IMPERIAL

Module Specification

Basic details

UID		Cohorts covered (Earliest cohort)	
Long title	Advanced Deep Learning Systems		
New code	ELEC70109	New short title	
Brief description of module *(approx. 600 chars.)*	The widespread adoption of deep learning methods has been largely driven by the availability of easy-to-use systems such as PyTorch and TensorFlow. However, it is less common for users to explore the internals of the libraries and understand how they function, as well as how to optimize the high-level code for hardware systems. When deep learning algorithms are deployed into custom hardware, they are often modified to run faster and more efficiently. This module will provide you with the basic concepts and principles of modern deep learning systems, and explore how optimizations can be applied from both the software and hardware aspects of the system stack.		
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	18	
Group teaching	0	*Incl. seminars, tutorials, problem classes.*
Lab/ practical	0	
Other scheduled	2	*Incl. project supervision, fieldwork, external visits.*
Independent study	105	*Incl. wider reading/ practice, follow-up work, completion of assess*
Placement		*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 2	Other	

Ownership

Primary department	DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGIN
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		Krystian	Mikolajczyk
Lecturer		Christos	Bouganis
Lecturer		Yassir	Jedra

Learning and teaching

Module description

Learning outcomes	On successful completion of this module, you'll be able to : (1) Analyze the design principles of modern machine learning systems (2) Argue the mapping of high-level Python code in Pytorch or Tensorflow into actual hardware (such as GPUs and FPGAs) (3) Assess the potential benefits of software and hardware optimizations (4) Argue by comparing and contrasting how various vision and language models can benefit from different optimizations and being mapped to hardware.
Module content	The module introduces the design, optimisation, and deployment of modern deep learning systems, with an emphasis on foundation models and large-scale AI. It covers transformer architectures for language, vision, and multimodal learning, including attention mechanisms, embeddings, Mixture-of-Experts, and retrieval-augmented generation. Students study parameter-efficient adaptation techniques, distributed training, compiler technologies, model compression, and inference optimisation across heterogeneous hardware. The module also explores multimodal and embodied AI systems, agentic AI, and practical deployment considerations, including benchmarking, evaluation, robustness, and responsible AI. Through analysis of recent research papers and a substantial group project, students gain experience in designing, implementing, optimising, and evaluating scalable deep learning systems using modern software frameworks and hardware accelerators.
Learning and Teaching Approach	This module will consist of 9 two-hour lecture sessions. Lectures will provide you with the necessary theories and a series of background readings. You will also learn through a practical project done in small groups during the term.
Assessment Strategy	The module is assessed by coursework which consists of a group project in Deep Learning (80%), as well as through an online quiz (20%).
Feedback	You will be provided with written comments on the quality of submitted coursework results.
Reading list	A reading list will be provided in lectures

Quality assurance

Office use only

Date of first approval	May 2023	QA Lead	
Date of last revision	July 2026	Department staff	
Date of this approval		Date of collection	
		Date exported	
Module leader	KRYSTIAN MIKOLAJCZYK	Date imported	
Notes/ comments			

Template version

Assessment details

Grading method	Numeric	Pass mark	50%

Assessments

Assessment type	Assessment description	Weighting	Pass mark	Must pass?
Coursework	Group project	80%	50%	N
Examination	Test	20%	50%	N
		100%		