Perceptron and Human Cognition: Frank Rosenblatt Perspectives

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Abstract

Frank Rosenblatt is a pioneer researher on hardware realizing a computational model for the investigation of possible models of a human brain. The models he proposed are collective called *Perceptron*. From his publications, we can find out the clues for the early researches along this line. Two important point of views from Frank Rosenblatt on his researches on human cognition are presented here.

The content presented here has been presented in my undergraduate final year project [1]. Interested reader can download from `john.digi-pack.io/papers/LAR.pdf` for the report.

1 Fundamental Questions on Human Cognition [2, p.386]

If we are eventually to understand the capability of higher organisms for the perceptual recognition, generalization, recall and thinking, we must first have answers to the following three fundamental questions:

1. How is information about the physical world sensed, or detected, by a biological system?
2. In what form is the information stored, or remembered?
3. How does information stored or remembered influence recognition and behavior.

The first of these questions is in the province of sensory physiology, and is the only one for which appreciable understanding has been achieved. With regard to the second question, two alternative positions have been maintained.

The first suggests that storage of sensory information is in the form of coded representation of images, with same sort of one-to-one mapping between sensory

stimulus and the stored pattern . According to this hypothesis, if one understood the code of the nervous system, one should in principle be able to discover exactly what an organism remembers by reconstructing the original sensory patterns from the "memory traces".

The alternative approach which stems from the tradition of British empiricism, hazards the guess that images of stimuli may never really record at all, and that the central nervous system simply act as an intricate switching network, where retention takes the form of new connections, or pathways, between centers of activity. The important feature of this approach is that there is never any simple mapping of the stimulus into memory, according to some code which would permit its later reconstruction.

Corresponding to these two positions on the method of information retention, there exist two hypotheses with regard to the third question. The "code memory theorists" are forced to conclude that recognition of any stimulus involves the matching of systematic comparison of the contents of storage with incoming sensory patterns. The theorists in the empiricist tradition have essentially combined the answer to the third question with their answer to the second: since the stored information takes the form of new connections, or transmission channels in the neurons system, it follows that the new stimuli will make use of these new pathways which have been created, automatically activating the appropriate response without requiring any separate process for their recognition or identification. The theory backing the Perceptron and neural network takes the empiricist or connectionist position.

At this moment, the reader should realize that in the recent decades, "code memory theorists" was the symbolic approach. It played a main role in the study of artificial intelligence research.

2 Duplicating Human Learning [3, p.97]

In a conference held in 1959, Frank Rosenblatt had been asked a few questions regarding to his work and his viewpoint of human cognition. In the response of a question, Frank Rosenblatt had made clearly that his intention is not to duplicate human learning.

Martha Evans (Los Alamos Scientific Laboratory):

You mentioned that the learning curves achieved in the horizontal-vertical discrimination were different from those of adult humans in similar learning situations. Are you attempting to duplicate human learning? Have you considered " better " modes of learning or would you?

Rosenblatt:

Well, first of all let me say that we are interested in duplicating human learning, if it is possible to do so. We are interested in determining the extent to which

it is feasible to consider such a thing as duplicating human learning, or at least understanding how human learning operates. Whether or not there exists a better mode of learning is in a sense an empirical question to which I don't feel we can supply an answer at this point.

We are interested, however, not only in studying human learning, but in studying the behavior of networks which include biological nervous systems as a subclass. That is to say, we are interested in the study of signal transmission networks which involve connected nodes or cell points which have functional characteristics similar to those of biological neurons, but not necessarily identical. If it emerges from the study of such systems that some of these behave better than others or some of them do in fact behave better than the human nervous system, this would be a very interesting finding indeed. But it would emerge from the study of this general class of systems and is not something I feel we can specifically aim for at this point.

References

[1] J. Sum, "Neural Network for Character Recognition," available at http://john.digi-pack.io/papers/LAR.pdf, 1992, Final Year Project Report, Department of Electronic Engineering, Hong Kong Polytechnic University.

[2] F. Rosenblatt, "The Perceptron: a probabilistic model for information storage and organization in the brain." *Psychological Review*, vol. 65, no. 6, p. 386, 1958.

[3] ——, "Perceptual generalization over transformation groups," *Self Organizing Systems*, pp. 63–100, 1960.