

## Chapter 93

# Neural Networks and Their Accelerated Evolution From an Economic Analysis Perspective

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### ABSTRACT

*In 1943, the neuropsychologist Warren McCulloch and the mathematician Walter Pitts published the paper “A Logical Calculus of the Ideas Immanent in Nervous Activity,” establishing the foundation of the neural networks. The transition from the biological neuron to the artificial one, from the perceptron to the multi-layer perceptron, from Hopfield networks to Kohonen networks, from bi-directional associative memories to Boltzmann machines, from basic radial functions to Hamming networks, represent a strong proof of the long journey in the study of the neural networks. Using the characteristics of a neural network, an overview of the works in the neural computing are included in the paperwork, namely a taxonomy of the neural networks based on a number of criteria. The paperwork includes the conclusion of the research. At the end, possible further research directions are highlighted.*

### INTRODUCTION

The expression ‘neural networks’ is a relatively new one in the history of universal science. It represents an automated system, similar to the human brain and works under its corresponding rules, leading to substantial outputs, based on the economic phenomenon analysed. ANN is a separate section of Artificial

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cial Intelligence, which in turn designates a research area in Computer Science. Neural networks, as a component of Artificial Intelligence, deal with the processing of specific data structures, learning and classification data algorithms, based on human brain operation.

From the perspective of recognition models, neural networks can be considered an extension of various conventional techniques that have been developed during several decades, namely conventional recognition model like the statistical model that is considered essential for a clear understanding of neural networks. Extensions of this topic can be found in many articles about statistical recognition models that laid the statistical foundations of neural networks: Duda and Hart (1973), Hand (1981), Devijer and Kitter (1982), Fukunaga (1990), Ripley (1994), Cheng and Titterington (1994).

## **BACKGROUND**

The history of neural networks can be divided into five stages: the beginning of neural networks; the golden age; the quiet years, years of renewed enthusiasm showing the interaction between biological experimentation, modelling and computer stimulation, with hardware implementation, finishing with the fifth stage – permanent development.

### **1940-1950: The Beginning of Neural Networks**

In 1943 the neuropsychologist Warren McCulloch and the mathematician Walter Pitts published the paper “A Logical Calculus of the Ideas Immanent in Nervous Activity”, laying the foundations of neural networks. The first precursors of computers were developed as true electronic brains, being supported by Konrad Zuse, who calculated ballistic trajectories using manual procedure. In 1941, in Berlin, at the German Institute for Aviation Research, Z3, Konrad Zuse (1993) designed an electromechanical computer, which was the first programmable computing machine, fully automated, being used to perform statistical analysis for wings vibrations.

Warren McCulloch and Walter Pitts (1947) indicated a practical field for the application and recognition of spatial models by neural networks.

Another researchers like Norbert Wiener and von Neumann, showed that research on the human brain design using computers could be a very interesting thing.

In 1949, Donald Hebb wrote *The Organization of Behaviour* and showed that neuronal connection is becoming stronger as it is used, being a fundamental concept for the learning process of a network. Moreover, Hebb developed the rule that bears his name, and which is the basis for almost all of neuronal learning procedures. Hebb could not postulate this rule due to the absence of neurological research, the only able to confirm this result.

Karl Lashley (1950) argued, as a neuro-psychologist, that the storing of information by the brain is designed as a distributed system. His thesis was based on experiments on rats.

### **1950-1960: The Golden Age of Neural Networks**

The most remarkable event of that time was the building of the first neuro-computer (The Snark) by Marvin Minsky (1951), which was able to adapt automatically the weights. Snark operated successfully from a technical point of view, but never exercised extremely interesting functions of information processing.

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