

UČNI NAČRT PREDMETA / COURSE SYLLABUS							
<b>Predmet:</b>		Računalniške storitve v oblaku					
<b>Course title:</b>		Cloud Computing					
<b>Študijski program in stopnja</b> Study programme and level		<b>Študijska smer</b> Study field		<b>Letnik</b> Academic year		<b>Semester</b> Semester	
Interdisciplinarni magistrski študijski program Računalništvo in matematika		ni smeri		1 in 2		prvi	
Interdisciplinary Masters study programme Computer Science and Mathematics		none		1 in 2		first	
<b>Vrsta predmeta / Course type</b>				izbirni			
<b>Univerzitetna koda predmeta / University course code:</b>				63541			
<b>Predavanja</b> Lectures	<b>Seminar</b> Seminar	<b>Vaje</b> Tutorial	<b>Klinične vaje</b> work	<b>Druge oblike študija</b>	<b>Samost. delo</b> Individ. work	<b>ECTS</b>	
45	20	10			105	6	
<b>Nosilec predmeta / Lecturer:</b>			Matjaž Branko Jurič				
<b>Jeziki / Languages:</b>		<b>Predavanja / Lectures:</b> slovenski/Slovene, angleški/English					
		<b>Vaje / Tutorial:</b> slovenski/Slovene, angleški/English					
<b>Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:</b>				<b>Prerequisites:</b>			
<b>Vsebina:</b>				<b>Content (Syllabus outline):</b>			
Razvoj aplikacij, ki se izvajajo na strežnikih				Developing applications for the server-side Definition of cloud computing: what is cloud			

<p>Definicija računalništva v oblaku: kaj je računalništvo v oblaku, namen, vloga in pomen, cilji</p> <p>Izzivi: upravljanje infrastrukture, arhitektura aplikacij za oblak, shranjevanje podatkov, varnost, ostali vidiki</p> <p>Lastnosti: samo oskrba na zahtevo, elastičnost in skalabilnost, dostop v obliki storitev, nadzor storitev, souporaba virov (pooling), itd.</p> <p>Storitveni modeli: IaaS (Infrastruktura kor storitev), PaaS (Platforma kot storitev), SaaS (Aplikacije kot storitve), XaaS</p> <p>Podrobni pregled IaaS (Infrastruktura kor storitev)</p> <p>Pregled konceptov, arhitekturni vidik</p> <p>Privatni oblak, javni oblak, hibridni oblak, virtualni oblak</p> <p>Spoznavanje in primerjava najpomembnejših IaaS tehnologij</p> <p>Podrobni pregled PaaS (Platforma kot storitev)</p> <p>Pregled konceptov, arhitekturni vidik</p> <p>Spremembe v razvojnih modelih: Trajno stanje: distribuirani datotečni sistemi, nestrukturirane shrambe, NoSQL baze, SQL baze v oblaku, Poslovna logika: spletne storitve, REST storitve, ostale tehnologije, Izvajalno okolje</p> <p>Spoznavanje in primerjava najpomembnejših PaaS tehnologij: Java EE, Azure, Google App Engine, itd.</p> <p>Podrobni pregled SaaS (Aplikacije kot storitve)</p> <p>Pregled konceptov, arhitekturni vidik</p>	<p>computing, purpose, role and importance, objectives</p> <p>Challenges: Infrastructure Management, Application Architecture for cloud, data storage, security, other aspects</p> <p>Features: on demand self-provisioning, elasticity and scalability, access in the form of services, monitoring, sharing of resources (pooling), etc..</p> <p>Service models: IaaS (Infrastructure-as-a-Service), PaaS (Platform-as-a-Service), SaaS (Software-as-a-Service), XaaS</p> <p>Detailed overview of IaaS:</p> <p>Overview of concepts, architectural perspective</p> <p>Private cloud, public cloud, hybrid cloud, virtual cloud</p> <p>Getting to know and compare the most important IaaS technologies</p> <p>Detailed overview of PaaS:</p> <p>Overview of concepts, architectural perspective</p> <p>Changes in development models: data persistence: distributed file systems, unstructured storage, NoSQL database, SQL database in the cloud, Business tier: Web services, REST services, other technology runtime environment</p> <p>Understanding and comparison of major PaaS technologies: Java EE, Azure, Google App Engine, etc.</p> <p>Detailed overview of SaaS:</p> <p>Overview of concepts, architectural perspective</p> <p>Access Models, Development Concepts</p> <p>Business models, Cloud Services (location, data delivery, data enrichment, integration services, business intelligence, etc.).</p>
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<p>Model dostopa, koncept razvoja</p> <p>Poslovni model, storitve v oblaku (lokacijske, dostava podatkov, bogatenje podatkov, integracijske storitve, poslovna inteligenca, itd.)</p> <p>Namestitveni modeli</p> <p>Zasebni, javni, hibridni, skupni oblak</p> <p>Na lokaciji, pri ponudniku, hibridni model, pregled ponudnikov</p> <p>Migracija v oblak</p> <p>Nadzor, upravljanje, SLA in QoS</p> <p>Praktični del:</p> <p>Vzpostavitev lastnega računalniškega oblaka</p> <p>Razvoj aplikacij za oblak</p> <p>Tehnološki vidiki</p> <p>Vsebinsko-poslovni vidiki</p> <p>Razvoj inovativnih aplikacij, ki delujejo v oblaku</p> <p>Konfiguriranje hibridnega računalniškega oblaka</p> <p>Spoznavanje najpomembnejših javnih oblakov: Amazon, Google App Engine, Azure, OpenStack, itd.</p> <p>Študija prenosljivost oblačnih rešitev med ponudniki</p> <p>Razvoj specifičnih razširitev za oblak</p>	<p>Deployment models</p> <p>Private, public, hybrid, shared cloud</p> <p>On premises, remote, hybrid model, overview of providers</p> <p>Migration to the cloud Control, management, SLA and QoS Practical part:</p> <p>Deploying, setting up and configuring your own Cloud</p> <p>Developing applications for the cloud</p> <p>Technological aspects</p> <p>Content and business aspects</p> <p>Development of innovative applications that run in the cloud</p> <p>Configuring a hybrid cloud</p> <p>Getting to know the most important public clouds: Amazon, Google App Engine, Azure, OpenStack, etc.</p> <p>Portability study between cloud solution providers</p> <p>Development of cloud-specific extensions</p>
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**Temeljni literatura in viri / Readings:**

