

UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet:	Napredni pristopi planiranja in razvrščanja
Course title:	Advanced Approaches to Planning and Scheduling

Študijski program in stopnja Study programme and level	Modul Module	Letnik Academic year	Semester Semester
Informacijske in komunikacijske tehnologije, 3. stopnja	Računalniške strukture in sistemi	1	1
Information and Communication Technologies, 3 rd cycle	Computer Structures and Systems	1	1

Vrsta predmeta / Course type Izbirni / Elective

Univerzitetna koda predmeta / University course code: IKT3-702

Predavanja Lectures	Seminar Seminar	Sem. vaje Tutorial	Lab. vaje Laboratory work	Druge oblike	Samost. delo Individ. work	ECTS
15	15			15	105	5

**Navedena porazdelitev ur velja, če je vpisanih vsaj 15 študentov. Drugače se obseg izvedbe kontaktnih ur sorazmerno zmanjša in prenese v samostojno delo. / This distribution of hours is valid if at least 15 students are enrolled. Otherwise the contact hours are linearly reduced and transferred to individual work.*

Nosilec predmeta / Lecturer: Prof. dr. Gregor Papa

Jeziki / Predavanja / Lectures: Slovenščina, angleščina / Slovenian, English
Languages: Vaje / Tutorial:

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

Zaključen študij druge stopnje s področja informacijskih ali komunikacijskih tehnologij ali zaključen študij druge stopnje na drugih področjih z znanjem osnov s področja predmeta. Potrebna so tudi osnovna znanja matematike, računalništva in informatike.

Prerequisites:

Completed second cycle studies in information or communication technologies or completed second cycle studies in other fields with knowledge of fundamentals in the field of this course. Basic knowledge of mathematics, computer science and informatics is also requested.

Vsebina:

Uvod:
Terminologija in definicije
Planiranje in razvrščanje:
Hierarhičnost, zahteve in omejitve, osnovni pristopi (hevrstični, deterministični, stohastični)
Področja uporabe:
Proizvodnja, logistika/transport, upravljanje virov
Modeliranje problemov:

Content (Syllabus outline):

Introduction:
Terminology and Definitions
Planning and Scheduling:
Hierarchy, requirements and constraints, basic approaches (heuristic, deterministic, stochastic)
Application Fields:
Production, logistics/transport, resource management
Problem Modeling:
Complexity, constraints handling, multi-criteria,

Zahtevnost, upoštevanje omejitev, večkriterijskost, večnivojskost
 Integrirano planiranje in razvrščanje:
 Značilnosti, pristopi, izvedbe
 Planiranje in razvrščanje v spremenljivih okoljih in v negotovih pogojih:
 Vpliv na modeliranje, izvedbo, natančnost
 Napredni algoritmi planiranja in razvrščanja:
 Tehnike, izvedbe, računska zahtevnost, časovna odzivnost, natančnost, zanesljivost, (samo)-prilagodljivost
 Analiza učinkovitosti algoritmov:
 Načrtovanje eksperimenta, mere učinkovitosti, analiza rezultatov, predstavitev rezultatov.

multi-level
 Integrated Planning and Scheduling:
 Characteristics, approaches, applications
 Planning and Scheduling in Dynamic Environments and Uncertain Conditions:
 influence on modeling, application, accuracy
 Advanced Planning and Scheduling Algorithms:
 Techniques, applications, computational complexity, response time, accuracy, reliability, (self)-adaptability
 Algorithms' performance analysis:
 Experimental design, performance metrics, results analysis, results presentation.

Temeljna literatura in viri / Readings:

Izbrana poglavja iz naslednjih knjig: / Selected chapters from the following books:

- J.M. Framinan, R. Leisten, and R.R. García, *Manufacturing Scheduling Systems: An Integrated View on Models, Methods and Tools*. Springer, 2014, ISBN: 978-1-4471-6271-1
- M.L. Pinedo, *Planning and Scheduling in Manufacturing and Services*. Springer, 2007. ISBN: 978-0387221984
- C. Jaffeux, and P. Wieser (eds.), *Essentials of Logistics and Management*. EPFL Press 2012. ISBN: 978-1466573086
- A. Ceder, *Public Transit Planning and Operation: Theory, Modeling, and Practice*. CRC Press, 2007. ISBN: 978-0750661669
- T. Bartz-Beielstein et al., *Benchmarking in Optimization: Best Practice and Open Issues*. arXiv:2007.03488v1, 2020.

