

TSA Tutorial 0

21.4.2021

A quick outlook on our research

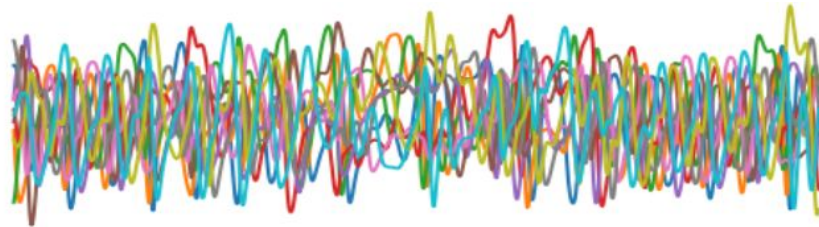


Time Series Analysis

Pretty much all real-world systems, such as the brain, are dynamical systems

Most of these systems are nonlinear and exhibit multi-scale behavior in both space and time

How well can we understand these systems with a data-driven approach?



Unsupervised Learning

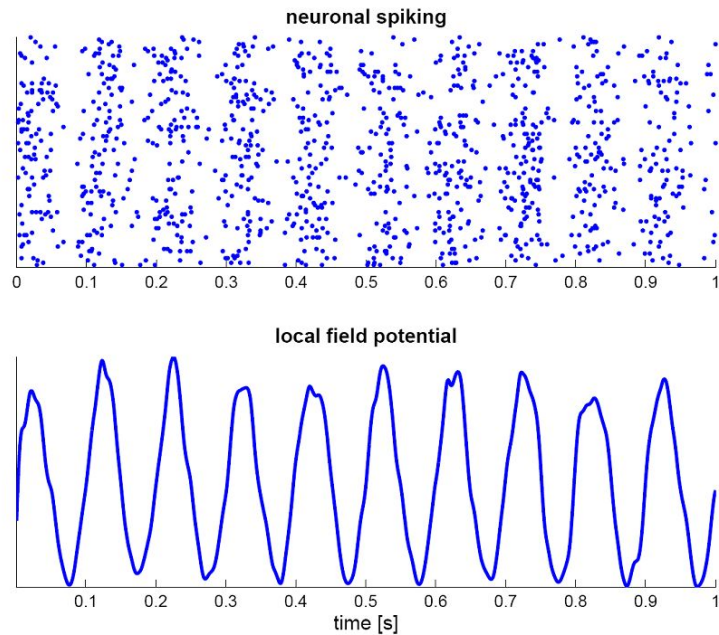
“What I cannot create, I do not understand.”
Richard Feynman

Find meaningful structure within fluctuating data

Assume that data is not fully random, but ***generated by some process*** whose structure we can deduce

We don't need labels, but simply the ability to predict new data → invert and improve our model based on the quality of the prediction

