Workshop on

Reliability and Safety (RaS 2023)

under the International Conference on Information and Digital Technologies

June 20-22, 2023
Žilina, Slovakia

Visegrad Fund

SRDA

ESRA

Preface

The International Conference on Information and Digital Technologies (IDT 2023) provides a forum for the presentation and discussion of scientific contributions covering the theories and methods in the field of information and digital technologies, and their application to a wide range of industrial, civil, and social sectors and problem areas. IDT 2023 is also an opportunity for researchers, practitioners, academics, and engineers to meet, exchange ideas, and gain insights from each other. IDT 2023 offers a multidisciplinary platform to address information systems' technological, societal, and financial aspects.

The conference program includes International Workshop on Reliability and Safety (RaS);

The International Workshop on Reliability and Safety is organized under the support of Visegrad Grant Programme of the International Visegrad Fund by the project "***Exchange Reliability and Safety Experience in the V4 region***" (ERaSEV4) with reg.no. 22230200. Collaboration between academic staff, representatives of enterprises, and young researchers in the areas of Reliability and Safety will be established at this event. The modern trends of teaching and research aspects of the RaS will be discussed at the workshop. The conception of the RaS network in V4 will be discussed and clarified. Together with the International Visegrad Fund, this workshop is supported by the Slovak Research and Development Agency through the project "***New methods development for reliability analysis of complex systems***" (reg.no. APVV-18-0027).

Initially, more than a hundred contributed papers were submitted for the conference review. Approximately half of these submissions have been recommended by reviewers for presentation at the Conference and publication in the proceedings. The review process was mainly organized by the Workshop chairs and the process was made by a large number of reviewers, which are gratefully acknowledged for their contributions to the improvement of quality of the accepted papers. Each paper was reviewed by at least two anonymous reviewers in order to ensure fair and high-quality reviews. Our organization team is grateful to all reviewers who help us to select papers for the presentation at the Conference and publication in the proceedings.

In addition to regular sessions, the event offers distinguished keynote lectures. At the event will be presented lectures of Keynote Speakers:

- *Self-sufficient electric energy supply at home* by prof. Marko Čepin (University of Ljubljana, Slovenia);
- *Benefits of Petri nets for systems modeling and probabilistic assessment in reliability engineering* by prof. Nicolae Brinzei (University of Lorraine, France);
- *Maintenance optimization of complex multi-component systems* by prof. Radim Briš (VSB—Technical University of Ostrava, Czech Republic);
- *Multi-Diagnosis Cough Classification Evaluation* by prof. Martin Lukač (Hiroshima City University / Nazarbayev University, Japan / Kazakhstan).

We thank Keynote Speakers for offering their unique perspectives on information technologies in the Reliability and Safety area.

We gratefully acknowledge the Faculty of Management Science and Informatics of the University of Žilina, European Reliability and Safety Association (ESRA), the Czechoslovakia section of IEEE, and the Reliability Society Chapter of IEEE Czechoslovakia Section for the sponsoring, organizational, and technical support.

We also thank all the contributed paper authors for their submissions and presentations.

Organization team of RaS-2023

RaS 2023 Programme Committee

Chair: Levashenko Vitaly, Slovakia

Co-Chairs: Zaitseva Elena, Slovakia

Baraldi Piero, Italy
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Berenguer Christophe, France
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Di Maio Francesco, Italy
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Levitin Gregory, Israel
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Luntovskyy Andriy, Germany
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Podofillini Luca, Switzerland
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Sztrik Janos, Hungary
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Xie Min, Hong Kong
Yanushkevich Svetlana, Canada
Zio Enrico, Italy

RaS 2023 Organizing Committee

Chair: Sedlacek Peter, Slovakia

Blahova Linda, Slovakia
Ilovska Anna, Slovakia
Mrena Michal, Slovakia
Piatrikova Lucia, Slovakia
Rusnak Patrik, Slovakia

Organizers:

RaS 2023. Time Schedule

Tuesday, June 20, 2023	
09:20-10:45	Registration
10:45-11:00	Opening of the Conference (room RC009)
11:00-12:30	**The Industrial Centre** (room RC009)
12:30-13:20	Lunch
13:20-20:00	Tour of the Bojnice Castle and dinner
Wednesday, June 21, 2023	
09:20-11:00	**Section RaS1** room RC009
11:00-11:30	Coffee/tea
11:30-12:30	**The First Plenary Section** (room RC009)
12:30-13:20	Lunch
13:20-15:30	**Section RaS2** room RC009
15:30-16:00	Coffee/tea
16:00-18:00	**Section IDT** room RC009
18:00-20:00	Reception
Thursday, June 22, 2023	
09:20-11:00	**Section RaS3** room RC009
11:00-11:30	Coffee/tea
11:30-12:30	**The Second Plenary Section** (room RC009)
12:30-13:20	Lunch
13:20-15:00	**The Third Plenary Section** (room RC009)
15:00-15:30	Coffee/tea
15:30-17:00	**Section BT** room RC001
17:00-17:15	Closing ceremony (room RC009)

Detailed Schedule

Tuesday, June 20, 2023

Opening of the Conference **10:15-10:30 (room RC009)**
Click here to join.

The Conference Opening	Prof. Elena Zaitseva
Welcome words of the Program Committee Chair	Prof. Marko Cepin
Welcome words of the Vice-Rector	Dr. Michal Kohani

The Industrial Centre **11:30-12:30 (room RC009)**
Click here to join.

Moderators: **Prof. Elena Zaitseva, Slovakia**

Assistant: **Ing. Michal Mrena, Slovakia**

Dr. Martin Komenda (Faculty of Medicine, Masaryk University, Institute of Health Information and Statistics, Czech Republic)

Data-driven decision making in practice: Experiences in academia and government

Data-driven decision-making is nowadays one of the domains that have huge potential. This is mainly because data, information systems and user interactions on the Internet are constantly increasing. However, it is crucial to handle this phenomenon correctly. The use of proven methodologies, the choice of effective and secure technologies and the appropriate involvement of the human factor seem to be essential. The workshop will not only provide the theoretical background of the complex data mining process and its application in real life. Still it will also present selected domains from medical education and Czech healthcare, where data plays a key role, using real-life examples.

Team building **13:30-20:00 Tour to Bojnice**

Wednesday, June 21, 2023

Section RaS1 09:20-11:00 (room RC009)

Click here to join.

Chair: **Dr. Stanislaw Czapp, Poland**

Assistant: **Ing. Michal Mrena, Slovakia**

Zoltan Gal, Djamila Talbi and Mahmoud Tourky *On the Localization Properties of Swarm Intelligence Algorithms*
Yehor Zheliazkov, Larysa Globa and Iuliia Yamnenko *Intelligent lighting system for comfortable living of the older people*
Jozef Papan, Ivana Bridova, Slavomír Tatarka and Michal Hraska *Fault Tolerance Solutions in IoT and Smart City*
Lenka Přibylová, Radim Briš, Vojtěch Novák and Lubomír Martínek *An Application of Prospensity Score Matching on Colorectal Data*
Andriy Luntovskyy, Igor Melnyk and Alina Pochynok *5G and Beyond: Shannon's Channel Capacity*

The First Plenary Section 11:30-12:30 (room RC009)

Click here to join.

Moderators: **Prof. Elena Zaitseva, Slovakia**

Assistant: **Ing. Michal Mrena, Slovakia**

Prof. Marko Čepin (University of Ljubljana, Slovenia)

