

UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet: Osnove podatkovnih baz
Course title: Basics of Databases

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Univerzitetni študijski program prve stopnje Računalništvo in informatika Interdisciplinarni univerzitetni študijski program prve stopnje Računalništvo in in matematika Interdisciplinarni univerzitetni študijski program prve stopnje Upravna informatika	ni smeri	2	zimski
University study programme Computer and Information Science, 1st cycle Interdisciplinary university study programme Computer Science and Mathematics , 1st cycle Interdisciplinary university study programme in Administrative Informatics 1 st Cycle	none	2	fall

Vrsta predmeta / Course type

obvezni predmet / compulsory course

Univerzitetna koda predmeta / University course code:

63208

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje Laboratory work	Druge oblike študija Field work	Samost. delo Individ. work	ECTS
45	/	30	/	/	105	6

Nosilec predmeta / Lecturer:

prof. dr. Marko Bajec

Jeziki /

Languages:

Predavanja / slovenščina
Lectures: Slovene
Vaje / Tutorial: slovenščina
 Slovene

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

Prerequisites:

Vsebina:

predavanja:

I. Uvod v PB

1. Zgodovina področja;
2. Sistemi za upravljanje s PB (SUPB);
3. Vrste SUPB;
4. Vloge pri upravljanju PB;

II. Opisovanje, shranjevanje ter poizvedovanje v PB

5. tri-nivojska predstavitev podatkov;
6. Shramba in indeksiranje podatkov;
7. Formalni poizvedovalni jeziki;
8. Osnove SQL;
9. Predstavitev QBE;
10. XML PB in XQuery;

III. Osnove načrtovanja PB

11. tri-nivojski pristop k načrtovanju PB;
12. Konceptualno načrtovanje;
13. Logično načrtovanje;
14. Osnove normalizacije;
15. Fizično načrtovanje.
16. Podatkovna skladišča in njihovo načrtovanje

Opcijsko: noSQL in newSQL osnove

Content (Syllabus outline):

lectures:

I. Introduction to DB

1. History of data bases;
2. DB management systems (DBMS);
3. Types of DBMS;
4. Roles in DB Management;

II. Describing, Storing and Querying data in DB

5. 3-tire data representation;
6. Data storing and indexing;
7. Formal query languages;
8. SQL basics;
9. QBE;
10. XML SUPB, XQuery;

III. DB design - basics

11. 3-level data modelling approach;
12. Conceptual data modelling;
13. Logical data modelling;
14. Normalisation - basics;
15. Physical data modelling.
16. Data warehouses and their design;

Optional: noSQL and newSQL basics

Temeljni literatura in viri / Readings:

1. Thomas M. Connolly, Carolyn E. Begg (2009). *Database Systems, A Practical Approach to Design, Implementation and Management*, Fifth Edition, Addison-Wesley.
2. Raghu Ramakrishnan, Johannes Gehrke (2003). *Database Management Systems*, Third Edition, McGraw-Hill.

Cilji in kompetence:

Cilj predmeta je študentom računalništva in informatike predstaviti osnove o podatkovnih bazah, kaj so prednosti uporabe podatkovnih baz v primerjavi z drugimi načini shranjevanja podatkov; kako podatkovne baze delujejo in kako upravljamo z njimi; kako poizvedujemo po podatkih v podatkovnih bazah, kako jih načrtujemo ter kako z njimi upravljamo.

Splošne kompetence:

- Sposobnost razumevanja in reševanja strokovnih problemov s področja računalništva in informatike.
- Sposobnost iskanja virov informacij in kritične evaluacije razpoložljivih virov.
- Sposobnost uporabe pridobljenega znanja za samostojno reševanje problemov; sposobnost izpopolnjevanja pridobljenega znanja;

Specifične kompetence:

- Osnovne spretnosti s področja računalništva in informatike;
- Sposobnost prenosa znanja na sodelavce tako v tehničnih kot raziskovalnih skupinah.
- Osnovno znanje in spretnosti, ki so potrebni za nadaljevanje študija na drugi bolonjski stopnji.

Objectives and competences:

The aim of this course is to explain students the basics of databases, i.e. advantages of using database systems over using file systems, how databases and database management systems work, how we manage them; how we design databases, how we query databases etc.

General competencies:

- The ability to understand and solve professional challenges in computer and information science.
- The ability to search knowledge sources and to search for resources and critically evaluate information.
- 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.

Specific competencies:

- Basic skills in computer and information science, which includes basic theoretical skills, practical knowledge and skills essential for the field of computer and information science;
- The ability to transmit knowledge to co-workers in technology and research groups.
- Basic skills in computer and information science, allowing the continuation of studies in the second study cycle.

Predvideni študijski rezultati:

Intended learning outcomes:

Znanje in razumevanje:
 Poznavanje osnovnih principov delovanja sistemov za upravljanje s podatkovnimi bazami. Poznavanje tehnik načrtovanja podatkovnih baz. Poznavanje formalnih jezikov za poizvedovanje po podatkovnih bazah. Poznavanje prednosti uporabe podatkovnih baz.

Uporaba:
 Uporaba v sklopu razvoja informacijskih sistemov in druge programske opreme, ki zahteva obvladovanje večjih količin podatkov.

Refleksija:
 Zmožnost izboljševanja pristopov modeliranja, predstavitve in hranjenja podatkov v okviru praktičnih problemov.

Prenosljive spretnosti - niso vezane le na en predmet:
 Spretnosti uporabe domače in tuje literature in drugih virov, uporaba IKT, uporaba sistematičnih pristopov, analiza potreb, identifikacija in reševanje problemov, delo v timih.

Knowledge and understanding:
 Understanding basic principles of systems for database management. Understanding of database design techniques and approaches. Understanding of formal database query languages. Understanding advantages the use of database management systems brings.

Application:
 The use within information system development and development of other computer programs that demand or work with high volumes of data.

Reflection:
 Capability for improving modelling techniques, data representation and storing while solving practical problems.

Transferable skills: ability to use domestic and foreign literature, the use of ICT, the use of systematical approaches in solving problems, ability to identification of problems and their resolution, team work.

Metode poučevanja in učenja:

Predavanja, računske vaje z ustnimi nastopi, projektni način dela pri domačih nalogah in seminarjih.

Learning and teaching methods:

Lectures, Practical exercises, homeworks and seminars in team.

Delež (v %) /
 Weight (in %)

Načini ocenjevanja:

Assessment:

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

Pet najpomembnejših del:

ŽITNIK, Slavko, ŠUBELJ, Lovro, BAJEC, Marko. SkipCor : skip-mention coreference resolution using linear-chain conditional random fields. *PloS one*, ISSN 1932-6203, Jun. 2014, vol. 9, no. 6, str. 1-14

ŠUBELJ, Lovro, FIALA, Dalibor, BAJEC, Marko. Network-based statistical comparison of citation topology of bibliographic databases. *Scientific reports*, ISSN 2045-2322, 2014, 4, str. 1-10

FIALA, Dalibor, ŠUBELJ, Lovro, ŽITNIK, Slavko, BAJEC, Marko. Do PageRank-based author rankings outperform simple citation counts?. *Journal of informetrics*, ISSN 1751-1577, Apr. 2015, vol. 9, no. 2, str. 334-348

KRALLINGER, Martin, ŽITNIK, Slavko, BAJEC, Marko, et al. The CHEMDNER corpus of chemicals and drugs and its annotation principles. *Journal of cheminformatics*, ISSN 1758-2946. [Online ed.], 2015, vol. 7, suppl. 1, str. 1-17

ŠUBELJ, Lovro, FIALA, Dalibor, BAJEC, Marko. Network-based statistical comparison of citation topology of bibliographic databases. *Scientific reports*, ISSN 2045-2322, 2014, 4, str. 1-10

UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet: Razvoj informacijskih sistemov
Course title: Information Systems Development

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Univerzitetni študijski program prve stopnje Računalništvo in informatika Interdisciplinarni univerzitetni študijski program prve stopnje Računalništvo in in matematika Interdisciplinarni univerzitetni študijski program prve stopnje Upravna informatika	Modul: Obvladovanje informatike	3	zimski
University study programme Computer and Information Science, 1st cycle University study programme Computer Science and Mathematics , 1st cycle Interdisciplinary university Study Programme in Administrative Informatics 1 st Cycle	Module: Management of Information Systems	3	fall

Vrsta predmeta / Course type

izbirni predmet / elective course
 obvezni predmet / compulsory course

Univerzitetna koda predmeta / University course code:

63252

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje Laboratory work	Druge oblike študija Field work	Samost. delo Individ. work	ECTS
45	20	10	/	/	105	6

Nosilec predmeta / Lecturer:

prof. dr. Marko Bajec

**Jeziki /
Languages:**

**Predavanja /
Lectures:** slovenščina
 Slovenske
Vaje / Tutorial: slovenščina

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:**Prerequisites:****Vsebina:****predavanja:**

- I. Splošno o razvoju IS
 - 1. opis življenjskih modelov razvoja IS
 - 2. pristopi in metodologije razvoja IS
 - 3. problem obvladovanja kakovosti razvoja IS;
- II. Strukturni razvoj
 - 4. osnove strukturnega razvoja;
 - 5. predstavitev osnovnih aktivnosti strukturnega razvoja;
- III. Objektni razvoj
 - 6. osnove objektnega razvoja;
 - 7. predstavitev osnovnih aktivnosti objektnega razvoja;
 - 8. primerjava objektni-strukturni razvoj;
- IV. Sodobne lahke in agilne metodologije
 - 9. predstavitev osnovnih konceptov;
 - 10. predstavitev dobrih praks;
 - 11. konkretni primeri lahkih in agilnih pristopov.

Content (Syllabus outline):**Lectures:**

- I. General information about IS development
 - 1. software development life cycles;
 - 2. IS development approaches and methods;
 - 3. Managing quality of IS development;
- II. Structured IS development
 - 4. Basics of structured IS development;
 - 5. Main activities of structured IS development;
- III. Object-oriented development
 - 6. Basics of object-oriented IS development;
 - 7. Main activities of object-oriented IS development;
 - 8. Comparison of structured and object-oriented IS development;
- IV. Light and agile methods for IS development
 - 9. Basic concepts;
 - 10. Good practices;
 - 11. Examples of light and agile approaches.

Temeljni literatura in viri / Readings:

1. Jeffrey A. Hoffer, Joey George, Joe Valacich (2013), Modern Systems Analysis and Design (7th Edition), Addison-Wesley.
2. Martin Fowler (2003). UML Distilled: A Brief Guide to the Standard Object Modeling Language, Third Edition. Addison-Wesley.
3. Thomas A. Pender (2002). UML Weekend Crash Course. Wiley Publishing.
4. Per Kroll, Philippe Kruchten, Grady Booch (2003), The Rational Unified Process Made Easy: A Practitioner's Guide to the RUP), Addison-Wesley.
5. Martin, C. Robert (2003). Agile Software Development: Principles, Patterns and Practices. Prentice Hall.
6. Cockburn, A (2006). Agile Software Development (2nd Edition). Pearson Education.

Cilji in kompetence:

Cilj predmeta je študente naučiti sistematičnih in discipliniranih pristopov k razvoju informacijskih sistemov. V okviru predmeta bodo predstavljeni tako tradicionalni kot tudi modernejši pristopi k razvoju informacijskih sistemov.

Splošne kompetence:

- Sposobnost kritičnega razmišljanja;
- Razvoj spretnosti s kritičnim, analitičnim in sintetičnim razmišljanjem;
- Sposobnost definiranja, razumevanja in reševanja strokovnih izzivov s področja računalništva in informatike;
- Sposobnost uporabe pridobljenega znanja za samostojno reševanje problemov; sposobnost izpopolnjevanja pridobljenega znanja;
- Sposobnost timskega dela v profesionalnem okolju;
- Vodenje manjšega strokovnega tima.

Specifične kompetence

- Sposobnost samostojnega izvajanja lažjih in zahtevnejših inženirskih ter organizacijskih nalog na določenih ožjih področjih računalništva in informatike.
- Osnovno znanje in spretnosti, ki so potrebni za nadaljevanje študija na drugi bolonjski stopnji.

Objectives and competences:

The goal of this course is to teach students how to manage non-trivial IS development using systematical and disciplined approaches. Within the course the students will learn both, traditional and modern approaches and principles of IS development.

General competencies:

- Ability of critical thinking;
- Developing skills in critical, analytical and synthetic thinking;
- The ability to define, understand and solve creative 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;
- The ability of teamwork within the professional environment; management of a small professional team.

Specific competencies:

- The ability to independently perform both less demanding and complex engineering and organisational tasks in certain narrow areas and independently solve specific well-defined tasks in computer and information science.
- Basic skills in computer and information science, allowing the continuation of studies in the second study cycle.

Predvideni študijski rezultati:

Znanje in razumevanje:
 Pristopi k razvoju IS; strukturne tehnike; objektne tehnike; sodobne, sociološko naravnane tehnike razvoja; ključni problemi in dejavniki uspeha pri razvoju IS.

Uporaba:
 Izbira in uporaba različnih tehnik pri skupinskem razvoju informacijskih rešitev; obvladovanje razvoja.

Refleksija:
 Poglabljeno razumevanje problematike skupinskega razvoja in zmožnost razvoja novih, posameznim skupinam prilagojenih pristopov.

Prenosljive spretnosti - niso vezane le na en predmet:
 Spretnosti uporabe domače in tuje literature in drugih virov, uporaba IKT, uporaba sistematičnih pristopov, analiza potreb, identifikacija in reševanje problemov, delo v timih.

Intended learning outcomes:

Knowledge and understanding:
 Approaches to IS development; Structured techniques; Modern, socio-oriented techniques of IS development; Key problems and success factors in IS development.

Application:
 Selection and use different techniques in collaborative IS development; Management of IS development.

Reflection:
 Understanding of the intrinsic problems of collaborative IS development; skills to tailor or engineer new methods, sound to particular circumstances.

Transferable skills: skills to use domestic and international literature and other sources, the use of ICT, employment of systematic approaches, problem analysis, problem identification and resolving, collaborative work...

Metode poučevanja in učenja:

Predavanja, računske vaje z ustnimi nastopi, projektni način dela.

Learning and teaching methods:

Lectures, exercises, project work.

Načini ocenjevanja:

Način (pisni izpit, ustno izpraševanje, naloge, projekt):
Sprotno preverjanje (domače naloge, kolokviji in projektno delo)
Končno preverjanje (pisni in ustni izpit)

Ocene: 6-10 pozitivno, 5 negativno (v skladu s Statutom UL).

Delež (v %) /

Weight (in %)

Assessment:

Type (examination, oral, coursework, project):
Continuing (homework, midterm exams, project work)
Final (written and oral exam)

Grading: 6-10 pass, 5 fail (according to the rules of University of Ljubljana).

Reference nosilca / Lecturer's references:

Pet najpomembnejših del:

- 1.** BAJEC, Marko, KRISPER, Marjan. Agilne metodologije razvoja informacijskih sistemov. *Uporab. inform. (Ljubl.)*, apr., maj, jun. 2003, letn. 11, št. 2, str. 68-76, ilustr. [COBISS.SI-ID [3679060](#)] kategorija: 1C (Z2); upoštevana uvrstitev: MBP; tipologijo je verificiral OSICT točke: 15, št. avtorjev: 2
- 2.** BAJEC, Marko, VAVPOTIČ, Damjan, KRISPER, Marjan. Practice-driven approach for creating project-specific software development methods. *Inf. softw. technol.*. [Print ed.], 2007, vol. 49, no. 4, str. [345]-365, ilustr. [COBISS.SI-ID [5815124](#)], [JCR, WoS, št. citatov do 24. 5. 2011: 10, brez avtocitatov: 7, normirano št. citatov: 6] kategorija: 1A3 (Z1); upoštevana uvrstitev: SCI; tipologijo je verificiral OSICT točke: 21.95, št. avtorjev: 3
- 3.** BAJEC, Marko, VAVPOTIČ, Damjan. A framework and tool-support for reengineering software development methods. *Informatica (Vilnius)*, 2008, vol. 19, no. 3, str. 321-344, ilustr. [COBISS.SI-ID [6701396](#)], [JCR, WoS, št. citatov do 6. 5. 2011: 2, brez avtocitatov: 2, normirano št. citatov: 2] kategorija: 1A3 (Z1); upoštevana uvrstitev: SCI; tipologijo je verificiral OSICT točke: 37.85, št. avtorjev: 2
- 4.** VAVPOTIČ, Damjan, BAJEC, Marko. An approach for concurrent evaluation of technical and social aspects of software development methodologies. *Inf. softw. technol.*. [Print ed.], 2009, vol. 51, no. 2, str. 528-545, ilustr. [COBISS.SI-ID [6803284](#)], [JCR, WoS, št. citatov do 6. 8. 2011: 3, brez avtocitatov: 2, normirano št. citatov: 2] kategorija: 1A1 (Z1); upoštevana uvrstitev: SCI; tipologijo je verificiral OSICT točke: 52.59, št. avtorjev: 2
- 5.** ŽVANUT, Boštjan, BAJEC, Marko. A tool for IT process construction. *Inf. softw. technol.*. [Print ed.], Apr. 2010, vol. 52, no. 4, str. 397-410, ilustr. [COBISS.SI-ID [7558484](#)], [JCR, WoS, št. citatov do 7. 5. 2010: 0, brez avtocitatov: 0, normirano št. citatov: 0] kategorija: 1A1 (Z1); upoštevana uvrstitev: SCI; tipologijo je verificiral OSICT točke: 52.59, št. avtorjev: 2

Celotna bibliografija je dostopna na SICRISu:

<http://sicris.izum.si/search/rsr.aspx?lang=slv&id=9270>.

UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet: Principi programskih jezikov
Course title: Principles of Programming Languages

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Univerzitetni študijski program prve stopnje Računalništvo in informatika Univerzitetni študijski program prve stopnje Računalništvo in matematika	ni smeri	2	poletni
University study programme Computer and Information Science, 1st cycle University study programme Computer Science and Mathematics , 1st cycle	none	2	spring

Vrsta predmeta / Course type

izbirni predmet / elective course

Univerzitetna koda predmeta / University course code:

63220

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje Laboratory work	Druge oblike študija Field work	Samost. delo Individ. work	ECTS
45	/	30	/	/	105	6

Nosilec predmeta / Lecturer:

prof. dr. Andrej Bauer

**Jeziki /
Languages:**

**Predavanja /
Lectures:** slovenščina
Slovene
Vaje / Tutorial: slovenščina
Slovene

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

Prerequisites:



Vsebina:

- Modeli računanja in paradigme programiranja: imperativno, postopkovno programiranje; deklarativno, nepostopkovno, programiranje; objektno programiranje; funkcijsko programiranje; logično in relacijsko programiranje; programiranje z omejitvami; paralelno programiranje; genetsko programiranje; programiranje s primeri; itd.
- Pregled programskih jezikov za razne paradigme programiranja
- Elementi jezikov postopkovnega programiranja
- Nepostopkovno programiranje, logično programiranje in programski jezik prolog: logika kot programski jezik, postopkovni pomen programa kot avtomatsko dokazovanje izrekov, primeri simboličnega programiranja in deklarativnega snovanja programov
- Programiranje z omejitvami: ideje, principi in primeri, logično programiranje z omejitvami (CLP)
- Obravnavanje sintakse in semantike programskih jezikov: gramatike, operativna, prevajalska, denotacijska in aksiomska semantika
- Denotacijska semantika, povezava s gramatiko jezika, primeri denotacijskih definicij
- Aksiomska semantika in dokazovanje pravilnosti programov: parcialna in totalna pravilnost, invariantni pogoji, tehnike dokazovanja pravilnosti programov, uporaba najšibkejših predpogojev, avtomatsko dokazovanje pravilnosti

Content (Syllabus outline):

- Computational models and programming paradigms: imperative, procedural programming; declarative, non-procedural programming; functional programming; logic and relational programming; programming with constraints; parallel programming; genetic programming; programming by examples; etc.
- Overview of programming languages for various programming paradigms
- Elements of languages for imperative programming
- Declarative programming, logic programming and the Prolog language: logic as a programming language, procedural meaning of programs as automatic theorem proving, examples of symbolic programming and declarative program design
- Programming with constraints: ideas, principles and examples, constraint logic programming (CLP)
- Handling of syntax and semantics of programming languages: grammars, operational, translational, denotational and axiomatic semantics
- Denotational semantics, relation to the the grammar of a language, examples of denotational definitions
- Axiomatic semantics and proving correctness of programs: partial and total correctness, invariant conditions, techniques of proving program correctness, using weakest preconditions, automatic correctness

proving

Temeljna literatura in viri / Readings:

Robert W. Sebesta, Concepts of Programming Languages, 8th edition, Addison-Wesley 2007.

Peter van Roy, Seif Haridi, Concepts, Techniques, and Models of Computer Programming, MIT Press 2004.

Ivan Bratko, Prolog Programming for Artificial Intelligence, 4th edition, Pearson Education, Addison-Wesley, 2001.

Ivan Bratko, Prolog in umetna inteligenca, Založba FE in FRI, ponatis 2011.

Cilji in kompetence:

Cilj je predstaviti principe in pregled vrst programskih jezikov, vključno z različnimi modeli računanja, formalnim obravnavanjem sintakse in semantike jezikov ter pravilnosti programov; Razumevanje različnih vzorcev oz. paradigem programiranja ter njihove uporabe v ustreznih programskih jezikih; Praktična uporaba simboličnega programiranja, nepostopkovnega programiranja in programiranja z omejitvami

Objectives and competences:

To introduce the principles and types of programming languages, including models of computation, formal treatment of the syntax and semantics of languages and program correctness; Understanding of various programming paradigms and their use in corresponding programming languages; Practical applications of symbolic, declarative and constraint programming

Predvideni študijski rezultati:

Znanje in razumevanje:
Razumevanje različnih pristopov k programiranju in primernost raznih pristopov za reševanje raznih problemov;
Pregled principov in mehanizmov raznih vrst programskih jezikov;
Razumevanje načinov za opisovanje sintakse in pomena programskih jezikov ter formalno dokazovanje pravilnosti programov.
Uporaba:
Razvoj spretnosti simboličnega programiranja, programiranja v logiki in programiranja z omejitvami.

Intended learning outcomes:

Knowledge and understanding:
Understanding of various approaches to programming and suitability of these approaches to solving various problems;
Overview of the principles and mechanisms of types of programming languages;
Understanding ways of defining the syntax and semantics of languages, and formal proofs of program correctness.
Application:
Skill of symbolic programming, logic and constrain programming

Refleksija:

Sposobnost razmišljanja o alternativnih formulacijah problemov ter pristopov k njihovemu reševanju;
 Kako različni modeli računanja, paradigme programiranja in vrste jezikov spodbujajo alternativne pristope k računalniškemu reševanju problemov.
 Prenosljive spretnosti - niso vezane le na en predmet:
 Razširjene spretnosti snovanja programov.

Reflection:

Ability of thinking about alternative formulations of problems and approaches to their solution;
 How different computational models, programming paradigms and languages, support alternative approaches to computer problem solving

Transferable skills:

Enhanced skills of program design

Metode poučevanja in učenja:

Predavanja, avditorne vaje and exercises, domače naloge

Learning and teaching methods:

Lectures, practical work and exercises, home work

Načini ocenjevanja:	Delež (v %) / Weight (in %)	Assessment:
Način (pisni izpit, ustno izpraševanje, naloge, projekt): Sprotno preverjanje (domače naloge) Končno preverjanje (pisni in ustni izpit)	 50% 50%	Type (examination, oral, coursework, project): Continuing (homework) Final (written and oral exam)
Ocene: 6-10 pozitivno, 5 negativno (v skladu s Statutom UL).		Grading: 6-10 pass, 5 fail (according to the rules of University of Ljubljana).

Reference nosilca / Lecturer's references:**Pet najpomembnejših del:**

BAUER, Andrej, PRETNAR, Matija. Programming with algebraic effects and handlers. V: Journal of logical and algebraic methods in programming : Special Issue on Domains X, International workshop on Domain Theory and applications, Swansea, 5-7 September, 2011, (Journal of logical and algebraic methods in programming, ISSN 2352-2208, Vol. 84, iss. 1, 2015). <http://dx.doi.org/10.1016/j.jlamp.2014.02.001>

BAUER, Andrej, PRETNAR, Matija. An effect system for algebraic effects and handlers. Logical methods in computer science, ISSN 1860-5974, 2014, vol. 10, iss. 4, paper 9 (str. 1-29). <http://arxiv.org/pdf/1306.6316>.

BAUER, Andrej, PLOTKIN, Gordon, SCOTT, Dana S. Cartesian closed categories of separable Scott domains. Theoretical computer science, ISSN 0304-3975, 2014, vol. 546, str. 17-29.

BAUER, Andrej, HOFMANN, Martin, KARBYSHEV, Aleksandr. On monadic parametricity of second-order functionals. V: PFENNING, Frank (ur.).

Foundations of software science and computation structures : 16th International Conference, FOSSACS 2013, held as part of the European Joint Conferences on Theory and Practice of Software, ETAPS 2013, Rome, Italy, March 16-24, 2013 : proceedings, 16th International Conference on Foundations of Software Science and Computational Structures, FOSSACS 2013, Rome, Italy, March 16-24, 2013, (Lecture notes in computer science, ISSN 0302-9743, 7794). Berlin; Heidelberg: Springer, cop. 2013, str. 225-240.

http://dx.doi.org/10.1007/978-3-642-37075-5_15.

BAUER, Andrej, STONE, Christopher A. RZ: a tool for bringing constructive and computable mathematics closer to programming practice. Journal of logic and computation, ISSN 0955-792X, 2009, vol.

19, no. 1, str. 17-43. <http://dx.doi.org/10.1093/logcom/exn026>

BAUER, Andrej, HÖTZEL ESCARDÓ, Martín, SIMPSON, Alex. Comparing functional paradigms for exact real-number computation. V: WIDMAYER, Peter (ur.). Automata, languages and programming : 29th international colloquium, ICALP 2002, Málaga, Spain, July 8-13, 2002 : proceedings, (Lecture notes in computer science, ISSN 0302-9743, 2380). Berlin;

London: Springer, cop. 2002, str. 488-500.

UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet: Osnove umetne inteligence
Course title: Introduction to Artificial Intelligence

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Univerzitetni študijski program prve stopnje Računalništvo in informatika Univerzitetni študijski program prve stopnje Računalništvo in matematika	ni smeri	3	zimski
University study programme Computer and Information Science, 1st cycle University study programme Computer Science and Mathematics , 1st cycle	none	3	fall

Vrsta predmeta / Course type

obvezni predmet / compulsory course

Univerzitetna koda predmeta / University course code:

63214

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje Laboratory work	Druge oblike študija Field work	Samost. delo Individ. work	ECTS
45	/	30	/	/	105	6

Nosilec predmeta / Lecturer:

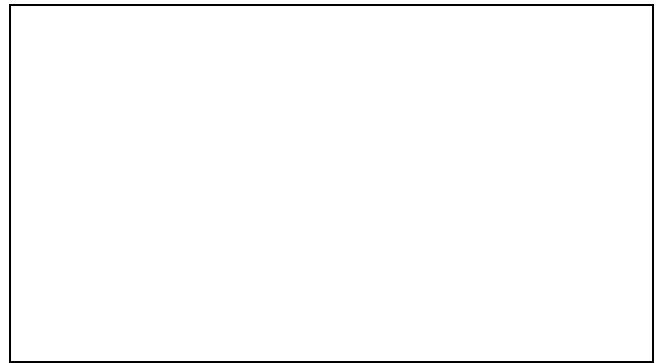
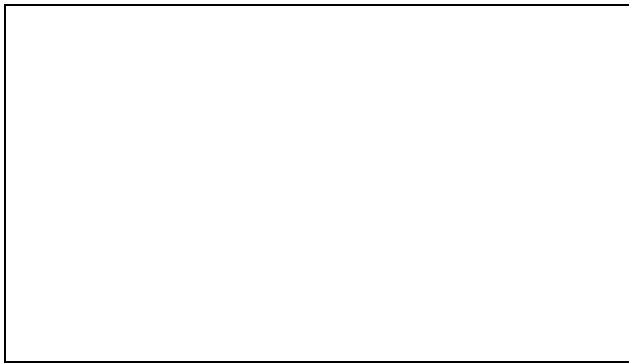
izr.prof. dr. Zoran Bosnić

**Jeziki /
Languages:**

**Predavanja /
Lectures:** slovenščina
Slovene
Vaje / Tutorial: slovenščina
Slovene

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

Prerequisites:

**Vsebina:**

- Uvod v umetno inteligenco in primeri uporabe
- Prostor stanj in osnovni algoritmi preiskovanja: globinsko, širinsko, iterativno poglobljanje, zahtevnost teh algoritmov
- Hevristično preiskovanje, algoritma A* in IDA*, izrek o popolnosti A*, lastnosti ocenitvenih funkcij ter analiza časovne in prostorske zahtevnosti
- Dekompozicija problemov z AND/OR grafi, algoritmi iskanja v AND/OR grafih, hevristično preiskovanje in algoritem AO*
- Strojno učenje: problem učenja iz podatkov, iskanje zakonitosti v podatkih in podatkovno rudarjenje, opisni jeziki in prostori hipotez, učenje odločitvenih dreves, regresijskih dreves, modelnih dreves, ter pravil. Programska orodja strojnega učenja in primeri uporabe.
- Predstavitev znanja in ekspertni sistemi: predstavitev znanja s pravili, ogrodji, semantičnimi mrežami, ontologije; algoritmi sklepanja in generiranje razlage; obravnavanje negotovega znanja, bayesovske mreže
- Planiranje po principu sredstev in ciljev, planiranje s popolno in delno urejenostjo, regresiranje ciljev, primeri uporabe v robotiki in logistiki

Content (Syllabus outline):

- Introduction to Artificial Intelligence, examples of applications
- State space and basic search algorithms: depth-first, breadth-first and iterative deepening, complexity of these algorithms
- Heuristic search, algorithms A* and IDA*, admissibility theorem for A*, properties of heuristic function and analysis of time and space complexity
- Problem decomposition with AND/OR graphs, search in AND/OR graphs, heuristic search algorithm AO*
- Machine learning: problem of learning from data, data mining, description languages and hypothesis spaces, induction of decision trees, regression trees, model trees, and rules. Software tools for machine learning and applications.
- Knowledge representation and expert systems: knowledge representation with rules, frames, semantic networks, ontologies; inference algorithms and generating explanation; handling uncertain knowledge, Bayesian networks
- Means-ends planning, total-order and partial-order planning, goal regression, applications in robotics and logistics

Temeljni literatura in viri / Readings:

I. Bratko, Prolog Programming for Artificial Intelligence, 4th edition, Pearson Education, Addison-Wesley 2011, ISBN: 0201403757.

S. Russell, P. Norvig, Artificial Intelligence: A Modern Approach, Third edition, Pearson Education, Prentice-Hall 2010, ISBN: 0136042597.

I. Bratko, Prolog in umetna inteligenca, Založba FE in FRI, ponatis 2011.

I. Kononenko, Strojno učenje, Založba FE in FRI, 2005.

Materiali na spletu (Spletna učilnica FRI; Ivan Bratko home page): Prosojnice predavanj, naloge.

Cilji in kompetence:

- Seznaniti slušatelje z osnovnimi koncepti, idejami, metodami in tehnikami umetne inteligence
- Sposobnost reševanja problemov z metodami umetne inteligence
- Zmožnost razumevanja literatura s področja umetne inteligence
- Prispevati k razumevanju relevantnosti tehničnih dosežkov umetne inteligence glede na njihove implikacije v filozofiji in psihologiji

Objectives and competences:

- Teach basic concepts, ideas, methods and techniques of artificial intelligence (AI)
- Ability to solve problems with methods of artificial intelligence
- Ability to understand the literature in the area of AI
- Contribute to the understanding of the relevance of technical achievements of AI with respect to their implications in philosophy and psychology

Predvideni študijski rezultati:

Znanje in razumevanje:

Študent spozna in razume osnovne in najpogostejše uporabljane metode umetne inteligence.

Uporaba:

Študent je zmožen uporabiti metode umetne inteligence pri načrtovanju in izvedbi konkretnih računalniških aplikacij na širokem področju uporabe.

Refleksija:

Študent je zmožen presoditi o implikacijah tehničnih dosežkov umetne inteligence na možnosti in omejitve pri uporabi računalnikov, meje računalniške inteligence, podobnosti in razlike z naravno inteligenco ter nekaterimi vprašanji področja kognitivne znanosti.

Prenosljive spretnosti - niso vezane le na en predmet:

Intended learning outcomes:

Knowledge and understanding:

The student recognises and understands the most frequently applied techniques of AI

Application:

The students is capable of applying methods of AI in the planning and development of concrete computer applications in various application areas

Reflection:

The student is capable of judging the implications of technical achievements of AI regarding the possibilities and limitations in computer applications, the limits of computer intelligence, similarities and differences with human intelligence, and some questions of cognitive science.

Transferable skills:

Skills are not limited to one subject; the student is capable of applying the learned methods in

Je zmožen uporabiti obdelane metode v sklopu načrtovanja računalniških aplikacij in sistemov.

the development of computer applications and systems in general.

Metode poučevanja in učenja:

Predavanja, laboratorijske vaje, domače naloge, individualni ali skupinski projekti

Learning and teaching methods:

Lectures, laboratory exercises, homework, individual and team projects

Načini ocenjevanja:

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

Sprotno preverjanje (domače naloge, kolokviji in projektno delo)

Končno preverjanje (pisni in/ali ustni izpit)

Ocene: 6-10 pozitivno, 5 negativno (v skladu s Statutom UL).

Delež (v %) /

Weight (in %)

Assessment:

Type (written and oral exam, coursework, project):

Continuing (homework, project work)

Final (written and/or oral exam)

Grading: 6-10 pass, 5 fail (according to the rules of University of Ljubljana).

Reference nosilca / Lecturer's references:

Pet najpomembnejših del:

1. ZUPANC, Kaja, BOSNIĆ, Zoran. Automated essay evaluation with semantic analysis. Knowledge-based systems, ISSN 0950-7051. [Print ed.], Mar. 2017, vol. 120, str. 118-132.
2. OCEPEK, Uroš, RUGELJ, Jože, BOSNIĆ, Zoran. Improving matrix factorization recommendations for examples in cold start. Expert systems with applications, ISSN 0957-4174. [Print ed.], Nov. 2015, vol. 42, no. 19, str. 6784-6794.
3. BOSNIĆ, Zoran, DEMŠAR, Jaka, KEŠPRET, Grega, Rodrigues, Pedro Pereira, Gama, João, Kononenko, Igor. Enhancing data stream predictions with reliability estimators and explanation. Engineering applications of artificial intelligence, ISSN 0952-1976. [Print ed.], 2014, vol. 34, str. 178-192.
4. BOSNIĆ, Zoran, KONONENKO, Igor. Estimation of individual prediction reliability using the local sensitivity analysis. Applied intelligence, ISSN 0924-669X. [Print ed.], Dec. 2008, vol. 29, no. 3, str. 187-203, ilustr.
5. BOSNIĆ, Zoran, KONONENKO, Igor. Comparison of approaches for estimating reliability of individual regression predictions. Data & Knowledge Engineering, ISSN 0169-023X. [Print ed.], Dec. 2008, vol. 67, no. 3, str. 504-516.

Celotna bibliografija je dostopna na SICRISu / For complete bibliography see SICRIS:
<http://sicris.izum.si/search/rsr.aspx?lang=slv&id=31318>.

UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet: Programiranje specifičnih platform
Course title: Platform Based Development

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Univerzitetni študijski program prve stopnje Računalništvo in informatika Univerzitetni študijski program prve stopnje Računalništvo in matematika	Modul: Razvoj programske opreme	3	poletni
University study programme Computer and Information Science, 1st cycle University study programme Computer Science and Mathematics, 1st cycle	Module: Software Development	3	spring

Vrsta predmeta / Course type

izbirni predmet / elective course

Univerzitetna koda predmeta / University course code:

63287

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje Laboratory work	Druge oblike študija Field work	Samost. delo Individ. work	ECTS
45	/	30	/	/	105	6

Nosilec predmeta / Lecturer:

izr. prof. dr. Zoran Bosnić

**Jeziki /
Languages:**

**Predavanja /
Lectures:** slovenščina
Slovene
Vaje / Tutorial: slovenščina
Slovene

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

Prerequisites:

Vsebina:

Predmet vsebuje teme s področja programiranja specifičnih platform, ki so priporočene v ACMjevem kurikulumu za računalništvo. Konkretna vsebina se bo letno prilagajala trendom, zato kurikulum ni omejen na konkretne platforme.

1. pregled platform (spletne, mobilne, igralne, industrijske, vgradne, robotske, paralelne/skalabilne,...),
2. podprti programski jeziki
3. programiranje z uporabo specifičnih knjižnic,
4. programiranje glede na omejitve posamezne platforme,
5. programski jeziki za mobilne platforme,
6. ravnotežje poraba/zmogljivost in analiza izvrševanja programa,
7. omejitve in izzivi mobilnih platform ter brezžična komunikacija, lokacijske aplikacije in nove tehnologije (navidezna in obogatena resničnost,...),
8. programiranje in pristopi za časovno kritične interaktivne platforme,
9. omejitve platform za časovno kritične interaktivne aplikacije,
10. izbrane vsebine iz programiranja industrijskih/robotskih/vgradnih platform,
11. izbrane vsebine iz programiranja igralnih platform.

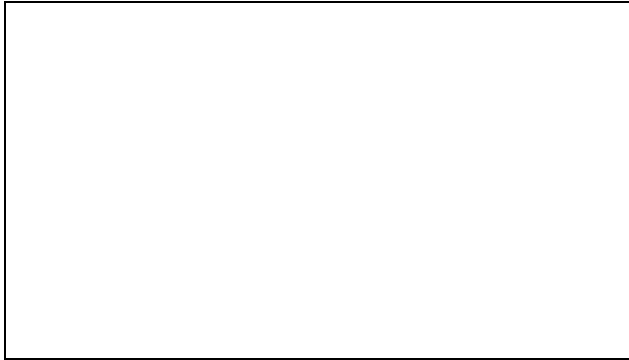
Vaje potekajo konzultacijsko in seminarско. Gradi se projekt skozi sprinte po Scrum metodi razvoja programske opreme.

Content (Syllabus outline):

The course will include topics in platform based development recommended in the ACM curriculum for CS. The topics will continually adapt to contemporary trends, thus the course is not constrained to a specific platform.

1. overview of platforms (web, mobile, game, industrial, embedded, robotic, paralel/scalable,...),
2. supported/domain-specific programming languages
3. programming via platform-specific APIs
4. programming under platform constraints,
5. mobile platform languages,
6. performance/power tradeoffs and profiling,
7. mobile platform constraints and challenges with wireless communication, location-aware applications and emerging technologies (virtual and augmented reality,...)
8. programming languages and approaches for time-critical interactive platforms,
9. platform constraints for time-critical interactive applications,
10. selected topics from industrial/robotic/embedded platforms programming,
11. selected topics from game platforms programming.

Practical part of the course consists of seminar work and consultations (tutorial). Students build the project using sprints as specified by



Scrum software engineering methodology.

Temeljni literatura in viri / Readings:

1. D. Crockford: JavaScript: The Good Parts, O'Reilly Media; 1st edition (May 2008)
2. P. A. Laplante , S. J. Ovaska :Real-Time Systems Design and Analysis: Tools for the Practitioner, Wiley-IEEE Press; 4 edition (November 22, 2011)
3. M. Neuburg: iOS 9 Programming Fundamentals with Swift: Swift, Xcode, and Cocoa Basics, O'Reilly Media, 2015.
4. R. Meier: Professional Android 4 Application Development, 3rd Edition; Wrox, 2012.
5. R. Ierusalimschy: Programming in LUA, Lua.org, 2013.

Cilji in kompetence:

Cilj predmeta je spoznati različne moderne računalniške platforme in se spoznati s specifikami razvoja programske opreme na teh platformah.

Splošne kompetence:

- Zmožnost kritičnega razmišljanja.
- Zmožnost definirati, razumeti in rešiti kreativne strokovne izzive na področju računalništva in informatike.
- Zmožnost apliciranja in nadgrajevanja pridobljenega znanja.

Predmetno specifične kompetence:

- Zmožnost prenosa znanja sodelavcem v tehnoloških ekipah.
- Veščine in praktično znanje o posebnih strojni opremi platform, specialnih programskih jezikih in omejitvah posameznih platform.

Objectives and competences:

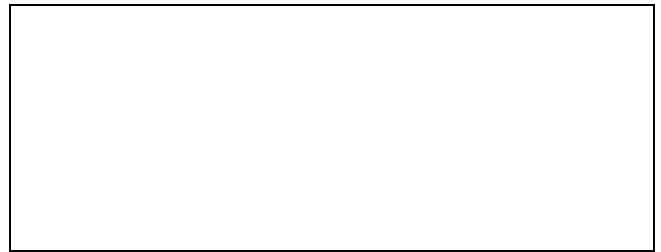
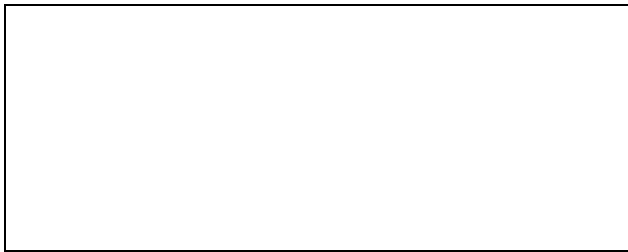
The aim of the course is to gain expertise on several modern platforms and learn the specifics of software development for these.

General competences:

- Ability of critical thinking.
- The ability to define, understand and solve creative professional challenges in computer and information science.
- The ability to apply and upgrade acquired knowledge.

Subject specific competences:

- The ability to transmit knowledge to co-workers in technology groups.
- Practical knowledge and skills of particular computer hardware of specific platforms, special programming languages and constraints associated with these.

**Predvideni študijski rezultati:**

Znanje in razumevanje: razumevanje omejitev, ki jih različne platforme predstavljajo za razvijalce; razumevanje potrebnega ravnotežja med zmogljivostmi in porabo programja; razumevanje prednosti in slabosti programiranja za platformo v primerjavi s programiranjem brez takšnih omejitev.

Uporaba: razvoj programskega izdelka na izbranih specifičnih oziroma časovno kritičnih platformah, npr. mobilnih, interaktivnih, igralnih in robotskih platformah. **Refleksija:** Poleg konkretnih znanj bodo študenti dobili tudi širok teoretični pregled nad posebnostmi, ki jih prinaša razvoj produkta za različne platforme.

Prenosljive spretnosti - niso vezane le na en predmet: Znanje programiranja je potrebno za večino drugih predmetov študija.

Intended learning outcomes:

Knowledge and understanding: understanding limitations imposed by various platforms for software developers; mastering the performance/power tradeoff; understanding and comparing specific platform oriented languages with general purpose programming.

Application: developing a software product for selected mobile or time-critical platforms, e.g., interactive, game and robotic platforms.

Reflection: Besides practical skills students shall gain theoretical background on particularities associated with platform based development.

Transferable skills: Programming is the basic skill and an implicitly required prerequisite for most other courses.

Metode poučevanja in učenja:

Predavanja in domača naloga. Poseben poudarek je na individualnem delu študentov.

Learning and teaching methods:

Lectures and homework with special emphasis on individual work.

Načini ocenjevanja:

Delež (v %) /

Weight (in %)

Assessment:

Način (pisni izpit, ustno izpraševanje, naloga, projekt):
Sprotno preverjanje (domače naloge)
Končno preverjanje (pisni in ustni izpit)
Ocene: 6-10 pozitivno, 5 negativno (v skladu s Statutom UL).

50%**50%**

Type (examination, oral, coursework, project):
Continuing (homework)
Final (written and oral exam)
Grading: 6-10 pass, 5 fail (according to the rules of University of Ljubljana).

Reference nosilca / Lecturer's references:**Pet najpomembnejših del:**

1. OCEPEK, Uroš, BOSNIĆ, Zoran, NANČOVSKA ŠERBEC, Irena, RUGELJ, Jože. Exploring the relation between learning style models and preferred multimedia types. *Computers & Education*, ISSN 0360-1315. [Print ed.], Nov. 2013, vol. 69, str. 343-355.
2. BOSNIĆ, Zoran, KONONENKO, Igor. Estimation of individual prediction reliability using the local sensitivity analysis. *Appl. intell. (Boston)*. [Print ed.], Dec. 2008, vol. 29, no. 3, p. 187-203, ilustr.
3. BOSNIĆ, Zoran, KONONENKO, Igor. Comparison of approaches for estimating reliability of individual regression predictions. *Data knowl. eng.*. [Print ed.], Dec. 2008, vol. 67, no. 3, p. 504-516
4. ŠTRUMBELJ, Erik, BOSNIĆ, Zoran, KONONENKO, Igor, ZAKOTNIK, Branko, GRAŠIČ-KUHAR, Cvetka. Explanation and reliability of prediction models: the case of breast cancer recurrence. *Knowledge and information systems*, 2010, vol. 24, no. 2, p. 305-324
5. BOSNIĆ, Zoran, KONONENKO, Igor. Automatic selection of reliability estimates for individual regression predictions. *Knowl. eng. rev.*, 2010, vol. 25, no. 1, p. 27-47

Celotna bibliografija je dostopna na SICRISu:

<http://sicris.izum.si/search/rsr.aspx?lang=slv&id=31318>.

UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet: Računalniške komunikacije
Course title: Computer Communications

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Univerzitetni študijski program prve stopnje Računalništvo in informatika	ni smeri	1	poletni
Interdisciplinarni univerzitetni študijski program prve stopnje Računalništvo in matematika		2	
Interdisciplinarni univerzitetni študijski program prve stopnje Upravna informatika		1	
University study programme Computer and Information Science, 1st cycle	none	1	spring
Interdisciplinary University study programme Computer Science and Mathematics , 1st cycle		2	
Interdisciplinary university Study Programme in Administrative Informatics 1 st Cycle		1	

Vrsta predmeta / Course type

obvezni predmet / compulsory course

Univerzitetna koda predmeta / University course code:

63209

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje Laboratory work	Druge oblike študija Field work	Samost. delo Individ. work	ECTS
45	/	30	/	/	105	6

Nosilec predmeta / Lecturer:

izr.prof. dr. Zoran Bosnić

**Jeziki /
Languages:**

**Predavanja /
Lectures:** slovenščina
Slovene

Vaje / Tutorial: slovenščina
Slovene

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

Prerequisites:

Vsebina:

1. Uvod: računalniška omrežja in internet
2. Osnovni pojmi: plasti, protokoli, storitve, protokolarni sklad. Hrbtenica in krajevna omrežja; kje nastajajo zakasnitve.
3. Aplikacijska plast: storitve, pregled standardnih protokolov. Zasnova omrežnih aplikacij, standardni protokoli HTTP, FTP, SMTP, DNS. Delovanje e-pošte, peer-to-peer aplikacij, vtičev (socket) in uporaba storitev transportne plasti.
4. Predstavitvena in sejna plast: vsebina in storitve, primeri.
5. Transportna plast: storitve, multipleksiranje, povezavni in nepovezavni prenos (TCP in UDP), zanesljiv prenos podatkov, nadzor zasičenja (congestion control), izvedba le tega v TCP.
6. Omrežna plast: storitve, virtualne zveze in datagramske povezave, delovanje usmerjevalnikov, naslavljanje v internetu (IP in IPv6), temelji usmerjanja.
7. Prenosni sistem – povezavna in fizična plast, krajevna omrežja (LAN): storitve, zaznavanje in odpravljanje napak, protokoli za skupinski prenosni medij,. Fizični naslovi (MAC) in preslikava v IP naslove (ARP), delovanje stikal. Ethernet, PPP, brezžična omrežja, aktualni standardi (npr. IEEE 802.11x, Bluetooth). Celularna omrežja, mobilnost. Prenos signalov, prenosni mediji, vrste modulacije.
8. Omrežna varnost, zanesljivost in zaščita,

Content (Syllabus outline):

1. Introduction: Computer networks and internet
2. Basic notions: layer, protocol, service, protocol stack. Backbone and local area networks; transmission latency sources.
3. Application layers: services, network application basics, overview of well-known protocols. Protocols HTTP, FTP, SMTP, DNS. E-mail functionalities, peer-to-peer applications, sockets, use of transport layer services.
4. Presentation and session layer: their purpose and services.
5. Transport layer: services, multiplexing, connection-oriented and connectionless transfer (TCP and UDP), reliable data transfer, congestion control and its implementation inside TCP.
6. Network layer: services, virtual and datagram connections, routing, addressing in internet (IPv4 and IPv6), routers.
7. Transmission system – data link and physical layer, local area networks (LANs): services, error detection and correction techniques, media access protocols, addressing (MAC addresses) and mapping of MAC address to IP addresses (protocol ARP), switches and their functionalities. Ethernet, PPP, wireless networks, current standards (IEEE 802.11x, Bluetooth), cellular networks, mobile networks, transmission of signals, media types, modulations.
8. Network security, reliability and protections.

celovitost sporočil, avtentikacija, pregled varovanja e-pošte, TCP povezav (SSL), omrežne povezave (IPSec), brezžične povezave. Požarne pregrade, IDS, IPS sistemi. Aktualni omrežni napadi in obramba pred njimi.

9. Pomen upravljanja omrežja.

Message integrity, authentication, protection of e-mail, TCP connections (SSL), network connection (IPSec), wireless connections). Firewalls, IDS/IPS systems. Network attacks and defense from them.

9. Network management.

Temeljni literatura in viri / Readings:

1. J. F. Kurose, K. W. Ross, M. Ciglarič, Z. Bosnić: Računalniške komunikacije. Pearson, England, 2014, ISBN 978-1-78399-776-3.

Dodatna literatura:

1. J. F. Kurose, K. W. Ross: Computer Networking, A top-down Approach Featuring Internet. 4. izdaja, Addison Wesley 2007. Poglavja 2-6 in 8.A.S. Tanenbaum, Computer Networks, 4. izdaja, Prentice Hall PTR, 2002.

Cilji in kompetence:

Cilj predmeta je študentom računalništva in informatike predstaviti osnove delovanja računalniških omrežij in pomembnejših protokolov. Kompetence, ki jih bo študent pridobil, so zlasti:

- sposobnost uporabe informacijsko-komunikacijske tehnologije in sistemov
- razumevanje delovanja večplastnih sistemov sodobnih komunikacij
- sposobnost uporabe in načrtovanja omrežnih storitev
- usposobljenost za načrtovanje omrežij in smiselno dodeljevanje omrežnih naslovov
- usposobljenost za postavitve preprostega omrežja (domače omrežje), za osnovno nastavljanje kompleksnih usmerjevalnikov in za postavitve krajevnega omrežja s stikali in brezžičnimi dostopnimi točkami.

Objectives and competences:

The main goal is to present the students of computer science and informatics the basics of computer networking and the most important communication protocols in this area. The competences that the students will acquire, are:

- capability to use information and communication systems and technology
- understanding of how multi-layer communication systems work
- use and design of network services
- being capable of designing network architectures and implementing network addressing
- capability for installing and administering a simple (home) network, performing basic routing settings and configuring switches and wireless access points.

Predvideni študijski rezultati:

Znanje in razumevanje:

Poznavanje glavnih omrežnih modelov (TCP/IP in ISO/OSI). Razumevanje razlike med arhitekturo in strukturo. Poznavanje in ločevanje funkcionalnosti posamezne plasti.

Intended learning outcomes:

Knowledge and understanding:

Knowledge of formal network models (TCP/IP and ISO/OSI). Understanding differences between architecture and structure. Differentiating between functionalities of

Sposobnost umestitve konkretnega problema na ustrezno plast v modelu.

Uporaba:
Uporaba omrežnih protokolov in storitev v svojih izvedbah.

Refleksija:
Spoznavanje in razumevanje medsebojne soodvisnosti plasti v različnih večplastnih modelih omrežij in povezava s konkretnimi izvedbami.

Prenosljive spretnosti - niso vezane le na en predmet:
Reševanje različnih problemov na osnovi večplastnih arhitekturnih modelov storitev. Reševanje različnih problemov na osnovi različnih strukturnih modelov omrežij in topologij.

different network layers. Linking the networking challenges with the appropriate network layer.

Application:
Use of network protocols and services in own configurations.

Reflection:
Becoming familiar and acquiring understanding of how the network layers are inter-dependent of each other; linking these findings with particular network implementations.

Transferrable skills:
Solving various problems using various multilayer service architecture models. Solving problems based on the structural network and network topology models.

Metode poučevanja in učenja:

Predavanja, laboratorijske vaje, seminarški način dela pri domačih nalogah, konzultacije pri izvajanju seminarških nalog (konkretni projekti). Poseben poudarek je na tekočem sledenju teorije in na tiskem delu in medsebojnem usklajevanju pri vajah in seminarjih.

Learning and teaching methods:

Lectures, tutorials, homeworks in the form of seminars, consultations for preparing of seminars (particular selected projects). Special emphasis is given on the following and understanding of given theoretical knowledge and on team work and cooperation within tutorials and seminars.

Delež (v %) /

Weight (in %)

Načini ocenjevanja:

Assessment:

Način (pisni izpit ali ustno izpraševanje, naloge, projekt):		Type (examination, oral, coursework, project):
Sprotno preverjanje (domače naloge, kolokviji in laboratorijske vaje)	40%	Continuing (homework, midterm exams, laboratory exercises)
Končno preverjanje (pisni ali ustni izpit)	60%	Final (written or oral exam)
Ocene: 6-10 pozitivno, 5 negativno (v skladu s Statutom UL).		Grading: 6-10 pass, 5 fail (according to the rules of University of Ljubljana).

Reference nosilca / Lecturer's references:

Pet najpomembnejših del:

- OCEPEK, Uroš, BOSNIĆ, Zoran, NANČOVSKA ŠERBEC, Irena, RUGELJ, Jože. Exploring the relation between learning style models and preferred multimedia types. Computers &

Education, ISSN 0360-1315. [Print ed.], Nov. 2013, vol. 69, str. 343-355.

2. BOSNIĆ, Zoran, KONONENKO, Igor. Estimation of individual prediction reliability using the local sensitivity analysis. Appl. intell. (Boston). [Print ed.], Dec. 2008, vol. 29, no. 3, p. 187-203, ilustr.
3. BOSNIĆ, Zoran, KONONENKO, Igor. Comparison of approaches for estimating reliability of individual regression predictions. Data knowl. eng.. [Print ed.], Dec. 2008, vol. 67, no. 3, p. 504-516
4. ŠTRUMBELJ, Erik, BOSNIĆ, Zoran, KONONENKO, Igor, ZAKOTNIK, Branko, GRAŠIČ-KUHAR, Cvetka. Explanation and reliability of prediction models: the case of breast cancer recurrence. Knowledge and information systems, 2010, vol. 24, no. 2, p. 305-324
5. BOSNIĆ, Zoran, KONONENKO, Igor. Automatic selection of reliability estimates for individual regression predictions. Knowl. eng. rev., 2010, vol. 25, no. 1, p. 27-47

Celotna bibliografija je dostopna na SICRISu:

<http://sicris.izum.si/search/rsr.aspx?lang=slv&id=31318>.

UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet: Osnove oblikovanja
Course title: Introduction to Graphics Design

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Univerzitetni študijski program prve stopnje Računalništvo in informatika	Modul: Medijske tehnologije	3	poletni
Interdisciplinarni univerzitetni študijski program prve stopnje Računalništvo in matematika			
Interdisciplinarni univerzitetni študijski program Upravna informatika prve stopnje		3	
Interdisciplinarni univerzitetni študijski program prve stopnje Multimedija		2	
University study programme Computer and Information Science, 1st cycle	Module: Media Technologies	3	spring
Interdisciplinary university study programme Computer Science and Mathematics , 1st cycle			
Interdisciplinary university study programme in Administrative Informatics 1 st cycle		3	
Interdisciplinary university study programme Multimedia, 1st cycle		2	

Vrsta predmeta / Course type

izbirni predmet / elective course
 obvezni predmet / compulsory course

Univerzitetna koda predmeta / University course code:

63271

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje	Druge oblike študija	Samost. delo	ECTS
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		Laboratory work	Field work	Individ. work	
45	/	30	/	105	6

Nosilec predmeta / Lecturer: izr. prof. dr. Narvika Bovcon

Jeziki / Languages:	Predavanja / Lectures:	slovenščina Slovene
	Vaje / Tutorial:	slovenščina Slovene

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

Prerequisites:

Vsebina:

1. Izbrana poglavja iz zgodovine in razvoja oblikovanja. Umetnost in znanost, oblikovanje in tehnologija.
2. Osnovne likovne prvine, barvna teorija, kompozicija – vaje: vizualne študije, barvne študije.
3. Osnove tipografije in zakonitosti uporabe črkovnih vrst in družin.
4. Oblikovalski prelom formata in strukturiranje formata z likovnimi in tipografskimi elementi.
5. Zakonitosti ekranske slike in principi montaže slik.
6. Strukturiranje sporočila skladno z zakonitostmi komunikacijskega koda in v odvisnosti od družbenega konteksta sporočanja.
7. Koncept interaktivnosti v novih medijih.
8. Načrtovanje uporabniškega vmesnika: – 1. poudarek na inovativnosti komunikacije med uporabnikom in računalnikom; – 2. poudarek na

Content (Syllabus outline):

1. Selected topics from the history of graphic design. Art and science, design and technology.
2. Graphic elements, colour theory, composition – practical work: visual studies, colour studies.
3. Typography: the basics and the principles of use.
4. Structuring of the graphic layout with visual and typographic elements.
5. Digital image and the principles of montage of images.
6. Structuring of the message according to the communication medium and with respect to the social context of the communication.
7. The concept of interactivity in new media.
8. Designing of user interfaces: – 1. with focus on the innovative concept of the human-computer interaction design; – 2. with focus on the effective visual

ustrezno strukturirani vizualni komunikaciji elementov vmesnika, ki posreduje informacije o interakciji z vmesnikom.

9. Vizualizacija podatkov. Projektna naloga.
10. Uporabniški paket grafičnih programov Adobe: uporaba programov iz paketa.

communication of the graphical elements of the interface that guides the interaction.

9. Data visualisation. Project work.
10. The Adobe software package: practical work.

Temeljni literatura in viri / Readings:

- Data Flow: Visualising Information in Graphic Design. Berlin: Gestalten, 2008.
- Flusser, V. Digitalni videz. Ljubljana: Študentska založba, 2000.
- Manovich, L. The Language of New Media. MIT, 2001.
- Samara, T. Design Elements: A Graphic Style Manual. Rockport Publishers, 2007.
- Strehovec, J. Besedilo in novi mediji. Ljubljana: LUD Literatura, 2007.
- Tufte, R. E. The Visual Display of Quantitative Information. Graphics Press LLC, 2001.
- Virtualni učitelji in priročniki za programe Adobe: Illustrator, Photoshop, After Effects, Premiere.

Cilji in kompetence:

Cilj predmeta je študentom predstaviti osnove načrtovanja vizualnih komunikacij. Oblikovalske načrtovalske metode bodo študenti računalništva in informatike uporabili pri načrtovanju novomedijskih vmesnikov, vizualizacij podatkov, elektronskih dokumentov in spletnih strani.

Objectives and competences:

The aim of the course is to introduce the students of computer and information sciences to the elements of visual language and the strategies of visual communication. The students will employ design methods to conceptualize new media interfaces, they will be able to effectively use graphic design elements to visualize data and present the contents of electronic documents and web pages.

Predvideni študijski rezultati:

Znanje in razumevanje:
Poznavanje zakonitosti likovnega izražanja, od osnovnih likovnih prvin do principov gradnje podobe. Poznavanje zakonitosti uporabe črkovnih vrst. Poznavanje medijskih zakonitosti ekranske slike. Razumevanje strukturiranosti komunikacije v odvisnosti od komunikacijskega koda in ciljne skupine sporočanja.

Uporaba:
Uporaba oblikovalskih metod in uporabniških oblikovalskih programov za oblikovanje spletnih strani, elektronskih dokumentov,

Intended learning outcomes:

Knowledge and understanding:
The laws of visual expression: the elements of visual language and the principles of image composition. The use of typography. Media specific design and design for the screen. The structure of communication and its dependence on the communicative code and the target audience.

Application:
The use of graphic design methods and the design software for designing web pages, digital

računalniških vmesnikov, vizualizacijo podatkov.

Refleksija:

Spoznavanje in razumevanje oblikovalskega procesa kot integralnega dela pri načrtovanju komunikacije med računalnikom in uporabnikom.

Prenosljive spretnosti - niso vezane le na en predmet:

Reševanje problemov pri načrtovanju uporabniku prijaznih računalniških vmesnikov in elektronskih dokumentov, ki temelji na zakonitostih oblikovalske stroke in metodah vizualnega sporočanja.

documents, computer interfaces, visualising information.

Reflection:

The understanding of graphic design process as an integral part of the human-computer interaction design.

Transferable skills:

Problem solving in human friendly approaches to interface design and digital document design, which draws on graphic design methods.

Metode poučevanja in učenja:

Predavanja, vaje v šoli, seminarji zajemajo domače delo. Poseben poudarek je na sprotnem študiju. Poseben vidik je vpeljevanje v skupinsko delo na kompleksnem oblikovalskem projektu.

Learning and teaching methods:

Lectures, practical work in school, project work at home. Emphasis on continuous work parallel to the lectures. Team-work experience on a complex multimedia design project.

Načini ocenjevanja:

Način (pisni izpit, ustno izpraševanje, naloge, projekt):
Sprotno preverjanje (domače naloge, kolokviji in projektno delo).
Končno preverjanje (pisni in/ali ustni izpit).
Ocene: 6-10 pozitivno, 5 negativno (v skladu s Statutom UL).

Delež (v %) /

Weight (in %)

Assessment:

Type (examination, oral, coursework, project):
Continuing (homework, midterm exams, project work).
Final (written and/or oral exam)
Grading: 6-10 pass, 5 fail (according to the rules of University of Ljubljana).

Reference nosilca / Lecturer's references:

Pet najpomembnejših del:

1.01 Izvirni znanstveni članek

1. BOVCON, Narvika. Literary aspects in new media art works. CLCWeb, ISSN 1481-4374. [Online ed.], 2014, vol. 15, no. 7, str. 1-13, ilustr.

