Research Proposal Presentation

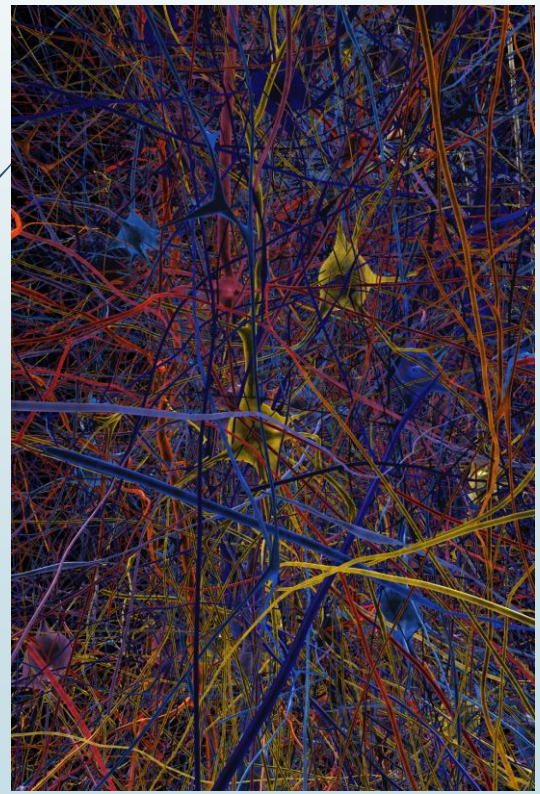
Alaa Ekky

Outline of Presentation

- Title Proposal
- Background
- Aims and Objectives
- Methodology
- Preliminary Results

Title Proposal

- **Title: Communication Theoretic Analysis of Brain Cortical Circuits**



- Internet of Nano Things (IoNT) & Internet of Bio-Nano Things (IoBNT)
  - Implanting Nanoscale devices

End Result?

Background

Model

- Digital Reconstruction of the microcircuitry of somatosensory cortex of a Juvenile rat.
- Available at the Neocortical Microcircuit Collaboration Portal (NMC).

Layers

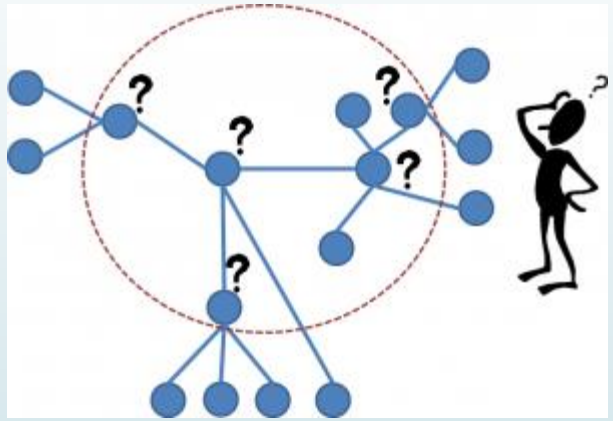
- Layers are represented as Cortical Columns.
- 6 Layers – Layer 2 and Layer 3 are not separated.

Morphology Types

- 55 Major Morphology types (m-types) present.
- Layer 1 contains unique set of m-types.

Aims and Objectives

- Use approaches in communication networks such as Network Tomography, where inference of network topology can be established.
- Through data mining of packet information and to use this to infer the cortical network topology.



Methodology

Proposed Tools to use

NEURON
for empirically-based simulations of neurons and networks of neurons

NEURON Simulator

RapidMiner

- Stage 1
  - Generate a data set using the Neuron Simulator. A model is provided from the NMC portal.
  - Provide different stimulants such as step currents and Presynaptic m-types.
  - Measure the time (in ms) and voltage (in mv). Plot the spike train for each cortical column.
- Stage 2
  - Export the results to an excel file.
  - Create a python script to loop through the excel file, calculate frequency of spike trains and delay between spike trains.
- Stage 3
  - Pass the results to RapidMiner and estimate the performance of a learning model.
  - Estimate the accuracy of the model.

