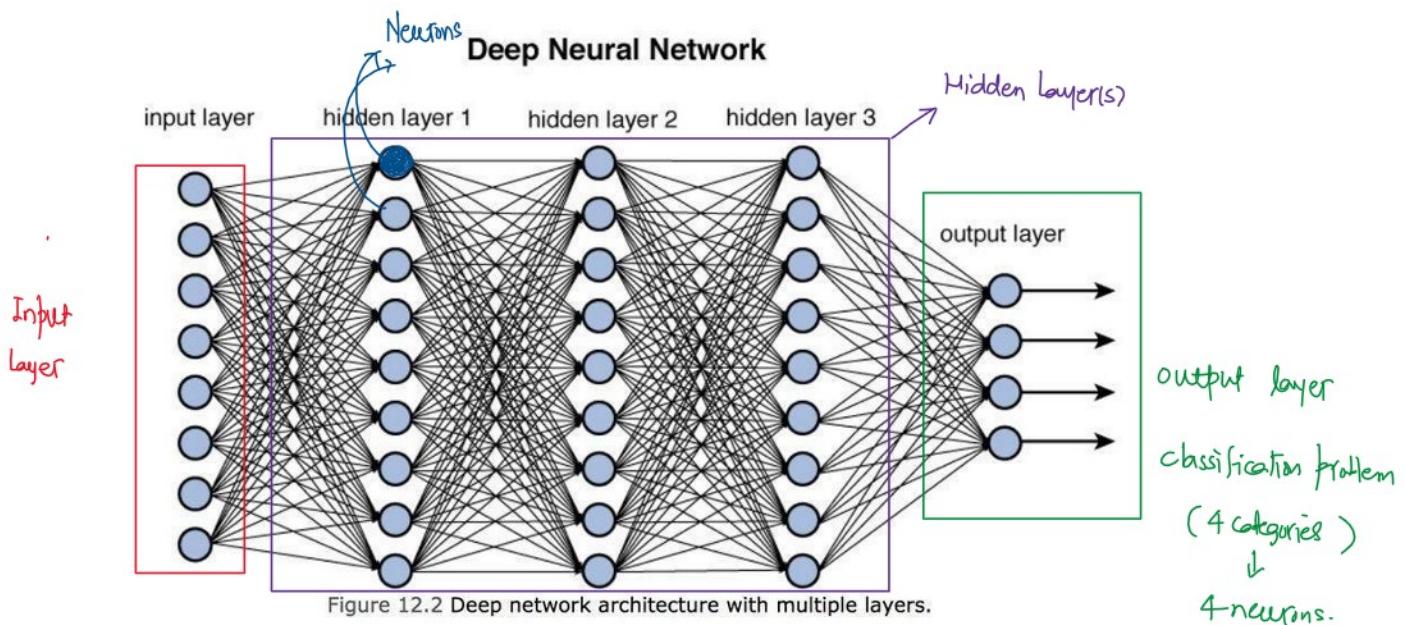


Neural Network Architecture

08 June 2025 11:55



Intuition behind Neural Network

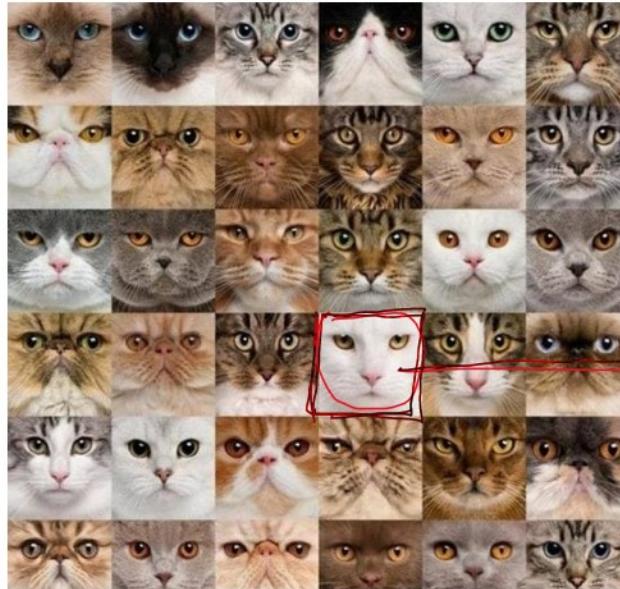
What's the most sophisticated algo. in the world?



Cat A new born baby (1-2 yrs old)

