

СПИСОК ДЖЕРЕЛ ІНФОРМАЦІЇ (СТИЛЬ IEEE)

- [1] K. Yamkovyi, “Adaptation of LambdaMART model to semi-supervised learning”, *Вісник Національного технічного університету «ХПІ».* Серія: Системний аналіз, управління та інформаційні технології, № 1 (9), с. 76—81, 2023.
- [2] L. Lyubchyk та K. Yamkovyi, “Comparative Analysis of Modified Semi-Supervised Learning Algorithms on a Small Amount of Labelled Data”, *System Research & Information Technologies*, № 4, с. 34—43, 2022.
- [3] O. Axiezer, Г. Грінберг, Л. Любчик та К. Ямковий, “Failure rate regression model building from aggregated data using kernel-based machine learning methods”, *Вісник Національного технічного університету «ХПІ».* Серія: Системний аналіз, управління та інформаційні технології, № 2 (8), с. 51—56, 2022.
- [4] L. Lyubchyk, O. Akhiezer, G. Grinberg та K. Yamkovyi, “Machine Learning-Based Failure Rate Identification for Predictive Maintenance in Industry 4.0”, в *2022 12th International Conference on Dependable Systems, Services and Technologies (DESSERT)*, IEEE, Афіни, Греція, 2022, с. 1—5. DOI: 10.1109/DESSERT58054.2022.10018614.
- [5] L. Lyubchyk, G. Grinberg та K. Yamkovyi, “Integral Indicator for Complex System Building Based on Semi-Supervised Learning”, в *2018 IEEE First International Conference on System Analysis & Intelligent Computing (SAIC)*, IEEE, Київ, Україна, 2018, с. 1—5.
- [6] S. El Gibari, T. Gómez та F. Ruiz, “Building composite indicators using multicriteria methods: A review”, *Journal of Business Economics*, т. 89, № 1, с. 1—24, 2019.
- [7] P. Zhou, B. W. Ang та D. Q. Zhou, “Weighting and aggregation in composite indicator construction: A multiplicative optimization approach”, *Social indicators research*, т. 96, с. 169—181, 2010.
- [8] J. R. C.-E. Commission та ін., *Handbook on constructing composite indicators: methodology and user guide*. OECD publishing, 2008.

- [9] H. Mizobuchi, “Measuring world better life frontier: a composite indicator for OECD better life index”, *Social Indicators Research*, t. 118, c. 987—1007, 2014.
- [10] E. K. Zavadskas ta Z. Turskis, “Multiple criteria decision making (MCDM) methods in economics: an overview”, *Technological and Economic Development of Economy*, t. 17, № 2, c. 397—427, 2011. DOI: 10 . 3846 / 20294913 . 2011 . 593291. eprint: <https://doi.org/10.3846/20294913.2011.593291>. url: <https://doi.org/10.3846/20294913.2011.593291>.
- [11] E. Jiménez-Fernández, A. Sánchez ta M. Ortega-Pérez, “Dealing with weighting scheme in composite indicators: an unsupervised distance-machine learning proposal for quantitative data”, *Socio-Economic Planning Sciences*, t. 83, c. 101339, 2022.
- [12] Z. T. Edmundas Kazimieras Zavadskas ta S. Kildienė, “State of art surveys of overviews on MCDM/MADM methods”, *Technological and Economic Development of Economy*, t. 20, № 1, c. 165—179, 2014. DOI: 10 . 3846 / 20294913 . 2014 . 892037. eprint: <https://doi.org/10.3846/20294913.2014.892037>. url: <https://doi.org/10.3846/20294913.2014.892037>.
- [13] J. J. H. Liou ta G.-H. Tzeng, “Comments on “Multiple criteria decision making (MCDM) methods in economics: an overview””, *Technological and Economic Development of Economy*, t. 18, № 4, c. 672—695, 2012. DOI: 10 . 3846 / 20294913 . 2012 . 753489. eprint: <https://doi.org/10.3846/20294913.2012.753489>. url: <https://doi.org/10.3846/20294913.2012.753489>.
- [14] A. Hsu ta A. Zomer, “Environmental performance index”, *Wiley StatsRef: Statistics Reference Online*, c. 1—5, 2014.
- [15] V. Strijov, G. Granić, Ž. Jurić, B. Jelavić ta S. A. Maričić, “Integral indicator of ecological impact of the Croatian thermal power plants”, *Energy*, t. 36, № 7, c. 4144—4149, 2011.
- [16] M. McGillivray ta H. White, “Measuring development? The UNDP’s human development index”, *Journal of international development*, t. 5, № 2, c. 183—192, 1993.