<http://docs.lib.purdue.edu/cgi/viewcontent.cgi?article=2391&context=clcweb>. [COBISS.SI-ID 10410068]

2. BOVCON, Narvika, VAUPOTIČ, Aleš, KLEMENC, Bojan, SOLINA, Franc. "Atlas 2012" augmented reality : a case study in the domain of fine arts. V: First International Conference, SouthCHI 2013, Maribor, Slovenia, July 1-3, 2013. HOLZINGER, Andreas (ur.), et al. Human factors in computing and informatics : proceedings, (Lecture notes in computer science, ISSN 0302-9743, 7946). Heidelberg [etc.]: Springer, cop. 2013, str. 477-496, ilustr. <http://eprints.fri.uni-lj.si/2098/>. [COBISS.SI-ID 2782459] tipologija 1.08 -> 1.01

3. BOVCON, Narvika. Jezik gibljivih slik v računalniških vizualizacijah literarnozgodovinske podatkovne zbirke. *Literatura in gibljive slike : tematski sklop = Literature and moving images : thematic section*, (Primerjalna književnost, ISSN 0351-1189, letn. 37, št. 2). Ljubljana: Slovensko društvo za primerjalno književnost, 2014, letn. 37, št. 2, str. 119-133, 235-242, [244], ilustr. [COBISS.SI-ID 55119202]

4. BOVCON, Narvika. Pomenske mreže v arhivskih zbirkah - čas računalnikov in čas fotografije. *Dialogi*, ISSN 0012-2068, 2010, letn. 46, št. 11/12, str. 24-45, ilustr. <http://eprints.fri.uni-lj.si/1387/>. [COBISS.SI-ID 8148564]

3.12 Razstava

5. BOVCON, Narvika, MERVIČ, Vanja, VAUPOTIČ, Aleš. *Tehniške slike = Technical images : razstava na festivalu Speculum Artium 2015, 15.-17. oktober 2015, 7. mednarodni festival novomedijske kulture Integriteta realnosti*. [COBISS.SI-ID 4119547]

Celotna bibliografija je dostopna na SICRISu:

<http://www.sicris.si/search/rsr.aspx?lang=slv&id=33966>.

UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet: Digitalno načrtovanje

Course title: Digital Design

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Univerzitetni študijski program prve stopnje Računalništvo in informatika Univerzitetni študijski program prve stopnje Računalništvo in matematika	Modul: Računalniški sistemi	3	zimski
University study programme Computer and Information Science, 1st cycle University study programme Computer Science and Mathematics , 1st cycle	Module: Computer systems	3	fall

Vrsta predmeta / Course type

izbirni predmet /elective course

Univerzitetna koda predmeta / University course code:

63260

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje Laboratory work	Druge oblike študija Field work	Samost. delo Individ. work	ECTS
45	10	20	/	/	105	6

Nosilec predmeta / Lecturer:

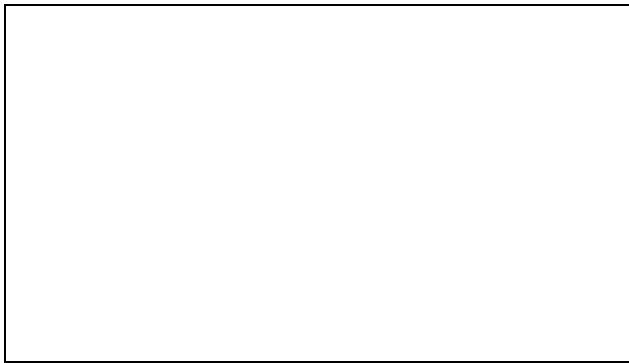
izr. prof. dr. Patricio Bulić

**Jeziki /
Languages:**

Predavanja / Lectures:	slovenščina Slovene
Vaje / Tutorial:	slovenščina Slovene

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

Prerequisites:

**Vsebina:**

1. Uvod v načrtovanje in testiranje digitalnih sistemov;
2. Jeziki HDL za opis strojne opreme (VHDL, Verilog), napotki za kodiranje, simulacija, sinteza;
3. Tehnologija in pregled programabilnih vezij;
4. Računalniška aritmetika ter načrtovanje in sinteza odločitvenih vezij;
5. Načrtovanje sekvenčnih vezij: sinhrona in asinhrona vezja, pomnilne celice, register, registerski niz, števeci, splošni končni avtomat, pomnilnik);
6. Urin signal: sinteza, distribucija, »clock gating«, sinhronizacija;
7. Načrtovanje (mikro)procesorja: podatkovne poti, kontrolna enota, cevovod
8. Načrtovanje sinhronskih komunikacijskih vmesnikov (PS/2, I2C, PCI)
9. Načrtovanje asinhronskih komunikacijskih vmesnikov (USART)
10. Sinteza pomnilnikov RAM in ROM, sinteza dvokanalnih pomnilnikov
11. Sinteza grafičnih vmesnikov
12. Modularna gradnja sistemov: sistem na čipu (SOC, System-on-Chip).

Content (Syllabus outline):

1. Introduction to design and testing of digital systems;
2. Languages for hardware description (VHDL, Verilog, Abel-HDL, ...);
3. Technology and survey of programmable logic circuits
4. Computer arithmetics: design and synthesis of decision digital circuits,
5. Design of time dependant synchronous and asynchronous circuits, flip-flops, counters, registers, finite automata;
6. Clock signal, distribution and clock gating, synchronization;
7. Design of microprocessor, data paths, control unit, pipeline;
8. Design of synchronous communication adapters (PS/2, I2C, PCI);
9. Design of asynchronous comm. adapters (USART);
10. Memory synthesis: RAM,ROM, dual-channel
11. Design of simple graphics interfaces
12. Modular system synthesis: system on chip (SOC).

Temeljni literatura in viri / Readings:

1. Wakerly, John F. Digital design : principles and practices, Upper Saddle River : Pearson/Prentice Hall, 2006;
2. Enoch Hwang. Digital Logic and Microprocessor Design with VHDL. Thomson/Nelson, 2006.
3. Richard E. Haskell & Darrin M. Hanna, Digital Design. 2nd Ed. LBE Books 2012.
4. Zapiski s predavanj, gradivo za vaje / Lecture notes, exercises

Cilji in kompetence:

Študenta želimo naučiti samostojne uporabe in načrtovanja digitalnih vezij z uporabo sodobnih jezikov HDL in načrtovalskih orodij za simulacijo in sintezo. Pri tem jih opozorimo na specifičnosti le-teh in naučimo upoštevati optimalne pristope. Pri predmetu študentje pridobijo znanje in izkušnje pri načrtovanju in testiranju digitalnih sistemov ter uporabi sodobnih načrtovalskih orodij, razvijejo spretnosti za skupinsko razvojno delo ter poglobijo tehnično znanje.

Objectives and competences:

We instruct students how computer-aided design tools are used to both simulate the VHDL or Verilog design and to synthesize the design to actual hardware. Specific behaviour of HDL tools is emphasized. We present the design of digital circuit using optimal approaches. As part of the course, students develop familiarity and confidence with designing, building and testing digital circuits, including the use of CAD tools, develop team-building skills and enhance technical knowledge through both written assignments and design projects.

Predvideni študijski rezultati:

Znanje in razumevanje:

104 Osnove digitalnih vezij
202 Arhitektura računalniških sistemov
208 Organizacija računalniških sistemov

Načrtovanje in implementacija kombinatoričnih in sekvenčnih vezij z uporabo VHDL/Verilog, časovna analiza vezij, načrtovanje končnih avtomatov, načrtovanje kompleksnih digitalnih gradnikov kot delov končnih sistemov, ustno in pisno poročanje o načrtovanih sistemih

Uporaba:

Načrtovanje kompleksnih digitalnih vezij, oziroma delov sistemov na čipu (SoC).

Refleksija:

Razumevanje delovanja in sposobnost načrtovanja samostojnih digitalnih sistemov.

Prenosljive spretnosti - niso vezane le na en predmet:

Izdelava seminarja in preizkus vezja.

Intended learning outcomes:

Knowledge and understanding:

104 Introduction to Digital Circuits
202 Computer Systems Architecture
208 Organisation of Computer Systems

Design and implement combinational and sequential logic circuits using VHDL/Verilog, analyze the timing of digital circuits, design and implement state machines, use a complex sequential logic circuit as part of a solution to an open-ended design problem, give oral and written reports on all aspects of a design project.

Application:

Design of some complex digital circuits or a part of system on chip (SOC).

Reflection:

Understanding and the ability to design complex digital systems.

Transferable skills: They are not connected only to this particular work.

Project report and the design implementation.

Metode poučevanja in učenja:**Learning and teaching methods:**

Predavanja, laboratorijske vaje na katerih se uporabljajo sodobna orodja za načrtovanje digitalnih sistemov ter vezij FPGA, domače naloge, končni projekt	Lectures, a series of lab assignments using modern CADF tools and FPGAs, homeworks, final project
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Delež (v %) /

Weight (in %) **Assessment:**

Načini ocenjevanja:

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

Reference nosilca / Lecturer's references:

Pet najpomembnejših del: / Five most important works:

1. AVRAMOVIĆ, Aleksej, BABIĆ, Zdenka, RAIČ, Dušan, STRLE, Drago, BULIĆ, Patricio. An approximate logarithmic squaring circuit with error compensation for DSP applications. *Microelectronics journal*, 2014, vol. 45, iss. 3, str. 263-271.
2. ČEŠNOVAR, Rok, RISOJEVIĆ, Vladimir, BABIĆ, Zdenka, DOBRAVEC, Tomaž, BULIĆ, Patricio. A GPU implementation of a structural-similarity-based aerial-image classification. *J. supercomput.*, Aug. 2013, vol. 65, no. 2, str. 978-996.
3. BULIĆ, Patricio, GUŠTIN, Veselko, ŠONC, Damjan, ŠTRANCAR, Andrej. An FPGA-based integrated environment for computer architecture. *Comput. appl. eng. educ.*, Mar. 2013, vol. 21, no. 1, str. 26-35.
4. LOTRIČ, Uroš, BULIĆ, Patricio. Applicability of approximate multipliers in hardware neural networks. *Neurocomputing*, Nov. 2012, vol. 96, str. 57-65.
5. BABIĆ, Zdenka, AVRAMOVIĆ, Aleksej, BULIĆ, Patricio. An iterative logarithmic multiplier. *Microprocess. micro syst.*, 2011, vol. 35, no. 1, str. 23-33.

Celotna bibliografija izr. prof. Patricia Bulića je dostopna na SICRISu:

<http://sicris.izum.si/search/rsr.aspx?lang=slv&id=4520>.

UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet:	Organizacija računalniških sistemov
Course title:	Computer Systems Organisation

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Univerzitetni študijski program prve stopnje Računalništvo in informatika	ni smeri	2	zimski
University study programme Computer and Information Science, 1st cycle	none	2	fall

Vrsta predmeta / Course type obvezni predmet / compulsory course

Univerzitetna koda predmeta / University course code: 63218

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje Laboratory work	Druge oblike študija Field work	Samost. delo Individ. work	ECTS
45	/	30	/	/	105	6

Nosilec predmeta / Lecturer: izr. prof. dr. Patricio Bulić

Jeziki / Languages:	Predavanja / Lectures:	slovenščina Slovene
	Vaje / Tutorial:	slovenščina Slovene

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

Vsebina: **Content (Syllabus outline):**

Predavanja obsegajo naslednja poglavja:

1. Polprevodniška tehnologija CMOS, logični nivoji, logični gradniki v tehnologiji CMOS, urin signal, sinhronizacija, metastabilnost.
2. Vhod in izhod: osnovne lastnosti V/I naprav, V/I priključki
3. Paralelni V/I krmilniki
4. Serijski V/I vmesniki
5. Prekinitve in prekinitveni krmilniki
6. Prekinitveno voden V/I
7. Neposreden dostop do pomnilnika, krmilniki DMA
8. Pomnilniška hierarhija, navidezni pomnilnik
9. Prenosne poti, vodila
10. Vrste prenosov: sinhronski, asinhronski, eksplozijski, ukazno-protokolski, izvorno-sinhronski
11. Paralelni sistemi: večjedrni in mnogojedrni sistemi
12. Predpomnilniška skladnost

Vsa poglavja bodo podprta s primeri iz prakse: Intel Nehalem microarchitecture, Intel Ivy Bridge chipset in STM32F4 SOC

The course consists of the following chapters:

1. Semiconductor CMOS technology, logic levels, basic CMOS elements, clock, synchronization and meta-stability
2. Input and output: basic I/O block and its properties
3. Parallel I/O adapters and controllers
4. Serial I/O adapters and controllers
5. Interrupts and interrupts controllers
6. Interrupt driven I/O
7. Direct memory access, DMA controllers
8. Memory hierarchy, virtual memory
9. Transmission lines, buses
10. Data transfer: synchronous, asynchronous, burst, command sequencing, source-synchronous
11. Parallel systems: multi- and many-core systems
12. Cache coherency

All chapters will cover the case studies: Intel Nehalem microarchitecture, Intel Ivy Bridge chipset and STM32F4 SOC

Temeljni literatura in viri / Readings:

1. D. A. Patterson, J. L. Hennessy: Computer Organization and Design: The Hardware/Software Interface, The Fourth Revised Edition, Elsevier 2012.
2. D. Kodek: *Arhitektura in organizacija računalniških sistemov*, Bi-Tim, Ljubljana 2008
3. Zapiski s predavanj, gradivo za vaje in stari izpiti na domači strani predmeta

1. D. A. Patterson, J. L. Hennessy: Computer Organization and Design: The Hardware/Software Interface, The Fourth Revised Edition, Elsevier 2012.
2. D. Kodek: *Arhitektura in organizacija računalniških sistemov*, Bi-Tim, Ljubljana 2008
3. Lecture notes, exercises and old exams published on the course home page

Cilji in kompetence:

Cilj predmeta je spoznati delovanje in organizacijo digitalnih računalniških sistemov, bolje razumeti, kako se sistemska programska oprema poveže s strojno opremo ter kako trendi v tehnologiji in aplikacijah vplivajo na neprestane spremembe v organizaciji računalniških sistemov.

Objectives and competences:

The goal of the course is to teach the design and operation of a digital computer and to better understand why hardware is and how system software interacts with hardware, and to understand how the trends in technology and applications drive continuing changes in the field.

Predvideni študijski rezultati:

Znanje in razumevanje:

Poglobljeno poznavanje organizacije računalniških sistemov in strojne opreme na kateri se izvajajo računski postopki ter vmesnikov med strojno in programsko opremo.

Uporaba:

Razumeti kako računalnik deluje in kakšne so njihove omejitve predstavlja osnovo za razvoj visoko kvalitetne programske opreme. Pomembno tudi pri nakupu računalniške opreme.

Refleksija:

Odpraviti pogosto stanje, kjer se na računalnik gleda kot na črno škatlo, ki izvaja programe na neznan način.

Prenosljive spretnosti - niso vezane le na en predmet:

Predmet se dopolnjuje s predmeti s področja programiranja, operacijskih sistemov, algoritmov in digitalnih vezij.

Intended learning outcomes:

Knowledge and understanding:

A deeper understanding of computer systems organization and the hardware environment upon which all computing is based, and the interface it provides to higher software layers.

Application:

Understanding of how computers work and what are their limitations represents the basis for high quality software development. It is also important for computer procurement.

Reflection:

Preventing the common situation where the computer is treated as just a black box that executes programs in some mysterious way.

Transferable skills:

The course is complemented with courses teaching programming, operating systems, algorithms and digital design.

Metode poučevanja in učenja:

Predavanja s sprotno predstavitvijo realnih zgledov, laboratorijske vaje na katerih študentje uporabljajo moderen računalniški sistem in programirajo vse vmesnike/krmilnike, ki jih spoznajo na predavanjih ter domače naloge.

Learning and teaching methods:

Lectures with modern case studies, a series of lab assignments using modern computer system and programming tools to develop drivers for all devices/controllers presented in lectures, and homeworks.

Načini ocenjevanja:

Način (pisni izpit in ustno izpraševanje):
Sprotno delo poteka v obliki domačih naloge, projektnega dela in kolokvijev.
Končno preverjanje: pisni in ustni izpit
 Ocene: 6-10 pozitivno, 5 negativno (v skladu s Statutom UL).

Delež (v %) /

Weight (in %)

Assessment:

Type (written examination, oral examination):
Continuing work (homeworks, midterm exams, project work).
Final: written and oral exam
 Grading: 6-10 pass, 5 fail (according to the Statute of UL).

Reference nosilca / Lecturer's references:**Pet najpomembnejših del:**

1. AVRAMOVIĆ, Aleksej, BABIĆ, Zdenka, RAIČ, Dušan, STRLE, Drago, BULIĆ, Patricio. An approximate logarithmic squaring circuit with error compensation for DSP applications. *Microelectronics journal*, 2014, vol. 45, iss. 3, str. 263-271.
2. ČEŠNOVAR, Rok, RISOJEVIĆ, Vladimir, BABIĆ, Zdenka, DOBRAVEC, Tomaž, BULIĆ, Patricio. A GPU implementation of a structural-similarity-based aerial-image classification. *J. supercomput.*, Aug. 2013, vol. 65, no. 2, str. 978-996.
3. BULIĆ, Patricio, GUŠTIN, Veselko, ŠONC, Damjan, ŠTRANCAR, Andrej. An FPGA-based integrated environment for computer architecture. *Comput. appl. eng. educ.*, Mar. 2013, vol. 21, no. 1, str. 26-35.
4. LOTRIČ, Uroš, BULIĆ, Patricio. Applicability of approximate multipliers in hardware neural networks. *Neurocomputing*, Nov. 2012, vol. 96, str. 57-65.
5. BULIĆ, Patricio, DOBRAVEC, Tomaž. An approximate method for filtering out data dependencies with a sufficiently large distance between memory references. *J. supercomput.*, 2011, vol. 56, no. 2, str. 226-244
6. BABIĆ, Zdenka, AVRAMOVIĆ, Aleksej, BULIĆ, Patricio. An iterative logarithmic multiplier. *Microprocess. microsyst.*, 2011, vol. 35, no. 1, str. 23-33

Celotna bibliografija izr. prof. Patricia Bulića je dostopna na SICRISu:

<http://sicris.izum.si/search/rsr.aspx?lang=slv&id=11542>.

UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet:	Angleški jezik – nivo A
Course title:	English, level A

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Univerzitetni študijski program računalništva in informatike, 1. stopnja	ni smeri	2, 3	poletni
University study programme Computer and Information Science, 1st cycle	None	2,3	spring

Vrsta predmeta / Course type izbirni predmet /elective course

Univerzitetna koda predmeta / University course code: 63222

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje Laboratory work	Druge oblike študija Field work	Samost. delo Individ. work	ECTS
30	/	15	/	/	/	3

Nosilec predmeta / Lecturer: lekt. mag. Nina Bostič Bishop

Jeziki / Languages:	Predavanja / Lectures:	slovenščina in angleščina Slovene and English
	Vaje / Tutorial:	slovenščina in angleščina Slovene and English

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

Prerequisites:

Vsebina:

Content (Syllabus outline):

Slovnica:

- časi;
- predlogi;
- tvorba vprašanj;
- modalni glagoli;
- predložne zveze;
- števila in števnik, prezentacija grafov;
- pasiv;
- pogojniki;
- frazni glagoli.

Besedišče:

- prvi kontakti in predstavljanje;
- opis študija na fakulteti;
- vpljudnostne fraze;
- izmenjava informacij;
- predstavitev podjetja in dejavnosti;
- jezik poslovnih predstavitev;
- korespondenca in telefoniranje;
- dogovori in zmenki;
- tipične napake.

Grammar:

- tenses;
- prepositions;
- forming questions;
- modal verbs;
- prepositional phrases;
- numbers, presentation of figures in charts and graphs;
- passive voice;
- conditionals and temporary clauses;
- phrasal verbs.

Vocabulary:

- first encounters;
- study at the Faculty of Computer and Information Science;
- phrases and exchanging information;
- presentations;
- correspondence and telephoning;
- meetings and reports;
- quoting what people think and what they have said;
- typical mistakes.

Temeljni literatura in viri / Readings:

1. Williams A. in Pile L. (2002) Pass Cambridge, BEC Vantage. Summertown Publishing: Oxford.
 2. Littleford David, Halstead John in Charles Mulraine. (2004). Career Skills: Opening Doors into the Job Market. New York: Palgrave Macmillan.
 3. Badger I. (2006). English for work. Longman: Edinburgh.
- Dodatna literatura:
4. Anderson K. (2004). Study speaking. Cambridge University Press: Cambridge.
 5. Remacha Esteras, Santiago. (2003). English for computer users. Workbook. Cambridge: Cambridge: University Press.
 6. Štros M. (2006). English correspondence. Babylon d.o.o.: Ljubljana.
 7. Brieger, N. In Pohl, A. (2002). Technical English Vocabulary and Grammar. Summertown: Summertown Publishing Limited.
 8. EVROTERM. Večjezična terminološka baza izrazov Evropske unije. Dostopno na: <http://www.sigov.si/evroterm>.
 9. Cambridge Dictionary Online. Dostopno na <http://dictionary.cambridge.org>.

Cilji in kompetence:**Objectives and competences:**

Cilj predmeta je poglobiti splošno jezikovno znanje študentov ter jih seznaniti z jezikom stroke oz. osnovno strokovno terminologijo glede na študijsko smer. Pri predmetu se bodo študenti seznanili s spremembami in novostmi v angleškem jeziku, korespondence in pri predstavitev. Študenti bodo spoznali tudi strukturo fakultete (nazive laboratorijev, smeri, predmetnika) v tujem jeziku ter razvili bralno razumevanje strokovnih besedil in utrdili pripravo povzетkov vsebine v angleščini. Poleg tega bodo razvili tudi specifične poslovne komunikacijske veščine (telefoniranje, elektronska pošta, neformalni pogovori, predstavitev naloge oz. referata, predstavitev oddelka ali laboratorija, pisanje C.V.-ja in spremnega pisma, priprava na razgovor za delovno mesto).

Main goal is to:

- expand general knowledge of English and introduce the terminology used in the field of computer science;
- inform students about changes in English language, correspondence and new trends in presentation techniques;
- familiarise students with vocabulary necessary for describing their study, faculty and university;
- develop strategies for business communication i.e. telephoning, correspondence, presentation, writing CV.

Predvideni študijski rezultati:

Znanje in razumevanje:

Predmet bo študentom omogočil:

- utrditi in razširiti splošno in strokovno znanje angleškega jezika;
- samostojno učenje jezika in uporabo različnih virov (slovarji, učbeniki, časopisi in revije, spletne strani, ipd);
- pisanje povzетkov besedil;
- brati, analizirati in razumeti različna avtentična strokovna besedila;
- pripravo na mednarodne izpite Univerze Cambridge in pridobitev spričevala o aktivnem znanju angleškega jezika.

Uporaba:

S pridobljenim spričevalom o aktivnem znanju ang. jezika bo študent lahko izkazal znanje, ki ga je pridobil v programu, ki v celoti temelji na priporočenem evropskem jezikovnem okviru. Sam bo lahko svoje znanje ocenil s stopnjami od A1 do C2 glede na usvojeno znanje in pridobljeno oceno ob koncu programa, kar mu bo še v posebno pomoč pri izmenjavi študentov, v okviru evropskih programov: Erasmus, Leonardo, ipd.

Refleksija:

Študentje bodo glede na usvojeno znanje s

Intended learning outcomes:

Knowledge and understanding:

Application: to recognise and understand the meaning of written and oral communication in English; to recognise and achieve the communication strategies

Reflection: Students will be able to discuss advantages and disadvantages of learning a foreign language by means of technical support e.g. computers. They will use information technologies for searching information on www.

Transferable skills:

On completion of this course the student will be able to:

- use correctly the typical structures of general English and ESP;
- use the most appropriate strategies in language communication.

The language certificate based on Common European Language Framework (self-assessment) will enable students to take part in Erasmus, Leonardo and similar exchange programs.

področja tehnike (npr. računalništva) ugotavljati prednosti in slabosti uporabe le-teh pri učenju tujega jezika.
 Prenosljive spretnosti - niso vezane le na en predmet:
 Jasno in učinkovito ustno in pisno izražanje, samostojno učenje in iskanje informacij, kritično razmišljanje, timsko delo, organiziranje časa.

Metode poučevanja in učenja:

- predavanja
- lektorske vaje
- delo v parih in skupinah
- problemsko zasnovano učenje jezika in analiza študijskih primerov
- A/V predstavitve

Learning and teaching methods:

- lectures
- practice
- pair work
- problem solving and case study
- A/V presentations

Delež (v %) /

Weight (in %)

Načini ocenjevanja:

Assessment:

Način (pisni izpit, ustno izpraševanje, naloge, projekt):
Sprotno preverjanje (domače naloge, kolokviji in projektno delo)
Končno preverjanje (pisni in ustni izpit)

50%

50%

Type (examination, oral, coursework, project):
Continuing (homework, midterm exams, project work)
Final (written and oral exam)

Ocene: 6-10 pozitivno, 5 negativno (v skladu s Statutom UL).

Grading: 6-10 pass, 5 fail (according to the rules of University of Ljubljana).

Reference nosilca / Lecturer's references:

Pet najpomembnejših del:

1. BOSTIČ, Nina. Model essay as a feedback tool in task 2 of the IELTS writing exam instruction for Slovene students. *ELOPE*, ISSN 1581-8918. [Tiskana izd.], Spring 2011, vol. 8, str. 91-105. [COBISS.SI-ID [49094242](#)]

2. BOSTIČ, Nina. The dispute between Jonathan Franzen and Oprah Winfrey. *Acta neophilologica*, ISSN 0567-784X, 2008, letn. 41, št. 1/2, str. 25-32. [COBISS.SI-ID [38079842](#)]

3 RUGELJ, Darja (urednik), BOSTIČ Nina, et al.. *Faculty of Health Sciences*. Ljubljana: Faculty of Health Sciences, 2011. 122 str., ilustr. ISBN 978-961-6808-22-4. [COBISS.SI-ID [254659584](#)]

4 LUCARIELLO, Joan M., JURIŠEVIČ, Mojca (urednik, prevajalec), BOSTIČ Nina, et al. *Dvajset najpomembnejših psiholoških načel za poučevanje in učenje od vrtca do srednje šole*. Ljubljana:

Pedagoška fakulteta, Center za raziskovanje in spodbujanje nadarjenosti (CRSN), cop. 2016. 38 str. ISBN 978-961-253-195-9. <http://www.apa.org/ed/schools/cpse/top-twenty-principles.aspx>. [COBISS.SI-ID [286846976](#)]

5 PLEVNIK, Miha (glavni in odgovorni urednik), CEFERIN Mojca, BOSTIČ Nina, KRIŽ Andrej. 43. *Krkinge nagrade : znanost povezuje : zbornik povzetkov : 23. simpozij, Novo mesto, 18. oktober 2013*. Novo mesto: Krka, [2013]. 91 str., ilustr. [COBISS.SI-ID [27187239](#)]

Celotna bibliografija je dostopna na COBISSu:

<http://izumbib.izum.si/bibliografije/Y20170313105702-A142909539.html>

UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet:	Angleški jezik – nivo B
Course title:	English, level B

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Univerzitetni študijski program računalništva in informatike, 1. stopnja	ni smeri	2, 3	zimski
University study programme Computer and Information Science, 1st cycle	none	2, 3	fall

Vrsta predmeta / Course type izbirni predmet /elective course

Univerzitetna koda predmeta / University course code: 63223

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje Laboratory work	Druge oblike študija Field work	Samost. delo Individ. work	ECTS
30	/	15	/	/	/	3

Nosilec predmeta / Lecturer: lekt. mag. Nina Bostič Bishop

Jeziki / Languages:	Predavanja / Lectures:	Angleščina English
	Vaje / Tutorial:	Angleščina English

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

Prerequisites:

Vsebina:

Content (Syllabus outline):

Pri predmetu obravnavamo različne teme s področja računalništva in tehničnih ved za doseganje:

- a) akademskih ciljev, ki se nanašajo na sposobnost branja tujejezičnih strokovnih besedil, znanstvenih revij in učbeniških gradiv;
- b) strokovnih ciljev, ki vključujejo sposobnost branja strokovnih besedil, ki se nanašajo na vsebino ostalih predmetov letnika, poročil, pisem; razumevanje govorov, pogajanj, dialogov, TV in radijskih programov; pisanje pogostih besedilnih vrst (povzetek, predstavitev, memorandum, elektronska pošta); primerno izražanje po telefonu, med pogajanja oz. sestanki in pri predstavitvah.
- c) principi tehnične komunikacije;
- d) priročnik + opisi programov (software/hardware);
- e) slovnične zakonitosti v tehniki;
- f) žargon – tehnična terminologija;
- g) tehnični teksti v luči različnih tipov angleščine.

Various topics from computer science field are studied in order to achieve :

- a) academic goals: students will be able to read professional texts, journals and textbooks
- b) professional goals which comprise the ability to read professional info, business reports , annual reports and letters, understand speeches, negotiations, conversations, TV programs; to write memoranda, professional emails; to communicate orally (in teleconferencing, negotiations, meetings, presentations
- c) principles of technical communication
- d) understanding manuals
- e) understanding grammar structures in technical texts
- f) understanding technical jargon
- g) technical texts in the light of different text types

Temeljni literatura in viri / Readings:

1. Harrison L., Cushen C. in Hutchison S. (2005). Achieve IELTS. Marshall Cavendish: London.
 2. Wyatt R. (2001). IELTS Examination. Peter Collin Publishing: London.
 3. Littleford David, Halstead John in Charles Mulraine. (2004). Career Skills: Opening Doors into the Job Market. New York: Palgrave Macmillan.
 4. Cottrell, Stella. (1999). The Study Skills Handbook. London: Macmillan Press LTD.
- Dodatna literatura:
5. Emmerson P. (2002). Business Grammar Builder. MacMillan: Oxford.
 6. Remacha Esteras, Santiago. (2003). English for computer users. Workbook. Cambridge: Cambridge: University Press.
 7. Davidson G. (2002). Learners' Companion Series Vocabulary. Learners Publishing: Singapore.
 8. Brieger, N. In Pohl, A. (2002). Technical English Vocabulary and Grammar. Summertown: Summertown Publishing Limited
 9. EVROTERM. Večjezična terminološka baza izrazov Evropske unije. Dostopno na: <http://www.sigov.si/evroterm>
 10. Cambridge Dictionary Online. Dostopno na <http://dictionary.cambridge.org>

Cilji in kompetence:

Cilj predmeta je poglobiti splošno jezikovno znanje študentov ter jih seznaniti z jezikom stroke oz. osnovno strokovno terminologijo glede na študijsko smer. Pri predmetu se bodo študenti seznanili s spremembami in novostmi v angleškem jeziku, korespondence in pri

Objectives and competences:

The aim of the subject is to enhance and expand the general knowledge of English and introduce terminology used in various fields of computer science. Students will be informed about changes and new trends in language learning and changes in

predstavitvah. Študenti bodo spoznali tudi strukturo fakultete (nazive laboratorijev, smeri, predmetnika) v tujem jeziku ter razvili bralno razumevanje strokovnih besedil in utrdili pripravo povzetkov vsebine v angleščini. Poleg tega bodo razvili tudi specifične poslovne komunikacijske veščine (telefoniranje, elektronska pošta, neformalni pogovori, predstavitev naloge oz. referata, predstavitev oddelka ali laboratorija, pisanje C.V.-ja in spremnega pisma, priprava na razgovor za delovno mesto).

correspondence and presentations. They will be able to describe the study and the structure of the Faculty, and develop critical attitude to different types of reading and writing. They will develop specific strategies needed for business communication, non-formal and formal talks, presentations of their departments and they will be able to produce different types of CVs needed for respective situations.

Predvideni študijski rezultati:

Znanje in razumevanje:

Predmet bo študentom omogočil:

- utrditi in razširiti splošno in strokovno znanje angleškega jezika;
- samostojno učenje jezika in uporabo različnih virov (slovarji, učbeniki, časopisi in revije, spletne strani, ipd);
- pisanje povzetkov besedil;
- brati, analizirati in razumeti različna avtentična strokovna besedila;
- pripravo na mednarodne izpite Univerze Cambridge in pridobitev spričevala o aktivnem znanju angleškega jezika.

Uporaba:

S pridobljenim spričevalom o aktivnem znanju ang. jezika bo študent lahko izkazal znanje, ki ga je pridobil v programu, ki v celoti temelji na priporočenem evropskem jezikovnem okviru. Sam bo lahko svoje znanje ocenil s stopnjami od A1 do C2 glede na usvojeno znanje in pridobljeno oceno ob koncu programa, kar mu bo še v posebno pomoč pri izmenjavi študentov, v okviru evropskih programov: Erasmus, Leonardo, ipd.

Refleksija:

Študentje bodo glede na usvojeno znanje s področja tehnike (npr. računalništva) ugotavljati prednosti in slabosti uporabe le-teh pri učenju tujega jezika.

Prenosljive spretnosti - niso vezane le na en predmet:

Jasno in učinkovito ustno in pisno izražanje,

Intended learning outcomes:

Knowledge and understanding:

Application:

Upon completion of this course the students will be able to:

- expand the general knowledge of the English language
- work independently when studying the language by using various sources(dictionaries, web pages
- write summaries
- read, analyse and understand various authentic texts
- take one of internationally recognised tests, e.g. Cambridge University tests, TOEFL tests. Which will enable them to assess their knowledge on the basis of Common European Language Framework (from A1 to C2); and will also give them to participate in international exchange programmes: Erasmus, Leonardo and similar.

Reflection:

The students will be able to differentiate between the weaknesses and threats of different electronic means in language learning

Transferable skills: communicate ideas effectively and clearly, develop critical thinking, team well and have a sense of time management.

samostojno učenje in iskanje informacij, kritično razmišljanje, timsko delo, organiziranje časa.

Metode poučevanja in učenja:

- predavanja
- lektorske vaje
- delo v parih in skupinah
- problemsko zasnovano učenje jezika in analiza študijskih primerov
- A/V predstavitve

Learning and teaching methods:

- lectures
- practice
- pair work
- problem solving
- student case studies
- A/V presentations

Načini ocenjevanja:

Delež (v %) /

Weight (in %)

Assessment:

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

Sprotno preverjanje (domače naloge, kolokviji in projektno delo)

Končno preverjanje (pisni in ustni izpit)

Ocene: 6-10 pozitivno, 5 negativno (v skladu s Statutom UL).

50%

50%

Type (examination, oral, coursework, project):

Continuing (homework, midterm exams, project work)

Final (written and oral exam)

Grading: 6-10 pass, 5 fail (according to the rules of University of Ljubljana).

Reference nosilca / Lecturer's references:

Pet najpomembnejših del:

1. BOSTIČ, Nina. Model essay as a feedback tool in task 2 of the IELTS writing exam instruction for Slovene students. *ELOPE*, ISSN 1581-8918. [Tiskana izd.], Spring 2011, vol. 8, str. 91-105.

[COBISS.SI-ID [49094242](#)]

2. BOSTIČ, Nina. The dispute between Jonathan Franzen and Oprah Winfrey. *Acta neophilologica*, ISSN 0567-784X, 2008, letn. 41, št. 1/2, str. 25-32. [COBISS.SI-ID [38079842](#)]

3 RUGELJ, Darja (urednik), BOSTIČ Nina, et al.. *Faculty of Health Sciences*. Ljubljana: Faculty of Health Sciences, 2011. 122 str., ilustr. ISBN 978-961-6808-22-4. [COBISS.SI-ID [254659584](#)]

4 LUCARIELLO, Joan M., JURIŠEVIČ, Mojca (urednik, prevajalec), BOSTIČ Nina, et al. *Dvajset najpomembnejših psiholoških načel za poučevanje in učenje od vrtca do srednje šole*. Ljubljana: Pedagoška fakulteta, Center za raziskovanje in spodbujanje nadarjenosti (CRSN), cop. 2016. 38 str. ISBN 978-961-253-195-9. <http://www.apa.org/ed/schools/cpse/top-twenty-principles.aspx>.

[COBISS.SI-ID [286846976](#)]

5 PLEVNIK, Miha (glavni in odgovorni urednik), CEFERIN Mojca, BOSTIČ Nina, KRIŽ Andrej. 43.

Krkinge nagrade : znanost povezuje : zbornik povzetkov : 23. simpozij, Novo mesto, 18. oktober 2013. Novo mesto: Krka, [2013]. 91 str., ilustr. [COBISS.SI-ID [27187239](#)]

Celotna bibliografija je dostopna na COBISSu:

<http://izumbib.izum.si/bibliografije/Y20170313105702-A142909539.html>

UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet:	Angleški jezik – nivo C
Course title:	English, level C

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Univerzitetni študijski program računalništva in informatike, 1. stopnja	ni smeri	2, 3	poletni
University study programme Computer and Information Science, 1st cycle	none	2, 3	spring

Vrsta predmeta / Course type izbirni predmet /elective course

Univerzitetna koda predmeta / University course code: 63224

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje Laboratory work	Druge oblike študija Field work	Samost. delo Individ. work	ECTS
30	/	15	/	/	/	3

Nosilec predmeta / Lecturer: lekt. mag. Nina Bostič Bishop

Jeziki / Languages:	Predavanja / Lectures:	angleščina English
	Vaje / Tutorial:	angleščina English

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

Prerequisites:

Vsebina:

Content (Syllabus outline):

1. Slovnica – splošni pregled, ponovitev in utrjevanje skladno s stopnjo zahtevnosti posameznega izpita: pregled časov, modalni glagoli, frazni glagoli, glagolske strukture s prehodnimi in neprehodnimi glagoli, odvisni stavki, pogojni stavki, raba določnega in nedoločnega člena, predlogi, vezne besede.

2. Vsebinsko tematski sklopi iz literature, ki je predpisana za pripravo na posamezni izpit: Study at University, University departments, Dealing with problems, Working together (employment policy and applying for a job), Jobs and careers, Special projects, Meetings, Presentations, Applying for projects, Information and communication, Operations management. Sklopi pokrivajo splošne in specifične teme; odvisno od vrste in stopnje zahtevnosti izpita.

3. Predstavitev poteka in delov posameznih izpitov (govorjenje, poslušanje, pisanje, branje) ter nasveti, kako jih čim bolj učinkovito opraviti.

1. Grammar – general overview, revision and practice in accordance with the level of corresponding exam type: tenses, modal verbs, phrasal verbs, different verb structures with transitive and intransitive verbs, passive voice, conditional clauses, definite and indefinite article, prepositions and link words.

2. Various topics prescribed for the corresponding exam type: Study at University, University departments, Dealing with problems, Working together (employment policy and applying for a job), Jobs and careers, Special projects, Meetings, Presentations, Applying for projects, Information and communication, Operations management. Topics are of general and specific nature; depending on the type and level of exam.

3. Presentation covers four key skills (speaking, listening, writing and reading) with guidelines for effective presentations.

Temeljni literatura in viri / Readings:

Predpisana in potrjena literatura Univerze Cambridge za pripravo na izpit:

1. Williams A. in Pile L. (2002) Pass Cambridge, Bec Higher. Summertown Publishing: Oxford.
2. Emmerson P. (2007). Business English Handbook Advanced. McMillan: Oxford.
3. Henninger-Chiang, Tracy in Judee Reel. (1998). Professional Presentations: How to Succeed in International Business. Michigan: The University of Michigan Press.
4. Porter, David. (2001). Check your vocabulary for Academic English. A workbook for students. London: Peter Collin Publishing.

Dodatna literatura:

1. Harrison L., Cushen C. in Hutchison S. (2005). Achieve IELTS. Marshall Cavendish: London.
2. Wyatt R. (2001). IELTS Examination. Peter Collin Publishing: London.
3. Anderson K. (2004). Study speaking. Cambridge University Press: Cambridge.
4. Cambridge Dictionary Online. Dostopno na <http://dictionary.cambridge.org>.

Cilji in kompetence:

Cilj predmeta je pripraviti študente na enega izmed mednarodno priznanih izpitov Univerze Cambridge iz splošne (npr. FCE, CAE, CPE, IAEELTS) oz. poslovne (BEC Preliminary, BEC Vantage in BEC Higher) angleščine.

Objectives and competences:

The aim of the course is to prepare students for one of the internationally recognised exams offered by the University Cambridge in general (e.g. FCE, CAE, CPE, IAEELTS) or business English (BEC Preliminary, BEC Vantage and BEC Higher).

Mednarodni izpiti iz splošne angleščine ocenjujejo jezikovno spretnost kandidatov, ki se odpravljajo na študij ali delo v angleško govoreče države.

The international exams in general English assess the foreign language skills of candidates who study or work in a foreign country.

Predvideni študijski rezultati:

Znanje in razumevanje:

Predmet bo študentom omogočil:

- pripravo na mednarodne izpite Univerze Cambridge in pridobitev spričevala o aktivnem znanju angleškega jezika.

Uporaba:

S pridobljenim spričevalom o aktivnem znanju ang. jezika bo študent lahko izkazal znanje, ki ga je pridobil v programu, ki v celoti temelji na priporočenem evropskem jezikovnem okviru. Sam bo lahko svoje znanje ocenil s stopnjami od A1 do C2 glede na usvojeno znanje in pridobljeno oceno ob koncu programa, kar mu bo še v posebno pomoč pri izmenjavi študentov ali pri delu v tujini.

Refleksija:

Študentje bodo glede na pridobljeno znanje zmožni opraviti enega izmed omenjenih izpitov.

Prenosljive spretnosti - niso vezane le na en predmet:

Jasno in učinkovito ustno in pisno izražanje ter povečanje samozavesti študentov pri komunikaciji v angleškem jeziku.

Intended learning outcomes:

Knowledge and understanding:

The course will allow students:

- to prepare for international English exams offered by the University of Cambridge and help them acquire a formal language certificate.

Application:

With the acquired formal language certificate the students can demonstrate their English language knowledge acquired in the programme, which is entirely based on the recommended common European language framework.

They will be able of assessing their own knowledge with levels from A1 to C2 depending on the acquired knowledge and the awarded grade at the end of the course, which will be of special help during student exchange or while working abroad.

Reflection:

Students will be able to pass a specific exam according to the level of knowledge which they acquired.

Transferable skills:

Clear and effective oral and written communication and raising self-confidence when using English language.

Metode poučevanja in učenja:

- predavanja
- lektorske vaje
- delo v parih in skupinah
- problemsko zasnovano učenje jezika in analiza študijskih primerov
- A/V predstavitve

Learning and teaching methods:

- lectures
- tutorials
- pair and group work
- problem solving
- case studies
- A/V presentations

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

Reference nosilca / Lecturer's references:

Pet najpomembnejših del:

BOSTIČ, Nina. Model essay as a feedback tool in task 2 of the IELTS writing exam instruction for Slovene students. *ELOPE*, ISSN 1581-8918. [Tiskana izd.], Spring 2011, vol. 8, str. 91-105.

[COBISS.SI-ID [49094242](#)]

2. BOSTIČ, Nina. The dispute between Jonathan Franzen and Oprah Winfrey. *Acta neophilologica*, ISSN 0567-784X, 2008, letn. 41, št. 1/2, str. 25-32. [COBISS.SI-ID [38079842](#)]

3 RUGELJ, Darja (urednik), BOSTIČ Nina, et al.. *Faculty of Health Sciences*. Ljubljana: Faculty of Health Sciences, 2011. 122 str., ilustr. ISBN 978-961-6808-22-4. [COBISS.SI-ID [254659584](#)]

4 LUCARIELLO, Joan M., JURIŠEVIČ, Mojca (urednik, prevajalec), BOSTIČ Nina, et al. *Dvajset najpomembnejših psiholoških načel za poučevanje in učenje od vrtca do srednje šole*. Ljubljana: Pedagoška fakulteta, Center za raziskovanje in spodbujanje nadarjenosti (CRSN), cop. 2016. 38 str. ISBN 978-961-253-195-9. <http://www.apa.org/ed/schools/cpse/top-twenty-principles.aspx>.

[COBISS.SI-ID [286846976](#)]

5 PLEVNIK, Miha (glavni in odgovorni urednik), CEFERIN Mojca, BOSTIČ Nina, KRIŽ Andrej. *43. Krkine nagrade : znanost povezuje : zbornik povzetkov : 23. simpozij, Novo mesto, 18. oktober 2013*. Novo mesto: Krka, [2013]. 91 str., ilustr. [COBISS.SI-ID [27187239](#)]

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<http://izumbib.izum.si/bibliografije/Y20170313105702-A142909539.html>

UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet: Komunikacijski protokoli
Course title: Communication Protocols

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Univerzitetni študijski program prve stopnje Računalništvo in informatika Univerzitetni študijski program prve stopnje Računalništvo in matematika	Modul: Računalniška omrežja	3	zimski
University study programme Computer and Information Science, 1st cycle University study programme Computer Science and Mathematics, 1st cycle	Modul: Computer Networks	3	fall

Vrsta predmeta / Course type

izbirni predmet / elective course

Univerzitetna koda predmeta / University course code:

63258

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje Laboratory work	Druge oblike študija Field work	Samost. delo Individ. work	ECTS
45	/	30	/	/	105	6

Nosilec predmeta / Lecturer:

izr. prof. dr. Mojca Ciglarič

**Jeziki /
Languages:**

**Predavanja /
Lectures:** slovenščina
Slovene
Vaje / Tutorial: slovenščina
Slovene

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

Prerequisites:

Opravljen izpit Računalniške komunikacije in solidno znanje s tega področja.

Passed Computer communications. Solid knowledge from the area of networking.

Vsebina:

1. Uvod, vloga komunikacijskih protokolov in njihov pomen v sodobnih omrežjih. Protokolarni skladi in protokolarne storitve.
2. Načrtovanje komunikacijskih protokolov
3. Formalna specifikacija komunikacijskih protokolov
4. Metode, tehnike in orodja za analizo in testiranje komunikacijskih protokolov
5. Standardni usmerjevalni protokoli (usmerjanje znotraj avtonomnega sistema, globalno usmerjanje med avtonomnimi sistemi).
6. Večpredstavni protokoli (protokoli za prenos zvoka in videa prek IP, kakovost storitve) in razpošiljanje (multicast).
7. Analiza in primerjava delovanja značilnih protokolov v IPv4 in IPv6; prehodni mehanizmi. Študije izbranih protokolov omrežne in povezavne plasti.
8. Protokoli za zagotavljanje varnosti (avtentikacija, integriteta, nezanikanje...)
9. Protokoli v porazdeljenih sistemih (usklajevanje ure in globalnih stanj, volitve, vzajemno izključevanje, konsenzus)
10. Namenski protokoli: mobilnost, signalizacija v telekomunikacijah, nadzor omrežij, upravljanje z identitetami in imeniki, LDAP, protokoli v prekrivnih (»overlay«) omrežjih, v navideznih omrežjih, v avtomobilskih omrežjih....

Content (Syllabus outline):

1. Introduction and role of communication protocols in modern networks. Protocol stack and protocol services.
2. Communication protocol design.
3. Formal specification of communication protocols.
4. Communication protocol analysis and testing methods and techniques.
5. Standard routing protocols: intradomain routing, interdomain routing.
6. Multimedia (voice and video over IP, quality of service), multicast protocols.
7. Comparison of advanced protocols in IPv4 and IPv6; transition mechanisms. Case studies in network and data link layer.
8. Security-related protocols (authentication, integrity, nonrepudiation, ...)
9. Distributed protocols: time synchronization, global states, election, mutual exclusion, consensus)
10. Studies of selected protocols: mobility, signalling, network management, identity management and directories, LDAP, overlay network protocols, virtual networking protocols, vehicle networking...

Temeljni literatura in viri / Readings:

1. J. F. Kurose, K. W. Ross: Computer Networking, A top-down Approach Featuring Internet. 6. izdaja, Pearson 2012.
2. Mojca Ciglarič, Zoran Bosnić, James F. Kurose, Keith W. Ross: Računalniške komunikacije, Pearson Education, 2014.
3. IETF: RFC specifications and standards. <http://www.ietf.org>
4. D. Malone, N.R. Murphy: IPv6 Network Administration, O'Reilly 2005.

Cilji in kompetence:

Cilj predmeta je študentom računalništva in informatike predstaviti principe načrtovanja, analize in delovanja protokolov na splošno ter podrobno predstaviti nekatere standardne internetne protokole. Kompetence, ki jih bo študent pridobil, so zlasti

- Sposobnost kritičnega razmišljanja
- Razumevanje delovanja protokolov in protokolarnih skladov
- Sposobnost načrtovanja, analize, popravljanja in implementacije lastnih komunikacijskih protokolov
- Poznavanje pomembnejših standardnih protokolov posameznih komunikacijskih plasti
- Usposobljenost za programsko uporabo standardnih omrežnih/komunikacijskih protokolov
- Usposobljenost za postavitve, konfiguriranje in administracijo izbranih protokolarnih strežnikov
- Sposobnost razumevanja in reševanja strokovnih izzivov v računalništvu
- Razvoj profesionalne odgovornosti in etike
- Skladnost z varnostnimi, funkcionalnimi, ekonomskimi in okoljskimi vodili.
- Sposobnost iskanja virov znanja in njihovega kritičnega vrednotenja
- Sposobnost uporabe pridobljenega znanja za reševanje tehničnih in znanstvenih problemov v računalništvu; sposobnost nadgrajevanja pridobljenega znanja.
- Sposobnost prenašanja znanja sodelavcem v strokovnih in raziskovalnih skupinah

Objectives and competences:

The objective of the course is overview of the protocol design principles, protocol analysis and operation in general, as well as detailed study of a few actual protocols.

The students will gain the following competencies:

- Ability of critical thinking
- Understanding of protocol stacks and protocol operation,
- ability to design, analyze, debug and implement own protocols,
- In-depth knowledge of the most important standard protocols for each layer
- Ability to use standard network / communication protocols in own applications
- Ability to install, configure and manage protocol servers.
- The ability to understand and solve professional challenges in computer and information science
- Development of professional responsibility and ethics.
- Compliance with security, functional, economic and environmental principles.
- The ability to search knowledge sources and to search for resources and critically evaluate information.
- 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.
- The ability to transmit knowledge to co-workers in technology and research groups.
- Practical knowledge and skills of

- Praktično znanje in spretnosti na področju strojne in programske opreme ter informatike, potrebno za uspešno strokovno delo v računalništvu

computer hardware, software and information technology necessary for successful professional work in computer and information science.

Predvideni študijski rezultati:

Znanje in razumevanje:

Dobro poznavanje omrežnih, internetnih in usmerjevalnih protokolov, razumevanje formalne predstavitve in pomena analize protokolov. Razumevanje medsebojne odvisnosti in komplementarnosti protokolov.

Uporaba:

Uporaba omrežnih protokolov in storitev v svojih izvedbah. Sposobnost izgradnje, analize in kritičnega ovrednotenja lastnih protokolov. Sposobnost zagotavljanja osnovnega nivoja sistemske varnosti.

Refleksija:

Spoznavanje in razumevanje medsebojne soodvisnosti protokolov različnih arhitekturnih plasti. Razumevanje pomena formalizacije komunikacije v obliko protokola. Zavedanje o (ne)varnosti sistema.

Prenosljive spretnosti - niso vezane le na en predmet:

Sposobnost abstrakcije različnih problemov v formalni model protokola. Sposobnost videnja možnosti rešitve problemov v obliki protokolov.

Intended learning outcomes:

Knowledge and understanding:

Solid knowledge of network protocols, IP and routing protocols, understanding of protocol formal description and protocol analysis. Awareness of mutual co-dependence and complementarity of protocols

Application:

Use of existing protocols and / or services in own applications. Ability to build, analyse and critically assess own protocols. Ability to provide a basic level of system security.

Reflection:

Learning and understanding mutual co-dependency of protocols in different (adjacent) architectural layers of protocol stack. Understanding the communication formalization into the form of protocol. Security awareness.

Transferable skills:

Ability to abstract different problems into the protocol formal model. Ability to see problem solutions in the form of protocols.

Metode poučevanja in učenja:

Predavanja, laboratorijske vaje, seminarski način dela pri domačih nalogah, konzultacije pri izvajanju seminarskih nalog (konkretni projekti). Poseben poudarek je na timskem delu, delo je podprto s sodobnimi oblikami komunikacije (internet, forumi, spletna učilnica, virtualni laboratorij).

Learning and teaching methods:

Lectures, exercises, laboratory work, seminal work, individual homework, consultation, teamwork projects. Individual work is supported by modern communication means – internet, forum, LMS, virtual laboratory.

Delež (v %) /

Načini ocenjevanja:

Weight (in %) **Assessment:**

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

Pet najpomembnejših del:

ŠKOBERNE, Nejc, MAENNEL, Olaf, PHILLIPS, Iain, BUSH, Randy, ŽORŽ, Jan, CIGLARIČ, Mojca. IPv4 address sharing mechanism classification and tradeoff analysis. IEEE/ACM transactions on networking, ISSN 1063-6692, 2014, vol. 22, no. 2, pp. 391-404.

PORENTA, Jernej, CIGLARIČ, Mojca. Comparing commercial IP reputation databases to open-source IP reputation algorithms. Computer systems science and engineering, ISSN 0267-6192, 2013, vol. 28, no. 1, pp. 1-14.

ŠKOBERNE, Nejc, CIGLARIČ, Mojca. Practical evaluation of stateful NAT64/DNS64 translation. Advances in electrical and computer engineering, ISSN 1582-7445. [Print ed.], 2011, vol. 11, no. 3, pp. 49-54.

PANČUR, Matjaž, CIGLARIČ, Mojca. Impact of test-driven development on productivity, code and tests: a controlled experiment. Information and software technology, ISSN 0950-5849. [Print ed.], Jun. 2011, vol. 53, no. 6, pp. 557-573.

CIGLARIČ, Mojca. Effective message routing in unstructured peer-to-peer overlays. IEE proc., Commun. [Print ed.], October 2005, vol. 152, no. 5, str. 673-678.

Celotna bibliografija je dostopna na SICRISu:

<http://sicris.izum.si/search/rsr.aspx?lang=slv&id=8265>.

UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet: Sistemska programska oprema
Course title: System Software

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Univerzitetni študijski program prve stopnje Računalništvo in informatika Univerzitetni študijski program prve stopnje Računalništvo in matematika	Modul: Algoritmi in sistemski programi	3	zimski
University study programme Computer and Information Science, 1st cycle University study programme Computer Science and Mathematics, 1st cycle	Module: Algorithms and system programs	3	fall

Vrsta predmeta / Course type

izbirni predmet /elective course

Univerzitetna koda predmeta / University course code:

63264

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje Laboratory work	Druge oblike študija Field work	Samost. delo Individ. work	ECTS
45	10	20	/	/	105	6

Nosilec predmeta / Lecturer:

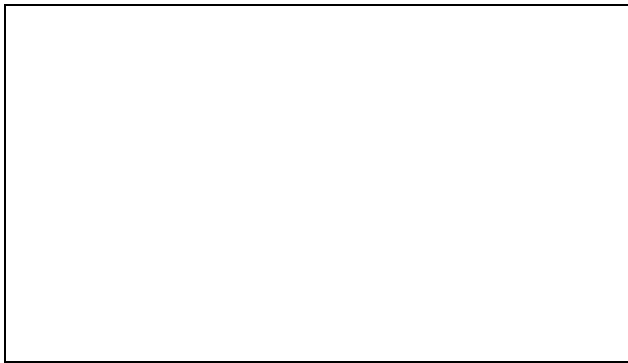
doc. dr. Tomaž Dobravec

**Jeziki /
Languages:**

**Predavanja /
Lectures:** slovenščina
Slovene
Vaje / Tutorial: slovenščina
Slovene

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

Prerequisites:

**Vsebina:**

1. osnova zbirnih in strojnih jezikov;
2. vsebina in organizacija objektnih datotek;
3. zbirnik, nalagalnik in povezovalnik;
4. statično in dinamično povezovanje
5. makro procesorji;
6. sistemski klici in prekinitve;
7. implementacija vhoda in izhoda ter orodja datotečnega sistema;
8. upravljanje s pomnilnikom
9. razhroščevalniki;
10. jedro operacijskega sistema Linux;
11. navidezni stroji.
12. nalaganje, povezovanje in izvajanje v javanskem navideznem stroju

Content (Syllabus outline):

1. basics about machine and assembly languages
2. content and organization of object files
3. assembler, linker, loader
4. static and dynamic linking
5. macro processors
6. system calls and interrupts
7. input/output implementation and file system tools
8. memory management
9. debugging
10. linux kernel
11. virtual machines
12. loading, linking and running in java virtual machine

Temeljni literatura in viri / Readings:

- Leland L. Beck: System software: An Introduction to Systems Programming (3. izdaja). Addison-Wesley, 1997.
- K. Robbins and S. Robbins: UNIX Systems Programming: Communication, Concurrency and Threads (2.izdaja). Prentice Hall, 2003.
- Damjan Zazula, Mitja Lenič: Principi sistemske programske opreme. Založba FERi 2008

Cilji in kompetence:**Cilj:**

Cilj predmeta je študentom računalništva in informatike predstaviti sistemske programe, orodja in standarde sistemske programske opreme, ter prikazati podobnosti in razlike med pristopi, ki se uporabljajo v aktualnih operacijskih sistemih.

Objectives and competences:**Objectives:**

The main goal of this course is to introduce the concepts, tools and standards of system programming and to show the current implementations in the actual operating systems.

Kompetence:

- Razvijanje sposobnosti kritičnega, analitičnega in sintetičnega razmišljanja.
- Sposobnost razumevanja in reševanja strokovnih izzivov na področju računalništva in informatike.
- Sposobnost opredelitve, razumevanja in reševanja poklicnih izzivov.
- Sposobnost za uporabo pridobljenega znanja pri samostojnem reševanju tehničnih in znanstvenih problemov v računalništvu in informatiki; sposobnost nadgradnje pridobljenega znanja.
- Osnovna znanja iz računalništva in informatike, ki vključujejo osnovne teoretične spretnosti, praktična znanja in spretnosti, ki so pomembne za področje računalništva in informatike.
- Praktično znanje in poznavanje računalniške strojne opreme, programske opreme in informacijske tehnologije, ki je potrebno za uspešno strokovno delo na področju računalništva in informatike.

Competences:

- Developing skills in critical, analytical and synthetic thinking.
- The ability to understand and solve professional challenges in computer and information science.
- The ability to define, understand and solve creative 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.
- Basic skills in computer and information science, which includes basic theoretical skills, practical knowledge and skills essential for the field of computer and information science;
- Practical knowledge and skills of computer hardware, software and information technology necessary for successful professional work in computer and information science.

Predvideni študijski rezultati:**Znanje in razumevanje:**

Poznavanje osnovnih pojmov sistemske programske opreme, delovanja operacijskega sistema in njegovih komponent ter obstoječih implementacij. Razumevanje principov delovanja sistemskih programov in nekaterih drugih osnovnih gradnikov operacijskega sistema.

Uporaba:

Uporaba in razvoj sistemskih programov pri izdelavi uporabniške programske in strojne opreme.

Refleksija:

Poznavanje osnovnih pojmov sistemske programske opreme je ključnega pomena za razumevanje delovanja računalniškega sistema kot celote. Znanje je uporabno tako pri uporabi in razvoju uporabniške opreme kot tudi pri načrtovanju in izdelavi strojne opreme.

Prenosljive spretnosti:

Poznavanje osnovnih gradnikov računalniškega sistema pomeni poznavanje mej mogočega in zato prispeva h kvalitetnejši delu na praktično vseh področjih uporabe računalnika in razvoja programske in strojne opreme.

Intended learning outcomes:**Knowledge and understanding:**

The knowledge of the basic terms of system programming, operating systems and tools with implementation. Understanding the principles of system programs and some other basic building blocks of the operating system.

Application:

Use and development of system software.

Reflection:

Knowledge of the basic concepts of system software is crucial to understanding how a computer system works. Knowledge is useful both in application and development of user software, as well as in the design and manufacture of hardware.

Transferable skills:

The knowledge of the basic building blocks of a computer system helps us to find the limits of computer system and therefore contributes to higher quality work in virtually all areas of computer use and development of software and hardware.

Metode poučevanja in učenja:

Predavanja, laboratorijske vaje, domače naloge.

Learning and teaching methods:

Lectures, exercises and home work

Načini ocenjevanja:

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

Sprotno preverjanje (domače naloge, kolokviji in projektno delo)

Delež (v %) /

Weight (in %)

50%

Assessment:

Type (examination, oral, coursework, project):

Continuing (homework, midterm exams, project work)

Končno preverjanje (pisni in ustni izpit)	50%	Final (written and oral exam)
Ocene: 6-10 pozitivno, 5 negativno (v skladu s Statutom UL).		Grading: 6-10 pass, 5 fail (according to the rules of University of Ljubljana).

Reference nosilca / Lecturer's references:

Pet najpomembnejših del:

MIHELIC, Jurij, DOBRAVEC, Tomaž. SicSim: a simulator of the educational SIC/XE computer for a system-software course. *Computer applications in engineering education*, ISSN 1061-3773, 2015, vol. 23, no. 1, pp. 137-146

ČEŠNOVAR, Rok, RISOJEVIĆ, Vladimir, BABIĆ, Zdenka, DOBRAVEC, Tomaž, BULIĆ, Patricio. A GPU implementation of a structural-similarity-based aerial-image classification. *The journal of supercomputing*, ISSN 0920-8542, 2013, vol. 65, no. 2, pp. 978-996

BULIĆ, Patricio, DOBRAVEC, Tomaž. An approximate method for filtering out data dependencies with a sufficiently large distance between memory references. *The journal of supercomputing*, ISSN 0920-8542, 2011, vol. 56, no. 2, pp. 226-244

DOBRAVEC, Tomaž, ŽEROVNIK, Janez, ROBIČ, Borut. An optimal message routing algorithm for circulant networks. *J. systems archit.* [Print ed.], 2006, vol. 52, no. 5, str. [298]-306

DOBRAVEC, Tomaž, ROBIČ, Borut. Restricted shortest paths in 2-circulant graphs. *Comput. commun.* [Print ed.], March 2009, vol. 32, no. 4, str. 685-690

Celotna bibliografija je dostopna na SICRISu:

<http://sicris.izum.si/search/rsr.aspx?lang=slv&id=10416>.

UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet: Ekonomika in podjetništvo
Course title: Economics and Entrepreneurship

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Univerzitetni študijski program prve stopnje Računalništvo in informatika	ni smeri	3	poletni
University study programme Computer and Information Science, 1st cycle	none	3	spring

Vrsta predmeta / Course type izbirni predmet / elective course

Univerzitetna koda predmeta / University course code: 63248

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje Laboratory work	Druge oblike študija Field work	Samost. delo Individ. work	ECTS
45	10	20	/	/	105	6

Nosilec predmeta / Lecturer: prof. dr. Drnovšek Mateja

Jeziki / Languages:	Predavanja / Lectures:	slovenščina Slovene
	Vaje / Tutorial:	slovenščina Slovene

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

Prerequisites:

Vsebina:

Content (Syllabus outline):

Vsebinski poudarki predmeta vključujejo razumevanje:

- Osnovnih ekonomskih konceptov
- Posebnosti podjetniškega procesa
- osnovnih pojmov v poslovno – računovodskih izkazih
- konceptov, pomembnih za sprejemanje poslovnih odločitev in analize uspeha poslovanja
- časovni vrednosti denarja
- konceptov pomembnih za razvijanje podjetniške priložnosti
- metodologije priprave poslovnega načrta
- uporabe poslovnega načrta za pridobivanje sredstev, graditev podjetniške skupine in nadzor doseganja zastavljenih ciljev
- poslovnih modelov za rast podjetja

The contents of the course include understanding of :

- key concepts from economic theory
- specificities of entrepreneurship process
- key concepts in business – accounting statements
- concepts that are important for business decision making and assessment of business making effectiveness
- time value of money
- concepts that are important for development of business opportunities
- use of methodology of business plan
- use of business plan for resource assembly, entrepreneurial team formation and control of entrepreneurial goal attainment
- business model for further growth

Temeljni literatura in viri / Readings:

Drnovšek, M., Stritar, R. (2007). Priročnik za pisanje poslovnega načrta. Ljubljana: Ekonomska fakulteta, 2004.

