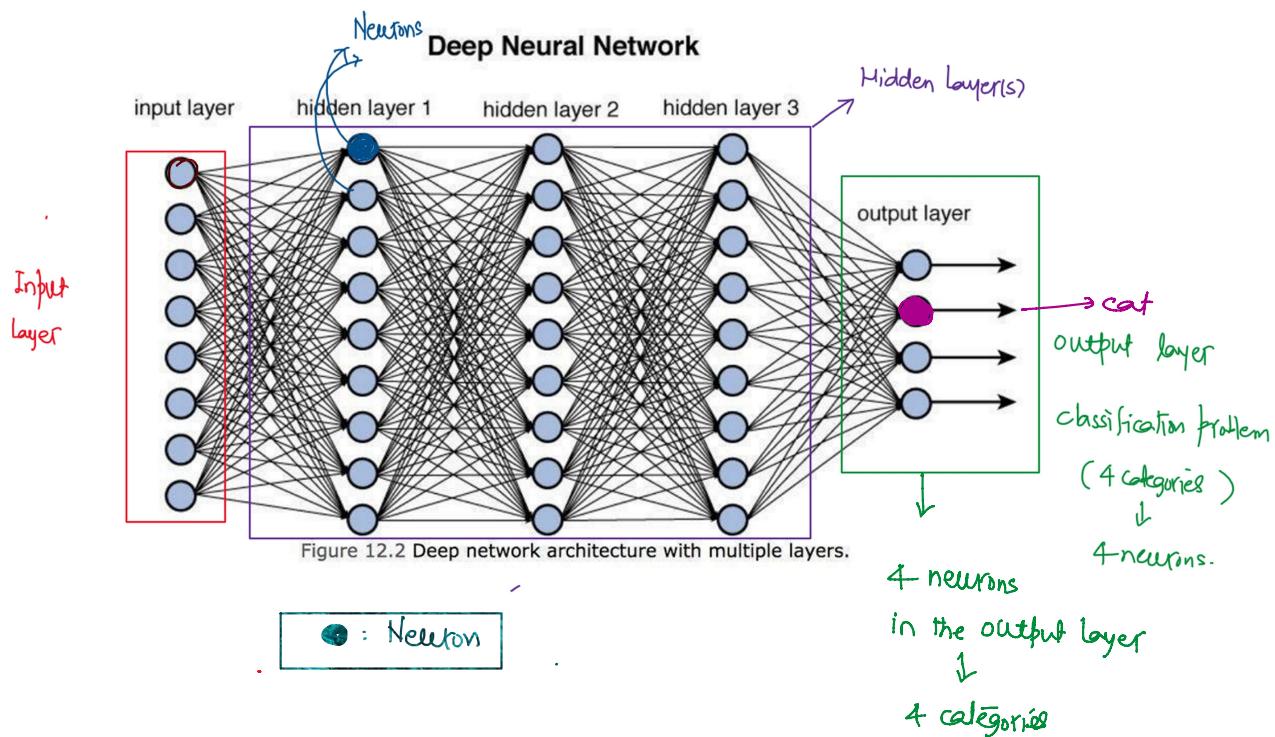


# Neural Network Architecture

14 September 2025 12:33

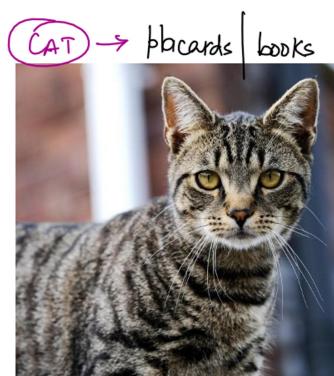


## Intuition behind neural network

A new born baby (1-2 yrs old)

↓ teaching a baby.

CAT → visuals → placards | books



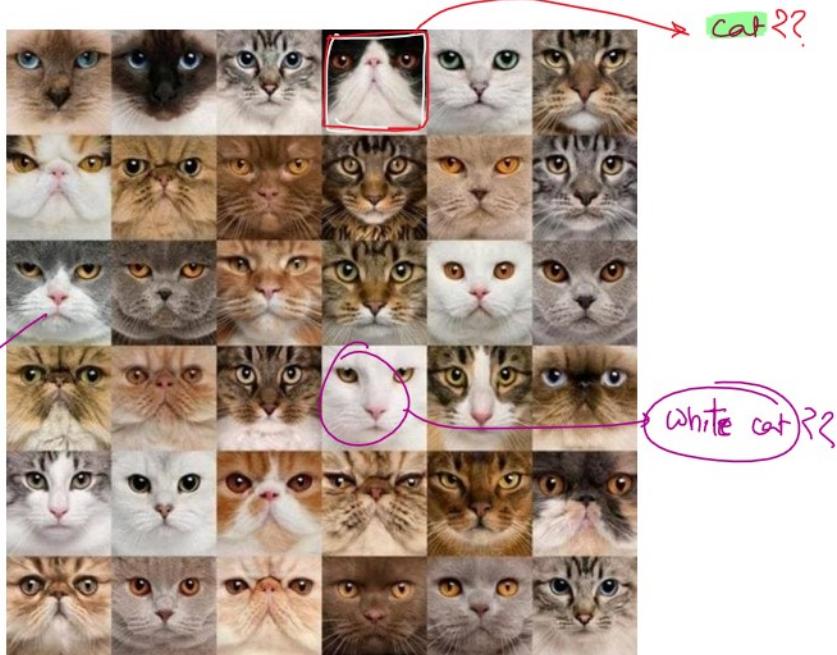
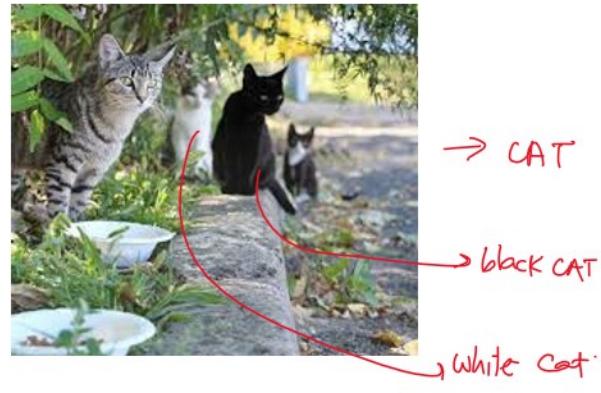
→ extract the features  
of a cat.

baby tries to observe  
and learn.

Parents

→ labelling  
this image

the image is a CAT.

