Deep Learning : Perceptron – Learning Algorithm

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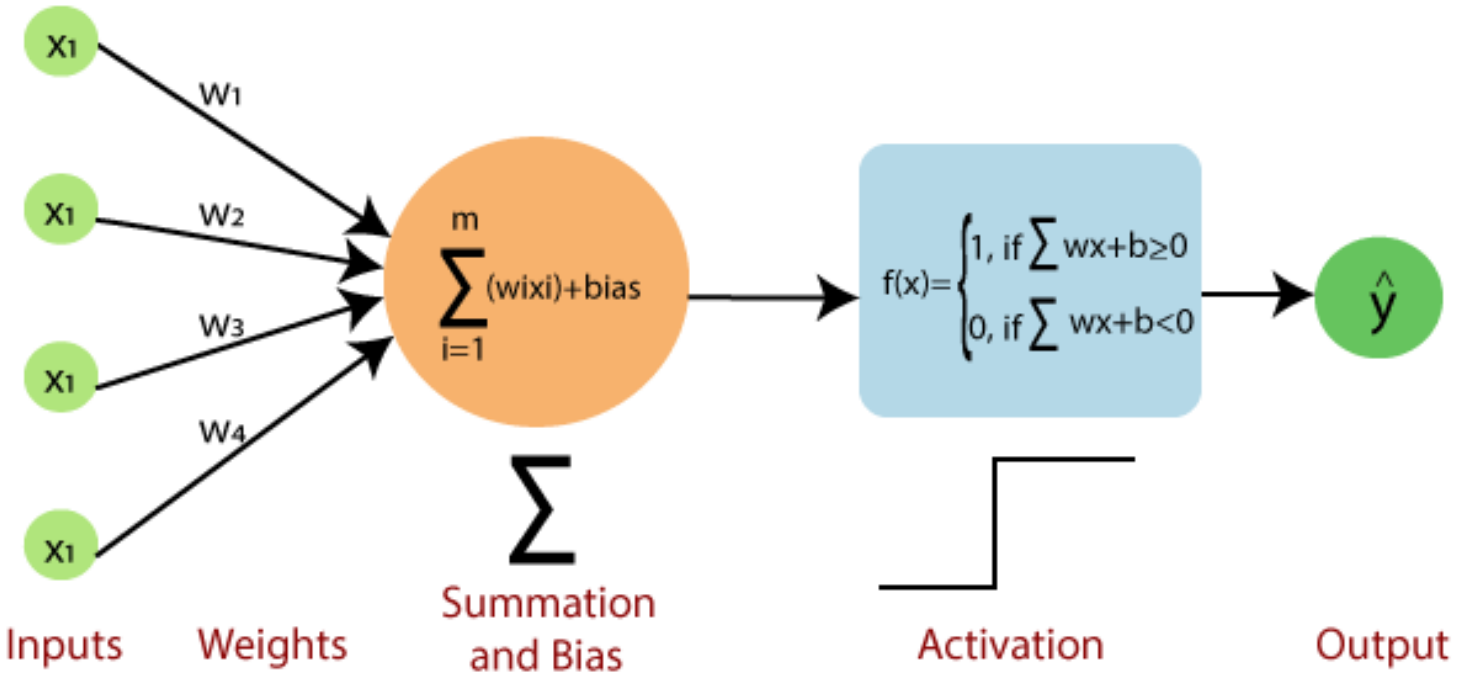
Perceptron


x1
x1
x1
x1
w1
w2
w3
w4
m
∑ (wixi)+bias
i=1
f(x)= 1, if ∑ wx+b≥0
0, if ∑ wx+b<0
ŷ
Inputs
Weights
Summation and Bias
Activation
Output

Learning Algorithm

(General Working Structure)

Initialise w_1, w_2, b

Iterate over data:

$\mathscr{L} = compute\_loss(x_i)$

$update(w_1, w_2, b, \mathscr{L})$

till satisfied

Weight	Screen size	Like
0.19	0.64	1
0.63	0.87	1
0.33	0.67	0
1	0.88	0

Learning Algorithm

What does perceptron learning algorithm looks like ?