Hočevar M., Igličar S., Zaman M.: Osnove računovodstva, Ekonomska in naloge. Ljubljana: Ekonomska fakulteta, 2007.

Kosi, U., Marc, M., Peljhan, D.: Uvod v poslovanje: pojasnila, primeri ostali: Management, 19. poglavje, Radovljica 2002.

Iz vseh navedenih virov so izbrana poglavja.

Cilji in kompetence:

Cilj predmeta je študente seznaniti z osnovnimi ekonomskimi, poslovno-finančnimi kategorijami in procesom razvoja in preverjanja podjetniške priložnosti. Študent osvoji osnovna znanja pomembna za razvoj in izkoriščanje poslovnih priložnosti in znanja, povezana z metodologijo poslovnega načrtovanja. Študent osvoji poznavanje osnovnih poslovnih modelov rasti podjetja.

Objectives and competences:

The goal of the course is that student understands key economic, business & accounting concepts and with process of opportunity development and assessment. Student acquires key knowledge for development and exploitation of entrepreneurial opportunities and methodology for business planning. Student understands core business models for growth of a venture.

Predvideni študijski rezultati:

Znanje in razumevanje:

Študent osvoji tehnike izbiranja poslovnih idej, razvijanja poslovnih idej v poslovne priložnosti ter tehnike vrednotenja poslovnih priložnosti. Študent osvoji osnove poslovne in

Intended learning outcomes:

Knowledge and understanding:

Student uses basic techniques of opportunity development and techniques for entrepreneurial opportunity exploration and assessment. Student acquires basic business

računovodske koncepte in jih zna vsebinsko uporabljati. Študent osvoji metodologijo priprave poslovnega načrta.

Uporaba
Predmet je tesno povezan s poslovno prakso. Spretnosti uporabne v načrtovanju rasti in razvoja podjetja.

Refleksija:
Študent bolje razume lastne izkušnje, ki izhajajo iz poslovne prakse, pridobi spretnosti kritičnega ovrednotenja skladnosti med teoretičnimi načeli in praktičnim ravnanjem ipd.

Prenosljive spretnosti:
Študent pridobi spretnosti, zbiranja in interpretiranja podatkov iz različnih podatkovnih virov, uporaba IKT in drugih didaktičnih pripomočkov, spretnosti ustnega in pisnega sporazumevanja, ter učinkovitih javnih predstavitev.

and accounting terminology and its contextual use.

Application:
The course gives strong emphasis to practical use of acquired skills and knowledge and thus develops the students' ability to set up, run and grow a business.

Reflection:
Based on theoretical knowledge, the student will be able to recognize the patterns of entrepreneurial behaviour when faced with best practices of entrepreneurs and on the basis of this connect theory with practical decisions.

Transferable skills:
Student develops ability to gather, interpret and appropriately use various sources of information, capabilities of critical thinking, effective communication and public speaking.

Metode poučevanja in učenja:

Predavanja: 3 ure na teden
Študenti na predavanjih osvojijo poznavanje in razumevanje osnovnih, predhodno omenjenih, konceptov in metodologije poslovnega načrtovanja. Na predavanjih uporabljamo študije primerov, video posnetke in obiske znanih podjetij, da bi študentom čim bolj približali podjetniško prakso.

Vaje: 2 uri na teden
Na vajah študenti utrjujejo teoretično znanje in koncepte, pridobljene na predavanjih. To znanje praktično preverjajo na pripravi poslovnega načrta. S tem namenom študenti delajo v skupinah po 5 članov. Na koncu predmeta sledi prezentacija pripravljenih poslovnih načrtov.

Learning and teaching methods:

Lectures: 3 hours per week.
In lectures students gain knowledge of above - mentioned basic concepts, methodology of entrepreneurial process and planning of new ventures. Case studies are often used and guest visits from entrepreneurs (and also videos) are used to convey to students the practical experience of entrepreneurship.

Tutorials: 2 hours per week.
In tutorials, the theoretical knowledge discussed in lectures is reinforced. Students practically implement their knowledge on business plan development. The students work in groups of maximum 5 members. At the end of the course, business plans are evaluated and presented in front of the class.

Delež (v %) /

Načini ocenjevanja:

Weight (in %)

Assessment:

<p>Način (pisni izpit, ustno izpraševanje, naloge, projekt): Sprotno preverjanje (domače naloge, kolokviji)</p>	<p>60%</p>	<p>Type (examination, oral, coursework, project): Continuing (homework, midterm exams)</p>
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Projektno delo	40%	Project work
Ocene: 6-10 pozitivno, 5 negativno (v skladu s Statutom UL).		Grading: 6-10 pass, 5 fail (according to the rules of University of Ljubljana).

Reference nosilca / Lecturer's references:

Pet najpomembnejših del:

DRNOVŠEK, Mateja, GLAS, Miroslav. The entrepreneurial self-efficacy of nascent entrepreneurs: the case of two economies in transition. *J. enterp. cult.*, June 2002, vol. 10, no. 2, str. 107-131.

HISRICH, Robert D., DRNOVŠEK, Mateja. Entrepreneurship and small business research: a European perspective. *Journal of small business and enterprise development*, 2002, vol. 9, no. 2, str. 172-222.

CARDON, Melissa S., WINCENT, Joakim, SINGH, Jagdip, DRNOVŠEK, Mateja. The nature and experience of entrepreneurial passion. *Acad. Manage. rev.*, 2009, vol. 34, no. 3, str. 511-532.

DRNOVŠEK, Mateja, WINCENT, Joakim, CARDON, Melissa S. Entrepreneurial self-efficacy and business start-up: developing a multi-dimensional definition. *Int. j. entrep. behav. res.*, 2010, vol. 14, no. 4, str. 329-348.

DRNOVŠEK, Mateja, ÖRTQVIST, Daniel, WINCENT, Joakim. The effectiveness of coping strategies used by entrepreneurs and their impact on personal well-being and venture performance = Učinkovitost strategija suočavanja poduzetnika sa stresom i njihov utjecaj. *Zb. rad. Ekon. fak. Rij.*, 2010, vol. 28, sv. 2, str. 193-220.

Celotna bibliografija je dostopna na SICRISu:

<http://sicris.izum.si/search/rsr.aspx?lang=slv&id=16130>. (za izr. prof. dr. Drnovšek)

UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet: Diskretne strukture
Course title: Discrete Structures

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Univerzitetni študijski program prve stopnje Računalništvo in informatika	ni smeri	1	zimski
University study programme Computer and Information Science, 1st cycle	none	1	fall

Vrsta predmeta / Course type

obvezni predmet / compulsory course

Univerzitetna koda predmeta / University course code:

63203

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje Laboratory work	Druge oblike študija Field work	Samost. delo Individ. work	ECTS
45	/	15	15	/	105	6

Nosilec predmeta / Lecturer:

prof. dr. Gašper Fijavž

**Jeziki /
Languages:**

**Predavanja /
Lectures:** slovenščina
Slovene
Vaje / Tutorial: slovenščina
Slovene

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

Prerequisites:

Vsebina:

Content (Syllabus outline):

predavanja:

- Izjavni in predikatni račun: resničnostna tabela in konstrukcijsko drevo izjavnega izraza, nabori izjavnih veznikov, sklepanje v izjavnem računu, pomožni sklepi; predikati in kvantifikatorji.
- Množice: operacije, sistemi z eno neznanko.
- Relacije: lastnosti in operacije, predstavitev, ekvivalenčna relacija, delna urejenost, ovojnice.
- Funkcije in preslikave: injektivnost, surjektivnost, inverzna preslikava, kompozitum, Dirichletov princip.
- Moč množic: princip vključitev in izključitev.
- Osnove teorije števil: razširjeni Evklidov algoritem, linearne diofantske enačbe, Eulerjeva funkcija φ , modulska aritmetika, RSA kriptosistem.
- Permutacije: računanje s permutacijami, parnost permutacij, konjugirane permutacije.
- Grafi: izomorfizem grafov, operacije z grafi, nekatere družine grafov, podgrafi, povezanost, drevesa, Eulerjev in Hamiltonov problem, barvanja grafov.

vaje :

Vaje so deloma avditorne in so namenjene skupinskemu utrjevanju obravnavane snovi z računskimi primeri s pomočjo asistenta. Delno vaje potekajo laboratorijsko, s samostojnim delom študentov z računalnikom. Pri laboratorijskih vajah se uporablja programska oprema za simbolično računanje (Mathematica, npr.).

domače naloge:

Domače naloge so predvidene v tedenskem ritmu in obvezne. Vsebine domačih nalog praviloma sledijo temam iz kontaktnih ur.

lectures:

- Propositional and predicate calculus: truth tables, construction trees, complete sets of connectives, formal reasoning; predicates and quantifiers.
- Naive set theory: operations, systems of equalities.
- Relations: properties and operations, equivalence relations, partial orders, closure.
- Mappings: injective and surjective mappings, inverse mapping, composition, pigeonhole principle.
- Basic counting: inclusion-exclusion.
- Number theory: extended Euclidean algorithm, linear Diophantine equations, Euler function φ , modular arithmetic, RSA algorithm.
- Permutations: computing with permutations, parity, conjugate permutations.
- Graph theory: isomorphism, operations, graph families, subgraphs, connectivity, trees and forests, Euler and Hamilton graphs, graph colourings.

exercise groups:

Exercise group time is in part devoted to the classical blackboard approach, the students solve computational problems with some help of TA. In part of the exercise groups the students individually solve computerized versions of problems using symbolic computation software.

homework:

Homework assignments are distributed on a weekly basis. The assignments are obligatory. Their purpose is to prepare the students for continuously working on the DS topics.

Temeljni literatura in viri / Readings:

1. G. Fijavž, Diskretne strukture, Ljubljana, 2014, <http://matematika.fri.uni-lj.si/ds/ds.pdf>.
2. J. L. Hein: Discrete Structures, Logic, and Computability, Jones & Bartlett, 2001.

(dodatno)

3. V. Batagelj, S. Klavžar: DS1, DMFA, Ljubljana, 1997.
4. V. Batagelj, S. Klavžar: DS2, DMFA, Ljubljana, 2000.
5. R. J. Wilson, J. J. Watkins: Uvod v teorijo grafov, DMFA, Ljubljana, 1997.
6. P. Grossman: Discrete mathematics for computing, Macmillan, 2002.

Cilji in kompetence:

Zmožnost kritičnega razmišljanja.

Razvoj veščin kritičnega, analitičnega in sintetičnega razmišljanja.

Cilj predmeta je poglobiti študentovo razumevanje matematične logike in formalnega sklepanja ter študenta seznaniti z osnovami diskretne matematike.

Objectives and competences:

Ability of critical thinking.

Developing skills in critical, analytic and synthetic thinking.

The object of the course is to deepen student's understanding of mathematical logic and formal reasoning, together with the basics of discrete mathematics.

Predvideni študijski rezultati:

Znanje in razumevanje:

Po zaključku tega predmeta bo študent sposoben izkazati znanje in razumevanje osnovnih principov diskretne matematike, matematične logike in njune uporabe v računalništvu.

Uporaba:

Uporaba metod matematične logike in diskretne matematike pri načrtovanju računalniških postopkov in programov.

Refleksija:

Spoznavanje matematičnega jezika za konsistentno in natančno opisovanje pojavov in razumevanje odnosa med teoretičnim modelom in njegovo implementacijo na različnih področjih računalništva.

Prenosljive spretnosti - niso vezane le na en predmet:

Matematična abstrakcija pojmov in problemov je v računalništvu potrebna in pogosto uporabljana.

Intended learning outcomes:

Knowledge and understanding:

After successfully finishing the course a student will master the basic principles of discrete mathematics, mathematical logic and their application in CS.

Application:

Using mathematical logic and discrete mathematics in algorithm design.

Reflection:

Using mathematical formalization to accurately and consistently describe the relation between a theoretical model and its implementation.

Transferable skills:

Mathematical abstraction is frequently needed in all areas of computer science.

Metode poučevanja in učenja:

Predavanja, računske vaje z ustnimi nastopi in delom z računalniki, domače naloge. Poseben poudarek je na sprotnem študiju z domačimi nalogami, na samostojnem delu z računalnikom računalnikom in uporabo programske opreme za simbolično računanje.

Learning and teaching methods:

Lectures, exercise groups, homework assignments. The focus lies in continuous work with home assignments, individual work using computer and symbolic computation software.

Delež (v %) /

Weight (in %)

Načini ocenjevanja:**Assessment:**

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

Sprotno preverjanje (domače naloge, kolokviji)

Končno preverjanje (izpit)

Ocene: 6-10 pozitivno, 5 negativno (v skladu s Statutom UL).

50%

50%

Type (examination, oral, coursework, project):

Continuing (homework, midterm exams)

Final (written exam)

Grading: 6-10 pass, 5 fail (according to the rules of University of Ljubljana).

Reference nosilca / Lecturer's references:**Pet najpomembnejših del:**

1. FIJAVŽ, Gašper. Minor-minimal 6-regular graphs in the Klein bottle. *Eur. j. comb.*, 2004, vol. 25, no. 6, str. 893-898. [COBISS.SI-ID [13177433](#)]

2. FIJAVŽ, Gašper. Contractions of 6-connected toroidal graphs. *J. comb. theory, Ser. B*, 2007, vol. 97, no. 4, str. 553-570. [COBISS.SI-ID [14332761](#)]

3. FIJAVŽ, Gašper, WOOD, David Richard. Graph minors and minimum degree. *Electron. j. comb. (On line)*. [Online ed.], 2010, vol. 17, no. 1, r151 (30 str.). http://www.combinatorics.org/Volume_17/PDF/v17i1r151.pdf. [COBISS.SI-ID 1581320].

4. DUJMOVIĆ, Vida, FIJAVŽ, Gašper, JORET, Gwenaël, SULANKE, Thom, WOOD, David Richard. On the maximum number of cliques in a graph embedded in a surface. *European journal of combinatorics*, ISSN 0195-6698, 2011, vol. 32, no. 8, str. 1244-1252.

5. FIJAVŽ, Gašper, PISANSKI, Tomaž, RUS, Jernej. Strong traces model of self-assembly polypeptide structures. *MATCH Communications in Mathematical and in Computer Chemistry*, ISSN 0340-6253, 2014, vol. 71, no. 1, str. 199-212.

Celotna bibliografija je dostopna na SICRISu:

<http://sicris.izum.si/search/rsr.aspx?lang=slv&id=9390>.

UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet: Organizacija in management
Course title: Organisation and Management

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Univerzitetni študijski program prve stopnje Računalništvo in informatika Interdisciplinarni univerzitetni študijski program prve stopnje Računalništvo in matematika Interdisciplinarni univerzitetni študijski program prve stopnje Multimedija	Modul: Informacijski sistemi	3	poletni
University study programme Computer and Information Science, 1st cycle Interdisciplinary university study programme Computer Science and Mathematics , 1st cycle Interdisciplinary university study programme Multimedia, 1st cycle	Module: Information systems	3	spring

Vrsta predmeta / Course type izbirni predmet / elective course

Univerzitetna koda predmeta / University course code: 63250

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje Laboratory work	Druge oblike študija Field work	Samost. delo Individ. work	ECTS
45	10	20	/	/	105	6

Nosilec predmeta / Lecturer: doc. dr. Tomaž Hovelja

Jeziki / Languages:	Predavanja / Lectures:	slovenščina Slovene
	Vaje / Tutorial:	slovenščina Slovene

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

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Prerequisites:

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Vsebina:

Predmet pokriva ključne teme sodobnega managementa in vedenja v organizacijah in sicer: opredelitev pojmov (organizacija, poslovanje, poslovni model); določljivke vedenja posameznikov v organizaciji za uspešno delovanje (osebne lastnosti, motivacija, znanje, spretnosti, medsebojna interakcija) razumevanje gradnikov poslovnega modela (predpostavka vrednosti, ključni redki viri, ključne poslovne aktivnosti, profitna formula); analiza poslovnega modela (spoznavanje poslovnega modela, vrednotenje ustreznosti poslovnega modela, diagnosticiranje vzrokov odstopanj od zelenega stanja, opsijski pristop k iskanju sprememb poslovnega modela).

Content (Syllabus outline):

The content covers the following contemporary key topics from organization, management and organizational behaviour: key definitions (firm, organization, business, business model); determinants of individual behaviour in organizations (personality characteristics, motivation, knowledge, skills, interpersonal interactions); fine-grained look at the elements of the business model (value proposition, scarce resources, business activities, and profit formula); analysis of the business model (identifying the business model, evaluation of the business model, diagnosis of the problems of the business model, strategic options approach to the identification of solution for the problems).

Temeljni literatura in viri / Readings:

Daft Richard L. and Marcic Dorothy: Understanding Management: Seventh Edition. Mason, Ohio: South-Western Cengage Learning, 2010, 672 pages.
Izbor temeljnih in sodobnih znanstveni članki s področja managementa, aplikativne psihologije in sociologije (a selection of fundamental and contemporary scientific articles from the field of management, applied psychology and sociology).

Cilji in kompetence:

Objectives and competences:

Temeljni cilj predmeta je seznanitev študentov s ključnimi vsebinami organizacije in managementa in jim tako omogočiti uspešno opravljanje managerske funkcije v podjetjih in zavodih.

Za doseg svojega cilja bo pri študentih potrebno razviti sledeče sposobnosti:

1. študenti morajo osvojiti znanja o ključnih organizacijskih in managerskih vsebinah,
2. študente je potrebno usposobiti za preučevanje in reševanje organizacijskih in managerskih problemov v podjetjih in zavodih,
3. študenti morajo razumeti povezanost problematike poslovanja in organizacije ter problematike vzpostavitve in spreminjanja informacijskih sistemom v podjetjih in zavodih.

The objective of the course is to present to students key topics from the field of organization and management, which will enable them to successfully perform in management roles in enterprises and government institutions.

To reach this objective the following student competences need to be developed:

1. students have to acquire the knowledge from key topics of organization and management,
2. students need to learn how to examine and solve organizational and management issues in enterprises and government institutions,
3. students need to understand the interconnectedness of organization and management issues with information system deployment and change issues.

Predvideni študijski rezultati:

Znanje in razumevanje:

Študenti bodo temeljito spoznali ključne vsebine organizacije in managementa

Uporaba:

Študentom bo omogočeno uspešno vključevanje v management podjetij in zavodov z razvojem njihove sposobnosti preučevanja in reševanja organizacijskih in managerskih problemov

Refleksija:

Predmet bo študentom omogočil kritično ovrednotenje lastnega delovanja v podjetju, kot tudi razumevanje problematike odmikov med od njega pričakovanim in dejansko opravljenim delom.

Prenosljive spretnosti - niso vezane le na en predmet:

Intended learning outcomes:

Knowledge and understanding:

The students will gain a thorough understanding of key topics in organization and management.

Application:

The students will be able to examine and solve organizational and management issues thus enabling them to occupy management positions.

Reflection:

The course will enable students to critically evaluate their work as well as what is expected of them in a managerial role in enterprises and government institutions.

Transferable skills:

Študenti bodo pridobili širši pogled na potrebo po skladnosti posameznikovih kompetenc z organizacijskimi pričakovanji, skladnosti me poslovanjem in organizacijo ter informacijskim sistemom v podjetjih in zavodih.

The students will gain a broader view and understanding about the needed person-organization fit, needed alignment in enterprises and government institutions between business and organization on one side and information system on the other.

Metode poučevanja in učenja:

Predavanja, vaje s skupinsko diskusijo, igro vlog in simulacijami resničnih situacij, študije primerov, praktično timsko projektno delo na seminarских nalogah s predstavitvijo narejenega.

Learning and teaching methods:

Lectures, exercises with group discussion, role playing, simulations or real world situations, case studies, team project work on seminars with required presentation of the results.

Načini ocenjevanja:	Delež (v %) / Weight (in %)	Assessment:
Način (pisni izpit, ustno izpraševanje, naloge, projekt):		Type (examination, oral, coursework, project):
Individualna seminarska naloga	20%	Individual project work
Sprotno preverjanje z domačimi nalogami na vajah, sodelovanje na predavanjih	40%	Continuing homework from exercises, in-class participation.
Pisni izpit	40%	Final written exam
Ocene: 6-10 pozitivno, 5 negativno (v skladu s Statutom UL).		Grading: 6-10 pass, 5 fail (according to the rules of University of Ljubljana).

Reference nosilca / Lecturer's references:

doc.dr. Tomaž Hovelja
Objavljeni članki v revijah z visokim faktorjem vpliva - na primer:
 a. HOVELJA, Tomaž, VAVPOTIČ, Damjan, ŽVANUT, Boštjan. A balanced scorecard-based model for evaluating e-learning and conventional pedagogical activities in nursing. Assessment & evaluation in higher education, ISSN 1469-297X, August 2015, ilustr.
<http://dx.doi.org/10.1080/02602938.2015.1075957>, doi: 10.1080/02602938.2015.1075957
 b. VRHOVEC, Simon, HOVELJA, Tomaž, VAVPOTIČ, Damjan, KRISPER, Marjan. Diagnosing organizational risks in software projects : Stakeholder resistance. International journal of project management, ISSN 0263-7863. [Print ed.], Aug. 2015, vol. 33, iss. 6, str. 1262-1273, graf. prikazi, tabele, doi: 10.1016/j.ijproman.2015.03.007
 c. HOVELJA, Tomaž, VASILECAS, Olegas, VAVPOTIČ, Damjan. Exploring the influences of the use of elements comprising information system development methodologies on strategic business goals.

Technological and economic development of economy, ISSN 2029-4913. [Print ed.], 2015, vol. 21, no. 6, str. 885-898, ilustr.

<http://www.tandfonline.com/doi/pdf/10.3846/20294913.2015.1074130>, doi:
[10.3846/20294913.2015.1074130](https://doi.org/10.3846/20294913.2015.1074130).

d. MAHNIČ, Viljan, HOVELJA, Tomaž. Teaching user stories within the scope of a software engineering capstone course : analysis of students' opinions. *International journal of engineering education*, ISSN 0949-149X, 2014, vol. 30, no. 4, str. 901-915.

e. HOVELJA, Tomaž, VASILECAS, Olegas, RUPNIK, Rok. A model of influences of environmental stakeholders on strategic information systems planning success in an enterprise. *Technological and economic development of economy*, ISSN 2029-4913. [Print ed.], 2013, vol. 19, no. 3, str. 465-488, ilustr. <http://www.tandfonline.com/doi/pdf/10.3846/20294913.2013.818591>, doi:
[10.3846/20294913.2013.818591](https://doi.org/10.3846/20294913.2013.818591)

f. VAVPOTIČ, Damjan, HOVELJA, Tomaž. Improving the evaluation of software development methodology adoption and its impact on enterprise performance. *Computer science and information systems*, ISSN 1820-0214. [Print ed.], Jan. 2012, vol. 9, no. 1, str. 165-187

g. MAHNIČ, Viljan, HOVELJA, Tomaž. On using planning poker for estimating user stories. *The Journal of Systems and Software*, ISSN 0164-1212. [Print ed.], Sep. 2012, vol. 85, no. 9, str. 2086-2095.

UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet: Postopki razvoja programske opreme
Course title: Software Development Processes

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Univerzitetni študijski program prve stopnje Računalništvo in informatika Univerzitetni študijski program prve stopnje Računalništvo in matematika	Modul: Razvoj programske opreme	3	zimski
University study programme Computer and Information Science, 1st cycle University study programme Computer Science and Mathematics, 1st cycle	Module: Software Development	3	Fall

Vrsta predmeta / Course type

izbirni predmet / elective course

Univerzitetna koda predmeta / University course code:

63254

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje Laboratory work	Druge oblike študija Field work	Samost. delo Individ. work	ECTS
45	10	20	/	/	105	6

Nosilec predmeta / Lecturer:

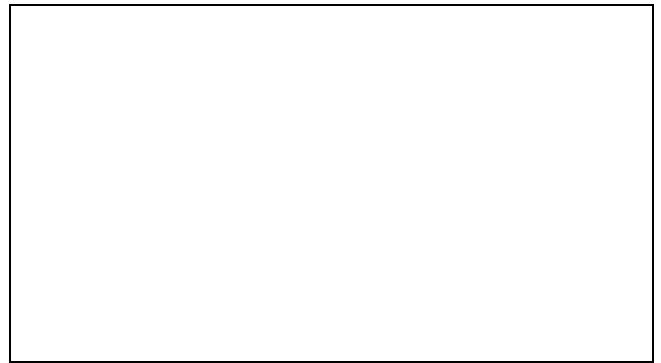
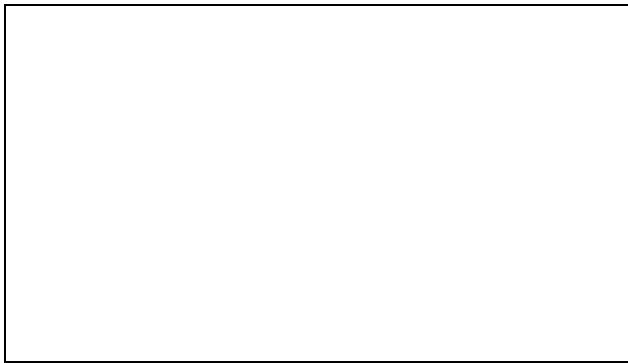
prof. dr. Branko Matjaž Jurič

**Jeziki /
Languages:**

**Predavanja /
Lectures:** slovenščina
Slovene
Vaje / Tutorial: slovenščina
Slovene

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

Prerequisites:

**Vsebina:**

1. Razvoj večslojnih aplikacijskih rešitev, spoznavanje postopkov razvoja.
2. Razvoj vmesnega sloja in poslovne ter funkcionalne logike.
3. Arhitekture večslojnih informacijskih sistemov
4. Porazdeljeni objektni modeli
5. Oddaljeno proženje metod
6. Strežniške komponentne tehnologije in vsebniki
7. Strežniška javanska zrna
8. Vzorci za vmesni sloj
9. Sporočilni sistemi, vrste in teme ter spoznavanje JMS
10. Zagotavljanje trajnega stanja podatkov
11. Objektno-relacijska preslikava in uporaba JPA
12. Razvoj predstavitevne nivoja z uporabo JSP in Servletov
13. Pristopi k razvoju programske opreme:
 - a. Objektno orientiran pristop
 - b. Storitveno orientiran pristop (SOA)
14. Spoznavanje platforme Java EE
15. Praktični primer razvoja strežniške aplikacije z uporabo Java EE
16. Upravljanje z izvorno kodo, preoblikovanje kode
17. Verzioniranje in upravljanje sprememb
18. Testiranje programske opreme, avtomatsko testiranje, testno voden razvoj programske opreme
19. Upravljanje izvorne kode in delo v skupinah
- 20.

Content (Syllabus outline):

1. Development of multi-tier application solutions, learn about development processes.
2. Development of the middle tier and the business and functional logic.
3. Multi-tier architecture of information systems
4. Distributed object models
5. Remote method invocation
6. Server component technologies and component containers
7. Enterprise Java Beans
8. Patterns for the middle-tier
9. Messaging systems, queues and topics, learn about JMS
10. Ensuring data persistence
11. Object-relational mapping and the use of JPA
12. Development of presentation layer using JSP and Servlets
13. Approaches to software development:
 - a. Object-oriented approach
 - b. Service-oriented approach (SOA)
14. Understanding the Java EE Platform
15. A practical example of development of server applications using Java EE
16. Source code management, code refactoring
17. Versioning and change management
18. Software testing, automated testing, test-driven software development
19. Source code management and collaborative work

Temeljni literatura in viri / Readings:

1. I. Sommerville: Software Engineering: (8th Edition), Addison Wesley, 2006.
2. S. McConnell Code Complete: A Practical Handbook of Software Construction, Microsoft Press; 2nd edition, 2004.
3. 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
4. JURIČ, Matjaž B., KRIŽEVNIK, Marcel. *WS-BPEL 2.0 for SOA composite applications: define, model, implement, and monitor real-world BPEL business processes with SOA-powered BPM*. Birmingham: Packt Publishing, cop. 2010. 616 str., ilustr. ISBN 978-1-847197-94-8
5. D. Phillips: *The Software Project Manager's Handbook: Principles That Work at Work (Practitioners)*, Wiley-IEEE Computer Society Press, 2004.

Cilji in kompetence:

Cilj predmeta je študente seznaniti z osnovami sodobnih metod razvoja programske opreme in inženirskim pristopom k razvoju ter na praktičnem primeru preizkusiti postopke razvoja, kot se uporabljajo v realnem svetu v podjetjih. Tako se študentje spoznajo z najsodobnejšimi postopki razvoja programske opreme in se bodo po zaključku študija lažje vključili v ekipe razvijalcev in vodij projektov.

Objectives and competences:

The objective is to get familiar with the contemporary software development methods and engineering approach to development, and to verify the development approaches on a practical example, as software development is done in real-world projects in companies. Students will get familiar with the state-of-the-art software development approaches and will be able to seamlessly integrate with real world projects and teams.

Predvideni študijski rezultati:

Znanje in razumevanje:
Poznavanje sodobnih postopkov razvoja programske opreme in razumevanje njihovega izvora ter medsebojne povezanosti.
Uporaba:
Uporaba inženirskih metod pri razvoju programske opreme.
Refleksija:
Razumevanje primernosti uporabe določenih postopkov razvoja programske opreme glede na tip in zahteve.
Prenosljive spretnosti - niso vezane le na en predmet:
Poznavanje in uporaba metod za delo v skupini, ki rešuje intelektualno zahtevne naloge, trening učinkovitega pisnega in ustnega sporazumevanja s sodelavci.

Intended learning outcomes:

Knowledge and understanding:
Understanding of contemporary software development approaches, familiarity with their origins and interdependencies.
Application:
Application of engineering methods for software development.
Reflection:
Understanding of applicability of specific software development methods based on types and requirements.
Transferable skills:
Familiarity with and usage of methods for teamwork, which help to solve intellectually advanced tasks, training of efficient written and oral communication within the team.

Metode poučevanja in učenja:

Predavanja, praktično delo na primerih, seminarska naloga s praktičnim preizkusom razvoja programske opreme z uporabo najsodobnejših metod.

Learning and teaching methods:

Lectures, practical work on examples, seminar work with practical verification of software development using contemporary methods.

		Delež (v %) / Weight (in %)	Assessment:
Načini ocenjevanja:			
Način (pisni izpit, ustno izpraševanje, naloge, projekt):			Type (examination, oral, coursework, project):
Sprotno preverjanje (domače naloge, kolokviji in projektno delo)	50%		Continuing (homework, midterm exams, project work)
Končno preverjanje (pisni izpit)	50%		Final (written exam)
Ocene: 6-10 pozitivno, 5 negativno (v skladu s Statutom UL).			Grading: 6-10 pass, 5 fail (according to the rules of University of Ljubljana).

Reference nosilca / Lecturer's references:**Pet najpomembnejših del:**

Najpomembnejše objave:

WSDL and BPEL extensions for event driven architecture. *Inf. softw. technol.* [Print ed.], 2010, vol. 52, iss. 10, str. 1023-1043, doi: 10.1016/j.infsof.2010.04.005.

WSDL and UDDI extensions for version support in web services. *J. syst. softw.* [Print ed.], 2009, vol. 82, iss. 8, str. 1326-1343.

WS-BPEL extension for versioning. *Inf. softw. technol.* [Print ed.], 2009, vol. 51, iss. 8, str. 1261-1274.

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.

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.

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.

Oracle fusion middleware patterns: real-world composite applications using SOA, BPM, Enterprise 2.0, business intelligence, identity management, and application infrastructure: 10 unique architecture patterns powered by Oracle Fusion Middleware. Birmingham: Packt Publishing, cop. 2010. 224 str., ilustr. ISBN 978-1-847198-32-7.

WS-BPEL 2.0 for SOA Composite Applications with IBM WebSphere 7: define, model, implement, and monitor real-world BPEL 2.0 business processes with SOA-powered BPM. Birmingham: Packt Publishing, cop. 2010. 644 str., ilustr. ISBN 978-1-849680-46-2.

Celotna bibliografija je dostopna na SICRISu:

<http://sicris.izum.si/search/rsr.aspx?lang=slv&id=10545>.

UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet: Verjetnost in statistika
Course title: Probability and Statistics

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Univerzitetni študijski program prve stopnje Računalništvo in informatika	ni smeri	2	zimski
University study programme Computer and Information Science, 1st cycle	none	2	fall

Vrsta predmeta / Course type

obvezni predmet / compulsory course

Univerzitetna koda predmeta / University course code:

63213

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje Laboratory work	Druge oblike študija Field work	Samost. delo Individ. work	ECTS
45	10	20	/	/	105	6

Nosilec predmeta / Lecturer:

prof. dr. Aleksandar Jurišić

**Jeziki /
Languages:**

**Predavanja /
Lectures:** slovenščina
Slovene
Vaje / Tutorial: slovenščina
Slovene

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

Prerequisites:

Vsebina:

Content (Syllabus outline):

Teorija verjetnosti, matematični opis naključij/slučajnosti, je osnova za igre na srečo, zavarovalništvo in velik del moderne znanosti.

Za statistiko *slučajen* ne pomeni *neurejen*. Za slučajnostjo je neke vrste red, ki se pokaže šele na dolgi rok, po velikem številu ponovitev.

Naučili se bomo prepoznati dobre in slabe metode *pridobivanja podatkov*. Vsaka množica podatkov vsebuje informacije o neki skupini posameznikov. Informacije so urejene v spremenljivke. Če podatke uredimo v obliki tabele, potem vsaka vrstica vsebuje podatke o enem *posamezniku*, vsak stolpec pa vsebuje vrednosti ene *spremenljivke* za vse posameznike.

Statistična orodja in ideje nam pomagajo odkriti naravo množice podatkov z uporabo grafov in števil, ki opišejo glavne značilnosti. Tak pristop imenujemo *analiza podatkov*. Začnemo z obravnavo ene spremenljivke, nato si ogledamo povezave med več spremenljivkami.

Statistično sklepanje je proces, pri katerem pridemo do zaključkov na podlagi danih podatkov. Neformalno statistično sklepanje velikokrat temelji na grafični predstavitvi podatkov. Formalno pa sklepanje uporablja verjetnost, da se odločimo do kakšne mere smo lahko prepričani, ali so naši zaključki pravilni, tj. odgovarja na specifična vprašanja s predpisano stopnjo zaupanja.

Predavanja predmeta obsegajo:

1. Definicija verjetnosti, računanje z dogodki, pogojna verjetnost, obrazec razbitja in Bayesov obrazec, Bernullijevo zaporedje neodvisnih poskusov, Laplaceov intervalski obrazec, funkcija napake, Bernullijev zakon velikih števil.
2. Slučajne spremenljivke in vektorji, diskretne in zvezne porazdelitve,

Probability theory, the mathematical description of randomness/uncertainty, is the basis for gambling, insurance and much of modern science.

In statistics »*random*« is not synonym for »*haphazard*«. Randomness is kind of order that emerges only in the long run, in many repetitions. We will learn to recognize good and bad methods of *producing data*. Each set of data contains information about some group of individuals. If we collect data in the form of table, then each row contains data about the corresponding *individual* and each column contains values of one *variable* for all individuals.

Statistical tools and ideas assist us to uncover the nature of a set of data using graphs and numbers, which describe main attributes. Such study is called *data analysis*. We start with one variable and then check relations among several variables.

Statistical inference is a process which infers conclusions based on given data. Informally, statistical inference is often based on graphical presentation of data. Formally, statistical inference uses probability, to judge till what degree are our conclusions reliable, it answers specific questions with a known degree of confidence.

Lectures:

1. Definition of probability, algebra of events, conditional probability, Bayes rule, Bernoulli trials, Laplace interval formula, Error function, Bernoulli law of large numbers.
2. Random variables and vectors, discrete and continuous distributions, independence,

neodvisnost slučajnih spremenljivk, funkcije slučajnih spremenljivk, funkcije slučajnih vektorjev, pogojne porazdelitve, gostota zvezne pogojne porazdelitve.

3. Matematično upanje, disperzija in višji momenti, karakteristične funkcije, zaporedja slučajnih spremenljivk in slučajni procesi, limitni izreki, šibki in krepki zakon velikih števil, neenakost Čebiševa, Centralni limitni izrek.
4. Osnovna naloga statistike, porazdelitve vzorčnih statistik, vzorčno povprečje, reprodukcijska lastnost normalne porazdelitve, hi-kvadrat porazdelitev, Studentova porazdelitev, (intervalno) ocenjevanje parametrov, intervali zaupanja, testiranje statističnih hipotez, analiza variance, kovariance in linearne regresije.

Vaje: Namen vaj pri predmetu verjetnost in statistika je dvojen:

1. utrjevanje pri predavanjih obravnavane snovi z računskimi primeri in
2. kvalitativna in kvantitativna predstavitev nekaterih tipičnih, vendar »nešolskih« primerov, ki so za študente računalništva in informatike relevantni.

Pri vajah študenti sami rešujejo naloge, zato je udeležba pri vajah obvezna.

Domače naloge in kvizi:

Namen domačih nalog in projektov je ponuditi študentom priložnost za povsem samostojno reševanje nekoliko kompleksnejših nalog iz verjetnosti in statistike, ki poleg računske spretnosti zahtevajo tudi nekoliko temeljitejši premislek. Oboje presega možnosti pri vajah in naj bi navajalo k samostojnem delu. Kvizi pa spodbujajo sprotno delo in dajo študentom povratno informacijo o njihovem znanju.

functions of random variables, functions of random vectors, conditional distributions, density of conditional probability.

3. Expected value, standard deviations and higher moments, sequences of random variables and random processes, limit theorems, inequality of Chebyshev, Central Limit Theorem.
4. The main goal of statistics, the sampling distribution of statistics, sample average, reproduction property of the normal distribution, the hi-square distribution, the Student distribution, confidence intervals, estimation, statistical hypothesis testing, analysis of variance, covariance and linear regression.

Tutorials: Purpose of tutorials for the course Introduction to Probability and Statistics:

1. Detailed study of the material from the lectures through examples.
2. Qualitative and quantitative introduction of some typical (real-life) examples that are relevant for students of computer science.

Tutorials are guided, however, students are independently trying to solve problems, so their presence is compulsory.

Homeworks and quizzes:

The purpose of homeworks and projects is to offer students a possibility to independent solving of more complex problems in probability and statistics, which assume beside calculation techniques also more comprehensive skills. Both exceeds tutorial work and leads students to independent work. Quizzes encourage students to do current work and give them feedback on their knowledge.

Temeljna literatura in viri / Readings:

W. Mendenhall and T. Sincich: Statistics for engineering and the sciences, 5th edition, Pearson-Prentice-Hall, 2007 (prvih 11 poglavij/first 11 chapters).

Dodatna literatura:

1. M. Hladnik: Verjetnostni račun in statistika, zapiski predavanj, Ljubljana, 2002.
2. David S. Moore, Part II, Statistics: The Science of Data, v knjigi For All Practical Purposes (Mathematical Literacy in today's world), urednik S. Garfunkel, Consortium for Mathematics and Its Applications (COMAP), 8. izdaja, W. H. Freeman and Company, 2003 (v pripravi je tudi slovenski prevod).
3. L. Gonick in W. Smith, *The Cartoon guide to Statistics*, 1993.
4. J. Čibej, Matematika, kombinatorika, verjetnostni račun, statistika, DZS, 1994.

Cilji in kompetence:

Cilj predmeta je študentom računalništva in informatike predstaviti osnovne *teorije verjetnosti* in *statistike*. Študent, ki je poslušal ta predmet, bi moral znati opisati napovedljive vzorce, ki na dolgi rok vladajo slučajnim izidom ter doseči osnovno statistično pismenost, tj. sposobnost sledenja in razumevanja argumentov, ki izhajajo iz podatkov.

Objectives and competences:

The aim of this course is to introduce students of computer and information sciences to basics of probability *theory* and *statistics*. A student who attended this course should be able to describe predictable patterns that on long term rule to random outcomes and to achieve basic statistical literacy, that is an ability to follow and understand arguments that come from data.

Predvideni študijski rezultati:

Znanje in razumevanje: Poznavanje metod odkrivanja zakonitosti iz podatkov, zmožnost njihove rabe in ovrednotenja njihovih rezultatov.

Uporaba: Uporaba pri odkrivanju zakonitosti iz resničnih podatkov.

Refleksija: Spoznavanje in razumevanje uglašenosti med teorijo in njeno rabo na konkretnih primerih.

Prenosljive spretnosti - niso vezane le na en predmet: Predmet je osnova za številne predmete, pri katerih poznavanje in razumevanje vzorcev v podatkih omogoča kvalitetnejše odločanje in učinkovito rabo virov.

Intended learning outcomes:

Knowledge and understanding: Student masters the basic techniques to detect relations from data, and ability to use techniques and to evaluate their results.

Application: The ability to detect certain relations from real data.

Reflection: Learning and understanding the soundness between theory and practice applied to specific examples of probability and statistics.

Transferable skills - not related to a single course: This course is a foundation for several courses, where the study and understanding of data patterns allows better decision making and efficient usage of given sources.

Metode poučevanja in učenja:

Learning and teaching methods:

Predavanja, računske vaje z urotnimi nastopi, seminarski način dela pri projektih. Poseben poudarek je na sprotne študiju in na skupinskem delu pri vajah in seminarjih. Ogleдали si bomo tudi kakšen video.

Lectures, tutorials, assignments, projects, office hours, lab work. There will be a special emphasis on real-time studies and team work (tutorials and seminars). We will occasionally watch a video material related to the course material.

Delež (v %) /

Weight (in %) **Assessment:**

Načini ocenjevanja:

Sprotno preverjanje (domače naloge, kolokviji in projektno delo)	50%	On-going coursework (assignments, midterms, project work),
Končno preverjanje (pisni in ustni izpit)	50%	Final (written and oral).
Ocene: 6-10 pozitivno, 5 negativno (v skladu s Statutom UL).		Failing mark 5 and passing marks 6-10 (examinations follow the above mentioned Pravilnik/Statut UL).

Reference nosilca / Lecturer's references:

Pet najpomembnejših del:

1. A. Jurišić and J. H. Koolen, Classification of the family $AT_4(qs, q, q)$ of antipodal tight graphs, *J. Combin. Th. (A)* **118** (2011), 842-852.
2. A. Jurišić, A. Munemasa and Y. Tagami, On graphs with complete multipartite graphs, *Discrete Math.* **310** (2010), 1812-1819.
3. A. E. Brouwer, A. Jurišić in J. Koolen, Characterization of the Patterson graph, *J. Algebra* **320** (2008), 1189-1199.
4. A. Jurišić in P. Terwilliger, Pseudo 1-homogeneous distance-regular graphs, *J. Alg. Combin.* **28** (2008), 509-529.
5. K. Coolsaet in A. Jurišić, Using equality in the Krein conditions to prove nonexistence of certain distance-regular graphs, *J. Combin. Th. (A)* **115** (2008), 1086-1095.

Celotna bibliografija je dostopna na SICRISu:

<http://sicris.izum.si/search/rsr.aspx?lang=slv&id=6518>.

UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet:	Fizika
Course title:	Physics

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Univerzitetni študijski program prve stopnje Računalništvo in informatika	ni smeri	1	zimski
University study programme Computer and Information Science, 1st cycle	none	1	fall

Vrsta predmeta / Course type obvezni predmet / compulsory course

Univerzitetna koda predmeta / University course code: 63205

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje Laboratory work	Druge oblike študija Field work	Samost. delo Individ. work	ECTS
45	/	30	/	/	105	6

Nosilec predmeta / Lecturer: prof. dr. Borut Paul Kerševan

Jeziki / Languages:	Predavanja / Lectures:	slovenščina Slovene
	Vaje / Tutorial:	slovenščina Slovene

<p>Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:</p> <div style="border: 1px solid black; height: 150px; width: 100%;"></div>	<p>Prerequisites:</p> <div style="border: 1px solid black; height: 150px; width: 100%;"></div>
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Vsebina: _____ **Content (Syllabus outline):** _____

predavanja:

Mehanika

1. Uvod: Uporaba vektorjev in odvodov ter integralov v fiziki.
2. Kinematika točkastega telesa.
3. Dinamika točkastega telesa: masa, sile, Newtonovi zakoni, gravitacija.
4. Delo, energija, moč.
5. Gibalna količina, trki teles.
6. Dinamika togih razsežnih teles: središče mase, navor, vztrajnostni moment, vrtilna količina.
7. Mehanska nihanja in valovanja.

Elektrika in optika

1. Elektrostatika: električni naboj, električne sile.
2. Električno polje in električni potencial.
3. Snov v električnem polju.
4. Električna vezja z enosmernim tokom.
5. Magnetostatika: trajni magneti in elektromagneti, magnetna sila.
6. Magnetno polje, magnetni pretok.
7. Snov v magnetnem polju.
8. Indukcijski zakon, induktivnost.
9. Vezja z izmeničnim električnim tokom, električni transformator.
10. Električni nihajni krog, elektromagnetno valovanje.
11. Svetloba kot elektromagnetno valovanje, interferenca, uklon, optična vlakna in optične komunikacije.

vaje:

Namen vaj pri predmetu fizika je dvojen:

1. Utrjevanje pri predavanjih obravnavane snovi z računskimi primeri in
2. kvalitativna in kvantitativna predstavitev posebnih primerov, ki so relevantni za študente računalništva in informatike.

Pri vajah študenti s pomočjo učitelja sami rešujejo naloge, zato je udeležba pri vajah obvezna.

lectures:

Mechanics

1. Introduction: use of vectors, derivatives and integrals in physics.
2. Kinematics of the point-like body.
3. Dynamics of the point-like body: mass, forces, Newton laws, gravitation.
4. Work, energy, power.
5. Momentum, collisions.
6. Dynamics of physical bodies: mass center, torque, moment of inertia, angular momentum.
7. Mechanical oscillations and waves.

Electricity and Optics

1. Electrostatics: electric charge, electric forces.
2. Electric field and electric potential.
3. Matter in electric field.
4. Direct current (DC) circuits
5. Magnetostatics: permanent magnets and electromagnets, magnetic force.
6. Magnetic field, magnetic flux.
7. Matter in magnetic field.
8. Induction law, inductivity.
9. Circuits with alternating electric (AC) current, electric transformer.
10. Electric oscillator, electromagnetic waves.
11. Light as electromagnetic radiation, interference, diffraction, optical fibers and optical communications.

exercises:

The aim of exercises in physics is twofold:

1. Strengthening of the concepts considered in lectures with numeric examples, and
2. Qualitative and in quantitative presentation of some specific examples relevant for the students of computer science and informatics.

With the help of the assistant students solve numerical exercises, therefore the presence of students is obligatory.

domače naloge:

Namen domačih nalog je sprotno preverjanje znanja in razumevanja učne snovi.

home exercises:

The aim of home exercises is to regularly test understanding and knowledge of the current topics.

Temeljni literatura in viri / Readings:

1. R. Kladnik: Visokošolska fizika - Mehanski in toplotni pojavi (DZS Ljubljana, več izdaj).
2. R. Kladnik: Visokošolska fizika – Električna, atomika (DZS Ljubljana, več izdaj).
3. M. Ambrožič, I. Drevenšek Olenik, M. Vilfan, Fizika – učno gradivo (spletna učilnica FRI).

Dodatna literatura

1. J. Strnad, Fizika, 1. del, 2. del (DMFA založništvo, Ljubljana, 2007, 1995).
2. D. Halliday, R. Resnick, J. Walker, Fundamentals of Physics (J. Wiley & Sons, več izdaj).

Zbirke nalog

1. J. Žitnik: Univerzitetne fizikalne naloge, 1. in 2. del (Tehniška založba Slovenije, Ljubljana 2002)
2. R. Osredkar: Fizika – izpitne naloge (Založba FE in FRI, Ljubljana 2003).
3. I. Drevenšek-Olenik, B. Golob, I. Serša: Naloge iz fizike za študente tehniških fakultet, (DMFA založništvo, Ljubljana 2003).
4. D. Horvat, J. Možina, R. Petkovšek, Naloge iz tehniške fizike (fakulteta za strojništvo, Univerza v Ljubljani 2007).

Cilji in kompetence:

Študenti pridobijo poglobljeno znanje o fizikalnih pojavih in zakonih na področju mehanike, elektrike in magnetizma ter valovne optike. Spoznajo naravoslovno-znanstveni pristop k reševanju problemov, ki sloni na t.i. »fizikalni metodi« – to je izgradnji analitičnih modelov opazovanih pojavov na osnovi merskih podatkov. Pridobljeno znanje predstavlja podlago za modelsko analizo pri reševanju različnih tehniških problemov.

Objectives and competences:

The students attain extended knowledge on natural phenomena and related laws of physics in the fields of mechanics, electricity, magnetism and wave optics. They became familiar with the scientific method of problem solving, which is based on »physics method« – this is construction of the analytical models of investigated phenomena on the basis of measurement data. The obtained knowledge provides a base for construction of analytical models in solving various technical problems.

Predvideni študijski rezultati:**Intended learning outcomes:**

Znanje in razumevanje:
 Poznavanje osnovnih fizikalnih zakonov; kvantitativna obravnava posameznih fizikalnih pojavov in z njimi povezanih računskih primerov. Razumevanje pomena in uporabe analitičnih modelov pri inženirskem delu.

Uporaba:
 Uporaba fizikalnih metod in zakonitosti pri obravnavi problemov v računalništvu in informatiki.

Refleksija:
 Spoznavanje in razumevanje uglasenosti med teorijo in njeno praktično uporabo na izbranih konkretnih primerih s področja modeliranja naravnih pojavov.

Prenosljive spretnosti - niso vezane le na en predmet:
 Reševanje različnih problemov na osnovi modelov, ki so v primeru fizike pregledni in sorazmerno preprosti, je v računalništvu splošna in pogosto uporabljena metoda.

Knowledge and understanding:
 Understanding of fundamental laws of physics; quantitative treatment of specific physical phenomena and related numeric examples. Understanding the relevance and application of analytical models in engineering work.

Application:
 Application of physics methods and laws for problem solving in computer and information science.

Reflection:
 Recognizing and understanding interrelation between theory and its practical application via specific examples of models of natural phenomena.

Transferable skills – not limited to a single subject:
 Solving different problems on the basis of models (which are clear and relatively simple in physics) is a general and frequently used method in computer science.

Metode poučevanja in učenja:

Predavanja, računske vaje z ustnimi nastopi, domače naloge. Poseben poudarek je na sprotnem študiju z domačimi nalogami in na skupinskem delu pri vajah.

Learning and teaching methods:

Lectures, calculus exercises with oral participation, homework problems. Special attention is given to continuing work based on homework problems and group work at calculus exercises.

Delež (v %) /

Weight (in %)

Načini ocenjevanja:

Assessment:

<p>Način (pisni izpit, ustno izpraševanje, domače naloge in projekti): Končno preverjanje (pisni in ustni izpit): pogoj za pozitivno oceno izpita so opravljene obveznosti sprotnega dela (domačih nalog in projektov) v tekočem študijskem letu.</p> <p>Ocene: 6-10 pozitivno, 5 negativno (v skladu s Statutom UL).</p>	<p>obvezno (obligatory)</p> <p>100%</p>	<p>Type (written exam, oral exam, homework problems and projects): Final (written and oral exam): the pre-condition for a positive grade of the exam are fulfilled obligations of the continuing work (homework, project work) in the current year of studies.</p> <p>Grading: 6-10 pass, 5 fail (according to the rules of University of Ljubljana).</p>
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Reference nosilca / Lecturer's references:

Pet najpomembnejših del iz obdobja zadnjih 5 let (2011-2016):

- 1) AAD, G., CINDRO, Vladimir, DELIYERGIYEV, Maksym, DOLENC, Irena, FILIPČIČ, Andrej, FRATINA, Saša, GORIŠEK, Andrej, KERŠEVAN, Borut Paul, KRAMBERGER, Gregor, MAČEK, Boštjan, MANDIĆ, Igor, MIJOVIĆ, Liza, MIKUŽ, Marko, TYKHONOV, Andrii, et al., ATLAS Collaboration. A particle consistent with the Higgs boson observed with the ATLAS detector at the large hadron collider. *Science*, ISSN 0036-8075, 2012, vol. 338, no. 6114, str. 1576-1582, doi: [10.1126/science.1232005](https://doi.org/10.1126/science.1232005). [COBISS.SI-ID [26464551](https://www.cobiss.si/id/26464551)], [JCR, SNIP, WoS do 25. 6. 2017: št. citatov (TC): 45, čistih citatov (CI): 45, Scopus do 26. 8. 2017: št. citatov (TC): 56, čistih citatov (CI): 56]
- 2) AAD, G., CINDRO, Vladimir, DELIYERGIYEV, Maksym, DOLENC, Irena, FILIPČIČ, Andrej, FRATINA, Saša, GORIŠEK, Andrej, KERŠEVAN, Borut Paul, KRAMBERGER, Gregor, MAČEK, Boštjan, MANDIĆ, Igor, MIJOVIĆ, Liza, MIKUŽ, Marko, TYKHONOV, Andrii, et al., ATLAS Collaboration. Observation of a new particle in the search for the Standard Model Higgs boson with the ATLAS detector at the LHC. *Physics letters. Section B*, ISSN 0370-2693. [Print ed.], 2012, vol. 716, no. 1, str. 1-29, doi: [10.1016/j.physletb.2012.08.020](https://doi.org/10.1016/j.physletb.2012.08.020). [COBISS.SI-ID [26060071](https://www.cobiss.si/id/26060071)], [JCR, SNIP, WoS do 27. 8. 2017: št. citatov (TC): 4232, čistih citatov (CI): 4117, Scopus do 26. 8. 2017: št. citatov (TC): 3647, čistih citatov (CI): 3587]
- 3) AAD, G., CINDRO, Vladimir, FILIPČIČ, Andrej, GORIŠEK, Andrej, KERŠEVAN, Borut Paul, KRAMBERGER, Gregor, MANDIĆ, Igor, MIJOVIĆ, Liza, MIKUŽ, Marko, ŠFILIGOJ, Tina, VALENČIČ, Nika, et al., ATLAS Collaboration. Combined measurement of the Higgs boson mass in pppp collisions at $\sqrt{s}=7$ and 8 TeV with the ATLAS and CMS experiment. *Physical review letters*, ISSN 0031-9007. [Print ed.], 2015, vol. 114, no. 19, str. 191803-1-191803-33, doi: [10.1103/PhysRevLett.114.191803](https://doi.org/10.1103/PhysRevLett.114.191803). [COBISS.SI-ID [28811815](https://www.cobiss.si/id/28811815)], [JCR, SNIP, WoS do 27. 8. 2017: št. citatov (TC): 216, čistih citatov (CI): 216, Scopus do 31. 8. 2017: št. citatov (TC): 245, čistih citatov (CI): 244]
- 4) 5. AAD, G., CINDRO, Vladimir, DELIYERGIYEV, Maksym, DOLENC, Irena, FILIPČIČ, Andrej, FRATINA, Saša, GORIŠEK, Andrej, KERŠEVAN, Borut Paul, KRAMBERGER, Gregor, MAČEK, Boštjan, MANDIĆ, Igor, MIJOVIĆ, Liza, MIKUŽ, Marko, TYKHONOV, Andrii, et al., ATLAS Collaboration. Observation of associated near-side and away-side long-range correlations in $\sqrt{s_{NN}}=5.02$ TeV proton-lead collisions with the ATLAS detector. *Physical review letters*, ISSN 0031-9007. [Print ed.], 2013, vol. 110, no. 18, str. 182302-1-182302-18, doi: [10.1103/PhysRevLett.110.182302](https://doi.org/10.1103/PhysRevLett.110.182302). [COBISS.SI-ID [26742311](https://www.cobiss.si/id/26742311)], [JCR, SNIP, WoS do 27. 8. 2017: št. citatov (TC): 228, čistih citatov (CI): 223, Scopus do 26. 8. 2017: št. citatov (TC): 184, čistih citatov (CI): 184]
- 5) AD, G., CINDRO, Vladimir, DOLENC, Irena, FILIPČIČ, Andrej, FRATINA, Saša, GORIŠEK, Andrej, KERŠEVAN, Borut Paul, KRAMBERGER, Gregor, MAČEK, Boštjan, MANDIĆ, Igor (pisar), MIJOVIĆ, Liza, MIKUŽ, Marko, TYKHONOV, Andrii, et al., ATLAS Collaboration. Search for the Standard Model Higgs boson in the diphoton decay channel with 4.9fb–14.9fb–1 of pppp collision data at $\sqrt{s}=7$ TeV with ATLAS. *Physical review letters*, ISSN 0031-9007. [Print ed.], 2012, vol. 108, no. 11, str. 111803-1-111803-19, doi: [10.1103/PhysRevLett.108.111803](https://doi.org/10.1103/PhysRevLett.108.111803). [COBISS.SI-ID [25702695](https://www.cobiss.si/id/25702695)], [JCR, SNIP, WoS do 22. 1. 2017: št. citatov (TC): 161, čistih citatov (CI): 157, Scopus do 25. 6. 2017: št. citatov (TC): 119, čistih citatov (CI): 118]

Vsi podatki so dostopni na COBISS:

<http://www.sicris.si/search/rsr.aspx?lang=slv&id=10492>.

UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet: Algoritmi in podatkovne strukture 1

Course title: Algorithms and data structures 1

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Univerzitetni študijski program prve stopnje Računalništvo in informatika Univerzitetni študijski program prve stopnje Računalništvo in matematika	ni smeri	2	zimski
University study programme Computer and Information Science, 1st cycle University study programme Computer Science and Mathematics , 1st cycle	none	2	fall

Vrsta predmeta / Course type

obvezni predmet / compulsory course

Univerzitetna koda predmeta / University course code:

63279

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje Laboratory work	Druge oblike študija Field work	Samost. delo Individ. work	ECTS
45	/	30	/	/	105	6

Nosilec predmeta / Lecturer:

prof. dr. Igor Kononenko

Jeziki /

Languages:

Predavanja /

Lectures:

Vaje / Tutorial:

slovenščina

Slovene

slovenščina

Slovene

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

Prerequisites:

Poznavanje osnov programiranja.

Knowledge of basic programming.

Vsebina:

predavanja:

1. Iteracija in rekurzija
2. Reševanje problemov in algoritmi
3. Analiza časovne zahtevnosti algoritmov
4. Abstraktni podatkovni tip; ADT seznam
5. Osnovni abstraktni podatkovni tipi: množica, vrsta, sklad, preslikava
6. Zgoščene tabele
7. Abstraktni podatkovni tip drevo; primer: Izrazna drevesa
8. Abstraktni podatkovni tip slovar, Iskalna drevesa: binarna, rdeče-črna
9. Iskalna drevesa: AVL, B-drevesa
10. Abstraktna podatkovna tipa prioriteta vrsta (kopica) disjunktna množice
11. Abstraktna podatkovna tipa graf in usmerjeni graf
12. Iskanje najdaljših poti z dinamičnim programiranjem (kritična pot)
13. Iskanje najkrajših poti v usmerjenem grafu (algoritem Dijkstra)
14. Minimalno vpeto drevo v neusmerjenem grafu; Primov in Kruskalov algoritem.
15. Dokazovanje parcialne in totalne pravilnosti programov

vaje:

Na vajah bodo študenti utrjevali snov, ki so jo obravnavali na predavanjih, tako da jo bodo uporabili pri reševanju praktičnih problemov. Pri tem bodo poudarili na samostojnem delu študentov ob pomoči asistentov. Na vajah bodo študenti implementirali več manjših programov (tudi kot domače naloge) ter obsežnejše programe v obliki seminarskih nalog, ki jih bodo zagovarjali na vajah in s tem

Content (Syllabus outline):

Lectures:

1. Iteration and recursion
2. Problem solving and algorithms
3. Analysing time-complexity of algorithms
4. Abstract data type; ADT list
5. Basic abstract data types: set, queue, stack, mapping
6. Hash tables
7. Abstract data type tree; example: expression trees
8. Abstract data type dictionary, search trees: binary, red-black
9. Search trees: AVL, B-trees
10. Abstract data type priority queue (heap) and disjunctive sets
11. Abstract data types graph and directed graph (digraph)
12. Searching for longest paths with dynamic programming (critical path)
13. Searching for shortest paths in directed graphs (algorithm Dijkstra)
14. Minimum spanning tree in undirected graphs; Prim and Kruskal algorithms.
15. Verification of partial and total program correctness

tutorials:

Practical applications of the knowledge gained through lectures. The emphasis is on the autonomous work of students with the help of assistants. During tutorials (as well at home work), students will implement several short programs and will get grades for their presentation of seminar works.

Home works:

dobili oceno iz vaj.

domače naloge:

Namen domačih nalog je ponuditi študentom priložnost za reševanje preprostejših problemov s samostojnim razvojem krajših programov in jih s tem spodbuditi k sprotnemu študiju.

The purpose of home works is to offer each student the opportunity to autonomously develop short programs and to encourage them for continuous study.

Temeljna literatura in viri / Readings:

1. I. Kononenko in sod.: **Programiranje in algoritmi**, Založba FE in FRI, 2008.

Pomožna literatura:

1. I. Kononenko in M. Robnik-Šikonja: **Algoritmi in podatkovne strukture 1**, Založba FE in FRI, 2003.
2. A.V. Aho, J.E. Hopcroft, J.D. Ullman: *Data Structures and Algorithms*, Addison Wesley, 1983.
3. Thomas H. Cormen, Stein Clifford, Charles E. Leiserson, Robert L. Rivest: *Introduction to Algorithms*, second edition. The MIT Press, 2001.

Cilji in kompetence:

Cilj predmeta je spoznavanje osnovnih principov načrtovanja in analize algoritmov na osnovnih in dinamičnih podatkovnih strukturah.

Kompetence:

Zmožnost kritičnega, analitičnega in sintetičnega razmišljanja. Zmožnost razumevanja in reševanja profesionalnih problemov iz računalništva in informatike. .). Zmožnost uporabiti pridobljenega znanja za reševanje tehničnih in znanstvenih problemov v računalništvu in informatiki, zmožnost nadgrajevanja pridobljenega znanja. Osnovne veščine iz računalništva in informatike, ki vključujejo teoretične veščine, praktično znanje in veščine, ki so bistvene za področje računalništva in informatike. . Osnovne veščine iz računalništva in informatike, ki omogočajo nadaljevanje študija na 2. stopnji.

Objectives and competences:

The goal of the course is to acquiring the basic principles of design and analysis of algorithms and basic and dynamic data structures.

Competences:

Developing skills in critical, analytical and synthetic thinking. 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. Basic skills in computer and information science, which includes basic theoretical skills, practical knowledge and skills essential for the field of computer and information science; Basic skills in computer and information science, allowing the continuation of studies in the second study cycle.

Predvideni študijski rezultati:

Intended learning outcomes:

Znanje in razumevanje:
 Sposobnost samostojnega razvoja programov, poznavanje osnovnih podatkovnih struktur in algoritmov, sposobnost samostojnega načrtovanja podatkovnih struktur in algoritmov.