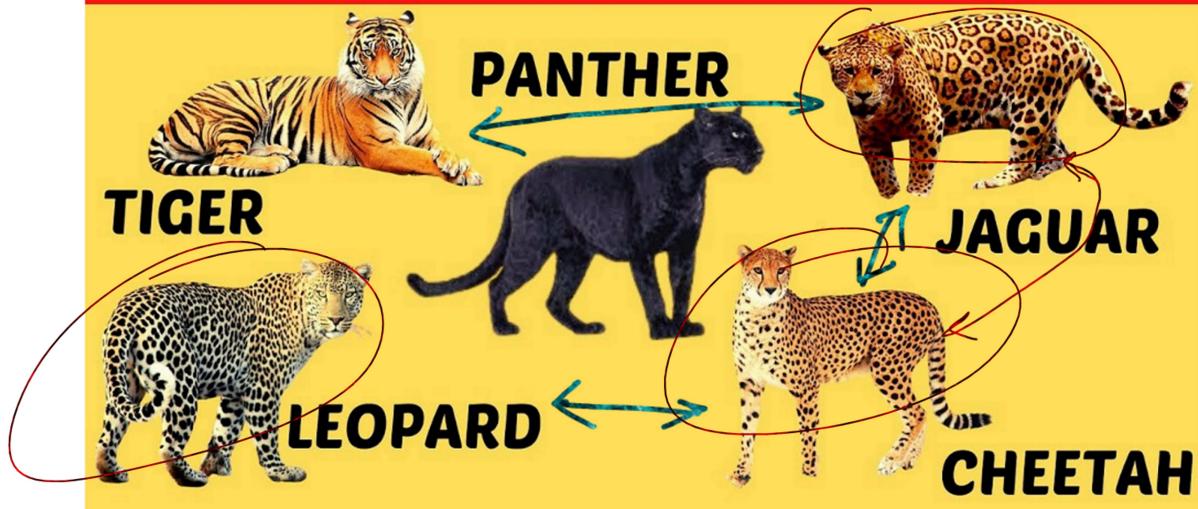


→ Most of us are not able to  
recognize the bird as there is  
either no training or limited  
training.

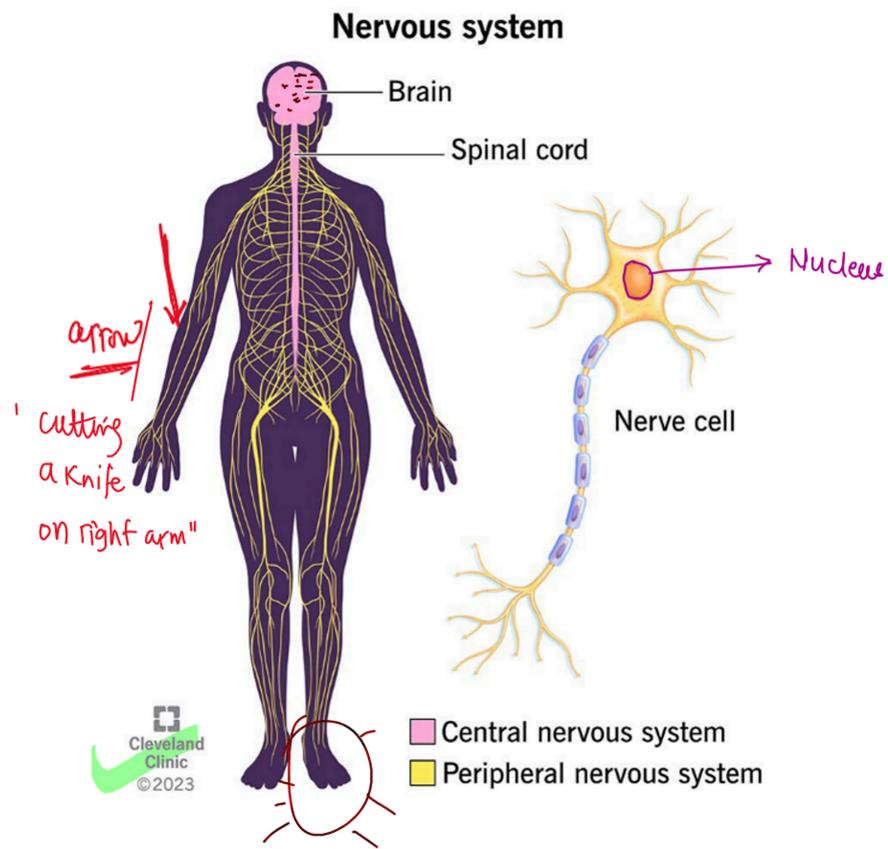
Flamingo - is a rare bird.

I m g - is a rare b'rd.

## Do You know the Difference?



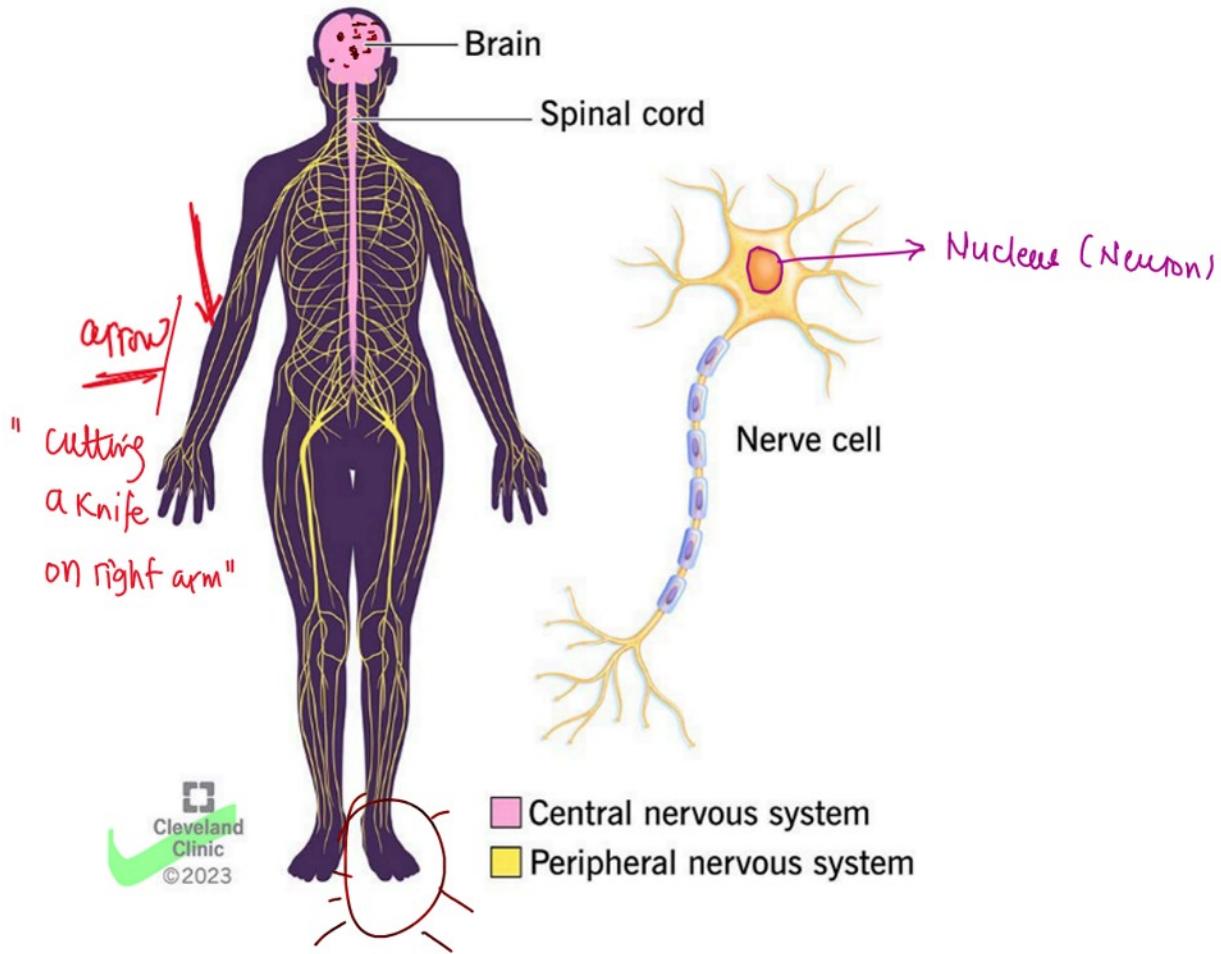
*Connecting the dots between human brain and neural network*



