

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet: Algoritmi in podatkovne strukture 1
Course title: Algorithms and data structures 1

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Računalništvo in informatika, prva stopnja, univerzitetni	Ni členitve (študijski program)	2. letnik	Zimski

Univerzitetna koda predmeta/University course code:

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
45		30			105	6

Nosilec predmeta/Lecturer:

Vrsta predmeta/Course type:

Jeziki/Languages:	Predavanja/Lectures:	Slovenščina
	Vaje/Tutorial:	Slovenščina

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

Poznavanje osnov programiranja.

Prerequisites:

Knowledge of basic programming.

Vsebina:

predavanja:

Iteracija in rekurzija
 Reševanje problemov in algoritmi
 Analiza časovne zahtevnosti algoritmov
 Abstraktni podatkovni tip; ADT seznam
 Osnovni abstraktni podatkovni tipi: množica, vrsta, sklad, preslikava
 Zgoščene tabele
 Abstraktni podatkovni tip drevo; primer: Izrazna drevesa
 Abstraktni podatkovni tip slovar, Iskalna drevesa: binarna, rdeče-črna
 Iskalna drevesa: AVL, B-drevesa
 Abstraktna podatkovna tipa prioriteta vrsta (kopica) disjunktne množice
 Abstraktna podatkovna tipa graf in usmerjeni graf
 Iskanje najdaljših poti z dinamičnim programiranjem (kritična pot)
 Iskanje najkrajših poti v usmerjenem grafu (algoritem Dijkstra)
 Minimalno vpeto drevo v neusmerjenem grafu; Primov in Kruskalov algoritem.
 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

Content (Syllabus outline):

Lectures:

Iteration and recursion
 Problem solving and algorithms
 Analysing time-complexity of algorithms
 Abstract data type; ADT list
 Basic abstract data types: set, queue, stack, mapping
 Hash tables
 Abstract data type tree; example: expression trees
 Abstract data type dictionary, search trees: binary, red-black
 Search trees: AVL, B-trees
 Abstract data type priority queue (heap) and disjunctive sets
 Abstract data types graph and directed graph (digraph)
 Searching for longest paths with dynamic programming (critical path)
 Searching for shortest paths in directed graphs (algorithm Dijkstra)
 Minimum spanning tree in undirected graphs; Prim and Kruskal algorithms.
 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

reševanju praktičnih problemov. Pri tem bodo poudarki na samostojnem delu študentov ob pomoči asistentov. Na vajah bodo študenti implementirali več manjših programov (tudi kot domače naloge) ter obsežnejše programe v obliki seminarских nalog, ki jih bodo zagovarjali na vajah in s tem 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.

well at home work), students will implement several short programs and will get grades for their presentation of seminar works.

Home works:

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:

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

Pomožna literatura:

I.Kononenko in M. Robnik-Šikonja: **Algoritmi in podatkovne strukture 1**, Založba FE in FRI, 2003.

A.V.Aho, J.E.Hopcroft, J.D.Ullman: **Data Structures and Algorithms**, Addison Wesley, 1983.

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 infromatike, ki vključujejo teoretične veščine, praktično znanje in veščine, ki so bistvene za področje računalništva in informatike. . Osnovne veščine iz računalništva in infromatike, 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:

Z uspešno zaključenim predmetom bo študent:

- sposoben samostojnega razvoja programov, uporabe osnovnih podatkovnih struktur in algoritmov, sposoben samostojnega načrtovanja podatkovnih struktur in algoritmov.
- lahko uporabil principe programiranja in načrtovanja podatkovnih struktur in algoritmov za razvoj obsežnih programskih sistemov.
- prilagodil znane algoritme za reševanje podobnih problemov iz preiskovanja seznamov, dreves in grafov
- razlikoval med različno učinkovitimi algoritmi za reševanje istega problema
- zmožen načrtovanja rešitve različnih problemov s programi in algoritmi in zmožen uporabe naučenih principov pri programiranju v poljubnem programskem jeziku.

Intended learning outcomes:

With successful completion of this course the student will

- be able to: autonomously develop programs, to use the basic data structures and algorithms, to independently design data structures and algorithms.
- use the learned principles for programming and design of data structures and algorithms for the development of large systems.
- adapt the known algorithms for solving similar problems in searching lists, trees and graphs
- differentiate among different complexity of algorithms for solving the same problem
- be able to design the solution of different problems using programs and algorithms, and to use the learned concepts for programming 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 na samostojnem delu pri domačih nalogah, vajah in seminarjih.	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/Weight	Assessment:
Način (pisni izpit, ustno izpraševanje, naloge, projekt): Sprotno preverjanje (domače naloge, kolokviji in projektno delo)		Type (examination, oral, coursework, project): Continuing (homework, midterm exams, project work)
Ocena vaj	50,00 %	Grade for tutorials
Končno preverjanje (pisni in ustni izpit)	50,00 %	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:

<p>Pet najpomembnejših del:</p> <p>KONONENKO, Igor, KUKAR, Matjaž. <i>Machine learning and data mining: introduction to principles and algorithms</i>. Chichester: Horwood Publishing, cop. 2007. XIX, 454 str.</p> <p>ŠTRUMBELJ, Erik, KONONENKO, Igor. An efficient explanation of individual classifications using game theory. <i>J. mach. learn. res.</i>, Jan. 2010, vol. 11, no. [1], str. 1-18.</p> <p>ROBNIK ŠIKONJA, Marko, KONONENKO, Igor. Theoretical and empirical analysis of ReliefF and RReliefF. <i>Mach. learn.</i>, 2003, vol. 53, str. 23-69.</p> <p>KONONENKO, Igor, BRATKO, Ivan. Information-based evaluation criterion for classifier's performance. <i>Mach. learn.</i>, 1991, vol. 6, no. 1, str. 67-80.</p> <p>KONONENKO, Igor. Machine learning for medical diagnosis: history, state of the art and perspective. <i>Artif. intell. med.</i>, 2001, vol. 23, no. 1, str. 89-109.</p> <p>Celotna bibliografija prof. dr. Igorja Kononenka je dostopna na SICRISu: http://sicris.izum.si/search/rsr.aspx?lang=slv&id=5066</p>

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet: Algoritmi in podatkovne strukture 2
Course title: Algorithms and data structures 2

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Računalništvo in informatika, prva stopnja, univerzitetni	Ni členitve (študijski program)	2. letnik	Letni

Univerzitetna koda predmeta/University course code: 63280

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
45		30			105	6

Nosilec predmeta/Lecturer: Borut Robič

Vrsta predmeta/Course type: obvezni predmet /compulsory course

Jeziki/Languages:

Predavanja/Lectures:	Slovenščina
Vaje/Tutorial:	Slovenščina

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

Vsebina:

Predavanja:

- Uvod: splošno o metodah razvoja algoritmov, o analizi algoritmov, o računski zahtevnosti algoritmov in problemov
- Deli in vladaj: opis metode, primeri problemov in algoritmov (glejte primere v točki 12 spodaj)
- Požrešna metoda: opis metode, primeri
- Postopno izboljševanje: opis, primeri
- Dinamično programiranje: opis, primeri
- Sestopanje: opis metode, primeri
- Razveji in omeji: opis metode, primeri
- Linearno programiranje: opis metode, simpleksni algoritem, primeri
- Izbrane višje podatkovne strukture
- NP-težki računski problemi: spodnja meja časovne zahtevnosti, intuitivno o razredih P, NP in NP-težkih problemih
- Metode reševanja NP-težkih problemov: hevristični algoritmi, aproksimacijski algoritmi, verjetnostni algoritmi, parametrizirani algoritmi, eksaktni eksponentni algoritmi, primeri
- 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;

Content (Syllabus outline):

Lectures:

- Intro: about methods of algorithm design, analysis of algorithms, and computational complexity of algorithms and problems
- Divide-and-Conquer: description of the method, examples of problems and algorithms (see examples 12 below)
- Greedy method: description, examples
- Iterative improvement: descr., examples
- Dynamic programming: descr., examples
- Backtracking: description, examples
- Branch&Bound: description, examples
- Linear programming: descr., Simplex algorithm, examples
- Selected advanced data structures
- NP-hard computational problems: lower bounds on time complexity, informally about P, NP and NP-hard problems;
- Methods of solving NP-hard problems: heuristic algorithms, approximation algorithms, randomized algorithms, parameterized algorithms, exact exponential algorithms, examples
- 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

<p>maksimalni pretok & Ford-Fulkersonov alg.; najkrajše poti & Bellman-Fordov ter Floyd-Warshallov alg.); izbrani problemi iz računske geometrije.</p> <p>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.</p> <p>Domače in seminarske naloge: Namen domačih in seminarskih nalog je dati študentom priložnost za reševanje raznih računskih problemov s samostojnim razvojem algoritmov in njihovim programiranjem (in jih spodbuditi k sprotnemu študiju).</p>	<p>(searching a graph; topological sort; maximum flow & Ford-Fulkerson alg.; shortest paths & algorithms of Bellman-Ford, and Floyd-Warshall); selected problems from computational geometry.</p> <p>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.</p> <p>Home works and seminars: These are necessary for a student to independently practice the design and implementation of algorithms .</p>
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<p>Temeljna literatura in viri/Readings:</p> <p>B. Robič: <i>Algoritmi</i> (to appear, instead of 2. below) B. Vilfan: <i>Osnovni algoritmi</i>, Založba FE in FRI, 2002</p> <p>Dodatna literatura: T. Cormen et al. <i>Introduction to Algorithms</i>, McGraw-Hill, 3rd ed., 2009 B. Robič: <i>Aproksimacijski algoritmi</i>, Založba FE in FRI, 2. izdaja, 2009</p>	
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<p>Cilji in kompetence:</p> <p>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.</p>	<p>Objectives and competences:</p> <p>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.</p>
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<p>Predvideni študijski rezultati:</p> <p>Študent bo po opravljenem predmetu:</p> <ul style="list-style-type: none"> -- poznal razvoj algoritmov, analizo algoritmov in osnovne razrede zahtevnosti; -- sposoben razvijati alg. z metodo deli in vladaj, s požrešno metodo, z metodo dinamičnega programiranja, z metodo sestopanja ter z metodo razveji in omeji; -- sposoben prepoznati probleme kot linearne programe, rešljive s simpleksnim algoritmom; -- poznal učinkovite alg. za probleme iskanja, linearne algebre, Fourierove transformacije, kombinatorične optimizacije in iskanja vzorcev. -- sposoben samostojnega načrtovanja alg. in ustreznih podatkovnih struktur, in analiziranja njihove zahtevnosti; -- poznal osnovne pojme o NP-težkih problemih in metodah njihovega reševanja. <p>Uporaba: Uporaba naučenih principov pri načrtovanju algoritmov in njihovem programiranju.</p> <p>Refleksija: Razumevanje osnovnih principov načrtovanja algoritmov in razumevanje njihove vloge pri reševanju računskih problemov.</p>	<p>Intended learning outcomes:</p> <p>After completing the course the student will:</p> <ul style="list-style-type: none"> -- know how to design and analyse algorithms and understand the basic complexity classes; -- be able to design algorithms using the methods divide and conquer, greedy method, dynamic programming, backtracking, branch and bound; -- be able to recognize problems definable as linear programs and solvable with simplex alg. -- understand efficient algorithms for problems of searching, linear algebra, Fourier transform, combinatorial optimiz. and pattern matching; -- be capable to design algorithms and data structures for various problems and analyse their complexities; -- know the basics of NP-hard problems and the methods for solving them. <p>Application: use of the principles and methods in algorithm design and implementation</p> <p>Reflection: understanding of the basic principles of algorithm design and their role in efficient solving of computational problems</p> <p>Transferable skills: there are many and useful in other subjects. For example, the ability to plan, design, and</p>
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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).	implement algorithmic solutions to various problems (regardless of the programming language used)
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Metode poučevanja in učenja:	Learning and teaching methods:
Predavanja, domače naloge, seminarski način dela pri vajah. Poudarek je na sprotne študiju in samostojnem delu pri vajah, seminarskih in domačih nalogah.	Lectures, tutorial, home works, seminars.

Načini ocenjevanja:	Delež/Weight	Assessment:
Način: pisni izpit, ustno izpraševanje, naloge, projekt		Type: exam, oral, coursework, project
Sprotno preverjanje: domače naloge, projektno delo	50,00 %	Continuing: homework, project work
Končno preverjanje: pisni in ustni izpit	50,00 %	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:

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: Analiza algoritmov in heuristično reševanje problemov
Course title: Analysis of Algorithms and Heuristic Problem Solving

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Računalništvo in informatika, prva stopnja, univerzitetni	Ni členitve (študijski program)	3. letnik	Letni

Univerzitetna koda predmeta/University course code: 63263

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
45	10	20			105	6

Nosilec predmeta/Lecturer: Marko Robnik Šikonja

Vrsta predmeta/Course type: izbirni predmet /elective course

Jeziki/Languages:

Predavanja/Lectures:	Slovenščina, Angleščina
Vaje/Tutorial:	Slovenščina, Angleščina

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:
Analiza rekurzivnih algoritmov: substitucijska metoda, rešitev za algoritme deli in vladaj, metoda Akra-Bazzi.
Verjetnostna analiza: definicija, analiza stohastičnih algoritmov.
Randomizacija algoritmov.
Amortizirana analiza kompleksnosti algoritmov.
Reševanje linearnih rekurzivnih enačb.
Razreda P in NP: definicija, NP-polnost, standardni NP-polni problemi.
Prevedljivost in reševanje NP-polnih problemov.
Aproksimacijski algoritmi.
Kombinatorična optimizacija, lokalno preiskovanje, simulirano ohlajanje.
Linearno programiranje za reševanje problemov.
Metaheuristike in stohastično preiskovanje: vodeno lokalno preiskovanje, preiskovanje s spremenljivo soseščino, tabu preiskovanje.
Populacijske metode: genetski algoritmi, optimizacija z rojem delcev, diferencialna evolucija, umetni imunski sistemi.

Content (Syllabus outline):

Lecture topics:
Analysis of recursive algorithms: substitution method, solution for divide and conquer approach, Akra-Bazzi method.
Probabilistic analysis: definition, analysis of stochastic algorithms.
Randomization of algorithms.
Amortized analysis of algorithm complexity.
Solving linear recurrences.
Classes P and NP: definitions, NP-completeness, standard NP-complete problems.
Reducibility and solving NP-complete problems.
Approximation algorithms.
Combinatorial optimization, local search.
Linear programming for problem solving.
Metaheuristics and stochastic search: guided local search, variable neighbourhood search, and tabu search.
Population methods: genetic algorithms, particle swarm optimization, differential evolution, artificial immune systems.

Temeljna literatura in viri/Readings:

T.H. Cormen, C.E. Leiserson, R.L. Rivest, C. Stein: *Introduction to Algorithms, 3rd edition*. MIT Press, 2009
R. Sedgewick, P. Flajolet: *An Introduction to the Analysis of Algorithms*. Addison-Wesley, 1995
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:

Po koncu predmeta bodo študente znali analizirati algoritme in njihovo računsko zahtevnost. Sposobni bodo ovrednotiti delovanje hevrističnih metod za reševanje zahtevnih problemov in bodo takšno analizo izvedli na realnem problemu. Konkretno bodo uporabljali splošne metode za analizo rekurzivnih algoritmov: substitucijsko metodo in drevesno metodo uporabljali metode za analizo algoritmov deli in vladaj: mojstrovo metoda in metodo Akra-Bazzi verjetnostno analizirali programe uporabljali amortizirano analizo algoritmov, poznali ideje aproksimacijskih tehnik, uporabljali, razlikovali in vrednotili hevristične pristope in meta-hevristik za reševanje težkih problemov, uporabljali in primerjali populacijske optimizacijske metode in principe evolucijskega računanja.

Intended learning outcomes:

Upon passing the exam, the students will know how to analyze algorithms and their computational complexity. They will be capable to evaluate heuristic techniques for efficient solving of difficult problems and will be able to do such an analysis on real world problem. Specifically, they will use of methods for analysis of recursive algorithms: the substitution method and recursive-tree method, use methods for analysis of divide-and-conquer algorithms: master theorem and Akra-Bazzi method, probabilistically analyze the algorithms, use the amortized analysis of algorithms, knowing the ideas of approximation algorithms, use and evaluate of heuristic methods and metaheuristics for solving complex problems, use and compare population-based techniques and principles of evolutionary computation in optimization.

Metode poučevanja in učenja:

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.

Learning and teaching methods:

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.
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Načini ocenjevanja:	Delež/Weight	Assessment:
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.	50,00 %	Continuing: homework, project work.
Končno preverjanje: pisni in ustni izpit.	50,00 %	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:

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.

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.

ROBNIK ŠIKONJA, Marko, KONONENKO, Igor. Theoretical and empirical analysis of ReliefF and RReliefF. *Machine learning*, 2003, 53:23-69.

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

KRANJEC, Janez, ORAČ, Roman, PODPEČAN, Vid, LAVRAČ, Nada, ROBNIK ŠIKONJA, Marko. CloudFlows: online workflows for distributed big data mining. *FGCS*, 2017, vol. 68, pp. 38-58

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: Angleški jezik nivo A

Course title: English-level A

Študijski programi in stopnja

Računalništvo in informatika, prva stopnja, univerzitetni

Študijska smer

Ni členitve (študijski program)

Letnik

Semestri

Letni

Univerzitetna koda predmeta/University course code:

63222

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
30		15			45	3

Nosilec predmeta/Lecturer: Nina Bishop Bostič

Vrsta predmeta/Course type: izbirni predmet/elective course

Jeziki/Languages:

Predavanja/Lectures:

Slovenščina, Angleščina

Vaje/Tutorial:

Slovenščina, Angleščina

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

Prerequisites:

Vsebina:

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;
- vljudnostne fraze;
- izmenjava informacij;
- predstavitev podjetja in dejavnosti;
- jezik poslovnih predstavitev;
- korespondenca in telefoniranje;
- dogovori in zmenki;
- tipične napake.

Content (Syllabus outline):

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.

Temeljna literatura in viri/Readings:

Williams A. in Pile L. (2002) Pass Cambridge, BEC Vantage. Summertown Publishing: Oxford.

Littleford David, Halstead John in Charles Mulraine. (2004). Career Skills: Opening Doors into the Job Market. New York: Palgrave Macmillan.

Badger I. (2006). English for work. Longman: Edinburgh.

Dodatna literatura:

Anderson K. (2004). Study speaking. Cambridge University Press: Cambridge.
 Remacha Esteras, Santiago. (2003). English for computer users. Workbook. Cambridge: Cambridge: University Press.
 Štros M. (2006). English correspondence. Babylon d.o.o.: Ljubljana.
 Brieger, N. In Pohl, A. (2002). Technical English Vocabulary and Grammar. Summertown: Summertown Publishing Limited.
 EVROTERM. Večjezična terminološka baza izrazov Evropske unije. Dostopno na: <http://www.sigov.si/evroterm>.
 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 predstavitev. 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).

Objectives and competences:

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

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.

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

Načini ocenjevanja:**Delež/Weight****Assessment:**

Način (pisni izpit, ustno izpraševanje, naloge, projekt):	Delež/Weight	Assessment:
Način (pisni izpit, ustno izpraševanje, naloge, projekt):		Type (examination, oral, coursework, project):
Sprotno preverjanje (domače naloge, kolokviji in projektno delo)	50,00 %	Continuing (homework, midterm exams, project work)
Končno preverjanje (pisni in ustni izpit)	50,00 %	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:

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. Krkine 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 programi in stopnja

Računalništvo in informatika, prva stopnja, univerzitetni

Študijska smer

Ni členitve (študijski program)

Letnik

Semestri

Zimski

Univerzitetna koda predmeta/University course code:

63223

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
30		15			45	3

Nosilec predmeta/Lecturer: Nina Bishop Bostič

Vrsta predmeta/Course type: izbirni predmet/elective course

Jeziki/Languages:

Predavanja/Lectures:

Angleščina

Vaje/Tutorial:

Angleščina

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

Prerequisites:

Vsebina:

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

- akademiških ciljev, ki se nanašajo na sposobnost branja tujejezičnih strokovnih besedil, znanstvenih revij in učbeniških gradiv;
- 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 pogajanjem oz. sestanki in pri predstavitvah.
- principi tehnične komunikacije;
- priročnik + opisi programov (software/hardware);
- slovnicične zakonitosti v tehniki;
- žargon – tehnična terminologija;
- tehnični teksti v luči različnih tipov angleščine.

Content (Syllabus outline):

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

- academic goals: students will be able to read professional texts, journals and textbooks
- 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
- principles of technical communication
- understanding manuals
- understanding grammar structures in technical texts
- understanding technical jargon
- technical texts in the light of different text types

Temeljna literatura in viri/Readings:

Harrison L., Cushen C. in Hutchison S. (2005). Achieve IELTS. Marshall Cavendish: London.

Wyatt R. (2001). IELTS Examination. Peter Collin Publishing: London.

Littleford David, Halstead John in Charles Mulraine. (2004). Career Skills: Opening Doors into the Job Market. New York: Palgrave Macmillan.

Cottrell, Stella. (1999). The Study Skills Handbook. London: Macmillan Press LTD.

Dodatna literatura:

Emmerson P. (2002). Business Grammar Builder. MacMillan: Oxford.

Remacha Esteras, Santiago. (2003). English for computer users. Workbook. Cambridge: Cambridge: University Press.
 Davidson G. (2002). Learners' Companion Series Vocabulary. Learners Publishing: Singapore.
 Brieger, N. In Pohl, A. (2002). Technical English Vocabulary and Grammar. Summertown: Summertown Publishing Limited
 EVROTERM. Večjezična terminološka baza izrazov Evropske unije. Dostopno na: <http://www.sigov.si/evroterm>
 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 predstavitev. 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).

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

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.

Metode poučevanja in učenja:

Learning and teaching methods:

- predavanja - lektorske vaje - delo v parih in skupinah - problemsko zasnovano učenje jezika in analiza študijskih primerov - A/V predstavitve	- lectures - practice - pair work - problem solving - student case studies - A/V presentations
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Načini ocenjevanja:	Delež/Weight	Assessment:
Način (pisni izpit, ustno izpraševanje, naloge, projekt):		Type (examination, oral, coursework, project):
Sprotno preverjanje (domače naloge, kolokviji in projektno delo)	50,00 %	Continuing (homework, midterm exams, project work)
Končno preverjanje (pisni in ustni izpit)	50,00 %	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:

- 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](#)]
 - 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](#)]
 - 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](#)]
 - 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](#)]
 - 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](#)]
- 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 programi in stopnja

Računalništvo in informatika, prva stopnja, univerzitetni

Študijska smer

Ni členitve (študijski program)

Letnik

Semestri

Letni

Univerzitetna koda predmeta/University course code:

63224

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
30		15			45	3

Nosilec predmeta/Lecturer:

Nina Bishop Bostič

Vrsta predmeta/Course type:

izbirni predmet/elective course

Jeziki/Languages:

Predavanja/Lectures:

Angleščina

Vaje/Tutorial:

Angleščina

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

Prerequisites:

Vsebina:

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.

Content (Syllabus outline):

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.

Temeljna literatura in viri/Readings:

Predpisana in potrjena literatura Univerze Cambridge za pripravo na izpit:

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

Dodatna literatura:

Harrison L., Cushen C. in Hutchison S. (2005). Achieve IELTS. Marshall Cavendish: London.
 Wyatt R. (2001). IELTS Examination. Peter Collin Publishing: London.
 Anderson K. (2004). Study speaking. Cambridge University Press: Cambridge.
 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. Mednarodni izpiti iz splošne angleščine ocenjujejo jezikovno spretnost kandidatov, ki se odpravljajo na študij ali delo v angleško govoreče države.

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).
 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/Weight****Assessment:**

Načini ocenjevanja:	Delež/Weight	Assessment:
Način (pisni izpit, ustno izpraševanje, naloge, projekt):		Type (examination, oral, coursework, project):
Sprotno preverjanje (domače naloge, kolokviji in projektno delo)	50,00 %	Continuing (homework, midterm exams, project work)
Končno preverjanje (pisni in ustni izpit)	50,00 %	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:

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. 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: Arhitektura računalniških sistemov
Course title: Computer Systems Architecture

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Računalništvo in informatika, prva stopnja, univerzitetni	Ni členitve (študijski program)	1. letnik	Letni

Univerzitetna koda predmeta/University course code: 63212

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
45		30			105	6

Nosilec predmeta/Lecturer: Branko Šter

Vrsta predmeta/Course type: obvezni predmet/compulsory course

Jeziki/Languages:

Predavanja/Lectures:	Slovenščina
Vaje/Tutorial:	Slovenščina

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

Poznavanje osnov digitalnih vezij.

Prerequisites:

Knowing the 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:

Narava računanja, kompleksnost, omejitve, teoretični modeli računanja.

Zgodovinski pregled dosedanjega razvoja strojev za računanje.

Von Neumannov arhitekturni model, osnovni principi delovanja. Vhod in izhod, prekinitve, lokalnost pomnilniških dostopov, Amdahl's zakon, strojna in programska oprema.

Predstavitev informacije in osnove računalniške aritmetike.

Ukazi in strojni jezik: načini naslavljanja, operacije, formati, RISC-CISC

Centralna procesna enota: podatkovna enota, aritmetično-logična enota, kontrolna enota.

Analiza zgradbe in delovanja CPE na primeru RISC računalnika.

Paralelizem na nivoju ukazov: cevovod, cevovodne nevarnosti, odpravljanje cevovodnih nevarnosti, dinamično razvrščanje, špekulativno izvrševanje, večizstavitveni procesorji. Paralelizem na nivoju niti, večjedrni procesorji.

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 just 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:

Nature of computation, complexity, limitations, theoretical models of computation.

Survey of historical development of computing machines.

Von Neumann architecture model and basic principles of operation. Input and output, interrupts, locality of memory references, Amdahl's law, hardware and software.

Representation of information and basic computer arithmetic.

Instructions and machine language: addressing modes, operations, formats, RISC-CISC.

Central processing unit: datapath with arithmetic-logic unit, control unit.

Analysis of CPU design and operation using a RISC computer as an example.

Instruction level parallelism: pipeline, pipeline hazards. Pipeline hazard elimination, dynamic scheduling, register renaming, speculative execution, multiple-issue

<p>Glavni pomnilnik: tehnologija, organizacija, zaščita Predpomnilniki: princip delovanja, vrste zgrešitev, zgrešitvena kazen, problem skladnosti Navidezni pomnilnik</p>	<p>processors. Thread level parallelism, multi-core processors. Main memory: technology, organization, protection. Cache memories: principles of operation, types of cache misses, miss penalty, coherency problem. Virtual Memory</p>
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Temeljna literatura in viri/Readings:

<p>D. Kodek: <i>Arhitektura in organizacija računalniških sistemov</i>, Bi-Tim, Ljubljana 2008, poglavja 1 do 8. Dodatna literatura: 1. J. L. Hennessy, D. A. Patterson: <i>Computer Architecture: A Quantitative Approach</i>, 4. izdaja, Morgan Kaufmann, San Francisco 2007. 2. D. A. Patterson, J. L. Hennessy: <i>Computer Organization and Design: The Hardware/Software Interface</i>, 4. izdaja, Morgan Kaufmann, Burlington 2009.</p>

Cilji in kompetence:

<p>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.</p>	<p>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.</p>
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Predvideni študijski rezultati:

<p>Po uspešno opravljenem predmetu naj bi bili študenti zmožni: - razumeti osnovne koncepte računanja - razložiti, kako deluje računalnik - poznati omejitve računalnikov - zapisovati in pretvarjati med številskimi zapisi, ki jih uporabljajo računalniki - razložiti arhitekturo konkretnega RISC računalnika - pisati programe v zbirnem jeziku - uporabiti kvantitativne metode za primerjavo in ocenjevanje različnih računalniških arhitektur - razumeti in vrednotiti pristope za povečanje učinkovitosti računalnikov (cevodov in drugi paralelizmi, predpomnilnik, itd.) - uporabiti znanje računalniške arhitekture pri razvijanju bolj učinkovite programske opreme</p>	<p>Intended learning outcomes: After the completion of the course a student will be able to: - understand basic concepts of computation - explain, how the computer works - know limitations of computers - write and convert between different number presentations used by computers - explain the architecture of a specific RISC computer - write programs in assembly language - apply quantitative methods for comparison and evaluation of different computer architectures - understand and evaluate techniques for improving efficiency of computers (pipeline and other paralelizms, cache memory, etc.) - apply knowledge of computer architecture in developing more efficient software</p>
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Metode poučevanja in učenja:

<p>Predavanja, laboratorijske vaje in domače naloge.</p>	<p>Learning and teaching methods: Lectures, laboratory work and homeworks.</p>
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Načini ocenjevanja:	Delež/Weight	Assessment:
Sprotno delo poteka v obliki laboratorijskih vaj, domačih nalog in kolokvijev.	33,00 %	Midterm work consists of laboratory exercises, homeworks and midterm exams.
Končno preverjanje (računski izpit)	33,00 %	Final exam (written exam)
Končno preverjanje (teoretični izpit)	33,00 %	Final exam (theoretical 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:

Branko Šter: Selective recurrent neural network. *Neural processing letters*, 38(1): 1-15, 2013.

Dominik Olszewski, Branko Šter: Asymmetric clustering using the alpha–beta divergence. *Pattern Recognition*, 47(5): 2031-2041, 2013.

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.

Andrej Dobnikar, Branko Šter: Structural properties of recurrent neural networks. *Neural processing letters*, 29(2): 75-88, 2009.

