

## Záznamy vložené do ASEP za UI (1. 11. – 31. 12. 2022)

### New ICS records in ASEP (1. 11. – 31. 12. 2022)

0563809 - ÚI 2023 CH eng M - Monography Chapter

**Diéguez, M. - [Fernández-Duque, David](#)**

Decidability for S4 Gödel Modal Logics.

*Computational Intelligence and Mathematics for Tackling Complex Problems 4*. Cham: Springer, 2023

- (Cornejo, M.; Harmati, I.; Koczy, L.; Medina-Moreno, J.), s. 1-7. Studies in Computational

Intelligence, 1040. ISBN 978-3-031-07706-7

**R&D Projects:** GA ČR(CZ) GA22-01137S

**Institutional support:** RVO:67985807

**Keywords :** Completeness \* Fuzzy logic \* Gödel logic \* Modal logic

[https://dx.doi.org/10.1007/978-3-031-07707-4\\_1](https://dx.doi.org/10.1007/978-3-031-07707-4_1)

[DOI: 10.1007/978-3-031-07707-4\\_1](https://doi.org/10.1007/978-3-031-07707-4_1)

We introduce semantics for crisp and fuzzy Gödel S4 based on bi-relational frames. We then show that each version of the logic is sound and complete for its respective class of frames and enjoys the finite model property. From this we conclude that both the crisp and fuzzy versions of Gödel S4 are decidable.

**Permanent Link:** <https://hdl.handle.net/11104/0335600>

0565534 - ÚI 2023 US eng M - Monography Chapter

**[Kalina, Jan](#)**

On Analyzing Complex Data Within Clinical Decision Support Systems.

*Diverse Perspectives and State-of-the-Art Approaches to the Utilization of Data-Driven Clinical Decision*

*Support Systems*. Hershey: IGI Global, 2023 - (Connolly, T.; Papadopoulos, P.; Soflano, M.), s. 84-104.

ISBN 9781668450925

**Institutional support:** RVO:67985807

**Keywords :** clinical decision making \* deep learning \* machine learning \* dimensionality reduction \* big data

**OECD category:** Computer sciences, information science, bioinformatics (hardware development to be 2.2, social aspect to be 5.8)

<https://dx.doi.org/10.4018/978-1-6684-5092-5.ch004>

[DOI: 10.4018/978-1-6684-5092-5.ch004](https://doi.org/10.4018/978-1-6684-5092-5.ch004)

Clinical decision support systems (CDSSs) represent digital health tools applicable to important tasks within the clinical decision-making process. Training data-driven CDSSs requires extracting medical knowledge from the available information by means of machine learning. The analysis of the complex (possibly big or high-dimensional) training data allows knowledge relevant to be obtained for clinical decisions related to the diagnosis, therapy, or prognosis. This chapter is devoted to training CDSSs by machine learning based on complex data. Remarkable recent examples of CDSSs including those based on deep learning are recalled here. Principles, challenges, or ethical aspects of machine learning are discussed here in the context of CDSSs. Attention is paid to dimensionality reduction, deep learning methods for big data, or explainability of the data analysis methods. Data analysis issues are discussed also for two particular CDSSs on which the author of this chapter participated.

**Permanent Link:** <https://hdl.handle.net/11104/0337060>

0565535 - ÚI 2023 US eng M - Monography Chapter

**[Kalina, Jan](#)**

Robust Dimensionality Reduction: A Resistant Search for the Relevant Information in Complex Data. *Convergence of Big Data Technologies and Computational Intelligent Techniques*. Hershey: IGI Global, 2023 - (Gupta, G.), s. 186-210. ISBN 9781668452646

**Institutional support:** RVO:67985807

**Keywords :** Computational Intelligence \* Complexity Reduction \* Machine Learning \* Variable Selection \* Outlying Measurements \* Robustness \* Sparsity \* Comprehensibility

**OECD category:** Computer sciences, information science, bioinformathics (hardware development to be 2.2, social aspect to be 5.8)

<https://dx.doi.org/10.4018/978-1-6684-5092-5.ch004>

[DOI: 10.4018/978-1-6684-5264-6.ch009](https://doi.org/10.4018/978-1-6684-5264-6.ch009)

With the increasing availability of massive data in various fields of applications such as engineering, economics, or biomedicine, there appears an urgent need for new reliable tools for obtaining relevant knowledge from such data, which allow one to find and interpret the most relevant features (variables). Such interpretation is however infeasible for the habitually used methods of machine learning, which can be characterized as black boxes. This chapter is devoted to variable selection methods for finding the most relevant variables for the given task. After explaining general principles, attention is paid to robust approaches, which are suitable for data contaminated by outlying values (outliers). Three main approaches to variable selection (prior, intrinsic, and posterior) are explained, and their recently proposed examples are illustrated on applications related to credit risk management and molecular genetics. These examples reveal recent robust approaches to data analysis to be able to outperform non-robust tools.

**Permanent Link:** <https://hdl.handle.net/11104/0337062>

0565542 - ÚI 2023 SG eng M - Monography Chapter

**[Kalina, Jan](#) - [Vidnerová, Petra](#) - [Soukup, Lubomír](#)**

Modern Approaches to Statistical Estimation of Measurements in the Location Model and Regression. *Handbook of Metrology and Applications*. Singapore: Springer, 2022 - (Aswal, D.; Yadav, S.; Takatsuji, T.; Rachakonda, P.; Kumar, H.). ISBN 978-981-19-1550-5

**R&D Projects:** GA ČR(CZ) GA22-02067S

**Institutional support:** RVO:67985807 ; RVO:67985556

**Keywords :** regression \* measurement error \* error propagation \* robustness \* Bayesian estimation

**OECD category:** Statistics and probability

[DOI: 10.1007/978-981-19-1550-5\\_125-1](https://doi.org/10.1007/978-981-19-1550-5_125-1)

Metrology as the science about measurement is highly intertwined with statistical point estimation. Evaluating and controlling uncertainty of measurements and analyzing them by means of exploratory data analysis (EDA) or predictive data mining requires to exploit advanced tools of statistical estimation. The main focus of the chapter is devoted to nonstandard approaches to the analysis of measurements in two fundamental models, namely, the location model and linear regression. Robust regression methods, which are resistant to the presence of outlying (anomalous) measurements, are discussed here. An illustration of their performance over a real dataset related to thyroid disease and a Monte Carlo simulation reveal here the least weighted squares estimator, which has remained quite neglected so far, outperforms much more renowned robust regression estimators in terms of the variability. Further, Bayesian estimation in the location model is revealed here to have the ability to incorporate previous measurements in a very intuitive way. Finally, the chapter gives a warning that linear regression performed on data contaminated by measurement errors yields biased estimates and requires specific estimation tools for the so-called measurement error model.

**Permanent Link:** <https://hdl.handle.net/11104/0337067>

0564523 - ÚI 2023 RIV CZ cze M - Monography Chapter

**[Wiedermann, Jiří](#) - van Leeuwen, J.**

Autonomní vozidla, která spolupracují a rozumí: Intelligentní algoritmy pod kapotou.

*Automatizované řízení vozidel a autonomní doprava: technické a humanitní perspektivy*. Praha: Academia, 2022 - (Černý, D.; Vaculín, O.; Zámečník, P.), s. 54-84. ISBN 978-80-200-3358-1

**Institutional support:** RVO:67985807

**Permanent Link:** <https://hdl.handle.net/11104/0336185>

0565679 - ÚI 2023 US eng J - Journal Article

**[Figueroa-Garcia, J.C.](#) - [Neruda, Roman](#) - [Hernandez-Pérez, G.](#)**

A genetic algorithm for multivariate missing data imputation.

*Information Sciences*. Roč. 619, January 2023 (2023), s. 947-967. ISSN 0020-0255. E-ISSN 1872-6291

**Institutional support:** RVO:67985807

**Keywords :** Missing data \* Genetic algorithms \* Multivariate missing data \* Data imputation

**OECD category:** Computer sciences, information science, bioinformathics (hardware development to be 2.2, social aspect to be 5.8)

**OECD category:** Computer sciences, information science, bioinformathics (hardware development to be 2.2, social aspect to be 5.8)

**Impact factor:** 8.233, year: 2021

**Method of publishing:** Open access

<https://dx.doi.org/10.1016/j.ins.2022.11.037>

[DOI: 10.1016/j.ins.2022.11.037](https://doi.org/10.1016/j.ins.2022.11.037)

Some data mining, AI and data processing tasks might have data loss whose estimation/imputation is an important problem to be solved. Genetic algorithms are efficient and flexible global optimization methods able to deal with both multiple missing observations and multiple features such as continuous/discrete/binary data which are often found in multivariate databases unlike classical missing data estimation methods which only deal with univariate-continuous data. This paper presents a genetic algorithm to impute multiple missing observations in multivariate data which minimizes a new multi-objective (fitness) function based on the Minkowski distance of the means, variances, covariances and skewness between available/completed data. To do so, two sets of examples were tested: a continuous/discrete dataset which is compared to both the EM algorithm and auxiliary regressions, and a comparison over seven benchmark datasets.

**Permanent Link:** <https://hdl.handle.net/11104/0337194>

0565994 - ÚI 2023 RIV US eng J - Journal Article

**[Pidnebesna, Anna](#) - [Fajnerová, I.](#) - [Horáček, J.](#) - [Hlinka, Jaroslav](#)**

Mixture Components Inference for Sparse Regression: Introduction and Application for Estimation of Neuronal Signal from fMRI BOLD.

