DOCUMENT

Name and surname	prof. RNDr. Jiří Pospíchal, DrSc.
Document type:	Characteristics of the submitted research/ artistic/other output
The name of the university	University of Ss. Cyril and Methodius in Trnava
The seat of the university	Nám. J. Herdu 2, 917 01 Trnava
The name of the faculty	Faculty of Natural Sciences
The seat of the faculty	Nám. J. Herdu 2, 917 01 Trnava

Surname awarded to the assessed person

Pospíchal

Name awarded to the assessed person

Jiří

Degrees awarded to the assessed person

prof. RNDr. DrSc.

Hyperlink to the entry of the person in the Register of university staff

https://www.portalvs.sk/regzam/detail/13527

Area of assessment

Applied informatics

Category of the research/ artistic/other output

scientific output

Year of publication of the research/artistic/other output

2018

ID of the record in the Central Registry of Publication Activity (CRPA) or the Central Registry of Artistic Activity (CRAA)

ID: 102488

Hyperlink to the record in CRPA or CRAA

https://app.crepc.sk/?fn=detailBiblioFormChildA1J5D0&sid=6869FA06720F1784BBCD76ECD8&seo=CREP%C4%8C-detail-%C4%8Cl%C3%A1nok

Hyperlink to the record in another publicly accessible register, catalogue of research/ artistic/other outputs

https://www.webofscience.com/wos/woscc/full-record/WOS:000437824300007

Characteristics of the output in the format of the CRPA or the CRAA bibliographic record, if the output is not available in a publicly accessible register or catalogue of outputs

ADD Chalupa, D., Pospíchal, J. (2018). Analysis of Iterated Greedy Heuristic for Vertex Clique Covering. Computing and Informatics, 37(2), 385-404. (IF 0.421) A

Hyperlink to the webpage where the output is available (full text, other documentation, etc.)

https://www.cai.sk/ojs/index.php/cai/article/view/2018_2_385/890

Characteristics of the author's contribution

The evaluated person participated as a co-author (50%) in all phases of the creation of the output, from the very design of the solution concept, through experimental testing, analysis of the achieved results, to the process of writing the article and incorporating review recommendations. In addition, one of the co-authors of the article was a doctoral student of the evaluated person at the time of publication of the output.

Annotation of the output with contextual information concerning the description of creative process and the content of the research/artistic/other activity, etc.

Analysis of iterated greedy heuristic for vertex clique covering [print] / David Chalupa, Jiří Pospíchal, 2018. In: Computing and Informatics : Computers and Artificial Intelligence : Computers and Artificial Intelligence. - ISSN 1335-9150, Roč. 37, č. 2 (2018), s. 385-404 [print].

Annotation of the output in English

The aim of the vertex clique covering problem (CCP) is to cover the vertices of a graph with as few cliques as possible. We analyse the iterated greedy (IG) algorithm for CCP, which was previously shown to provide strong empirical results for real-world networks. It is demonstrated how the techniques of analysis for randomised search heuristics can be applied to IG, and several practically relevant results are obtained. We show that for triangle-free graphs, IG solves CCP optimally in expected polynomial time. Secondly, we show that IG finds the optimum for CCP in a specific case of sparse random graphs in expected polynomial time with high probability. For Barabasi-Albert model of scale-free networks, which is a canonical model explaining the growth of social, biological or computer networks, we obtain that IG obtains an asymptotically optimal approximation in polynomial time in expectation. Last but not least, we propose a slightly modified variant of IG, which guarantees expected polynomial-time convergence to the optimum for graphs with non-overlapping triangles.

List of maximum 5 most significant citations corresponding to the output

1. Novák, O. (2021, September). Search Strategy of Large Nonlinear Block Codes. In 2021 24th Euromicro Conference on Digital System Design (DSD) (pp. 527-534). IEEE. [WOS]
2. Strash, D., & Thompson, L. (2022). Effective Data Reduction for the Vertex Clique Cover Problem. In 2022 Proceedings of the Symposium on Algorithm Engineering and Experiments (ALENEX) (pp. 41-53). Society for Industrial and Applied Mathematics. [WOS]
3. Novák, O. (2023). Nonlinear compression block codes: Exact and random search strategy. Microprocessors and Microsystems, 101, 104877. [WOS]
4. Novák, O. (2023, September). Deterministic Search Strategy of Compression Codes. In 2023 26th Euromicro Conference on Digital System Design (DSD) (pp. 198-205). IEEE. [WOS]
5. Novák, O. (2022, August). Nonlinear compression block codes search strategy. In 2022 25th Euromicro Conference on Digital System Design (DSD) (pp. 665-670). IEEE. [WOS]