Uporaba:
 Uporaba naučenih principov pri programiranju in načrtovanju podatkovnih struktur in algoritmov za razvoj obsežnih programskih sistemov.

Refleksija:
 Razumevanje osnovnih principov načrtovanja programov in algoritmov in razumevanje njihove vloge pri razvoju programskih sistemov.

Prenosljive spretnosti - niso vezane le na en predmet:
 Zmožnost načrtovanja rešitve različnih problemov s programi in algoritmi, zmožnost uporabe naučenih principov pri programiranju v poljubnem programskem jeziku.

Knowledge and understanding:
 The ability to autonomously develop programs, the familiarity with basic data structures and algorithms, the ability to independently design data structures and algorithms.

Application:
 The use of the learned principles for programming and design of data structures and algorithms for the development of large systems.

Reflection:
 Understanding of basic principles of designing programs and algorithms and understanding of their role for the development of large systems.

Transferable skills:
 The ability to design the solution of different problems using programs and algorithms, the ability to use the learned concepts for programming in an arbitrary programming language.

Metode poučevanja in učenja:

Predavanja, domače naloge, seminarski način dela pri vajah. Poseben poudarek je na sprotnem študiju in na samostojnem delu pri domačih nalogah, vajah in seminarjih.

Learning and teaching methods:

Lectures, home works, seminar works during tutorials. The emphasis is on continuous study and on autonomous and independent work at home works, exercises and seminars.

Načini ocenjevanja:	Delež (v %) / Weight (in %)	Assessment:
Način (pisni izpit, ustno izpraševanje, naloge, projekt): Sprotno preverjanje (domače naloge, kolokviji in projektno delo) Ocena vaj Končno preverjanje (pisni in ustni izpit)	50% 50%	Type (examination, oral, coursework, project): Continuing (homework, midterm exams, project work) Grade for tutorials Final (written and oral exam)
Ocene: 6-10 pozitivno, 5 negativno (v skladu s Statuom UL).		Grading: 6-10 pass, 5 fail (according to the rules of University of Ljubljana).

Reference nosilca / Lecturer's references:

Pet najpomembnejših del:

1. KONONENKO, Igor, KUKAR, Matjaž. *Machine learning and data mining: introduction to principles and algorithms*. Chichester: Horwood Publishing, cop. 2007. XIX, 454 str.
2. ŠTRUMBELJ, Erik, KONONENKO, Igor. An efficient explanation of individual classifications using game theory. *J. mach. learn. res.*, Jan. 2010, vol. 11, no. [1], str. 1-18.
3. ROBNIK ŠIKONJA, Marko, KONONENKO, Igor. Theoretical and empirical analysis of ReliefF and RReliefF. *Mach. learn.*, 2003, vol. 53, str. 23-69.
4. KONONENKO, Igor, BRATKO, Ivan. Information-based evaluation criterion for classifier's performance. *Mach. learn.*, 1991, vol. 6, no. 1, str. 67-80.
5. KONONENKO, Igor. Machine learning for medical diagnosis: history, state of the art and perspective. *Artif. intell. med.*, 2001, vol. 23, no. 1, str. 89-109.

Celotna bibliografija prof. dr. Igorja Kononenka je dostopna na SICRISu:

<http://sicris.izum.si/search/rsr.aspx?lang=slv&id=5066>.

UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet: Inteligentni sistemi
Course title: Intelligent Systems

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Univerzitetni študijski program prve stopnje Računalništvo in informatika Univerzitetni študijski program prve stopnje Računalništvo in matematika	Modul: Umetna inteligenca	3	zimski
University study programme Computer and Information Science, 1st cycle University study programme Computer Science and Mathematics , 1st cycle	Module: Artificial Intelligence	3	fall

Vrsta predmeta / Course type

izbirni predmet /elective course

Univerzitetna koda predmeta / University course code:

63266

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje Laboratory work	Druge oblike študija Field work	Samost. delo Individ. work	ECTS
45	6	24	/	/	105	6

Nosilec predmeta / Lecturer:

prof. dr. Igor Kononenko, izr. prof. dr. Marko Robnik Šikonja

**Jeziki /
Languages:**

**Predavanja /
Lectures:** slovenščina
Slovene
Vaje / Tutorial: slovenščina
Slovene

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

Za uspešno delo je potrebno poznavanje osnov statistike in programiranja.

Prerequisites:

Knowledge of basic statistics and programming.

Vsebina:**Teme predavanj:**

1. Inteligenca in umetna inteligenca ter interakcija človek-stroj: temeljna filozofska vprašanja glede inteligence in umetne inteligence, vloga umetne inteligence.
2. Strojno učen je in podatkovno rudarjenje, pregled osnovnih algoritmov.
3. Predprocesiranje podatkov, diskretizacija, vizualizacija.
4. Inteligentna analiza podatkov.
5. Osnovni principi strojnega učenja, ocenjevanje učenja, kombiniranje algoritmov strojnega učenja .
6. Paralelno distribuirano procesiranje in umetne nevronske mreže.
7. Evolucijsko računanje in genetski algoritmi.
8. Osnovni principi modeliranja: učenje kot modeliranje, kakovost modelov, evaluacija modelov.
9. Statistično modeliranje: bayesovsko sklepanje, linearni in regresijski modeli, multivariatni modeli, neparametrični modeli, stohastični procesi.
10. Sistemi za podporo odločanju: klasična teorija odločanja, teorija uporabnosti in teorija iger, večkriterijsko odločanje, negotovost in upoštevanje tveganj, skupinsko odločanje, kakovost odločitvenih modelov.
11. Inteligentni agenti: pregled področja, agentne arhitekture in teorija agentov, večagentni sistemi.
12. Procesiranje naravnega jezika: vektorska predstavitev besedil, korpusne metode, pridobivanje informacij, povzemanje., tekstovno rudarjenje.
13. Spodbujevano učenje: osnovni pristopi in algoritmi, Q učenje, TD učenje
14. Hevristično preiskovanje: princip minimaksa, alfa-beta rezanje, Monte Carlo drevesno preiskovanje.

Content (Syllabus outline):**Lecture topics:**

1. Intelligence, artificial intelligence (AI) and human-machine interaction: basic philosophical questions about intelligence and AI, the role of AI
2. Machine learning and data mining, overview of basic algorithms
3. Data preprocessing, discretization, visualization.
4. Intelligent data analysis
5. Basic principles of machine learning (ML), evaluation of learning, combining ML algorithms
6. Parallel distributed processing and artificial neural networks
7. Evolutionary computation and genetic algorithms
8. Basic principles of modelling: learning as modelling, model quality, model evaluation
9. Statistical modelling: Bayesian reasoning, linear models, regression models, multivariate models, non-parametric models, stochastic processes
10. Decision support systems: classical decision theory, utility functions, game theory, multi-parameter decision models, uncertainty and risk management, group decision making, quality of decision models
11. Intelligent agents: overview and state-of-the-art, agent architectures , multiagent systems.
12. Natural language processing: vector presentation of documents, corpus based methods, information extraction, automatic summarization, text mining.
13. Reinforcement learning: basic approaches and algorithms, Q learning, TD learning
14. Heuristic search: minimax principle, alpha-beta pruning, Monte Carlo tree search.

Temeljni literatura in viri / Readings:

- Kononenko, M. Robnik-Šikonja: Inteligentni sistemi, Založba FE in FRI, Ljubljana, 2010.
- I. Kononenko, M. Kukar: Machine Learning and Data Mining, Horwood publ., 2007.
- S.J. Russell, P. Norvig: Artificial Intelligence: A Modern Approach, 3rd ed. Prentice Hall, 2009.

Cilji in kompetence:

Cilj predmeta je študente seznaniti s področjem inteligentnih sistemov, ki vsebuje nabor orodij in pristopov za reševanje problemov, ki jih je težko ali nepraktično reševati z drugimi metodami. Študenti morajo biti sposobni teoretično znanje praktično uporabiti na realnih problemih iz znanstvenega in poslovnega okolja. Študenti morajo biti za dani problem sposobni presoje, katero od predstavljenih tehnik uporabiti, ter sestaviti prototip rešitve.

Splošne kompetence:

- sposobnost razumevanja in reševanja profesionalnih izzivov,
- sposobnost profesionalne komunikacije v domačem in tujem jeziku,
- sposobnost samostojne uporabe pridobljenega znanja za reševanje tehničnih in znanstvenih problemov v računalništvu in informatiki,
- seznanjenost z raziskovalnimi metodami na področju računalništva in informatike.

Predmetno-specifične kompetence:

- uporaba osnovnih algoritmov strojnega učenja
- predpriprava podatkov za podatkovno rudarjenje
- izbira pomembnih atributov
- vrednotenje odločitvenih modelov
- uporaba sistemov za podatkovno rudarjenje
- uporaba sistemov za optimizacijo z evolucijskim računanjem
- analiza besedil s tehnikami podatkovnega rudarjenja
- uporaba orodij za spodbujevano učenje.

Objectives and competences:

The goal of the course is the students to become acquainted with the field of intelligent systems, which includes a collection of tools and approaches for solving problems which are difficult or unpractical to tackle with other methods. Students will be able to apply the gained theoretical knowledge on real-world problems from scientific and business environment. The students shall be able to decide which of the presented techniques should be used for a given problem, and to develop a prototype solution.

General competences:

- the ability to understand and solve professional challenges in computer and information science,
- the ability of professional communication in the native language as well as a foreign language,
- the ability to apply acquired knowledge in independent work for solving technical and scientific problems in computer and information science,
- familiarity with research methods in the field of computer science.

Subject-specific competences:

- using basic machine learning algorithms
- preprocessing data for data mining
- feature subset selection
- evaluation of decision models
- using data mining systems
- using optimizations packages with evolutionary techniques
- text analysis and text mining
- using reinforcement learning tools

Predvideni študijski rezultati:**Znanje in razumevanje:**

Poznavanje različnih tehnik in metod, ki se uporabljajo pri modeliranju inteligentnih sistemov. Sposobnost za analizo, sintezo in predvidevanje rešitev ter njihovih posledic na konkretnih problemih z uporabo znanstvenih metod.

Uporaba:

Uporaba predstavljenih metod na konkretnih problemih iz znanstvenega in poslovnega okolja. Poznavanje in uporaba orodij za statistično modeliranje in podatkovno rudarjenje.

Refleksija:

Spoznavanje in razumevanje pomena temeljnega matematičnega in statističnega znanja, uglasenosti med teorijo in njeno aplikacijo na konkretnih primerih s področja inteligentnega modeliranja. Avtonomnost, (samo)kritičnost, (samo)refleksivnost, prizadevanje za kakovost.

Prenosljive spretnosti - niso vezane le na en predmet:

Prenos naučenih principov na načrtovanje obsežnih sistemov, kjer lahko principi inteligentnih rešitev pomagajo izboljšati uporabnost in uspešnost sistema. Sposobnost pridobivanja, selekcije in ocenjevanja novih informacij in zmožnost ustrezne interpretacije v kontekstu. Sposobnost za upravljanje s časom, za samo pripravo in načrtovanje ter samokontrolo izvajanja načrtov in postopkov. Timsko delo, pisanje poročil in člankov. Koherentno obvladanje temeljnega znanja, pridobljenega pri obveznih predmetih, ter sposobnost povezovanja znanja z različnih področij in njegova uporaba v praksi.

Metode poučevanja in učenja:**Intended learning outcomes:****Knowledge and understanding:**

Expertise in several techniques and methods, used for intelligent system modelling. The ability for analysis, synthesis and anticipation of solutions and their consequences for target problems using the scientific methodology.

Application:

The use of the presented methods on target problems from scientific and business environment. The understanding and usage of tools for statistical modelling and data mining.

Reflection:

The recognition and understanding of the meaning of basic mathematical and statistical knowledge, the relation between theory and its application in concrete examples of intelligent modelling and learning. Autonomy, (self) criticalness, (self) reflexivity, aspiration for quality.

Transferable skills:

The transfer of the learned principles to planning of large systems where the principles of intelligent solutions help to improve the usability and the system performance. The ability to receive, select and evaluate new information and a proper interpretation in a context. A self-control and ability to manage limited time when preparing, planning and implementing plans and processes. Team work, writing of reports and articles, public presentations. Coherent mastering of basic knowledge, gained through mandatory courses, and the ability to combine the knowledge from different fields and to apply it in practice.

Learning and teaching methods:

Predavanja, vaje z ustnimi nastopi in predstavitvami, seminarski način dela pri domačih nalogah. Študenti bodo v manjših skupinah samostojno reševali realen problem. Skupine bodo svoje naloge in rešitve opisale v pisnem poročilu in predstavile ostalim v obliki kratke predstavitve, ki je ocenjena skupaj s poročilom.

Lectures, assignments with written and oral demonstrations and presentations, seminar works and homework. Students from small project teams and autonomously solve assignments based on real-life problems. The teams describe their solutions in written reports and prepare short oral presentations. Written reports and oral presentations are graded.

Delež (v %) /

Načini ocenjevanja:

Weight (in %) **Assessment:**

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

Pet najpomembnejših del/ Five most important works:

KONONENKO Igor:

1. KONONENKO, Igor, KUKAR, Matjaž. Machine learning and data mining: introduction to principles and algorithms. Chichester: Horwood Publishing, 2007.
2. ŠTRUMBELJ, Erik, KONONENKO, Igor. An efficient explanation of individual classifications using game theory. J. mach. learn. res., Jan. 2010, vol. 11, no. [1], str. 1-18.
3. ROBNIK ŠIKONJA, Marko, KONONENKO, Igor. Theoretical and empirical analysis of ReliefF and RReliefF. Mach. learn., 2003, vol. 53, str. 23-69.
4. KONONENKO, Igor, BRATKO, Ivan. Information-based evaluation criterion for classifier's performance. Mach. learn., 1991, vol. 6, no. 1, str. 67-80.
5. KONONENKO, Igor. Machine learning for medical diagnosis: history, state of the art and perspective. Artif. intell. med., 2001, vol. 23, no. 1, str. 89-109.

Celotna bibliografija prof. dr. Kononenka je dostopna na SICRISu:

<http://sicris.izum.si/search/rsr.aspx?lang=slv&id=5066>.

ROBNIK-ŠIKONJA Marko:

1. ROBNIK ŠIKONJA, Marko. Data generators for learning systems based on RBF networks. *IEEE transactions on neural networks and learning systems*, May 2016, vol. 27, no. 5, pp. 926-938.
2. PIČULIN, Matej, ROBNIK ŠIKONJA, Marko. Handling numeric attributes with ant colony based classifier for medical decision making. *Expert systems with applications*, Nov. 2014, vol. 41, no. 16, pp. 7524-7535.
3. ROBNIK ŠIKONJA, Marko, VANHOOF, Koen. Evaluation of ordinal attributes at value level. *Data mining and knowledge discovery*, 2007, vol. 14, no. 2, pp. 225-243.
4. ROBNIK ŠIKONJA, Marko, KONONENKO, Igor. Theoretical and empirical analysis of ReliefF and

RReliefF. *Machine learning*, 2003, 53:23-69.

5. ROBNIK ŠIKONJA, Marko, KONONENKO, Igor. Explaining classifications for individual instances. *IEEE Transactions on Knowledge and Data Engineering*, 2008, 20(5):589-600.

Celotna bibliografija je dostopna na SICRISu

<http://sicris.izum.si/search/rsr.aspx?lang=slv&id=8741>.

Complete bibliography is available in SICRIS:

<http://sicris.izum.si/search/rsr.aspx?lang=eng&id=8741>.

UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet: Multimedijски sistemi
Course title: Multimedia Systems

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Univerzitetni študijski program prve stopnje Računalništvo in informatika Univerzitetni študijski program prve stopnje Računalništvo in matematika	Modul: Medijske tehnologije	3	zimski
University study programme Computer and Information Science, 1st cycle University study programme Computer Science and Mathematics , 1st cycle	Module: Media technologies	3	fall

Vrsta predmeta / Course type

izbirni predmet /elective course

Univerzitetna koda predmeta / University course code:

63270

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje Laboratory work	Druge oblike študija Field work	Samost. delo Individ. work	ECTS
45	10	20	/	/	105	6

Nosilec predmeta / Lecturer:

izr. prof. dr. Matej Kristan

**Jeziki /
Languages:**

**Predavanja /
Lectures:** slovenščina
Slovene
Vaje / Tutorial: slovenščina
Slovene

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

Prerequisites:

**Vsebina:****Predavanja:**

1. Pregled področja Multimedijskih sistemov in izzivi
2. Manipulacija slikovnih gradiv
3. Manipulacija video podatkov in standardi zapisa video podatkov
4. Pridobivanje informacij s tekstom
5. Arhitektura sistema za pridobivanje multimedijskih informacij
6. Evaluacija multimedijskih sistemov za pridobivanje informacij
7. Metode za avtomatsko opisovanje vsebine slik
8. Razgradnja slikovne informacije
9. Razgradnja video informacije
10. Interaktivni mediji in obogatena resničnost v multimedijskem sistemu
11. Standardi za brezizgubno stiskanje multimedijskih vsebin
12. Standardi za izgubno stiskanje multimedijskih vsebin

Vaje:

Vaje bodo potekale v obliki projektno-orientiranih nalog v primerno opremljenih študentskih laboratorijih. Študentje v okviru projektov samostojno implementirajo algoritme, ki jih obravnavamo na predavanjih in jih preizkušajo na različnih naborih podatkov zajetih z različnimi senzorskimi sistemi. Sprotno in obvezno delo na projektih omogoča poglobljeno in kritično razumevanje obravnavane tematike, spodbuja pa tudi samostojno mišljenje in kreativnost.

Content (Syllabus outline):**Lectures:**

1. Introduction to multimedia, overview of the field and challenges
2. Manipulation of image data
3. Video standards and manipulation of video data
4. Text-based information retrieval
5. Architecture of multimedia information retrieval
6. Evaluation of multimedia systems for information retrieval
7. Automatic image content description
8. Segmentation of image content
9. Segmentation of video content
10. Interactive media and augmented reality in multimedia systems
11. Lossless compression standards in multimedia
12. Lossy compression standards in multimedia

Exercises:

Exercises will take a form of project-oriented exercises in properly equipped student laboratories. Students will implement various algorithms, that will be covered in lectures, and test them on different datasets using a variety of sensor systems. Exercises will support an in-depth understanding of the theory. They will also encourage independent thinking and creativity.

Temeljni literatura in viri / Readings:

Obvezna:

- A. Del Bimbo: Visual Information Retrieval, Morgan Kaufmann 1999, ISBN 1-55860-624-6.
- C. D. Manning, P. Raghavan, H. Schütze, Introduction to Information Retrieval, Cambridge University Press. 2008

Dopolnilna:

Mark S. Li Ze-Nian and Drew, Fundamentals of Multimedia, Prentice-Hall of India (2005)
Članki iz revij, kot npr. IEEE Multimedia. (dostopno na spletu)

Cilji in kompetence:

Multimedijski sistemi so nepogrešljiv del sodobnih informacijskih tehnologij. Študenti naj bi v okviru tega predmeta pridobili znanja in veščine potrebne za uporabo, načrtovanje in razvoj multimedijskih sistemov. Obravnavani bodo problemi učinkovitih predstavitev in obdelave več predstavitvenih podatkov, kot so besedilo, grafika, animacije, slike in video.

Polega tega bodo študenti osvojili naslednje kompetence:

- Sposobnost razumevanja in reševanja strokovnih izzivov s področja računalništva in informatike
- Sposobnost strokovne komunikacije v materinem in tujem jeziku.
- Sposobnost neodvisnega reševanja tako manj zahtevnih kakor kompleksnih inženirskih in organizacijskih problemov iz ozkih področji, kakor tudi specifičnih dobro definiranih problemov s področja računalništva in informatike.

Objectives and competences:

Multimedia systems are an indispensable part of modern information technology. In the framework of this course, the students will acquire knowledge and skills needed for use, design and development of multimedia systems. The course will also deal with the problems related to efficient representations and processing multimedia data, such as text, graphics, animations, images, and video.

In addition, the students will obtain the following competences:

- The ability to understand and solve professional challenges in computer and information science.
- The ability of professional communication in the native language as well as a foreign language.
- The ability to independently perform both less demanding and complex engineering and organisational tasks in certain narrow areas and independently solve specific well-defined tasks in computer and information science.

Predvideni študijski rezultati:

Znanje in razumevanje:

Poznavanje računalniških tehnologij in računalniških metodologij za uporabo in razvoj komponent in multimedijskih sistemov.

Uporaba:

Uporaba računalniških tehnologij in računalniških metodologij pri specifičnih

Intended learning outcomes:

Knowledge and understanding:

Understanding of computer technology and computational methodology for use and development of components for multimedia systems.

Application:

Use of computer technology and computational

aplikacijah multimedijskih sistemov.

Refleksija:

Spoznavanje in razumevanje uglasenosti med teorijo in njeno aplikacijo na konkretnih primerih s področja modeliranja multimedijskih sistemov.

Prenosljive spretnosti - niso vezane le na en predmet:

Reševanje drugih konceptualno sorodnih problemov (npr. na drugih modalnostih) na osnovi modelov multimedijskih sistemov.

methodology for specific applications of multimedia systems.

Reflection:

Understanding how the theory can be tuned for different application scenarios in the area of multimedia systems.

Transferable skills:

Solving other conceptually similar problems (e.g., other modalities) based on the models of multimedia systems.

Metode poučevanja in učenja:

Predavanja, laboratorijske vaje v računalniški učilnici z aktivnim sodelovanjem. Individualno delo na vajah. Teorija s predavanj se praktično analizira na vajah. Poseben poudarek je na sprotnem študiju in sprotnem delu pri vajah.

Learning and teaching methods:

Lectures, laboratory exercises in computer classroom with active participation. Individual work on exercises. Theory from the lectures made concrete with hands-on laboratory exercises. Special emphasis will be put on continuous assessment at exercises.

Načini ocenjevanja:

Način (pisni izpit, ustno izpraševanje, vaje):
Sprotno preverjanje (domače naloge in laboratorijske vaje)
Končno preverjanje (pisni in ustni izpit)

Ocene: 6-10 pozitivno, 5 negativno (v skladu s Statutom UL).

Delež (v %) /
Weight (in %)

Assessment:

Type (examination, oral, laboratory exercises):
Continuing (homework and laboratory exercises)
Final (written and oral exam)

Grading: 6-10 pass, 5 fail (according to the rules of University of Ljubljana).

Reference nosilca / Lecturer's references:

Pet najpomembnejših del:

KRISTAN, Matej, LEONARDIS, Aleš. Online discriminative kernel density estimator with Gaussian kernels. *IEEE transactions on cybernetics*, vol. 44, (3), 2014, str. [355-365], [COBISS.SI-ID [9907284](#)]

ČEHOVIN, Luka, KRISTAN, Matej, LEONARDIS, Aleš. Robust visual tracking using an adaptive coupled-layer visual model. *IEEE trans. pattern anal. mach. intell.* [Print ed.], 2012, str. [1-14], [COBISS.SI-ID [9431124](#)]

KRISTAN, Matej, LEONARDIS, Aleš, SKOČAJ, Danijel. Multivariate online kernel density estimation

with Gaussian kernels. *Pattern recogn.*. [Print ed.], 2011, vol. 44, no. 10/11, str. 2630-2642.
[COBISS.SI-ID [8289876](#)]

KRISTAN, Matej, SKOČAJ, Danijel, LEONARDIS, Aleš. Online kernel density estimation for interactive learning. *Image vis. comput.*. [Print ed.], Jul. 2010, vol. 28, no. 7, str. 1106-1116, ilustr.
[COBISS.SI-ID [7326804](#)]

KRISTAN, Matej, KOVAČIČ, Stanislav, LEONARDIS, Aleš, PERŠ, Janez. A two-stage dynamic model for visual tracking. *IEEE trans. syst. man cybern., Part B, Cybern.*. [Print ed.], Dec. 2010, vol. 40, no. 6, str. 1505-1520, ilustr. [COBISS.SI-ID [7709524](#)]

Celotna bibliografija je dostopna na SICRISu:

<http://sicris.izum.si/search/rsr.aspx?lang=slv&id=32801>.

UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet: Umetno zaznavanje
Course title: Machine Perception

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Univerzitetni študijski program prve stopnje Računalništvo in informatika	Modul: Umetna inteligenca	3	zimski
Univerzitetni študijski program prve stopnje Računalništvo in matematika			
Univerzitetni študijski program prve stopnje Multimedija		2, 3	
University study programme Computer and Information Science, 1st cycle	Module: Artificial Intelligence	3	fall
University study programme Computer Science and Mathematics , 1st cycle			
University study programme Multimedia, 1st cycle			

Vrsta predmeta / Course type

izbirni predmet / elective course

Univerzitetna koda predmeta / University course code:

63267

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje Laboratory work	Druge oblike študija Field work	Samost. delo Individ. work	ECTS
45	10	20	/	/	105	6

Nosilec predmeta / Lecturer:

izr. prof. dr. Matej Kristan

Jeziki /
Languages:

Predavanja /
Lectures: angleščina
English
Vaje / Tutorial:
angleščina
English

Prerequisites:

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

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Vsebina:

<p>Vsebina predmeta:</p> <ol style="list-style-type: none">1. Pregled področja umetnega zaznavanja, aplikacijski doseg in znanstveni izzivi2. Procesiranje slik<ol style="list-style-type: none">a. Nastanek slike v kamerib. Binarizacija, morfološke operacije, segmentacijac. Barvni prostori in zaznavanjed. Linearni in nelinearni filtri3. Odvodi slike in zaznavanje robov<ol style="list-style-type: none">a. Zaznavanje robov z odvodib. Robovi za zaznavanje objektovc. Zaznavanje parametričnih oblik4. Prileganje modelov<ol style="list-style-type: none">a. Normalne enačbeb. Homogeni sistemic. Robustne metode5. Lokalne značilnice<ol style="list-style-type: none">a. Detektorji kotovb. Lokalni opisniki z izbiro merila in afino adaptacijo6. Stereoskopija in zaznavanje globine<ol style="list-style-type: none">a. Nekalibrirani in kalibrirani sistemi ter rekonstrukcija7. Razpoznavanje objektov<ol style="list-style-type: none">a. Podprostorske metode (PCA, LDA)b. Razpoznavanje z lokalnimi značilnicami8. Detekcija objektov<ol style="list-style-type: none">a. Zapis vizualnih lastnosti in postopki za detekcijo9. Zaznavanje gibanja
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Content (Syllabus outline):

<p>Lectures:</p> <ol style="list-style-type: none">1. Overview of the field of Machine perception and scientific challenges2. Image processing<ol style="list-style-type: none">a. Image formationb. Binarization, morphology, segmentationc. Colour spaces and colour perceptiond. Linear and nonlinear filters3. Image derivatives and edge perception<ol style="list-style-type: none">a. Derivative-based edge perceptionb. Edge-based object perceptionc. Parametric shape perception4. Model fitting<ol style="list-style-type: none">a. Normal equationsb. Homogenous systemsc. Robust approaches5. Local features<ol style="list-style-type: none">a. Corner perceptionb. Local descriptors in scale space and affine adaptation6. Stereoscopia and depth perception<ol style="list-style-type: none">a. Calibrated and uncalibrated systems and reconstruction7. Object recognition<ol style="list-style-type: none">a. Subspace methods (PCA, LDA)b. Local-features-based recognition8. Object detection<ol style="list-style-type: none">a. Visual features and detection approaches9. Motion perception

- a. Lokalno gibanje in metode za sledenje objektov

Vaje:

Vaje bodo potekale v obliki projektno-orientiranih nalog v primerno opremljenih študentskih laboratorijih. Študentje v okviru nalog samostojno implementirajo algoritme in jih preizkušajo na različnih naborih podatkov zajetih z različnimi senzorskimi sistemi. Sprotno in obvezno delo na projektih omogoča poglobljeno in kritično razumevanje obravnavane tematike, spodbuja pa tudi samostojno mišljenje in kreativnost.

- a. Local motion perception and object tracking

Exercises:

Exercises will take a form of project-oriented exercises in properly equipped student laboratories. Students will implement various algorithms and test them on different datasets using a variety of sensor systems. Exercises will support an in-depth understanding of the theory. They will also encourage independent thinking and creativity.

Temeljna literatura in viri / Readings:

Obvezna:

- D. Forsyth and J. Ponce, Computer Vision: A modern approach, Prentice Hall 2011.
- R. Szeliski, Computer Vision: Algorithms and Applications, Springer, 2011

Dopolnilna:

- H. R. Schiffman: Sensation and Perception, An Integrated Approach, John Wiley & Sons 2001.

Izbrani članki iz revij IEEE PAMI, CVIU, IJCV, Pattern Recognition (dostopno na spletu)

Cilji in kompetence:

Študenti bodo v okviru tega predmeta pridobili konkretna znanja in veščine s področja računalniškega vida. Razvili bodo kompetence z nizkonivojskega procesiranja slik, 3D geometrije kamer in sterea, detekcije objektov, razpoznavanja objektov in osnove izračunavanja gibanja v videoposnetkih. Osvojili bodo tudi matematične osnove za reševanje zahtevnih inženirskih problemov, ki so značilni za analizo tako kompleksnih signalov kot so slike in videoposnetki.

Poleg tega bodo študenti osvojili naslednje kompetence:

- Sposobnost razumevanja in reševanja strokovnih izzivov s področja računalništva in informatike

Objectives and competences:

In the framework of this course, the students will acquire concrete knowledge and skills in the area of machine perception. The students will develop competences in low-level image processing, 3D geometry of stereo systems, object detection, object recognition, and motion extraction in video sequences. The students will also practice mathematical basics crucial for solving demanding engineering problems, which are essential for analysis of complex signals such as images and video.

In addition, the students will obtain the following competences:

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

- Sposobnost strokovne komunikacije v materinem in tujem jeziku.
- Sposobnost neodvisnega reševanja tako manj zahtevnih kakor kompleksnih inženirskih in organizacijskih problemov iz ozkih področji, kakor tudi specifičnih dobro definiranih problemov s področja računalništva in informatike.

- The ability of professional communication in the native language as well as a foreign language.
- The ability to independently perform both less demanding and complex engineering and organisational tasks in certain narrow areas and independently solve specific well-defined tasks in computer and information science.

Predvideni študijski rezultati:

Znanje in razumevanje:

Poznavanje računalniških tehnologij in računalniških metodologij za uporabo in razvoj komponent in sistemov računalniškega zaznavanja.

Uporaba:

Uporaba računalniških tehnologij in računalniških metodologij pri specifičnih aplikacijah avtonomnih inteligentnih kognitivnih sistemov.

Refleksija:

Spoznavanje in razumevanje uglasenosti med teorijo in njeno aplikacijo na konkretnih primerih s področja modeliranja umetnih inteligentnih spoznavnih/zaznavnih sistemov.

Prenosljive spretnosti - niso vezane le na en predmet:

Reševanje drugih konceptualno sorodnih problemov (npr. na drugih modalnostih) na osnovi modelov računalniškega in kognitivnega zaznavanja.

Intended learning outcomes:

Knowledge and understanding:

Understanding of computer technology and computational methodology for use and development of components for machine vision systems.

Application:

Use of computer technology and computational methodology for specific applications of autonomous intelligent cognitive systems.

Reflection:

Understanding how the theory can be tuned for different application scenarios in the area of intelligent perceptual/cognitive systems.

Transferable skills: Solving other conceptually similar problems (e.g., other modalities) based on the models of machine and artificial cognitive perception.

Metode poučevanja in učenja:

Learning and teaching methods:

Predavanja, laboratorijske vaje v računalniški učilnici z aktivnim sodelovanjem. Individualno delo na vajah. Teorija s predavanj se praktično analizira na vajah. Poseben poudarek je na sprotne študiju in sprotne delu pri vajah.

Lectures, laboratory exercises in computer classroom with active participation. Individual work on exercises. Theory from the lectures made concrete with hands-on laboratory exercises. Special emphasis will be put on continuous assessment at exercises.

Delež (v %) /

Weight (in %)

Načini ocenjevanja:

Assessment:

Način (pisni izpit, ustno izpraševanje, vaje):	Delež (v %) / Weight (in %)	Type (examination, oral, laboratory exercises):
Sprotno preverjanje (domače naloge in laboratorijske vaje)	50%	Continuing (homework and laboratory exercises)
Končno preverjanje (pisni in ustni izpit)	50%	Final (written and oral exam)
Ocene: 6-10 pozitivno, 5 negativno (v skladu s Statutom UL).		Grading: 6-10 pass, 5 fail (according to the rules of University of Ljubljana).

Reference nosilca / Lecturer's references:

Pet najpomembnejših del:

KRISTAN, Matej, LEONARDIS, Aleš. Online discriminative kernel density estimator with Gaussian kernels. *IEEE transactions on cybernetics*, vol. 44, (3), 2014, str. [355-365], [COBISS.SI-ID [9907284](#)]

ČEHOVIN, Luka, KRISTAN, Matej, LEONARDIS, Aleš. Robust visual tracking using an adaptive coupled-layer visual model. *IEEE trans. pattern anal. mach. intell.*. [Print ed.], 2012, str. [1-14], [COBISS.SI-ID [9431124](#)]

KRISTAN, Matej, LEONARDIS, Aleš, SKOČAJ, Danijel. Multivariate online kernel density estimation with Gaussian kernels. *Pattern recogn.*. [Print ed.], 2011, vol. 44, no. 10/11, str. 2630-2642. [COBISS.SI-ID [8289876](#)]

KRISTAN, Matej, SKOČAJ, Danijel, LEONARDIS, Aleš. Online kernel density estimation for interactive learning. *Image vis. comput.*. [Print ed.], Jul. 2010, vol. 28, no. 7, str. 1106-1116, ilustr. [COBISS.SI-ID [7326804](#)]

KRISTAN, Matej, KOVAČIČ, Stanislav, LEONARDIS, Aleš, PERŠ, Janez. A two-stage dynamic model for visual tracking. *IEEE trans. syst. man cybern., Part B, Cybern.*. [Print ed.], Dec. 2010, vol. 40, no. 6, str. 1505-1520, ilustr. [COBISS.SI-ID [7709524](#)]

Celotna bibliografija je dostopna na SICRISu:

<http://sicris.izum.si/search/rsr.aspx?lang=slv&id=32801>.

UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet: Tehnologija upravljanja podatkov
Course title: Data Management Technologies

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Univerzitetni študijski program prve stopnje Računalništvo in informatika Interdisciplinarni univerzitetni študijski program prve stopnje Računalništvo in matematika Interdisciplinarni univerzitetni študijski program prve stopnje Upravna informatika	Modul: Obvladovanje informatike	3	zimski
University study programme Computer and Information Science, 1st cycle Interdisciplinary University study programme Computer Science and Mathematics , 1st cycle Interdisciplinary university Study Programme in Administrative Informatics 1 st Cycle	Module: Management of Information Systems	3	fall

Vrsta predmeta / Course type

izbirni predmet / elective course
obvezni predmet / compulsory course

Univerzitetna koda predmeta / University course code:

63226

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje Laboratory work	Druge oblike študija Field work	Samost. delo Individ. work	ECTS
45	10	20	/	/	105	6

Nosilec predmeta / Lecturer: izr. prof. dr. Matjaž Kukar

Jeziki / Predavanja / slovenščina

Languages:

Lectures:	Slovene
Vaje / Tutorial:	slovenščina Slovene

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

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Prerequisites:

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Vsebina:

Predavanja obsegajo dva tematska sklopa:

Eksterni vidiki obvladovanja podatkov:

1. Podatkovne baze in podatkovna skladišča
2. Načrtovanje podatkovnih baz
 - Konceptualno, logično in fizično načrtovanje
 - Normalizacija relacij
 - Optimizacija performans
 - Porazdeljene podatkovne baze
3. Načrtovanje podatkovnih skladišč
 - Namen in načrtovanje podatkovnih skladišč
 - Zagotavljanje kvalitete shranjenih podatkov
 - Pristopi k analizi shranjenih podatkov
4. Načrtovanje nerelacijskih podatkovnih baz
 - Nerelacijsko modeliranje podatkov

Interni vidiki obvladovanja podatkov:

1. Zagotavljanje dostopnosti in konsistentnosti podatkov
 - Upravljanje sočasnosti dostopa do podatkovne baze
 - Varovanje in obnavljanje podatkovne baze

Content (Syllabus outline):

Course topics:

External data management:

1. Databases and data warehouses
2. Database design:
 - conceptual, logical and physical design
 - advanced normalization,
 - performance optimization
 - distributed databases
3. Data warehouse design:
 - design methodologies,
 - data quality assurance,
 - data analysis
4. Non-relational database design (NoSQL)
 - Non-relational data modelling

Internal data management:

1. Assuring availability and consistency of stored data:
 - concurrent data access,
 - data archival and recovery
 - distributed and parallel databases

- Porazdeljeni in vzporedni podatkovni sistemi
2. Optimizacija in evalvacija poizvedb
 - Načrtovanje izvajanja poizvedb
 - Vrednotenje zahtevnosti osnovnih operacij
 - Alternativne strategije izvajanja poizvedb
 3. Upravljanje delno strukturiranih in nestrukturiranih podatkov
 - Sodobni nerelacijski podatkovni sistemi
 - Delo s prostorskimi in časovnimi podatki
 - Delo z drugimi delno strukturiranimi ali nestrukturiranimi podatki (tekst, zvok, slika, sekvence, JSON, XML)

Vaje:

1. Seznaniti se s tipičnimi problemi pri obvladovanju podatkov in s pristopi za reševanje le-teh.
2. Spoznati in obvladati orodja za načrtovanje in uporabo podatkovnih baz.
3. Obvladati uporabo produktov teh orodij v praktičnih primerih (v obliki seminarske naloge).

Pri vajah se študenti seznanijo z orodji za obvladovanje podatkov (predvsem načrtovanje) in jih v okviru svojih domačih nalog samostojno uporabijo v praktičnih primerih. Rezultate domačih nalog predstavijo v obliki seminarjev.

2. Query evaluation and optimization:
 - query execution planning,
 - estimating the costs of basic operations,
 - alternative plan considerations
3. Management of semi-structured and unstructured data types:
 - Modern non-relational database systems
 - spatial and temporal data,
 - other semi-structured data (audio, video, images, sequences, JSON, XML)

Tutorial topics:

1. Recognize typical data management problems and approaches for solving them
2. Get to know various tools for database design and utilization, and use them in practical problems.
3. Using the products of aforementioned tools for a practical database implementation (in terms of a substantial project)

Through the tutorial students get familiar with various data management tools and use them - in course of their projects – as a part of a practical problem solution. The final part of the project is a public presentation of the assigned problem, its solution and results.

Temeljni literatura in viri / Readings:

1. T. M. Connolly, C. E. Begg: Database Systems: A Practical Approach to Design, Implementation and Management, 4th edition, Addison Wesley, 2004.
2. S. Sumathi, S. Esakkirajan: Fundamentals of Relational Database Management Systems, Springer, 2007.
3. R. Ramakrishnan, J. Gehrke: Database Management Systems, 3rd edition, McGraw-Hill, 2002.
4. Seven Databases in Seven Weeks: A Guide to Modern Databases and the NoSQL Movement, Pragmatic Bookshelf, 2012

Cilji in kompetence:

Cilj predmeta je študentom računalništva in informatike predstaviti principe in pristope za upravljanje podatkov z dveh vidikov: **zunanjega**, s poudarkom na primernem načrtovanju in pripravi, ter **notranjega**, s poudarkom na tehnologijah znotraj podatkovnih baz.

Splošne kompetence:

- sposobnost kritičnega mišljenja
- razvoj sposobnosti kritičnega, analitičnega in sintetičnega mišljenja
- sposobnost definiranja, razumevanja in reševanja strokovnih izzivov na področju računalništva in informatike
- Skladnost z varnostnimi, funkcionalnimi, ekonomskimi in okoljskimi vodili.
- sposobnost samostojne uporabe pridobljenega znanja pri reševanju tehničnih in znanstvenih izzivov na področju računalništva in informatike; sposobnost nadgradnje pridobljenega znanja

Predmetno specifične kompetence:

- sposobnost razumevanja in uporabe znanja računalništva in informatike na drugih tehničnih in relevantnih področjih (ekonomija, organizacijske vede ipd.);
- praktična znanja in veščine na področju strojne opreme, programske opreme in informacijskih tehnologij, ki so nujna za uspešno delo na področju računalništva in informatike
- sposobnost samostojne izvedbe manj zahtevnih in zahtevnih inženirskih in organizacijskih opravil na določenih ozkih področjih in neodvisnega reševanja določenih dobro opredeljenih opravil na področju računalništva in informatike

Objectives and competences:

The main course objective is to present principles and approaches to data management from two points of view: **external**, focusing on proper database/data warehouse design and data preparation, and **internal**, focusing on intrinsic key database technologies.

General competences:

- ability of critical thinking
- developing skills in critical, analytical and synthetic thinking
- the ability to define, understand and solve creative professional challenges in computer and information science;
- compliance with security, functional, economic and environmental principles
- 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

Subject specific competences:

- The ability to understand and apply computer and information science knowledge to other technical and relevant fields (economics, organisational science, etc)
- practical knowledge and skills of computer hardware, software and information technology necessary for successful professional work in computer and information science
- the ability to independently perform both less demanding and complex engineering and organisational tasks in certain narrow areas and independently solve specific well-defined tasks in computer and information science

Predvideni študijski rezultati:

Intended learning outcomes:

Znanje in razumevanje:
 Poznavanje problematike upravljanja s podatki, ter razumevanje principov in pristopov za njihovo reševanje. Poznavanje konceptov in področij uporabnosti sodobnih nerelacijskih (NoSQL) podatkovnih sistemov.

Uporaba:
 Uporaba pridobljenih znanj in orodij za obvladovanje podatkov v inženirskem in raziskovalnem delu.

Refleksija:
 Spoznavanje in razumevanje povezav med teoretičnimi principi za obvladovanje podatkov in njihovo uporabo v praksi.

Prenosljive spretnosti - niso vezane le na en predmet:
 Načrtovanje, obvladovanje, hranjenje in analiza različnih vrst podatkov se neposredno ali posredno uporablja na področjih informacijskih sistemov, poslovne inteligence, spletnih storitev in inteligentnih sistemov.

Knowledge and understanding:
 Recognizing data management problems, and understanding principles and approaches for solving them. Comprehension of basic concepts and usability of non-relational (NoSQL) databases.

Application:
 Using acquired knowledge and tools for data management in engineering and research work.

Reflection:
 Introduction and comprehension of connections between specific theoretical data management technologies, and their practical use.

Transferable skills:
 Database design, data storage, management and analysis are directly or indirectly being used in information systems, business intelligence, web services and intelligent systems.

Metode poučevanja in učenja:

Predavanja in seminarski način dela pri domačih nalogah. Poseben poudarek je na sprotnem študiju in na skupinskem delu pri domačih nalogah in seminarjih.

Learning and teaching methods:

Lectures, homework and project work with explicit focus on simultaneous studies (for homeworks) and teamwork (for projects).

Delež (v %) /

Weight (in %)

Načini ocenjevanja:

Assessment:

<p>Način (pisni izpit, ustno izpraševanje, naloge, projekt): Sprotno preverjanje (domače naloge, kolokviji in projektno delo) Končno preverjanje (pisni in ustni izpit)</p> <p>Ocene: 6-10 pozitivno, 5 negativno (v skladu s Statutom UL).</p>	<p>60% 40%</p>	<p>Type (examination, oral, coursework, project): Continuing (homework, midterm exams, project work) Final (written and oral exam)</p> <p>Grading: 6-10 pass, 5 fail (according to the rules of University of Ljubljana).</p>
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Reference nosilca / Lecturer's references:**Pet najpomembnejših del:**

1. KONONENKO, Igor, KUKAR, Matjaž. Machine learning and data mining: introduction to principles and algorithms. Chichester: Horwood Publishing, 2007.
2. PETELIN, Boris, KONONENKO, Igor, MALAČIČ, Vlado, KUKAR, Matjaž. Multi-level association rules and directed graphs for spatial data analysis. Expert syst. appl. [Print ed.], 2013, vol. 40, issue 12, 4957-4970.
3. KUKAR, Matjaž, KONONENKO, Igor, GROŠELJ, Ciril. Modern parameterization and explanation techniques in diagnostic decision support system: a case study in diagnostics of coronary artery disease. Artif. intell. med., Jun. 2011, vol. 52, no. 2, 77-90.
4. ŠAJN, Luka, KUKAR, Matjaž. Image processing and machine learning for fully automated probabilistic evaluation of medical images. Computer methods and programs in biomedicine, ISSN 0169-2607. [Print ed.], Dec. 2011, vol. 104, no. 3, 75-86,
5. KUKAR, Matjaž. Quality assessment of individual classifications in machine learning and data mining. Knowledge and information systems, 2006, vol. 9, no. 3.

Celotna bibliografija je dostopna na SICRISu:

<http://sicris.izum.si/search/rsr.aspx?lang=slv&id=8453>.

UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet: Osnove informacijskih sistemov
Course title: Introduction to Information Systems

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Univerzitetni študijski program prve stopnje Računalništvo in informatika	ni smeri	1	poletni
University study programme Computer and Information Science, 1st cycle	none	1	spring

Vrsta predmeta / Course type

obvezni predmet / compulsory course

Univerzitetna koda predmeta / University course code:

63215

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje Laboratory work	Druge oblike študija Field work	Samost. delo Individ. work	ECTS
45	/	30	/	/	105	6

Nosilec predmeta / Lecturer:

doc. dr. Dejan Lavbič

Jeziki /

Languages:

Predavanja / slovenščina
Lectures: Slovene
Vaje / Tutorial: slovenščina
Slovene

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

Prerequisites:

Vsebina:

1. Informacijski sistem, podatki, informacije, znanje,
2. Entropija in informacijski sistem,
3. Vrednotenje informacij (poslovni učinki informacij oz. informacijskih sistemov),
4. Poslovni sistem, poslovne funkcije, poslovni procesi,
5. Ravni odločanja v poslovnem sistemu (transakcijska, operativna, taktična in strateška),
6. Kategorije informacijskih sistemov - transakcijski, upravljalni, povezovalni,
7. Informacijske tehnologije in informacijski sistemi,
8. Poslovne aplikacije, funkcionalni informacijski podsistemi,
9. Integralni poslovni informacijski sistemi (ERP),
10. Informacijski sistemi in uspešnost poslovanja – doseganje konkurenčne prednosti,
11. Poslovno – informacijska arhitektura (povezave med poslovnim sistemom oz. poslovnimi procesi z aplikacijami informacijskega sistema in tehnološko infrastrukturo),
12. Informacijski sistemi in elektronsko poslovanje (B2C, B2B, B2G),
13. Informacijski sistemi v storitvenih dejavnostih,
14. Informacijski sistemi v industriji.
15. Napredne tehnologije pri razvoju informacijskih sistemov.

Content (Syllabus outline):

1. Information system, data, information, knowledge
2. Entropy and Information system
3. Evaluation of information (business impact of information and information system)
4. Enterprise, business functions, business processes,
5. Decision-making levels in enterprises (transactional, operational, tactical and strategic)
6. Categories of information systems (transaction, management, integration),
7. Information technology and information systems
8. Business applications, functional information subsystems
9. Enterprise Resource Planning (ERP) system
10. Information systems and business effectiveness - achieving a competitive advantage
11. Enterprise architecture (relations between business and IT domain – e.g. links between business processes, applications and technology infrastructure)
12. Information systems and electronic business (B2C, B2B, B2G)
13. Information systems in the service sector,
14. Information systems in the industry.
15. Advanced technologies in information system development.

Temeljni literatura in viri / Readings:

- Steven Alter, **Information Systems: Foundation of e-business**, Prentice Hall College, 2001.
- O'Brien James, Marakas George, **Management Information Systems**, McGraw-Hill/Irwin, 2010.
- Rolf T. Wigand et al., **Introduction to Business Information Systems**, Springer, 2003.
- Avison David, Fitzgerald Guy, **Information systems development: Methodologies, techniques & tools**, 2006.

Cilji in kompetence:

Cilj predmeta je študentom računalništva in informatike predstaviti ključne koncepte informacijskih sistemov, različne kategorije informacijskih sistemov ter mesto in vlogo informacijskega sistema v poslovnih sistemih. Znanja, ki jih študenti pridobijo v okviru predmeta, so ključna za razumevanje delovanja in uporabe sodobnih informacijskih sistemov.

V okviru laboratorijskih vaj študenti neposredno spoznavajo sodobne informacijske tehnologije in razvojna okolja, ki so namenjena razvoju računalniških aplikacij za podporo informacijskim sistemom.

Objectives and competences:

The aim of the course is to present students key concepts of information systems, different categories of information systems and their role in enterprises. Knowledge that students acquire in this course is fundamental to understand the operation and use of modern information systems.

Through laboratory exercises students become familiar with modern information technologies and development environments for computer applications development to support information systems.

Predvideni študijski rezultati:**Znanje in razumevanje:**

Poznavanje osnovnih pojmov s področja informacijskih sistemov. Zmožnost umestitve informacijskega sistema v kontekst poslovnega okolja in potrebo po vpeljavi v poslovni sistem. Razumevanje vloge informacijskih tehnologij v okviru sodobnih informacijskih sistemov.

Uporaba:

Uporaba informacijskih tehnologij za razvoj računalniško podprtih informacijskih sistemov.

Refleksija:

Spoznavanje in razumevanje uglasenosti med teorijo in prakso na konkretnih primerih s področja informacijskih sistemov (npr. preizkusi delovanja v konkretnem razvojnem okolju).

Prenosljive spretnosti – niso vezane le na en predmet:

Uporaba IKT, pisno in ustno poročanje, delo v timih, komunikacijske in voditeljske spretnosti pri vodenju in sodelovanju v projektni ekipi.

Intended learning outcomes:**Knowledge and understanding:**

Knowledge of basic concepts in the field of information systems. Capability of information system placement in the context of business environment and the need for its deployment in an enterprise. Understanding the role of information technologies in the context of modern information systems.

Application:

Use of information technologies for the development of computerized information systems.

Reflection:

Awareness and understanding of harmony between the theory and practice on concrete examples from the field of information systems (e.g. functional testing in the specific development environment).

Transferable skills – not tied to just one subject:

The use of ICT, oral and written reports, teamwork, communication and leadership skills in leadership and participation in the project team.

Metode poučevanja in učenja:

Predavanja, laboratorijske vaje, seminarske naloge. Poseben poudarek je na seminarskih nalogah, kjer študenti sami razvijejo primer informacijskega sistema in ob tem teoretična znanja prenesejo v prakso.

Learning and teaching methods:

Lectures, laboratory exercises and seminars. Particular emphasis is placed on seminars, where students develop an example of an information system and thus transfer their theoretical knowledge into practice.

Načini ocenjevanja:

Delež (v %) /
Weight (in %)

Assessment:

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

Reference nosilca / Lecturer's references:**Pet najpomembnejših del:**

- Lavbič, Dejan, Bajec, Marko. 2012. **Employing Semantic Web technologies in financial instruments trading.** International Journal of New Computer Architectures and their Applications. 1(2), str. 167-182.
- Lavbič, Dejan, Iztok Lajovic, Krisper, Marjan. 2010. **Facilitating information system development with Panoramic view on data.** Computer Science and Information Systems. 7(4), str. 737 - 768.
- Lavbič, Dejan, Vasilecas, Olegas, Rupnik, Rok. 2010. **Ontology based Multi-Agent System to support business users and management.** Technological and economic development of economy, 16(2), str. 327 - 347.
- Lavbič, Dejan, Krisper, Marjan. 2010. **Facilitating ontology development with continuous evaluation.** Informatica, 21(4), str. 533 - 552.
- Lavbič, Dejan, Krisper, Marjan. 2008. **Rapid Ontology Development model based on Business Rules management approach for the use in business applications,** 10th International Conference on Enterprise Information Systems.

Celotna bibliografija je na voljo na SICRIS / Complete bibliography is available at SICRIS:
<http://www.sicris.si/search/rsr.aspx?lang=slv&id=18907>.

UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet:	Spletno programiranje
Course title:	Web Programming

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Univerzitetni študijski program prve stopnje Računalništvo in informatika	Modul: Razvoj programske opreme	3	zimski
Univerzitetni študijski program prve stopnje Računalništvo in matematika			
Interdisciplinarni univerzitetni študijski program prve stopnje Multimedija			
University study programme Computer and Information Science, 1st cycle	Module: Software Development	3	fall
University study programme Computer Science and Mathematics , 1st cycle			
Interdisciplinary university study programme Multimedia, 1st cycle			

Vrsta predmeta / Course type

izbirni predmet / elective course
obvezni predmet / compulsory course

Univerzitetna koda predmeta / University course code:

63255

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje Laboratory work	Druge oblike študija Field work	Samost. delo Individ. work	ECTS
45	20	10	/	/	105	6

Nosilec predmeta / Lecturer:

doc. dr. Dejan Lavbič

**Jeziki /
Languages:**

**Predavanja /
Lectures:** slovenščina
Slovene

Vaje / Tutorial: slovenščina

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:**Prerequisites:****Vsebina:****Predavanja:****Uvod**

1. Delovanje spleta; razvoj interneta, arhitektura klient-strežnik; komunikacijski protokol HTTP
2. Osnovni spletni standardi: HTML (DHTML...), CSS; osnove oblikovanja

Tehnologije na strani odjemalcev

3. JavaScript, rokovanje z dogodki, DOM, specifikacije posameznih brskalnikov, obrazci, validacija vnosov, JQuery
4. HTML5 Canvas
5. asinhroni zahtevki z Ajax
6. aplikacije na eni strani

Strežniške tehnologije

7. Pregled osnov strežniških tehnologij; delovanje skript, dinamično generiranje strani, HTTP GET in POST zahtevki, piškotki (cookies)
8. Spletne aplikacije v tehnologiji JavaScript.

Ostalo

9. XML tehnologije. Sintaksa XML. Sheme. Pregledovanje dokumentov XML. Modeli in jeziki: DOM, SAX, XSLT, XPath, XQuery, Open XML.
10. Dostop aplikacijskega strežnika do podatkovne baze
11. REST spletne storitve. Storitveno usmerjena arhitektura. Pisanje porazdeljenih aplikacij.
12. Varnost na spletu. Upravljanje z

Content (Syllabus outline):**Lectures:****Introduction**

1. World Wide Web, rise of internet, client-server architecture, communication protocols and HTTP.
2. Basic web standards: HTML (DHTML, ...), CSS, basics of web design

Client-side technologies

3. JavaScript, event handling, DOM, contemporary web browser specifics, forms, input validation, JQuery
4. HTML5 Canvas
5. Asynchronous requests and Ajax.
6. Single Page applications.

Server technologies

7. An overview of server technologies, scripts, dynamic generation of pages, HTTP GET and POST requests, cookies, etc.
8. Web applications in JavaScript technology

Other

9. XML technologies, XML syntax and schemes. Viewing of XML documents. Models and languages: DOM, SAX, XSLT, XPath, XQuery, Open XML.
10. Database access from application server
11. REST Web services. Service oriented architecture. Programming distributed applications.

identitetami. Profiliranje uporabnikov.
13. Web 2.0. Semantični splet.

Vaje:

Laboratorijski projekt izdelave celostne rešitve porazdeljene spletne aplikacije, razdeljen v posamezne faze (statične strani, kode na strani odjemalca, strežniška koda, storitve) in samostojno delo na projektih z zaključno predstavitevijo študentov.

12. Internet security. Identity management, user profiling.
13. Web 2.0. Semantic web.

Tutorials:

Laboratory project: programming of distributed full stack web application, divided into individual phases (static pages, client-side code, server-side code, services). The students will develop the projects that will be introduced with the final presentation.

Temeljni literatura in viri / Readings:

1. Robert W. Sebesta: Programming the World Wide Web, Pearson Education, 2014.
2. Paul J. Deitel, Harvey M. Deitel, Abbey Deitel et al.: Internet & World Wide Web: How to program, Pearson, 2012.
3. Marijn Haverbeke: Eloquent JavaScript: A Modern Introduction to Programming, No Starch Press, 2014.
4. Simon Holmes: Getting MEAN with Mongo, Express, Angular, and Node, Manning Publications, 2015.

Cilji in kompetence:

Cilj predmeta je študentom računalništva in informatike predstaviti tehnologije povezane z razvojem spletnih aplikacij z vidika celostne rešitve, tako na strani odjemalca, kot strežnika in usposabljanje študentov za samostojen razvoj tovrstnih aplikacij.

Predvidene kompetence:

- poznavanje statičnih tehnologij HTML, CSS, XML,
- poznavanje programskega jezika JavaScript za razvoj na strani odjemalca,
- poznavanje tehnologije Node.js (programski jezik JavaScript) za razvoj na strani strežnika,
- poznavanje NoSQL podatkovne baze MongoDB,
- razvoj z uporabo spletnih storitev,
- snovanje aplikacij v arhitekturi model-pogled-kontrola,
- razvoj z upoštevanjem principov varnosti.

Objectives and competences:

The main course objective is to introduce the students of computer and information science the technologies, connected with the full stack development of web applications (on the server and the client-side). The students shall be equipped with knowledge to independently develop such applications.

The competences that students gain are:

- knowledge of static technologies HTML, CSS, XML,
- knowledge of JavaScript programming language for client-side development
- knowledge of Node.js technology (JavaScript programming language) for server-side development,
- knowledge of MongoDB NoSQL database
- web service development,
- employment of the model-view-controller architecture,
- consideration of security principles.

Predvideni študijski rezultati:

Intended learning outcomes:

Znanje in razumevanje:
 Poznavanje osnovnih tehnologij za razvoj spletnih aplikacij.

Uporaba:
 Razvoj celovitih spletnih rešitev, tako na strani odjemalca, kot strežnika.

Refleksija:
 Spoznavanje in razumevanje uglasenosti med teorijo in njeno aplikacijo na konkretnih primerih s področja razvoja spletnih aplikacij.

Prenosljive spretnosti - niso vezane le na en predmet:
 Razvoj spletnih rešitev na različnih strokovnih področjih. Hitro seznanjanje z novimi tehnologijami. Uporaba spletnih virov in dokumentacij za pomoč pri razvoju aplikacij.

Knowledge and understanding:
 Knowing the most common technologies for web applications development.

Application:
 Development of complex web solutions, using server- and client-side development techniques.

Reflection:
 Becoming familiar and understanding the web application development theory and applications on particular examples.

Transferable skills:
 Development of web application for various areas connected with computer science. Becoming quickly familiar with new technologies. Using online sources and documentation for help with application development.

Metode poučevanja in učenja:
 Predavanja s praktičnimi demonstracijami, izvajanje laboratorijskega projekta pod mentorstvom asistenta.

Learning and teaching methods:
 Lectures with practical examples/demonstrations, making of laboratory project (guided by the assistant).

Delež (v %) /

Načini ocenjevanja:

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

Sprotno preverjanje (domače naloge, kolokviji in projektno delo) **50%**

Končno preverjanje (pisni ali ustni izpit) **50%**

Ocene: 6-10 pozitivno, 1-5 negativno (v skladu s Statutom UL).

Weight (in %) **Assessment:**

Type (examination, oral, coursework, project):

Continuing (homework, midterm exams, project work)

Final (written or oral exam)

Grading: 6-10 pass, 1-5 fail (according to the rules of University of Ljubljana).

Reference nosilca / Lecturer's references:

Pet najpomembnejših del:

1. ZRNEC, Aljaž, LAVBIČ, Dejan. Social network aided plagiarism detection. British journal of educational technology, ISSN 0007-1013, Jan. 2017, vol. 48, no. 1, str. 113-128.
2. MATEK, Tadej, ZRNEC, Aljaž, LAVBIČ, Dejan. Learning SQL with artificial intelligent aided approach. International journal of information and education technology : IJJET, ISSN 2010-

3689, Nov. 2017, vol. 7, no. 11, str. 803-808.

3. FIDLER, Miloš, LAVBIČ, Dejan. Research about measurability of information quality. Knowledge management in organizations : proceedings, (Lecture notes in business information processing, ISSN 1865-1348, 224), Springer, 2015, str. 272-281.
4. LAVBIČ, Dejan, BAJEC, Marko. Employing semantic web technologies in financial instruments trading : Dejan Lavbič and Marko Bajec. International journal of new computer architectures and their applications, ISSN 2220-9085. 2012, vol. 2, no. 1, str. 167-182.
5. LAVBIČ, Dejan, LAJOVIC, Iztok, KRISPER, Marjan. Facilitating information system development with panoramic view on data. Computer science and information systems, ISSN 1820-0214, 2010, vol. 7, no. 4, str. 737-767.

Celotna bibliografija je dostopna na SICRISu:

<http://sicris.izum.si/search/rsr.aspx?lang=slv&id=18907>

UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet: Porazdeljeni sistemi
Course title: Distributed Systems

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Univerzitetni študijski program prve stopnje Računalništvo in informatika Univerzitetni študijski program prve stopnje Računalništvo in matematika	Modul: Računalniški sistemi	3	zimski
University study programme Computer and Information Science, 1st cycle University study programme Computer Science and Mathematics, 1st cycle	Module: Computer systems	3	fall

Vrsta predmeta / Course type

izbirni predmet /elective course

Univerzitetna koda predmeta / University course code:

63261

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje Laboratory work	Druge oblike študija Field work	Samost. delo Individ. work	ECTS
45	10	20	/	/	105	6

Nosilec predmeta / Lecturer:

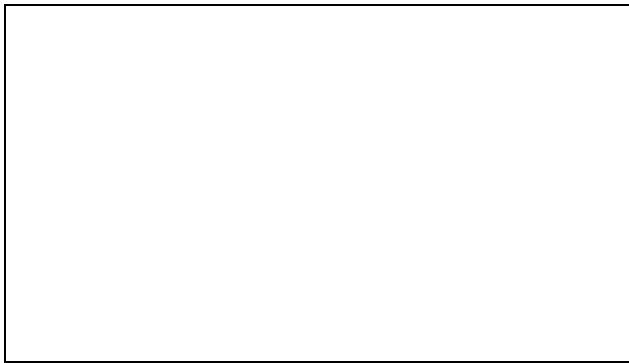
izr. prof. dr. Uroš Lotrič

**Jeziki /
Languages:**

**Predavanja /
Lectures:** slovenščina
Slovene
Vaje / Tutorial: slovenščina
Slovene

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

Prerequisites:



Vsebina:

1. Uvod: cilji paralelizacije, komunikacija in koordinacija, programerske napake
2. Dekompozicija problema: podatkovni in funkcijski paralelizem, cevovod, raztegljivost
3. Komunikacija in koordinacija: večprocesorski sistemi (deljeni pomnilnik, sovisnost predpomnilnika, medsebojno izključevanje, prepreke, pogojne spremenljivke), večračunalniški sistemi (izmenjevanje sporočil, točka-točka in skupinsko, latenca in pasovna širina)
4. Paralelni algoritmi, analiza in programiranje: koncepti in primeri uporabe (nerodno paralelni algoritmi, deli in vladaj, razprši in združi, gospodar-suženj), analiza (pohitritev in Amdahlov zakon, raztegljivost)
5. Paralelne arhitekture: Flynnovo označevanje, večprocesorski sistemi (SIMD, UMA, NUMA), večračunalniški sistemi (gruča, grid, oblak), grafične procesne enote in moderni koprocesorji in heterogeni sistemi, povezovanje (vodila, mreže)
6. Zmogljivost paralelnih sistemov: uravnavanje obremenitve, razporejanje opravil, stroški komunikacije, vpliv predpomnilnika, prostorska in časovna lokalnost, energijska učinkovitost
7. Teoretični modeli paralelnega računanja: modeli paralelnega računanja (PRAM, BSP), modeli izmenjevanja sporočil (CSP), modeliranje odvisnosti v algoritmu,

Content (Syllabus outline):

1. Fundamentals: goals, communication, coordination, programming errors
2. Parallel decomposition: data and functional parallelism, pipeline, scalability
3. Communication and coordination: shared-memory systems (shared memory, cache coherence, mutual exclusion, barriers, conditional variables, semaphores), distributed-memory systems (message passing, point-to-point versus multicast, latency and throughput)
4. Parallel algorithms, analysis and programming: concepts and examples (embarrassingly parallel algorithms, divide and conquer, map reduce, master slave), analysis (speedup and Amdahl's law, scalability)
5. Parallel architectures: Flynn's taxonomy, shared-memory systems (SIMD, UMA, NUMA), distributed-memory systems (cluster, grid, cloud), graphic processing units, modern coprocessors and heterogeneous systems, topologies (buses and interconnects)
6. Parallel performance: load balancing, scheduling and contention, communication overhead, cache effects, spatial and temporal data locality, energy efficiency
7. Theoretical models of parallel computing: formal models of parallel computation (PRAM, BSP), formal models of message passing (CSP), formal models of computational

modeli zagotavljanja skladnosti v sistemih z deljenim pomnilnikom

8. Porazdeljeni sistemi: napake na mreži in vozliščih, razpoložljivost, kompromisi pri načrtovanju sistemov in servisnih storitev, primeri porazdeljenih algoritmov (volitve, odkrivanje)

dependencies, models of shared memory consistency

8. Distributed systems: network- and node-based faults, availability, distributed system and service design tradeoffs, examples of distributed algorithms (election, discovery)

Temeljni literatura in viri / Readings:

1. P.S. Pacheco. An Introduction to Parallel Programming, Morgan Kaufman, 2011.
2. M. J. Quinn. Parallel Programming in C with MPI and OpenMP. Mc Graw Hill, 2003.
3. B.R. Gaster et. al. Heterogeneous computing with OpenCL. Morgan Kaufmann, 2013.
4. G. Coulouris et al. Distributed Systems: Concepts and Design. Pearson, 2012.

