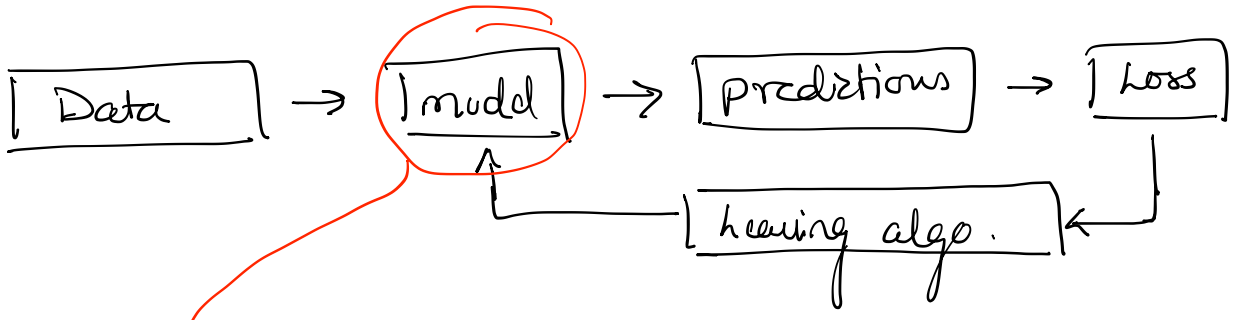


AI / ML / DL

- SVM
- RFs
- DTs
- ⋮

ANN

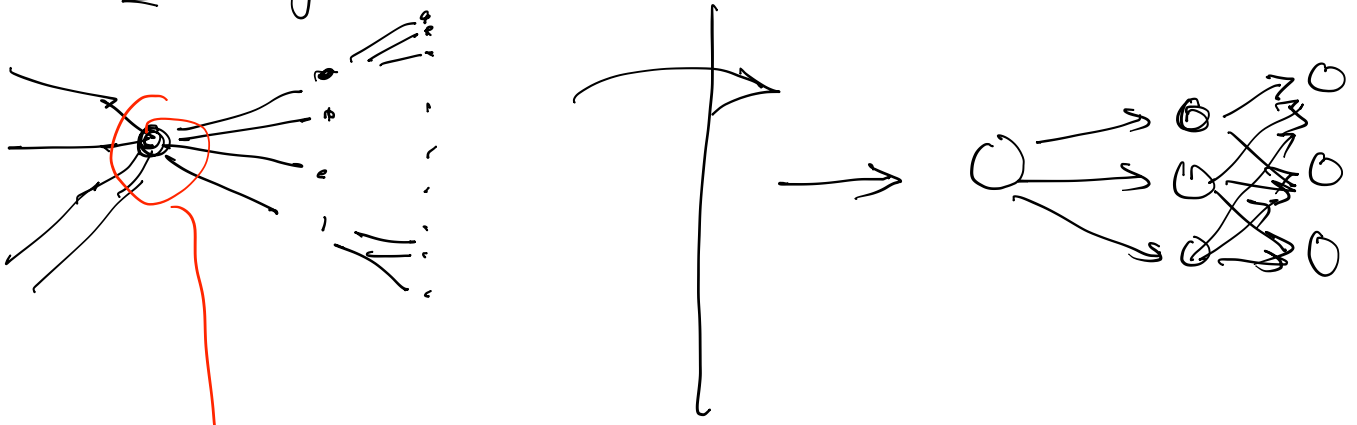
- Fully connected
- Convolution NN
- LSTMs
- GRUs
- ⋮

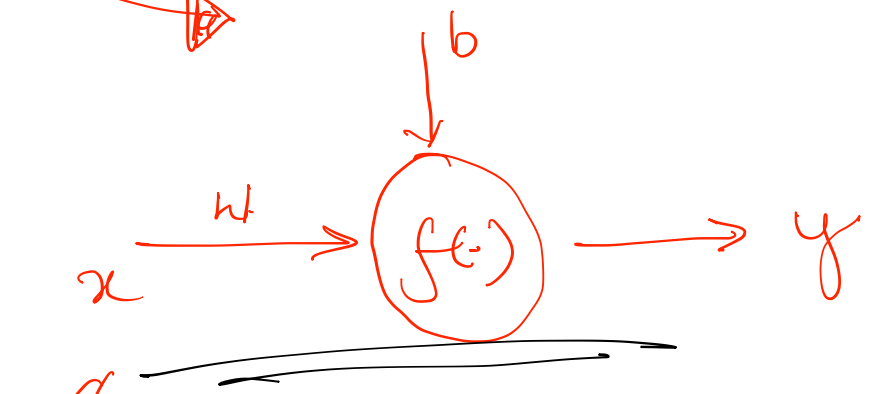
Basic element of ANN: Preceptron

or

Neuron

biological neurons





without b

$$y = f(wx)$$

$$y = f(wx + b)$$

$$\boxed{y = mx + c} \quad (\text{if } f = I(\cdot))$$

$$y = f(wx + w_0 \cdot 1)$$

$$= f(\underline{w}^T \underline{x})$$

column vectors.

