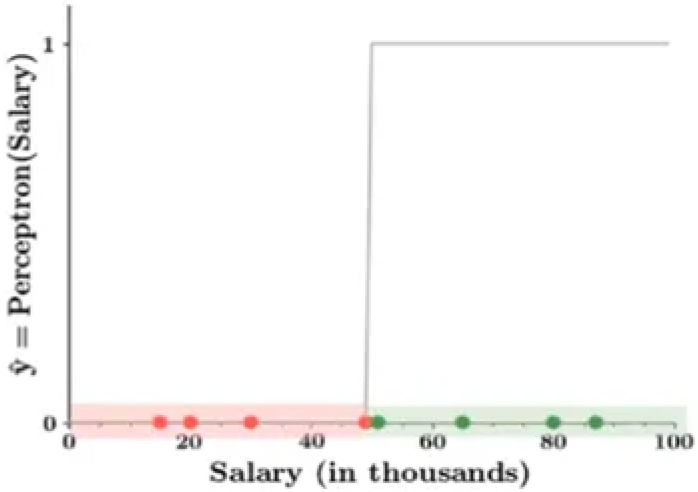
Deep Learning : Sigmoid Neuron

राष्ट्रीय प्रौद्योगिकी संस्थान सिक्किम
NATIONAL INSTITUTE OF TECHNOLOGY SIKKIM

Course Instructor:
Dr. Bam Bahadur Sinha
Assistant Professor
Computer Science & Engineering
National Institute of Technology Sikkim

Why Sigmoid Neuron?