Self-sufficient electric energy supply at home

Electric energy supply at home is an issue, which offers more solutions than years ago. The objective is to present an evaluation of self-sufficient electric energy supply at home. The method bases on the solar power plant as the primary source of power generation. The storage of electric energy with direct current electric battery is considered as the secondary power source, knowing that night hours are without the primary power generation. The real case time dependent home consumption is determined and the real case of solar power plant generation is considered. The size of solar power plant and the size of the battery are optimised based on the consumption and based on 100 % self-sufficient power system. One parameter optimisation bases on minimisation of costs for such a system. The model includes realistic yearly time dependent home consumption curve, realistic yearly time dependent solar power plant generation curve and realistic yearly time dependent curve of state of charge of battery, which is a function of solar power and home consumption. The time resolution of this model can vary based on density of data points of solar power generation and density of points of determined power consumption. Results include comparison of costs related with different size of solar power plant and with different size of battery. The most important result is a combination of the size of solar power plant and the size of battery, which are both related with the smallest overall costs. Consideration of different years gives different results due to different sun irradiation through the hours of the year due to weather changes. Consideration of different locations gives different results due to the same reason. Results show relatively large cost of all cases, which exceeds the cost of buying electrical energy from actual provider at the current conditions.

Section RaS2 — 13:20-15:30 (room RC009)

Click here to join.

Chair: **Prof. Radim Briš, Czech Republic**

Assistant: **Ing. Michal Mrena, Slovakia**

Stanislaw Czapp, Filip Ratkowski, Seweryn Szultka, Krzysztof Szuchnik and Michał Kołtun *Study of Soil Temperature and Moisture Changes in a Physical Model of an Underground Cable Line*
Radim Briš and Pavel Jahoda *Maintenance Optimization of Dormant Systems Submitted to Failure Based PM and Imperfect CM*
Andrea Galadíková and Norbert Adamko *Usage of Proximal Policy Optimization Algorithm for Personnel Assignment in Railway Nodes*
Djamila Talbi, Zoltan Gal and Janos Sztrik *Low Latency &High Speed Communication Service on LEO Satellite Constellation*
Hanan Tariq, Stanislaw Czapp and Vitaly Levashenko *RCDs Tripping in the Range from DC to AC 50 kHz for Slowly Rising Residual Current*
Igor Melnyk, Serhii Tuhai, Mykhailo Skrypka, Alina Pochynok, etc. *Approximation of Boundary Trajectory of Short-Focus Electron Beam using Third Order Root-Polynomial Functions and Recurrent Matrixes Approach*

Section IDT2 — 16:00-18:00 (room RC009)

Click here to join.

Chair: **Dr. Jozef Kostolny, Slovakia**

Assistant: **Ing. Michal Mrena, Slovakia**

Mária Bajúzová, Roman Hrmo, Nika Kvaššayová and Miroslav Kvaššay *The Rate of Use of Digital Tools in Relation to Teachers' Creativity*
Marek Klimo, Eugen Antal and Miroslav Kvassay *Education Tools for Teaching Classical Ciphers*
David Arie, Yuriy Bunyak, Olga Sofina, Roman Kvyetnyy and Oleg Bisikalo *The Model to Simulate Grades of Team-Play Learning on the UnispherTM platform*
Tamila Kolomoiets, Olena Bielikova, Anna Kurienkova and Viktoriia Vorokh *Experimental Verification of Using Augmented Reality Technology for Teaching Global Reading to Preschoolers with Autism Spectrum Disorders*
Oleh Ilkiv, Olha Krasovska, Yuliia Pereguda, Lidiya Zavatska, Andrii Yasinskyi *The efficiency of Distance Learning in Ukrainian Higher Education Institutions During Martial Law Period*
Linda Blahova, Jozef Kostolny and Veronika Karcolova *Enhancing Learning Outcomes with Interactive Courses*
Jakub Horecny and Jozef Kostolny *Segmentation of MRI images using clustering algorithms*

Thursday, June 22, 2023

Section RaS3 9:20-11:00 (room RC009)

Click here to join.

