IMPERIAL

Module Specification

Basic details

UID		Cohorts covered	Earliest cohort: Latest c:
Long title	Distributed Optimisation and Learning		
New code	ELEC70082	New short title	
Brief description of module *(approx. 600 chars.)*	You will see how learning algorithms, from least mean squares to backpropagation can be derived from risk minimization, and how these insights can be exploited to derive distributed counterparts of the algorithms, both in federated and decentralised settings. You will become familiar with the challenges associated with developing distributed systems (what to share, heterogeneity, adversaries, model-fusion), as well their advantages once properly designed (privacy, robustness, communication efficiency). Material will be accompanied by applications in signal processing, communications, and other areas.		
	607 characters		
Available as a standalone module/ short course?	Y		

Statutory details

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

Allocation of study hours

	Hours	
Lectures	20	
Group teaching	10	*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 assessments*
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 2	Other	

Ownership

Primary department	Electrical and Electronic Engineering
Additional teaching departments	N/A
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
Lecturer		Stefan	Vlaski

Learning and teaching

Module description

Learning outcomes	By the end of this module, you will be able to (1) recommend settings where distributed solutions are likely to yield substantial improvements, (2) develop distributed/decentralised versions of centralised algorithms, (3) analytically quantify trade-offs associated with distributed implementations, and (4) implement algorithmic solutions in code, making use of relevant packages.
Module content	The module will cover (1) empirical risk minimisation and (stochastic) gradient descent with variants, (2) multi-objective optimisation and Pareto optimisation, (3) distributed and federated learning, (4) graph and network theory, (5) primal schemes for Pareto optimisation (penalty, diffusion), (6) primal-dual schemes for Pareto optimisation and (7) multitask learning, (8) privacy and (9) learning with limited communication resources.
Learning and Teaching Approach	Module material is covered in weekly lectures of 2 hours each. Material is reinforced in biweekly homeowork assignments (4 over the course of the term), supported through tutorial session (1 hour per week). A small practical project complements analytical homework assignments.
Assessment Strategy	30% midterm exam, 30% final exam, 20% homework assignments, 20% small project.
Feedback	All assessed material will be returned to you with marks within 2 weeks. You will receive summative and formative feedback on the midterm exam. You will receive individual summative and formative feedback on the small project. The feedback on the final exam will be provided in the form of annotated model solutions.
Reading list	The reading list will be provided in session

Quality assurance

Date of first approval	February 2022
Date of last revision	July 2023

Office use only

QA Lead	
Department staff	

Date of this approval		Date of collection	
		Date exported	
Module leader	Stefan Vlaski	Date imported	
Notes/ comments			

Template version #####

Assessment details

Grading method	Numeric	Pass mark	50%

Assessments

Assessment type	Assessment description	Weighting	Pass mark	Must pass?
Examination	Midterm exam	30%	50%	N
Examination	Final exam	30%	50%	N
Coursework	Homework #1 (Problem Set)	5%	50%	N
Coursework	Homework #2 (Problem Set)	5%	50%	N
Coursework	Homework #3 (Problem Set)	5%	50%	N
Coursework	Homework #4 (Problem Set)	5%	50%	N
Coursework	Project (code + 1-page report)	20%	50%	N
		100%		