Záznamy vložené do ASEP za UI (1. 9. – 31. 10. 2025)

New ICS records in ASEP (1. 9. – 31. 10. 2025)

0639079 - ÚI 2026 RIV US eng M - Monography Chapter
Kalina, Jan
Simplifying Data With Robust Variable Selection for Enhanced Interpretability and Energy Efficiency.
AI-Based Solutions for Engineering. Hershey: IGI Global, 2025 - (Yücel, M.; Oral, H.), s. 39-70. ISBN 9798337307466
R&D Projects: GA ČR(CZ) GA25-15490S
Grant - others:AV ČR(CZ) StrategieAV21/34
Program: StrategieAV
Institutional support: RVO:67985807
Keywords : Robust variable selection * Dimensionality reduction * Outliers * Energy-efficient computation * Approximate computing
OECD category: Statistics and probability
DOI: https://doi.org/10.4018/979-8-3373-0746-6.ch002
Machine learning, a cornerstone of artificial intelligence, equips engineers and scientists with powerful tools for uncovering valuable insights from complex, large-scale datasets across diverse applications. Engineering applications increasingly demand transparency and interpretability, particularly to understand the reasoning behind specific outcomes and decisions. This chapter addresses this need by exploring dimensionality reduction techniques that enhance model interpretability by focusing on the most significant variables. By employing robust, outlier-resistant methods, we enable a closer analysis of how individual data points impact results, making these approaches ideal for real-world data with inherent noise or contamination. The utility of these techniques is demonstrated on two datasets, one from gene expression analysis and the other from credit scoring. Furthermore, we discuss the relationship between dimensionality reduction and energy-efficient approximate computation, highlighting its relevance for engineering applications in AI.
Permanent Link: https://hdl.handle.net/11104/0369589

0639366 - ÚI 2026 RIV DE eng J - Journal Article
Braunfeld, Samuel Walker - Nešetřil, J. - Ossona de Mendez, P. - Siebertz, S.
On First-Order Transductions of Classes of Graphs.
Logical Methods in Computer Science. Roč. 21, č. 2 (2025). ISSN 1860-5974. E-ISSN 1860-5974
Institutional support: RVO:67985807
Keywords : Finite model theory * first-order transductions * structural graph theory
OECD category: Pure mathematics
Impact factor: 1, year: 2024 ; **AIS:** 0.361, rok: 2024
Method of publishing: Open access
Result website:
https://doi.org/10.46298/lmcs-21(2:26)2025
DOI: https://doi.org/10.46298/lmcs-21(2:26)2025
We study various aspects of the first-order transduction quasi-order on graph classes, which provides a way of measuring the relative complexity of graph classes based on whether one can encode the other using a formula of first-order (FO) logic. In contrast with the conjectured simplicity of the

transduction quasi-order for monadic second-order logic, the FO-transduction quasi-order is very complex, and many standard properties from structural graph theory and model theory naturally appear in it. We prove a local normal form for transductions among other general results and constructions, which we illustrate via several examples and via the characterizations of the transductions of some simple classes. We then turn to various aspects of the quasi-order, including the (non-)existence of minimum and maximum classes for certain properties, the strictness of the pathwidth hierarchy, the fact that the quasi-order is not a lattice, and the role of weakly sparse classes in the quasi-order.
Permanent Link: https://hdl.handle.net/11104/0369809

0639509 - ÚI 2026 US eng J - Journal Article
Braunfeld, Samuel Walker - Laskowski, M.
Indiscernibles in monadically NIP theories.
Bulletin of the London Mathematical Society. Online first 25 July 2025 (2025). ISSN 0024-6093. E-ISSN 1469-2120
Institutional support: RVO:67985807
Impact factor: 0.9, year: 2024 ; **AIS:** 1.064, rok: 2024
Method of publishing: Open access
DOI: https://doi.org/10.1112/blms.70155
We prove various results around indiscernibles in monadically NIP theories. First, we provide several characterizations of monadic NIP in terms of indiscernibles, mirroring previous characterizations in terms of the behavior of finite satisfiability. Second, we study (monadic) distality in hereditary classes and complete theories. Here, via finite combinatorics, we prove a result implying that every planar graph admits a distal expansion. Finally, we prove a result implying that no monadically NIP theory interprets an infinite group, and note an example of a (monadically) stable theory with no distal expansion that does not interpret an infinite group
Permanent Link: https://hdl.handle.net/11104/0369927

0640620 - ÚI 2026 DE eng J - Journal Article
Dropka, N. - Petkovic, M. - Frank-Rotsch, C. - Linke, D. - Holeňa, Martin
Toward a Universal Czochralski Growth Model Leveraging Data-Driven Techniques.
Advanced Theory and Simulations. Online 17 September 2025 (2025), č. článku e01159. E-ISSN 2513-0390
Institutional support: RVO:67985807
Impact factor: 2.9, year: 2024 ; **AIS:** 0.677, rok: 2024
Method of publishing: Open access
DOI: https://doi.org/10.1002/adts.202501159
The Czochralski (Cz) method is widely employed for growing crystalline semiconductors from low-vapor-pressure materials. Although furnace designs vary depending on the material, shared hot-zone components, such as crucibles, supports, heaters, insulation, and radiation shields-indicate the potential for a universal Cz furnace model. This study focuses on Cz furnaces that utilize resistance heating. Data-driven techniques including Decision Trees (DT), Symbolic Regression (SR), Artificial Neural Networks (ANN), and Shapley Additive exPlanations (SHAP) are applied to investigate the relationships between furnace design, process parameters, and crystal quality during bulk crystal growth across a range of materials and scales. DT and SR are employed for their interpretability, ANN for its predictive accuracy, and SHAP to enhance model transparency by quantifying feature importance. The analysis explores the correlation between solid–liquid interface deflection, the Voronkov criterion, and 21 input parameters describing furnace geometry, gas composition, crystal and radiation shield thermophysical properties, and growth conditions. The training dataset consists of

632 computational fluid dynamics (CFD) simulations of Cz growth involving silicon, germanium, gallium antimonide, and indium antimonide. Feature engineering using DTs is performed to reduce input dimensionality. The results demonstrate the feasibility of generating a universal Cz growth model that utilizes machine learning techniques to optimize performance across diverse grown materials, furnace configurations, and production scales.
Permanent Link: https://hdl.handle.net/11104/0371000

0639567 - ÚI 2026 NL eng J - Journal Article
Španiel, F. - Anýž, J. - Grygarová, D. - Hubený, J. - Koudelka, V. - Shalkin, I. - Štrobl, J. - Hlinka, Jaroslav - Nagy, T. - Jakob, L. - Schneider, J. - Kudelka, J. - Bakštein, E.
Infra-slow frequency oscillations propagating through multiple organs convey information on phase-specific timing for self-initiated actions.
Brain Research. Online 30 September 2025 (2025), č. článku 149964. ISSN 0006-8993. E-ISSN 1872-6240
R&D Projects: GA MŠMT(CZ) EH22_008/0004643
Institutional support: RVO:67985807
Keywords : Infra-slow frequency oscillations * Self-initiated action * Pupillary hippus * Heart rate variability * Respiratory patterns
Impact factor: 2.6, year: 2024 ; **AIS:** 0.713, rok: 2024
DOI: https://doi.org/10.1016/j.brainres.2025.149964
Cognitive functions crucial for voluntary actions fluctuate with infra-slow frequencies (ISF, <0,2 Hz), indicating their potential impact with self-driven behavior. ISF's involvement in brain-body interaction suggests that the link between ISF oscillations and self-initiated actions can be explored through low-frequency physiological readouts in peripheral organs. Based on these insights, we investigated if ISF in peripheral systems relates to spontaneous motor activity. We analyzed pupillary hippus, heart RR intervals, and respiration against self-paced button presses across various ISF frequencies in 16 participants. Our results were validated with a second dataset of 25 healthy individuals.
Self-initiated actions were more likely to occur within a specific phase of the slow3 ISF band (0.073–0.198 Hz) across all observed organ systems. We found phase-locking in the slow3 across those physiological signals, indicating synchronized ISF oscillations spreading throughout the body. The phase locking of spontaneous actions is not distributed randomly. At certain phases of ISF slow3 oscillations, self-initiated actions prevail. This suggests that determined ISF oscillations detectable in the autonomic nervous system relate to when we act. Further exploration of this pathway could deepen insights into the complexities of conscious action initiation. The study did not measure the timing or presence of conscious intention and therefore cannot determine whether conscious will is the final trigger for action
Permanent Link: https://hdl.handle.net/11104/0369995

0639086 - ÚI 2026 RIV NL eng J - Journal Article
Stepanova, N. - Turčičová, Marie
Adaptive exact recovery in sparse nonparametric models.
Statistical Inference for Stochastic Processes. Roč. 28, October 2025 (2025), č. článku 15. ISSN 1387-0874. E-ISSN 1572-9311
R&D Projects: GA MŠMT(CZ) EH22_008/0004583
Institutional support: RVO:67985807
Keywords : Gaussian white noise * sparsity * exact selection * sharp selection boundary * Hamming risk * functional ANOVA model
Impact factor: 1, year: 2024 ; **AIS:** 0.421, rok: 2024
Method of publishing: Open access
Result website:https://doi.org/10.1007/s11203-025-09333-w

DOI: https://doi.org/10.1007/s11203-025-09333-w
We observe an unknown function of d variables f(t), t ∈ [0, 1]^d, in the Gaussian white noise model of intensity ε > 0. We assume that the function f is regular and that it is a sum of k-variate functions, where k varies from 1 to s (1 ≤ s ≤ d). These functions are unknown to us and only a few of them are nonzero. In this article, we address the problem of identifying the nonzero components of f in the case when d = d_ε → ∞ as ε → 0 and s is either fixed or s = s_ε → ∞, s = o(d) as ε → ∞. This may be viewed as a variable selection problem. We derive the conditions when exact variable selection in the model at hand is possible and provide a selection procedure that achieves this type of selection. The procedure is adaptive to a degree of model sparsity described by the sparsity parameter β ∈ (0, 1). We also derive conditions that make the exact variable selection impossible. Our results augment previous work in this area.
Permanent Link: https://hdl.handle.net/11104/0369599