Barrie Sosinsky, Cloud Computing Bible, Wiley, 2011.

George Reese, Cloud Application Architectures: Building Applications and Infrastructure in the

Cloud, O'Reilly Media, 2009.

David S. Linthicum, Cloud Computing and SOA Convergence in Your Enterprise, Addison-Wesley Professional, 2009.

John Rhoton, Risto Haukioja, Cloud Computing Architected: Solution Design Handbook, Recursive Press, 2011.

Matjaz B. Juric et al., Do more with SOA Integration, Packt Publishing, 2011.

### **Cilji in kompetence:**

Cilj predmeta je osvojiti poglobljene znanje in poznavanje področja računalništva v oblaku in vseh nivojev storitvene usmerjenosti (XaaS), osvojiti znanje s področja infrastrukture, platforme in aplikacij v obliki storitev, spoznati načrtovalske vzorce, arhitekturne modele in dobre prakse ter razumeti pomen inovativnih aplikacij v oblaku.

Kompetence:

Študentje bodo sposobni vzpostaviti infrastrukturo za delovanje privatnih, hibridnih in zasebnih oblakov, načrtovati in implementirati arhitekturo platforme PaaS, načrtovati in implementirati aplikacije, ki se izvajajo na PaaS, razumeti specifične oblačnih arhitektur in infrastruktur. Usposobljeni bodo za razvoj SaaS aplikacij na najpomembnejših PaaS/IaaS. Razumeli bodo pomen inovacij v oblaku.

### **Objectives and competences:**

The course objective is to provide an in-depth knowledge and understanding of the scope of cloud computing and all levels of service orientation (XaaS), provide knowledge of infrastructure, platforms, and applications in the form of services, get familiar with design patterns, architectural models and best practices and understand the importance of innovative applications in the cloud.