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: Brežična in mobilna omrežja
Course title: Mobile and Wireless Networks

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Računalništvo in informatika, prva stopnja, univerzitetni	Ni členitve (študijski program)	3. letnik	Letni

Univerzitetna koda predmeta/University course code: 63259

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
45	10	20			105	6

Nosilec predmeta/Lecturer: Nikolaj Zimic

Vrsta predmeta/Course type: izbirni predmet/elective course

Jeziki/Languages:

Predavanja/Lectures:	Slovenščina
Vaje/Tutorial:	Slovenščina

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

Vsebina:	Content (Syllabus outline):
predavanja: <ol style="list-style-type: none">Uvod v brezžična omrežjaFizični nivoLokalna in osebna omrežjaMestna in prostrana omrežjaBrezžični internetAd Hoc brezžična omrežjaTransportni nivo in varnostKvaliteta storitevHibridna brezžična omrežja	lectures: <ol style="list-style-type: none">Introduction to wireless networksPhysical layer reviewLocal and personal wireless networksMetropolitan and wide area wireless networksWireless internetAd Hoc wireless networksTransport layer and security protocolsQuality of serviceHybrid wireless networks

Temeljna literatura in viri/Readings:

- Matthew S. Gast, 802.11 Wireless Networks: The Definitive Guide: Enabling Mobility with Wi-Fi Networks 3rd Edition, O'Reilly Media, ISBN-10: 1491963549
- Sauter, Martin, "From GSM to LTE-Advanced Pro and 5G: An Introduction to Mobile Networks and Mobile Broadband 3rd Edition", Wiley; 3 edition, 2017, ISBN-10: 111934686X
- C. Siva Ram Murthy and B. S. Manoj, "Ad-Hoc Wireless Networks: Architectures and Protocols," Prentice-Hall, 2004, ISBN: 0-13-147023-X.
- 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
- Erik Dahlman, Stefan Parkvall, Johan Skold, "4G, LTE-Advanced Pro and The Road to 5G, Third Edition", Academic Press, 2016, ISBN-10: 0128045752

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.
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Predvideni študijski rezultati:	Intended learning outcomes:
<p>Znanje in razumevanje: Po uspešno opravljenem modulu na bi bili študenti zmožni: izkazati znanje in razumevanje osnovnih principov brezžičnih omrežij, razlikovati med osebnimi, lokalnimi in prostranimi brezžičnimi omrežji, zasnovati brezžično lokalno omrežje z vstopno točko, zasnovati brezžično Ad Hoc omrežje, razumeti metode prijavljanja v brezžično omrežje, uporabiti različna mobilna omrežja, predlagati hibridna brezžična omrežja.</p> <p>Uporaba: Uporaba brezžičnih in mobilnih omrežij pri raznih pogojih uporabe (industrija, hišna omrežja, osebna omrežja, ...).</p> <p>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).</p>	<p>Knowledge and understanding: After successful completion of the course, students should be able to: to understand the principles of wireless networks, distinguish between personal, local, and wide area wireless networks, design a wireless local area network with an access point, design a wireless ad hoc network, understand authentication and authorization methods in the wireless network, use different mobile networks, propose hybrid wireless networks.</p> <p>Application: Wireless and mobile networks applications in various working conditions (industrial, house, personal networks ...)</p> <p>Reflection: Comprehension and understanding wireless data transmission theory and its application in real world application from the field.</p> <p>Transferable skills: Solving of the similar problems from field of the computer communications.</p>

Metode poučevanja in učenja:	Learning and teaching methods:
Predavanja, laboratorijske vaje.	Lectures, lab practice.

Načini ocenjevanja:	Delež/Weight	Assessment:
Način (pisni izpit, ustno izpraševanje, naloge, projekt):		Type (examination, oral, coursework, project):
Sprotno preverjanje (domače naloge, kolokviji in projektno delo)	50,00 %	Continuing (homework, midterm exams, project work)
Končno preverjanje (pisni in ustni izpit)	50,00 %	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:
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.], May/Jun. 2017, vol. 14, no. 3, str. 721-727, 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. 1199-120

PETRONI, Mattia, ZIMIC, Nikolaj, MRAZ, Miha, MOŠKON, Miha. Stochastic simulation algorithm for gene regulatory networks with multiple binding sites. *Journal of computational biology*, ISSN 1066-5277. [Print ed.], Mar. 2015, vol. 22, no. 3, str. 218-226,

ŠOBERL, Domen, ZIMIC, Nikolaj, LEONARDIS, Aleš, KRIVIC, Jaka, MOŠKON, Miha. Hardware implementation of FAST algorithm for mobile applications. *Journal of signal processing systems for signal, image, and video technology*, ISSN 1939-8018. [Print ed.], 2015, vol. 79, no. 3, str. 247-256,

PEČAR, Primož, MRAZ, Miha, ZIMIC, Nikolaj, JANEŽ, Miha, LEBAR BAJEC, Iztok. Solving the ternary quantum-dot cellular automata logic gate problem by means of adiabatic switching. *Japanese journal of applied physics*, ISSN 0021-4922, 2008, vol. 47, no. 6, str. 5000-5006

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet: Digitalno načrtovanje
Course title: Digital Design

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Računalništvo in informatika, prva stopnja, univerzitetni	Ni členitve (študijski program)	3. letnik	Zimski

Univerzitetna koda predmeta/University course code: 63260

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
45	10	20			105	6

Nosilec predmeta/Lecturer: Patricio Bulić

Vrsta predmeta/Course type: izbirni predmet/elective course

Jeziki/Languages:

Predavanja/Lectures:	Slovenščina
Vaje/Tutorial:	Slovenščina

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

Vsebina:

Uvod v načrtovanje in testiranje digitalnih sistemov;
Jeziki HDL za opis strojne opreme (VHDL, Verilog),
napotki za kodiranje, simulacija, sinteza;
Tehnologija in pregled programabilnih vezij;
Računalniška aritmetika ter načrtovanje in sinteza
odločitvenih vezij;
Načrtovanje sekvenčnih vezij: sinhrona in asinhrona
vezja, pomnilne celice, register, registerski niz, števc,
splošni končni avtomat, pomnilnik);
Urin signal: sinteza, distribucija, »clock gating«,
sinhronizacija;
Načrtovanje (mikro)procesorja: podatkovne poti,
kontrolna enota, cevovod
Načrtovanje sinhronskih komunikacijskih vmesnikov
(PS/2, I2C, PCI)
Načrtovanje asinhronskih komunikacijskih vmesnikov
(USART)
Sinteza pomnilnikov RAM in ROM, sinteza dvokanalnih
pomnilnikov
Sinteza grafičnih vmesnikov
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).

Temeljna literatura in viri/Readings:

Wakerly, John F. Digital design : principles and practices, Upper Saddle River : Pearson/Prentice Hall, 2006;
Enoch Hwang. Digital Logic and Microprocessor Design with VHDL. Thomson/Nelson, 2006.
Richard E. Haskell & Darrin M. Hanna, Digital Design. 2nd Ed. LBE Books 2012.

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:

Po uspešno opravljenem modulu naj bi bili študenti zmožni:
 Na sistematičen način implementirati večji digitalni sistem v FPGA z uporabo jezika VHDL
 Razumeti pojme, kot so vzpostavitevni čas, držalni čas, minimalna perioda, zakasnitev, vzpostavitevna margina
 Izogniti se pastem, kot so metastabilnost in trave
 Razložiti principe programskih jezikov za opisovanje hardvera
 Izvajati logično sintezo ter opraviti časovno analizo implementiranega vezja ter njegovo porabo moči
 Izvajati funkcionalno testiranje digitalnih sistemov pred in po sintezi

Intended learning outcomes:

After the completion of the course a student will be able to:
 Implement a larger digital system in a systematic way in FPGA using VHDL
 Understand timing in digital systems: setup time, hold time, delay, setup margin
 Avoid metastability and glitches in digital design
 Explain the principle functionality of a hardware description language that models digital hardware
 Perform logic synthesis, place-and-route, as well as timing and power optimization and analysis
 Perform functional testing and performance estimation and verification both preand post-synthesis

Metode poučevanja in učenja:

Predavanja, laboratorijske vaje na katerih se uporabljajo sodobna orodja za načrtovanje digitalnih sistemov ter vezij FPGA, domače naloge, končni projekt.

Learning and teaching methods:

Lectures, a series of lab assignments using modern CADF tools and FPGAs, homeworks, final project.

Načini ocenjevanja:**Delež/Weight****Assessment:**

Način (pisni izpit, ustno izpraševanje, naloge, projekt):		Type (examination, oral, coursework, project):
Sprotno preverjanje (domače naloge, kolokviji in projektno delo)	50,00 %	Continuing (homework, midterm exams, project work)
Končno preverjanje (pisni in ustni izpit)	50,00 %	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:

1. AVRAMOVIČ, Aleksej, BABIČ, Zdenka, RAIČ, Dušan, STRLE, Drago, BULIČ, 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, RISOJEVIČ, Vladimir, BABIČ, Zdenka, DOBRAVEC, Tomaž, BULIČ, Patricio. A GPU implementation of a structural-similarity-based aerial-image classification. *J. supercomput.*, Aug. 2013, vol. 65, no. 2, str. 978-996.
3. BULIČ, 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: Diplomski seminar

Course title: Diploma seminar

Študijski programi in stopnja

Študijska smer

Letnik

Semestri

Računalništvo in informatika, prva stopnja, univerzitetni

Ni členitve (študijski program)

3. letnik

Letni

Univerzitetna koda predmeta/University course code:

63281

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
45	10	5			120	6

Nosilec predmeta/Lecturer: Franc Solina

Vrsta predmeta/Course type: obvezni predmet/compulsory course

Jeziki/Languages:

Predavanja/Lectures:

Slovenščina

Vaje/Tutorial:

Slovenščina

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:

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),

Content (Syllabus outline):

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

<p>vizualizacijske metode za kreativne procese (miselne skice itd.). Govorne predstavitve (načrtovanje, projekcijski materiali, nastop).</p> <p>Vaje: oblikovanje čim bolj 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).</p> <p>3. naloga: priprava govorne predstavitve o temi diplomskega dela (pregled, problem, načrtovana rešitev).</p> <p>Pred govornim nastopom v okviru vaj mora vsebino predstavitve vsakemu študentu potrditi njegov mentor diplomskega dela!</p> <p>Spodbuja se diskusija po govornih nastopih!</p> <p>Predavanja:</p> <p>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.</p> <p>Vaje: individualno posvetovanje z asistenti o diplomskem delu – tutorski način dela.</p> <p>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.</p> <p>Izdelava in zagovor diplomskega dela: Poleg predavanj zajema predmet tudi izdelavo in zagovor diplomskega dela v sodelovanju z izbranim mentorjem.</p>	<p>processes (mind maps etc.). Oral presentations (planning, projection materials, presentation).</p> <p>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).</p> <p>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!</p> <p>Lectures:</p> <p>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.</p> <p>Tutorial: individual consultation with assistants about the diploma thesis – tutor approach.</p> <p>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.</p> <p>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.</p>
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Temeljna literatura in viri/Readings:

M. Hladnik.
Praktični spisovnik ali Šola strokovnega ubesedovanja, 6. spremenjena izd., Filozofska fakulteta, Univerza v Ljubljani, Ljubljana, 2002.

R. K. Wysocki, R. McGary. Effective Project Management, Traditional, Adaptive, Extreme, 3rd Edition. Wiley, Indianapolis, IN, 2003.

D. Allen. Getting Things Done: The Art of Stress-Free Productivity. Penguin Books, 2001.

internetni viri za preiskovanje znanstvene literature (Google Scholar, Microsoft Academic Research, Web of Knowledge, Cobiss, SICRIS).

Tobias Oetiker Hubert Partl, Irene Hyna in Elisabeth Schlegl (slovenski prevod in priredba Bor Plestenjak). Ne najkrajši uvod v LATEX2ε, 2006

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 in etičnimi zahtevami

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 professional and ethical standards. The framework of this course will assure that the students will take a project based approach to their

<p>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.</p> <p>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, objavljanje, 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.</p> <p>Cilj predmeta je tudi pretok idej in krepitev kolektiva znotraj generacije na osnovi diskusij po ustnih nastopih.</p>	<p>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.</p> <p>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.</p> <p>The goal of the seminar is also to encourage the flow of ideas and discussions within each generation of students after oral presentations.</p>
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<p>Predvideni študijski rezultati:</p> <p>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.</p> <p>Uporaba: Orodja za pisanje akademskih tekstov (LaTeX, BibTeX), orodja za iskanje in pregledovanje 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.</p> <p>Refleksija: Spoznanje, da je uspešno komuniciranje o rezultatih svojega dela predpogoj za njegovo ustrezno vrednotenje.</p> <p>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.</p>	<p>Intended learning outcomes:</p> <p>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.</p> <p>Application: Tools for writing of academic texts (LaTeX, BibTeX), tools for searching and overviewing 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.</p> <p>Reflection: Realization that successful communication of the results of one's own work is a necessary prerequisite for its proper assessment.</p> <p>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.</p>
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<p>Metode poučevanja in učenja:</p> <p>Individualno delo z mentorjem. Predavanja, praktične vaje z ustnimi nastopi, seminarski način dela pri domačih nalogah, tutorski način dela.</p>	<p>Learning and teaching methods:</p> <p>Individual work with thesis advisor. Lectures and tutorials, oral presentations, homeworks and tutor based instruction.</p>
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Načini ocenjevanja:	Delež/Weight	Assessment:
2. naloga (pregledni članek)	10,00 %	Homework 2
3. naloga (govorni nastop)	10,00 %	Homework 3
4. naloga (osnutek dipl. dela)	10,00 %	Homework 4
pisni test o snovi s predavanj	10,00 %	Written test
napisano diplomsko delo	40,00 %	Written diploma thesis
zagovor diplomskega dela	20,00 %	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:

Dela, ki ilustrirajo širok razpon različnih tem, ki jih je nosilec obravnaval v svojih delih:

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. Jaklič, A. Leonardis, F. Solina. Segmentation and Recovery of Superquadrics}, volume 20 of *Computational imaging and vision*. Kluwer, Dordrecht, 2010.

1. A. Jaklič, F. Solina, L. Šajn. User interface for a better eye contact in videoconferencing. *Displays* 46: 25–36, 2017.
2. B. Batagelj, F. Solina. Preservation of an interactive computer-based art installation—a case study. *International journal of arts & technology* 10 (3): 206-230, 2017.
3. A. Jaklič, M. Erič, I. Mihajlović, Ž. Stopinšek, F. Solina. Volumetric models from 3D point clouds: The case study of sarcophagi cargo from a 2nd/3rd century AD Roman shipwreck near Sutivan on island Brač, Croatia. *Journal of Archaeological Science* 62 (October 2015): 143–152, 2015.
4. E. Pavlin, Ž. Elsner, T. Jagodnik, B. Batagelj, F. Solina. From illustrations to an interactive art installation. *Journal of Information, Communication and Ethics in Society* 13 (2): 130-145, 2015.
5. F. Solina. 15 seconds of fame. *Leonardo* 37 (2): 105-110, 2004.

Nosilec je bil urednik številnih zbornikov in dveh revij, mentor pri 12 doktoratih, 40 magisterijih, 140 diplomah.

Lecturer was editor of several proceedings and two journals, advisor of 12 PhD theses, 40 master theses and 140 diploma works.

Celotna bibliografija je dostopna na SICRISu:

<http://sicris.izum.si/search/rsr.aspx?lang=slv&id=6749>.

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet: Diskretne strukture
Course title: Discrete Structures

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Računalništvo in informatika, prva stopnja, univerzitetni	Ni členitve (študijski program)	1. letnik	Zimski

Univerzitetna koda predmeta/University course code: 63203

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
45		30			105	6

Nosilec predmeta/Lecturer: Gašper Fijavž

Vrsta predmeta/Course type: obvezni predmet/compulsory course

Jeziki/Languages:

Predavanja/Lectures:	Slovenščina
Vaje/Tutorial:	Slovenščina

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

Vsebina:

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 :

Content (Syllabus outline):

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:

<p>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.).</p> <p>domače naloge: Domače naloge so predvidene v tedenskem ritmu in obvezne. Vsebine domačih nalog praviloma sledijo temam iz kontaktnih ur.</p>	<p>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.</p> <p>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.</p>
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Temeljna literatura in viri/Readings:

<ol style="list-style-type: none"> 1. G. Fijavž. Diskretne strukture, Založba FRI, Ljubljana, 2017; dostopno tudi na http://matematika.fri.uni-lj.si/ds/ds.pdf. (dodatno) 1. J. L. Hein. Discrete Structures, Logic, and Computability, Jones & Bartlett, 2001. 2. V. Batagelj, S. Klavžar. DS1, DMFA, Ljubljana, 1997. 3. V. Batagelj, S. Klavžar. DS2, DMFA, Ljubljana, 2000. 4. R. J. Wilson, J. J. Watkins. Uvod v teorijo grafov, DMFA, Ljubljana, 1997. 5. P. Grossman. Discrete mathematics for computing, Macmillan, 2002.
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Cilji in kompetence:

<p>Zmožnost kritičnega razmišljanja. Razvoj veččin kritičnega, analitičnega in sintetičnega razmišljanja. Cilj predmeta je poglobiti študentovo razumevanje matematične logike in formalnega sklepanja ter študenta seznaniti z osnovami diskretne matematike.</p>	<p>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.</p>
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Predvideni študijski rezultati:

<p>Po uspešnem zaključku tega predmeta bo študent:</p> <ul style="list-style-type: none"> - sposoben izkazati znanje in razumevanje osnovnih principov diskretne matematike, matematične logike in njune uporabe v računalništvu, - razumel pojem formalnega dokaza in ga v omejenih pogojih sposoben rekonstruirati samostojno, - razumel in uporabljal znanje iz osnovnih matematičnih struktur, množic, relacij in preslikav, - poznal osnove kombinatoričnega preštevanja, - uporabljal osnovne rezultate teorije števil in modulske aritmetike, - razumel algebraične pojme teorije permutacij, - razumel in uporabljal osnovne pojme iz teorije grafov, - sposoben formulirati nekatere probleme kombinatorične optimizacije v jeziku teorije grafov. 	<p>Intended learning outcomes: After the completion of the course a student will be able to:</p> <ul style="list-style-type: none"> - understand the basic principles of discrete mathematics, mathematical logic and their application in computer science, - understand the notion of a formal proof and in a limited sense construct an example independently, - understand and use the knowledge on basic mathematical structures, sets, relations, mappings, - know the basics of counting, - use the fundamental results of number theory and modular arithmetic, - understand the algebraic background of permutations, - understand and use the basic notions of graph theory, - formulate several problems of combinatorial optimization as graph problems.
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Metode poučevanja in učenja:

<p>Predavanja, računske vaje z ustreznimi 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.</p>	<p>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.</p>
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Načini ocenjevanja:	Delež/Weight	Assessment:
Način (pisni izpit, ustno izpraševanje, naloge, projekt):		Type (examination, oral, coursework, project):
Sprotno preverjanje (domače naloge, kolokviji)	50,00 %	Continuing (homework, midterm exams)
Končno preverjanje (izpit)	50,00 %	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:

- 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.).
 - DUJMOVIČ, 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.
 - 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.
 - 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.
 - 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: Ekonomika in podjetništvo
Course title: Economics and Entrepreneurship

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Računalništvo in informatika, prva stopnja, univerzitetni	Ni členitve (študijski program)		Letni

Univerzitetna koda predmeta/University course code: 63248

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
45	10	20			105	6

Nosilec predmeta/Lecturer: Tomaž Hovelja

Vrsta predmeta/Course type: izbirni predmet/elective course

Jeziki/Languages:	Predavanja/Lectures:	Slovenščina
	Vaje/Tutorial:	Slovenščina

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

Vsebina:

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

Content (Syllabus outline):

- 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

Temeljna literatura in viri/Readings:

Drnovšek, M., Stritar, R. (2007). Priročnik za pisanje poslovnega načrta. Ljubljana: Ekonomska fakulteta, 2004.
Hočevar M., Iglčar S., Zaman M.: Osnove računovodstva, Ekonomska in naloge. Ljubljana: Ekonomska fakulteta, 2007.
Blank, Steve, Dorf, Bob: The Startup Owner's Manual: The Step-By-Step Guide for Building a Great Company, 2012.

Cilji in kompetence:

Cilj predmeta je študente seznaniti z osnovnimi ekonomskimi, poslovno-finančnimi kategorijami in procesom razvoja in preverjanja podjetniške priložnosti.

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.

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.	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.
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Predvideni študijski rezultati:	Intended learning outcomes:
<p>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 računovodske koncepte in jih zna vsebinsko uporabljati. Študent razume pojme, zakonitosti, strukture, procese, relatije in postopke v poslovanju ter zna poskati povezave s prakso. Študent osvoji metodologijo priprave poslovnega načrta.</p> <p>Uporaba Predmet je tesno povezan s poslovno prakso. Spretnosti uporabne v načrtovanju rasti in razvoja podjetja.</p> <p>Refleksija: Študent bolje razume lastne izkušnje, ki izhajajo iz poslovne prakse, pridobi spretnosti kritičnega ovrednotenja skladnosti med teoretičnimi načeli in praktičnim ravnanjem ipd.</p> <p>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.</p>	<p>Knowledge and understanding: Student uses basic techniques of opportunity development and techniques for entrepreneurial opportunity exploration and assessment. Student acquires basic business and accounting terminology and its contextual use. Student understands concepts, rules, structures, processes, and relationships in business economics and knows how to relate them to business practice. Student acquires methodology of business plan preparation.</p> <p>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.</p> <p>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.</p> <p>Transferable skills: Student develops ability to gather, interpret and appropriately use various sources of information, capabilities of critical thinking, effective communication and public speaking.</p>

Metode poučevanja in učenja:	Learning and teaching methods:
<p>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.</p> <p>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.</p>	<p>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.</p> <p>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.</p>

Načini ocenjevanja:	Delež/Weight	Assessment:
Način (pisni izpit, ustno izpraševanje, naloge, projekt):		Type (examination, oral, coursework, project):
Sprotno preverjanje (domače naloge, kolokviji)	50,00 %	Continuing (homework, midterm exams)
Projektno delo	50,00 %	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:

LEVSTEK, Aleš, HOVELJA, Tomaž, PUCIHAR, Andreja. IT governance mechanisms and contingency factors : towards an adaptive it governance model. *Organizacija : revija za management, informatiko in kadre*, ISSN 1318-5454.

[Tiskana izd.], nov. 2018, vol. 51, no. 4, str. 286-310.

KOJIĆ, Aleksandar, HOVELJA, Tomaž, VAVPOTIČ, Damjan. Ogrodje za izboljšanje procesov razvoja informacijskih sistemov z uporabo hevrstik za izboljšave splošnih poslovnih procesov. *Elektrotehniški vestnik*, ISSN 0013-5852.

[Slovenska tiskana izd.], 2016, letn. 83, št. 1/2, str. 47-53.

MAHNIČ, Viljan, HOVELJA, Tomaž. The influence of diffusion of innovation theory factors on undergraduate students' adoption of Scrum. *International journal of engineering education*, ISSN 0949-149X, 2016, no. 5, part A, str. 2121-2133.

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

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

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. Information technology deployment in a transition economy : results from Slovenia. *Ekonomski anali : naučno-stručni časopis Ekonomskog fakulteta u Beogradu*, ISSN 0013-3264, 2009, vol. 54, no. 183, str. 56-88

Celotna bibliografija je dostopna na SICRISu:

https://www.sicris.si/public/jqm/search_basic.aspx?lang=slv&opdescr=search&opt=2&subopt=1&code1=cmn&code2=auto&search_term=toma%C5%BE%20hovelja (za izr. prof. dr. Tomaž Hovelja)

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet: Elektronsko poslovanje
Course title: Electronic Business

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Računalništvo in informatika, prva stopnja, univerzitetni	Ni členitve (študijski program)	3. letnik	Zimski

Univerzitetna koda predmeta/University course code: 63249

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
45		30			105	6

Nosilec predmeta/Lecturer: Denis Trček

Vrsta predmeta/Course type: izbirni predmet/elective course

Jeziki/Languages:

Predavanja/Lectures:	Slovenščina
Vaje/Tutorial:	Slovenščina

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

Vsebina:

Poglavja predmeta obsegajo:
Uvod in temeljne definicije.
Kratek zgodovinski pregled razvoja e-poslovanja.
Sistemski pogled na e-poslovanje skozi analizo generičnih struktur (zunanje in notranje logistične verige in verige dodane vrednosti ter vpliv odločanja na njihovo obnašanje).
Tehnološki vidiki: RIP, XML, spletne storitve, komponentne arhitekture, digitalni plačilni sistemi (BitCoin), semantični splet, internet stvari, mobilne aplikacije.
Organizacijski vidiki: evolucija poslovnih funkcij, procesov in informacijskih sistemov, novi poslovni modeli, revizijski postopki - COBI.
Zakonodajni vidiki s poudarkom na ZEPEP, ZEPEP-A, ter ZEKOM.
Specifični vidiki načrtovanja in vpeljave sistemov e-poslovanja: spremembe strateškega načrtovanja IS, uporaba formalnih metod (jezik Z), skladnost s standardi kot je Common Criteria.
Varovanje intelektualne lastnine.
1. Zaključki.
2. Addendum: Mini vložki s praktičnim delom, ki pokrivajo najnovejše trende.

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 compliance with standards like Common Criteria.
8. Intellectual property issues.
9. Conclusions.
10. Addendum: Mini practical tasks covering the latest selected technological trends.

Temeljna literatura in viri/Readings:

D. Trček: *Elektronsko poslovanje*, kopije prosojnic, FRI, Ljubljana, 2017.

Dodatna literatura / Additional literature:

R. Kalakota: *E-business*, Addison Wesley, New York, 2002.

Dave Chaffey: *E-Business and E-Commerce Management*, FT Prentice Hall, 2011.

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:

Po opravljenem predmetu bo študent:

- razumel koncepte elektronskega poslovanja;
- poznal ključne poslovne rešitve s področja e-poslovanja;
- sposoben razvoja osnovnih rešitev s področja e-poslovanja in njihovega upravljanja;
- sposoben integracije pridobljenih znanj z drugimi pridruženimi inženirskimi področji, predvsem razvoja informacijskih sistemov ter spletnih in mobilnih aplikacij;
- obvladal temeljne koncepte podjetniškega razmišljanja;
- sposoben samostojne pisne in ustne predstavitve problematike s področja e-poslovanja.

Intended learning outcomes:

After completing this course a student will:

- understand the key concepts of e-business;
- know the key business solutions in the area of e-business;
- be able to develop basic solutions for e-business and their administration;
- will know how to integrate acquired knowledge with associated engineering areas, in particular information systems development, web and mobile applications;
- will be familiar with the basic principles of business thinking;
- will be able to prepare short articles and their oral presentations with themes in the area of e-business.

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.

Načini ocenjevanja:

Delež/Weight Assessment:

50 % ocene predstavlja sprotno delo študenta v obliki preverjanj na vajah (domače naloge, kvizi, praktičen projekt),	50,00 %	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 načeloma v pisni obliki, lahko pa tudi v pisni in ustni obliki (pri čemer lahko nosilec namesto ustnega izpita uvede seminar).	50,00 %	The other 50% is obtained on the basis of a written exam, or written and oral exam (the lecturer may decide that a seminal work replaces the oral exam).
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).		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.
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:

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:	Fizika
Course title:	Physics

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Računalništvo in informatika, prva stopnja, univerzitetni	Ni členitve (študijski program)	1. letnik	Zimski

Univerzitetna koda predmeta/University course code: 63205

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
45		30			105	6

Nosilec predmeta/Lecturer: Borut Paul Kerševan

Vrsta predmeta/Course type: obvezni predmet/compulsory course

Jeziki/Languages:	Predavanja/Lectures:	Slovenščina
	Vaje/Tutorial:	Slovenščina

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

Vsebina:

predavanja:

Mehanika

Uvod: Uporaba vektorjev in odvodov ter integralov v fiziki.

Kinematika točkastega telesa.

Dinamika točkastega telesa: masa, sile, Newtonovi zakoni, gravitacija.

Delo, energija, moč.

Gibalna količina, trki teles.

Dinamika togih razsežnih teles: središče mase, navor, vztrajnostni moment, vrtilna količina.

Mehanska nihanja in valovanja.

Elektrika in optika

Elektrostatika: električni naboj, električne sile.

Električno polje in električni potencial.

Snov v električnem polju.

Električna vezja z enosmernim tokom.

Magnetostatika: trajni magneti in elektromagneti, magnetna sila.

Magnetno polje, magnetni pretok.

Snov v magnetnem polju.

Indukcijski zakon, induktivnost.

Vezja z izmeničnim električnim tokom, električni transformator.

Električni nihajni krog, elektromagnetno valovanje.

Svetloba kot elektromagnetno valovanje, interferenca, uklon, optična vlakna in optične komunikacije.

Content (Syllabus outline):

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.

<p>vaje: Namen vaj pri predmetu fizika je dvojen:</p> <ol style="list-style-type: none"> 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. <p>Pri vajah študenti s pomočjo učitelja sami rešujejo naloge, zato je udeležba pri vajah obvezna.</p> <p>domače naloge: Namen domačih nalog je sprotno preverjanje znanja in razumevanja učne snovi.</p>	<p>11. Light as electromagnetic radiation, interference, diffraction, optical fibers and optical communications.</p> <p>exercises: The aim of exercises in physics is twofold:</p> <ol style="list-style-type: none"> 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. <p>With the help of the assistant students solve numerical exercises, therefore the presence of students is obligatory.</p> <p>home exercises: The aim of home exercises is to regularly test understanding and knowledge of the current topics.</p>
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Temeljna literatura in viri/Readings:

<ol style="list-style-type: none"> 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). <p>Dodatna literatura</p> <ol style="list-style-type: none"> 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). <p>Zbirke nalog</p> <ol style="list-style-type: none"> 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).
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Cilji in kompetence:

<p>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.</p>	<p>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.</p>
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Predvideni študijski rezultati:

<p>Po uspešnem zaključku tega predmeta bo študent:</p> <ul style="list-style-type: none"> -sposoben izkazati znanje in razumevanje osnovnih fizikalnih zakonov s področja klasične mehanike in elektromagnetizma, -sposoben kvantitativno obravnavati posamezne konkretne fizikalne pojave v naravi, -sposoben opisati osnove fizikalnega pristopa k znanstvenemu eksperimentu na podlagi zgodovinskih odkritij, -sposoben z uporabo zahtevnejših matematičnih orodij in pristopov (na primer diferencialni račun) analitično rešiti reprezentativne fizikalne probleme, 	<p>Intended learning outcomes: After the completion of the course a student will be able to:</p> <ul style="list-style-type: none"> -understand the fundamental laws of physics from the field of classical mechanics and electromagnetism, -perform quantitative treatment of specific physical phenomena in nature, -describe the basics of the physics approach in a scientific experiment based on historical discoveries, -use advanced mathematical tools and approaches (e.g. Calculus) for analytic solutions for representative physics problems,
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-poznal pomen in načine uporabe analitičnih modelov, ki so v primeru fizike pregledni in sorazmerno preprosti, pri reševanju različnih fizikalnih problemov, -sposoben v prihodnosti aplicirati fizikalni pristop in metode (poenotavitev modelov, veljavni približki, upeljava ohranitvenih izrekov) pri obravnavi problemov v računalništvu in informatiki.	-conceptualize the significance and methods of using analytical models, which are in physics straightforward and comparatively simple, for solving different physics problems, -apply in future studies the physics approach and methods (simplified models, valid approximations, introduction of conservation laws) when solving problems in computer and information science.
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Metode poučevanja in učenja: Predavanja, računske vaje z ustnimi nastopi, domače naloge. Poseben poudarek je na sprotne 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.
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Načini ocenjevanja:	Delež/Weight	Assessment:
Način (pisni izpit, ustno izpraševanje, domače naloge in projekti): Način (pisni izpit, ustno izpraševanje, domače naloge in projekti): Končno preverjanje (pisni in ustni izpit): pogoj za pozitivno oceno izpita so opravljene obveznosti sprotne dela (domačih nalog in projektov) v tekočem študijskem letu. Ocene: 6-10 pozitivno, 5 negativno (v skladu s Statutom UL).	100,00 %	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. Grading: 6-10 pass, 5 fail (according to the rules of University of Ljubljana).