Chair: **Dr. Zoltan Gal, Hungary**

Assistant: **Ing. Michal Mrena, Slovakia**

Jörg Kammermann, Igor Bolvashenkov, Gabriel Romero, Hans-Georg Herzog *Reliability Statistics of Traction Electric Drive Components: Overview and Analysis*
Agata Szultka, Seweryn Szultka, Stanislaw Czapp, Kamil Makowski, Peter Sedlacek *Estimation of the Maximum Permissible PV Power to be Connected to the MV Grid*
David Matis and Peter Tarabek *Reinforcement learning for weighted p-median problem*
Ihor Kliushnikov, Vyacheslav Kharchenko, Herman Fesenko, Vitaly Levashenko *Reliability Models of Multi-state UAV-based Monitoring Systems: Mission Efficiency Degradation Issues*
Martin Lukac and Michitaka Kameyama *Verification Based Algorithm Selection*
Oleksandr Zhukov and Vitalii Horbenko *A Comparative Study of Deep Convolutional Neural Network Architectures to Identify Full Bee Body in Images*
Viktoria Sorokina and Sergey Ablameyko *2D Cast Shadow Generation in E-commerce Using Transformer*

The Second Plenary Section 11:30-12:30 (room RC009)

Click here to join.

Moderators: **Prof. Nicolae Brinzei, France**

Assistant: **Ing. Michal Mrena, Slovakia**

Prof. Radim Briš (VSB—Technical University of Ostrava, Czech Republic)

Maintenance optimization of complex multi-component systems

A complex multi-component system consists of a finite number of non-identical components that can be realized as maintained components with different maintenance modes, for example non-repairable components, repairable components with corrective maintenance, repairable components with latent failures that are identified by means of preventive maintenance, component with preventive maintenance policy in which the component is restored (either repaired or renewed), etc. Arbitrary components are considered without any restrictions on the form of the probability distribution assigned to time to failure and repair duration, i.e. ageing components are allowed.

Any optimization problem can be formulated in terms of an objective function f(x) for a given scope, where the optimizer is intended to find the solution constrained by a number of restrictions imposed on the decision variables. Different formulations of the maintenance optimization problem will be presented and solved in the lecture, starting from an one-objective to multi-objective optimization problem. Effective methods to find optimal maintenance strategy of a complex system respecting a given reliability constraint will be described. For example, cost-optimization problem is demonstrated and solved where decision variables are changeable maintenance parameters that are optimally selected from a set of possible realistic maintenance modes.

The Third Plenary Section 13:20-15:00 (room RC009)

Click here to join.

Moderators: **Prof. Radim Bris, Czech Republic**

Assistant: **Ing. Michal Mrena, Slovakia**

Prof. Nicolae Brinzei (University of Lorraine, France)

Benefits of Petri nets for systems modeling and probabilistic assessment in reliability engineering

Assessment of systems dependability belongs to important tasks in many engineering fields. Such an assessment can be done using various mathematical methodologies depending on the mathematical representation of the system. In this lecture, we will focus on Petri nets and especially in Stochastic Petri nets which are one of the most common representations of functional and dysfunctional behaviour of system and its components. They are able to take into account stochastic processes of failures and maintenance, reconfiguration of dynamic systems due to failures, redundancy. We will present the dynamic behavior of Stochastic Petri nets, their performance measures from which dependability measures can be obtained. To assess these measures, two approaches can be considered: an analytical approach based on Markov chain theory, or an approach based on Monte-Carlo simulation. Both approaches are discussed and compared. Some applications to real industrial systems will also be presented.

Prof. Martin Lukac (Hiroshima City University, Japan)

Multi-Diagnosis Cough Classification Evaluation

The sound classification is an open problem when it comes to classification. In particular and with the recent outbreak of COVID-19 a large amount of research has been invested in cough classification as a method of early detection and subsequent prevention. However usually the methodologies available are considering specific approaches such as very large datasets, data augmentation or even combination of breathing with coughs in order to increase the classification accuracy. In this work we study the classification of coughs into several diagnostic categories as a function of volume of the dataset and size of the data samples. For this purpose we use a dataset collected using our developed mobile application, prepare several datasets and evaluate different classifiers. First we assume that we do not have enough data for an end-to-end deep learning approach. Second we also consider that the variety might be low. Finally we also assume that the data is unbalanced. In order to deal with these problems we propose a study on using fast and shallow classifiers, data manipulation such as sample adaptive length and sample overlapping. As a result we determine that while it is overall the most accurate to process the sounds as whole, sampling them into samples with overlapping segments allows to recover most of the information from the whole samples and obtains similar accuracy.