teaching a baby

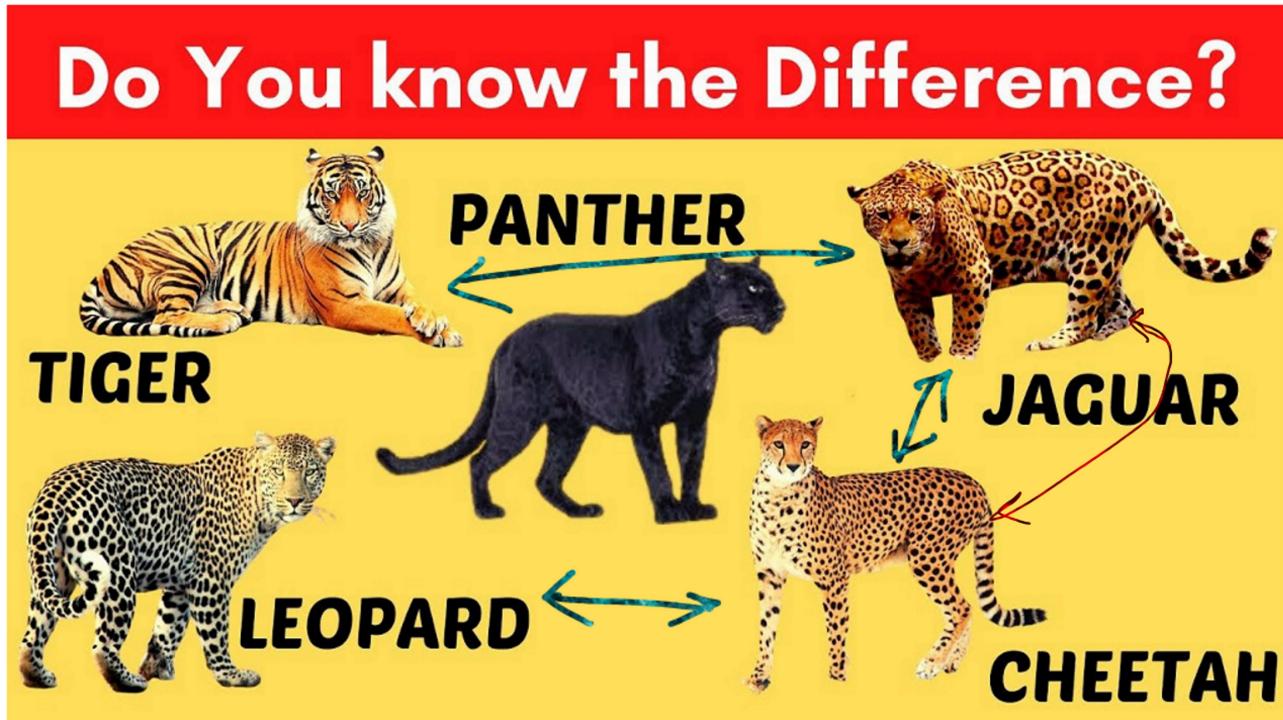
CAT → placards | books





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

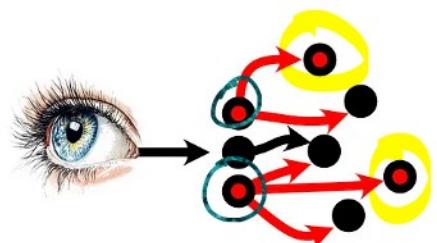
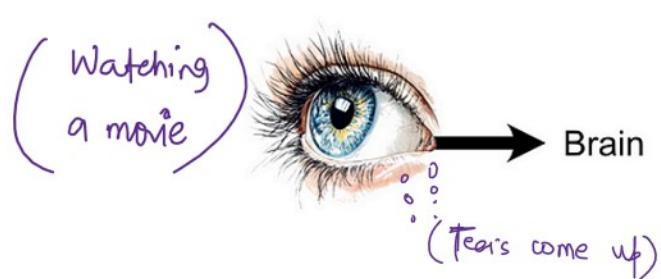
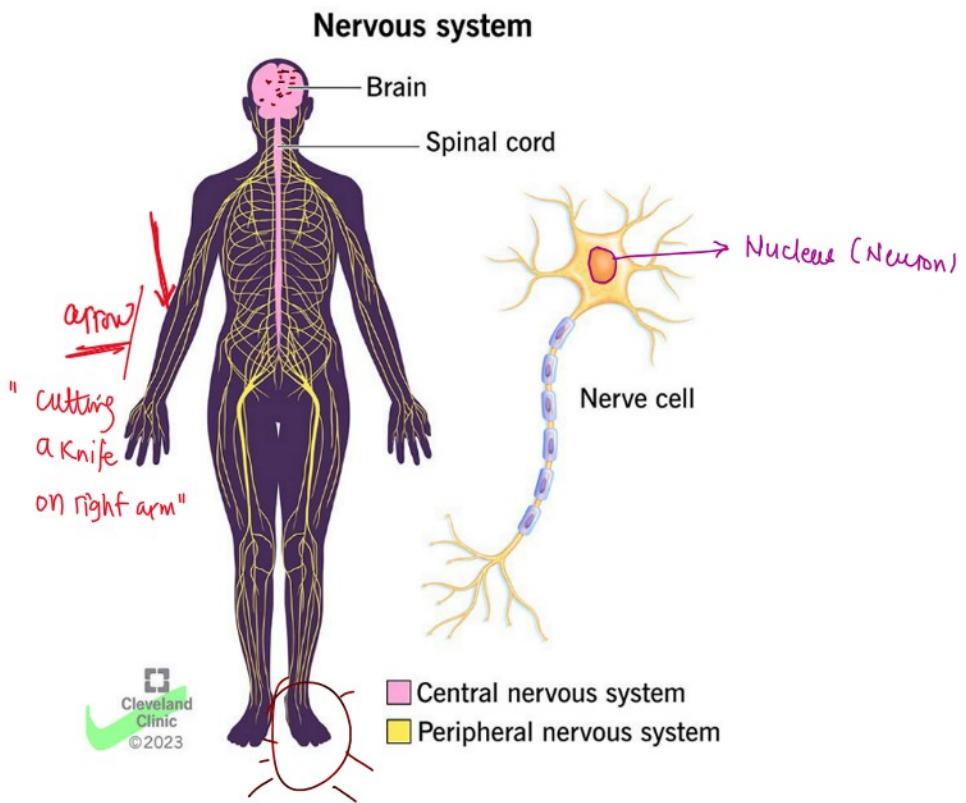
Flamingo → is a rare bird.



Connecting the dots between human brain and neural network

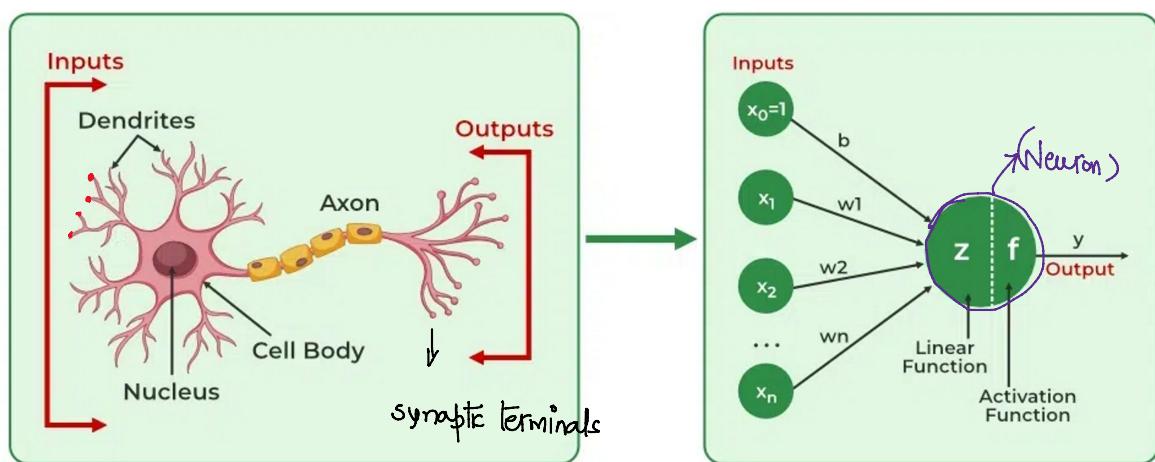
[How does your brain respond to pain? - Karen D. Davis](#)