Salary (in thousands)	Can buy a car?
80	1
20	0
65	1
15	0
30	0
49	0
51	1
87	1

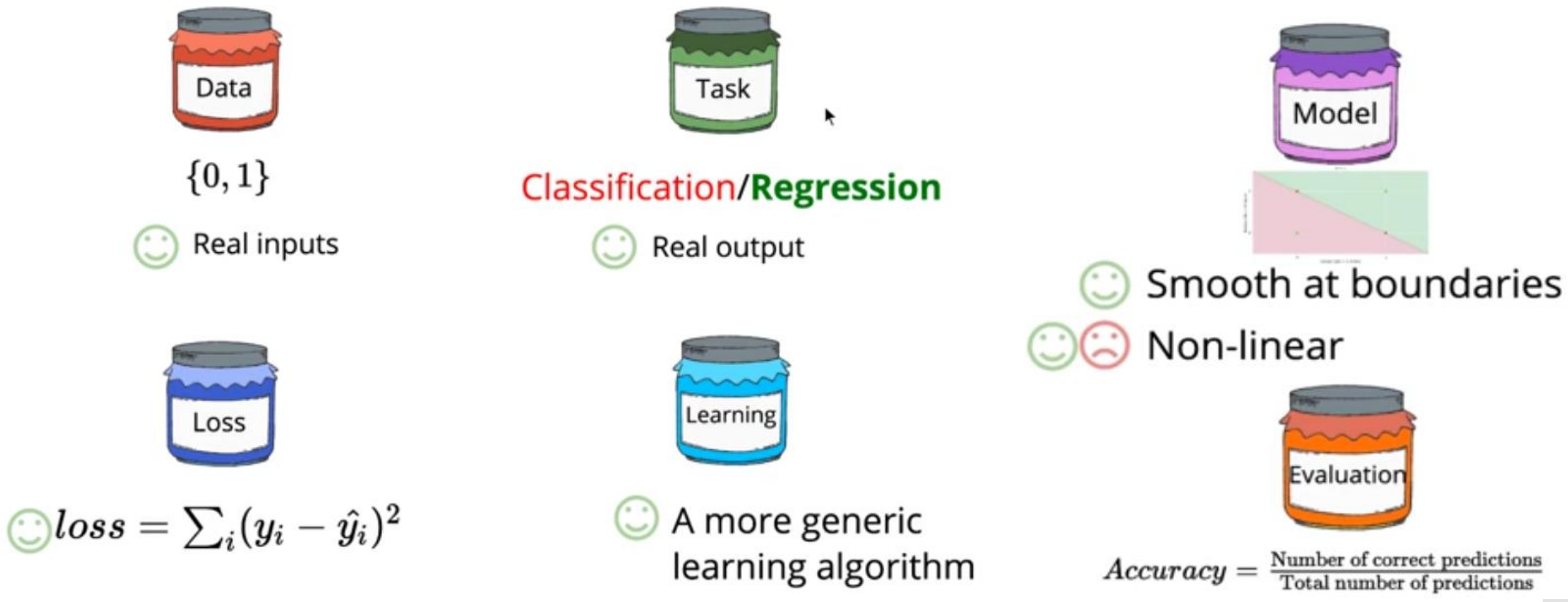


Small change in the input to a perceptron can sometimes cause the output to completely flip from **0** to **1**.

To overcome

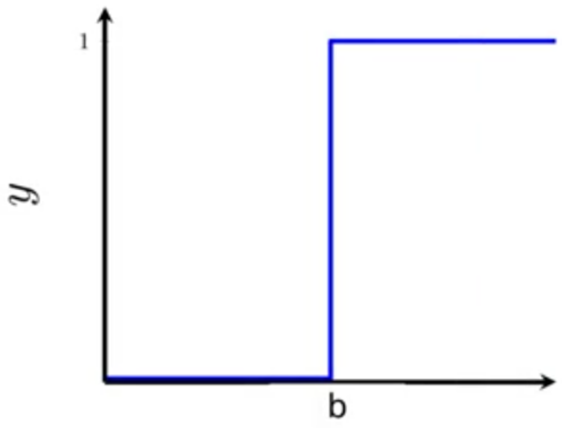
Sigmoid Neuron
(smooth boundary decisions)

Sigmoid Neuron

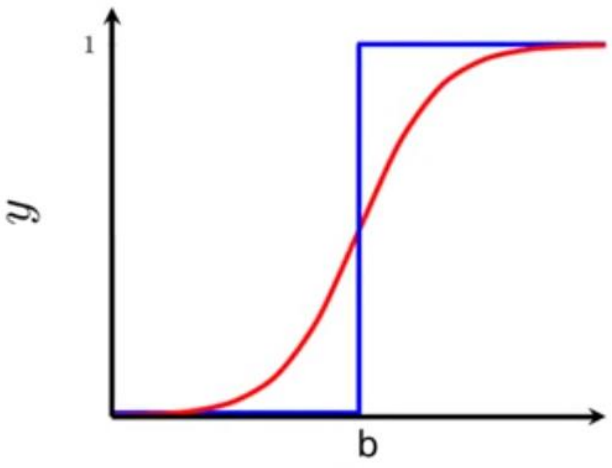


RMSE

Can we have a smoother (not-so-harsh) function?

