IMPERIAL

Module Specification

Basic details

UID		Cohorts covered (Earliest cohort)	
Long title	Neuroscience for Machine Learners		
New code	ELEC70110	New short title	

Brief description of module *(approx. 600 chars.)*

The mathematical/computational study of the brain shares a rich history with machine learning, with substantial mutual interactions between the two fields. In this course, students of machine learning will learn some of that history and how contemporary thinking in neuroscience can inform and be informed by developments in machine learning. The course will cover some basic biological background, an overview of brain models, and go in depth into models of learning in brains and machines. It will also outline trends in neuromorphic computing, the design of brain-inspired computational hardware

Available as a standalone module/ short course? N

Statutory details

	ECTS	CATS	Non-credit	
Credit value	5	10	N	HECOS codes

FHEQ level: 7

Allocation of study hours

	Hours	
Lectures	10	
Group teaching	20	*Incl. seminars, tutorials, problem classes.*
Lab/ practical	0	
Other scheduled	0	*Incl. project supervision, fieldwork, external visits.*
Independent study	95	*Incl. wider reading/ practice, follow-up work, completion of assess*
Placement	0	*Incl. work-based learning and study that occurs overseas.*
Total hours	125	
ECTS ratio	25.00	

Project/placement activity

Is placement activity allowed? No

Module delivery

Delivery mode	Taught/ Campus	Other	
Delivery term	Term 1	Other	

Ownership

Primary department: Electrical Engineering

Additional teaching departments:

Delivery campus	South Kensington

Collaborative delivery

Collaborative delivery?	N

External institution	N/A
External department	N/A
External campus	N/A

Associated staff

Role	CID	Given name	Surname
Module Leader		Dan	Goodman

Learning and teaching

Module description

Learning outcomes

At the end of this module you will be able to:
1. Compare and contrast the underlying aims, objectives, and methodologies employed in neuroscience and machine learning.
2. Argue how developments in neuroscience and machine learning have mutually influenced each other.
3. Decide on the application of techniques in computational neural modelling.
4. Derive mathematical relationships between theories of learning in brains and machines.
5. Compose and modify training algorithms for biologically realistic "spiking neural networks".
6. Assess potential future points of cross-over between machine learning and neuroscience.

Module content

- History of links between neuroscience and machine learning
- Challenges for machine learning (robustness, sample efficiency, etc.)
- Basic biology of the brain (neurons, synapses, spikes, etc.)
- Basic models of the brain
- Different factors and constraints on learning in brain and machines
- Biological and machine learning rules and their mathematical relationships
- Training spiking neural networks with surrogate gradient descent and other algorithms
- Overview of different types of neuromorphic computing hardware
- Open issues in neuroscience and their relationship to machine learning

Learning and Teaching Approach

This will be a flipped classroom module with lecture materials recorded as videos to be watched when students wish, and classes focussed on applying the knowledge and techniques in a practical computational setting.

Assessment Strategy

There will be:
- One coursework combining mathematical theory and computational analysis
- One written test to be taken in exam conditions based on the coursework
- One online quiz

The coursework will cover mathematical models of neurons and biological neural networks (ILO 3-4), and training spiking neural networks (ILO 5).
The written test will assess students' understanding of the work they did in the coursework, to work around the use of LLMs in doing the coursework.
The online quiz will assess overall knowledge (ILO 1, 2, 6).

Feedback	Assessment will be summative via grades and comments on coursework and quiz, and formative via feedback in flipped classes.
Reading list	Nothing required.

Quality assurance

Date of first approval	
Date of last revision	May 2026
Date of this approval	
Module leader	Dan Goodman
Notes/ comments	

Office use only

QA Lead	
Department staff	
Date of collection	
Date exported	
Date imported	

Template version

Assessment details

Grading method	Numeric	Pass mark	50%

Assessments

Assessment type	Assessment description	Weighting	Pass mark	Must pass?
Coursework	Colab experiments on brain models and training spiking neural networks	60%	50%	N
Examination	Online quiz assessing overall knowledge	20%	50%	N
Examination	Written test assessing understanding of coursework	20%	50%	N
		100%		