Characteristics of the output's impact on socio-economic practice

The article belongs to a series of research tasks solved within the VEGA project focused on network security. The article solves the clique vertex coverage (CCP) problem, the goal is to cover the vertices of a graph with as few cliques as possible. We analyze an iterated greedy (IG) algorithm for CCP, which has previously been shown to provide strong empirical results for real-world networks. Among other things, for the Barabási- Albert model of scale-free networks, which is the canonical model explaining the growth of social, biological or computer networks, we show that IG obtains an asymptotically optimal approximation in polynomial time. This problem is used e.g. for the analysis of complex infections (like computer viruses) through group interactions.

Characteristics of the output and related activities' impact on the educational process

The problem solved in the output (contribution to the analysis of computer virus infections) has an indirect impact on the subject Information security, which is taught in applied informatics at the workplace. The problem solved in the output directly corresponds to the content of this subject in terms of methodology, shows the connection between theory and practice and will positively influence the educational process. In addition, the topic also corresponds to the subject of graph algorithms and their applications, which is taught in applied informatics at the workplace. The issue addressed in the output directly corresponds to the contents of this subject.

Area of assessment

Applied informatics

Category of the research/ artistic/other output

scientific output

Year of publication of the research/artistic/other output

2021

ID of the record in the Central Registry of Publication Activity (CRPA) or the Central Registry of Artistic Activity (CRAA)

436954

Hyperlink to the record in CRPA or CRAA

https://app.crepc.sk/?fn=detailBiblioFormChildA1HO72&sid=A1A8EB404CE9E8974F9DB2A156&seo=CREP%C4%8C-detail-kapitola-/-pr%C3%ADspevok

Hyperlink to the record in another publicly accessible register, catalogue of research/ artistic/other outputs

https://www.scopus.com/record/display.uri?eid=2-s2.0-85101106807&origin=recordpage

Characteristics of the output in the format of the CRPA or the CRAA bibliographic record, if the output is not available in a publicly accessible register or catalogue of outputs

Transition Graph Analysis of Sliding Tile Puzzle Heuristics / Dirgová Luptáková, Iveta [Autor, 50%] ; Pospíchal, Jiří [Autor, 50%]. – [recenzované]. – DOI 10.1007/978-3-030-61659-5_13. – SCOPUS In: Recent advances in soft computing and cybernetics [textový dokument (print)] [elektronický dokument] / Matoušek, Radek [Zostavovateľ, editor] ; Kůdela, Jakub [Zostavovateľ, editor]. – 1. vyd. – Cham (Švajčiarsko) : Springer Nature, 2021. – (Studies in fuzziness and soft computing, ISSN 1434-9922 ; Vol. 403). – ISBN 978-3- 030-61658-8. – ISBN (elektronické) 978-3-030-61659-5, s. 149-156 [tlačená forma] [online]

Hyperlink to the webpage where the output is available (full text, other documentation, etc.)

https://link.springer.com/chapter/10.1007/978-3-030-61659-5_13

Characteristics of the author's contribution

As the main author (50%), the evaluated person participated in all phases of the creation of the output, from the very design of the solution concept, through experimental testing, analysis of the achieved results, to the process of writing the article and incorporating review recommendations.

Annotation of the output with contextual information concerning the description of creative process and the content of the research/artistic/other activity, etc.

The sliding tile puzzle or n-puzzle is a standard game-solving problem using a tree search algorithm such as A* that involves heuristics. A typical example of such a puzzle is the 15 puzzle, which consists of a square frame containing 4 × 4 numbered square tiles, one of which is missing. The goal is to place the tiles in the correct order by sliding tile moves that use the empty space. The problem is NP-complete, and for puzzles involving a larger number of tiles, the search space is too large for standard tree search algorithms. This type of puzzle is therefore quite often used to analyze and test heuristics. The aim of this paper is to obtain a better characterization of popular heuristics used for this kind of problem by analyzing the transition graph of admissible moves. Our analysis shows that both Manhattan Distance heuristics and Out-of-place Tiles work correctly only near the target, otherwise the information they provide is almost useless for a single move, IDA* with these heuristics works mainly due to the reduction of tree search branching for multiple consecutive moves.

Annotation of the output in English

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Characteristics of the output's impact on socio-economic practice

The article belongs to the research task solved within the APVV project focused on the use of computational intelligence. The article solves the problem of the effectiveness of the use of heuristics when searching the solution space with additional heuristic information. This problem indirectly contributes to applications related to pathfinding in networks (e.g. routing).