Cilji in kompetence:

Pridobiti osnovno teoretično in praktično znanje s področij vzporednih in porazdeljenih sistemov, paralelnega programiranja in procesiranja. Razumeti računalniška omrežja, medprocesorsko komunikacijo in značilnosti snovanja paralelnih algoritmov. Naučiti se programiranja sistemov s knjižnicami pthreads, OpenMP, OpenCL in MPI. Razumeti Grid in koncept računalništva v oblaku. Seznaniti se s trendi razvoja.

Objectives and competences:

To get the basic theoretical and practical knowledge from the areas of parallel and distributed systems, parallel programming and processing. To understand computer networks, inter-process communication and features of parallel algorithm design. To learn programming with pthreads, OpenMP, CUDA, and MPI. To understand Grid and concept of cloud computing. To realize future trends.

Predvideni študijski rezultati:

Intended learning outcomes:

Znanje in razumevanje:

Študenti se pri predmetu spoznajo z osnovnimi pojmi vzporednih in porazdeljenih sistemov, arhitekturo, posebnostmi komunikacije in koordinacije med elementi. Velik poudarek je na spoznavanju in programiranju paralelnih algoritmov, dekompoziciji problema na podlagi uveljavljenih formalnih modelov, teoretični analizi in merjenju zmogljivosti.

Uporaba:

Znanja, pridobljena pri tem predmetu, spadajo med specialna računalniška znanja. Sposobnost samostojnega in praktičnega načrtovanja in programiranja vzporednih in porazdeljenih računalniških, sposobnost evalvacije vzporednih in porazdeljenih sistemov.

Refleksija:

Spoznavanje in razumevanje uglasenosti med teorijo in njeno aplikacijo na konkretnih primerih s področja načrtovanja in programiranja vzporednih in porazdeljenih sistemov.

Prenosljive spretnosti:

Spretnosti uporabe domače in tuje literature in drugih tehniških virov, zbiranja in interpretiranja podatkov, identifikacija in reševanje problemov pri programiranju vzporednih sistemov, kritična analiza in ocena uporabnosti konkretnega vzporednega oz. porazdeljenega sistema ali algoritma.

Knowledge and understanding:

The course focuses on the basic concepts of parallel and distributed systems, their architecture, communication, and coordination among elements. Important part of the course is in theoretical analysis and programming of important parallel algorithms, including parallel decomposition, theoretical analysis based on formal theoretical models, and performance evaluation.

Application:

Student with skills gained in this course will be capable of designing, programming, and evaluating parallel and or distributed systems.

Reflection:

Awareness and understanding of connection between the theory and its application on parallel and distributed systems.

Transferable skills:

Capability of reading and understanding domestic and foreign technical literature, gathering and interpreting data, identifying and solving problems, critical analysis and evaluation of the usefulness of parallelization of distributed system and/or algorithms.

Metode poučevanja in učenja:

Predavanja, seminarji, laboratorijske vaje, projektno delo na laboratorijskih vajah, individualne domače naloge.

Learning and teaching methods:

Lectures, laboratories, homework

Načini ocenjevanja:

Delež (v %) / **Assessment:**

Weight (in %)

Način (ustno izpraševanje, domače naloge, projektno delo):		Type (examination, oral, homework):
Domače naloge	33 %	Homework
Projekt	33 %	Project
Ustni izpit	34 %	Oral exam
Ocene: 6-10 pozitivno, 5 negativno (v skladu s Statutom UL).		Grading: 6-10 pass, 5 fail (according to the rules of University of Ljubljana).

Reference nosilca / Lecturer's references:

Pet najpomembnejših del:

1. LOTRIČ, Uroš, DOBNIKAR, Andrej. Parallel implementations of recurrent neural network learning. *Lect. notes comput. sci.*, 2009, vol. 5495, 99-108
2. SILVA, Catarina, LOTRIČ, Uroš, RIBEIRO, Bernardete, DOBNIKAR, Andrej. Distributed text classification with an ensemble kernel-based learning approach. *IEEE trans. syst. man cybern., Part C Appl. rev.*, May 2010, vol. 40, 287-297
3. LOTRIČ, Uroš, BULIČ, Patricio. Applicability of approximate multipliers in hardware neural networks. *Neurocomputing*, 2012, vol. 96, 57-65
4. SLUGA, Davor, CURK, Tomaž, ZUPAN, Blaž, LOTRIČ, Uroš. Acceleration of information-theoretic data analysis with graphics processing units. *Prz. Elektrotech.*, 2012, 136-139
5. CANKAR, Matija, ARTAČ, Matej, ŠTERK, Marjan, LOTRIČ, Uroš, SLIVNIK, Boštjan. Co-allocation with collective requests in grid systems. *Journal for universal computer science*, 2013, vol. 96, 282-300

Celotna bibliografija izr. prof. dr. Lotriča je dostopna na SICRISu:

<http://sicris.izum.si/search/rsr.aspx?lang=slv&id=9241>.

UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet: Teorija informacij in sistemov
Course title: Theory of Information and Systems

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Univerzitetni študijski program prve stopnje Računalništvo in informatika	ni smeri	2	poletni
University study programme Computer and Information Science, 1st cycle	none	2	spring

Vrsta predmeta / Course type

obvezni predmet / compulsory course

Univerzitetna koda predmeta / University course code:

63216

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje Laboratory work	Druge oblike študija Field work	Samost. delo Individ. work	ECTS
45	/	30	/	/	105	6

Nosilec predmeta / Lecturer:

izr. prof. dr. Uroš Lotrič

**Jeziki /
Languages:**

**Predavanja /
Lectures:** slovenščina
Slovene
Vaje / Tutorial: slovenščina
Slovene

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

Prerequisites:

Vsebina:

Content (Syllabus outline):

1. Entropija in medsebojna informacija
2. Komunikacijski vir in kanal: vir brez spomina, vir s spominom, tipi kanalov, kapaciteta kanala
3. Stiskanje podatkov: tipi kodov, Kraftova neenakost, Shannonov in Huffmanov kod, aritmetični kodi, LZW
4. Varno kodiranje: linearni bločni kodi, konvolucijski kodi, kombinirani kodi, preverjanje parnosti, kodi CRC
5. Tajno kodiranje: osnovni kriptografski sistemi, odpornost, sodobni kriptografski sistemi: Lucifer, DES, RSA
6. Signali: zapis v časovnem in frekvenčnem prostoru, kapaciteta kanala, vzorčenje
7. Verjetnost in sklepanje: primerjava modelov, kompleksnost Kolmogorova, princip najkrajšega opisa

1. Entropy and mutual information
2. Communication source and channel: memory less and memory sources, types of channels, channel capacity
3. Data compression: codes, Kraft's inequality, Shannon and Huffman coding, arithmetic codes, LZW
4. Noisy-channel coding: linear block codes, convolution codes, combinations, parity check, CRC codes
5. Cryptology: basic systems, relative redundancy, modern cryptographic systems: Lucifer, DES, RSA
6. Signals: time-domain and frequency-domain description, channel capacity, sampling
7. Probability and inference: model comparison, Kolmogorov complexity, minimum description length principle

Temeljni literatura in viri / Readings:

1. D.G. Luenberger: Information Science, Princeton University, 2006.
2. J.C.A. van der Lubbe: Information Theory, Cambridge, 1997.
3. N. Pavešić: Informacija in kodi, Založba FE in FRI, 1997.

Cilji in kompetence:

Razumeti osnovne pojme informacijske teorije (IT) kot so entropija, medsebojna informacija in njihov pomen za razvoj računalništva. Osvojiti osnovne koncepte in postopke kodiranja informacij, prenosa in varovanja informacij, tajnega kodiranja. Sposobnost identificiranja in reševanja problemov povezanih s tematiko.

Objectives and competences:

To understand the basic concepts of information theory (IT) like entropy and mutual information and its importance in computer science. To seize basic ideas and algorithms for information coding, compression, necessity of redundancy checks, and cryptology. Capability of identifying and solving problems connecting to the covered topics.

Predvideni študijski rezultati:

Znanje in razumevanje:
Pridobiti znanja s področja teorije informacij, spoznati metode in postopke kodiranja in stiskanja podatkov, varnostnega kodiranja, tajnega kodiranja ter sklepanja.

Uporaba:
Uporaba teorije in postopkov na realnih problemih stiskanja podatkov, pri zaščiti

Intended learning outcomes:

Knowledge and understanding:
To acquire knowledge from the field of information theory, to get familiar with the methods for coding and compression, noisy-channel coding, cryptology and inference.

Application:
Use of theories and procedures on real-world problems like coding and compression of data,

prenosa informacij in kriptiranju, ter pri sklepanju.

Refleksija:

Poglobljeno razumevanje teorije informacij in sistemov na osnovi praktičnih izkušenj na realnih problemih.

Prenosljive spretnosti:

Spretnosti uporabe domače in tuje literature in drugih tehniških virov, zbiranja in interpretiranja podatkov, identifikacija in reševanje realnih problemov z osvojenimi znanji. Pridobljena znanja bodo študentom koristila pri predmetih kot so Računalniške komunikacije, Komunikacijski protokoli, Osnove umetne inteligence, Kriptografija in računalniška varnost.

redundancy checks, cryptology, and inference.

Reflection:

To deepen the understanding of the theory of information and systems based on practical experiences at solving real-world problems.

Transferable skills:

Capability of reading and understanding domestic and foreign technical literature, gathering and interpreting data, identifying and solving real-world problems. Acquired skills are a good basis for the following courses: Computer communications, Communication protocols, Introduction to artificial intelligence, Cryptography and computer security.

Metode poučevanja in učenja:

Predavanja in vaje so usmerjene v razumevanje teorije in postopkov ter v sposobnost uporabe znanja na realnih problemih.

Learning and teaching methods:

Lectures and exercises are focused on understanding of the theory and procedures in order to get the skills for the application on real problems.

Načini ocenjevanja:	Delež (v %) / Weight (in %)	Assessment:
Način (pisni izpit, ustno izpraševanje, naloge, projekt): Sprotno preverjanje (domače naloge, kolokviji) Končno preverjanje (pisni in ustni izpit)	50 % 50 %	Type (examination, oral, coursework, project): Continuing (homework, midterm) Final (written and oral exam)
Ocene: 6-10 pozitivno, 5 negativno (v skladu s Statutom UL).		Grading: 6-10 pass, 5 fail (following regulations of UL).

Reference nosilca / Lecturer's references:

Pet najpomembnejših del:

1. BRATINA, Marko, DOBNIKAR, Andrej, LOTRIČ, Uroš. Time-series modeling using information-theory techniques, Elektrotehniški vestnik, 2009, vol. 76, 240-245
2. SILVA, Catarina, LOTRIČ, Uroš, RIBEIRO, Bernardete, DOBNIKAR, Andrej. Distributed text classification with an ensemble kernel-based learning approach. IEEE trans. syst. man cybern., Part C Appl. rev., May 2010, vol. 40, 287-297
3. LOTRIČ, Uroš, BULIĆ, Patricio. Applicability of approximate multipliers in hardware neural networks. Neurocomputing, 2012, vol. 96, 57-65
4. SLUGA, Davor, CURK, Tomaž, ZUPAN, Blaž, LOTRIČ, Uroš. Acceleration of information-

- theoretic data analysis with graphics processing units. Prz. Elektrotech., 2012, 136-139
5. CANKAR, Matija, ARTAČ, Matej, ŠTERK, Marjan, LOTRIČ, Uroš, SLIVNIK, Boštjan. Co-allocation with collective requests in grid systems. Journal for universal computer science, 2013, vol. 96, 282-300

Celotna bibliografija je dostopna na SICRISu:

<http://sicris.izum.si/search/rsr.aspx?lang=slv&id=4494>.

UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet: Programiranje 1

Course title: Programming 1

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Univerzitetni študijski program prve stopnje Računalništvo in informatika	ni smeri	1	zimski
Univerzitetni študijski program prve stopnje Računalništvo in matematika			
Univerzitetni študijski program prve stopnje Multimedija			
University study programme Computer and Information Science, 1st cycle	none	1	fall
University study programme Computer Science and Mathematics, 1st cycle			
University study programme Multimedia, 1st cycle			

Vrsta predmeta / Course type

obvezni predmet / compulsory course

Univerzitetna koda predmeta / University course code:

63277

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje Laboratory work	Druge oblike študija Field work	Samost. delo Individ. work	ECTS
45	/	30	/	/	105	6

Nosilec predmeta / Lecturer:

prof. dr. Viljan Mahnič

Jeziki /

Languages:

Predavanja /

Lectures:

Vaje / Tutorial:

slovenščina
Slovene
slovenščina
Slovene

Pogoji za vključitev v delo oz. za opravljanje

Prerequisites:

študijskih obveznosti:

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Vsebina:

predavanja:

1. Pregled programskih jezikov s poudarkom na sodobnih programskih jezikih 3. generacije
2. Primer preprostega programa, postopek priprave programa, prevajanje in izvajanje
3. Osnovni podatkovni tipi
 - Predstavitev celih in realnih števil, znakov ter logičnih vrednosti
 - Deklaracije konstant in spremenljivk
4. Stavki
 - Prireditveni stavek, pisanje izrazov, operatorji in njihova prioriteta
 - Izbirni stavki
 - Ponavljalni stavki
5. Metode
 - Vloga in vrste metod
 - Formalni in dejanski parametri
 - Rekurzija
6. Razredi in objekti
 - Spremenljivke in metode objekta
 - Konstruktorji, večkratno definiranje konstruktorjev
 - Dostopna določila
 - Vnaprej deklarirani razredi
7. Tabele
 - Enodimenzionalne in večdimenzionalne tabele
 - Tabele objektov
8. Nizi
9. Dedovanje
 - Redefinicija metod
 - Konstruktorji v podrazredih
 - Dinamično povezovanje

Content (Syllabus outline):

lectures:

1. Overview of programming languages with emphasis on 3rd generation
2. Writing, compiling and executing a simple computer program
3. Basic data types
 - Integer and real numbers, characters and logical values
 - Constants and variables declaration
4. Programming statements
 - The assignment statement, expressions, operators, operator precedence
 - Conditional statements
 - Loops
5. Methods
 - The role and classification of methods
 - Formal and actual parameters
 - Recursion
6. Classes and objects
 - Instance variables and methods
 - Constructors, overloading constructors
 - Access modifiers
 - Using predefined classes
7. Arrays
 - One-dimensional and multidimensional arrays
 - Arrays of objects
8. Strings
9. Inheritance
 - Overriding superclass methods
 - Using superclass constructors in

<p>podprogramov</p> <ul style="list-style-type: none"> • Abstraktni razredi in abstraktne metode • Razred Object • Vmesnik (interface) <p>10. Grafične knjižnice, komponente grafičnega uporabniškega vmesnika</p> <p>11. Dogodkovno vodeno programiranje</p> <p>vaje: Na vajah študenti rešujejo praktične probleme, s katerimi utrjujejo snov, ki so jo obravnavali na predavanjih. Poudarek je na samostojnem delu ob pomoči asistentov.</p> <p>domače naloge: Študenti dobijo seznam nalog (programov), ki jih morajo izdelati doma in zagovarjati na vajah v vnaprej predpisanih rokih. S tem jih vzpodbujamo k sprotnemu študiju in samostojnemu delu. Študent, ki nima pozitivno ocenjenih domačih nalog, ne more pristopiti k izpitu.</p>
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<p>subclasses</p> <ul style="list-style-type: none"> • Dynamic method binding • Abstract classes and abstract methods • The Object class • Creating and using interfaces <p>10. Graphics and GUI widget toolkits, components of GUI</p> <p>11. Event driven programming</p> <p>lab practice: Students solve practical problems to reinforce the understanding of topics covered during lectures. Individual work under the guidance of teaching assistants is emphasized.</p> <p>homework: Students are given a list of programs that must be developed outside contact hours and submitted for evaluation within prescribed deadlines, thus preventing them from procrastinating and encouraging self-reliance. Completion of these assignments is a prerequisite for entering the exam.</p>

Temeljni literatura in viri / Readings:

<p>1. V. Mahnič, L. Fürst, I. Rožanc: Java skozi primere, Bi-TIM, 2008.</p> <p>2. J. Farrell: Java Programming, Seventh Edition, Course Technology, Cengage Learning, 2014.</p> <p>Dodatna literatura:</p> <p>1. I. Horton: Beginning Java, Java 7 Edition, John Wiley & Sons, Inc., 2011</p> <p>2. Uroš Mesojedec, Borut Fabjan: Java 2: Temelji programiranja, Pasadena, 2004.</p>
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Cilji in kompetence:

<p>Cilj predmeta je študentom predstaviti osnovne koncepte objektno usmerjenega programiranja v enem izmed splošno namenskih programskih jezikov 3. generacije in jih usposobiti za samostojen razvoj enostavnih računalniških programov.</p> <p>Predvidene kompetence:</p> <ul style="list-style-type: none"> • razvoj sposobnosti za kritično, analitično in sintetično razmišljanje, • sposobnost razumevanja in reševanja strokovnih izzivov na področju računalništva in informatike,
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Objectives and competences:

<p>The main objective is to teach students basic concepts of object-oriented programming in a general-purpose 3rd generation programming language, thus making them able to develop computer programs of low complexity.</p> <p>The competences students gain are:</p> <ul style="list-style-type: none"> • developing skills in critical, analytical and synthetic thinking, • the ability to understand and solve professional challenges in computer and information science. • the ability to apply acquired knowledge in
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- sposobnost uporabe pridobljenega znanja pri samostojnem delu za reševanje tehničnih in znanstvenih problemov na področju računalništva in informatike; sposobnost nadgradnje pridobljenega znanja,
- temeljna znanja na področju računalništva in informatike, ki vključujejo temeljna teoretična znanja, praktična znanja in znanja, ki so bistvena za področje računalništva in informatike,
- temeljna znanja na področju računalništva in informatike, ki so pomembna za nadaljevanje študija na drugi stopnji.

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

- basic skills in computer and information science, which includes basic theoretical skills, practical knowledge and skills essential for the field of computer and information science.
- basic skills in computer and information science, allowing the continuation of studies in the second study cycle.

Predvideni študijski rezultati:

Znanje in razumevanje:

- postopka priprave in izvajanja programa,
- osnovnih programskih konstruktorov in podatkovnih struktur,
- konceptov objektno usmerjenega programiranja,
- osnovnih algoritmov za reševanje tipičnih programerskih problemov,
- dogodkovno vodenega programiranja in osnovnih komponent uporabniškega vmesnika.

Uporaba:

Uporaba naučenih konceptov pri samostojnem razvoju enostavnejših računalniških programov.

Refleksija:

Spoznavanje in razumevanje vloge programerja pri reševanju problemov različnih uporabnikov.

Prenosljive spretnosti - niso vezane le na en predmet:

Spretnost pri uporabi domače in tuje literature ter uporabniške dokumentacije. Pridobivanje sposobnosti za samostojno reševanje problemov.

Intended learning outcomes:

Knowledge and understanding of:

- the process of writing, compiling, and running a computer program
- basic programming constructs and data structures
- object-oriented programming concepts
- basic algorithms for typical program problems solving
- event-driven programming and basic components of GUI

Application:

Application of concepts learned in development of simple computer programs.

Reflection:

Understanding of the role of a programmer in solving problems of different end-users.

Transferable skills:

The ability of using Slovenian and foreign literature and user manuals. Capability for self-reliant problem solving.

Metode poučevanja in učenja:

Learning and teaching methods:

<ul style="list-style-type: none"> • <i>Predavanja</i> z aktivno udeležbo študentov (razlaga, diskusija, vprašanja, primeri, reševanje problemov); • <i>Laboratorijske vaje</i> (refleksija izkušenj, praktično reševanje več tipičnih problemov na računalniku, predstavitev in zagovor programskih rešitev, diskusija, sporočanje povratne informacije); • <i>Domače naloge</i> (samostojna izdelava računalniških programov) • Individualne <i>konsultacije</i> (diskusija, dodatna razlaga, obravnava specifičnih vprašanj) 	<ul style="list-style-type: none"> • <i>Lectures</i> with active participation of students (explanation, discussion, questions, examples, problem solving); • <i>Lab practice</i> (reflection of experience, practical problem solving, presentation of solutions, discussion, communication of feedback information) • <i>Homework</i> (individual development of simple computer programs) • Individual consultation hours (discussion, additional explanation, specific problems solving)
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Delež (v %) /

Načini ocenjevanja:

Weight (in %)

Assessment:

<p>Način (pisni izpit, ustno izpraševanje, naloge, projekt):</p> <p>Sprotno preverjanje (3 seminarske naloge, kratki testi v obliki kvizov)</p> <p>Končno preverjanje (izpit)</p> <p>Ocene: 6-10 pozitivno, 5 negativno (v skladu s Statutom UL).</p>	<p>50%</p> <p>50%</p>	<p>Type (examination, oral, coursework, project):</p> <p>Continuing (three homework programming projects, short tests)</p> <p>Final (exam)</p> <p>Grading: 6-10 pass, 5 fail (according to the rules of University of Ljubljana).</p>
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Reference nosilca / Lecturer's references:

Pet najpomembnejših del:

1. MAHNIČ, Viljan. A capstone course on agile software development using Scrum. *IEEE trans. ed.*, Feb. 2012, vol. 55, no. 1, str. 99-106
2. MAHNIČ, Viljan, HOVELJA, Tomaž. On using planning poker for estimating user stories. *J. syst. softw.*. Sep. 2012, vol. 85, no. 9, str. 2086-2095.
3. MAHNIČ Viljan. Teaching Scrum through team-project work: students' perceptions and teacher's observations. *International journal of engineering education*, 2010, vol. 26, no. 1, str. 96-110.
4. FÜRST, Luka, MAHNIČ, Viljan. Introductory programming course: motivating students with prior knowledge. *World transactions on engineering and technology education*, ISSN 1446-2257, 2013, vol. 11, no. 4, str. 400-405. [http://wiete.com.au/journals/WTE&TE/Pages/Vol.11,%20No.4%20\(2013\)/08-Fuerst-L.pdf](http://wiete.com.au/journals/WTE&TE/Pages/Vol.11,%20No.4%20(2013)/08-Fuerst-L.pdf).
5. MAHNIČ, Viljan, FÜRST, Luka, ROŽANC, Igor. *Java skozi primere*. Šenčur: Bi-tim, 2008. XIV, 478 str., ponovni ponatis 2012.

Celotna bibliografija je dostopna na SICRISu:

<http://sicris.izum.si/search/rsr.aspx?lang=slv&id=4767>.

UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet: Tehnologija programske opreme
Course title: Software Engineering

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Univerzitetni študijski program prve stopnje Računalništvo in informatika Univerzitetni študijski program prve stopnje Računalništvo in matematika	ni smeri	3	poletni
University study programme Computer and Information Science, 1st cycle University study programme Computer Science and Mathematics , 1st cycle	none	3	spring

Vrsta predmeta / Course type

obvezni predmet / compulsory course

Univerzitetna koda predmeta / University course code:

63256

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje Laboratory work	Druge oblike študija Field work	Samost. delo Individ. work	ECTS
45	10	20	/	/	105	6

Nosilec predmeta / Lecturer:

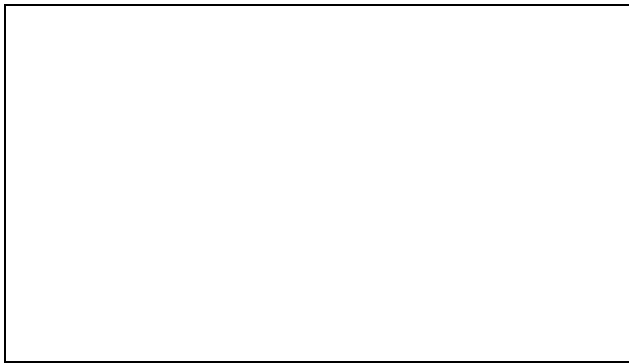
prof. dr. Viljan Mahnič

**Jeziki /
Languages:**

**Predavanja /
Lectures:** slovenščina
Slovene
Vaje / Tutorial: slovenščina
Slovene

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

Prerequisites:



Vsebina:

predavanja:

Temeljne vsebine:

1. Osnovni koncepti
 - a. Kaj je tehnologija programske opreme
 - b. Faze v razvoju programske opreme
 - c. Modeli razvojnega procesa (npr. slapovni, inkrementalni, agilni)
2. Orodja in okolja za razvoj programske opreme
 - a. Upravljanje konfiguracije in nadzor različic
 - b. Avtomatizirana gradnja in zvezna integracija
 - c. Orodja za pomoč pri analizi in načrtovanju (orodja CASE)
3. Opredelitev zahtev
 - a. Ugotavljanje zahtev
 - b. Dokumentiranje zahtev
 - c. Nefunkcionalne zahteve
 - d. Ovrednotenje in uporaba specifikacije zahtev
4. Modeliranje
 - a. Klasične tehnike (npr. diagrami entite-razmerja, diagrami podatkovnih tokov, diagrami prehajanja stanj)
 - b. Jezik UML
5. Načrtovanje programske opreme
 - a. Principi načrtovanja (abstrakcija, modularnost, delitev odgovornosti, skrivanje detajlov, sklopljenost in povezanost, ponovna uporaba)
 - b. Klasične metode načrtovanja (funkcionalna dekompozicija, strukturirane metode)
 - c. Objektno usmerjena analiza in

Content (Syllabus outline):

lectures:

Core topics:

1. Basic concepts
 - a. What is Software Engineering
 - b. Phases in the development of software
 - c. Software process models (e.g., waterfall, incremental, agile)
2. Software engineering tools and environments
 - a. Configuration management and version control
 - b. Automated builds and continuous integration
 - c. Requirements analysis and design modeling tools (CASE tools)
3. Requirements engineering
 - a. Requirements elicitation
 - b. Requirements documentation
 - c. Non-functional requirements
 - d. Evaluation and use of requirements specifications
4. Modeling
 - a. Classic modeling techniques (e.g., entity-relationship diagrams, data flow diagrams, finite state machines)
 - b. The Unified Modeling Language
5. Software design
 - a. Software design principles (abstraction, modularity, separation of concerns, information hiding, coupling and cohesion, reuse)
 - b. Classical design methods (functional decomposition, data flow design)
 - c. Object-oriented analysis and design (Rational Unified Process)

- načrtovanje (RUP)
- d. Načrtovalski vzorci
- 6. Programiranje
 - a. Dobre prakse (defenzivno programiranje, varno programiranje, uporaba mehanizmov za lovljenje izjem, prestrukturiranje kode)
 - b. Standardi kodiranja
 - c. Strategije za integracijo
- 7. Testiranje programske opreme
 - a. Testiranje in življenjski cikel
 - b. Strukturirani pregledi
 - c. Testiranje enot, integracijsko testiranje, testiranje funkcionalnosti, sistemsko testiranje
 - d. Testiranje po metodi črne in bele škatle
 - e. Regresijsko testiranje in avtomatizacija testiranja
 - f. Testno voden razvoj
- 8. Vzdrževanje in nadgradnje
 - a. Glavni vzroki problemov pri vzdrževanju
 - b. Značilnosti programske opreme, ki je primerna za vzdrževanje
 - c. Obratno inženirstvo in prestrukturiranje
 - d. Ponovna uporaba programske opreme

Izbirne vsebine:

- 9. Modeli za izboljšanje kakovosti razvojnega procesa
 - a. CMMI (Capability Maturity Model Integration) for Development
 - b. PSP (Personal Software Process)
 - c. TSP (Team Software Process)
- 10. Agilni in vitki razvoj programske opreme
 - a. Scrum
 - b. Extreme Programming
 - c. Kanban
 - d. Uravnoteženje agilnosti in discipline

vaje:

Skupinsko delo na projektih, ki so čim bolj podobni realnim. Projekte lahko predlagajo študenti sami, potrditi pa jih morata nosilec predmeta in asistent. Lahko pa problem definira nosilec predmeta v sodelovanju z ustreznim naročnikom. Velikost skupin je

- d. Design patterns
- 6. Software construction
 - a. Coding practices (defensive coding practices, secure coding practices, use of exception handling mechanisms, refactoring)
 - b. Coding standards
 - c. Integration strategies
- 7. Software testing
 - a. Testing and the software life cycle
 - b. Inspections and walkthroughs
 - c. Unit, integration, validation, and system testing
 - d. Black-box and white-box testing techniques
 - e. Regression testing and test automation
 - f. Test-driven development
- 8. Software maintenance and evolution
 - a. Major causes of maintenance problems
 - b. Characteristics of maintainable software
 - c. Reverse engineering and refactoring
 - d. Software reuse

Elective topics:

- 9. Process improvement models
 - a. CMMI (Capability Maturity Model Integration) for Development
 - b. PSP (Personal Software Process)
 - c. TSP (Team Software Process)
- 10. Agile and lean software development
 - a. Scrum
 - b. Extreme Programming
 - c. Kanban
 - d. Balancing agility and discipline

lab practice:

Team-work on almost real projects. Projects can be proposed by students themselves and approved by instructors or can be defined by teacher in co-operation with real customers. Group sizes are restricted to four and students are given the opportunity to decide who they

omejena na štiri študente, študenti pa lahko sami izbirajo, s kom bodo delali. Vsaka skupina mora določiti vodjo projekta in ostale vloge, za katere meni, da so potrebne za realizacijo projekta. Študente spodbujamo, da delajo na projektu tudi izven ur, ki so po urniku predvidene za izvedbo predmeta. Za spremljanje dela na projektih definiramo mejnike (kontrolne točke), na katerih študenti pokažejo, kaj so že naredili, in dobijo nasvete za nadaljnje delo.

should work with. Each group is asked to nominate a Project Manager and identify specific roles which they feel will be important in managing the group. Students are encouraged to work on the project outside the officially scheduled hours. There are several progress meetings (milestones) with the tutor before the final presentation takes place.

Temeljni literatura in viri / Readings:

1. H. van Vliet: Software Engineering, Third Edition, John Wiley & Sons, 2008.
2. I. Jacobson, G. Booch, J. Rumbaugh: The unified software development process, Addison-Wesley, 1999.

Dodatno:

3. M. Seidl, M. Scholz, C. Huemer, G. Kappel: UML @ Classroom, An Introduction to Object-Oriented Modeling, Springer, 2015.
4. CMMI[®] for Development (CMMI-DEV), Version 1.3 CMU/SEI-2010-TR-033, Software Engineering Institute, Carnegie Mellon University, 2010.
5. K. Schwaber: Agile Project Management with Scrum, Microsoft Press, 2004.

Cilji in kompetence:

Cilj predmeta je predstaviti pregled aktivnosti v življenjskem ciklu razvoj programske opreme, ki so potrebne ne glede na to, kateri model razvojnega procesa se uporablja. Da bi obvladali te aktivnosti, študentje kombinirajo teoretična znanja s praktičnim delom na (skoraj) realnem projektu.

Predvidene kompetence:

- sposobnost opredelitve, razumevanja in reševanja kreativnih strokovnih izzivov na področju računalništva in informatike;
- sposobnost uporabe pridobljenega znanja pri samostojnem delu za reševanje tehničnih in znanstvenih problemov na področju računalništva in informatike; sposobnost nadgradnje pridobljenega znanja,
- sposobnost skupinskega dela v profesionalnem delovnem okolju; vodenje manjše strokovne skupine;
- sposobnost administrativnega vodenja procesov, povezanih z raziskovanjem,

Objectives and competences:

The aim of the course is to provide an overview of activities in the software development life cycle that must be preformed regardless of the process model used. In order to master these activities, the students combine theoretical knowledge with practical work on a quasi-real software project.

The competences the students gain are:

- the ability to define, understand and solve creative 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.
- the ability of teamwork within the professional environment; management of a small professional team;
- the ability for administrative management of processes related to research, industry, education and other fields;

industrijo, izobraževanjem in drugimi področji;

- sposobnost razumevanja in uporabe znanja računalništva in informatike na drugih tehničnih in relevantnih področjih (ekonomija, organizacijske vede ipd.);
- praktično znanje in spretnosti, potrebne za uspešno strokovno delo na področju računalništva in informatike;
- samostojno reševanje zahtevnih razvojnih, inženirskih in organizacijskih nalog kot tudi povprečno zahtevnih raziskovalnih nalog na področju računalništva in informatike.

- the ability to understand and apply computer and information science knowledge to other technical and relevant fields (economics, organisational science, etc);
- practical knowledge and skills of computer hardware, software and information technology necessary for successful professional work in computer and information science;
- the ability to tackle demanding developmental, engineering, and organisational tasks as well as moderately demanding research tasks in their fields of study.

Predvideni študijski rezultati:

Znanje in razumevanje:

Poznavanje in razumevanje:

- vseh aktivnosti v življenjskem ciklu razvoja programske opreme,
- različnih pristopov k razvoju programske opreme,
- najpomembnejših razvojnih metodologij,
- diagramskih tehnik za modeliranje sistema, ki ga razvijamo,
- kriterijev, ki vplivajo na izbor in prilagoditev metodologije.

Uporaba:

Uporaba naučenih metodologij, orodij in diagramskih tehnik pri delu na konkretnem projektu s področja razvoja programske opreme.

Refleksija:

Razumevanje okoliščin, ki vplivajo na potek razvoja programskih sistemov in izbor najprimernejše rešitev v konkretnih primerih.

Prenosljive spretnosti - niso vezane le na en predmet:

Sposobnosti za skupinsko delo, vodenje, načrtovanje in organizacijo, pripravo predstavitev in medosebno komuniciranje, iskanje informacij, pisno in ustno poročanje.

Intended learning outcomes:

Knowledge and understanding:

Knowledge and understanding of:

- activities in the software development life cycle,
- different approaches to software development,
- the most important development methodologies,
- diagramming techniques for system modelling,
- criteria that affect the choice and adaptation of development methodology.

Application:

Application of software development methods, tools and diagramming techniques in a context of an (almost) real software development project.

Reflection:

Understanding circumstances that affect the development of software and the choice of the most appropriate solution.

Transferable skills:

Professional skills like teamwork, management/leadership, planning and organizing, presentation and communication, information search, written and oral reporting.

Metode poučevanja in učenja:

- *Predavanja* z aktivno udeležbo študentov (razlaga, diskusija, vprašanja, primeri, reševanje problemov).
- *Laboratorijske vaje* (skupinsko delo na večjem projektu razvoja programske opreme, ki služi kot študija primera za ilustracijo potrebnih aktivnosti).
- *Konsultacije* (diskusija, dodatna razlaga, obravnava specifičnih vprašanj).

Learning and teaching methods:

- *Lectures* with active participation on the part of students (explanation, discussion, questions, examples, problem solving).
- *Lab practice* (teamwork on an quasi-real software development project that serves as a case study for illustration of required activities).
- *Consultations* (discussion, additional explanation, answers to specific questions)

Delež (v %) /

Načini ocenjevanja:

Weight (in %)

Assessment:

<p>Način (pisni izpit, ustno izpraševanje, naloge, projekt):</p> <p>Sprotno preverjanje: seminarske naloge, delo na projektu</p> <p>Končno preverjanje: pisni izpit</p> <p>Ocene: 6-10 pozitivno, 5 negativno (v skladu s Statutom UL).</p>	<p>50%</p> <p>50%</p>	<p>Type (examination, oral, coursework, project):</p> <p>Continuing assessment: seminal and project work</p> <p>Final assessment: written exam</p> <p>Grading: 6-10 pass, 5 fail (according to the rules of University of Ljubljana).</p>
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Reference nosilca / Lecturer's references:**Pet najpomembnejših del:**

1. MAHNIČ, Viljan. A capstone course on agile software development using Scrum. *IEEE trans. ed.*, Feb. 2012, vol. 55, no. 1, str. 99-106.
2. MAHNIČ, Viljan, HOVELJA, Tomaž. On using planning poker for estimating user stories. *J. syst. softw.*, Sep. 2012, vol. 85, no. 9, str. 2086-2095.
3. MAHNIČ, Viljan, ŽABKAR, Nataša. Measuring progress of Scrum-based software projects. *Electronics and Electrical Engineering*. 2012, vol. 18, no. 8, str. 73-76.
4. MAHNIČ, Viljan. Teaching Scrum through team-project work: students' perceptions and teacher's observations. *International journal of engineering education*, 2010, vol. 26, no. 1, str. 96-110.
5. MAHNIČ, Viljan, HOVELJA, Tomaž. Teaching user stories within the scope of a software engineering capstone course: analysis of students' opinions. *International journal of engineering education*, 2014, vol. 30, no. 4, str. 901-915.

Celotna bibliografija je dostopna na SICRISu:

<http://sicris.izum.si/search/rsr.aspx?lang=slv&id=4767>.

UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet: Računalniška grafika in tehnologija iger
Course title: Computer Graphics and Game Technology

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Univerzitetni študijski program prve stopnje Računalništvo in informatika Univerzitetni študijski program prve stopnje Računalništvo in matematika	Modul: Medijske tehnologije	3	zimski
University study programme Computer and Information Science, 1st cycle University study programme Computer Science and Mathematics , 1st cycle	Module: Media technologies	3	fall

Vrsta predmeta / Course type izbirni predmet /elective course

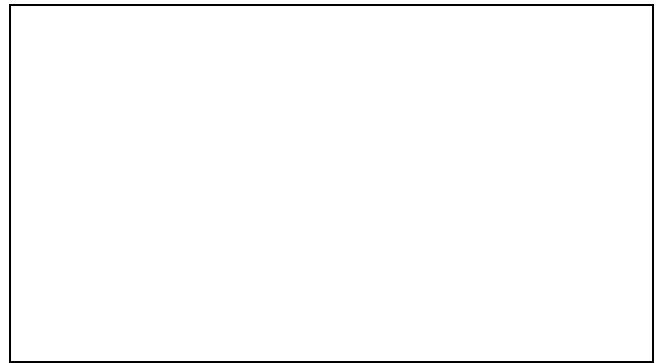
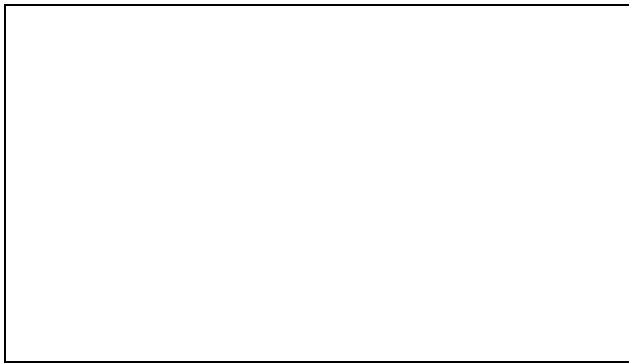
Univerzitetna koda predmeta / University course code: 63269

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje Laboratory work	Druge oblike študija Field work	Samost. delo Individ. work	ECTS
45	10	20	/	/	105	6

Nosilec predmeta / Lecturer: doc. dr. Matija Marolt

Jeziki / Languages:	Predavanja / Lectures:	slovenščina Slovene
	Vaje / Tutorial:	slovenščina Slovene

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

**Vsebina:****Predavanja:**

1. Uvod.
2. Geometrija, affine transformacije, koordinatni sistemi. Homogene koordinate.
3. Predstavitve predmetov: poligoni, deljene ploskve, parametrične krivulje. Hierarhije.
4. Upodabljanje: barve.
5. Lokalno osvetljevanje in senčenje.
6. Teksture.
7. Grafični cevovod: izločanje in rezanje, rasterizacija, z-buffer.
8. Senčilniki
9. Detekcija trkov. Metode razdelitve prostora
10. Načrtovanje iger.
11. Globalno upodabljanje: sledenje žarka, sevalna metoda, kartiranje fotonov.

Vaje:

Laboratorijski projekt izdelave interaktivne igre. Na vajah podan uvod v OpenGL in Unity in samostojno delo na projektih z zaključno predstavitevijo študentov.

Content (Syllabus outline):**Lectures:**

1. Introduction.
2. Geometry, affine transformations, coordinate systems, homogeneous coordinates.
3. Representations: polygons, subdivision surfaces, parametric curves. Hierarchies.
4. Rendering: colors.
5. Local illumination and shading.
6. Texture mapping.
7. Graphics pipeline: culling and clipping, rasterisation, z-buffer.
8. Shaders
9. Collision detection. Space partitioning methods.
10. Game design.
11. Global illumination: raytracing, radiosity, photon mapping.

Laboratory:

Students will implement an interactive game. Exercises will include an introductory course on OpenGL and Unity and individual project work with final public presentation of results.

Temeljni literatura in viri / Readings:

1. Nikola Guid: Računalniška grafika. Univerza v Mariboru, FERl.
2. D. Hearn, M.P. Baker: Computer Graphics with OpenGL, Pearson Prentice Hall, NJ USA.
3. D.H. Eberly: 3D Game Engine Design, Morgan Kaufman Publishers, CA USA.

Cilji in kompetence:

Cilj predmeta je študentom predstaviti programsko in algoritmično ozadje računalniške grafike in iger. Študenti bodo pridobili naslednje kompetence:

- razumevanje in reševanje izzivov na področju računalništva in informatike;
- uporabo znanja za samostojno delo pri reševanju tehničnih in znanstvenih problemov na področju računalništva in informatike; sposobnost nadgradnje znanj;
- sposobnost samostojnega izvajanja manj in bolj zahtevnih inženirskih in organizacijskih nalog na ožjih področjih in samostojno reševanje dobro definiranih nalog na področju računalništva in informatike;
- sposobnost samostojnega razvoja 3D interaktivnih grafičnih aplikacij in iger.

Objectives and competences:

The objective is to present students the programming and algorithmic background of computer graphics and games. When completing the course, students will be able to gain the following competences:

- 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.
- the ability to independently perform both less demanding and complex engineering and organisational tasks in certain narrow areas and independently solve specific well-defined tasks in computer and information science
- the ability to independently develop interactive 3D applications and games.

Predvideni študijski rezultati:

Znanje in razumevanje:

Poznavanje ozadja računalniške grafike in računalniških iger.

Uporaba:

Razvoj interaktivnih 3D vizualizacij in računalniških iger.

Refleksija:

Spoznavanje in razumevanje uglasenosti med teorijo in njeno aplikacijo na konkretnih primerih s področja računalniške grafike in iger.

Prenosljive spretnosti - niso vezane le na en predmet:

Razvoj grafičnih vizualizacij na različnih strokovnih področjih.

Intended learning outcomes:

Knowledge and understanding:

Knowledge of background of computer graphics and games.

Application:

Development of interactive 3D visualizations and computer games.

Reflection:

Knowing and understanding of the balance between the theory and practice on concrete examples from the field of computer graphics and games.

Transferable skills:

Developing graphical visualization in various fields.

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Metode poučevanja in učenja:

Predavanja s praktičnimi demonstracijami, izvajanje laboratorijskega projekta pod mentorstvom asistenta.

Learning and teaching methods:

Lectures with practical demonstrations, laboratory work under the supervision of assistants.

Delež (v %) /

Načini ocenjevanja:

Weight (in %)

Assessment:

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

<p>Pet najpomembnejših del:</p> <ol style="list-style-type: none"> 1. LESAR, Žiga, BOHAK, Ciril, MAROLT, Matija. Evaluation of angiogram visualization methods for fast and reliable aneurysm diagnosis. Medical imaging 2015 : image perception, observer performance, and technology assessment : 25-26 February 2015, Orlando, Florida, United States. 2. BOHAK, Ciril, SODJA, Anže, MAROLT, Matija, MITROVIĆ, Uroš, PERNUŠ, Franjo. Fast segmentation, conversion and rendering of volumetric data using GPU. IWSSIP 2014 : proceedings, (International Conference on Systems, Signals, and Image Processing (Print), ISSN 2157-8672), 2014, str. 239-242. 3. MAROLT, Matija. A connectionist approach to automatic transcription of polyphonic piano music. IEEE trans. multimedia. [Print ed.], str. 439-449, ilustr. [COBISS.SI-ID 4203860] 4. MAROLT, Matija. A mid-level representation for melody-based retrieval in audio collections. IEEE trans. multimedia. [Print ed.], Dec. 2008, vol. 10, no. 8, str. 1617-1625, ilustr. [COBISS.SI-ID 6908756] 5. Matija Marolt, "Automatic transcription of bell chiming recordings", IEEE transactions on audio, speech, and language processing, vol. 20, no. 3, str. 844-853, Mar. 2012. <p>Celotna bibliografija je dostopna na SICRISu: http://sicris.izum.si/search/rsr.aspx?lang=slv&id=8948.</p>

UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet:	Matematično modeliranje
Course title:	Mathematical Modeling

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Univerzitetni študijski program prve stopnje Računalništvo in informatika	ni smeri	2	poletni
University study programme Computer and Information Science, 1st cycle	none	2	spring

Vrsta predmeta / Course type izbirni predmet / elective course

Univerzitetna koda predmeta / University course code: 63219

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje Laboratory work	Druge oblike študija Field work	Samost. delo Individ. work	ECTS
45	/	30	/	/	105	6

Nosilec predmeta / Lecturer: prof. dr. Nežka Mramor Kosta

Jeziki / Languages:	Predavanja / Lectures:	slovenščina Slovene
	Vaje / Tutorial:	slovenščina Slovene

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

Vsebina: _____ **Content (Syllabus outline):** _____

Vsebina zajema dokaj obsežen pregled možnih tem, ki so lahko zajete v študentskih projektih. Na predavanjih se vsako leto predstavi tiste od navedenih tem, ki so za izdelavo projektov potrebne (ne pa nujno vsako leto vse navedene teme).

1. Uvod v matematično modeliranje, napake pri modeliranju in pri računanju.
2. Geometrijski modeli: parametrizirane krivulje, regularne in singularne točke, tangenta in normala, dolžina loka, ploščine in volumni, primeri in uporaba, interpolacija in aproksimacija s krivuljami, zleпки. Parametrizirane ploskve, koordinatne krivulje, prva fundamentalna forma in površina. Triangulacije.
3. Linearni modeli: SVD in PCA, posplošeni inverzi, linearne transformacije (Fourierjeva, Laplaceova, valčna), linearno programiranje.
4. Nelinearni modeli: modeliranje s funkcijami več spremenljivk, nelinearna optimizacija: lokalni, vezani in globalni ekstremi. Primeri optimizacijskih modelov. Integrali funkcij dveh spremenljivk.
5. Stohastični modeli: Markovske verige.
6. Dinamični modeli: Modeliranje z diferencialnimi enačbami in sistemi, primeri, začetni in robni problemi. Reševanje diferencialnih enačb 1. reda. Eulerjeva metoda. Linearne diferencialne enačbe in sistemi. Numerične metode za integriranje diferencialnih enačb. Tiri in invariantne množice dinamičnih sistemov. Primeri dinamičnih sistemov.

The contents of the course represents a rather large list of topics which are connected to the student projects. In the lectures, the topics relevant for the current student projects will be explained (possibly not all topics every year)

1. Introduction to mathematical modelling, computational and modelling errors.
2. Geometric models: parametric curves, regular and singular points, tangent and normal, arc length, areas and volumes, examples and applications, interpolation and approximation with curves, splines. Parametric surfaces, coordinate curves, first fundamental form. Triangulations
3. Linear models: SVD and PCA, general inverses, linear transformations (Fourier, Laplace, wavelet), linear programming.
4. Nonlinear models: models with functions of several variables. Continuous optimization: local, constrained and global extrema.
5. Stochastic models: Markov chains.
6. Dynamical models: modelling with differential equations and systems, examples of initial and boundary problems. Solving order one differential equations. Euler method. Linear differential equations and systems. Numerical integration. Orbits and invariant sets of dynamical systems. Examples.

Temeljna literatura in viri / Readings:

Temeljna literatura:

7. B. Orel, Osnove numerične matematike, Fakulteta za računalništvo in informatiko, cop. 1997.

Dodatna literatura:

1. M. Braun: Differential equations and their applications, Springer, 1991.
2. J. Guckenheimer, P. Holmes: Nonlinear Oscillators, Dynamical Systems, and Bifurcations of Vector Fields, Applied Mathematical Sciences no. 42, Springer, 2002.
3. [Lectures on differential equations MIT](#) Open CourseWare video.

Cilji in kompetence:

Cilj predmeta je nadgraditi osnovno poznavanje in razumevanje pojmov matematične analize z zahtevnejšimi pojmi, prikazati njihovo uporabo pri matematičnem modeliranju pojavov v računalništvu in drugih znanostih in pa osnovne metode za računanje dobljenih modelov.

Splošne kompetence:

- Razvijanje sposobnost kritičnega, analitičnega in sintetičnega razmišljanja.
- Sposobnost prenašanja znanja in sposobnost pisanja v domačem in tujem jeziku.
- Sposobnost uporabe pridobljenega znanja pri samostojnem delu in reševanju tehničnih in znanstvenih problemov na področju računalništva; sposobnost nadgraditi pridobljeno znanje.

Predmetno specifične kompetence:

- Sposobnost razumevanja in uporabe znanj s področja računalništva in informatike na drugih tehničnih in relevantnih področjih (ekonomiji, organizacijskih vedah itd.)
- Samostojno reševati zahtevne razvojne, inženirske in organizacijske naloge, pa tudi zmerno zahtevne raziskovalne naloge na svojem področju.
- Razumeti relevantne matematične koncepte in jih uporabiti pri modeliranju pojavov na drugih področjih.
- Sposobnost implementirati relevantne matematične modele v obliki

Objectives and competences:

The goal of the course is to introduce students to advanced concepts and tools of mathematical analysis and demonstrate their application in mathematical modelling of phenomena in computer science and in other sciences, as well as the basic methods for computing solutions of the obtained models.

General competences:

- Developing skills in critical, analytical and synthetic thinking.
- The ability of knowledge transfer and writing skills in the native language as well as a foreign language.
- 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.

Subject specific competences:

- The ability to understand and apply computer and information science knowledge to other technical and relevant fields (economics, organisational science, etc);
- Independently tackle demanding developmental, engineering, and organisational tasks as well as moderately demanding research tasks in their fields of study.
- To understand the relevant mathematical concepts and apply them to model phenomena in other fields.
- Ability to implement relevant mathematical models in the form of computer algorithms.

računalniških algoritmov

Predvideni študijski rezultati:

Znanje in razumevanje:

Po zaključku tega predmeta bo študent sposoben uporabljati pojme matematične analize za modeliranje preprostih pojavov, računati rešitve dobljenih modelov in jih ovrednotiti.

Uporaba:

Uporaba metod matematične analize pri modeliranju pojavov in pri načrtovanju in analizi računalniških algoritmov, postopkov in programov.

Refleksija:

Spoznavanje matematičnega jezika za konsistentno in natančno opisovanje pojavov in razumevanje odnosa med teoretičnim modelom in njegovo implementacijo na različnih področjih računalništva.

Prenosljive spretnosti - niso vezane le na en predmet:

Osnovni pojmi matematične analize so v računalništvu in nasploh v znanostih pogosto orodje za formalno opisovanje pojavov. Matematična abstrakcija pojmov in problemov je v računalništvu potrebna in pogosto uporabljana.

Intended learning outcomes:

Knowledge and understanding:

After completing this course the student will be able to use concepts of mathematical analysis in modelling simple phenomena and processes, compute solutions of the obtained models, and evaluate them.

Application:

Applying methods of mathematical analysis in modelling, designing and analysing computer algorithms, processes and programs.

Reflection:

Learning the language of mathematics for a consistent and precise description of phenomena and for understanding the relation between the theoretical model and its implementation in different fields of computer science.

Transferable skills:

Basic models of mathematical analysis are frequently used as tools for formal description of phenomena in computer science as well as in other sciences. Mathematical abstraction of concepts and problems is necessary and standard in computer science.

Metode poučevanja in učenja:

Predavanja, vaje domače naloge. Poseben poudarek je na sprotne študiju z domačimi nalogami in projekti, ki se delno rešujejo na vajah. Vaje so podprte s programskima paketoma Matlab in Mathematica. Domače naloge in projekti so delno individualne in delno skupinske in se ustno zagovarjajo. Spodbuja se skupinsko delo.

Learning and teaching methods:

Lectures, lab exercises and homework problems and projects. Special attention will be put on continuing work through homework problems and projects. Matlab and Mathematica are used at lab exercises and in homework problems and projects. Homework problems and projects are partly individual and partly group and are presented orally. Group work is encouraged.

Delež (v %) /

Načini ocenjevanja:

Weight (in %) **Assessment:**

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

Pet najpomembnejših del:

MRAMOR KOSTA, Neža. A strong excision theorem for generalized Tate cohomology. *Bull. Aust. Math. Soc.*, 2005, vol. 72, no. 1, str. 7-15. [COBISS.SI-ID [13683545](#)]

KING, Henry C., KNUDSON, Kevin, MRAMOR KOSTA, Neža. Generating discrete Morse functions from point data. *Exp. math.*, 2005, vol. 14, no. 4, str. 435-444. <http://www.expmath.org/>. [COBISS.SI-ID [13872985](#)]

JAWOROWSKI, Jan, MRAMOR KOSTA, Neža. The degree of maps of free G-manifolds. *J. fixed point theory appl. (Print)*, 2007, vol. 2, no. 2, str. 209-213. <http://dx.doi.org/10.1007/s11784-007-0047-0>. [COBISS.SI-ID [14569305](#)]

JERŠE, Gregor, MRAMOR KOSTA, Neža. Ascending and descending regions of a discrete Morse function. *Comput. geom.* [Print ed.], 2009, vol. 42, iss. 6-7, str. 639-651. <http://dx.doi.org/10.1016/j.comgeo.2008.11.001>, doi: [10.1016/j.comgeo.2008.11.001](https://doi.org/10.1016/j.comgeo.2008.11.001). [COBISS.SI-ID [14994265](#)]

AYALA, Rafael, VILCHES, Jose Antonio, JERŠE, Gregor, MRAMOR KOSTA, Neža. Discrete gradient fields on infinite complexes. *Discrete contin. dyn. syst.*, 2011, vol. 30, no. 3, str. 623-639. <http://dx.doi.org/10.3934/dcds.2011.30.623>. [COBISS.SI-ID [15865945](#)]

Celotna bibliografija je dostopna na SICRISu:

<http://sicris.izum.si/search/rsr.aspx?lang=slv&id=6588>.

UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet: Osnove matematične analize
Course title: Calculus

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Univerzitetni študijski program prve stopnje Računalništvo in informatika	ni smeri	1	zimski
University study programme Computer and Information Science, 1st cycle	none	1	fall

Vrsta predmeta / Course type

obvezni predmet / compulsory course

Univerzitetna koda predmeta / University course code:

63202

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje Laboratory work	Druge oblike študija Field work	Samost. delo Individ. work	ECTS
45	/	30	/	/	105	6

Nosilec predmeta / Lecturer:

prof. dr. Nežka Mramor Kosta

**Jeziki /
Languages:**

**Predavanja /
Lectures:** slovenščina
Slovene
Vaje / Tutorial: slovenščina
Slovene

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

Prerequisites:

Vsebina:

Content (Syllabus outline):

1. Realna števila, kompleksna števila, zaporedja, limita zaporedja, vrste.
2. Funkcije: osnovne lastnosti, graf, zveznost in limita funkcije, lastnosti zveznih funkcij, bisekcija in sekantna metoda za reševanje nelinearnih enačb, funkcije več spremenljivk.
3. Odvod: definicija in geometrijski pomen odvoda, pravila za računanje in odvodi elementarnih funkcij, parcialni odvodi funkcije več spremenljivk, verižno pravilo, diferencial in linearna aproksimacija funkcije, l'Hospitalovo pravilo, gradient funkcije več spremenljivk. Uporaba odvoda: stacionarne točke in lokalni ekstremi, globalni ekstremi, reševanje optimizacijskih nalog. Taylorjev polinom in Taylorjeva vrsta.
4. Integral: nedoločeni integral, določeni integral in ploščine. osnovne numerične metode za računanje določenega integrala (trapezna in Simpsonova metoda), zveza med nedoločenim in določenim integralom, primeri neelementarnih funkcij.
5. Diferencialne enačbe: zakoni rasti, rešitve diferencialnih enačb, enačba z ločljivima spremenljivkama, linearna diferencialna enačba, primeri uporabe.

1. Real numbers, complex numbers, sequences, limits and convergent sequences, series.
2. Functions: basic properties, graph. Continuity and limits, properties of continuous functions, bisection, secant method, functions of several variables.
3. Derivatives: definition and geometric interpretation of derivative, rules for differentiation, partial derivatives, differential, linear approximation, l'Hospital's rule, gradient. Applications: critical points and local extrema, global extrema, solving optimization problems, Taylor polynomial and Taylor series.
4. Integral: indefinite integral, definite integral and areas, numerical integration (trapezoid and Simpson's rule), fundamental theorem of calculus (connection between indefinite and definite integrals), examples of nonelementary functions.
5. Differential equations: growth models, solutions, separable equations, linear first degree differential equations, examples.

Temeljna literatura in viri / Readings:

1. G. Tomšič, B. Orel, N. Mramor: Matematika I, Matematika II; Ljubljana, Založba FE in FRI.
2. J. Stewart: Calculus: early transcendentals (5th edition), Brooks/Cole - Thomson, cop. 2003, poglavja 1 do 9.
3. Dan Sloughter: Yet Another Calculus Text, <http://www.freebookcentre.net/maths-books-download/Yet-Another-Calculus-Text.html>
4. Andrew D. Hwang: Calculus for Mathematicians, Computer Scientists, and Physicists <http://www.freebookcentre.net/maths-books-download/Calculus-for-Mathematicians,-Computer-Scientists,-and-Physicists-An-Introduction-to-Abstract-Mathematics-%28pdf%29.html>

Cilji in kompetence:

Objectives and competences:

Cilj predmeta je utrditi poznavanje in razumevanje osnovnih pojmov matematične analize kot so konvergenca, odvod in integral, prikazati njihove osnovne lastnosti in pa njihovo uporabo pri reševanju problemov v računalništvu in nasploh v znanostih.

Splošne kompetence:

- Sposobnost kritičnega razmišljanja
- Razvijanje sposobnosti kritičnega, analitičnega in sintetičnega razmišljanja
- Razumevanje in uporaba matematičnih pojmov in matematičnega načina razmišljanja
- Razumevanje pojma abstrakcije

Predmetno specifične kompetence:

- Osnovne sposobnosti na področju računalništva in informatike, ki vključujejo osnovne teoretične sposobnosti, praktično znanje in ključne sposobnosti na področju računalništva in informatike
- Osnovna znanja na področju računalništva in informatike, ki dopuščajo nadaljevanje študija na drugi stopnji
- Razumevanje matematičnih pojmov konvergenca, zveznosti, odvoda in integrala
- Sposobnost uporabe osnovnih matematičnih pojmov so zaporedja, vrste, funkcije, odvod in integral pri reševanju problemov na področju računalništva in informatike in na drugih relevantnih področjih.

The goal of this course is to provide a broad understanding of the basic concepts of mathematical analysis, such as convergence, derivative and integral, and demonstrate how they can be applied to solve problems in computer science and science as a whole.

General competences:

- Ability of critical thinking.
- Developing skills in critical, analytical and synthetic thinking.
- Understanding and using mathematical concepts and mathematical thinking
- Understanding the concept of abstraction

Subject specific competencies

- Basic skills in computer and information science, which includes basic theoretical skills, practical knowledge and skills essential for the field of computer and information science;
- Basic skills in computer and information science, allowing the continuation of studies in the second study cycle.
- Understanding the concepts of convergence, continuity, derivatives and integrals
- Ability to use basic mathematical concepts like sequences, series, functions, derivatives and integrals in solving problems from computer science and other relevant fields.

Predvideni študijski rezultati:

Znanje in razumevanje:

Po zaključku tega predmeta bo študent sposoben uporabljati osnovne pojme matematične analize in razumeti matematične formule in modele, ki na njih temeljijo.

Uporaba:

Uporaba osnovnih metod matematične analize pri načrtovanju in analizi računalniških algoritmov, postopkov in programov.

Intended learning outcomes:

Knowledge and understanding:

After concluding this course the student will be able to use the basic concepts of mathematical analysis and understand mathematical formulae and models based on them.

Application:

Methods of calculus and mathematical analysis applied to design and analysis of computer algorithms, procedures and programs.

Refleksija:

Spoznavanje matematičnega jezika za konsistentno in natančno opisovanje pojavov in razumevanje odnosa med teoretičnim modelom in njegovo implementacijo na različnih področjih računalništva in informatike.

Prenosljive spretnosti - niso vezane le na en predmet:

Osnovni pojmi matematične analize so v računalništvu in nasploh v znanostih pogosto orodje za formalno opisovanje pojavov. Matematična abstrakcija pojmov in problemov je v računalništvu potrebna in pogosto uporabljana.

