

PROGRAMSKI ALGORITMI IN PROTOKOLI

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Programski algoritmi in protokoli
Course title:	Algorithms and Protocols
Članica nosilka/UL Member:	UL FS

Študijski programi in stopnja	Študijska smer	Letnik	Semestri	Izbirnost
Strojništvo - Razvojno raziskovalni program, druga stopnja, magistrski	Mehatronika in laserska tehnika (smer)	1. letnik	1. semester	obvezni

Univerzitetna koda predmeta/University course code:	0566810
Koda učne enote na članici/UL Member course code:	6056-M

Predavanja /Lectures	Seminar /Seminar	Vaje /Tutorials	Klinične vaje /Clinical tutorials	Druge oblike študija /Other forms of study	Samostojno delo /Individual student work	ECTS
30		30			65	5

Nosilec predmeta/Lecturer:	doc. dr. Dominik Kozjek, izr. prof. dr. Rok Vrabič
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Izvajalci predavanj:	
Izvajalci seminarjev:	
Izvajalci vaj:	
Izvajalci kliničnih vaj:	
Izvajalci drugih oblik:	
Izvajalci praktičnega usposabljanja:	

Vrsta predmeta/Course type:	Obvezni strokovni predmet na smeri Mehatronika in laserska tehnika, ki je izbirni strokovni predmet na ostalih smereh./Compulsory specialised course in the study of Mechatronics and laser technology, which is an elective specialised course in other fields of study.
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Jeziki/Languages:	Predavanja/Lectures:	Slovenščina
	Vaje/Tutorial:	Slovenščina

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

Prerequisites:

Izpolnjevanje pogojev za vpis v Magistrski študijski program II. stopnje Strojništvo - Razvojno raziskovalni program.	Meeting the enrollment conditions for the Master's study programme of Mechanical Engineering - Research and Development program.
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Vsebina:

1. Predavanje: Uvod
 - Predstavitev predmeta
 - Prevajanje programov
 - Spremljivke
 - Vhodi/izhodi
 - Zanke
2. Predavanje: Podatkovni tipi in operatorji
 - Osnovni podatkovni tipi
 - Seznami
 - Iteratorji
 - Asociativni seznami
 - Bitni operatorji
3. Predavanje: Kazalci in reference
 - Reference
 - Kazalci
 - Dinamično dodeljevanje spomina
4. Predavanje: Objektno orientirano programiranje
 - Vidnost podatkov (enkapsulacija)
 - Dedovanje
 - Večobličnost (polimorfizem)
 - Testiranje programov
5. Predavanje: Orodja jezika C++
 - Predloge, generično programiranje
 - Pregled standardne knjižnice
6. Predavanje: Kopice in čakalne vrste
 - Kopice
 - Čakalne vrste
 - Medpomnilnik
 - Implementacija s C++
7. Predavanje: Rekurzija
 - Rekurzivne funkcije
 - Repna rekurzija
 - Vračanje (backtracking)
8. Predavanje: Binarna drevesa
 - Binarna drevesa
 - Iskanje z binarnimi drevesi
 - Balansiranje
 - Implementacija s C++
9. Predavanje: Urejanje
 - Klasični algoritmi urejanja (bubble sort, merge sort, insertion sort, quicksort)
 - Algoritmična kompleksnost
 - Urejanje z binarnimi drevesi
 - Orodja C++ standardne knjižnice
10. Predavanje: Grafi
 - Podatovne strukture za grafe
 - Iskanje v širino
 - Iskanje v globino
11. Predavanje: OSI/ISO komunikacijski model
 - Plasti
 - Protokoli
 - Primeri
12. Predavanje: Internet
 - Delovanje in struktura
 - Fizični gradniki
 - Domenski sistemi DNS
 - Usmerjanje z vektorjem razdalj

Content (Syllabus outline):

