Warsaw University of Technology

COURSE OFFERED IN THE DOCTORAL SCHOOL

Code of the course	4606-ES-00000JL-0302	Name of the course	Polish	Modelowanie zachowań społecznych
			English	Modeling of social behavior
Type of the course	specialized			
Course coordinator	Dr hab. Agata Fronczak , prof. PW	Course teacher	Dr inż. Anna Chmiel Dr inż. Piotr Górski	
Implementing unit	WF	Scientific discipline / disciplines*	physical sciences, mathematics	
Level of education	Doctoral studies	Semester	winter	
Language of the course	English			
Type of assessment	passing the course (70%) and test (30%)	Number of hours in a semester	30	ECTS credits: 2
Minimum number of participants	10	Maximum number of participants	30	Available for students (BSc, MSc): Yes/~~No~~

Type of classes		Lecture	Auditory classes	Project classes	Laboratory	Seminar
Number of hours	in a week	1		1		
	in a semester	15		15		

* does not apply to the Researcher's Workshop

1. Prerequisites

program skills in any language, basic algebra

2. Course objectives

To acquire fundamental knowledge and practical experience in modeling social processes using agent-based models. Agent-based models are computer simulations used to study the interactions between people, things, places, and time. This method has wide applications in economics, social sciences and epidemiology

3. Course content (separate for each type of classes)

Lecture

1. Why do natural scientists and engineers study social processes?
2. Classical models, continuous and discrete opinions, such as (the Sznajd model, the voter and q-voter models, the Axelrod model, the Deffuant model)
3. Opinion models on complex networks
4. Game theory (Prisoner's Dilemma, zero-sum games, cooperation games)
5. Formation of interpersonal connections in social networks (homophily theory, triangle closure). Models of connection formation. Co-evolutionary models of opinions and changes in connections.
6. Emergence of friends and foes (positive and negative edges, structural balance). Models with two-agent and three-agent dynamics.
7. Multi-agent interactions, structural balance examples in various networks: political networks, animal networks, neural networks, genetic networks, and protein networks
8. Data-driven modeling, modeling vaccine opinions during a pandemic, modeling elections
9. Dynamics of human behavior on the Internet, scaling of email response times, negative emotions as fuel for discussions.

Laboratory

Student Projects will involve the following topics:

1. q-voter model on a complete graph.
2. Exploration of properties of selected network models.
3. Cont-Bouchaud model.
4. q-voter model with co-evolution.
5. Structural balance in real networks.
6. Models of information propagation (threshold, SIR, MK).
7. Analysis of dynamics of online discussions.

4. Learning outcomes			
Type of learning outcomes	Learning outcomes description	Reference to the learning outcomes of the WUT DS	Learning outcomes verification methods*
Knowledge			
K01	To the extent that allows for the revision of existing paradigms - knows global achievements, including theoretical foundations and general issues and selected detailed models of continuous and discrete social processes	SD_W2,	tests
K02	agent-based modeling methods and their application in interdisciplinary problems	SD_W3,	Tests, active participation during classes
K03	basic principles of knowledge transfer to the social sphere and commercialization of scientific results	SD_W5,	project evaluation
Skills			
S01	Draw correct conclusions based on the results of numerical simulations and be able to determine the causes of the system's behavior	SD_U1	project evaluation
S02	critically analyze and evaluate the results of scientific research, contribution to the development of agnet modeling, in particular assess the usefulness and possibility of using the results of theoretical work in practical applications to new problems in modeling social behavior on the Internet	SD_U2	project evaluation
S03	Transfer research findings to the economic and social spheres	SD_U3	project evaluation
Social competences			

SC01	Critically assess the achievements of the represented scientific discipline, including one's own contribution to the development of modeling social behavior	SD_K1	project evaluation

*Allowed learning outcomes verification methods: exam; oral exam; ; oral test; project evaluation; report evaluation; presentation evaluation; active participation during classes; homework; tests

5. Assessment criteria
Presentation of the project results as the most important elements of passing the course (70%) and test (30%)

6. Literature
Primary references: [1] . C. Castellano, S. Fortunato and V. Loreto, Statistical physics of social dynamics, Rev. Mod. Phys. 81, 591-646 (2009) [2] S. Galam, Sociophysics: A Physicists Modeling of Psycho-Political Phenomena, Springer, New York (2012). [3] M. Jusup, P. Holme, K. Kanazawa, M. Takayasu, I. Romić, Z. Wang, S. Geček, T. Lipić, B. Podobnik, L. Wang, Wei Luo, T. Klanjšček, J. Fan, S. Boccaletti, M. Perc, Social physics, Physics Reports, Vol 948, 2022, Secondary references: [1] Samin Aref, Mark C Wilson, Balance and frustration in signed networks, Journal of Complex Networks, Volume 7, Issue 2, April 2019, Pages 163–189, https://doi.org/10.1093/comnet/cny015, https://arxiv.org/pdf/1712.04628 [2]

7. PhD student's workload necessary to achieve the learning outcomes**		
No.	Description	Number of hours
1	Hours of scheduled instruction given by the academic teacher in the classroom	15
2	Hours of consultations with the academic teacher, exams, tests, etc.	10
3	Amount of time devoted to the preparation for classes, preparation of presentations, reports, projects, homework	20
4	Amount of time devoted to the preparation for exams, test, assessments	10
	Total number of hours	**55**
	ECTS credits	**2**

** 1 ECTS = 25-30 hours of the PhD students work (2 ECTS = 60 hours; 4 ECTS = 110 hours, etc.)

8. Additional information	
Number of ECTS credits for classes requiring direct participation of academic teachers	1
Number of ECTS credits earned by a student in a practical course	1