Reference nosilca/Lecturer's references:

AAD, G., CINDRO, Vladimir, DELIYERGIYEV, Maksym, DOLENC, Irena, FILIPČIČ, Andrej, FRATINA, Saša, GORIŠEK, Andrej, KERŠEVAN, Borut Paul, KRAMBERGER, Gregor, MAČEK, Boštjan, MANDIČ, Igor, MIJOVIČ, 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](#)], [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]

AAD, G., CINDRO, Vladimir, DELIYERGIYEV, Maksym, DOLENC, Irena, FILIPČIČ, Andrej, FRATINA, Saša, GORIŠEK, Andrej, KERŠEVAN, Borut Paul, KRAMBERGER, Gregor, MAČEK, Boštjan, MANDIČ, Igor, MIJOVIČ, 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](#)], [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]

AAD, G., CINDRO, Vladimir, FILIPČIČ, Andrej, GORIŠEK, Andrej, KERŠEVAN, Borut Paul, KRAMBERGER, Gregor, MANDIČ, Igor, MIJOVIČ, Liza, MIKUŽ, Marko, ŠFILIGOJ, Tina, VALENCIČ, 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](#)], [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]

5. AAD, G., CINDRO, Vladimir, DELIYERGIYEV, Maksym, DOLENC, Irena, FILIPČIČ, Andrej, FRATINA, Saša, GORIŠEK, Andrej, KERŠEVAN, Borut Paul, KRAMBERGER, Gregor, MAČEK, Boštjan, MANDIČ, Igor, MIJOVIČ, 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](#)], [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]

AD, G., CINDRO, Vladimir, DOLENC, Irena, FILIPČIČ, Andrej, FRATINA, Saša, GORIŠEK, Andrej, KERŠEVAN, Borut Paul, KRAMBERGER, Gregor, MAČEK, Boštjan, MANDIČ, Igor (pisar), MIJOVIČ, 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: Inteligentni sistemi
Course title: Intelligent Systems

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Računalništvo in informatika, prva stopnja, univerzitetni	Ni členitve (študijski program)	3. letnik	Zimski

Univerzitetna koda predmeta/University course code: 63266

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
45	6	24			105	6

Nosilec predmeta/Lecturer: Marko Robnik Šikonja

Vrsta predmeta/Course type: izbirni predmet/elective course

Jeziki/Languages:

Predavanja/Lectures:	Angleščina
Vaje/Tutorial:	Angleščina

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. Strojno učenje in podatkovno rudarjenje, pregled osnovnih algoritmov.
2. Predprocesiranje podatkov, diskretizacija, vizualizacija.
3. Inteligentna analiza podatkov.
4. Gručenje podatkov.
5. Osnovni principi strojnega učenja, ocenjevanje učenja, kombiniranje algoritmov strojnega učenja.
6. Paralelno distribuirano procesiranje in umetne nevronske mreže.
7. Osnovni principi modeliranja: učenje kot modeliranje, kakovost modelov, evalvacija modelov.
8. Statistično modeliranje: bayesovsko sklepanje, linearni in regresijski modeli, multivariatni modeli, neparametrični modeli, stohastični procesi.
9. Evolucijsko računanje: genetski algoritmi, metode rojev, optimizacija s kolonijo mravelj.
10. Večagentni sistemi: pregled inteligentnih agentov, agentne arhitekture in teorija agentov, večagentni sistemi za inteligentno reševanje problemov.
11. Procesiranje naravnega jezika: vektorska predstavitev besedil, korpusne metode, pridobivanje informacij, povzemanje, tekstovno rudarjenje.
12. Spodbujevano učenje: osnovni pristopi in algoritmi, Q učenje, TD učenje.

Content (Syllabus outline):

Lecture topics:

1. Machine learning and data mining, overview of basic algorithms
2. Data preprocessing, discretization, visualization.
3. Intelligent data analysis.
4. Clustering.
5. Basic principles of machine learning (ML), evaluation of learning, combining ML algorithms.
6. Parallel distributed processing and artificial neural networks.
7. Basic principles of modelling: learning as modelling, model quality, model evaluation.
8. Statistical modelling: Bayesian reasoning, linear models, regression models, multivariate models, non-parametric models, stochastic processes.
9. Evolutionary computation: genetic algorithms, swarm intelligence, ant colony optimization.
10. Multiagent systems: overview of intelligent agents, agent architectures, multiagent systems for intelligent problem solving.
11. Natural language processing: vector presentation of documents, corpus based methods, information extraction, automatic summarization, text mining.
12. Reinforcement learning: basic approaches and algorithms, Q learning, TD learning.

Temeljna 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:

Ob koncu predmeta bodo študenti;
poznali in uporabljali različne tehnike in metode, ki se uporabljajo pri modeliranju inteligentnih sistemov
poznali in uporabljali orodja za strojno učenje
poznali in uporabljali pristope za analizo besedil
reševali in analizirali konkretne primere inteligentnih sistemov z uporabo znanstvenih metod
uprabljali in vrednotili orodja za statistično modeliranje in podatkovno rudarjenje
sposobni analize problemov s področja inteligentnih sistemov in izbora primernih tehnik za njihovo reševanje
uprabljali in medsebojni primerjali metode evolucijskega računanja

Intended learning outcomes:

Upon course completion the student will:
know and use various techniques and methods for modelling of intelligent systems
know and use machine learning tools
know and use text analysis approaches
solve and analyze examples of intelligent systems using scientific methods
use and evaluate tools for statistical modelling and data mining
be capable to analyze problems from the area of intelligent systems and choose adequate approaches for their solutions
use and compare different approaches for evolutionary computing

Metode poučevanja in učenja:**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.
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Načini ocenjevanja:	Delež/Weight	Assessment:
Način: pisni in ustni izpit, naloge, projekt.		Type: written and oral exam, coursework, project.
Sprotno preverjanje: domače naloge, kolokviji in projektno delo.	50,00 %	Continuing: homework, project work.
Končno preverjanje: pisni in ustni izpit.	50,00 %	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/ 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. 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. KRANJC, Janez, ORAČ, Roman, PODPEČAN, Vid, LAVRAČ, Nada, ROBNIK ŠIKONJA, Marko. CloudFlows: online workflows for distributed big data mining. *FGCS*, 2017, vol. 68, pp. 38-58
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: Izbrana poglavja iz računalništva in informatike
Course title: Topics in Computer and Information Science

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Računalništvo in informatika, prva stopnja, univerzitetni	Ni členitve (študijski program)		Letni

Univerzitetna koda predmeta/University course code: 63225

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
45		30			105	6

Nosilec predmeta/Lecturer:

Vrsta predmeta/Course type: izbirni predmet/elective course

Jeziki/Languages:

Predavanja/Lectures:	Slovenščina, Angleščina
Vaje/Tutorial:	Slovenščina, Angleščina

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

Prerequisites:

Vsebina:

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.

Content (Syllabus outline):

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.

Temeljna 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:

Po uspešnem zaključku tega predmeta bo študent:
-spoznal nova področja in prijeme, ki v obstoječem predmetniku še niso zajeta,

Intended learning outcomes:

After the completion of the course a student will:
-obtain a broader overview and understanding of the field of study, and of up to date methods and concepts,

-uporabljal najnovejše pristope in tehnike z izbranega področja računalništva in informatike, -razumeval primernosti izbranih pristopov s področja računalništva in informatike za reševanje praktičnih primerov v poslovnih okoljih, -reševal kompleksne probleme, razvijal kompleksne sisteme.	-apply current approaches and techniques from the specific field of computer and information science, -understand the advantages of the chosen approaches in computer and information science in solving specific practical tasks, -solve complex problems, design complex systems.
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Metode poučevanja in učenja: Predavanja, laboratorijske vaje	Learning and teaching methods: Lectures, lab exercises
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Načini ocenjevanja:	Delež/Weight	Assessment:
Način (pisni izpit, ustno izpraševanje, naloge, projekt):		Type (examination, oral, coursework, project):
Sprotno preverjanje (domače naloge, kolokviji in projektno delo)	50,00 %	Continuing (homework, midterm exams, project work)
Končno preverjanje (pisni in ustni izpit)	50,00 %	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:

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet: Izračunljivost in računska zahtevnost
Course title: Computability and Computational Complexity

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Računalništvo in informatika, prva stopnja, univerzitetni	Ni členitve (študijski program)	2. letnik	Zimski

Univerzitetna koda predmeta/University course code: 63283

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
45		30			105	6

Nosilec predmeta/Lecturer: Borut Robič

Vrsta predmeta/Course type: obvezni predmet /compulsory course

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, aproksimativnem in paralelnem

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

<p>računanju. Osnovno o interaktivnem dokazovanju. Primeri v praksi.</p> <p>9. <i>Novejši pristopi</i>: Osnovno o kvantnem računanju.</p>	<p>classes. NP-completeness/hardness and methods of proving it. Examples and applications.</p> <p>8. <i>Coping with hard problems</i>: Basics of randomized, approximation, and parallel computing. Basics of interactive proving. Examples and application.</p> <p>9. <i>Recent approaches</i>: Basics of quantum computing.</p>
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Temeljna literatura in viri/Readings:

B. Robič: *The Foundations of Computability Theory*, Springer, 2014 (to appear)
 S.Arora, B.Barak *Computational Complexity: A modern approach*, Cambridge Univ Press (2009)

Dodatna literatura:

M. Sipser: *Introduction to the Theory of Computation*, Course Technology (2006)
 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:

Študent bo po opravljenem predmetu:

- razumel delovanje in uporabo končnih avtomatov, regularnih jezikov, izrazov in gramatik;
- razumel delovanje in uporabo skladovnih avtomatov, kontekstno neodvisnih jezikov in gramatik;
- razumel delovanje in uporabo Turingovih strojev in izračunljivih ter izračunljivo preštevanih jezikov;
- razumel (Church/Turingovo) Tezo o izračunljivosti in zvezo med izračunljivimi (izračunljivo preštevanimi, neizračunljivimi) jeziki ter odločljivimi (polodločljivimi, neodločljivimi) problemi;
- spoznal nekaj nerešljivih računskih problemov;
- razumel vlogo nedeterminizma v računanju;
- razumel časovno ali prostorsko zahtevnost računskim problemom in osnovne razrede zahtevnosti (DTIME, NTIME, DSPACE, NSPACE, and P, NP, ...);
- razumel pojme NP-polnosti in NP-težkosti računskega problema;
- spoznal problem SAT, nekatere druge NP-polne probleme ter metodo dokazovanja NP-polnosti s prevedbo.

Intended learning outcomes:

After completing the course the student will:

- understand the working, properties, and use of finite automata, regular languages, expressions, and grammars;
- understand the working, properties, and use of pushdown automata, context-free languages and grammars;
- understand the working, properties, and use of Turing machines computable and computably enumerable (c.e.) languages;
- understand the (Church/Turing) Computability Thesis, and the link between computable (c.e., incomputable) languages and decidable (semi-decidable, undecidable) problems;
- be acquainted with selected incomputable computational problems;
- understand the role of non-determinism in computation;
- understand the time- and space-complexity of computational problems and fundamental complexity classes (DTIME, NTIME, DSPACE, NSPACE, and P, NP, ...)
- understand the concept of NP-completeness and NP-hardness;
- know the SAT, some other NP-complete problems, and the method of proving NP-completeness by reduction.

Metode poučevanja in učenja:

Predavanje, domače naloge, seminarski način dela pri vajah. Poudarek je na sprotnem 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:	Delež/Weight	Assessment:
Način (pisni izpit, ustno izpraševanje, naloge, projekt): Oceno sestavljata dva dela:		Type: exam, oral, coursework, project Continuing: homework, project work
prvi (50%) je za sprotno delo,	50,00 %	Continuing: homework, project work
drugi (50%) pa za ustni in pisni izpit.	50,00 %	Final: written and oral exam
Obveznosti predmeta so uspešno opravljene le, če sta oba dela pozitivna. V sprotno delo sodijo vaje in seminarske naloge. 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:

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: Komunikacijski protokoli
Course title: Communication Protocols

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Računalništvo in informatika, prva stopnja, univerzitetni	Ni členitve (študijski program)	3. letnik	Letni

Univerzitetna koda predmeta/University course code: 63258

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
45		30			105	6

Nosilec predmeta/Lecturer: Mojca Ciglarič

Vrsta predmeta/Course type: izbirni predmet/elective course

Jeziki/Languages:

Predavanja/Lectures:	Slovenščina
Vaje/Tutorial:	Slovenščina

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

Opravljen izpit Računalniške komunikacije in solidno znanje s tega področja.

Prerequisites:

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

Vsebina:

Uvod, vloga komunikacijskih protokolov in njihov pomen v sodobnih omrežjih. Protokolarni skladi in protokolarne storitve.
Načrtovanje komunikacijskih protokolov
Formalna specifikacija komunikacijskih protokolov
Metode, tehnike in orodja za analizo in testiranje komunikacijskih protokolov
Standardni usmerjevalni protokoli (usmerjanje znotraj avtonomnega sistema, globalno usmerjanje med avtonomnimi sistemi).
Večpredstavni protokoli (protokoli za prenos zvoka in videa prek IP, kakovost storitve) in razpošiljanje (multicast).
Analiza in primerjava delovanja značilnih protokolov v IPv4 in IPv6; prehodni mehanizmi. Študije izbranih protokolov omrežne in povezavne plasti.
Protokoli za zagotavljanje varnosti (avtentikacija, integriteta, nezanikanje...)
Protokoli v porazdeljenih sistemih (usklajevanje ure in globalnih stanj, volitve, vzajemno izključevanje, konsenzus)
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):

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

Temeljna literatura in viri/Readings:

J. F. Kurose, K. W. Ross: Computer Networking, A top-down Approach Featuring Internet. 7. izdaja, Pearson 2017.
[Mojca Ciglarič](#), [Zoran Bosnić](#), [James F. Kurose](#), [Keith W. Ross](#): Računalniške komunikacije, Pearson Education, 2014.
IETF: RFC specifications and standards. <http://www.ietf.org>
M.S.Komal: A Guide to Secure and Efficient IPv6 Transition, Lap Lambert Academic Publishing, 2017.

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

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

Predvideni študijski rezultati:

Po uspešno opravljenem modulu bodo študentje zmožni:

- našteti in opredeliti delovanje značilnih omrežnih in aplikacijskih protokolov, formulirati njihovo formalno definicijo in poiskati morebitne logične napake v njihovi zasnovi, ter opisati medsebojno odvisnost in komplementarnost protokolov
- standardne omrežne protokole in storitve vključiti v svoje lastne programske rešitve ter načrtovati, razviti in formalno ovrednotiti delovanje lastnih protokolov.
- v računalniškem sistemu zasnovati skupek varnostnih mehanizmov za zagotovitev osnovnega varnostnega nivoja

Intended learning outcomes:

After successful completion of the course, the students will be able to:

- identify and define how different typical network and application protocols work, formulate their formal definition and find eventual errors in their logical design; describe mutual codependence and complementarity of protocols.
- include standard network and application protocols into own solutions and design, develop and evaluate own protocols
- design a cluster of security mechanisms in a computer system to ensure a basic security level
- defend their choice of security mechanisms regarding the security demands of a problem domain

- zagovarjati izbiro varnostnih mehanizmov glede na zahteve sistema ali aplikacije in pojasniti - povzemati različne parcialne rešitve problemov v obliko formalnega protokola	- to include different parcial problem solutions into a formal protocol formulation.
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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, form, LMS, virtual laboratory.
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Načini ocenjevanja:	Delež/Weight	Assessment:
Način (pisni izpit, ustno izpraševanje, naloge, projekt):		Type (examination, oral, coursework, project):
Sprotno preverjanje (domače naloge, kolokviji in projektno delo)	50,00 %	Continuing (homework, midterm exams, project work)
Končno preverjanje (pisni izpit)	50,00 %	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: 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: Linearna algebra
Course title: Linear Algebra

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Računalništvo in informatika, prva stopnja, univerzitetni	Ni členitve (študijski program)	1. letnik	Letni

Univerzitetna koda predmeta/University course code: 63207

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
45		30			105	6

Nosilec predmeta/Lecturer: Polona Oblak

Vrsta predmeta/Course type: obvezni predmet/compulsory course

Jeziki/Languages:

Predavanja/Lectures:	Slovenščina
Vaje/Tutorial:	Slovenščina

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

Prerequisites:

Vsebina:

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 sprotnemu študiju predmeta. Študentje lahko domače naloge rešujejo

Content (Syllabus outline):

Lectures:

1. Basic operations with vectors,
2. Operations with matrices,
3. Systems of linear equations,
4. Vector spaces,
5. Orthogonal projections and overdetermined 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

Temeljna literatura in viri/Readings:

1. Bojan Ore: Linearna algebra, Založba FRI, 2017, dostopno na <http://matematika.fri.uni-lj.si/LA/lapdf>.
2. Gilbert Strang, Introduction to Linear Algebra, Cambridge press, 2003.
3. David Poole: Linear Algebra, A Modern Introduction, Brooks/Cole, 2011.

4. Aleksandra Franc: [Rešene naloge iz linearne algebre](http://matematika.fri.uni-lj.si/la/la_zbirka.pdf), 2019, dostopno na http://matematika.fri.uni-lj.si/la/la_zbirka.pdf.

Cilji in kompetence:

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.

Objectives and competences:

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:

Študent naj bi po uspešno opravljenem predmetu:
 - poznal in razumel osnovne objekte (skalarji, vektorji, matrike) in relacije med njimi,
 - uporabljal osnovne operacije nad njimi ter razumeval lastnosti teh operacij,
 - bil sposoben uporabe metod linearne algebre pri reševanju problemov, ki izvirajo v drugih področjih (računalništvo, naravoslovje, tehnika),
 - spoznal, da je iste metode mogoče uporabiti pri reševanju različnih konkretnih primerov s področja modeliranja različnih pojavov z računalniki,
 - uporabljal abstrakcijo linearne algebre in linearnih sistemov za modeliranje konkretnih problemov in iskanje njihovih rešitev.

Intended learning outcomes:

After successfully completing the course, the students will be able to:
 - know and use basic objects (scalars, vectors, matrices) and the relationships between them,
 - perform basic operations over them, and understand the properties of these operations,
 - apply methods of linear algebra to solving problems arising in other fields (computer science, science, engineering),
 - realize that the same methods can be used in solving various concrete examples in the field of modelling various phenomena with computers,
 - use of abstraction of linear algebra and linear systems to model and solve specific problems.

Metode poučevanja in učenja:

Predavanja, laboratorijske vaje, domače naloge

Learning and teaching methods:

Lectures, lab practice, homeworks

Načini ocenjevanja:

Delež/Weight

Assessment:

Način (pisni izpit):		Type (written exam): Continuing (homework, midterm exams, project work)
Sprotno preverjanje (domače naloge, kolokviji in projektno delo)	50,00 %	Continuing (homework, midterm exams, project work)
Končno preverjanje (pisni in ustni izpit)	50,00 %	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:

- OBLAK, Polona. The upper bound for the index of nilpotency for a matrix commuting with a given nilpotent matrix. *Linear multilinear algebra*, 2008, vol. 56, no. 6, str. 701-711.
- DOLŽAN, David, OBLAK, Polona. Invertible and nilpotent matrices over antirings. *Linear algebra appl.*, 2009, vol. 430, iss. 1, str. 271-278.
- KOŠIR, Tomaž, OBLAK, Polona. On pairs of commuting nilpotent matrices. *Transform. groups*, 2009, vol. 14, no. 1, str. 175-182.
- DOLINAR, Gregor, GUTERMAN, Aleksandr Ėmilevič, KUZMA, Bojan, OBLAK, Polona. Extremal matrix centralizers. *Linear Algebra and its Applications*, 2013, vol. 438, iss. 7, str. 2904-2910.
- OBLAK, Polona, ŠMIGOC, Helena. The maximum of the minimal multiplicity of eigenvalues of symmetric matrices whose pattern is constrained by a graph. *Linear Algebra and its Applications*, 2017, vol. 512, str. 48-70.

Celotna bibliografija je dostopna na SICRISu:

<http://sicris.izum.si/search/rsr.aspx?lang=slv&id=6758>

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet: Matematično modeliranje
Course title: Mathematical Modelling

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Računalništvo in informatika, prva stopnja, univerzitetni	Ni členitve (študijski program)	2. letnik	Letni

Univerzitetna koda predmeta/University course code: 63219

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
45		30			105	6

Nosilec predmeta/Lecturer: Žiga Virk

Vrsta predmeta/Course type: izbirni predmet /elective course

Jeziki/Languages:

Predavanja/Lectures:	Slovenščina, Angleščina
Vaje/Tutorial:	Slovenščina, Angleščina

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

Prerequisites:

Vsebina:

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

Content (Syllabus outline):

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)

Introduction to mathematical modelling, computational and modelling errors.

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

Linear models: SVD and PCA, general inverses, linear transformations (Fourier, Laplace, wavelet), linear programming.

Nonlinear models: models with functions of several variables. Continuous optimization: local, constrained and global extrema.

Stochastic models: Markov chains.

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.

diferencialnih enačb. Tiri in invariantne množice dinamičnih sistemov. Primeri dinamičnih sistemov.

Temeljna literatura in viri/Readings:

B. Orel, Osnove numerične matematike, Fakulteta za računalništvo in informatiko, cop. 1997.

James Stewart: Calculus: early transcendentals (8th edition), Cengage Learning, 2016.

[Searle: Linear Models](#)

Paul's Online Math Notes: [Differential equations](#)

M. Braun: Differential equations and their applications, Springer, 1991.

J. Guckenheimer, P. Holmes: Nonlinear Oscillators, Dynamical Systems, and Bifurcations of Vector Fields, Applied Mathematical Sciences no. 42, Springer, 2002.

[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 računalniških algoritmov.

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.

Predvideni študijski rezultati:

Po zaključku tega predmeta bo študent sposoben uporabljati matematične pojme za modeliranje preprostih pojavov, iskati rešitve ali približne rešitve dobljenih modelov in jih ovrednotiti razumel pojem parametrizirane krivulje in ploskve in znal takšne objete analizirati in uporabiti pri modeliranju geometrijskih in drugih problemov znal razlikovati med linearnimi in nelinearnimi pojavi, znal zapisati linearen matematičen model in uporabiti metode linearne algebre za iskanje rešitev znal zapisati nelinearen matematičen model in uporabiti ustrezne algoritme in matematične metode za njegovo reševanje

Intended learning outcomes:

After completing this course the student will be able to use basic mathematical in modelling simple phenomena and processes, compute solutions or approximate solutions of the obtained models, and evaluate them understand the concepts of parametrized curve and surface, analyze them, and apply them to geometric and other problems distinguish between linear and nonlinear phenomena be able to construct a linear model and apply methods of linear algebra to find solutions

<p>razumel pojem diferencialne enačbe (ali sistema diferencialnih enačb) in njene rešitve in obvladal preproste prijeme za reševanje diferencialnih enačb 1. reda,</p> <p>razumel strukturo rešitev linearnih diferencialnih enačb in sistemov,</p> <p>poznal osnovne algoritme za integriranje nelinearnih diferencialnih enačb</p> <p>obvladal uporabo diferencialnih enačb in sistemov diferencialnih enačb za modeliranje preprostih pojavov iz realnega sveta</p>	<p>be able to construct a nonlinear model and apply suitable algorithms and mathematical methods to find solutions</p> <p>understand the concept of a differential equation (or system of equations) and its solution and master simple solving techniques</p> <p>understand the structure of the solution space of linear differential equations</p> <p>understand basic algorithms for numerical integration</p> <p>be able to use differential equations to model simple real world phenomena</p>
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<p>Metode poučevanja in učenja:</p> <p>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.</p>	<p>Learning and teaching methods:</p> <p>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.</p>
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Načini ocenjevanja:	Delež/Weight	Assessment:
Način (pisni izpit, ustno izpraševanje, naloge, projekt):		Type (examination, oral, coursework, project):
Sprotno preverjanje (domače naloge, kolokviji in projektno delo)	50,00 %	Continuing (homework, midterm exams, project work)
Končno preverjanje (pisni in ustni izpit)	50,00 %	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).

<p>Reference nosilca/Lecturer's references:</p> <ul style="list-style-type: none"> VIRK, Žiga. Small loop spaces. <i>Topology and its Applications</i>, ISSN 0166-8641, 2010, vol. 157, no. 2, str. 451-455. VIRK, Žiga. Realizations of countable groups as fundamental groups of compacta. <i>Mediterranean journal of mathematics</i>, 2013, vol. 10, no. 3, str. 1573-1589. DYDAK, Jerzy, VIRK, Žiga. Preserving coarse properties. <i>Revista matemática Complutense</i>, 2016, vol. 29, iss. 1, str. 191-206. EDELSBRUNNER, Herbert, VIRK, Žiga, WAGNER, Hubert. Smallest enclosing spheres and Chernoff points in Bregman geometry. V: SPECKMANN, Bettina (ur.), TÓTH, Csaba D. (ur.). <i>34th International Symposium on Computational Geometry : SoCG 2018, June 11-14, 2018, Budapest, Hungary</i>, VIRK, Žiga. Approximations of 1-dimensional intrinsic persistence of geodesic spaces and their stability. <i>Revista matemática Complutense</i>, Jan. 2019, vol. 32, iss. 1, str. 195-213. <p>Celotna bibliografija je dostopna na SICRISu: http://sicris.izum.si/search/rsr.aspx?lang=slv&id=20092</p>
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UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet: Modeliranje računalniških omrežij
Course title: Computer Networks Modeling

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Računalništvo in informatika, prva stopnja, univerzitetni	Ni členitve (študijski program)	3. letnik	Zimski

Univerzitetna koda predmeta/University course code: 63257

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
45	10	20			105	6

Nosilec predmeta/Lecturer: Miha Mraz

Vrsta predmeta/Course type: izbirni predmet/elective course

Jeziki/Languages:

Predavanja/Lectures:	Slovenščina
Vaje/Tutorial:	Slovenščina

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

Vsebina:

Predavanja:

- Teoretične osnove
- Zahteve, strežniki, čakalne vrste, Kendallova notacija
- Modeliranje z vidika časa in zaloge možnih stanj
- Intenzivnost prihajajočih zahtev in strežbe
- Strežne enote (diskretne, eksponentne, Erlangove, ...),
- Strežne mreže
- Opredelitev simulacijskih parametrov (breme, metrike, potrebni resursi, itd.)

Analiza in interpretacija simulacijskih rezultatov
Petrijeve mreže, barvne Petrijeve mreže
Ocenjevalne metrike, latenca

- Uporaba teorije v praksi
Modeliranje in simulacije omrežij
Modeliranje in simulacije protokolov
Modeliranje in simulacije višje nivojskih protokolov in storitev
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

Content (Syllabus outline):

Lectures:

- Theoretical basics
- Requests, servers, queues, Kendall's notation
- Modelling regarding time and modelling regarding the possible states of the system
- Request arrival rate in request serving rate
- Serving units (discrete, exponential, Erlang's, ...),
- Serving networks
- Definition of simulation parameters (work-load, metrics, required resources, etc.)

