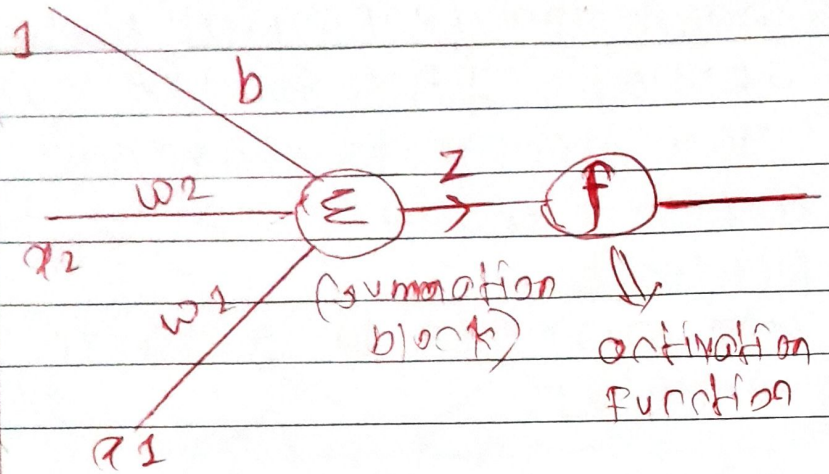
Perceptron

What is perceptron ?

- perceptron is a algorithm, used in supervised machine learning. It has a single design it becomes building block of deep learning.

- So, design of perceptron,



- perceptron is a model but we can call it mathematical model, you can call it mathematical function.

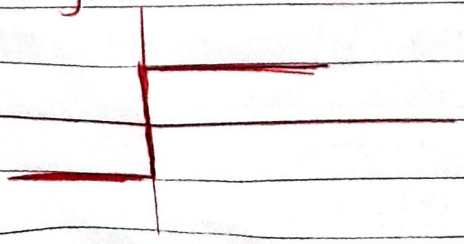
Input provided from this port

- connection of this weights and biases to summation block
- x_2 through connection, x_1 through connection } weights
  1 through connection } biases
- At summation block, this operation happens. ⟹ Dot product.

$$x_1 . w_1 + x_2 . w_2 + b = z$$

- This 'z' value goes to activation function, Activation function work is given 'z' & its range might be -1 to 1 or anything.

- e.g. of activation function is step function.



- if z value gretter or equal to then output is 1.
- if $z < 0$ then 0.

How we use this design?

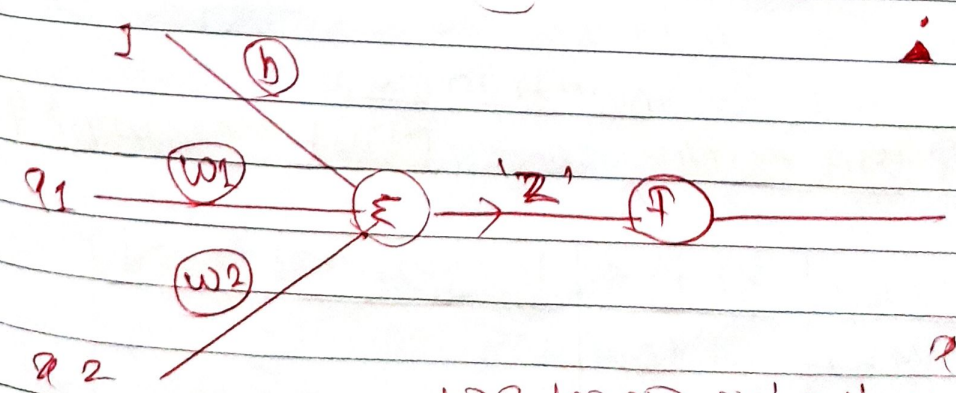
- Let's take a small problem, We have 1000 student data

id	cgpa	placement (Y/N)
79	7.8	1
69	5.5	0
804	7.9	1
80	6.0	0

- To predict something or to form ocal building we have to do two things,

i) Training
ii) Prediction

- In here in perceptron too, we have to do above two things.



- We pass row by row value, for first row, q1 becomes 79 q2 becomes 7.8 we know output while training, so we can find weights w1, w2 or b

We find this value's w1, w2 and b, this is core idea of training

- After training and after finding w1, w2 & b value we can predict
- Let's say,

$w_1 = 5.1$
$w_2 = 2$
$b = 3$

- Now predict on new row, basically new student with iq '100' and cgpa '7.8' we have to predict placement (Y/N).

iq => 100
cgpa => 5.1

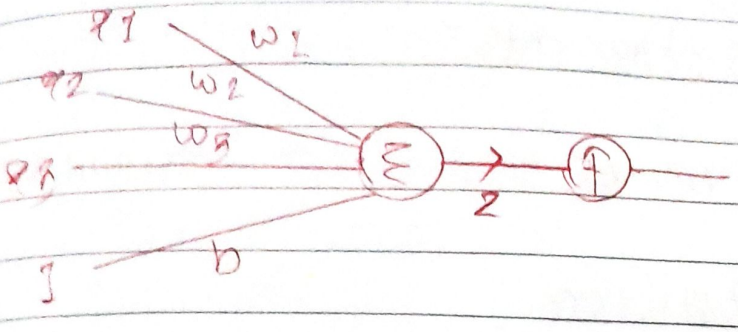
- Now, we calculate this,

$100 \cdot 1 + 5.1 + 2 + 3 = 113.2$

- 'z' value को हम activation function में डालेंगे तो simple $z \geq 0$ then output will be 1.

What if we have more than two input columns?

