Fakulteta za informacijske študije
Faculty of information studies

ITIS 22
00010110

13th International Conference on Information Technologies and Information Society

ITIS 2022

Book of Abstracts

Edited by: Nuša Erman

November 10-11, 2022

Šmarješke Toplice, Slovenia

13th International Conference on Information Technologies and Information Society

ITIS 2022

Book of Abstracts

November 10-11, 2022

Šmarješke Toplice, Slovenia

Organized by

Faculty of Information Studies in Novo mesto

Supported by

Računalniške novice

Kataložni zapis o publikaciji (CIP)

pripravili v Narodni in univerzitetni knjižnici v Ljubljani

COBISS.SI-ID 134555395
ISBN 978-961-93391-9-0 (PDF)

Organizing and Program Committee

Nuša Erman (Chair), Slovenia

Borut Lužar, Slovenia

Blaž Rodič, Slovenia

Zoran Levnajić, Slovenia

Alenka Pandiloska Jurak, Slovenia

Anja Dular, Slovenia

Tanja Bančič, Slovenia

Published by: Faculty of information studies in Novo mesto

Ljubljanska cesta 31a

8000 Novo mesto, Slovenia

Edited by: Nuša Erman

EDITOR'S NOTE: Participants were asked to submit abstracts written in English. Keywords were chosen by participants and their number has not been reduced. Authors of abstracts are responsible for the reliability of contents and other statements made in their work. Abstracts are not proofread.

PROGRAM

THURSDAY, 10.11.2022

8:30 – 9:30	***Registration***
9:30 – 9:40	***Welcome address***
9:40 – 10:30	*Keynote speaker*: ***Pavle Boškoski*** **Graph concepts for labour market modeling**
10:30 – 10:35	*Break*
10:35 – 10:55	*Ingrid Franko Uhernik* Knowledge and information skills are the intellectual property of the individual, company or institution
10:55 – 11:15	*Lorena Mihelač* The detection of (ir)regularity in music and why it matters
11:15 – 11:45	***Coffee break***
11:45 – 12:05	*Matej Barbo* Using SD and ABM to model the influence of driving safety aids on the incidence of traffic accidents
12:05 – 12:25	*Ivan Radoš* Applying car retail data - Impact on the business flow prediction
12:25 – 12:45	*Juraj Petrović* AudIT audience response system
12:45 – 14:30	***Lunch***
14:30 – 15:20	Keynote speaker: ***Boris Podobnik*** **Love-hate relationship between democracy and corruption**
15:20 – 15:25	*Break*
15:25 – 15:45	*Andrej Dobrovoljc* Electricity consumption prediction
15:45 – 16:05	*Peter Zupančič* Intelligent Analysis of Employee Data to Support Decision-making in Companies: A Survey of User Needs
16:05 – 16:30	***Coffee break***
16:30 – 17:10	Invited speaker: ***Marjan Cugmas*** **Blockmodeling dynamic networks: evaluation study**
17:10 – 18:40	Roundtable: ***Victor Cepoi*** **Jean Monnet Module Technology Innovation Communities 2030 - Societies after the crisis**
19:00	***Dinner***

FRIDAY, 11.11.2022

9:30 – 10:20	Keynote speaker: ***Srđan Škrbić*** **Distributed optimization and HPC**
10:20 – 10:25	*Break*
10:25 – 10:45	*Ljubiša Mičić* Comparation of human mobility in Slovenia, Serbia and Bosnia and Herzegovina based on data from Google COVID-19 Community Mobility Reports
10:45 – 11:15	***Coffee break***
11:15 – 11:55	Invited speaker: ***Timotej Hrga*** **Solving SDP relaxations of Max-Cut problem with large number of hypermetric inequalities**
11:55 – 12:15	*Janez Povh* Ground truth clustering is not the optimum clustering
12:15	***Farewell address***

KEYNOTES

Graph concepts for labour market modeling

Presented by keynote speaker:

Pavle Boškoski

Faculty of Information Studies in Novo mesto, Ljubljanska cesta 31a, 8000 Novo mesto, Slovenia

Jožef Stefan Institute, Jamova cesta 39, 1000 Ljubljana, Slovenia

pavle.boskoski@fis.unm.si

Abstract: The labour landscape is constantly changing, and the labour market is getting more dynamic. The COVID pandemic is further hastening these changes. Accurate and timely information is becoming essential for selecting the optimal career path.

