Reconstructing the Topology of Spiking Neural Networks Based on the Firing Activity

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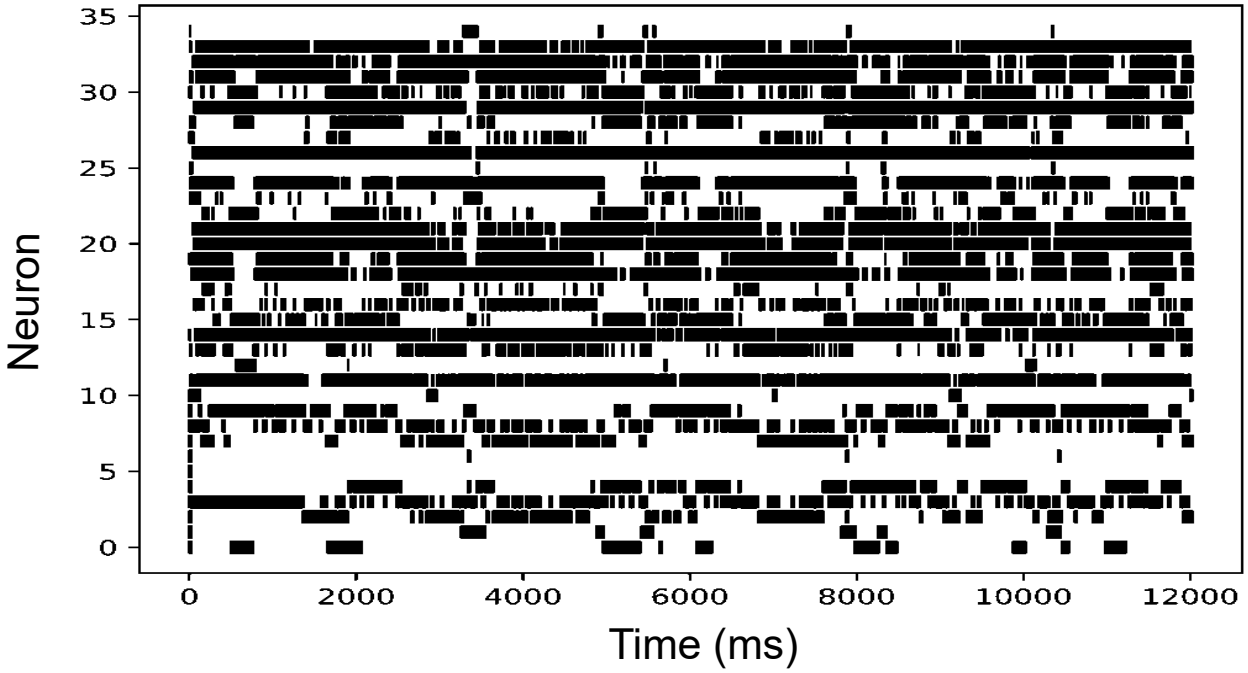

Figure 1: parallel recordings of neuronal activity in 35 neurons during 12000 ms.

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Background

Meassuring the connectivity between neurons in the brain is a hard problem because:

- The use of different imaging techniques and tracing experiments, can be very laborious, time-consuming and may involve animal experiments.
- Even with the most advanced imaging techniques it is still not possible to snapshot the detailed connectivity of large networks in vivo.
- A single neuron in some areas of the brain may have >10.000 synapses (connections) with other neurons.

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Problem

The methodes to reconstruct the topology of biological neural networks based on network activity have limited accuracy and are mostly limited to synthetic data lacking biological relevant dynamics.

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Given

• We will provide the students with both synthetic and real datasets from parallel recordings of neuronal activity.

• Some of the datasets will include information describing the topology of the corresponding neural network.

• The datasets without topological information will be used to test and evaluate the performance of the proposed solutions.

