0545760 - ÚI 2022 eng J - Journal Article
Běhounek, L. - Majer, Ondrej
A graded semantics for counterfactuals.
Synthese. Online 04 September 2021 (2021). ISSN 0039-7857. E-ISSN 1573-0964

This article presents an extension of Lewis' analysis of counterfactuals to a graded framework. Unlike standard graded approaches, which use the probabilistic framework, we employ that of many-valued logics. Our principal goal is to provide an adequate analysis of the main background notion of Lewis' approach—the one of the similarity of possible worlds. We discuss the requirements imposed on the analysis of counterfactuals by the imprecise character of similarity and concentrate in particular on robustness, i.e., the requirement that small changes in the similarity relation should not significantly change the truth value of the counterfactual in question. Our second motivation is related to the logical analysis of natural language: analyzing counterfactuals in the framework of many-valued logics allows us to extend the analysis to counterfactuals that include vague statements. Unlike previous proposals of this kind in the literature, our approach makes it possible to apply gradedness at various levels of the analysis and hence provide a more detailed account of the phenomenon of vagueness in the context of counterfactuals. Finally, our framework admits a novel way of avoiding the Limit Assumption, keeping the core of Lewis' truth condition for counterfactuals unchanged.
Permanent Link: http://hdl.handle.net/11104/0322423

0545822 - ÚI 2022 RIV CH eng J - Journal Article
Kořenek, Jakub - Hlinka, Jaroslav
Causality in Reversed Time Series: Reversed or Conserved?
Entropy. Roč. 23, August 2021 (2021), č. článku 1067. E-ISSN 1099-4300

The inference of causal relations between observable phenomena is paramount across scientific disciplines; however, the means for such enterprise without experimental manipulation are limited. A commonly applied principle is that of the cause preceding and predicting the effect, taking into account other circumstances. Intuitively, when the temporal order of events is reverted, one would expect the cause and effect to apparently switch roles. This was previously demonstrated in bivariate linear systems and used in design of improved causal inference scores, while such behaviour in linear systems has been put in contrast with nonlinear chaotic systems where the inferred causal direction appears unchanged under time reversal. The presented work explores the conditions under which the causal reversal happens—either perfectly, approximately, or not at all—using theoretical analysis, low-dimensional examples, and network simulations, focusing on the simplified yet illustrative linear vector autoregressive process of order one. We start with a theoretical analysis that demonstrates that a perfect coupling reversal under time reversal occurs only under very specific conditions, followed up by constructing low-dimensional examples where indeed the dominant causal direction is even conserved rather than reversed. Finally, simulations of random as well as realistically motivated network coupling patterns from brain and climate show that level of coupling reversal and conservation can be well predicted by asymmetry and anormality indices introduced based on the

theoretical analysis of the problem. The consequences for causal inference are discussed.
Permanent Link: http://hdl.handle.net/11104/0322468

Tichopád, A. - Pecen, Ladislav - Sedlák, V.
Could the new coronavirus have infected humans prior November 2019?

The pandemic caused by the SARS-CoV-2 virus is believed to originate in China from where it spread to other parts of the world. The first cluster of diseased individuals was reported in China as early as in December 2019. It has also been well established that the virus stroke Italy later in January or in February 2020, hence distinctly after the outbreak in China. The work by Apolone et al. published in the Italian Medical Journal in November 2020 and retracted upon expression of concern on 22 March 2021, however propose that the virus could have stroke people already in September 2019, possibly following even earlier outbreak in China. By fitting an early part of the epidemic curve with the exponential and extrapolating it backwards, we could estimate the day-zero of the epidemic and calculated its confidence intervals in Italy and China. We also calculated how probable it is that Italy encountered the virus prior 1 January 2020. We determined an early portion of the epidemic curve representing unhindered exponential growth which fit the exponential model with high determination >0.97 in both countries. We conservatively suggest that the day-zero in China and Italy was 8 December 2019 (95% CI: 3 Dec., 20 Dec.) and 22 January 2020 (95% CI: 16 Jan., 29 Jan.), respectively. Given the uncertainty of the very early data in China and adjusting hence our model to fit the exponentially behaved data only, we can even admit that the pandemic originated through November 2019 (95% CI: 31 Oct., 22 Dec.). With high confidence (p <0.01) China encountered the virus prior Italy. We generally view any pre-pandemic presence of the virus in humans before November 2019 as very unlikely. The later established dynamics of the epidemics data suggests that the country of the origin was China.
Permanent Link: http://hdl.handle.net/11104/0322483

Brožová, K. - Holubová, A. - Bořilová, P. - Brabec, Marek - Kohout, P. - Hadač, J. - Brož, J.
Hypoglycemia during treatment with the ketogenic diet in a child with refractory epilepsy - results of continuous glucose monitoring.

