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An Associative Content-Addressable Memory *

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In biological systems, the internal representation of the information and the organization of the memory substratum are probably strictly related. It is a common view that the information items are represented in the brain by means of sets of features belonging to a large repertoire. An associative storage process involving sets of these features might concern a number of corresponding regions spread through the brain. In this communication, the application of the model of an associative memory previously proposed (Bottini, 1980) to the case above described is presented. In the model the information storage and recall processes are realized, respectively, through convolution-like and correlation-like operations, i.e. using a kind of mathematics that appears to be particularly suitable for describing the calculations that neural networks might carry out. The central point of the model is a noise-like coding of the information items to be stored. Adopting, for example, an autoassociative memory scheme, it is shown that the set of features representing an item determines both the noise-like key required for coding the item itself on storage and the location of the memory trace built in this way inside the whole memory of the system. Any sufficiently-large feature subset (recall key), which partially describes a given item stored, will yield a noise-like key still correlating sharply with the corresponding storage key, and, at the same time, will locate, although partially, the corresponding memory trace, thus producing however a complete recall of that item. The system then shows a content-addressable memory property. Accordingly only a small fraction of the whole memory is "activated" during the information storage and recall steps. Stored items sharing some features of the recall key will be recalled and separated according to whether the recall key is a longer or a shorter part of each of them. The consequence of the use of nonlinear mathematics as far as the system performance is concerned have been studied. Finally, using the results of the storage capacity calculation for the original model, the storage capacity of the memory system here presented is computed.

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