

UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet: Modeliranje in simulacija družbenih sistemov
Course title: Modelling and Simulation of Social Systems

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Informacijska družba, doktorski študijski program tretje stopnje	-	Prvi	Prvi
Information Society, third cycle Doctoral Study Programme	-	First	First

Vrsta predmeta / Course type

Izbirni/ Optional

Univerzitetna koda predmeta / University course code:

1-ID-DR-IP-MSDS-2024-02-05

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje work	Druge oblike študija	Samost. delo Individ. work	ECTS
10	20	/	/	/	270	10

Nosilec predmeta / Lecturer: izr. prof. dr. Blaž Rodič

Jeziki / Languages:

Predavanja / Lectures: slovenski / Slovenian, angleški / English
Vaje / Tutorial:

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:

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Prerequisites:

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Vsebina:

Predmet je usmerjen k sodobnim znanjem in raziskavam za namene razvoja simulacijskih modelov sistemov v sodobni družbi z uporabo informacijske tehnologije.

Predvideni so naslednji tematski sklopi:

- Namen študija predmeta, vsebina študija predmeta, študijska literatura.
- Simulacija sistemov in reševanje družbenih in organizacijskih problemov.
- Oris simulacijskih metodologij.
- Razvoj zasnove modela za izbrani projekt.
- Izbira najbolj primernega orodja in metodologije za izbrani projekt.

Content (Syllabus outline):

The course is geared towards advanced knowledge and research for development of simulation models of systems in modern society using information technology.

Course contains the following chapters:

- The purpose of the study, content of course, textbooks.
- Simulation of systems and solving social and organizational problems.
- Outline of simulation methodologies.
- Development of the model design for the selected project.
- Selection of the most appropriate tools and methodologies for the selected project.
- Collection and preparation of data.

<ul style="list-style-type: none"> • Zbiranje in priprava podatkov. • Verifikacija in validacija modelov. • Zvezna simulacija in sistemska dinamika; metodologija, pregled orodij. • Vzročno posledični diagrami in referenčni odziv sistema. • Diferenčne in diferencialne enačbe v simulaciji. • Razvoj modelov sistemske dinamike. • Primeri modelov sistemske dinamike družbenih sistemov. • Modeliranje z agenti; metodologija, pregled orodij. • Primeri agentnih modelov družbenih sistemov. • Uporaba agentnega modeliranja v orodju Anylogic. • Zbiranje podatkov, analiza ter predstavitev rezultatov. • Načrtovanje eksperimentov. • Optimizacija modelov in sistemov. • Projektno delo. 	<ul style="list-style-type: none"> • Verification and validation of models. • Continuous simulation and system dynamics; methodology, an overview of the tools. • Cause-effect diagrams and reference system response. • Differential and differential equations in the simulation. • Examples of System Dynamics models of Social Systems. • Development of system dynamics models. • Agent Based Modelling; methodology; overview of tools. • Examples of Agent Based models of Social Systems. • Agent Based Modelling with Anylogic. • Data collection, analysis, and presentation of results. • Design of Experiments. • Optimization models and systems. • Project work.
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Temeljni literatura in viri / Readings:

<ul style="list-style-type: none"> • Gilbert, N. (2019), <i>Agent-Based Models 2nd Ed.</i>, Quantitative Applications in the Social Sciences Vol. 153, SAGE Publications • Gilbert N. (Ed.), Doran J. (Ed.) (2020), <i>Simulating Societies: The Computer Simulation of Social Phenomena 1st Ed.</i>, Routledge • Borshchev, A. (2022). <i>The Big Book of Simulation Modeling</i>, AnyLogic North America • Grigoryev, I. (2023) <i>AnyLogic 8 in Three Days: A Quick Course in Simulation Modeling 6th Ed.</i>, AnyLogic North America • Railsback, S. F., & Grimm, V. (2019). <i>Agent-Based and Individual-Based modeling: A Practical Introduction, Second Edition</i>. Princeton University Press. Gilbert, N. (2019). <i>Agent-Based models</i>. SAGE Publications, Incorporated.