Reflection:

Understanding the mathematical language for the purpose of consistent and precise description of phenomena and for understanding the relationship between a theoretical model and its implementation in different fields of computer science and informatics.

Transferable skills:

Fundamental concepts of mathematical analysis are standard tools for formal description of phenomena in computer science and generally in science. Mathematical abstraction of concepts and problems is necessary and generally used in computer science.

Metode poučevanja in učenja:

Predavanja, računske vaje z ustnimi nastopi, domače naloge. Poseben poudarek je na sprotnem študiju z domačimi nalogami in na skupinskem delu pri vajah.

Learning and teaching methods:

Lectures, lab exercises with oral presentations, homework problems. Special attention will be given to continuing work with homework problems and group work.

Delež (v %) /

Weight (in %)

Načini ocenjevanja:**Assessment:**

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

Sprotno preverjanje (domače naloge, kolokviji in projektno delo)

Končno preverjanje (pisni in ustni izpit)

Ocene: 6-10 pozitivno, 5 negativno (v skladu s Statutom UL).

50%

50%

Type (examination, oral, coursework, project):

Continuing (homework, midterm exams, project work)

Final (written and oral exam)

Grading: 6-10 pass, 5 fail (according to the rules of University of Ljubljana).

Reference nosilca / Lecturer's references:**Pet najpomembnejših del:**

MRAMOR KOSTA, Neža. A strong excision theorem for generalized Tate cohomology. *Bull. Aust. Math. Soc.*, 2005, vol. 72, no. 1, str. 7-15. [COBISS.SI-ID [13683545](#)]

KING, Henry C., KNUDSON, Kevin, MRAMOR KOSTA, Neža. Generating discrete Morse functions from point data. *Exp. math.*, 2005, vol. 14, no. 4, str. 435-444. <http://www.expmath.org/>.

[COBISS.SI-ID [13872985](#)]

JAWOROWSKI, Jan, MRAMOR KOSTA, Neža. The degree of maps of free G-manifolds. *J. fixed point theory appl. (Print)*, 2007, vol. 2, no. 2, str. 209-213. <http://dx.doi.org/10.1007/s11784-007-0047-0>. [COBISS.SI-ID [14569305](#)]

JERŠE, Gregor, MRAMOR KOSTA, Neža. Ascending and descending regions of a discrete Morse function. *Comput.. geom.. [Print ed.]*, 2009, vol. 42, iss. 6-7, str. 639-651.

<http://dx.doi.org/10.1016/j.comgeo.2008.11.001>, doi: [10.1016/j.comgeo.2008.11.001](https://doi.org/10.1016/j.comgeo.2008.11.001).

[COBISS.SI-ID [14994265](#)]

AYALA, Rafael, VILCHES, Jose Antonio, JERŠE, Gregor, MRAMOR KOSTA, Neža. Discrete gradient fields on infinite complexes. *Discrete contin. dyn. syst.*, 2011, vol. 30, no. 3, str. 623-639.

<http://dx.doi.org/10.3934/dcds.2011.30.623>. [COBISS.SI-ID [15865945](#)]

Celotna bibliografija je dostopna na SICRISu:

<http://sicris.izum.si/search/rsr.aspx?lang=slv&id=6588>.

UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet: Modeliranje računalniških omrežij
Course title: Computer Networks Modelling

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Univerzitetni študijski program prve stopnje Računalništvo in informatika Interdisciplinarni univerzitetni študijski program prve stopnje Računalništvo in matematika	Modul: Računalniška omrežja	3	zimski
University study programme Computer and Information Science, 1st cycle Interdisciplinary university study programme Computer Science and Mathematics , 1st cycle	Module: Computer networks	3	fall

Vrsta predmeta / Course type

izbirni predmet / elective course

Univerzitetna koda predmeta / University course code:

63257

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje Laboratory work	Druge oblike študija Field work	Samost. delo Individ. work	ECTS
45	10	20	/	/	105	6

Nosilec predmeta / Lecturer:

prof. dr. Miha Mraz

**Jeziki /
Languages:**

Predavanja / Lectures:	slovenščina Slovene
Vaje / Tutorial:	slovenščina Slovene

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

**Vsebina:****Predavanja:**

1. Teoretične osnove
 1. Zahteve, strežniki, čakalne vrste, Kendallova notacija
 2. Modeliranje z vidika časa in zaloge možnih stanj
 3. Intenzivnost prihajajočih zahtev in strežbe
 4. Strežne enote (diskretne, eksponentne, Erlangove, ...),
 5. Strežne mreže
 6. Opredelitev simulacijskih parametrov (breme, metrike, potrebni resursi, itd.)
 7. Analiza in interpretacija simulacijskih rezultatov
 8. Petrijeve mreže, barvne Petrijeve mreže
 9. Ocenjevalne metrike, latenca
2. Uporaba teorije v praksi
 1. Modeliranje in simulacije omrežij
 2. Modeliranje in simulacije protokolov
 3. Modeliranje in simulacije višje nivojskih protokolov in storitev
 4. Orodja za modeliranje in simulacijo računalniških omrežij (OpNet, NS2, OMNeT++, TETCOS, GTNetS, itd.)

Vaje:

Namen vaj pri navedenem predmetu je predvsem v predstavitvi uporabe zgoraj navedenih teoretičnih osnov na reševanju praktičnih problemov s področja računalniških omrežij. V ta namen se bodo uporabljala na vajah ustrezna programska

Content (Syllabus outline):**Lectures:**

1. Theoretical basics
 1. Requests, servers, queues, Kendall's notation
 2. Modelling regarding time and modelling regarding the possible states of the system
 3. Request arrival rate in request serving rate
 4. Serving units (discrete, exponential, Erlang's, ...),
 5. Serving networks
 6. Definition of simulation parameters (work-load, metrics, required resources, etc.)
 7. Analysis and interpretation of simulation results
 8. Petri nets, Coloured Petri nets
 9. Performance metrics, latency
2. Practical use of theory presented
 1. Modelling and simulation of networks
 2. Modelling and simulation of protocols
 3. Modelling and simulation of higher layer protocols and services
 4. Tools for network modelling and simulation (OpNet, NS2, OMNeT++, TETCOS, GTNetS, etc.)

Laboratory courses:

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.

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](https://nbn-resolving.org/urn:nbn:si:coibis-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 teoretičnega znanja na reševanje praktičnih problemov, do katerih prihaja na področju računalniških omrežij.

Ostale kompetence:

- Razvoj spretnosti v analitičnem in sinteznem razmišljanju
- Praktično obvladovanje sestavnih delov računalniških sistemov za uspešno profesionalno delo
- Zmožnost razumevanja in reševanja profesionalnih problemov
- Zmožnost uporabe in nadgradnje znanja pri samostojnem delu

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 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 *sistemske* 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:

Predavanja bodo potekala ustno, vaje v obliki projektnega dela na konkretnih aplikativnih zgledih.

Learning and teaching methods:

Lectures and oral presentations of the subject.
 Seminal work on real-life examples and problems.

Načini ocenjevanja:

Način (pisni izpit, ustno izpraševanje, naloge, projekt):
Sprotno preverjanje (domače naloge, kolokviji in projektno delo)
Končno preverjanje (pisni in ustni izpit)

Delež (v %) /

Weight (in %)

Assessment:

Type (examination, oral, coursework, project):
Continuing (homework, midterm exams, project work)
Final (written and oral exam)

50%

50%

Ocene: 6-10 pozitivno, 5 negativno (v skladu s Statutom UL).		Grading: 6-10 pass, 5 fail (according to the rules of University of Ljubljana).
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Reference nosilca / Lecturer's references:

Pet najpomembnejših del:

1. 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., doi: [10.1109/TCBB.2016.2550456](https://doi.org/10.1109/TCBB.2016.2550456). [COBISS.SI-ID [1536851139](https://www.cobiss.si/id/1536851139)], [[JCR](#), [SNIP](#)]
2. 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., doi: [10.1089/cmb.2016.0065](https://doi.org/10.1089/cmb.2016.0065). [COBISS.SI-ID [1536999619](https://www.cobiss.si/id/1536999619)], [[JCR](#), [SNIP](#)]
3. 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., doi: [10.1109/TCBB.2015.2424424](https://doi.org/10.1109/TCBB.2015.2424424). [COBISS.SI-ID [1536282563](https://www.cobiss.si/id/1536282563)], [[JCR](#), [SNIP](#), [WoS](#)]
4. 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., doi: [10.1109/TCBB.2013.2295792](https://doi.org/10.1109/TCBB.2013.2295792). [COBISS.SI-ID [10323028](https://www.cobiss.si/id/10323028)], [[JCR](#), [SNIP](#), [WoS](#)]
5. 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](https://www.cobiss.si/id/9950804)], [[JCR](#), [SNIP](#), [WoS](#)]

Celotna bibliografija je dostopna na SICRISu:

<http://sicris.izum.si/search/rsr.aspx?lang=slv&id=8066>.

UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet: Zanesljivost in zmogljivost računalniških sistemov
Course title: Computer Systems Reliability and Performance

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Univerzitetni študijski program prve stopnje Računalništvo in informatika	Modul: Računalniški sistemi	3	poletni
Interdisciplinarni univerzitetni študijski program prve stopnje Računalništvo in matematika		2, 3	
Univerzitetni študijski program prve stopnje Računalništvo in matematika	Module: Computer systems	3	spring
Interdisciplinarni univerzitetni študijski program prve stopnje Računalništvo in matematika		2, 3	
Interdisciplinarni univerzitetni študijski program prve stopnje Multimedia		2, 3	
University study programme Computer and Information Science, 1st cycle	Module: Computer systems	3	spring
Interdisciplinary university study programme Computer Science and Mathematics, 1st cycle		2, 3	
Interdisciplinary university study programme Multimedia, 1st cycle		2, 3	

Vrsta predmeta / Course type

izbirni predmet / elective course

Univerzitetna koda predmeta / University course code:

63262

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje Laboratory work	Druge oblike študija Field work	Samost. delo Individ. work	ECTS
45	20	10	/	/	105	6

Nosilec predmeta / Lecturer:

prof. dr. Miha Mraz

**Jeziki /
Languages:**

**Predavanja /
Lectures:** slovenščina
Slovene
Vaje / Tutorial: slovenščina
Slovene

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

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Prerequisites:

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Vsebina:

Predavanja:

1. Zanesljivost rač. sistemov
 1. Osnovni pojmi (napaka, odpoved, redundanca, MTBF, MTTR, MTTF, degradirano delovanje, nedelujoče stanje sistema, itd.)
 2. Matematično teoretične osnove zanesljivosti
 3. Modeliranje zanesljivosti
 4. Zanesljivost elektronskih komponent – pregled standardov
 5. Zanesljivost programske opreme
 6. Osnove sistemske zanesljivosti
 7. Diagnostika v računalniških sistemih
 8. Pregled konkretnih metod za določevanje zanesljivosti (FMEA, FTA, itd.)
 9. Pregled programskih orodij za določevanje zanesljivosti
2. Zmogljivost rač. sistemov
 1. Metrike za ocenjevanje zmogljivosti
 2. Bremena v računalniških sistemih
 3. Metode za ocenjevanje zmogljivosti (analitični, simulacijski ali meritveni pristop)
 4. Monitorji
 5. Koncepti določanja zmogljivosti: meritve, simulacije, analitični pristop
 6. Postopki za pohitritev programske opreme
 7. Pomnilniške hierarhije
 8. Zmogljivost računalniških omrežij

Content (Syllabus outline):

Lectures:

1. Reliability of computer systems
 1. Basic terms (error, failure, redundancy, MTBF, MTTR, MTTF, performance degradation, system failure, etc.)
 2. Mathematical theory in reliability estimation
 3. Modelling the reliability
 4. Reliability assessment of electronic components – overview of the standards available
 5. Software reliability
 6. Basics of system reliability
 7. Computer diagnostics
 8. Overview of selected methods for reliability assessment (FMEA, FTA, etc.)
 9. Overview of software tools for reliability assessment
2. Performance of computer systems
 1. Metrics for performance evaluation
 2. Work-loads in computer systems
 3. Methods for performance evaluation (analytical, simulational and measurement approach)
 4. Computer system performance monitoring
 5. Performance evaluation concepts: measurements, simulations, analytical approach
 6. Methods for improving the system performance
 7. Memory hierarchies

Vaje:

Namen vaj pri navedenem predmetu je predvsem v predstavitvi uporabe zgoraj navedenih metod in pristopov na praktičnih primerih iz realnega sveta. V ta namen se bodo uporabljala na vajah ustrezna programska orodja (npr. Relex, Reliability Workbench itd.).

8. Capabilities of computer systems

Laboratory courses:

Methods and approaches presented during the lectures will be demonstrated on practical real-world examples during the laboratory courses. Different software tools will be used for the demonstrations, such as Relex, Reliability Workbench etc.

Temeljni literatura in viri / Readings:

1. M. L Shooman: Reliability of computer systems and networks, J. Wiley & Sons, New York 2002.
2. N. Zimic, M. Mraz: Temelji zmogljivosti računalniških sistemov, Fakulteta za rač. in informatiko, Ljubljana, 2006.

Cilji in kompetence:

Cilj predmeta je študentom računalništva in informatike predstaviti osnovne metode in pristope na področjih računalniške zanesljivosti in zmogljivosti. Obe sta ključni za uspešnost delovanja kakršnegakoli računalniškega sistema. Predmet naj bi študentom podal tako teoretične osnove in metode obeh področij, kot tudi skušal čim boljše predstaviti uporabo teoretičnih osnov in metod na konkretnih problemih načrtovanja in vzdrževanja računalniških sistemov. Ostale kompetence:

- Razvoj spretnosti v analitičnem in sinteznem razmišljanju.
- Sposobnost razumevanja in reševanja profesionalnih problemov
- Zmožnost profesionalne komunikacije v materinem in tujem jeziku.
- Zmožnost uporabe in nadgradnje znanja pri samostojnem delu
- Zmožnost timskega dela v profesionalnem okolju; upravljanje manjših delovnih enot

Objectives and competences:

Objective of the course is to present the basic methods and approaches from the field of reliability and performance of computer systems assessment to the students of computer and information science. Reliability and performance of computer system are vital for its effectivity. Students will comprehend theoretical knowledge from both disciplines and will also learn their practical values from the examples of real-life problems. Other competences:

- Developing skills in critical, analytical and synthetic thinking.
- The ability to understand and solve professional challenges in computer and information science.
- The ability of professional communication in the native language as well as a foreign language.
- 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.
- The ability of teamwork within the professional environment; management of a small professional team.

Predvideni študijski rezultati:

Znanje in razumevanje:
Poznavanje teoretičnih in metodoloških znanj področij zanesljivosti in zmogljivosti.
Razumevanje pomena obeh področij.
Poznavanje uporabe metodoloških znanj v praksi.
Uporaba:
Uporaba metodoloških znanj pri načrtovanju in vzdrževanju raznovrstnih računalniških sistemov, ki nas vse bolj obkrožajo.
Refleksija:
Razumevanje povezave med teoretičnimi znanji in metodologijami ter konkretnimi problemi zmogljivosti in zanesljivosti v računalniških sistemih.
Prenosljive spretnosti - niso vezane le na en predmet:
Večina predstavljenih metodologij odpira *sistemski* zorni kot načrtovalca ali upravitelja na rač. sistem (aplikacijo). Slednji spodbuja predvsem vidike, kot so kritična analiza, sinteza, delov v timih, socialne spretnosti.

Intended learning outcomes:

Knowledge and understanding:
Having the theoretical and methodological knowledge from the field of computer reliability and performance. Understanding the importance of both disciplines. Knowing the practical values of both disciplines.

Application:
Application of methodological knowledge in design and support of various computer systems.

Reflection:
Understanding the relations among theoretical knowledge and methodologies and practical problems from the field of reliability and performance of computer systems.

Transferable skills – are not bound only to this course:
Students gain a new perspective as designers or supports of a computer system (application). This perspective opens new viewpoints such as critical analysis, synthesis, team work and social skills.

Metode poučevanja in učenja:

Predavanja bodo potekala ustno, vaje v obliki projektne dela na konkretnih aplikativnih zgledih.

Learning and teaching methods:

Lectures and oral presentations of the subject. Seminal work on real-life examples and problems.

Načini ocenjevanja:

Delež (v %) /

Weight (in %)

Assessment:

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

Pet najpomembnejših del:

1. 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., doi: [10.1109/TCBB.2016.2550456](https://doi.org/10.1109/TCBB.2016.2550456). [COBISS.SI-ID [1536851139](https://www.cobiss.si/id/1536851139)], [JCR, SNIP]
2. 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., doi: [10.1089/cmb.2016.0065](https://doi.org/10.1089/cmb.2016.0065). [COBISS.SI-ID [1536999619](https://www.cobiss.si/id/1536999619)], [JCR, SNIP]
3. 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., doi: [10.1109/TCBB.2015.2424424](https://doi.org/10.1109/TCBB.2015.2424424). [COBISS.SI-ID [1536282563](https://www.cobiss.si/id/1536282563)], [JCR, SNIP, WoS]
4. 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., doi: [10.1109/TCBB.2013.2295792](https://doi.org/10.1109/TCBB.2013.2295792). [COBISS.SI-ID [10323028](https://www.cobiss.si/id/10323028)], [JCR, SNIP, WoS]
5. 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](https://www.cobiss.si/id/9950804)], [JCR, SNIP, WoS]

Celotna bibliografija je dostopna na SICRISu:

<http://sicris.izum.si/search/rsr.aspx?lang=slv&id=8066>.

UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet: Linearna algebra
Course title: Linear Algebra

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Univerzitetni študijski program prve stopnje Računalništvo in informatika	ni smeri	1	poletni
University study programme Computer and Information Science, 1st cycle	none	1	spring

Vrsta predmeta / Course type

obvezni predmet / compulsory course

Univerzitetna koda predmeta / University course code:

63207

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje Laboratory work	Druge oblike študija Field work	Samost. delo Individ. work	ECTS
45	/	30	/	/	105	6

Nosilec predmeta / Lecturer:

prof. dr. Bojan Orel

**Jeziki /
Languages:**

**Predavanja /
Lectures:** slovenščina
Slovene
Vaje / Tutorial: slovenščina
Slovene

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

Prerequisites:

Vsebina:

Content (Syllabus outline):

Predavanja:

1. Osnovne operacije z vektorji,
2. operacije z matrikami,
3. sistemi linearnih enačb,
4. vektorski prostori,
5. ortogonalne projekcije in predoločeni sistemi,
6. simetrične in ortogonalne matrike,
7. determinante,
8. lastni vektorji in lastne vrednosti

Vaje:

- utrjevanje pri predavanjih obravnavane snovi z računskimi primeri
- študij primerov, ki so za študente računalništva in informatike relevantni, ne spadajo pa v glavni tok snovi na predavanjih

Pri vajah je poudarek na samostojnem reševanju nalog pod strokovnim vodstvom asistenta.

Domače naloge:

Domače naloge so predvidene v tedenskem ritmu, obvezne in časovno manj zahtevne. Namen domačih nalog je pripraviti študenta k sprotneemu študiju predmeta. Študentje lahko domače naloge rešujejo bodisi individualno bodisi skupinsko. Vsebine domačih nalog praviloma sledijo temam iz kontaktnih ur.

Lectures:

1. Basic operations with vectors,
2. Operations with matrices,
3. Systems of linear equations,
4. Vector spaces,
5. Orthogonal projections and over determined systems,
6. Symmetric and orthogonal matrices,
7. Determinants,
8. Eigenvalues and eigenvectors

Lab practice:

- ✦ Support of the theoretical knowledge by practical examples
- ✦ Study of examples relevant for the computer science and informatics students

At the lab practice sessions students will individually solve problems under the supervision of an assistant.

Homeworks:

Homework assignments are obligatory and provided in a weekly rhythm, but less time demanding. The purpose of homework is to prepare students to prompt study of the subject. Students can solve homeworks either individually or collectively. The contents of homework topics are usually following contact hours.

Temeljni literatura in viri / Readings:

B. Orel: Linearna algebra, ZaFri 2013.
I. Vidav: Višja matematika I;
G. Strang: Introduction to linear algebra

Cilji in kompetence:**Objectives and competences:**

Cilj predmeta je študenta seznaniti z metodami linearne algebre in ga usposobiti, da bo lahko te metode uporabljal pri reševanju problemov z različnih področij računalništva.

The course aims to acquaint students with the methods of linear algebra, and train them to use these methods in solving problems in various areas of computer science.

Predvideni študijski rezultati:

Znanje in razumevanje:
Poznavanje osnovnih objektov (skalarji, vektorji, matrike) in relacij med njimi, poznavanje osnovnih operacij nad njimi ter razumevanje lastnosti teh operacij.

Uporaba:
Sposobnost uporabe metod linearne algebre pri reševanju problemov, ki izvirajo v drugih področjih (računalništvo, naravoslovje, tehnika).

Refleksija:
Spoznanje, da je iste metode mogoče uporabiti pri reševanju različnih konkretnih primerov s področja modeliranja različnih pojavov z računalniki.

Prenosljive spretnosti - niso vezane le na en predmet:
Uporaba abstraktnih sistemov za reševanje konkretnih problemov, identifikacija in reševanje problemov.

Intended learning outcomes:

Knowledge and understanding:
Knowledge of basic objects (scalars, vectors, matrices) and the relationships between them, knowledge of basic operations over them, and understanding of the properties of these operations.

Application:
Ability to apply methods of linear algebra to solve problems arising in other fields (computer science, science, engineering).

Reflection:
The realization that the same method can be used in solving various concrete examples in the field of modelling various phenomena with computers.

Transferable skills:
The use of abstract systems to solve specific problems, identify and solve problems.

Metode poučevanja in učenja:

Predavanja, laboratorijske vaje, domače naloge

Learning and teaching methods:

Lectures, lab practice, homeworks

Načini ocenjevanja:

Delež (v %) /

Weight (in %)

Assessment:

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

Pet najpomembnejših del:

Celotna bibliografija je dostopna na SICRISu:

<http://sicris.izum.si/search/rsr.aspx?lang=slv&id=6758>.

UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet: Algoritmi in podatkovne strukture 2

Course title: Algorithms and Data Structures 2

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Univerzitetni študijski program prve stopnje Računalništvo in informatika Univerzitetni študijski program prve stopnje Računalništvo in matematika	ni smeri	2	poletni
University study programme Computer and Information Science, 1st cycle University study programme Computer Science and Mathematics , 1st cycle	none	2	spring

Vrsta predmeta / Course type

obvezni predmet / compulsory course

Univerzitetna koda predmeta / University course code:

63280

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje Laboratory work	Druge oblike študija Field work	Samost. delo Individ. work	ECTS
45	/	30	/	/	105	6

Nosilec predmeta / Lecturer:

prof. dr. Borut Robič

**Jeziki /
Languages:**

**Predavanja /
Lectures:** slovenščina
Slovene

Vaje / Tutorial: slovenščina
Slovene

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

Prerequisites:

Vsebina:

Predavanja:

1. Uvod: splošno o metodah razvoja algoritmov, o analizi algoritmov, o računski zahtevnosti algoritmov in problemov
2. Deli in vladaj: opis metode, primeri problemov in algoritmov (glejte primere v točki 12 spodaj)
3. Požrešna metoda: opis metode, primeri
4. Postopno izboljševanje: opis, primeri
5. Dinamično programiranje: opis, primeri
6. Sestopanje: opis metode, primeri
7. Razveji in omeji: opis metode, primeri
8. Linearno programiranje: opis metode, simpleksni algoritem, primeri
9. Izbrane višje podatkovne strukture
10. NP-težki računski problemi: spodnja meja časovne zahtevnosti, intuitivno o razredih P, NP in NP-težkih problemih
11. Metode reševanja NP-težkih problemov: heuristični algoritmi, aproksimacijski algoritmi, verjetnostni algoritmi, parametrizirani algoritmi, eksaktni eksponentni algoritmi, primeri
12. Primeri problemov in algoritmov: napredno urejanje & Heapsort, Quicksort; problem izbiranja & linearni algoritmi; matrično množenje & Strassenov alg.; diskretna Fourierova transformacija & FFT alg., iskanje v nizih & Knuth-Morris-Prattov algoritem; osnovni in zahtevnejši problemi in algoritmi na grafih (iskanje v grafu; topološko urejanje; maksimalni pretok & Ford-Fulkersonov alg.; najkrajše poti & Bellman-Fordov ter Floyd-

Content (Syllabus outline):

Lectures:

1. Intro: about methods of algorithm design, analysis of algorithms, and computational complexity of algorithms and problems
2. Divide-and-Conquer: description of the method, examples of problems and algorithms (see examples 12 below)
3. Greedy method: description, examples
4. Iterative improvement: descr., examples
5. Dynamic programming: descr., examples
6. Backtracking: description, examples
7. Branch&Bound: description, examples
8. Linear programming: descr., Simplex algorithm, examples
9. Selected advanced data structures
10. NP-hard computational problems: lower bounds on time complexity, informally about P, NP and NP-hard problems;
11. Methods of solving NP-hard problems: heuristic algorithms, approximation algorithms, randomized algorithms, parameterized algorithms, exact exponential algorithms, examples
12. Example problems and algorithms: advanced sorting & Heapsort, Quicksort; selection problem & linear algorithms; matrix multiplication & Strassen alg.; Discrete Fourier Transformation & FFT alg; string matching & Knuth-Morris-Pratt; elementary and other graph problems and algorithms (searching a graph; topological sort; maximum flow & Ford-Fulkerson alg.; shortest paths & algorithms of Bellman-Ford, and Floyd-Warshall); selected problems from

Warshallov alg.) ; izbrani problemi iz računske geometrije.

Vaje: Na vajah bodo študentje utrjevali snov, podano na predavanjih. Snov bodo uporabili za reševanje praktičnih problemov, pri čemer bo poudarek na samostojnem delu ob pomoči asistentov. Implementirali bodo več manjših programov (kot domače naloge) in obsežnejše programe (kot seminarske naloge), ki jih bodo zagovarjali na vajah.

Domače in seminarske naloge:

Namen domačih in seminarских nalog je dati študentom priložnost za reševanje raznih računskih problemov s samostojnim razvojem algoritmov in njihovim programiranjem (in jih spodbuditi k sprotnemu študiju).

computational geometry.

Tutorial: Students will use the topics given during the lectures to independently solve practical problems (with the assistance of the TAs if needed). They will implement several smaller programs (home works) as well as larger programs (seminars), and present them at the tutorial.

Home works and seminars:

These are necessary for a student to independently practice the design and implementation of algorithms .

Temeljni literatura in viri / Readings:

1. B. Robič: *Algoritmi* (to appear, instead of 2. below)
2. B. Vilfan: *Osnovni algoritmi*, Založba FE in FRI, 2002

Dodatna literatura:

3. T. Cormen et al. *Introduction to Algorithms*, McGraw-Hill, 3rd ed., 2009
4. B. Robič: *Aproksimacijski algoritmi*, Založba FE in FRI, 2. izdaja, 2009

Cilji in kompetence:

Cilj predmeta je pridobiti poglobljeno znanje s področij načrtovanja algoritmov, analize algoritmov, uporabe podatkovnih struktur, izbranih problemov in algoritmov ter ob vsem tem utrjevati in poglobljati znanje programiranja.

Objectives and competences:

To gain deeper knowledge of algorithm design methods, analysis of algorithms, use of data structures , selected problems and algorithms, and at the same time, to improve and deepen programming skills.

Predvideni študijski rezultati:

Znanje in razumevanje:

Sposobnost samostojnega načrtovanja algoritmov in ustreznih podatkovnih struktur pri reševanju računskih problemov, sposobnost analiziranja zahtevnosti problemov in kakovosti rešitev, sposobnost samostojnega razvoja programov.

Uporaba:

Uporaba naučenih principov pri načrtovanju algoritmov in njihovem programiranju.

Refleksija:

Intended learning outcomes:

Knowledge and understanding:

The ability to independently design algorithms and data structures for solving particular computational problems; the ability to independently analyze computational complexity of algorithms (and sometimes problems as well); the ability to independently develop and implement computer programs.

Application: use of the principles and methods in algorithm design and implementation

Razumevanje osnovnih principov načrtovanja algoritmov in razumevanje njihove vloge pri reševanju računskih problemov.
 Prenosljive spretnosti - niso vezane le na en predmet:
 Zmožnost načrtovanja učinkovite oz. primerne algoritmične rešitve različnih problemov, zmožnost uporabe naučenih principov pri programiranju rešitve (ne glede na izbrani programski jezik).

Reflection: understanding of the basic principles of algorithm design and their role in efficient solving of computational problems

Transferable skills: there are many and useful in other subjects. For example, the ability to plan, design, and implement algorithmic solutions to various problems (regardless of the programming language used)

Metode poučevanja in učenja:

Predavanja, domače naloge, seminarski način dela pri vajah. Poudarek je na sprotnem študiju in samostojnem delu pri vajah, seminarških in domačih nalogah.

Learning and teaching methods:

Lectures, tutorial, home works, seminars.

	Delež (v %) / Weight (in %)	Assessment:
Načini ocenjevanja:		
Način: pisni izpit, ustno izpraševanje, naloge, projekt		Type: exam, oral, coursework, project
Sprotno preverjanje: domače naloge, projektno delo	50%	Continuing: homework, project work
Končno preverjanje: pisni in ustni izpit	50%	Final: written and oral exam
Ocene: 6-10 pozitivno, 5 negativno (v skladu s Statutom UL).		Grading: 6-10 pass, 5 fail (according to the rules of University of Ljubljana).

Reference nosilca / Lecturer's references:

Pet najpomembnejših del:

ČIBEJ, U., SLIVNIK, B., ROBIČ, B. The complexity of static data replication in data grids. *Parallel comput.*. 31(8/9):[900]-912, 2005.

SULISTIO, A., ČIBEJ, U., VENUGOPAL, S., ROBIČ, B., BUYYA, R.. A toolkit for modelling and simulating data Grids : an extension to GridSim. *Concurr. comput.*. 20(13):1591-1609, 2008.

TROBEC, R., ŠTERK, M., ROBIČ, B. Computational complexity and parallelization of the meshless local Petrov-Galerkin methods. *Comput. struct.*. 87(1/2):81-90, 2009.

MIHELIČ, J., ROBIČ, B. Flexible-attribute problems. *Comput. Optimiz. appl.* 47(3):553-566, 2010.

MIHELIČ, J., MAHJOUR, A., RAPINE, C., ROBIČ, B. Two-stage flexible-choice problems under uncertainty. *Eur. J. Oper. Res.*. 201(2):399-403, 2010

Celotna bibliografija je dostopna na SICRISu:

<http://sicris.izum.si/search/rsr.aspx?lang=slv&id=5202>.

UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet: Izračunljivost in računska zahtevnost
Course title: Computability and Computational Complexity

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Univerzitetni študijski program računalništva in informatike, 1. stopnja Univerzitetni študijski program prve stopnje Računalništvo in matematika	ni smeri	2	zimski
University study programme Computer and Information Science, 1st cycle University study programme Computer Science and Mathematics , 1st cycle	none	2	fall

Vrsta predmeta / Course type obvezni predmet / compulsory course

Univerzitetna koda predmeta / University course code: 63283

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje Laboratory work	Druge oblike študija Field work	Samost. delo Individ. work	ECTS
45	/	30	/	/	105	6

Nosilec predmeta / Lecturer: prof. dr. Borut Robič

Jeziki / Languages:	Predavanja / Lectures:	slovenščina
	Vaje / Tutorial:	slovenščina

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

**Vsebina:****Predavanja:**

1. *Uvod*: Algoritem intuitivno.
2. *Zgodovina*: Kriza v osnovah matematike 20. stoletja. Reševanje iz krize. Formalni sistemi. Hilbertov program. Godlova izreka.
3. *Uvod v izračunljivost*: Kaj je algoritem in računanje? Računski modeli. Church-Turingova teza. Turingov stroj in različice. Nedeterminizem.
4. Univerzalni TS. Model RAM in splošno namenski računalniki. Izrek o rekurziji, rekurzivno definiranje in računanje.
5. *Neizračunljivost*. Jezik in množica. Odločitveni problemi. Neizračunljivi problemi obstajajo. Metode za dokazovanje neizračunljivosti (diagonalizacija, prevedbe, Riceov izrek) Primeri neizr. problemov in praktične posledice na raznih področjih. (Osnovno o relat. izračunljivosti in hierarhijah.)
6. *Avtomati, gramatike, jeziki*: Končni avtomat, regularna gramatika, izraz in jezik. Skladovni avtomat, kontekstno neodvisna gramatika in jezik. Linearno omejeni avtomat, kontekstno odvisna gramatika in jezik. Primeri in uporaba.
7. *Uvod v računsko zahtevnost*: Časovna, prostorska, in druge zahtevnosti. Lahki in težki problemi. Razreda P, NP, EXP in drugi. NP-polnost/težkost in njeno dokazovanje. Primeri in uporaba.
8. *Obvladovanje težkih problemov*: Osnovno o verjetnostnem,

Content (Syllabus outline):**Lectures:**

1. *Introduction*: Algorithm intuitively.
2. *History*: Foundational crisis in 20th century mathematics. Solving the crisis. Formal systems. Hilbert's program. Godel's theorems.
3. *Introduction to computability*: What is algorithm and computation? Models of comp. Church-Turing thesis. Turing machine and versions. Nondeterminism.
4. Universal TM. RAM model and general purpose computers. Recursion theorem, recursive definitions and execution.
5. *Incomputability*. Sets vs. languages. Decision problems. Incomputable problems exist. Methods of proving incomputability (diagonalization, reductions, Rice's theorem). Examples of incomputable problems and consequences in various fields. (Basics of relative computability and hierarchies.)
6. *Automata, grammars, languages*: Finite automata, regular grammars, expressions and languages. Pushdown automata, context-free grammars and languages. Linear bounded automata, context-sensitive grammars and languages. Examples and application.
7. *Introduction to computational complexity*: Time, space, and other complexities. Easy and hard problems. Classes P, NP, EXP and other complexity classes. NP-completeness/hardness and

aproksimativnem in paralelnem računanju. Osnovno o interaktivnem dokazovanju. Primeri v praksi.

9. *Novejši pristopi*: Osnovno o kvantnem računanju.

Vaje: Na vajah bodo študentje utrjevali snov, podano na predavanjih. Snov bodo uporabili za reševanje praktičnih problemov, pri čemer bo poudarek na samostojnem delu ob pomoči asistentov. Implementirali bodo več manjših programov (kot domače naloge) in obsežnejše programe (kot seminarske naloge), ki jih bodo zagovarjali na vajah.

Domače in seminarske naloge:

Namen domačih nalog je ponuditi študentom priložnost za samostojno reševanje zahtevnejših nalog s področja izračunljivost in računske zahtevnosti, ki poleg domiselnosti zahtevajo nekoliko temeljitejši teoretični premislek. Oboje presega možnosti pri vajah in navaja k samostojnemu delu.

methods of proving it. Examples and applications.

8. *Coping with hard problems*: Basics of randomized, approximation, and parallel computing. Basics of interactive proving. Examples and application.
9. *Recent approaches*: Basics of quantum computing.

Home works and seminars:

Temeljni literatura in viri / Readings:

1. B. Robič: *The Foundations of Computability Theory*, Springer, 2014 (to appear)
2. S.Arora, B.Barak *Computational Complexity: A modern approach*, Cambridge Univ Press (2009)

Dodatna literatura:

3. M. Sipser: *Introduction to the Theory of Computation*, Course Technology (2006)
4. B. Robič: *Aproksimacijski algoritmi*, Založba FE in FRI, 2. izd. (2009)

Cilji in kompetence:

Cilj predmeta je dvojen: 1) študenta opremiti s sodobnim znanjem s področja teoretičnega računalništva in 2) študenta usposobiti, da bo lahko to znanje uspešno uporabljal pri reševanju problemov v praksi

Objectives and competences:

Major part of the course is devoted to computability and computational complexity theory emphasizing on application on various disciplines of computer science. In part the course covers the historical development of the field as well as its recent achievements, again focusing on practical problem solving.

Predvideni študijski rezultati:

Znanje in razumevanje:

Sodobno razumevanja pojmov algoritem, računanje, izračunljivost, računska zahtevnost in obvladljivost ter povezav med njimi.
Sposobnost samostojnega analiziranja

Intended learning outcomes:

Knowledge and understanding:

Student will possess knowledge and skills in computability and computational complexity theory.

Application:

računske zahtevnosti problemov in možnosti za učinkovit izračun (kakovostnih) rešitev.

Uporaba:
Uporaba naučenih pojmov, principov in tehnik pri reševanju konkretnih računskih problemov v praksi.

Refleksija:
Razumevanje postopkov za analizo zahtevnosti računskih problemov in poznavanje strategij in metod za njihovo reševanje.

Prenosljive spretnosti - niso vezane le na en predmet.

Computability and computational complexity theory is fundamental to efficient problem solving, algorithm design and analysis, and design of complex software.

Reflection:
Learning deep and intricate facts of the computability and computation complexity theory and their use in various disciplines in computer science.

Transferable skills:
We will treat the topics with as much of mathematical rigor as necessary for clear and develop a birds-eye look at the theory by explaining the motivation and intuition behind the various notions and facts of this theory .

Metode poučevanja in učenja:

Predavanja, domače naloge, seminarski način dela pri vajah. Poudarek je na sprotne študiju in samostojnem delu pri vajah, seminarskih in domačih nalogah.

Learning and teaching methods:

Lectures and exercise groups, homework assignments.
Frequent homework assignments shall not be time consuming. Some of the homework assignments will be more demanding – projects – which may be distributed to students divided in groups.

Načini ocenjevanja:

Način (pisni izpit, ustno izpraševanje, naloge, projekt):
Oceno sestavljata dva dela: prvi (50%) je za sprotne delo, drugi (50%) pa za ustni in pisni izpit.
Obveznosti predmeta so uspešno opravljene le, če sta oba dela pozitivna.
V sprotne delo sodijo vaje in seminarske naloge.
Ocene: 6-10 pozitivno, 5 negativno (v skladu s Statutom UL).

Delež (v %) /

Weight (in %)

Assessment:

50% 50%	<p>Type: exam, oral, coursework, project Continuing: homework, project work</p> <p>Continuing: homework, project work Final: written and oral exam</p> <p>Grading: 6-10 pass, 5 fail (according to the rules of University of Ljubljana).</p>
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Reference nosilca / Lecturer's references:

Pet najpomembnejših del:

ROBIČ, B. *The Foundations of Computability Theory*, Springer, 2014 (to appear)

BEZENŠEK, M., ROBIČ, B. A survey of parallel and distributed algorithms for the Steiner tree problem. *Int. J. Par. Program.* 42:287-319, 2013

MIHELIČ, J., MAHJOUR, A., RAPINE, C., ROBIČ, B. Two-stage flexible-choice problems under uncertainty. *Eur. J. Oper. Res.* 201(2):399-403, 2010

MIHELIČ, J., ROBIČ, B. Flexible-attribute problems. *Comput. Optimiz. Appl.* 47(3):553-566, 2010

TROBEC, R., ŠTERK, M., ROBIČ, B. Computational complexity and parallelization of the meshless local Petrov-Galerkin methods. *Comput. Struct.* 87(1/2):81-90, 2009.

Celotna bibliografija je dostopna na SICRISu:

<http://sicris.izum.si/search/rsr.aspx?lang=slv&id=5202>.

UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet: Operacijski sistemi
Course title: Operating Systems

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Univerzitetni študijski program prve stopnje Računalništvo in informatika Univerzitetni študijski program prve stopnje Računalništvo in matematika	ni smeri	2	poletni
University study programme Computer and Information Science, 1st cycle University study programme Computer Science and Mathematics , 1st cycle	none	2	spring

Vrsta predmeta / Course type

obvezni predmet / compulsory course

Univerzitetna koda predmeta / University course code:

63217

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje Laboratory work	Druge oblike študija Field work	Samost. delo Individ. work	ECTS
45	/	30	/	/	105	6

Nosilec predmeta / Lecturer:

prof. dr. Borut Robič

**Jeziki /
Languages:**

**Predavanja /
Lectures:** slovenščina
Slovene
Vaje / Tutorial: slovenščina
Slovene

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

Prerequisites:



Vsebina:

Predavanja:

1. Uvod: zgodovina OS, komponente OS, osnovno o organizaciji rač. sistema
2. Strukture v OS: komponente in servisi OS, sistemski klici, sistemski programi, navidezni stroji, razvoj OS
3. Procesi: proces, operacije na procesih, razvrščanje
4. Niti: nit, modeli večnitnosti, primeri operacijskih sistemov
5. Razvrščanje: kriteriji kakovosti, algoritmi, razvrščanje niti, primeri OS
6. Komunikacija: vrste medprocesne komunikacije, strežnik-odjemalec, P2P
7. Sinhronizacija: problem kritičnih odsekov, rešitve, semaforji, klasični sinhronizacijski problemi, monitorji,...
8. Smrtni objem: preprečevanje, ogibanje, zaznavanje, reševanje iz s.o,...
9. Glavni in navidezni pomnilnik: menjavanje, dodeljevanje, odstranjevanje, segmentacija,...
10. Datotečni sistem: datoteka, dostop, mape, souporaba, zaščita, implementacija d.s.,...
11. Pomožni pomnilnik: disk, razvrščanje na disku, upravljanje s prostorom,...
12. Vhodno-izhodni sistem: strojna oprema, vmesnik upor.-V/I, V/I in jedro
13. Zaščita in varnost: cilji, načela, matrika dostopa, pretnje, kriptografija, požarni zid,...
14. OS in porazdeljeni sistemi: problemi zaradi porazdeljenosti, rešitve, trendi
15. OS in namenski sistemi: sistem v realnem času, OS in multimedija, trendi
16. Izbrani primeri sodobnih OS (bodo obravnavani tudi pri točkah zgoraj).

Content (Syllabus outline):

Predavanja:

1. Introduction: history of OS, components of OS, computer-system structures
2. Operating-system structures: OS components and services, system calls, system programs, virtual machines, OS design
3. Processes: process, operations on processes, scheduling
4. Threads: thread, multithreading models, example operating systems
5. Scheduling: scheduling criteria and algorithms, thread scheduling, example OS
6. Communication: models of interprocess communication, client-server, P2P
7. Synchronization: critical-section problem, solutions, semaphore, classical synch. problems, monitors, ...
8. Deadlocks: deadlock prevention, avoidance, and detection, recovery from deadlocks,...
9. Main and virtual memory: swapping, allocation, paging, segmentation,...
10. File-systems: file, access, directory, sharing, protection, file-system implementation,...
11. Mass-storage: discs, disc scheduling, free-space management,...
12. I/O system: I/O hardware, application I/O interface, I/O and kernel
13. Protection and security: goals, principles, access matrix, threats, cryptography, fire-wall ...
14. OS and distributed systems: problems, solutions, trends
15. OS and in special-purpose systems: real-time systems, OS and multimedia, trends
16. Selected examples of OS (will be explained above).

Vaje:

Na vajah bodo študentje utrjevali snov, ki je bila podana na predavanjih. Snov bodo uporabili za reševanje praktičnih problemov s področja OS, pri čemer bo poudarek na samostojnem delu ob pomoči asistentov. Implementirali bodo več manjših programov (tudi kot domače naloge) pa tudi obsežnejše programe (kot seminarske naloge). Naloge bodo definirane tako, da se bodo nadgrajevale in dopolnjevale v preprosto, a delujočo OS. Študentje bodo naloge zagovarjali na vajah.

domače in seminarske naloge:

Namen domačih in seminarских nalog je študentom omogočiti, da v praksi zasnujejo zelo preprosto, a delujočo OS ali njegove dele in se tudi tako spoznajo s problematiko operacijskih sistemov.

Tutorial:

Students will use the topics given during the lectures to independently solve practical problems (with the assistance of the TAs if needed). They will implement several smaller programs (home works) as well as larger programs (seminars) that can be parts of a simple OS. Students will present their results at the tutorial.

Home works and seminars:

These are necessary for a student to understand how an operating system works and independently practice the design and implementation of a simple operating system.

Temeljna literatura in viri / Readings:

1. A. Silberschatz et al.: Operating systems concepts, Wiley, 2007.
2. B. Robič: Operacijski sistemi (v pripravi).

Dodatna literatura

1. A. Tanenbaum, A. Woodhull: Operating systems: design and implementation, Prentice-Hall, 2006.

Cilji in kompetence:

Cilj predmeta je podati kakovostno znanje s področja sodobnih operacijskih sistemov: obrazložiti vlogo OS v različnih vrstah računalniških sistemov (povezanost s strojno in programsko opremo ter uporabnikom); pojasniti naloge, zgradbo, delovanje, implementacijo in sodelovanje sestavnih delov OS; in seznaniti poslušalca s trendi in razvojnimi alternativami OS.

Objectives and competences:

To gain good knowledge of operating systems; to understand the role of OS in various computer systems; to understand the trends in the development of OS

Predvideni študijski rezultati:

Znanje in razumevanje:
Poznavanje komponent sodobnega operacijskega sistema, njihove vloge, delovanja in posebnosti. Uporaba:
Uporaba naučenih principov pri uporabi katerega koli operacijskega sistema in pri načrtovanju sistemske programske opreme.

Intended learning outcomes:

Knowledge and understanding:
Knowledge of the components of a modern OS, their role in computer systems, their internal working and properties

Application:
The knowledge is useful in the design of any

Usposobljenost za načrtovanje računalniških sistemov.
 Refleksija:
 Razumevanje osnovnih principov delovanja sodobnih operacijskih sistemov in razumevanje njihove vloge v sodobnem računalniškem sistemu.
 Prenosljive spretnosti - niso vezane le na en predmet:
 Lažje načrtovanje in razvoj systemske programske opreme (npr, zbirnikov, nalagalnikov, povezovalnikov, gonilnikov).
 Lažja prilagoditev na nov OS.

operating system and any other system software as well
 Reflection:
 Understanding how the OS works and how together with hardware makes a computer system useful.
 Transferable skills:
 these are many and useful in other subjects. For example, the ability to plan, design, and implement system programs and especially large programs.

Metode poučevanja in učenja:

Predavanja, domače naloge, seminarski način dela pri vajah. Poudarek je na sprotnem študiju in samostojnem delu pri domačih nalogah, vajah in seminarskih nalogah.

Learning and teaching methods:

Lectures, tutorial, home works, seminars.

Načini ocenjevanja:	Delež (v %) / Weight (in %)	Assessment:
Način (pisni izpit, ustno izpraševanje, naloge, projekt): Sprotno preverjanje (domače naloge, kolokviji in projektno delo) Končno preverjanje (pisni in ustni izpit) Ocene: 6-10 pozitivno, 5 negativno (v skladu s Statutom UL).	50% 50%	Type (exam, oral, coursework, project): Continuing (homework, project work) Final (written and oral exam) Grading: 6-10 pass, 5 fail according to the rules of University of Ljubljana).

Reference nosilca / Lecturer's references:

Pet najpomembnejših del:

ČIBEJ, U., SLIVNIK, B., ROBIČ, B. The complexity of static data replication in data grids. *Parallel comput.*. 31(8/9):[900]-912, 2005.

SULISTIO, A., ČIBEJ, U., VENUGOPAL, S., ROBIČ, B., BUYYA, R.. A toolkit for modelling and simulating data Grids: an extension to GridSim. *Concurr. comput.*. 20(13):1591-1609, 2008.

TROBEC, R., ŠTERK, M., ROBIČ, B. Computational complexity and parallelization of the meshless

local Petrov-Galerkin methods. *Comput. struct.*. 87(1/2):81-90, 2009.

MIHELIČ, J., ROBIČ, B. Flexible-attribute problems. *Comput. Optimiz. appl.* 47(3):553-566, 2010.

MIHELIČ, J., MAHJOUR, A., RAPINE, C., ROBIČ, B. Two-stage flexible-choice problems under uncertainty. *Eur. J. Oper. Res.*. 201(2):399-403, 2010

Celotna bibliografija je dostopna na SICRISu:

<http://sicris.izum.si/search/rsr.aspx?lang=slv&id=5202>.

UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet:	Računska zahtevnost in hevristično programiranje
Course title:	Computation Complexity and Heuristic Programming

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Univerzitetni študijski program prve stopnje Računalništvo in informatika Univerzitetni študijski program prve stopnje Računalništvo in matematika	Modul: Algoritmi in sistemski programi	3	zimski
University study programme Computer and Information Science, 1st cycle University study programme Computer Science and Mathematics , 1st cycle	Module: Algorithms and System Utilities	3	fall

Vrsta predmeta / Course type izbirni predmet /elective course

Univerzitetna koda predmeta / University course code: 63263

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje Laboratory work	Druge oblike študija Field work	Samost. delo Individ. work	ECTS
45	10	20	/	/	105	6

Nosilec predmeta / Lecturer: izr. prof. dr. Marko Robnik Šikonja

Jeziki / Languages:	Predavanja / Lectures:	slovenščina Slovene
	Vaje / Tutorial:	slovenščina Slovene

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

Poznavanje osnovnih algoritmov in podatkovnih struktur.

Prerequisites:

Knowledge of basic algorithms and data structures.

Vsebina:

Vsebina predmeta:

1. Analiza rekurzivnih algoritmov: substitucijska metoda, rešitev za algoritme deli in vladaj, metoda Akra-Bazzi.
2. Verjetnostna analiza: definicija, analiza stohastičnih algoritmov.
3. Randomizacija algoritmov.
4. Amortizirana analiza kompleksnosti algoritmov.
5. Reševanje linearnih rekurzivnih enačb.
6. Razreda P in NP: definicija, NP-polnost, standardni NP-polni problemi.
7. Prevedljivost in reševanje NP-polnih problemov.
8. Aproksimacijski algoritmi.
9. Kombinatorična optimizacija, lokalno preiskovanje, simulirano ohlajanje.
10. Linearno programiranje za reševanje problemov.
11. Metaheuristicke in stohastično preiskovanje: vodeno lokalno preiskovanje, preiskovanje s spremenljivo soseščino, tabu preiskovanje.
12. Populacijske metode: genetski algoritmi, optimizacija z rojem delcev, diferencialna evolucija, umetni imunski sistemi.

Content (Syllabus outline):

Lecture topics:

1. Analysis of recursive algorithms: substitution method, solution for divide and conquer approach, Akra-Bazzi method.
2. Probabilistic analysis: definition, analysis of stochastic algorithms.
3. Randomization of algorithms.
4. Amortized analysis of algorithm complexity.
5. Solving linear recurrences.
6. Classes P and NP: definitions, NP-completeness, standard NP-complete problems.
7. Reducibility and solving NP-complete problems.
8. Approximation algorithms.
9. Combinatorial optimization, local search.
10. Linear programming for problem solving.
11. Metaheuristics and stochastic search: guided local search, variable neighbourhood search, and tabu search.
12. Population methods: genetic algorithms, particle swarm optimization, differential evolution, artificial immune systems.

Temeljni literatura in viri / Readings:

1. T.H. Cormen, C.E. Leiserson, R.L. Rivest, C. Stein: *Introduction to Algorithms, 3rd edition*. MIT Press, 2009
2. R. Sedgewick, P. Flajolet: *An Introduction to the Analysis of Algorithms*. Addison-Wesley, 1995
3. M. Gendreau, J.-Y. Potvin: *Handbook of Metaheuristics, 2nd Edition*. Springer, 2010.

Dodatna literatura je na razpolago v obliki znanstvenih člankov.

Additional literature is available in the form of scientific papers.

Cilji in kompetence:

Cilj predmeta je študente seznaniti z analizo algoritmov, računsko zahtevnostjo in učinkovitim reševanjem zahtevnih problemov, ki potrebujejo posebne pristope in optimizacijske tehnike.

Splošne kompetence:

- sposobnost kritičnega razmišljanja,
- sposobnost definiranja, razumevanja in reševanja ustvarjalnih profesionalnih izzivov,
- sposobnost prenosa znanja in pisne komunikacije v domačem in tujem jeziku.

Predmetno-specifične kompetence:

- uporaba metod za analizo rekurzivnih algoritmov: substitucijska metoda, drevesna metoda.
- metode za analizo algoritmov deli in vladaj: mojstrova metoda in metoda Akra-Bazzi
- verjetnostna analiza algoritmov,
- uporaba amortizirane analize algoritmov,
- prevedba nekaterih NP-polnih problemov,
- poznavanje ideje aproksimacijskih tehnik,
- poznavanje hevrističnih pristopov in meta-hevristik za reševanje težkih problemov,
- uporaba populacijskih optimizacijskih metod in principov evolucijskega računanja.

Objectives and competences:

The goal of the course is the students to become acquainted with the analysis of algorithms, computational complexity and techniques for efficient solving of difficult problems, requiring optimization techniques and approximations.

General competences:

- ability of critical thinking,
- the ability to define, understand and solve creative professional challenges in computer and information science,
- the ability of knowledge transfer and writing skills in the native language as well as a foreign language.

Subject-specific competences:

- use of methods for analysis of recursive algorithms; substitution method, recursive-tree method,
- use of methods for analysis of divide-and-conquer algorithms: master theorem and Akra-Bazzi method,
- probabilistic analysis of algorithms,
- use of amortized analysis of algorithms,
- reduction of some NP-complete problems,
- use of heuristic methods and metaheuristics, for solving complex problems,
- use of population techniques and principles of evolutionary computation in optimization.

Predvideni študijski rezultati:**Znanje in razumevanje:**

Poznavanje različnih tehnik in metod, ki se uporabljajo pri analizi kompleksnosti algoritmov in pri reševanju zahtevnih optimizacijskih in kombinatoričnih problemov. Sposobnost za analizo, sintezo in predvidevanje rešitev konkretnih problemov z uporabo znanstvenih metod.

Uporaba:

Uporaba predstavljenih metod na konkretnih problemih iz tehničnega in poslovnega okolja. Poznavanje in uporaba orodij za reševanje in analizo tovrstnih problemov. Študenti morajo biti za dani problem sposobni presoje, katero od predstavljenih tehnik uporabiti, ter sestaviti prototip rešitve.

Refleksija:

Spoznavanje in razumevanje pomena temeljnega matematičnega in statističnega znanja, uglašenosti med teorijo in njeno aplikacijo na konkretnih primerih analize algoritmov in s področja heurističnega programiranja. Avtonomija, (samo) kritičnost, (samo) refleksija, težnja po kakovosti.

Prenosljive spretnosti - niso vezane le na en predmet:

Sposobnost pridobivanja, selekcije in ocenjevanja novih informacij in možnost ustrezne interpretacije v kontekstu. Sposobnost za upravljanje s časom, za samo pripravo in načrtovanje ter samokontrolo izvajanja načrtov in postopkov. Timsko delo, pisanje poročil, javne predstavitve rezultatov. Koherentno obvladanje temeljnega znanja, pridobljenega pri obveznih predmetih, ter sposobnost povezovanja znanja z različnih področij in njegova uporaba v praksi.

Intended learning outcomes:**Knowledge and understanding:**

Knowledge of several techniques and methods, used for analysis of algorithms and for solving complex optimization and combinatorial problems. The ability for analysis, synthesis and anticipation of solutions and their consequences for target problems using the scientific methodology.

Application:

The use of the presented methods on target problems from scientific and business environment. The understanding and usage of tools for analysis and solving such problems. The students are able to decide which of the presented techniques should be used for a given problem, and to develop a prototype solution.

Reflection:

The recognition and understanding of the importance of basic mathematical and statistical knowledge, the relation between theory and its application in concrete examples of analysis of algorithms and heuristic programming. Autonomy, (self) criticalness, (self) reflexivity, aspiration for quality.

Transferable skills:

The ability to receive, select and evaluate new information and a proper interpretation in a context. A self-control and ability to manage limited time when preparing, planning and implementing plans and processes. Team work, writing of reports, public presentations of the results. Coherent mastering of basic knowledge, gained through mandatory courses, and the ability to combine the knowledge from different fields and apply it in practice.

Metode poučevanja in učenja:**Learning and teaching methods:**

Predavanja, naloge s pisnimi poročili in z ustnimi nastopi in predstavitvami, seminarski način dela in domače naloge, ki stimulirajo sproten študij. Študenti bodo v manjših skupinah samostojno reševali in analizirali zahtevne optimizacijske probleme. Skupine bodo svoje naloge, analize in rešitve opisale v pisnem poročilu in predstavile ostalim v obliki kratke predstavitve, ki se ocenjuje skupaj s poročilom.

Lectures, assignments with written and oral demonstrations and presentations, seminar works and home works, which stimulate continuous learning. The emphasis is on the continuous study and on autonomous work on assignments and seminars. Students form small project teams and autonomously solve assignments based on real-life problems. The teams describe their solutions in written reports and prepare short oral presentations. Written reports and oral presentations are graded.

Načini ocenjevanja:

Delež (v %) / **Assessment:**
Weight (in %)

Način: pisni in ustni izpit, domače naloge, predstavitev projekta, projekt.		Type: oral and written examination, coursework, project presentation, project.
Sprotno preverjanje: domače naloge, projektno delo.	50%	Continuing: homework, project work.
Končno preverjanje: pisni in ustni izpit.	50%	Final: written and oral exam.
Ocene: 6-10 pozitivno, 5 negativno (v skladu s Statutom UL).		Grading: 6-10 pass, 5 fail (according to the rules of University of Ljubljana).

Reference nosilca / Lecturer's references:**Pet najpomembnejših del/ Five most important works:**

1. ROBNIK ŠIKONJA, Marko. Data generators for learning systems based on RBF networks. *IEEE transactions on neural networks and learning systems*, May 2016, vol. 27, no. 5, pp. 926-938.
2. ROBNIK ŠIKONJA, Marko, VANHOOF, Koen. Evaluation of ordinal attributes at value level. *Data mining and knowledge discovery*, 2007, vol. 14, no. 2, str. 225-243.
3. ROBNIK ŠIKONJA, Marko, KONONENKO, Igor. Theoretical and empirical analysis of ReliefF and RReliefF. *Machine learning*, 2003, 53:23-69.
4. ROBNIK ŠIKONJA, Marko, KONONENKO, Igor. Explaining classifications for individual instances. *IEEE Transactions on Knowledge and Data Engineering*, 2008, 20(5):589-600.
5. ROBNIK ŠIKONJA, Marko, KONONENKO, Igor, ŠTRUMBELJ, Erik: Quality of Classification Explanations with PRBF. *Neurocomputing*, 96:37-46, 2012

Celotna bibliografija je dostopna na SICRISu

<http://sicris.izum.si/search/rsr.aspx?lang=slv&id=8741>.

Complete bibliography is available in SICRIS:

[http://sicris.izum.si/search/rsr.aspx?lang=eng&id=8741.](http://sicris.izum.si/search/rsr.aspx?lang=eng&id=8741)

UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet: Planiranje in upravljanje informatike
Course title: Informatics Planning and Management

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Univerzitetni študijski program prve stopnje Računalništvo in informatika Interdisciplinarni univerzitetni študijski program prve stopnje Računalništvo in in matematika Interdisciplinarni univerzitetni študijski program prve stopnje Upravna informatika	Modul: Obvladovanje informatike	3	poletni
University study programme Computer and Information Science, 1st cycle University study programme Computer Science and Mathematics , 1st cycle Interdisciplinary university study programme in Administrative Informatics 1 st Cycle	Module: Management of Information Systems	3	spring

Vrsta predmeta / Course type

izbirni predmet / elective course
obvezni predmet / compulsory course

Univerzitetna koda predmeta / University course code:

63253

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje Laboratory work	Druge oblike študija Field work	Samost. delo Individ. work	ECTS
45	/	30	/	/	105	6

Nosilec predmeta / Lecturer:

doc. dr. Rok Rupnik

**Jeziki /
Languages:**

**Predavanja /
Lectures:** slovenščina
Slovene
Vaje / Tutorial: slovenščina

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:**Prerequisites:****Vsebina:**

Temeljna vsebinska področja predmeta zajemajo naslednje:

- opredelitev in pregled obvladovanja informatike skozi čas:
 - opredelitev in časovni pregled strateškega planiranja, poslovno-informacijskih arhitektur, standardov, metodologij in ogrodij;
- strateško planiranje informatike:
 - poslovna strategija, strateški elementi, analiza stanja, tehnološka vizija, načrt informacijske tehnologije, prioritete projektov, operativni plan;
- metodologije strateškega planiranja informatike:
 - pregled metodologij strateškega planiranja, EMRIS (Enotna metodologija razvoja informacijskih sistemov);
- poslovno-informacijske arhitekture:
 - arhitekturne ravni – poslovna, aplikativna, tehnološka, usklajenost poslovne in informacijske domene, storitveno usmerjena arhitektura (SOA), konceptualni model arhitekture (ISO 1471);
- arhitekturne metode in ogrodja:
 - Zachman, Togaf, Archimate;

Content (Syllabus outline):

Basic course content areas include the following:

- definition and review of IT governance through time:
 - definition and time review of strategic IS/IT planning, enterprise architecture, standards, methodologies and frameworks;
- strategic IS/IT planning:
 - business strategy, strategic elements, analysis of the existing situation, technological vision, information technology plan, projects priorities, operation plan;
- strategic IS/IT planning methodologies:
 - review of strategic IS/IT planning methodologies, EMRIS (Unified information systems development methodology);
- enterprise architectures:
 - architecture layers - business, application and technology, business –IT alignment, service-oriented architecture (SOA), conceptual architecture model (ISO 1471);
- architecture methods and frameworks:
 - Zachman, Togaf, Archimate;
- business and IT management instruments:

- instrumenti upravljanja poslovnih sistemov in instrumenti upravljanja informatike:
 - EFQM, BSC, standardi ISO (9000, 17799, 27000);
- organizacija informatike:
 - organizacija informatike v poslovnem sistemu, vrste organizacijskih shem organizacijske enote za informatiko.
- procesi informatike:
 - plansko organizacijski, izvedbeni, podporni in nadzorni.
- vrednotenje uspešnosti informatike in ravni zrelosti (CMMI),
- ogrodja in najboljše prakse upravljanja informatike:
 - COBIT, ITIL, upravljanje varnosti, zagotavljanje neprekinjenosti poslovanja.

- EFQM, BSC, ISO standards (9000, 17799, 27000);
- organizing the IT function:
 - organizing the IT function in an enterprise, different organizational charts for IT function.
- IT processes:
 - plan and organize, implementation, support and control.
- Evaluation of IT success and levels of maturity (CMMI)
- Frameworks and best practices for IT governance:
 - COBIT, ITIL, security management, business continuity.

Temeljni literatura in viri / Readings:

- Strategic Planning, George A. Steiner, Free Press, 2008
- Executive's Guide to IT Governance: Improving Systems Processes with Service Management, COBIT, and ITIL, Wiley, 2013
- IT Governance: Policies & Procedures, Michael Wallace, Larry Webber, Wolters Kluwer Law & Business, 2013

Cilji in kompetence:

Cilj predmeta je študentom predstaviti osnovne pojme, pristope, metode in instrumente upravljanja informatike v poslovnih sistemih. Gre za področje strateškega planiranja, poslovno-informacijskih arhitektur ter drugih mehanizmov celostnega obvladovanja informatike.

Objectives and competences:

The aim of the course is to present students key concepts, methods and instruments for IT governance in enterprises. Content areas include strategic IS/IT planning, enterprise architectures and other mechanisms for holistic IT governance.