*Applied Mathematical Modelling*. Roč. 116, April 2023 (2023), s. 735-748. ISSN 0307-904X. E-ISSN 1872-8480

**R&D Projects:** GA ČR(CZ) GA21-32608S

**Grant - others:** AV ČR(CZ) AP1901

**Program:** Akademická prémie - Praemium Academiae

**Institutional support:** RVO:67985807

**Keywords :** FMRI \* BOLD \* Deconvolution \* Mixtures with varying concentrations \* Neuronal signal estimation

**OECD category:** Statistics and probability

**Impact factor:** 5.336, year: 2021

**Method of publishing:** Limited access

<https://dx.doi.org/10.1016/j.apm.2022.11.034>

[DOI: 10.1016/j.apm.2022.11.034](https://doi.org/10.1016/j.apm.2022.11.034)

Sparse linear regression methods including the well-known LASSO and the Dantzig selector have become ubiquitous in the engineering practice, including in medical imaging. Among other tasks, they have been successfully applied for the estimation of neuronal activity from functional magnetic resonance data without prior knowledge of the stimulus or activation timing, utilizing an approximate knowledge of the hemodynamic response to local neuronal activity. These methods work by generating a parametric family of solutions with different sparsity, among which an ultimate choice is made using an information criteria. We propose a novel approach, that instead of selecting a single option from the family of regularized solutions, utilizes the whole family of such sparse regression solutions. Namely, their ensemble provides a first approximation of probability of activation at each time-point, and together with the conditional neuronal activity distributions estimated with the theory of mixtures with varying concentrations, they serve as the inputs to a Bayes classifier eventually deciding on the verity of activation at each time-point. We show in extensive numerical simulations that this new method performs favourably in comparison with standard approaches in a range of realistic scenarios. This is mainly due to the avoidance of overfitting and underfitting that commonly plague the solutions based on sparse regression combined with model selection methods, including the corrected Akaike Information Criterion. This advantage is finally documented in selected fMRI task datasets.

**Permanent Link:** <https://hdl.handle.net/11104/0337441>

0566011 - ÚI 2023 CH eng J - Journal Article

**Lahutsina, A. - Španiel, F. - Mrzilková, J. - Morozova, A. - [Brabec, Marek](#) - Musil, V. - Zach, P.**

Morphology of Anterior Cingulate Cortex and Its Relation to Schizophrenia.

*Journal of Clinical Medicine*. Roč. 12, č. 1 (2023), č. článku 33. E-ISSN 2077-0383

**Institutional support:** RVO:67985807

**Keywords :** MRI \* schizophrenia \* morphology \* anatomy \* cingulate and paracingulate sulci

**OECD category:** Statistics and probability

**Impact factor:** 4.964, year: 2021

**Method of publishing:** Open access

<https://dx.doi.org/10.3390/jcm12010033>

[DOI: 10.3390/jcm12010033](https://doi.org/10.3390/jcm12010033)

Cortical folding of the anterior cingulate cortex (ACC), particularly the cingulate (CS) and the paracingulate (PCS) sulci, represents a neurodevelopmental marker. Deviations in in utero development in schizophrenia can be traced using CS and PCS morphometry. In the present study, we measured the length of CS, PCS, and their segments on T1 MRI scans in 93 patients with first-episode schizophrenia and 42 healthy controls. Besides the length, the frequency and the left-right asymmetry of CS/PCS were compared in patients and controls. Distribution of the CS and PCS morphotypes in patients was different from controls. Parcellated sulcal pattern CS3a in the left hemisphere was longer in patients ( $53.8 \pm 25.7$  mm vs.  $32.7 \pm 19.4$  mm in controls,  $p < 0.05$ ), while in CS3c it was reversed—longer in controls ( $52.5 \pm 22.5$  mm as opposed to  $36.2 \pm 12.9$  mm, n.s. in patients). Non parcellated PCS in the right hemisphere were longer in patients compared to controls ( $19.4 \pm 10.2$  mm vs.  $12.1 \pm 12.4$  mm,  $p < 0.001$ ). Therefore, concurrent presence of PCS1 and CS1 in the left hemisphere and to some extent in the right hemisphere may be suggestive of a higher probability of schizophrenia.

**Permanent Link:** <https://hdl.handle.net/11104/0337446>

0565517 - ÚI 2023 RIV CH eng J - Journal Article

Řasová, K. - [Martinková, Patrícia](#) - [Vařejková, Michaela](#) - Miznerová, B. - Pavlíková, M. - Hlinovská, J. - Hlinovský, D. - [Philippová, Š.](#) - [Novotný, M.](#) - [Pospíšilová, K.](#) - [Biedková, P.](#) - [Vojtková, R.](#) - [Havlík, J.](#) - [Bríd O'Leary, V.](#) - [Černá, M.](#) - [Bartoš, A.](#) - [Phillip, T.](#)

COMIRESTROKE—A clinical study protocol for monitoring clinical effect and molecular biological readouts of COMprehensive Intensive REhabilitation program after STROKE: A four-arm parallel-group randomized double blinded controlled trial with a longitudinal design.

*Frontiers in Neurology*. Roč. 13, 1 November 2022 (2022), č. článku 954712. ISSN 1664-2295. E-ISSN 1664-2295

**Institutional support:** RVO:67985807

**Keywords :** ischemic stroke \* lncRNA—long non-coding RNA \* motor disability \* rehabilitation \* physiotherapy \* motor recovery \* international classification of functioning \* disability and health model

**OECD category:** Computer sciences, information science, bioinformatics (hardware development to be 2.2, social aspect to be 5.8)

**Impact factor:** 4.086, year: 2021

**Method of publishing:** Open access

<https://dx.doi.org/10.3389/fneur.2022.954712>

[DOI: 10.3389/fneur.2022.954712](https://doi.org/10.3389/fneur.2022.954712)

**INTRODUCTION:** While the role of physiotherapy as part of a comprehensive inpatient rehabilitation is indisputable, clear evidence concerning the effectiveness of different rehabilitation managements [interdisciplinary implementing the International Classification of Functioning, disability and health (ICF) vs. multidisciplinary model] and physiotherapy categories (neuroproprioceptive “facilitation, inhibition” vs. motor/skill acquisitions using technologies) are still lacking. In this study, four kinds of comprehensive inpatient rehabilitation with different management and content of physical therapy will be compared. Moreover, focus will be placed on the identification of novel biological molecules reflective of effective rehabilitation. Long non-coding RNAs (lncRNAs) are transcripts (>200 bps) of limited coding potential, which have recently been recognized as key factors in neuronal signaling pathways in ischemic stroke and as such, may provide a valuable readout of patient recovery and neuroprotection during therapeutic progression. **METHODS AND ANALYSIS:** Adults after the first ischemic stroke in an early sub-acute phase with motor disability will be randomly assigned to one of four groups and undergo a 3 weeks comprehensive inpatient rehabilitation of different types: interdisciplinary team work using ICF model as a guide; multidisciplinary teamwork implementing neuroproprioceptive “facilitation and inhibition” physiotherapy; multidisciplinary teamwork implementing technology-based physiotherapy; and standard multidisciplinary teamwork. Primary (the Goal Attainment Scale, the Patient-Reported Outcomes Measurement Information System, and the World Health Organization Disability Assessment Schedule) and secondary (motor, cognitive, psychological, speech and swallowing functions, functional independence) outcomes will be measured. A blood sample will be obtained upon consent (20 mls; representing pre-rehabilitation molecular) before and after the inpatient program. Primary outcomes will be followed up again 3 and 12 months after the end of the program. The overarching aim of this study is to determine the effectiveness of various rehabilitation managements and physiotherapeutic categories implemented by patients post ischemic stroke via analysis of primary, secondary and long non-coding RNA readouts. This clinical trial will offer an innovative approach not previously tested and will provide new complex analysis along with public assessable molecular biological evidence of various rehabilitation methodology for the alleviation of the effects of ischemic stroke.

**Permanent Link:** <https://hdl.handle.net/11104/03370470563807> - ÚI 2023 US eng J - Journal Article [Liczbińska, G.](#) - [Brabec, Marek](#) - [Piontek, J.](#) - [Malina, R. M.](#)

Age at menarche, environmental stress, and social inequality: Evidence from Poland in the 1930s–1950s.

*American Journal of Human Biology*. Online first 11 October 2022 (2022). ISSN 1042-0533. E-ISSN

1520-6300

**Institutional support:** RVO:67985807

**OECD category:** Statistics and probability

**Impact factor:** 2.947, year: 2021

<https://dx.doi.org/10.1002/ajhb.23817>

[DOI: 10.1002/ajhb.23817](https://doi.org/10.1002/ajhb.23817)

**OBJECTIVE:** To address the relationship between socioeconomic factors and age of menarche among Polish women born and reared in periods that varied considerably in environmental stresses: the Great Depression of the 1930s, the interval of World War II, and the interval of communist rule following World War II through the 1950s. **METHODS:** The data set included information on age at menarche and socioeconomic status (SES) of 718 women born during the Great Depression ( $n = 182$ ), WWII ( $n = 189$ ), and post-WWII through the 1950s ( $n = 347$ ). A structured semi-parametric statistical model (generalized additive model [GAM] class) was used for analysis. An ANOVA-like linear model was used to test for marginal effects of SES-related factors and their interactions together with nonparametric seasonal effect. **RESULTS:** The influence of period of birth, month of birth, region of early childhood, and father's education, and the interaction between period of birth and father's education on age at menarche were statistically significant. During the economic crisis and the interval of WWII, differences in ages at menarche between the extreme categories of father's education were marked. The differences in ages at menarche between women from the lowest and highest social groups were markedly reduced among women born during the post-war interval. In addition, women born in February–March attained menarche earlier than women born in September–October. **CONCLUSIONS:** Unpredictable conditions associated with the economic crisis and war conditions had a stronger impact on age at menarche among women from families of lower SES compared to women from better economic circumstances. Individuals born and reared in low SES conditions likely suffered more severe deterioration across the spectrum of the standard of living and quality of life compared to those with a higher SES.

