Machine Learning

Supervised machine learning →

↳ It is a type of machine learning which is deal with label data.

↳ It solve two type of problems.

① Regression based problem

② classification based problem

Label data

↳ two type of feature

Input feature

or

independent feature

output feature

or

dependent feature

or

Target value

eg - package prediction

Cgpa	package
10	9.5
9	8.6
7	5.5
7.5	6.0

Regression based problem

↳ In this problem the output feature data type is continous form

ex - age, weight, package prediction, house price prediction

⇒ Machine learning algorithm solved regression based problem

1. linear regression
2. Ridge regression
3. Lasso regression
4. Support vector regression

⑤ decision tree regression

⑥ Random forest regression

⇒ classification based problem

↳ this type problem, output feature is discrete form.

① Result prediction

Marks	Result
90	P → 1
30	F → 0
45	P → 1
22	F → 0

② Mail spam detection

③ disease prediction

④ Image classification

unsupervised machine learning

↳ It is a type of ML which deals with unlabeled data type

↳ It is used to solve the following type of problem.

1. clustering → grouping — customer segmentation
2. dimensional reduction
3. Anomaly detection
4. Association

Problem

↳ House price prediction

no. of bedroom

no. of washroom

Total Area

unsupervised machine learning algorithm

1. K-means
2. DBSCAN
3. principle component analysis (PCA)

Supervised ML algorithm solved classification based problem.

1. linear regression
2. support vector classification
3. Decision tree classification
4. Random forest classification

- Linear regression →

↳ It is supervised ML, solved regression based problem.

↳ There are three type of linear regression-

① Simple linear regression

$(y = mx + b)$

② multiple linear regression

$(y = m_1 x_1 + m_2 x_2 + b)$

③ polynomial linear regression

$(y = \beta_0 + \beta_1 x_1 + \beta_2 x_1^2)$

data 200 row

↳ data point

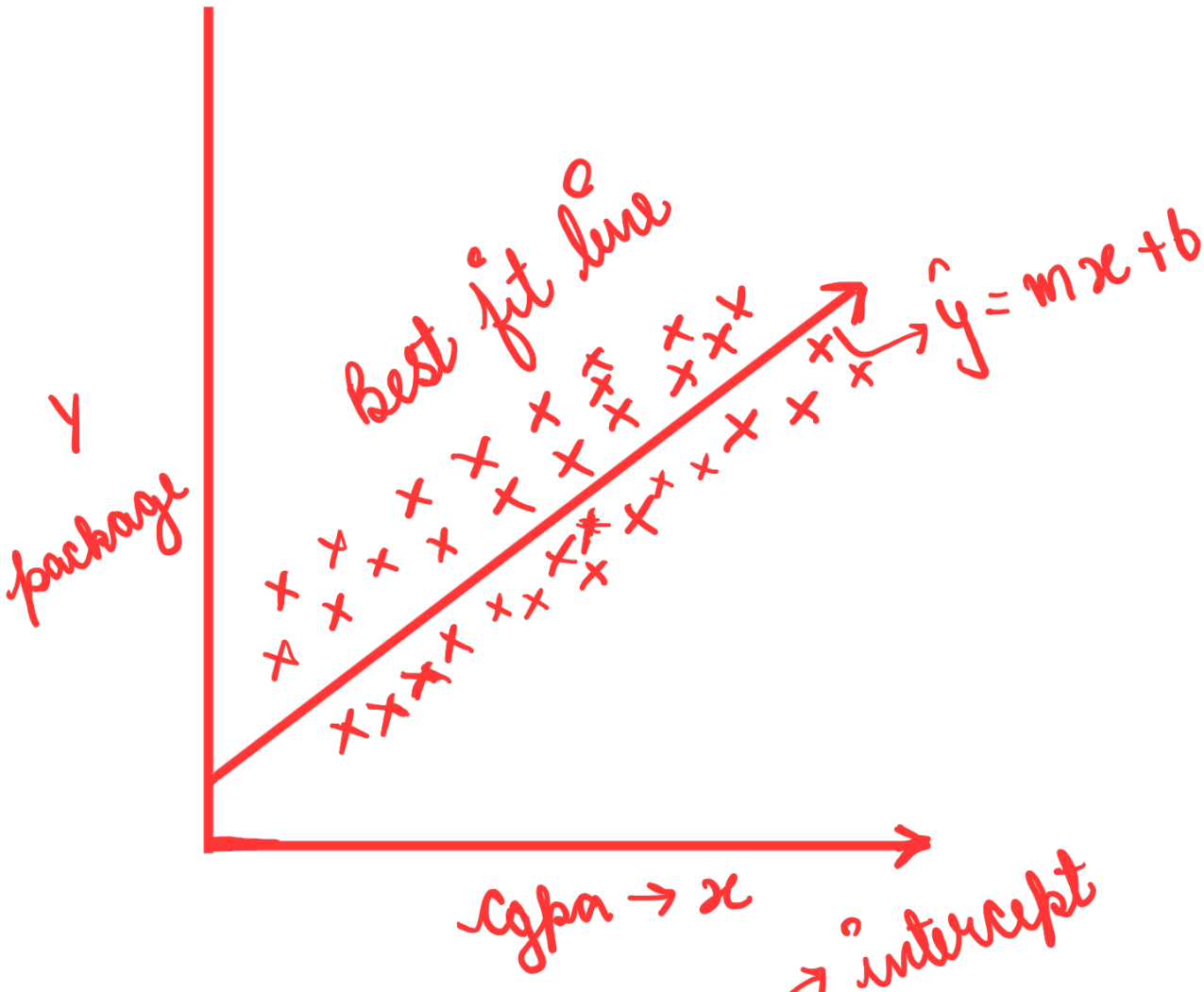
x	y
Cgpa	package
10	7.5
9.5	7
8.5	6.5
7.0	5.5
6	4.5
-	-
-	-
-	-
-	-