$$\hat{y} = 1 \text{ (if } \sum_{i=0}^{n} w_i x_i \geq 0)$$
$$\hat{y} = 0 \text{ (otherwise)}$$

$$\hat{y} = 1 \text{ (if } \mathbf{w}.\mathbf{x} \geq 0)$$
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Stepwise explanation of Perceptron Learning Algorithm

Algorithm: Perceptron Learning Algorithm

$P \leftarrow$ *inputs with label* 1;

$N \leftarrow$ *inputs with label* 0;

Initialize **w** randomly;

while !*convergence* **do**

  Pick random $\mathbf{x} \in P \cup N$;

  if $\mathbf{x} \in P$ *and* $\sum_{i=0}^{n} w_i * x_i < 0$ **then**

    $\mathbf{w} = \mathbf{w} + \mathbf{x}$;

  end

  if $\mathbf{x} \in N$ *and* $\sum_{i=0}^{n} w_i * x_i \geq 0$ **then**

    $\mathbf{w} = \mathbf{w} - \mathbf{x}$;

  end

end

//the algorithm converges when all the inputs are classified correctly

Will this algorithm always work?

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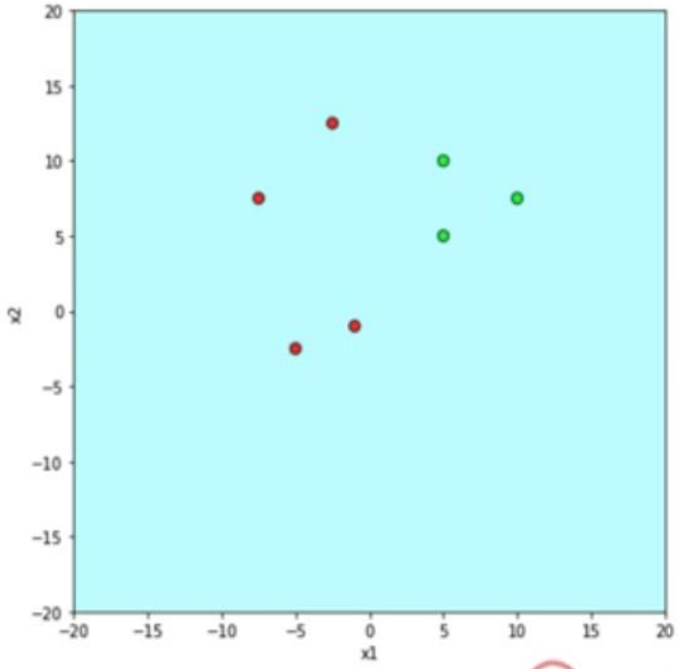
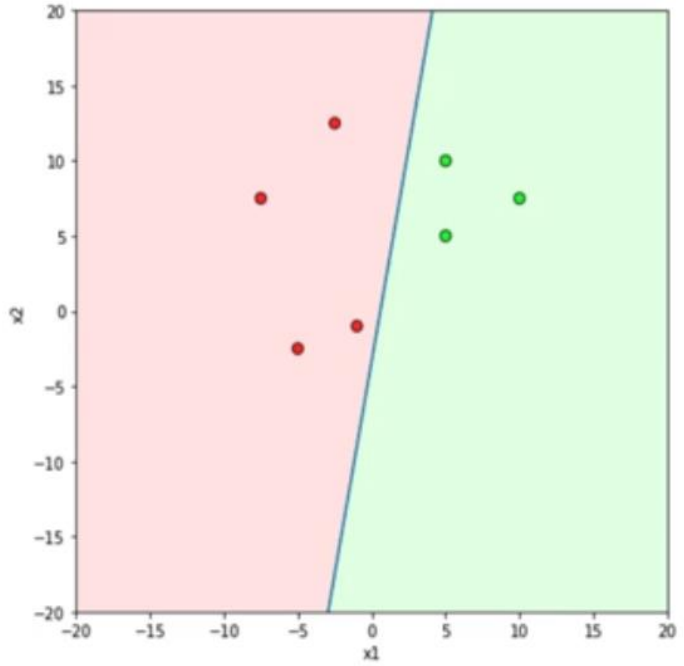




☹ Only if the data is linearly separable

Perceptron Algorithm will always work for a linearly separable data

Definition

Two sets P and N of points in an n-dimensional space are called absolutely linearly separable if (n+1) real number exists such that every point (x1, x2, x3, …xn) belongs to P satisfies $\sum_{i=1 \text{ to } n} wi*xi > w0$ *and every point (x1, x2, ..., xn) belongs to N satisfies* $\sum wi*xi < w0$

Proposition

If the sets P and N are finite and linearly separable, the perceptron learning algorithm will converge in a finite number of steps.