**Permanent Link:** <https://hdl.handle.net/11104/0335599>

0565843 - ÚI 2023 RIV GB eng J - Journal Article

**Fernández-Duque, David - Joosten, J.J. - Pakhomov, F. - Papafilippou, K. - Weierman, A.**  
Arithmetical and Hyperarithmetical Worm Battles.

*Journal of Logic and Computation*. Roč. 32, č. 8 (2022), s. 1558-1584. ISSN 0955-792X. E-ISSN 1465-363X

**Institutional support:** RVO:67985807

**Keywords :** provability logics \* independence results \* ordinal analysis

**Impact factor:** 0.509, year: 2021

**Method of publishing:** Limited access

<https://dx.doi.org/10.1093/logcom/exac067>

[DOI: 10.1093/logcom/exac067](https://doi.org/10.1093/logcom/exac067)

Japaridze's provability logic GLP has one modality  $[n]$  for each natural number and has been used by Beklemishev for a proof theoretic analysis of Peano arithmetic (PA) and related theories. Among other benefits, this analysis yields the so-called Every Worm Dies (EWD) principle, a natural combinatorial statement independent of PA. Recently, Beklemishev and Pakhomov have studied notions of provability corresponding to transfinite modalities in GLP. We show that indeed the natural transfinite extension of GLP is sound for this interpretation and yields independent combinatorial principles for the second-order theory ACA of arithmetical comprehension with full induction. We also provide restricted versions of EWD related to the fragments  $I\Sigma(n)$  of PA. In order to prove the latter, we show that standard Hardy functions majorize their variants based on tree ordinals.

**Permanent Link:** <https://hdl.handle.net/11104/0337335>

0563344 - ÚI 2023 US eng J - Journal Article

**Marmolejo-Ramos, F. - Tejo, M. - [Brabec, Marek](#) - Kužílek, J. - Joksimovic, S. - Kovanovic, V. - González, J. - Kneib, T. - Bühlmann, P. - Kook, L. - Briseño-Sánchez, G. - Ospina, R.**

Distributional regression modeling via generalized additive models for location, scale, and shape: An overview through a data set from learning analytics.

*Wiley Interdisciplinary Reviews-Data Mining and Knowledge Discovery*. Online First 21 October 2022 (2022). ISSN 1942-4787. E-ISSN 1942-4795

**Institutional support:** RVO:67985807

**Keywords :** causal regularization \* causality \* educational data mining \* generalized additive models for location, scale and shape \* learning analytics \* machine learning \* statistical learning \* statistical modeling \* supervised learning

**OECD category:** Statistics and probability

**Impact factor:** 7.558, year: 2021

**Method of publishing:** Open access

<https://dx.doi.org/10.1002/widm.1479>

[DOI: 10.1002/widm.1479](https://doi.org/10.1002/widm.1479)

The advent of technological developments is allowing to gather large amounts of data in several research fields. Learning analytics (LA)/educational data mining has access to big observational unstructured data captured from educational settings and relies mostly on unsupervised machine learning (ML) algorithms to make sense of such type of data. Generalized additive models for location, scale, and shape (GAMLSS) are a supervised statistical learning framework that allows modeling all the parameters of the distribution of the response variable with respect to the explanatory variables. This article overviews the power and flexibility of GAMLSS in relation to some ML techniques. Also, GAMLSS' capability to be tailored toward causality via causal regularization is briefly commented. This overview is illustrated via a data set from the field of LA.

**Permanent Link:** <https://hdl.handle.net/11104/0335333>

0563234 - ÚI 2023 DE eng J - Journal Article

**Patti, G. - [Pecen, Ladislav](#) - Casalnuovo, G. - Manu, M. C. - Kirchhof, P. - De Caterina, R.**

Heterogeneity of outcomes within diabetic patients with atrial fibrillation on edoxaban: a sub-analysis from the ETNA-AF Europe registry.

*Clinical Research in Cardiology*. August 2022 (2022). ISSN 1861-0684. E-ISSN 1861-0692

**Institutional support:** RVO:67985807

**Keywords :** Diabetes \* Insulin \* Atrial fibrillation \* Thromboembolic events \* Mortality

**Impact factor:** 6.138, year: 2021

**Method of publishing:** Open access

[DOI: 10.1007/s00392-022-02080-5](https://doi.org/10.1007/s00392-022-02080-5)

**BACKGROUND:** Recent data have suggested that insulin-requiring diabetes mostly contributes to the overall increase of thromboembolic risk in patients with atrial fibrillation (AF) on warfarin. We evaluated the prognostic role of a different diabetes status on clinical outcome in a large cohort of AF patients treated with edoxaban. **METHODS:** We accessed individual patients' data from the prospective, multicenter, ETNA-AF Europe Registry. We compared the rates of ischemic stroke/transient ischemic attack (TIA)/systemic embolism, myocardial infarction (MI), major bleeding and all-cause death at 2 years according to diabetes status. **RESULTS:** Out of an overall population of 13,133 patients, 2885 had diabetes (22.0%), 605 of whom (21.0%) were on insulin. The yearly incidence of ischemic stroke/TIA/systemic embolism was 0.86% in patients without diabetes, 0.87% in diabetic patients not receiving insulin ( $p = 0.92$  vs no diabetes) and 1.81% in those on insulin ( $p = 0.002$  vs no diabetes;  $p = 0.014$  vs diabetes not on insulin). The annual rates of MI and major bleeding were 0.40%, 0.43%, 1.04% and 0.90%, 1.10% and 1.71%, respectively. All-cause yearly

mortality was 3.36%, 5.02% and 8.91%. At multivariate analysis, diabetes on insulin was associated with a higher rate of ischemic stroke/TIA/systemic embolism [adjusted HR 2.20, 95% CI 1.37-3.54,  $p = 0.0011$  vs no diabetes + diabetes not on insulin] and all-cause death [aHR 2.13 (95% CI 1.68-2.68,  $p < 0.0001$  vs no diabetes)]. Diabetic patients not on insulin had a higher mortality [aHR 1.32 (1.11-1.57),  $p = 0.0015$ ], but similar incidence of stroke/TIA/systemic embolism, MI and major bleeding, vs those without diabetes. CONCLUSIONS: In a real-world cohort of AF patients on edoxaban, diabetes requiring insulin therapy, rather than the presence of diabetes per se, appears to be an independent factor affecting the occurrence of thromboembolic events during follow-up. Regardless of the diabetes type, diabetic patients had a lower survival compared with those without diabetes.

**Permanent Link:** <https://hdl.handle.net/11104/0335269>

0565992 - ÚI 2023 RIV NL eng J - Journal Article

**Marushka, J. - Brokešová, J. - Ugo Ogadah, Ch. - Kazemi, A. - [Duintjer Tebbens, Jurjen](#) - Šklubalová, Z.**

Milling of pharmaceutical powder carrier excipients: Application of central composite design.

*Advanced Powder Technology*. Roč. 33, č. 12 (2022), č. článku 103881. ISSN 0921-8831. E-ISSN 1568-5527

**Keywords :** Excipient \* Milling \* Quality by design \* Particle size

**Impact factor:** 4.969, year: 2021

**Method of publishing:** Limited access

<https://dx.doi.org/10.1016/j.apt.2022.103881>

[DOI: 10.1016/j.apt.2022.103881](https://doi.org/10.1016/j.apt.2022.103881)

Pharmaceutical powder carriers are often used to prevent agglomeration of a micronized drug in the co-milling process. Twenty-four pharmaceutical excipients were subjected to preliminary mild milling conditions in this work. Ten of them showed acceptable milling properties with alginic acid, calcium alginate, microcrystalline cellulose (Avicel® 200), carrageenan, and hypromellose having the best particle size reduction without any aggregation while maintaining a narrow span. For the latter five substances, circumscribed central composite design (CCD) evaluating the effect of the factors milling speed and time on the responses (particle size, particle size distribution) for three milling ball sizes was used to establish optimal milling conditions. For all ten possible factor combinations and each ball size, a quadratic response surface model was used to predict the response variable. For three substances out of five, the best results were achieved using 5-mm balls. Thermal characteristics showed the good stability of excipients under optimized milling conditions.

**Permanent Link:** <https://hdl.handle.net/11104/0337433>

0564950 - ÚI 2023 US eng J - Journal Article

**[Rehák Bučková, Barbora](#) - Mareš, J. - Škoch, A. - [Kopal, Jakub](#) - [Tintěra, J.](#) - Dineen, R.A. - [Řasová, K.](#) - [Hlinka, Jaroslav](#)**

Multimodal-neuroimaging machine-learning analysis of motor disability in multiple sclerosis.

