

	UČNI NAČRT PREDMETA/COURSE SYLLABUS
Predmet	Agentno modeliranje in agentni sistemi
Course title	Agent-Based Modelling and Agent Systems

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Poslovna informatika / 1. stopnja	Računalništvo in informatika	3. letnik	5.
Business Informatics / 1 st Cycle	Computer and Information Science	3 rd year	5 th

Vrsta predmeta/Course type modularni / module

Univerzitetna koda predmeta/University course code I_RI_3_M3_UNI

Predavanja Lectures	Seminar Seminar	Sem. vaje Tutorial	Lab. vaje Laboratory work	Teren. vaje Field work	Samost. delo Individ. work	ECTS
30			30		90	6

Nosilec predmeta/Lecturer: prof. dr. Matjaž Gams

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

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

Prerequisites:

<ul style="list-style-type: none"> • Vpis v tretji letnik študijskega programa. • Študent mora pred izpitom pripraviti in predstaviti seminarsko nalogo. 	<ul style="list-style-type: none"> • The prerequisite for inclusion is enrolment in the third year of study. • Students have to successfully prepare and present a seminar paper before the examination.
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Vsebina:

Content (Syllabus outline):

<ul style="list-style-type: none"> • <i>Znanstvena metoda:</i> Splošno o strukturah znanstvenega védenja, znanstvenih aktivnostih in procesih, znanstvenem razmišljanju in pridobivanju znanja, kritično razmišljanje na podlagi opazljivih, empiričnih in merljivih dokazov. • <i>Uvod:</i> Predstavitev motivacije in ciljev študija modeliranja agentov in agentnih 	<ul style="list-style-type: none"> • <i>Scientific method:</i> General introduction to the structures of scientific knowledge, scientific activities and processes, scientific thinking and acquiring knowledge, critical thinking based on observable, empirical and measurable evidence. • <i>Introduction:</i> Presentation of the motivation and objectives of the study of
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<p>sistemov, definicija komputacijskega agenta in njegove aplikativnosti na razponu področij, razlika med agentnim modeliranjem in agentnimi sistemi, pregled relevantnih konceptov in področij za snovanje agentov (umetna inteligenca, umetno življenje, robotika, kognitivna znanost), lastnosti agentov in od kod izvirajo, študije agentnih sistemov skozi različne discipline, trendi v modeliranju in agentnih sistemih ter konkretni primeri rabe znotraj gospodarskih in negospodarskih sektorjev.</p> <ul style="list-style-type: none"> • <i>Informacijska družba</i>: Definicija informacijske družbe kot družbe prihodnosti, lastnosti informacijske družbe, pregled konkretnih primerov. Ponazoritev trendov v informacijski družbi ter vloga modeliranja agentov in agentnih sistemov v njej, kratek zgodovinski pregled. Modeliranje družbe in vloga modeliranih agentov v resnični družbi. • <i>Umetna inteligenca</i>: Predstavitev umetne inteligenca kot podstati agentov, pregled najpomembnejših področij s predstavitvijo primerov. Področja bodo predstavljena po Russell in Norvig (2016) ter Poole in Mackworth (2017). Kratek pregled discipline umetne inteligenca skozi zgodovino in trende. • <i>Agentno modeliranje</i>: predstavitev agentnega modeliranja, najpomembnejših elementov (teorije iger, kompleksni sistemi, emergenca, evolucijski sistemi, metode Monte Carlo ...), predstavitev disciplin, kjer se agentno modeliranje uporablja (simulacije v znanstvenih disciplinah, inženirskih disciplinah, družboslovnih disciplinah ...), oblike agentov in simulacij, teorije agentnega modeliranja, trendi in uporabni primeri. • <i>Agentni sistemi</i>: predstavitev agentnih in multiagentnih sistemov, pregled tehnologij agentnih sistemov (inteligentni kognitivni asistenti, roboti, omrežni agenti, agenti v inženirskih 	<p>agent-based modelling and agent systems, definition of a computational agent and its application in a wide range of areas, the difference between agent-based modelling and agent systems, an overview of the relevant concepts and areas for the design of agents (artificial intelligence, artificial life, robotics, cognitive science), agent properties and their foundation, the study of agent systems through different disciplines, trends in agent-based modelling and agent systems, concrete examples and use of cases within industrial and non-industrial sectors.</p> <ul style="list-style-type: none"> • <i>Information society</i>: Definition of the information society as the society of the future, properties of the information society, concrete examples and advantages of the information society. Overview of trends in the fields of the information society and the role of agent systems in it, a brief historical overview of information society. Agent-based modelling of society and its role. • <i>Artificial intelligence</i>: Presentation of artificial intelligence as a foundation of computational agents, an overview of the most important areas with examples. The relevant areas of research will be based on Russell and Norvig (2016), and Poole and Mackworth (2017). Short overview of the artificial intelligence discipline throughout history and trends. • <i>Agent-based modelling</i>: Presentation of agent-based modelling, its most important parts (game theory, complex systems, emergence, evolutionary systems, Monte Carlo methods, etc.), presentation of disciplines where agent-based modelling is used (simulations in scientific disciplines, engineering disciplines, social sciences ...), types of agents and simulations, agent-based modelling theories, trends and useful examples. • <i>Agent systems</i>: Presentation of agent and multi-agent systems, overview of agent systems technologies (intelligent
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<p>situacijah ...), taksonomija agentov (pasivni, aktivni, kompleksni, ostale razdelitve), lastnosti agentov (avtonomija, inteligenca ...).</p> <ul style="list-style-type: none"> • <i>Pregled sorodnih relevantnih področij:</i> nevronske mreže (pregled), komunikacija človek-stroj in človek-računalnik (različne modalitete komuniciranja, inteligentni vmesniki ...), modeliranje uporabnikov in profilizacija, odločitveni sistemi, robotika, kognitivna znanost (predstavitev študija človekovega uma, kognicije in intelligence, povezane discipline, osnovne paradigme in koncepti, primeri, kognitivne tehnologije), pregled področij in panog, kjer agenti služijo raziskovanju in aplikativnemu reševanju problemov, predstavitev kompleksnih sistemov. • <i>Izzivi pri razvoju inteligentnih sistemov:</i> Predstavitev poteka agentnega modeliranja in simuliranja ter razvoja agentnih sistemov, način odkrivanja novega znanja z agentnim modeliranjem v negospodarstvu (znanost, načrtovanje politik ...) in gospodarstvu, način reševanja problemov z agenti in razvojne rešitve, težave pri snovanju agentov. • <i>Orodja in rešitve:</i> Predstavitev, pregled in preizkušanje sodobnih orodij in rešitev, ki so na voljo pri snovanju agentov in sorodnih področij. 	<p>cognitive assistants, robots, network agents, agents in engineering situations, etc.), taxonomy of agents (passive, active, complex, other divisions), agent properties (autonomy, intelligence, etc.)</p> <ul style="list-style-type: none"> • <i>Overview of relevant areas:</i> neural networks (overview), human-machine and human-computer communication (various modes of communication, intelligent interfaces, profiling, etc.), cognitive science (study of the human mind, cognition and intelligence, related disciplines, basic paradigms and concepts, examples, cognitive technologies), overview of areas and fields where computational agents can be used to research phenomena or solve problems, presentation of complex systems. • <i>Challenges in the design of intelligent systems:</i> Presentation of the design of agent-based modelling and simulation, knowledge discovery with agent-based modelling in non-industry (science, policy-planning, etc.) and industry, solving problems with agents and different design solutions, common problems in the design of agents. • <i>Tools and solutions:</i> Presentation, review and testing of modern tools and solutions, available for the design of computational agents and in related fields.
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Temeljna literatura in viri/Readings:

