Paper Summaries: Phase II

# Markram, H., Gerstner, W. and Sjöström, P.J., 2012. Spike-timing-dependent plasticity: a comprehensive overview. *Frontiers in synaptic neuroscience*, *4*, p.2.

This paper comprehensively introduces the history of the study of the spiking-timing-dependent plasticity property of biological neuronal network. The paper explained why timing of biological signals is important and how such binary signal form can make neuronal network so complicated and enables incredible ability like learning and adapting. This paper helped us to obtain better understanding of the spiking neural network from a biological perspective.

# Morrison, A., Aertsen, A. and Diesmann, M., 2007. Spike-timing-dependent plasticity in balanced random networks. *Neural computation*, *19*(6), pp.1437-1467.

This paper discusses the benefit of introducing spike-timing-dependent plasticity (STDP) into the artificial neuronal network. It also investigates how high level of network connectivity would affect the neuron dynamics. The papers gives us a very good example of how STDP can be implemented in an artificial spiking neural network.

# Turrigiano, G.G. and Nelson, S.B., 2000. Hebb and homeostasis in neuronal plasticity. *Current opinion in neurobiology*, *10*(3), pp.358-364.

This paper investigates how STDP property enables neuronal network to facilitate Hebbian unsupervised learning and introduces a new property called homeostasis, which suppresses the activity of certain neurons that fire too frequently so that they do not negatively affect other neurons in the network. This vies us insight about how a learning algorithm can be implemented using SNN, STDP and homeostasis property.

# Kheradpisheh, S.R., Ganjtabesh, M., Thorpe, S.J. and Masquelier, T., 2018. STDP-based spiking deep convolutional neural networks for object recognition. *Neural Networks*, *99*, pp.56-67.

This paper discusses about an actual complete example of SNN running certain learning algorithms. We learned how input data is preprocessed and how network is constructed with STDP systematically. This paper provides a good example of how we can construct an effective learning scheme using SNN.

# Querlioz, D., Bichler, O., Dollfus, P. and Gamrat, C., 2013. Immunity to device variations in a spiking neural network with memristive nanodevices. *IEEE Transactions on Nanotechnology*, *12*(3), pp.288-295.

This paper gives us another example of how SNN learning can be achieved and how it can be implemented using memristive nanodevices. It describes how synaptic behavior and neuron dynamics are defined and implemented in the system, which helps us to better understand the structure needed to build an effective SNN.

# Marcel, S. and Romain, B., 2019. Brian 2, an intuitive and efficient neural simulator. *eLife*, *8*.

This paper introduces the fundamental working mechanics behind the Brian 2 spiking neuron network simulator. The paper gives us better insight on how the simulator should be manipulated to realize our SNN design and how to compress the network as well.