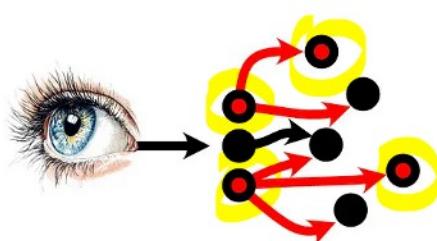
[How does your brain respond to pain? - Karen D. Davis](#)

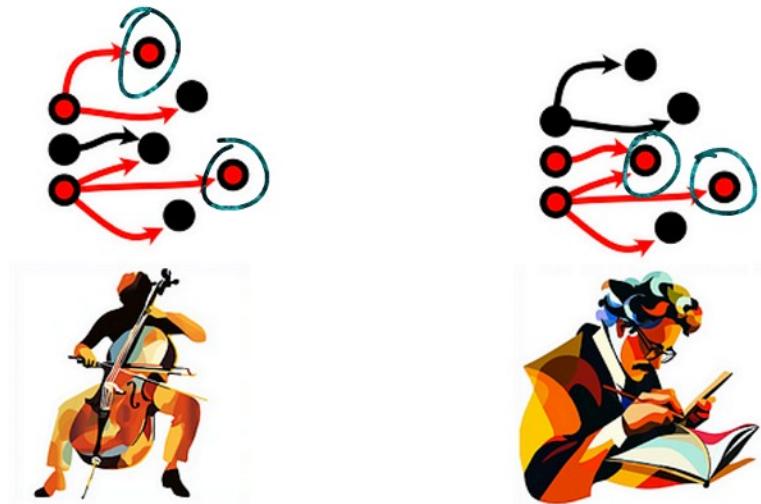


## Nervous system



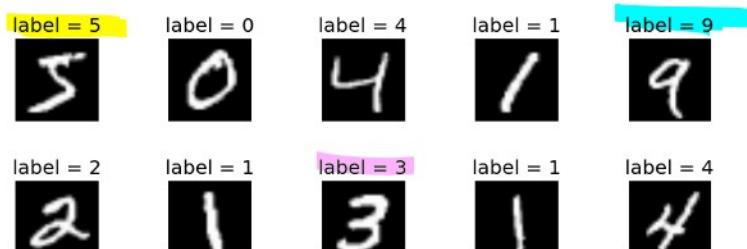
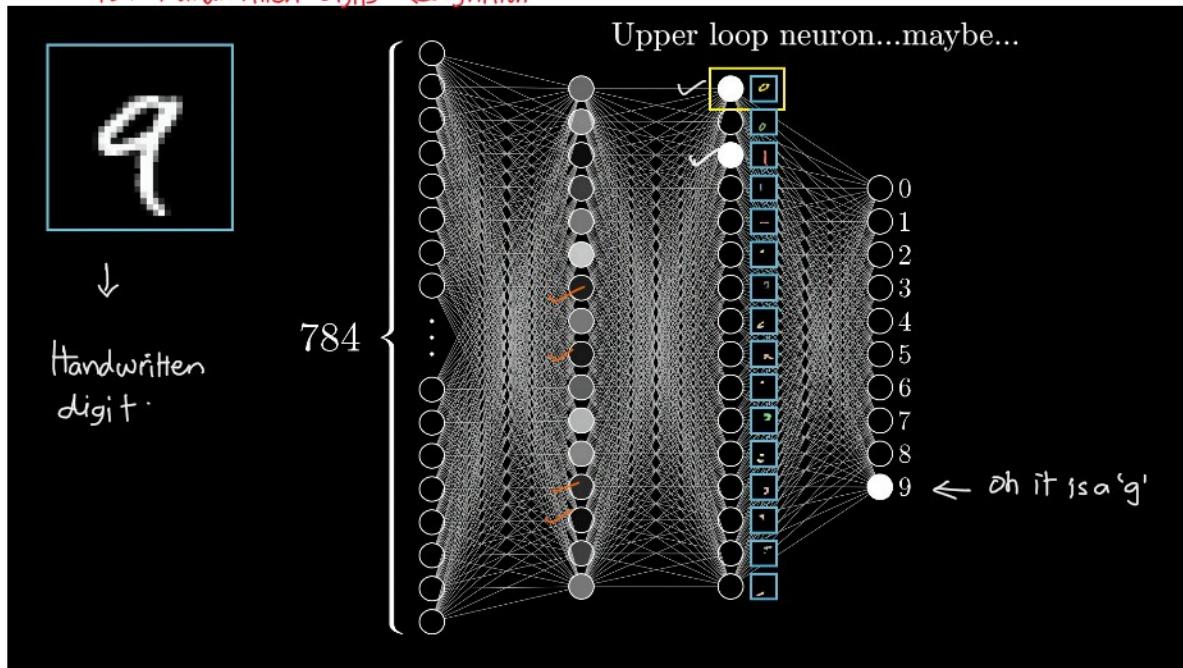
Watching a movie