Section BT 15:30-17:00 (room RC001)

Click here to join.

Chair: **Dr. Jan Rabcan, Slovakia**

Assistant: **Dr. Peter Sedlacek, Slovakia**

Ainura Gumarova, Gaukhar Kamalova, Aigul Kubegenova and Jan Rabcan *Building a Model and Assessing the Level of Morbidity During the Epidemic*
Olha Shaposhnyk, Vitalii Babenko, Maksym Chernykh, Svetlana Yanushkevich and Ievgen Nastenko *Inferring Cognitive Load Level from Physiological and Personality Traits*
Pavol Galcik, Michal Mrena and Lucia Piatrikova *Advanced Priority Queues in the OPTICS Clustering Algorithm*
Behnaz Jafari, Kenneth Lai and Svetlana Yanushkevich *Investigating Association and Causal Relationships between Physiological Signals and Affective State*
Hajah Sueno, Fritz Tuazon, Francis Michael Solmayor, Gil Jason Tuna, Joeny Germo *CheckApp: A Web-based Multipurpose Telemedicine System for E-checkups and Face-to-Face Consultations*
Sergii Tukaiev, Svitlana Fedorchuk, Mykola Makarchuk, Borys Palamar and João Miguel Alves Ferreira *Facial electrodermal potentials at rest state as objective criteria of emotional burnout severity*

Welcome to the metropolis of Northwest Slovakia

Žilina is a natural centre of north-western Slovakia and with a population of 81 940 inhabitants (as per 2021) it ranks among the largest cities in Slovakia. Žilina is situated around 200 km from Bratislava, the capital of Slovakia.

Žilina is located in the valley of the Váh river, in the Žilina Basin, at the confluence of the Váh river with its tributaries Kysuca and Rajčanka. The Žilina Basin is surrounded by the mountain ranges of Malá Fatra (Lesser Fatra), Strážovské vrchy (Strážov Hills), Súľovské vrchy (Súľov Hills), Javorníky and Kysucká vrchovina (Kysuce Highlands).

Žilina is a centre of significant political, cultural, sport and public health care institutions. The city of Žilina is the seat of the Žilina Region. Together with the Region, it keeps a stable position of the second or third place in gross domestic product per inhabitant. Its economic potential can be proven by the fact that Žilina has the biggest number of traders per thousand inhabitants. As for the number of joint stock companies and limited companies, Žilina keeps third position in Slovakia. The Slovak Commercial and Industrial Chamber in Žilina is the second biggest in Slovakia.

Nowadays, the city of Žilina represents a dynamic development accelerated by KIA Motors Slovakia investments. However, the City is not only a centre of car production, but together with the Upper Váh River Region (Horné Považie), it is an interesting tourist destination.

Interesting events held in the city of Žilina and its surroundings during the year (Carnival Slovakia, Central European Festival of Concert Art, Old Town Festival, Folklore Festival in Terchová, Medieval Day, Rajec Marathon etc.) make the development of the City tourism more dynamic.

The city of Žilina is a centre of theatres, museums, galleries, parks and sports facilities. Its historical centre is crossed by one of the longest and the most beautiful pedestrian zones in Slovakia.