Analysis and interpretation of simulation results
Petri nets, Coloured Petri nets
Performance metrics, latency

- Practical use of theory presented
Modelling and simulation of networks
Modelling and simulation of protocols
Modelling and simulation of higher layer protocols and services
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.

na vajah ustrezna programska orodja (npr. OpNet, NS2, OMNeT++, TETCOS, GTNetS, itd.).	
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Temeljna literatura in viri/Readings:

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], e-book, 2017

Cilji in kompetence:

<p>Cilj predmeta je študentom računalništva in informatike predstaviti osnovne metode izgradnje modelov in izvajanja simulacij z zornega kota računalniških omrežij. S teoretičnega vidika temelji predmet na splošni teoriji strežbe, ki študente seznanja s problematiko zahtev, strežnikov (resursov), čakalnih vrst, ozkih grl, itd. S praktičnega vidika bo študentom predstavljen prenos teoretičnih znanj na reševanje praktičnih problemov, do katerih prihaja na področju računalniških omrežij.</p> <p>Ostale kompetence:</p> <p>Razvoj spretnosti v analitičnem in sinteznem razmišljanju</p> <p>Praktično obvladovanje sestavnih delov računalniških sistemov za uspešno profesionalno delo</p> <p>Zmožnost razumevanja in reševanja profesionalnih problemov</p> <p>Zmožnost uporabe in nadgradnje znanja pri samostojnem delu</p>	<p>Objectives and competences:</p> <p>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.</p> <p>Other competences:</p> <p>Developing skills in critical, analytical and synthetic thinking.</p> <p>Practical knowledge and skills of computer hardware, software and information technology necessary for successful professional work in computer and information science.</p> <p>The ability to understand and solve professional challenges in computer and information science.</p> <p>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.</p>
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Predvideni študijski rezultati:

<p>Po uspešnem zaključku tega predmeta bo študent: razumel osnovne koncepte modeliranja in simulacij, poznal osnove teorije strežbe, poznal osnove modeliranja delovanja komunikacijskih protokolov, sposoben oceniti ali pridobiti kvantitativne vrednosti modeliranega omrežja, sposoben identificirati sestavne dele omrežja in njegove zmogljivostne karakteristike</p> <p>sposoben postavitev modela računalniškega omrežja kot celote in ocene njegove zmogljivosti ter ozkih grl.</p>	<p>Intended learning outcomes:</p> <p>After the completion of the course a student will be able to:</p> <ul style="list-style-type: none"> - understand the basics of modelling and simulation, - know the basics of service theory, - know the basics of the modelling of communication protocols, - will be capable to assess or acquire the quantitative properties of modelled network, - will be able to identify the composition of the network and its capabilities, - will be able to construct the model of a computer network and asses its capabilities and bottlenecks.
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Metode poučevanja in učenja:

<p>Predavanja bodo potekala ustno, vaje v obliki projektnega dela na konkretnih aplikativnih zgledih.</p>	<p>Learning and teaching methods:</p> <p>Lectures and oral presentations of the subject. Seminal work on real-life examples and problems.</p>
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Načini ocenjevanja:

<p>Način (pisni izpit, ustno izpraševanje, naloge, projekt):</p>	<p>Delež/Weight</p>	<p>Assessment:</p> <p>Type (examination, oral, coursework, project):</p>
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Sprotno preverjanje (domače naloge, kolokviji in projektno delo)	50,00 %	Continuing (homework, midterm exams, project work)
Končno preverjanje (pisni in ustni izpit)	50,00 %	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:

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](#)], [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](#)], [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](#)], [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](#)], [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](#)], [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: Modulski izbirni predmet 1/4
Course title:

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Računalništvo in informatika, prva stopnja, univerzitetni	Ni členitve (študijski program)	3. letnik	Zimski

Univerzitetna koda predmeta/University course code: 0003

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
45		30			105	6

Nosilec predmeta/Lecturer:

Vrsta predmeta/Course type:

Jeziki/Languages:

Predavanja/Lectures:

Vaje/Tutorial:

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

Prerequisites:

Vsebina:

Content (Syllabus outline):

Temeljna literatura in viri/Readings:

Cilji in kompetence:

Objectives and competences:

Predvideni študijski rezultati:

Intended learning outcomes:

Metode poučevanja in učenja:

Learning and teaching methods:

Reference nosilca/Lecturer's references:

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet: Modulski izbirni predmet 2/4
Course title:

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Računalništvo in informatika, prva stopnja, univerzitetni	Ni členitve (študijski program)	3. letnik	Zimski

Univerzitetna koda predmeta/University course code: 0004

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
45		30			105	6

Nosilec predmeta/Lecturer:

Vrsta predmeta/Course type:

Jeziki/Languages:

Predavanja/Lectures:

Vaje/Tutorial:

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

Prerequisites:

Vsebina:

Content (Syllabus outline):

Temeljna literatura in viri/Readings:

Cilji in kompetence:

Objectives and competences:

Predvideni študijski rezultati:

Intended learning outcomes:

Metode poučevanja in učenja:

Learning and teaching methods:

Reference nosilca/Lecturer's references:

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet: Modulski izbirni predmet 3/4
Course title:

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Računalništvo in informatika, prva stopnja, univerzitetni	Ni členitve (študijski program)	3. letnik	Letni

Univerzitetna koda predmeta/University course code: 0003

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
45		30			105	6

Nosilec predmeta/Lecturer:

Vrsta predmeta/Course type:

Jeziki/Languages:

Predavanja/Lectures:

Vaje/Tutorial:

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

Prerequisites:

Vsebina:

Content (Syllabus outline):

Temeljna literatura in viri/Readings:

Cilji in kompetence:

Objectives and competences:

Predvideni študijski rezultati:

Intended learning outcomes:

Metode poučevanja in učenja:

Learning and teaching methods:

Reference nosilca/Lecturer's references:

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet: Modulski izbirni predmet 4/4
Course title:

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Računalništvo in informatika, prva stopnja, univerzitetni	Ni členitve (študijski program)	3. letnik	Letni

Univerzitetna koda predmeta/University course code: 0004

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
45		30			105	6

Nosilec predmeta/Lecturer:

Vrsta predmeta/Course type:

Jeziki/Languages:

Predavanja/Lectures:

Vaje/Tutorial:

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

Prerequisites:

Vsebina:

Content (Syllabus outline):

Temeljna literatura in viri/Readings:

Cilji in kompetence:

Objectives and competences:

Predvideni študijski rezultati:

Intended learning outcomes:

Metode poučevanja in učenja:

Learning and teaching methods:

Reference nosilca/Lecturer's references:

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet: Multimedijski sistemi
Course title: Multimedia Systems

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Računalništvo in informatika, prva stopnja, univerzitetni	Ni členitve (študijski program)	3. letnik	Zimski

Univerzitetna koda predmeta/University course code: 63270

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
45	10	20			105	6

Nosilec predmeta/Lecturer: Matej Kristan

Vrsta predmeta/Course type: izbirni predmet/elective course

Jeziki/Languages:

Predavanja/Lectures:	Slovenščina, Angleščina
Vaje/Tutorial:	Slovenščina, Angleščina

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. Evalvacija 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 in seminar:

Vaje bodo potekale v obliki projektno-orientiranih nalog in seminarjev 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

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 and seminar:

Exercises will take a form of project-oriented exercises and seminars 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.

tematike, spodbuja pa tudi samostojno mišljenje in kreativnost.	
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Temeljna 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:

Po uspešnem zaključku predmeta naj bi študenti:

- razumeli osnove razgradnje in preoblikovanja slik za uporabo v informacijskih in multimedijskih sistemih,
- razumeli osnove sistemov za pridobivanje informacij na podlagi teksta,
- bili sposobni implementirati sisteme za avtomatsko razgradnjo videa in sisteme za poizvedovanje po video vsebini,
- razumeli osnovne postopke stiskanja slik in videa, ki se uporabljajo v standardnih kodekih.
- razumeli osnove obogatene resničnosti in bili sposobni načrtovati sisteme obogatene resničnosti z markerjem.
- poznal algoritmično ozadje računalniških tehnologij in računalniških metodologij značilne za mnoge aplikacije multimedijskih sistemov.

Intended learning outcomes:

After completing this course a students will be able to:

- understand the basics of image decomposition and transformation for use in information and multimedia systems,
- understand the basics of text-based information retrieval systems,
- implement systems for automatic video decomposition and video querying,
- understand the basics of image and video compression used in standard codecs,
- understand the basics of augmented reality and be able to design marker-based augmented reality systems,
- know the algorithmic background of computer technologies and methodologies specific for modern multimedia applications.

Metode poučevanja in učenja:

Predavanja, laboratorijske vaje v računalniški učilnici z aktivnim sodelovanjem. Individualno delo na vajah. Teorija s predavanjem se praktično analizira na vajah. Poseben poudarek je na sprotne študiju in sprotne 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:	Delež/Weight	Assessment:
Način (pisni izpit, ustno izpraševanje, vaje):		Type (examination, oral, laboratory exercises):
Sprotno preverjanje (domače naloge in laboratorijske vaje)	50,00 %	Continuing (homework and laboratory exercises)
Končno preverjanje (pisni in ustni izpit)	50,00 %	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:

LUKEŽIČ, Alan, ČEHOVIN ZAJC, Luka, KRISTAN, Matej. Deformable parts correlation filters for robust visual tracking. *IEEE transactions on cybernetics*, ISSN 2168-2267, 2017, vol. , no. , str. 1-13, [COBISS.SI-ID [1537625283](#)],

KRISTAN, Matej, SULIČ KENK, Vildana, KOVAČIČ, Stanislav, PERŠ, Janez. Fast image-based obstacle detection from unmanned surface vehicles. *IEEE transactions on cybernetics*, ISSN 2168-2267 , 2016, vol. 46, no. 3, str. 641-654, [COBISS.SI-ID [1536310979](#)],

KRISTAN, Matej, MATAS, Jiří, LEONARDIS, Aleš, VOJÍŘ, Tomáš, PFLUGFELDER, Roman, FERNÁNDEZ, Gustavo, NEBEHAY, Georg, PORIKLI, Fatih, ČEHOVIN ZAJC, Luka. A novel performance evaluation methodology for single-target trackers. *IEEE transactions on pattern analysis and machine intelligence*, ISSN 0162-8828. [Print ed.], Nov. 2016, vol. 38, no. 11, str. 2137-2155, [COBISS.SI-ID [1536872643](#)]

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](#)]

Celotna bibliografija je dostopna na SICRISu:
<http://sicris.izum.si/search/rsr.aspx?lang=slv&id=32801>.

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet: Operacijski sistemi
Course title: Operating Systems

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Računalništvo in informatika, prva stopnja, univerzitetni	Ni členitve (študijski program)	2. letnik	Letni

Univerzitetna koda predmeta/University course code: 63217

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
45		30			105	6

Nosilec predmeta/Lecturer: Borut Robič

Vrsta predmeta/Course type: obvezni predmet /compulsory course

Jeziki/Languages:

Predavanja/Lectures:	Slovenščina
Vaje/Tutorial:	Slovenščina

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. Proces: 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

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 ...

<p>15. OS in namenski sistemi: sistem v realnem času, OS in multimedija, trendi</p> <p>16. Izbrani primeri sodobnih OS (bodo obravnavani tudi pri točkah zgoraj).</p> <p>Vaje:</p> <p>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.</p> <p>Domače in seminarske naloge:</p> <p>Namen domačih in seminarskih 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.</p>	<p>14. OS and distributed systems: problems, solutions, trends</p> <p>15. OS and in special-purpose systems: real-time systems, OS and multimedia, trends</p> <p>16. Selected examples of OS (will be explained above).</p> <p>Tutorial:</p> <p>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.</p> <p>Home works and seminars:</p> <p>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.</p>
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Temeljna literatura in viri/Readings:

<p>A. Silberschatz et al.: Operating systems concepts, Wiley, 2007.</p> <p>B. Robič: Operacijski sistemi (v pripravi).</p> <p>Dodatna literatura</p> <p>1. A. Tanenbaum, A. Woodhull: Operating systems: design and implementation, Prentice-Hall, 2006.</p>
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Cilji in kompetence:

<p>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.</p>	<p>Objectives and competences:</p> <p>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.</p>
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Predvideni študijski rezultati:

<p>Študent bo po opravljenem predmetu:</p> <ul style="list-style-type: none"> - poznal zgodovinski razvoj OS in njegovih komponent; - poznal vlogo in rabo sistemskih klicev; - poznal vlogo in rabo procesov, niti in algoritmov za njihovo razvrščanje; - poznal vrste medprocesne komunikacije in sinhronizacije; - poznal klasične probleme sinhronizacije, npr. problem kritičnih odsekov, in načine njihovega reševanja s semaforji, monitorij itd. - poznal vlogo in delovanje navideznega pomnilnika, datotečnega sistema, vhodno/izhodnega sistema; - poznal načine za doseganje zaščite in varnosti; - poznal izbrane sodobne OS. <p>Refleksija:</p> <p>Razumevanje osnovnih principov delovanja sodobnih operacijskih sistemov in razumevanje njihove vloge v sodobnem računalniškem sistemu.</p> <p>Prenosljive spretnosti - niso vezane le na en predmet:</p>	<p>Intended learning outcomes:</p> <p>After the completion of the course the student will:</p> <ul style="list-style-type: none"> - know the historical development of OS and its components; - understand the role and use of system calls; - understand the role and use of processes, threads, and their scheduling algorithms; - understand the methods of process communication and synchronization; - understand the classical problems of synchronization, such as The Critical Section Problem, and the methods for their solving by semaphors, monitors etc. - understand the role and workings of virtual memory, file system, and I/O system; - know methods of protection and security; - know some selected contemporary OS. <p>Reflection:</p> <p>Understanding how the OS works and how together with hardware makes a computer system useful.</p> <p>Transferable skills:</p>
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Lažje načrtovanje in razvoj sistemske programske opreme (npr, zbirnikov, nalagalnikov, povezovalnikov, gonilnikov). Lažja prilagoditev na nov OS.	these are many and useful in other subjects. For example, the ability to plan, design, and implement system programs and especially large programs.
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Metode poučevanja in učenja:	Learning and teaching methods:
Predavanja, domače naloge, seminarski način dela pri vajah. Poudarek je na sprotnem študiju in samostojnem delu pri domačih nalogah, vajah in seminarskih nalogah.	Lectures, tutorial, home works, seminars.

Načini ocenjevanja:	Delež/Weight	Assessment:
Način (pisni izpit, ustno izpraševanje, naloge, projekt):		Type (exam, oral, coursework, project):
Sprotno preverjanje (domače naloge, kolokviji in projektno delo)	50,00 %	Continuing (homework, project work)
Končno preverjanje (pisni in ustni izpit)	50,00 %	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:

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., MAHJOUB, 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: Organizacija in management
Course title: Organisation and Management

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Računalništvo in informatika, prva stopnja, univerzitetni	Ni členitve (študijski program)	3. letnik	Letni

Univerzitetna koda predmeta/University course code: 63250

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
45	10	20			105	6

Nosilec predmeta/Lecturer: Tomaž Hovelja

Vrsta predmeta/Course type: izbirni predmet /elective course

Jeziki/Languages:

Predavanja/Lectures:	Slovenščina
Vaje/Tutorial:	Slovenščina

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

Prerequisites:

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, opcijski 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).

Temeljna 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:

Temeljni cilj predmeta je seznanitev študentov s ključnimi vsebinami organizacije in managementa in jim

Objectives and competences:

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

<p>tako omogočiti uspešno opravljanje managerske funkcije v podjetjih in zavodih.</p> <p>Za doseg svojega cilja bo pri študentih potrebno razviti sledeče sposobnosti:</p> <p>študenti morajo osvojiti znanja o ključnih organizacijskih in managerskih vsebinah,</p> <p>študente je potrebno usposobiti za preučevanje in reševanje organizacijskih in managerskih problemov v podjetjih in zavodih,</p> <p>študenti morajo razumeti povezanost problematike poslovanja in organizacije ter problematike vzpostavitve in spreminjanja informacijskih sistemom v podjetjih in zavodih.</p>	<p>management roles in enterprises and government institutions.</p> <p>To reach this objective the following student competences need to be developed:</p> <p>students have to acquire the knowledge from key topics of organization and management,</p> <p>students need to learn how to examine and solve organizational and management issues in enterprises and government institutions,</p> <p>students need to understand the interconnectedness of organization and management issues with information system deployment and change issues.</p>
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<p>Predvideni študijski rezultati:</p> <p>Študenti bodo temeljito spoznali in razumeli ključne vsebine organizacije in managementa.</p> <p>Študenti bodo sposobni kritične analize, sinteze in vrednotenja ključnih vsebin na preučavnih področjih.</p> <p>Študenti bodo morali zgornje sposobnosti pokazati na praktičnem primeru ocene organizacijskih in managerskih dejavnikov treh delniških družb.</p> <p>Študentom bo omogočeno uspešno vključevanje v management podjetij in zavodov z razvojem njihove sposobnosti preučevanja in reševanja organizacijskih in managerskih problemov.</p> <p>Predmet bo študentom omogočil kritično vrednotenje lastnega delovanja v podjetju, kot tudi razumevanje problematike odmikov med od njega pričakovanim in dejansko opravljenim delom.</p> <p>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.</p>	<p>Intended learning outcomes:</p> <p>The students will gain a thorough understanding of key topics in organization and management.</p> <p>The students will be able to critically analyze, synthesize and evaluate key topics of organization and management.</p> <p>The students will need to demonstrate their practical ability to evaluate key organizational and management characteristics for 3 publicly traded companies.</p> <p>The students will be able to examine and solve organizational and management issues thus enabling them to occupy management positions.</p> <p>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.</p> <p>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.</p>
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<p>Metode poučevanja in učenja:</p> <p>Predavanja, vaje s skupinsko diskusijo, igro vlog in simulacijami resničnih situacij, študije primerov, praktično timsko projektno delo na seminarških nalogah s predstavitev narejenega.</p>	<p>Learning and teaching methods:</p> <p>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.</p>
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Načini ocenjevanja:	Delež/Weight	Assessment:
Način (pisni izpit, ustno izpraševanje, naloge, projekt):		Type (examination, oral, coursework, project):
Individualna seminarska naloga	50,00 %	Individual project work
Sprotno preverjanje z domačimi nalogami na vajah, sodelovanje na predavanjih	0,00 %	Continuing homework from exercises, in-class participation.
Pisni izpit	50,00 %	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).

<p>Reference nosilca/Lecturer's references:</p> <p>doc.dr. Tomaž Hovelja</p> <p>Objavljeni članki v revijah z visokim faktorjem vpliva - na primer:</p>
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- 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.
- 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
- 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: Organizacija računalniških sistemov
Course title: Computer Systems Organisation

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Računalništvo in informatika, prva stopnja, univerzitetni	Ni členitve (študijski program)	2. letnik	Zimski

Univerzitetna koda predmeta/University course code: 63218

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
45		30			105	6

Nosilec predmeta/Lecturer: Patricio Bulić

Vrsta predmeta/Course type: obvezni predmet/compulsory course

Jeziki/Languages:

Predavanja/Lectures:	Slovenščina
Vaje/Tutorial:	Slovenščina

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

Vsebina:

Predavanja obsegajo naslednja poglavja:
Polprevodniška tehnologija CMOS, logični nivoji, logični gradniki v tehnologiji CMOS, urin signal, sinhronizacija, metastabilnost.
Vhod in izhod: osnovne lastnosti V/I naprav, V/I priključki
Paralelni V/I krmilniki
Serijski V/I vmesniki
Prekinitve in prekinitveni krmilniki
Prekinitveno voden V/I
Neposreden dostop do pomnilnika, krmilniki DMA
Pomnilniška hierarhija, navidezni pomnilnik
Prenosne poti, vodila
Vrste prenosov: sinhronski, asinhronski, eksplozijski, ukazno-protokolski, izvorno-sinhronski
Paralelni sistemi: večjedrni in mnogojedrni sistemi
Predpomnilniška skladnost
Vsa poglavja bodo podprta s primeri iz prakse: Intel Nehalem microarchitecture, Intel Ivy Bridge chipset in STM32F4 SOC.

Content (Syllabus outline):

The course consists of the following chapters:
Semiconductor CMOS technology, logic levels, basic CMOS elements, clock, synchronization and meta-stability
Input and output: basic I/O block and its properties
Parallel I/O adapters and controllers
Serial I/O adapters and controllers
Interrupts and interrupts controllers
Interrupt driven I/O
Direct memory access, DMA controllers
Memory hierarchy, virtual memory
Transmission lines, buses
Data transfer: synchronous, asynchronous, burst, command sequencing, source-synchronous
Parallel systems: multi- and many-core systems
Cache coherency
All chapters will cover the case studies: Intel Nehalem microarchitecture, Intel Ivy Bridge chipset and STM32F4 SOC.

Temeljna literatura in viri/Readings:

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

D. A. Patterson, J. L. Hennessy: Computer Organization and Design: The Hardware/Software Interface, The Fourth Revised Edition, Elsevier 2012.

D. Kodek: Arhitektura in organizacija računalniških sistemov, Bi-Tim, Ljubljana 2008

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:

Po uspešno opravljenem modulu naj bi bili študenti zmožni:
Razumeti strukturo in organizacijo računalniškega sistema
Razložiti delovanje gradnikov računalniškega sistema: I/O, prekinitveni krmilnik, DMA, časovniki, vodila
Razumeti in razložiti delovanje sodobnih pomnilniških čipov (SDRAM, DDR SDRAM)
Razumeti signale in časovne parametre pri pomnilniških čipih in protokole na vodilih
Razumeti in razložiti delovanje navideznega pomnilnika
V programskem jeziku C napisati nizkonivojske programe za uporabo I/O, DMA, prekinitvenega krmilnika, časovnikov za sistem na čipu STM32F4
V programskem jeziku C napisati callback funkcije, prekinitveno servisne podprograme ter implementirati zamenjavo konteksta na sistemu na čipu STM32F4

Intended learning outcomes:

After the completion of the course a student will be able to:
Understand the internal structure and organization of a computer system
Explain principles and functionality of the basic building blocks: I/O, DMA controller, interrupt controller, timers, bus
Understand and explain the principles of the modern memory chips (SDRAM, DDR SDRAM)
Understand SDRAM signals and timings; understand signal, timings and protocols on the buses
Understand and explain the principles of virtual memory
Write low-level programs for I/O, DMA, interrupt controller and timers in the STM32F4 SoC
Write call-back functions, interrupt handlers and context-switching routines using C

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:

Delež/Weight

Assessment:

Načini ocenjevanja:	Delež/Weight	Assessment:
Način (pisni izpit in ustno izpraševanje):		Type (written examination, oral examination):
Sprotno delo poteka v obliki domačih naloge, projektnega dela in kolokvijev.	50,00 %	Continuing work (homeworks, midterm exams, project work).
Končno preverjanje: pisni in ustni izpit	50,00 %	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 Statute of UL).

Reference nosilca/Lecturer's references:

AVRAMOVIČ, Aleksej, BABIČ, Zdenka, RAIČ, Dušan, STRLE, Drago, BULIČ, Patricio. An approximate logarithmic squaring circuit with error compensation for DSP applications. *Microelectronics journal*, 2014, vol. 45, iss. 3, str. 263-271.

ČEŠNOVAR, Rok, RISOJEVIČ, Vladimir, BABIČ, Zdenka, DOBRAVEC, Tomaž, BULIČ, Patricio. A GPU implementation of a structural-similarity-based aerial-image classification. *J. supercomput.*, Aug. 2013, vol. 65, no. 2, str. 978-996.

BULIČ, 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.

LOTRIČ, Uroš, BULIĆ, Patricio. Applicability of approximate multipliers in hardware neural networks.

Neurocomputing, Nov. 2012, vol. 96, str. 57-65.

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

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=11542>.

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet: Osnove digitalnih vezij
Course title: Introduction to Digital Circuits

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Računalništvo in informatika, prva stopnja, univerzitetni	Ni členitve (študijski program)	1. letnik	Zimski

Univerzitetna koda predmeta/University course code: 63204

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
45		30			105	6

Nosilec predmeta/Lecturer: Nikolaj Zimic

Vrsta predmeta/Course type: obvezni predmet/compulsory course

Jeziki/Languages:

Predavanja/Lectures:

Vaje/Tutorial:

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

Prerequisites:

Vsebina:

predavanja:

1. Realizacija avtomatov
2. Osnove VHDL
3. Programabilna logična vezja
4. Boolova algebra
5. Preklopne funkcije in preklopna vezja
6. Funkcijsko polni sistemi
7. Minimizacija preklopnih funkcij
8. Strukturalna preklopna vezja (kodirnik, dekodirnik, multiplekser, ROM, ...)
9. Aritmetično logična vezja
10. Sekvenčna vezja
11. Načrtovanje avtomatov

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

Temeljna 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.

M. Moškon, Priprave na vaje za predmet Osnove digitalnih vezij, 2016, elektronska različica

M. Morris R. Mano, Michael D. Ciletti, Digital Design: With an Introduction to the Verilog HDL, VHDL, and SystemVerilog (6th Edition), 2017, 0134549899

Cilji in kompetence:

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 preklonih strukturah in sistemih, pomnilnimi celicami in osnovami avtomatov.

Objectives and competences:

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:

Po uspešnem zaključku tega predmeta bo študent zmožen:

izkazati znanje in razumevanje osnovnih principov digitalne logike,
 uporabljati postopke minimizacije preklonih funkcij,
 razumeti in uporabiti strukturalen zapis logičnih funkcij,
 uporabiti aritmetično-logična vezja kot gradnike,
 razumeti delovanje sekvenčnih vezij,
 analizirati delovanje avtomata,
 realizirati avtomat z logičnimi vezji.

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:

After successful completion of the course, students should be able to:

understand the basic principles of digital logic,
 use techniques for minimizing switching functions,
 understand and apply a structural logic functions,
 use arithmetic logic circuits like building blocks,
 understand the operation of sequential logical circuits,
 analyze the operation of the state automaton,
 realize an automaton with logical circuits.

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: **Learning and teaching methods:**

Predavanja,
 ,
 laboratorijske vaje.

Lectures, lab practice.

Načini ocenjevanja:**Delež/Weight****Assessment:**

Način (pisni izpit, ustno izpraševanje, naloge, projekt):		
Sprotno preverjanje (domače naloge, kolokviji in projektno delo)	50,00 %	
Končno preverjanje (pisni in ustni izpit)	50,00 %	
Ocene: 6-10 pozitivno, 5 negativno (v skladu s Statutom UL).		

Reference nosilca/Lecturer's references:

VASYLCHENKOVA, Anastasiia, MRAZ, Miha, ZIMIC, Nikolaj, MOŠKON, Miha. Classical mechanics approach applied to analysis of genetic oscillators. IEEE/ACM transactions on computational biology and bioinformatics, ISSN 1545-5963. [Print ed.], May/Jun. 2017, vol. 14, no. 3, str. 721-727,

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. 1199-120

PETRONI, Mattia, ZIMIC, Nikolaj, MRAZ, Miha, MOŠKON, Miha. Stochastic simulation algorithm for gene regulatory networks with multiple binding sites. *Journal of computational biology*, ISSN 1066-5277. [Print ed.], Mar. 2015, vol. 22, no. 3, str. 218-226,

ŠOBERL, Domen, ZIMIC, Nikolaj, LEONARDIS, Aleš, KRIVIC, Jaka, MOŠKON, Miha. Hardware implementation of FAST algorithm for mobile applications. *Journal of signal processing systems for signal, image, and video technology*, ISSN 1939-8018. [Print ed.], 2015, vol. 79, no. 3, str. 247-256,

PEČAR, Primož, MRAZ, Miha, ZIMIC, Nikolaj, JANEŽ, Miha, LEBAR BAJEC, Iztok. Solving the ternary quantum-dot cellular automata logic gate problem by means of adiabatic switching. *Japanese journal of applied physics*, ISSN 0021-4922, 2008, vol. 47, no. 6, str. 5000-5006

UČNI NAČRT PREDMETA/COURSE SYLLABUS

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

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Računalništvo in informatika, prva stopnja, univerzitetni	Ni členitve (študijski program)	1. letnik	Letni

Univerzitetna koda predmeta/University course code: 63215

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
45		30			105	6

Nosilec predmeta/Lecturer: Dejan Lavbič

Vrsta predmeta/Course type: obvezni predmet/compulsory course

Jeziki/Languages:

Predavanja/Lectures:	Slovenščina
Vaje/Tutorial:	Slovenščina

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

Vsebina:

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

Content (Syllabus outline):

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

Temeljna 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:

Po uspešnem zaključku tega predmeta bo študent:

- sposoben izkazati znanje iz poznavanja osnovnih pojmov s področja informacijskih sistemov,
- razumel umestitev informacijskega sistema v kontekst poslovnega okolja in potrebo po vpeljavi v poslovni sistem,
- razumel vlogo informacijskih tehnologij v okviru sodobnih informacijskih sistemov,
- uporabljal informacijske tehnologije za razvoj računalniško podprtih informacijskih sistemov,
- poznal in razumel uglašenost med teorijo in prakso na konkretnih primerih s področja informacijskih sistemov (npr. preizkusi delovanja v konkretnem razvojnem okolju),
- uporabljal sistem za obvladovanje verzij in podporna orodja za delo v skupini,
- uporabljal IKT, pisnega sporočanja in komunikacijskih spretnosti pri medsebojnem vrednotenju izdelkov.

Intended learning outcomes:

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

- understand basic concepts in the field of information systems,
- understand information system placement in the context of business environment and the need for its deployment in an enterprise,
- understand the role of information technologies in the context of modern information systems,
- use information technologies for the development of computerized information systems,
- understand and be aware 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),
- use version control system and support tools for collaboration in teams,
- use ICT, written reports and communication skills in peer-review of software products.

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/Weight

Assessment:

Načini ocenjevanja:	Delež/Weight	Assessment:
Način (pisni izpit, ustno izpraševanje, naloge, projekt):		Type (examination, oral, coursework, project):
Sprotno preverjanje (domače naloge, kolokviji in projektno delo)	50,00 %	Continuing (homework, midterm exams, project work)
Končno preverjanje (pisni in ustni izpit)	50,00 %	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:

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: Osnove matematične analize
Course title: Calculus

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Računalništvo in informatika, prva stopnja, univerzitetni	Ni členitve (študijski program)	1. letnik	Zimski

Univerzitetna koda predmeta/University course code: 63202

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
45		30			105	6

Nosilec predmeta/Lecturer: Žiga Virk

Vrsta predmeta/Course type: obvezni predmet /compulsory course

Jeziki/Languages:

Predavanja/Lectures:	Slovenščina
Vaje/Tutorial:	Slovenščina

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

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Vsebina:

- Realna števila, kompleksna števila, zaporedja, limita zaporedja, vrste.
- Funkcije: osnovne lastnosti, graf, zveznost in limita funkcije, lastnosti zveznih funkcij, bisekcija in sekantna metoda za reševanje nelinearnih enačb, funkcije več spremenljivk.
- 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.
- 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.
- Diferencialne enačbe: zakoni rasti, rešitve diferencialnih enačb, enačba z ločljivima spremenljivkama, linearna diferencialna enačba, primeri uporabe.

Content (Syllabus outline):

- Real numbers, complex numbers, sequences, limits and convergent sequences, series.
- Functions: basic properties, graph. Continuity and limits, properties of continuous functions, bisection, secant method, functions of several variables.
- 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.
- 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.
- Differential equations: growth models, solutions, separable equations, linear first degree differential equations, examples.

Temeljna literatura in viri/Readings:

- G. Tomšič, B. Orel, N. Mramor: Matematika I, Matematika II; Ljubljana, Založba FE in FRI.

2. J. Stewart: Calculus: early transcendentals (8th edition), Cengage Learning, 2016, poglavja 1-8 in 14.
3. Dan Sloughter: Yet Another Calculus Text, <http://www.freebookcentre.net/maths-books-download/Yet-Another-Calculus-Text.html>

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:

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 konvergence, 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.

Objectives and competences:

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:

Po uspešnem zaključku predmeta bo študent obvladal osnovne pojme in principe matematične analize in razumel zvezo med simboličnim, grafičnim in numeričnim opisom

obvladal dokazovanje z matematično indukcijo, in osnovne računske manipulacije z realnimi in kompleksnimi števili

razumel pojem zaporedja in konvergence

razumel pojem funkcijske odvisnosti in zveznosti, razumel pojem odvoda, obvladal računanje nezahtevnih odvodov in njihovo uporabo pri analizi funkcijskih odvisnosti in reševanju preprostih optimizacijskih problemov

razumel pojem integrala, poznal osnovne principe za računanje integralov in zvezo med odvodom in integralom

poznal osnovne principe in primere uporabe teh pojmov v računalniških algoritmih in pri reševanju problemov iz realnega sveta

Intended learning outcomes:

Knowledge and understanding:

After completion of the course the student will master the basic concepts and principles of calculus and understand the connection between their symbolic, graphic and numeric representations

master simple proofs with mathematical induction and basic manipulations with real and complex numbers

understand the concepts of sequence and convergence

understand the concept of functional dependence and continuity

understand the concept of derivative, be able to compute relatively simple derivatives and use them in function analysis and in simple optimization problems

understand the concept of integral, master basic principles for computing integrals, and understand the connection between indefinite and definite integrals

know basic principles and examples of applying these concepts to computer algorithms and to real world problems

Metode poučevanja in učenja:	Learning and teaching methods:
Predavanja, računske vaje z ustnimi nastopi, domače naloge. Poseben poudarek je na sprotnem študiju z domačimi nalogami in na skupinskem delu pri vajah.	Lectures, lab exercises with oral presentations, homework problems. Special attention will be given to continuing work with homework problems and group work.