*Brain Imaging and Behavior*. Online 17 November 2022 (2022). ISSN 1931-7557. E-ISSN 1931-7565

**R&D Projects:** GA ČR GA13-23940S; GA MZd(CZ) NU21-08-00432

**Grant - others:** AV ČR(CZ) StrategieAV21/1; AV ČR(CZ) StrategieAV21/26

**Program:** StrategieAV; StrategieAV

**Institutional support:** RVO:67985807

**Keywords :** Multiple sclerosis \* Machine learning \* Multimodal analysis \* Prediction \* MRI

**OECD category:** Clinical neurology

**Impact factor:** 3.224, year: 2021

**Method of publishing:** Limited access

[DOI: 10.1007/s11682-022-00737-3](https://doi.org/10.1007/s11682-022-00737-3)

Motor disability is a dominant and restricting symptom in multiple sclerosis, yet its neuroimaging correlates are not fully understood. We apply statistical and machine learning techniques on multimodal neuroimaging data to discriminate between multiple sclerosis patients and healthy controls and to predict motor disability scores in the patients. We examine the data of sixty-four multiple sclerosis patients and sixty-five controls, who underwent the MRI examination and the evaluation of motor disability scales. The modalities used comprised regional fractional anisotropy, regional grey matter volumes, and functional connectivity. For analysis, we employ two approaches: high-dimensional support vector machines run on features selected by Fisher Score (aiming for maximal classification accuracy), and low-dimensional logistic regression on the principal components of data (aiming for increased interpretability). We apply analogous regression methods to predict symptom severity. While fractional anisotropy provides the classification accuracy of 96.1% and 89.9% with both approaches respectively, including other modalities did not bring further improvement. Concerning the prediction of motor impairment, the low-dimensional approach performed more reliably. The first grey matter volume component was significantly correlated ( $R = 0.28-0.46$ ,  $p < 0.05$ ) with most clinical scales. In summary, we identified the relationship between both white and grey matter changes and motor impairment in multiple sclerosis. Furthermore, we were able to achieve the highest classification accuracy based on quantitative MRI measures of tissue integrity between patients and controls yet reported, while also providing a low-dimensional classification approach with comparable results, paving the way to interpretable machine learning models of brain changes in multiple sclerosis.

**Permanent Link:** <https://hdl.handle.net/11104/0336527>

0563340 - ÚI 2023 RIV NL eng J - Journal Article

**Hofmeister, J. - Hošek, J. - Baltaziuk, K. - Tenčík, A. - Iarema, V. - Brabec, Marek - Pettit, J.**

Species-rich plant communities in interior habitats of small forest fragments: The role of seed dispersal and edge effect.

*Journal of Vegetation Science*. Roč. 33, č. 5 (2022), č. článku e13152. ISSN 1100-9233. E-ISSN 1654-1103

**Institutional support:** RVO:67985807

**Keywords :** dispersal strategy \* edge effect \* forest fragmentation \* forest specialists \* generalists \* light quality \* plant communities \* seed dispersal \* seed viability \* semiparametric modeling \* species richness

**OECD category:** Statistics and probability

**Impact factor:** 3.389, year: 2021

**Method of publishing:** Limited access

<https://dx.doi.org/10.1111/jvs.13152>

[DOI: 10.1111/jvs.13152](https://doi.org/10.1111/jvs.13152)

**QUESTIONS:** What are the effects of environmental and dispersal filters on vegetation in small and species-rich fragments of temperate forests in which species richness increases along the edge-interior gradient? Location Small fragments of thermophilic forests in central Bohemia, Czech Republic.

**METHODS:** Repeated vegetation surveys and seed rain samplings were conducted in 71 plots located in 17 forest fragments (0.4 to 255 ha) in an agricultural landscape in Central Europe. A subsequent assessment of seed viability was performed via germination in a greenhouse. We evaluated species richness, composition and the similarities between forest vegetation and viable available seeds, accounting for potentially significant environmental conditions. Particularly, we examined the effects of species with different associations to the forest environment in combination with prevalent dispersal strategies. **RESULTS:** Species richness and composition of the herb layer vegetation (including tree and shrub seedlings) in small forest fragments reflected seed distribution and, to a lesser extent, seed viability. Plant species composition showed a nested pattern according to the distance from the forest edge, the species at the edge represented a subset of the species in the forest interior. Forest

specialist species with spatially limited dispersal consistently achieved the highest species richness in forest interiors (>200 m from the forest edge), although this differed depending on aspect. Species richness of generalists and open-land species benefitted from higher light quality and vice versa for forest specialists. CONCLUSIONS: Small forest fragments maintain species-rich herb layer communities confined in area-limited interior habitats. They do this despite being mostly or entirely under the influence of the edge effect and impoverished of forest specialists. Moreover, the species-rich interiors of the small forest fragments are likely prone to negative changes in species composition induced either by canopy closure or opening in the future.

**Permanent Link:** <https://hdl.handle.net/11104/0335327>

0563350 - ÚI 2023 NL eng J - Journal Article

**Haniková, Zuzana**

Rational Pavelka logic: The best among three worlds?

*Fuzzy Sets and Systems*. Online 12 August 2022 (2022). ISSN 0165-0114. E-ISSN 1872-6801

**R&D Projects:** GA ČR(CZ) GA18-00113S

**Institutional support:** RVO:67985807

**Keywords :** fuzzy logic \* Łukasiewicz logic \* Rational Pavelka logic \* rational truth constants \* graded formula

**OECD category:** Computer sciences, information science, bioinformatics (hardware development to be 2.2, social aspect to be 5.8)

**Impact factor:** 4.462, year: 2021

**Method of publishing:** Limited access

**DOI:** [10.1016/j.fss.2022.08.010](https://doi.org/10.1016/j.fss.2022.08.010)

This comparative survey explores three formal approaches to reasoning with partly true statements and degrees of truth, within the family of Łukasiewicz logic. These approaches are represented by infinite-valued Łukasiewicz logic ( $\mathbb{L}$ ), Rational Pavelka logic (RPL) and a logic with graded formulas that we refer to as Graded Rational Pavelka logic (GRPL). Truth constants for all rationals between 0 and 1 are used as a technical means to represent degrees of truth. Łukasiewicz logic ostensibly features no truth constants except 0 and 1; Rational Pavelka logic includes constants in the basic language, with suitable axioms; Graded Rational Pavelka logic works with graded formulas and proofs, following the original intent of Pavelka, inspired by Goguen's work. Historically, Pavelka's papers precede the definition of GRPL, which in turn precedes RPL; retrieving these steps, we discuss how these formal systems naturally evolve from each other, and we also recall how this process has been a somewhat contentious issue in the realm of Łukasiewicz logic. This work can also be read as a case study in logics, their fragments, and the relationship of the fragments to a logic.

**Permanent Link:** <https://hdl.handle.net/11104/0335337>

0563824 - FZÚ 2023 RIV US eng J - Journal Article

**Acero, M. A. - Adamson, P. - Aliaga, L. - Filip, Peter - Haki, František - Lokajíček, Miloš - Zálešák, Jaroslav** ... Total 205 authors

Improved measurement of neutrino oscillation parameters by the NOvA experiment.

*Physical Review D*. Roč. 106, č. 3 (2022), č. článku 032004. ISSN 2470-0010. E-ISSN 2470-0029

**R&D Projects:** GA MŠk(CZ) LM2018113

**Institutional support:** RVO:68378271 ; RVO:67985807

**Keywords :** NOvA \* CP: violation \* asymmetry \* neutrino: mixing angle

**OECD category:** Particles and field physics; Particles and field physics (UIVT-O)

**Impact factor:** 5.407, year: 2021

**Method of publishing:** Open access

**DOI:** [10.1103/PhysRevD.106.032004](https://doi.org/10.1103/PhysRevD.106.032004)

We present new  $\nu\mu\rightarrow\nu e$ ,  $\nu\mu\rightarrow\nu\mu$ ,  $\bar{\nu}\mu\rightarrow\bar{\nu}e$ , and  $\bar{\nu}\mu\rightarrow\bar{\nu}\mu$  oscillation measurements by the NOvA experiment, with a 50% increase in neutrino-mode beam exposure over the previously reported results. The additional data, combined with previously published neutrino and antineutrino data, are all analyzed using improved techniques and simulations. A joint fit to the  $\nu e$ ,  $\nu\mu$ ,  $\bar{\nu}e$ , and  $\bar{\nu}\mu$  candidate samples within the 3-flavor neutrino oscillation framework continues to yield a best-fit point in the normal mass ordering and the upper octant of the  $\theta_{23}$  mixing angle, with  $\Delta m_{322}^2=(2.41\pm 0.07)\times 10^{-3}$  eV<sup>2</sup> and  $\sin^2\theta_{23}=0.57-0.04+0.03$ . The data disfavor combinations of oscillation parameters that give rise to a large asymmetry in the rates of  $\nu e$  and  $\bar{\nu}e$  appearance.

**Permanent Link:** <https://hdl.handle.net/11104/0335615>

0564951 - ÚI 2023 US eng J - Journal Article

**Golden, R. - Delanois, J. E. - Šanda, Pavel - Bazhenov, M.**

Sleep prevents catastrophic forgetting in spiking neural networks by forming a joint synaptic weight representation.