Bojnice Castle

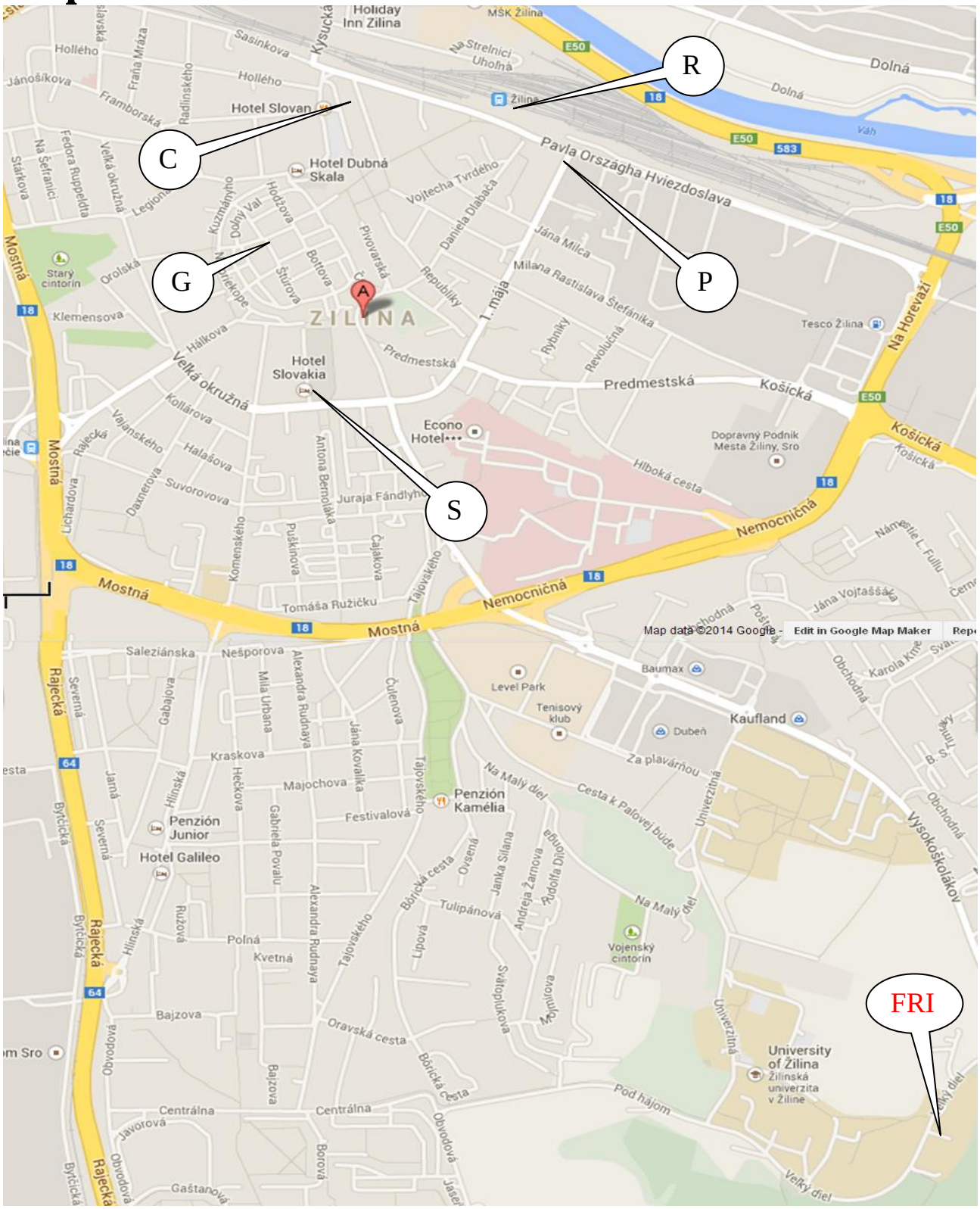
Bojnice Castle is a medieval castle in Bojnice, Slovakia. It is a Romantic castle with some original Gothic and Renaissance elements. Bojnice Castle is one of the most visited castles in Slovakia, receiving hundreds of thousands of visitors every year and also being a popular filming stage for fantasy and fairy-tale movies. The castle is renowned for its attractions, including the popular Castle Fairytale, the International Festival of Ghosts and Spirits and the Summer Music Festival. The romantic castle is also a popular location for filming fairy tale movies, such as Fantaghirò.

