

A HYBRID NEURAL NETWORK OF ADDRESSABLE AND CONTENT-ADDRESSABLE MEMORY

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We investigate the memory structure and retrieval of the brain and propose a hybrid neural network of addressable and content-addressable memory which is a special database model and can memorize and retrieve any piece of information (a binary pattern) both addressably and content-addressably. The architecture of this hybrid neural network is hierarchical and takes the form of a tree of slabs which consist of binary neurons with the same array. Simplex memory neural networks are considered as the slabs of basic memory units, being distributed on the terminal vertexes of the tree. It is shown by theoretical analysis that the hybrid neural network is able to be constructed with Hebbian and competitive learning rules, and some other important characteristics of its learning and memory behavior are also consistent with those of the brain. Moreover, we demonstrate the hybrid neural network on a set of ten binary numeral patterns.

Keywords: Forward neural network; addressable memory; content-addressable memory; associative memory; Hebbian learning; competitive learning.

1. INTRODUCTION

The memory structure and retrieval of the brain is a very important and interesting problem in the field of neural systems. In the past few decades, many models have been proposed to simulate the memory structure and retrieval of the brain. Among them, the most popular ones are the Hebbian learning rule and the competitive learning rule. The Hebbian learning rule is based on the idea that the strength of the connection between two neurons is increased if they are activated simultaneously. The competitive learning rule is based on the idea that the strength of the connection between two neurons is decreased if they are activated simultaneously. In this paper, we propose a hybrid neural network of addressable and content-addressable memory. This network is designed to simulate the memory structure and retrieval of the brain. It is a hierarchical network consisting of a tree of slabs. Each slab is a simple memory unit, which is a binary neuron with the same array. The network is trained using Hebbian and competitive learning rules. The network is able to memorize and retrieve any piece of information (a binary pattern) both addressably and content-addressably. We demonstrate the network on a set of ten binary numeral patterns.

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