*PLoS Computational Biology*. Online 18 November 2022 (2022). ISSN 1553-734X. E-ISSN 1553-7358

**Institutional support:** RVO:67985807

**Keywords :** spiking model \* catastrophic forgetting \* sleep

**OECD category:** Computer sciences, information science, bioinformatics (hardware development to be 2.2, social aspect to be 5.8)

**Impact factor:** 4.779, year: 2021

**Method of publishing:** Open access

<https://dx.doi.org/10.1371/journal.pcbi.1010628>

[DOI: 10.1371/journal.pcbi.1010628](https://doi.org/10.1371/journal.pcbi.1010628)

Artificial neural networks overwrite previously learned tasks when trained sequentially, a phenomenon known as catastrophic forgetting. In contrast, the brain learns continuously, and typically learns best when new training is interleaved with periods of sleep for memory consolidation. Here we used spiking network to study mechanisms behind catastrophic forgetting and the role of sleep in preventing it. The network could be trained to learn a complex foraging task but exhibited catastrophic forgetting when trained sequentially on different tasks. In synaptic weight space, new task training moved the synaptic weight configuration away from the manifold representing old task leading to forgetting. Interleaving new task training with periods of off-line reactivation, mimicking biological sleep, mitigated catastrophic forgetting by constraining the network synaptic weight state to the previously learned manifold, while allowing the weight configuration to converge towards the intersection of the manifolds representing old and new tasks. The study reveals a possible strategy of synaptic weights dynamics the brain applies during sleep to prevent forgetting and optimize learning.

**Permanent Link:** <https://hdl.handle.net/11104/0336528>

0564952 - ÚI 2023 RIV eng J - Journal Article

**Pidnebesna, Anna - Šanda, Pavel - Kalina, A. - Hammer, J. - Marusič, P. - Vlček, K. - Hlinka, Jaroslav**

Tackling the challenges of group network inference from intracranial EEG data.

*Frontiers in Neuroscience*. Roč. 16, 01 December 2022 (2022), č. článku 1061867. E-ISSN 1662-4548

**R&D Projects:** GA ČR(CZ) GA19-11753S

**Institutional support:** RVO:67985807

**Keywords :** connectivity analysis \* Phase Locking Value \* Directed Transfer Function \* intracranial EEG \* information flow \* visual pathways \* ventral visual stream \* dorsal visual stream

**Impact factor:** 4.677, year: 2020

**Method of publishing:** Open access

<https://dx.doi.org/10.3389/fnins.2022.1061867>

[DOI: 10.3389/fnins.2022.1061867](https://doi.org/10.3389/fnins.2022.1061867)

**INTRODUCTION:** Intracranial EEG (iEEG) data is a powerful way to map brain function, characterized by high temporal and spatial resolution, allowing the study of interactions among neuronal populations that orchestrate cognitive processing. However, the statistical inference and analysis of brain networks using iEEG data faces many challenges related to its sparse brain coverage, and its inhomogeneity across patients. **METHODS:** We review these challenges and develop a methodological pipeline for estimation of network structure not obtainable from any single patient, illustrated on the inference of the interaction among visual streams using a dataset of 27 human iEEG recordings from a visual experiment employing visual scene stimuli. 100 ms sliding window and multiple band-pass filtered signals are used to provide temporal and spectral resolution. For the connectivity analysis we showcase two connectivity measures reflecting different types of interaction between regions of interest (ROI): Phase Locking Value as a symmetric measure of synchrony, and Directed Transfer Function— asymmetric measure describing causal interaction. For each two channels, initial uncorrected significance testing at  $p < 0.05$  for every time-frequency point is carried out by comparison of the data-derived connectivity to a baseline surrogate-based null distribution, providing a binary time-frequency connectivity map. For each ROI pair, a connectivity density map is obtained by averaging across all pairs of channels spanning them, effectively agglomerating data across relevant channels and subjects. Finally, the difference of the mean map value after and before the stimulation is compared to the same statistic in surrogate data to assess link significance. **RESULTS:** The analysis confirmed the function of the parieto-medial temporal pathway, mediating visuospatial information between dorsal and ventral visual streams during visual scene analysis. Moreover, we observed the anterior hippocampal connectivity with more posterior areas in the medial temporal lobe, and found the reciprocal information flow between early processing areas and medial place area. **DISCUSSION:** To summarize, we developed an approach for estimating network connectivity, dealing with the challenge of sparse individual coverage of intracranial EEG electrodes. Its application provided new insights into the interaction between the dorsal and ventral visual streams, one of the iconic dualities in human cognition.

**Permanent Link:** <https://hdl.handle.net/11104/0336529>

0563602 - ÚI 2023 RIV NL eng J - Journal Article

[Cintula, Petr](#) - [Grimau, Berta](#) - [Noguera, C.](#) - [Smith, N.J.J.](#)

These degrees go to eleven: fuzzy logics and gradable predicates.

*Synthese*. Roč. 200, October 2022 (2022), č. článku 445. ISSN 0039-7857. E-ISSN 1573-0964

**R&D Projects:** GA ČR(CZ) GA18-00113S

**Institutional support:** RVO:67985807 ; RVO:67985556

**Keywords :** Vagueness \* Fuzzy logic \* Formal semantics \* Gradable adjectives \* Sorites paradox

**OECD category:** Philosophy, History and Philosophy of science and technology

**Impact factor:** 1.595, year: 2021

**Method of publishing:** Limited access

[DOI: 10.1007/s11229-022-03909-2](https://doi.org/10.1007/s11229-022-03909-2)

In the literature on vagueness one finds two very different kinds of degree theory. The dominant kind of account of gradable adjectives in formal semantics and linguistics is built on an underlying framework involving bivalence and classical logic: its degrees are not degrees of truth. On the other hand, fuzzy logic based theories of vagueness—largely absent from the formal semantics literature but playing a significant role in both the philosophical literature on vagueness and in the contemporary logic literature—are logically nonclassical and give a central role to the idea of degrees of truth. Each kind of degree theory has a strength: the classical kind allows for rich and subtle analyses of the comparative form of gradable adjectives and of various types of gradable precise adjectives, while the fuzzy kind yields a compelling solution to the sorites paradox. This paper argues that the fuzzy kind of theory can match the benefits of the classical kind and hence that the burden is on the latter to match

the advantages of the former. In particular, we develop a new version of the fuzzy logic approach that—unlike existing fuzzy theories—yields a compelling analysis of the comparative as well as an adequate account of gradable precise predicates, while still retaining the advantage of genuinely solving the sorites paradox.

**Permanent Link:** <https://hdl.handle.net/11104/0335529>

0565958 - ÚI 2023 US eng J - Journal Article

**Sanchez, S. M. - [Schmidt, Helmut](#) - Gallardo, G. - Anwander, A. - Brauer, J. - Friederici, A. D. - Knösche, T.R.**

White matter brain structure predicts language performance and learning success.

*Human Brain Mapping*. Online First 18 November 2022 (2022). ISSN 1065-9471. E-ISSN 1097-0193

**Institutional support:** RVO:67985807

**Keywords :** Cognitive performance \* Language performance \* Learning process \* White matter \* Working memory

**Impact factor:** 5.399, year: 2021

**Method of publishing:** Open access

<https://dx.doi.org/10.1002/hbm.26132>

**DOI:** [10.1002/hbm.26132](https://doi.org/10.1002/hbm.26132)

Individual differences in the ability to process language have long been discussed. Much of the neural basis of these, however, is yet unknown. Here we investigated the relationship between long-range white matter connectivity of the brain, as revealed by diffusion tractography, and the ability to process syntactically complex sentences in the participants' native language as well as the improvement thereof by multiday training. We identified specific network motifs by singular value decomposition that indeed related white matter structural connectivity to individual language processing performance. First, for two such motifs, one in the left and one in the right hemisphere, their individual prevalence significantly predicted the individual language performance, suggesting an anatomical predisposition for the individual ability to process syntactically complex sentences. Both motifs comprise a number of cortical regions, but seem to be dominated by areas known for the involvement in working memory rather than the classical language network itself. Second, we identified another left hemispheric network motif, whose change of prevalence over the training period significantly correlated with the individual change in performance, thus reflecting training induced white matter plasticity. This motif comprises diverse cortical areas including regions known for their involvement in language processing, working memory and motor functions. The present findings suggest that individual differences in language processing and learning can be explained, in part, by individual differences in the brain's white matter structure. Brain structure may be a crucial factor to be considered when discussing variations in human cognitive performance, more generally.

**Permanent Link:** <https://hdl.handle.net/11104/0337422>

0565995 - ÚI 2023 CH eng J - Journal Article

**Súkeníková, L. - Černý, V. - Thon, T. - Roubalová, R. - Jirásková Zakostelská, J. - Novotná, O. - Petrásková, P. - Boráková, K. - Kocourková, I. - Lodinová-Žádníková, R. - Musil, Z. - Kolářová, L. - Prokešová, L. - [Valenta, Zdeněk](#) - Hrdý, J.**

Effect of Early Postnatal Supplementation of Newborns by Probiotic Strain E. coli O83:K24:H31 on Allergy Incidence, Dendritic cells and Microbiota.

