IMPERIAL

Module Specification

Basic details

UID		Cohorts covered	Earliest cohort: Latest c:
Long title	Self-Organising Multi-Agent Systems		
New code	ELEC70071	New short title	

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

The paradigm of self-organisation is fundamental to theories of collective action in economic science and democratic governance in political science. This module takes an innovative but systematic approach to transforming theories of economics and politics (and elements of philosophy, psychology, and jurisprudence) into an executable logical specification of conventional rules. It shows how sets of such rules, called institutions, provide an algorithmic basis for designing and implementing cyber-physical systems, enabling intelligent software processes (called agents) to manage themselves in the face of competition for scarce resources. It also points the way to implementing socio-technical systems for the Digital Society which are sustainable, fair and legitimate.

776 characters

Available as a standalone module/ short course? N

Statutory details

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

Allocation of study hours

	Hours	
Lectures	20	
Group teaching	4	*Incl. seminars, tutorials, problem classes.*
Lab/ practical	70	
Other scheduled	0	*Incl. project supervision, fieldwork, external visits.*
Independent study	31	*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 1	Other	

Ownership

Primary department	Electrical & Electronic 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
Professor		Jeremy	Pitt

Learning and teaching

Module description

Learning outcomes	On successful completion of this module, you should be able to: 1. Analyse situations of coordination and strategic interaction in distributed systems of autonomous components (agents); 2. Account for basic concepts of computational agency, self-organisation, and the social construction of conceptual resources; 3. Design and operationalise systems which are regulated by mutually-agreed and mutable conventional rules; 4. Specify and implement algorithms for strategic decision-making related to action selection, preference selection, dispute resolution, opinion formation, and collective action; and 5. Create self-organised solutions to "social" problems in multi-agent systems, such as sustainability, fairness, knowledge management and legitimate self-governance.
Module content	Part 1: Foundations Agents & Multi-Agent Systems: BDI architecture, MAPE architecture, agent communication languages and protocols, institutionalised power, bounded rationality Self-Organisation & Self-Adaptation: autonomous systems, autonomic systems, dynamic norm-governed systems, evolutionary computing, complexity and stability **Part 2:** Strategic Interaction Game Theory: 2-player sequential games, dominant strategy, Nash Equilibrium, mechanism design, Evolutionary GT Social Choice Theory: voting rules and winner determination, manipulation, Arrow's Theorem and other paradoxes Opinion Formation: opinion dynamics, social networks, social influence, leadership Institutions: electronic institutions, Ostrom's principles, collective action, sustainability **Part 3:** Social Interaction Justice: distributive, retributive, procedural, interactional Exchange: conceptual resources: trust, forgiveness and social capital; gift economies, economies of esteem Knowledge: processes of aggregation, alignment and codification; knowledge commons Governance: constitutional choice, -archy and -ocracy, polycentricity, liberal democracy, basic

Learning and Teaching Approach	The module is intended to provide equal balance between theory and practice, with theory developed in lectures, reinforced by a corresponding investment in practical laboratory work, each being considered to make an equal contribution to students' academic progress and prowess. The laboratory work is a whole class practical exercise in building a multi-agent system to solve a substantial problem. The students will be encouraged to realise that many of the problems they are facing in undertaking this enterprise can be analysed, and indeed solved, by applying the techniques being studied in the lectures. As a beneficial side-effect this is intended to reinforce their personal development and support the development of transferable skills in project management, teamworking, and decision-making. The module will provide further opportunity for students to develop their skills in different programming paradigms. The curriculum is intentionally broad to expose the students to the considerable variety of theories, and to provide an inter-disciplinary overview, but with sufficient depth to appreciate the complexity and timeliness of the subject, that these topics are the subject of intensive research and development, both in the college and around the world, and have many applications. Finally, you are encouraged to engage in reflection, i.e. to think about your change as an individual as an outcome of undergoing a learning process and experience. In particular, you will relate what you have learnt in theory (and applied in the laboratory) as it applies to yourself and you cohort, as a "self-organising multi-agent system" yourselves. In particular, the aim is to link technical systems involving strategic and social problem-solving to the students' own decision-making and self-organisation processes, and so how this introspective knowledge might be applied in the design and development of socio-technical and cyber-physical systems in general.
Assessment Strategy	This moduel is assessed 100% by Coursework. You will be work in teams of 6-8 people on a problem that involved the entire class. This is a collective test of ability to apply theoretical knowledge through the development of a large-scale system that will require implementation of relevant algorithms. As part of the assessment of this work, there will be a written report, a demonstration and an oral presentation. Elements of self-assessment and peer-assessment will also be included. These mechanisms will enable an accurate assessment of individual ability and expertise, as well as a candid assessment of your contribution to the collective enterprise.
Feedback	Regular weekly meetings will be held throughout the coursework to monitor and evaluate progress. Substantive written feedback on the final report will be given at the conclusion of the course. Reflection, and a discussion of your reflection, will be encouraged throughout and after the process.
Reading List	Jeremy Pitt, Self-Organising Multi-Agent Systems: Algorithmic Foundations of Cyber-Anarcho-Socialism. World Scientific, 2021.

Quality assurance

Date of first approval	
Date of last revision	July 2025
Date of this approval	
Module leader	Prof. Jeremy Pitt

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QA Lead	
Department staff	
Date of collection	
Date exported	
Date imported	

Notes/ comments	

Assessment details

Grading method	Numeric	Pass mark	50%

Assessments

Assessment type	Assessment description	Weighting	Pass mark	Must pass?
Coursework	Group Project Report, Presentation & Demonstration	100%	50%	N
		100%		