0638819 - ÚI 2026 RIV BE eng J - Journal Article
Böhm, A. - Lucka, J. - Segev, A. - Kollárová, M. - Toth, S. - Jajcay, Nikola - Bezák, B.
A novel, non-invasive AI-based telemonitoring system for heart failure: Detection of undiagnosed hyperthyroidism in an asymptomatic patient.
European Journal of Case Reports in Internal Medicine. Roč. 12, č. 8 (2025). ISSN 2284-2594
Institutional support: RVO:67985807
Keywords : Heart failure * telemonitoring * artificial intelligence * hyperthyroidism * photoplethysmography
OECD category: Cardiac and Cardiovascular systems
Method of publishing: Open access
Result website:
https://doi.org/10.12890/2025_005420
DOI: https://doi.org/10.12890/2025_005420
BACKGROUND: Untreated thyroid disorders may precipitate heart failure (HF) decompensation. Assessment of cardiac filling pressures may aid in the early detection and prevention of clinical decompensation. Therapy guided by monitoring of cardiac filling pressures has been shown to improve quality of life and survival and reduce hospitalizations of individuals with HF. We have developed a non-invasive method to assess left ventricular filling pressures (LVFP) by analysing the photoplethysmography signal with Seeling HeartCore technology (Seerlinq, Bratislava, Slovakia). CASE DESCRIPTION: A 99-year-old female visited the clinic for a routine cardiac check-up. Laboratory investigations showed elevated NTproBNP and moderately elevated high sensitive troponin T. HeartCore algorithm indicated elevated LVFP. As part of the evaluation of worsening of sub-clinical HF, extended laboratory tests revealed low thyroid-stimulating hormone with high free thyroxine levels indicating increased thyroid function. The endocrinologist diagnosed hyperthyroidism with multinodular goitre and prescribed thiamazole. To prevent progression to clinical HF decompensation, the dose of furosemide was increased. At 4 months, during scheduled cardiac follow-up, the patient was clinically doing well, without any signs or symptoms of HF. DISCUSSION: Remote monitoring devices that track pressures in the pulmonary artery require invasive implantation and are associated to potential complications. The high cost of these devices presents a significant barrier to widespread use. SEERLINQ is a novel system for remote haemodynamic monitoring based on non-invasive assessment of LVFP, presenting a promising alternative to current invasive methods. CONCLUSION: This case underscores the potential benefits of this technology in the early recognition of pre-clinical deterioration and its implementation for remote home monitoring in patients with HF.
Permanent Link: https://hdl.handle.net/11104/0369379

0638622 - ÚVGZ 2026 RIV DE eng J - Journal Article
Lehnert, M. - Janků, Zdeněk - Novotný, D. - Jurek, M. - Geletič, Jan
Assessment of air temperature indices and urban heat island intensity
based on two meteorological networks in Prague, Czechia.
Theoretical and Applied Climatology. Roč. 156, č. 9 (2025). ISSN 0177-798X. E-ISSN 1434-4483
Institutional support: RVO:86652079 ; RVO:67985807
Keywords : Urban heat island * Network of meteorological measurements * Air temperature indices * Local climate zones * Heat waves
OECD category: Meteorology and atmospheric sciences
Impact factor: 2.7, year: 2024 ; **AIS:** 0.589, rok: 2024
Method of publishing: Open access
Result website: https://link.springer.com/content/pdf/10.1007/s00704-025-05707-5.pdf
DOI: https://doi.org/10.1007/s00704-025-05707-5
The growing focus on studying urban climate has been driven by the broader interest in the impacts of climate change. Even though urban climate modelling continues to expand, in-situ measurements in urban areas remain irreplaceable. This study is the first to evaluate a set of measurements from a municipal network for climate monitoring (OICT), and data from the Czech Hydrometeorological Institute network (CHMI) in Prague (Czechia). Our study, based on data from 2023, shows the spatiotemporal variation in air temperature in the city, which results, on average, in minimum, maximum, and mean daily air temperature differences of up to 3.2 °C. The highest values of heat air temperature indices, as well as urban heat island intensity based on daily mean, minimum, and maximum temperature (UHII*), were recorded in local climate zones LCZ 2, LCZ 5, and LCZ 8, the lowest in LCZ B and LCZ D. The intrazonal spatial variability results from the specifics in solar irradiation at the station during the day, as well as from the characteristics of the surface, the relief, and the general “representativeness” of the parent LCZ class properties. Prague’s UHII* is spatially less extensive at night and has a different spatial pattern to the daytime conditions. The UHII* enhancement during the heat-wave period was low (0.1 °C on average). Comparing seasons, UHII* was 0.4 °C lower on average in winter than in summer. Such results demonstrate that the recently established network has the potential to contribute to our understanding of the (changing) climate in Prague.
Permanent Link: https://hdl.handle.net/11104/0369236

0639074 - ÚI 2026 DE eng J - Journal Article
Kalina, Jan
A Robust Coefficient of Determination Based on Implicit Weighting.
Applications of Mathematics. Accepted September 2025. ISSN 0862-7940. E-ISSN 1572-9109
Institutional support: RVO:67985807
Method of publishing: Open access
DOI: https://doi.org/10.21136/AM.2025.0105-25
Permanent Link: https://hdl.handle.net/11104/0369585

0639076 - ÚI 2026 J - Journal Article
Elavsky, S. - Brabec, Marek - Malý, Marek - Knapová, L. - Kaštovská, B. - Sebera, M. - Ely, M. - Jandačková, V. K. - Keller, J. - Pavel, M.
The Temporal Dynamics of the Association between Daily Physical Activity and Life Satisfaction.
ANNALS OF BEHAVIORAL MEDICINE. Accepted September 2025. ISSN 0883-6612. E-ISSN 1532-4796
R&D Projects: GA MŠMT(CZ) EH22_008/0004583
Institutional support: RVO:67985807
Permanent Link: https://hdl.handle.net/11104/0369587

0639507 - ÚI 2026 RIV CH eng C - Conference Paper (international conference)
Keikha, Vahideh - Löffler, M. - Saumell, M. - Valtr, P.
Guarding a 1.5D Terrain with Imprecise Viewpoints.
Combinatorial Algorithms. 36th International Workshop, IWOCA 2025 Proceedings. Cham: Springer, 2025 - (Fernau, H.; Zhu, B.), s. 3-16. Lecture Notes in Computer Science, 15885. ISBN 978-3-031-98739-7. ISSN 0302-9743.
[IWOCA 2025: International Workshop on Combinatorial Algorithms /36./. Bozeman (US), 21.07.2025-24.07.2025]
Grant - others: Akademie věd - GA AV ČR(CZ) L100302301
Institutional support: RVO:67985807
Keywords : 1.5D terrain * Data imprecision * Multiple Viewpoints * Visibility
Result website: https://doi.org/10.1007/978-3-031-98740-3_1
DOI: https://doi.org/10.1007/978-3-031-98740-3_1
Given an n-vertex 1.5D terrain T and a set of m edges of T, we study the problem of placing one viewpoint on each edge so that the total length of the visible portions of the terrain is maximized. We present an O(n+mlogm) time 12-approximation algorithm for the general problem, and polynomial-time algorithms for the cases m=1 and m=2. Additionally, we show that the problem of computing a point on T maximizing the visible portion of T can be solved in O(n3) time.
Permanent Link: https://hdl.handle.net/11104/0369926

0639500 - ÚI 2026 RIV DE eng C - Conference Paper (international conference)
Ayala-Rincón, M. - Cerna, David M. - Kutsia, T. - Ringeissen, Ch.
Combining Generalization Algorithms in Regular Collapse-Free Theories.
10th International Conference on Formal Structures for Computation and Deduction (FSCD 2025). LIPICs Proceedings, vol. 337. Dagstuhl: Schloss Dagstuhl – Leibniz-Zentrum für Informatik, 2025 - (Fernández, M.), č. článku 7. Leibniz International Proceedings in Informatics (LIPIcs), 337. ISBN 978-3-95977-374-4. ISSN 1868-8969.
[FSCD 2025: International Conference on Formal Structures for Computation and Deduction /10./. Birmingham (GB), 14.07.2025-20.07.2025]
R&D Projects: GA ČR(CZ) GF22-06414L
Institutional support: RVO:67985807
Keywords : Generalization * Anti-unification * Equational theories * Combination
OECD category: Computer sciences, information science, bioinformathics (hardware development to be 2.2, social aspect to be 5.8)
Result website: https://doi.org/10.4230/LIPIcs.FSCD.2025.7
DOI: https://doi.org/10.4230/LIPIcs.FSCD.2025.7
We look at the generalization problem modulo some equational theories. This problem is dual to the unification problem: given two input terms, we want to find a common term whose respective two instances are equivalent to the original terms modulo the theory. There exist algorithms for finding generalizations over various equational theories. We focus on modular construction of equational generalization algorithms for the union of signature-disjoint theories. Specifically, we consider the class of regular and collapse-free theories, showing how to combine existing generalization algorithms to produce specific solutions in these cases. Additionally, we identify a class of theories that admit a generalization algorithm based on the application of axioms to resolve the problem. To define this class, we rely on the notion of syntactic theories, a concept originally introduced to develop unification procedures similar to the one known for syntactic unification. We demonstrate that syntactic theories are also helpful in developing generalization procedures similar to those used for syntactic generalization.
Permanent Link: https://hdl.handle.net/11104/0369920

0639493 - ÚI 2026 RIV DE eng C - Conference Paper (international conference)
Bonnet, E. - Braunfeld, Samuel Walker - Eleftheriadis, I. - Geniet, C. - Mählmann, N. - Pilipczuk, M. - Przybyszewski, W. - Toruńczyk, S.
Separability Properties of Monadically Dependent Graph Classes.
52nd International Colloquium on Automata, Languages, and Programming (ICALP 2025). Proceedings. Dagstuhl: Schloss Dagstuhl – Leibniz-Zentrum für Informatik, 2025 - (Censor-Hillel, K.; Grandoni, F.; Ouaknine, J.; Puppis, G.), č. článku 147. Leibniz International Proceedings in Informatics (LIPIcs), 334. ISBN 978-3-95977-372-0.
[ICALP 2025: EATCS International Colloquium on Automata, Languages, and Programming /52./. Aarhus (DK), 08.07.2025-11.07.2025]
Institutional support: RVO:67985807
Keywords : Structural graph theory * Monadic dependence
Result website:https://doi.org/10.4230/LIPIcs.ICALP.2025.147
DOI: https://doi.org/10.4230/LIPIcs.ICALP.2025.147
A graph class $\mathcal{C}$ is monadically dependent if one cannot interpret all graphs in colored graphs from $\mathcal{C}$ using a fixed first-order interpretation. We prove that monadically dependent classes can be exactly characterized by the following property, which we call flip-separability: for every $r \in \mathbb{N}$, $\varepsilon > 0$, and every graph $G \in \mathcal{C}$ equipped with a weight function on vertices, one can apply a bounded (in terms of $\mathcal{C}$,r,ε) number of flips (complementations of the adjacency relation on a subset of vertices) to G so that in the resulting graph, every radius-r ball contains at most an ε-fraction of the total weight. On the way to this result, we introduce a robust toolbox for working with various notions of local separations in monadically dependent classes.
Permanent Link: https://hdl.handle.net/11104/0369910

0639226 - ÚI 2026 CH eng C - Conference Paper (international conference)
Pérez Cabrera, Iván - Vomlel, J. - Martinková, Patrícia
From RBMs to BN2A Models: Parameter Transformation for Interpretable Educational Diagnostics.
Symbolic and Quantitative Approaches to Reasoning with Uncertainty. ECSQARU 2025 Proceedings. Cham: Springer, 2026 - (Sauerwald, K.; Thimm, M.), s. 104-117. Lecture Notes in Artificial Intelligence, 16099. ISBN 978-3-032-05133-2. ISSN 0302-9743
R&D Projects: GA MŠMT(CZ) EH22_008/0004583; GA ČR(CZ) GA25-18070S
Institutional support: RVO:67985807
Keywords : Restricted Boltzmann Machines * BN2A models * Educational Assessment * Interpretable machine learning
DOI: https://doi.org/10.1007/978-3-032-05134-9_8
Restricted Boltzmann Machines (RBMs) are bipartite graphical models with binary latent and observed variables that have shown promise for representation learning. However, their lack of interpretable parameters limits their utility in domains requiring explainability, like educational assessment. Despite extensive RBM research, non-negativity constraints on weights—essential for monotonicity in educational contexts—remain largely unexplored. To address this, we propose a method to translate RBMs into a specialized class of bipartite Bayesian networks, which we term BN2A networks, characterized by strict 2-layer separation (hidden and observed variables), Noisy-AND conditional probability tables, and directly interpretable parameters for educational models. Our work establishes a mathematical transformation from RBM weights to BN2A's interpretable parameters (leak and penalty probabilities), theoretical analysis showing BN2A's constrained connectivity is a subset of RBM architectures, and empirical evidence that the transformation preserves model fidelity under realistic conditions. By bridging these paradigms, our method leverages RBM's representational power while achieving BN2A's interpretability, opening new possibilities for adaptive learning systems and diagnostic tools.
Permanent Link: https://hdl.handle.net/11104/0369689