- [17] H. Trabold-Nübler, “The human development index—a new development indicator?”, *Intereconomics*, т. 26, с. 236—243, 1991.
- [18] B. Hoskins, M. Saisana та C. M. Villalba, “Civic competence of youth in Europe: Measuring cross national variation through the creation of a composite indicator”, *Social Indicators Research*, т. 123, с. 431—457, 2015.
- [19] D. Pearce, K. Hamilton та G. Atkinson, “Measuring sustainable development: progress on indicators”, *Environment and Development Economics*, т. 1, № 1, с. 85—101, 1996.
- [20] M. Segovia-González та I. Contreras, “A Composite Indicator to Compare the Performance of Male and Female Students in Educational Systems”, *Social Indicators Research*, т. 165, № 1, с. 181—212, 2023.
- [21] D. Carment, S. Prest та Y. Samy, *Security, development and the fragile state: Bridging the gap between theory and policy*. Routledge, 2009.
- [22] L. Hudriková та ін., “Composite indicators as a useful tool for international comparison: The Europe 2020 example”, *Prague economic papers*, т. 22, № 4, с. 459—473, 2013.
- [23] Y. Shi, X. Ge, X. Yuan, Q. Wang, J. Kellett, F. Li та K. Ba, “An integrated indicator system and evaluation model for regional sustainable development”, *Sustainability*, т. 11, № 7, с. 2183, 2019.
- [24] N. Ivanova, “Formation of the integral indicator of economic security of the region by taxonomy method”, *Технологический аудит и резервы производств*, т. 2, № 5 (40), с. 24—30, 2018.
- [25] J. Messner, “Fragile States Index Annual Report 2020”, 2020.
- [26] L. Carlsen та R. Bruggemann, “Fragile state index: Trends and developments. A partial order data analysis”, *Social indicators research*, т. 133, с. 1—14, 2017.
- [27] J. Arreola Hernandez та M. A. Al Janabi, “Forecasting of dependence, market, and investment risks of a global index portfolio”, *Journal of Forecasting*, т. 39, № 3, с. 512—532, 2020.
- [28] X. Wang та X. Huang, “A risk index to model uncertain portfolio investment with options”, *Economic Modelling*, т. 80, с. 284—293, 2019.

- [29] S. Binmahfouz ta ih., “Investment characteristics of Islamic investment portfolios: Evidence from Saudi mutual funds and global indices”, 2012.
- [30] M. Stutzer, “A portfolio performance index”, *Financial Analysts Journal*, t. 56, № 3, c. 52—61, 2000.
- [31] M. T. Leung, H. Daouk ta A.-S. Chen, “Using investment portfolio return to combine forecasts: a multiobjective approach”, *European Journal of Operational Research*, t. 134, № 1, c. 84—102, 2001.
- [32] M. Zheng, I. Zada, S. Shahzad, J. Iqbal, M. Shafiq, M. Zeeshan ta A. Ali, “Key performance indicators for the integration of the service-oriented architecture and scrum process model for IOT”, *Scientific Programming*, t. 2021, c. 1—11, 2021.
- [33] L. Bodo, H. Oliveira, F. A. Breve ta D. M. Eler, “Semi-supervised learning applied to performance indicators in software engineering processes”, в *International Conference on Software Engineering Research and Practice (SERP 2015), Las Vegas, EUA*, 2015, c. 255—261.
- [34] K. Martyn ta M. Kadziński, “Deep preference learning for multiple criteria decision analysis”, *European Journal of Operational Research*, t. 305, № 2, c. 781—805, 2023.
- [35] J. Sanz-Rodriguez, J. M. M. Dodero ta S. Sánchez-Alonso, “Ranking learning objects through integration of different quality indicators”, *IEEE transactions on learning technologies*, t. 3, № 4, c. 358—363, 2010.
- [36] T.-Y. Liu ta ih., “Learning to rank for information retrieval”, *Foundations and Trends® in Information Retrieval*, t. 3, № 3, c. 225—331, 2009.
- [37] Z. Cao, T. Qin, T.-Y. Liu, M.-F. Tsai ta H. Li, “Learning to rank: from pairwise approach to listwise approach”, в *Proceedings of the 24th international conference on Machine learning*, 2007, c. 129—136.
- [38] T.-Y. Liu, J. Xu, T. Qin, W.-Y. Xiong ta H. Li, “LETOR: Benchmark Dataset for Research on Learning to Rank for Information Retrieval”, 2007. url: <https://api.semanticscholar.org/CorpusID:14596754>.

