Robotics, Artificial Intelligence and Embedded Systems

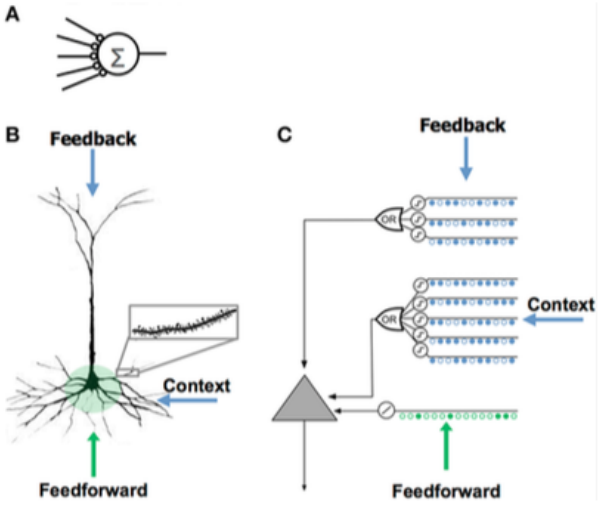
Human Brain Project

Bachelor Thesis, Master Thesis

Hierarchical Temporal Memory (HTM) with Spiking Neural Networks

BACKGROUND

The Hierarchical Temporal Memory is an unsupervised, associative neural network based on variations of Hebbian Learning [1]. Spatio-Temporal correlations are learned online and the output is multi-step future prediction. It distinguishes from classical deep learning networks because of its unsupervised characteristic and online learning capabilities. Great performance could already be demonstrated in sensory data prediction and clustering, but in first steps as well on sensory-motor tasks.



YOUR TASK

While the HTM currently is implemented as a rate-based neural network, you will implement a version with biologically plausible spiking neurons. For this purpose the neural network simulator NEST [2] and the abstraction language PyNN [3] are used. In a first step the Spatial Pooler, than the Temporal pooler should be implemented as a equivalent spiking neural networks. Performance comparison to the original implementation evaluates for efficiency and learning capabilities. In a second step the networks should be enhanced to exploit special characteristics of Spiking Neurons such as a time relation of the STDP learning paradigm. A final evaluation can tell what advantages and disadvantages a spiking implementation of the HTM offers.

REQUIRED SKILLS

- Python, C++
- Experience with Machine Learning Applications
- Knowledge in Rate Based and Spiking Neural Networks

FURTHER READING

https://numenta.org/hierarchical-temporal-memory/
http://www.nest-simulator.org/

CONTACT

Benedikt Feldotto
✉ feldotto@in.tum.de

Technical University of Munich
Faculty of Informatics
Chair of Robotics, AI and Real-Time Systems
www6.in.tum.de