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





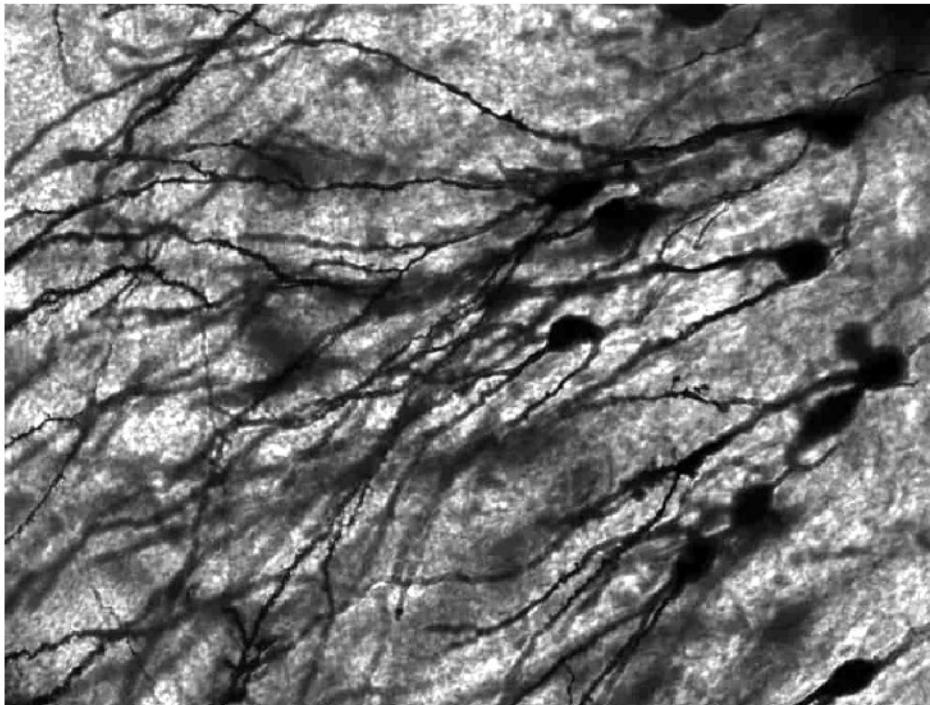
human brain has different layers. In every layer, different set of neurons are going to get fired due to different stimulation.



is based on the

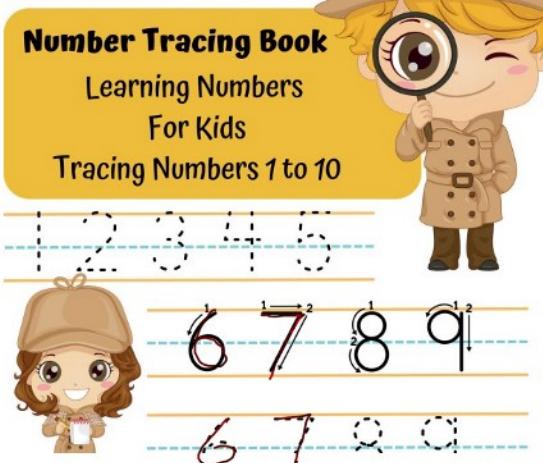
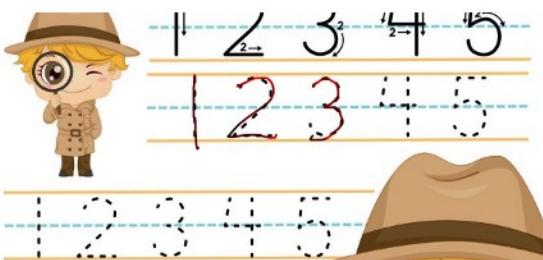
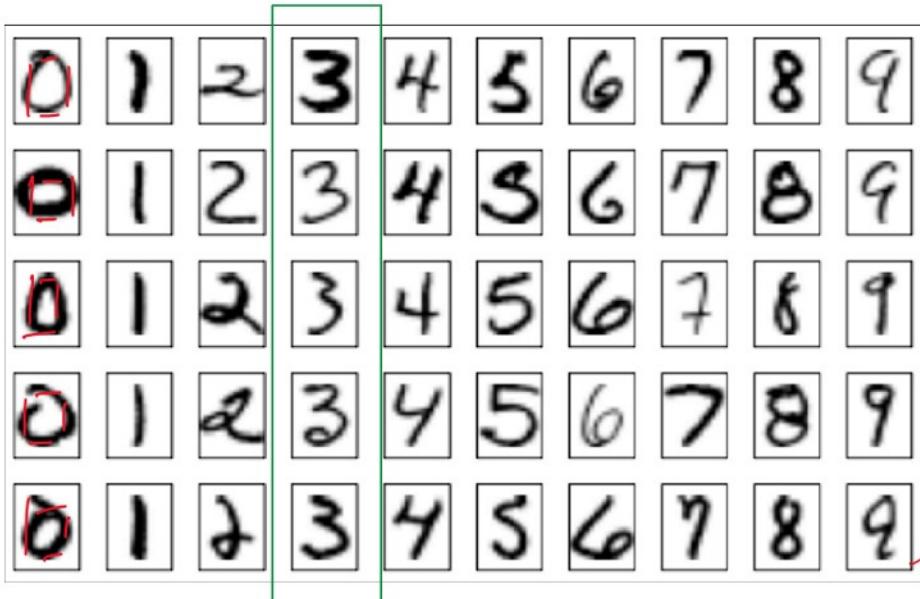


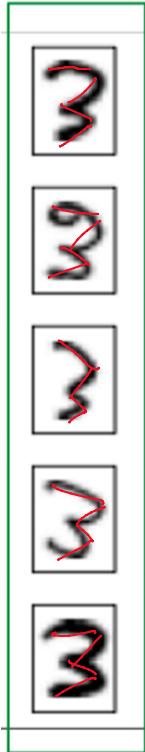
~ Approximately 86 billions of neurons exist in the human body.



