

# COMS30017

## Computational Neuroscience

Week 4: Synapses and Synaptic Plasticity

**Video 3: WHAT IS SYNAPTIC PLASTICITY?**

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# Intended learning outcomes

- Understand the concept of synaptic plasticity;
- Gain intuition around possible functions for synaptic plasticity;

# Synapses change

- The magnitude of a synapse's electrical response to an action potential can change depending on the activity history of the synapse (known as plasticity).
- These changes can be **short**-lasting (ms~s) or **long**-lasting (hours~years)
- Even the way synapses change can change itself, a process called **metaplasticity** (won't be explored in this course).

# Synapses have memory?

- Synaptic plasticity is generally believed to be the primary basis of long-term memory in the brain.
- Other neural components are also plastic (intrinsic excitability, neural morphology, etc), but their role in learning and memory is poorly understood. We will not cover them in this unit.
- Synapses increase or decrease their strength according to certain 'rules of plasticity'.

# Synapses have memory?

- Linked to learning and memory in the following way:
  - Neural activity during learning triggers synaptic strength changes.
  - Synaptic strength changes alters the propensity for neurons to fire.
  - Next time the same neural circuit receives an input, it responds in a different fashion than it otherwise would have.

Associative memory  
(e.g. Pavlov's dogs)

# What to consider in a synaptic plasticity rule?

- Spike times
- Spiking rates
- Cooperativity
  - Normalization
- Other kinds of plasticity
- Networks

# Summary

- There are many kinds of plasticity in neuroscience;
- Synaptic plasticity is a paradigm of memory;
- Also useful from the point of start of ANNs;