cgpa (x) = 9.5

package = ?

simple linear regression

↳ $y = mx + b$



intercept

$$b = \bar{y} - m\bar{x}$$

coefficient

$$m = \frac{\sum_{i=1}^{n} (x_i - \bar{x})(y_i - \bar{y})}{\sum_{i=1}^{n} (x_i - \bar{x})^2}$$

$\bar{y}$ = mean of package

$\bar{x}$ = mean of cgpa

y_i = package

x_i = cgpa

deep learning - It is sub field of AI and ML. It is the structure of deep learning inspired by human brain.

DL - logical structure

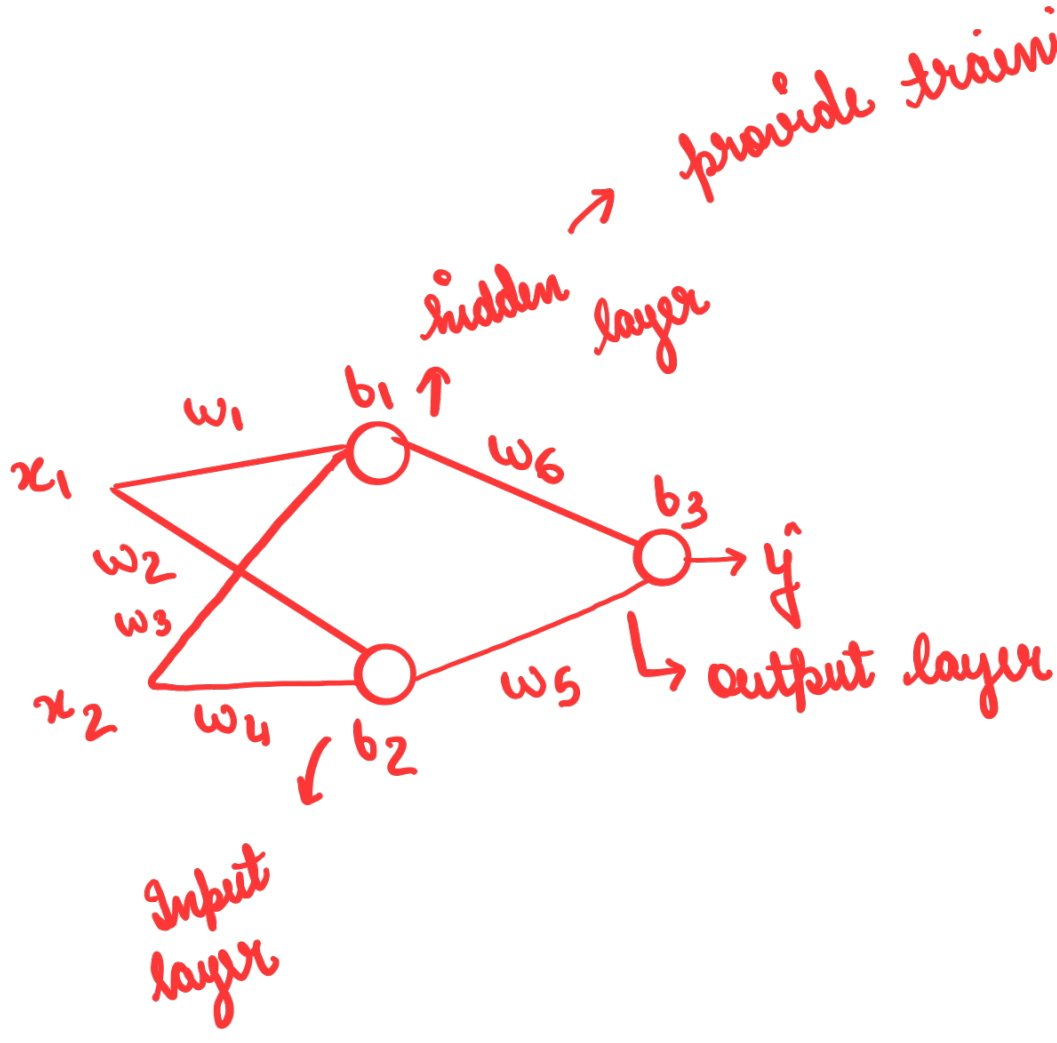
↳ neural network

ex - placement prediction

x_1 Cgpa	x_2 iq	y placement (actual value)
10	100	1 → placed
4	70	0 → not placed

$\hat{y}$ ↓ predicted value

ANN → Artifical neural network



$w_1, w_2, w_3, w_4, w_5, w_6$

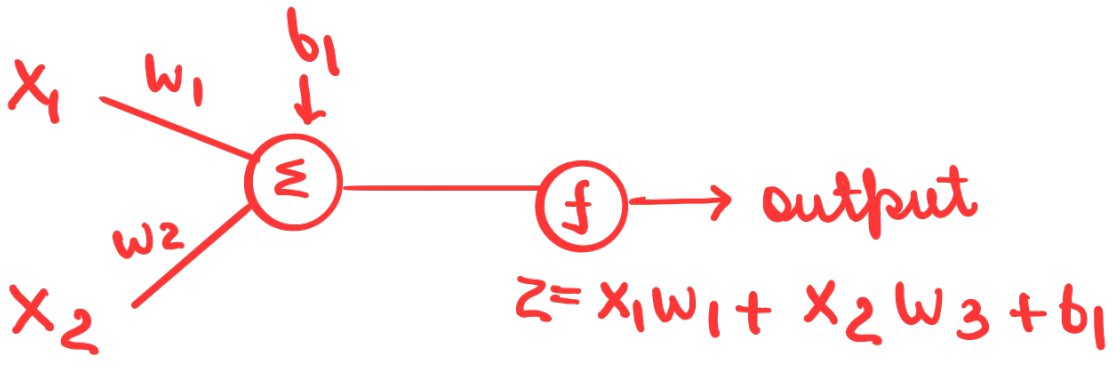
b_1, b_2, b_3

} learnable parameter

O → neuron or perception

perceptron → ① It is a algorithm or set of rules.

② In perceptron, first recieve input, then this input multiply by weight and add bias then applied activation function.



step function

↓

one type of activation function

$$O_1 = f(z) \begin{cases} z \geq 0, & O_1 = 1 \\ z < 0, & O_2 = 0 \end{cases}$$

3. due to design, perceptron is building block of deep learning.

4. It is behave as supervised learning.

Activation function - It is mathematical function, which determine the output of neuron.

It is represent the non-linearity of the model.