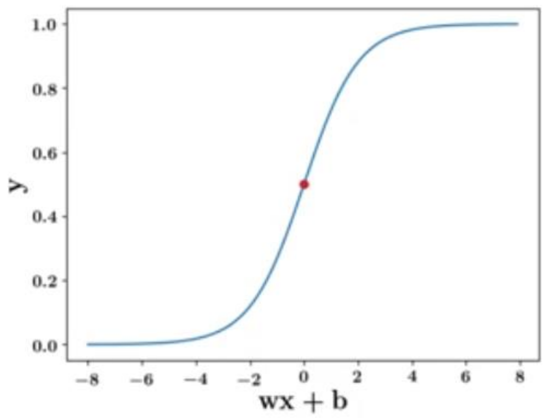


$\sum_{i=1}^{n} w_i x_i$

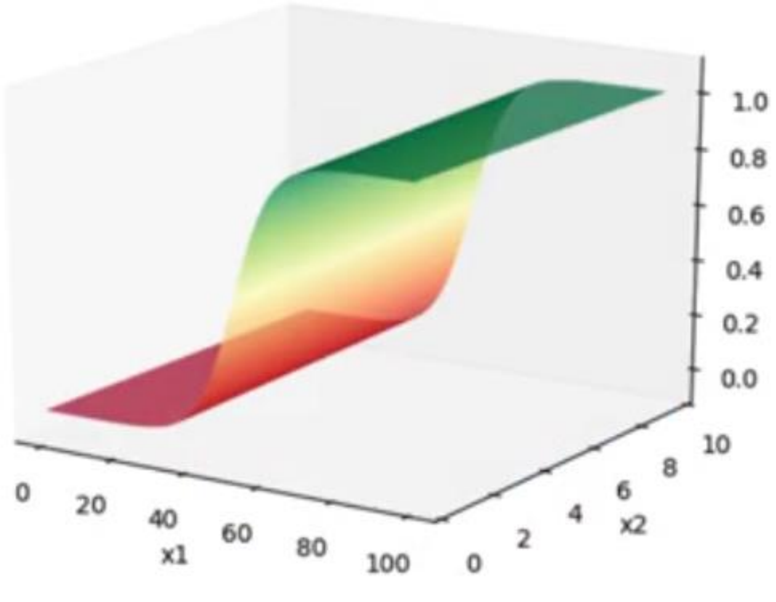


$\sum_{i=1}^{n} w_i x_i$

$$y = \frac{1}{1 + e^{-(wx+b)}}$$