0638738 - ÚI 2026 eng C - Conference Paper (international conference)
Vidnerová, Petra - Neruda, Roman
Network Text Analysis Framework for Mapping Research Trends: A Neural Architecture Search Case Study (ACCEPTED to ITAT 2025 Proceedings).
[ITAT 2025: Information technologies -- Applications and Theory /25./. Telgárt (SK), 26.09.2025-30.09.2025]
R&D Projects: GA MŠMT(CZ) EH23_025/0008711
Institutional support: RVO:67985807
Keywords : network text analysis * semantic graphs * large language models application * neural architecture search
Understanding the evolution of research trends is critical for navigating rapidly developing scientific literature. Large Language Models (LLMs) offer powerful tools for analysing scientific texts, enabling the extraction of key concepts and the construction of semantic networks. These capabilities can support the study of emerging ideas and research trends through graph-based representations. In this paper, we present a network-based text analysis framework designed to map the evolution of scientific knowledge. Our goal is to extract conceptual structures from research papers and construct graphs that represent both the occurrence of terms and their interrelationships. The integration of temporal information allows us to track the emergence and transformation of research themes. We demonstrate this framework using a case study on Neural Architecture Search (NAS) field, a fast-growing subfield in machine learning focused on the automated design of neural networks. Using data from ArXiv combined with metadata and citation records from OpenAlex, we construct and analyse graphs of keywords and articles. This allows us to reveal the dynamics of the NAS research landscape and highlight methodological trends and conceptual shifts.
Permanent Link: https://hdl.handle.net/11104/0369331

0638481 - ÚI 2026 RIV CH eng C - Conference Paper (international conference)
Kůrková, Věra - Sanguineti, M.
Classification of large data sets by neural networks: A probabilistic viewpoint.
Artificial Neural Networks and Machine Learning – ICANN 2025. Proceedings, Part I. Cham: Springer, 2025 - (Senn, W.; Sanguineti, M.; Saudargiene, A.; Tetko, I.; Villa, A.; Jirsa, V.; Bengio, Y.), s. 480-486. Lecture Notes in Computer Science, 16068. ISBN 978-3-032-04557-7. ISSN 0302-9743.
[ICANN 2025: International Conference on Artificial Neural Networks /34./. Kaunas (LT), 09.09.2025-12.09.2025]
R&D Projects: GA ČR(CZ) GA25-15490S
Institutional support: RVO:67985807
Keywords : Binary classification * Accuracy of approximation * Random classifiers * Concentration of measure * Method of bounded differences * Growth functions
OECD category: Computer sciences, information science, bioinformathics (hardware development to be 2.2, social aspect to be 5.8)
Result website:
https://doi.org/10.1007/978-3-032-04558-4_38
DOI: https://doi.org/10.1007/978-3-032-04558-4_38
A probabilistic approach to the classification of large data sets is presented. For data drawn from distributions that do not satisfy the naive Bayes assumption (when the presence of features is not independent of one another), conditions on the distributions are given that guarantee the almost deterministic behavior of errors in approximation by neural networks. It is shown that mean values of correlations with network computational units, together with the growth of sizes of their sets of input/output functions, can be used to assess the suitability of networks for classes of tasks characterized by probabilities modeling their relevance for a given type of applications.
Permanent Link: https://hdl.handle.net/11104/0369134

0639114 - ÚTIA 2026 RIV JP eng C - Conference Paper (international conference)
Kratochvíl, Václav - Jiroušek, Radim - Daniel, Milan
Learning Belief Functions from Data via Polyhedral Methods.
Proceedings of the 25th Czech-Japan Seminar on Data Analysis and Decision Making under Uncertainty. Osaka: Osaka Metropolitan University, 2025 - (Kusunoki, Y.; Kratochvíl, V.), s. 9-20
[Czech-Japan Seminar on Data Analysis and Decision Making under Uncertainty 2025 /25./. Otsu City, Siga (JP), 09.09.2025-12.09.2025]
Institutional support: RVO:67985556 ; RVO:67985807
Keywords : belief functions * linear programing * polytop
OECD category: Statistics and probability
Result website:https://library.utia.cas.cz/separaty/2025/MTR/kratochvil-0639114.pdf
We present a polyhedral framework for learning belief functions from data when empirical lower and upper probability bounds are obtained from Jeffreys' binomial confidence intervals. Such bounds, interpreted as empirical belief and plausibility values for all subsets of the outcome space, generally yield a pseudo-belief function that may not correspond to any valid basic probability assignment (BPA) satisfying the axioms of Dempster–Shafer theory.
Our approach formulates the correction problem as a system of linear constraints in the BPA space, where the feasible solutions form a convex polyhedron of belief functions consistent with the empirical bounds. We investigate several linear optimization criteria for selecting a representative BPA from this feasible set, including L1-projection to the empirical lower bounds, Dubois–Prade entropy maximization, sparsity-oriented objectives, and cardinality-weighted allocations.
Permanent Link: https://hdl.handle.net/11104/0370095

0639265 - ÚI 2026 RIV eng U - Conference, Workshop Arrangement
Martinková, Patrícia - Netík, Jan
Development of Interactive Shiny Modules for Psychometric Research Dissemination.
[Minneapolis, 14.07.2025-14.07.2025, (W-WRD)]
R&D Projects: GA MŠMT(CZ) EH22_008/0004583; GA ČR(CZ) GA25-18070S
Institutional support: RVO:67985807
Keywords : R * Shiny
Result website:
https://www.psychometricsociety.org/post/development-interactive-shiny-modules-psychometric-research-dissemination
Shiny applications are interactive web applications built entirely in R, designed for general data visualization and analysis. They enable dynamic demonstrations of statistical concepts and algorithms, facilitating teaching, learning, and dissemination of methodological research. ShinyItemAnalysis (SIA) is an R package and Shiny application specifically designed for the interactive presentation of psychometric methods and the analysis of multi-item measurements in education, psychology, and related fields (Martinková & Hladká, 2023). The package recently introduced open, extendable functionality through add-on modules that can easily reuse features already implemented in the main SIA application (Martinková, Netík, & Hladká, 2025). In this workshop, participants will explore the fundamentals of building Shiny applications using a traditional approach and contrast it with the innovative modular framework of SIA, which will be the primary focus for the remainder of the session. We will provide a comprehensive overview of the SIA infrastructure, combining psychometric concepts with practical functionalities such as data uploading and processing. The workshop also includes a hands-on introduction to the SIAtools package, designed to streamline the development of add-on modules. Practical demonstrations will feature sample modules from SIAmodules and other packages, providing participants with actionable insights into designing and deploying their own interactive applications for psychometric research and education.
Permanent Link: https://hdl.handle.net/11104/0369728

0639244 - ÚI 2026 RIV eng U - Conference, Workshop Arrangement
Martinková, Patrícia - Hladká, Adéla - Netík, Jan
Modelling Responses in Multi-Item Measurements with R and Shiny (Pre-Conference event of EAM 2025 - XI European Congress of Methodology).
[San Cristobal de La Laguna, 22.07.2025-22.07.2025, (W-EUR)]
R&D Projects: GA MŠMT(CZ) EH22_008/0004583; GA ČR(CZ) GA25-18070S
Institutional support: RVO:67985807
Keywords : psychometrics * R * Shiny * testing
Result website:
https://eam2025.eu/workshops/
Item response analysis is crucial for developing high-quality educational and psychological assessments. It not only provides valuable insight into respondent behaviors or student performance but also informs evidence-based policies. Over the years, various methods have been proposed for modeling item responses based on respondent data. Recently, more complex data, such as item text wording, have also been harnessed with numerous analytical methods. This workshop equips participants with a deeper understanding of item response analysis and practical skills for performing it using traditional methods, regression models, item response theory (IRT), and machine learning techniques. We will start with a step-by-step development of IRT models, illustrating their relationships with traditional item characteristics and simpler regression models. Next, we will explore differential item functioning and measurement invariance – key concepts for detecting potentially biased items and a detailed understanding of student performance and respondent behavior across different social groups. The final part will be devoted to item text analysis using machine learning methods. The workshop follows selected chapters from “Computational Aspects of Psychometric Methods: With R”, authored by the instructors and published by CRC Press/Chapman C Hall in 2023. The course lectures will be complemented by practical exercises, allowing participants to apply the presented techniques using R, a free and open-source statistical software. We will utilize the ShinyItemAnalysis and difNLR packages, along with other R packages. Moreover, an interactive ShinyItemAnalysis application and its add-on modules will be used for hands-on training, enabling the participants to perform all necessary analyses in a user-friendly environment. Before the course, the participants will receive detailed instructions on how to install the necessary software. Previous experience with R is a plus, but the course is designed to be accessible even for R novices. References: Martinková, P., C Hladká, A. (2023). Computational Aspects of Psychometric Methods: With R. Chapman and Hall/CRC.
Permanent Link: https://hdl.handle.net/11104/0369708

0640393 - MÚA 2026 RIV cze U - Conference, Workshop Arrangement
Martinovská, Soňa - Víta, Martin
Umělá inteligence v archivním světě.
[Artificial intelligence in the archival world.]
[Praha, 23.09.2025, (W-EUR 15/1)]
Grant - others:AV ČR(CZ) StrategieAV21/34
Program: StrategieAV
Institutional support: RVO:67985921 ; RVO:67985807
Keywords : artificial intelligence * new technologies * archiving
OECD category: History (history of science and technology to be 6.3, history of specific sciences to be under the respective headings)
Result website:
https://www.mua.cas.cz/cs/udalost/umela-inteligence-v-archivnim-svete
Odborný workshop se zaměřil na možnosti využití umělé inteligence v archivnictví a na sdílení praktických zkušeností mezi archiváři z různých institucí a odborníky z oblasti IT. Nabídl přehled aktuálních projektů a nástrojů, které využívají AI například při automatizovaném přepisu archiválií,

inteligentním vyhledávání, v předarchivní péči, spisové službě či při tvorbě on-line výstav. Workshop byl dostupný také online formou live streamu.
The expert workshop focused on the possibilities of using artificial intelligence in archival practice and on sharing practical experience among archivists from different institutions and IT specialists. It offered an overview of current projects and tools employing AI, for example in automated transcription of archival materials, intelligent search, pre-archival care, records management, and the creation of online exhibitions. The workshop was also available online via a live stream.
Permanent Link: https://hdl.handle.net/11104/0370797