Načini ocenjevanja:	Delež/Weight	Assessment:
Način (pisni izpit, ustno izpraševanje, naloge, projekt):		Type (examination, oral, coursework, project):
Sprotno preverjanje (domače naloge, kolokviji in projektno delo)	50,00 %	Continuing (homework, midterm exams, project work)
Končno preverjanje (pisni in ustni izpit)	50,00 %	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:

- VIRK, Žiga. Small loop spaces. *Topology and its Applications*, ISSN 0166-8641, 2010, vol. 157, no. 2, str. 451-455.
- VIRK, Žiga. Realizations of countable groups as fundamental groups of compacta. *Mediterranean journal of mathematics*, 2013, vol. 10, no. 3, str. 1573-1589.
- DYDAK, Jerzy, VIRK, Žiga. Preserving coarse properties. *Revista matemática complutense*, 2016, vol. 29, iss. 1, str. 191-206.
- EDELSBRUNNER, Herbert, VIRK, Žiga, WAGNER, Hubert. Smallest enclosing spheres and Chernoff points in Bregman geometry. V: SPECKMANN, Bettina (ur.), TÓTH, Csaba D. (ur.). *34th International Symposium on Computational Geometry : SoCG 2018, June 11-14, 2018, Budapest, Hungary*,
- VIRK, Žiga. Approximations of 1-dimensional intrinsic persistence of geodesic spaces and their stability. *Revista matemática complutense*, Jan. 2019, vol. 32, iss. 1, str. 195-213.

Celotna bibliografija je dostopna na SICRISu:
<http://sicris.izum.si/search/rsr.aspx?lang=slv&id=20092>

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet: Osnove oblikovanja
Course title: Introduction to Graphics Design

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Računalništvo in informatika, prva stopnja, univerzitetni	Ni členitve (študijski program)	3. letnik	Letni

Univerzitetna koda predmeta/University course code: 63271

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
45		30			105	6

Nosilec predmeta/Lecturer: Narvika Bovcon

Vrsta predmeta/Course type: izbirni predmet/elective course

Jeziki/Languages:

Predavanja/Lectures:	Slovenščina
Vaje/Tutorial:	Slovenščina

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 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.

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 communication of the graphical elements of the interface that guides the interaction.
9. Data visualisation. Project work.
10. The Adobe software package: practical work.

Temeljna literatura in viri/Readings:

Data Flow: Visualising Information in Graphic Design. Berlin: Gestalten, 2008. Kubel, H., Williams, S. Type: New Perspectives in Typography. Laurence King, 2015.
Colborne, G. Simple and Usable Web, Mobile, and Interaction Design (Voices That Matter). New Readers, 2010.

Lal, R. Digital Design Essentials: 100 Ways to Design Better Desktop, Web, and Mobile Interfaces. Rockport Publishers, 2013.

Manovich, L. The Language of New Media. MIT, 2001.

Samara, T. Design Elements: A Graphic Style Manual. Rockport Publishers, 2007.

Tufte, R. E. The Visual Display of Quantitative Information. Graphics Press LLC, 2001.

The Design Annual.

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:

Po uspešno zaključenem modulu bodo študenti zmožni:

- prepoznati zakonitosti likovnega izražanja,
- pomniti osnovne likovne prvine in principe gradnje podobe,
- dekodirati vizualna sporočila,
- koristiti zakonitosti uporabe črkovnih vrst in barv,
- uporabljati oblikovalske metode in oblikovalske programe za oblikovanje spletnih strani, računalniških vmesnikov, vizualizacijo podatkov,
- zasnovati, načrtovati in izdelati lasten oblikovalski izdelek,
- interpretirati oblikovalski proces kot integralni del pri načrtovanju komunikacije med računalnikom in uporabnikom,
- pregledati področje in analizirati primere dobre prakse,
- testirati, evalvirati in preoblikovati lastni oblikovalski izdelek,
- integrirati oblikovalsko mišljenje in metodologijo pri načrtovanju uporabniku prijaznih računalniških vmesnikov.

Intended learning outcomes:

After successful completion of the module, students will be able to:

- recognize the laws of visual expression,
- remember the elements of visual language and the principles of image composition,
- decode visual messages,
- use adequately typography and colour,
- use graphic design methods and the design software to design web pages, computer interfaces and visualize information,
- conceptualize, develop and realize a design product,
- interpret graphic design process as an integral part of the human-computer interaction design,
- explore the state of the art design solutions,
- test, evaluate and redesign own design projects.

Metode poučevanja in učenja:

Predavanja, vaje v šoli, seminarji zajemajo domače delo. Poseben poudarek je na sprotne 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:

Delež/Weight

Assessment:

Načini ocenjevanja:	Delež/Weight	Assessment:
Način (pisni izpit, ustno izpraševanje, naloge, projekt):		Type (examination, oral, coursework, project):
Sprotno preverjanje (domače naloge, kolokviji in projektno delo).	50,00 %	Continuing (homework, midterm exams, project work).
Končno preverjanje (pisni in/ali ustni izpit).	50,00 %	Final (written and/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:

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] ^[1] ~~[2]~~ ^[3] ~~[4]~~ ^[5] ~~[6]~~ ^[7] ~~[8]~~ ^[9] ~~[10]~~ ^[11] ~~[12]~~ ^[13] ~~[14]~~ ^[15] ~~[16]~~ ^[17] ~~[18]~~ ^[19] ~~[20]~~ ^[21] ~~[22]~~ ^[23] ~~[24]~~ ^[25] ~~[26]~~ ^[27] ~~[28]~~ ^[29] ~~[30]~~ ^[31] ~~[32]~~ ^[33] ~~[34]~~ ^[35] ~~[36]~~ ^[37] ~~[38]~~ ^[39] ~~[40]~~ ^[41] ~~[42]~~ ^[43] ~~[44]~~ ^[45] ~~[46]~~ ^[47] ~~[48]~~ ^[49] ~~[50]~~ ^[51] ~~[52]~~ ^[53] ~~[54]~~ ^[55] ~~[56]~~ ^[57] ~~[58]~~ ^[59] ~~[60]~~ ^[61] ~~[62]~~ ^[63] ~~[64]~~ ^[65] ~~[66]~~ ^[67] ~~[68]~~ ^[69] ~~[70]~~ ^[71] ~~[72]~~ ^[73] ~~[74]~~ ^[75] ~~[76]~~ ^[77] ~~[78]~~ ^[79] ~~[80]~~ ^[81] ~~[82]~~ ^[83] ~~[84]~~ ^[85] ~~[86]~~ ^[87] ~~[88]~~ ^[89] ~~[90]~~ ^[91] ~~[92]~~ ^[93] ~~[94]~~ ^[95] ~~[96]~~ ^[97] ~~[98]~~ ^[99] ~~[100]~~ ^[101] ~~[102]~~ ^[103] ~~[104]~~ ^[105] ~~[106]~~ ^[107] ~~[108]~~ ^[109] ~~[110]~~ ^[111] ~~[112]~~ ^[113] ~~[114]~~ ^[115] ~~[116]~~ ^[117] ~~[118]~~ ^[119] ~~[120]~~ ^[121] ~~[122]~~ ^[123] ~~[124]~~ ^[125] ~~[126]~~ ^[127] 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UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Osnove podatkovnih baz
Course title:	Basics of Databases

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Računalništvo in informatika, prva stopnja, univerzitetni	Ni členitve (študijski program)	2. letnik	Zimski

Univerzitetna koda predmeta/University course code:

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
45		30			105	6

Nosilec predmeta/Lecturer:

Vrsta predmeta/Course type:

Jeziki/Languages:	Predavanja/Lectures:	Slovenščina
	Vaje/Tutorial:	Slovenščina

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 načrtovanja;
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

Temeljna literatura in viri/Readings:

Thomas M. Connolly, Carolyn E. Begg (2009). *Database Systems, A Practical Approach to Design, Implementation and Management*, Fifth Edition, Addison-Wesley.

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:

Po uspešno zaključenem modulu bodo študenti zmožni:

- načrtovati enostavne in kompleksnejše podatkovne baze,
- razviti aplikacije z dostopom do različnih sistemov za upravljanje s podatkovnimi bazami,
- poizvedovati po različnih vrstah podatkovnih baz,
- analizirati poizvedbe,
- optimizirati podatkovne baze ter poizvedbe,
- uporabiti algoritme s področja podatkovnih baz na sorodnih problemih.

Intended learning outcomes:

After successful completion of the module, students will be able to:

design simple and complex databases, develop applications with access to various database management systems, retrieve data from different types of databases, analyze queries from performance perspective, optimize databases and queries, reuse database algorithms for similar problems.

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.

Načini ocenjevanja:

Delež/Weight

Assessment:

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

Type (examination, oral, coursework, project):

Sprotno preverjanje (domače naloge, kolokviji in projektno delo)

50,00 %

Continuing (homework, midterm exams, project work)

Končno preverjanje (pisni in ustni izpit)

50,00 %

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:

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: Osnove umetne inteligence
Course title: Introduction to Artificial Intelligence

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Računalništvo in informatika, prva stopnja, univerzitetni	Ni členitve (študijski program)	3. letnik	Zimski

Univerzitetna koda predmeta/University course code: 63214

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
45		30			105	6

Nosilec predmeta/Lecturer: Zoran Bosnić

Vrsta predmeta/Course type: obvezni predmet/compulsory course

Jeziki/Languages:

Predavanja/Lectures:	Slovenščina
Vaje/Tutorial:	Slovenščina

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

Temeljna literatura in viri/Readings:

. 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:

Seznanimi slušatelje z osnovnimi koncepti, idejami, metodami in tehnikami umetne inteligence
Sposobnost reševanja problemov z metodami umetne inteligence
Zmožnost razumevanja literature 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:

Po uspešnem zaključku predmeta bo študent:
- poznal osnovne in najpogostejše uporabljane metode umetne inteligence,
- sposoben pojasniti implikacije dosežkov umetne inteligence in relacije s kognitivno znanostjo, psihologijo, medicino, logiko, matematiko in drugimi sorodnimi področji.
- sposoben opredeliti, kje so tehnične meje področja,
- sposoben uporabe preiskovalnih algoritmov in metod strojnega učenja na realnih problemih,
- sposoben primerjanja časovne in prostorske učinkovitosti uporabljanih metod,
- sposoben formulirati probleme iz realnega življenja kot probleme, ki so rešljivi z metodami umetne inteligence.

Intended learning outcomes:

After the completion of the course the student will be able to:
- know the basic and most commonly used methods in the field of artificial intelligence (AI),
- explain implications of the AI achievements, and its relation with cognitive science, psychology, medicine, logic, mathematics and other related fields,
- define the technical boundaries of the field,
- use the search and machine learning algorithms on real problems,
- compare time and spatial complexity of the taught algorithms,
- formulate selected problems from the real world as problems that are solvable with the AI algorithms.

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:

Delež/Weight

Assessment:

Načini ocenjevanja:	Delež/Weight	Assessment:
Način (pisni izpit, ustno izpraševanje, naloge, projekt):		Type (written and oral exam, coursework, project):
Sprotno preverjanje (domače naloge, kolokviji in projektno delo)	50,00 %	Continuing (homework, project work)
Končno preverjanje (pisni in/ali ustni izpit)	50,00 %	Final (written and/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:

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: Planiranje in upravljanje informatike
Course title: Informatics Planning and Management

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Računalništvo in informatika, prva stopnja, univerzitetni	Ni členitve (študijski program)	3. letnik	Letni

Univerzitetna koda predmeta/University course code: 63253

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
45		30			105	6

Nosilec predmeta/Lecturer: Rok Rupnik

Vrsta predmeta/Course type: izbirni predmet/elective course

Jeziki/Languages:

Predavanja/Lectures:	Slovenščina
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;
- 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.

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: 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:

<ul style="list-style-type: none"> • procesi informatike: plansko organizacijski, izvedbeni, podporni in nadzorni. • vrednotenje uspešnosti informatike in ravni zrelosti (CMMI), • ogrođja in najboljše prakse upravljanja informatike: • COBIT, ITIL, upravljanje varnosti, zagotavljanje neprekinjenosti poslovanja. 	<p>plan and organize, implementation, support and control.</p> <ul style="list-style-type: none"> • Evaluation of IT success and levels of maturity (CMMI) • Frameworks and best practices for IT governance: • COBIT, ITIL, security management, business continuity.
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Temeljna 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
 COBIT 4.1
 COBIT 5

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:

Po uspešnem zaključku tega predmeta bo študent:

- Sposoben pokazati znanje in razumevanje osnovnih pojmov področja obvladovanja informatike
- Razumel koncepte ogrođij/standardov COBIT 4.1, COBIT 5 and ITIL 3 in v okviru tega koncepte procesov informatike in organiziranosti informatike v podjetjih
- Razumel proces in koncepte strateškega planiranja informatike
- Razumel in uporabljal znanje področja Poslovne analize na podlagi standarda BABoK
- Razumel in uporabljal znanje področja poslovno-informacijskih arhitektur
- Razumel vlogo direktorja informatike in ostalih ključnih strokovnjakov informatike v podjetjih

Intended learning outcomes:

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

- Understand the basic principles of IT governance
- Understand the concepts of frameworks/standards of: COBIT 4.1, COBIT 5 and ITIL 3. As part of that student will understand IT processes and concepts of IT organisation in companies
- Understand the process and the concepts of information systems strategic planning
- Understand and use the knowledge of the area of Business analysis based on BABoK standard
- Understand and use of knowledge of the area of Enterprise architecture
- Understand the role of CIO (Chief Information Officer) and other key IT experts in companies

Metode poučevanja in učenja:

Predavanja in laboratorijske vaje ter seminarji. V okviru laboratorijskih vaj in seminarjev gre za skupinsko delo. Na predavanjih bodo v omejenem obsegu (10% do 15%) sodelovali strokovnjaki iz gospodarstva. Njihovo sodelovanje ne bodo le predavanja v ožjem pomenu besede, temveč tudi sodelovanje v diskusijah.

Learning and teaching methods:

Lectures, laboratory exercises and seminars. Laboratory exercises and seminars are organised as teamwork. On lectures, the participation and collaboration of experts from the industry is also planned: not only through pure lectures, but also taking part in discussions.

Načini ocenjevanja:

Delež/Weight

Assessment:

Način (pisni izpit, ustno izpraševanje, naloge, projekt):		Type (examination, oral, coursework, project):
ena seminarska naloga	45,00 %	one project
dva kolokvija med semestrom ali ustni izpit	45,00 %	two examinations during semester or oral examination
sodelovanje na predavanjih	10,00 %	active participation on lectures

Ocene: 6-10 pozitivno, 5 negativno (v skladu s Statutom UL).	Grading: 6-10 pass, 5 fail (according to the UL Statutes).
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Reference nosilca/Lecturer's references:

- 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: Porazdeljeni sistemi
Course title: Distributed Systems Computer

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Računalništvo in informatika, prva stopnja, univerzitetni	Ni členitve (študijski program)	3. letnik	Zimski

Univerzitetna koda predmeta/University course code: 63261

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
45	10	20			105	6

Nosilec predmeta/Lecturer: Uroš Lotrič

Vrsta predmeta/Course type: izbirni predmet/elective course

Jeziki/Languages:	Predavanja/Lectures:	Slovenščina
	Vaje/Tutorial:	Slovenščina

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

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

v algoritmu, modeli zagotavljanja skladnosti v sistemih z deljenim pomnilnikom	models of computational dependencies, models of shared memory consistency
8. Porazdeljeni sistemi: napake na mreži in vozliščih, razpoložljivost, kompromisi pri načrtovanju sistemov in servisnih storitev, primeri porazdeljenih algoritmov (volitve, odkrivanje)	8. Distributed systems: network- and node-based faults, availability, distributed system and service design tradeoffs, examples of distributed algorithms (election, discovery)

Temeljna 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.
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Predvideni študijski rezultati:

Po uspešnem zaključku predmeta bo študent: poznal tipične vzporedne in porazdeljene računalniške sisteme razumel težave pri komunikaciji in koordinaciji med elementi v sistemu obvladal postopke dekompozicije problema na podlagi uveljavljenih formalnih modelov znan pisati učinkovite programe za vzporedne in porazdeljene sisteme znan uporabljati različne knjižnice in ogrodja za paralelizacijo večprocesorskih sistemov, večračunalniških sistemov, koprocesorjev, omrežij in oblakov znan izbrati primerno strojno in programsko opremo in ju uporabiti pri reševanju izbranega problema znan teoretično analizirati algoritem in oceniti možnosti za uspešno paralelizacijo	Intended learning outcomes: After the completion of the course a student will be able to: recognize parallel and distributed computing systems understand problems arising with communication and coordination among nodes decompose a problem based on recognized formal models write efficient programs for parallel and distributed architectures use contemporary libraries and frameworks for programming of parallel and distributed systems, coprocessors, grids, and clouds choose appropriate hardware and software to solve a problem at hand make theoretical analysis of an algorithm and estimate the improvement due to parallelization
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Metode poučevanja in učenja:

Predavanja, seminarji, laboratorijske vaje, projektno delo na laboratorijskih vajah, individualne domače naloge.	Learning and teaching methods: Lectures, laboratories, homework
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Načini ocenjevanja:

Načini ocenjevanja:	Delež/Weight	Assessment:
Način (ustno izpraševanje, domače naloge, projektno delo):		Type (examination, oral, homework):
Domače naloge	33,00 %	Homework
Projekt	33,00 %	Project
Ustni izpit	34,00 %	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:

1. 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
2. LOTRIČ, Uroš, BULIĆ, Patricio. Applicability of approximate multipliers in hardware neural networks. Neurocomputing, 2012, vol. 96, 57-65
3. SLUGA, Davor, CURK, Tomaž, ZUPAN, Blaž, LOTRIČ, Uroš. Acceleration of information-theoretic data analysis with graphics processing units. Prz. Elektrotech., 2012, 136-139
4. 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
5. SLUGA, Davor, CURK, Tomaž, ZUPAN, Blaž, LOTRIČ, Uroš. Heterogeneous computing architecture for fast detection of SNP-SNP interactions. BMC bioinformatics, 2014, vol. 15, 1-16

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:	Postopki razvoja programske opreme
Course title:	Software Development Processes

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Računalništvo in informatika, prva stopnja, univerzitetni	Ni členitve (študijski program)	3. letnik	Zimski

Univerzitetna koda predmeta/University course code:

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
45	10	20			105	6

Nosilec predmeta/Lecturer:

Vrsta predmeta/Course type:

Jeziki/Languages:	Predavanja/Lectures:	Slovenščina
	Vaje/Tutorial:	Slovenščina

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:
 1. Objektno orientiran pristop
 2. 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

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:
 1. Object-oriented approach
 2. 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

Temeljna 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:

Po uspešnem zaključku predmeta bo študent:

- sposoben razvijati sodobne programske rešitve in uporabljati sodobne postopke razvoja programske opreme,
- razumel in uporabljal najprimernejše postopke razvoja programske opreme glede na tip in zahteve,
- načrtoval arhitekturo kompleksnih aplikacij in programskih sistemov,
- razvijal vmesni sloj programske opreme,
- razumel, načrtoval in razvijal spletne storitve,
- uporabljal sodobna razvojna orodja,
- razumel in apliciral načrtovalske vzorce,
- uporabljal agilne pristope in DevOps orodja,
- poznal programske platforme.

Intended learning outcomes:

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

- develop modern software solutions and use modern software development processes,
- understand and use the most suitable software development procedures according to the software type and requirements,
- plan the architecture of complex applications and software systems,
- develop middleware layer,
- understand, plan and develop web services,
- use modern development tools,
- understand and apply design patterns,
- use agile approaches and DevOps tools,
- be familiar with programming platforms.

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.

Načini ocenjevanja:**Delež/Weight****Assessment:**

Načini ocenjevanja:	Delež/Weight	Assessment:
Način (pisni izpit, ustno izpraševanje, naloge, projekt):		Type (examination, oral, coursework, project):
Sprotno preverjanje (domače naloge, kolokviji in projektno delo)	50,00 %	Continuing (homework, midterm exams, project work)
Končno preverjanje (pisni izpit)	50,00 %	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:

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: Prevaljalniki
Course title: Compilers

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Računalništvo in informatika, prva stopnja, univerzitetni	Ni členitve (študijski program)	3. letnik	Letni

Univerzitetna koda predmeta/University course code: 63265

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
45		30			105	6

Nosilec predmeta/Lecturer: Boštjan Slivnik

Vrsta predmeta/Course type: izbirni predmet/elective course

Jeziki/Languages:

Predavanja/Lectures:	Slovenščina, Angleščina
Vaje/Tutorial:	Slovenščina, Angleščina

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

Vsebina:

- Uvod: razbitje prevajalnika na prednji in zadnji del, zgradba prevajalnika kot cevovoda, izbira prevajanega programskega jezika in ciljnega zbirnika.
- 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.
- 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.
- Abstraktna sintaksa: poenostavljena interna predstavitev prevajanega programa;
 - domača naloga: generiranje abstraktnega sintaksnega drevesa prevajanega programa.
- Semantična analiza: analiza podatkovnih tipov, (ne)dosegljivosti kode,...;
 - domača naloga: izdelava semantičnega analizatorja za preverjanje tipov.
- Klicni zapisi: klicni zapisi za aktivacijo (gnezdenih, rekurzivnih)

Content (Syllabus outline):

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.

Lexical analysis:
 describing programming language symbols with regular expressions, breaking the compiled program into lexical tokens
 Homework: construction of lexical analyser based on finite automata.

Parsing:
 describing syntax with a context-free grammar, parsing procedure and error recovery
 Homework: construction of stack-based LR(k) syntax analyser

Abstract syntax:
 simplified internal representation of the compiled program
 Homework: generating an abstract syntax tree of the compiled program.

Semantic analysis:
 type checking, unreachable code detection,...
 Homework: construction of semantic analyser for type-checking.

Activation records:
 description of records for activation of nested or recursive functions, and their implementation with stack

<p>podprogramov, uporaba sklada ali kopice za realizacijo klicnih zapisov; - domača naloga: načrt klicnih zapisov.</p> <p>7. Vmesna koda: drevesna ali ukazna vmesna koda, uporaba začasnih spremenljivk, nivoji vmesne kode, prevod v vmesno kodo; - domača naloga: izdelava generatorja vmesne kode.</p> <p>8. Osnovni bloki: kanonizacija klicev in skokov v vmesni kodi, oblikovanje osnovnih blokov, permutacija osnovnih blokov; - domača naloga: izračun osnovnih blokov.</p> <p>9. Izbira strojnih ukazov: prevod vmesne kode v ukaze zbirnika z uporabo začasnih spremenljivk; - domača naloga: generator strojne kode brez registrov.</p> <p>10. Analiza aktivnosti začasnih spremenljivk: analiza aktivnosti začasnih spremenljivk na osnovi grafov poteka in podatkovnih enačb; - domača naloga: izračun interferenčnega grafa spremenljivk.</p> <p>11. Izbira registrov: barvanje interferenčnega grafa in izračun preliva začasnih spremenljivk v klicni zapis; - domača naloga: izračun preslikave začasnih spremenljivk v registre in preliv.</p> <p>12. Zaključek: domača naloga: združitev prvih desetih domačih nalog v delujoč prevajalnik.</p>	<p>or heap. Homework: activation records design Intermediate code: tree- or instruction-based intermediate code, temporary variables, translation to intermediate code. Homework: construction of intermediate code generator 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 Instruction selection: translation of intermediate code to target assembler using only temporary variables Homework: target code generator (without register allocation) Liveness analysis: activity analysis of temporary variables based on flow graphs and dataflow equations. Homework: construction of a flow graph. Register allocation: colouring of inference graphs, spilling temporary variables into activation records. Homework: allocation of registers to temporary variables and spilling. Conclusion: Homework: integration of earlier homework into a working compiler.</p>
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Temeljna 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 strojen 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

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

<p>samostojno reševanje specifičnih dobro definiranih opravil v računalništvu in informatiki Osnovne veščine v računalništvu in informatiki, ki omogočajo nadaljevanje študija na drugi stopnji</p>	<p>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</p>
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<p>Predvideni študijski rezultati:</p> <p>Po uspešnem zaključku tega predmeta bo študent: razumel zgradbo in delovanje prevajalnika; razumel zgradbo prevedenega programa in njegovo pomnilniško organizacijo; znan implementirati algoritme sintaksne analize; znan implementirati semantično analizo programskega jezika; razumel klicne zapise in statične povezave; razumel pomen in zgradbo vmesne kode; znan implementirati generator strojne kode in dodeljevanje registrov; razumel enostavne metode avtomatske optimizacije kode in jo znal uporabljati pri pisanju programov.</p>	<p>Intended learning outcomes:</p> <p>After the completion of the course a student will be able to: understand the structure of a compiler and how it works; understand the structure of the compiled program and its memory layout; implement algorithms for performing syntax analysis; implement semantic analysis of a programming language; understand the stack frames and static links; understand the importance and the structure of the intermediate code; Implement code generator and register allocation; understand simple methods used for automatic code optimization and use them at designing efficient programs.</p>
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<p>Metode poučevanja in učenja:</p> <p>Predavanja in domače naloge (seminarski način dela). Poseben poudarek je na sprotne oddajanju domačih nalog.</p>	<p>Learning and teaching methods:</p> <p>Lectures and homework with explicit focus on simultaneous studies (for homeworks).</p>
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Načini ocenjevanja:	Delež/Weight	Assessment:
Način (pisni izpit, ustno izpraševanje, naloge, projekt):		Type (examination, oral, coursework, project):
Sprotno preverjanje (domače naloge)	50,00 %	Continuing (homeworks)
Končno preverjanje (pisni in ustni izpit)	50,00 %	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).

<p>Reference nosilca/Lecturer's references:</p> <p>SLIVNIK, Boštjan. On different LL and LR parsers used in LLLR parsing. Computer Languages, Systems & Structures, ISSN: 1477-8424, Dec. 2017, vol. 50, str. 108-126. SLIVNIK, Boštjan. Measuring the complexity of domain-specific languages developed using MDD. Software quality journal, ISSN 0963-9314, Sep. 2016, vol. 24, no. 3, str. 737-753. SLIVNIK, Boštjan. LL conflict resolution using the embedded left LR parser. Computer Science and Information Systems, 2012, vol. 9, no. 3, str. 1105-1124. POTOČNIK, Matic, ČIBEJ, Uroš, SLIVNIK, Boštjan. Linter - a tool for finding bugs and potential problems in Scala code. Proceedings of the 29th Annual ACM Symposium on Applied Computing, Gyeongju, Korea, March 24-28, 2014, str. 1615-1616. SLIVNIK, Boštjan. LLLR parsing. V: Proceedings of the 28th annual ACM Symposium on Applied Computing, Coimbra, Portugal, March 18-22, 2013, Association for Computing Machinery, str. 1698-1699. SLIVNIK, Boštjan, VILFAN, Boštjan. Producing the left parse during bottom-up parsing. Information processing letters. [Print ed.], Dec. 2005, vol. 96, no. 6, str. 220-224. Celotna bibliografija je dostopna na SICRISu: http://sicris.izum.si/search/rsr.aspx?lang=slv&id=7849.</p>
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UČNI NAČRT PREDMETA/COURSE SYLLABUS

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

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Računalništvo in informatika, prva stopnja, univerzitetni	Ni členitve (študijski program)	2. letnik	Letni

Univerzitetna koda predmeta/University course code: 63220

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
45		30			105	6

Nosilec predmeta/Lecturer: Andrej Bauer

Vrsta predmeta/Course type: izbirni predmet/elective course

Jeziki/Languages:

Predavanja/Lectures:	Slovenščina
Vaje/Tutorial:	Slovenščina

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 raznimi 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 syntacs 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.
 Refleksija:
 Sposobnost razmišljanja o alternativnih formulacijah problemov ter pristopov k njihovem 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.

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
 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/Weight****Assessment:**

Način (pisni izpit, ustno izpraševanje, naloge, projekt):		Type (examination, oral, coursework, project):
Sprotno preverjanje (domače naloge)	50,00 %	Continuing (homework)
Končno preverjanje (pisni in ustni izpit)	50,00 %	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:

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: Programiranje 1
Course title: Programming 1

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Računalništvo in informatika, prva stopnja, univerzitetni	Ni členitve (študijski program)	1. letnik	Zimski

Univerzitetna koda predmeta/University course code: 63277

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
45		30			105	6

Nosilec predmeta/Lecturer: Luka Fürst

Vrsta predmeta/Course type: obvezni predmet /compulsory course

Jeziki/Languages:

Predavanja/Lectures:	Slovenščina
Vaje/Tutorial:	Slovenščina

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

Vsebina:

predavanja:

Pregled programskih jezikov s poudarkom na sodobnih programskih jezikih 3. generacije
Primer preprostega programa, postopek priprave programa, prevajanje in izvajanje
Osnovni podatkovni tipi
Predstavitev celih in realnih števil, znakov ter logičnih vrednosti
Deklaracije konstant in spremenljivk
Stavki
Prireditveni stavki, pisanje izrazov, operatorji in njihova prioriteta
Izbirni stavki
Ponavljalni stavki
Metode
Vloga in vrste metod
Formalni in dejanski parametri
Rekurzija
Razredi in objekti
Spremenljivke in metode objekta
Konstruktorji, večkratno definiranje konstruktorjev
Dostopna določila
Vnaprej deklarirani razredi
Tabele
Enodimenzionalne in večdimenzionalne tabele
Tabele objektov
Nizi
Dedovanje

Content (Syllabus outline):

lectures:

Overview of programming languages with emphasis on 3rd generation
Writing, compiling and executing a simple computer program
Basic data types
Integer and real numbers, characters and logical values
Constants and variables declaration
Programming statements
The assignment statement, expressions, operators, operator precedence
Conditional statements
Loops
Methods
The role and classification of methods
Formal and actual parameters
Recursion
Classes and objects
Instance variables and methods
Constructors, overloading constructors
Access modifiers
Using predefined classes
Arrays
One-dimensional and multidimensional arrays
Arrays of objects
Strings
Inheritance
Overriding superclass methods

<p>Redefinicija metod Konstruktorji v podrazredih Dinamično povezovanje podprogramov Abstraktni razredi in abstraktne metode Razred Object Vmesnik (interface) Grafične knjižnice, komponente grafičnega uporabniškega vmesnika 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>	<p>Using superclass constructors in subclasses Dynamic method binding Abstract classes and abstract methods The Object class Creating and using interfaces Graphics and GUI widget toolkits, components of GUI 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>
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Temeljna literatura in viri/Readings:

V. Mahnič, L. Fürst, I. Rožanc: Java skozi primere, Bi-TIM, 2008.
J. Farrell: Java Programming, Seventh Edition, Course Technology, Cengage Learning, 2014.
Dodatna literatura:
I. Horton: Beginning Java, Java 7 Edition, John Wiley & Sons, Inc., 2011
Uroš Mesojedec, Borut Fabjan: Java 2: Temelji programiranja, Pasadena, 2004.