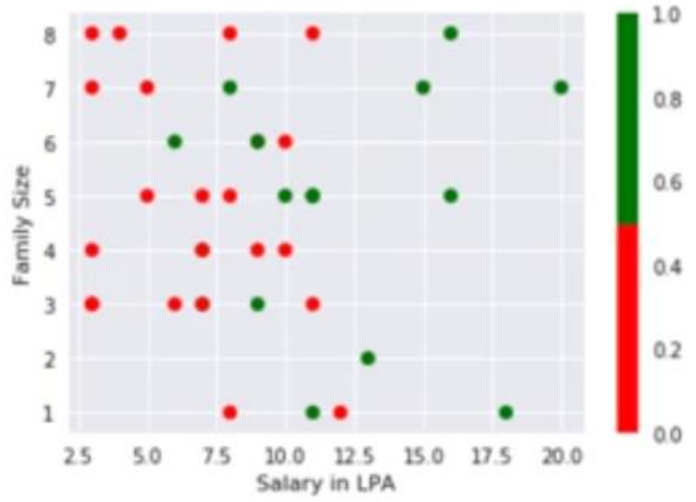


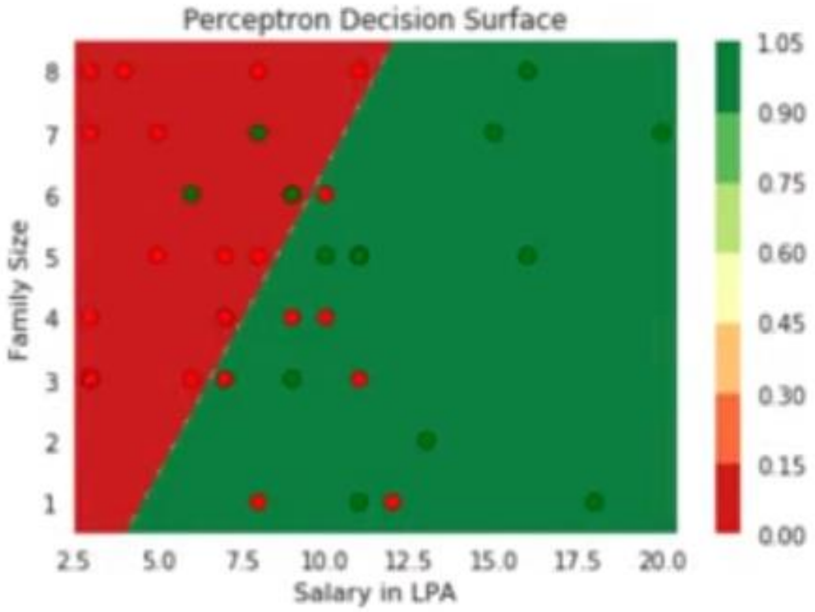
$$wx + b = 0, y = 0.5$$

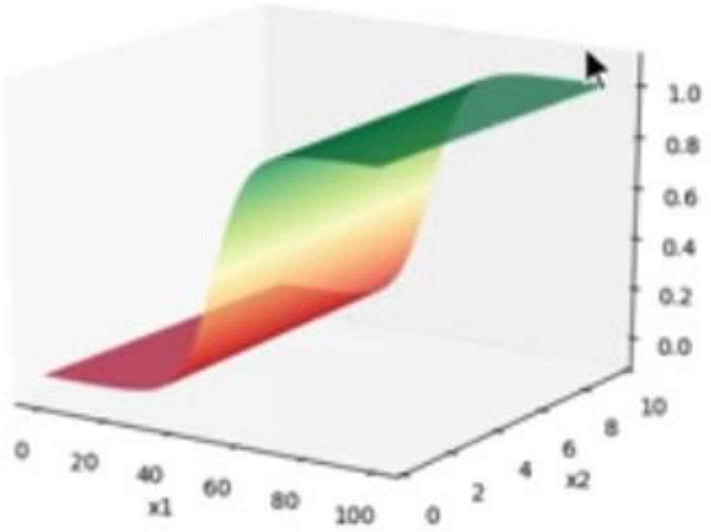