Cilji in kompetence:

<p>Seznantiti slušatelje z metodami in tehnologijami na področju modeliranja in simulacije sistemov, spoznati metodologije agentnega modeliranja in sistemske dinamike za modeliranje sistemov, osvojiti postopke priprave simulacijskega eksperimenta in interpretacije rezultatov, izvedba celovitega projekta s področja modeliranja in simulacije na primeru.</p>

Objectives and competences:

<p>To acquaint students with the methods and technologies in the field of modelling and simulation systems, to familiarize with the methodologies of Agent-Based Modelling, and System Dynamics modelling, learn the process of preparing simulation experiments, interpret the results, the implementation of a comprehensive case-based project in the field of modelling and simulation.</p>

Učna enota prispeva k razvoju naslednjih splošnih kompetenc:

- sposobnost identificiranja danega raziskovalnega problema, njegove analize ter možnih rešitev
- sposobnost obvladanja standardnih metod, postopkov in procesov raziskovalnega dela na različnih znanstvenih področjih
- sposobnost za reševanje konkretnih raziskovalnih problemov na posameznih področjih družbenih in ostalih ved
- razvoj veščin in spretnosti v uporabi znanja na raziskovalnem področju doktorske disertacije
- sposobnost inovativne uporabe in kombiniranja raznih raziskovalnih metod

in predmetno-specifičnih kompetenc:

- sposobnost uporabe modeliranja in simulacije za modeliranje družbenih sistemov
- znanje razvoja modelov systemske dinamike
- znanje razvoja agentnih modelov
- znanje povezovanja simulacijskih modelov s podatkovnimi bazami

Learning unit contributes to the development of the following general and subject-specific competencies:

- the ability to identify, analyze and construct solution a given research problem
- mastery of standard methods and approaches in the process of scientific research in various scientific fields
- skills and abilities for solving concrete research problems in various fields of social and other sciences
- development of skills and abilities in usage of knowledge in doctoral research
- ability of innovative combined usage of various research methodologies

and course specific competences:

- ability to use simulation modeling in modelling of social systems
- knowledge of system dynamics model development
- knowledge of agent-based model development
- ability to connect simulation models with databases

Predvideni študijski rezultati:

Znanje in razumevanje:

Študent/študentka pridobi znanja za

- kvantitativno modeliranje družbenih sistemov,
- zbiranje in analizo podatkov o modeliranem sistemu,
- definicijo kriterijev in dinamično testiranje hipoteze,
- modeliranje po metodologiji systemske dinamike in agentnega modeliranja
- verifikacijo in validacijo modela,
- zbiranje in strukturiranje podatkov za potrebe modeliranja in priprave scenarijev,

Intended learning outcomes:

Knowledge and understanding:

The student has the knowledge of:

- quantitative modelling of social systems,
- collecting and analysing data about the modelled system,
- definition of criteria and dynamic testing of hypothesis,
- modelling using methodologies of system dynamics and agent-based modelling
- verification and validation of the model,
- collection and structuring of data for modelling and scenario preparation,

Metode poučevanja in učenja:

- *Predavanja* z aktivno udeležbo študentov; kratka razlaga, diskusija, razprava na primerih, reševanje problematike.
- *Seminarsko delo v obliki priprave projektne naloge*: predlog raziskovalnega projekta, utemeljitev raziskave, poročanje o rezultatih in podajanje predloga rešitev.
- *Individualno delo študentov*; samostojni študij znanstvene in strokovne literature in rezultatov raziskav.

Learning and teaching methods:

- *Lectures* with active students' involvement (explanation, discussion, questions, examples, problem solving).
- *Seminar work*: preparation of project paper: a proposal for a research project, justification of research, reporting results, and proposing solutions.
- Individual and group consultations (discussions, supplementary explanations, treatment of specific questions).

Delež (v %) /

Weight (in %)

Načini ocenjevanja:**Assessment:**

Način (pisni izpit, ustno izpraševanje, naloge, projekt):

Type (examination, oral, coursework, project):

- Projektna naloga

100

- Project paper

Reference nosilca / Lecturer's references:

- Barbo, M., & Rodič, B. (2023). Modeling the influence of safety aid market penetration on traffic safety: Case of collision warning system for powered two-wheelers. *Accident Analysis & Prevention*, 192, 107240. <https://doi.org/10.1016/j.aap.2023.107240>
- Rodič, B. (2017). Industry 4.0 and the new simulation modelling paradigm. *Organizacija*, 50(3), 193–207. <https://doi.org/10.1515/orga-2017-0017>
- Kanduč, T., & Rodič, B. (2016). Optimisation of machine layout using a force generated graph algorithm and simulated annealing. *International Journal of Simulation Modelling*, 15(2), 275–287. [https://doi.org/10.2507/ijssimm15\(2\)7.335](https://doi.org/10.2507/ijssimm15(2)7.335)
- Rodič, B., & Kanduč, T. (2015). Optimisation of a complex manufacturing process using discrete event simulation and a novel heuristic algorithm. *International journal of mathematical models and methods in applied sciences*. 2015, vol. 9, pg. 320-329. ISSN 1998-0140.
- Kanduč, T., & Rodič, B. (2015). Optimization of a furniture factory layout. *Croatian Operational Research Review*. <https://doi.org/10.17535/corr.2015.0010>