Characteristics of the output and related activities' impact on the educational process

The problem solved in the output (analysis of heuristics when searching the state space) has an indirect impact on the subject of research in informatics, which is taught by the evaluated person. The problem solved in the output corresponds to the content of this subject, from the methodological point of view it shows the connection between theory and practice and will positively influence the educational process. The impacts can also be seen in the subject of the application of artificial and computational intelligence, which the evaluated person teaches.

Area of assessment

Applied informatics

Category of the research/ artistic/other output

scientific output

Year of publication of the research/artistic/other output

1990

Hyperlink to the record in another publicly accessible register, catalogue of research/ artistic/other outputs

https://www.webofscience.com/wos/woscc/full-record/WOS:A1990DE23800001

Characteristics of the output in the format of the CRPA or the CRAA bibliographic record, if the output is not available in a publicly accessible register or catalogue of outputs

ADC Kvasnicka, V., & Pospichal, J. (1990). Canonical indexing and constructive enumeration of molecular graphs. Journal of chemical information and computer sciences, 30(2), 99-105. A+ *(1997: 2.073 – IF, Q1 – JCR, 1999: Q1 – SJR) Cited by 45/1

Type of the output (if the output is not registered in CRPA or CRAA)

article

Hyperlink to the webpage where the output is available (full text, other documentation, etc.)

https://pubs.acs.org/doi/pdf/10.1021/ci00066a001

Characteristics of the author's contribution

The evaluated person participated as a co-author (50%) in all phases of the creation of the output, from the very design of the solution concept, through experimental testing, analysis of the achieved results, to the process of writing the article and incorporating review recommendations.

Annotation of the output with contextual information concerning the description of creative process and the content of the research/artistic/other activity, etc.

Canonical indexing of molecular graphs based on the maximum digital code corresponds to the triangular part of the adjacency matrix. The graph-theoretic properties of this indexing allow the formulation of exhaustive and non-redundant constructive enumeration of connected graphs with a prescribed number of vertices and edges. The correctness of the concept is confirmed by a series of theorems.

Annotation of the output in English

Canonical indexing of molecular graphs based on the maximum digital code corresponds to the triangular part of the adjacency matrix. The graph-theoretic properties of this indexing allow the formulation of exhaustive and non-redundant constructive enumeration of connected graphs with a prescribed number of vertices and edges. The correctness of the concept is confirmed by a series of theorems.

List of maximum 5 most significant citations corresponding to the output

1. Itzhakov, A., & Codish, M. (2020, April). Incremental symmetry breaking constraints for graph search problems. In Proceedings of the AAAI Conference on Artificial Intelligence (Vol. 34, No. 02, pp. 1536-1543). [WOS, SCOPUS]
2. Kerber, A., Laue, R., Meringer, M., Rücker, C., & Schymanski, E. (2013). Mathematical chemistry and chemoinformatics. de Gruyter. [WOS, SCOPUS]
3. Meringer, M. (2010). Structure enumeration and sampling. Handbook of chemoinformatics algorithms, 233-267. [WOS, SCOPUS]
4. Konstantinova, E. V., & Skorobogatov, V. A. (2001). Application of hypergraph theory in chemistry. Discrete Mathematics, 235(1-3), 365-383. [WOS, SCOPUS]
5. Raman, V. S., & Maranas, C. D. (1998). Optimization in product design with properties correlated with topological indices. Computers & Chemical Engineering, 22(6), 747-763. [WOS, SCOPUS]

Characteristics of the output's impact on socio-economic practice

The article belongs to a series of research tasks solved within the VEGA project Use of modern informatics tools for structure-property correlation of molecules. The output demonstrates the use of informatics methods for the generation of chemical compounds.

Characteristics of the output and related activities' impact on the educational process

The problem solved in the output (chemical informatics) has an indirect impact on the subject research in informatics, which is taught by the evaluated person. The problem solved in the output corresponds to the content of this subject, from the methodological point of view it shows the connection between theory and practice and will positively influence the educational process. The effects can also be seen indirectly in the subject of graph algorithms and their applications, which is taught in applied informatics at the workplace.