Wikipedia: Neurons in the human brain.

Handwritten digits recognition (MNIST database)



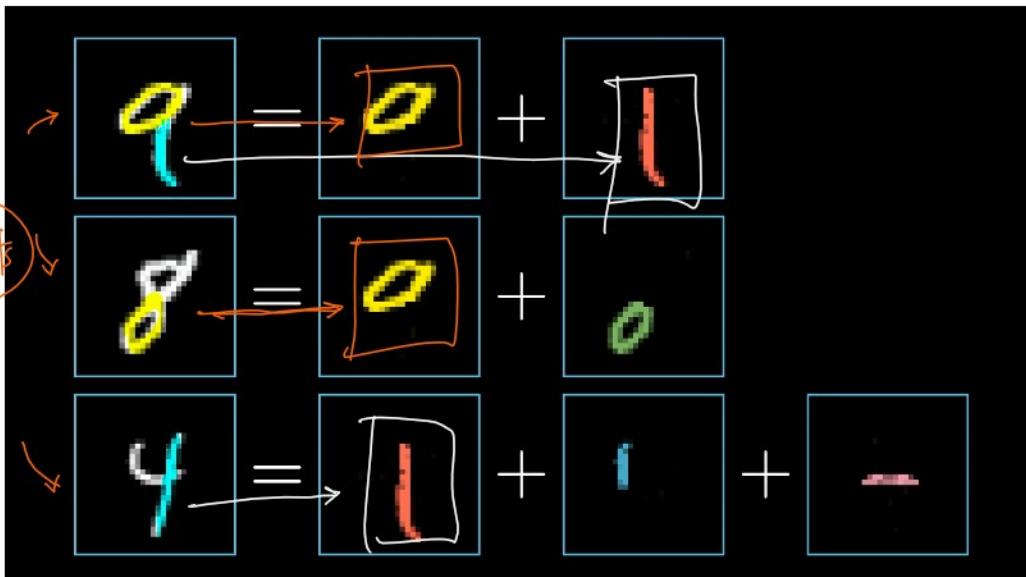


Basic Pattern

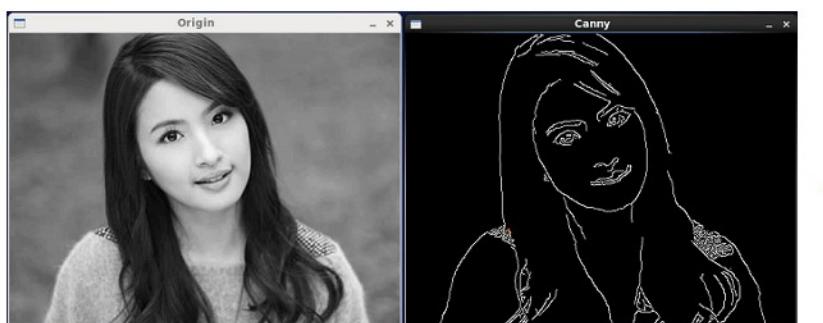
3



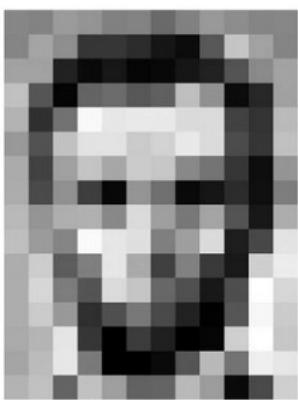
Pattern



NN model is extracting the features during the training



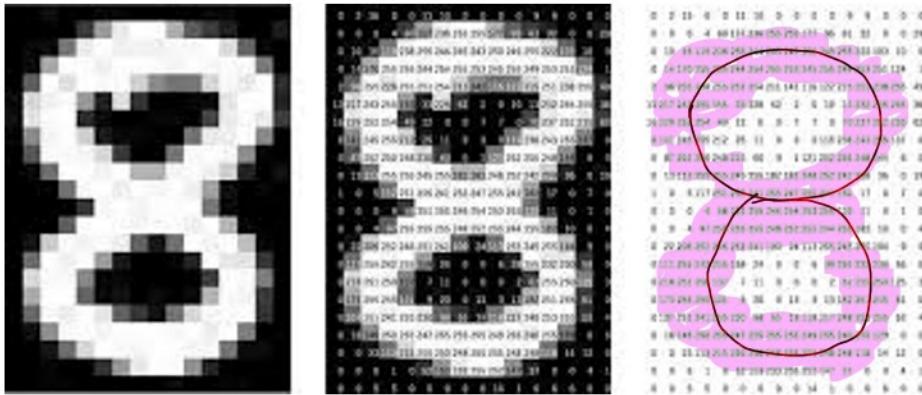
→ Person vs Cat



157	158	174	168	160	181	129	151	172	161	155	156
155	182	163	74	75	62	33	17	110	210	180	154
180	180	50	14	34	6	10	33	48	105	159	181
206	109	5	124	131	111	120	204	166	15	56	180
194	68	157	251	237	239	239	228	227	87	71	201
172	106	207	233	233	214	220	239	228	36	74	206
188	68	179	205	205	211	158	139	75	20	169	
189	97	68	84	16	15	11	31	62	22	148	
199	148	191	103	168	227	178	144	162	106	36	190
205	176	154	282	236	311	146	178	228	43	93	234
190	216	114	149	2	187	86	11	79	38	218	241
190	224	147	108	227	41	127	103	36	101	255	224
190	214	173	66	103	143	96	50	2	109	249	215
187	196	230	75	1	81	47	0	6	217	255	211
183	206	237	145	6	0	12	108	200	138	243	236
195	206	123	207	177	121	123	200	175	13	96	218