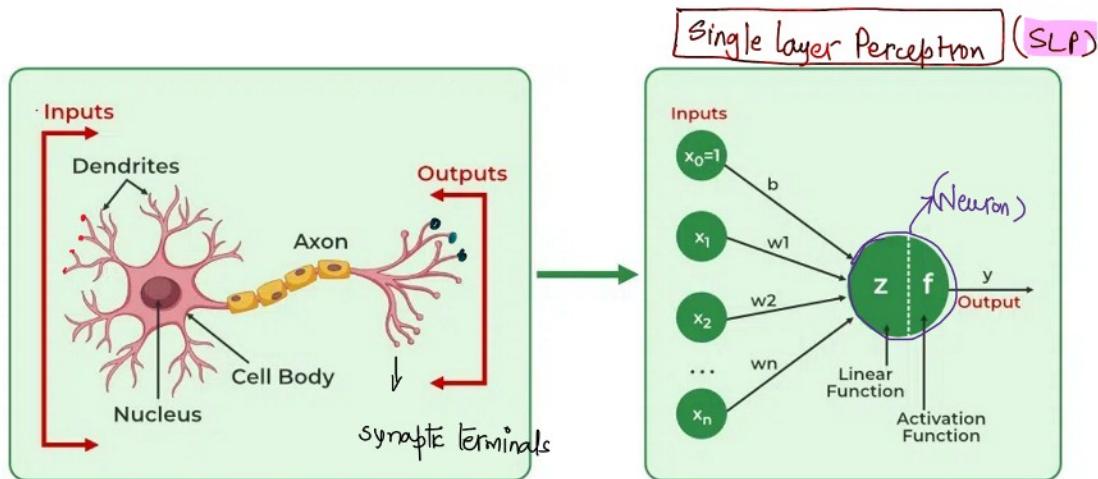
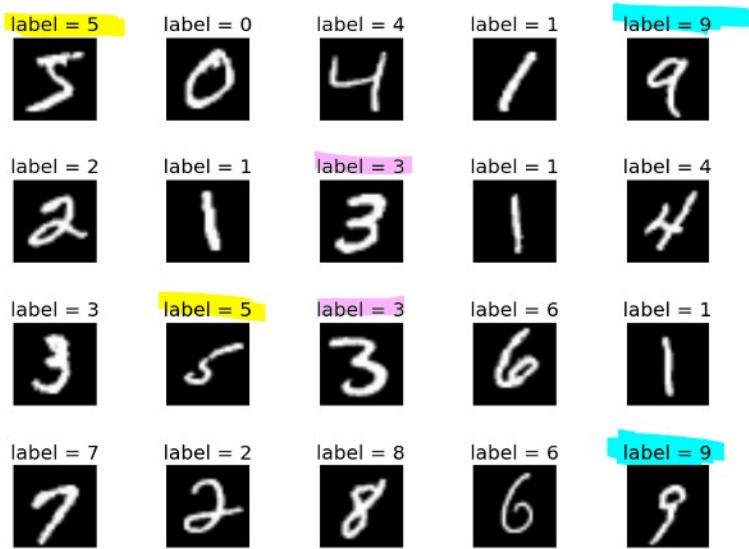




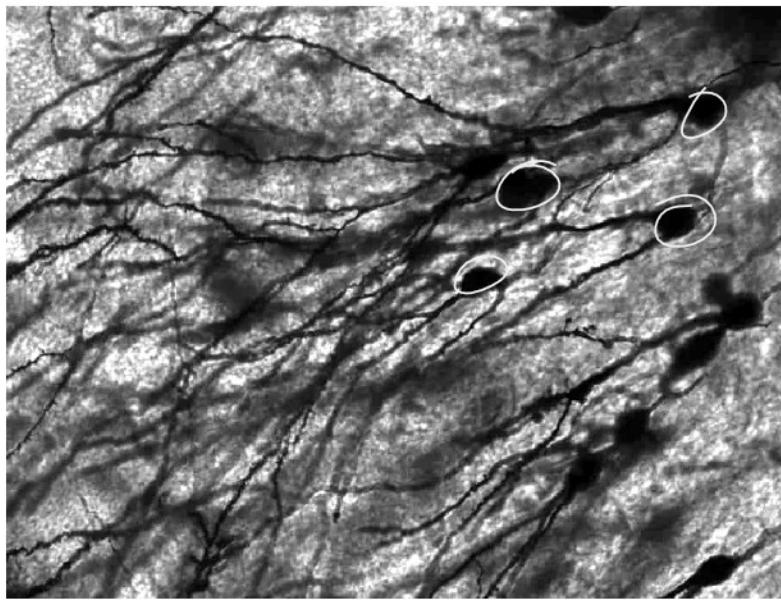
A human brain has deep layers of billions of neurons  
however different set of neurons are going to get  
fired due to different stimulation

MNIST Handwritten Digits Recognition





[similarity in the structure]



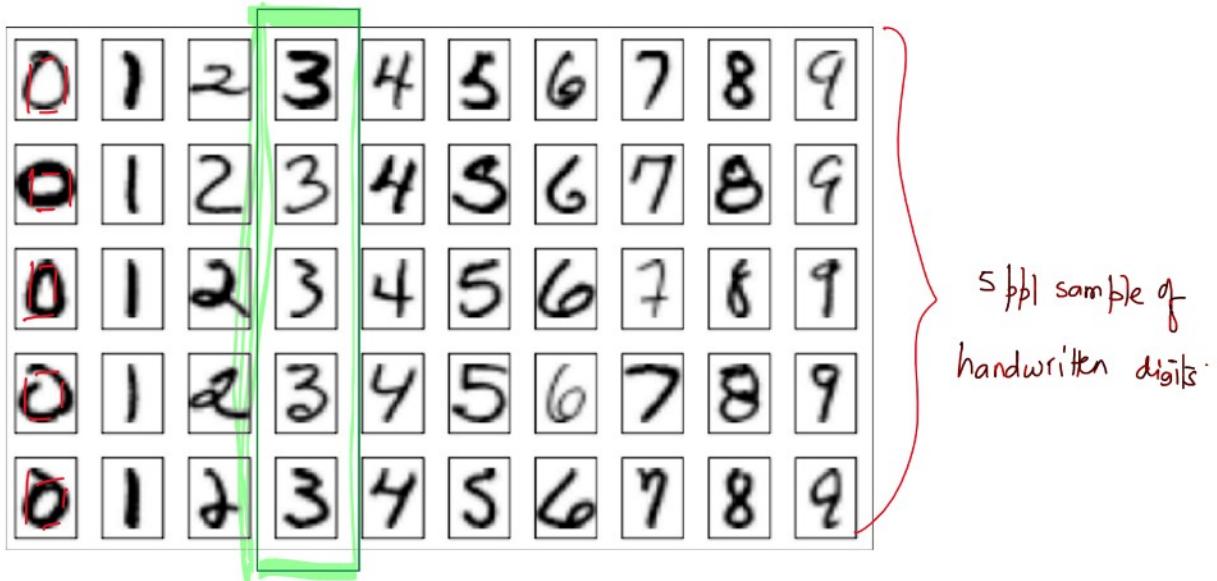
"Don't drive without Helmet"