Methods for modelling labour flow and thus mapping viable career paths vary significantly based on the available data. Roughly, the approaches belong to two groups. The first group consists of methods that employ fully observable micro-level data (national statistical data, HR agency registry, job search site databases). The second group are approaches that derive occupation similarity measures based solely on occupation-skill ontologies.

This talk will provide an overview of both groups. The analysis uses more than 450,000 job transitions recorded in the Statistical Office of the Republic of Slovenia and the occupation-skill ontology provided by ESCO. On one side, the talk touches the concepts of ensemble community detection for modelling the labour market evolution. On the other hand, various explainable occupation similarity measures are explored using the concepts of bipartite graphs.

Viewing the labour market concepts through the framework of graph theory, it becomes possible to explore the dynamic behaviour of the market through explainable and computationally efficient approaches.

Love-hate relationship between democracy and corruption

Presented by keynote speaker:

Boris Podobnik

Zagreb School of Economics and Management, Croatia

Faculty of Information Studies in Novo mesto, Slovenia

Luxembourg School of Business, Luxembourg

University of Rijeka, Faculty of Civil Engineering, Croatia

bp@phy.hr

Abstract: Physics has a long tradition of laying rigorous quantitative foundations for social phenomena. This is especially true of statistical mechanics and its offshoots such as network science. Here, we up the ante for physics forays into the territory of social sciences by (i) empirically documenting a tipping point in the relationship between democratic norms and corruption suppression, and then (ii) demonstrating how such a tipping point emerges from a micro-scale mechanistic model of spin dynamics in a complex network.

Specifically, the tipping point in the relationship between democratic norms and corruption suppression is such that democratisation has little effect on suppressing corruption below a critical threshold, but a large effect above the threshold. The micro-scale model of spin dynamics underpins this phenomenon by reinterpreting spins in terms of unbiased (i.e., altruistic) and biased (i.e., parochial) other-regarding behaviour, as well as the corresponding voting preferences. Under weak democratic norms, dense social connections of parochialists enable coercing enough opportunist voters to vote in favour of perpetuating parochial in-group bias. Society may, however, strengthen democratic norms in a rapid turn of events during which opportunists adopt altruism and vote to subdue bias. The emerging model outcome at the societal scale thus mirrors the data, implying that democracy either perpetuates or suppresses corruption depending on the prevailing democratic norms.

The fact that quantitative physical methods explain why democratisation may fall short of overcoming corruption offers actionable insights for policymakers, which is all the more important given the enormous burden that corruption puts on social welfare and economic growth.

Distributed optimization and HPC

Presented by keynote speaker:

Srdjan Skrbić

Faculty of Information Studies in Novo mesto, Slovenia

University of Novi Sad, Faculty of Sciences, Serbia

srdjan.skrbic@fis.unm.si

Abstract: With the development of AI, machine learning, and big data processing, distributed optimization has emerged as a valuable tool for solving large-scale problems using HPC environments. We focus on distributed algorithms for solving large-scale convex optimization problems. The basic idea is that for some optimization problem that has a separable structure, a distributed algorithm is designed that solves that optimization problem on a network of distributed computers. In doing so, the tendency is toward the use of classic and well-tested iterative methods for numerical optimization (e.g., gradient descent or Newton's method) and their mapping to distributed structures.

