



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	/	4. ali 5.	8. ali 9.
Five-year master's degree program Subject Teacher	/		

Vrsta predmeta / Course type

Izbirni / Elective

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:

Aleš Holobar

Jeziki /

Languages:

Predavanja /

Lectures:

slovenščina / Slovenian

Vaje / Tutorial:

slovenščina / Slovenian

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

Ni pogojev.

Prerequisites:

None.

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.

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 of assembly programming language , basic

- Strojni in simbolični jeziki: princip zbiranja, 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, virtualizacija in vsebniki.
- Komunikacija človek-stroj: naravni vmesniki, vmesniki mišice-stroj, vmesniki možgani-stroj, kinetični uporabniški vmesniki.

- 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, virtualisation and containers.
- Human-computer communication: natural user interfaces, muscle-computer interfaces, brain-computer interfaces, kinetic user interfaces.

### Temeljni literatura in viri / Readings:

- AMD64 Architecture Programmer's Manual: Volumes 1-5, Advanced Micro Devices, 2021.
- Intel® 64 and IA-32 Architectures Software Developer's Manual Combined Volumes: 1, 2A, 2B, 2C, 2D, 3A, 3B, 3C, 3D, and 4, Intel Corporation, 2021.
- C. Negus: Linux Bible, John Wiley & Sons, 2020.
- P. Yosifovich: Windows 10 System Programming, Part 1, Independently Published, 2020
- D. Abbott: Linux for embedded and real-time applications, Elsevier ; Oxford : Newnes, cop. 2017.

### Cilji in kompetence:

### Objectives and competences:

Cilj predmeta je poučiti študente o osnovah systemske programske opreme in doseči, da jo bodo razumeli in znali uporabiti systemska programska orodja sodobnih operacijskih sistemov.

The objective of this course is for the students to be able to understand and use system software tools, including system programming and special-purpose software in modern operating systems.

**Predvideni študijski rezultati:**

Znanje in razumevanje:

Po zaključku tega predmeta bo študent sposoben:

- razumeti pomen in delovanja systemske programske opreme ter osnovnih postopkov za vrednotenje računalniških sistemov in aplikacij,
- uporabljati systemske klice za delo z zbirkami, računalniškimi omrežji in namenskimi napravami,
- razumeti prednosti in delovanje dinamičnih izvajalnih okolij in dinamičnega povezovanja
- uporabljati systemska orodja za vrednotenje in izboljšanje delovanja računalniških instalacij in aplikacij.
- razumeti pomen ter oceniti 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 systemskem 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,
- understand the advantages and operation of dynamic execution environments and dynamic linking
- use system tools to evaluate and improve the computer system and application performance.
- understand the importance and identify 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:**

**Learning and teaching methods:**

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

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

**Načini ocenjevanja:**

Delež (v %) /  
Weight (in %)

**Assessment:**

<b>Sprotni način</b>		<b>Constant assessment methods</b>
• laboratorijske vaje	50	• lab work
• 1. kolokvij	25	• 1st midterm examination
• 2. kolokvij	25	• 2nd midterm examination

Opomba: Kolokvija se lahko nadomestita s pisnim izpitom v deležu 50 %.

Note: The midterm examinations may be replaced by written exam in the weight of 50 %.

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

- URH, Filip, HOLOBAR, Aleš. Automatic identification of individual motor unit firing accuracy from high-density surface electromyograms. IEEE transactions on neural systems and rehabilitation engineering. [Print ed.]. Date of Publication: 03 January 2020, str. 1-8, ilustr. ISSN 1534-4320. DOI: 10.1109/TNSRE.2019.2961680. [COBISS.SI-ID 22931734]
- KRANJEC, Jernej, HOLOBAR, Aleš. Improved assessment of muscle excitation from surface electromyograms in isometric muscle contractions. IEEE transactions on neural systems and rehabilitation engineering. [Print ed.]. July 2019, vol. 27, no. 7, str. 1483-1491, ilustr. ISSN 1534-4320. DOI: 10.1109/TNSRE.2019.2922453. [COBISS.SI-ID 22511638]
- KALC, Miloš, ŠKARABOT, Jakob, DIVJAK, Matjaž, URH, Filip, KRAMBERGER, Matej, VOGRIN, Matjaž, HOLOBAR, Aleš. Motor unit identification in the M waves recorded by high-density electromyography. IEEE transactions on bio-medical engineering. Date of Publication: 28 November 2022, 11 str, ilustr. ISSN 0018-9294. DOI: 10.1109/TBME.2022.3224962. [COBISS. SI-ID 131436291]