- [39] J. Beel ta B. Gipp, “Google Scholar’s ranking algorithm: an introductory overview”, в *Proceedings of the 12th international conference on scientometrics and informetrics (ISSI’09)*, Rio de Janeiro (Brazil), т. 1, 2009, с. 230—241.
- [40] S.-H. Kim ta B. L. Nelson, “Recent advances in ranking and selection”, в *2007 Winter Simulation Conference*, IEEE, 2007, с. 162—172.
- [41] P. Pobrotyn, T. Bartczak, M. Synowiec, R. Białobrzeski ta J. Bojar, “Context-aware learning to rank with self-attention”, *arXiv preprint arXiv:2005.10084*, 2020.
- [42] S. K. Karmaker Santu, P. Sondhi ta C. Zhai, “On application of learning to rank for e-commerce search”, в *Proceedings of the 40th international ACM SIGIR conference on research and development in information retrieval*, 2017, с. 475—484.
- [43] G. Aslanyan ta U. Porwal, “Position bias estimation for unbiased learning-to-rank in ecommerce search”, в *String Processing and Information Retrieval: 26th International Symposium, SPIRE 2019, Segovia, Spain, October 7–9, 2019, Proceedings* 26, Springer, 2019, с. 47—64.
- [44] H. Abdollahpouri, R. Burke ta B. Mobasher, “Controlling popularity bias in learning-to-rank recommendation”, в *Proceedings of the eleventh ACM conference on recommender systems*, 2017, с. 42—46.
- [45] A. Halavais, *Search engine society*. John Wiley & Sons, 2017.
- [46] O. Chapelle ta Y. Chang, “Yahoo! learning to rank challenge overview”, в *Proceedings of the learning to rank challenge*, PMLR, 2011, с. 1—24.
- [47] A. Usta, I. S. Altingovde, R. Ozcan ta Ö. Ulusoy, “Learning to rank for educational search engines”, *IEEE Transactions on Learning Technologies*, т. 14, № 2, с. 211—225, 2021.
- [48] C. Macdonald, R. L. Santos ta I. Ounis, “The whens and hows of learning to rank for web search”, *Information Retrieval*, т. 16, с. 584—628, 2013.
- [49] J. Davidson, B. Liebald, J. Liu ta ін., “The YouTube video recommendation system”, в *Proceedings of the fourth ACM conference on Recommender systems*, 2010, с. 293—296.

- [50] Y. Deldjoo, M. Elahi, P. Cremonesi, F. Garzotto, P. Piazzolla та M. Quadrana, “Content-based video recommendation system based on stylistic visual features”, *Journal on Data Semantics*, т. 5, с. 99—113, 2016.
- [51] O. Celma, “Music recommendation”, в *Music recommendation and discovery: The long tail, long tail, and long play in the digital music space*, Springer, 2010, с. 43—85.
- [52] Y. Song, S. Dixon та M. Pearce, “A survey of music recommendation systems and future perspectives”, Citeseer.
- [53] T. Joachims, “Optimizing Search Engines using Clickthrough Data”, *Proceedings of the ACM SIGKDD International Conference on Knowledge Discovery and Data Mining*, серп. 2002. DOI: 10.1145/775047.775067.
- [54] C. Burges, T. Shaked, E. Renshaw, A. Lazier, M. Deeds, N. Hamilton та G. Hullender, “Learning to rank using gradient descent”, в *Proceedings of the 22nd international conference on Machine learning*, 2005, с. 89—96.
- [55] C. J. Burges, “From RankNet to LambdaRank to LambdaMART: An Overview”, тех. звіт. MSR-TR-2010-82, лип. 2010. url: <https://www.microsoft.com/en-us/research/publication/from-ranknet-to-lambdarank-to-lambdamart-an-overview/>.
- [56] C. Moreira. “Learning To Rank”. (2017), url: http://web.ist.utl.pt/~catarina.p.moreira/machine_learning.html#learning_to_rank.html (дата зверн. 22.09.2023).
- [57] F. Xia, T.-Y. Liu, J. Wang, W. Zhang та H. Li, “Listwise approach to learning to rank - Theory and algorithm”, січ. 2008, с. 1192—1199. DOI: 10.1145/1390156.1390306.
- [58] A. Agresti, *Analysis of ordinal categorical data*. John Wiley & Sons, 2010, т. 656.
- [59] Y. Wang, L. Wang, Y. Li, D. He та T.-Y. Liu, “A theoretical analysis of NDCG type ranking measures”, в *Conference on learning theory*, PMLR, 2013, с. 25—54.
- [60] K. Järvelin та J. Kekäläinen, “Cumulated gain-based evaluation of IR techniques”, *ACM Transactions on Information Systems (TOIS)*, т. 20, № 4, с. 422—446, 2002.