Types of Activation function

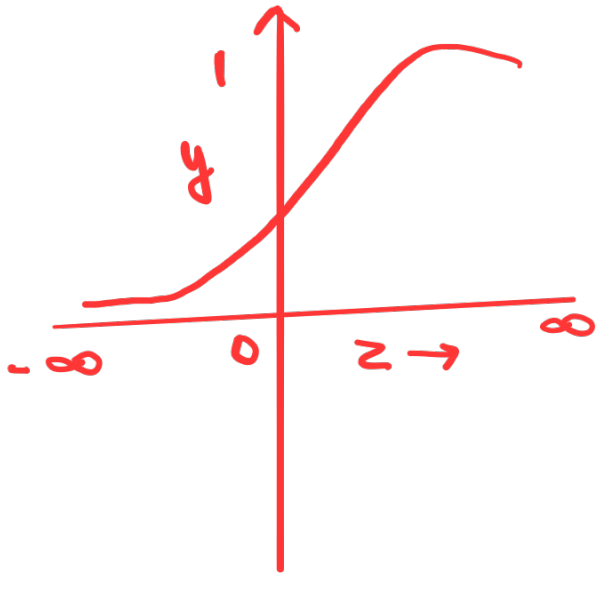
① Sigmoid activation function

↳ It is work on output layer in Binary classification based problem.

$$Y = \sigma(z) = \frac{1}{1+e^{-z}}$$

Range ↳ (0 to 1)