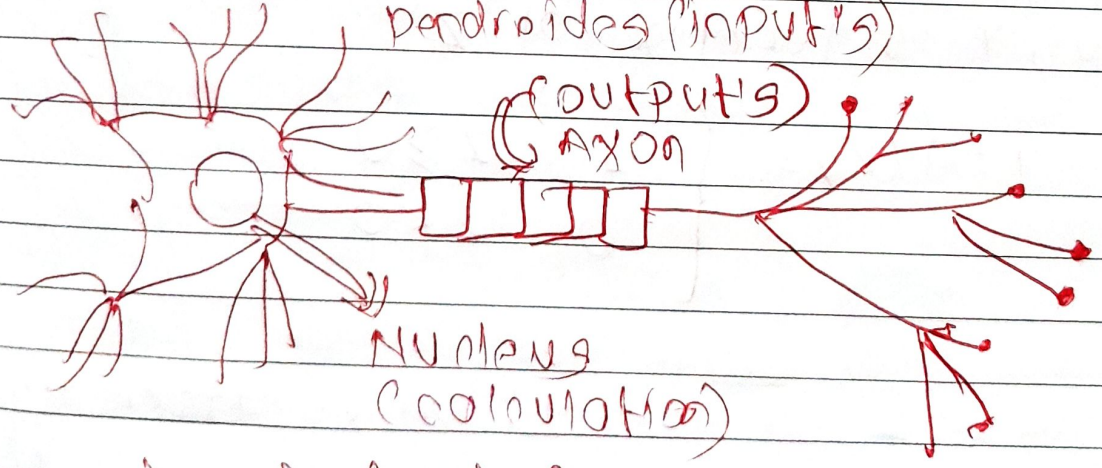
iq (x_1)	cgpa (x_2)	state (x_3)	Placement (Y/N)



- Everything is similar just add weight to new feature.

- One thing about deep learning, it's heavily inspired by human nervous system

Neuron vs Perceptron



- हम बोला देखो बोली बहुत similarities है.

Interpretation

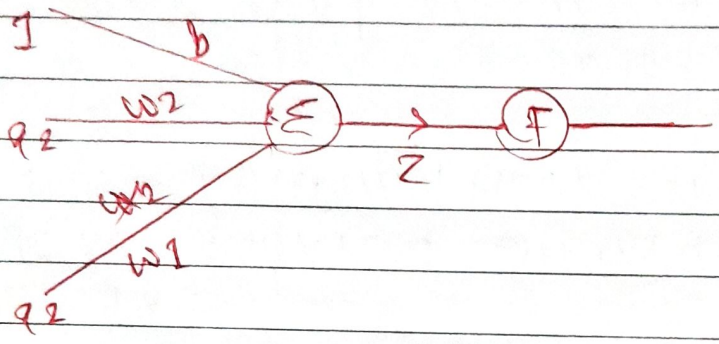
We get values of w1, w2 and b after training

Weights actually, tells interpretation about

connection and strength.

- So, weights give us feature importance.

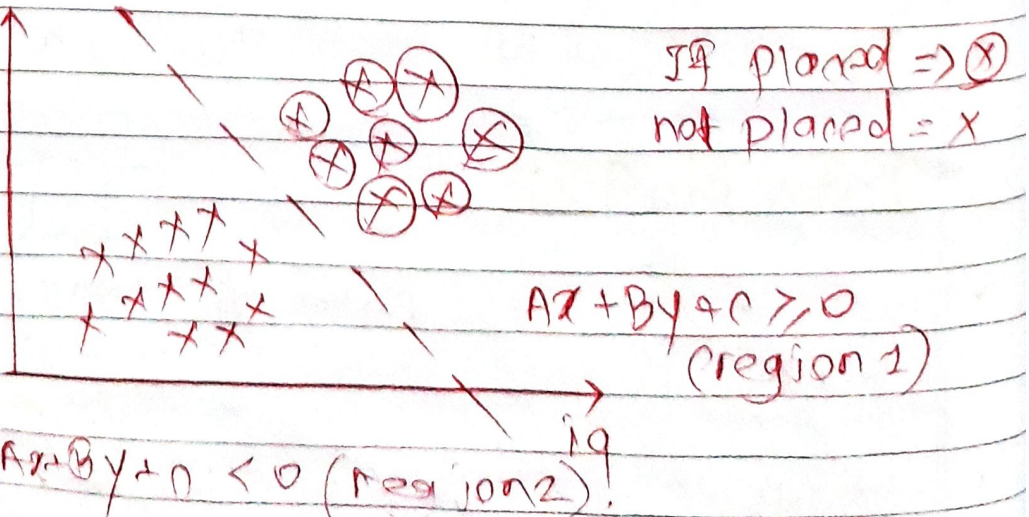
Geometric intuition



- Y is 0 or 1 based on 'z' value
- So, Y is function of 'z'

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

- Now plot our dataset on x scatter plot.



- Replace, $w1 \Rightarrow A$,
  $w2 = B$,
  $b = C$
  $x1 = x$
  $x2 = y$

$Ax + By + C = z$ this is equation of line, perceptron is nothing but line.

$Ax + By + C\ (z) \geq 0 \Rightarrow 1$
$Ax + By + C\ (z) < 0 \Rightarrow 0$

} this are region's both of this equations.

- In nutshell, perceptron is line basically it creates region
- Thats why perceptron is binary classifier.
  If we have three feature,
- In three features perceptron is plane

In short,
2 d perceptron ant as line
3 d perceptron ant as plane.
4 d onward ant as hyperplanes.

- Limitation is perceptron assume data is linear sort of linear.