0639344 - ÚI 2026 CZ cze N - Newspaper Article
ČTK - Geletič, Jan
Vědci zmapují on-line dotazníkem pocitovou teplotu.
Právo. Roč. 35, č. 167 (2025), s. 18-18. ISSN 1211-2119
Institutional support: RVO:67985807
Keywords : popularizace vědy * popularisation of science
OECD category: Meteorology and atmospheric sciences
Pocitovou teplotu v Praze má zmapovat nový projekt vědců z Ústavu informatiky Akademie věd ČR. Připravili on-line dotazník, kde každý, kdo se v létě pohybuje v Praze, může zaznamenat svou pocitovou teplotu. Výsledky budou sbírat do poloviny září, možná déle. Akademie věd o tom informovala v tiskové zprávě. Cílem je například zlepšit plánování adaptačních opatření ve městech. V dotazníku je mapa Prahy rozdělena do takzvaných kvadrátů neboli čtverců, díky čemuž člověk může ohodnotit vícero oblastí velkoměsta. Při kliknutí na konkrétní oblast se člověku ukáže okno s otázkou: Jaké tepelné podmínky zde během letních dní obvykle pociťujete? Na výběr k zadání má z vícero možností od zimy po horko. Poté je možné zadat pohlaví, věkovou skupinu, zda dotyčný žije trvale v Praze a jaké má nejvyšší dosažené vzdělání. Avšak tyto informace není povinné uvádět. Všechna data jsou plně anonymní. Výsledky budou využity v mezinárodním evropském projektu CARMINE a Strategie AV21. Poslouží ale také pro diskusi se spolupracujícím pražským magistrátem, Operátorem ICT, Institutem plánování a rozvoje hlavního města Prahy a dalšími subjekty, které řeší městské klima v Praze. Zároveň výsledky poslouží jako jeden z podkladů pro preciznější plánování opatření ke zmírnění nebo snížení dopadů změny klimatu Pocitová teplota je teplota, kterou člověk subjektivně vnímá, a může se výrazně lišit od skutečné teploty vzduchu, jež je v dané době naměřená teploměrem. Výsledky poslouží pro preciznější plánování opatření ke zmírnění dopadů změny klimatu.
Permanent Link: https://hdl.handle.net/11104/0369788

0638820 - ÚI 2026 N - Newspaper Article
Padavic-Callaghan, K. - Haniková, Zuzana - Clarke-Doane, J.
Why mathematicians want to destroy infinity – and may succeed.
NEW SCIENTIST. 4. August 2025 (2025). ISSN 0262-4079
Institutional support: RVO:67985807
Keywords : popularisation of science * popularizace vědy * logic
Result website:
https://www.newscientist.com/article/2489813-why-mathematicians-want-to-destroy-infinity-and-may-succeed/

Mathematicians who call themselves ultrafinitists think that extremely large numbers are holding back science, from logic to cosmology, and they have a radical plan to do something about it.
Permanent Link: https://hdl.handle.net/11104/0369380

0639362 - ÚI 2026 CZ cze E - Electronic Document
Seyčková, Z. - Geletič, Jan
AV ČR z Univerzity Palackého v Olomouci žádá o pomoc s mapováním pocitové teploty na území Prahy.
Praha: Praha11.cz, 2025
Institutional support: RVO:67985807
Keywords : popularisation of science * popularizace vědy * klima
OECD category: Meteorology and atmospheric sciences
Result website:
https://www.praha11.cz/cs/media/aktuality/deje-se-na-jiznim-meste-a-v-okoli/av-cr-z-univerzity-palackeho-v-olomouci-zada-o-pomoc-s-mapovanim-pocitove-teploty-na-uzemi-prahy.html
Dovolujeme si Vás, společně s tvůrci dotazníku z Ústavu informatiky AV ČR a z Univerzity Palackého v Olomouci, požádat o pomoc s mapováním pocitové teploty na území hl. m. Prahy. Pocitová teplota vyjadřuje subjektivní vnímání okolí občany města; mapujeme ji pomocí online dotazníku, na úrovni celého města: https://www.pocitovemapy.cz/tepelny-komfort-praha/
Permanent Link: https://hdl.handle.net/11104/0369806

0639353 - ÚI 2026 CZ cze E - Electronic Document
Red. - Geletič, Jan
Mapování pocitové teploty v Praze – krátký dotazník.
Praha: Praha7.cz, 2025
Institutional support: RVO:67985807
Keywords : popularisation of science * popularizace vědy * klima
OECD category: Meteorology and atmospheric sciences
Result website:
https://www.praha7.cz/mapovani-pocitove-teploty-v-praze-kratky-dotaznik/
Ústav informatiky AV ČR, v. v. i., ve spolupráci s Magistrátem hl. m. Prahy, si vás dovoluje požádat o vyznačení kvadrátů, které v souvislosti s vysokými letními teplotami vnímáte pozitivně nebo negativně. Součástí anonymního mapování je i nepovinný krátký dotazník o vaší osobě. Budeme rádi za čas, který dotazníku věnujete, i případné sdílení.
Permanent Link: https://hdl.handle.net/11104/0369801

0638822 - ÚI 2026 CZ cze E - Electronic Document
Janků, Z. - Geletič, Jan
Ve městech při vedrech pozor na otevřená náměstí, sídliště či parkoviště, upozorňuje klimatolog.
Praha: Novinky.cz, 2025
Grant - others:AV ČR(CZ) StrategieAV21/36
Program: StrategieAV
Institutional support: RVO:67985807
Keywords : popularisation of science * popularizace vědy * klima * rozhovor * interview
OECD category: Meteorology and atmospheric sciences
Result website:
https://www.novinky.cz/clanek/pocasi-ve-mestech-pri-vedrech-pozor-na-otevrena-namesti-sidliste-ci-parkoviste-upozornuje-klimatolog-40531507
Letní vedra ve městech představují rostoucí zdravotní riziko. Městský klimatolog Jan Geletič z Ústavu informatiky Akademie věd ČR v rozhovoru pro Novinky vysvětluje, jakým městským prostorům se vyhýbat a proč je důležité mapovat pocitovou teplotu v různých čtvrtích a jak to může pomoci v plánování rozvoje měst. Do nového projektu v Praze se může zapojit i veřejnost.
Permanent Link: https://hdl.handle.net/11104/0369381

0639081 - ÚI 2026 CZ cze E - Electronic Document
Hávová, N. - Geletič, Jan
Věda Plus (21. 8. 2025).
Praha: Český rozhlas PLUS, 2025
Institutional support: RVO:67985807
Keywords : popularizace vědy * popularisation of science
Result website:
https://www.mujrozhlas.cz/veda-plus/je-vam-horko-kdyz-v-techto-dnech-jdete-po-ulici
Možná je problém v příliš tmavé fasádě okolního domu anebo kamenné zídce místo plotu. Mají totiž vliv na naši pocitovou teplotu. - Až jeden stupeň Celsia je rozdíl teplot mezi pražským parkem Stromovka a přilehlou čtvrtí Holešovice. Ukázal to pilotní projekt monitoring mikroklimatu.
Permanent Link: https://hdl.handle.net/11104/0369592

0639343 - ÚI 2026 CZ cze E - Electronic Document
Geletič, Jan - Hradilová, E.
Vědci mapují pocitovou teplotu v Praze, spustili dotazník.
Praha: PrazskaDrbna.cz, 2025
Institutional support: RVO:67985807
Keywords : popularisation of science * popularizace vědy * klima
OECD category: Meteorology and atmospheric sciences
Result website:
https://prazska.drbna.cz/zpravy/vzdelani/17625-vedci-mapuji-pocitovou-teplotu-v-praze-spustili-dotaznik.html
Pocitovou teplotu v Praze má zmapovat nový projekt vědců z Ústavu informatiky Akademie věd ČR. Připravili on-line dotazník, kde každý, kdo se v létě pohybuje v Praze, může zaznamenat svou pocitovou teplotu. Výsledky budou sbírat do poloviny září, možná déle. Cílem je například zlepšit plánování adaptačních opatření ve městech.
Permanent Link: https://hdl.handle.net/11104/0369789

0639342 - ÚI 2026 CZ cze E - Electronic Document
Nováčková, Ž. - Šubrt, M. - Geletič, Jan
Vědci z Ústavu informatiky AV ČR spustili projekt, který mapuje pocitovou teplotu v Praze (audio rozhovor).
Praha: Radio Prostor, 2025
Institutional support: RVO:67985807
Keywords : popularizace vědy * popularisation of science
Result website:
https://www.radioprostor.cz/clanek/vedci-z-ustavu-informatiky-av-cr-spustili-projekt-ktery-mapuje-pocitovou-teplotu-v-praze-y12N7
Připravili proto dotazník, kde každý, kdo se v létě pohybuje v Praze, může zaznamenat svou pocitovou teplotu. Co přesně je to pocitová teplota a proč je důležité ji měřit? Ve vysílání Rádia Prostor jsme se ptali doktora Jana Geletiče, vedoucí vědecký pracovník ústavu Akademia věd.
Permanent Link: https://hdl.handle.net/11104/0369786

0639263 - ÚI 2026 US eng A - Abstract

Netík, Jan - Martinková, Patrícia

Adapting transformers to wording-based item difficulty prediction.

IMPS 2025 Abstracts. Minnesota: IMPS, 2025. s. 171-171.

[IMPS 2025: Annual Meeting of the Psychometric Society. 15.07.2025-18.07.2025, Minnesota]

R&D Projects: GA MŠMT(CZ) EH22_008/0004583; GA ČR(CZ) GA25-18070S

Institutional support: RVO:67985807

Result website:

https://www.psychometricsociety.org/sites/main/files/file-attachments/imps2025-abstracts.pdf?1752054245

Accurate item difficulty estimation is a fundamental challenge in high-stakes educational test construction. Traditionally, difficulty is estimated through small-scale pretesting or expert judgments. However, pilot samples may not accurately represent the target population, estimates may exhibit large errors, and expert ratings are not sufficiently reliable. Alternatively, difficulty can be derived from item wording, but most approaches use various text features extracted from extensively preprocessed wording, leading to a loss of crucial morphosyntactic information. To address this, recent research (Netík et al., 2024) has explored fine-tuning transformer models that enable circumventing the preprocessing step, yet improvements over feature-based methods have been only marginal, presumably due to insufficient item wording representation. This paper introduces architectural modifications to improve model performance by ensuring a more comprehensive representation of the item. We propose three key changes: (1) a multitask learning framework that jointly predicts item difficulty and classifies wording components to encourage balanced attention distribution, (2) an encoding strategy that processes wording parts separately before merging them into a unified representation, and (3) leveraging deeper layers of the encoder stack instead of relying solely on the last hidden states of the first token. Additionally, we compare these odifications with the few-shot learning capabilities of state-of-the-art large language models and explore the potential of using their predictions to generate training data for fine-tuning smaller models. We aim to contribute to a more robust transformer-driven solution for item difficulty prediction, potentially reducing reliance on established yet limited approaches while improving the precision of difficulty estimates.

Permanent Link: https://hdl.handle.net/11104/0369726

0639256 - ÚI 2026 ES eng A - Abstract

Brabec, Marek

Analysis of long-term and feedback effects in individual physical activity patterns.

XI Conference –European Congress of Methodology. Book of Abstracts. San Cristobal de La Laguna: University of La Laguna, 2025. s. 5-5.

