

UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet: Analiza senzorskih podatkov
Course title: Sensor Data Analysis

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Senzorske tehnologije, 3. stopnja	/	1	1
Sensor Technologies, 3 rd cycle	/	1	1

Vrsta predmeta / Course type: Izbirni / Elective

Univerzitetna koda predmeta / University course code: ST3-551

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje work	Druge oblike študija	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. Dunja Mladenić

Jeziki / Predavanja / Lectures: Slovenski ali angleški / Slovene or English
Languages: Vaje / Tutorial: Slovenski ali angleški / Slovene or English

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

Zaključen študij druge stopnje ustrezne (naravoslovne ali tehniške) smeri ali zaključen študij drugih smeri z dokazanim poznavanjem osnov področja predmeta (pisna dokazila, pogovor).

Prerequisites:

Completed second cycle studies in natural sciences or engineering or completed second cycle studies in other fields with proven knowledge of fundamentals in the field of this course (certificates, interview).

Vsebina:

- Osnovne lastnosti senzorskih podatkov in metapodatkov za potrebe analize senzorskih podatkov, vključno s statističnimi podatki, podatki o lokaciji senzorjev in dinamičnimi podatki povezanimi s časom.
- Primerjava obravnavanja senzorskih podatkov iz podatkovne baze in senzorskih podatkov, pridobljenih v realnem času.
- Predprocesiranje senzorskih podatkov, vključno s čiščenjem podatkov in bogatenjem podatkov z uporabo predznanja in/ali konteksta.
- Integracija drugih relevantnih podatkov (npr. vreme, tekstovna sporočila) s senzorskimi podatki.

Content (Syllabus outline):

- Basic properties of sensor data and sensor metadata from the viewpoint of sensor data analysis including static data, data connected to sensor location and dynamic data connected to time.
- Comparison of handling sensor data stored in a database and handling sensor data obtained from a real-time data stream.
- Pre-processing of sensor data including: data cleaning, sensor data enrichment using background knowledge and/or context.
- Integration of other relevant data (e.g. weather, text messages) with sensor data.

- Osnovne in napredne metode za analizo senzorskih podatkov, vključno s prepoznavanjem vzorcev, detekcijo anomalij, modeliranjem in napovedovanjem.
- Poglobljeno individualno delo na obravnavi realnega primera iz študentovega raziskovalnega dela: izbira primernih podatkov in relevantnega problema, ki ga bo študent obravnaval z metodami analize senzorskih podatkov, izbira primernih pristopov za predprocesiranje podatkov in metod za analizo podatkov.

- Basic and advanced methods for sensor data analysis including pattern matching and recognition, anomaly detection, modelling and prediction.
- In-depth individual study of a real case related to student's research interests: selection of data sources and a relevant problem to be addressed via sensor data analysis, selection of appropriate data pre-processing and suitable data analysis methods.

Temeljni literatura in viri / Readings:

Knjiga / Book

- Charu C. Aggarwal (ed.): Managing and Mining Sensor Data, 2013, Springer.
- Joao Gama and Mohamed M. Gaber (eds.): Learning from Data Streams, Springer, 2007.
- Jure Leskovec, Anand Rajaraman and Jeff Ullman: Mining of Massive Datasets, 2013
<http://infolab.stanford.edu/~ullman/mmds.html>

Revije / Periodicals

- IEEE Transactions on Knowledge and Data Engineering.
- Data Mining and Knowledge Discovery, Springer.

Cilji in kompetence:

Cilji:

- poznavanje lastnosti senzorskih podatkov in metapodatkov ter pomembnosti upoštevanja lokacije senzorjev in časa senzorskih meritev,
- razumevanje obravnavanja senzorskih podatkov, predprocesiranja senzorskih podatkov in integracije različnih podatkovnih virov,
- razumevanje in uporaba različnih metod za analizo senzorskih podatkov,
- primerjava in uporaba primernih virov podatkov glede na zahteve dane aplikacije, izbira ustreznih korakov predprocesiranja, metod za analizo podatkov in načina ovrednotenja rezultatov analize.

Kompetence:

- sposobnost primerjalne analize senzorskih podatkov glede na lastnosti in zahteve,
- sposobnost realizacije smiselnega in izvedljivega zaporedja akcij za obravnavo in predprocesiranje senzorskih podatkov ter povezovanje z drugimi podatki,

Objectives and competences:

Objectives:

- knowing properties of sensor data and sensor metadata and importance of considering sensor location and time sensor measurement when relevant,
- understanding handling of sensor data, data pre-processing and integration of different data sources potentially of different modality,
- understanding and using sensor data analysis methods,
- comparing and choosing the appropriate data sources for a given application requirements of sensor data analysis, selecting pre-processing steps, suitable data analysis methods and experimental setting.

Competencies:

- ability of comparative analysis of sensor data based on their properties and in relation to the application requirements,
- constructing a meaningful, feasible pipeline for handling and pre-processing sensor data and connection to other data,

- sposobnost izbire in uporabe primerne metode za analizo potencialno velikih količin senzorskih podatkov,
- sposobnost eksperimentalnega ovrednotenja in primerjave rezultatov analize senzorskih podatkov.

- capability of selecting and applying sensor data analysis methods on potentially large amount of data potentially arriving with high intensity over data stream,
- capability of evaluating and comparing results of sensor data analysis.

Predvideni študijski rezultati:

- Znanje in razumevanje:
- poznavanje lastnosti senzorskih podatkov,
 - razumevanje posebnosti obravnave senzorskih podatkov in osnov obravnave drugih relevantnih podatkov,
 - osnovno razumevanje prednosti in slabosti različnih postopkov predprocesiranja in metod analize,
 - vključevanje pridobljenega znanja in izkušenj v raziskovalno delo.

Intended learning outcomes:

- Knowledge and understanding:
- familiarity with properties of sensor data,
 - understanding specifics of handling sensor data and basics of handling other data for integration with sensor data,
 - basic understanding of advantages and disadvantages of applying different preprocessing steps and data analysis methods,
 - application of acquired knowledge and experience in research work.

Metode poučevanja in učenja:

Interaktivno delo s študentom v okviru predavanj in seminarske naloge vključno s predprocesiranjem senzorskih podatkov, uporabo metod za analizo senzorskih podatkov in ovrednotenje rezultatov analize, ter usmerjeno reševanje realnih problemov.

Learning and teaching methods:

Interactive work with a student in the frame of lectures and seminar work, including preprocessing of sensor data, methods for sensor data analysis and evaluation, as well as supervised solving of real problems.

Načini ocenjevanja:

Delež (v %) /
Weight (in %)

Assessment:

Seminarska naloga s predstavitvijo in zagovorom rešitve izbranega primera.	60 %	Seminar work with presentation and defence of the solution for the selected problem.
Ustni izpit.	40 %	Oral exam.

Reference nosilca / Lecturer's references:

- KENDA, Klemen, FORTUNA, Carolina, MORARU, Alexandra, MLADENIĆ, Dunja, FORTUNA, Blaž, GROBELNIK, Marko. Mashups for the web of things. In: ENDRES-NIGGEMEYER, Brigitte (ed.). Semantic mashups : intelligent reuse of web resources. Berlin; Heidelberg: Springer, 2013.
- GROBELNIK, Marko, MLADENIĆ, Dunja. Automated knowledge discovery in advanced knowledge management. Journal of knowledge management, ISSN 1367-3270, 2005, vol. 9.
- MLADENIĆ, Dunja, EDDY, William F., ZIOLKO, Scott. Data mining of baskets collected at different locations over one year. Informatica, ISSN 0350-5596, 2001, 25:3.