# A CRITIQUE OF THE ROSENBLATT PERCEPTRON PAPER

The author theorizes and also tries to propose his findings related to how the humans or higher living things perceive and act upon the world. For this, obviously the 1st step would be to sense the surrounding while the next two steps are to retain the information sensed and the response mechanism on the information stored (in cellular level!). The 2nd and the 3rd steps being the focus of Rosenblatt. His connectionist or empiricist views on the same topic have been solidly laid out. His work is largely based on the findings by Hebb, Hayek etc.

The first is the organization of the perceptron with feed-forward excitatory connections. Along with these, it also includes complimentary feedback inhibitory connections. When an image is projected by the sensory units, the stimuli excites only the excitatory units while there is no response from inhibitory cells. With respect to these, 3 systems can be formulated:

1. $\alpha\ systems$ – Impulses are provided to the Active Cells which are stored and hence gain over a period.
2. $\beta\ systems$ – There is constant feed which is directly proportional to the activity of the cells
3. $\gamma\ systems$ – The units reinforced gain at the expense of the inactive source sets.

With the 3 possible types of systems that could exist with respect to the stimuli gains, the next step would be to subdivide the process itself. They are subdivided into the predominant phase and the post dominant phase. In the predominant phase, stimuli are generated but there is no response yet. While the post dominant phase is where the Active units provide a response.

In the detailed analysis of the predominant phase, an analysis of how the perceptron responds considering the 3 above systems each is laid out. The objective of the analysis is to observe the responses of the excitatory and the inhibitory cells and also their behavior with respect to the threshold $\theta$. He arrives at a conclusion that,

1. If the number of excitatory and inhibitory cells are equal, the proportion of activated units remain constant irrespective of the number/ size of the sensory units illuminated.
2. As $\theta$ increases, the proportion of activated units decreases.

Hence, to control the number of activated units, the number of inhibitory origin points and the value of $\theta$ can be varied. The conditions are of considerable importance as it can be utilized for discrimination learning. This holds true for all the 3 systems described but in different capacities.

We must now observe how the learning happens in the perceptron. For this, two different paradigms are considered. One is with respect to the learning process while the other is with respect to the learning environment. Two learning systems are assumed which are the sum ($\sum$) systems and the mean ($\mu$) systems. As their definition says, in the $\sum$ system, the stimuli having the greatest net value gets to have the response first. While in the $\mu$ system, the stimuli with the greatest mean value respond first.

Now that this is established, we shall now observe how the learning occurs under two different circumstances. In the Ideal condition, the perceptron is constantly shown a series of objects of only one class. By constantly reinforcing the correct values of responses, the perceptron is forced to give the required responses. Now the learning is assumed to be complete and the perceptron is tested against the same set of objects to check the probability of correctness. The other experiment would be to check the probability of correctness with objects related to the same class but not used in the learning process. (This is probably the genesis of Supervised Learning!!) It must be observed that this type of learning system is obviously poor in generalization.

In the differentiated environment, the perceptron is presented with multiple classes of objects. In this form of learning process, the perceptron is able to generalize and predict very well given a large set of objects. Rosenblatt theorizes that with infinite such examples, the probability of correct generalization is equal to the probability of correct responses. This is mostly probably true with regard to my personal view.

In both these environments, the $\gamma$ system performed better than both the $\alpha$ and $\beta$ systems. The $\sum$ learning performed poorly in both $\alpha$ and $\beta$ systems as compared to the $\mu$ learning while it was the same in $\gamma$ system.

Lastly, Rosenblatt presents the concept of bivalent system, where positive reinforcement is applied for correct responses while a negative reinforcement for an incorrect response. We can clearly predict the difference as compared to the above monovalent system discussed.

This paper presents strong formulations in terms of the learning process of a perceptron and is surely a base for all developments made until now.

One point we must put in perspective is the unclarity with respect to reinforcement learning and Supervised learning during this period of time. Since most of the research work was started during this period, it could be called the nemesis of Artificial Intelligence. We must observe that research related to reinforcement learning had also been carried out to some extent with the rats and called the trial and error learning. The intricate detail that must be observed is that in both the Supervised Learning and Reinforcement Learning, the trial and error learning process occurs but examples are presented while in the other the environment is presented!