HEBB NETWORK

INTRODUCTION

- Hebbian Learning Rule, also known as Hebb Learning Rule, was proposed by Donald O Hebb.
- It is one of the first and also easiest learning rules in the neural network. It is used for pattern classification.
- It is a single layer neural network, i.e. it has one input layer and one output layer. The input layer can have many units, say n.
- The output layer only has one unit. Hebbian rule works by updating the weights between neurons in the neural network for each training sample.
- The weight and bias update in Hebb rule is given by:

$$w_i(new) = w_i(old) + x_i y$$

$$b(new) = b(old) + y$$

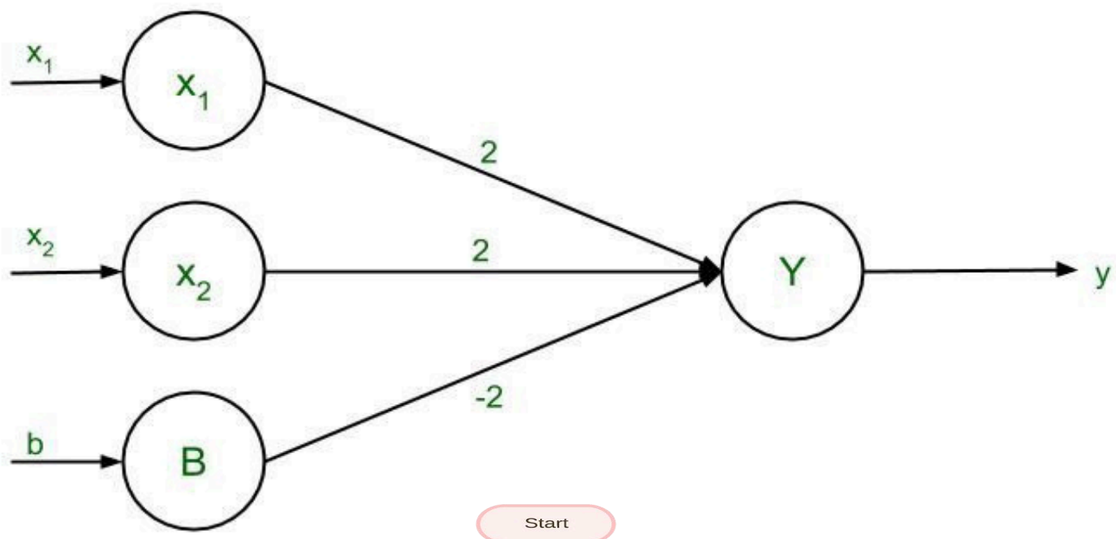
HEBBIAN LEARNING RULE ALGORITHM

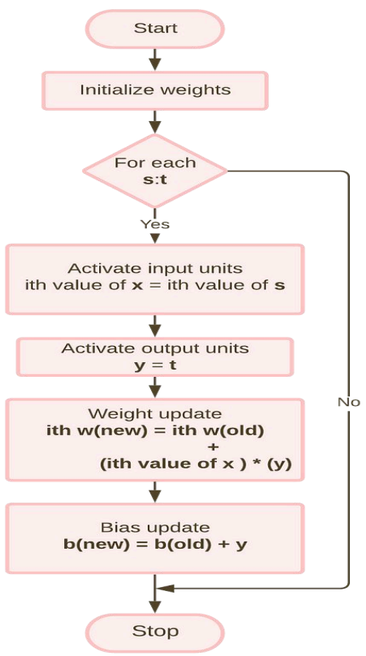
1. Set all weights to zero, $w_i = 0$ for i=1 to n, and bias to zero.
2. For each input vector, S(input vector) : t(target output pair), repeat steps 3-5.
3. Set activations for input units with the input vector $X_i = S_i$ for i = 1 to n.
4. Set the corresponding output value to the output neuron, i.e. y = t.
5. Update weight and bias by applying Hebb rule for all i = 1 to n:

IMPLEMENTING AND GATE

INPUT				TARGET	
	x_1	x_2	b		y
X_1	-1	-1	1	Y_1	-1
X_2	-1	1	1	Y_2	-1
X_3	1	-1	1	Y_3	-1
X_4	1	1	1	Y_4	1

Truth Table of AND Gate using bipolar sigmoidal function





Applications of Hebb Networks in Soft Computing

- **1.Pattern Recognition & Associative Memory**: Hebb networks learn to recognize and recall patterns by strengthening synaptic connections with repeated exposure, making them useful for tasks like image/speech recognition and content-addressable memory.
- **2.Data Clustering**: By adjusting weights based on input similarity, Hebb networks cluster similar data, applied in market segmentation, document clustering, and bioinformatics.
- **3.Adaptive Control Systems**: Hebbian learning helps adaptive control systems, such as robotics, by adjusting to environmental feedback for tasks like navigation and control.
- **4.Feature Extraction**: Hebb networks extract key features from data, useful for tasks like dimensionality reduction while preserving essential information.
- **5.Neurobiological & NLP Modeling:** Hebb networks model biological learning processes and are used in NLP for word association and semantic memory by learning word co-occurrences in text.

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