



Univerza v Mariboru

Fakulteta za naravoslovje  
in matematiko

## UČNI NAČRT PREDMETA / COURSE SYLLABUS

<b>Predmet:</b>	<b>Sistemska programska oprema</b>
<b>Course title:</b>	<b>System Software</b>

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Enovit magistrski študijski program druge stopnje Predmetni učitelj	/	5.	9
Five-year master's degree program Subject Teacher	/		

Vrsta predmeta / Course type:

Univerzitetna koda predmeta / University course code:

Predavanja Lectures	Seminar Seminar	Sem. vaje Tutorial	Lab. vaje Laboratory work	Teren. vaje Field work	Samost. delo Individ. work	ECTS
30		3	42		105	6

Nosilec predmeta / Lecturer:

Jeziki / Languages:	Predavanja / Lectures:	<input type="text" value="slovenščina / Slovenian"/>
	Vaje / Tutorial:	<input type="text" value="slovenščina / Slovenian"/>

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

Prerequisites:

**Vsebina:**

- Uvod: lastnosti in principi sistemske programske opreme, statično in dinamično programsko izvajalno okolje.
- Računalniško shranjevanje in prenašanje informacij: standardizirani znakovni kodi in nabori, jeziki za oblikovanje in izmenjavo podatkov.
- Strojni in simbolični jeziki: princip zbiranja,

**Content (Syllabus outline):**

- Introduction: properties and principles of system software, static and dynamic programme environment.
- Information storage and transmission: standardised character codes and fonts, graphical page description languages, data exchange, mark-up languages.
- Machine and symbolic languages: principle

osnove delovanja zbirnika, sistemsko odvisne in neodvisne funkcije.

- Poenoteni vmesni nivoji: statični objektni moduli in princip dinamičnih razrednih zbirk pri javi in .NET, pomen internih struktur (globalne tabele, prenaslovitvene tabele, nabor konstant) in primeri (ELF pri OS linux, PE pri OS windows, ART pri OS Android).
- Statično povezovanje: razreševanje globalnih sklicevanj, prenaslavljanje, knjižnice objektnih modulov, tvorba izvedljivih programov.
- Dinamično povezovanje: uporaba nabora konstant v razrednih zbirkah, dinamično povezljive knjižnice.
- Nalaganje: začetno nalaganje operacijskega sistema, začetni nalagalnik, diskovna struktura s particijami in nalagalnimi zapisi, nalaganje s prenaslavljanjem, BIOS in UEFI.
- Nadziranje delovanja programov: očiščevalnik, uporaba programske prekinitve pri koračnem izvajanju in prekinitvenih točkah, simbolični očiščevalnik, krpanje in simbolični krpalnik.
- Komunikacija z V/I napravami in gonilniki: Sistemski klici in signali, jedro in njegovi moduli v OS Linux, zasnova jedra pri OS Windows, gonilniki v OS Linux in OS Windows, podatkovna vodila in prekinitve.
- Komunikacija človek-stroj: naravni vmesniki, vmesniki mišice-stroj, vmesniki možgani-stroj, kinetični uporabniški vmesniki.

of assembly programming language , basic operation of assembler, machine-dependent and independent functions.

- Unified intermediate level: static object modules and the principle of dynamic Java class and .NET files, importance of internal structures (global tables, relocation tables, constant pool), and examples (Linux ELF, Windows PE, Android ART ).
- Static linking: global symbol resolution, relocation, object libraries, output executable programs.
- Dynamic linking: implementation of constant pools in class files, dynamic linked libraries.
- Loading: boot loading of operating system, initial loader, disk partitioning and boot records, loading with relocation, BIOS and UEFI.
- Checking the executed programs: debugger, step-by-step execution and breakpoints based on software interrupts, symbolic debugger, patching and symbolic patch.
- Communication with I/O devices: system calls and signals, kernel and it's modules in OS Linux, kernel in OS Windows, Linux drivers, Windows drivers, data buses and programme interrupts
- Human-computer communication: natural user interfaces, muscle-computer interfaces, brain-computer interfaces, kinetic user interfaces.

### Temeljni literatura in viri / Readings:

- D. Zazula, M. Lenič: Principi sistemske programske opreme, Univerza v Mariboru, Fakulteta za elektrotehniko, računalništvo in informatiko, Maribor, 2006.
- I. Englander: The Architecture of Computer Hardware, Systems Software, and Networking, John Wiley & Sons, 2010.
- D. Abbott: Linux for embedded and real-time applications, Elsevier ; Oxford : Newnes, cop. 2013.
- M. E. Russinovich, D. A. Solomon, A. Ionescu: Windows internals, Microsoft Press, 2012.
- M. Kerrisk The Linux programming interface : a Linux and UNIX System Programming Handbook , San Francisco : No Starch Press, 2010.

- W. J. Savitch, K. Mock: Absolute Java, Pearson Education, 2010.

**Cilji in kompetence:**

Cilj predmeta je poučiti študente o osnovah sistemske programske opreme ter jih pri tem seznaniti s sistemskim programiranjem in uporabo obstoječih programskih orodij.

