

# Machine Learning and Neuroscience

## Master of Science thesis project

Dec 22, 2018

### Machine learning in neuroscience

In recent years, machine learning and artificial intelligence algorithms have been utilized in solving many fascinating problems in different fields of science, including neuroscience. Machine learning has seen a rapid development in recent years and has now become a mainstream tool in both research and industry. In particular, so called "deep networks" with free and easy-to-use tools such as TensorFlow has become very popular for learning and inference from observed data. The field of neuroscience has many applications for machine learning as data, in particular at the level of networks of biological nerve cells, are very difficult to interpret in terms of properties of underlying nerve cells. One reason is that data sets from electrical recordings in the cortex are huge (gigabytes of data is not unusual from a single recording session).

Another reason is that the electrical signals themselves do not react to the activity of the nerve cells in a simple and intuitive way. In this project, machine learning techniques will be used to analyse and interpret data from neuroscience simulations and experiments.

The first step is to apply convolutional neural networks on data generated by simulations of neural network using tools developed at CINPLA at the University of Oslo. In this model world the outcome is known and the accuracy of machine learning in making predictions can be tested. The next is to apply such validated machine learning tools on experimental data recorded at CINPLA. Here we will use techniques from unsupervised learning with autoencoders and reinforcement learning applied to data with noise as well.

**Milestones and plans.** The milestones are as follows

1. Spring 2019: Analyze simulated data with Convolutional Networks and reproduce results from simulations
2. Fall 2019: Include reinforcement learning and autoencoders and analyse data from experiments at CINPLA on for example visual cortex in mammals
3. Spring 2020: Finalize thesis project

The thesis is expected to be handed in May/June 2020.