[EAM 2025: European Congress of Methodology /11./. 23.07.2025-25.07.2025, San Cristobal de La Laguna]

R&D Projects: GA MŠMT(CZ) EH22_008/0004583; GA ČR(CZ) GA25-18070S

Institutional support: RVO:67985807

Result website:

https://congress.eam2025.eu/event/2/book-of-abstracts.pdf

This methodological study has been conducted as part of the „Research of Excellence on Digital Technologies and Wellbeing CZ.02.01.01/00/22_008/0004583“ co-financed by the European Union and is based on analyzing large-scale ecological momentary assessment data of daily step counts from the „Healthy Aging in Industrial Environment HAIE CZ.02.1.01/0.0/0.0/16_019/0000798“ project. It starts with traditional mixed effects linear hierarchical Markovian (AR-type) model allowing for the separation of between- and within-subject relationships to important covariates (such as sex, age, exercise identity, education, SES level) and their interactions. We show that the traditional additive modeling is not sufficient and there are important interactions with place of residence. Then, we carefully explore seasonality of the physical activity at two scales (weekly and annual) proving their significance and quantifying their relative contributions. We demonstrate that corrections for

seasonality are important in that if unadjusted, they distort systematically individual dynamics and give false impression of external controllability of the activity (e.g. by intervention) where important parts are pre-determined by largely unchangeable seasonal patterns. Further insight is based on modeling autoregressive component in a nonlinear way (accounting for local saturation effects connected with over- or under-exercising that cannot be captured by linear models) utilizing the flexible generalized additive modeling approach. Since the long-term effects (related e.g. to fatigue after cumulative over-exercising spanning several days) in the AR dynamical structure are notoriously difficult to model, we approach the problem from the complexity-penalizing viewpoint and regularize the higher lag coefficient behavior based on flexible (soft) constraints. This allows us to demonstrate long-term dynamic details that operate above the seasonal behavior and hence are controllable in principle. Since our model is hierarchical with individual-specific random effects, we are able to separate and quantify several sources of inter-individual variability and show that specific parts of inter-individual structural variability in the physical activity dynamics is an important feature to consider when designing new interventions programs.
Permanent Link: https://hdl.handle.net/11104/0369719

0638809 - ÚI 2026 eng A - Abstract
Hlinka, Jaroslav - Tomeček, D. - Kolenič, M. - Rehák Bučková, B. - Tintěra, J. - Horáček, J. - Španiel, F.
Classification of schizophrenia from resting state connectivity: role of reduced dimension and noise. *OHBM 2025 Abstracts.* Brisbane: Organization for Human Brain Mapping, 2025. s. 1924-1925, č. článku Poster no 1135..
[OHBM 2025: Annual Meeting of the Organization for Human Brain Mapping /31./. 24.06.2025-28.06.2025, Brisbane]
R&D Projects: GA MŠMT(CZ) EH22_008/0004643
Institutional support: RVO:67985807
INTRODUCTION: Schizophrenia is widely understood as a dysconnection syndrome, including disruption of functional connectivity (FC). Advanced machine learning techniques have been explored such as the use of permutation homology features (Caputi, 2021) and deep learning (Mahmood, 2021), but the improvements over classical methods remain incremental, potentially due to structured noise in fMRI data that can bias connectivity results (Kopal, 2020), and the imbalance between high-dimensional features and limited sample sizes (Poldrack, 2017). Thus, this study evaluates the role of denoising strategies combined with efficient robust classifiers (Rehák Bučková, 2023) using principal component analysis (PCA) and logistic regression, to classify schizophrenia from FC. METHODS: Resting-state fMRI data were collected from 100 first-episode psychosis (FEP) patients and 90 healthy controls. At the time of the MRI scan, the average duration of untreated psychosis in patients was 3.23 months (S.D. = 4.82), average duration of antipsychotic treatment 2.29 months (S.D. = 4.58). Controls were age- and sex-matched but had slightly higher education levels ($p < 0.001$). 3T MRI scanner (Siemens Magnetom Trio) at the Institute of Clinical and Experimental Medicine in Prague, Czech Republic was used. Functional images were obtained using T2-weighted echo-planar imaging (EPI) with blood oxygenation level-dependent (BOLD) contrast using SENSE imaging. GE-EPIs (TR/TE=2000/30 ms, flip angle=70°) with 35 axial slices acquired continuously in sequential decreasing order covering the entire cerebrum (voxel size=3×3×3 mm, slice dimensions 48x64 voxels). The next 400 functional volumes were used. Three preprocessing pipelines were compared: 1. Raw Data: motion correction and normalization. 2. Moderate Denoising: added regression of six motion parameters and mean signals from white matter and CSF, followed by bandpass filtering, 3. Stringent Denoising: regression of motion parameters, their derivatives, and five PCA components from white matter and CSF, plus linear detrending and filtering, corresponding to the default setting of the CompCor, i.e. component-based noise correction method (Behzadi, 2007) in the CONN toolbox (Whitfield-Gabrieli, 2012). FC was quantified in line with quantitative recommendations (Hlinka, 2011)

via Pearson's correlation; between 90 brain regions (AAL atlas). Dimensionality reduction using PCA was applied to the 4005 FC features, and logistic regression classifiers trained. Performance was evaluated using leave-one-out cross-validation, accuracy assessed across varying numbers of principal components. See (Hlinka, 2024) and (Tomecek, 2024) for details concerning the methods and group comparison results. RESULTS: Classification accuracy differed substantially across pipelines, see Fig. 1 for results visualization. For raw data, accuracy peaked at 74% using 44 components but declined with higher dimensions due to overfitting. In contrast, moderate denoising achieved the highest accuracy of 82% with just 24 components, and stringent denoising reached 81% with 45 components. Importantly, the results were robust across a range of components, with denoised data consistently outperforming raw data. Combining multiple denoising strategies did not further improve accuracy. CONCLUSIONS: Denoising significantly enhances the classification of schizophrenia from resting-state FC, with both moderate and stringent denoising strategies yielding comparable performance. Despite differences in preprocessing, accuracy improved by approximately 10% compared to raw data. Dimensionality reduction via PCA played a critical role. These findings underscore the importance of careful fMRI preprocessing in neuroimaging-based classification tasks. However, the lack of substantial improvement from combining strategies highlights persistent challenges in achieving higher classification accuracy. SUPPORTED BY: ERDF-Project Brain dynamics, No. CZ.02.01.01/00/22_008/0004643.
Permanent Link: https://hdl.handle.net/11104/0369372

0638808 - ÚI 2026 eng A - Abstract
Tomeček, D. - Pitra, Zbyněk - Klepl, Dominik - Tintěra, J. - Španiel, F. - Hlinka, Jaroslav
Classifying First-Episode Schizophrenia Using Functional Connectivity Patterns: A Comparative Study. *OHBM 2025 Abstracts.* Brisbane: Organization for Human Brain Mapping, 2025. s. 2087-2088, č. článku Poster no 1231..
[OHBM 2025: Annual Meeting of the Organization for Human Brain Mapping /31./. 24.06.2025-28.06.2025, Brisbane]
R&D Projects: GA MŠMT(CZ) EH22_008/0004643; GA ČR(CZ) GA23-07074S; GA MZd(CZ) NU21-08-00432
Institutional support: RVO:67985807
INTRODUCTION: The abnormal developmental processes of the brain likely appear long before clinical symptoms of schizophrenia (Stachowiak et al., 2013). Several studies have been conducted describing impaired connectivity between multiple brain networks in schizophrenia (see Dong et al. (2018) or Ruiz-Torras et al. (2023)). However, the reported findings are highly inconsistent, possibly due to a priori choice of selected brain regions of interest, heterogenic clinical samples (Li et al., 2016), or underpowered studies (Dong et al., 2018). In this study, we utilized resting-state fMRI data to build a model for the classification of healthy controls and patients with a first episode of schizophrenia. METHODS: We obtained resting-state fMRI data from 190 subjects in total - 90 healthy controls (average age/SD: 27.69/6.82) and 100 patients (average age/SD: 28.75/6.83). A default preprocessing pipeline for volume-based analyses (direct normalization to MNI-space) was applied to fMRI data in the CONN toolbox for Matlab 2016b. In the next step, we used two popular data extraction techniques - atlas-based - using Automated Anatomical Labeling (AAL) atlas with 90 regions (Tzourio-Mazoyer et al., 2002) and the Craddock atlas with 200 regions (Craddock et al., 2012) and - data-driven - decomposition of the functional data using spatial independent component analysis (ICA) in the GIFT toolbox for Matlab 2016b. In the ICA approach, we created a full set of 27 components (ICA27) and a selected subset of nine components (ICA9) that matched those from Arbabshirani et al. (2013). All extracted time series were band-pass filtered with a window of 0.017−0.15 Hz and linearly detrended. Eventually, we computed functional connectivity (FC) between 90 regions of the AAL atlas (AAL90) and 200 regions of the Craddock atlas (Craddock200) and functional network connectivity (FNC) between the independent components separately for the ICA27

and ICA9 data sets. In addition to the data sets with the original number of features, we also created their PCA-reduced version into 36 principal components. Ten randomly selected subjects were removed from the patients' group to balance the number of subjects in both classes. We used a set of multiple classifiers implemented directly in Matlab 2016b, including linear discriminant analysis (LDA), quadratic discriminant analysis (QDA), support vector machine (SVM) with linear, quadratic, polynomial, and RBF kernels, k-nearest neighbor (KNN), Naive Bayes (NB), random forest (RF) in default, with bagging or boosting, and decision tree (DT) in default. Hyper-parameter values were selected by a grid search performed on the training set and evaluated using a five-fold cross-validation. All classifiers were evaluated using a leave-oneout cross-validation scheme. RESULTS: In terms of the highest achieved accuracy, see Fig. 1, we reached 86.11% with the AAL90 data set (linear SVM+PCA), which outperformed both ICA9 (71.11%, NB) and ICA27 (72.78%, NB+PCA). The Craddock200 features performed slightly better than all ICA-based models but still worse than the AAL90 features. Similarly, the dimensionality reduction did not substantially decrease the performance of the classifiers in general. In fact, in many cases, it has led to considerable improvement. CONCLUSIONS: On average, features from atlas-based functional connectivity performed better compared to ICA-based functional network connectivity features. We found the best classification accuracy with features from the AAL90 data set that achieved 86.11% using the linear SVM classifier. On average, linear classifiers performed slightly better on all data sets compared to other algorithms. Reduction of the data dimension using PCA before running the classifier might be warranted, as it generally improved the performance across other design choices. ACKNOWLEDGEMENT: The publication was supported by ERDF-Project Brain dynamics No. CZ.02.01.01/00/22_008/0004643, GACR project No. 23-07074S, AZV project No. NU21-08-00432.
Permanent Link: https://hdl.handle.net/11104/0369370