Bojnice Castle was first mentioned in written records in 1113, in a document held at the Zobor Abbey. Originally built as a wooden fort, it was gradually replaced by stone, with the outer walls being shaped according to the uneven rocky terrain. Its first owner was Matthew III Csák, who received it in 1302 from the King Ladislaus V of Hungary. Later, in the 15th century, it was owned by King Matthias Corvinus, who gave it to his illegitimate son John Corvinus in 1489. Matthias liked to visit Bojnice and it was here that he worked on his royal decrees. He used to dictate them under his beloved linden tree, which is now known as the "Linden tree of King Matthias". After his death the castle became the property of the Zápolya family (see John Zápolya). The Thurzós, the richest family in the northern Kingdom of Hungary, acquired the castle in 1528 and undertook its major reconstruction. The former fortress was turned into a Renaissance castle. From 1646 on, the castle's owners were the Pálffys, who continued to rebuild the castle.

Finally, the last famous castle owner from the Pálffy family, Count János Ferenc Pálffy (1829-1908), made a complex romantic reconstruction from 1888 to 1910 and created today's beautiful imitation of French castles of the Loire valley. He not only had the castle built, but also was the architect and graphic designer. He utilized his fine artistic taste and love for collecting pieces of art. He was one of the greatest collectors of antiques, tapestries, drawings, paintings and sculptures of his time. After his death and long quarrels, his heirs sold many precious pieces of art from the castle and then, on 25 February 1939, sold the castle, the health spa, and the surrounding land to Ján Baťa.

After 1945, when Bata's property was confiscated by the Czechoslovak government, the castle became the seat of several state institutions. On 9 May 1950, a huge fire broke out in the castle, but it was rebuilt at government expense. After this reconstruction, a museum specializing in the documentation and presentation of the era of architectural neo-styles was opened here. Bojnice Museum is now part of the Slovak National Museum today.

Map of Žilina



C – Hotel Center Park
G – Grand Hotel;
P – Penzion Pars
S – Slovakia Hotel

A – Historical centrum of the city

R – Railway station (near auto station)
FRI – Faculty of Information Sciences and Management

Distance between A and R is near 10 minutes by foot.
Distance between S and FRI is near 25-30 minutes by foot.

Key points in Žilina

The Faculty of Management Science and Informatics of University of Žilina (UNIZA). The address is (in Slovak):