*Frontiers in Immunology*. Accepted December 2022. ISSN 1664-3224. E-ISSN 1664-3224

**Institutional support:** RVO:67985807

**Method of publishing:** Open access

**Permanent Link:** <https://hdl.handle.net/11104/0337442>

0565990 - ÚI 2023 RIV CH eng C - Conference Paper (international conference)

[Sedlár, Igor](#) - [Wannenburg, Johann Joubert](#)

Embedding Kozen-Tiuryn Logic into Residuated One-Sorted Kleene Algebra with Test.

*Logic, Language, Information, and Computation*. Cham: Springer, 2022 - (Ciabattoni, A.; Pimentel, E.; de Queiroz, R.), s. 221-236. Lecture Notes in Computer Science, 13468. ISBN 978-3-031-15297-9. ISSN 0302-9743.

[WoLLIC 2022: International Workshop on Logic, Language, Information, and Computation /28./. Iași (RO), 20.09.2022-23.09.2022]

**R&D Projects:** GA MŠk(CZ) EF18\_053/0017594

**Institutional support:** RVO:67985807

**Keywords :** Hoare logic \* Kleene algebra with codomain \* Kleene algebra with tests \* Partial correctness \* Substructural logic

[https://dx.doi.org/10.1007/978-3-031-15298-6\\_14](https://dx.doi.org/10.1007/978-3-031-15298-6_14)

[DOI: 10.1007/978-3-031-15298-6\\_14](https://doi.org/10.1007/978-3-031-15298-6_14)

Kozen and Tiuryn have introduced the substructural logic S for reasoning about correctness of while programs (ACM TOCL, 2003). The logic S distinguishes between tests and partial correctness assertions, representing the latter by special implicational formulas. Kozen and Tiuryn's logic extends Kleene algebra with tests, where partial correctness assertions are represented by equations, not terms. Kleene algebra with codomain, KAC, is a one-sorted alternative to Kleene algebra with tests that expands Kleene algebra with an operator that allows to construct a Boolean subalgebra of tests. In this paper we show that Kozen and Tiuryn's logic embeds into the equational theory of the expansion of KAC with residuals of Kleene algebra multiplication and the upper adjoint of the codomain operator.

**Permanent Link:** <https://hdl.handle.net/11104/0337430>

0563276 - ÚI 2023 RIV CH eng C - Conference Paper (international conference)

[Fernández-Duque, David](#) - [Gougeon, P.](#)

Fixed Point Logics and Definable Topological Properties.

Lecture Notes in Computer Science. In: *Logic, Language, Information, and Computation*. Cham: Springer, 2022 - (Ciabattoni, A.; Pimentel, E.; de Queiroz, R.), Roč. 13468 (2022), s. 36-52. Lecture Notes in Computer Science, 13468. ISBN 978-3-031-15297-9. ISSN 0302-9743.

[WoLLIC 2022: International Workshop on Logic, Language, Information, and Computation /28./. Iași (RO), 20.09.2022-23.09.2022]

**Institutional support:** RVO:67985807

**Keywords :** Mu-calculus \* Expressivity \* Topological semantics

[DOI: 10.1007/978-3-031-15298-6\\_3](https://doi.org/10.1007/978-3-031-15298-6_3)

Modal logic enjoys topological semantics that may be traced back to McKinsey and Tarski, and the classification of topological spaces via modal axioms is a lively area of research. In the past two decades, there has been interest in extending topological modal logic to the language of the mu-calculus, but previously no class of topological spaces was known to be mu-calculus definable that was not already modally definable. In this paper we show that the full mu-calculus is indeed more expressive than standard modal logic, in the sense that there are classes of topological spaces (and weakly transitive Kripke frames) which are mu-definable, but not modally definable. The classes we exhibit satisfy a modally definable property outside of their perfect core, and thus we dub them imperfect spaces. We show that the mu-calculus is sound and complete for these classes. Our examples are minimal in the sense that they use a single instance of a greatest fixed point.

**Permanent Link:** <https://hdl.handle.net/11104/0337431>

0564518 - ÚI 2023 RIV CZ eng C - Conference Paper (international conference)

**[Kalina, Jan](#) - [Janáček, P.](#)**

A Bootstrap Comparison of Robust Regression Estimators.

*Mathematical Methods in Economics 2022: Proceedings*. Jihlava: College of Polytechnics Jihlava, 2022 - (Vojáčková, H.), s. 161-167. ISBN 978-80-88064-62-6.

[MME 2022: International Conference on Mathematical Methods in Economics /40./, Jihlava (CZ), 07.09.2022-09.09.2022]

**R&D Projects:** GA ČR GA21-05325S

**Institutional support:** RVO:67985807 ; RVO:67985556

**Keywords :** linear regression \* robust estimation \* nonparametric bootstrap \* bootstrap hypothesis testing

**OECD category:** Statistics and probability

<https://mme2022.vspj.cz/download/proceedings-4.pdf>

The ordinary least squares estimator in linear regression is well known to be highly vulnerable to the presence of outliers in the data and available robust statistical estimators represent more preferable alternatives. It has been repeatedly recommended to use the least squares together with a robust estimator, where the latter is understood as a diagnostic tool for the former. In other words, only if the robust estimator yields a very different result, the user should investigate the dataset closer and search for explanations. For this purpose, a hypothesis test of equality of the means of two alternative linear regression estimators is proposed here based on nonparametric bootstrap. The performance of the test is presented on three real economic datasets with small samples. Robust estimates turn out not to be significantly different from non-robust estimates in the selected datasets. Still, robust estimation is beneficial in these datasets and the experiments illustrate one of possible ways of exploiting the bootstrap methodology in regression modeling. The bootstrap test could be easily extended to nonlinear regression models.

**Permanent Link:** <https://hdl.handle.net/11104/0336179>

0564516 - ÚI 2023 RIV CZ eng C - Conference Paper (international conference)

**[Kalina, Jan](#) - [Neoral, Aleš](#)**

Recent Trends in Machine Learning with a Focus on Applications in Finance.

*The 16th International Days of Statistics and Economics Conference Proceedings*. Praha: Melandrium, 2022 - (Löster, T.; Pavelka, T.), s. 187-196. ISBN 978-80-87990-29-2.

[International Days of Statistics and Economics /16./, Praha (CZ), 08.09.2022-10.09.2022]

**Grant - others:** GA ČR(CZ) GA21-19311S

**Institutional support:** RVO:67985807

**Keywords :** statistical learning \* automated machine learning \* metalearning \* financial data analysis \* stock market investing

**OECD category:** Computer sciences, information science, bioinformatics (hardware development to be 2.2, social aspect to be 5.8)

[https://msed.vse.cz/msed\\_2022/article/577-Kalina-Jan-paper.pdf](https://msed.vse.cz/msed_2022/article/577-Kalina-Jan-paper.pdf)

Machine learning methods penetrate to applications in the analysis of financial data, particularly to supervised learning tasks including regression or classification. Other approaches, such as reinforcement learning or automated machine learning, are not so well known in the context of finance yet. In this paper, we discuss the advantages of an automated data analysis, which is beneficial especially if a larger number of datasets should be analyzed under a time pressure. Important types of learning include reinforcement learning, automated machine learning, or metalearning. This paper overviews their principles and recalls some of their inspiring applications. We include a discussion of the importance of the concept of information and of the search for the most

relevant information in the field of mathematical finance. We come to the conclusion that a statistical interpretation of the results of the automatic machine learning remains crucial for a proper understanding of the knowledge acquired by the analysis of the given (financial) data.

**Permanent Link:** <https://hdl.handle.net/11104/0336174>

0565960 - ÚI 2023 RIV DE eng C - Conference Paper (international conference)

**Yorsh, U. - Behr, A. S. - Kockmann, N. - Holeňa, Martin**

Text-to-Ontology Mapping via Natural Language Processing Models.

*Proceedings of the 22st Conference Information Technologies – Applications and Theory (ITAT 2022)*. Aachen: Technical University & CreateSpace Independent Publishing, 2022 - (Ciencialová, L.; Holeňa, M.; Jajcay, R.; Jajcayová, R.; Mráz, F.; Pardubská, D.; Plátek, M.), s. 28-34. ISSN 1613-0073. [ITAT 2022: Conference Information Technologies - Applications and Theory /22./, Zuberec (SK), 23.09.2022-27.09.2022]

**Institutional support:** RVO:67985807

**Keywords :** text analysis \* language models \* fastText \* BERT \* matching text to ontologies

**OECD category:** Computer sciences, information science, bioinformathics (hardware development to be 2.2, social aspect to be 5.8)

<https://ceur-ws.org/Vol-3226/paper3.pdf>

The paper presents work in progress attempting to solve a text-to-ontology mapping problem. While ontologies are being created as formal specifications of shared conceptualizations of application domains, different users often create different ontologies to represent the same domain. For better reasoning about concepts in scientific papers, it is desired to pick the ontology which best matches concepts present in the input text. We have started to automatize this process and attack the problem by utilizing state-of-the-art NLP tools and neural networks. Given a specific set of ontologies, we experiment with different training pipelines for NLP machine learning models with the aim to construct representative embeddings for the text-to-ontology matching task. We assess the final result through visualizing the latent space and exploring the mappings between an input text and ontology classes.