INVITED CONTRIBUTIONS

Blockmodeling dynamic networks: evaluation study

Presented by invited speaker:

Marjan Cugmas

Marjan Cugmas
University of Ljubljana, Faculty of Social Sciences, Slovenia
marjan.cugmas@fdv.uni-lj.si

Aleš Žiberna
University of Ljubljana, Faculty of Social Sciences, Slovenia
ales.ziberna@fdv.uni-lj.si

Abstract: Blockmodeling is a set of approaches to study the network structure. Recently, several blockmodeling approaches have been proposed for temporal networks, but have not been comprehensively evaluated. Therefore, the Monte Carlo evaluation of these types of blockmodeling approaches will be presented. Networks with different properties were generated (e.g., network size, block densities, blockmodel type, stability of clusters over time), but a special attention was paid to generate networks considering local network mechanisms, which makes the generated networks more like real social networks. Guidelines for choosing among considered blockmodeling approaches will be given.

Solving SDP relaxations of Max-Cut problem with large number of hypermetric inequalities

Presented by invited speaker:

Timotej Hrga

University of Ljubljana, Faculty of Mathematics and Physics, Slovenia

timotej.hrga@fmf.uni-lj.si

Abstract: We present a computational study of SDP-based bounds for Max-Cut that use a subset of hypermetric inequalities as cutting planes to strengthen the basic relaxation. Solving these relaxations is computationally challenging due to the potentially large number of violated constraints. To overcome these difficulties, we describe a heuristic separation algorithm for hypermetric inequalities and propose to use the augmented Lagrangian method as a bounding routine. Computational experiments show that the resulting relaxations provide very tight bounds for the Max-Cut.

ABSTRACTS

Knowledge and information skills are the intellectual property of the individual, company or institution

Sašo Murtič
Faculty of Information Studies in Novo mesto, Slovenia
Faculty of Industrial Engineering, Slovenia
saso.murtic@gmail.com

Ingrid Franko Uhernik
Faculty of Information Studies in Novo mesto, Slovenia
Faculty of Industrial Engineering, Slovenia
ingrid.uhernik@gmail.com

Abstract: Property or Eigentum, in the objective sense, represents everything that belongs to someone, i.e., all his things (real property) and all his rights, while in the subjective sense it gives the power to the owner of the things or rights to do whatever he wants with the object of property and the benefits it brings, to create or achieve, to the exclusion of all others.

The purpose of the research is to draw attention to the need to protect the knowledge, innovation, intellectual property rights and achievements of an individual, group, company or institution. Knowledge creators are active all the time, and in our work, we often forget to protect our own knowledge, innovation, intellectual property rights and so on.

As a method, we review the education systems and ranking of innovation, knowledge and creativity by level of importance. As a result, we expect to identify methods and levers for the safe acquisition of knowledge and the protection of its ownership in both objective and subjective terms.

We expect our research to encourage higher education teachers and students to identify new innovations, knowledge and intellectual property rights achievements, while opening the possibility of finding appropriate legal bases for their protection. However, there are constraints to be expected in various legal bases, but especially in the regulations of individual companies or institutions, where knowledge, innovations or copyright work may constitute trade secrets for them.

The detection of (ir)regularity in music and why it matters

Lorena Mihelač
School Centre Novo mesto, Slovenia
lorena.mihelac@sc-nm.si

Janez Povh
University of Ljubljana, Faculty of mechanical engineering, Slovenia
Rudolfovo – Science and Technology Centre Novo mesto, Slovenia
janez.povh@rudolfovo.eu

Geraint A Wiggins
AI Lab, Vrije Universiteit Brussel, Belgium
School of Electronic Engineering and Computer Science, Queen Mary University of London, UK
Geraint.Wiggins@vub.be

