

Zbornik 25. mednarodne multikonference
INFORMACIJSKA DRUŽBA

Proceedings of the 25th International Multiconference
INFORMATION SOCIETY

2022

Slovenska konferenca o umetni inteligenci
Slovenian Conference on Artificial Intelligence
Mitja Luštrek, Matjaž Gams, Rok Piltaver

Kognitivna znanost
Cognitive Science
Toma Strle, Borut Trpin, Olga Markič

Odkrivanje znanja in podatkovna skladišča - SiKDD
Data Mining and Data Warehouses - SiKDD
Dunja Mladenić, Marko Grobelnik

Kognitonika
Cognitonics
Vladimir A. Fomichov, Olga S. Fomichova

15. mednarodna konferenca o prenosu tehnologij
15th International Technology Transfer Conference
Špela Stres, Robert Blatnik

Demografske in družinske analize
Demographic and Family Analyzes
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Vzgoja in izobraževanje v informacijski družbi
Education in Information Society
Uroš Rajkovič, Borut Batagelj

Vseprisotne zdravstvene storitve in pametni senzorji
Pervasive Health and Smart Sensing
Nina Reščič, Oscar Mayora, Daniel Denkovski

Srednjeevropska konferenca o uporabnem
teoretičnem računalništvu
Middle-European Conference on Applied
Theoretical Computer Science
Andrej Brodnik, Gábor Galambos, Branko Kavšek

Legende računalništva in informatike
Legends of Computing and Informatics
Borut Žalik, Matjaž Gams

Ljubljana, Slovenija
10.-14. oktober
10-14 October
Ljubljana, Slovenia

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PREDGOVOR MULTIKONFERENCI INFORMACIJSKA DRUŽBA 2022

Petindvajseta multikonferenca *Informacijska družba* je preživela probleme zaradi korone. Zahvala za skoraj normalno delovanje konference gre predvsem tistim predsednikom konferenc, ki so kljub prvi pandemiji modernega sveta pogumno obdržali visok strokovni nivo.

Pandemija v letih 2020 do danes skoraj v ničemer ni omejila neverjetne rasti IKTja, informacijske družbe, umetne inteligence in znanosti nasploh, ampak nasprotno – rast znanja, računalništva in umetne inteligence se nadaljuje z že kar običajno nesluteno hitrostjo. Po drugi strani se nadaljuje razpadanje družbenih vrednot ter tragična vojna v Ukrajini, ki lahko pljuske v Evropo. Se pa zavedanje večine ljudi, da je potrebno podpreti stroko, krepi. Konec koncev je v 2022 v veljavo stopil not raziskovalni zakon, ki bo izboljšal razmere, predvsem leto za letom povečeval sredstva za znanost.

Letos smo v multikonferenco povezali enajst odličnih neodvisnih konferenc, med njimi »Legende računalništva«, s katero postavljamo nov mehanizem promocije informacijske družbe. IS 2022 zajema okoli 200 predstavitev, povzetkov in referatov v okviru samostojnih konferenc in delavnic ter 400 obiskovalcev. Prireditve so spremljale okrogle mize in razprave ter posebni dogodki, kot je svečana podelitev nagrad. Izbrani prispevki bodo izšli tudi v posebni številki revije Informatica (<http://www.informatica.si/>), ki se ponaša s 46-letno tradicijo odlične znanstvene revije. Multikonferenco Informacijska družba 2022 sestavljajo naslednje samostojne konference:

- Slovenska konferenca o umetni inteligenci
- Izkopavanje znanja in podatkovna skladišča
- Demografske in družinske analize
- Kognitivna znanost
- Kognitonika
- Legende računalništva
- Vseprisotne zdravstvene storitve in pametni senzorji
- Mednarodna konferenca o prenosu tehnologij
- Vzgoja in izobraževanje v informacijski družbi
- Študentska konferenca o računalniškem raziskovanju
- Matcos 2022

Soorganizatorji in podporniki konference so različne raziskovalne institucije in združenja, med njimi ACM Slovenija, SLAIS, DKZ in druga slovenska nacionalna akademija, Inženirska akademija Slovenije (IAS). V imenu organizatorjev konference se zahvaljujemo združenjem in institucijam, še posebej pa udeležencem za njihove dragocene prispevke in priložnost, da z nami delijo svoje izkušnje o informacijski družbi. Zahvaljujemo se tudi recenzentom za njihovo pomoč pri recenziranju.

S podelitvijo nagrad, še posebej z nagrado Michie-Turing, se avtonomna stroka s področja opredeli do najbolj izstopajočih dosežkov. Nagrado Michie-Turing za izjemen življenjski prispevek k razvoju in promociji informacijske družbe je prejel prof. dr. Jadran Lenarčič. Priznanje za dosežek leta pripada ekipi NIJZ za portal zVEM. »Informacijsko limono« za najmanj primerno informacijsko potezo je prejela cenzura na socialnih omrežjih, »informacijsko jagodo« kot najboljšo potezo pa nova elektronska osebna izkaznica. Čestitke nagrajencem!

Mojca Ciglarič, predsednik programskega odbora
Matjaž Gams, predsednik organizacijskega odbora

FOREWORD - INFORMATION SOCIETY 2022

The 25th *Information Society Multiconference* (<http://is.ijs.si>) survived the COVID-19 problems. The multiconference survived due to the conference chairs who bravely decided to continue with their conferences despite the first pandemics in the modern era.