Domain → z → $(-1, \infty)$



↑ hyperbolic tangent

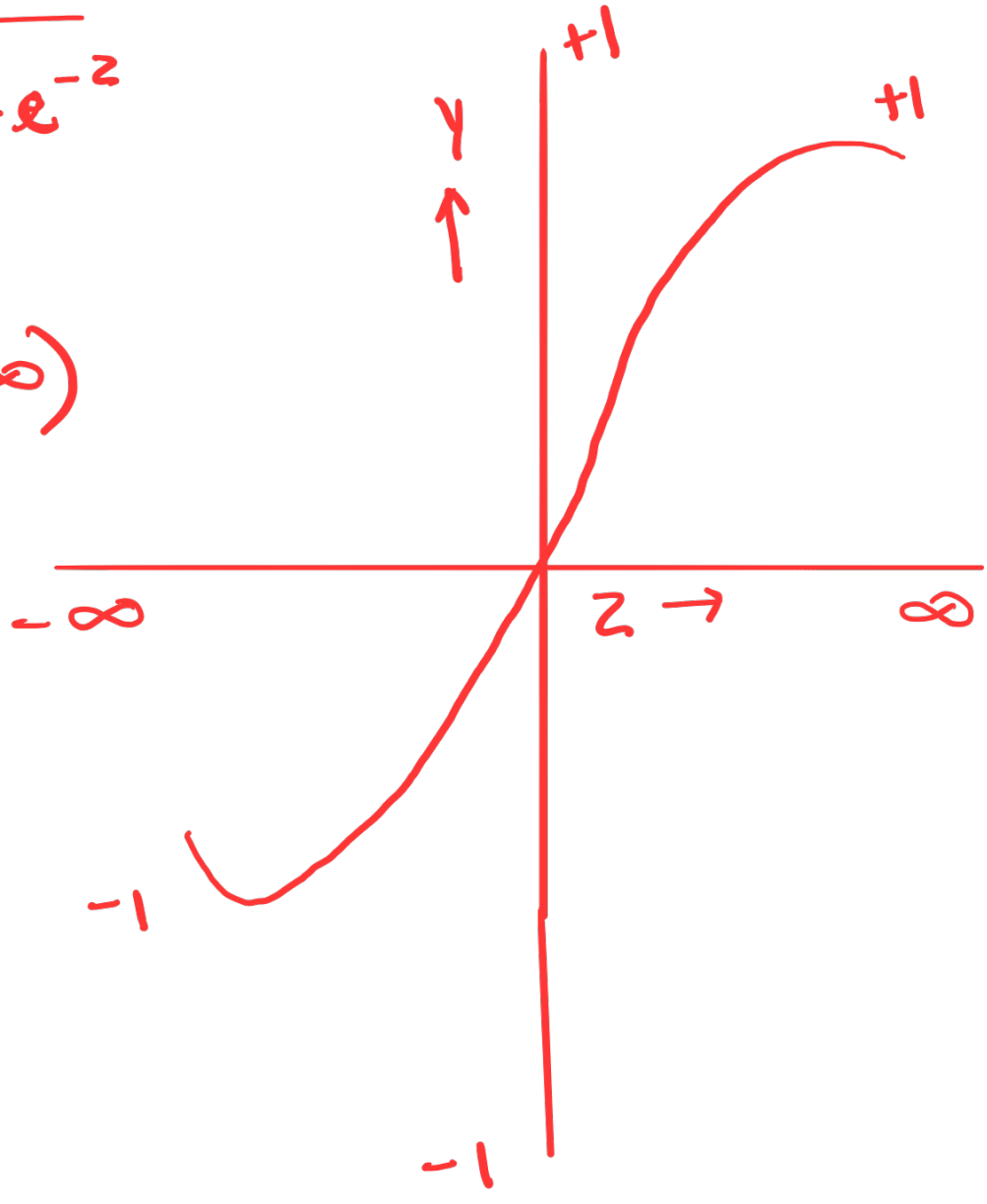
Tan h activation function

$$Y = \frac{e^{z} - e^{-z}}{e^{z} + e^{-z}}$$

↓

(-1 to 1)

$z = (-\infty, \infty)$



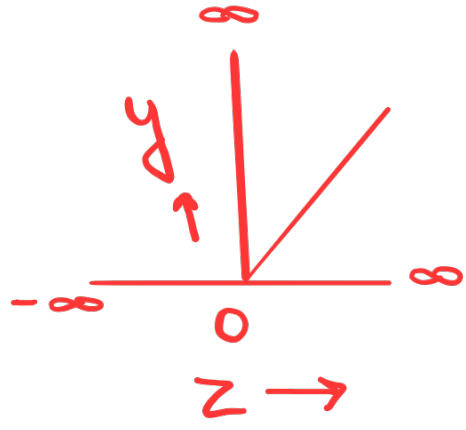
Relu activation function

$y = \max(0, z)$

↓

0 to ∞

$z = -\infty$ to ∞



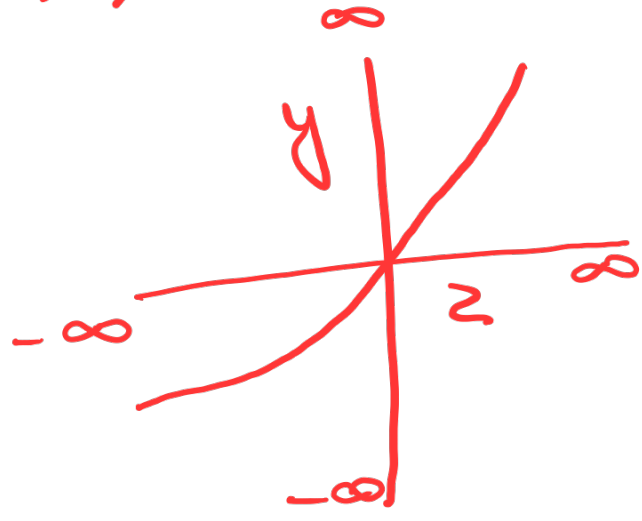
