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Keio University

Thesis Abstract

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Thesis Title

Neuromorphic Networks for Prediction Applications

Thesis Summary

Artificial neural networks represent a powerful class of machine learning algorithms, well suited for any type of technical application: from engineering applications to scientific computing. However, artificial neural networks designs are increasingly deviating from the functional architecture of brain circuits they originated from, focusing on very sophisticated yet very segmented implementations, at the opposite end of a multi-purpose intelligence. Instead, current advances in neuroscience converge toward models of the encoding of sensory signals as well as rewards, learning and behavioral dynamics, indicating that, in the near future, tools such as artificial neural networks should be capable of providing better insights about the brain architecture. Here, the main objective is to provide a few key concepts and methods to leverage the power of predictive, biologically plausible, neural networks.

The expert implementation of task-specific neural networks versus the practical needs of innovators, engineers, physicists or biologists to analyze their models regardless of the complexity or type of data they are working with, also emphasize the critical importance of designing general-purpose algorithms, and as such, bio-inspired artificial neural networks represent a viable solution. Prediction can be used to control complex hardware, validate experiments or create innovative interactions. Biological plausibility brings in flexibility and adaptability to differ- ent situations and desired outputs, thus facilitating data processing for experts and non-experts alike.