Predvideni študijski rezultati:

Znanje in razumevanje:
 Poznavanje pristopov, metod, arhitektur ter instrumentov upravljanja informatike.
 Razumevanje strateškega planiranja in izbranih metod upravljanja informatike.
 Uporaba:

Intended learning outcomes:

Knowledge and understanding:
 Knowledge of approaches, methods, architectures and IT governance instruments.
 Understanding of strategic IS/IT planning and selected methods of IT governance.
 Application:

Uporaba mehanizmov upravljanja informatike pri delu informatika.

Refleksija:

Razumevanje skladnosti med teorijo upravljanja informatike in praktičnim ravnanjem na podlagi konkretnih primerov uporabe v poslovnih sistemih ter najboljših praks.

Prenosljive spretnosti - niso vezane le na en predmet:

Metode upravljanja informatike povezujejo med seboj različne vidike informatike, predstavljajo celostno obvladovanje informatike in so tako uporabne v okviru vseh področij informatike kot dela poslovnega sistema.

Use of IT governance mechanisms at daily work of informatics professionals.

Reflection:

Understanding the consistency between theory of IT governance and its practical use based on concrete examples of applications in enterprises and best practices.

Transferable skills - not tied to just one course: IT governance methods interconnect various informatics related aspects, enable holistic IT governance and are therefore useful in the context of all areas of informatics as a part of an enterprise.

Metode poučevanja in učenja:

Predavanja in laboratorijske vaje ter seminarji. V okviru laboratorijskih vaj in seminarjev gre za skupinsko delo.

Learning and teaching methods:

Lectures, laboratory exercises and seminars. Laboratory exercises and seminars are organised as teamwork.

Delež (v %) /

Weight (in %)

Načini ocenjevanja:

Assessment:

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

- ena seminarska naloga
- dva kolokvija med semestrom ali ustni izpit
- sodelovanje na predavanjih

45%

45%

10%

Ocene: 6-10 pozitivno, 5 negativno (v skladu s Statutom UL).

Type (examination, oral, coursework, project):

- one project
- two examinations during semester or oral examination
- active participation on lectures

Grading: 6-10 pass, 5 fail (according to the UL Statutes).

Reference nosilca / Lecturer's references:

Pet najpomembnejših del:

- HOVELJA, Tomaž, VASILECAS, Olegas, RUPNIK, Rok. A model of influences of environmental stakeholders on strategic information systems planning success in an enterprise. Technological and economic development of economy, ISSN 2029-4913. [Print ed.], 2013, vol. 19, no. 3, str. 465-488
- HOVELJA, Tomaž, VASILECAS, Olegas, RUPNIK, Rok. A novel approach for the evaluation of investments in preconfigured software products for enterprises that organisationally differ

from enterprises in USA and Germany, *Ciência e Técnica Vitivinícola Journal* (ISSN: 0254-0223), v tisku

- HOVELJA, Tomaž, ROŽANEC, Alenka, RUPNIK, Rok. Measuring the success of the strategic information systems planning in enterprises in Slovenia. *Management*, ISSN 1331-0194, 2010, vol. 15, no. 2, str. 25-46
- Metodologija strateškega planiranja
- Rok Rupnik (glavni avtor s soavtorji). *Enotna metodologija razvoja informacijskih sistemov. [Zv. 2], Strateško planiranje. 2. izd.* Ljubljana: Vlada Republike Slovenije, Center Vlade RS za informatiko, 2003. XV, 446 str., ilustr. ISBN 961-6389-08-4
- Glavni avtor strateških planov informatike za vsrto večjih slovenskih podjetij: SŽ, Elektro Celja, Elektro Ljubljana, ELES, Plinovodi, Dravske elektrarne Maribor.

UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet: Razvoj inteligentnih sistemov
Course title: Development of Intelligent Systems

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Univerzitetni študijski program prve stopnje Računalništvo in informatika Interdisciplinarni univerzitetni študijski program prve stopnje Računalništvo in matematika	Modul: Umetna inteligenca	3	poletni
University study programme Computer and Information Science, 1st cycle Interdisciplinary university study programme Computer Science and Mathematics, 1st cycle	Module: Artificial intelligence	3	spring

Vrsta predmeta / Course type

izbirni predmet /elective course

Univerzitetna koda predmeta / University course code:

63268

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje Laboratory work	Druge oblike študija Field work	Samost. delo Individ. work	ECTS
45	/	30	/	/	105	6

Nosilec predmeta / Lecturer:

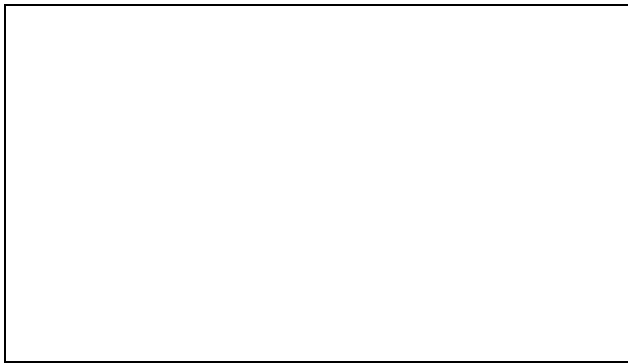
izr. prof. dr. Danijel Skočaj

**Jeziki /
Languages:**

**Predavanja /
Lectures:** angleščina
English
Vaje / Tutorial: angleščina
English

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

Prerequisites:

**Vsebina:**

Predmet bo v teoriji in na praktičnih primerih predstavil sledeče vsebine:

1. Tehnologije in orodja za razvoj inteligentnih sistemov: uvod
2. Značilne aplikacije inteligentnih tehnologij
3. Tehnološke platforme in razvojne metodologije
4. Orodja sistemov umetnega zaznavanja, strojnega učenja in sklepanja, s poudarkom na tehnikah njihove integracije
5. Pristopi k integraciji tehnik umetnega zaznavanja, strojnega učenja in načrtovanja akcij v agentni sistem, ki deluje v realnem času
6. Specifične lastnosti senzorsko-robotskih sistemov
7. Osnove mobilne robotike
8. Študijski primeri razvoja kompleksnih inteligentnih sistemov

Na predavanjih bodo študenti spoznavali ključne tehnologije in orodja, s katerimi bodo tekom semestra na vajah in v okviru projektov oz. seminarskih nalog reševali praktične probleme. Pri tem bodo kombinirali znanja, ki so jih pridobili pri predmetih Inteligentni sistemi in Umetno zaznavanje istega modula. Poudarek bo na razvoju praktičnih, delujočih rešitev v simulacijskih okoljih in predvsem na razvoju praktičnih rešitev, ki bodo v realnem času delovale na primernih robotskih platformah. Pri tem bodo študenti spoznali odprtokodna in prostodostopna okolja in orodja za razvoj inteligentnih sistemov.

Content (Syllabus outline):

During the course the following topics will be presented:

1. Technologies and tools for the development of intelligent systems: an introduction
2. Typical applications of intelligent technologies
3. Technological platforms and development methodologies
4. Tools for machine perception, machine learning and reasoning, with the emphasis on the techniques for integration of these tools
5. Approaches to the integration of machine perception, learning, and planning into an artificial real-time agent system
6. Specific properties of robotic systems
7. Basics of mobile robotics
8. Case studies of the development of complex intelligent systems

The lectures will familiarize the students with key technologies and tools. The students will use these on practical problems within the scope of laboratory classes and projects. They will combine the knowledge and skills obtained in Artificial Intelligence and Machine Perception classes from the same course module. The emphasis of this course will be on the development of practical and functional implementations in both in simulation environments and especially in real-time systems operating on robot platforms. The implementations will be developed in open-

source frameworks and tools for development of intelligent systems.

Temeljni literatura in viri / Readings:

- Dokumentacija prostodostopnega Robotskega operacijskega sistema ROS
Documentation of the open source Robot Operating System ROS
<http://www.ros.org>.
- Dokumentacija prostodostopne knjižnice za delo s slikovnimi in 3D podatki PCL
Documentation of the open source Point Cloud Library PCL
<http://pointclouds.org>.
- Dokumentacija prostodostopne knjižnice računalniškega vida za delo s slikami OpenCV
Documentation of the open source library for computer vision OpenCV
<http://opencv.org>
- S. Thrun, W. Burgard, D. Fox, Probabilistic Robotics (Intelligent Robotics and Autonomous Agents series), The MIT Press, 2005.

Cilji in kompetence:

Cilj predmeta je študente naučiti povezati ter v praksi uporabiti znanja s področij umetne inteligence in umetnega zaznavanja v namene samostojnega razvoja inteligentnega sistema. Pri predmetu se bodo naučili pravilno zasnovati inteligentni sistem, izbrati ustrezne metode in orodja, implementirati nove komponente ter te z že obstoječimi integrirati v delujoč robotski sistem.

Študentje bodo razvijali sposobnosti kritičnega in analitičnega razmišljanja. Osvojili bodo tudi veščine iskanja po ustreznih podatkovnih virih, najdeno informacijo pa bodo znali tudi kritično ovrednotiti. Osvojili bodo tudi sposobnost apliciranja osvojenega znanja za reševanje tehničnih problemov in sposobnost samostojnega opravljanja inženirskih nalog na področju inteligentne robotike, kjer bodo sposobni samostojnega reševanja specifičnih dobro opredeljenih nalog. Ker bo večino dela potekala v skupinah, bodo študentje osvojili tudi veščine skupinskega dela.

Objectives and competences:

The course aims at teaching the students to develop an intelligent system by integrating techniques from artificial intelligence and machine perception. Students will learn how to design an intelligent system, how to select which tools and methods to use, and how to implement new components and integrate them into a functional robot system.

The students will develop skills in critical and analytical thinking. They will also acquire the ability to search knowledge sources and to search for resources and critically evaluate information. They will acquire the ability to apply the acquired knowledge in independent work for solving technical problems and to independently perform engineering tasks in the field of intelligent robotics. They will be able to solve specific well-defined tasks from this area. Since most of the work will be performed in teams, the students will also acquire the ability of team work.

Predvideni študijski rezultati:

Znanje in razumevanje: Poznavanje metod in orodij umetnega zaznavanja in umetne inteligence, njihove soodvisnosti ter načinov za njihovo integracijo v delujoče sisteme.

Uporaba: Uporaba metod in orodij umetnega zaznavanja in umetne inteligence, načrtovanje integriranih inteligentnih sistemov ter implementacija teh sistemov za reševanje praktičnih problemov.

Refleksija: Razumevanje primernosti teoretičnih metod za reševanje praktičnih primerov ter njihovih omejitev, sposobnost analitičnega razmišljanja, sposobnost analize in reševanja praktičnih problemov z razvojem inteligentnih sistemov.

Prenosljive spretnosti: Kombiniranje znanj pridobljenih pri predmetih s področja umetnega zaznavanja in inteligence, multidisciplinarni pristopi, spretnosti iskanja in uporaba literature, uporaba primerne (predvsem odprtokodne) programske opreme, identifikacija in reševanje kompleksnih problemov.

Intended learning outcomes:

Knowledge and understanding: Knowledge on methods and tools from machine perception and artificial intelligence and their integration within real-world functional systems.

Application: The application of techniques from machine perception and artificial intelligence, design and implementation of integrated intelligent systems for solving practical problems.

Reflection: Understanding the suitability of theoretical methods for solving practical problems, as well as understanding their requirements and limitations. The ability of analyzing and solving problems by developing intelligent systems.

Transferable skills: Combining the knowledge and skills the students learned during the courses on Artificial Intelligence and Machine perception, multidisciplinary approach, skills for searching and using the literature, application of suitable (primarily open source) software and hardware, identification and solving of complex problems.

Metode poučevanja in učenja:

Predavanja s podporo avdio-vizualne opreme, laboratorijske vaje v računalniški učilnici z ustrezno strojno in programsko opremo, vključno s primernimi senzorsko-robotskimi platformami. Delo posamezno in v skupinah. Velik poudarek na praktičnem razvojnem delu in reševanju problemov ter implementaciji na robotskih sistemih.

Learning and teaching methods:

Lectures with the appropriate audio-visual equipment in a classroom with suitable hardware and software, including appropriate robot platforms. Individual and group work. Emphasis on hands-on approaches and problem solving including implementation of the developed solutions on robotic systems.

Delež (v %) /

Weight (in %)

Načini ocenjevanja:**Assessment:**

Način (pisni izpit, ustno izpraševanje, naloge, projekt): Sprotno preverjanje (domače naloge in projektno delo)	50%	Type (examination, oral, coursework, project): Continuing (homework, project work)
Končno preverjanje (izpitna naloga in	50%	Final (project and oral exam)

ustni izpit)		
Ocene: 6-10 pozitivno, 5 negativno (v skladu s Statutom UL).		Grading: 6-10 pass, 5 fail (according to the rules of University of Ljubljana).

Reference nosilca / Lecturer's references:

Pet najpomembnejših del:

- Skočaj D, Vrečko A, Mahnič M, Janiček M, Kruijff G-J, Hanheide M, Hawes N, Wyatt J, Keller T, Zhou K, Zillich M, Kristan M (2016) An integrated system for interactive continuous learning of categorical knowledge. *Journal of experimental & theoretical artificial intelligence*, vol. 28, iss. 5, str. 823-848.
- Ridge B, Leonardis A, Ude A, Deniša M, Skočaj D (2015) Self-supervised online learning of basic object push affordances. *International journal of advanced robotic systems*, vol. 12, str. 24-1-24-18.
- Uršič P, Tabernik D, Boben M, Skočaj D, Leonardis A, Kristan M (2013) Room categorization based on a hierarchical representation of space. *International journal of advanced robotic systems*, vol. 10, str. 1-13.
- JL Wyatt, Aydemir A, Brenner M, Hanheide M, Hawes N, Jensfelt P, Kristan M, Kruijff G-J M, Lison P, Pronobis A, Sjöo K, Vrečko A, Zender H, Zillich M, Skočaj D (2010) Self-understanding and self-extension: a systems and representational approach. *IEEE Trans Auton Ment Dev* 2(4): 282-303.
- Skočaj D, Leonardis A, Bischof H (2007) Weighted and robust learning of subspace representations. *Pattern Recogn* 40 (5): [1556]-1569.

Celotna bibliografija izr. prof. dr. Skočaja je dostopna na SICRISu:

<http://sicris.izum.si/search/rsr.aspx?lang=slv&id=10425>.

UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet:	Prevajalniki
Course title:	Compilers

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Univerzitetni študijski program prve stopnje Računalništvo in informatika Univerzitetni študijski program prve stopnje Računalništvo in matematika	Modul: Algoritmi in sistemski programi	3	poletni
University study programme Computer and Information Science, 1st cycle University study programme Computer Science and Mathematics , 1st cycle	Module: Algorithms and system programs	3	spring

Vrsta predmeta / Course type

izbirni predmet /elective course

Univerzitetna koda predmeta / University course code:

63265

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje Laboratory work	Druge oblike študija Field work	Samost. delo Individ. work	ECTS
45	/	30	/	/	105	6

Nosilec predmeta / Lecturer:

doc. dr. Boštjan Slivnik

**Jeziki /
Languages:**

Predavanja / Lectures:	slovenščina Slovene
Vaje / Tutorial:	slovenščina Slovene

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

Prerequisites:



Vsebina:

1. Uvod:
razbitje prevajalnika na prednji in zadnji del, zgradba prevajalnika kot cevovoda, izbira prevajanega programskega jezika in ciljnega zbirnika.
2. Leksikalna analiza:
opis simbolov programskega jezika z regularnimi izrazi in razbitje prevajanega programa na osnovne simbole;
- domača naloga: izdelava leksikalnega analizatorja na osnovi končnih avtomatov.
3. Sintaksna analiza:
opis sintakse s kontekstno neodvisno gramatiko, postopek sintaksne analize in reševanje iz napak med sintaksno analizo;
- domača naloga: izdelava sintaksnega analizatorja na osnovi skladovnega avtomata po algoritmu LR.
4. Abstraktna sintaksa:
poenostavljena interna predstavitev prevajanega programa;
- domača naloga: generiranje abstraktnega sintaksnega drevesa prevajanega programa.
5. Semantična analiza:
analiza podatkovnih tipov, (ne)dosegljivosti kode,...;
- domača naloga: izdelava semantičnega analizatorja za preverjanje tipov.
6. Klicni zapisi:
klicni zapisi za aktivacijo (gnezdenih, rekurzivnih) podprogramov, uporaba

Content (Syllabus outline):

1. Introduction:
Decomposition of a compiler into front end and back end. Compiler as a staged pipeline. Choosing the source program language and the target assembler.
2. Lexical analysis:
describing programming language symbols with regular expressions, breaking the compiled program into lexical tokens
Homework: construction of lexical analyzer based on finite automata.
3. Parsing:
describing syntax with a context-free grammar, parsing procedure and error recovery
Homework: construction of stack-based LR(k) syntax analyzer
4. Abstract syntax:
simplified internal representation of the compiled program
Homework: generating an abstract syntax tree of the compiled program.
5. Semantic analysis:
type checking, unreachable code detection,...
Homework: construction of semantic analyzer for type-checking.
6. Activation records:
description of records for activation of nested or recursive functions, and their implementation with stack or heap.
Homework: activation records design
7. Intermediate code:
tree- or instruction-based intermediate code, temporary variables, translation

sklada ali kopice za realizacijo klicnih zapisov;
- domača naloga: načrt klicnih zapisov.

7. Vmesna koda:
drevesna ali ukazna vmesna koda, uporaba začasnih spremenljivk, nivoji vmesne kode, prevod v vmesno kodo;
- domača naloga: izdelava generatorja vmesne kode.
8. Osnovni bloki:
kanonizacija klicev in skokov v vmesni kodi, oblikovanje osnovnih blokov, permutacija osnovnih blokov;
- domača naloga: izračun osnovnih blokov.
9. Izbira strojnih ukazov:
prevod vmesne kode v ukaze zbirnika z uporabo začasnih spremenljivk;
- domača naloga: generator strojne kode brez registrov.
10. Analiza aktivnosti začasnih spremenljivk:
analiza aktivnosti začasnih spremenljivk na osnovi grafov poteka in podatkovnih enačb;
- domača naloga: izračun interferenčnega grafa spremenljivk.
11. Izbira registrov:
barvanje interferenčnega grafa in izračun preliva začasnih spremenljivk v klicni zapis;
- domača naloga: izračun preslikave začasnih spremenljivk v registre in preliv.
12. Zaključek:
domača naloga: združitev prvih desetih domačih nalog v delujoč prevajalnik.

to intermediate code.

Homework: construction of intermediate code generator

8. Basic blocks:
canonization of calls and jumps in intermediate code, grouping of statements into basic blocks, permutation of basic blocks
Homework: formation of basic blocks
9. Instruction selection:
translation of intermediate code to target assembler using only temporary variables
Homework: target code generator (without register allocation)
10. Liveness analysis:
activity analysis of temporary variables based on flow graphs and dataflow equations.
Homework: construction of a flow graph.
11. Register allocation:
coloring of inference graphs, spilling temporary variables into activation records.
Homework: allocation of registers to temporary variables and spilling.
12. Conclusion:
Homework: integration of earlier homework into a working compiler.

Temeljni literatura in viri / Readings:

1. Andrew W. Appel, Modern Compiler Implementation in Java, Cambridge University Press, 2002.
2. Boštjan Vilfan, Prevajanje programskih jezikov, 1. del, Fakulteta za elektrotehniko in računalništvo, 1991.
3. Steven Muchnick, Advanced Compiler Design and Implementation, Morgan Kaufmann, 1997.

Cilji in kompetence:

Predstavitev zgradbe, delovanja in izdelave prevajalnika za prevajanje programskih jezikov v zbirnik.

Splošne kompetence:

- Sposobnost razumevanja in reševanja strokovnih izzivov v računalništvu in informatiki
- Sposobnost definiranja, razumevanja in reševanja strokovnih izzivov v računalništvu in informatiki
- Sposobnost uporabe pridobljenega znanja pri samostojnem reševanju tehničnih in znanstvenih problemov v računalništvu in informatiki; sposobnost razširjanja pridobljenega znanja

Predmetno-specifične kompetence:

- Praktično znanje in veščine s področja strojev in programske opreme ter informacijske tehnologije, ki so potrebne za uspešno strokovno delo v računalništvu in informatiki
- Sposobnost samostojnega izvajanja enostavnih in zahtevnih opravil v določenih ožjih področjih in samostojno reševanje specifičnih dobro definiranih opravil v računalništvu in informatiki
- Osnovne veščine v računalništvu in informatiki, ki omogočajo nadaljevanje študija na drugi stopnji

Objectives and competences:

Presentation of compiler architecture and functional parts, as well as construction and implementation of a working compiler from a chosen programming language into assembler.

General competences:

- The ability to understand and solve professional challenges in computer and information science
- The ability to define, understand and solve creative 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

Subject-specific competences:

- Practical knowledge and skills of computer hardware, software and information technology necessary for successful professional work in computer and information science
- The ability to independently perform both less demanding and complex engineering and organisational tasks in certain narrow areas and independently solve specific well-defined tasks in computer and information science
- Basic skills in computer and information science, allowing the continuation of studies in the second study cycle

Predvideni študijski rezultati:

Znanje in razumevanje:

Razumevanje delovanja prevajalnika: poznavanje algoritmov za sintaksno in semantično analizo programov ter algoritmov za generiranje vmesne in strojne kode; poznavanje omejitev prevajalnikov. Poznavanje delovanja prevedenih programov.

Uporaba:

Prevajalnik je osnovno orodje pri razvoju programske opreme, zato se pridobljeno

Intended learning outcomes:

Knowledge and understanding:

Understanding the workings of a modern compiler implies familiarity with algorithms for syntax and semantic program analysis, generation of intermediate and target machine code, as well as awareness of compilers' limitations. By knowing all this, one also knows and understands how compiled programs work.

Application:

Compiler is a fundamental software

znanje avtomatsko uporablja pri vsakem programiranju.
 Refleksija:
 Spoznavanje in razumevanje odnosa med programiranjem in izvajanjem programov.
 Prenosljive spretnosti - niso vezane le na en predmet:
 Algoritmi za analizo strukturiranih besedil, pisanje učinkovito kodiranih programov.

development tool, and therefore the acquired knowledge is (explicitly or implicitly) useful in all programming tasks.
 Reflection:
 Understanding of relations between writing programs and their execution.
 Transferable skills:
 Algorithms for analysis of structured texts, writing efficiently coded programs.

Metode poučevanja in učenja:

Predavanja in domače naloge (seminarski način dela). Poseben poudarek je na sprotnem oddajanju domačih nalog.

Learning and teaching methods:

Lectures and homework with explicit focus on simultaneous studies (for homeworks).

Delež (v %) /

Weight (in %)

Načini ocenjevanja:

Assessment:

Način (pisni izpit, ustno izpraševanje, naloge, projekt):
Sprotno preverjanje (domače naloge)
Končno preverjanje (pisni in ustni izpit)

 Ocene: 6-10 pozitivno, 5 negativno (v skladu s Statutom UL).

50%
50%

Type (examination, oral, coursework, project):
Continuing (homeworks)
Final (written and oral exam)

 Grading: 6-10 pass, 5 fail (according to the rules of University of Ljubljana).

Reference nosilca / Lecturer's references:

Pet najpomembnejših del:

1. SLIVNIK, Boštjan. LL conflict resolution using the embedded left LR parser. Computer Science and Information Systems, 2012, vol. 9, no. 3, str. 1105-1124.
2. POTOČNIK, Matic, ČIBEJ, Uroš, SLIVNIK, Boštjan. Linter - a tool for finding bugs and potential problems in Scala code. V: Proceedings of the 29th Annual ACM Symposium on Applied Computing, Gyeongju, Korea, March 24-28, 2014. Proceedings of the 29th Annual ACM Symposium on Applied Computing, Gyeongju, Korea, March 24-28, 2014. [S. l.]: Association for Computing Machinery, cop. 2014, str. 1615-1616, graf. prikazi. [COBISS.SI-ID 10520660]
3. SLIVNIK, Boštjan. LLLR parsing. V: Proceedings of the 28th annual ACM Symposium on Applied Computing 2013, Coimbra, Portugal, March 18-22. [S. l.]: Association for Computing Machinery, 2013, str. 1698-1699. [COBISS.SI-ID 9735508]
4. SLIVNIK, Boštjan. The embedded left LR parser. V: GANZHA, Maria (ur.), MACIASZEK, Leszek (ur.), PAPRZYCKI, Marcin (ur.). FedCSIS : proceedings of the Federated Conference on Computer Science and Information Systems, September 18-21, 2011, Szczecin, Poland.

Los Alamitos: IEEE Computer Society Press, 2011, str. 871-878, graf. prikazi. [COBISS.SI-ID 8628564]

5. SLIVNIK, Boštjan, VILFAN, Boštjan. Producing the left parse during bottom-up parsing. Inf. process. lett.. [Print ed.], Dec. 2005, vol. 96, no. 6, str. [220]-224. [COBISS.SI-ID 5075284]
6. SLIVNIK, Boštjan, VILFAN, Boštjan. Improved error recovery in generated LR parsers. Informatica (Ljublj.), 2004, vol. 28, no. 3, str. 257-263, ilustr. [COBISS.SI-ID 4902484]

Celotna bibliografija je dostopna na SICRISu:

<http://sicris.izum.si/search/rsr.aspx?lang=slv&id=7849>.

UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet: Programiranje 2

Course title: Programming 2

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Univerzitetni študijski program prve stopnje Računalništvo in informatika	ni smeri	1	poletni
Univerzitetni študijski program prve stopnje Računalništvo in matematika			
Univerzitetni študijski program prve stopnje Multimedija			
University study programme Computer and Information Science, 1st cycle	none	1	summer
University study programme Computer Science and Mathematics, 1st cycle			
University study programme Multimedia, 1st cycle			

Vrsta predmeta / Course type

obvezni predmet / compulsory course

Univerzitetna koda predmeta / University course code:

63278

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje Laboratory work	Druge oblike študija Field work	Samost. delo Individ. work	ECTS
45	/	30	/	/	105	6

Nosilec predmeta / Lecturer:

doc. dr. Boštjan Slivnik

Jeziki /

Languages:

Predavanja /

Lectures:

Vaje / Tutorial:

slovenščina
Slovene
slovenščina
Slovene

Pogoji za vključitev v delo oz. za opravljanje

Prerequisites:

študijskih obveznosti:

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Vsebina:

1. Uvod v programski jezik C.
2. Osnovni podatkovni tipi in osnovne kontrolne strukture.
3. Razvoj programov in razhroščevanje.
4. Kazalci in tabele (1. del).
5. Kazalci in tabele (2. del).
6. Funkcije in prenos argumentov.
7. Dinamično dodeljevanje pomnilnika.
8. Nizi.
9. Vhodno-izhodne operacije.
10. Strukture.
11. Enostavni algoritmi urejanja.
12. Rekurzija in algoritmi sestopanja (1. del).
13. Rekurzija in algoritmi sestopanja (2. del).
14. Predprocesor.

Content (Syllabus outline):

1. Introduction to C programming language.
2. Basic data types and basic control structures.
3. Program design and debugging.
4. Pointers and arrays (part 1).
5. Pointers and arrays (part 2).
6. Functions and parameter passing.
7. Dynamic memory allocation.
8. Strings.
9. Input-output operations.
10. Structures.
11. Simple sorting algorithms.
12. Recursion and backtracking (part 1).
13. Recursion and backtracking (part 2).
14. Preprocessor.

Temeljni literatura in viri / Readings:

1. B. W. Kernighan, D. Ritchie: Programski jezik C, Fakulteta za računalništvo in informatiko, 1994.
2. T. Dobravec: abC, Fakulteta za računalništvo in informatiko, 2010.
3. A. Kavčič, M. Privošnik, C. Bohak, M. Marolt, S. Divjak: Programiranje in algoritmi skozi primere, Založba FE in FRI, 2010

Cilji in kompetence:

Cilj predmeta je razširiti znanje programiranja skozi študij bazičnih in naprednejših tehnik programiranja.

Splošne kompetence:

- Sposobnost kritičnega, analitičnega in sintetičnega razmišljanja
- Sposobnost razumevanja in reševanja

Objectives and competences:

The goal of the course is to widen the programming skills by learning the most basic and advanced programming techniques.

General competences:

- Developing skills in critical, analytical and synthetic thinking
- The ability to understand and solve

strokovnih izzivov v računalništvu in informatiki

- Sposobnost uporabe pridobljenega znanja pri samostojnem reševanju tehničnih in znanstvenih problemov v računalništvu in informatiki; sposobnost razširjanja pridobljenega znanja

Predmetno-specifične kompetence:

- Osnovne veščine v računalništvu in informatiki – osnovne teoretične veščine, praktično znanje, bistvene veščine za področje računalništva in informatiki
- Osnovne veščine v računalništvu in informatiki, ki omogočajo nadaljevanje študija na drugi stopnji

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

Subject-specific competences:

- Basic skills in computer and information science, which includes basic theoretical skills, practical knowledge and skills essential for the field of computer and information science
- Basic skills in computer and information science, allowing the continuation of studies in the second study cycle

Predvideni študijski rezultati:

Znanje in razumevanje:

Sposobnost samostojnega razvoja programov, poznavanje osnovnih podatkovnih struktur in algoritmov.

Uporaba:

Pisanje programov za reševanje zmerno težkih programskih nalog.

Refleksija:

Razumevanje osnovnih principov načrtovanja programov in algoritmov in razumevanje njihove vloge pri razvoju programskih sistemov.

Prenosljive spretnosti - niso vezane le na en predmet:

Zmožnost načrtovanja rešitve različnih problemov s programi in algoritmi, zmožnost uporabe predstavljenih principov pri programiranju v poljubnem programskem jeziku.

Intended learning outcomes:

Knowledge and understanding:

The ability to independently develop programs, the familiarity with basic data structures and algorithms.

Application:

Writing simple programs for solving moderate programming problems.

Reflection:

Understanding the basic principles of designing programs and algorithms and understanding their role in the development of large systems.

Transferable skills:

The ability to design the solution of different problems using programs and algorithms, the ability to use the presented programming concepts in an arbitrary programming language.

Metode poučevanja in učenja:

Learning and teaching methods:

Predavanja, domače naloge, seminarski način dela pri vajah. Poseben poudarek je na sprotnem študiju in domačih nalogah.

Lectures, home works, seminar works during tutorials. The emphasis is on continuous study and homeworks.

Delež (v %) /

Weight (in %)

Načini ocenjevanja:

Assessment:

<p>Način (pisni izpit, ustno izpraševanje): Sprotno preverjanje (kolokviji) Končno preverjanje (pisni izpit)</p> <p>Ocene: 6-10 pozitivno, 5 negativno (v skladu s Statutom UL).</p>	<p>50% 50%</p>	<p>Type (examination, written and oral): Continuing (midterm exams) Final (written exam)</p> <p>Grading: 6-10 pass, 5 fail (according to the rules of University of Ljubljana).</p>
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Reference nosilca / Lecturer's references:

Pet najpomembnejših del:

1. ROŽANC, Igor, SLIVNIK, Boštjan. Using reverse engineering to construct the platform independent model of a web application for student information systems. Computer Science and Information Systems, ISSN 1820-0214, 2013, vol. 10, no. 4, str. 1557-1583, ilustr. <http://www.comsis.org/archive.php?show=pprmd276-1212>, doi: 10.2298/CSIS121218068R. [COBISS.SI-ID 10226516]
2. CANKAR, Matija, ARTAČ, Matej, ŠTERK, Marjan, LOTRIČ, Uroš, SLIVNIK, Boštjan. Co-allocation with collective requests in grid systems. Journal for universal computer science, ISSN 0948-6968, 2013, vol. 19, no. 3, str. 282-300, ilustr. http://www.jucs.org/jucs_19_3/coallocation_with_collective_requests/jucs_19_03_0282_0300_cankar.pdf. [COBISS.SI-ID 9797972]
3. SLIVNIK, Boštjan. LL conflict resolution using the embedded left LR parser. Computer Science and Information Systems, ISSN 1820-0214, Sep. 2012, vol. 9, no. 3, str. 1105-1124, ilustr. [COBISS.SI-ID 9583700]
4. SLIVNIK, Boštjan, VILFAN, Boštjan. Producing the left parse during bottom-up parsing. Information processing letters, ISSN 0020-0190. [Print ed.], Dec. 2005, vol. 96, no. 6, str. [220]-224. [COBISS.SI-ID 5075284]
5. POTOČNIK, Matic, ČIBEJ, Uroš, SLIVNIK, Boštjan. Linter - a tool for finding bugs and potential problems in Scala code. V: Proceedings of the 29th Annual ACM Symposium on Applied Computing, Gyeongju, Korea, March 24-28, 2014. Proceedings of the 29th Annual ACM Symposium on Applied Computing, Gyeongju, Korea, March 24-28, 2014. [S. l.]: Association for Computing Machinery, cop. 2014, str. 1615-1616, graf. prikazi. [COBISS.SI-ID 10520660]
6. SLIVNIK, Boštjan. LLLR parsing. V: Proceedings of the 28th annual ACM Symposium on Applied Computing 2013, Coimbra, Portugal, March 18-22. [S. l.]: Association for Computing Machinery, 2013, str. 1698-1699. [COBISS.SI-ID 9735508]

UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet: Diplomski seminar

Course title: Diploma seminar

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Univerzitetni študijski program prve stopnje Računalništvo in informatika	ni smeri	3	letni
University study programme Computer and Information Science, 1st cycle	none	3	spring

Vrsta predmeta / Course type

obvezni predmet / compulsory course

Univerzitetna koda predmeta / University course code:

63281

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje Laboratory work	Druge oblike študija Field work	Samost. delo Individ. work	ECTS
45	10	5	/	/	120	6

Nosilec predmeta / Lecturer:

prof. dr. Franc Solina in vsi ustrezno habilitirani pedagogi

Jeziki /

Languages:

Predavanja /

Lectures:

Vaje / Tutorial:

slovenščina

Slovene

slovenščina

Slovene

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

Pogoj za vključitev v delo je vpis v 3. letnik študija. Študent lahko opravi vse obveznosti pri predmetu šele po tem, ko opravi vse preostale obveznosti na študijskem programu.

Prerequisites:

Enrollment into 3rd year of studies. The course work may be completed in full only after the student has passed all other requirements of the study programme.

Vsebina:

Content (Syllabus outline):

Predavanja:

Poduk o pomenu in poteku izdelave diplomskega dela. Etika in plagiatorstvo.

1. naloga: vsak študent izbere mentorja in temo diplomskega dela!

Predavanja:

Kako se lotimo iskanja in pregledovanja relevantne literature za izbrano temo. Vizualno in logično urejanje besedil. Pisanje strokovnih besedil (vrste, struktura, citiranje, priprava, jezik, recenziranje). Zaznavne in komunikacijske sposobnosti pri človeku (vid, sluh, otip, govor, pisava, neverbalno komuniciranje).

Vaje: Google Scholar, Microsoft Academic Research, Web of Knowledge, Cobiss in SICRIS, ePrints.FRI, LaTeX in BibTeX.

2. naloga: vsak študent pregleda širše področje teme svojega diplomskega dela in o tem napiše pregledni članek.

Predavanja:

Pomen obvladovanja osebne produktivnosti, projektni pristop k doseganju ciljev (tradicionalni, adaptivni in ekstremni projekti), vizualizacijske metode za kreativne procese (miselne skice itd.). Govorne predstavitve (načrtovanje, projekcijski materiali, nastop).

Vaje: oblikovanje čimbolj jasno oblikovanih ciljev diplomskega dela in določanje korakov za njihovo doseganje. Metode za osebno produktivnost (Getting Things Done, Pomodoro), orodja za vizualizacijo miselnih vzorcev, orodja za pripravo projekcijskih materialov (MS PowerPoint, Impress, Prezi).

3. naloga: priprava govorne predstavitve o temi diplomskega dela (pregled, problem, načrtovana rešitev).

Pred govornim nastopom v okviru vaj mora vsebino predstavitve vsakemu študentu potrditi njegov mentor diplomskega dela! Spodbuja se diskusija po govornih nastopih!

Lectures:

Instruction on the purpose and process of preparing a diploma thesis. Ethics and plagiarism.

Homework 1: every student must select a mentor and a topic of his diploma thesis!

Lectures:

How to start with searching and studying the relevant literature for the selected topic. Visual and logical text editing. Writing of technical texts (types, structure, citing, preparation, language, reviewing). Perceptual and communicative capabilities of humans (sight, hearing, touch, speaking, writing, non-verbal communication).

Tutorial: Google Scholar, Microsoft Academic Research, Web of Knowledge, Cobiss and SICRIS, ePrints.FRI, LaTeX and BibTeX.

Homework 2: every student writes an overview article on the topic of his diploma thesis.

Lectures:

Managing of personal productivity, project based approach to reaching goals (traditional, adaptive and extreme projects), visualization methods for creative processes (mind maps etc.). Oral presentations (planning, projection materials, presentation).

Tutorial: outline of clearly defined goals of the diploma thesis and definition of steps in reaching these goals. Methods for personal productivity (Getting Things Done, Pomodoro), tools for visualization of mind maps, tools for preparation of projection materials (MS PowerPoint, Impress, Prezi).

Homework 3: preparation of oral presentation on the diploma thesis (overview, problem, solution).

Before the oral presentation in the framework of the tutorial every student must get an approval of the contents of the presentation from his diploma mentor! Discussion after each presentation is encouraged!

Predavanja:

Znanstveno publiciranje (konference, revije, knjige, elektronske publikacije, odprt dostop, recenzije), zmogljivosti medmrežja (komuniciranje, okolja za sodelovanje, podatkovne zbirke, znanstvena in strokovna socialna omrežja), zaščita intelektualne lastnine (patenti, licence, avtorske pravice), kreativnost in načrtovanje kariere.

Vaje: individualno posvetovanje z asistenti o diplomskem delu – tutorski način dela.

4. naloga: študent pripravi osnutek svojega diplomskega dela v ciljnem formatu s pomočjo ustreznega vzorca, ki bo ustrezno razčlenjen na poglavja. Pregledni članek in literaturo že ustrezno vključi v dokument. Pri tistih poglavjih, ki še ne bodo do konca napisana, točno določi korake, ki ga bodo pripeljali do zaključka diplomskega dela.

Izdelava in zagovor diplomskega dela: Poleg predavanj zajema predmet tudi izdelavo in zagovor diplomskega dela v sodelovanju z izbranim mentorjem.

Lectures:

Scientific publication (conferences, journals, books, e-publications, open access, reviews), resources on the Internet (communication, tools for cooperation, data bases, scientific social networks), protection of intellectual property (patents, licences, author rights), creativity and career planning.

Tutorial: individual consultation with assistants about the diploma thesis – tutor approach.

Homework 4: every student prepares the outline of his/hers diploma thesis in the final format with the help of the necessary template by giving the chapter structure. The overview article and literature must be already integrated in the thesis outline. For the unfinished chapters, clear steps must be outlined what needs to be done in order to finish the diploma thesis.

Completion and defense of the diploma thesis: in addition to the lectures, the course includes individual work on the diploma thesis under the supervision on the thesis advisor.

Temeljni literatura in viri / Readings:

1. Joseph A. Devito. Human Communication, The Basic Course. 11th Edition, Allyn & Bacon, 2008.
2. M. Hladnik. Praktični spisovnik ali Šola strokovnega ubesedovanja, 6. spremenjena izd., Filozofska fakulteta, Univerza v Ljubljani, Ljubljana, 2002.
3. R. K. Wysocki, R. McGary. Effective Project Management, Traditional, Adaptive, Extreme, 3rd Edition. Wiley, Indianapolis, IN, 2003.
4. D. Allen. Getting Things Done: The Art of Stress-Free Productivity. Penguin Books, 2001.
5. internetni viri za preiskovanje znanstvene literature (Google Scholar, Microsoft Academic Research, Web of Knowledge, Cobiss, SICRIS).

Cilji in kompetence:

Cilj predmeta je izdelava diplomskega dela, zaključne naloge na študijskem programu.

Študenta želimo na strukturiran način pripeljati vse študente do dobro napisanega diplomskega dela, v skladu z vsemi strokovnimi

Objectives and competences:

The goal of the course is to write the diploma thesis.

Within the course we direct a student in structured way to a successfully completed diploma thesis which meets all the required

in etičnimi zahtevami

Okvir diplomskega seminarja bo poskrbel, da se na projektni način lotijo dela na diplomskem delu. Mentor pri diplomskem delu, ki si ga bo študent moral izbrati, bo imel vlogo naročnika, ki bo skupaj s študentom definiral temo diplomskega dela. Diplomski seminar pa bo poskrbel da bo delo na diplomskem delu napredovalo po predvidenem terminskem načrtu in na metodološko primeren način.

Po vsebinski plati bo torej delo posameznega študenta v okviru diplomskega seminarja določeno z njegovo izbrano diplomsko temo, predavanja pa bodo pokrila splošna znanja o tem, kako se lotiti tega dela in na kaj je potrebno paziti (organizacija dela, osebna produktivnost, preiskovanje literature, spletne zmogljivosti, pisanje, citiranje, ocenjevanje, objavlanje, govorne predstavitve, intelektualna lastnina, etika). Vaje pri predmetu pa bodo poskrbele, da bodo rezultati študentskega dela sproti in skrbno pregledani vsaj po formalni plati, tako da se bodo mentorji diplomskih del lahko osredotočili le na vsebinske vidike.

Cilj predmeta je tudi pretok idej in krepitev kolektiva znotraj generacije na osnovi diskusij po ustnih nastopih.

professional and ethical standards.

The framework of this course will assure that the students will take a project based approach to their diploma theses. The thesis advisor selected by the student from among the faculty will, together with the student, define the topic of the thesis. The Diploma seminar will assure that the work on the thesis will progress according to the defined schedule and using proper methodology.

The actual work of each student in this diploma seminar will be determined by the selection of his diploma topic, while the lectures will cover general knowledge on how to approach this work (organization of work, personal productivity, searching of literature, Internet resources, writing, citing, reviewing, publishing, oral presentations, intellectual property, ethics). Tutorials will assure that all results of the student's work will be carefully and timely evaluated at least on formal basis, so that the mentors of diploma theses will be able to concentrate solely on the actual contents.

The goal of the seminar is also to encourage the flow of ideas and discussions within each generation of students after oral presentations.

Predvideni študijski rezultati:

Znanje in razumevanje:

vizualno in logično urejanje tekstov, strokovni jezik, akademsko publiciranje, bibliometrija, intelektualna lastnina (patenti, licence, avtorske pravice), etika in plagiatorstvo, projektni pristop k doseganju ciljev (klasični, adaptivni in ekstremni projekti), delo v skupini, javno komuniciranje (ustno, tradicionalni mediji, medmrežje), kreativnost in načrtovanje kariere.

Uporaba:

Orodja za pisanje akademskih tekstov (LaTeX, BibTeX), orodja za iskanje in pregledovanje

Intended learning outcomes:

Knowledge and understanding:

visual and logical text editing, technical language, academic publishing, bibliometry, intellectual property (patents, licences, author rights), ethics and plagiarism, project approach to achieving goals (classical, adaptive and extreme projects), work in groups, public communication (oral, traditional media, Internet), creativity and career planning.

Application:

Tools for writing of academic texts (LaTeX, BibTeX), tools for searching and overviewing

literature (Google Scholar, Microsoft Academic Research, Web of Knowledge, Cobiss in SICRIS), orodja za govorne predstavitve (MS Power Point, Impress, Prezi), sistemi osebne produktivnosti (Getting Things Done, Pomodoro), okolja za sodelovanje na medmrežju, podatkovne zbirke.

Refleksija:

Spoznanje, da je uspešno komuniciranje o rezultatih svojega dela predpogoj za njegovo ustrezno vrednotenje.

Prenosljive spretnosti - niso vezane le na en predmet:

Iskanje informacij, sposobnost predstavitve dosežkov v pisni obliki in v obliki ustne prezentacije so nujen del dobre inženirske izobrazbe.

literature (Google Scholar, Microsoft Academic Research, Web of Knowledge, Cobiss and SICRIS), tools for oral presentations (MS Power Point, Impress, Prezi), systems for personal productivity (Getting Things Done, Pomodoro), environments for cooperation on the Internet, databases for research.

Reflection:

Realization that successful communication of the results of one's own work is a necessary prerequisite for its proper assessment.

Transferable skills:

Search for information, the ability to present results in written form and in the form of oral presentations are an essential part of any good engineering education.

Metode poučevanja in učenja:

Individualno delo z mentorjem.
Predavanja, praktične vaje z ustnimi nastopi, seminarski način dela pri domačih nalogah, tutorski način dela.

Learning and teaching methods:

Individual work with thesis advisor. Lectures and tutorials, oral presentations, homeworks and tutor based instruction.

Načini ocenjevanja:	Delež (v %) / Weight (in %)	Assessment:
2. naloga (pregledni članek)	10%	Homework 2
3. naloga (govorni nastop)	10%	Homework 3
4. naloga (osnutek dipl. dela)	10%	Homework 4
pisni test o snovi s predavanj	10%	Written test
napisano diplomsko delo	40%	Written diploma thesis
zagovor diplomskega dela	20%	Defense
Ocene: 6-10 pozitivno, 5 negativno (v skladu s Statutom UL).		Grading: 6-10 pass, 5 fail (according to University Statute).

Reference nosilca / Lecturer's references:

Pet najpomembnejših del:

F. Solina and R. Bajcsy.

Recovery of parametric models from range images: The case for superquadrics with global deformations.

IEEE Transactions on Pattern Analysis and Machine Intelligence, PAMI-12(2):131-147, 1990.

A. Leonardis, A. Jaklič, and F. Solina.

Superquadrics for segmentation and modeling range data.

IEEE Transactions on Pattern Recognition and Machine Intelligence, PAMI-19(11):1289-1295, 1997.

P. Peer, F. Solina.

Panoramic Depth Imaging: Single Standard Camera Approach.

International Journal of Computer Vision, 47(1/2/3):149--160, 2002.

F. Solina. 15 seconds of fame. Leonardo (Oxf.), 37(2): 105-110, 125, 2004.

J. Krivic, F. Solina. Part-level object recognition using superquadrics.

Computer vision and image understanding, 95(1):105-126, 2004.

A. Jaklič, A. Leonardis, F. Solina.

Segmentation and Recovery of Superquadrics}, volume 20 of Computational imaging and vision. Kluwer, Dordrecht, 2010.

Celotna bibliografija je dostopna na SICRISu:

<http://sicris.izum.si/search/rsr.aspx?lang=slv&id=6749>.

UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet: Arhitektura računalniških sistemov
Course title: Computer Systems Architecture

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Univerzitetni študijski program prve stopnje Računalništvo in informatika	ni smeri	1	poletni
Univerzitetni študijski program prve stopnje Računalništvo in matematika			
Univerzitetni študijski program prve stopnje Multimedija			
University study programme Computer and Information Science, 1st cycle	none	1	spring
University study programme Computer Science and Mathematics , 1st cycle			
University study programme Multimedia, 1st cycle			

Vrsta predmeta / Course type

obvezni predmet / compulsory course

Univerzitetna koda predmeta / University course code:

63212

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje Laboratory work	Druge oblike študija Field work	Samost. delo Individ. work	ECTS
45	/	30	/	/	105	6

Nosilec predmeta / Lecturer:

prof. dr. Branko Šter

Jeziki /

Languages:

Predavanja /

Lectures:

Vaje / Tutorial:

slovenščina
Slovene
slovenščina
Slovene

Pogoji za vključitev v delo oz. za opravljanje

Prerequisites:

študijskih obveznosti:

Poznavanje osnov digitalnih vezij.

Basics of digital circuits.

Vsebina:

Kako so narejeni računalniki in kako delujejo? Zakaj se princip delovanja od prvih računalnikov do danes skoraj ni spremenil? Kaj se dogaja v stroju med reševanjem problemov? To so samo nekatera od vprašanj, na katera odgovarja predmet Arhitektura računalniških sistemov.

Pri predmetu bodo študenti v teoriji in na praktičnih primerih spoznali naslednje vsebine:

1. Narava računanja, kompleksnost, omejitve, teoretični modeli računanja.
2. Zgodovinski pregled dosedanjega razvoja strojev za računanje.
3. Von Neumannov arhitekturni model, osnovni principi delovanja. Vhod in izhod, prekinitve, lokalnost pomnilniških dostopov, Amdahlov zakon, strojna in programska oprema.
4. Predstavitev informacije in osnove računalniške aritmetike.
5. Ukazi in strojni jezik: načini naslavljanja, operacije, formati, RISC-CISC
6. Centralna procesna enota: podatkovna enota, aritmetično-logična enota, kontrolna enota.
7. Analiza zgradbe in delovanja CPE na primeru RISC računalnika.
8. Paralelizem na nivoju ukazov: cevovod, cevovodne nevarnosti, odpravljanje cevovodnih nevarnosti, dinamično razvrščanje, špekulativno izvrševanje, večizstavitveni procesorji. Paralelizem na nivoju niti

Content (Syllabus outline):

How are computers designed and how they work? Why has the principle of operation remained almost unchanged from the first computers to today? What is going on in the machine during problem solving? These are only some of the questions that are answered by the Computer Systems Architecture course.

During the course the students will in theory and on practical examples study the following topics:

1. Nature of computation, complexity, limitations, theoretical models of computation.
2. Survey of historical development of computing machines.
3. Von Neumann architecture model and basic principles of operation. Input and output, interrupts, locality of memory references, Amdahl's law, hardware and software.
4. Representation of information and basic computer arithmetic.
5. Instructions and machine language: addressing modes, operations, formats, RISC-CISC.
6. Central processing unit: datapath with arithmetic-logic unit, control unit.
7. Analysis of CPU design and operation using a RISC computer as an example.
8. Instruction level parallelism: pipeline, pipeline hazards. Pipeline hazard elimination, dynamic scheduling, register renaming, speculative execution, multiple-issue processors. Thread level parallelism.
9. Main memory: technology, organization,

9. Glavni pomnilnik: tehnologija, organizacija, zaščita
10. Predpomnilniki: princip delovanja, vrste zgrešitev, zgrešitvena kazen, problem skladnosti
11. Navidezni pomnilnik

- protection.
10. Cache memories: principles of operation, types of cache misses, miss penalty, coherency problem.
11. Virtual Memory

Temeljni literatura in viri / Readings:

1. D. Kodek: *Arhitektura in organizacija računalniških sistemov*, Bi-Tim, Ljubljana 2008, poglavja 1 do 8.

Dodatna literatura:

1. J. L. Hennessy, D. A. Patterson: *Computer Architecture: A Quantitative Approach*, 4. izdaja, Morgan Kaufmann, San Francisco 2007.
2. D. A. Patterson, J. L. Hennessy: *Computer Organization and Design: The Hardware/Software Interface*, 4. izdaja, Morgan Kaufmann, Burlington 2009.

Cilji in kompetence:

Namen predmeta je predstaviti študentom področje arhitekture računalniških sistemov. To področje je osnovnega pomena za vse študente računalništva, ker daje razumevanje o tem, kaj stroj za računanje je. Na koncu predmeta bo vsak študent poznal osnovne elemente računalnika, kako so ti deli med seboj povezani, razlikoval različne nivoje programiranja in razumel osnovno zgradbo strojev za računanje.

Kompetence:

Razvoj veščin kritičnega, analitičnega in sintetičnega mišljenja.

Zmožnost definiranja, razumevanja in reševanja ustvarjalnih profesionalnih izzivov v računalništvu in informatiki.

Osnovne veščine v računalništvu in informatiki.

Praktično znanje in veščine, potrebne za uspešno profesionalno delo v računalništvu in informatiki.

Objectives and competences:

The aim of the course is to introduce students to the field of computer systems architecture. This is a fundamental field for all computer science students since it gives understanding of what a computing machine is. At the end of this course the students will know the basic elements of a computer, comprehend how this elements link together, distinguish different levels of programming, and understand the basis of computing machines design.

Competences:

Developing skills in critical, analytical and synthetic thinking.

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

Basic skills in computer and information science.

Practical knowledge and skills necessary for successful professional work in computer and information science.

Predvideni študijski rezultati:

Intended learning outcomes:

Znanje in razumevanje:

Poznavanje arhitekture računalniških sistemov in osnovnih orodij za razvoj strojev za računanje. Ta vključujejo kvantitativne metode za primerjavo in ocenjevanje različnih računalniških arhitektur.

Uporaba:

Razumeti, kako računalnik deluje in kakšne so njegove omejitve, predstavlja osnovo za razvoj kvalitetne programske opreme. Pomembno pa je tudi pri nakupu računalniške opreme.

Refleksija:

Odpraviti pogosto stanje, kjer se na računalnik gleda kot na črno škatlo, ki izvaja programe na čudežen način.

Prenosljive spretnosti:

Predmet se dopolnjuje s predmeti s področja programiranja, algoritmov in digitalnih vezij.

Knowledge and understanding:

Understanding of computer systems architecture and basic tools for development of computing machines. These include quantitative methods for comparison and evaluation of different computer architectures.

Application:

Understanding of how computers work and what are their limitations represents the basis for high quality software development. It is also important for computer procurement.

Reflection:

Preventing a common situation where a computer is treated as a black box that executes programs in some mysterious way.

Transferable skills:

The course is complemented with courses teaching programming, algorithms and digital circuits.

Metode poučevanja in učenja:

Predavanja, laboratorijske vaje in domače naloge.

Learning and teaching methods:

Lectures, laboratory work and homeworks.

Načini ocenjevanja:

Sprotno delo poteka v obliki laboratorijskih vaj, domačih nalog in kolokvijev.

Končno preverjanje (računski in teoretični izpit)

Ocene: 6-10 pozitivno, 5 negativno (v skladu s Statutom UL).

Delež (v %) /

Weight (in %) /

Assessment:

1/3

1/3 + 1/3

Midterm work consists of laboratory exercises, homeworks and midterm exams.

Final exam (written and theoretical exam)

Grading: 6-10 pass, 5 fail (according to the rules of University of Ljubljana).

Reference nosilca / Lecturer's references:**Pet najpomembnejših del:**

1. Branko Šter: Selective recurrent neural network. *Neural processing letters*, 38(1): 1-15, 2013.
2. Dominik Olszewski, Branko Šter: Asymmetric clustering using the alpha–beta divergence. *Pattern Recognition*, 47(5): 2031-2041, 2013.
3. Rok Gaber, Tina Lebar, Andreja Majerle, Branko Šter, Andrej Dobnikar, Mojca Benčina, Roman

Jerala: Designable DNA-binding domains enable construction of logic circuits in mammalian cells. *Nature Chemical Biology*, 10(3): 203-208, 2014.

4. Andrej Dobnikar, Branko Šter: Structural properties of recurrent neural networks. *Neural processing letters*, 29(2): 75-88, 2009.
5. Jernej Zupanc, Damjana Drobne, Branko Šter: Markov random field model for segmenting large populations of lipid vesicles from micrographs. *Journal of liposome research*, 21(4): 315-323, 2011.

UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet:	Elektronsko poslovanje
Course title:	Electronic Business

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Univerzitetni študijski program prve stopnje Računalništvo in informatika Interdisciplinarni univerzitetni študijski program prve stopnje Računalništvo in matematika Interdisciplinarni univerzitetni študijski program prve stopnje Multimedija Interdisciplinarni univerzitetni študijski program prve stopnje Upravna informatika	Modul: Informacijski sistemi	3	zimski
University study programme Computer and Information Science, 1st cycle Interdisciplinary university study programme Computer Science and Mathematics , 1st cycle Interdisciplinary university study programme Multimedia, 1st cycle Interdisciplinary university study programme in Administrative Informatics 1 st cycle	Module: Information systems	3	fall

Vrsta predmeta / Course type

izbirni predmet / elective course obvezni predmet / compulsory course
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Univerzitetna koda predmeta / University course code:

63249

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje Laboratory work	Druge oblike študija Field work	Samost. delo Individ. work	ECTS
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45	/	30	/	/	105	6
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Nosilec predmeta / Lecturer: prof. dr. Denis Trček

Jeziki / Languages:	Predavanja / Lectures:	slovenščina Slovene
	Vaje / Tutorial:	slovenščina Slovene

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

Prerequisites:

Vsebina:

Poglavja predmeta obsegajo:

1. Uvod in temeljne definicije.
2. Kratek zgodovinski pregled razvoja e-poslovanja.
3. Sistemski pogled na e-poslovanje skozi analizo generičnih struktur (zunanje in notranje logistične verige in verige dodane vrednosti ter vpliv odločanja na njihovo obnašanje).
4. Tehnološki vidiki: RIP, XML, spletne storitve, komponentne arhitekture, digitalni plačilni sistemi (BitCoin), semantični splet, internet stvari, mobilne aplikacije.
5. Organizacijski vidiki: evolucija poslovnih funkcij, procesov in informacijskih sistemov, novi poslovni modeli, revizijski postopki - COBI.
6. Zakonodajni vidiki s poudarkom na ZEPEP, ZEPEP-A, ter ZEKOM.
7. Specifični vidiki načrtovanja in vpeljave sistemov e-poslovanja: spremembe strateškega načrtovanja IS, uporaba formalnih metod (jezik Z), skladnost s

Content (Syllabus outline):

The course contains the following themes:

1. Introduction and basic definitions.
2. Short historical overview of the e-business field.
3. Systemic view on e-business through its generic structures (internal and external logistic and value added chains, the influence of decision making on their behavior).
4. Technological views: EDI, XML, web services, component architectures, digital payment systems (BitCoin), semantic web technologies, internet of things and mobile applications.
5. Organizational views: evolution of business functions, processes and information systems, new business models, auditing procedures (COBIT).
6. Legislation views with emphasis on ZEPEP, ZEPEP-A, ZEKOM.
7. Specific views related to development and introduction of e-business systems: strategic planning changes, use of formal methods (language Z), and

- standardi kot je Common Criteria.
8. Varovanje intelektualne lastnine.
 9. Zaključki.
 10. Addendum: Mini vložki s praktičnim delom, ki pokrivajo najnovejše trende.

- compliance with standards like Common Criteria.
8. Intellectual property issues.
 9. Conclusions.
 10. Addendum: Mini practical tasks covering the latest selected technological trends.

Temeljni literatura in viri / Readings:

1. D. Trček: *Elektronsko poslovanje*, kopije prosojnic, FRI, Ljubljana, 2016.

Dodatna literatura / Additional literature:

2. R. Kalakota: *E-business*, Addison Wesley, New York, 2002.
3. Dave Chaffey: *E-Business and E-Commerce Management*, FT Prentice Hall, 2011.
4. Sterman J.: *Business Dynamics*, Prentice Hall, 2002.

Cilji in kompetence:

Cilj predmeta je seznaniti študenta s tehnološkimi, organizacijskimi in zakonskimi (pravnimi) znanji, ki jih prinaša elektronsko poslovanje (ter najnovejšimi trendi na tem področju). Poudarek je na praktični usposobljenosti študenta, saj se študent nauči modelirati poslovni (pod)proces, razvije ustrezno aplikacijo za e-poslovanje v okviru tega (pod)procesa in jo integrira v zaledni informacijski sistem.

Kategorizirane kompetence:

- Sposobnost definiranja, razumevanja in reševanja kreativnih profesionalnih izzivov na področju računalništva in informatike.
- Sposobnost profesionalnega komuniciranja v materinem in tujem jeziku.
- Sposobnost biti skladen z varnostnimi, funkcionalnimi in okoljskimi zahtevami.
- Sposobnost razumevanja in uporabe znanja računalništva in informatike na drugih relevantnih področjih (organizacija, itd.).
- Sposobnost samostojnega reševanja in izvedbe manj zahtevnih oz. manj kompleksnih inženirskih in organizacijskih opravil v računalništvu in informatiki.

Objectives and competences:

The objective of the course is to familiarize students with technological, organizational and legal knowledge that is required in e-business along with the latest trends in this area. The emphasis is on practical skills, i.e., students model a business (sub)process, develop a necessary e-business application and integrate it with the background information system.

Categorized competences:

- The ability to define, understand and solve creative professional challenges in computer and information science.
- The ability of professional communication in the native language as well as in a foreign language.
- Compliance with security, functional, economic and environmental principles.
- The ability to understand and apply computer and information science knowledge to other technical and relevant fields (organisational science, etc).
- The ability to independently perform less demanding and less complex engineering and organisational tasks requiring the application of in computer and information systems domain.

Predvideni študijski rezultati:

Znanje in razumevanje:
Razumevanje konceptov elektronskega poslovanja ter integracija z znanji, dobljenimi pri drugih predmetih s tehničnega in organizacijskega področja.

Uporaba:
Sposobnost za razvoj, administracijo ali vodenje sistemov e-poslovanja v organizacijah.

Refleksija:
Razumevanje teoretičnih konceptov, pridobljenih na predavanjih skozi praktično realizacijo na vajah.

Prenosljive spretnosti - niso vezane le na en predmet:
Sposobnost integracije pridobljenih znanj z drugimi področji (obvladovanje in načrtovanje inf. sistemov, vodenje projektov, razvoj spletnih aplikacij, mobilne platforme), sposobnost samostojne pisne in ustne predstavitve strokovne problematike ter javnega nastopanja, podjetniško razmišljanje.

Intended learning outcomes:

Knowledge and understanding:
Understanding of concepts of e-business and their integration with knowledge and skills obtained through other related courses.

Application:
Ability to develop, administer and manage e-business systems in organizations.

Reflection:
Understanding of theoretical concepts and their practical implementation through laboratory work.

Transferable skills:
Ability to integrate knowledge from various fields (and other courses) like information systems planning, information systems management, web applications development and mobile platforms. Further, stimulation of entrepreneurship's mind-set and ability to communicate, work in teams, and public presentation of work.

Metode poučevanja in učenja:

Predavanja, vaje s projektnim delom (praktične prototipne implementacije), lastne predstavitve.

Udeležba na vajah je obvezna (zahtevan procent udeležbe se določi ob začetku študijskega leta).

Nosilec predmeta lahko določi obvezno udeležbo tudi na predavanjih.

Learning and teaching methods:

Lectures, laboratory work (with practical prototype implementations), students' presentations.

Attendance of laboratory work is mandatory (the exact percentage is announced at the beginning of a study year).

The lecturer may impose mandatory attendance of lectures.