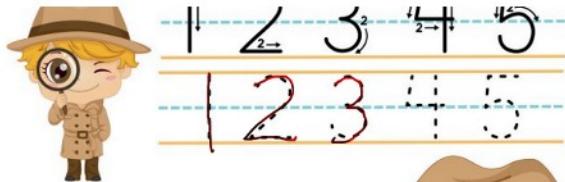
source: Wiki → Neurons in the human brain

Intuitively how does a neural network model learns ?

Modified National Institute of Standards and Technology

Handwritten Digits Recognition [MNIST database]





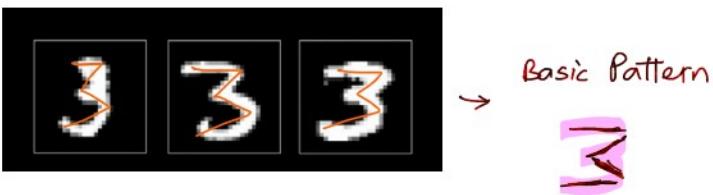
1 2 3 4 5

**Number Tracing Book**  
Learning Numbers  
For Kids  
Tracing Numbers 1 to 10

1 2 3 4 5

A cartoon girl in a trench coat and hat uses a magnifying glass to trace the numbers 6, 7, 8, and 9 on ruled paper. The numbers are shown with stroke order: 6 (top-left curve, middle vertical, bottom-right vertical), 7 (top-left curve, middle vertical, top-right vertical), 8 (top-left curve, middle vertical, top-right vertical, middle vertical), and 9 (top-left curve, middle vertical, top-right vertical, middle vertical, bottom-right vertical).

6 7 8 9

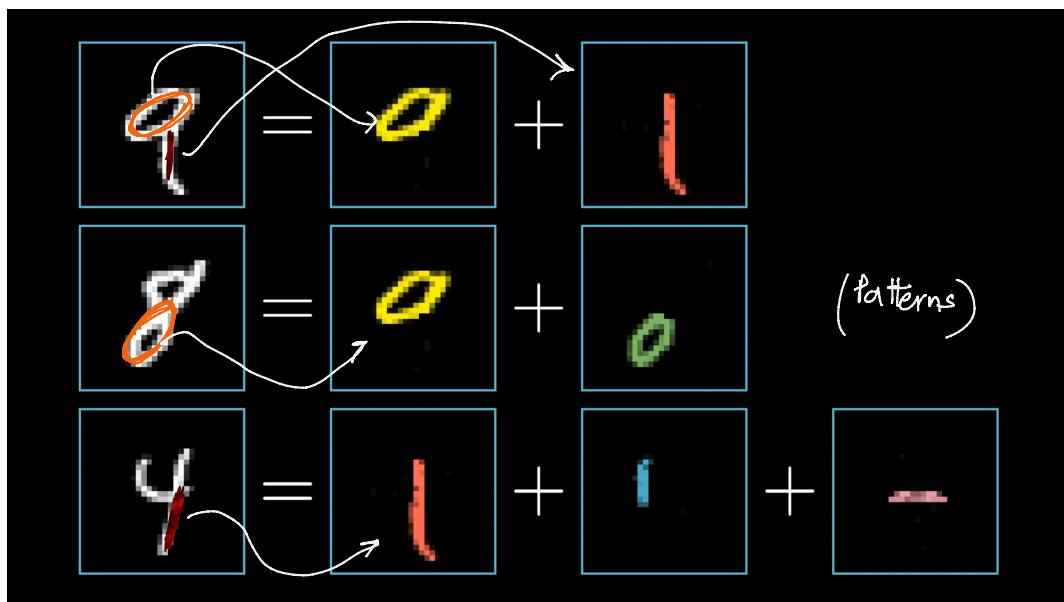




[Seven segment display]



Pattern

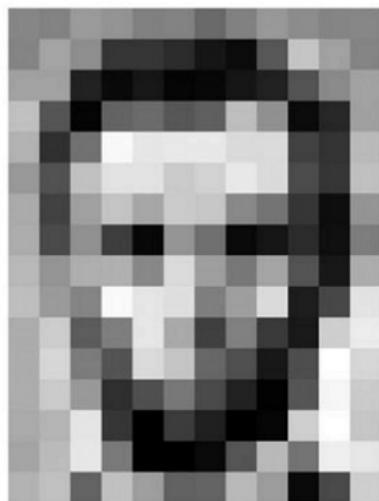


111 mod 1 1 - th - ly  
deu n h trainin aulo m - ly



Former US President

Abraham Lincoln

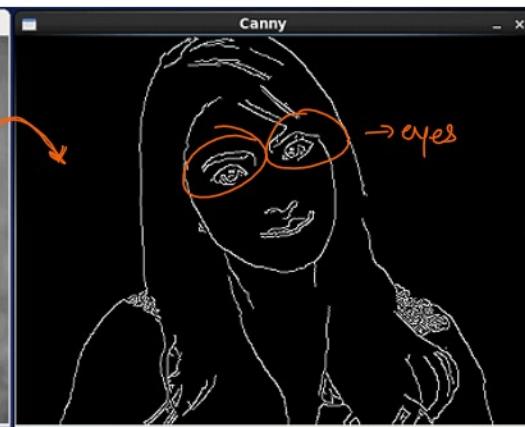
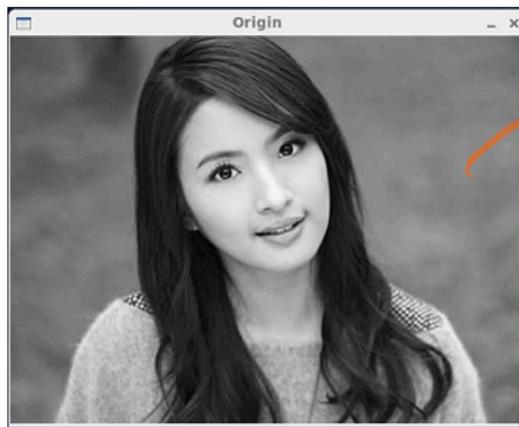


