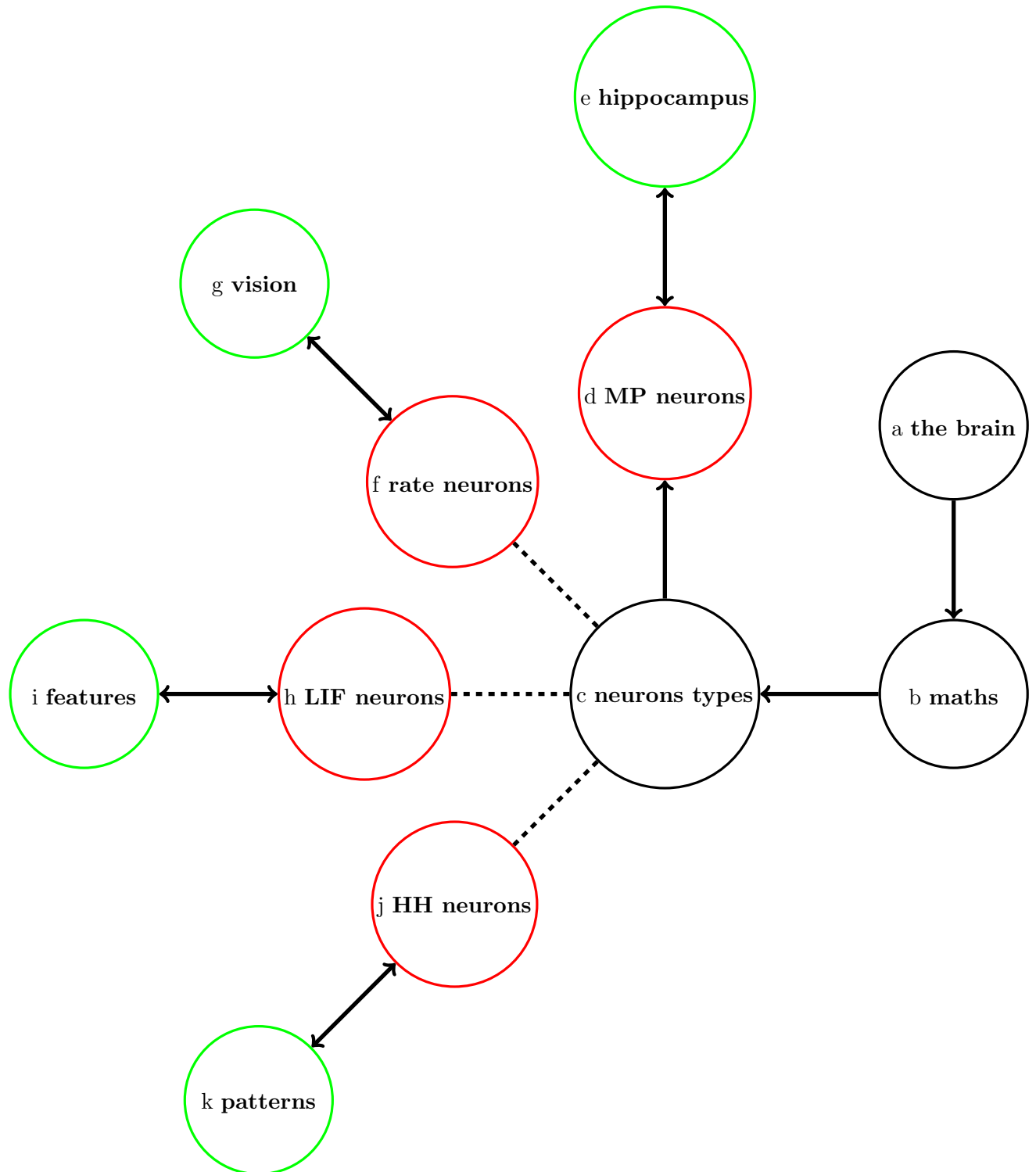


Course plan



Key to the plan

- (a) **the brain:** A quick and easy outline introduction to the brain and neuroscience.
- (b) **some math:** An introduction to differential equations and their numerical solution.
- (c) **neuron types:** An overview of neuronal modelling.
- (d) **MP neurons:** The McCulloch-Pitts model of neurons, simple synapses.
- (e) **hippocampus:** Description of the hippocampus and auto-associative memory computations.
- (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.

Lecture list

1. Introduction to the course and to the brain. (a 01-29 Conor)
2. More on the brain. (a 01-31 Conor)
3. Still more on the brain. (a 02-05 Conor)
4. Introduction to differential equations. (b 02-07 Conor)
5. Numerical solutions to differential equations. (b 02-12 Conor)
6. Modelling neurons. (c 02-14 Cian)
7. The McCulloch-Pitts neuron, Perceptrons, and Hopfield networks. (d 02-19 Cian)
8. The Hippocampus. (e 02-21 Cian)
9. Models of hippocampal computations: Pattern separation, pattern completion, and path integration. (e 02-26 Cian)
10. Firing rates, dealing with neuronal data, receptive fields. (f 02-28 Cian)
- [Reading week]
11. The visual system. (g 03-12 Cian)

12. V1 and sparse coding. (g 03-14 Cian)
13. Spikes and analysing spike data. (h 03-19 Cian)
14. Leaky integrate and fire model neurons. F-I curves (h 03-21 Cian)
15. Synapses and synaptic plasticity. (i 03-26 Rui)
16. Short-term synaptic plasticity (i 03-28 Rui)
17. Long term synaptic plasticity. (i 04-02 Rui)
18. Q+A session with Conor, Rui and Cian (04-04)
- [Easter break, 3 weeks]
19. Ion channels. (j 04-30 Conor)
20. The Hodgkin-Huxley equation and spikes. (j/k 05-02 Conor)
21. Dynamical systems approaches, the Morris-Lecar model, phase diagrams. (k 05-07 Conor)
22. Central pattern generators, bursting. (k 05-09 Conor)