Cilji in kompetence:

Cilj predmeta je seznaniti študenta s pristopi planiranja in razvrščanja za različne tipe proizvodnih in transportnih/logističnih operacij/sistemov s poudarkom na naprednih algoritmih računske inteligence.

Kompetence študenta z uspešno zaključenim predmetom bodo vključevale razumevanje in sposobnost zasnove in obravnave zahtevnih problemov planiranja/razvrščanja na različnih hierarhičnih nivojih ter pridobitev vedenja o zasnovi in izvedbi sistemov za napredno planiranje in razvrščanje ter analizo učinkovitosti njihovega delovanja, tako na področjih proizvodnje in/ali transporta.

Objectives and competences:

The goal of the course is to familiarize the student with the methods of planning and scheduling for different types of manufacturing and transportation/logistic operations/systems, where the stress is on advanced algorithms of computational intelligence.

The competencies of the students completing this course successfully would include understanding and ability to formulate and manage complex planning/scheduling problems at different hierarchical levels, and be knowledgeable about the design and application of systems for advanced planning and scheduling, and their performance analysis in the fields of manufacturing and/or transportation.

Predvideni študijski rezultati:

Intended learning outcomes:

Študenti bodo z uspešno opravljenimi obveznostmi tega predmeta pridobili:

- znanstveno védenje o formuliranju in analizi hierarhičnih problemov planiranja in razvrščanja
- znanstvene aktivnosti, kot je modeliranje zahtevnih problemov planiranja/razvrščanja
- pregled obstoječih nalog in metod planiranja in razvrščanja
- pregled obstoječih nalog in metod računske inteligence
- sposobnost uporabe obstoječih metod na drugih področjih, kjer so potrebni pristopi planiranja in razvrščanja
- sposobnost analize učinkovitosti delovanja algoritmov

Students successfully completing this course will acquire:

- Scientific knowledge on formulating and analysing hierarchical planning and scheduling problems
- Scientific activities, such as modelling complex planning/scheduling problems
- Overview of existing tasks and methods of planning and scheduling
- Overview of existing tasks and methods of computational intelligence
- The ability to apply existing methods to other fields that require efficient planning and scheduling approaches
- The ability to analyse algorithms performance

Metode poučevanja in učenja:

Predavanja, seminar, konzultacije, individualno delo

Learning and teaching methods:

Lectures, seminar, consultancy, individual work

Delež (v %) /

Načini ocenjevanja:

Weight (in %)

Assessment:

Seminarska naloga	50 %	Seminar work
Ustni zagovor seminarske naloge	50 %	Oral defense of seminar work

Reference nosilca / Lecturer's references:

- M. Albano, L. L. Ferreira, G. Di Orio, Giovanni, P. Maló, G. Webers, E. Jantunen, I. Gabilondo, M. Viguera, **G. Papa**, "Advanced sensor-based maintenance in real-world exemplary cases," *Automatika*, vol. 61, no. 4, pp. 537-553, 2020, doi: 10.1080/00051144.2020.1794192.
- R. Hribar, P. Potočnik, J. Šilc, **G. Papa**, "A comparison of models for forecasting the residential natural gas demand of an urban area," *Energy*, vol. 167, pp. 511-522, 2019, doi: 10.1016/j.energy.2018.10.175.
- **G. Papa**, "Parameter-less algorithm for evolutionary-based optimization: for continuous and combinatorial problems," *Computational Optimization and Applications*, vol. 56, no. 1, pp. 209-229, 2013.
- P. Korošec, U. Bole, and **G. Papa**, "A multi-objective approach to the application of real-world production scheduling," *Expert Systems with Applications*, vol. 40, no. 15, pp. 5839-5853, 2013.
- P. Korošec, and **G. Papa**, "Metaheuristic approach to transportation scheduling in emergency situations," *Transport*, vol. 28, no. 1, pp. 46-59, 2013.