COMS30017 Computational Neuroscience

Week 3 Problem sheet

Video 1

- What is the pathway undergone an electric signal, starting as an Action Potential at the presynaptic neuron, and ending as a Post-synaptic Potential, at the postsynaptic neuron?
- What is the difference between ionotropic and metabotropic receptor?
- Why is a synapse considered unreliable?
- What characteristics of a synapse are useful for computational functions?

Video 2

- What are the advantages of using a phenomenological model of a synapse instead of detailed molecular dynamics?
- Write down an equation for an inhibitory synapse.
- If a synaptic receptor is connected to an ionic channel that has a reversal potential of +10mV, would that synapse be considered excitatory or inhibitory?
- What is the equivalent electrical circuit representation of a synapse?

Video 3

- Name three factors that can influence synaptic plasticity.
- What are the two main timescales of synaptic plasticity (give approximate values)?
- Explain why memory is a synaptic feature.

Video 4

- What is the main cause of short-term synaptic depression/facilitation?
- Explain how short-term depression/facilitation can function as a low/high-pass filter for action potentials.

Video 5

- Rephrase Hebb's rule with your own words.
- Explain how a simple model of Hebb's rule would be unstable.
- What property of the BCM model is seen the development of visual circuit?
- What kind of glutamate receptor is considered crucial for Hebbian plasticity and why?
- Give the equations for the basic pairwise STDP model, and draw the corresponding graph.