Generating Hypotheses in Self-Organizing Maps

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ABSTRACT

The Multilevel Hypermap Architecture (MHA) belongs to self-organizing maps and is an extension of the Hypermap introduced by Kohonen.

Instead of two levels proposed in the Hypermap, the data and the context level, the MHA supports several levels of data relationship and therefore the input vector consists also of an arbitrary number of levels [1]. In the MHA there is the same number of levels in the weight vector of each unit and these levels are related to the corresponding levels of the input vector. A varying number of levels for the units of the map is supported.

The MHA is trained with the different levels of the input vector whose representation is a hierarchy of encapsulated subsets of units, the so called clusters and subclusters, which define different generalized stages of classification.

By means of MHA it is possible to analyze structured or hierarchical data, i.e.

- data with priorities, e.g. projection of hierarchical data structures in data bases
- data with context (data bases, associative memories)
- time series, e.g. speech, moving objects
- data with varying degrees of exactness, e.g. sequences of measured data

One advantage of the MHA is the support for both, the classification of data and the projection of the structure in one unified map. The resulting hierarchy has some redundancy like in biological systems.

In the previous years some real world applications using the MHA were reported in the literature. Beside a system for speech processing and recognition [3] an application which deals with an implementation of the Modified Hypermap Architecture for classification of image objects within moving scenes and an application related to the analysis of fMRI images of auditory cortex activity which were obtained from acoustic stimulation [2] are carried out.

With the new hypothetical learning algorithm the MHA has an advantage in learning and representing weak data relationships. Furthermore the MHA is able to find these relationships by itself without the need to present it in the input learning data. This behavior will be also useful in the case of working like an associative memory.

From cognitive psychology we know the representation of categorical knowledge in a hierarchical order with approximately seven levels. Because of a similarity to its hierarchical structure the MHA seems to be useful for more cognitive tasks and therefore will give a contribution to artificial intelligence. This behavior have to be proven in the next time by implementing applications. One application using the hypothetical learning in a speech processing system is already in work.

We are very interested in a wide-ranging use of the Multilevel Hypermap Architecture. Therefore the MHA software containing the main modules, the documentation and some examples is available on our FTP server (ftp://ftp.ifn-magdeburg.de/mha).

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