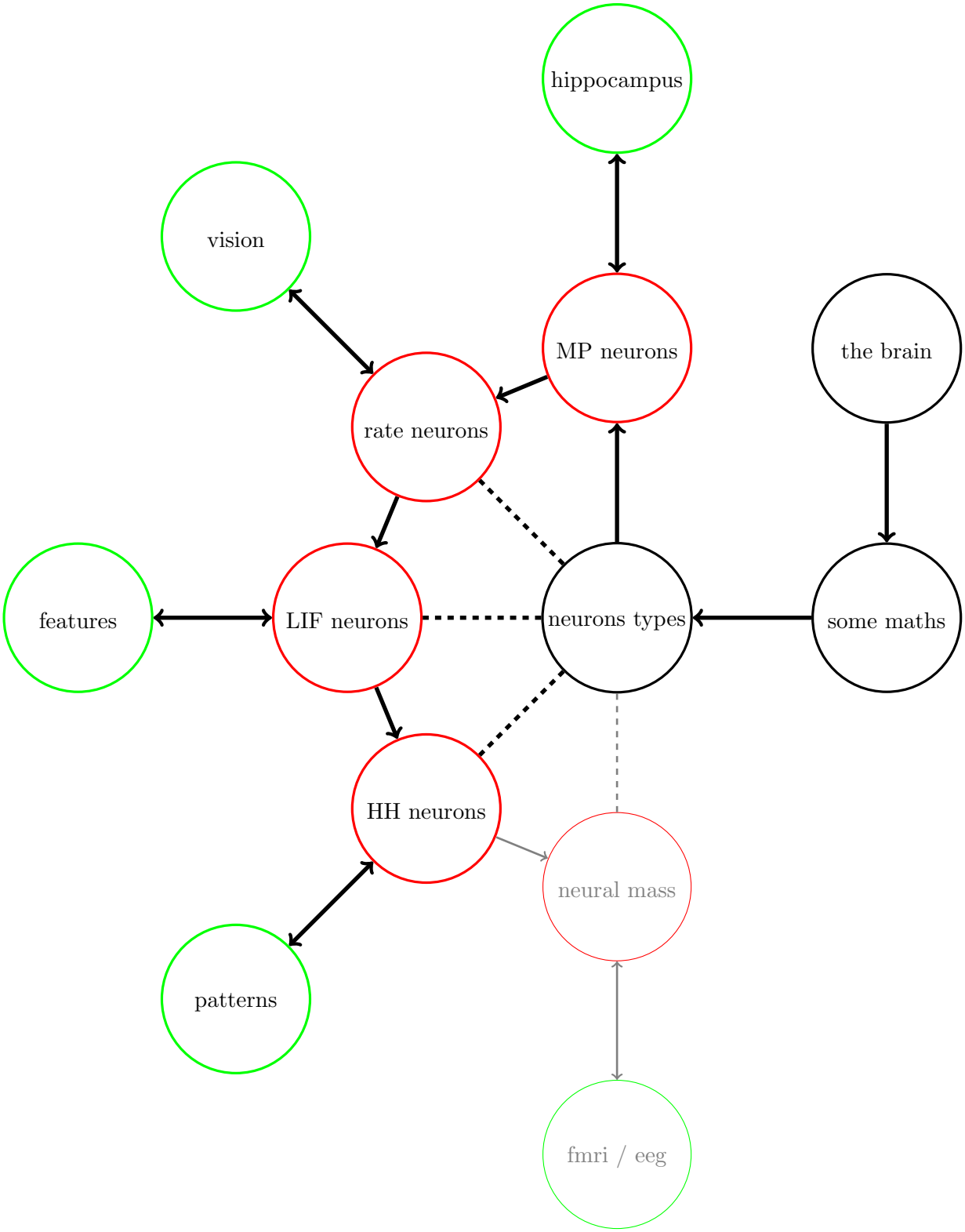
Course plan


hippocampus
vision
MP neurons
the brain
rate neurons
features
LIF neurons
neurons types
some maths
HH neurons
neural mass
patterns
fmri / eeg

Key to the plan

(a) **the brain:** A quick and easy outline introduction to the brain and neuroscience.

(b) **some math:** An introduction to scientific computing and differential equations.

(c) **neuron types:** An overview of neuronal modelling.

(d) **MP neurons:** The McCulloch Pitts model of neurons, simple synapses.

(e) **hippocampus:** Hebbian plasticity, description of the hippocampus and auto-associative memory.

(f) **rate neurons:** The rate model of neurons, including receptive fields.

(g) **vision:** The visual pathway; V1, receptive fields in V1 and sparse coding.

(h) **LIF neurons:** Spiking, spike triggered averages and time histograms, the leaky integrate and fire neuron.

(i) **features:** Spike timing dependent plasticity and feature extraction.

(j) **HH neurons:** Ion channels and Hodgkin-Huxley neurons; Morris-Lecar and other models.

(k) **patterns:** Some ideas from dynamical systems, central pattern generators.

(l) **neural mass:** Neural mass models and field equations for neurons.

(m) **fmri / eeg:** From neurons to the brain; modelling the interactions of brain regions.

The last two sections are aspirational, it is likely there will not be time to discuss them and they will not be examined.

Rough lecture list

This is a rough guide, it might change as the course progresses.

1. Introduction to the course and to the brain. (a)
2. More on the brain. (a)
3. Scientific programming in Python or Julia. (b)
4. Introduction to differential equations. (b)
5. The example of the 'bucket equation' (b)
6. Scientific programming in Python or Julia, redux. (b)
7. Modelling neurons. (c)
8. The McCullough-Pitts neuron and Hebbian plasticity. (d)

9. The Hippocampus. (e)
10. CA3 as a auto-associative memory, pattern seperation. (e)
11. Firing rates, dealing with neuronal data, receptive fields. (f)
12. The visual system. (g)
13. V1 and sparse coding. (g)
14. Spikes and analysing spike date. (h)
15. Simple models of neurons: leaky integrate and fire neurons. FI curves (h)
16. Synapses and synaptic plasticity. (i)
17. STDP and feature extraction. (i)
18. Ion channels. (j)
19. The Hodgkin-Huxley equation and spikes. (j)
20. Dynamical systems approachs, the Morris-Lecar model, phase diagrams. (j/k)
21. Central pattern generators, bursting. (k)
22. Spare lecture.