157	153	174	168	160	152	129	191	172	161	155	156
155	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	239	227	87	71	201
172	106	207	233	233	214	220	239	228	98	74	206
188	88	179	209	186	215	211	198	139	75	20	169
189	97	165	84	10	168	134	11	31	62	22	148
199	148	191	193	158	227	170	143	182	106	36	190
205	174	155	252	236	231	149	178	228	43	95	234
190	216	116	149	236	187	86	160	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	6	0	12	108	200	138	243	236
195	206	123	207	177	121	123	200	175	13	96	218

→ Abraham Lincoln



Pixelated image (how to take an image
and convert it into pixelated image)
 ↴
ad-hoc [Handson] → Saturday (14 June)

Intuition → Mathematics → coding (Building the model)
 from scratch

ARTIFICIAL NEURAL NETWORK ARCHITECTURE

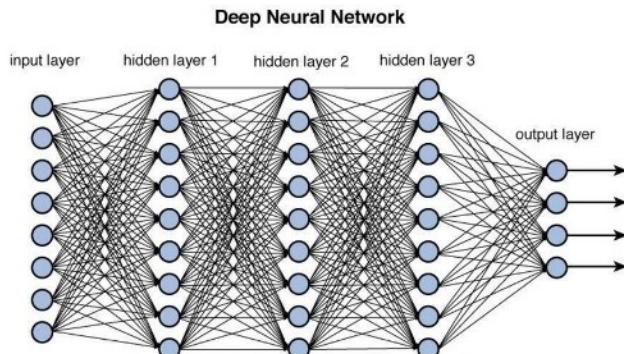
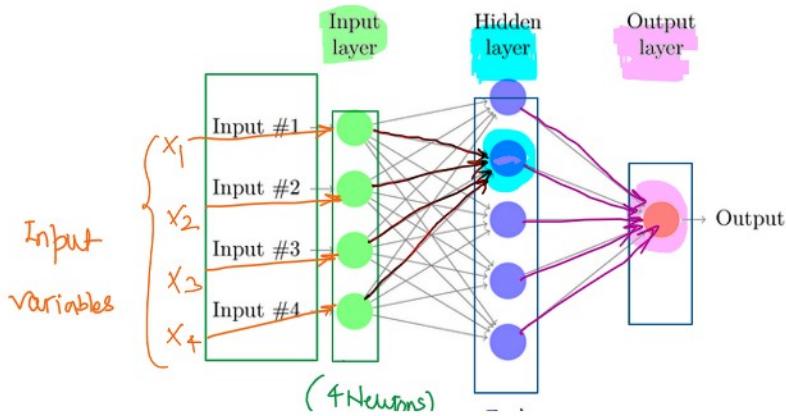
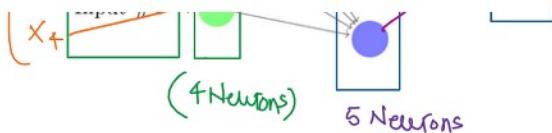
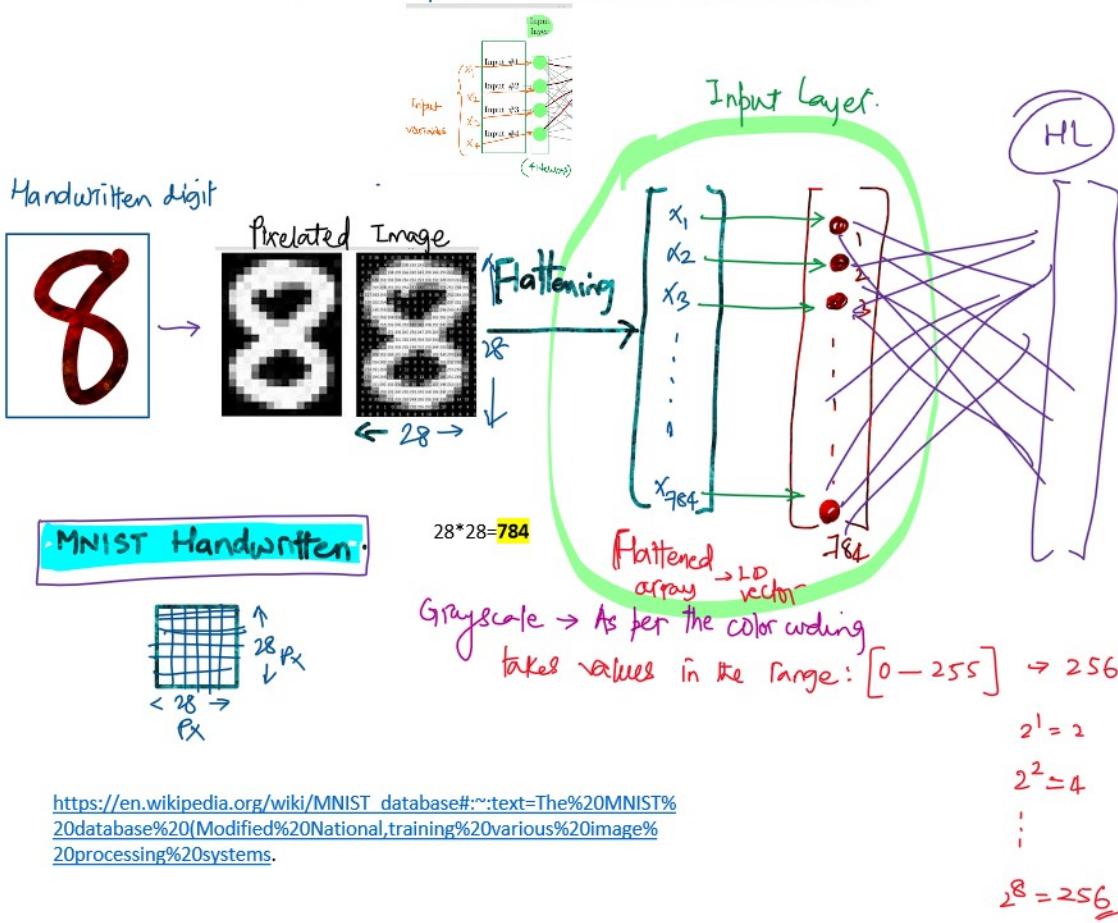


Figure 12.2 Deep network architecture with multiple layers.