- [61] C. Burges, R. Ragno та Q. Le, “Learning to Rank with Nonsmooth Cost Functions”, в *Advances in Neural Information Processing Systems*, B. Schölkopf, J. Platt та T. Hoffman, ред., т. 19, MIT Press, 2006. url: https://proceedings.neurips.cc/paper_files/paper/2006/file/af44c4c56f385c43f2529f9b1b018f6a-Paper.pdf.
- [62] T. Li, H. Zhang, C. Yuan, Z. Liu та C. Fan, “A PCA-based method for construction of composite sustainability indicators”, *The International Journal of Life Cycle Assessment*, т. 17, с. 593–603, 2012.
- [63] L. Ruan та M. Yuan, “Dimension reduction and parameter estimation for additive index models”, *Statistics and its Interface*, т. 3, № 4, с. 493–499, 2010.
- [64] V. Strijov та P. Letmathe, “Integral indicators based on data and rank-scale expert estimations”, в *Intellectual Information Processing. In: Conference Proceedings, Cyprus*, 2010, с. 107–110.
- [65] V. Strijov та V. Shakin, “Index construction: the expert-statistical method”, *Environmental research, engineering and management*, т. 26, № 4, с. 51–55, 2003.
- [66] E. H. Forman та S. I. Gass, “The Analytic Hierarchy Process—An Exposition”, *Operations Research*, т. 49, № 4, с. 469–486, 2001. DOI: 10.1287/opre.49.4.469.11231. eprint: <https://doi.org/10.1287/opre.49.4.469.11231>. url: <https://doi.org/10.1287/opre.49.4.469.11231>.
- [67] N. D. Pankratova та N. I. Nedashkovskaya, “Evaluation of Ecology Projects for Black Sea Odessa Region on Basis of a Network BOCR Criteria Model”, в *2018 IEEE First International Conference on System Analysis & Intelligent Computing (SAIC)*, IEEE, 2018, с. 1–5.
- [68] N. I. Nedashkovskaya, “Investigation of methods for improving consistency of a pairwise comparison matrix”, *Journal of the Operational Research Society*, т. 69, № 12, с. 1947–1956, 2018.
- [69] N. I. Nedashkovskaya, “Method for evaluation of the uncertainty of the paired comparisons expert judgements when calculating the decision alternati-

ves weights”, *Journal of Automation and Information Sciences*, т. 47, № 10, 2015.