The ketogenic diet (KD) is an effective treatment for intractable epilepsy in children. Hypoglycemia can be one of its side-effects, which is considered to be present mainly during the introductory phase of KD. Continuous glucose monitoring in a 6-year old non-diabetic child treated with KD for more than 8 months revealed long periods of asymptomatic hypoglycemia (8.9% of the total time under 2.5 mmol/l, 10.6% of the total time in the range between 2.5-3.0, 29.1% in the range of 3.0-3.6 mmol/l). The episodes of serious hypoglycemia were associated with a fasting state. The amount of sacharides in KD was increased with substantial glycemic profile improvement.
Permanent Link: http://hdl.handle.net/11104/0322467

Miron, L. - Chiriac, R. - Brabec, Marek - Badescu, V.
Ignition delay and its influence on the performance of a Diesel engine operating with different Diesel–biodiesel fuels.

The ignition delay is an important parameter which characterizes the initiation of combustion process and consequently its development in Diesel engines. This parameter mainly depends on chemical factors which are related to the fuel structure and its properties and also on physical factors which are related to the engine operating conditions. The need for alternative fuels usage in Diesel engines determined by the depletion of petroleum resources and by the regulations imposed on pollutant emissions have enforced the researches on renewable biofuels. Among these new fuels, biodiesel B7, actually in use, and biodiesel B20, in prospective, have received a particular interest. In this sense, an experimental and theoretical study was performed on a tractor Diesel engine aiming to determine the ignition delay of the rapeseed biodiesel B7 and B20 and to compare them with the ignition delay of pure Diesel fuel for full load and different engine speeds as tested operating conditions. This present study represents an extension of the previously mentioned research having now as objectives: to review what are the methods used for the ignition delay evaluation, to perform a comparison between several commonly Arrhenius type relationships used for the assessment of ignition delay and the ignition delay experimentally determined, and to offer a better understanding of the influences induced by the ignition delay respectively by the fuel reactivity on performance, efficiency and emissions of compression ignited engines operating with different Diesel–biodiesel fuels. The novelty of this work consists in the statistical approach to probability density of ignition delay which leads to better estimation of this crucial parameter and consequently to better control of the combustion process.
Permanent Link: http://hdl.handle.net/11104/0322480

Gerstner, M. - Taher H. - Škoch, A. - Hlinka, Jaroslav - Guye M. - Bartolomei F. - Jirsa, V. - Zakharova, A. - Olmi S.
Patient-specific network connectivity combined with a next generation neural mass model to test clinical hypothesis of seizure propagation.

Dynamics underlying epileptic seizures span multiple scales in space and time, therefore, understanding seizure mechanisms requires identifying the relations between seizure components within and across these scales, together with the analysis of their dynamical repertoire. In this view, mathematical models have been developed, ranging from single neuron to neural population. In this study we consider a neural mass model able to exactly reproduce the dynamics of heterogeneous spiking neural networks. We combine the mathematical modelling with structural information from non-invasive brain imaging, thus building large-scale brain network models to explore emergent dynamics and test clinical hypothesis. We provide a comprehensive study on the effect of external drives on neuronal networks exhibiting multistability, in order to investigate the role played by the neuroanatomical connectivity matrices in shaping the emergent dynamics. In particular we systematically investigate the conditions under which the network displays a transition from a low activity regime to a high activity state, which we identify with a seizure-like event. This approach allows us to study the biophysical parameters and variables leading to multiple recruitment events at the network level. We further exploit topological network measures in order to explain the differences and the analogies among the subjects and their brain regions, in showing recruitment events at different parameter values. We demonstrate, along the example of diffusion-weighted magnetic resonance imaging (MRI) connectomes of 20 healthy subjects and 15 epileptic patients, that individual variations in structural connectivity, when linked with mathematical dynamic models, have the capacity to explain changes in spatiotemporal organization of brain dynamics, as observed in network-based brain disorders. In particular, for epileptic patients, by means of the integration of the clinical hypotheses on the epileptogenic zone (EZ), i.e. the local network where highly synchronous seizures originate, we have identified the sequence of recruitment events and discussed their links with the topological properties of the specific connectomes. The predictions made on the basis of the

implemented set of exact mean-field equations turn out to be in line with the clinical pre-surgical evaluation on recruited secondary networks.
Permanent Link: http://hdl.handle.net/11104/0322469

