**Kanaka Rajan – CNeuro Lectures 2021**

**Lecture 1 Abstract (Basic)**

*Method and Logic in Recurrent Neural Network (RNN) Models*
In this introductory lecture, we’ll review the basic elements (“building blocks”) of neural network models, including the role of recurrent connections, linear and non-linear activity, types of time-varying activity (“dynamics”) produced by RNNs, and input-driven vs. spontaneous dynamics. This lecture is designed to discuss both the tractability and computational power of RNN models— laying the foundation to appreciate why they have become such a powerful tool in the neurosciences.

**Lecture 2 Abstract (Advanced)**

*RNNs for Mechanism Discovery in Neuroscience*
In this more advanced lecture, we’ll explore the many ways in which RNNs have been applied to neuroscience research and the discoveries they’ve enabled. We’ll discuss how RNNs are built, how they can leverage existing experimental data to infer mechanisms inaccessible from measurements alone, and how they can be used to make predictions that guide experimental design. This lecture builds on the method and logic of RNNs to help us appreciate the insights that can be gained when neural networks are "trained to do something” in a manner consistent with data collected from the biological brain.

**Supplementary Readings**

* Barak, O. (2017). Recurrent neural networks as versatile tools of neuroscience research. Current Opinion in Neurobiology, 46, 1–6. doi: https://doi.org/10.1016/j.conb.2017.06.003
* Perich, M. G., & Rajan, K. (2020). Rethinking brain-wide interactions through multi-region “network of networks” models. Current Opinion in Neurobiology, 65, 146–151. doi: <https://doi.org/10.1016/j.conb.2020.11.003>
* Jazayeri, M., Ostojic, S. (2021). Interpreting neural computations by examining intrinsic and embedding dimensionality of neural activity. <https://arxiv.org/abs/2107.04084>
* Vogels, T. P., Rajan, K., & Abbott, L. F. (2005). Neural network dynamics. Annual Review of Neuroscience, 28(1), 357–376. doi: <https://doi.org/10.1146/annurev.neuro.28.061604.135637>