[0-255 → 256 pixels]

157	153	174	168	160	152	129	151	172	161	155	166
155	182	163	74	75	62	93	17	110	210	180	354
180	180	50	14	34	6	10	33	48	106	159	181
206	109	5	134	131	111	120	204	166	15	56	180
194	68	137	251	237	239	239	228	227	87	71	201
172	106	207	233	233	214	220	239	228	98	74	206
188	88	179	206	165	215	211	158	139	75	20	169
189	97	165	84	10	13	2	11	31	62	22	148
199	168	191	153	158	227	178	142	142	106	36	190
205	174	154	252	236	291	149	178	228	43	95	234
190	216	116	149	2	187	85	19	79	38	218	241
190	224	147	108	227	117	102	36	101	255	224	
190	214	173	66	103	143	96	50	2	109	249	215
187	196	236	75	1	81	47	0	6	217	255	211
183	202	237	145	0	0	12	108	200	138	243	236
195	206	123	207	177	121	123	200	175	13	96	218

✓

157	153	174	168	150	182	129	151	172	161	185	156
165	182	163	74	75	62	33	17	110	210	180	154
180	180	50	14	34	6	10	33	48	106	159	181
206	109	5	124	131	111	120	204	166	15	56	180
194	68	137	251	237	239	239	228	227	87	71	201
172	105	207	233	233	214	220	239	228	98	74	206
188	88	179	209	185	215	211	158	139	75	20	169
189	97	165	84	10	13	2	11	31	62	22	148
199	160	191	193	158	227	179	143	142	106	36	190
205	174	155	252	236	231	149	178	228	43	95	234
190	216	116	149	236	187	86	150	79	38	218	241
190	224	147	108	227	210	127	102	36	101	255	224
190	214	173	66	103	143	96	50	2	109	249	215
187	196	235	75	1	81	47	0	6	217	255	211
183	202	237	145	0	0	12	108	200	138	243	236
195	206	123	207	177	121	123	200	175	13	96	218



→ Person vs Cat



Pixelated Image  
↓  
( how to take an image  
and convert it into pixels )

## **ARTIFICIAL NEURAL NETWORK ARCHITECTURE**

## Deep Neural Network

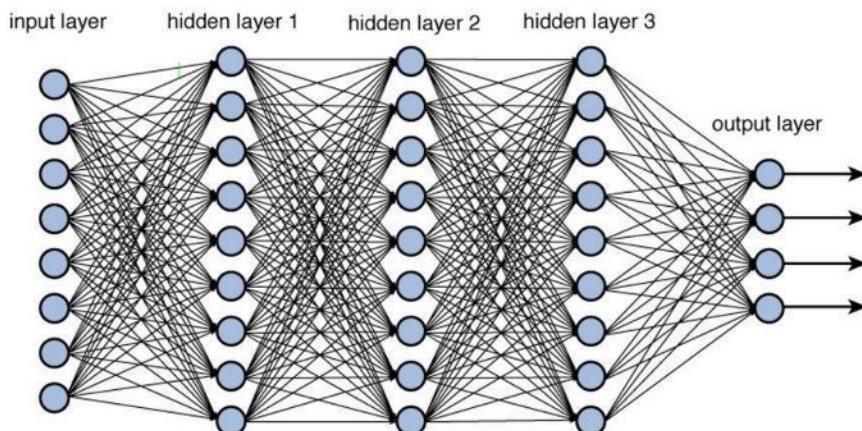
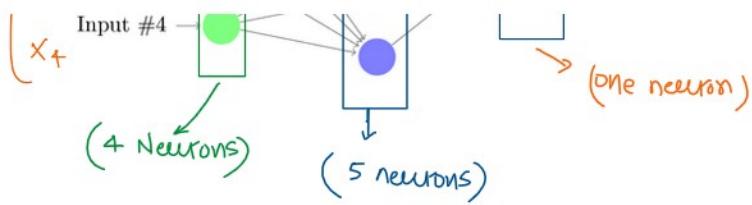


Figure 12.2 Deep network architecture with multiple layers.

Diagram illustrating a neural network architecture:

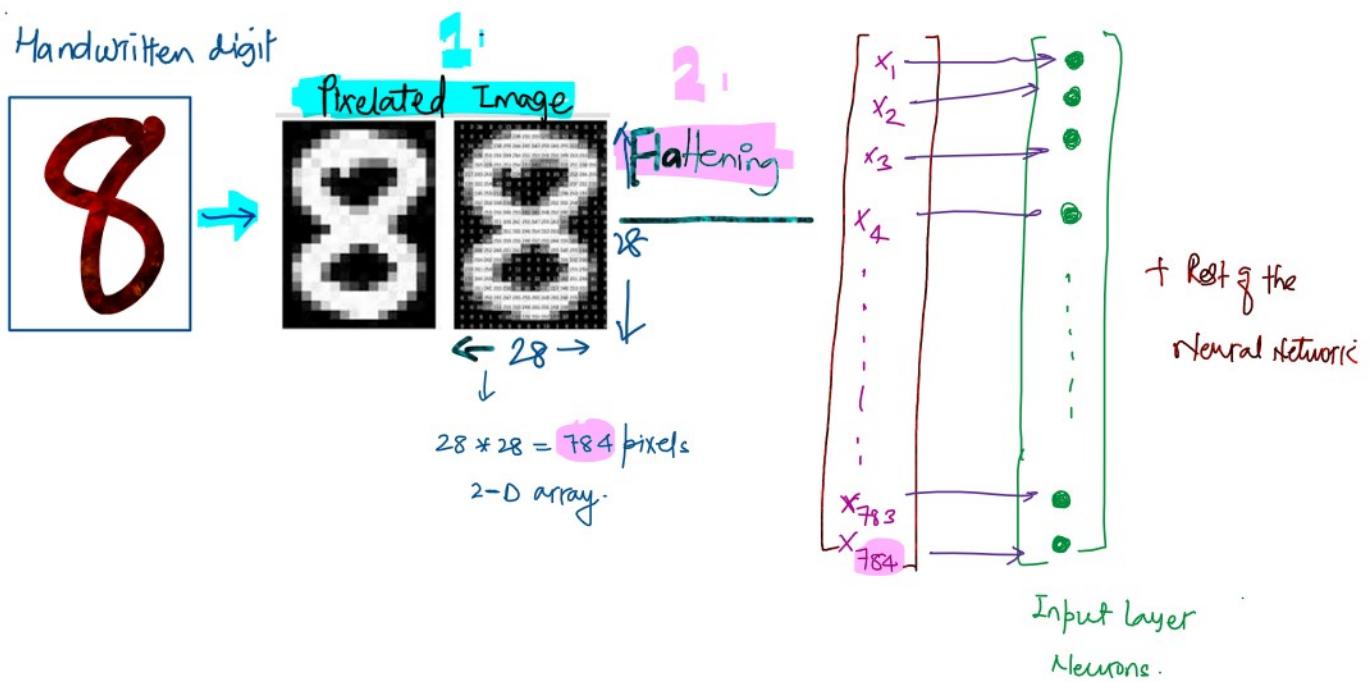
- Input layer**: Contains 4 green neurons labeled  $x_1, x_2, x_3, x_4$ . A bracket on the left labeled "Input Variables" groups these neurons.
- Hidden layer**: Contains 5 blue neurons.
- Output layer**: Contains 1 red neuron.