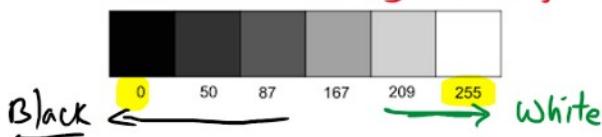




Input layer: Input layer is responsible to accept the **pixelated** and **flattened** training dataset and pass it to the rest of the network.



As per the color coding → Greyscale.



* Pro-tip

Input layer has **no learnable parameters**
 (no weights or biases associated with input layer)

(no weights or biases associated with input layer)

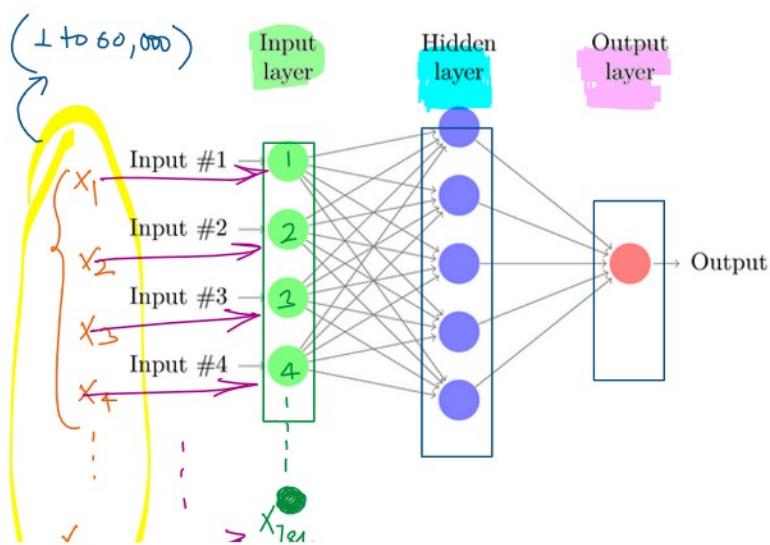
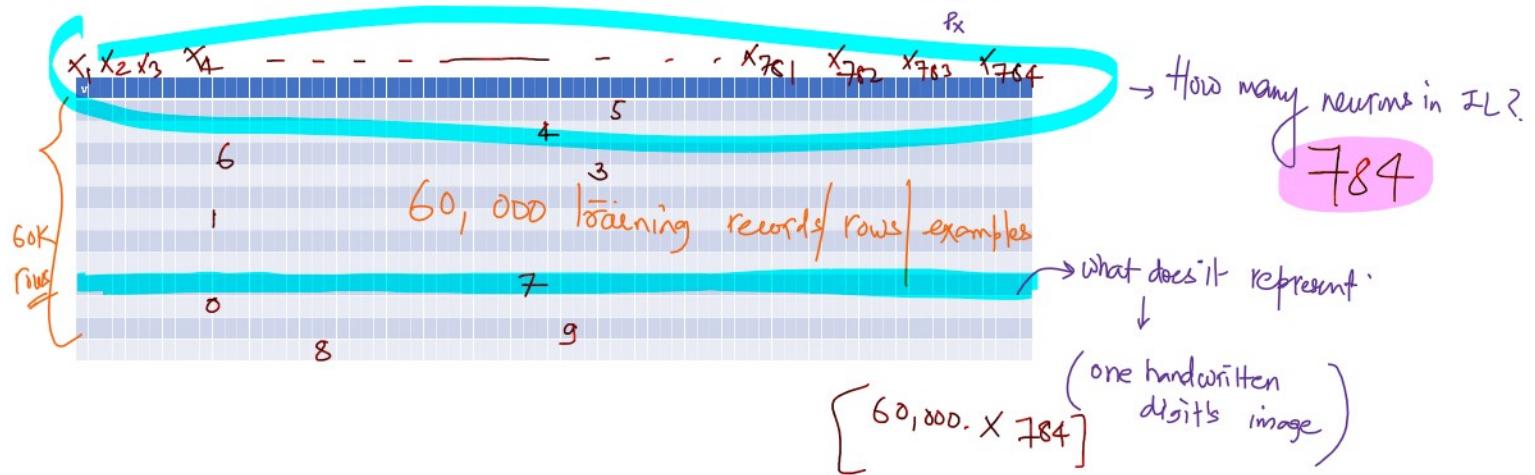
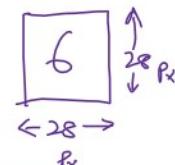
*1. No calculation is done in the input layer.

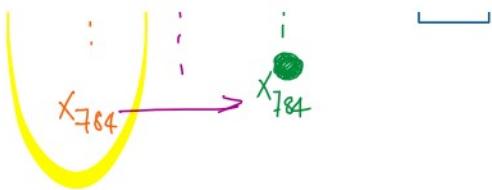
*2. No. of neurons in the input layer = no. of features in 1-D vector

no. of variables

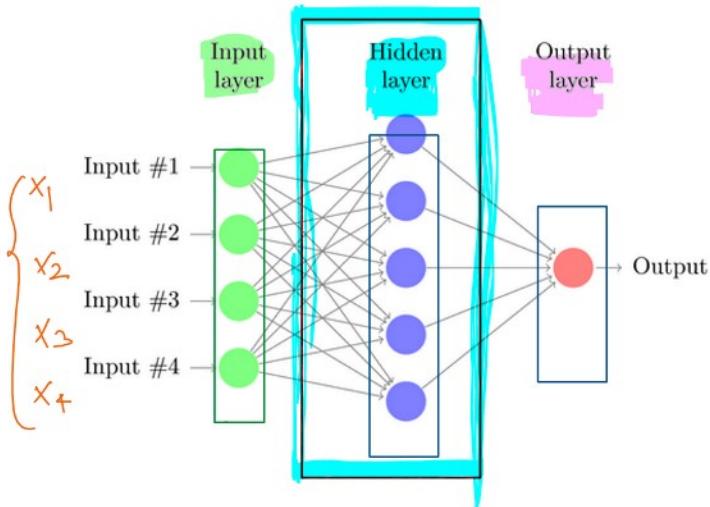
[+ variable is connected to + neuron in the input layer]