Abstract: Regularity exists in natural and human-made objects, including biology, physics, engineering, architecture, and art, and plays an important role in human life. The detection of repeated structures (patterns) is important, as it governs our recognition and understanding of the world. Therefore, finding patterns that are repeated and form a regular structure can help understand and analyze abnormalities in the structure due to some criteria (e.g., unexpected delivery of rain, form of shell, use of chords in the harmonic progression and its impact on listener enjoyment of a musical piece and so on). Formally, regularity represents a class of configurations that an observer tends to utilize or recognize when it occurs. In music, regularity is experienced as a strong structured texture with dominant periodic patterns and strong neighboring relationships, where musical ideas are arranged in a shape appreciable by the human mind. Conversely, irregularity is experienced in a non-structured or weakly structured musical piece, where the relationship between patterns can be rarely detected, and enjoyment is affected due to the large mental space required for processing musical content full of novelties. In a recent research work (Mihelač et al., 2022), examining the musical structure of 736 monophonic children's folk songs from 22 European countries, irregularity was found in children's folk songs. By simulating and detecting (ir)regularity with IDyOM (computational model of human melodic pitch prediction) and own algorithm, Ir_Reg (which classifies melodies according to the regularity of their musical structure), absence of regular structure in children's folk songs was found in Great Britain, Norway and Switzerland. These findings were surprisingly, as children's folk songs are considered to be simple, non-complex and regular in structure. Future examination of (ir)regularity in musical structure, using IDyOM and the algorithm Ir_Reg could clarify which patterns, and in which circumstances they appear to be "chaotic" in musical structure, regardless of genre.

Using SD and ABM to model the influence of driving safety aids on the incidence of traffic accidents

Matej Barbo
Faculty of Information Studies, Slovenia
matej.barbo@gmail.com

Blaž Rodič
Faculty of Information Studies, Slovenia
blaz.rodic@fis.unm.si

Abstract: In the event of traffic accident, powered two-wheeler (PTW) drivers have very high risk of suffering severe injury. Likelihood, that PTW driver is handicapped for live is higher than likelihood of fatal outcome. Vision Zero is a road traffic safety project, supported also by European Commission, aiming to reduce road deaths close to zero by 2050 and halve the number of serious injuries in the EU by 2030. Technologies, commonly known under umbrella term Advanced Driver Assistance Systems (ADAS), play a major role in achieving this goal. As a part of doctoral dissertation we developed a low abstraction level simulation model using Agent-Based modelling (ABM) methodology, supported by System Dynamics (SD), which enables us to evaluate potential impact of Motorcycle Emergency Braking Warning System (MEBWS) on reducing rear-end accidents. Model is calibrated to correspond to real traffic speeds within common traffic speed limits in the EU and allows simulating three most common rear-end accident scenarios.

Digital transformation of monitoring customer behaviour in the cars sales

Ivan Radoš
Faculty of Information Studies in Novo mesto, Slovenia
termo.rados@gmail.com

Miljenko Hajnić
Faculty of Information Studies in Novo mesto, Slovenia
hajnic.m@gmail.com

Ivona Radoš
University of Rijeka, Faculty of Economics and Business, Croatia
ilakic123@gmail.com

Abstract: Predicting car sales trends is an important part of designing sale plans, so the identification of user types (potential buyers) plays a big role in it. Data mining was utilized in this research to gather data from multiple sources for future predictions and achieve better service quality and consumer satisfaction. Gathered users (buyers) data from multiple sources were joined according to the defined logic and common key to get the total number of buyers that purchased cars, online by software platform developed for selling cars and offline in physical stores. This research was conducted on a real company Neostar which is a part of the biggest conglomerate in Croatia and brings answers on the impact of web advertising compared to the classic TV advertising campaigns. It also provides interesting results on the impact of geo-location where the car is physically located and the number of completed car purchases.

AudIT audience response system

Juraj Petrović

University of Zagreb, Faculty of Electrical Enineering and Computing, Croatia

juraj.petrovic@fer.hr

Abstract: In this talk, I will present the context and the outcomes of the ALTII Erasmus+ project, especially the AudIT audience response system. AudIT (www.audit.altii.online) is a tool developed to foster interactivity in live or virtual lectures by enabling its participants to answer lecturer's questions or pose their own questions. It enables lecture participants to send answers to multiple choice questions or to send textual data including simple markup formatting and mathematical formulas in LaTeX. The lecturer is provided with an environment for question posing and answer display. They can choose between displaying a question for the audience or displaying the acquired data as a bar graph, a pie chart, a tag cloud, or a textual display with additional option of answers clustering based on text similarity. AudIT is implemented as a web application (HTML, PhP, JavaScript) and uses server sent events (SSE) to push data to both lecturer and their audience. It has a modular architecture to allow functionality expansion and uses the thick client architecture as much as possible to offload work from server and foster scalability.