Area of assessment

Applied informatics

Category of the research/ artistic/other output

scientific output

Year of publication of the research/artistic/other output

2022

ID of the record in the Central Registry of Publication Activity (CRPA) or the Central Registry of Artistic Activity (CRAA)

520406

Hyperlink to the record in CRPA or CRAA

https://app.crepc.sk/?fn=detailBiblioFormChildI1HP2L&sid=A3B65ED8C4EA60F68C45C806B2&seo=CREP%C4%8C-detail-%C4%8Cl%C3%A1nok

Hyperlink to the record in another publicly accessible register, catalogue of research/ artistic/other outputs

https://www.webofscience.com/wos/woscc/full-record/WOS:000850957300001

Characteristics of the output in the format of the CRPA or the CRAA bibliographic record, if the output is not available in a publicly accessible register or catalogue of outputs

Transition Graph Analysis of Sliding Tile Puzzle Heuristics Type of document conference paper Authors Dirgová Luptáková, Iveta; Pospíchal, Jiří Name: Recent advances in soft computing and cybernetics (text document (print)) (elektronický dokument) Pp. 149-156

Hyperlink to the webpage where the output is available (full text, other documentation, etc.)

https://www.mdpi.com/2076-3417/12/17/8852#

Characteristics of the author's contribution

The reviewee was the first co-author out of three (45%), and was involved in all stages of the development of the output, from the design of the solution concept itself, through experimental testing, analysis of the results achieved results, to the process of writing the paper and incorporating the review recommendations.

Annotation of the output with contextual information concerning the description of creative process and the content of the research/artistic/other activity, etc.

Solar energy is one of the most popular sources of renewable energy today. It is therefore essential to be able to predict solar power generation and adapt energy needs to these predictions. This paper uses the Transformer deep neural network model, in which the attention mechanism is typically applied in NLP or vision problems. Here, it is extended by combining features based on their spatiotemporal properties in solar irradiance prediction. The results were predicted for arbitrary long-time horizons since the prediction is always 1 day ahead, which can be included at the end along the timestep axis of the input data and the first timestep representing the oldest timestep removed. A maximum worst-case mean absolute percentage error of 3.45% for the one-day-ahead prediction was obtained, which gave better results than the directly competing methods.

Annotation of the output in English

Solar energy is one of the most popular sources of renewable energy today. It is therefore essential to be able to predict solar power generation and adapt energy needs to these predictions. This paper uses the Transformer deep neural network model, in which the attention mechanism is typically applied in NLP or vision problems. Here, it is extended by combining features based on their spatiotemporal properties in solar irradiance prediction. The results were predicted for arbitrary long-time horizons since the prediction is always 1 day ahead, which can be included at the end along the timestep axis of the input data and the first timestep representing the oldest timestep removed. A maximum worst-case mean absolute percentage error of 3.45% for the one-day-ahead prediction was obtained, which gave better results than the directly competing methods.

List of maximum 5 most significant citations corresponding to the output

1. Cui, S., Lyu, S., Ma, Y., & Wang, K. (2024). Improved informer PV power short-term prediction model based on weather typing and AHA-VMD-MPE. Energy, 307, 132766. (29 WOS citations)
2. Gao, Y., Miyata, S., Matsunami, Y., & Akashi, Y. (2023). Spatio-temporal interpretable neural network for solar irradiation prediction using transformer. Energy and Buildings, 297, 113461. (10 WOS citations)
3. Xu, Y., Zheng, S., Zhu, Q., Wong, K. C., Wang, X., & Lin, Q. (2024). A complementary fused method using GRU and XGBoost models for long-term solar energy hourly forecasting. Expert Systems with Applications, 124286. (6 WOS citations)
4. Wu, Y. K., Phan, Q. T., & Zhong, Y. J. (2023). Overview of Day-ahead Solar Power Forecasts Based on Weather Classifications and a Case Study in Taiwan. IEEE Transactions on Industry Applications. (5 citations)
5. Cargan, T. R., Landa-Silva, D., & Triguero, I. (2024). Local-global methods for generalised solar irradiance forecasting. Applied Intelligence, 54(2), 2225-2247. (3 citations)

Characteristics of the output's impact on socio-economic practice

The result demonstrates the use of computational intelligence for solar energy forecasting and is therefore relevant to the renewable energy industry, more specifically to photovoltaic power plants and their predictive output.

Characteristics of the output and related activities' impact on the educational process

The problem solved in the output (chemical informatics) has an indirect impact on the subject research in informatics, which is taught by the evaluated person. The problem solved in the output corresponds to the content of this subject, from the methodological point of view it shows the connection between theory and practice and will positively influence the educational process. The impacts can also be seen indirectly in the subject of application of artificial and computational intelligence, which the evaluated person teaches.