$$= f\left(\begin{bmatrix} w & w_0 \end{bmatrix} \begin{bmatrix} x \\ 1 \end{bmatrix}\right)$$

f = activation fn. ⇒ Introducing non linearity

$y = wx + b$ → ✓ lin. eqn.

→ Linear system ? No.

System: $y = f(x)$

Homogeneity ✓

$y_1 = f(x_1)$

$y_2 = f(x_2)$

$x_2 = a \cdot x_1$

If $y_2 = a \cdot y_1$

Superposition ✓

$y_1 = f(x_1)$

$y_2 = f(x_2)$

$x_3 = x_1 + x_2$

$y_3 = y_1 + y_2 = f(x_1) + f(x_2)$

$= f(x_1 + x_2)$

$= f(x_3)$

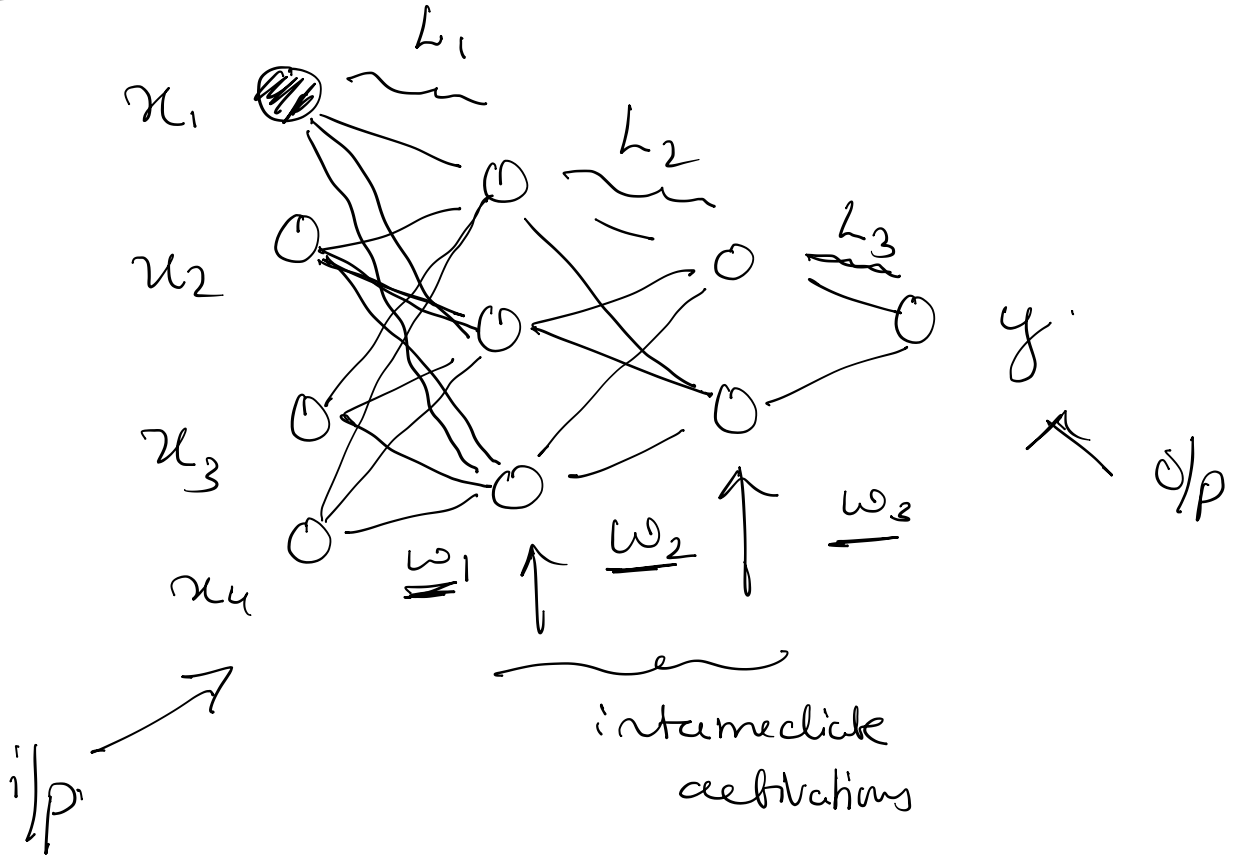
$y = wx + b$ → $y_2 \neq a \cdot y_1$ → $y_3 \neq y_1 + y_2$