0545611 - ÚI 2022 RIV eng J - Journal Article
Bezhanishvili, G. - Bezhanishvili, N. - Moraschini, T. - Stronkowski, Michał
Profiniteness and representability of spectra of Heyting algebras.
Advances in Mathematics. Roč. 391, 19 November 2021 (2021), č. článku 107959. ISSN 0001-8708. E-ISSN 1090-2082
Institutional support: RVO:67985807
Keywords : Heyting algebra * Profinite algebra * Profinite completion * Representation Problem * Priestley space * Esakia space
Subject RIV: BA - General Mathematics
OBOR OECD: Pure mathematics
Impact factor: 1.688, year: 2020
http://dx.doi.org/10.1016/j.aim.2021.107959
 DOI: 10.1016/j.aim.2021.107959

We prove that there exist profinite Heyting algebras that are not isomorphic to the profinite completion of any Heyting algebra. This resolves an open problem from 2009. More generally, we characterize those varieties of Heyting algebras in which profinite algebras are isomorphic to profinite completions. It turns out that there exists largest such. We give different characterizations of this variety and show that it is finitely axiomatizable and locally finite. From this it follows that it is decidable whether in a finitely axiomatizable variety of Heyting algebras all profinite members are profinite completions. In addition, we introduce and characterize representable varieties of Heyting algebras, thus drawing connection to the classical problem of representing posets as prime spectra.
Permanent Link: http://hdl.handle.net/11104/0322290

0545345 - FZÚ 2022 RIV US eng J - Journal Article
Acero, M. A. - Adamson, P. - Aliaga, L. - Filip, Peter - Hakl, František - Lokajíček, Miloš - Zálešák, Jaroslav
Seasonal variation of multiple-muon cosmic ray air showers observed in the NOvA detector on the surface.
Physical Review D. Roč. 104, č. 1 (2021), s. 1-8, č. článku 012014. ISSN 2470-0010. E-ISSN 2470-0029
R&D Projects: GA MŠk(CZ) LM2018113
Institutional support: RVO:68378271 ; RVO:67985807
Keywords : NOvA * flux: time dependence * multiplicity: dependence
Subject RIV: BF - Elementary Particles and High Energy Physics; BF - Elementary Particles and High Energy Physics (UIVT-O)
OBOR OECD: Particles and field physics; Particles and field physics (UIVT-O)
Impact factor: 5.296, year: 2020
http://hdl.handle.net/11104/0322059
 DOI: 10.1103/PhysRevD.104.012014

We report the rate of cosmic ray air showers with multiplicities exceeding 15 muon tracks recorded in the NOvA Far Detector between May 2016 and May 2018. The detector is located on the surface under an overburden of 3.6 meters water equivalent. We observe a seasonal dependence in the rate of multiple-muon showers, which varies in magnitude with multiplicity and zenith angle. During this period, the effective atmospheric temperature and surface pressure ranged between 210 K and 230 K and 940 mbar and 990 mbar, respectively, the shower rates are anticorrelated with the variation in the effective temperature. The variations are about 30% larger for the highest multiplicities than the lowest multiplicities and 20% larger for showers near the horizon than vertical showers.
Permanent Link: http://hdl.handle.net/11104/0322059

0545840 - ÚI 2022 US eng J - Journal Article
Vlček, Jan - Lukšan, Ladislav
Two limited-memory optimization methods with minimum violation of the previous secant conditions.
Computational Optimization and Applications. Online 12 September 2021 (2021). ISSN 0926-6003. E-ISSN 1573-2894
Institutional support: RVO:67985807
Keywords : Unconstrained minimization * Variable metric methods * Limited-memory methods *

Variationally derived methods * Global convergence * Numerical results
Subject RIV: BA - General Mathematics
OBOR OECD: Applied mathematics
Impact factor: 2.167, year: 2020

Limited-memory variable metric methods based on the well-known Broyden-Fletcher-Goldfarb-Shanno (BFGS) update are widely used for large scale optimization. The block version of this update, derived for general objective functions in Vlček and Lukšan (Numerical Algorithms 2019), satisfies the secant conditions with all used difference vectors and for quadratic objective functions gives the best improvement of convergence in some sense, but the corresponding direction vectors are not descent directions generally. To guarantee the descent property of direction vectors and simultaneously violate the secant conditions as little as possible in some sense, two methods based on the block BFGS update are proposed. They can be advantageously used together with methods based on vector corrections for conjugacy. Here we combine two types of these corrections to satisfy the secant conditions with both the corrected and uncorrected (original) latest difference vectors. Global convergence of the proposed algorithm is established for convex and sufficiently smooth functions. Numerical experiments demonstrate the efficiency of the new methods.
Permanent Link: http://hdl.handle.net/11104/0322481

