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# The Perceptron

# The perceptron learns an explicit hyperplane through trial and error

- Makes online updates to  $\mathbf{w}$  for every misclassified point.
- Simple update rule:  $\mathbf{w} \leftarrow \mathbf{w} + y_i \mathbf{x}_i$
- Comes with convergence guarantees given linear separability, which is a reasonable assumption in many real world scenarios include text classification!

**Definition:**  $\text{sign}(z) = 1$  if  $z \geq 0$ ,  $-1$  otherwise.

**Inputs:** number of iterations,  $T$ ; training examples  $(\underline{x}_t, y_t)$  for  $t \in \{1 \dots n\}$  where  $\underline{x} \in \mathbb{R}^N$  is an input, and  $y_t \in \{-1, +1\}$  is a label.

**Initialization:**  $\underline{\theta} = \underline{0}$  (i.e., all parameters are set to 0)

**Algorithm:**

- For  $j = 1 \dots T$ 
  - For  $t = 1 \dots n$ 
    1.  $y' = \text{sign}(\underline{x}_t \cdot \underline{\theta})$
    2. If  $y' \neq y_t$  Then  $\underline{\theta} = \underline{\theta} + y_t \underline{x}_t$ , Else leave  $\underline{\theta}$  unchanged

**Output:** parameters  $\underline{\theta}$

- Taken from Collins, Convergence Proof for the Perceptron Algorithm (2012)