Competences:

Students will be able to deploy the infrastructure for the operation of private, hybrid and private clouds, to design and implement PaaS platform architecture, design and implement applications that are implemented on PaaS, understand the specifics of cloud architectures and infrastructures. Students will be trained to develop SaaS applications on most important PaaS / IaaS platforms and understand the importance of innovation in the cloud.

### **Predvideni študijski rezultati:**

Po uspešnem zaključku predmeta bo študent:  
- razvijal programske rešitve za delovanje v oblaku

- poznal lastnosti javnih in zasebnih oblakov- razumel infrastrukture in arhitekture računalniških oblakov- razumel cloud-native arhitekturo in jo uporabil pri razvoju- obvladal

### **Intended learning outcomes:**

After successful completion of the course a student will be able to:

- Develop cloud-based software solutions

- Understand the characteristic public and private clouds

- Understand the infrastructures and

razvoj mikrororitev- razumel in uporabljal vzorce za razvoj mikrororitev- uporabil vsebnike in orkestracijo vsebnikov- sposoben razvoja SaaS aplikacij

architecture of computer clouds

- Understand the cloud-native architecture and use it in the development
- master the development of microservices
- understand and use patterns for the development of microservices
- use containers and orchestration of containers
- capable of developing SaaS applications

**Metode poučevanja in učenja:**

Predavanja, računalniške vaje, projektni način dela pri seminarjih.

**Learning and teaching methods:**

Lectures, computer-based workshops, project work, seminars.

Delež (v %) /

**Načini ocenjevanja:**

Weight (in %)

**Assessment:**

<p>Način (pisni izpit, naloge, projekt): Sprotno preverjanje (vaje, kolokviji in projektno delo)</p>	<p>50%</p>	<p>Type (examination, coursework, project): Continuing (workshops, midterm exams, project work)</p>
<p>Končno preverjanje (pisni in ustni izpit)</p>		<p>Final (written and oral exam)</p>
<p>Ocene: 6-10 pozitivno, 5 negativno (v skladu s Statutom UL).</p>		<p>Grading: 6-10 pass, 5 fail (according to the rules of University of Ljubljana).</p>

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

Matjaž Branko Jurič:  
 – JURIČ, Matjaž B., MATHEW, Benny, SARANG, Poornachandra G.. Business process execution language for web services : an architect and developer's guide to orchestrating web services using BPEL4WS. Birmingham: Packt Publishing, 2006. X, 353 str., ilustr. ISBN 1-904811-81-7 [COBISS.SI-

ID 10391318]

- JURIČ, Matjaž B., PANT, Kapil. Business process driven SOA using BPMN and BPEL : from business process modeling to orchestration and service oriented architecture. Birmingham, Mumbai: Packt Publishing, cop. 2008. V, 311 str., ilustr. ISBN 978-1-84719-146-5 [COBISS.SI-ID 12558102]
- JURIČ, Matjaž B., LOGANATHAN, Ramesh, SARANG, Poornachandra G., JENNINGS, Frank. SOA approach to integration : XML, web services, ESB, and BPEL in real-world SOA projects. Birmingham, Mumbai: Packt Publishing, cop. 2007. VIII, 366 str., ilustr. ISBN 978-1-904811-17-6 [COBISS.SI-ID 12558358]
- JURIČ, Matjaž B., ŠAŠA BASTINOS, Ana, ROZMAN, Ivan. WS-BPEL extensions for versioning. Information and software technology, ISSN 0950-5849. [Print ed.], 2009, vol. 51, iss. 8, str. 1261-1274 [COBISS.SI-ID 13370646]
- JURIČ, Matjaž B., ŠAŠA BASTINOS, Ana, BRUMEN, Boštjan, ROZMAN, Ivan. WSDL and UDDI extensions for version support in web services. The Journal of Systems and Software, ISSN 0164-1212. [Print ed.], 2009, vol. 82, iss. 8, str. 1326-1343 [COBISS.SI-ID 13371158]
- JURIČ, Matjaž B. WSDL and BPEL extensions for event driven architecture. Information and software technology, ISSN 0950-5849. [Print ed.], 2010, vol. 52, iss. 10, str. 1023-1043 [COBISS.SI-ID 14364950]