



Univerza v Mariboru

Fakulteta za naravoslovje
in matematiko

| UČNI NAČRT PREDMETA / COURSE SYLLABUS | | | | | | | |
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| Predmet: | Računalniške arhitekture | | | | | | |
| Course title: | Computer Architecture | | | | | | |
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| 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 | / | | | 3. | 5 | | |
| Five-year master's degree program Subject Teacher | / | | | | | | |
| Vrsta predmeta / Course type | | | | Obvezni / Obligatory | | | |
| 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: | | Janez Brest | | | | | |
| Jeziki / Languages: | Predavanja / Lectures: | | slovenščina / Slovenian | | | | |
| | Vaje / Tutorial: | | slovenščina / Slovenian | | | | |
| Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti: | | | | Prerequisites: | | | |
| Ni pogojev. | | | | None. | | | |
| Vsebina: | | | | Content (Syllabus outline): | | | |
| <ul style="list-style-type: none">Uvod: zgodovinski pregled računalniških arhitektur, strojne komponente, zmogljivost, predstavitev podatkov.Instrukcijska množica: karakteristike, načini naslavljanj, instrukcijski formati, semantični prepad, zbirni jezik.Arhitektura 80x86: zgodovinski pregled, zgradba, načini delovanja, instrukcijska množica CISC.Komponente računalnika: centralno procesna enota, instrukcijski cikel, | | | | <ul style="list-style-type: none">Introduction: historic overview of computer architectures, hardware components, performance, data representation.Instruction set: characteristics, addressing modes, instruction formats, semantic gap, assembly language.Architecture 80x86: historic overview, structure, modes of operation, CISC instruction set.Computer components: central processing unit, instruction cycle, memory, devices, | | | |

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| <p>pomnilnik, naprave, prekinitve.</p> <ul style="list-style-type: none"> • Pomnilnik: hierarhija, zgodovinski pregled, zunanji pomnilnik, analitični modeli zmogljivosti. • Predpomnilnik: vloga, struktura, funkcije preslikave, politika pisanja. • Operacijski sistem: arhitekturni vidik, večopravnost, upravljanje s pomnilnikom, razvrščanje procesov. • Navidezni pomnilnik: razdeljevanje in odstranjevanje, izmenjevanje, tabela strani, TLB, segmentacija. • Centralno procesna enota: struktura, registri, notranja vodila, mikroprogram, izvršitev instrukcije. • Cevenje: pohitritve, podroben instruksijski cikel, stopnje cevenja, hazardi, predvidevanje vejitev. • Paralelne arhitekture: superskalarnost, procesorji SMP, NUMA, grozdne arhitekture. | <p>interrupts.</p> <ul style="list-style-type: none"> • Memory: hierarchy, historic overview, external memory, analytical performance models. • Cache: role, structure, mapping functions, writing policy. • Operating system: architectural view, multitasking, memory management, scheduling. • Virtual memory: partitioning, paging, swapping, page table, TLB, segmentation. • Central processing unit: structure, registers, datapath, microprogram, instruction execution. • Pipelining: speedup, detailed instruction cycle, pipelining levels, hazards, branch prediction. • Parallel architectures: superscalar, SMP, NUMA, cluster architectures. |
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Temeljni literatura in viri / Readings:

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| <ul style="list-style-type: none"> • W. Stallings: <i>Computer Organizations and Architecture, Designing for Performance</i>, Tenth Ed., Prentice Hall, 2015. • D. A. Paterson, J. L. Hennessy: <i>Computer Architecture: A Quantitative Approach</i>, Morgan Kaufmann Publishers. Inc., 2011. • D. A. Patterson, J. L. Hennessy: <i>Computer Organization and Design: The Hardware/Software Interface</i>, Fourth Ed., Morgan Kaufmann, 2011. • D. Kodek: <i>Arhitektura računalniških sistemov</i>. 2. popravljena in razširjena izdaja, Bi_tim, Ljubljana, 2008. • S. G. Shiva: <i>Advanced Computer Architectures</i>, Taylor & Francis Group, Boca Raton, 2006. |
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Cilji in kompetence:

Cilj predmeta je vpeljati študente, da bodo sposobni razumeti organizacijo in arhitekturo računalnika od von Neumannovega modela do novejših arhitektur.

Objectives and competences:

The objective of this course is to acquaint students that they will be able to understand organization and architecture of a computer dating from von Neumann model to modern architectures.