0639262 - ÚI 2026 US eng A - Abstract
Cichrová, Michaela - Martinková, Patrícia
Detecting differential item functioning using varying coefficient models.
IMPS 2025 Abstracts. Minnesota: IMPS, 2025. s. 329-329.
[IMPS 2025: Annual Meeting of the Psychometric Society. 15.07.2025-18.07.2025, Minnesota]
R&D Projects: GA MŠMT(CZ) EH22_008/0004583; GA ČR(CZ) GA25-18070S
Institutional support: RVO:67985807
Result website:
https://www.psychometricsociety.org/sites/main/files/file-attachments/imps2025-abstracts.pdf?1752054245
Testing for Differential Item Functioning (DIF) is an important step in the analysis of multi-item measurements. Traditionally, DIF has been investigated using a categorical grouping variable, which can be either dichotomous (e.g., gender, where groups are male and female) or polytomous (e.g., education level, with multiple categories such as high school, undergraduate, and graduate). This approach works well in many situations, but there are circumstances where the variable of interest is continuous, such as age or income. In such cases, treating the variable as categorical by arbitrarily dividing it into discrete groups may lead to a significant loss of valuable information and potentially obscure complex relationships within the data. We propose the use of varying coefficient models to better handle the continuity of covariates in DIF detection. These models allow the effect of the covariate to vary smoothly, capturing more intricate patterns that simpler methods may overlook. To demonstrate their effectiveness, we compare several model forms through a comprehensive simulation study. The simplest model is a direct extension of the logistic regression model, commonly used for DIF detection with dichotomous grouping variables. We compare the models in terms of their accuracy while also considering computational challenges, interpretability, and the identifiability issues that arise in more complex models.
Permanent Link: https://hdl.handle.net/11104/0369724

0639260 - ÚI 2026 US eng A - Abstract
Vařejková, Michaela - Martinková, Patrícia
Detection of aberrant response behavior in context of robust logistic regression methods.
IMPS 2025 Abstracts. Minnesota: IMPS, 2025. s. 330-330.
[IMPS 2025: Annual Meeting of the Psychometric Society. 15.07.2025-18.07.2025, Minnesota]
R&D Projects: GA MŠMT(CZ) EH22_008/0004583; GA ČR(CZ) GA25-18070S
Institutional support: RVO:67985807
Result website:
https://www.psychometricsociety.org/sites/main/files/file-attachments/imps2025-abstracts.pdf?1752054245

Accurately modelling item responses is a key objective in psychometrics. Generalized linear and nonlinear models provide a useful framework for this task. However, traditional logistic regression is highly sensitive to outliers, which can strongly influence parameter estimates and compromise assessment validity. These outliers often arise due to measurement errors, misclassifications, or aberrant responses. To address this issue, we explore robust logistic regression using M-estimators within the generalized linear model framework. This approach incorporates robust weighting functions to reduce the influence of extreme values in both the response and predictor spaces. Our simulation study demonstrates that while classical logistic regression is heavily affected by misclassified outliers, robust logistic regression remains stable and provides more reliable stimates.
This method presents a practical alternative to traditional item response modeling approaches, effectively mitigating the impact of anomalies without introducing additional item parameters
Permanent Link: https://hdl.handle.net/11104/0369722

0639238 - ÚI 2026 ES eng A - Abstract
Cichrová, Michaela - Martinková, Patrícia - Raudenská, P.
Differential item functioning in online health-information seeking measurement.
XI Conference –European Congress of Methodology. Book of Abstracts. San Cristobal de La Laguna: University of La Laguna, 2025. s. 230-230.
[EAM 2025: European Congress of Methodology /11./. 23.07.2025-25.07.2025, San Cristobal de La Laguna]
R&D Projects: GA MŠMT(CZ) EH22_008/0004583; GA ČR(CZ) GA25-18070S
Institutional support: RVO:67985807
Result website:
https://congress.eam2025.eu/event/2/book-of-abstracts.pdf
As digital health information becomes increasingly important in personal and public health decision-making, measuring internet usage for health-related purposes is crucial for understanding global digital health trends, which can contribute to designing policies and web-based tools. The International Social Survey Programme (ISSP) introduced a standardized questionnaire to assess online health information-seeking behaviour and collected data across diverse populations in 30 countries. Detailed item-level analysis, including detection of differential item functioning, may provide granular information on between-group differences across diverse populations. In our work, we focus on testing differential item functioning (DIF) with respect to the country and age of the respondents to assess whether the questionnaire measures online health information-seeking behaviour consistently across different ages and nationalities and to better understand differences among respondents. If DIF is present, individuals with the same level of engagement but from various countries or age brackets may respond differently to certain items, which may remain unnoticed if the comparison is conducted based on total scores only. Traditional DIF detection methods compare a fixed number of demographic groups, meaning that respondents would need to be divided into a fixed amount of age cohorts. However, such a grouping can lead to information loss and may fail to detect

more complex DIF patterns. To address this, we introduce a new DIF detection method utilizing varying coefficient regression models, which allows for a more nuanced analysis of age-based DIF. These models enable us to test the statistical significance of DIF using submodel tests and to assess the practical significance of DIF by using area-based effect size measures. We apply our newly proposed method to the dataset and compare the results with those obtained by grouping age into cohorts. We also discuss differences with respect to countries.
Permanent Link: https://hdl.handle.net/11104/0369706

0639246 - ÚI 2026 ES eng A - Abstract
Pavlech, Ján - Martinková, Patrícia
Employing item response theory and factor analysis to purify latent trait estimates.
XI Conference –European Congress of Methodology. Book of Abstracts. San Cristobal de La Laguna: University of La Laguna, 2025. s. 219-219.
[EAM 2025: European Congress of Methodology /11./. 23.07.2025-25.07.2025, San Cristobal de La Laguna]
R&D Projects: GA MŠMT(CZ) EH22_008/0004583; GA ČR(CZ) GA25-18070S
Institutional support: RVO:67985807
Result website: https://congress.eam2025.eu/event/2/book-of-abstracts.pdf
The binary factor analysis (FA) model and the 2-parameter item response theory (IRT) model impose different structures and assumptions, but the models are well known to be equivalent (Martinková & Hladká, 2023, Section 7.5). In this work, we investigate a generalization of the FA model to three- and four-parameters using the mixture-dichotomized model, and its relationship with the three- and four-parameter IRT model. We then focus on the estimation of the ability scores cleaned of guessing and inattention in the context of educational assessment, or of pretending and dissimulation in the context of psychological assessment, which we term the NGI (non-guessing and non-inattention) scores. We propose a Bayesian estimation method, and compare it with other alternatives. We discuss the advantages of NGI scores over total scores and other estimates of latent scores, as well as the strengths and limitations of various estimation methods. The methods are illustrated using real data examples from well-being and educational assessment.
Permanent Link: https://hdl.handle.net/11104/0369709

0639266 - ÚI 2026 US eng A - Abstract
Bartoš, František
Fast and efficient robust Bayesian meta-analysis with spike-and-slab priors.
IMPS 2025 Abstracts. Minnesota: IMPS, 2025. s. 31-31.
[IMPS 2025: Annual Meeting of the Psychometric Society. 15.07.2025-18.07.2025, Minnesota]
R&D Projects: GA ČR(CZ) GA25-18070S
Institutional support: RVO:67985807
Result website:
https://www.psychometricsociety.org/sites/main/files/file-attachments/imps2025-abstracts.pdf?1752054245
Meta-analyses are vital for synthesizing evidence across multiple studies, yet their validity is frequently undermined by publication bias. To address this issue, we developed robust Bayesian meta-analysis (RoBMA), which integrates multiple publication bias adjustment methods—such as selection models and PET-PEESE—using Bayesian model-averaging (BMA). Traditionally, RoBMA employed JAGS and bridge sampling to estimate individual models and combine them via BMA, providing a robust framework for evidence synthesis. In recent advancements, we expanded RoBMA to incorporate meta-regression and three-level models, enabling its application to a wide range of meta-analytic settings. However, these extensions substantially increase the model space, rendering traditional estimation methods computationally demanding. This talk reviews these methodological developments

and introduces a significant enhancement: spike-and-slab model-averaging for both parameters and model components within RoBMA. Leveraging the spike-and-slab model-averaging markedly improves computational efficiency, facilitating applications to larger samples and more complex problems. The method retains RoBMA's robustness while overcoming the computational bottlenecks of expanded model spaces, delivering fast and reliable estimates. We illustrate the practical benefits of this innovation through examples and discuss its implications for advancing meta-analytic research.
Permanent Link: https://hdl.handle.net/11104/0369729

0639235 - ÚI 2026 ES eng A - Abstract
Vařejková, Michaela - Martinková, Patrícia - Potužníková, E.
Longitudinal Stability of Repeated Covariate Equating in High-Stakes Assessments.
XI Conference –European Congress of Methodology. Book of Abstracts. San Cristobal de La Laguna: University of La Laguna, 2025. s. 86-86.
[EAM 2025: European Congress of Methodology /11./. 23.07.2025-25.07.2025, San Cristobal de La Laguna]
R&D Projects: GA MŠMT(CZ) EH22_008/0004583; GA ČR(CZ) GA25-18070S
Institutional support: RVO:67985807
Result website:
https://congress.eam2025.eu/event/2/book-of-abstracts.pdf
In high-stakes educational assessments, ensuring score comparability across multiple test forms is essential for fairness and validity, particularly when test-taker groups differ in ability. Traditional test equating methods rely on anchor items, which allow direct score adjustments between test forms. However, when anchor items are unavailable, covariate equating provides an alternative by using external variables correlated with the test scores (such as grades, prior test scores, or school type) to adjust for ability differences between test-taker groups. One challenge in this approach arises when the covariates themselves are measured using multiple test forms, which may introduce bias into the equating process. A proposed solution is repeated covariate equating, where the covariates are equated before being incorporated into the primary equating process. By analyzing trends across multiple exam years, we aim to determine how repeated covariate equating evolves over time and how changes in the tested population influence test score comparability. This study explores the longitudinal stability of repeated covariate equating by analyzing test score comparability over multiple years (2016–2024) in the Czech Republic's national Matura exam, with a focus on the English Language test. Given that the test is administered in both spring and autumn terms, differences in student characteristics across sessions must be accounted for to ensure comparability. Additionally, as test-taking patterns shift over time — due to changes in student cohorts, evolving test-taking behaviors, and shifts in the composition of non-mandatory subject selections — the effectiveness of equating methods may vary across years. Our study examines whether score comparability is maintained consistently when applying repeated covariate equating over an extended period. Using kernel equating for non-equivalent groups, we adjust for school type, gender, and Czech Language scores as covariates. We equate the autumn test administration to the corresponding spring administration within each year and examine year-to-year equating outcomes to assess whether and how the equating results vary over time. Specifically, we analyze differences in equated scores across years, evaluate the stability of the regression coefficients for covariates, and assess changes in the standard errors of equating. Furthermore, we investigate whether pre-equating the Czech Language test scores (which are themselves measured using multiple test forms) enhances the stability of equated English scores over time.
Permanent Link: https://hdl.handle.net/11104/0369707

0639231 - ÚI 2026 ES eng A - Abstract
Martinek, Filip - Martinková, Patrícia - Netík, Jan
Modeling difficulty of listening comprehension items with machine learning.
XI Conference –European Congress of Methodology. Book of Abstracts. San Cristobal de La Laguna: University of La Laguna, 2025. s. 282-282.
[EAM 2025: European Congress of Methodology /11./. 23.07.2025-25.07.2025, San Cristobal de La Laguna]
R&D Projects: GA MŠMT(CZ) EH22_008/0004583; GA ČR(CZ) GA25-18070S
Institutional support: RVO:67985807
Result website: https://congress.eam2025.eu/event/2/book-of-abstracts.pdf
Understanding the difficulty of items in educational assessment is crucial for test development, teaching, and learning. While prior research used text features and machine learning to model the difficulty of reading comprehension items (Štěpánek et al., 2023), listening comprehension (LC) presents additional complexity. Beyond textual factors, LC item difficulty can be influenced by several additional factors, including variations in speech rate, voice characteristics, and others. In this study, we analyze data from English, German, and French listening sections of the Czech Matura exams. We extract text features commonly used in reading comprehension difficulty modeling, including readability indices and similarity measures. Additionally, we incorporate audio-specific features, such as speech rate, confidence scores from automatic speech recognition (ASR) models, and voice distinguishability derived from a speaker diarization model. This feature set allows us to capture the linguistic and auditory effects on LC item difficulty. Using these features, we train a regression model to predict the final LC difficulty as described by student response data. The optimal model is selected based on accuracy measures of different models and model parameters, and compared to predictions of content experts to assess alignment between computational modeling and human evaluation. The model is implemented into an interactive application to aid exam development. This tool aims to provide educators and test developers with insights into LC item difficulty, allowing for more informed test development.
Permanent Link: https://hdl.handle.net/11104/0369696