Leaky relu activation function

↳ solve dead neuron problem

$y = \max(0.01z, z)$

↳ $-\infty$ to ∞

$z = -\infty$ to ∞

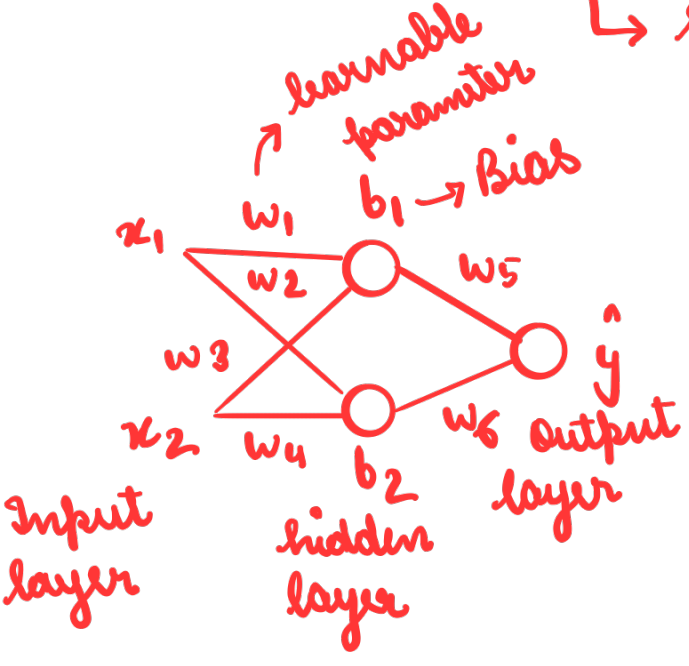


ex → placement prediction

x_1 Cgpa	x_2 iq	y placed
10	120	1
5	80	0

ANN → Artifical neural network

↳ simple neural network



If your problem Binary classification based then we use sigmoid activation function

