

UČNI NAČRT PREDMETA / COURSE SYLLABUS (leto / year 2017/18)						
<b>Predmet:</b>	Modeliranje računalniških omrežij					
<b>Course title:</b>	Computer networks modelling					
<b>Študijski program in stopnja</b> <b>Study programme and level</b>	<b>Študijska smer</b> <b>Study field</b>		<b>Letnik</b> <b>Academic year</b>		<b>Semester</b> <b>Semester</b>	
Interdisciplinarni univerzitetni študijski program Računalništvo in matematika	ni smeri		3		prvi	
Interdisciplinary first cycle academic study programme Computer Science and Mathematics	none		3		first	
<b>Vrsta predmeta / Course type</b>			izbirni / elective			
<b>Univerzitetna koda predmeta / University course code:</b>			63257			
<b>Predavanja</b> <b>Lectures</b>	<b>Seminar</b> <b>Seminar</b>	<b>Vaje</b> <b>Tutorial</b>	<b>Klinične vaje</b> <b>work</b>	<b>Druge oblike študija</b>	<b>Samost. delo</b> <b>Individ. work</b>	<b>ECTS</b>
45	10	20			105	6
<b>Nosilec predmeta / Lecturer:</b>			prof. dr. Miha Mraz			
<b>Jeziki / Languages:</b>	<b>Predavanja / Lectures:</b>		slovenski / Slovene			
	<b>Vaje / Tutorial:</b>		slovenski / Slovene			
<b>Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:</b>			<b>Prerequisites:</b>			
Vpis v letnik študija.			Enrolment in the programme.			
<b>Vsebina:</b>			<b>Content (Syllabus outline):</b>			

<p>Predavanja:</p> <p>1. Teoretične osnove</p> <p>Zahteve, strežniki, čakalne vrste, Kendallova notacija</p> <p>Modeliranje z vidika časa in zaloge možnih stanj</p> <p>Intenzivnost prihajajočih zahtev in strežbe</p> <p>Strežne enote (diskretne, eksponentne, Erlangove, ...),</p> <p>Strežne mreže</p> <p>Opredelitev simulacijskih parametrov (breme, metrike, potrebni resursi, itd.)</p> <p>Analiza in interpretacija simulacijskih rezultatov</p> <p>Petrijeve mreže, barvne Petrijeve mreže</p> <p>Ocenjevalne metrike, latenca</p> <p>2. Uporaba teorije v praksi</p> <p>Modeliranje in simulacije omrežij</p> <p>Modeliranje in simulacije protokolov</p> <p>Modeliranje in simulacije višje nivojskih protokolov in storitev</p> <p>Orodja za modeliranje in simulacijo računalniških omrežij (OpNet, NS2, OMNeT++, TETCOS, GTNetS, itd.)</p> <p>Vaje:</p> <p>Namen vaj pri navedenem predmetu je predvsem v predstavitvi uporabe zgoraj navedenih teoretičnih osnov na reševanju praktičnih problemov s področja računalniških</p>	<p>Lectures:</p> <p>1. Theoretical basics</p> <p>Requests, servers, queues, Kendall's notation</p> <p>Modelling regarding time and modelling regarding the possible states of the system</p> <p>Request arrival rate in request serving rate</p> <p>Serving units (discrete, exponential, Erlang's, ...),</p> <p>Serving networks</p> <p>Definition of simulation parameters (work-load, metrics, required resources, etc.)</p> <p>Analysis and interpretation of simulation results</p> <p>Petri nets, Coloured Petri nets</p> <p>Performance metrics, latency</p> <p>2. Practical use of theory presented</p> <p>Modelling and simulation of networks</p> <p>Modelling and simulation of protocols</p> <p>Modelling and simulation of higher layer protocols and services</p> <p>Tools for network modelling and simulation (OpNet, NS2, OMNeT++, TETCOS, GTNetS, etc.)</p> <p>Laboratory courses:</p> <p>Methods and approaches presented during the lectures will be demonstrated on practical computer network examples during the laboratory courses. Different software tools will be used such as OpNet, NS2, OMNeT++, TETCOS, GTNetS, etc.</p>
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omrežij. V ta namen se bodo uporabljala na vajah ustrezna programska orodja (npr. OpNet, NS2, OMNeT++, TETCOS, GTNetS, itd.).

### Temeljni literatura in viri / Readings:

1. N. C. Hock: Queueing Modelling Fundamentals, J.Wiley &, Sons, New York, 1996.
2. M. E. Woodward: Communication and computer networks: modelling with discrete-time queues, Pentech Press, London 1993.
3. M. Mraz, M. Moškon: Modeliranje računalniških omrežij. 1. izd. Ljubljana: Založba FE in FRI, 2012. ISBN 978-961-6209-80-9. <https://ucilnica.fri.uni-lj.si/course/view.php?id=209>. [COBISS.SI-ID 265042944]

### Cilji in kompetence:

Cilj predmeta je študentom računalništva in informatike predstaviti osnovne metode izgradnje modelov in izvajanja simulacij z zornega kota računalniških omrežij. S teoretičnega vidika temelji predmet na splošni teoriji strežbe, ki študente seznanja s problematiko zahtev, strežnikov (resursov), čakalnih vrst, ozkih grl, itd. S praktičnega vidika bo študentom predstavljen prenos teoretičnih znanj na reševanje praktičnih problemov, do katerih prihaja na področju računalniških omrežij.