Predvideni študijski rezultati:

Znanje in razumevanje:

Po zaključku tega predmeta bo študent sposoben:

- razumeti in podrobno razložiti delovanje

Intended learning outcomes:

Knowledge and understanding:

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

- understand and explain in detail the

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| <p>posameznih računalniških komponent, njihovo vlogo in parametre zmogljivosti,</p> <ul style="list-style-type: none"> • z uporabo zbirnega jezika programirati posamezne komponente računalnika, • razumevanje inštrukcijskega cikla in delovanja računalnika. | <p>operation of specific computer components, their role and performance parameters,</p> <ul style="list-style-type: none"> • program specific computer components with assembly language, • understand the instruction cycle and how a computer works. |
| <p><u>Prenosljive/ključne spretnosti in drugi atributi:</u></p> <ul style="list-style-type: none"> • Spretnosti komuniciranja: ustni zagovor laboratorijskih vaj, pisno izražanje pri pisnem izpitu. • Uporaba informacijske tehnologije: uporaba zbirnega jezika za programiranje in orodij za simulacijo procesorja. • Reševanje nalog: načrtovanje arhitektur, programiranje strojnih komponent, izračun parametrov zmogljivosti. | <p><u>Transferable/Key skills and other attributes:</u></p> <ul style="list-style-type: none"> • <i>Communication skills:</i> oral lab work defence, manner of expression at written examination. • <i>Use of information technology:</i> use of assembly for programming and tools for processor simulation. • <i>Problem solving:</i> designing architecture, programming of hardware components, performance evaluation. |

Metode poučevanja in učenja:

- Predavanja: pri predavanjih študentje spoznajo teoretične vsebine predmeta. Predavanja se izvajajo kot klasična predavanja v frontalni obliki z diskusijo ob primerih uporabe konceptov programiranja.
- Seminarske vaje: pri seminarskih vajah se študentje seznanijo s potekom računalniških vaj.
- Računalniške vaje: pri računalniških vajah študentje uporabljajo usvojeno znanje programiranja na konkretnih problemih.
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Learning and teaching methods:

- Lectures: in lectures, students get to know the theoretical contents of the course. Lectures are conducted as classical lectures in frontal form, interleaved with discussions on practical examples.
- Tutorials: in tutorial exercises, students are informed about lab work.
- Lab work: in laboratory exercises, students work on individual programming tasks.
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Načini ocenjevanja:

Delež (v %) /
Weight (in %)

Assessment:

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| <ul style="list-style-type: none"> • laboratorijske vaje, • 1. kolokvij, • 2. kolokvij. | <p>50%</p> <p>25 %</p> <p>25 %</p> | <ul style="list-style-type: none"> • lab work, • 1st midterm examination, • 2nd midterm examination. |
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Opomba: Kolokvija se lahko nadomestita s pisnim izpitom v deležu 50 %.

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

Reference nosilca / Lecturer's references:

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- FISTER, Iztok, BREST, Janez, IGLESIAS, Andres, GÁLVEZ, Akemi, DEB, Suash, FISTER, Iztok. On selection of a benchmark by determining the algorithms' qualities. IEEE access, ISSN 2169-3536, 9 Feb. 2021, vol. 9, str. 51166 – 51178. <https://ieeexplore.ieee.org/document/9350587/keywords#keywords>, doi: 10.1109/ACCESS.2021.3058285. [COBISS.SI-ID 59061763]
- BREST, Janez, BOŠKOVIĆ, Borko. Low autocorrelation binary sequences: best-known peak sidelobe level values. IEEE access, ISSN 2169-3536, 4 May 2021, vol. 9, str. 67713 - 67723, doi: 10.1109/ACCESS.2021.3077541. [COBISS.SI-ID 63018499]
- BOŠKOVIĆ, Borko, BREST, Janez. Two-phase protein folding optimization on a three-dimensional AB off-lattice model. Swarm and evolutionary computation, ISSN 2210-6502, Sep. 2020, vol. 57, str. 1-16, doi: 10.1016/j.swevo.2020.100708. [COBISS.SI-ID 19046659]
- SEPEŠY MAUČEC, Mirjam, BREST, Janez. Slavic languages in phrase-based statistical machine translation: a survey. Artificial intelligence review, ISSN 0269-2821. [Print ed.], Jan. 2019, vol. 51, iss. 1, str. 77-117, ilustr., doi: 10.1007/s10462-017-9558-2. [COBISS.SI-ID 20561174]