Cilji in kompetence:

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.

Predvidene kompetence:
razvoj sposobnosti za kritično, analitično in sintetično razmišljanje,
sposobnost razumevanja in reševanja 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, 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.

Objectives and competences:

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.

The competences students gain are:
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:

Po uspešnem zaključku tega predmeta bo študent zmožen:
razumeti postopek priprave, prevajanja in izvajanja računalniškega programa

Intended learning outcomes:

After the completion of the course, a student will be able to:
understand the process of writing, compiling, and running a computer program

<p>razumeti in uporabljati osnovne programske konstrukte in podatkovne strukture</p> <p>razumeti koncepte objektno usmerjenega programiranja (vključno z dedovanjem)</p> <p>razumeti in uporabljati osnovne algoritme za reševanje tipičnih programerskih problemov</p> <p>izkazati poznavanje osnov računalniške grafike in osnovnih komponent grafičnega uporabniškega vmesnika</p> <p>izkazati poznavanje osnov dogodkovno vodenega programiranja</p> <p>pisati enostavne računalniške programe v splošno namenskem jeziku tretje generacije</p>	<p>understand and use basic programming constructs and data structures</p> <p>understand the concepts of object-oriented programming (including inheritance)</p> <p>understand and use basic algorithms for solving typical programming problems</p> <p>know the basics of computer graphics and basic components of GUI</p> <p>know the principles of event-driven programming</p> <p>write simple computer programs in a general purpose programming language</p>
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<p>Metode poučevanja in učenja:</p> <p><i>Predavanja</i> z aktivno udeležbo študentov (razlaga, diskusija, vprašanja, primeri, reševanje problemov);</p> <p><i>Laboratorijske vaje</i> (refleksija izkušenj, praktično reševanje več tipičnih problemov na računalniku, predstavitev in zagovor programskih rešitev, diskusija, sporočanje povratne informacije);</p> <p><i>Domače naloge</i> (samostojna izdelava računalniških programov)</p> <p>Individualne <i>konsultacije</i> (diskusija, dodatna razlaga, obravnava specifičnih vprašanj)</p>	<p>Learning and teaching methods:</p> <p><i>Lectures</i> with active participation of students (explanation, discussion, questions, examples, problem solving);</p> <p><i>Lab practice</i> (reflection of experience, practical problem solving, presentation of solutions, discussion, communication of feedback information)</p> <p><i>Homework</i> (individual development of simple computer programs)</p> <p>Individual consultation hours (discussion, additional explanation, specific problems solving)</p>
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Načini ocenjevanja:	Delež/Weight	Assessment:
Način (pisni izpit, ustno izpraševanje, naloge, projekt):		Type (examination, oral, coursework, project):
Sprotno preverjanje (3 seminarske naloge, kratki testi v obliki kvizov)	50,00 %	Continuing (three homework programming projects, short tests)
Končno preverjanje (izpit)	50,00 %	Final (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).

<p>Reference nosilca/Lecturer's references:</p> <p>Pet najpomembnejših del:</p> <p>FÜRST, Luka, MERNIK, Marjan, MAHNIČ, Viljan. Improving the graph grammar parser of Rekers and Schürr. <i>IET Software</i>, 2011, vol. 5, no. 2, str.246-261.</p> <p>FÜRST, Luka, MERNIK, Marjan, MAHNIČ, Viljan. Converting metamodels to graph grammars: doing without advanced graph grammar features. <i>Software and systems modeling</i>, 2015, vol. 14, no. 3, str. 1297-1317.</p> <p>FÜRST, Luka, ČIBEJ, Uroš, MIHELIC, Jurij. Maximum exploratory equivalence in trees. <i>FedCSIS 2015</i>, Łódź, Poljska, september 2015, str. 507-518.</p> <p>FÜRST, Luka, MAHNIČ, Viljan. Introductory programming course: motivating students with prior knowledge. <i>World transactions on engineering and technology education</i>, 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.</p> <p>MAHNIČ, Viljan, FÜRST, Luka, ROŽANC, Igor. <i>Java skozi primere</i>. Šenčur: Bi-tim, 2008. XIV, 478 str., ponovni ponatis 2012.</p> <p>Celotna bibliografija je dostopna na Cobissu oziroma Sicrisu: http://bib.cobiss.si/cobiss/BibPersonal.jsp?init=t&code=25527</p>
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UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet: Programiranje 2
Course title: Programming 2

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Računalništvo in informatika, prva stopnja, univerzitetni	Ni členitve (študijski program)	1. letnik	Letni

Univerzitetna koda predmeta/University course code: 63278

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
45		30			105	6

Nosilec predmeta/Lecturer: Boštjan Slivnik

Vrsta predmeta/Course type: obvezni predmet/compulsory course

Jeziki/Languages:

Predavanja/Lectures:	Slovenščina
Vaje/Tutorial:	Slovenščina

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

Vsebina:

Uvod v programski jezik C.
Osnovni podatkovni tipi in osnovne kontrolne strukture.
Razvoj programov in razhroščevanje.
Kazalci in tabele (1. del).
Kazalci in tabele (2. del).
Funkcije in prenos argumentov.
Dinamično dodeljevanje pomnilnika.
Nizi.
Vhodno-izhodne operacije.
Strukture.
Enostavni algoritmi urejanja.
Rekurzija in algoritmi sestopanja (1. del).
Rekurzija in algoritmi sestopanja (2. del).
Preprocesor.

Content (Syllabus outline):

Introduction to C programming language.
Basic data types and basic control structures.
Program design and debugging.
Pointers and arrays (part 1).
Pointers and arrays (part 2).
Functions and parameter passing.
Dynamic memory allocation.
Strings.
Input-output operations.
Structures.
Simple sorting algorithms.
Recursion and backtracking (part 1).
Recursion and backtracking (part 2).
Preprocessor.

Temeljna literatura in viri/Readings:

B. W. Kernighan, D. Ritchie: Programski jezik C, Fakulteta za računalništvo in informatiko, 1994.
T. Dobravec: abC, Fakulteta za računalništvo in informatiko, 2010.
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:

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:

<p>Sposobnost kritičnega, analitičnega in sintetičnega razmišljanja</p> <p>Sposobnost razumevanja in reševanja strokovnih izzivov v računalništvu in informatiki</p> <p>Sposobnost uporabe pridobljenega znanja pri samostojnem reševanju tehničnih in znanstvenih problemov v računalništvu in informatiki; sposobnost razširjanja pridobljenega znanja</p> <p>Predmetno-specifične kompetence:</p> <p>Osnovne veščine v računalništvu in informatiki – osnovne teoretične veščine, praktično znanje, bistvene veščine za področje računalništva in informatiki</p> <p>Osnovne veščine v računalništvu in informatiki, ki omogočajo nadaljevanje študija na drugi stopnji</p>	<p>Developing skills in critical, analytical and synthetic thinking</p> <p>The ability to understand and solve professional challenges in computer and information science</p> <p>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</p> <p>Subject-specific competences:</p> <p>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</p> <p>Basic skills in computer and information science, allowing the continuation of studies in the second study cycle</p>
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Predvideni študijski rezultati:

<p>Po uspešnem zaključku tega predmeta bo študent:</p> <p>znan reševati zmerno težke programske naloge;</p> <p>sposoben pisati programe v programskem jeziku C;</p> <p>razumel nizko nivojsko programiranje;</p> <p>sposoben uporabljati rekurzijo za reševanje problemov;</p> <p>sposoben uporabljati kazalce za pisanje učinkovitih programov;</p> <p>sposoben uporabljati dinamično dodeljevanje in sproščanje pomnilnika;</p> <p>sposoben uporabljati rekurzivne podatkovne strukture;</p> <p>sposoben uporabljati sistemske klice v programskem jeziku C;</p> <p>sposoben pisati programe sestavljene iz več neodvisnih enot.</p>
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Intended learning outcomes:

<p>After the completion of the course a student will be able to:</p> <p>solve medium-level programming exercises;</p> <p>write programs in C programming language;</p> <p>understand low-level programming techniques;</p> <p>use recursion to solve programming problems;</p> <p>use pointers to write efficient programs;</p> <p>manage dynamic memory allocation and deallocation;</p> <p>use recursive data structures;</p> <p>use system calls in the C programming language;</p> <p>write C programs consisting of multiple compilation units.</p>
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Metode poučevanja in učenja:

<p>Predavanja, domače naloge, seminarski način dela pri vajah. Poseben poudarek je na sprotnem študiju in domačih nalogah.</p>
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Learning and teaching methods:

<p>Lectures, home works, seminar works during tutorials. The emphasis is on continuous study and homeworks.</p>

Načini ocenjevanja:

Delež/Weight

Assessment:

Način (pisni izpit, ustno izpraševanje):	Delež/Weight	Assessment:
Sprotno preverjanje (kolokviji)	50,00 %	Type (examination, written and oral): Continuing (midterm exams)
Končno preverjanje (pisni izpit)	50,00 %	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:

<p>SLIVNIK, Boštjan. On different LL and LR parsers used in LLLR parsing. Computer Languages, Systems & Structures, ISSN: 1477-8424, Dec. 2017, vol. 50, str. 108-126.</p> <p>SLIVNIK, Boštjan, VILFAN, Boštjan. Producing the left parse during bottom-up parsing. Information processing letters, ISSN 0020-0190, Dec. 2005, vol. 96, no. 6, str. 220-224.</p> <p>SLIVNIK, Boštjan. Measuring the complexity of domain-specific languages developed using MDD. Software quality journal, ISSN 0963-9314, Sep. 2016, vol. 24, no. 3, str. 737-753.</p> <p>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.</p>
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POTOČNIK, Matic, ČIBEJ, Uroš, SLIVNIK, Boštjan. Linter - a tool for finding bugs and potential problems in Scala code. Proceedings of the 29th Annual ACM Symposium on Applied Computing, Gyeongju, Korea, March 24-28, 2014, str. 1615-1616.

Celotna bibliografija je dostopna na SICRISu:

<http://sicris.izum.si/search/rsr.aspx?lang=slv&id=7849>.

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet: Programiranje specifičnih platform
Course title: Platform Based Development

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Računalništvo in informatika, prva stopnja, univerzitetni	Ni členitve (študijski program)	3. letnik	Letni

Univerzitetna koda predmeta/University course code: 63287

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
45		30			105	6

Nosilec predmeta/Lecturer: Veljko Pejović

Vrsta predmeta/Course type: izbirni predmet/elective course

Jeziki/Languages:

Predavanja/Lectures:	Slovenščina, Angleščina
Vaje/Tutorial:	Slovenščina, Angleščina

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.

- pregled platform (mobilne, vgradne, porazdeljene, spletne, industrijske, robotske, paralelne/skalabilne,...),
 - podprti programski jeziki
 - programiranje z uporabo specifičnih knjižnic,
 - programiranje glede na omejitve posamezne platforme,
 - programski jeziki za mobilne platforme,
 - ravnotežje poraba/zmogljivost in analiza izvrševanja programa,
 - omejitve in izzivi mobilnih platform ter brezžična komunikacija,
 - odčitavanje mobilnih senzorjev in konekstno zavedanje (npr. lokacijske aplikacije),
 - programiranje in pristopi za časovno kritične interaktivne platforme,
 - omejitve platform za časovno kritične interaktivne aplikacije,
 - izbrane vsebine iz mobilnega zdravstva, pametnih mest/hiš/tovarn, in ostalih domen,
- 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.

- overview of platforms (mobile, embedded, distributed, web, industrial, robotic, parallel/scalable,...),
 - supported/domain-specific programming languages
 - programming via platform-specific APIs
 - programming under platform constraints,
 - mobile platform languages,
 - performance/power tradeoffs and profiling,
 - mobile platform constraints and challenges with wireless communication
 - mobile sensing and context awareness (e.g. location-aware applications)
 - programming languages and approaches for time-critical interactive platforms,
 - platform constraints for time-critical interactive applications,
 - selected topics from mobile healthcare, smart city/home/factory, and other domains
- 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.

Temeljna literatura in viri/Readings:

1. Yener, M., & Dundar, O. (2016). *Expert Android Studio*. John Wiley & Sons.
2. Simon DE. (1999). *An embedded software primer*. Addison-Wesley Professional
3. R. Meier: *Professional Android 4 Application Development*, 3rd Edition; Wrox, 2012.
4. 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:

- Po uspešno opravljenem predmetu bodo študenti zmožni:
- razlikovati med specifikami različnih platform,
 - prenesti osvojena znanja med platformami,
 - uporabiti platformo za realizacijo produkta,
 - razviti programski izdelek na platformi,
 - analizirati zmogljivost strojne opreme in potrebe po virih programskega izdelka,
 - argumentirati izbor specifične strojne in programske opreme za razvoj izdelka.

Intended learning outcomes:

- After successful completion of the course, students will be able to:
- differentiate between specifics of different platforms,
 - transfer obtained knowledge between platforms,
 - use the platform for product development,
 - develop software product on the platform,
 - analyze hardware efficiency and software product needs for resources,
 - argument selection of specific hardware and software for the development of the product.

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/Weight****Assessment:**

Način (pisni izpit, ustno izpraševanje, naloge, projekt):		Type (examination, oral, coursework, project):
Sprotno preverjanje (domače naloge)	50,00 %	Continuing (homework)
Končno preverjanje (pisni in ustni izpit)	50,00 %	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. PEJOVIĆ, Veljko, MUSOLESI, Mirco. Anticipatory mobile computing : a survey of the state of the art and research challenges. *ACM computing surveys*, ISSN 0360-0300. [Print ed.], Apr. 2015, vol. 47, no. 3, str. 1-29

2. PEJOVIĆ, Veljko, BELDING, Elizabeth M. WhiteRate : a context-aware approach to wireless rate adaptation. *IEEE transactions on mobile computing*, ISSN 1536-1233. [Print ed.], Apr. 2014, vol. 13, no. 4, str. 921-934
3. LATHIA, Neal, PEJOVIĆ, Veljko, RACHURI, Kiran K., MASCOLO, Cecilia, MUSOLESI, Mirco, RENTFROW, Peter J. Smartphones for large-scale behavior change interventions. *IEEE pervasive computing : mobile and ubiquitous systems*, ISSN 1536-1268. [Print ed.], 2013, vol. 12, no. 3, str. 66-73
4. PEJOVIĆ, Veljko, LATHIA, Neal, MASCOLO, Cecilia, MUSOLESI, Mirco. Mobile-based experience sampling for behaviour research. V: TKALČIČ, Marko (ur.), et al. *Emotions and personality in personalized services : models, evaluation and applications*, (Human-computer interaction series, ISSN 1571-5035). [S. l.]: Springer. cop. 2016, str. 141-161
5. PEJOVIĆ, Veljko, MUSOLESI, Mirco. InterruptMe. V: *UbiComp'14 : proceedings of the 2014 ACM International Joint Conference on Pervasive and Ubiquitous Computing, September 13-17, 2014, Seattle, WA, USA*. New York (NY): ACM. cop. 2014, str. 897-908

Celotna bibliografija je dostopna na SICRISu:

<http://www.sicris.si/search/rsr.aspx?opt=1&lang=slv&id=43813>.

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet: Računalniška grafika in tehnologija iger
Course title: Computer Graphics and Game Technology

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Računalništvo in informatika, prva stopnja, univerzitetni	Ni členitve (študijski program)	3. letnik	Zimski

Univerzitetna koda predmeta/University course code: 63269

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
45	10	20			105	6

Nosilec predmeta/Lecturer: Matija Marolt

Vrsta predmeta/Course type: izbirni predmet/elective course

Jeziki/Languages:

Predavanja/Lectures:	Slovenščina
Vaje/Tutorial:	Slovenščina

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

Vsebina:

Predavanja:

- Uvod.
- Matematične osnove.
- Afine transformacije, koordinatni sistemi. Homogene koordinate. Projekcije.
- Predstavitve predmetov: poligoni, deljene ploskve, parametrične krivulje. Hierarhije.
- Lokalno osvetljevanje in senčenje.
- Teksture.
- Grafični cevovod: izločanje in rezanje, rasterizacija, z-buffer.
- Senčilniki
- Detekcija trkov.
- Metode razdelitve prostora.
- Barve.
- Globalno upodabljanje: sledenje žarka.

Vaje:

Laboratorijski projekt izdelave interaktivne igre. Na vajah podan uvod v OpenGL in Unity in samostojno delo na projektih z zaključno predstavitvijo študentov.

Content (Syllabus outline):

Lectures:

- Introduction.
- Basic math.
- Affine transformations, coordinate systems, homogeneous coordinates. Projections.
- Representations: polygons, subdivision surfaces, parametric curves.
- Hierarchies.
- Local illumination and shading.
- Texture mapping.
- Graphics pipeline: culling and clipping, rasterisation, z-buffer.
- Shaders
- Collision detection.
- Space partitioning methods.
- Colors.
- Global illumination: raytracing.

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.

Temeljna literatura in viri/Readings:

- Nikola Guid: Računalniška grafika. Univerza v Mariboru, FERl.
- D. Hearn, M.P. Baker: Computer Graphics with OpenGL, Pearson Prentice Hall, NJ USA.
- D.H. Eberly: 3D Game Engine Design, Morgan Kaufman Publishers, CA USA.

<p>Cilji in kompetence:</p> <p>Cilj predmeta je študentom predstaviti programsko in algoritmično ozadje računalniške grafike in iger. Študenti bodo pridobili naslednje kompetence:</p> <ul style="list-style-type: none"> - 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. 	<p>Objectives and competences:</p> <p>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:</p> <ul style="list-style-type: none"> - 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.
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<p>Predvideni študijski rezultati:</p> <p>Po uspešnem zaključku tega predmeta bo študent:</p> <ul style="list-style-type: none"> - razumel matematično ozadje osnovnih algoritmov v računalniški grafiki - poznal različne načine predstavitve 3D predmetov - razumel delovanje posameznih faz grafičnega cevovoda - razumel osnove optimizacijskih tehnik potrebnih za doseganje interaktivnosti v grafičnih aplikacijah - razumel principe nizkonivojskega in visokonivojskega programiranja 3D grafičnih aplikacij - sposoben implementirati interaktivno 3D grafično aplikacijo in igro z uporabo nizkonivojskih ali visokonivojskih programskih knjižnic. 	<p>Intended learning outcomes:</p> <p>After the completion of the course the student will be able to:</p> <ul style="list-style-type: none"> - understand the mathematical background of basic computer graphics algorithms - know the different representations of 3D objects - understand the inner workings of the graphics pipeline - understand the basics of optimization techniques needed to develop interactive graphical applications - understand the principles of low-level and high-level 3D graphics programming - develop an interactive 3D graphical application or game using low-level or high-level programming libraries.
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<p>Metode poučevanja in učenja:</p> <p>Predavanja s praktičnimi demonstracijami, izvajanje laboratorijskega projekta pod mentorstvom asistenta.</p>	<p>Learning and teaching methods:</p> <p>Lectures with practical demonstrations, laboratory work under the supervision of assistants.</p>
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Načini ocenjevanja:	Delež/Weight	Assessment:
Način (pisni izpit, ustno izpraševanje, naloge, projekt):		Type (examination, oral, coursework, project):
Sprotno preverjanje (domače naloge, kolokviji in projektno delo)	50,00 %	Continuing (homework, midterm exams, project work)
Končno preverjanje (pisni in ustni izpit)	50,00 %	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).

<p>Reference nosilca/Lecturer's references:</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. PESEK, Matevž, LEONARDIS, Aleš, MAROLT, Matija. Robust real-time music transcription with a compositional hierarchical model. PloS one, ISSN 1932-6203, Jan. 2017, vol. 12, no. 1, str. 1-21 [COBISS.SI-ID 1537322179]

Celotna bibliografija je dostopna na SICRISu:

<http://sicris.izum.si/search/rsr.aspx?lang=slv&id=8948>.

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet: Računalniške komunikacije
Course title: Computer Communications

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Računalništvo in informatika, prva stopnja, univerzitetni	Ni členitve (študijski program)	1. letnik	Letni

Univerzitetna koda predmeta/University course code: 63209

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
45		30			105	6

Nosilec predmeta/Lecturer: Zoran Bosnić

Vrsta predmeta/Course type: obvezni predmet/compulsory course

Jeziki/Languages:

Predavanja/Lectures:	Slovenščina
Vaje/Tutorial:	Slovenščina

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

Prerequisites:

Vsebina:

Uvod: računalniška omrežja in internet
Osnovni pojmi: plasti, protokoli, storitve, protokolarni sklad. Hrbtenica in krajevna omrežja; kje nastajajo zakasnitve.
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.
Predstavljena in sejna plast: vsebina in storitve, primeri.
Transportna plast: storitve, multipleksiranje, povezavi in nepovezavni prenos (TCP in UDP), zanesljiv prenos podatkov, nadzor zasičenja (congestion control), izvedba le tega v TCP.
Omrežna plast: storitve, virtualne zveze in datagramske povezave, delovanje usmerjevalnikov, naslavljanje v internetu (IP in IPv6), temelji usmerjanja.
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.
Omrežna varnost, zanesljivost in zaščita, celovitost sporočil, avtentikacija, pregled varovanja e-pošte, TCP

Content (Syllabus outline):

Introduction: Computer networks and internet
Basic notions: layer, protocol, service, protocol stack.
Backbone and local area networks; transmission latency sources.
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.
Presentation and session layer: their purpose and services.
Transport layer: services, multiplexing, connection-oriented and connectionless transfer (TCP and UDP), reliable data transfer, congestion control and its implementation inside TCP.
Network layer: services, virtual and datagram connections, routing, addressing in internet (IPv4 and IPv6), routers.
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.
Network security, reliability and protections. Message integrity, authentication, protection of e-mail, TCP

povezav (SSL), omrežne povezave (IPSec), brezžične povezave. Požarne pregrade, IDS, IPS sistemi. Aktualni omrežni napadi in obramba pred njimi. Pomen upravljanja omrežja.	connections (SSL), network connection (IPSec), wireless connections). Firewalls, IDS/IPS systems. Network attacks and defense from them. Network management.
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Temeljna literatura in viri/Readings:

J. F. Kurose, K. W. Ross, M. Ciglarič, Z. Bosnić: Računalniške komunikacije. Pearson, England, 2014, ISBN 978-1-78399-776-3. Dodatna literatura: J. F. Kurose, K. W. Ross: Computer Networking, A top-down Approach Featuring Internet. 4. izdaja, Addison Wesley 2007. Poglavlja 2-6 in 8.A.S. Tanenbaum, Computer Networks, 4. izdaja, Prentice Hall PTR, 2002.

Cilji in kompetence:

<p>Cilj predmeta je študentom računalništva in informatike predstaviti osnove delovanja računalniških omrežij in pomembnejših protokolov. Competence, ki jih bo študent pridobil, so zlasti:</p> <ul style="list-style-type: none"> • 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. 	<p>Objectives and competences:</p> <p>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:</p> <ul style="list-style-type: none"> • 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.
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Predvideni študijski rezultati:

<p>Po uspešnem zaključku predmeta bo študent:</p> <ul style="list-style-type: none"> - poznal komunikacijska modela TCP/IP in ISO/OSI, - sposoben definirati namen poglavitnih protokolov na vsaki plasti modela TCP/IP, - znal pojasniti lastnosti in glavne komunikacijske protokole v omrežju Internet, - sposoben uporabiti virtualno okolje za načrtovanje omrežij, - sposoben uporabljati analizatorje omrežnega prometa za vpogled v komunikacijo in odpravljanje težav, - sposoben načrtovanja postavitve in administriranja manjših lokalnih omrežij. 	<p>Intended learning outcomes:</p> <p>After the completion of the course the student will be able to:</p> <ul style="list-style-type: none"> - know communication models TCP/IP and ISO/OSI, - define the purpose of major protocols on each of the TCP/IP layers, - explain characteristics and functions of main Internet protocols, - use virtual environment for planning and designing networks, - use network traffic analyzers for protocol analysis and network troubleshooting, - plan and administer smaller local aera networks.
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Metode poučevanja in učenja:

<p>Predavanja, laboratorijske vaje, seminarski način dela pri domačih nalogah, konzultacije pri izvajanju seminarskih nalog (konkretni projekti). Poseben poudarek je na tekočem sledenju teorije in na timskem delu in medsebojnem usklajevanju pri vajah in seminarjih.</p>	<p>Learning and teaching methods:</p> <p>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.</p>
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Načini ocenjevanja:

Delež/Weight Assessment:

Način (pisni izpit ali ustno izpraševanje, naloge, projekt): Sprotno preverjanje (domače naloge, kolokviji in laboratorijske vaje)		Type (examination, oral, coursework, project): Continuing (homework, midterm exams, laboratory exercises)
Končno preverjanje (pisni ali ustni izpit)	100,00 %	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:

1. KUROSE, James F., ROSS, Keith W., BOSNIĆ, Zoran (avtor, urednik), CIGLARIČ, Mojca (avtor, urednik). Računalniška omrežja : compiled from Computer networking, sixth edition. [2. izd.]. Harlow (England) [etc.]: Pearson, 2015. 462 str., ilustr. ISBN 978-1-78447-872-8.
2. 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.
3. 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.
4. 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
5. 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

Celotna bibliografija je dostopna na SICRISu:

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

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet: Računalniške tehnologije
Course title: Computer Technologies

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Računalništvo in informatika, prva stopnja, univerzitetni	Ni členitve (študijski program)	2. letnik	Letni

Univerzitetna koda predmeta/University course code: 63221

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
45		30			105	6

Nosilec predmeta/Lecturer: Rok Žitko

Vrsta predmeta/Course type: izbirni predmet/elective course

Jeziki/Languages:

Predavanja/Lectures:	Slovenščina
Vaje/Tutorial:	Slovenščina

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

Prerequisites:

Vsebina:

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.

Content (Syllabus outline):

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

15. Implementacije kvantnih računalnikov: dokoherenca, ujeti ioni, JMR, SQUID, kvantne pike.	14. Data storage: flash memories, magnetic data storage, optical disks. 15. Quantum computer implementations: decoherence, trapped ions, NMR, SQUID, quantum dots
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Temeljna literatura in viri/Readings:

<p>R. Žitko: Računalniške tehnologije, DMFA (2017) 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).</p>
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Cilji in kompetence:

<p>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.</p>	<p>Objectives and competences: 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.</p>
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Predvideni študijski rezultati:

<p>Po uspešnem zaključku tega predmeta bo študent:</p> <ul style="list-style-type: none"> - imel pregled nad področji sodobne fizike, ki so relevantna v računalniških in informacijskih vedah, - poznal (aksiomske) temelje kvantne mehanike in osrednjo vlogo pojma informacije, - razumel osnove kvantnega računalništva in možnih strojnih implementacij, - uporabil znanje linearne algebre za reševanje fizikalnih problemov, - znal reševati preproste probleme v kvantni mehaniki, - poznal kateri materiali so pomembni za izdelavo polprevodniških naprav in kako delujejo tranzistorji, - vedel, kako so shranjeni podatki v magnetnih in polprevodniških napravah, - zmožen napovedati tehnološke spremembe, ki jih lahko pričakujemo v naslednjih nekaj letih. 	<p>Intended learning outcomes: After the completion of the course a student will be able to:</p> <ul style="list-style-type: none"> - have an overview of the topics in modern physics relevant for computer and information sciences, - know the (axiomatic) foundations of quantum mechanics and the central role of the information, - understand the basis of quantum computing and possible hardware implementations, - apply the knowledge in linear algebra to physical problems, - solve simple problems in quantum mechanics, - know which materials are relevant in semiconductor devices and how transistors work, - know how data is stored in magnetic in semiconducting devices, - predict technological changes in the coming years.
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Metode poučevanja in učenja:

<p>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.</p>	<p>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.</p>
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Načini ocenjevanja:

Načini ocenjevanja:	Delež/Weight	Assessment:
Način (pisni izpit, ustno izpraševanje, naloge, projekt):		Type (examination, oral, coursework, project):
Sprotno preverjanje (domače naloge, kolokviji in projektno delo)	50,00 %	Continuing (homework, midterm exams, project work)
Končno preverjanje (pisni in ustni izpit)	50,00 %	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:

- M. Klanjšek et al., A high-temperature quantum spin liquid with polaron spins, Nature Physics (2017).
- E. J. H. Lee et al., Scaling of subgap excitations in a superconductor-semiconductor nanowire quantum dot, Phys. Rev. B 95, 180502(R) (2017).
- 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: Računalništvo v praksi I
Course title: Computer Science in Practice I

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Računalništvo in informatika, prva stopnja, univerzitetni	Ni členitve (študijski program)		Letni, Zimski

Univerzitetna koda predmeta/University course code: 63241

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
5				40	45	3

Nosilec predmeta/Lecturer: Gašper Fijavž

Vrsta predmeta/Course type: izbirni predmet/elective course

Jeziki/Languages:

Predavanja/Lectures:	Slovenščina, Angleščina
Vaje/Tutorial:	Slovenščina, Angleščina

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

Prerequisites:

Vsebina:

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.

Content (Syllabus outline):

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

Praktično delo v skupini	
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Temeljna literatura in viri/Readings:

S Berkun: The Art of Project Management (Theory in Practice) O'Reilly 2005
T DeMarco, T Lister: Peopleware: Productive Projects and Teams. Dorset House Publishing. 1999.
M Holcombe and F Ipaté: Correct Systems: building business process solutions. Springer
Vicens Q, Bourne PE (2007): Ten simple rules for a successful collaboration, PLoS Computational Biology 3(3): e44.
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 pridobivanje znanj, ki so potrebni za delo skupine, pripravo terminskega in vsebinskega načrta za delo skupine itd.

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.

Predvideni študijski rezultati:

Po zaključku predmeta bo študent:

- spoznal osnovne zakonitosti pri posredovanju znanja in popularizaciji računalniškega področja manjši skupini predvsem mlajših članov,
- spoznal organizacijo dela v manjših skupinah,
- znan administrativno voditi procese v zvezi z raziskovalnimi in/ali pedagoškimi aktivnostmi,
- razumel pomen in uporabo takih znanj pri strokovnem delu strokovnjaka na področju računalništva in informatike,
- znan pisno posredovati rezultate dela.

