

Chapter 2

History of Neural Networks

Abstract Here we are presenting a brief history of neural networks, given in Haykin (Neural networks: a comprehensive foundation, 2002) [7], Zurada (Introduction to artificial neural systems, 2001) [8], Nielsen (Neurocomputing, 1990 [9] in terms of the development of architectures and algorithms that are widely used today. The history of neural networks has been divided in four stages: Beginning of neural networks, First golden age, Quiet Years and Renewed enthusiasm which shows the interplay among biological experimentation, modeling and computer simulation, hardware implementation.

Keywords Perceptron • ADALINE • Signal processing • Pattern recognition • Biological modeling • Neurocomputing

2.1 The 1940s: The Beginning of Neural Networks

The beginning of Neurocomputing is often taken to be the research article of McCulloch and Pitts [10] published in 1943, which showed that even simple types of neural networks could, in principle, compute any arithmetic or logical function, was widely read and had great influence. Other researchers, principally Norbert Wiener and von Neumann, wrote a book and research paper [11, 12] in which the suggestion was made that the research into the design of brain-like or brain-inspired computers might be interesting.

In 1949 Hebb wrote a book [13] entitled *The Organization of Behaviour* which pursued the idea that classical psychological conditioning is ubiquitous in animals because it is a property of individual neurons. This idea was not itself new, but Hebb took it further than anyone before him had by proposing a specific learning law for the synapses of neurons. Hebb then used this learning law to build a qualitative explanation of some experimental results from psychology. Although there were many other people examining the issues surrounding the neurocomputing in the 1940s and early 1950s, their work had more the effect of setting the

stage for later developments than of actually causing those developments. Typical of this era was the construction of first neurocomputer (the *Snark*) by Marvin Minsky in 1951. The Snark did operated successfully from a technical stand point but it never actually carried out any particularly interesting information processing functions.

2.2 The 1950s and 1960s: The First Golden Age of Neural Networks

The first successful neuro-computer (the Mark I perceptron) was developed during 1957 and 1958 by Frank Rosenblatt, Charles Wightman, and others. As we know it today, Rosenblatt as the founder of Neurocomputing. His primary interest was pattern recognition. Besides inventing the perceptron, Rosenblatt also wrote an early book on Neurocomputing, *Principles of Neurodynamics* [14].

Slightly later than Rosenblatt, but cut from similar cloth, was Bernard Widrow. Widrow, working with his graduate students (most notably Marcian E. “Ted” Hoff, who later went on to invent the microprocessor) developed a different type of neural network processing element called ADALINE, which was equipped with a powerful new learning law which, unlike the perceptron leaning law, is still in widespread use. Widrow and his students applied the ADALINE successfully to a large number of toy problems, and produced several films of their successes. Besides Rosenblatt and Widrow, there were a number of other people during the late 1950s and early 1960s who had substantial success in the development of neural network architectures and implementation concepts.

Notwithstanding the considerable success of these early Neurocomputing researchers, the field suffered from two glaringly obvious problems. *First*, the majority of researchers approached the subject from a qualitative and experimental point of view. This experimental emphasis resulted in a significant lack of rigor and a looseness of thought that bothered many established scientists and engineers who established the field. *Second*, an unfortunate large fraction of neural networks researchers were carried away by their enthusiasm in their statements and their writings. For example, there were widely publicized predictions that artificial brains were just a few years away from development, and other incredible statements.

Besides the hype and general lack of rigor, by the mid 1960s researchers had run out of good ideas. The final episode of this era was a campaign led by Marvin Minsky and Seymour Papert to discredit neural network research and divert neural network research funding to the field of “Artificial Intelligence”. The campaign was waged by the means of personal persuasion by Minsky and Papert and their allies, as well as by limited circulation of unpublished technical manuscript (which was further published in 1969 by Minsky and Papert as the book *Perceptrons* [15]).

The implicit thesis of *Perceptrons* was that essentially all neural networks suffer from the same “fatal flaw” as the perceptron; namely the inability to usefully

compute certain essential predicates such as XOR. To make this point the authors reviewed several proposed improvements to the perceptron and showed that these were also unable to perform well. They left the impression that neural network research had been proven to be a dead end.

2.3 The 1970s: The Quiet Years

In spite of Minsky and Papert's demonstration of the limitations of perceptrons, research on neural network continued. A great deal of neural network research went on under the headings of adaptive signal processing, pattern recognition, and biological modeling. In fact, Many of the current leaders in the field began to publish their work during 1970s. Examples include Amari [16], Fukushima [17], Grossberg [18] and Klopff and Gose [19]. These people, and those who came in over the next 13 years, were the people who put the field of neural network on a firm footing and prepared the way for the renaissance of the field.

2.4 The 1980s: Renewed Enthusiasm

By the early 1980s many Neurocomputing researchers became bold enough to begin submitting proposals to explore the development of neuro-computers and of neural network applications. In the years 1983–1986 John Hopfield, an established physicist of worldwide reputation, had become interested in neural networks a few years earlier. Hopfield wrote two highly readable papers on neural networks in 1982 [20] and 1984 [21] and these, together with his many lectures all over the world, persuaded hundreds of highly qualified scientists, mathematicians, and technologists to join the emerging field of neural networks.

In 1986, with the publication of the “PDP books” (Parallel Distributed Processing, Volumes I and II, edited by Rumelhart and McClelland [22]), the field exploded. In 1987, the first open conference on neural networks in modern times, the IEEE International Conference on Neural Networks was held in San Diego, and the International Neural Network Society (INNS) was formed. In 1988 the INNS journal *Neural Networks* was founded, followed by Neural Computation in 1989 and the IEEE Transactions on Neural Networks in 1990.

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