How does this help when data is not linearly separable?

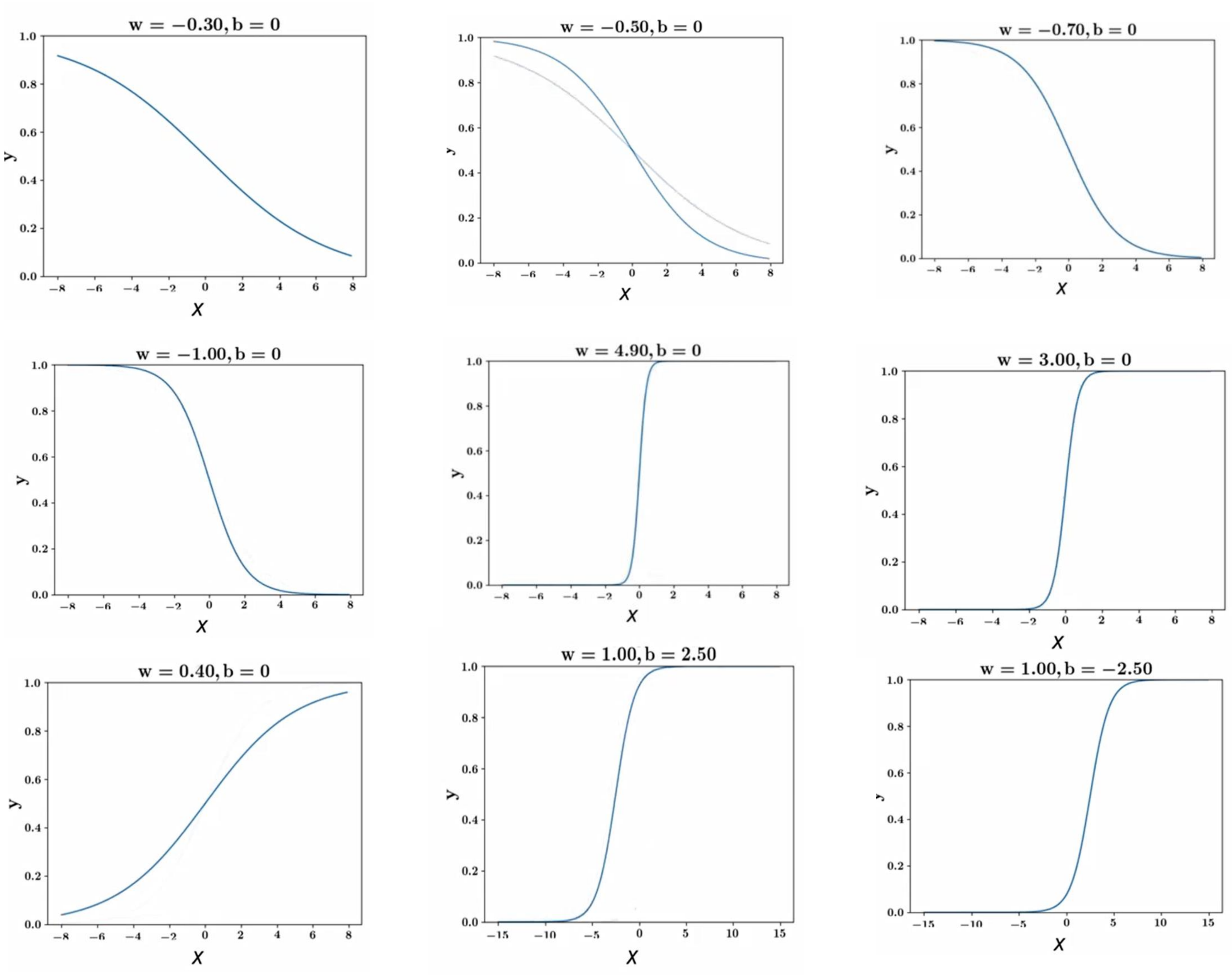
	Salary in LPA	Family Size	Buys Car?
0	11	8	1
1	20	7	1
2	4	8	0
3	8	7	0
4	11	5	1