Delež (v %) /

Weight (in %)

Assessment:**Načini ocenjevanja:**

50 % ocene predstavlja sprotno delo študenta v obliki preverjanj na vajah (domače naloge, kvizi, praktičen projekt),	50%	50% of the final grade is obtained on the basis of on-going laboratory work (home-works, quizzes, practical project implementations and presentations).
50 % ocene pa predstavlja izpit, ki je	50%	The other 50% is obtained on the basis

<p>načeloma v pisni obliki, lahko pa tudi v pisni in ustni obliki (pri čemer lahko nosilec namesto ustnega izpita uvede seminar).</p> <p>Za uspešno opravljene obveznosti pri predmetu morata biti pozitivni obe delni oceni. Pristop k pisnemu izpitu je možen le po uspešno opravljenih obveznostih pri vajah (in v primeru dodatnih zahtev, ki se nanašajo na predavanja, po izpolnitvi le-teh).</p> <p>Ocene: 6-10 pozitivno, 5 negativno (v skladu s Statutom UL).</p>		<p>of a written exam, or written and oral exam (the lecturer may decide that a seminal work replaces the oral exam).</p> <p>To be eligible for the written exam, a candidate must have successfully completed laboratory work, and fulfilled other obligations related to lecturing that the lecturer may have imposed. For successful completion of the course both grades have to be positive.</p> <p>Grading: 6-10 pass, 5 fail (according to the rules of University of Ljubljana).</p>
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Reference nosilca / Lecturer's references:

Pet najpomembnejših del / Five relevant publications

TRČEK, Denis, BRODNIK, Andrej. Hard and soft security provisioning for computationally weak pervasive computing systems in e-health. IEEE wireless communications, ISSN 1536-1284. [Print ed.], Aug. 2013, vol. 20, no. 4, 8 str., ilustr. [COBISS.SI-ID 10091092].

TRČEK, Denis. Trust management in the pervasive computing era. IEEE security & privacy, ISSN 1540-7993. [Print ed.], 2011, vol. 9, no. 4, str. 52-55, ilustr. <http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=5968087&tag=1>. [COBISS.SI-ID 8554836].

ZUPANČIČ, Eva, TRČEK, Denis. QADE : a novel trust and reputation model for handling false trust values in e-commerce environments with subjectivity consideration. Technological and economic development of economy, ISSN 2029-4913. [Print ed.], 2015, vol. , no. , str. 1-30, ilustr. <http://www.tandfonline.com/doi/abs/10.3846/20294913.2015.1022810#VXE-ArdWG70>, doi: 10.3846/20294913.2015.1022810. [COBISS.SI-ID 1536328643].

TRČEK, Denis. Qualitative assessment dynamics: complementing trust methods for decision making. International journal of information technology & decision making. [Online ed.], 2014, vol. 13, no. 1, str. 155-173, doi: 10.1142/S0219622014500072. [COBISS.SI-ID 10341204].

TORJUSEN, Arild B., ABIE, Habtamu, PAINTSIL, Ebenezer, TRČEK, Denis, SKOMEDAL, Åsmund. Towards run-time verification of adaptive security for IoT in eHealth , Proceedings of the ECSA 2014 Workshops & Tool Demos Track : ECSAW '14, (ACM proceedings, ISSN 2168-4081). New York (NY): The Association for Computing Machinery, 2014, str. 1-8, ilustr. <http://dl.acm.org/citation.cfm?id=2642807> [COBISS.SI-ID 10728532].

Celotna bibliografija je dostopna na SICRISu:

The whole bibliography can be obtained at the below URL:

<http://sicris.izum.si/search/rsr.aspx?lang=slv&id=7226>.

UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet: Brežična in mobilna omrežja
Course title: Mobile and Wireless Networks

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Univerzitetni študijski program prve stopnje Računalništvo in informatika Univerzitetni študijski program prve stopnje Računalništvo in matematika	Modul: Računalniška omrežja	3	poletni
University study programme Computer and Information Science, 1st cycle University study programme Computer Science and Mathematics, 1st cycle	Module: Computer networks	3	spring

Vrsta predmeta / Course type

izbirni predmet /elective course

Univerzitetna koda predmeta / University course code:

63259

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje Laboratory work	Druge oblike študija Field work	Samost. delo Individ. work	ECTS
45	10	20	/	/	105	6

Nosilec predmeta / Lecturer:

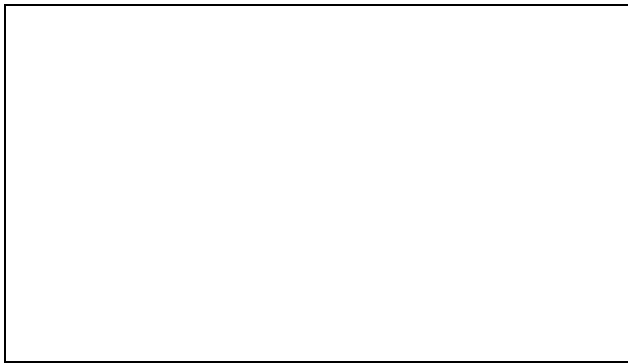
prof. dr. Nikolaj Zimic

**Jeziki /
Languages:**

**Predavanja /
Lectures:** slovenščina
Slovene
Vaje / Tutorial: slovenščina
Slovene

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

Prerequisites:

**Vsebina:****predavanja:**

1. Uvod v brezžična omrežja
2. Fizični nivo
3. Lokalna in osebna omrežja
4. Mestna in prostrana omrežja
5. Brezžični internet
6. Ad Hoc brezžična omrežja
7. Transportni nivo in varnost
8. Kvaliteta storitev
9. Hibridna brezžična omrežja

Content (Syllabus outline):**lectures:**

1. Introduction to wireless networks
2. Physical layer review
3. Local and personal wireless networks
4. Metropolitan and wide area wireless networks
5. Wireless internet
6. Ad Hoc wireless networks
7. Transport layer and security protocols
8. Quality of service
9. Hybrid wireless networks

Temeljni literatura in viri / Readings:

1. Sauter, Martin, "Communication systems for the mobile information society", Chichester : J. Wiley & Sons, cop. 2006, ISBN: 0-470-02676-6
2. C. Siva Ram Murthy and B. S. Manoj, "Ad-Hoc Wireless Networks: Architectures and Protocols," Prentice-Hall, 2004, ISBN: 0-13-147023-X.
3. Bernhard H. Walke, Stefan Mangold, Lars Berlemann, IEEE 802 Wireless Systems: Protocols, Multi-Hop Mesh/Relaying, Performance and Spectrum Coexistence, John Wiley & Sons, 12. jan. 2007, ISBN-13: 978-0470014394
4. Erik Dahlman, 3G Evolution: HSPA and LTE for Mobile Broadband, Academic Press, 2008, ISBN-13: 978-0123745385

Dodatna literatura:

1. Farid Dowlah (Ed), " Handbook of RF and Wireless Technologies," Elsevier, 2003, ISBN: 0750676957.
2. Andreas Molisch, "Wireless Communications," Wiley, 2005, 668 pp., ISBN: 047084888X.
3. Benny Bing (Ed), "Emerging Technologies in Wireless LANs," Cambridge Univ Press, 2008, ISBN: 0521895842.

Cilji in kompetence:**Objectives and competences:**

Cilj predmeta je študentom računalništva in informatike predstaviti brezžična in mobilna omrežja. Poudarek je na posebnostih, ki jih prinaša brezžičen prenos podatkov in mobilnost terminalov v računalniška omrežja.

The purpose of the course is to give the students a sound understanding of the architecture and operating principles of mobile and wireless networks. This course provides a general introduction to mobile networking, with an emphasis on the wireless data transmission and mobility of terminals.

Predvideni študijski rezultati:

Znanje in razumevanje:
Razumevanje delovanja brezžičnih omrežij.
Poznavanje razlik med različnimi brezžičnimi omrežji ter njihova uporaba.

Uporaba:
Uporaba brezžičnih in mobilnih omrežij pri raznih pogojih uporabe (industrija, hišna omrežja, osebna omrežja, ...).

Refleksija:
Spoznavanje in razumevanje uglasenosti med teorijo in njeno aplikacijo na konkretnih primerih s področja brezžičnega prenosa podatkov.
Prenosljive spretnosti - niso vezane le na en predmet:
Reševanje drugih konceptualno sorodnih problemov (npr. telefonska omrežja 3G in 4G).

Intended learning outcomes:

Knowledge and understanding:
Understanding of the basic wireless networks concepts. Understanding of the various wireless networks differences and its applications.

Application:
Wireless and mobile networks applications in various working conditions (industrial, house, personal networks ...)

Reflection:
Comprehension and understanding wireless data transmission theory and its application in real world application from the field.

Transferable skills:
Solving of the similar problems from field of the computer communications.

Metode poučevanja in učenja:

Predavanja, laboratorijske vaje.

Learning and teaching methods:

Lectures, lab practice.

Načini ocenjevanja:

Način (pisni izpit, ustno izpraševanje, naloge, projekt):
Sprotno preverjanje (domače naloge, kolokviji in projektno delo)

Delež (v %) /
Weight (in %)

50%

Assessment:

Type (examination, oral, coursework, project):
Continuing (homework, midterm exams, project work)

Končno preverjanje (pisni in ustni izpit)	50%	Final (written and oral exam)
Ocene: 6-10 pozitivno, 5 negativno (v skladu s Statutom UL).		Grading: 6-10 pass, 5 fail (according to the rules of University of Ljubljana).

Reference nosilca / Lecturer's references:

Pet najpomembnejših del:

PEČAR, Primož, RAMŠAK, Anton, ZIMIC, Nikolaj, MRAZ, Miha, LEBAR BAJEC, Iztok. Adiabatic pipelining: a key to ternary computing with quantum dots. *Nanotechnology (Bristol)*, 2008, vol. 19, no. 49, str. 1-12, ilustr.

LEBAR BAJEC, Iztok, ZIMIC, Nikolaj, MRAZ, Miha. The computational beauty of flocking: boids revisited. *Math. comput. model. dyn. syst.*, Aug. 2007, vol. 13, no. 4, str. [331]-347, ilustr

ZIMIC, Nikolaj, MRAZ, Miha. Decomposition of a complex fuzzy controller for the truck-and-trailer reverse parking problem. *Math. comput. model.* [Print ed.], Mar. 2006, vol. 43, no. 5/6, str. 632-645, ilustr.

LEBAR BAJEC, Iztok, ZIMIC, Nikolaj, MRAZ, Miha. Towards the bottom-up concept: extended quantum-dot cellular automata. *Microelectron. eng.* [Print ed.], 2006, vol. 83, no. 4/9, str. 1826-1829, ilustr

LEBAR BAJEC, Iztok, ZIMIC, Nikolaj, MRAZ, Miha. The ternary quantum-dot cell and ternary logic. *Nanotechnology (Bristol)*, 2006, vol. 17, no. 8, str. 1937-1942, ilustr

UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet: Osnove digitalnih vezij
Course title: Introduction to Digital Circuits

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Univerzitetni študijski program prve stopnje Računalništvo in informatika Univerzitetni študijski program prve stopnje Računalništvo in matematika	ni smeri	1	zimski
University study programme Computer and Information Science, 1st cycle University study programme Computer Science and Mathematics, 1st cycle	none	1	fall

Vrsta predmeta / Course type

obvezni predmet / compulsory course

Univerzitetna koda predmeta / University course code:

63204

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje Laboratory work	Druge oblike študija Field work	Samost. delo Individ. work	ECTS
45	/	30	/	/	105	6

Nosilec predmeta / Lecturer:

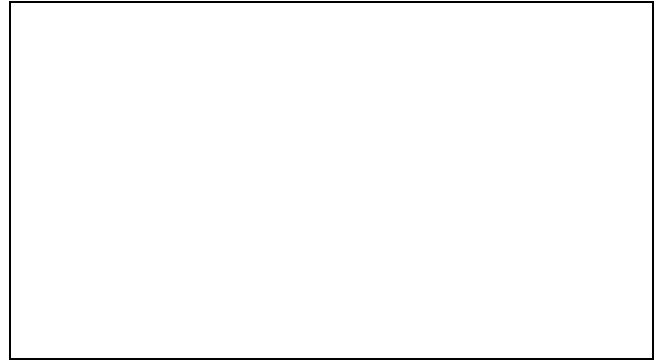
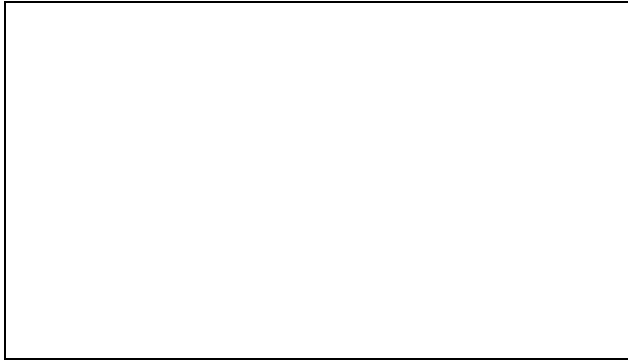
prof. dr. Nikolaj Zimic

**Jeziki /
Languages:**

**Predavanja /
Lectures:** slovenščina
Slovene
Vaje / Tutorial: slovenščina
Slovene

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

Prerequisites:

**Vsebina:****predavanja:**

1. Boolova algebra
2. Preklopne funkcije in preklopna vezja
3. Funkcijsko polni sistemi
4. Minimizacija preklopnih funkcij
5. Strukturalna preklopna vezja (kodirnik, dekodirnik, multiplekser, ROM, ...)
6. Aritmetično logična vezja
7. Sekvenčna vezja
8. Načrtovanje avtomatov
9. Realizacija avtomatov
10. Osnove VHDL
11. Programabilna logična vezja

Content (Syllabus outline):**lectures:**

1. Boolean algebra
2. Switching functions and circuits
3. Functionally complete logic systems
4. Circuit minimization
5. Structural switching circuits (coder, decoder, multiplexer, ROM, ...)
6. Arithmetical and logical circuits
7. Sequential circuits
8. Automata design
9. Automata realization
10. VHDL basics
11. Programmable logic circuits

Temeljni literatura in viri / Readings:**Osnovna:**

- J. Virant, Logične osnove odločanja in pomnjenja v računalniških sistemih, Ljubljana: Fakulteta za računalništvo in informatiko, 1996, ISBN 961-6209-01-9.
- I. Lebar Bajec, Preklopne strukture in sistemi: zbirka rešenih primerov in nalog z rešitvami, Ljubljana: Fakulteta za računalništvo in informatiko, 2002, ISBN 961-6209-31-0.
- K. Skahill, VHDL for Programmable Logic, Addison Wesley, 1996, ISBN 0-201-89586-2.

Dodatna literatura:

- T. Floyd, Digital fundamentals, Prentice Hall, cop. 1997, ISBN 0-13-398488-5.
- F. Wakerly, Digital design, Prentice Hall, cop. 2000, ISBN 0-13-769191-2.
- M. Mano, Digital design, Prentice Hall, (3rd edititon), cop., 2001, ISBN 0-13-062121-8.

Cilji in kompetence:**Objectives and competences:**

Študenti v okviru tega predmeta pridobijo osnovna znanja s področja digitalne logike. Spoznajo se z osnovnimi gradniki v računalništvu ter ustrezno logično obravnavo le-teh. Seznanijo se s časom v preklopnih strukturah in sistemih, pomnilnimi celicami in osnovami avtomatov.

The object of this course is mastering and understanding efficient practical solutions and gaining a thorough understanding of digital logic, time in digital domain, memory cell and basic of the automaton.

Predvideni študijski rezultati:

Znanje in razumevanje:
 Razumevanje delovanja enostavnih digitalnih vezij. Sposobnost minimizacije logičnih vezij. Razumevanje delovanja sekvenčnih vezij in avtomatov.
 Uporaba:
 Uporaba osnovnih orodij za načrtovanje vezij in izdelava enostavnih logičnih sklopov.
 Refleksija:
 Spoznavanje in razumevanje uglasenosti med teorijo in njeno aplikacijo na konkretnih primerih s enostavnih logičnih in sekvenčnih vezij.
 Prenosljive spretnosti - niso vezane le na en predmet:
 Uporaba binarne logike.
 Načrtovanje in izgradnja enostavnih digitalnih vezij.

Intended learning outcomes:

Knowledge and understanding:
 Understanding basic digital circuit design concepts. Mastering digital circuit minimization. Understanding the basics of the sequence circuit and automaton.
 Application:
 Using basic tools for circuit development and realization.
 Reflection:
 Comprehension and understanding of the basics of digital circuits design.
 Transferable skills:
 Boolean logic concepts.
 Basic digital circuits design.

Metode poučevanja in učenja:

Predavanja, laboratorijske vaje.

Learning and teaching methods:

Lectures, lab practice.

Delež (v %) /

Weight (in %)

Načini ocenjevanja:

Assessment:

Način (pisni izpit, ustno izpraševanje, naloge, projekt): Sprotno preverjanje (domače naloge, kolokviji in projektno delo) Končno preverjanje (pisni in ustni izpit)	50% 50%	Type (examination, oral, coursework, project): Continuing (homework, midterm exams, project work) Final (written and oral exam)
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Ocene: 6-10 pozitivno, 5 negativno (v skladu s Statutom UL).		Grading: 6-10 pass, 5 fail (according to the rules of University of Ljubljana).
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Reference nosilca / Lecturer's references:**Pet najpomembnejših del:**

PEČAR, Primož, RAMŠAK, Anton, ZIMIC, Nikolaj, MRAZ, Miha, LEBAR BAJEC, Iztok. Adiabatic pipelining: a key to ternary computing with quantum dots. *Nanotechnology (Bristol)*, 2008, vol. 19, no. 49, str. 1-12, ilustr.

LEBAR BAJEC, Iztok, ZIMIC, Nikolaj, MRAZ, Miha. The computational beauty of flocking: boids revisited. *Math. comput. model. dyn. syst.*, Aug. 2007, vol. 13, no. 4, str. [331]-347, ilustr

ZIMIC, Nikolaj, MRAZ, Miha. Decomposition of a complex fuzzy controller for the truck-and-trailer reverse parking problem. *Math. comput. model.* [Print ed.], Mar. 2006, vol. 43, no. 5/6, str. 632-645, ilustr.

LEBAR BAJEC, Iztok, ZIMIC, Nikolaj, MRAZ, Miha. Towards the bottom-up concept: extended quantum-dot cellular automata. *Microelectron. eng.* [Print ed.], 2006, vol. 83, no. 4/9, str. 1826-1829, ilustr

LEBAR BAJEC, Iztok, ZIMIC, Nikolaj, MRAZ, Miha. The ternary quantum-dot cell and ternary logic. *Nanotechnology (Bristol)*, 2006, vol. 17, no. 8, str. 1937-1942, ilustr

UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet:	Uvod v odkrivanje znanj iz podatkov
Course title:	Introduction to Data Mining

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester	
Univerzitetni študijski program prve stopnje Računalništvo in informatika	Modul: Informacijski sistemi	3	zimski	
Interdisciplinarni univerzitetni študijski program prve stopnje Računalništvo in in matematika				
Interdisciplinarni univerzitetni študijski program prve stopnje Multimedija				
Interdisciplinarni univerzitetni študijski program prve stopnje Upravna informatika		2		
Interdisciplinarni magistrski študijski program druge stopnje Multimedija		FRI 1		1
University study programme Computer and Information Science, 1st cycle	Module: Information systems	3	fall	
Interdisciplinary university study programme Computer Science and Mathematics , 1st cycle				
Interdisciplinary university study programme Multimedia, 1st cycle				2
Interdisciplinary university Study Programme in Administrative Informatics 1 st Cycle		FRI 1		1
Interdisciplinary Master study program Multimedia, level 2				

Vrsta predmeta / Course type

izbirni predmet / elective course

FRI 1 / FRI 1

Univerzitetna koda predmeta / University course code: 63251

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje Laboratory work	Druge oblike študija Field work	Samost. delo Individ. work	ECTS
45	20	10	/	/	105	6

Nosilec predmeta / Lecturer: prof. dr. Blaž Zupan

Jeziki / Languages:	Predavanja / Lectures:	slovenščina in angleščina Slovene
	Vaje / Tutorial:	slovenščina in angleščina Slovene

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

Prerequisites:

Vsebina:

Predmet bo v teoriji in na praktičnih primerih obravnaval sledeče vsebine:

1. Kaj je poslovna inteligenca? Predstavitev področja skozi pregled značilnih aplikacij. Vloga tehnologij in pristopov poslovne inteligence v informacijskih sistemih in elektronskem poslovanju. Tehnologije znanja.
2. Računalniško podprto odločanje. Predstavitev in zajemanje znanja. Odločitveni modeli. Obravnavanje nepopolnih in negotovih odločitvenih podatkov. Razlaga in analiza odločitev.
3. Metode in tehnike za računalniško podporo odločanje v skupinah.
4. Uvod v tehnike odkrivanja znanj iz večdimenzionalnih podatkov. Vloga

Content (Syllabus outline):

The course will in theory and through practical exercises and hands-on lectures include the following topics:

1. Introduction to business intelligence. Typical applications. Role of information technology. Knowledge-based systems.
2. Computer-assisted decision support. Decision support models. Treatment of uncertain and incomplete data. Explanation and analysis.
3. Methods and techniques for group decision making.
4. Introduction to techniques of data mining and knowledge discovery in data bases, with emphasis on their application in business intelligence. Data preprocessing, modelling. Supervised

podatkovnih skladišč in predobdelave podatkov. Uvod v tehnike strojne gradnje modelov odločanja in napovednih modelov.

5. Vizualizacija podatkov in modelov.
6. Razvrščanje v skupine.
7. Tehnike poslovne inteligence na spletu. rangiranje spletnih strani. Analiza podatkov iz družabnih mrež.
8. Priporočilni sistemi.
9. Orodja in razvoj sistemov poslovne inteligence. Integracija v informacijskih sistemih. Snovanje uporabniških vmesnikov za pomoč pri odločanju.
10. Psihosociološki in etični vidiki poslovne inteligence.

and unsupervised learning.

5. Data and model visualization.
6. Data clustering.
7. Business intelligence on the world-wide-web. Page ranking. Analysis of social networks.
8. Recommendation systems.
9. Data analysis toolboxes for business intelligence and their integration in information systems. Interface design of decision support systems.
10. Psychosociological and ethical issues.

Temeljni literatura in viri / Readings:

- Tan, P.-N., Steinbach, M., and Kumar, V. (2006) Introduction to Data Mining, Pearson Education.
- Segaran, T. (2007) Programming Collective Intelligence, O'Reilly.
- Dokumentacija prosto dostopnih programov za podatkovno analitiko (Orange, na strani <http://orange.biolab.si>, scikit-learn na strani <http://scikit-learn.org> in numpy na strani <http://www.numpy.org>).

Cilji in kompetence:

Cilj predmeta je spoznati metodološke osnove inteligentnih sistemov, ki so bili razviti na področju računalništva. Študente bomo naučili v praksi prepoznati njihove možne aplikacije ter tekom predmeta v okviru laboratorijskega dela naučeno znanje uporabiti na praktičnih primerih. Še posebej podrobno si bomo ogledali tehnike razvrščanja v skupine, priporočilnih sistemov, iskanja vzorcev v podatkih, gradnje napovednih modelov iz strukturiranih in tekstovnih zapisov in tehnike gradnje odločitvenih modelov.

Objectives and competences:

The aim of this course is an introduction to business intelligent methods and tools that were developed within computer science. Students will learn how to identify potential applications of business intelligence in practice. During the course, they will apply their methodological and development knowledge on real-life applications. In particular, the course will focus on data clustering, recommendations systems, association rule mining, inference of predictive models from structured and textual data, and on decision support techniques.

Predvideni študijski rezultati:

Intended learning outcomes:

Znanje in razumevanje: Poznavanje metod, tehnik in orodij poslovne inteligence.

Uporaba: Uporaba tehnik poslovne inteligence v informacijski sistemih in spletnih okoljih.

Refleksija: Sposobnost prepoznavanja priložnosti in niš, kjer lahko s tehnikami poslovne inteligence pridobimo konkurenčno prednost. Razumevanje primernosti teoretičnih pristopov s področja inteligentnih sistemov za reševanje praktičnih primerov v poslovnem okolju.

Prenosljive spretnosti - niso vezane le na en predmet: Veščine skriptnega programiranja. Odkrivanje znanj iz podatkov. Kognitivni aspekti odločanja.

Knowledge and understanding: Familiarity and practical understanding of business intelligence techniques.

Application: Utility of business intelligence approaches in information systems and on the web.

Reflection: Competence to determine where and when utility of business intelligence can provide competitive gains. Ability to identify the most useful techniques for a given practical problem.

Transferable skills: Programming in Python. Data mining. Cognitive aspects of decision-making.

Metode poučevanja in učenja:

Predavanja s podporo avdio-vizualne opreme, laboratorijske vaje v računalniški učilnici z osnovno računalniško opremo. Delo posamezno in v skupinah. Velik poudarek na praktičnem delu in reševanju problemov.

Learning and teaching methods:

Lectures using modern audio-visual equipment. Individual and group-based project assignments. Emphasis on practical exercises.

Načini ocenjevanja:	Delež (v %) / Weight (in %)	Assessment:
Domače naloge. Končno preverjanje (pisni izpit). Ocene: 6-10 pozitivno, 5 negativno (v skladu s Statutom UL).	50% 50%	Homeworks. Written exam. Grading: 6-10 pass, 5 fail (according to the rules of University of Ljubljana).

Reference nosilca / Lecturer's references:

Pet najpomembnejših del:

Toplak M, Mocnik R, Polajnar M, Bosnic Z, Carlsson L, Hasselgren C, Demsar J, Boyer S, Zupan B, Stalring J (2014) Assessment of machine learning reliability methods for quantifying the applicability domain of QSAR regression models, J Chem Inf Model, 54(2):431-441.

Zitnik M, Janjic V, Larminie C, Zupan B, Przulj N (2013) Discovering disease-disease associations by fusing systems-level molecular data, Scientific Reports, 13:3202.

Demsar J, Curk T, Erjavec A, Gorup C, Hocevar T, Milutinovic M, Mozina M, Polajnar M, Toplak M, Staric A, Stajdohar M, Umek L, Zagar L, Zbontar J, Zitnik M, Zupan B (2013) Orange: data mining toolbox in Python, Journal of Machine Learning Research, 14:2349-2353.

Zitnik M, Zupan B (2012) NIMFA: A Python Library for Nonnegative Matrix Factorization, Journal of Machine Learning Research, 13:849-853.

Kljajić Borštinar M, Kljajić M, Škraba A, Kofjač D, Rajkovič V (2011) The relevance of facilitation in group decision making supported by a simulation model, System Dynamics Review 27(3):270-293.

Celotna bibliografija prof. dr. Zupana je dostopna na SICRISu:

<http://sicris.izum.si/search/rsr.aspx?lang=slv&id=7764>.

Celotna bibliografija prof. dr. Rajkoviča je dostopna na SICRISu:

<http://sicris.izum.si/search/rsr.aspx?lang=slv&id=4169>.

UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet: Računalniške tehnologije
Course title: Computer Technologies

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Univerzitetni študijski program prve stopnje Računalništvo in informatika	ni smeri	2	poletni
University study programme Computer and Information Science, 1st cycle	none	2	spring

Vrsta predmeta / Course type

izbirni predmet / elective course

Univerzitetna koda predmeta / University course code:

63221

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje Laboratory work	Druge oblike študija Field work	Samost. delo Individ. work	ECTS
45	/	30	/	/	105	6

Nosilec predmeta / Lecturer:

doc. dr. Rok Žitko

**Jeziki /
Languages:**

**Predavanja /
Lectures:** slovenščina
Slovene
Vaje / Tutorial: slovenščina
Slovene

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

Prerequisites:

Vsebina:

Content (Syllabus outline):

1. Nihanje in valovanje: sklopljena nihala, opis valovanj, valovna enačba, načelo superpozicije, interferenca.
2. Delci in interakcije: polja, dualnost delec-valovanje, elektroni, fotoni, fotoefekt, sevanje črnega telesa.
3. Kvantna mehanika: dvonivojski sistem in qubit, spin, meritve, interpretacija
4. Kvantno računanje: osnovne operacije, unitarnost., Bellova stanja
5. Dinamika kvantnih delcev: Schroedingerjeva enačba, valovna funkcija, delec v jami, tunelski pojav
6. Verjetnostna interpretacija valovne funkcije, Heisenbergovo načelo nedoločenosti.
7. Elektronska mikroskopija
8. Elektroni v snovi: Bohrov model atoma, atomske orbitale, kemijska vez, molekule, kristali.
9. Kovine in polprevodniki: pregled materialov, enačba gibanja za elektrone, efektivna masa.
10. Lastnosti polprevodnikov: Hallov pojav, fotoprevodnost, senzorji svetlobe, FET, CMOS.
11. Heterostrukture: heterostik, 2D elektronski plin, kvantne jame, kvantne žice, kvantne pike.
12. Nanoelektronika: enoelektronski tranzistor, balistično prevajanje, kvantizirana prevodnost.
13. Magnetizem: feromagnetizem, magnetna anizotropija, magnetoupornost, spintronika
14. Hranjenje podatkov: flash pomnilniki, magnetno hranjenje podatkov, optični diski.
15. Implementacije kvantnih računalnikov: dokoherenca, ujeti ioni, JMR, SQUID, kvantne pike.

1. Oscillations and waves: coupled oscillators, description of wave phenomena, wave equation, superposition principle, interference
2. Particles and interactions: fields, particle-wave duality, electrons, photons, photoeffect, black-body radiations
3. Quantum mechanics: two-level system and qubit, spin, measurements, interpretation
4. Quantum computing: basic operators, unitarity, Bell states
5. Dynamics of quantum particles: Schroedinger equation, wave function, particle in a well, tunnelling
6. Probability interpretation of the wave function, Heisenberg uncertainty principle
7. Electron microscopy
8. Electrons in matter: Bohr model of an atom, atomic orbitals, chemical bond, molecules, crystals
9. Metals and semiconductors: review of materials, equation of motion for electrons, effective mass
10. Properties of semiconductors: Hall effect, photoconductivity, light sensors, FET, CMOS
11. Heterostructures: heterojunction, 2D electron gas, quantum wells, quantum wires, quantum dots
12. Nanoelectronics: single-electron transistor, ballistic conductance, quantized conductance
13. Magnetism: ferromagnetism, magnetic anisotropy, magnetoresistivity, spintronics
14. Data storage: flash memories, magnetic data storage, optical disks.
15. Quantum computer implementations: decoherence, trapped ions, NMR, SQUID, quantum dots

Temeljni literatura in viri / Readings:

R. Žitko: Računalniške tehnologije (skripta)
 Schwabl: Quantum Mechanics, Springer (2005).
 Kittel: Introduction to Solid State Physics (2004).
 Nielsen, Chuang: Quantum Computations and Quantum Information, Cambridge University Press (2000).
 Rainer Waser (Ed.), Nanoelectronics and Information Technology: Advanced Electronic Materials and Novel Devices, Wiley-VCH (2003).

Cilji in kompetence:

Objectives and competences:

Cilj predmeta je študentom računalništva in informatike predstaviti fizikalne in tehnološke temelje delovanja in izdelave računalnikov, osnove fizike trdne snovi in kvantne mehanike. S tem znanjem bodo študentje lažje predvideli prihodnje trende v razvoju tehnologije in bodo boljše pripravljene na ključne spremembe, ki jih lahko pričakujemo.

The objective of the course is to introduce the students of computer science and informatics to the physical and technological foundations of functioning and manufacture of computers, as well as the basics of solid-state physics and quantum mechanics. On the basis of this knowledge the students will have a better grasp of the coming trends in technological development and they will be well prepared for major developments in the field.

Predvideni študijski rezultati:

Znanje in razumevanje:
 Poznavanje osnovnih načel kvantne mehanike in osnovnih pojavov v trdni snovi.
 Razumevanje fizikalnih omejitev. Poznavanje prihajajočih tehnologij.

Uporaba:
 Uporaba kvantitativnih fizikalnih metod za razumevanje pojavov.

Refleksija:
 Spoznavanje temeljne vloge kvantnomehanskih pojavov v sodobni elektroniki.

Prenosljive spretnosti:
 Samostojno reševanje nekoliko kompleksnejših problemov, ki so bolj abstraktne narave.

Intended learning outcomes:

Knowledge and understanding:
 Understanding the basic principles of quantum mechanics and phenomena in solid-state materials. Understanding of physical limitation. Knowledge of upcoming technologies.

Application:
 Application of quantitative methods of physics to understand phenomena.

Reflection:
 Appreciation of the fundamental role of quantum-mechanical phenomena in modern electronics.

Transferable skills:
 Solving various complex problems of more abstract nature.

Metode poučevanja in učenja:

Predavanja, računske vaje z ustnimi nastopi, seminarski način dela pri domačih nalogah. Poseben poudarek je na sprotnem študiju in na skupinskem delu pri vajah in seminarjih.

Learning and teaching methods:

Lectures, calculus exercises with oral participation, home seminar work. There is a particular focus on continuous study and on team work in the frame of exercises and seminar work.

Delež (v %) /

Weight (in %)

Načini ocenjevanja:

Assessment:

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

Reference nosilca / Lecturer's references:

Pet najpomembnejših del:

D. Xiaoyu et al., How bad metals turn good : how bad metals turn good, Phys. Rev. Lett. 110, 086401 (2013)

J.-D. Pillet et al., Tunneling spectroscopy of a single quantum dot coupled to a superconductor : from Kondo ridge to Andreev bound states, Phys. Rev. B 88, 045101 (2013)

O. Bodensiek et al., Unconventional superconductivity from local spin fluctuations in the Kondo lattice, Phys. Rev. Lett. 110, 146406 (2013)

R. Žitko et al., Ground state of the parallel double quantum dot system, Phys. Rev. Lett. 108, 066602 (2012)

R. Žitko, et al. Tunable Kondo effect in a double quantum dot coupled to ferromagnetic contacts, Phys. Rev. Lett. 108, 166605 (2012)

Celotna bibliografija je dostopna na SICRISu:

<http://splet02.izum.si/cobiss/bibliography?langbib=slv&li=si&homelang=svn&code=23567>.

UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet: Izbrana poglavja iz računalništva in informatike
Course title: Topics in Computer and Information Science

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Univerzitetni študijski program prve stopnje Računalništvo in informatika	ni smeri	2, 3	poletni
University study programme Computer and Information Science, 1st cycle	none	2, 3	spring

Vrsta predmeta / Course type izbirni predmet / elective course

Univerzitetna koda predmeta / University course code: 63225

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje Laboratory work	Druge oblike študija Field work	Samost. delo Individ. work	ECTS
45	/	30	/	/	105	6

Nosilec predmeta / Lecturer: Gostujoči profesorji z drugih univerz/ visiting professors from other universities

Jeziki / Languages:
Predavanja / Lectures: Slovenščina, angleščina
Slovene, English
Vaje / Tutorial: Slovenščina, angleščina
Slovene, English

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

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Prerequisites:

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Vsebina:

Content (Syllabus outline):

Predmet je namenjen predstavitvi izbranih tem, ki so zanimiva zaradi novih teoretičnih odkritij, nedavnih metodoloških prebojev ali pa zaradi velike uporabnosti v praksi, ter kot taka niso zajeta v ostalih predmetih v programu. Predmet je med drugim namenjen tudi vključevanju uveljavljenih zunanjih in predavateljev v pedagoški proces na FRI. Podrobna vsebina se določi vsako leto posebej glede na predloge in strokovno usmeritev izbranega predavatelja.

The course is intended for introducing students to topics which are interesting due to recent theoretical findings, methodological breakthroughs or for their applicative value, and are as such not included into the existing curriculum. The course is also intended also for including visiting established researchers and lecturers in lectures at FRI the specific topic is determined yearly.

Temeljni literatura in viri / Readings:

Temeljna literatura se predpiše vsako leto posebej glede na vsebino in predloge izbranega predavatelja.
Determined yearly, with respect to the current topic of the course.

Cilji in kompetence:

Cilj predmeta je spoznati metodološke osnove in praktične implementacije ter uporabo izbranih najnovejših pristopov in tehnologij s področja računalništva in informatike.

Objectives and competences:

The goal of the course is to introduce basic methodological concepts as well as practical implementations and the use of specific recent approaches and technologies in computer and information science

Predvideni študijski rezultati:

Znanje in razumevanje:
Študenti spoznavajo nova področja in prijeme, ki v obstoječem predmetniku še niso zajeta.
Uporaba:
Uporaba najnovejših pristopov in tehnik z izbranega področja računalništva in informatike.

Refleksija:
Razumevanje primernosti izbranih pristopov s področja računalništva in informatike za reševanje praktičnih primerov v poslovnih okoljih.
Prenosljive spretnosti - niso vezane le na en predmet:
Reševanje kompleksnih problemov, razvoj kompleksnih sistemov.

Intended learning outcomes:

Knowledge and understanding:
A broader overview and understanding of the field of study, and of up to date methods and concepts.
Application:
Applying current approaches and techniques from the specific field of computer and information science.
Reflection:
Understanding the advantages of the chosen approaches in computer and information science in solving specific practical tasks.

Transferable skills:
Solving complex problems, designing complex systems.

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Metode poučevanja in učenja:

Predavanja, laboratorijske vaje

Learning and teaching methods:

Lectures, lab exercises

Delež (v %) /

Weight (in %)

Načini ocenjevanja:**Assessment:**

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

Sprotno preverjanje (domače naloge, kolokviji in projektno delo)**Končno preverjanje** (pisni in ustni izpit)

Ocene: 6-10 pozitivno, 5 negativno (v skladu s Statutom UL).

50%**50%**

Type (examination, oral, coursework, project):

Continuing (homework, midterm exams, project work)**Final** (written and oral exam)

Grading: 6-10 pass, 5 fail (according to the rules of University of Ljubljana).

Reference nosilca / Lecturer's references:**Pet najpomembnejših del:**

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UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet: Računalništvo v praksi I
Course title: Computer science in practice I

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Univerzitetni študijski program prve stopnje Računalništvo in informatika	ni smeri	3	zimski, poletni
University study programme Computer and Information Science, 1st cycle	none	3	fall, spring

Vrsta predmeta / Course type

Univerzitetna koda predmeta / University course code:

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje Laboratory work	Druge oblike študija Field work	Samost. delo Individ. work	ECTS
5	/	/	/	40	45	3

Nosilec predmeta / Lecturer:

Jeziki / Languages:
Predavanja / Lectures: slovenščina, angleščina
Slovene, English
Vaje / Tutorial: slovenščina, angleščina
Slovene, English

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

Prerequisites:

Vsebina:

Content (Syllabus outline):

Na uvodnih predavanjih študentom pojasnimo cilje predmeta in kako jih lahko dosežejo. Med aktivnosti, ki jih lahko štejejo kot obveznosti pri predmetu, sodijo sodelovanje pri izdelavi skupinskega projekta ali celoviti rešitvi problema s področja računalništva in informatike, predstavitev rešitve in ustrezna dokumentacija oziroma poročilo. Primeri problemov ali projektov lahko pokrivajo cel spekter vsebin: od povsem realno uporabnih – na primer dokumentiran in objavljen prispevek k večjemu v mednarodni skupnosti priznanemu odprtokodnemu projektu, predmetno tutorstvo, priprave in vodenja računalniškega krožka na osnovni ali srednji šoli do strokovne pomoči pri računalniških tekmovanjih.

Predmet predstavlja nadgradnjo predmeta Računalništvo v praksi I, pri čemer poudarja zlasti vodenje skupine in specifične probleme in vodstvene strategije.

VSEBINA

- **Skupinsko delo:** skupinski projekt, individualni projekt, vloge v skupini, dokumentacija v skupinskem delu. Vodenje skupine.
- **Upravljanje projekta:** faze projekta, strategije, orodja, nadzor kakovosti, testiranje rezultata. Upravljanje s tveganji. Metodologije upravljanja projektov.
- **Izgradnja in vodenje skupine:** pomen skupinskega dela, upravljanje ljudi, potrebne komunikacijske spretnosti, motivacija članov, delo s strankami.
- **Praktično delo v skupini**

After an introductory lecture on the necessary background of the activities involved in the course, the students' activities include participation in a group project or the solution of a suitable problem from the field of computer and information science, presentation of the solution including all documentation or a written report. Examples of suitable problems or projects range from documented and published contributions to open internationally acknowledged open source projects, classes and lab work with students of primary or secondary schools, tutoring work at lower level courses. The course upgrades the subject material of Computer science in practice I, while further attention is given to team leadership and leadership strategies.

CONTENTS

- **Team work:** team projects, individual project's tasks in a team, documenting team
- **Analysis of task specifications:** obtaining and analyzing specifications of the final consumer, functional and nonfunctional specifications, validation, managing modifications
- **Project management:** strategies, tools, quality control, testing.
- **Documentation:** technical, user, on-line, support.
- **Practical team work**

Temeljni literatura in viri / Readings:

1. S Berkun: The Art of Project Management (Theory in Practice) O'Reilly 2005
2. T DeMarco, T Lister: Peopleware: Productive Projects and Teams. Dorset House Publishing. 1999.
3. M Holcombe and F Ipaté: Correct Systems: building business process solutions. Springer
4. Vicens Q, Bourne PE (2007): Ten simple rules for a successful collaboration, PLoS Computational Biology 3(3): e44.
5. Keller Gustav, Binder Annette, Thiel Rolf Dietmar (1999). Boljša motivacija uspešnejše

učenje; Trening učnih navad. Ljubljana: Center za psihodiagnostična sredstva.

Cilji in kompetence:

Cilj predmeta je študentom omogočiti in s kreditnimi točkami ovrednotiti njihovo izven kurikularno strokovno, nepridobitno delo, ki je za profesionalno profiliranje strokovnjaka na področju računalništva in informatike potrebno, a ga učni načrt sicer ne pokriva.

Splošne kompetence:

- Sposobnost strokovnega sporazumevanja v domačem in v tujem jeziku
- Sposobnost skupinskega dela v strokovnem okolju, vodenje manjše strokovne skupine
- Sposobnost administrativnega vodenja procesov, povezanih z raziskovanjem, industrijo, izobraževanjem in drugimi področji
- Sposobnost prenašanja znanja in pisanja v domačem in tujem jeziku

Predmetno specifične kompetence:

- Sposobnost celovite obdelave manjših projektov in reševanja problemov iz prakse s področja računalništva in informatike.
- Naučiti se izbrati primerno orodje in tehnologijo za reševanje konkretnega problema
- Razvijati sposobnosti za posredovanje znanja in popularizacijo računalniških znanj in veščin.
- Sodelovanje pri skupinskem reševanju problemov, vodenja manjše skupine, pripravo gradiv, ki so za vodenje take skupine potrebna, organizacijo in

Objectives and competences:

The object of this course is to provide a framework for awarding study credit for extracurricular non-profit activities of students related to computer and information science that are not included in the curriculum of the study program and are necessary for a well formed expert in the field.

General competences:

- The ability of professional communication in the native language as well as a foreign language
- The ability of teamwork within the professional environment; management of a small professional team
- The ability for administrative management of processes related to research, industry, education and other fields
- The ability of knowledge transfer and writing skills in the native language as well as a foreign language.

Subject specific competences:

- Completing smaller practical projects and solve problems in the fields of computer and information science
- Obtaining the knowhow to choose the suitable tools and technologies for a specific problem
- Developing teaching skills and means for popularizing computer and information science topics and issues.
- Participating in group solutions, organizing and supervising the work of a smaller group including the preparation of the necessary materials, planning group work, etc.

pridobivanje znanj, ki so potrebni za delo skupine, pripravo terminskega in vsebinskega načrta za delo skupine itd.

Predvideni študijski rezultati:

Znanje in razumevanje:

Spoznavanje osnovnih zakonitosti pri posredovanju znanja in popularizaciji računalniškega področja manjši skupini predvsem mlajših članov, organizaciji njenega dela in razumevanje pomena in uporabe takih znanj pri strokovnem delu strokovnjaka na področju računalništva in informatike.

Intended learning outcomes:

Knowledge and understanding:

Basic educational principles and teaching practice in the process of introducing computer science topics to smaller groups of younger students, organization of group work, understanding the role of such competencies in the work of an expert in the field of computer and information science.

Metode poučevanja in učenja:

Predavanja, mentorski in seminarski način dela ter spremljanja dela študenta, z ustnim nastopom ob zaključku semestra. Poseben poudarek je na skupinskem delu pri seminarjih.

Learning and teaching methods:

Lectures, individual work with students and smaller groups of students, seminars with oral presentations with special emphasis on group work.

Delež (v %) /

Weight (in %) **Assessment:**

Načini ocenjevanja:

Način (pisni izpit, ustno izpraševanje, naloge, projekt):		Type (examination, oral, coursework, project):
Način (pisni izpit, ustno izpraševanje, naloge, projekt):		Type (examination, oral, coursework, project):
Sprotno preverjanje (domače naloge, kolokviji in projektno delo)	50%	Continuing (homework, midterm exams, project work)
Končno preverjanje (pisni in ustni izpit)	50%	Final (written and oral exam)
Ocene: opravil z odliko, opravil ali ni opravil (v skladu s Statutom UL).		Grading: passed with excellence, passed or failed (according to the Statute of UL).

Reference nosilca / Lecturer's references:

1. FIJAVŽ, Gašper, WOOD, David Richard. Graph minors and minimum degree. The Electronic journal of combinatorics, ISSN 1077-8926. [Online ed.], 2010, vol. 17, no. 1, r151 (30 str.).
2. DUJMOVIĆ, Vida, FIJAVŽ, Gašper, JORET, Gwenaël, SULANKE, Thom, WOOD, David Richard. On the maximum number of cliques in a graph embedded in a surface. European journal of combinatorics, ISSN 0195-6698, 2011, vol. 32, no. 8, str. 1244-1252.
3. ALAM, Muhammad Jawaherul, CHAPLICK, Steven, FIJAVŽ, Gašper, KAUFMANN, Michael, KOBOUROV, Stephen G., PUPYREV, Sergey. Threshold-coloring and unit-cube contact representation of graphs. V: BRANDSTÄDT, Andreas (ur.), JANSEN, Klaus (ur.), REISCHUK, Rüdiger (ur.). Graph-theoretic concepts in computer science : 39th International Workshop, WG 2013, Lübeck, Germany, June 19-21, 2013 : revised papers, WG 2013, 39th International Workshop on Graph-Theoretic Concepts in Computer Science, June 19 - 21, 2013, Lübeck, Germany, (Lecture notes in computer science, ISSN 0302-9743, 8165). Heidelberg [etc.]: Springer. cop. 2013, str. 26-37.
4. FIJAVŽ, Gašper, PISANSKI, Tomaž, RUS, Jernej. Strong traces model of self-assembly polypeptide structures. MATCH Communications in Mathematical and in Computer Chemistry, ISSN 0340-6253, 2014, vol. 71, no. 1, str. 199-212.
5. FIJAVŽ, Gašper, NAKAMOTO, Atsuhiko. Odd complete minors in even embeddings on surfaces. Discrete Mathematics, ISSN 0012-365X. [Print ed.], 2016, vol. 339, iss. 1, str. 165-178.

Celotna bibliografija je dostopna na SICRISu:

<http://www.sicris.si/search/rsr.aspx?lang=slv&id=9390>.

UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet: Računalništvo v praksi II
Course title: Computer science in practice II

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Univerzitetni študijski program prve stopnje Računalništvo in informatika	ni smeri	3	zimski, poletni
University study programme Computer and Information Science, 1st cycle	none	3	fall, spring

Vrsta predmeta / Course type

Univerzitetna koda predmeta / University course code:

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje Laboratory work	Druge oblike študija Field work	Samost. delo Individ. work	ECTS
5	/	/	/	40	45	3

Nosilec predmeta / Lecturer:

Jeziki / Languages:
Predavanja / Lectures: slovenščina, angleščina
Slovene, English
Vaje / Tutorial: slovenščina, angleščina
Slovene, English

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

Prerequisites:

Vsebina:

Content (Syllabus outline):

Na uvodnih predavanjih študentom pojasnimo cilje predmeta in kako jih lahko dosežejo. Med aktivnosti, ki jih lahko štejejo kot obveznosti pri predmetu, sodijo sodelovanje pri izdelavi skupinskega projekta ali celoviti rešitvi problema s področja računalništva in informatike, predstavitev rešitve in ustrezna dokumentacija oziroma poročilo. Primeri problemov ali projektov lahko pokrivajo cel spekter vsebin: od povsem realno uporabnih – na primer dokumentiran in objavljen prispevek k večjemu v mednarodni skupnosti priznanemu odprtokodnemu projektu, predmetno tutorstvo, priprave in vodenja računalniškega krožka na osnovni ali srednji šoli do strokovne pomoči pri računalniških tekmovanjih.

Predmet predstavlja nadgradnjo predmeta Računalništvo v praksi I, pri čemer poudarja zlasti vodenje skupine in specifične probleme in vodstvene strategije.

VSEBINA

- **Skupinsko delo:** skupinski projekt, individualni projekt, vloge v skupini, dokumentacija v skupinskem delu. Vodenje skupine.
- **Upravljanje projekta:** faze projekta, strategije, orodja, nadzor kakovosti, testiranje rezultata. Upravljanje s tveganji. Metodologije upravljanja projektov.
- **Izgradnja in vodenje skupine:** pomen skupinskega dela, upravljanje ljudi, potrebne komunikacijske spretnosti, motivacija članov, delo s strankami.
- **Praktično delo v skupini**

After an introductory lecture on the necessary background of the activities involved in the course, the students' activities include participation in a group project or the solution of a suitable problem from the field of computer and information science, presentation of the solution including all documentation or a written report. Examples of suitable problems or projects range from documented and published contributions to open internationally acknowledged open source projects, classes and lab work with students of primary or secondary schools, tutoring work at lower level courses. The course upgrades the subject material of Computer science in practice I, while further attention is given to team leadership and leadership strategies.

CONTENTS

- **Team work:** team projects, individual project's tasks in a team, documenting team
- **Analysis of task specifications:** obtaining and analyzing specifications of the final consumer, functional and nonfunctional specifications, validation, managing modifications
- **Project management:** strategies, tools, quality control, testing.
- **Documentation:** technical, user, on-line, support.
- **Practical team work**

Temeljni literatura in viri / Readings:

1. S Berkun: The Art of Project Management (Theory in Practice) O'Reilly 2005
2. T DeMarco, T Lister: Peopleware: Productive Projects and Teams. Dorset House Publishing. 1999.
3. M Holcombe and F Ipaté: Correct Systems: building business process solutions. Springer
4. Vicens Q, Bourne PE (2007): Ten simple rules for a successful collaboration, PLoS Computational Biology 3(3): e44.
5. Keller Gustav, Binder Annette, Thiel Rolf Dietmar (1999). Boljša motivacija uspešnejše

učenje; Trening učnih navad. Ljubljana: Center za psihodiagnostična sredstva.

Cilji in kompetence:

Cilj predmeta je študentom omogočiti in s kreditnimi točkami ovrednotiti njihovo izven kurikularno strokovno, nepridobitno delo, ki je za profesionalno profiliranje strokovnjaka na področju računalništva in informatike potrebno, a ga učni načrt sicer ne pokriva.

Splošne kompetence:

- Sposobnost strokovnega sporazumevanja v domačem in v tujem jeziku
- Sposobnost skupinskega dela v strokovnem okolju, vodenje manjše strokovne skupine
- Sposobnost administrativnega vodenja procesov, povezanih z raziskovanjem, industrijo, izobraževanjem in drugimi področji
- Sposobnost prenašanja znanja in pisanja v domačem in tujem jeziku

Predmetno specifične kompetence:

- Sposobnost celovite obdelave manjših projektov in reševanja problemov iz prakse s področja računalništva in informatike.
- Naučiti se izbrati primerno orodje in tehnologijo za reševanje konkretnega problema
- Razvijati sposobnosti za posredovanje znanja in popularizacijo računalniških znanj in veščin.
- Sodelovanje pri skupinskem reševanju problemov, vodenja manjše skupine, pripravo gradiv, ki so za vodenje take skupine potrebna, organizacijo in

Objectives and competences:

The object of this course is to provide a framework for awarding study credit for extracurricular non-profit activities of students related to computer and information science that are not included in the curriculum of the study program and are necessary for a well formed expert in the field.

General competences:

- The ability of professional communication in the native language as well as a foreign language
- The ability of teamwork within the professional environment; management of a small professional team
- The ability for administrative management of processes related to research, industry, education and other fields
- The ability of knowledge transfer and writing skills in the native language as well as a foreign language.

Subject specific competences:

- Completing smaller practical projects and solve problems in the fields of computer and information science
- Obtaining the knowhow to choose the suitable tools and technologies for a specific problem
- Developing teaching skills and means for popularizing computer and information science topics and issues.
- Participating in group solutions, organizing and supervising the work of a smaller group including the preparation of the necessary materials, planning group work, etc.

pridobivanje znanj, ki so potrebni za delo skupine, pripravo terminskega in vsebinskega načrta za delo skupine itd.

Predvideni študijski rezultati:

Znanje in razumevanje:

Spoznavanje osnovnih zakonitosti pri posredovanju znanja in popularizaciji računalniškega področja manjši skupini predvsem mlajših članov, organizaciji njenega dela in razumevanje pomena in uporabe takih znanj pri strokovnem delu strokovnjaka na področju računalništva in informatike.

Intended learning outcomes:

Knowledge and understanding:

Basic educational principles and teaching practice in the process of introducing computer science topics to smaller groups of younger students, organization of group work, understanding the role of such competencies in the work of an expert in the field of computer and information science.

Metode poučevanja in učenja:

Predavanja, mentorski in seminarski način dela ter spremljanja dela študenta, z ustnim nastopom ob zaključku semestra. Poseben poudarek je na skupinskem delu pri seminarjih.

Learning and teaching methods:

Lectures, individual work with students and smaller groups of students, seminars with oral presentations with special emphasis on group work.

Delež (v %) /

Weight (in %)

Načini ocenjevanja:

Assessment:

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

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

Sprotno preverjanje (domače naloge, kolokviji in projektno delo)

Končno preverjanje (pisni in ustni izpit)

Ocene: opravi z odliko, opravi ali ni opravi (v skladu s Statutom UL).

50%

50%

Type (examination, oral, coursework, project):

Type (examination, oral, coursework, project):

Continuing (homework, midterm exams, project work)

Final (written and oral exam)

Grading: passed with excellence, passed or failed (according to the Statute of UL).

Reference nosilca / Lecturer's references:

1. FIJAVŽ, Gašper, WOOD, David Richard. Graph minors and minimum degree. The Electronic journal of combinatorics, ISSN 1077-8926. [Online ed.], 2010, vol. 17, no. 1, r151 (30 str.).
2. DUJMOVIĆ, Vida, FIJAVŽ, Gašper, JORET, Gwenaël, SULANKE, Thom, WOOD, David Richard. On the maximum number of cliques in a graph embedded in a surface. European journal of combinatorics, ISSN 0195-6698, 2011, vol. 32, no. 8, str. 1244-1252.
3. ALAM, Muhammad Jawaherul, CHAPLICK, Steven, FIJAVŽ, Gašper, KAUFMANN, Michael, KOBOUROV, Stephen G., PUPYREV, Sergey. Threshold-coloring and unit-cube contact representation of graphs. V: BRANDSTÄDT, Andreas (ur.), JANSEN, Klaus (ur.), REISCHUK, Rüdiger (ur.). Graph-theoretic concepts in computer science : 39th International Workshop, WG 2013, Lübeck, Germany, June 19-21, 2013 : revised papers, WG 2013, 39th International Workshop on Graph-Theoretic Concepts in Computer Science, June 19 - 21, 2013, Lübeck, Germany, (Lecture notes in computer science, ISSN 0302-9743, 8165). Heidelberg [etc.]: Springer. cop. 2013, str. 26-37.
4. FIJAVŽ, Gašper, PISANSKI, Tomaž, RUS, Jernej. Strong traces model of self-assembly polypeptide structures. MATCH Communications in Mathematical and in Computer Chemistry, ISSN 0340-6253, 2014, vol. 71, no. 1, str. 199-212.
5. FIJAVŽ, Gašper, NAKAMOTO, Atsuhiko. Odd complete minors in even embeddings on surfaces. Discrete Mathematics, ISSN 0012-365X. [Print ed.], 2016, vol. 339, iss. 1, str. 165-178.

Celotna bibliografija je dostopna na SICRISu:

<http://www.sicris.si/search/rsr.aspx?lang=slv&id=9390>.

UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet:	Tehnične veščine
Course title:	Computer Science Skills

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Univerzitetni študijski program prve stopnje Računalništvo in informatika	ni smeri	2, 3	zimski/ poletni
University study program Computer and Information Science, 1 cycle	none	2, 3	fall/spring

Vrsta predmeta / Course type izbirni predmet / elective course

Univerzitetna koda predmeta / University course code: 63284

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje Laboratory work	Druge oblike študija Field work	Samost. delo Individ. work	ECTS
15	/	45	/	/	30	3

Nosilec predmeta / Lecturer: skrbnika študijskih programov računalništva in informatike 1. stopnje

Jeziki / Languages:	Predavanja / Lectures:	slovenščina, angleščina Slovene, English
	Vaje / Tutorial:	slovenščina, angleščina Slovene, English

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

Prerequisites:

Vsebina:

Content (Syllabus outline):

Predmet je praktično naravnan in je namenjen temu, da se študente seznanijo z delom v konkretnih računalniških okoljih in jezikih in s konkretnimi orodji, ki so v študijskem programu izpadli, so manj poudarjeni ali pa so se pojavili šele pred kratkim, so pa pomembni za delo v praksi in za sposobnost razumevanja in izvedbe konkretnih računalniških nalog in del. Primeri so posamezni programski jeziki (Coq, Scheme, Dart, Ceylon, Go, F#, Opa,...) in okolja (Mathematica, Django, Android, iOS), nove tehnologije v računalništvu (kvantni računalniki, DNA računalniki,...) in novi pristopi k računanju (kvantno računanje, Blue Brain,...). V računalništvu se takšne nove teme redno pojavljajo, nemogoče je, da bi bile vse takšne zanimivosti in novosti vključene v obvezne ali strokovno izbirne predmete, smiselno pa je, da ponudimo študentom možnost, da se njimi seznanijo.

The course is practically oriented and intended for introducing the students to practical work on specific platforms and in specific languages that are not included in other courses or have appeared only recently and are important for practical work and for completing specific tasks, and projects. Examples of such topics are specific programming languages (Coq, Scheme, Dart, Ceylon, Go, F#, Opa,...) and platforms (Mathematica, Django, Android, iOS), new and emerging technologies (quantum computers, DNA computers,...) and new approaches to computing (quantum computing, Blue Brain project,...). Such new topics and concepts regularly appear in computer and information science and it is reasonable to give the students an opportunity to learn about them.

Temeljna literatura in viri / Readings:

[Thomas H. Cormen](#), [Charles E. Leiserson](#): Introduction to Algorithms, 3rd edition, MIT Press, 2009.

Knuth, Donald: The Art of Computer Programming, ADDISON WESLEY (PEARSON (2011)

The pragmatic bookshelf (<http://pragprog.com/>)

Dodatna literatura se predpiše vsako leto posebej glede na vsebino in predloge izbranega predavatelja.

Additional literature is given annually based on the current topic of the course.

Cilji in kompetence:

Cilj predmeta je podrobneje spoznati praktične in učinkovite pristope in temeljito spoznati delo v posameznih orodjih, jezikih in okoljih.

Objectives and competences:

The object of this course is mastering and understanding efficient practical solutions and gaining a thorough understanding of specific tools, programming languages, or platforms.

Predvideni študijski rezultati:

Znanje in razumevanje:

Študenti spoznavajo praktično delo s konkretnimi orodji in okolji.

Uporaba:

Uporaba najnovejših pristopov in tehnik v

Intended learning outcomes:

Learning and understanding:

The students are acquainted with practical work using specific tools and specific platforms.

Application:

Applying state-of-the-art techniques and

izbranem okolju, jeziku ali orodju.

Refleksija:
 Temeljito poznavanje najnovejših orodij in platform, seznanjanje s povsem praktičnimi problemi in rešitvami pri konkretnem programerskem in razvojnem delu na področju računalništva.
 Prenosljive spretnosti - niso vezane le na en predmet: poznavanje praktičnih pristopov, prilagodljivost pri uporabi različnih orodij in delu v različnih računalniških okoljih.

approaches on a chosen platform, language, or tool.

Reflection:
 A thorough knowledge of a specific state-of-the-art tool or platform, a close encounter with practical problems and solutions in specific programming and engineering work in computer and information science.
 Transferable skills:
 Understanding »tricks of the trade«, developing a flexibility and ability to adapt to work in different contexts.

Metode poučevanja in učenja:

Predavanja, laboratorijske vaje.

Learning and teaching methods:

Lectures, lab. practice.

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

Reference nosilca / Lecturer's references:

izr. prof. dr. Zoran Bosnić

- ZUPANC, Kaja, BOSNIĆ, Zoran. Automated essay evaluation with semantic analysis. Knowledge-based systems, ISSN 0950-7051. [Print ed.], Mar. 2017, vol. 120, str. 118-132.
- OCEPEK, Uroš, RUGELJ, Jože, BOSNIĆ, Zoran. Improving matrix factorization recommendations for examples in cold start. Expert systems with applications, ISSN 0957-4174. [Print ed.], Nov. 2015, vol. 42, no. 19, str. 6784-6794.
- BOSNIĆ, Zoran, DEMŠAR, Jaka, KEŠPRET, Grega, Rodrigues, Pedro Pereira, Gama, João, Kononenko, Igor. Enhancing data stream predictions with reliability estimators and explanation. Engineering applications of artificial intelligence, ISSN 0952-1976. [Print ed.], 2014, vol. 34, str. 178-192.

4. BOSNIĆ, Zoran, KONONENKO, Igor. Estimation of individual prediction reliability using the local sensitivity analysis. *Applied intelligence*, ISSN 0924-669X. [Print ed.], Dec. 2008, vol. 29, no. 3, str. 187-203, ilustr.
5. BOSNIĆ, Zoran, KONONENKO, Igor. Comparison of approaches for estimating reliability of individual regression predictions. *Data & Knowledge Engineering*, ISSN 0169-023X. [Print ed.], Dec. 2008, vol. 67, no. 3, str. 504-516.

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<http://sicris.izum.si/search/rsr.aspx?lang=slv&id=31318>.

doc. dr. Tomaž Dobravec

MIHELIC, Jurij, DOBRAVEC, Tomaž. SicSim: A simulator of the educational SIC/XE computer for a system-software course. *Computer applications in engineering education*, ISSN 1061-3773, 2015, vol. 23, no. 1, pp. 137-146

ČEŠNOVAR, Rok, RISOJEVIĆ, Vladimir, BABIĆ, Zdenka, DOBRAVEC, Tomaž, BULIĆ, Patricio. A GPU implementation of a structural-similarity-based aerial-image classification. *The journal of supercomputing*, ISSN 0920-8542, 2013, vol. 65, no. 2, pp. 978-996

BULIĆ, Patricio, DOBRAVEC, Tomaž. An approximate method for filtering out data dependencies with a sufficiently large distance between memory references. *The journal of supercomputing*, ISSN 0920-8542, 2011, vol. 56, no. 2, pp. 226-244

DOBRAVEC, Tomaž, ŽEROVNIK, Janez, ROBIČ, Borut. An optimal message routing algorithm for circulant networks. *J. systems archit.*. [Print ed.], 2006, vol. 52, no. 5, str. [298]-306

DOBRAVEC, Tomaž, ROBIČ, Borut. Restricted shortest paths in 2-circulant graphs. *Comput. commun.*. [Print ed.], March 2009, vol. 32, no. 4, str. 685-690

Celotna bibliografija doc. dr. Dobravca je dostopna na SICRISu:

<http://sicris.izum.si/search/rsr.aspx?lang=slv&id=10416>.