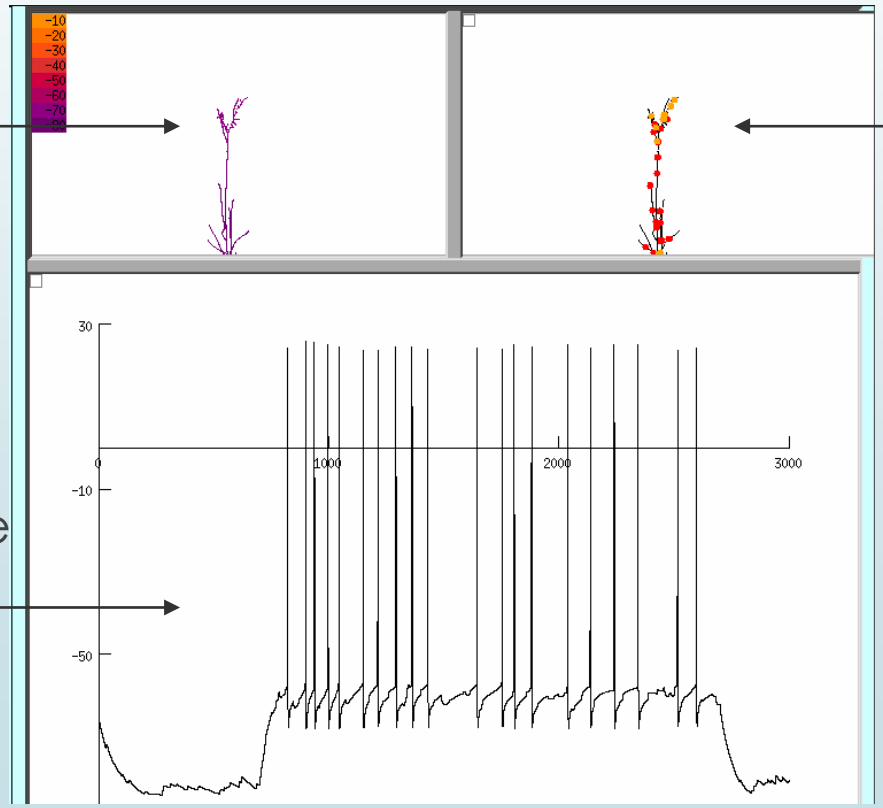
Preliminary Results

- NEURON Simulator

Morphology changes

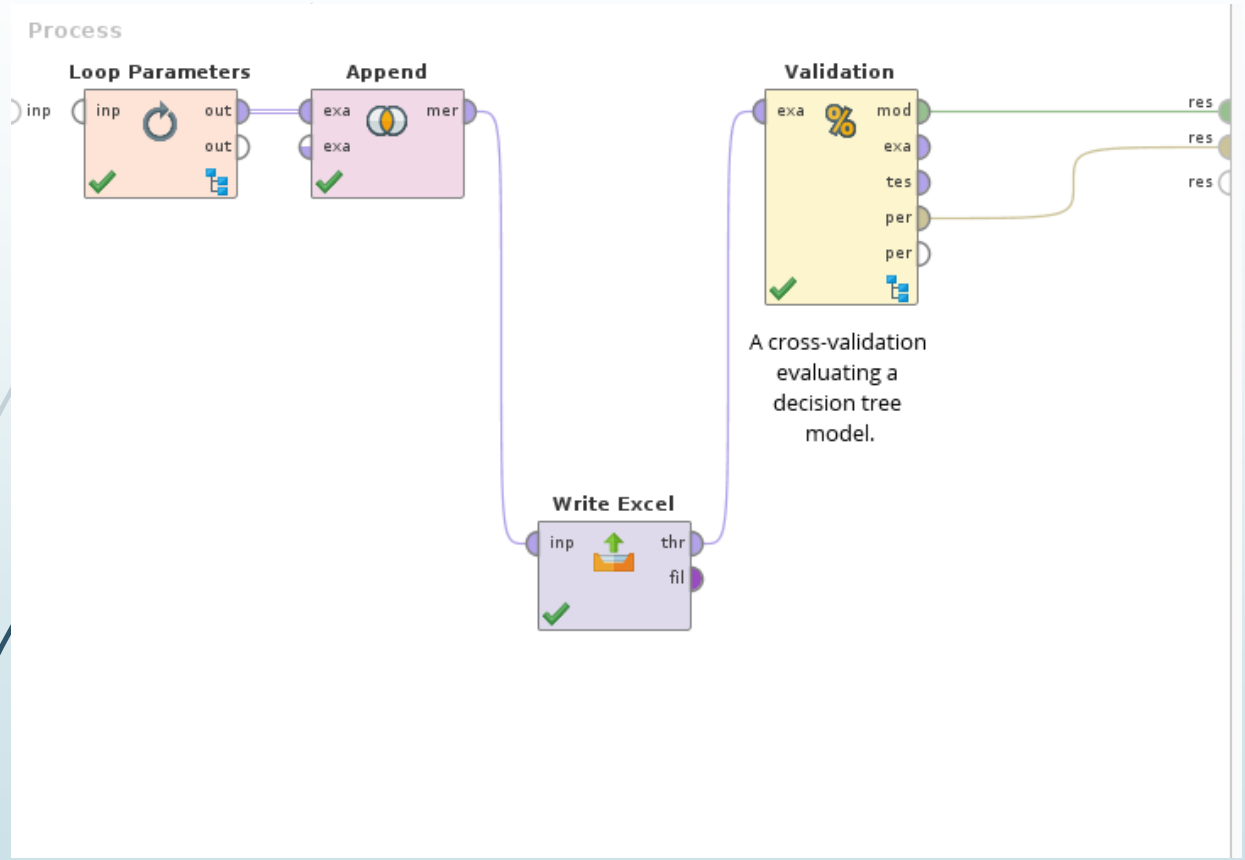
colour depending on membrane voltage

Membrane voltage in the soma



Location of activated synapses

- RapidMiner



- Loop Parameters. Append and Write Excel
- Validation
- Neural Network Model
- Cross Validation
- Output
- Accuracy and Precision

Questions?

- Thanks for Listening!