Electricity consumption prediction

Tomaž Čegovnik
Rudolfovo – Science and Technology Centre Novo mesto, Slovenia

Andrej Dobrovoljc
Rudolfovo – Science and Technology Centre Novo mesto, Slovenia
andrej.dobrovoljc@3ad.si

Janez Povh
Rudolfovo – Science and Technology Centre Novo mesto, Slovenia
janez.povh@rudolfovo.eu

Matic Rogar
University of Ljubljana, Faculty of mechanical engineering, Slovenija

Abstract: The measurement of electricity consumption at 15-minute granularity is increasingly mandated in the EU, including for households, and this also allows, once sufficient data have been collected, the prediction of future consumption at the same time intervals.

We present preliminary results of the industry project that aimed to build AI models to predict the next day electricity consumption at 15-minute granularity. We identified the main influencing factors, developed scripts and databases to collect data about these features and the electricity consumption data for each 15-minute interval, and finally developed AI models to predict the next day electricity consumption, for each 15-minute interval and for each consumer. The models that we generated are based on (i) similar days method combined with random forests and artificial neural networks, (ii) generalized linear models (GLM), and (iii) ARIMA (Autoregressive Integrated Moving Average) methodology. We implemented and tested these models on a dataset of approx. 2500 real customers, consisting of their 15-minute interval consumptions for the period of 2019-2021. The main influencing factor was the weather for which we collected (i) the data about the true weather: temperature, precipitation, pressure, humidity, wind speed, and power or solar radiation for each 30 minute time interval, for each weather station in Slovenia, and (ii) the data about the weather forecasts for the next three days, with the same weather variables, but with granularity of 4 hours, for every subregion in Slovenia having its own weather forecast.

Computing 2500 AI models in a given time window of few hours, where computation of each model demands approximately 5 minutes, is a computationally very intensive job. We therefore decided to use an HPC and libraries for parallel computation. We used R and Python libraries for parallel generation of models and predictions of consumptions. We also implemented automatic workflow for retrieving, cleaning and storing the data about electricity consumptions, weather reports and weather forecasts into MongoDB database. For better user experience, a visualization of past consumptions and future predictions was provided on Grafana tool.

Intelligent Analysis of Employee Data to Support Decision-making in Companies: A Survey of User Needs

Peter Zupančič
Faculty of Information Studies in Novo mesto, Slovenia
Peter.zupancic91@gmail.com

Jelena Klisara
Faculty of Information Studies in Novo mesto, Slovenia
jelena.klisara@fis.unm.si

Panče Panov
Jozef Stefan Institute, Slovenia
pance.panov@ijs.si

Abstract: As part of the dissertation entitled "Intelligent analysis of employee data to support decision-making in human resources management" we conducted a survey to determine user needs for software support for decision making based on employee data. The survey was sent to all companies (e.g. users) that use the system for recording working hours MojeUre. The results of the survey will be used to structure and design an intelligent tool that can leverage the historical data collected by the system, such as absence data, and enable the users of the system to facilitate organization within the company in case of unexpected employee absences. Our questionnaire was divided into three sections. The first section is used to obtain the demographic data of the respondents, the second section focuses on collecting the profile of the respondents, and the third section contains questions about the company's requirements for predicting absences and classifying employees into groups based on previous absence profiles. The results of the survey will help us in the development and deployment of our analytical tool. Only based on these results will we have guidelines on what is most useful for companies and in what way and direction we will develop the tool. From the results of the survey, it appears that the users consider the prediction of absences from the workplace to be very useful, as it allows companies to organize employees more easily in case of unexpected absences.

Comparation of human mobility in Slovenia, Serbia and Bosnia and Herzegovina based on data from Google COVID-19 Community Mobility Reports

Ljubiša Mićić

Faculty of Economics, University of Banja Luka, Bosnia and Herzegovina

Ljubisa.micic@ef.unibl.org

Abstract: Late 2019 and beginning of 2020 will be remembered by start of the COVID-19 pandemic. There was no record of a global event that changed living habits all over the globe. Changes have happened in the region also, including EU countries as well as Western Balkan countries. However, different countries reacted differently and has introduced different limitations and rules in different specific time period.

