Rosenblatt's Perceptrons

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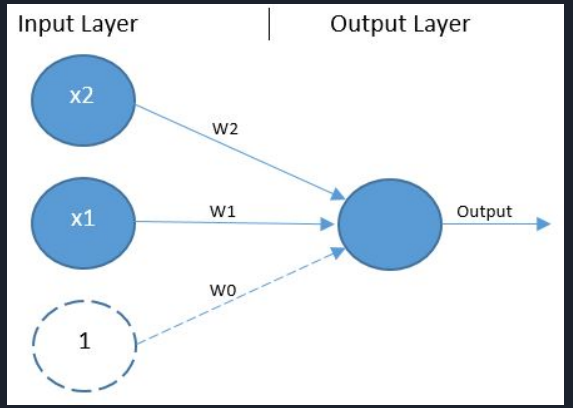
Background of Rosenblatt's Perceptrons

- Frank Rosenblatt was a scientist who was born in 1928 in New York.
- Rosenblatt attended Cornell University where he received his B.A. and Ph.D..
- He worked at the Cornell Aeronautical Laboratory in Buffalo, New York
- At this Laboratory he started conducting his work on the perceptrons around 1957

What is a Perceptron?

- Perceptron is an algorithm of connected networks that simulates an associative memory
- Simple perceptrons have an input and output layer of nodes which are all connected
- Each connection has a weight associated with it which can be adjusted to get desired output
- Adjusting the weights to produce a particular output is called the “training” of the network
    - This allows the network to learn

Simple Perceptron



What is a Perceptron?

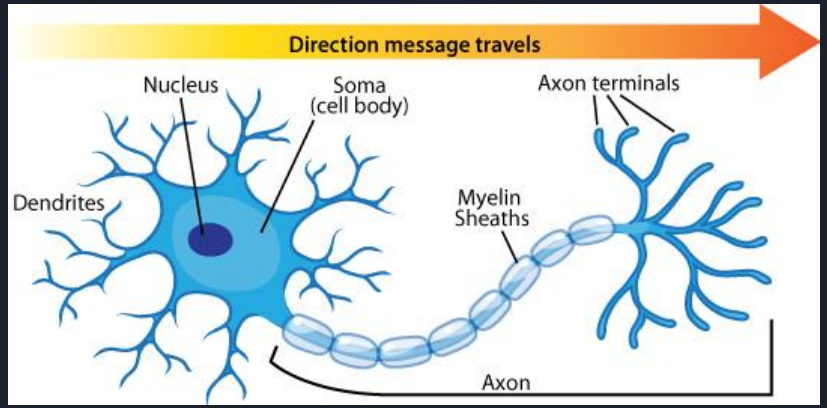
- A single artificial neuron
- Uses Heaviside step function
  - Zero for negative arguments
  - One for positive arguments
- First generation of neural networks

$$f(\mathbf{x}) = \begin{cases} 1 & \text{if } \mathbf{w} \cdot \mathbf{x} + b > 0, \\ 0 & \text{otherwise} \end{cases}$$

w = real-valued weights
x = input vector
b = bias

A binary single neuron model (1957)

- A neuron receives ‘communication messages’ from other neurons in form of electrical impulses of different strength (excitatory or inhibitory)
- A neuron integrates all the impulses received from other neurons
- If the resulting integration is larger than a certain threshold the neurons ‘fires’, triggering the action potential that is transmitted to other connected neurons.



Training

- By adjusting the weights of the connections between layers allows the “trained” outputs to match the desired output
- To accomplish training, send a given set of inputs through the network and compare the results with the set of target outputs
    - If there is a difference between the actual and target, then adjust the weights to produce a set of outputs closer to the target values

Limitations

- Only capable of separating data points with a single line
- Exclusive or (XOR) function
  - Inputs are not linearly separable
  - Can be solved by adding multiple layers
- Single neuron that can solve linear classification
  - Unable to solve non-linear separable problems