Ostale kompetence:

Razvoj spretnosti v analitičnem in sinteznem razmišljanju

Praktično obvladovanje sestavnih delov

### Objectives and competences:

Objective of the course is to present the basics in modelling and simulation of computer networks to the students of computer and information science. The course is based on the theory of service which acknowledges the students with the terms such as demands, serving units (resources), queues, bottlenecks etc. Students will learn the practical values of theoretical knowledge on the problems that arise in the field of computer networks.

Other competences:

Developing skills in critical, analytical and synthetic thinking.

Practical knowledge and skills of computer hardware, software and information technology necessary for successful professional work in

računalniških sistemov za uspešno profesionalno delo

Zmožnost razumevanja in reševanja profesionalnih problemov

Zmožnost uporabe in nadgradnje znanja pri samostojnem delu

computer and information science.

The ability to understand and solve professional challenges in computer and information science.

The ability to apply acquired knowledge in independent work for solving technical and scientific problems in computer and information science, the ability to upgrade acquired knowledge.

### **Predvideni študijski rezultati:**

Znanje in razumevanje:

Poznavanje teoretičnih in metodoloških znanj s področja modeliranja in simulacij. Razumevanje pomena področja. Poznavanje uporabe teoretičnih in metodoloških znanj skozi prizmo računalniških omrežij.

Uporaba:

Uporaba metodoloških znanj pri načrtovanju in vzdrževanju raznovrstnih računalniških omrežij in njihovih storitev, od katerih smo vse bolj odvisni.

Refleksija:

Razumevanje povezave med teoretičnimi znanji in metodologijami ter konkretnimi problemi do katerih prihaja v računalniških omrežjih.

Prenosljive spretnosti - niso vezane le na en predmet:

Večina predstavljenih metodologij odpira sistemski zorni kot bodočega diplomanta na računalniška omrežja. Slednji spodbuja predvsem vidike, kot so zbiranje in interpretiranje podatkov, identifikacija in reševanje problemov, kritična analiza in sinteza.

### **Intended learning outcomes:**

Knowledge and understanding:

Having the theoretical and methodological knowledge from the field modelling and simulations.

Understanding the importance of the field.

Application:

Application of methodological knowledge in design and support of various computer networks and their services.

Reflection:

Understanding the relations among theoretical knowledge and methodologies and practical problems from the field of computer networks.

Transferable skills – are not bound only to this course:

Students gain a new system perspective on the field of computer networks. This perspective opens new viewpoints such as data gathering and interpretation, problem identification and solving, critical analysis and synthesis.

### **Metode poučevanja in učenja:**

### **Learning and teaching methods:**

Predavanja bodo potekala ustno, vaje v obliki projektne delo na konkretnih aplikativnih zgledih.	Lectures and oral presentations of the subject. Seminal work on real-life examples and problems.
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Delež (v %) /

**Načini ocenjevanja:**

Weight (in %)

**Assessment:**

Način (pisni izpit, ustno izpraševanje, naloge, projekt):		Type (examination, oral, coursework, project):
Sprotno preverjanje (domače naloge, kolokviji in projektno delo)		Continuing (homework, midterm exams, project work)
Končno preverjanje (pisni in ustni izpit)	50%	Final (written exam)
Ocene: 6-10 pozitivno, 1-5 negativno (v skladu s Statutom UL)	50%	Grading: 6-10 pass, 1-5 fail.

**Reference nosilca / Lecturer's references:**

VASYLCHENKOVA, Anastasiia, MRAZ, Miha, ZIMIC, Nikolaj, MOŠKON, Miha. Classical mechanics approach applied to analysis of genetic oscillators. IEEE/ACM transactions on computational biology and bioinformatics, ISSN 1545-5963. [Print ed.], 2016, vol. , no. , str. 1-8, ilustr. [COBISS.SI-ID 1536851139]

BIZJAK, Manca, MRAZ, Miha, ZIMIC, Nikolaj, MOŠKON, Miha. Computational framework for modeling multiple noncooperative transcription factor binding and its application to the analysis of nuclear factor kappa B oscillatory response. Journal of computational biology, ISSN 1066-5277. [Print ed.], str. 1-11, ilustr. [COBISS.SI-ID 1536999619]

BORDON, Jure, MOŠKON, Miha, ZIMIC, Nikolaj, MRAZ, Miha. Fuzzy logic as a computational tool for quantitative modelling of biological systems with uncertain kinetic data. IEEE/ACM transactions on computational biology and bioinformatics, ISSN 1545-5963. [Print ed.], 2015, vol. 12, no. 5, str. 1199-1205, ilustr. [COBISS.SI-ID 1536282563]

MOŠKON, Miha, MRAZ, Miha. Systematic approach to computational design of gene regulatory networks with information processing capabilities. IEEE/ACM transactions on computational biology and bioinformatics, ISSN 1545-5963. [Print ed.], 2014, vol. 11, no. 2, str. 431-440, ilustr. [COBISS.SI-ID 10323028]

STRAŽAR, Martin, MRAZ, Miha, ZIMIC, Nikolaj, MOŠKON, Miha. An adaptive genetic algorithm for parameter estimation of biological oscillator models to achieve target quantitative system response. Natural computing, ISSN 1567-7818, Mar. 2014, vol. 13, no. 1, str. 119-127, ilustr. [COBISS.SI-ID 9950804]