multiclassification

↳ Softmax activation function

Total Trainable parameter →

$2 \times 2 = 4$ W

$= 2$ b

6 TP

$2 \times 1 = 2$ W

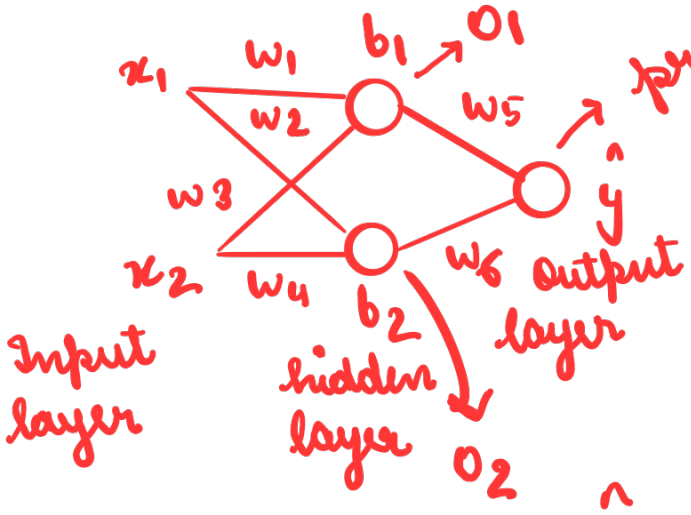
$= 1$ b

3 TP

$\Rightarrow$ 9 TP

Forward Propagation-

↳ We look 'input they multiply by weight, add bias and apply activation function, till end of the neural network



$$z_1 = x_1 w_1 + x_2 w_3 + b_1$$

$$o_1 = f(z_1)$$

$$z_2 = x_1 w_2 + x_2 w_4 + b_2$$

$$o_2 = f(z_2)$$

$$z_3 = o_1 w_5 + o_2 \times w_6 + b_3$$

$$\hat{y} = \sigma(z_3)$$

Predicted value = $y - \hat{y}$

$f \rightarrow$ relu activation function

$\sigma \rightarrow$ Sigmoid activation function

Predict value

↳ It is a mathematical function that measure how well a model's prediction match the actual value.

→ Loss function in Regression based problem

① Mean squared error (MSE)

$$MSE = \frac{\sum_{i=1}^{n} (y_i - \hat{y}_i)}{n}$$

$y_i \rightarrow$ actual value

$\hat{y}_i \rightarrow$ predicted value

$n \rightarrow$ number of data points.

② Mean absolute error (MAE)

$$MAE = \frac{\sum_{i=1}^{n} |y_i - \hat{y}_i|}{n}$$

→ Loss function in classification based problem
↳ Binary classification

① Binary cross entropy -

$$-\frac{1}{n}\sum_{i=1}^{n} y_i \log(\hat{y_i}) + (1-y_i)\log(1-\hat{y_i})$$

② categorical cross entropy -
↳ multiclassification

$$-\frac{1}{n}\sum_{i=1}^{n}\sum_{i=1}^{K} y_K \log(\hat{y_K})$$

y_i → actual value

$\hat{y_i}$ → predicted value

n → number of data points.

K → number of class

Backward propagation

↳ It is gradient estimation method commonly used for training a neural network to compute its parameter update.

$$L = (y - \hat{y})$$

weight updation formula →

$$W_{new} = W_{old} - \eta \frac{\partial L}{\partial W_{old}}$$

$$W_{5\,new} = W_5 - \eta \frac{\partial L}{\partial W_5}$$

Bias updation formula →

$$b_{new} = b_{old} - \eta \frac{\partial L}{\partial B_{old}}$$

$\eta \rightarrow$ learning rate

↳ 0.01 - 0.001

↳ A type of hyper parameter that can be changed via programmer.