**Permanent Link:** <https://hdl.handle.net/11104/0337425>

0565961 - ÚI 2023 RIV DE eng C - Conference Paper (international conference)

**Korel, L. - Behr, A. S. - Kockmann, N. - Holeňa, Martin**

Using Artificial Neural Networks to Determine Ontologies Most Relevant to Scientific Texts.

*Proceedings of the 22st Conference Information Technologies – Applications and Theory (ITAT 2022)*. Aachen: Technical University & CreateSpace Independent Publishing, 2022 - (Ciencialová, L.; Holeňa, M.; Jajcay, R.; Jajcayová, R.; Mráz, F.; Pardubská, D.; Plátek, M.), s. 44-54. ISSN 1613-0073. [ITAT 2022: Conference Information Technologies - Applications and Theory /22./, Zuberec (SK), 23.09.2022-27.09.2022]

**Institutional support:** RVO:67985807

**Keywords :** ontology \* text data \* text preprocessing \* text representation learning \* text classification

**OECD category:** Computer sciences, information science, bioinformathics (hardware development to be 2.2, social aspect to be 5.8)

<https://ceur-ws.org/Vol-3226/paper5.pdf>

This paper provides an insight into the possibility of how to find ontologies most relevant to scientific texts using artificial neural networks. The basic idea of the presented approach is to select a representative paragraph from a source text file, embed it to a vector space by a pre-trained fine-

tuned transformer, and classify the embedded vector according to its relevance to a target ontology. We have considered different classifiers to categorize the output from the transformer, in particular random forest, support vector machine, multilayer perceptron, k-nearest neighbors, and Gaussian process classifiers. Their suitability has been evaluated in a use case with ontologies and scientific texts concerning catalysis research. From results we can say the worst results have random forest. The best results in this task brought support vector machine classifier

**Permanent Link:** <https://hdl.handle.net/11104/0337426>

0564526 - ÚI 2023 RIV CH eng C - Conference Paper (international conference)

**[Wiedermann, Jiří](#) - [van Leeuwen, J.](#)**

Validating Non-trivial Semantic Properties of Autonomous Robots.

*Philosophy and Theory of Artificial Intelligence 2021 Conference Proceedings*. Cham: Springer, 2022 - (Magnani, L.), s. 91-104. Studies in Applied Philosophy, Epistemology and Rational Ethic, 63. ISBN 978-3-031-09152-0.

[PTAI 2021: Conference on Philosophy and Theory of Artificial Intelligence /4./ Gothenburg (SE), 27.09.2021-28.09.2021]

**Grant - others:** AV ČR(CZ) StrategieAV21/1

**Program:** StrategieAV

**Institutional support:** RVO:67985807

**Keywords :** Autonomous robots \* Cyber-physical systems \* Ethics of AI Semantic properties \* Rice's theorem \* Robot modelling \* Turing machines \* Verification

**DOI:** [10.1007/978-3-031-09153-7\\_8](https://doi.org/10.1007/978-3-031-09153-7_8)

A semantic property of autonomous robots is called non-trivial if some robots satisfy it and some do not, like adherence to rules of ethics or compliance with legal regulations. In order to study the validation problem for these properties, we model robots as cyber-physical systems with programmable control. Their behaviour is modelled by the infinite streams of interactions that they generate. We show that, under mild conditions, there can be no algorithmic method for deciding from a robot's program whether it satisfies a given non-trivial semantic property or not. The result provides a compelling analogue to Rice's theorem from classical computability theory, now for autonomous robots. We also show that no interactive verifiers of any kind whatsoever can exist for the problem. The results are fundamental to understanding the difficulty of validations in artificial intelligence.

**Permanent Link:** <https://hdl.handle.net/11104/0336186>

0565499 - ÚI 2023 RIV CZ eng L4 - Software

**[Coufal, David](#) - [Hakl, František](#) - [Vidnerová, Petra](#)**

General-purpose Library of ML/AI Methods.

**Internal code:** TN01000024/03-V005 ; 2022

**Technical parameters:** Kolekce programů a skriptů spustitelných z příkazové řádky, vyžaduje Python a běžně dostupné výpočetní knihovny. Zadání se definuje v textovém souboru, typicky ve formátu YAML. Vzhledem k výpočetní náročnosti doporučeno využití GPU nebo výpočetního clusteru s více CPU.

**Economic parameters:** Knihovna obsahuje dvě části. Skripty věnované rozšiřování datové základny pro učení navigace robota (GANs) a část zabývající se hledáním optimální architektury neuronových sítí (AnANAS). Rozšiřování datové základny je prováděno pomocí generativních neuronových sítí. Jsou implementovány architektury DCGAN a LSGAN v nepodmíněné i podmíněné verzi. Kvalita učení je monitorována pomocí FID skóre. AnANAS část je určena pro experimenty s hledáním optimální architektury hluboké neuronové sítě, jak s plně propojenými vrstvami tak sítě konvoluční. Umožňuje více-kriteriální optimalizaci, nabízí tři verze více-kriteriální optimalizace (NSGA, NSGA-II, NSGA-III) a implementaci základního standardního genetického algoritmu. Umožňuje paralelní výpočet na GPU nebo s využitím několika CPU.

**R&D Projects:** GA TA ČR(CZ) TN01000024

**Institutional support:** RVO:67985807

**Keywords :** deep neural networks \* generative adversarial networks \* conditional generation \* generative algorithms \* neural architecture search \* model selection \* evolutionary algorithms \* multiobjective optimisation \* hluboké neuronové sítě \* generativní adversiální sítě \* generativní algoritmy \* hledání architektury neuronové sítě \* evoluční algoritmy \* vícekritériální optimalizace

**OECD category:** Computer sciences, information science, bioinformatics (hardware development to be 2.2, social aspect to be 5.8)

**Permanent Link:** <https://hdl.handle.net/11104/0337029>

**Research data:** [Github.com](https://github.com)

0565500 - ÚI 2023 RIV CZ eng L4 - Software

**Coufal, David - Haki, František - Vidnerová, Petra**

General-purpose Library of ML/AI Methods for CUDA Cores.

**Internal code:** TN01000024/03-V009 ; 2022

**Technical parameters:** Refaktorovaný kód je poskytnut ve formě MATLAB MEX souborů. Ke spuštění vyžaduje MATLAB. Použití se řídí příslušnými licenčními podmínkami Akademické licence MATLABu.

**Economic parameters:** Refaktoriace Python + TensorFlow kódu do nativního CUDA kódu pomocí MATLAB GPU Coderu. Urychlení inference implementace neuronových sítí.

**R&D Projects:** GA TA ČR(CZ) TN01000024

**Institutional support:** RVO:67985807

**Keywords :** deep neural networks \* generative adversarial networks \* conditional generation \* generative algorithms \* MATLAB GPU Coder \* CUDA cores \* hluboké neuronové sítě \* generativní adversiální sítě \* generativní algoritmy

**OECD category:** Computer sciences, information science, bioinformatics (hardware development to be 2.2, social aspect to be 5.8)

The library contains an implementation of generative neural networks for the purpose of extending the data base of robot learning in MATLAB. The learned neural networks (generators) are compiled via MATLAB GPU Coder into native CUDA code to speed up inference.

**Permanent Link:** <https://hdl.handle.net/11104/0337034>

**Research data:** [Github.com](https://github.com)

0564948 - ÚI 2023 eng L4 - Software

**Kathpalia, Aditi - Paluš, Milan**

PermutationCCC.

**Internal code:** PermutationCCC ; 2022

**Institutional support:** RVO:67985807

<https://github.com/AditiKathpalia/PermutationCCC>

This is a Permutation Compression Complexity Causality or PCCC (MATLAB) toolbox which uses 'Compression Complexity Causality (CCC)' and 'Effort to Compress (ETC)'. This toolbox can be used standalone after including it on the MATLAB path. It is meant for research purposes only. Licensed under the Apache License, Version 2.0 (the "License"); you may not use this file except in compliance with the License. You may obtain a copy of the License at <http://www.apache.org/licenses/LICENSE-2.0>

**Permanent Link:** <https://hdl.handle.net/11104/0336525>

0563669 - ÚI 2023 RIV CZ eng L4 - Software

**Hladká, Adéla - Martinková, Patrícia - Zvára, K.**

difNLR: DIF and DDF Detection by Non-Linear Regression Models, Version 1.4.1.

**Internal code:** difNLR - Version 1.4.1 ; 2022

**Technical parameters:** R software package

**Economic parameters:** Umožňuje zadavatelům znalostních a psychologických testů provádět analýzu férovosti testů a jejich binárních, ordinálních a nominálních položek. Obsahuje nové metody založené na zobecnění logistické regresi. Nová verze nabízí predikci, různé parametrizace a vylepšenou grafickou reprezentaci výsledků.

**Institutional support:** RVO:67985807

**Keywords :** differential item functioning \* differential distractor functioning \* item analysis \* non-linear regression \* logistic regression

<https://CRAN.R-project.org/package=difNLR>

The difNLR package v 1.3.0 contains Differential Item Functioning (DIF) detection method based on non-linear regression for binary items. Both uniform and non-uniform DIF effects can be detected when considering one focal group. Package also includes models for DIF detection among ordinal items and for detection of Differential Distractor Functioning (DDF) among nominal items. Available under GPL-3 licence.