Behaviour of function on changing ‘w’ and ‘b’ value



Behaviour of function on changing ‘w’ and ‘b’ value

- If ‘w’ is –ve and b=0, we get negative slope.
- If ‘w’ is +ve and b=0, we get positive slope.
- If we keep decreasing the value of ‘b’, the slope shifts towards right of x-axis.
- If we keep increasing the value of ‘b’, the slope shifts towards left of x-axis.

Data and Task

Launch (within 6 months)	0	1	1	0	0	1	0	1	1
Weight (g)	151	180	160	205	162	182	138	185	170
Screen size (inches)	5.8	6.18	5.84	6.2	5.9	6.26	4.7	6.41	5.5
dual sim	1	1	0	0	0	1	0	1	0
Internal memory (>= 64 GB, 4GB RAM)	1	1	1	1	1	1	1	1	1
NFC	0	1	1	0	1	0	1	1	1
Radio	1	0	0	1	1	1	0	0	0
Battery(mAh)	3060	3500	3060	5000	3000	4000	1960	3700	3260
Price (INR)	15k	32k	25k	18k	14k	12k	35k	42k	44k

Task: Classification and Regression

Loss Function

Cross-Entropy (will be discussed later)

x_1	x_2	y	$\hat{y}$
1	1	1	0.6
2	1	1	0.7
1	2	0	0.2
2	2	0	0.5

x_1	x_2	y	$\hat{y}$
1	1	0.5	0.6
2	1	0.8	0.7
1	2	0.2	0.2
2	2	0.9	0.5

$$\hat{y} = \frac{1}{1 + e^{-(wx+b)}}$$

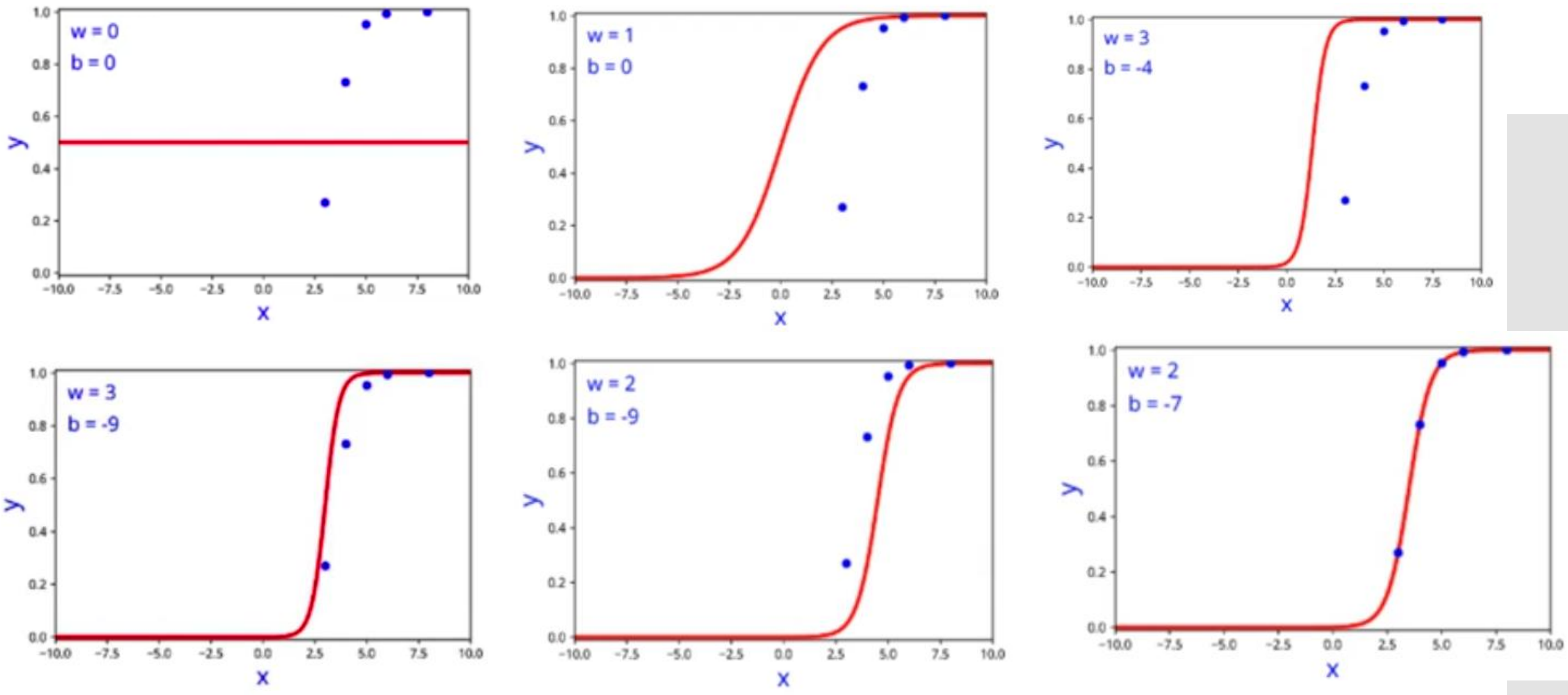
$$Loss = \sum_{i=1}^{4} (y - \hat{y})^2 = 0.18$$

In perceptron model, every wrong point identified incorrectly contributed more to the perceptron model, no matter how far it is from the boundary.

I/P	O/P
2	0.047
3	0.268
4	0.73
5	0.952
8	0.999

Learning Algorithm

Can ‘w’ and ‘b’ value be estimated using guess work?



w	b
0	0
1	0
3	-4
3	-9
2	-9
2	-7

Learning Algorithm

Initialise w, b

Iterate over data:

$compute\ \hat{y}$

$compute\ \mathscr{L}(w,b)$

$w_{t+1} = w_t - \eta \Delta w_t$

$b_{t+1} = b_t - \eta \Delta b_t$

till satisfied

I/P	O/P
3	0.268
4	0.73
5	0.952
6	0.994
8	0.999

$$\hat{y} = \frac{1}{1 + e^{-(wx+b)}}$$

$$Loss\mathscr{L}(w,b) = \sum_{i=1}^{5} (y_i - \hat{y}_i)^2$$