**Objectives and competences:**

The objective of this course is to acquaint students with basics of system software, including system programming and use of special-purpose software.

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

Po zaključku tega predmeta bo študent sposoben:

- razumeti pomen in delovanja sistemske programske opreme ter osnovnih postopkov za vrednotenje računalniških sistemov in aplikacij,
- uporabljati sistemske klice za delo z zbirkami, računalniškimi omrežji in namenskimi napravami,
- uporabljati sistemska orodja za vrednotenje in izboljšanje delovanja računalniških instalacij in aplikacij.
- razumeti pomen ter ovrednotiti prednosti in slabosti sodobnih uporabniških komunikacijskih vmesnikov med človekom in računalnikom

Prenosljive/ključne spretnosti in drugi atributi:

- Spretnosti komuniciranja: ustni zagovor laboratorijskih vaj in projekta, priprava in javna predstavitev poročila o študentskem projektu.
- Uporaba informacijske tehnologije: uporaba programskih orodij in naprav za delo v sistemskem računalniškem okolju.
- Organizacijske spretnosti: izdelava in vodenje preprostega projekta.
- Reševanje problemov: načrtovanje in izvedba študentskega projekta.
- Delo v skupini: skupinsko delo v študentskem projektu.

**Intended learning outcomes:**Knowledge and Understanding:

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

- understand the importance and operation of system software, and basic principles of computer system and application evaluation,
- implement system calls to access files, communication links, and special-purpose devices,
- use system tools to evaluate and improve the computer system and application performance.
- understand the importance and assess the advantages and disadvantages of modern human-computer communication interfaces.

Transferable/Key Skills and other attributes:

- Communication skills: oral lab work defence, preparation and presentation of the student project report.
- Use of information technology: use of special software tools and devices for the development at system level.
- Organization skills: design and coordination of simple project.
- Problem solving: designing and implementation of student projects.
- Team work: team work in a student project.

**Metode poučevanja in učenja:**

- predavanja,
- seminarske vaje,
- projektno delo,
- laboratorijske vaje,
- reševanje domačih nalog.

**Learning and teaching methods:**

- lectures,
- tutorials,
- project work,
- lab work,
- homework assignments.

**Načini ocenjevanja:**Delež (v %) /  
Weight (in %)**Assessment:**

- |                             |      |                              |
|-----------------------------|------|------------------------------|
| • opravljene domače naloge, | 15 % | • completed homeworks,       |
| • laboratorijske vaje,      | 35 % | • lab work,                  |
| • opravljen projekt,        | 15 % | • completed project work,    |
| • 1. vmesni pisni izpit,    | 12 % | • 1st midterm written exam,  |
| • 2. vmesni pisni izpit,    | 12 % | • 2nd midterm written exam,  |
| • 3. vmesni pisni izpit.    | 11 % | • 3rd midterm written exam . |

Opomba: V kolikor študent ni uspešno opravil vseh treh vmesnih izpitov, jih nadomesti z ustnim izpitom v deležu 35%.

Note: If a student has not successfully completed all three intermediate written exams, he/she must replace them with an oralexam in the weight of 35%.

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

- HOLOBAR, Aleš, OJSTERŠEK, Milan, ZAZULA, Damjan. Distributed Jacobi joint diagonalization on clusters of personal computers. Int. j. parallel program.. [Print ed.], 2006, vol. 34, no. 6, str. 509-530. <http://dx.doi.org/10.1007/s10766-006-0025-y>. [COBISS.SI-ID 10982678]
- HOLOBAR, Aleš, DIVJAK, Matjaž, KOROŠEC, Dean, ZAZULA, Damjan. Training scenario prototyping for VR-based simulation of neonatal decision-making. Comput. appl. eng. educ., 2007, vol. 15, iss. 4, str. 317-327. doi: 10.1002/cae.20121. [COBISS.SI-ID 12006934]
- HOLOBAR, Aleš, DIVJAK, Matjaž, PRELOG, Iztok, KOROŠEC, Dean, ZAZULA, Damjan. A distributed virtual reality-based system for neonatal decision-making training. Comput. appl. eng. educ., 2007, vol. 15, iss. 4, str. 329-339. doi: 10.1002/cae.20120. [COBISS.SI-ID 12007190]
- FARINA, Dario, JIANG, Ning, REHBAUM, Hubertus, HOLOBAR, Aleš, GRAIMANN, Bernhard, DIETL, Hans, ASZMANN, Oskar. The extraction of neural information from the surface EMG for the control of upper-limb prostheses : emerging avenues and challenges. IEEE transactions on neural systems and rehabilitation engineering, 2014, vol. 22, no. 4, str. 797-809, doi: 10.1109/TNSRE.2014.2305111. [COBISS.SI-ID 18018070]
- FARINA, Dario, HOLOBAR, Aleš. Human-machine interfacing by decoding surface electromyogram. IEEE signal processing magazine, ISSN 1053-5888. [Print ed.], Jan. 2015, vol. 32, no. 1, str. 115-120, doi: 10.1109/MSP.2014.2359242. [COBISS.SI-ID 18364950]