**Permanent Link:** <https://hdl.handle.net/11104/0335558>

**Research data:** [CRAN](#)

0563386 - ÚI 2023 eng A - Abstract

**Balasis, G. - Balikhin, M. A. - Chapman, S. - Consolini, G. - Daglis, I. A. - Donner, R. - Kurths, J. - Paluš, Milan - Runge, J. - Tsurutani, B. T. - Vassiliadis, D. - Wing, S. - Gjerloev, J. W. - Johnson, J. - Materassi, M. - Alberti, T. - Papadimitriou, C. - Boutsis, A. Z. ...** Total 19 authors

Complex systems methods characterizing nonlinear processes in the near-Earth electromagnetic environment: Recent advances and open challenges.

*The COSPAR 2022 Scientific Program Overview. 2022.*

[COSPAR 2022: Committee of Space Research Scientific Assembly /44./ 16.07.2022-24.07.2022, Athens / Virtual]

**Institutional support:** RVO:67985807

Learning from successful applications of methods originating in statistical mechanics or information theory in one scientific field (e.g., atmospheric physics or climatology) can provide important insights or conceptual ideas for other areas (e.g., space sciences) or even stimulate new research questions and approaches. For instance, quantification and attribution of dynamical complexity in output time series of nonlinear dynamical systems is a key challenge across scientific disciplines. Especially in the field of space physics, an early and accurate detection of characteristic dissimilarity between normal and abnormal states (e.g., pre-storm activity vs. magnetic storms) has the potential to vastly improve space weather diagnosis and, consequently, the mitigation of space weather hazards. This review provides a systematic overview on existing nonlinear dynamical systems-based methodologies along with key results of their previous application in a space physics context, which particularly illustrates how complementary modern complex systems approaches have recently shaped our understanding of nonlinear magnetospheric variability. The rising number of corresponding studies demonstrates that the multiplicity of nonlinear time series analysis methods developed during the last decades offers great potentials for uncovering relevant yet complex processes interlinking different geospace subsystems, variables and spatiotemporal scales.

**Permanent Link:** <https://hdl.handle.net/11104/0335363>

0564520 - ÚI 2023 CZ eng A - Abstract

**[Kalina, Jan](#) - [Janáček, P.](#)**

A Bootstrap Comparison of Robust Regression Estimators.

*Mathematical Methods in Economics 2022: Book of Abstracts*. Jihlava, 2022 - (Vojáčková, H.). s. 39-39. ISBN 978-80-88064-61-9.

[MME 2022: International Conference on Mathematical Methods in Economics /40./, 07.09.2022-09.09.2022, Jihlava]

**R&D Projects:** GA ČR GA21-05325S

**Institutional support:** RVO:67985807

**Keywords :** linear regression \* robust estimation \* nonparametric bootstrap \* bootstrap hypothesis testing

<https://mme2022.vspj.cz/download/book-of-abstracts-3.pdf>

The ordinary least squares estimator in linear regression is well known to be highly vulnerable to the presence of outliers in the data and available robust statistical estimators represent more preferable alternatives. It has been repeatedly recommended to use the least squares together with a robust estimator, where the latter is understood as a diagnostic tool for the former. In other words, only if the robust estimator yields a very different result, the user should investigate the dataset closer and search for explanations. For this purpose, a hypothesis test of equality of the means of two alternative linear regression estimators is proposed here based on nonparametric bootstrap. The performance of the test is presented on three real economic datasets with small samples. Robust estimates turn out not to be significantly different from non-robust estimates in the selected datasets. Still, robust estimation is beneficial in these datasets and the experiments illustrate one of possible ways of exploiting the bootstrap methodology in regression modeling. The bootstrap test could be easily extended to nonlinear regression models

**Permanent Link:** <https://hdl.handle.net/11104/0336183>

0565709 - ÚI 2023 A - Abstract

**[Dallmer-Zerbe, Isa](#) - [Jajcay, Nikola](#) - [Chvojka, J.](#) - [Jiruška, P.](#) - [Hlinka, Jaroslav](#)**

Comparing data- and model-driven approaches to identify epileptic brain states in rat and human electrophysiology.

*Epilepsia Open*. Roč. 63, Suppl. 2 (2022), s. 91-92. E-ISSN 2470-9239

**R&D Projects:** GA ČR(CZ) GA21-17564S; GA ČR(CZ) GA18-07908S

**Permanent Link:** <https://hdl.handle.net/11104/0337222>

0565174 - ÚI 2023 eng A - Abstract

**[Davoodi, Akbar](#)**

Graph Theory in Data Science. Crash course.

[School of Mathematics (Isfahan branch). Esfahan, 01.03.2022-18.03.2022]

**Method of presentation:** Přednáška

**Event organizer:** Institute for Research in Fundamental Sciences

**URL events:** <https://math.ipm.ac.ir/isfahan/StMembers.jsp>

**Institutional support:** RVO:67985807

**Permanent Link:** <https://hdl.handle.net/11104/0336680>

0564945 - ÚI 2023 eng A - Abstract

**[Geletič, Jan](#) - [Belda, M.](#) - [Bureš, Martin](#) - [Krč, Pavel](#) - [Resler, Jaroslav](#) - [Řezníček, Hynek](#)**

Simulation of potential complex effect of urban greenery in urban canyon; case study in Prague-Dejvice.

*2022 IAUC Virtual Poster Session: Conference Abstract book*. Sydney: University of New South Wales,

2022. s. 121-121.

[IAUC Virtual Poster Conference 2022. 30.08.2022-01.09.2022]

**Grant - others:** AV ČR(CZ) StrategieAV21/3

**Program:** StrategieAV

**Institutional support:** RVO:67985807

**Permanent Link:** <https://hdl.handle.net/11104/0336523>

0564546 - ÚI 2023 cze A - Abstract

**Hlinka, Jaroslav**

Sítě jako nový jazyk neurověd.

[Český a slovenský neurologický sjezd /30./, Praha, 23.11.2016-06.12.2016]

**Method of presentation:** Zvaná přednáška

**URL events:** <https://www.czech-neuro.cz/odborne-akce/sjezdy-a-akce-cns/>

**Permanent Link:** <https://hdl.handle.net/11104/0336231>

0564947 - ÚI 2023 DE eng A - Abstract

**Lehnert, M. - Geletič, Jan - Jurek, M. - Brabec, Marek**

Effect of blue and green features on thermal exposure and thermal sensation in Czech cities.

*EMS Annual Meeting Abstracts*. Bonn: EMS.

[EMS Annual Meeting 2022. 04.09.2022-09.09.2022, Bonn]

**Grant - others:** AV ČR(CZ) StrategieAV21/3

**Program:** StrategieAV

**Institutional support:** RVO:67985807

<https://meetingorganizer.copernicus.org/EMS2022/EMS2022-71.html>

**DOI:** [10.5194/ems2022-71](https://doi.org/10.5194/ems2022-71)

Climate change becomes more evident even in the generally mild climate of Central Europe. Analyses based on long-term temperature observations have confirmed growing numbers of hot days and nights and an increasing frequency of heat waves. In response to this risk, municipalities seek and invest into climate adaptation measures. However, the implemented measures are often inadequate or inefficient. In this study, we focus on the analyses of the effect of blue and green features to reduce heat stress in open public spaces in city centres; our research is conducted in collaboration with local representatives of four Czech cities of Brno, Olomouc, Ostrava and Pilsen. We selected representative locations in each of the four city centres as field measurement sites for air temperature, humidity, wind velocity and globe temperature during hot days. Based on our measurements the UTCI values in five-minute steps were calculated. At the same time, we conducted extensive questionnaire surveys of thermal comfort perceived by passers-by in each of the investigated locations. Our results show that in studied cities, trees within open areas of the city centre lead to a decrease in UTCI by 5–8°C during daytime in tree shade compared to sunlit paved areas. Irrigated and regularly cut lawns in open areas of the city centres cause a decrease of 0–1°C compared to sunlit paved areas. Small features of blue infrastructure (fountains, misting systems etc.) in open areas of the city centre lead to changes in UTCI in the range of –2.5 to +1.0°C, depending on the time of day and on the character of the water feature. Sprinkling the open areas (city squares) with water from tank trucks during heat waves lowers the UTCI by 1–3°C, yet this effect lasts only around 20 minutes (depending on air temperature and air flow). Influence of small water sprinklers and misting systems on the microclimate in distances exceeding 0.5 m from the given water feature was inconclusive. Finally, the results suggest a highly complex relationship between biometeorological indices and thermal sensation vote (TSV) in urban environments – open grassy areas exhibit a lower probability of higher TSV, on the other hand, the probability of higher TSV is higher under trees and near sprayed water-mist.

**Permanent Link:** <https://hdl.handle.net/11104/0336524>

0565158 - ÚI 2023 US eng V - Research Report

[Davoodi, Akbar](#) - Maherani, L.

*On the total versions of 1-2-3-conjecture for graphs and hypergraphs.*

Cornell University: Cornell University, 2022. 16 s. arXiv.org e-Print archive, arXiv:2204.13936 [math.CO].

**R&D Projects:** GA ČR(CZ) GA19-08740S

**Institutional support:** RVO:67985807

**Keywords :** vertex coloring \* edge weighting \* hypergraphs

**OECD category:** Pure mathematics

<https://arxiv.org/abs/2204.13936> DOI: [10.48550/arXiv.2204.13936](https://doi.org/10.48550/arXiv.2204.13936)

**Permanent Link:** <https://hdl.handle.net/11104/0336666>