→ overview of neural network

ANN - Artifical neural network or multilayer perception

↳ data - Tabular data

↳ Table

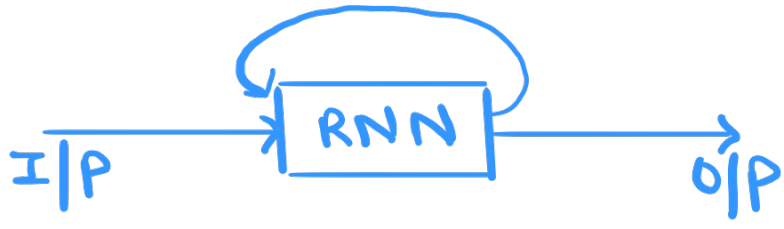
↳ rows and column

RNN - Recurrent neural network

↳ sequential data

↳ Text

↳ Time series data

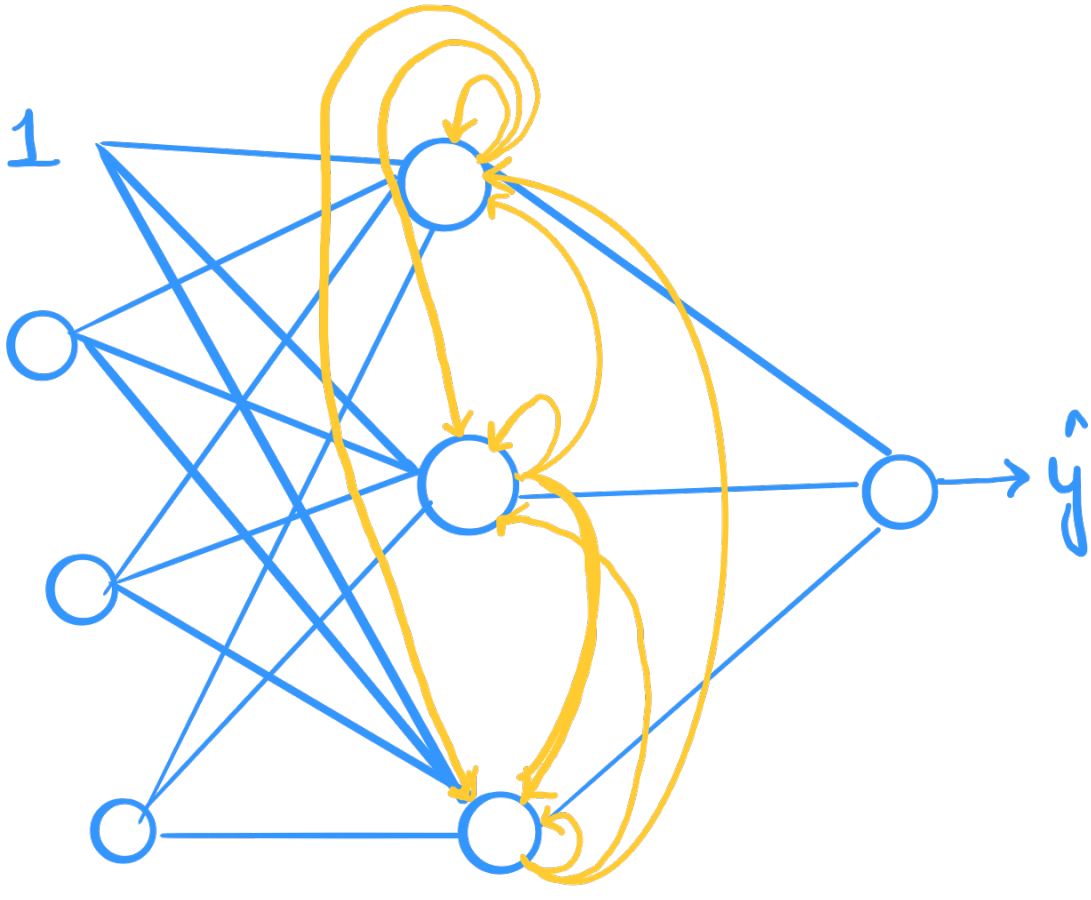


eg - Text, Time series

NLP – Sentiment analysis

movie was good	1
movie was Bad	0

	movie	was	good	bad
movie →	1	0	0	0
was →	0	1	0	0
good →	0	0	1	0
Bad →	0	0	0	1



$4 \times 3 = 12$ w

$3 \times 3 = 9$ w

$= 3$ b

---

24 TP

$24 + 4 = 28$ TP

$3 \times 1 = 3$ w

$= 1$ b

---

4 TP

CNN → convolutional neural network

↳ deal with Image

① convolutional layers

② pooling layers

③ feed forward layers

collection of pixel

↳ □