The connections show fully connected layers between the input and hidden layers, and between the hidden layer and the output neuron.

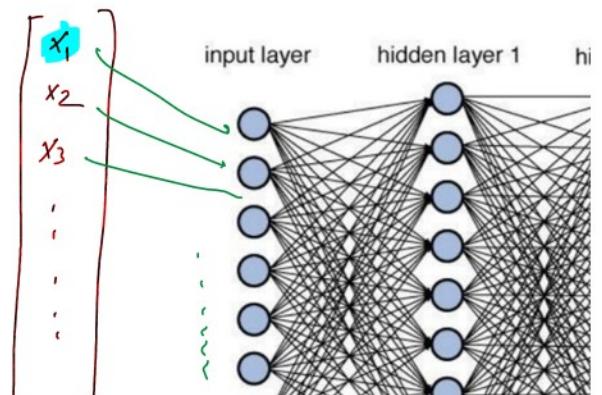
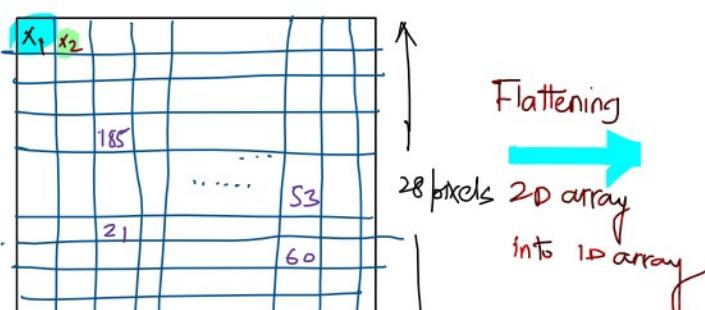


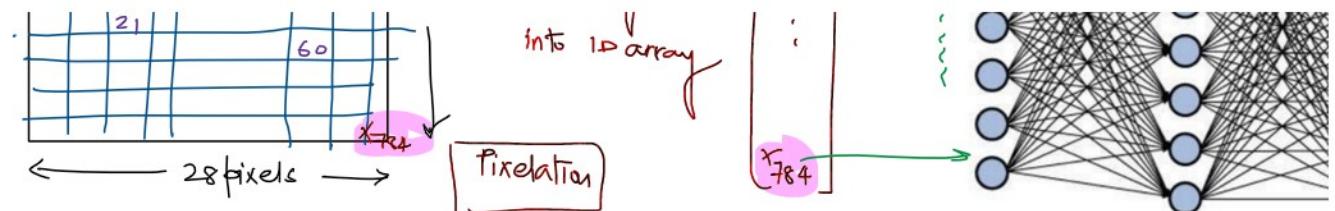
Input Layer Input layer is responsible to accept the pixelated and flattened training dataset and pass it to the rest of the network.

8 : Handwritten digit



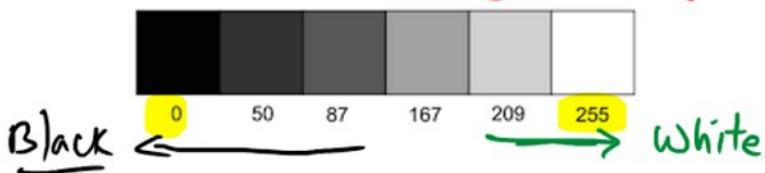
MNIST Handwritten Digits





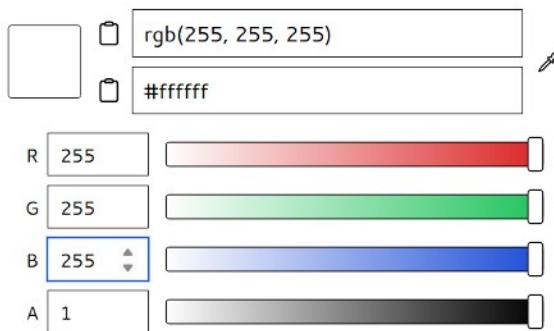
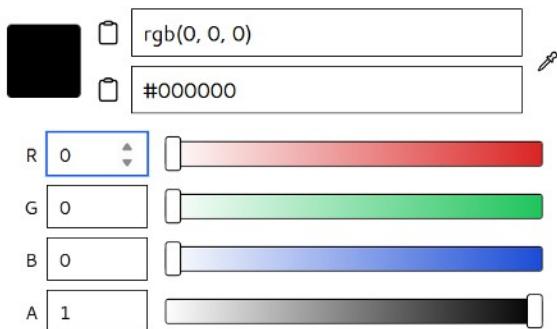
Grayscale color coding

As per the color coding  $\rightarrow$  Grayscale.



● Neurons  $\leftrightarrow$  Nodes  
 ✕ Lines/connections  $\rightarrow$  Edges  
 b/w Neurons

Graph Theory.