Temeljna literatura/Basic literature

- Poole, D. L. in Mackworth, A. K. (2017). *Artificial intelligence: Foundations of computational agents* (2nd ed.). Cambridge, United Kingdom: Cambridge University Press.
- Russell, S. J. in Norvig, P. (2016). *Artificial Intelligence: A Modern Approach* (3rd ed.). Upper Saddle River: Pearson.
- Wooldridge, M. J. (2012). *An introduction to MultiAgent systems*. Chichester: John Wiley & Sons.

Priporočljiva literatura/Recommended literature

- Bostrom, N. (2016). *Superintelligence*. Oxford: Oxford University Press.
- Hopgood, A. A. (2012). *Intelligent systems for engineers and scientists*. Boca Raton, Fla: CRC.
- Wilensky, U. in Rand, W. (2015). *An introduction to agent-based modeling: Modeling natural, social, and engineered complex systems with NetLogo*. Cambridge, MA: The MIT Press.

Cilji in kompetence:

Učna enota prispeva predvsem k razvoju naslednjih splošnih in specifičnih kompetenc:

- sposobnost definiranja, razumevanja in ustvarjalnega reševanja strokovnih izzivov na področjih računalništva in informatike,
- usposobljenost za permanentno spremljanje in presojo dogajanj na področju računalništva in informatike,
- kompetence za pridobivanje novih in poglobljanje pridobljenih strokovnih znanj računalništva in informatike,
- sposobnost uporabe pridobljenih znanj pri samostojnem reševanju strokovnih problemov računalništva in informatike za uspešno vključevanje v delovne procese v gospodarstvu in negospodarstvu,
- razvijanje poklicne identitete, profesionalne odgovornosti in etičnosti,
- usposobljenost za analizo in načrtovanje sistemov,
- poznavanje načinov predstavitve, zapisa in modeliranja informacij,
- usposobljenost za analizo in razvoj strojne in programske opreme,
- poznavanje zmožnosti in omejitev informacijskih tehnologij,
- razumevanje in sposobnost umeščanja računalniških in informacijskih znanj na različna področja tehnike in druga strokovno relevantna področja (ekonomija, poslovanje, organizacijske vede itd.).