MNIST: In the training dataset $\approx 60,000 \rightarrow$ 60,000 handwritten digits
testing dataset $\approx 10,000$





2. Hidden Layer(s)

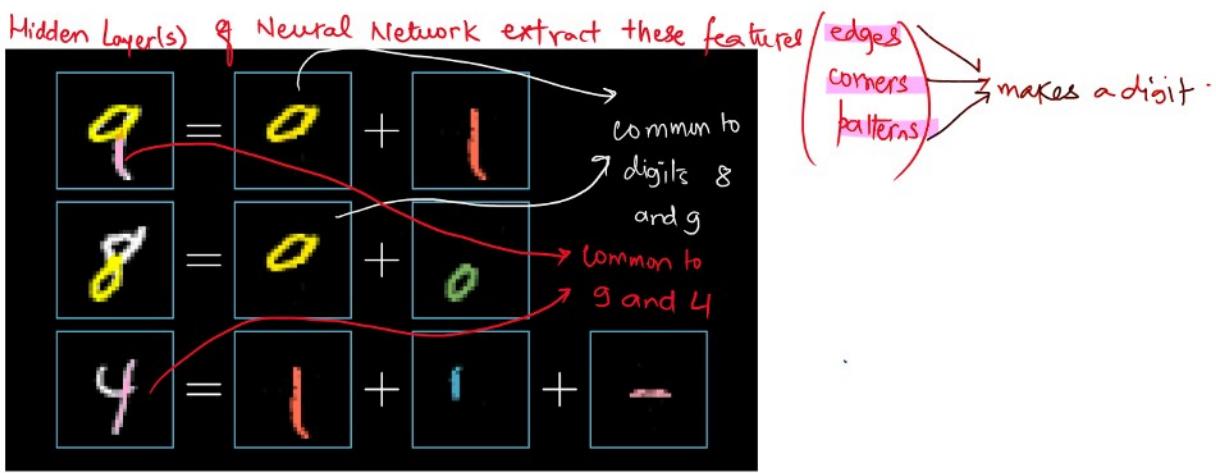


Why is hidden layer called so?

A hidden layer is called hidden because it is neither the part of the input layer nor the part of the output layer. Actually it exists between them and it performs complex computations which are not directly observable from the outside.

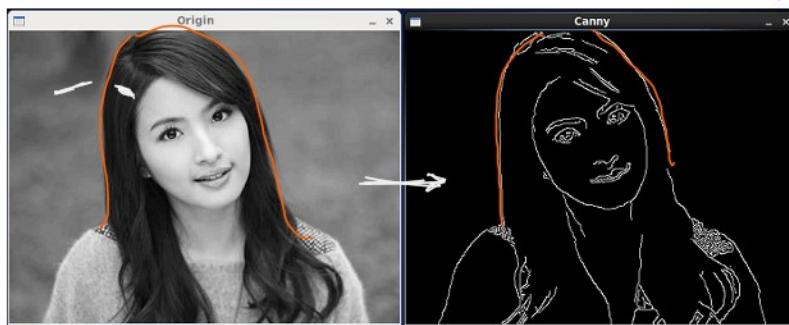
Note: We do not directly access the computations or activations inside the hidden layers hence, they are considered hidden.

- This is the second layer in the neural nw architecture diagram.
- Hidden layer can be one or many more: → minimum one HL is a must.



From <

Hidden layer is the most critical layer where most of the computation happens → allowing the model to learn representations and patterns from the data.



* Pro-tip

Feature Extraction

What do you mean by 'feature extraction' and how does ANN do it?

In the context of ANN, feature extraction refers to the process of automatically identifying the most important and relevant patterns, structures or signals in raw data that are useful for solving a specific problem

classification
regression.

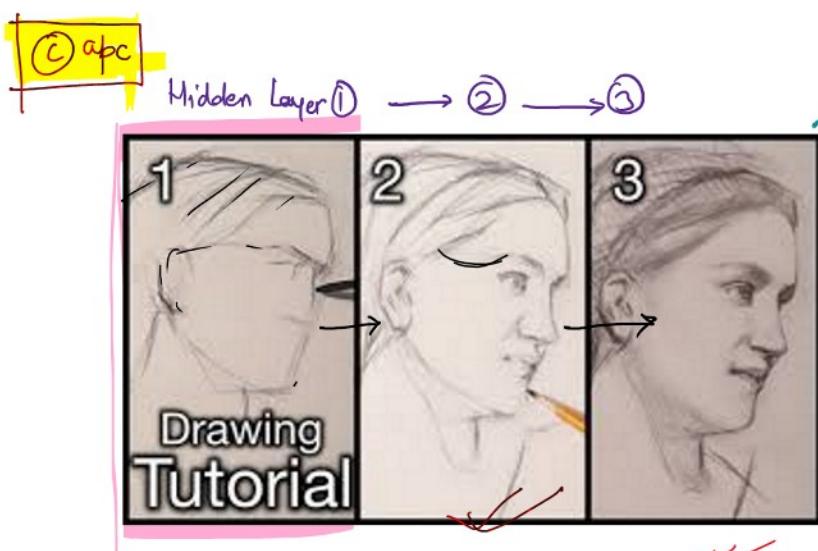
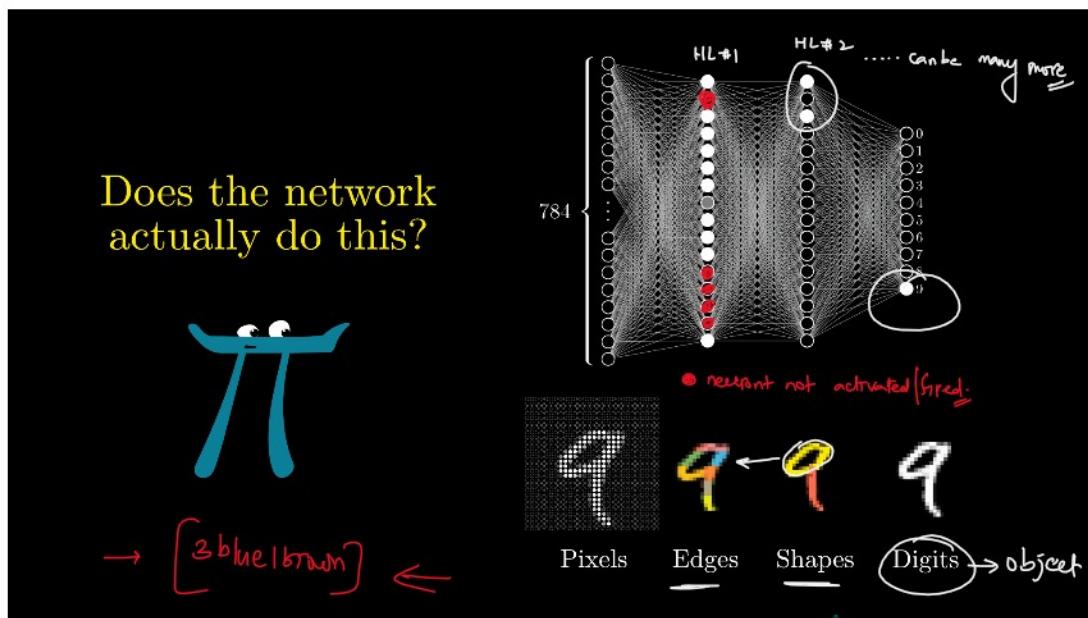
Feature extraction helps to identify important features – edges, corners, outlines and patterns in the training data which are not explicitly visible.