0638805 - ÚI 2026 eng A - Abstract
Kazimierczak, Katarzyna - Pidnebesna, Anna - Škoch, A. - Tintěra, J. - Španiel, F. - Hlinka, Jaroslav
Surface- and volume-based functional connectivity in the first episode psychosis patients.
OHBM 2025 Abstracts. Brisbane: Organization for Human Brain Mapping, 2025. s. 2079-2080, č. článku Poster no 1226..
[OHBM 2025: Annual Meeting of the Organization for Human Brain Mapping /31./. 24.06.2025-28.06.2025, Brisbane]
R&D Projects: GA MŠMT(CZ) EH22_008/0004643; GA MZd(CZ) NU21-08-00432
Institutional support: RVO:67985807
INTRODUCTION: Functional connectivity analysis has an important tool in exploring the brain dynamics in both healthy and patient populations (Caputi et al., 2021). The majority of functional connectivity (FC) studies utilize volume-based preprocessing approaches (Tomecek et al., 2024). However, surface based measures can capture better the topography of brain networks, offering additional insights. The disruptions in brain network connectivity in the first episode psychosis is believed to be an important factor in an emergence of symptoms. The aim of this study is to compare the volume- and surfacebased FC in FEP and healthy controls to better understand the patterns of network connectivity in the psychosis onset. METHODS: The dataset included T1 structural and resting-state scans 124 first episode psychosis patients and 75 age and gender matched healthy controls,45 females, being part of the Early-Stage Schizophrenia Outcome Study. The data was collected using a 3T Siemens Trio MRI scanner using EPI sequence, for resting-state 10 min, 300

volumes, TR=2s, TE=30ms, flip angle = 70° and structural T1-weighted structural volume was acquired using MPRAGE sequence, TI/TR/ TE = 900/2300/4.63 ms, flip angle 10°. The structural data were parcellated using recon-all procedure implemented in the Freesurfer (ver. 7.2.0). The connectivity analyses were performed using the CONN toolbox release 22a. The volumebased preprocessing pipeline included realignment and unwarping, slice timing correction, outlier detection, structural and functional direct segmentation and normalization to MNI template and smoothing (FWHM=8mm). In the surface-based pipeline realignment, slice timing correction, outlier detection were also performed, followed by indirect co-registration of functional to structural data, resampling of functional data within the cortical surface and smoothing of surface level functional data using 40 diffusion steps (equivalent to volumetric 8mm kernel). Next, the data resulting from both pipelines were filtered using band-pass filter (0.004 – 0.08 Hz) and denoised using aCompCor procedure (5 parameters for white matter and CSF) and motion artifacts were removed using 6 realignment parameters and their first order derivatives. Finally ROI-to-ROI connectivity matrices were calculated using Deskian-Killiany atlas (both volumetric and surface based with 68 ROIs) for each subject, and later used for second level between-subjects comparisons. Cluster-level inferences were based on parametric statistics from Gaussian Random Field theory. Results were thresholded using p-FDR < 0.05 cluster-size threshold. RESULTS: Using surface and volume-based strategies we observed different connectivity patterns while comparing FEP patients against the healthy controls. In the volume approach negative correlation between the insula (both right and left) and the left posterior cingulate was observed. In the surface-based analysis this connection did not reach statistical significance. Both approaches yielded positive change of correlations in the occipital regions. However, in the volume-based FC an overall pattern of hyper-connectivity was obtained, whereas surface-based FC was more balanced, displaying also hypo-connectivity. CONCLUSIONS: The choice between the surface- and volume-based connectivity analyses can be critical in functional imaging. In the studies of cortical activity and connectivity surface-based methods can offer significant advantages in reducing signal noise and increasing sensitivity. Approaches based on volumetric processing may introduce errors in anatomical positioning, further influencing the results of group level analyses. Adopting different strategies in functional connectivity may improve accuracy of studies and enhance our understanding of brain function in both healthy and clinical populations. ACKNOWLEDGEMENTS: The publication was supported by ERDF-Project Brain dynamics, No. CZ.02.01.01/00/22_008/0004643 and Czech Health Research Council Project No. NU21-08-00432.
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0639264 - ÚI 2026 US eng A - Abstract
Turčičová, Marie - Martinková, Patrícia
Thresholding method for identifying anomalies in wellbeing time series data.
IMPS 2025 Abstracts. Minnesota: IMPS, 2025. s. 15-15.
[IMPS 2025: Annual Meeting of the Psychometric Society. 15.07.2025-18.07.2025, Minnesota]
R&D Projects: GA MŠMT(CZ) EH22_008/0004583
Institutional support: RVO:67985807
Result website:
https://www.psychometricsociety.org/sites/main/files/file-attachments/imps2025-abstracts.pdf?1752054245
Identifying atypical patterns in digital behavior, physiological responses, and wellbeing metrics is essential for advancing psychometric research and intervention strategies. Anomaly detection techniques play a crucial role in (1) detecting deviations in digital behavior that may indicate excessive usage, social withdrawal, or digital addiction, (2) analyzing physiological and psychological responses, such as heart rate variability and stress indicators, to identify abnormal patterns related to technology use, and (3) monitoring responses to wellbeing interventions using digital technology by detecting atypical reactions that may require personalized approaches. To address these challenges, our research introduces an effective thresholding method for anomaly detection in multivariate data drawn

from a normal distribution - a common model for many psychometric and mental health variables, as well as the distribution of residuals in various statistical models (e.g. regression models or models for time series). The proposed method provides a theoretically grounded threshold that is asymptotically optimal, ensuring that the number of misidentified anomalies approaches zero as the sample size increases. Our approach is compared to other common thresholding methods through simulation, and its performance is further demonstrated using real data.
Permanent Link: https://hdl.handle.net/11104/0369727

0639255 - ÚI 2026 ES eng A - Abstract
Štěpánek, Lubomír - Štuka, Č. - Vejražka, M. - Martinková, Patrícia
Using machine learning on multiple true-false item texts to predict the difficulty of best singleanswer items: Identifying domain-specific text features beyond readability.
XI Conference –European Congress of Methodology. Book of Abstracts. San Cristobal de La Laguna: University of La Laguna, 2025. s. 281-281.
[EAM 2025: European Congress of Methodology /11./. 23.07.2025-25.07.2025, San Cristobal de La Laguna]
R&D Projects: GA ČR(CZ) GA25-18070S
Institutional support: RVO:67985807
Result website: https://congress.eam2025.eu/event/2/book-of-abstracts.pdf
Accurately estimating item difficulty is crucial for designing fair and effective assessments, particularly in high-stakes exams such as medical faculty admissions. This study investigates subject-specific textual elements that significantly influence item difficulty beyond traditional readability features and explores the predictive potential of machine learning algorithms in estimating the difficulty of best single-answer items derived from multiple true-false items. Using historical admission test data from the First Faculty of Medicine, Charles University in Prague, we employ pre-calibrated difficulty estimates of multiple true-false items to predict the difficulty of their reformulated best single-answer counterparts. Our approach goes beyond traditional textual features related to readability, such as word counts, vocabulary frequency, lexical similarity, and readability indices (Štěpánek, Dlouhá, & Martinková, 2023). Instead, we aim to leverage domain-specific contextual elements within item wording – particularly in subjects like physics, chemistry, and biology – that influence difficulty. These contextual and semantic elements include conceptual and knowledge representation features (such as domain-specific taxonomy or terminology abstractness), semantic embedding and contextual features (such as algorithm-estimated text complexity using large language models), syntactic and structural complexity (including text mode, sentiment density, and diction analyzed using language models), cognitive and conceptual load features (e.g., missing or aberrant information in the item wording), and domain-specific features (such as chemical or mathematical notation, formulas, or figures), among others. By adopting this approach, we seek to uncover key linguistic or conceptual patterns in item wording that strongly impact difficulty levels. Machine learning techniques are applied to identify these domain-specific difficulty-related textual and contextual features. The dataset includes multiple years of admission test responses, allowing us to match item wordings with test-takers' performance and apply the Rasch model for difficulty estimation. By comparing pre-calibrated multiple true-false item difficulties with the predicted and observed difficulties of their best single-answer versions, we evaluate the effectiveness of our approach in predicting difficulty shifts caused by item reformulation. The findings of this study may contribute to the field of educational assessment by demonstrating how machine learning can enhance difficulty estimation, particularly when transitioning between item formats. The extracted textual features provide insights into the linguistic and cognitive factors influencing item difficulty, which can inform test construction and item design in high-stakes assessments.
Permanent Link: https://hdl.handle.net/11104/0369717