Intended learning outcomes:

Upon completion of the course the student will learn:

- basic educational principles and teaching practice in the process of introducing computer science topics to smaller groups of younger students,
- to organize group work,
- to administer processes related to research and/or education,
- learn to understand the role of such competencies in the work of an expert in the field of computer and information science,
- to communicate work results in written manner.

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

Predavanja, mentorski in seminarski način dela ter spremljanja dela študenta, z ustnim nastopom ob zaključku semestra. Poseben poudarek je na skupinskem delu pri seminarjih.	Lectures, individual work with students and smaller groups of students, seminars with oral presentations with special emphasis on group work.
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Načini ocenjevanja:	Delež/Weight	Assessment:
Način (pisni izpit, ustno izpraševanje, naloge, projekt): Način (pisni izpit, ustno izpraševanje, naloge, projekt):		Type (examination, oral, coursework, project):
Sprotno preverjanje (domače naloge, kolokviji in projektno delo)		Continuing (homework, midterm exams, project work)
Končno preverjanje (pisni in ustni izpit)		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:

- 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.).
- 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.
- 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.
- 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.
- 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 programi in stopnja	Študijska smer	Letnik	Semestri
Računalništvo in informatika, prva stopnja, univerzitetni	Ni členitve (študijski program)		Letni, Zimski

Univerzitetna koda predmeta/University course code: 63242

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
5				40	45	3

Nosilec predmeta/Lecturer: Gašper Fijavž

Vrsta predmeta/Course type: izbirni predmet/elective course

Jeziki/Languages:

Predavanja/Lectures:	Slovenščina, Angleščina
Vaje/Tutorial:	Slovenščina, Angleščina

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

Prerequisites:

Vsebina:

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.

Content (Syllabus outline):

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

Praktično delo v skupini	
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Temeljna literatura in viri/Readings:

S Berkun: The Art of Project Management (Theory in Practice) O'Reilly 2005
T DeMarco, T Lister: Peopleware: Productive Projects and Teams. Dorset House Publishing. 1999.
M Holcombe and F Ipaté: Correct Systems: building business process solutions. Springer
Vicens Q, Bourne PE (2007): Ten simple rules for a successful collaboration, PLoS Computational Biology 3(3): e44.
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 pridobivanje znanj, ki so potrebni za delo skupine, pripravo terminskega in vsebinskega načrta za delo skupine itd.

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.

Predvideni študijski rezultati:

Po zaključku predmeta bo študent:

- spoznal osnovne zakonitosti pri posredovanju znanja in popularizaciji računalniškega področja manjši skupini predvsem mlajših članov,
- spoznal organizacijo dela v manjših skupinah,
- znan administrativno voditi procese v zvezi z raziskovalnimi in/ali pedagoškimi aktivnostmi,
- razumel pomen in uporabo takih znanj pri strokovnem delu strokovnjaka na področju računalništva in informatike,
- znan pisno posredovati rezultate dela.

Intended learning outcomes:

Upon completion of the course the student will learn:

- basic educational principles and teaching practice in the process of introducing computer science topics to smaller groups of younger students,
- to organize group work,
- to administer processes related to research and/or education,
- learn to understand the role of such competencies in the work of an expert in the field of computer and information science,
- to communicate work results in written manner.

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

Predavanja, mentorski in seminarski način dela ter spremljanje dela študenta, z ustnim nastopom ob zaključku semestra. Poseben poudarek je na skupinskem delu pri seminarjih.	Lectures, individual work with students and smaller groups of students, seminars with oral presentations with special emphasis on group work.
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Načini ocenjevanja:	Delež/Weight	Assessment:
Način (pisni izpit, ustno izpraševanje, naloge, projekt):		Type (examination, oral, coursework, project):
Sprotno preverjanje (domače naloge, kolokviji in projektno delo)	50,00 %	Continuing (homework, midterm exams, project work)
Končno preverjanje (pisni in ustni izpit)	50,00 %	Final (written and oral exam)
Ocene: opravi z odliko, opravi ali ni opravi (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: Razvoj informacijskih sistemov
Course title: Information Systems Development

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Računalništvo in informatika, prva stopnja, univerzitetni	Ni členitve (študijski program)	3. letnik	Letni

Univerzitetna koda predmeta/University course code: 63252

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
45	20	10			105	6

Nosilec predmeta/Lecturer: Marko Bajec

Vrsta predmeta/Course type: izbirni predmet/elective course

Jeziki/Languages:

Predavanja/Lectures:	Slovenščina
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.

Temeljna literatura in viri/Readings:

Jeffrey A. Hoffer, Joey George, Joe Valacich (2013), Modern Systems Analysis and Design (7th Edition), Addison-Wesley.

Martin Fowler (2003). UML Distilled: A Brief Guide to the Standard Object Modeling Language, Third Edition. Addison-Wesley.

Thomas A. Pender (2002). UML Weekend Crash Course. Wiley Publishing.

Per Kroll, Philippe Kruchten, Grady Booch (2003), The Rational Unified Process Made Easy: A Practitioner's Guide to the RUP), Addison-Wesley.

Martin, C. Robert (2003). Agile Software Development: Principles, Patterns and Practices. Prentice Hall.

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. studies in the second study cycle.

Predvideni študijski rezultati:

Po uspešno zaključenem modulu bodo študenti zmožni:

- načrtovati enostavne in kompleksnejše IS,
- analizirati zahteve za razvoj ali nakup IS,
- klasificirati vrste IS glede na njihove lastnosti, ki so pomembne za razvoj,
- izbrati najprimernejše postopke in tehnike za posamezen primer razvoja ali nakupa IS,
- oceniti primernost posameznih metodoloških pristopov za konkreten primer razvoja ali nakupa IS,
- razlikovati med življenjskimi cikli razvoja IS.

Intended learning outcomes:

After successfully completing the course, the students will be able to:
design simple and complex IS,
analyze requirements for development or procurement of IS,
classify IS types based on their characteristics important for development,
select most appropriate approaches and techniques for individual cases of IS development/procurement,
evaluate methodological guidelines for their suitability in individual cases of IS development/procurement,
differentiate among various IS development cycles.

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):

Delež/Weight

Assessment:

Type (examination, oral, coursework, project):

Sprotno preverjanje (domače naloge, kolokviji in projektno delo)	50,00 %	Continuing (homework, midterm exams, project work)
Končno preverjanje (pisni in ustni izpit)	50,00 %	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:

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 avtociatov: 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. *Informatika (Vilnius)*, 2008, vol. 19, no. 3, str. 321-344, ilustr. [COBISS.SI-ID [6701396](#)], [JCR, WoS, št. citatov do 6. 5. 2011: 2, brez avtociatov: 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 avtociatov: 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 avtociatov: 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: Razvoj inteligentnih sistemov
Course title: Development of Intelligent Systems

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Računalništvo in informatika, prva stopnja, univerzitetni	Ni členitve (študijski program)	3. letnik	Letni

Univerzitetna koda predmeta/University course code: 63268

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
45		30			105	6

Nosilec predmeta/Lecturer: Danijel Skočaj

Vrsta predmeta/Course type: izbirni predmet/elective course

Jeziki/Languages:

Predavanja/Lectures:	Angleščina, Slovenščina
Vaje/Tutorial:	Angleščina, Slovenščina

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.

Temeljna 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.
- D. Forsyth and J. Ponce, Computer Vision: A Modern Approach, 2nd Edition, Pearson, 2012.

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:

Po uspešno opravljenem predmetu bo študent:

- sposoben izkazati razumevanje osnovnih principov mobilne robotike, opisati osnovne koncepte, naštetih glavne komponente takšnih sistemov ter prepoznati njihovo funkcionalnost,
- sposoben povezati naučene koncepte s področja računalniškega vida, inteligentnih sistemov in robotike ter z razpoložljivo strojno in programsko opremo načrtovati in konstruirati robotsko-senzorski sistem primeren za reševanje dane naloge,
- pojasniti in primerjati delovanje različnih algoritmov s področja računalniškega vida in mobilne robotike in temu primerno izbrati, nadgraditi in razviti algoritme za reševanje zadanih nalog,
- spoznati in analizirati različna orodja, knjižnice, vmesnike in platforme, ki se uporabljajo na področju računalniškega vida in robotike, ter jih primerno uporabiti in integrirati v enovit senzorsko-robotski sistem,

Intended learning outcomes:

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

- demonstrate understanding of the basic principles of mobile robotics, describe the basic concepts, list the main components of such systems, and identify their functionality,
- able to integrate the previously learned concepts from the fields of computer vision, intelligent systems and robotics, and, using the available hardware and software, design and construct a robot-sensor system suitable to solve a given task,
- describe and compare the functionality of various algorithms from the fields of computer vision and mobile robotics, and appropriately choose, upgrade and develop algorithms for solving given tasks,
- use and analyse various tools, libraries, and platforms that are used in the fields of computer vision and robotics, to use them appropriately and integrate them into a coherent sensor-robot system,

<p>- ovrednotiti in analizirati razvito rešitev, rezultatom ustrezno razviti sistem nadgraditi, prenesti rešitev na nove naloge,</p> <p>- analizirati splošnost razvitega sistema, razumeti delovanje sistema v različnih pogojih, analizirati robustnost in splošnost razvitega sistema, posplošiti ugotovljene koncepte na večji razred sorodnih problemov.</p>	<p>- evaluate and analyse the developed solution, and upgrade the developed system correspondingly, transfer the solution to new tasks,</p> <p>- analyse the generality of the developed system, understand the applicability of the system in different conditions, analyse the robustness and generality of the developed system, generalize the identified concepts to a larger class of related problems.</p>
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<p>Metode poučevanja in učenja:</p> <p>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.</p>	<p>Learning and teaching methods:</p> <p>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.</p>
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Načini ocenjevanja:	Delež/Weight	Assessment:
Način (pisni izpit, ustno izpraševanje, naloge, projekt):		Type (examination, oral, coursework, project):
Sprotno preverjanje (domače naloge in projektno delo)	50,00 %	Continuing (homework, project work)
Končno preverjanje (izpitna naloga in ustni izpit)	50,00 %	Final (project 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).

<p>Reference nosilca/Lecturer's references:</p> <p>Uršič P, Leonardis A, Skočaj D, Kristan M (2017) Learning part-based spatial models for laser-vision-based room categorization. The international journal of robotics research, vol. 36, no. 4, str. 379-402.</p> <p>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.</p> <p>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.</p> <p>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.</p> <p>JL Wyatt, Aydemir A, Brenner M, Hanheide M, Hawes N, Jensfelt P, Kristan M, Kruijff G-J M, Lison P, Pronobis A, Sjö 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.</p> <p>Celotna bibliografija izr. prof. dr. Skočaja je dostopna na SICRISu: http://sicris.izum.si/search/rsr.aspx?lang=slv&id=10425.</p>

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet: Sistemska programska oprema
Course title: System Software

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Računalništvo in informatika, prva stopnja, univerzitetni	Ni členitve (študijski program)	3. letnik	Zimski

Univerzitetna koda predmeta/University course code: 63264

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
45	10	20			105	6

Nosilec predmeta/Lecturer: Tomaž Dobravec

Vrsta predmeta/Course type: izbirni predmet/elective course

Jeziki/Languages:

Predavanja/Lectures:	Slovenščina, Angleščina
Vaje/Tutorial:	Slovenščina, Angleščina

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

Vsebina:

- osnova zbirnih in strojnih jezikov;
- vsebina in organizacija objektnih datotek;
- zbirnik, nalagalnik in povezovalnik;
- statično in dinamično povezovanje
- makro procesorji;
- sistemski klici in prekinitve;
- implementacija vhoda in izhoda ter orodja datotečnega sistema;
- upravljanje s pomnilnikom
- razhroščevalniki;
- jedro operacijskega sistema Linux;
- navidezni stroji.
- nalaganje, povezovanje in izvajanje v javanskem navideznem stroju

Content (Syllabus outline):

basics about machine and assembly languages
content and organization of object files
assembler, linker, loader
static and dynamic linking
macro processors
system calls and interrupts
input/output implementation and file system tools
memory management
debugging
linux kernel
virtual machines
loading, linking and running in java virtual machine

Temeljna 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 FER 2008

Cilji in kompetence:

Cilj:
Cilj predmeta je študentom računalništva in informatike predstaviti sistemske programe, orodja in standarde sistemske programske opreme, ter prikazati podobnosti

Objectives and competences:

Objectives:
The main goal of this course is to introduce the concepts, tools and standards of system programming

<p>in razlike med pristopi, ki se uporabljajo v aktualnih operacijskih sistemih.</p> <p>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.</p>	<p>and to show the current implementations in the actual operating systems.</p> <p>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.</p>
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<p>Predvideni študijski rezultati:</p> <p>Po uspešnem zaključku tega predmeta bo študent:</p> <ul style="list-style-type: none"> - znal opredeliti razliko med uporabniško in sistemsko programsko opremo ter pomen te razlike pri izdelavi programskih komponent, - sposoben izkazati znanje in razumevanje osnovnih pojmov sistemske programske opreme in delovanja računalnika na najnižjem programskem nivoju, - razumel pojme zbiranja, povezovanja in nalaganja ter razumel razliko med statičnim in dinamičnim povezovanjem programskih komponent, - sposoben samostojno razviti komponente sistemske programske opreme, - znal raziskati komponente sistemske programske opreme, - sposoben zagovarjati pomen poznavanja programske opreme na najnižjem nivoju. 	<p>Intended learning outcomes:</p> <p>After the completion of the course a student will be able to:</p> <ul style="list-style-type: none"> - understand the difference between the user- and the system-software and the meaning of this difference in the phase of software development, - show the knowledge of the notions of the system software and the low-level operations of the computer, - understand the basic operation of the assembler, linker and loader and the difference between the static and dynamic linking of the software components, - use the fundamental results to develop the components of system software, - explore the components of system software, - present the knowledge of the low-level components of computer system
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<p>Metode poučevanja in učenja:</p> <p>Predavanja, laboratorijske vaje, domače naloge.</p>	<p>Learning and teaching methods:</p> <p>Lectures, exercises and home work</p>
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Načini ocenjevanja:	Delež/Weight	Assessment:
Način (pisni izpit, ustno izpraševanje, naloge, projekt):		Type (examination, oral, coursework, project):
Sprotno preverjanje (domače naloge, kolokviji in projektno delo)	50,00 %	Continuing (homework, midterm exams, project work)
Končno preverjanje (pisni in ustni izpit)	50,00 %	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:

KLOBOVES, Klemen, MIHELIČ, Jurij, BULIĆ, Patricio DOBRAVEC, Tomaž. FPGA-Based SIC/XE Processor and Supporting Toolchain. *International Journal of Engineering Education*, 2017, vol. 33, no. 6(A), pp. 1927–1939

MIHELIČ, 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, 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: Spletno programiranje
Course title: Web Programming

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Računalništvo in informatika, prva stopnja, univerzitetni	Ni členitve (študijski program)	3. letnik	Zimski

Univerzitetna koda predmeta/University course code: 63255

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
45	20	10			105	6

Nosilec predmeta/Lecturer: Dejan Lavbič

Vrsta predmeta/Course type: izbirni predmet/elective course

Jeziki/Languages:

Predavanja/Lectures:	Slovenščina
Vaje/Tutorial:	Slovenščina

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

Vsebina:

Predavanja:

Uvod

Delovanje spleta; razvoj interneta, arhitektura klient-strežnik; komunikacijski protokol HTTP

Osnovni spletni standardi: HTML (DHTML...), CSS; osnove oblikovanja

Tehnologije na strani odjemalcev

JavaScript, rokovanje z dogodki, DOM, specifikke posameznih brskalnikov, obrazci, validacija vnosov, JQuery

HTML5 Canvas

asinhroni zahtevki z Ajax

aplikacije na eni strani

Strežniške tehnologije

Pregled osnov strežniških tehnologij; delovanje skript, dinamično generiranje strani, HTTP GET in POST

zahtevki, piškotki (cookies)

Spletne aplikacije v tehnologiji JavaScript.

Ostalo

XML tehnologije. Sintaksa XML. Sheme. Pregledovanje dokumentov XML. Modeli in jeziki: DOM, SAX, XSLT, XPath, XQuery, Open XML.

Dostop aplikacijskega strežnika do podatkovne baze

REST spletne storitve. Storitveno usmerjena arhitektura.

Pisanje porazdeljenih aplikacij.

Varnost na spletu. Upravljanje z identitetami.

Profiliranje uporabnikov.

Web 2.0. Semantični splet.

Content (Syllabus outline):

Lectures:

Introduction

World Wide Web, rise of internet, client-server architecture, communication protocols and HTTP.

Basic web standards: HTML (DHTML, ...), CSS, basics of web design

Client-side technologies

JavaScript, event handling, DOM, contemporary web browser specifics, forms, input validation, JQuery HTML5 Canvas

Asynchronous requests and Ajax.

Single Page applications.

Server technologies

An overview of server technologies, scripts, dynamic generation of pages, HTTP GET and POST requests, cookies, etc.

Web applications in JavaScript technology

Other

XML technologies, XML syntax and schemes. Viewing of XML documents. Models and languages: DOM, SAX, XSLT, XPath, XQuery, Open XML.

Database access from application server

REST Web services. Service oriented architecture.

Programming distributed applications.

Internet security. Identity management, user profiling.

Web 2.0. Semantic web.

Tutorials:

<p>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 predstavitvijo študentov.</p>	<p>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.</p>
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<p>Temeljna literatura in viri/Readings: Robert W. Sebesta: Programming the World Wide Web, Pearson Education, 2014. Paul J. Deitel, Harvey M. Deitel, Abbey Deitel et al.: Internet & World Wide Web: How to program, Pearson, 2012. Marijn Haverbeke: Eloquent JavaScript: A Modern Introduction to Programming, No Starch Press, 2014. Simon Holmes: Getting MEAN with Mongo, Express, Angular, and Node, Manning Publications, 2015.</p>

<p>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:</p> <ul style="list-style-type: none"> • 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. 	<p>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:</p> <ul style="list-style-type: none"> • 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.
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<p>Predvideni študijski rezultati: Po uspešnem zaključku tega predmeta bo študent:</p> <ul style="list-style-type: none"> • poznal in razumel osnovne tehnologije za razvoj spletnih aplikacij, • razumel in znal uporabiti MVC arhitekturni slog pri razvoju spletnih aplikacij, • uporabil REST dostop do podatkovne baze, • razvil celovito spletno rešitev, tako na strani odjemalca, kot strežnika, • uporabil spletne vire in dokumentacijo za pomoč pri razvoju spletnih aplikacij, • z analitičnim pristopom pretvoril strežniško aplikacijo v aplikacijo na eni strani, ki se izvaja na odjemalcu, • uporabljal sistem za obvladovanje verzij in podporna orodja za delo v skupini, • uporabljal IKT, pisno sporočanje in komunikacijske in organizacijske spretnosti pri sodelovanju v skupini. 	<p>Intended learning outcomes: After the completion of the course a student will be able to:</p> <ul style="list-style-type: none"> • understand the most common technologies for web application development, • understand and employ MVC architectural style in web application development, • use REST to access database, • develop full stack application on the client and server side • use online sources and documentation in web application development, • transform server-based application to single-page-application by analytical approach, • use version control system and support tools for collaboration in teams, • use ICT, written reports and communication and organization skills in team collaboration.
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<p>Metode poučevanja in učenja: Predavanja s praktičnimi demonstracijami, izvajanje laboratorijskega projekta pod mentorstvom asistenta.</p>	<p>Learning and teaching methods: Lectures with practical examples/demonstrations, making of laboratory project (guided by the assistant).</p>
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Načini ocenjevanja:	Delež/Weight	Assessment:
Način (pisni izpit, ustno izpraševanje, naloge, projekt):		Type (examination, oral, coursework, project):
Sprotno preverjanje (domače naloge, kolokviji in projektno delo)	50,00 %	Continuing (homework, midterm exams, project work)
Končno preverjanje (pisni ali ustni izpit)	50,00 %	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:

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.

MATEK, Tadej, ZRNEC, Aljaž, LAVBIČ, Dejan. Learning SQL with artificial intelligent aided approach. International journal of information and education technology : IJIET, ISSN 2010-3689, Nov. 2017, vol. 7, no. 11, str. 803-808.

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.

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.

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: Splošno izbirni predmet
Course title: Specialist elective course

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Računalništvo in informatika, prva stopnja, univerzitetni	Ni členitve (študijski program)	2. letnik	

Univerzitetna koda predmeta/University course code: 0002

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
45		30			105	6

Nosilec predmeta/Lecturer:

Vrsta predmeta/Course type:

Jeziki/Languages:

Predavanja/Lectures:

Vaje/Tutorial:

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

Prerequisites:

Vsebina:

Content (Syllabus outline):

Temeljna literatura in viri/Readings:

Cilji in kompetence:

Objectives and competences:

Predvideni študijski rezultati:

Intended learning outcomes:

Metode poučevanja in učenja:

Learning and teaching methods:

Reference nosilca/Lecturer's references:

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet: Splošno izbirni predmet
Course title: Specialist elective course

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Računalništvo in informatika, prva stopnja, univerzitetni	Ni členitve (študijski program)	3. letnik	

Univerzitetna koda predmeta/University course code: 0002

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
45		30			105	6

Nosilec predmeta/Lecturer:

Vrsta predmeta/Course type:

Jeziki/Languages:

Predavanja/Lectures:

Vaje/Tutorial:

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

Prerequisites:

Vsebina:

Content (Syllabus outline):

Temeljna literatura in viri/Readings:

Cilji in kompetence:

Objectives and competences:

Predvideni študijski rezultati:

Intended learning outcomes:

Metode poučevanja in učenja:

Learning and teaching methods:

Reference nosilca/Lecturer's references:

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet: Strokovno izbirni predmet
Course title: General elective course

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Računalništvo in informatika, prva stopnja, univerzitetni	Ni členitve (študijski program)	2. letnik	Letni

Univerzitetna koda predmeta/University course code: 0001

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
45		30			105	6

Nosilec predmeta/Lecturer:

Vrsta predmeta/Course type:

Jeziki/Languages:

Predavanja/Lectures:

Vaje/Tutorial:

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

Prerequisites:

Vsebina:

Content (Syllabus outline):

Temeljna literatura in viri/Readings:

Cilji in kompetence:

Objectives and competences:

Predvideni študijski rezultati:

Intended learning outcomes:

Metode poučevanja in učenja:

Learning and teaching methods:

Reference nosilca/Lecturer's references:

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet: Strokovno izbirni predmet (moduli + seznam)
Course title:

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Računalništvo in informatika, prva stopnja, univerzitetni	Ni členitve (študijski program)	3. letnik	

Univerzitetna koda predmeta/University course code: 0009

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
45		30			105	6

Nosilec predmeta/Lecturer:

Vrsta predmeta/Course type:

Jeziki/Languages:

Predavanja/Lectures:

Vaje/Tutorial:

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

Prerequisites:

Vsebina:

Content (Syllabus outline):

Temeljna literatura in viri/Readings:

Cilji in kompetence:

Objectives and competences:

Predvideni študijski rezultati:

Intended learning outcomes:

Metode poučevanja in učenja:

Learning and teaching methods:

Reference nosilca/Lecturer's references:

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet: Strokovno izbirni predmet (seznam)

Course title:

Študijski programi in stopnja

Študijska smer

Letnik

Semestri

Računalništvo in informatika, prva stopnja, univerzitetni

Ni členitve (študijski program)

3. letnik

Univerzitetna koda predmeta/University course code:

0010

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
45		30			105	6

Nosilec predmeta/Lecturer:

Vrsta predmeta/Course type:

Jeziki/Languages:

Predavanja/Lectures:

Vaje/Tutorial:

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

Prerequisites:

Vsebina:

Content (Syllabus outline):

Temeljna literatura in viri/Readings:

Cilji in kompetence:

Objectives and competences:

Predvideni študijski rezultati:

Intended learning outcomes:

Metode poučevanja in učenja:

Learning and teaching methods:

Reference nosilca/Lecturer's references:

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet: Tehnične veščine
Course title: Computer Science Skills

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Računalništvo in informatika, prva stopnja, univerzitetni	Ni členitve (študijski program)		Letni, Zimski

Univerzitetna koda predmeta/University course code: 63284

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
15		45			30	3

Nosilec predmeta/Lecturer: Tomaž Dobravec, Zoran Bosnić

Vrsta predmeta/Course type: izbirni predmet/elective course

Jeziki/Languages:

Predavanja/Lectures:	Slovenščina, Angleščina
Vaje/Tutorial:	Slovenščina, Angleščina

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

Prerequisites:

Vsebina:

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 pristop 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.

Content (Syllabus outline):

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:

Po uspešnem zaključku tega predmeta bo študent:

- spoznal praktično delo v manjših skupinah,
- spoznal praktično delo s konkretnimi orodji in okolji,
- uporabljal najnovejše pristope in tehnike v izbranem okolju, jeziku ali orodju,
- temeljito spoznal najnovejša orodja in platforme, se seznanil s povsem praktičnimi problemi in rešitvami pri konkretnem programerskem in razvojnem delu na področju računalništva,
- spoznal praktične pristope in prilagodljivost pri uporabi različnih orodij in delu v različnih računalniških okoljih.

Intended learning outcomes:

After the completion of the course a student will:

- be acquainted with practical work in small groups,
- be acquainted with practical work using specific tools and specific platforms,
- apply state-of-the-art techniques and approaches on a chosen platform, language, or tool,
- obtain 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,
- understand »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/Weight

Assessment:

Načini ocenjevanja:	Delež/Weight	Assessment:
Način (pisni izpit, ustno izpraševanje, naloge, projekt):		Type (examination, oral, coursework, project):
Sprotno preverjanje (domače naloge, kolokviji in projektno delo)	50,00 %	Continuing (homework, midterm exams, project work)
Končno preverjanje (pisni in ustni izpit)	50,00 %	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:

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.

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.

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>.

doc. dr. Tomaž Dobravec

MIHELIČ, 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, BABIČ, Zdenka, DOBRAVEC, Tomaž, BULIČ, 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

BULIČ, 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>.

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet: Tehnologija upravljanja podatkov
Course title: Data Management Technologies

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Računalništvo in informatika, prva stopnja, univerzitetni	Ni členitve (študijski program)	3. letnik	Zimski

Univerzitetna koda predmeta/University course code: 63226

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
45	10	20			105	6

Nosilec predmeta/Lecturer: Matjaž Kukar

Vrsta predmeta/Course type: izbirni predmet/elective course

Jeziki/Languages:

Predavanja/Lectures:	Slovenščina
Vaje/Tutorial:	Slovenščina

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

Vsebina:

Predavanja obsegajo dva tematska sklopa:
Eksterni vidiki obvladovanja podatkov:
Podatkovne baze in podatkovna skladišča
Načrtovanje podatkovnih baz
Konceptualno, logično in fizično načrtovanje
Normalizacija relacij
Optimizacija performans
Porazdeljene podatkovne baze
Načrtovanje podatkovnih skladišč
Namen in načrtovanje podatkovnih skladišč
Zagotavljanje kvalitete shranjenih podatkov
Pristopi k analizi shranjenih podatkov
Načrtovanje nerelacijskih podatkovnih baz
Nerelacijsko modeliranje podatkov

Interni vidiki obvladovanja podatkov:

Zagotavljanje dostopnosti in konsistentnosti podatkov
Upravljanje sočasnosti dostopa do podatkovne baze
Varovanje in obnavljanje podatkovne baze
Porazdeljeni in vzporedni podatkovni sistemi
Optimizacija in evalvacija poizvedb
Načrtovanje izvajanja poizvedb
Vrednotenje zahtevnosti osnovnih operacij
Alternativne strategije izvajanja poizvedb
Upravljanje delno strukturiranih in nestrukturiranih podatkov
Sodobni nerelacijski podatkovni sistemi

Content (Syllabus outline):

Course topics:

External data management:

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

Internal data management:

- Assuring availability and consistency of stored data:
 - concurrent data access,
 - data archival and recovery
 - distributed and parallel databases
- Query evaluation and optimization:
 - query execution planning,
 - estimating the costs of basic operations,
 - alternative plan considerations

<p>Delo s prostorskimi in časovnimi podatki Delo z drugimi delno strukturiranimi ali nestrukturiranimi podatki (tekst, zvok, slika, sekvence, JSON, XML)</p> <p>Vaje: Seznani se s tipičnimi problemi pri obvladovanju podatkov in s pristopi za reševanje le-teh. Spoznati in obvladati orodja za načrtovanje in uporabo podatkovnih baz. 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.</p>	<p>3. Management of semi-structured and unstructured data types:</p> <ul style="list-style-type: none"> • Modern non-relational database systems • spatial and temporal data, • other semi-structured data (audio, video, images, sequences, JSON, XML) <p>Tutorial topics: Recognize typical data management problems and approaches for solving them Get to know various tools for database design and utilization, and use them in practical problems.</p> <ol style="list-style-type: none"> 1. the products of aforementioned tools for a practical database implementation (in terms of a substantial project) <p>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.</p>
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Temeljna literatura in viri/Readings:

1. T. M. Connolly, C. E. Begg: Database Systems: A Practical Approach to Design, Implementation and Management, 6th edition, Pearson, 2015.
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. I. Robinson, J. Webber, E. Eifrem: Graph Databases, O'Reilly, 2016.
5. Seven Databases in Seven Weeks: A Guide to Modern Databases and the NoSQL Movement, 2nd edition, Pragmatic Bookshelf, 2018

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.);

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)

<ul style="list-style-type: none"> • 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 	<ul style="list-style-type: none"> • 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
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<p>Predvideni študijski rezultati:</p> <p>Po uspešno zaključenem predmetu bodo študenti sposobni:</p> <ul style="list-style-type: none"> - uporabiti tehnologije upravljanja s podatki na raznolikih problemskih domenah - razlikovati med principi in pristopi za reševanje podatkovnih problemov - razlikovati in primerno uporabiti transakcijske sisteme in podatkovna skladišča - razlikovati koncepte in uporabljati tehnologije s področij sodobnih nerelacijskih (NoSQL) podatkovnih sistemov - uporabljati pridobljenih znanj in orodij za obvladovanje podatkov v inženirskem in raziskovalnem delu - samostojno uporabljati metode načrtovanja, obvladovanja, hranjenja in osnovne analize različnih vrst podatkov - neposrednega ali posrednega povezovanja tehnologij upravljanja podatkov z drugimi sistemi s področij poslovne inteligence, spletnih storitev in inteligentnih sistemov. 	<p>Intended learning outcomes:</p> <p>After successful course completion students will be able to:</p> <ul style="list-style-type: none"> - utilize data management technologies in diverse problem domains - differentiate between principles and approaches for solving data management problems - understand the differences between transactional databases and data warehouses and appropriately utilize them - understand the concepts behind modern nonrelational (NoSQL) databases, and utilize them when appropriate - utilize data management technologies in general engineering and research work - competently use methods and techniques for database planning, data management, storage, and basic data analytics - directly or indirectly connect data management technologies with other relevant systems, such as business intelligence, web technologies, and intelligent systems.
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<p>Metode poučevanja in učenja:</p> <p>Predavanja in seminarski način dela pri domačih nalogah. Poseben poudarek je na sprotne študiju in na skupinskem delu pri domačih nalogah in seminarjih.</p>	<p>Learning and teaching methods:</p> <p>Lectures, homework and project work with explicit focus on simultaneous studies (for homeworks) and teamwork (for projects).</p>
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Načini ocenjevanja:	Delež/Weight	Assessment:
Način (pisni izpit, ustno izpraševanje, naloge, projekt):		Type (examination, oral, coursework, project):
Sprotno preverjanje (domače naloge, kolokviji in projektno delo)	60,00 %	Continuing (homework, midterm exams, project work)
Končno preverjanje (pisni in ustni izpit)	40,00 %	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).

