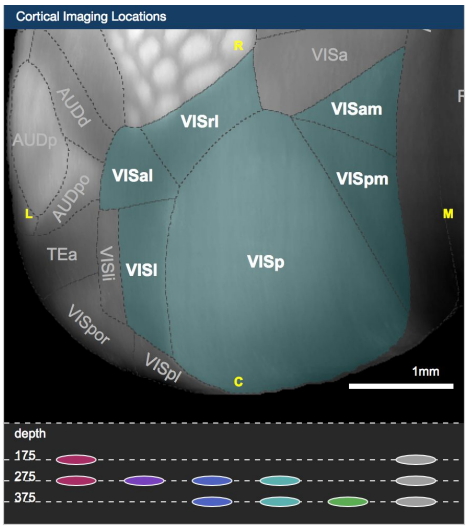
1) Supervisor(s): Raul Vicente

Candidate student: Mari-Liis Velner

Analyzing visually evoked calcium responses through cortical layers

Required background/material to learn: machine learning, possibly neural networks, data cleaning, basic understanding of calcium imaging



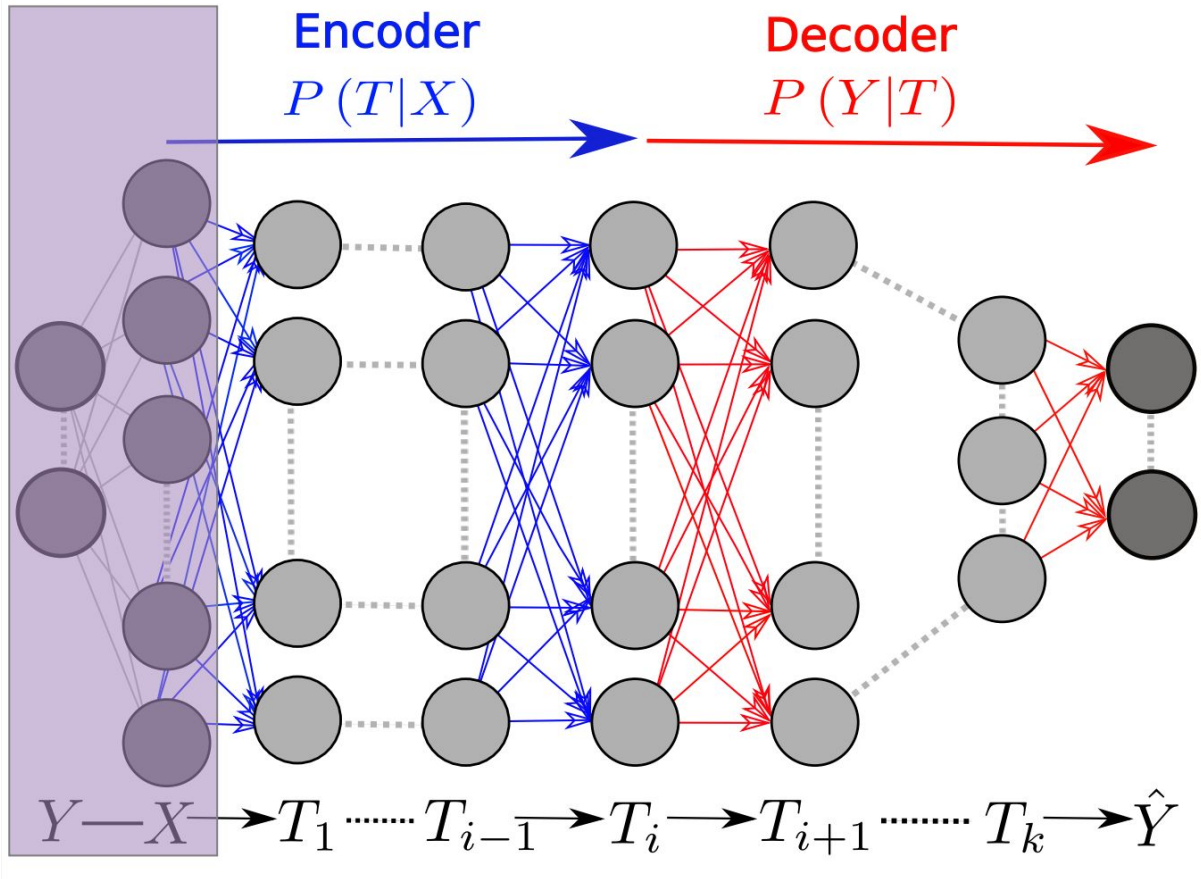
2) Supervisor(s): Raul Vicente

Candidate student:

Mutual information estimates for characterizing deep learning in large scale problems

(Basically tackling question 3 in page 16 of this paper https://arxiv.org/pdf/1703.00810.pdf)

Required background: information theory, deep learning.



3) Supervisors: Madis Vasser, Tambet Matiisen, Jaan Aru, Raul Vicente

Candidate student:

In this project you use Unity Machine Learning Agents to teach a virtual dog to sit, follow a ball, fetch a stick and so on. Training happens real-time inside VR, the trainer uses control button (“clicker”) to give reward for desired behavior. Shaping principle from animal training is used - you always reward 50% of cases which are closer to the desired behavior.