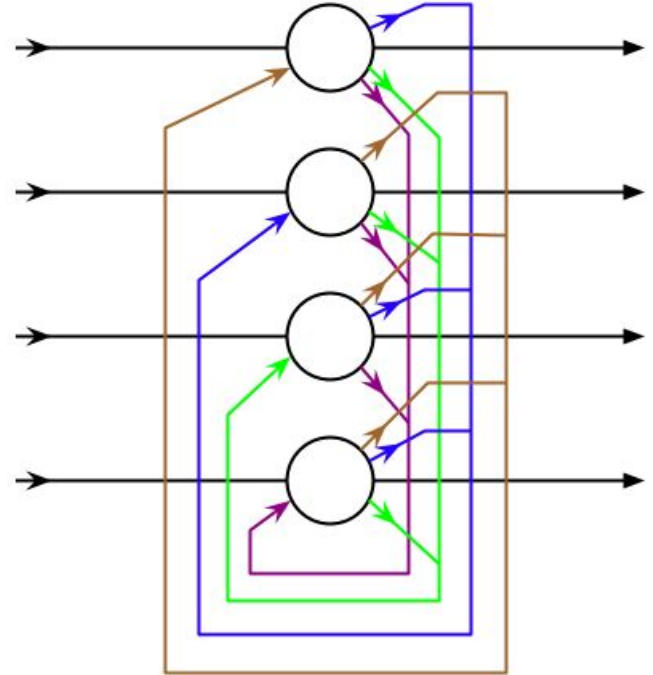
Finding hidden structure



Machine Learning Tools

Recurrent Neural Networks
are universal function approximators

→ they can model every possible dynamical system



Dynamical Systems in Neuroscience

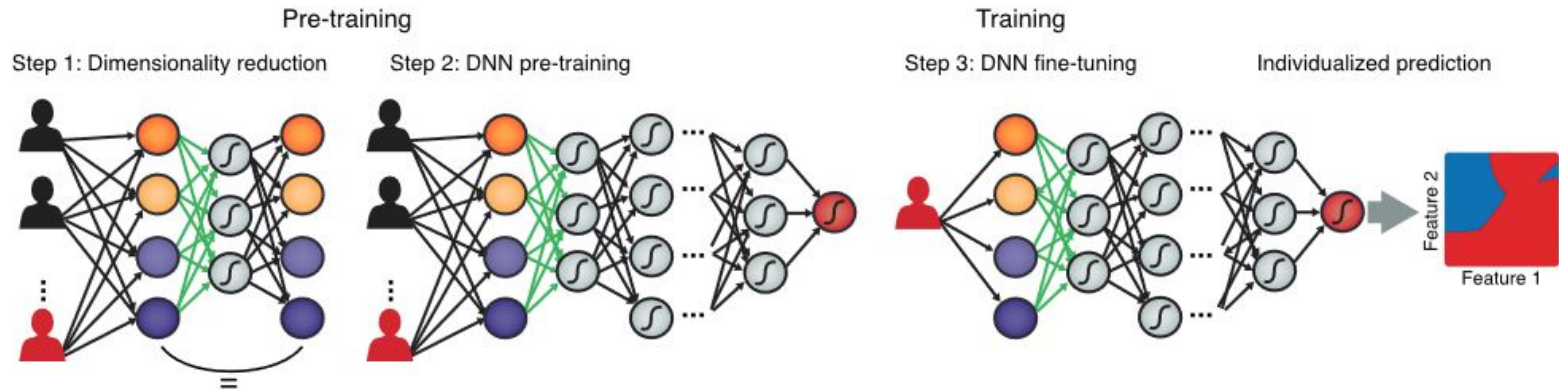
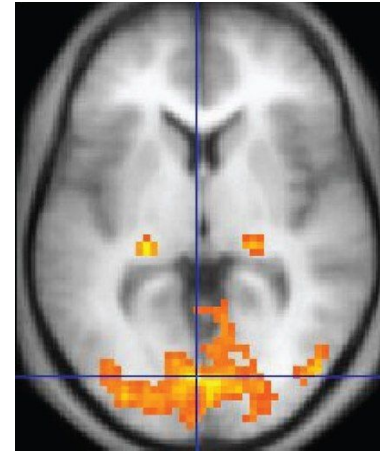


Fig. 5 DNNs for individualized (treatment) predictions. In order to employ more complex FNN or RNN models for person-tailored predictions, we can pre-train a NN on multiple individuals. We first reduce the input dimensions, e.g., with an autoencoder (step 1), and then pre-train a DNN on the reduced inputs for a large sample (step 2). The pre-trained network may then be fine-tuned on the specific individual in a third step (right panel). Future data points could then be used to forecast symptom onset, treatment response, or other mental health-

Organizational Questions

You can hand in sheet either alone or in groups of two

If you hand in alone, you need 6/12 points, in a group, you need 8/12 points

Make sure you upload your solutions either as pdf or html files (one file in total!)

If you need a grade for the lecture, you can let us know in the end and select 6 (if you hand in alone) or 8 (if you hand in as a group) out of 12 of the sheets you want to have graded in more detail. Based on the score, you will receive a grade.

Jupyter Notebooks

Notebooks are (in my opinion) the most straightforward way of solving the sheets, but Matlab is also in principle possible

You can write Latex in the Markdown sections of the notebook