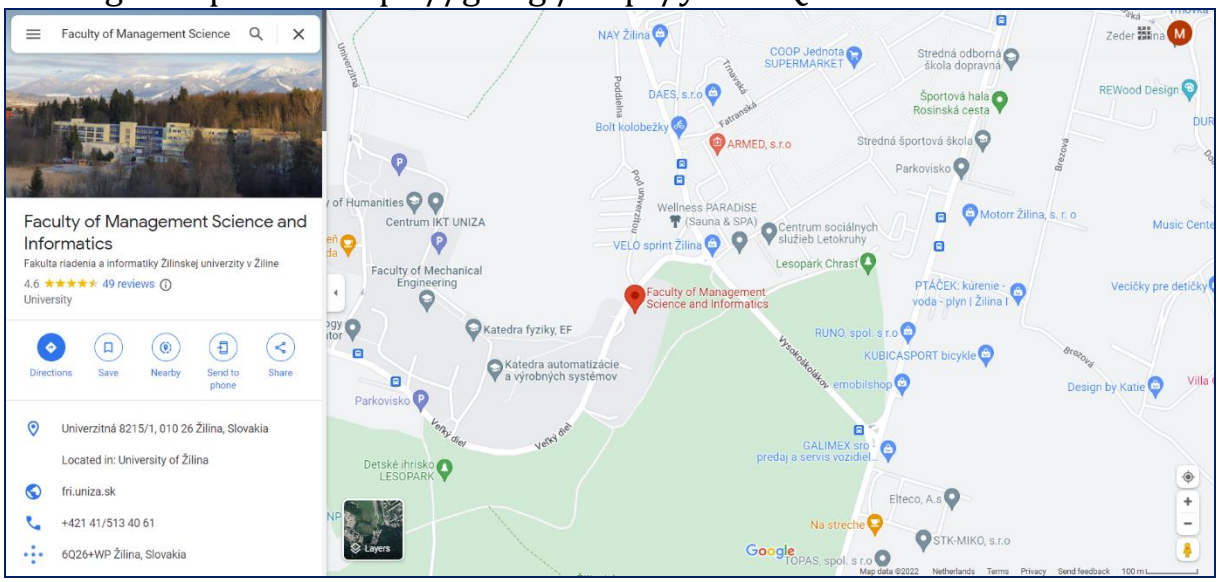
Fakulta riadenia a informatiky

Velky diel 3323

010 26 Žilina

Slovakia

Google maps link: https://goo.gl/maps/y92itPQYrrF4GPWC6



Hotel “Penzion Central Park” in situated the center of Žilina. The address is:

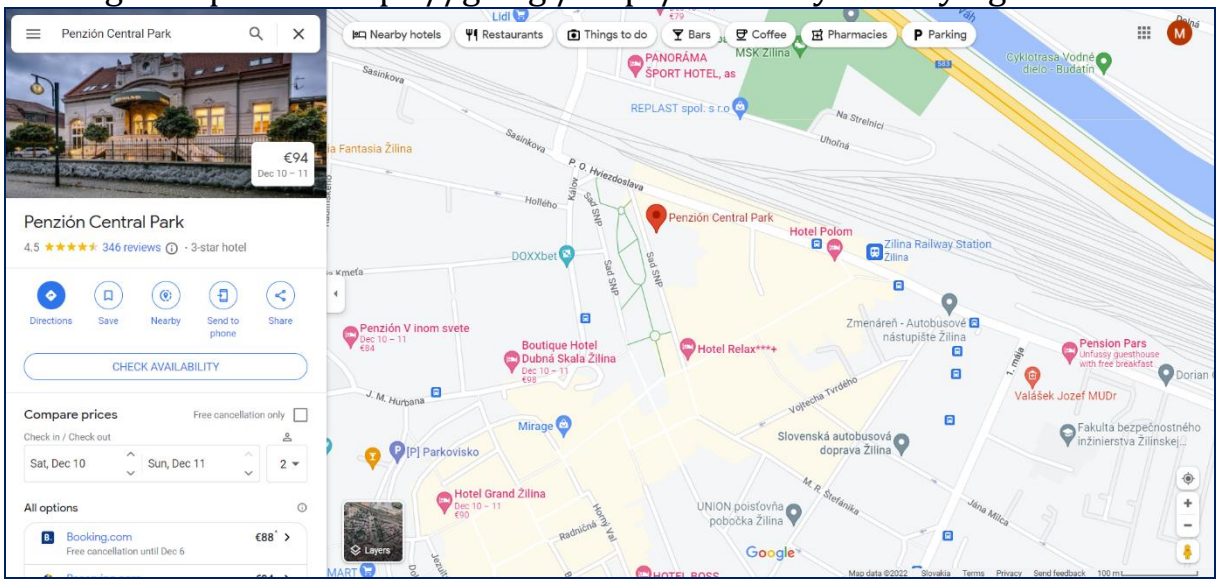
Penzion Central Park, s.r.o.

Sad SNP 663 / 18,

010 01 Žilina

Slovakia

Google maps link: https://goo.gl/maps/E4rKeWyYbrw5yMg6A



Recommendations for Accommodation

The most of the hotels are near the center of Žilina. Based on our previous experiences, we can recommend some of the following accommodations:

- Hotel Grand
- Hotel Boss
- Penzion Central Park: https://www.booking.com/Share-VxFczw
- Penzion Pars: https://www.booking.com/Share-sGLbT59
- Penzion Kamelia: https://www.booking.com/Share-03gQJ7m
- Hotel Dubná Skala: https://www.booking.com/Share-JlQCRGU
- CLAY Apartment Borik: https://www.booking.com/Share-DOH0y4

Žilina has a good public transport and a bus stop (named “Fatranska“) is 4 minutes from the faculty (https://goo.gl/maps/RPhEXsRAVo7t3Yg97).