

Dendritic computation and ANNs

Background: Recently, people showed that the complexity of single biological neuron is equivalent to an ANN with 5-8 layers ([Beniaguev et al, 2021](#)). Can you verify/falsely this hypothesis by training a deep neural network to fit the input-output relation of a biological neuron (model)?

Project setups: [Jupyter Notebook demo]

Project map: The project core is covered by Q1-4; subsequent questions can be taken in any order.

Q1. Simulate multi-compartment model using NEURON software. Inject inputs at different site on the dendritic tree and then record the somatic activity.

Q2. Train an ANN to fit the somatic activity. How many layers does it require for good fitting?

Q3. Compare the structure of the trained network with the original dendrites. Can you see the tree structure of the ANN? If not, can you add some regularization during the training to get the tree structure?

Q4. Use the trained network to predict the input-output relation of the NEURON model. Try complex input patterns.

Q5. If the shallow-layer ANN does not well predict the NEURON model behavior, can deep-layer ANN improve the performance?

Q6. Investigate how inhibitory inputs change the above story?