↳ due to bias term

(1) Activation fn "f" → makes y a nonlinear eqn.
→ makes 'y' as non-linear system.

(2) bias term 'b' → makes 'y' as non-linear system.

MLP:-

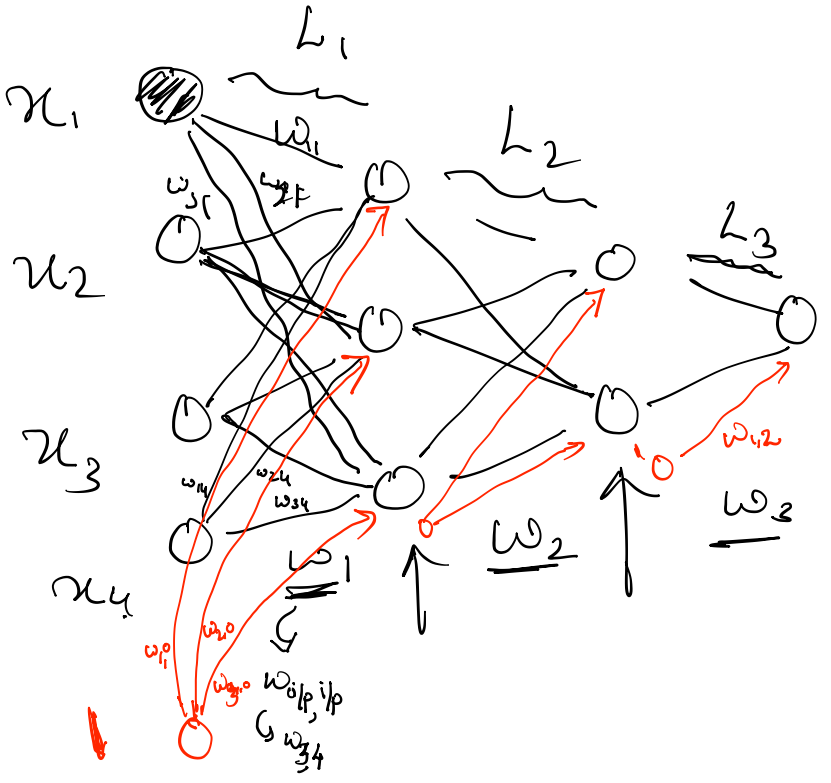


$$\underline{W} = [\underline{w_1} \quad \underline{w_2} \quad \underline{w_3}]$$

$$X = [x_1 \; x_2 \; x_3 \; x_4]^T$$

$$y = \underline{W}^T X$$

#parameters ⇒ Model



⇒ fully connected n/w.