1. Lecture: Introduction
 - Course overview
 - Compiling programs
 - Variables
 - Input/output
 - Loops
2. Lecture: Data types and operators
 - Basic data types
 - Lists
 - Iterators
 - Associative lists
 - Bit operators
3. Lecture: Pointers and references
 - References
 - Pointers
 - Dynamic memory allocation
4. Lecture: Object-oriented programming
 - Encapsulation
 - Inheritance
 - Polymorphism
 - Software testing
5. Lecture: C++ tools
 - Templates and generics
 - Standard library overview
6. Lecture: Heaps and queues
 - Heap
 - Queue
 - Stack
 - C++ implementation
7. Lecture: Recursion
 - Recursive functions
 - Tail recursion
 - Backtracking
8. Lecture: Binary trees
 - Binary tree
 - Binary tree search
 - Balancing
 - C++ implementation
9. Lecture: Sorting
 - Classic sorting algorithms (bubble sort, merge sort, insertion sort, quicksort)
 - Algorithmic complexity
 - Binary tree sorting
 - C++ standard library tools
10. Lecture: Graphs
 - Data structures for graphs
 - Breadth-first search
 - Depth-first search
11. Lecture: OSI/ISO communication model
 - Layers
 - Protocols
 - Examples
12. Lecture: Internet
 - Structure and operation
 - Physical structure
 - Domain name system DNS
 - Distance-vector routing

- Usmerjanje s stanjem povezav	- Link-state routing
13. Predavanje: Spletni protokoli	13. Lecture: Internet protocols
- TCP/IP - HTTP, HTML - MQTT - Uporaba	- TCP/IP - HTTP, HTML - MQTT - Use cases
14. Predavanje: Grafični vmesniki	14. Lecture: Graphical User Interfaces
- Dogodkovno programiranje - Spletno programiranje - Programiranje namiznih grafičnih vmesnikov	- Event-based programming - Web programming - Desktop GUI programming
15. Predavanje: Podatkovne baze	15. Lecture: Databases
- Protokoli in jeziki za upravljanje z bazami - Programiranje podatkovnih baz	- Protocols and languages - Database programming

Temeljna literatura in viri/Readings:

1. Bjarne Stroustrup: The C++ Programming Language, Addison-Wesley, 2000[COBISS.SI-ID 7992370]
2. Bjarne Stroustrup: A Tour of C++, Addison-Wesley, 2015[COBISS.SI-ID 37925381]
3. Stanley B. Lippman, Josee Lajoie, Barbara E. Moo: C++ Primer, Addison-Wesley, 2013[COBISS.SI-ID 513575543]
4. Goodrich, Michael T. ; Tamassia, Roberto ; Mount, David M. : Data Structures and Algorithms in C++, Wiley, 2024 [COBISS.SI-ID 3534932]
5. Jon Kleinberg, Eva Tardos: Algorithm Design, Addison-Wesley, 2006[COBISS.SI-ID 26825221]

Cilji in kompetence:

Cilji: 1. Spoznati programski jezik C++ in objektno orientirano programiranje. 2. Spoznati osnovne podatkovne strukture in programske algoritme. 3. Spoznati sodobne protokole za komunikacijo med napravami. 4. Spoznati uporabo podatkovnih baz prek programskih vmesnikov. Kompetence: 1. S6-MAG + P1-MAG: Sposobnost objektno orientiranega programiranja računalniških aplikacij s programskim jezikom C++. 2. S1-MAG + P4-MAG: Sposobnost razumevanja in uporabe osnovnih podatkovnih struktur in programskih algoritmov. 3. S7-MAG: Sposobnost razumevanja in uporabe sodobnih protokolov za komunikacijo med napravami. 4. P4-MAG: Sposobnost dela s podatkovnimi bazami prek programskih vmesnikov.	Objectives and competences: Objectives: 1. Understanding object-oriented programming and C++ programming language. 2. Understanding fundamental data structures and algorithms. 3. Understanding modern protocols for inter-device communication. 4. Understanding how to use database programming interfaces. Competences: 1. S6-MAG + P1-MAG: Development of object-oriented programs using C++ programming language. 2. S1-MAG + P4-MAG: Understanding and having the ability to use fundamental algorithms and data structures. 3. S7-MAG: Understanding and having the ability to use modern protocols for inter-device communication. 4. P4-MAG: The ability to work with databases using application programming interfaces.
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Predvideni študijski rezultati:

Znanja:	Intended learning outcomes:
	Learning outcomes:

Z2: Predmet je namenjen spoznavanju algoritmov in podatkovnih struktur, njihovi implementaciji s programskim jezikom C++ in spoznavanju modernih protokolov za povezljivost med napravami s primeri namiznega in spletnega programiranja. Spretnosti: S2.1: Programiranje v programskem jeziku C++. S2.2: Uporaba tipičnih podatkovnih struktur in implementacija programskih algoritmov. S2.3: Ustvarjanje lastnih namiznih in spletnih aplikacij.	Z2: The course details algorithms, data structures, and their implementation in the C++ programming language. Modern communication protocols and their use with desktop and Web programming are reviewed. Skills: S2.1: C++ programming. S2.2: Using fundamental algorithms and datastructures. S2.3: Developing desktop and Web applications.
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Metode poučevanja in učenja:

P1 Avditorna predavanja z reševanjem izbranih - za področje značilnih - teoretičnih in praktično uporabnih primerov. P2 Obravnava snovi po urejeni in vnaprej razloženi sistematiki. P3 Avditorne vaje, kjer se teoretično znanje s predavanj podkrepi z računskimi primeri. P4 Laboratorijske vaje z namenskimi didaktičnimi pripomočki (računalnik). P12 Individualizirane domače naloge v spletni učilnici. P13 Individualizirani kolokviji in izpiti s samodejnim popravljanjem.	Learning and teaching methods: P1 Formal lectures with domain-specific theoretical and practical examples. P2 Contents treated in orderly and pre-explained systematic manner. P3 Tutorials where the theoretical background from the lectures is supported by computational examples. P4 Laboratory work with dedicated teaching aids (computers). P12 Individualized homework in an online classroom. P13 Individualized exams with automatic grading.
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Načini ocenjevanja:

Delež/Weight

Assessment:

Teoretične vsebine (predavanja), preverjene pisno.	50,00 %	Theory (lectures) graded with written exams.
Praktični del (vaje) – pisno ocenjevanje.	30,00 %	Practical work (tutorials) – written exam.
Praktični del (vaje) – projektna naloga.	15,00 %	Practical work (tutorials) – project assignment.
Praktični del (vaje) – domače naloge.	5,00 %	Practical work (tutorials) – homeworks.

Ocenjevalna lestvica:

Grading system:

5 - 10, pri čemer velja, da je pozitivna ocena od 6 - 10	5 - 10, a student passes the exam if he is graded from 6 to 10
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Reference nosilca/Lecturer's references:

Dominik Kozjek:

1. **KOZJEK, Dominik**, PORTER, Conor, CARTER, Fred M., BHATTAD, Pradeep, BRACKMAN, Paul, LISOVICH, Aleksandr, MOGONYE, Jon-Erik, CAO, Jian. Iterative closest point-based data fusion of non-synchronized in-situ and ex-situ data in laser powder bed fusion. *Journal of manufacturing*

systems. Feb. 2023, vol. 66, str. 179-199, ilustr. ISSN 0278-6125.

<https://www.sciencedirect.com/science/article/pii/S0278612522002266>, DOI:

[10.1016/j.jmsy.2022.12.007](https://doi.org/10.1016/j.jmsy.2022.12.007). [COBISS.SI-ID [138879747](#)]

2. ERKOYUNCU, John Ahmet, NAMOANO, Bernadin, **KOZJEK, Dominik**, VRABIČ, Rok. Cognitive data imputation : case study in maintenance cost estimation. *CIRP annals*. 2023, vol. 72, iss. 1, str. 385-388, ilustr. ISSN 0007-8506.
<https://www.sciencedirect.com/science/article/pii/S0007850623000343>, <https://repozitorij.uni-lj.si/IzpisGradiva.php?id=147995>, DOI: [10.1016/j.cirp.2023.03.036](https://doi.org/10.1016/j.cirp.2023.03.036). [COBISS.SI-ID [158961155](#)]
3. **KOZJEK, Dominik**, VRABIČ, Rok, RIHTARŠIČ, Borut, LAVRAČ, Nada, BUTALA, Peter. Advancing manufacturing systems with big-data analytics : a conceptual framework. *International journal of computer integrated manufacturing*. [Print ed.]. 2020, vol. 33, no. 2, str.169-188, ilustr. ISSN 0951-192X.
<https://www.tandfonline.com/doi/full/10.1080/0951192X.2020.1718765>, <https://repozitorij.uni-lj.si/IzpisGradiva.php?id=147466>, DOI: [10.1080/0951192X.2020.1718765](https://doi.org/10.1080/0951192X.2020.1718765). [COBISS.SI-ID [17034523](#)]
4. **KOZJEK, Dominik**, VRABIČ, Rok, ERŽEN, Gregor, BUTALA, Peter. Identifying the business and social networks in the domain of production by merging the data from heterogeneous internet sources. *International journal of production economics*. [Print ed.]. Jun. 2018, vol. 200, str. 181-191, ilustr. ISSN 0925-5273. <https://www.sciencedirect.com/science/article/pii/S0925527318301518>, <https://repozitorij.uni-lj.si/IzpisGradiva.php?id=101582>, DOI: [10.1016/j.iipe.2018.03.026](https://doi.org/10.1016/j.iipe.2018.03.026). [COBISS.SI-ID [15977243](#)]
5. **KOZJEK, Dominik**, MALUS, Andreja, VRABIČ, Rok. Multi-objective adjustment of remaining useful life predictions based on reinforcement learning. V: GAO, Robert X. (ur.), EHMANN, Kornel F. (ur.). *53rd CIRP Conference on Manufacturing Systems 2020 : [July 1-3 at Northwestern University in Chicago, USA]*. [S. l.]: Elsevier, 2020. Str. 425-430, ilustr. Procedia CIRP, vol. 93. ISSN 2212-8271.
<https://www.sciencedirect.com/science/article/pii/S2212827120306582>, <https://repozitorij.uni-lj.si/IzpisGradiva.php?id=121028>, DOI: [10.1016/j.procir.2020.03.051](https://doi.org/10.1016/j.procir.2020.03.051). [COBISS.SI-ID [30188803](#)]