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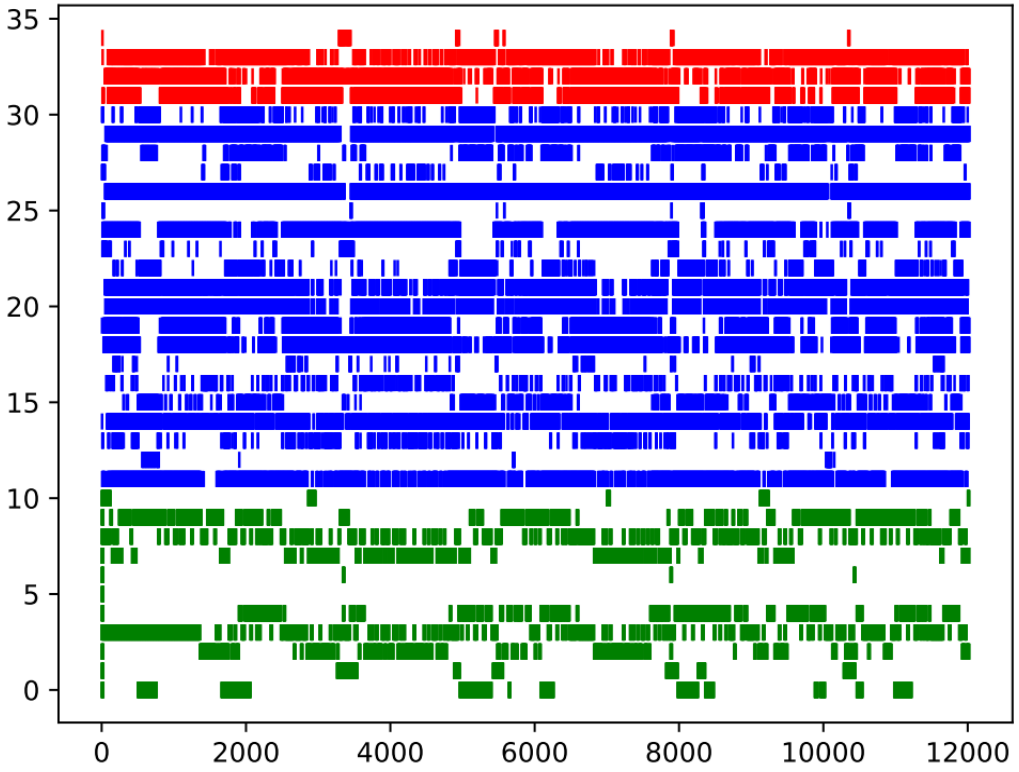

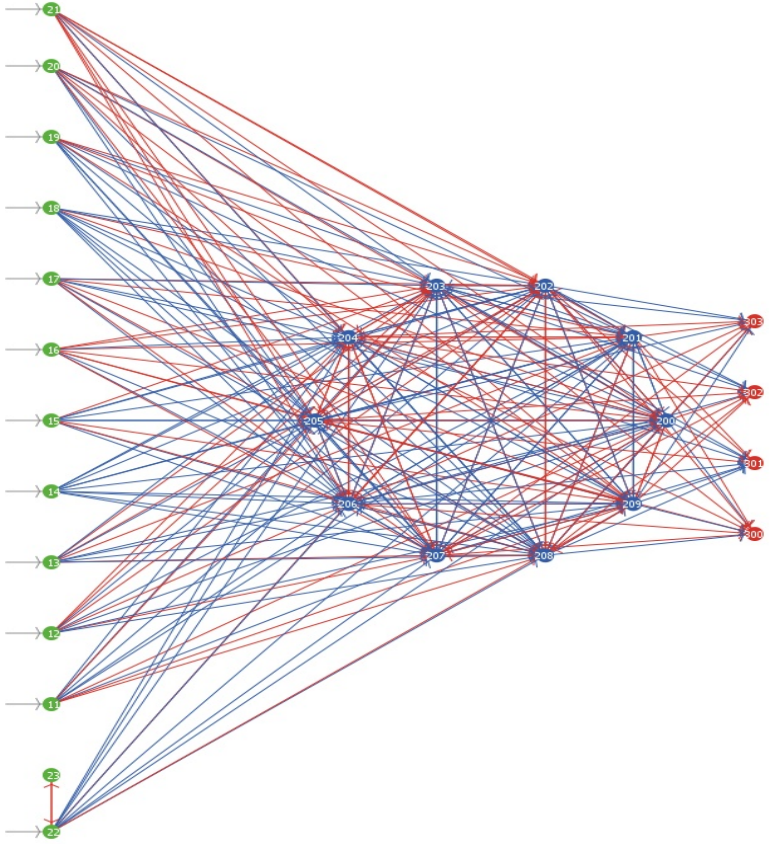

Figure 2: parallel recordings of neuronal activity (left) with ground truth network topology (right).

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Wanted

- First reconstruction of a tiny network with 3 neurons.
- Calculate the overall number of connections.
- Estimate the number of positive (excitatory) and negative (inhibitory) connections.
- Infer the distribution of the connection strengths across the network.

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Goal

To develop an algorithm for reconstructing the topology of a spiking neural network based on its spiking activity.

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Thank you!