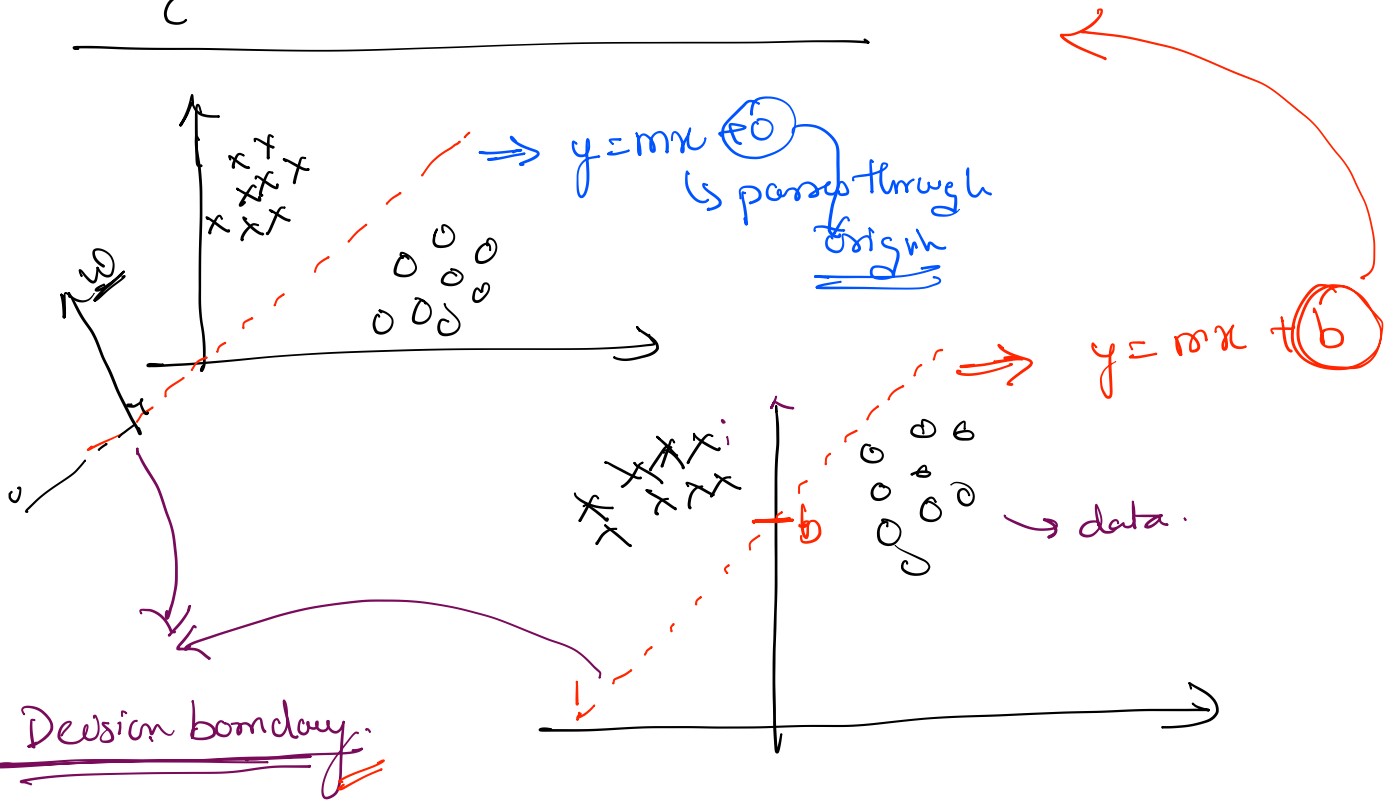
	L_1			L_2			L_3		
	i/p	o/p	w_1	i/p	o/p	w_2	i/p	o/p	w_3
w/o bias	4	3	12	3	2	6	2	1	2
with bias	4	3	4×3 +3 =15	3	2	3×2 +2 =8	2	1	2×1 +1 =3

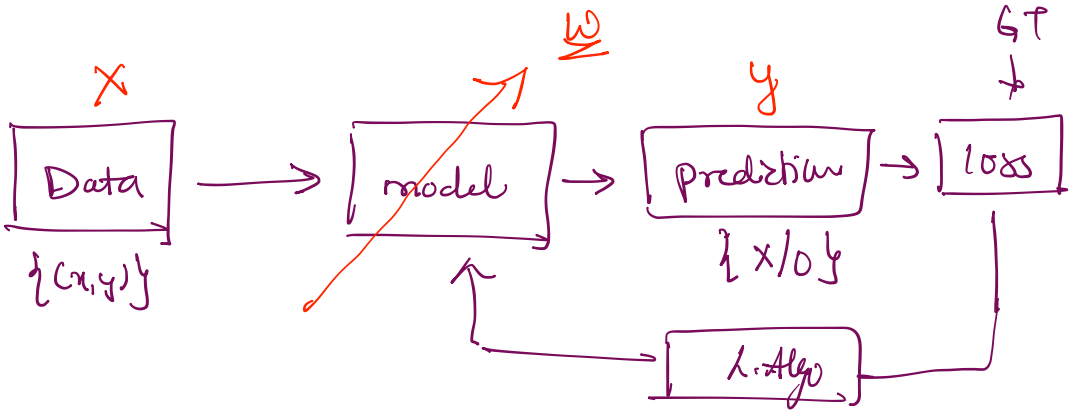
12+6+2 = 20

15+8+3 = 26

↳ # params for an Act. f^n $\Rightarrow 0$.

Why do we need bias term?





$y = w^T x$

$y(x,y)$ on the line

$y = 0$

$w^T x = 0$

$w \perp$ decision boundary.

→ How is w related to decision boundary