0545601 - ÚI 2022 CZ eng V - Research Report
Húsek, Dušan - Frolov, A. A. - Kerechanin, J. V. - Bobrov, P.D.
Assessment of Independent EEG Components Obtained by Different Methods for BCI Based on Motor Imagery.
Prague: ICS CAS, 2021. 17 s. Technical Report, V-1279.
Institutional support: RVO:67985807
Keywords : brain–computer interface * motor imagery * blind source separation * independent component analysis * common spatial patterns * cluster analysis * EEG pattern extraction * EEG analysis * ICA * CSP * BCI * motor imagery

Eight methods of decomposition of a multichannel EEG signal are compared in terms of their ability to identify the most physiologically significant components. The criterion for the meaningfulness of a method is its ability to reduce mutual information between components; to create components that can be attributed to the activity of dipoles located in the cerebral cortex; find components that are provided by other methods and for this case; and at the same time, these components should most contribute to the accuracy of the BCI based on imaginary movement. Independent component analysis methods AMICA, RUNICA and FASTICA outperform others in the first three criteria and are second only to the Common Spatial Patterns method in the fourth criterion. The components created by all methods for 386 experimental sessions of 27 subjects were combined into more than 100 clusters containing more than 10 elements. Additionally, the components of the 12 largest clusters were analyzed. They have proven to be of great importance in controlling BCI, their origins can be modeled using dipoles in the brain, and they have been detected by several degradation methods. Five of the 12 selected components have been identified and described in our previous articles. Even if the physiological and functional origins of the rest of identified components' are to be the subject of further research, we have shown that their physiological nature is at least highly probable.
Permanent Link: http://hdl.handle.net/11104/0322281

0545957 - ÚI 2022 US eng V - Research Report
Hartman, David - Pokorná, A.
Constructions of betweenness-uniform graphs from trees.
Cornell University, 2021. 6 s. arXiv.org e-Print archive, arXiv:2105.06777 [math.CO].
Institutional support: RVO:67985807
https://arxiv.org/abs/2105.06777
Permanent Link: http://hdl.handle.net/11104/0322563

0545425 - ÚI 2022 US eng V - Research Report
Savický, Petr
Examples of distance magic labelings of the 6-dimensional hypercube.
Cornell University, 2021. 3 s. arXiv.org e-Print archive, arXiv:2102.08212 [math.GM].
Institutional support: RVO:67985807
https://arxiv.org/abs/2102.08212

Permanent Link: http://hdl.handle.net/11104/0322112

0545956 - ÚI 2022 US eng V - Research Report
Hartman, David - Pokorná, A. - Valtr, P.
On the Connectivity and the Diameter of Betweenness-Uniform Graphs.
Cornell University, 2021. 17 s. arXiv.org e-Print archive, arXiv:2109.10594 [math.CO].
Institutional support: RVO:67985807
https://arxiv.org/abs/2109.10594
Permanent Link: http://hdl.handle.net/11104/0322562

0545299 - ÚI 2022 US eng V - Research Report
Allen, P. - Böttcher, J. - Clemens, D. - Hladký, Jan - Piguet, Diana - Taraz, A.
The tree packing conjecture for trees of almost linear maximum degree.
Cornell University, 2021. 150 s. arXiv.org e-Print archive, arXiv:2106.11720 [math.CO].
R&D Projects: GA ČR(CZ) GA19-08740S
Institutional support: RVO:67985807
https://arxiv.org/abs/2106.11720
Permanent Link: http://hdl.handle.net/11104/0322028

0545842 - ÚI 2022 cze E - Electronic Document
Rambousek, F. - Kolek, L. - Martinková, Patrícia
Ranní Plus.
Praha: Český rozhlas, 2021
Institutional support: RVO:67985807
Keywords : popularizace vědy * game-based learning * history representation * implicit attitudes * media in education * video games
https://program.rozhlas.cz/zaznamy#/plus/20/2021-09-08Ra