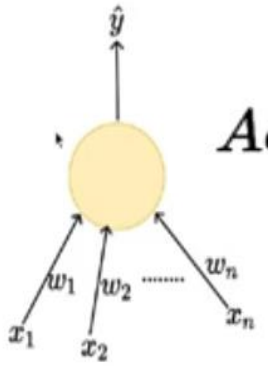
Evaluation

Launch (within 6 months)	0	1	1	0	0	1	0	1	1
Weight	0.19	0.63	0.33	1	0.36	0.66	0	0.70	0.48
Screen size	0.64	0.87	0.67	0.88	0.7	0.91	0	1	0.47
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	0.36	0.51	0.36	1	0.34	0.67	0	0.57	0.43
Price	0.09	0.63	0.41	0.19	0.06	0	0.72	0.94	1
Like (y)	**1**	**0**	**1**	**0**	**1**	**1**	**0**	**1**	**0**

1	0	0	1
0.23	0.34	0.44	0.54
0.74	0.93	0.34	0.42
0	1	0	0
1	0	0	0
0	0	1	0
1	1	1	0
1	1	1	0
0	0	1	0
0	1	0	0
0	1	1	0

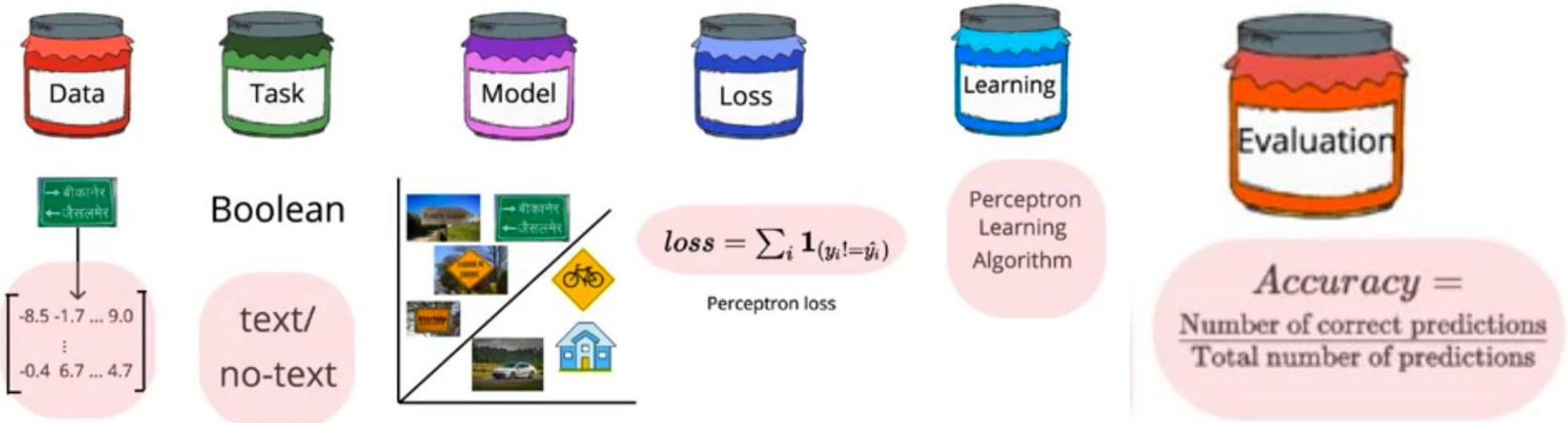
$$\hat{y} = \left(\sum_{i=1}^{n} w_i x_i \geq b\right)$$

$$loss = \sum_i \mathbf{1}_{(y_i != \hat{y}_i)}$$



$$Accuracy = \frac{\text{Number of correct predictions}}{\text{Total number of predictions}}$$

Summary of Perceptron Model



Implementation of the Perceptron Model