Pro-tip\*

Input layer has no learnable parameters

(weights and biases)

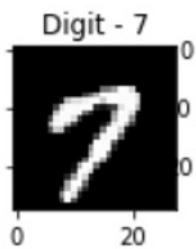
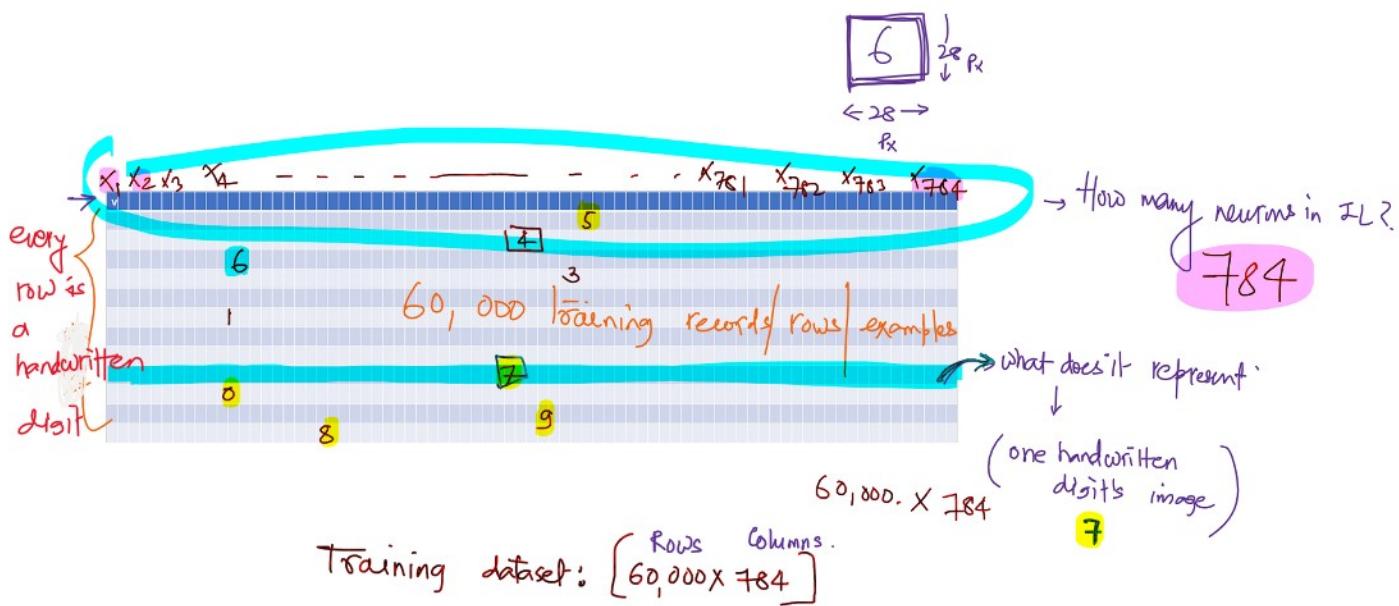


(No weights or biases associated with input layer)

#1. No calculation or learning happens in the input layer.

#2. Number of neurons in the input layer =  $\underbrace{\text{no. of features}}_{\substack{\text{in 1-D vector} \\ \text{no. of independent variables } (x_1, x_2, \dots, x_n)}}$

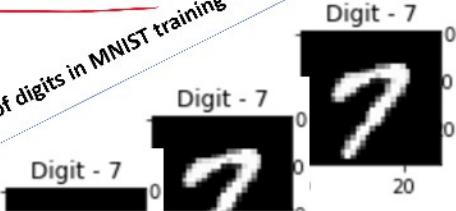
↓ independent variable or feature is connected to 1 neuron of the input layer.  $[ \bullet \rightarrow \bullet \text{ one to one connection} ]$



Line Project/ Research



① 60,000 images of digits in MNIST training dataset



MNIST dataset

$x_1, x_2, x_3, \dots, x_{784}$

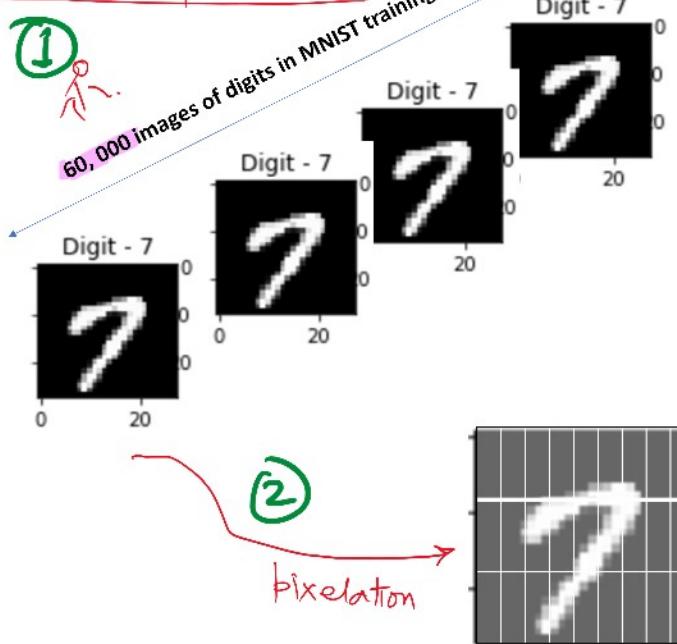
60,000 rows

Training dataset

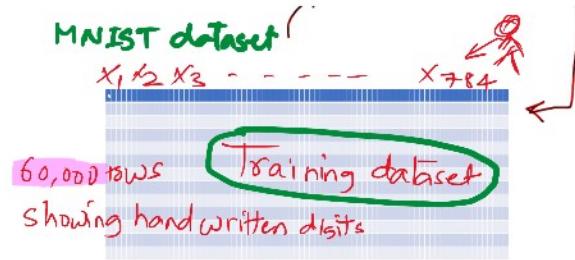
Showing handwritten digits

tensorflow + keras

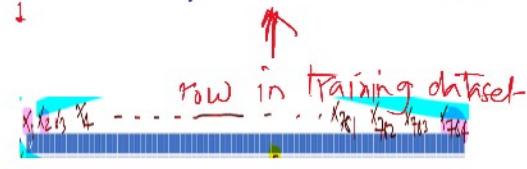
## Live Project / Research



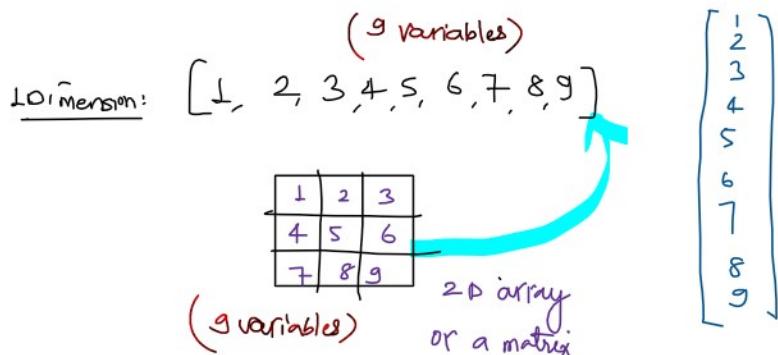
## MNIST dataset



④ repeat 60K Times



③ Flattening



7