Rok Vrabič:

1. ROŽMAN, Nejc, CORN, Marko, KOZJEK, Dominik, **VRABIČ, Rok**, PODRŽAJ, Primož. Autonomous production unit: an architecture for blockchain-based shared manufacturing. Robotics and computer-integrated manufacturing. Dec. 2025, vol. 96, [article no.] 103035, str. 1-19, ilustr. ISSN 0736-5845. <https://www.sciencedirect.com/science/article/pii/S0736584525000894>, DOI: [10.1016/j.rcim.2025.103035](https://doi.org/10.1016/j.rcim.2025.103035). [COBISS.SI-ID [236982787](#)].
2. ERKOYUNCU, John Ahmet, NAMOANO, Bernadin, KOZJEK, Dominik, **VRABIČ, Rok**. Cognitive data imputation : case study in maintenance cost estimation. *CIRP annals*. 2023, vol. 72, iss. 1, str. 385-388, ilustr. ISSN 0007-8506.
<https://www.sciencedirect.com/science/article/pii/S0007850623000343>, DOI: [10.1016/j.cirp.2023.03.036](https://doi.org/10.1016/j.cirp.2023.03.036). [COBISS.SI-ID [158961155](#)].
3. **VRABIČ, Rok**, ERKOYUNCU, John, FARSI, Maryam, ARIANSYAH, Dedy. An intelligent agent-based architecture for resilient digital twins in manufacturing. *CIRP annals*. 2021, vol. 70, iss. 1, str. 349-352, ilustr. ISSN 0007-8506.
<https://www.sciencedirect.com/science/article/pii/S0007850621000731?via%3Dihub>, DOI: [10.1016/j.cirp.2021.04.049](https://doi.org/10.1016/j.cirp.2021.04.049). [COBISS.SI-ID [76795907](#)].
4. ZDEŠAR, Andrej, BOŠNAK, Matevž, ZALETELJ, Viktor, **VRABIČ, Rok**, KLANČAR, Gregor. Učinkovito večagentno načrtovanje poti za logistični sistem. V: MUŠKINJA, Nenad (ur.), ROTOVNIK, Milan (ur.), BRATINA, Božidar (ur.). Zbornik štirinajste konference Avtomatizacija v industriji in gospodarstvu : 3. april 2025 Maribor, Slovenija. Ljubljana: Društvo avtomatikov Slovenije, 2025. Str. 38-43, ilustr. ISBN 978-961-96949-0-9. https://aig.si/25/zbornik/clanki/Zdesar_Andrej.pdf. [COBISS.SI-ID [233260291](#)].
5. ŽUŽEK, Tena, **VRABIČ, Rok**, MALUS, Andreja, ZDEŠAR, Andrej, KLANČAR, Gregor. Ant-colony-inspired grid graph optimization for improving logistic performance of multi-AMR systems. V: LEE, Soon-Geul (ur.). *Intelligent Autonomous Systems 18 : proceedings of the 18th International Conference IAS18-2023*. Cham: Springer, 2024. Vol. 1, str. 147-158, ilustr. Lecture notes in networks and systems (Online), vol. 795. ISBN 978-3-031-44851-5, ISBN 978-3-031-44981-9. ISSN 2367-3389.

https://link.springer.com/chapter/10.1007/978-3-031-44851-5_12, DOI: 10.1007/978-3-031-44851-5_12. [COBISS.SI-ID [194587907](#)].