The paper examines difference in human mobility between followed population in Slovenia, Serbia and Bosnia and Herzegovina in selected location groups. Selected countries had some similarities in measurements that have been taken however, specific time periods had different reactions so therefore, purpose of the paper would be to examine those possible differences in order to identify if specific measurements have significantly influenced mobility in those three countries. Additionally, those three countries had different vaccination rates, especially in the beginning of the vaccination availability, so those factors should be included too.

Research results could be used for further socio-economic analyses, including measurements effects on mobility, legal effects as well as cultural and regional differences in adoption and respective of legal government restrictions, including those connected to mobility.

Ground truth clustering is not the optimum clustering

Janez Povh
University of Ljubljana, Faculty of mechanical engineering, Slovenia
Rudolfovo – Science and Technology Centre Novo mesto
janez.povh@rudolfovo.eu

Ágoston Kolos Csaba
Corvinus University of Budapest, Hungary
kolos.agoston@uni-corvinus.hu

Timotej Hrga
University of Ljubljana, Faculty of mechanical engineering, Slovenia
timotej.hrga@fmf.uni-lj.si

Marianna E.-Nagy
Corvinus University of Budapest, Hungary
marianna.eisenberg-nagy@uni-corvinus.hu

Shudian Zhao
Alpen Adria University, Klagenfurt, Austria

Abstract: The data clustering problem is one of the most studied problems in the area of unsupervised learning. In this paper, we focus on specific formulation of the clustering problem as a mathematical optimization problem in binary variables, which are subject to linear constraints, and with the objective function, which represents the within-the-cluster similarity. We study the exact formulations underlying the well-known k-median and k-means problems and solve them with exact solvers like Gurobi or SOS-SDP solver from Piccialli et al., by using the Slovenian national supercomputer VEGA.

We solved these models for a benchmark dataset where the clustering ground truth is known, for the number of clusters k that is around the true k. We evaluated the optimum clustering with a list of external measures (by using the ground truth clustering) and the internal measures, and compare the results with results of some other heuristic clustering algorithms. Our results show that the criteria to detect the true number of clusters do not yield the optimum number of clustering. Likewise, the ground truth clustering provided by the data-provider, is not the same as the optimum clustering computed by solving the exact mathematical optimization models to optimality. Even more, each similarity measure (distance) can imply substantially different optimum solution, far from the ground truth clustering.

Online learning with applications and platforms

Nuša Erman
Faculty of Information Studies in Novo mesto, Slovenia
nusa.erman@fis.unm.si

Katarina Rojko
Faculty of Information Studies in Novo mesto, Slovenia
katarina.rojko@fis.unm.si

Abstract: Modern educational development has been greatly influenced by the accelerated spread of ICT to support teaching and learning. In this context, teachers need to constantly upgrade their digital skills, as they are confronted, among others, with a multitude of different and diverse educational platforms and applications. In this way, they can identify their advantages and disadvantages, and advise students about their applicability and use. On the other hand, it is important to be aware that online educational applications and platforms also represent competition for teachers and educational institutions (especially those in tertiary education) as they enable independent and on-demand online education. In this respect, teachers need to adapt their teaching methods, or their role will become irrelevant.

Accordingly, our contribution presents the analysis results based on the testing of various publicly available online educational platforms and applications carried out by students studying in the fields of informatics and computer science over the course of three academic years. The quantitative text analysis showed that the students ranked content as the most important when using educational platforms and applications, followed by other aspects (e.g., personal preferences, reason, user experience, price, knowledge, content, time, free, variety, quality, etc.). The most interesting fact is that the possibility of obtaining a certificate students ranked as the least important. Students also reported that testing educational applications and platforms gave them mostly positive experiences, and this view has only strengthened in the last two years. We assume that this finding is mainly due to the impact of the COVID-19 pandemic.