

Hierarchical Neural Network Model of Global-to-Fine Categorization in Inferior Temporal Cortex

1 abstract

Humans can classify various objects in the environment. However, the neuronal mechanism of the information processing on the categorization is not clear. Sugase et al. analyzed the neuron population responses in the inferior temporal cortex of the monkeys while presenting the face images. They found that the global categorization of species was represented in the earlier part of the neuron population responses, while the fine categorization of individual identity or emotional state was represented in the later part of the neuron population responses. The results suggested that the hierarchical relationship of the visual stimulus was represented by the neuron population responses of the inferior temporal cortex.

In this study, the hierarchical relationship of the global categorization and the fine categorization is modeled, based on the hierarchical neural network, Convolutional Restricted Boltzmann Machine (CRBM). CRBM is the associative memory model and can learn from lower-order to higher-order representation in the self-organized manner. The global categorization and the fine categorization are formed only with changing the sparseness. In the experiment, each categorization was formed with the images of human and monkey faces that were used in Sugase's study. As the result, the faces were classified into the human and the monkey category in the global categorization. The monkeys were classified into the emotional category and the humans were classified into the individual identity category in the fine categorization. This results are similar to the analytical results of the neuron population responses of the monkeys. In addition, the fine information was obtained early by using the global information as a tag. This results suggest that the hierarchical relationship of the categorization contributes to the improvement of the recognition speed.

keyword: inferior temporal cortex, hierarchical relationship, boltzmann machine, face responsible neuron