Univerza v Mariboru

Fakulteta za naravoslovje in matematiko

UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	Evolucijska teorija iger
Course title:	Evolutionary game theory

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Fizika 2. st.		**1**	**2**
Physics 2nd degree		**1**	**2**

Vrsta predmeta / Course type izbirni / optional

Univerzitetna koda predmeta / University course code:

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje work	Druge oblike študija	Samost. delo Individ. work	ECTS
45					**105**	**5**

Nosilec predmeta / Lecturer: Matjaž Perc

Jeziki / Languages:	**Predavanja / Lectures:**	**slovenski/Slovene**
	Vaje / Tutorial:	**slovenski/Slovene**

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	**Prerequisits:**
Ni pogojev.	None.

Vsebina:

1. Igre z in brez strategije kooperacije. 2. »Payoff« matrike pri dveh igralcih. 3. Primeri iger: npr. boj med spoloma, dilema zapornika, igra sokola in goloba. 4. Posplošitev na igre z več igralci, igre v prostoru.5. Tragedija in propad družbe.6. Aplikacije teorije iger v biologiji, npr. igra sokola in goloba v populacijskih sistemih, dilema zapornika v metaboličnih sistemih. 7. Aplikacije teorije iger v ekonomiji. 8. Evolucija kooperacije.

Content (Syllabus outline):

1. Cooperative and non-cooperative games. 2. Payoff matrix for two players. 3. Examples of games, e.g., prisoner's dilemma, hawk-dove game. 4.Generalization to n players and to spatial problems.5. Tragedy of the commons.6. Applications of the game theory in biology, e.g., hawk-dove game in population systems, prisoner's dilemma in metabolic systems. 7. Applications of the game theory in the economy. 8. Evolution of the cooperativity.

Temeljni literatura in viri / Readings:

·Hofbauer, J. and Sigmund, K. (1998). Evolutionary Games and Population Dynamics. Cambridge University Press, Cambridge.
·Axelrod, R. (1984) The Evolution of Cooperation. Basic Books, New York.
·Pfeiffer, T. and Schuster, S. (2005) Game-theoretical approaches to studying the evolution of biochemical systems. Trends Biochem. Sci. 30, 20-25.
·Hauert, C. and Szabo, G. (2005) Game theory and physics. Am. J. Phys. 73, 405-414.
·Drugi strokovni in znanstveni članki v revijah / Articles published in professional and scientific journals.

Cilji in kompetence:

·Razvijati sposobnosti za kvalitativno in kvantitativno analizo kompleksnih sistemov. ·Predstaviti zvezo med strukturo, dinamiko in evolucijo kompleksnih sistemov. ·Poudariti pomen evolucijskih mehanizmov za razvoj dinamike in strukture sistemov. ·Uporaba računalniških programov za simulacijo iger.

Objectives and competences:

·Developing skills for qualitative and quantitative analysis of complex systems.·Presenting interconnections between the structure, dynamics and the evolution of complex systems.·Pointing out the importance of evolutionary mechanisms for developing the system’s dynamics and its structure. ·Using computer programs for game simulations.

Predvideni študijski rezultati:

Znanje in razumevanje: Poznati metode za kvalitativno in kvantitativno analizo kompleksnih sistemov. ·Predstaviti zvezo med strukturo, dinamiko in evolucijo kompleksnih sistemov. ·Poudariti pomen evolucijskih mehanizmov za razvoj dinamike in strukture sistemov. ·Uporaba računalniških programov za implementacijo iger.

Prenesljive/ključne spretnosti in drugi atributi:·Metode kvantitativne analize kompleksnih sistemov so univerzalne in jih je mogoče uporabiti na najrazličnejših področjih. ·Poudarek je na prenosu znanja s primerov iz

Intended learning outcomes:

Knowledge and understanding: Knowledge and Understanding:·Be able to use methods for qualitative and quantitative analysis of complex systems.·Be able to realize interconnections between the structure, dynamics and the evolution of complex systems.·Know the importance of evolutionary mechanisms for developing the system’s dynamics and its structure. ·Using computer programs for the implementation of games.

Transferable/Key Skills and other attributes:·Methods for quantitative analysis of complex system are universal and can be

fizike na področja biologije, ekonomije.	implemented in different fields of research. ·In particular, a knowledge transfer from examples in physics to examples in biology, economics, etc. is emphasised.

Metode poučevanja in učenja:	**Learning and teaching methods:**
Predavanja in projektno delo.	Lectures and project work.

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**
Način (pisni izpit, ustno izpraševanje, naloge, projekt): Ustni izpit 50% Opravljeno projektno delo 50%		Type (examination, oral, coursework, project): Oral exam 50% Done project work 50%

Reference nosilca / Lecturer's references:

1. İZGI, Burhaneddin, ÖZKAYA, Murat, ÜRE, Nazım Kemal, PERC, Matjaž. Extended matrix norm method : applications to bimatrix games and convergence results. Applied mathematics and computation. [Print ed.]. Feb. 2023, vol. 438, str. 1-11. ISSN 0096-3003. DOI: 10.1016/j.amc.2022.127553. [COBISS.SI-ID 123701251]
2. JIANG, Luo-Luo, CHEN, Zhi, PERC, Matjaž, WANG, Zhen, KURTHS, Jürgen, MORENO, Yamir. Deterrence through punishment can resolve collective risk dilemmas in carbon emission games. Chaos. 2023, vol. 33, iss. 4, [article no.] 043127, 8 str. ISSN 1054-1500. DOI: 10.1063/5.0147226. [COBISS.SI-ID 149919747]
3. İZGI, Burhaneddin, ÖZKAYA, Murat, ÜRE, Nazım Kemal, PERC, Matjaž. Machine learning driven extended matrix norm method for the solution of large-scale zero-sum matrix games. Journal of computational science. Apr. 2023, vol. 68, [article no.] 101997, str. 1-7, tabele, graf. prikazi. ISSN 1877-7503. DOI: 10.1016/j.jocs.2023.101997. [COBISS.SI-ID 147417347]