The COVID-19 pandemic from 2020 till now did not decrease the growth of ICT, information society, artificial intelligence and science overall, quite on the contrary – the progress of computers, knowledge and artificial intelligence continued with the fascinating growth rate. However, the downfall of societal norms and progress seems to slowly but surely continue along with the tragical war in Ukraine. On the other hand, the awareness of the majority, that science and development are the only perspective for prosperous future, substantially grows. In 2020, a new law regulating Slovenian research was accepted promoting increase of funding year by year.

The Multiconference is running parallel sessions with 200 presentations of scientific papers at eleven conferences, many round tables, workshops and award ceremonies, and 400 attendees. Among the conferences, “Legends of computing” introduce the “Hall of fame” concept for computer science and informatics. Selected papers will be published in the *Informatica* journal with its 46-years tradition of excellent research publishing.

The Information Society 2022 Multiconference consists of the following conferences:

- Slovenian Conference on Artificial Intelligence
- Data Mining and Data Warehouses
- Cognitive Science
- Demographic and family analyses
- Cognitronics
- Legends of computing
- Pervasive health and smart sensing
- International technology transfer conference
- Education in information society
- Student computer science research conference 2022
- Matcos 2022

The multiconference is co-organized and supported by several major research institutions and societies, among them ACM Slovenia, i.e. the Slovenian chapter of the ACM, SLAIS, DKZ and the second national academy, the Slovenian Engineering Academy. In the name of the conference organizers, we thank all the societies and institutions, and particularly all the participants for their valuable contribution and their interest in this event, and the reviewers for their thorough reviews.

The award for life-long outstanding contributions is presented in memory of Donald Michie and Alan Turing. The Michie-Turing award was given to Prof. Dr. Jadran Lenarčič for his life-long outstanding contribution to the development and promotion of information society in our country. In addition, the yearly recognition for current achievements was awarded to NIJZ for the zVEM platform. The information lemon goes to the censorship on social networks. The information strawberry as the best information service last year went to the electronic identity card. Congratulations!

Mojca Ciglarič, Programme Committee Chair
Matjaž Gams, Organizing Committee Chair

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**Srednjeevropska konferenca o uporabnem
teoretičnem računalništvu**
**Middle-European Conference on Applied Theoretical
Computer Science**

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Andrej Brodnik, Gábor Galambos, Branko Kavšek

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PREDGOVOR

Leta 2019 – ko smo organizirali 3. MATCOS konferenco – smo trdno verjeli, da smo vzpostavili tradicionalni dogodek v Kopru. V naslednjih letih smo bili osredotočeni na premagovanje covida. Ob tem smo spoznali možnosti uporabe domačih pisarne in sodelovanja na spletnih izvedbah konferenc. Vsemu navkljub smo prepričani, da ostaja konferenca, na kateri pride do osebnega stika in pogovora, nenadomestljiva.

Zato smo pričeli s pripravo naslednje konference MATCOS, 4. po vrsti. Pri organizaciji in izvedbi smo imeli srečo, da so člani tako organizacijskega kot programskega odbora večinoma sprejeli tudi letošnje povabilo ter izdatno prispevali k organizaciji in izvedbi konference.

Vabljen predavanje je običajno eden osrednjih dogodkov konference. Letos bo to predavanje Györgyja Turána z University of Illinois at Chicago (USA) z naslovom »Interpretability of deep-learned error-correcting codes«. Predavanje nam bo posredovalo uvid v vpliv sodobne UI na načrtovanje klasičnih kod za popravljanje napak.

Poleg vabljenega predavanja bo na konferenci predstavljen še izbor člankov iz širokega področja računalništva in informatike vključno s primeri uporabe.

Tradicionalno prihaja na konferenco večina prispevkov in avtorjev iz Madžarske in Slovenije. Vendar je naš napor letos obrodil sad, saj so se jim na naše veliko zadovoljstvo pridružili avtorji še iz sedmih drugih držav in predstavili svoje delo.

Člani tako organizacijskega kot programskega odbora so v zadnjih nekaj mesecih opravili odlično delo. Zato vsem, ki so pomagali pri organizaciji in izvedbi konference MATCOS-22, iskrena zahvala.

Zaključujemo z željo, da boste te dni uživali v Kopru in da vzpostavite nove profesionalne stike na konferenci MATCOS-22.

V imenu organizatorjev
Andrej Brodnik in Gábor Galambos
sopredsdujoča

FOREWORD

In 2019 – when we organized the 3rd MATCOS conference – we strongly believed that we established a new tradition here in Koper. Then, the next few years we had to concentrate to win over the covid. We got acquainted with the possibilities of home offices and the organization of online conferences became current. But we are sure that a conference with personal interviews and discussions are irreplaceable.

So, this year we started to organize the next MATCOS conference, the 4th one. Fortunately, the former members of the Organizing Committee and the Program Committee accepted our invitation and took part actively in organization.

The invited talk is a central point while you organize a conference. This year György Turán from the University of Illinois at Chicago (USA) will present a talk on “Interpretability of deep-learned error-correcting codes”, and so, we can take a look the influence of modern AI research to the design of classical error-correcting processes.

Selecting among the submitted papers we sorted out those ones that came from a wide range of the computer science and its applications.

Following the “traditions” most of the participants come from Hungary and Slovenia, but it is really a great pleasure to see that our efforts have been successful: the authors represent new research results from 7 countries.

The members of PC and OC did an excellent job during the last few months. Thanks to everybody who helped to organise the MATCOS-22.

We hope you will enjoy these days in Koper and you can establish new professional contacts during the MATCOS-22 conference.

On behalf of the organisers

Andrej Brodnik and Gábor Galambos
co-chairs

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