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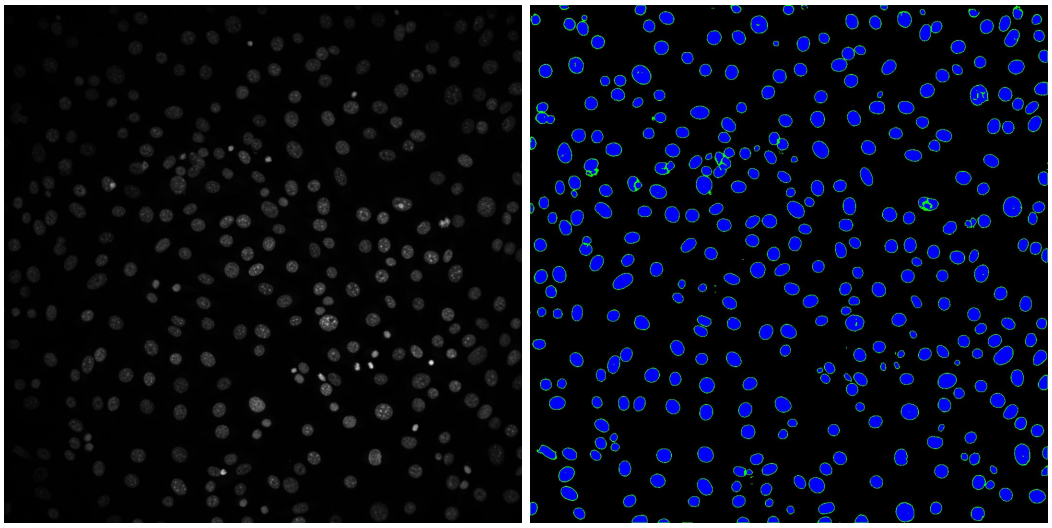
4) Supervisor(s): Daniel Majoral, Raul Vicente

Candidate student:

Deep learning for cell phenotype classification in microscopy images.

Required background: deep learning.



5. Supervisor(s): Tambet Matiisen, Kuldar Aas

Candidate student:

Finding people from archive images

Summary: The Estonian National Archives of Estonia has 500 000 digitized photos in it's library. About 10 000 photos are labeled by person names. The task is to find the same people from other photos and possibly construct a graph of relationships between people, based on the fact that when they are on the same group photo, probably they belong to the same family, went to the same school or worked together. Neural networks will be used for face recognition and clustering techniques are used to identify faces belonging the same person.

6. Supervisor(s): Tambet Matiisen, Vesal Vojdani, Kristjan Sägi, Triin Kask

Candidate student:

Generating unit tests using reinforcement learning

Summary: Code coverage is an important metric for measuring the quality of unit tests. The idea of this project is to study if reinforcement learning could be used to improve code coverage. Recurrent neural network is used to parse code and generate function calls. Reinforcement learning is used to improve the network, taking number of lines covered as a reward. The student has to be familiar with neural networks for text processing and policy gradient method for reinforcement learning.

7. Supervisor(s): Tambet Matiisen

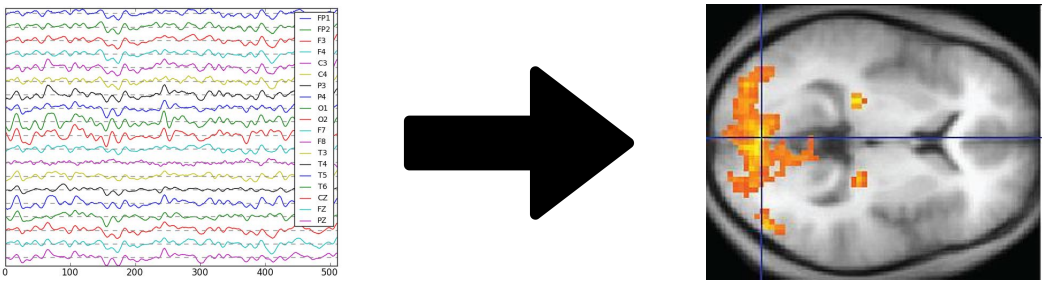
Candidate student: Roman Ring

Navigating mazes in Minecraft

Summary: Minecraft is a popular 3D video game where players can explore, craft tools and build arbitrary structures, making it a potentially rich environment for AI research. In this project you will teach an agent to navigate mazes in Minecraft using reinforcement learning. The main challenges in navigating mazes are exploration and memory - the agent should keep exploring new passages and keep track which paths it has already tried. Possibly novel network architectures must be explored to implement memory and exploration bonuses. The current implementation uses proximal policy optimization, policy gradient based methods similar to A3C.

8 Supervisor(s): Ilya Kuzovkin

Neural Network to map EEG data to fMRI data



We take a dataset where fMRI and EEG data were recorded simultaneously and try to solve source localization problem: from EEG data we try to predict where the activity is originating from in the brain. fMRI provides true answers to train on.

9. Supervisor(s): Madis Vasser, Jaan Aru;

Contact: madis.vasser@ut.ee, jaan.aru@gmail.com

Hallucinations from overweighting of perceptual priors

The thesis studies the top-down cognitive processes on perception and prediction by creating a uniformly gray world where the study subject must look around in order to spot tiny critters moving around. The aim is to induce the perception of stimuli even when none actually exist. It's also important to track the user's movement and responses in VR.

10. Supervisor(s): Madis Vasser, Jaan Aru;

Contact: madis.vasser@ut.ee, jaan.aru@gmail.com

Probing the internal world model of the brain

Summary: The thesis studies the internal world model of the brain by putting subjects in a VR environment consisting of visual white noise. The task of the subject is to report the exact moment when they start perceiving a generic environment from the noise. The environment fades in and fades out - the aim is to find the upper and lower bounds of such perception. We expect strong top down effects to occur, meaning that subject might perceive complex scenes even when none is presented.

11. Supervisors: Endel Põder

Applying DNN to visual search tasks, compare with human subjects. Endel's first try with DNN is here:
https://arxiv.org/ftp/arxiv/papers/1707/1707.09775.pdf