IMPERIAL

Module Specification

Basic details

UID		Cohorts covered	Earliest cohort: Latest:
Long title	Topics in Large Dimensional Data Processing		
New code	ELEC70037	New short title	
Brief description of module *(approx. 600 chars.)*	In this module, you will acquire technical skills to design convex and nonconvex optimization algorithms to process and to analyse large dimensional data. You will be exposed to various application domains where the development of tools for analysis of large dimensional data is essential. This includes applications in image/video processing, machine learning, collaborative filtering, social network, financial data analysis. 428 characters		
Available as a standalone module/ short course?	No		

Statutory details

	ECTS	CATS	Non-credit		
Credit value	5	10	N	HECOS codes	
FHEQ level	L7				

Allocation of study hours

	Hours	
Lectures	20	
Group teaching	0	*Incl. seminars, tutorials, problem classes.*
Lab/ practical	0	
Other scheduled	0	*Incl. project supervision, fieldwork, external visits.*
Independent study	105	*Incl. wider reading/ practice, follow-up work, completion of assessment*
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	Department of Electrical and Electronic Engineering
Additional teaching departments	0

Delivery campus	South Kensington

Collaborative delivery

Collaborative delivery?	No
External institution	
External department	
External campus	

Associated staff

Role	CID	Given name	Surname
Module Leader and Lecturer		Wei	Dai
Lecturer		Stefan	Vlaski
Lecturer		Chen	Qin
		0	0
		0	0
		0	0
		0	0
		0	0
		0	0
		0	0

Learning and teaching

Module description

Learning outcomes	Upon successful completion of this module, you will achieve the following learning outcomes: 1. Design algorithms tailored for processing large-dimensional data, with an emphasis on identifying sparse structures within the data for dimension reduction and human interpretation. 2. Apply principles from linear algebra, statistics, and optimization to model real-world challenges that involve large-dimensional data. 3. Implement and create efficient optimization methodologies for solving problems related to large-dimensional data. 4. Demonstrate proficiency in solving specific real-world problems by applying the acquired skills. These applications span various domains including sensing and imaging, online recommendation systems, computer vision, and machine learning tasks.
Module content	1. Introduction to large dimensional data processing: Challenges and Hidden Structures. 2. Mathematical tools for large dimensional data processing ** Matrix analysis ** Optimization: Convexity, duality, greedy algorithms, and proximal algorithms. 3. Formulations to explore sparsity in the data ** Linear inverse problems ** Sparse linear inverse problems ** Sparse bilinear inverse problems 4. Selected real-world applications ** Google page rank, compressed sensing, denoising, robust classification, Netflix problem, blind deconvolution, super-resolution, etc.
Learning support	1. Online lecture notes and videos for comprehensive review and revision. 2. GTAs host regular Q&A sessions to provide timely assistance and clarify concepts. 3. An online Q&A channel supports students who cannot attend in-person sessions. 4. Group projects as coursework foster peer-learning, collaboration, and teamwork. 5. Four coursework assignments throughout the term, followed by detailed performance charts for timely feedback and identifying areas of strength and improvement. 6. In-lecture discussions of selected coursework problems encourage peer-to-peer discourse and analysis of problem-solving strategies.

Pattern of learning and teaching activities	Two lectures per week, one Q&A session led by the GTAs weekly, and four coursework assignments distributed throughout the term.
Learning and Teaching Approach	1. Lectures delve into key concepts, fundamental theories, and various applications in detail. 2. Through coursework, students engage in learning and practical application of theory by solving problems. These exercises aim to enhance understanding and solidify theoretical concepts, drawing from both theoretical scenarios and real-world applications. 3. Selected problem solutions from coursework will be reviewed during lectures. This facilitates students' understanding of different problem-solving approaches, enabling them to tailor solutions to specific practical needs and compare various methods effectively.
Assessment Strategy	The module's assessment consists of four coursework assignments, with each assignment contributing 25% to the final mark.
Feedback	1. Regular Q&A sessions led by GTAs to clarify concepts, address questions, and offer timely assistance to students. 2. An online Q&A channel to offer help and support for students unable to attend regular sessions. 3. Detailed coursework performance charts to delineate areas of strength and areas needing improvement. 4. In-lecture discussions on selected problems to foster peer-to-peer discourse and analyze problem-solving approaches.
Reading list	Supplementary [1] Boyd, Stephen, Stephen P. Boyd, and Lieven Vandenberghe. Convex optimization. Cambridge university press, 2004. [2] Rish, Irina, and Genady Grabarnik. Sparse modeling: theory, algorithms, and applications. CRC press, 2014.

Quality assurance

Date of first approval	
Date of last revision	March 2024
Date of this approval	
Module leader	Dr. Wei Dai

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QA Lead	
Department staff	
Date of collection	
Date exported	
Date imported	

Notes/ comments

Template version #####

Assessment details

Grading method	Numerical	Pass mark	50%

Assessments

Assessment type	Assessment description	Weighting	Pass mark	Must pass?
Coursework	Design Project 1 (A Report)	25%	50%	N
Coursework	Design Project 2 (A Report)	25%	50%	N
Coursework	Design Project 3 (A Report)	25%	50%	N
Coursework	Design Project 4 (A Report)	25%	50%	N
0		0%	0%	0.00
0	0	0%	0%	0.00
0	0	0%	0%	0.00
0	0	0%	0%	0.00
0	0	0%	0%	0.00
0	0	0%	0%	0.00
0	0	0%	0%	0.00
0	0	0%	0%	0.00
		100%		