- Each successive hidden layer ...

- J v1.10/12
- Each successive hidden layer learns increasingly complex features

For example:

- Early hidden layers might detect edges or colors
- Middle hidden layers might detect shapes or textures
- Deeper hidden layers may identify objects or patterns. → 9 or 6



Output Layer

Output Layer

✓

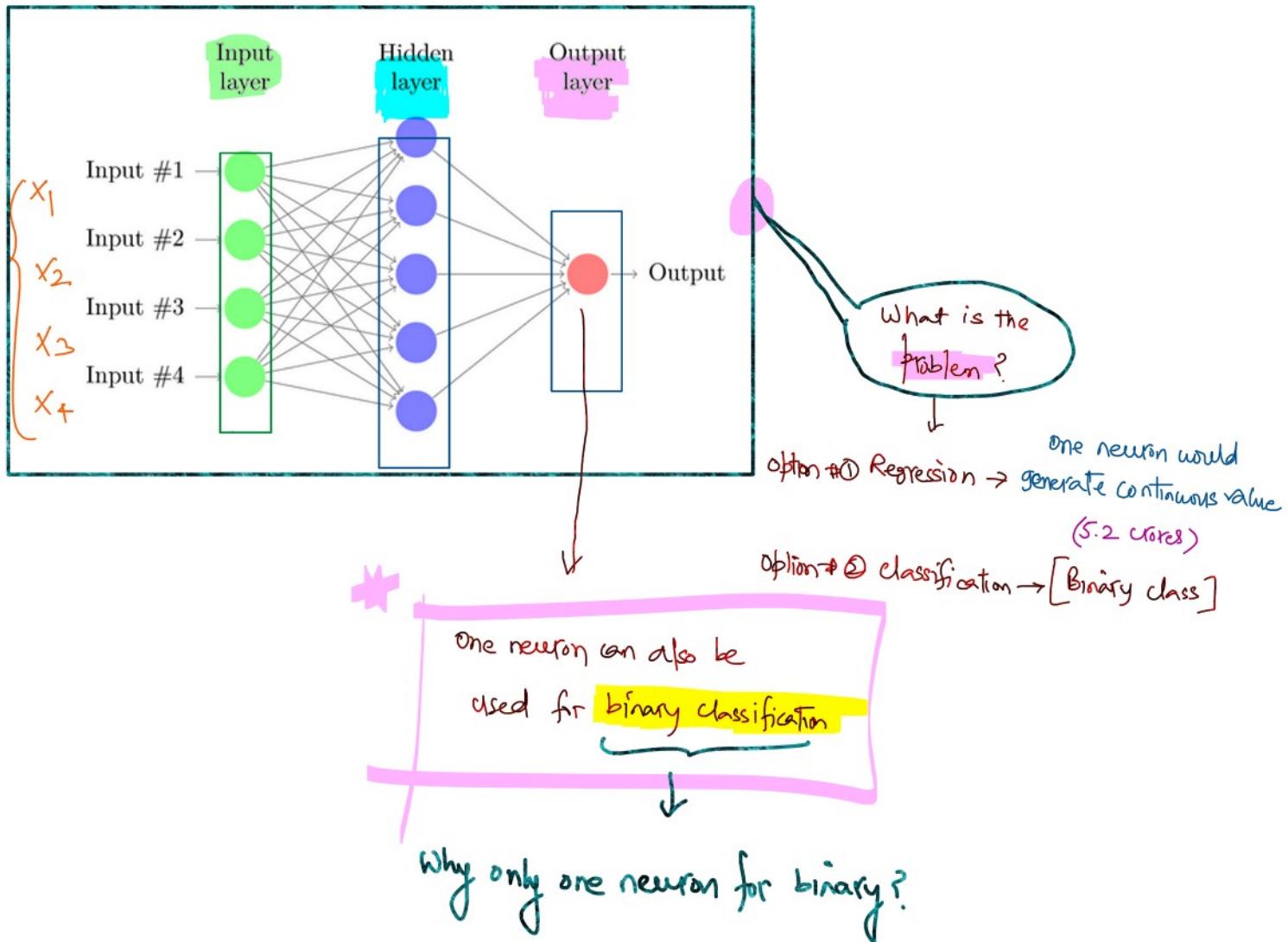
The final layer that produces the output for the neural network model.

Output can be a single value → single neuron → REGRESSION

or

multiple class

→ multiple neurons → CLASSIFICATION



- This neuron outputs a single probability value between (0 and 1) → using Sigmoid activation function

$$\text{output} \geq 0.5 \rightarrow \text{Class } \#1$$

output < 0.5 → class #0.

Multi-class → Softmax -