Způsob, jakým přemýšlíme o různých historických událostech, dokážou podle odborníků ovlivnit i počítačové hry. Vyplývá to z vědeckého experimentu, na kterém se podíleli odborníci z Univerzity Karlovy a Akademie věd. Pracovali s herní simulací zaměřenou na poválečný odsun německého obyvatelstva.
Permanent Link: http://hdl.handle.net/11104/0322482

0545426 - ÚI 2022 US eng V - Research Report
Kučera, P. - Savický, Petr
Bounds on the size of PC and URC formulas.
Cornell University, 2020. 24 s. arXiv.org e-Print archive, arXiv:2001.00819 [cs.LO].
R&D Projects: GA ČR(CZ) GA19-19463S
Institutional support: RVO:67985807
https://arxiv.org/abs/2001.00819
Permanent Link: http://hdl.handle.net/11104/0322113

0545866 - ÚI 2022 US eng V - Research Report
Campos Araújo, Pedro - Moreira, L. - Pavez-Signé, M.
Ramsey goodness of trees in random graphs.
Cornell University, 2020. 30 s. arXiv.org e-Print archive, arXiv:2001.03083 [math.CO].
Institutional support: RVO:67985807
https://arxiv.org/abs/2001.03083
Permanent Link: http://hdl.handle.net/11104/0322500

0545958 - ÚI 2022 US eng V - Research Report
Hartman, David - Hladík, M. - Říha, D.
Computing the spectral decomposition of interval matrices and a study on interval matrix power.
Cornell University, 2019. 9 s. arXiv.org e-Print archive, arXiv:1912.05275 [math.NA].
Institutional support: RVO:67985807
https://arxiv.org/abs/1912.05275
Permanent Link: http://hdl.handle.net/11104/0322564

0545427 - ÚI 2022 US eng V - Research Report
Kučera, P. - Savický, Petr
Propagation complete encodings of smooth DNNF theories.

Cornell University, 2019. 38 s. arXiv.org e-Print archive, arXiv:1909.06673 [cs.AI].
R&D Projects: GA ČR(CZ) GA19-19463S
Institutional support: RVO:67985807
https://arxiv.org/abs/1909.06673
Permanent Link: http://hdl.handle.net/11104/0322114

0545959 - ÚI 2022 US eng V - Research Report
Aranda, A. - Hartman, David
The independence number of HH-homogeneous graphs and a classification of MB-homogeneous graphs.
Cornell University, 2019. 17 s. arXiv.org e-Print archive, arXiv:1902.03126 [math.CO].
Institutional support: RVO:67985807
https://arxiv.org/abs/1902.03126
Permanent Link: http://hdl.handle.net/11104/0322565

0545428 - ÚI 2022 US eng V - Research Report
Kučera, P. - Savický, Petr
Backdoor Decomposable Monotone Circuits and their Propagation Complete Encodings.
Cornell University, 2018. 21 s. arXiv.org e-Print archive, arXiv:1811.09435 [cs.AI].
R&D Projects: GA ČR(CZ) GA19-19463S
Institutional support: RVO:67985807
https://arxiv.org/abs/1811.09435
Permanent Link: http://hdl.handle.net/11104/0322115

0545961 - ÚI 2022 US eng V - Research Report
Hartman, David - Aranda, A.
Morphism extension classes of countable L-colored graphs.
Cornell University, 2018. 12 s. arXiv.org e-Print archive, arXiv:1805.01781 [math.CO].
R&D Projects: GA ČR GBP202/12/G061
Institutional support: RVO:67985807
https://arxiv.org/abs/1805.01781
Permanent Link: http://hdl.handle.net/11104/0322567

0545960 - ÚI 2022 US eng V - Research Report
Hartman, David - Hladík, M.
Regularity radius: Properties, approximation and a not a priori exponential algorithm.
Cornell University, 2018. 16 s. arXiv.org e-Print archive, arXiv:1806.09988 [math.NA].
Institutional support: RVO:67985807
https://arxiv.org/abs/1806.09988
Permanent Link: http://hdl.handle.net/11104/0322566

0545429 - ÚI 2022 US eng V - Research Report
Kučera, P. - Savický, Petr - Vorel, V.
A lower bound on CNF encodings of the at-most-one constraint.
Cornell University, 2017. 38 s. arXiv.org e-Print archive, arXiv:1704.08934 [cs.CC].
R&D Projects: GA ČR GBP202/12/G061
Institutional support: RVO:67985807
https://arxiv.org/abs/1704.08934
Permanent Link: http://hdl.handle.net/11104/0322116