0640628 - ÚI 2026 RIV CZ cze A - Abstract
Řezníček, Hynek - Geletič, Jan - Belda, M. - Beneš, L. - Bureš, Martin - Eben, Kryštof - Fuka, V. - Krč, Pavel - Patiño, W. - Radović, J. - Vlček, O. - Resler, Jaroslav
Hledání kompromisů mezi tepelným stresem a kvalitou ovzduší při výsadbě stromů v městských ulicích.
[Finding trade-offs between heat stress and air quality in street tree planting scenarios.]
Výroční konference České meteorologické společnosti 2025: sborník abstraktů. Praha: ČMeS, ČHMÚ, 2025 - (Stašová, L.; Valeriánová, A.). s. 21-21. ISBN 978-80-7653-082-9.
[Česká meteorologická konference 2025. 23.09.2025-25.09.2025, Praha]
R&D Projects: GA TA ČR(CZ) SQ01010181
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Program: StrategieAV
Institutional support: RVO:67985807
Keywords : Uliční stromy * Tepelný stres * Zněčištění ovzduší * Prašnost * PALM * městská mezní vrstva atmosféry * proudění v uličním kaňonu
OECD category: Meteorology and atmospheric sciences
Result website:
https://www.chmi.cz/files/portal/docs/reditel/SIS/nakladatelstvi/assets/CMeS_2025.pdf
Zatímco pozitivní dopady v ulici rostoucích stromů na tepelný komfort chodců jsou v městských oblastech dobře zdokumentovány, vliv na kvalitu ovzduší, zejména na úrovni chodců, zůstává nadále nejasný. Jedná se především o změnu charakteru proudění a s ním spojené zvýšení koncentrací znečišťujících látek pocházejících z dopravy ve výškách odpovídajících chodcům. Mikroměřítkové modely městské mezní vrstvy založené na principu simulace velkých vírů (LES) mohou, díky prostorovému rozlišení v jednotkách metrů, poskytnout cenné poznatky o komplexních procesech uvnitř ulice. To umožňuje kombinovat realistické simulace kvality ovzduší s radiačně-energetickými proměnnými, jako jsou povrchová teplota nebo biometeorologické indexy. Nově publikovaná studie [Řezníček et al. 2025] využívá LES model PALM k realistické simulaci komplexního vlivu variant výsadby stromů ve dvou městských ulicích. Simulace zahrnovaly reálné geografické podmínky a kvazi-reálnou meteorologii pro zkoumání vlivu různých teplotních stratifikací. Scénáře byly počítány na doméně v Praze-Dejvicích (validace modelu PALM pro tuto oblast viz [Resler et al. 2021]). Výsledky odhalily významnou časo-prostorovou variabilitu v tepelném komfortu a koncentracích suspendovaných částic na úrovni chodců, což podtrhuje složitou interakci mezi městskou zelení, dynamikou proudění vzduchu a disperzí znečišťujících látek. Jak bylo očekáváno, stromy výrazně snižují hodnoty biometeorologického indexu UTCI v době maximálního oslunění, zároveň přispěly k mírnému ochlazení kaňonu po západu slunce (to ovšem platí za optimálních podmínek pro růst stromů, které jsou ve městech prakticky nereálné). V úzké ulici změny v proudění vzduchu způsobené přítomností hustě vysázených stromů vedly k výraznému nárůstu koncentrací suspendovaných částic PM_{10} o více než 100 % ve srovnání se scénářem bez stromů. Významné zvýšení je primárně přisuzováno zpomalení a vertikálnímu posunu primárního víru, což zabránilo disperzi znečišťujících látek do vyšších vrstev atmosféry. Studie zdůrazňuje potřebu pečlivého a zodpovědného urbanistického plánování při implementaci strategií výsadby stromů ve městech. Výsledky dokazují, že když se počet stromů v ulici zredukuje na polovinu, dopad na tepelný komfort zůstává srovnatelný se scénářem s plným počtem stromů, ale zhoršení kvality vzduchu je výrazně nižší. V současné době zároveň probíhá navazující projekt TAČR – MicroBUS, kde budou výsledky studie srovnány s měřeními v aerodynamickém tunelu. Praktická zjištění následně budou aplikována na scénáře budoucího rozvoje Legerovy ulice.
While the positive impacts of street trees on the thermal comfort of pedestrians are well documented in urban areas, the impact on air quality, especially at pedestrian level, remains unclear. This is mainly due to the change in the flow pattern and the associated increase in the concentrations of traffic pollutants at pedestrian levels. Micro-scale models for Urban boundary layer with large eddy simulation (LES) turbulence closure can provide valuable insights into complex processes inside the street in, due to their resolution in scales of units of meters. This allows a combination of realistic air

quality simulations with radiative-energy variables such as surface temperature or bio-meteorological indices. A recently published study [Řezníček et al. 2025] uses the LES model PALM to realistically simulate the complex impact of tree planting options on two urban streets. The simulations included realistic geographical conditions and quasi-realistic meteorology to investigate the impact of different temperature stratifications. The scenarios were calculated on well validated Prague-Dejvice domain. The results revealed significant spatio-temporal variability in thermal comfort and PM_{10} concentrations at the pedestrian level, which underlines the complex interaction between urban greenery, airflow dynamics and pollutant dispersion. As expected, trees significantly reduce the values of the bio-meteorological index UTCI at the time of maximum isolation, while contributing to a slight cooling of the canyon after sunset. In the narrow street canyons, tree-induced changes in airflow led to a substantial increase in PM_{10} concentrations by more than 100% compared to tree-free scenarios. The study highlights the need for careful and responsible urban planning when implementing tree planting strategies in cities. The results show that when the number of trees in a street is reduced by half, the impact on thermal comfort remains comparable to the scenario with a full number of trees, but the deterioration of air quality is significantly lower.
Permanent Link: https://hdl.handle.net/11104/0371010

0640609 - ÚI 2026 RIV DE eng A - Abstract
Geletič, Jan
AI potential in urban environmental modelling.
Resilient Society | Application of AI | Climate Change/Energy: Programme and Abstracts. Saxon Academy of Sciences and Humanities in Leipzig and Czech Academy of Sciences, 2025.
[Resilient Society | Application of AI | Climate Change/Energy: Second Czech-German Scientific Symposium. 22.09.2025-23.09.2025, Leipzig]
Grant - others:AV ČR(CZ) StrategieAV21/36
Program: StrategieAV
Institutional support: RVO:67985807

Urban areas are increasingly vulnerable to climate change impacts, particularly heatwaves. Related changes will directly affect the thermal comfort of dwellers. Previous studies revealed interesting patterns, daytime heat stress increases more uniformly across the city, whereas nighttime heat stress exhibits greater spatial heterogeneity. They are driven by factors such as shading, land cover or material properties. However, the influence of the factors above on outdoor thermal comfort, a precise understanding of all effects and interactions or their future prediction, remains insufficiently quantified. The current most accurate models, due to the complexity of urban surroundings, are based on the large-eddy simulation principle. Although this approach enables us to simulate an urban environment in the units of meters, it requires extreme computational cost, this represents a potential for deep learning models designed to predict human thermal comfort in complex urban environments.
Permanent Link: https://hdl.handle.net/11104/0370992

0640612 - ÚI 2026 cze A - Abstract
Geletič, Jan
Praha-Holešovice – tepelné prostředí člověka.
[Přednáška pro zastupitelstvo a Komisi pro adaptaci. 24.09.2025-24.09.2025, Praha]
Grant - others:AV ČR(CZ) StrategieAV21/36
Program: StrategieAV
Institutional support: RVO:67985807
Permanent Link: https://hdl.handle.net/11104/0370994

0640624 - ÚI 2026 US eng A - Abstract
Fussner, Daniel Wesley - Krawczyk, Krzysztof
Amalgamation in quasivarieties of Sugihara algebras.
2025 AMS Fall Western Sectional Meeting Program. Denver: American Mathematical Society, 2025.
[2025 AMS Fall Western Sectional Meeting. 23.08.2025-24.08.2025, Denver]
Institutional support: RVO:67985807
Result website: https://meetings.ams.org/math/fall2025w/meetingapp.cgi/Paper/49270
Recent years have witnessed our understanding of amalgamation in residuated structures expand very rapidly, with the most notable successes focusing on varieties of residuated lattices. In the present work, we give a complete classification of subquasivarieties of Sugihara algebras with the amalgamation property. This extends the state of the art in two directions. First, it provides an entry point toward such classification theorems in the setting of quasivarieties, whereas heretofore available classification results of this sort dealt only with subvarieties of certain varieties of residuated structures. Second, it offers a foray into the study of amalgamation in constant-free analogues of residuated lattices, whose theory is more difficult in several respects, due primarily to the more complicated theory of congruences in the constant-free setting. As arbitrary quasivarieties of Sugihara algebras lack the congruence extension property — which has often proven a key ingredient in studies of amalgamation in residuated lattices — these results may also hint at some general methods that may prove useful in the study of amalgamation when the congruence extension property is absent.
Permanent Link: https://hdl.handle.net/11104/0371003

0640351 - ÚI 2026 CZ cze A - Abstract
Vidnerová, Petra
Síťová textová analýza za využití jazykových modelů pro mapování vědecké literatury.
Umělá inteligence v interdisciplinární diskusi: Sborník abstraktů. Katedra filozofie, Západočeská univerzita v Plzni, a Filosofický ústav Akademie věd ČR, 2025. s. 12-13.
[Umělá inteligence v interdisciplinární diskusi. 17.10.2025-18.10.2025, Plzeň]
R&D Projects: GA MŠMT(CZ) EH23_025/0008711
Institutional support: RVO:67985807
Keywords : textová analýza * síťová textová analýza * neuronové sítě * velké jazykové modely
OECD category: Computer sciences, information science, bioinformathics (hardware development to be 2.2, social aspect to be 5.8)
Přednáška představí moderní přístupy textové analýzy - od základních principů až po využití pokročilých modelů založených na neuronových sítích. Bude vysvětleno, co textová analýza ke, jaké typy úloh řeší a jaké techniky se pro ni používají. Nastíníme klíčové pojmy, jako jsou word embeddings, neuronové sítě a transformery. Ukážeme, jak mohou být velké jazykové modely (LLM) využity při analýze textových dat. Představíme též síťovou textovou analýzu – metodu, která propojuje textovou analytiku s teorií sítí. Ukážeme, jak lze z těchto textů konstruovat sémantické citační sítě a jaké poznatky lze z těchto struktur odvodit. Na analýze vědeckých článků bude ukázáno, jak síťová analýza pomáhá lépe porozumět vztahům mezi pojmy, autory či tématy v odborné literatuře.
Permanent Link: https://hdl.handle.net/11104/0370756

0638477 - ÚI 2026 US eng V - Research Report
Kůrková, Věra - Sanguineti, M.
Networks with Finite VC Dimension: Pro and Contra.
Cornell: Cornell University, 2025. 14 s. arXiv.org e-Print archive, arXiv:2502.02679.
Institutional support: RVO:67985807
Result website:https://doi.org/10.48550/arXiv.2502.02679
DOI: https://doi.org/10.48550/arXiv.2502.02679

Approximation and learning of classifiers of large data sets by neural networks in terms of high-dimensional geometry and statistical learning theory are investigated. The influence of the VC dimension of sets of input-output functions of networks on approximation capabilities is compared with its influence on consistency in learning from samples of data. It is shown that, whereas finite VC dimension is desirable for uniform convergence of empirical errors, it may not be desirable for approximation of functions drawn from a probability distribution modeling the likelihood that they occur in a given type of application. Based on the concentration-of-measure properties of high dimensional geometry, it is proven that both errors in approximation and empirical errors behave almost deterministically for networks implementing sets of input-output functions with finite VC dimensions in processing large data sets. Practical limitations of the universal approximation property, the trade-offs between the accuracy of approximation and consistency in learning from data, and the influence of depth of networks with ReLU units on their accuracy and consistency are discussed.
Permanent Link: https://hdl.handle.net/11104/0369129
Research data: preprint at ArXiv.org

0639152 - FLÚ 2026 eng DMP - Data Management Plan
Kovářová, Karolína - Bořkovec, Kryštof - Kubátová, B.
Data Management Plan - Vědění ve věku nedůvěry.
[Data Management Plan - Knowledge in the Age of Distrust.]
R&D Projects: GA MŠMT(CZ) EH23_025/0008711
Institutional support: RVO:67985955 ; RVO:67985807
Keywords : knowledge transfer * disruptive technologies * epistemology * artificial intelligence * digital humanities * trust in science * rationality
OECD category: Philosophy, History and Philosophy of science and technology; Computer sciences, information science, bioinformathics (hardware development to be 2.2, social aspect to be 5.8) (UIVT-O)
Data Magamenet Plan for the project Knowledge in the Age of Distrust. The aim of the project is to understand the impact of new technologies and deep learning algorithms on the processes of generation, circulation, verification, and adaptation of scientific knowledge, as well as to analyze the key factors influencing human communication and information flows in the context of rapid development of information technologies. The research team will develop tools for analyzing and modeling information flows and their stability, integrating methods from computer science, semantic and logical text analysis with sociological and historical approaches.
Permanent Link: https://hdl.handle.net/11104/0370848