<p>Reference nosilca/Lecturer's references:</p> <p>KONONENKO, Igor, KUKAR, Matjaž. Machine learning and data mining: introduction to principles and algorithms. Chichester: Horwood Publishing, 2007.</p> <p>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.</p> <p>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.</p>
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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,

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: Teorija informacij in sistemov
Course title: Theory of Informations and Systems

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Računalništvo in informatika, prva stopnja, univerzitetni	Ni členitve (študijski program)	2. letnik	Letni

Univerzitetna koda predmeta/University course code: 63216

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
45		30			105	6

Nosilec predmeta/Lecturer: Uroš Lotrič

Vrsta predmeta/Course type: obvezni predmet /compulsory course

Jeziki/Languages:

Predavanja/Lectures:	Slovenščina
Vaje/Tutorial:	Slovenščina

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

Vsebina:

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

Content (Syllabus outline):

Entropy and mutual information
Communication source and channel: memory less and memory sources, types of channels, channel capacity
Data compression: codes, Kraft's inequality, Shannon and Huffman coding, arithmetic codes, LZW
Noisy-channel coding: linear block codes, convolution codes, combinations, parity check, CRC codes
Cryptology: basic systems, relative redundancy, modern cryptographic systems: Lucifer, DES, RSA
Signals: time-domain and frequency-domain description, channel capacity, sampling
Probability and inference: model comparison, Kolmogorov complexity, minimum description length principle

Temeljna literatura in viri/Readings:

D.G. Luenberger: Information Science, Princeton University, 2006.
J.C.A. van der Lubbe: Information Theory, Cambridge, 1997.
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

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

postopke kodiranja informacij, prenosa in varovanja informacij, tajnega kodiranja. Sposobnost identificiranja in reševanja problemov povezanih s tematiko.	and algorithms for information coding, compression, necessity of redundancy checks, and cryptology. Capability of identifying and solving problems connecting to the covered topics.
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Predvideni študijski rezultati:	Intended learning outcomes:
Po uspešnem zaključku tega predmeta bo študent zmožen: razumeti koncepte teorije informacij in uporabljati pomembne informacijske mere uporabljati metode in postopke kodiranja in stiskanja podatkov, Razumeti koncepte kanala in zmožnosti prenosa podatkov po kanalu uporabljati postopke varnostnega kodiranja v zašumljenih kanalih uporabljati osnovne postopke tajnega kodiranja pri kriptiranju razumeti enostavne sisteme in jih analizirati v časovnem in frekvenčnem prostoru	After successful completion of the course, student should be able to: understand the concepts of the information theory use coding and compression methods and techniques understand the channel and capabilities of sending data over it use methods for error detection and correction in noisy channels use basic cipher methods related to information theory understand simple systems and analyse them in time and frequency domain

Metode poučevanja in učenja:	Learning and teaching methods:
Predavanja in vaje so usmerjene v razumevanje teorije in postopkov ter v sposobnost uporabe znanja na realnih problemih.	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/Weight	Assessment:
Način (pisni izpit, ustno izpraševanje, naloge, projekt):		Type (examination, oral, coursework, project):
Sprotno preverjanje (domače naloge, kolokviji)	50,00 %	Continuing (homework, midterm)
Končno preverjanje (pisni in ustni izpit)	50,00 %	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:
<ol style="list-style-type: none"> BRATINA, Marko, DOBNIKAR, Andrej, LOTRIČ, Uroš. Time-series modeling using information-theory techniques, <i>Elektrotehniški vestnik</i>, 2009, vol. 76, 240-245 SILVA, Catarina, LOTRIČ, Uroš, RIBEIRO, Bernardete, DOBNIKAR, Andrej. Distributed text classification with an ensemble kernel-based learning approach. <i>IEEE trans. syst. man cybern., Part C Appl. rev.</i>, May 2010, vol. 40, 287-297 LOTRIČ, Uroš, BULIĆ, Patricio. Applicability of approximate multipliers in hardware neural networks. <i>Neurocomputing</i>, 2012, vol. 96, 57-65 SLUGA, Davor, CURK, Tomaž, ZUPAN, Blaž, LOTRIČ, Uroš. Acceleration of information-theoretic data analysis with graphics processing units. <i>Prz. Elektrotech.</i>, 2012, 136-139 SLUGA, Davor, LOTRIČ, Uroš. Quadratic mutual information feature selection. <i>Entropy</i>, 2017, vol. 19, 1-16 <p>Celotna bibliografija je dostopna na SICRISu: http://sicris.izum.si/search/rsr.aspx?lang=slv&id=4494.</p>

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet: Umetno zaznavanje
Course title: Machine Perception

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Računalništvo in informatika, prva stopnja, univerzitetni	Ni členitve (študijski program)	3. letnik	Zimski

Univerzitetna koda predmeta/University course code: 63267

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
45	10	20			105	6

Nosilec predmeta/Lecturer: Matej Kristan

Vrsta predmeta/Course type: izbirni predmet/elective course

Jeziki/Languages:

Predavanja/Lectures:	Angleščina, Slovenščina
Vaje/Tutorial:	Angleščina, Slovenščina

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

Vsebina:

Vsebina predmeta:

- Pregled področja umetnega zaznavanja, aplikacijski dosegi in znanstveni izzivi
- Procesiranje slik
 - Nastanek slike v kameri
 - Binarizacija, morfološke operacije, segmentacija
 - Barvni prostori in zaznavanje
 - Linearni in nelinearni filtri
- Odvodi slike in zaznavanje robov
 - Zaznavanje robov z odvodi
 - Robovi za zaznavanje objektov
 - Zaznavanje parametričnih oblik
- Prileganje modelov
 - Normalne enačbe
 - Homogeni sistemi
 - Robustne metode
- Lokalne značilnice
 - Detektorji kotov
 - Lokalni opisniki z izbiro merila in afino adaptacijo
- Stereoskopija in zaznavanje globine
 - Nekalibrirani in kalibrirani sistemi ter rekonstrukcija
- Razpoznavanje objektov
 - Podprostorske metode (PCA, LDA)
 - Razpoznavanje z lokalnimi značilnicami
- Detekcija objektov

Content (Syllabus outline):

Lectures:

- Overview of the field of Machine perception and scientific challenges
- Image processing
 - Image formation
 - Binarization, morphology, segmentation
 - Colour spaces and colour perception
 - Linear and nonlinear filters
- Image derivatives and edge perception
 - Derivative-based edge perception
 - Edge-based object perception
 - Parametric shape perception
- Model fitting
 - Normal equations
 - Homogenous systems
 - Robust approaches
- Local features
 - Corner perception
 - Local descriptors in scale space and affine adaptation
- Stereoscopy and depth perception
 - Calibrated and uncalibrated systems and reconstruction
- Object recognition
 - Subspace methods (PCA, LDA)
 - Local-features-based recognition
- Object detection
 - Visual features and detection approaches

<p>1. Zapis vizualnih lastnosti in postopki za detekcijo</p> <p>9. Zaznavanje gibanja</p> <p>1. Lokalno gibanje in metode za sledenje objektov</p> <p>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.</p>	<p>9. Motion perception</p> <p>1. Local motion perception and object tracking</p> <p>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.</p>
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Temeljna literatura in viri/Readings:

<p>Obvezna:</p> <ul style="list-style-type: none"> • D. Forsyth and J. Ponce, Computer Vision: A modern approach, Prentice Hall 2011. • R. Szeliski, Computer Vision: Algorithms and Applications, Springer, 2011 <p>Dopolnilna:</p> <ul style="list-style-type: none"> • H. R. Schiffman: Sensation and Perception, An Integrated Approach, John Wiley & Sons 2001. <p>Izbrani članki iz revij IEEE PAMI, CVIU, IJCV, Pattern Recognition (dostopno na spletu)</p>
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Cilji in kompetence:

<p>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 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.</p>	<p>Objectives and competences:</p> <p>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.</p> <p>In addition, the students will obtain the following competences:</p> <p>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.</p>
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Predvideni študijski rezultati:

<p>Po uspešnem zaključku predmeta naj bi študenti:</p> <ul style="list-style-type: none"> - poznali računalniške tehnologije in računalniške metodologije za razvoj komponent in sistemov računalniškega zaznavanja, - razumeli osnove nizkonivojskega procesiranja slik, - razumeli osnove 3D geometrije kamer in sterea, - razumeli osnove detekcije in razpoznavanja objektov, - poznali osnovne postopke izračunavanja gibanja v videoposnetkih, - bili sposobni obravnavati moderne algoritme računalniškega vida in strojnega vida, 	<p>Intended learning outcomes:</p> <p>After completing this course a students will be able to:</p> <ul style="list-style-type: none"> - understand computer technology and computational methodology for use and development of components for machine vision systems, - understand the basics of low-level image processing, - understand the basics of 3D geometry of stereo systems, - understand the basics of object detection, object recognition, - know basic motion extraction techniques in video sequences,
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- bili sposobni uporabe računalniških tehnologij in računalniških metodologij pri specifičnih aplikacijah avtonomnih inteligentnih kognitivnih sistemov.	- analyze modern computer vision and machine vision algorithms, - use computer technology and computational methodology for specific applications of autonomous intelligent cognitive systems.
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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 sprotne študiju in sprotne 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.
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Načini ocenjevanja:	Delež/Weight	Assessment:
Način (pisni izpit, ustno izpraševanje, vaje):		Type (examination, oral, laboratory exercises):
Sprotno preverjanje (domače naloge in laboratorijske vaje)	50,00 %	Continuing (homework and laboratory exercises)
Končno preverjanje (pisni in ustni izpit)	50,00 %	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:

LUKEŽIČ, Alan, ČEHOVIN ZAJC, Luka, KRISTAN, Matej. Deformable parts correlation filters for robust visual tracking. *IEEE transactions on cybernetics*, ISSN 2168-2267, 2017, vol. , no. , str. 1-13, [COBISS.SI-ID [1537625283](#)],

KRISTAN, Matej, SULIČ KENK, Vildana, KOVAČIČ, Stanislav, PERŠ, Janez. Fast image-based obstacle detection from unmanned surface vehicles. *IEEE transactions on cybernetics*, ISSN 2168-2267 , 2016, vol. 46, no. 3, str. 641-654, [COBISS.SI-ID [1536310979](#)],

KRISTAN, Matej, MATAS, Jiří, LEONARDIS, Aleš, VOJÍŘ, Tomáš, PFLUGFELDER, Roman, FERNÁNDEZ, Gustavo, NEBEHAY, Georg, PORIKLI, Fatih, ČEHOVIN ZAJC, Luka. A novel performance evaluation methodology for single-target trackers. *IEEE transactions on pattern analysis and machine intelligence*, ISSN 0162-8828. [Print ed.], Nov. 2016, vol. 38, no. 11, str. 2137-2155, [COBISS.SI-ID [1536872643](#)]

URŠIČ, Peter, LEONARDIS, Aleš, SKOČAJ, Danijel, KRISTAN, Matej. Learning part-based spatial models for laser-vision-based room categorization. *The international journal of robotics research*, ISSN 0278-3649, 2017, vol. 36, no. 4, str. 379-402, [COBISS.SI-ID [1537424323](#)]

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](#)]

Celotna bibliografija je dostopna na SICRISu:
<http://sicris.izum.si/search/rsr.aspx?lang=slv&id=32801>.

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet: Uvod v odkrivanje znanj iz podatkov
Course title: Introduction to Data Mining

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Računalništvo in informatika, prva stopnja, univerzitetni	Ni členitve (študijski program)	3. letnik	Letni

Univerzitetna koda predmeta/University course code: 63251

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
45	20	10			105	6

Nosilec predmeta/Lecturer: Blaž Zupan

Vrsta predmeta/Course type: izbirni predmet/elective course

Jeziki/Languages:

Predavanja/Lectures:	Slovenščina, Angleščina
Vaje/Tutorial:	Slovenščina, Angleščina

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 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.

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 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.

Temeljna literatura in viri/Readings:

- Zupan, B (2017) Uvod v odkrivanje znanj iz podatkov, Delovna skripta UL FRI, prosto dostopna na <https://github.com/BlazZupan/uozp-zapiski>.
- Tan, P.-N., Steinbach, M., and Kumar, V. (2006) Introduction to Data Mining, Pearson Education.
- 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:

Po uspešno opravljenem predmetu bodo študenti lahko:

- Pripravili podatke v obliki tabel, primernih za uporabo strojnega učenja.
- Prepoznali, ali gre pri danih podatkih za problem odkrivanja vzorcev ali napovedovanja.
- Izbrali primerno tehniko strojnega učenja za analizo podatkov in odkrivanje vzorcev.
- Za dane podatke uporabili primerno tehniko zmanjšanja dimenzionalnosti.
- Predstavili podatke v primerni vizualizaciji.
- Za dan problem uporabili primerno tehniko za ovrednotenje rezultatov analitičnih metod.
- Uporabili knjižnice za podatkovno analitiko v programskem jeziku Python.

Intended learning outcomes:

After successful completion of the course, the students should be able to:

- Prepare the data in attribute-value format susceptible for machine learning methods.
- For a given data set, distinguish between application of supervised and unsupervised learning.
- Given the data, select the right method for its analysis.
- Use feature dimensionality reduction techniques to help in understanding of the data.
- Use the most appropriate data visualisation technique for a given problem.
- Apply the right model evaluation and scoring approaches to assess the quality of the modelling technique.
- Use Python for data analytics.

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/Weight****Assessment:**

Domače naloge.	50,00 %	Homeworks.
Končno preverjanje (pisni izpit).	50,00 %	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:

Stajdohar M, Rosengarten RD, Kokosar J, Jeran L, Blenkus D, Shaulsky G, Zupan B (2017) dictyExpress: a web-based platform for sequence data management and analytics in Dictyostelium and beyond, *BMC Bioinformatics*. 2017 Jun 2;18(1):291.

Zitnik M, Zupan B (2016) Jumping across biomedical contexts using compressive data fusion, *Bioinformatics* 15;32(12):i90-i100.

Zitnik M, Nam EA, Dinh C, Kuspa A, Shaulsky G, Zupan B (2015) Gene prioritization by compressive data fusion and chaining, *PLoS Computational Biology* 11(10):e1004552.

Staric A, Demsar J, Zupan B (2015) Concurrent software architectures for exploratory data analysis. *WIREs Data Mining and Knowledge Discovery* 5(4):165-180.

Zitnik M, Zupan B (2015) Data fusion by matrix factorization. *IEEE Transactions on Pattern Analysis and Machine Intelligence* 37(1):41-53.

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

<http://sicris.izum.si/search/rsr.aspx?lang=slv&id=7764>

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet: Verjetnost in statistika

Course title: Probability and Statistics

Študijski programi in stopnja

Študijska smer

Letnik

Semestri

Računalništvo in informatika, prva stopnja, univerzitetni

Ni členitve (študijski program)

2. letnik

Zimski

Univerzitetna koda predmeta/University course code:

63213

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
45	10	20			105	6

Nosilec predmeta/Lecturer: Aleksandar Jurišić

Vrsta predmeta/Course type: obvezni predmet/compulsory course

Jeziki/Languages:

Predavanja/Lectures:

Slovenščina

Vaje/Tutorial:

Slovenščina

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

Prerequisites:

Vsebina:

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.

Content (Syllabus outline):

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

In statistics »*random*« is not a synonym for »*inexplicable*«. Randomness is a kind of order that emerges only in the long run, over 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 a 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 in uncovering the nature of a set of data using graphs and numbers which describe main attributes. This study is called *data analysis*. We start with one variable and then examine 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 to what degree our conclusions are reliable. It answers specific questions with a known degree of confidence.

<p>Predavanja predmeta obsegajo:</p> <p>Definicija verjetnosti, računanje z dogodki, pogojna verjetnost, obrazec razbitja in Bayesov obrazec, Bernoullijevo zaporedje neodvisnih poskusov, Laplaceov intervalski obrazec, funkcija napake, Bernoullijev zakon velikih števil.</p> <p>Slučajne spremenljivke in vektorji, diskretne in zvezne porazdelitve, neodvisnost slučajnih spremenljivk, funkcije slučajnih spremenljivk, funkcije slučajnih vektorjev, pogojne porazdelitve, gostota zvezne pogojne porazdelitve.</p> <p>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.</p> <p>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.</p> <p>Vaje: Namen vaj pri predmetu verjetnost in statistika je dvojen:</p> <p>utrjevanje pri predavanjih obravnavane snovi z računskimi primeri in kvalitativna in kvantitativna predstavitev nekaterih tipičnih, vendar »nešolskih« primerov, ki so za študente računalništva in informatike relevantni. Pri vajah študenti naj bi <i>sami</i> reševali naloge, zato je udeležba pri vajah obvezna.</p> <p>Domače naloge, projekti 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 bolj samostojnemu delu. Kvizi pa spodbujajo sprotno delo in dajo študentom povratno informacijo o njihovem znanju.</p>	<p>Lectures:</p> <p>Definition of probability, algebra of events, conditional probability, Bayes rule, Bernoulli trials, Laplace interval formula, error function, Bernoulli's law of large numbers.</p> <p>Random variables and vectors, discrete and continuous distributions, independence, functions of random variables, functions of random vectors, conditional distributions, density of conditional probability.</p> <p>Expected value, standard deviation and higher moments, sequences of random variables and random processes, limit theorems, Chebyshev's inequality, Central Limit Theorem.</p> <p>The main goal of statistics, the sampling distribution of statistics, sample average, reproduction property of the normal distribution, the chi-square distribution, the Student distribution, confidence intervals, estimation, statistical hypothesis testing, analysis of variance, covariance and linear regression.</p> <p>Tutorials: Purpose of tutorials for the course Introduction to Probability and Statistics:</p> <p>Detailed study of the material from the lectures through examples. Qualitative and quantitative introduction of some typical (real-life) examples that are relevant for students of computer science. Tutorials are guided, but students are supposed to be <i>independently</i> trying to solve problems, so their presence is compulsory.</p> <p>Homeworks, projects and quizzes: The purpose of homeworks and projects is to offer students the possibility to independently solve more complex problems in probability and statistics, which assume beyond calculation techniques also more comprehensive skills. These exceed tutorial work and lead students to more independent work. Quizzes encourage students to keep up with the work and give them feedback on their knowledge.</p>
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Temeljna literatura in viri/Readings:

W. Mendenhall and T. Sincich: Statistics for Engineering and the Sciences, 6th edition, Pearson-Prentice-Hall, 2015 (prvih 11 poglavij/first 11 chapters).

Dodatna literatura:

1. 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).
2. L. Gonick in W. Smith, *The Cartoon Guide to Statistics*, 1993.

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 the basics of *probability theory* and *statistics*. A student who attends this course should be able to describe predictable patterns that in the long term rule random outcomes and to achieve basic statistical literacy, that is an ability to follow and understand arguments that come from data.

Predvideni študijski rezultati:

Po uspešnem zaključku tega predmeta bo študent:
 - razumel metode osnov verjetnostnega računa in odkrivanja zakonitosti iz podatkov,
 - uporabljal osnovne metode odkrivanja zakonitosti iz resničnih podatkov in znal ovrednotiti njihove rezultate,
 - spoznal in razumel uglašenost med teorijo in njeno rabo na konkretnih primerih verjetnosti in statistike.
 Predmet je osnova za številne predmete, pri katerih poznavanje in razumevanje vzorcev v podatkih omogoča kvalitetnejše odločanje in učinkovito rabo virov.

Intended learning outcomes:

After successful completion of this course the student will be able to:
 - *understand* basic techniques to detect relationships from data,
 - *apply* basic methods to detect certain relationships from real data and to evaluate their results,
 - learn and understand the connection between theory and practice applied to specific examples of probability and statistics.
 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:

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

Learning and teaching methods:

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 video material related to the course material.

Načini ocenjevanja:

Delež/Weight

Assessment:

Sprotno preverjanje (domače naloge, kolokviji in projektno delo)	50,00 %	On-going coursework (assignments, midterms, project work),
Končno preverjanje (pisni in ustni izpit)	50,00 %	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:

- A. Jurišić and J. Vidali, [Restrictions on classical distance-regular graphs](#), *Journal of Algebraic Combinatorics* **46** (2017), 571–588.
- A. Jurišić and J. Vidali, [Extremal 1-codes in distance-regular graphs of diameter 3](#), *Designs Codes and Cryptography* **65** (2012), 29–47.
- A. Jurišić and J. Koolen, [Classification of the family AT4\(qs,q,q\)](#) of antipodal tight graphs, *J. Combin. Theory (A)* **118** (2011), 842–852.
- A. Jurišić, P. Terwilliger and A. Žitnik, [The Q-polynomial idempotents of a distance-regular graph](#), *J. Combin. Theory (B)* **100** (2010), 683–690.
- A. Jurišić, A. Munemasa and J. Tagami, [On graphs with complete multipartite mu-graphs](#), *Discrete Mathematics* **310** (2010), 1812–1819.

Celotna bibliografija je dostopna na SICRISu:

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

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet: Zanesljivost in zmogljivost računalniških sistemov
Course title: Computer Systems Reliability and Performance

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Računalništvo in informatika, prva stopnja, univerzitetni	Ni členitve (študijski program)	3. letnik	Letni

Univerzitetna koda predmeta/University course code: 63262

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
45	20	10			105	6

Nosilec predmeta/Lecturer: Miha Mraz

Vrsta predmeta/Course type: izbirni predmet/elective course

Jeziki/Languages:

Predavanja/Lectures:	Slovenščina
Vaje/Tutorial:	Slovenščina

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

Vsebina:

Predavanja:

- Zanesljivost rač. sistemov
 - Osnovni pojmi (napaka, odpoved, redundanca, MTBF, MTTR, MTTF, degradirano delovanje, nedelujoče stanje sistema, itd.)
 - Matematično teoretične osnove zanesljivosti
 - Modeliranje zanesljivosti
 - Zanesljivost elektronskih komponent – pregled standardov
 - Zanesljivost programske opreme
 - Osnove sistemske zanesljivosti
 - Diagnostika v računalniških sistemih
 - Pregled konkretnih metod za določevanje zanesljivosti (FMEA, FTA, itd.)
 - Pregled programskih orodij za določevanje zanesljivosti
- Zmogljivost rač. sistemov
 - Metrike za ocenjevanje zmogljivosti
 - Bremena v računalniških sistemih
 - Metode za ocenjevanje zmogljivosti (analitični, simulacijski ali meritveni pristop)
 - Monitorji
 - Koncepti določanja zmogljivosti: meritve, simulacije, analitični pristop
 - Postopki za pohitritev programske opreme
 - Pomnilniške hierarhije
 - Zmogljivost računalniških omrežij

Content (Syllabus outline):

Lectures:

- Reliability of computer systems
 - Basic terms (error, failure, redundancy, MTBF, MTTR, MTTF, performance degradation, system failure, etc.)
 - Mathematical theory in reliability estimation
 - Modelling the reliability
 - Reliability assessment of electronic components – overview of the standards available
 - Software reliability
 - Basics of system reliability
 - Computer diagnostics
 - Overview of selected methods for reliability assessment (FMEA, FTA, etc.)
 - Overview of software tools for reliability assessment
- Performance of computer systems
 - Metrics for performance evaluation
 - Work-loads in computer systems
 - Methods for performance evaluation (analytical, simulational and measurement approach)
 - Computer system performance monitoring
 - Performance evaluation concepts: measurements, simulations, analytical approach
 - Methods for improving the system performance
 - Memory hierarchies
 - Capabilities of computer systems

<p>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.).</p>	<p>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.</p>
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Temeljna literatura in viri/Readings:

<ol style="list-style-type: none"> 1. M. Rausand and A. Hoyland: System reliability theory: Models, statistical methods and applications, J. Wiley & Sons, 2004. 2. M. Mraz: Zanesljivost računalniških sistemov. https://ucilnica.fri.uni-lj.si/course/view.php?id=174. (e-book, 2017) 3. N. Zimic, M. Mraz: Temelji zmogljivosti računalniških sistemov, Fakulteta za rač. in informatiko, Ljubljana, 2006.
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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:

Po uspešnem zaključku tega predmeta bo študent:

- razumel pomen področij zanesljivosti in zmogljivosti računalniških sistemov,
- poznal osnove teorije zanesljivosti in zmogljivosti,
- znal med osnovnimi zmogljivostnimi metrikami izbrati ustrezno in jo uporabiti za oceno zmogljivosti računalniškega sistema,
- znal izbrati in uporabiti ustrezne kvalitativne ali kvantitativne metode za oceno systemske zanesljivosti,
- znal identificirati obseg sistema, njegova stanja in njegove funkcije,
- sposoben analitične in kritične obravnave opazovanega sistema.

Intended learning outcomes:

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

- understand the importance of computer systems reliability and performance assessment,
- know the basic theory of computer systems reliability and performance,
- will be able to choose an appropriate performance metric and apply it to assess the performance of a computer system,
- will be able to choose and use appropriate qualitative and quantitative methods for the assessment of computer system reliability,
- will be able to identify the scope of the system, and evaluate its states and functions.
- will be able to objectively analyse the observed system.

Metode poučevanja in učenja:	Learning and teaching methods:
Predavanja bodo potekala ustno, vaje v obliki projektne dela na konkretnih aplikativnih zgledih.	Lectures and oral presentations of the subject. Seminal work on real-life examples and problems.

Načini ocenjevanja:	Delež/Weight	Assessment:
Način (pisni izpit, ustno izpraševanje, naloge, projekt):		Type (examination, oral, coursework, project):
Sprotno preverjanje (domače naloge, kolokviji in projektne delo)	50,00 %	Continuing (homework, midterm exams, project work)
Končno preverjanje (pisni in ustni izpit)	50,00 %	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:

- 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](#)], [JCR, SNIP]
- 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](#)], [JCR, SNIP]
- 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](#)], [JCR, SNIP, WoS]
- 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](#)], [JCR, SNIP, WoS]
- 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](#)], [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:	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 Interdisciplinarni univerzitetni študijski program Upravna informatika prve stopnje	ni smeri	3	poletni
<u>University study programme</u> Computer and Information Science, 1 st cycle Interdisciplinary university study programme in Administrative Informatics 1 st 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:

doc. dr. Dejan Lavbič

Jeziki /

Predavanja / Lectures: slovenščina

Languages:

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 načrtovanje (RUP)
 - d. Načrtovalski vzorci
6. Programiranje

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)
 - d. Design patterns

- 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 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

- 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 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

študenti pokažejo, kaj so že naredili, in dobijo nasvete za nadaljnje delo.

progress meetings (milestones) with the tutor before the final presentation takes place.

Temeljni literatura in viri / Readings:

1. Roger S. Pressman, Bruce R. Maxim: Software Engineering: A Practitioner's approach, 8th edition, McGraw Hill, 2014.
2. Ian Sommerville: Software Engineering, 9th edition, Pearson, 2010.
3. H. van Vliet: Software Engineering, Third Edition, John Wiley & Sons, 2008.
4. I. Jacobson, G. Booch, J. Rumbaugh: The unified software development process, Addison-Wesley, 1999.

Dodatno:

5. M. Seidl, M. Scholz, C. Huemer, G. Kappel: UML @ Classroom, An Introduction to Object-Oriented Modeling, Springer, 2015.
6. CMMI[®] for Development (CMMI-DEV), Version 1.3 CMU/SEI-2010-TR-033, Software Engineering Institute, Carnegie Mellon University, 2010.
7. K. Schwaber: Agile Project Management with Scrum, Microsoft Press, 2004.

Cilji in kompetence:

Cilj predmeta je predstaviti pregled aktivnosti v življenjskem ciklu razvoja 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, industrijo, izobraževanjem in drugimi področji;
- sposobnost razumevanja in uporabe znanja računalništva in informatike na drugih

Objectives and competences:

The aim of the course is to provide an overview of activities in the software development life cycle that must be performed 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;
- the ability to understand and apply computer and information science knowledge to other

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, inženjskih in organizacijskih nalog kot tudi povprečno zahtevnih raziskovalnih nalog na področju računalništva in informatike.

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:

Po uspešnem zaključku tega predmeta bo študent zmožen:

- poznati in razumeti aktivnosti v življenjskem ciklu razvoja programske opreme
- poznati in razumeti različne pristope k razvoju programske opreme
- poznati najpomembnejše metodologije za razvoj programske opreme
- poznati in razumeti kriterije, ki vplivajo na izbor in prilagoditev razvojne metodologije
- uporabljati diagramske tehnike za modeliranje novega sistema
- razviti sposobnosti za skupinsko delo, vodenje, načrtovanje in organizacijo, pripravo predstavitev in medosebno komuniciranje, iskanje informacij, pisno in ustno poročanje
- uporabiti pridobljeno znanje pri razvoju realnih softverskih projektov

Intended learning outcomes:

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

- know and understand activities in the software development life cycle
- know and understand different approaches to software development
- know the most important software development methodologies
- know and understand the criteria that affect the choice and adaptation of the development methodology
- use diagramming techniques for system modelling
- develop professional skills like teamwork, management/leadership, planning and organizing, presentation and communication, information search, written and oral reporting
- apply acquired knowledge in the context of a real software development project

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).

Learning and teaching methods:

- *Lectures* with active participation on the part of students (explanation, discussion, questions, examples, problem solving).
- *Lab practice* (teamwork on a quasi-real software development project that serves as a case study for illustration of required activities).
- *Consultations* (discussion, additional explanation, answers to specific questions)