Objectives and competences:

The learning unit mainly contributes to the development of the following general and specific competences:

- the ability to define, understand and creatively solve professional challenges in the fields of computer and information science,
- being qualified for continuous monitoring and assessment of developments in the field of computer and information science,
- the competence to acquire new knowledge and deepen the existing knowledge of computer science and informatics,
- the ability to use acquired knowledge in the independent solving of professional problems in computer science and informatics for successful integration into work processes in the industrial and non-industrial sectors,
- developing professional identity, professional responsibility and ethics,
- being qualified for system analysis and design,
- knowing how to present, record and model information,
- being qualified for the analysis and development of hardware and software,
- knowing the capabilities and limitations of information technologies
- the ability to understand and place computer science and informatics knowledge in various fields of technology and other professionally relevant fields (economics, business, organizational sciences, etc.).

Predvideni študijski rezultati:**Študent/študentka:**

- pozna osnove znanstvenega pristopa in dejavnosti ter njeno aplikativnost v širšem delovanju tehnoloških področij, pozna osnovne koncepte agentnega modeliranja in agentnih sistemov, njihovo raznovrstnost, široko aplikativnost in se zaveda, da je njihova podstat umetna

Intended learning outcomes:**Students:**

- know the importance of the basics of the scientific approach, the scientific activities and their applications in the wider scope of technology, know the basic concepts of agent-based modelling and agent systems, their diversity, their broad applications, are aware of artificial

<p>inteligenca, a večkrat v kombinaciji s domenskimi znanjem,</p> <ul style="list-style-type: none"> • razume temeljne pojme, na katerih agentni sistemi temeljijo, razume, kako umetna inteligenca in agenti spreminjajo našo družbo kot tudi ožja, znanstvena področja, razume, koliko področij agenti pokrivajo in na kakšen način, razume osnove kognitivnih in vedenskih znanosti ter njihove temeljne aplikativnosti v agentih, razume pomembnost interdisciplinarnosti, skupinskega dela in sodelovanja za napredek družbe, • razvije sposobnosti konceptualnega razvijanja agentov in sposobnost za izbiranje metod za različne naloge, probleme in situacije, kjer agenti predstavljajo rešitve kot tudi vlogo metod glede na domeno in agentno rabo, • se usposobi za apliciranje umetne inteligence in agentov na konkretna področja in domene zanimanja, se usposobi za kritično presojo uporabnosti konceptov iz raziskovanja najrazličnejših sistemov, okolij in akterjev skozi agentno modeliranje in sisteme, se usposobi za etično presojo rabe agentov, se usposobi za analizo tehnološkega stanja entitete in podajanje predlogov za izboljšanje z vključitvijo agentov, se usposobi za predvidevanje prihodnjih potreb informacijske družbe, panog in raziskovalnih področij, kjer agenti pomagajo pri odkrivanju znanja in reševanju problemov. 	<p>intelligence as the foundation of computational agents, especially combined with domain knowledge,</p> <ul style="list-style-type: none"> • recognise fundamental concepts upon which computational agents are built, recognise the importance of artificial intelligence and agents in changing our society as well as in other, narrower areas of society, recognise the many areas they can improve, how they improve them, recognise the importance of the basics of cognitive and behavioural sciences and their applicability in computational agents, recognise the value of interdisciplinarity, teamwork and cooperation for society's advancement, • develop skills for the conceptual design of computational agents and the ability to choose methods for various problems and situations that agents solve as well as the role of different methods for specific domains and agents, • gain competence for the application of artificial intelligence and computational agents to more specific areas and domains of interest, gain competence for critical assessment of applying concepts from researching different systems, environments and actors to agent-based modelling and systems, gain competence for an ethical assessment of the computational agents use, gain competence for the analysis of the technological state of a given system and how to use agent technologies to improve it, gain competence to anticipate the future needs of the information society, various fields and research areas that benefit from using computational agents for knowledge discovery and problem solving.
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Metode poučevanja in učenja:

- *predavanja* z aktivno udeležbo študentov (razlaga, diskusija, vprašanja, primeri, reševanje problemov),
- *laboratorijske vaje*: refleksija izkušenj, praktično reševanje več tipičnih problemov na računalniku, predstavitev in

Learning and teaching methods:

- *lectures* with active student participation (explanation, discussion, questions, examples, problem solving),
- *laboratory work*: reflection on experience, practical solving of several typical problems on a computer, presentation

zagovor programskih rešitev, diskusija, sporočanje povratne informacije.	and defence of programming solutions, discussion, feedback.
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Načini ocenjevanja:	Delež (v %) Weight (in %)	Assessment:
Načini: <ul style="list-style-type: none"> • izpit • izdelava, predstavitev in zagovor seminarske naloge Ocenjevalna lestvica: ECTS.	60 % 40 %	Types: <ul style="list-style-type: none"> • exam • preparation, presentation and defence of the seminar paper Grading scheme: ECTS.