Area of assessment

Applied informatics

Category of the research/ artistic/other output

scientific output

Year of publication of the research/artistic/other output

1997

Hyperlink to the record in another publicly accessible register, catalogue of research/ artistic/other outputs

https://www.webofscience.com/wos/woscc/full-record/WOS:000072626300004

Characteristics of the output in the format of the CRPA or the CRAA bibliographic record, if the output is not available in a publicly accessible register or catalogue of outputs

ADC Kvasnička, V., & Pospíchal, J. (1997). A hybrid of simplex method and simulated annealing. Chemometrics and Intelligent Laboratory Systems, 39(2), 161-173. A+ Cited by 31 (Scopus)

Type of the output (if the output is not registered in CRPA or CRAA)

article

Hyperlink to the webpage where the output is available (full text, other documentation, etc.)

https://www.sciencedirect.com/science/article/pii/S0169743997000713

Characteristics of the author's contribution

The evaluated person participated as a co-author (50%) in all phases of the creation of the output, from the very design of the solution concept, through experimental testing, analysis of the achieved results, to the process of writing the article and incorporating review recommendations.

Annotation of the output with contextual information concerning the description of creative process and the content of the research/artistic/other activity, etc.

One of basic concepts of the well-known simplex optimization method is that from the current simplex set of points (solutions) a new point - reflection is constructed. The reflection point is used for a conditional updating of the simplex set. This simple and efficient idea is applied in the simulated annealing to suggest a new version of this stochastic optimization method. As a forerunner of the presented simulated annealing is the controlled random search invented by Price in the middle of seventies. He proposed the very important idea that a population of points is considered and from this population the simplex set is randomly selected. Reflection points update the population so that they conditionally substitute points with highest values of objective function. The simplex simulated annealing enhances further stronger stochastic and evolution character of this method. The construction of reflection points is randomized and their returning to the population is solved by the Metropolis criterion. A parallel version of simplex simulated annealing uses a decomposition of the whole population into disjoint subpopulations for which independent simulated annealings are done. The subpopulations randomly interact so that between two subpopulations their best points are exchanged and worst ones are eliminated.

Annotation of the output in English

One of basic concepts of the well-known simplex optimization method is that from the current simplex set of points (solutions) a new point - reflection is constructed. The reflection point is used for a conditional updating of the simplex set. This simple and efficient idea is applied in the simulated annealing to suggest a new version of this stochastic optimization method. As a forerunner of the presented simulated annealing is the controlled random search invented by Price in the middle of seventies. He proposed the very important idea that a population of points is considered and from this population the simplex set is randomly selected. Reflection points update the population so that they conditionally substitute points with highest values of objective function. The simplex simulated annealing enhances further stronger stochastic and evolution character of this method. The construction of reflection points is randomized and their returning to the population is solved by the Metropolis criterion. A parallel version of simplex simulated annealing uses a decomposition of the whole population into disjoint subpopulations for which independent simulated annealings are done. The subpopulations randomly interact so that between two subpopulations their best points are exchanged and worst ones are eliminated.

List of maximum 5 most significant citations corresponding to the output

1. Andris, P., & Frollo, I. (2016). Noise and interference in measured NMR images. Measurement, 77, 29-33. [WOS, SCOPUS]
2. Tang, M., Long, C., Guan, X., & Wei, X. (2012). Nonconvex dynamic spectrum allocation for cognitive radio networks via particle swarm optimization and simulated annealing. Computer Networks, 56(11), 2690-2699. [WOS, SCOPUS]
3. Luque, G., & Alba, E. (2011). Parallel genetic algorithms: Theory and real world applications. Studies in Computational Intelligence 367, pp. 1-183. Springer. [WOS, SCOPUS]
4. Bagirov, A. M., Rubinov, A. M., & Zhang, J. (2009). A multidimensional descent method for global optimization. Optimization, 58(5), 611-625. [WOS, SCOPUS]
5. Alba, E., Luque, G., Coello Coello, C. A., & Hernández Luna, E. (2007). Comparative study of serial and parallel heuristics used to design combinational logic circuits. Optimisation Methods and Software, 22(3), 485-509.[WOS, SCOPUS]

Characteristics of the output's impact on socio-economic practice

The article belongs to a series of research tasks solved within the VEGA project Neural networks, stochastic optimization algorithms and their parallel implementation. The output is a design of a new optimization method of computational intelligence, generally applicable in optimization from chemistry to computer networks or the design of logic circuits.

Characteristics of the output and related activities' impact on the educational process

The problem solved in the output (chemical informatics) has an indirect impact on the subject research in informatics, which is taught by the evaluated person. The problem solved in the output corresponds to the content of this subject, from the methodological point of view it shows the connection between theory and practice and will positively influence the educational process. The impacts can also be seen indirectly in the subject of application of artificial and computational intelligence, which the evaluated person teaches.