- [70] M. Kuznetsov та V. Strijov, “Methods of expert estimations concordance for integral quality estimation”, *Expert Systems with Applications*, т. 41, № 4, Part 2, с. 1988—1996, 2014, ISSN: 0957-4174. DOI: <https://doi.org/10.1016/j.eswa.2013.08.095>. url: <https://www.sciencedirect.com/science/article/pii/S0957417413007173>.
- [71] L. Lyubchyk та G. Grinberg, “Preference function reconstruction for multiple criteria decision making based on machine learning approach”, в *Recent developments and new directions in Soft Computing*, Springer, 2014, с. 53—63.
- [72] L. Lyubchyk та G. Grinberg, “Nonlinear expert preference function concordance identification for multiple criteria decision making”, дис. док., ТБиМС, 2014.
- [73] W. F. Zalatar та E. Clark, “Constructing a Composite Indicator for Manufacturing Companies Using Lean Metrics and Analytic Hierarchy Process”, в *2021 IEEE International Conference on Industrial Engineering and Engineering Management (IEEM)*, IEEE, 2021, с. 328—332.
- [74] K. Boudt, M. d’Errico, H. A. Luu, R. Pietrelli та ін., “Interpretability of Composite Indicators Based on Principal Components”, *Journal of Probability and Statistics*, т. 2022, 2022.
- [75] А. Н. Тихонов, “О некорректных задачах линейной алгебры и устойчивом методе их решения”, *Докл. АН СССР*, с. 591—594, 3 1965.
- [76] J. Kiefer та J. Wolfowitz, “Stochastic Estimation of the Maximum of a Regression Function”, *Annals of Mathematical Statistics*, т. 23, с. 462—466, 1952.
- [77] S. Ruder, “An overview of gradient descent optimization algorithms”, *CoRR*, т. abs/1609.04747, 2016. arXiv: 1609.04747. url: <http://arxiv.org/abs/1609.04747>.

- [78] C. Zhu, R. H. Byrd, P. Lu та J. Nocedal, “Algorithm 778: L-BFGS-B: Fortran Subroutines for Large-Scale Bound-Constrained Optimization”, *ACM Trans. Math. Softw.*, т. 23, № 4, с. 550—560, груд. 1997, ISSN: 0098-3500. DOI: 10.1145/279232.279236. url: <https://doi.org/10.1145/279232.279236>.
- [79] B. E. Boser, I. M. Guyon та V. N. Vapnik, “A Training Algorithm for Optimal Margin Classifiers”, в *Proceedings of the Fifth Annual Workshop on Computational Learning Theory*, cep. COLT '92, Pittsburgh, Pennsylvania, USA: Association for Computing Machinery, 1992, с. 144—152, ISBN: 089791497X. DOI: 10.1145/130385.130401. url: <https://doi.org/10.1145/130385.130401>.
- [80] C. Cortes та V. Vapnik, “Support-Vector Networks”, *Mach. Learn.*, т. 20, № 3, с. 273—297, вер. 1995, ISSN: 0885-6125. DOI: 10.1023/A:1022627411411. url: <https://doi.org/10.1023/A:1022627411411>.
- [81] B. Schölkopf та A. J. Smola, *Learning with Kernels: Support Vector Machines, Regularization, Optimization, and Beyond*. The MIT Press, черв. 2018, ISBN: 9780262256933. DOI: 10.7551/mitpress/4175.001.0001. url: <https://doi.org/10.7551/mitpress/4175.001.0001>.
- [82] B. Schölkopf, R. Herbrich та A. J. Smola, “A Generalized Representer Theorem”, в *Computational Learning Theory*, D. Helmbold та B. Williamson, ред., Berlin, Heidelberg: Springer Berlin Heidelberg, 2001, с. 416—426, ISBN: 978-3-540-44581-4.
- [83] S. L. Campbell та C. D. Meyer, *Generalized Inverses of Linear Transformations*. Society for Industrial та Applied Mathematics, 2009. DOI: 10.1137/1.9780898719048. eprint: <https://epubs.siam.org/doi/pdf/10.1137/1.9780898719048>. url: <https://epubs.siam.org/doi/abs/10.1137/1.9780898719048>.
- [84] N. Cristianini та J. Shawe-Taylor, *An introduction to support vector machines and other kernel-based learning methods*. Cambridge university press, 2000.
- [85] D. Laney та ін., “3D data management: Controlling data volume, velocity and variety”, *META group research note*, т. 6, № 70, с. 1, 2001.

- [86] S. Chaudhuri, “An overview of query optimization in relational systems”, в *Proceedings of the seventeenth ACM SIGACT-SIGMOD-SIGART symposium on Principles of database systems*, 1998, с. 34—43.
- [87] J. Gray, S. Chaudhuri, A. Bosworth, A. Layman, D. Reichart, M. Venkatrao, F. Pellow та H. Pirahesh, “Data cube: A relational aggregation operator generalizing group-by, cross-tab, and sub-totals”, *Data mining and knowledge discovery*, т. 1, с. 29—53, 1997.
- [88] K. Koidan. “GROUP BY in SQL Explained”. (2020), url: <https://learnsql.com/blog/group-by-in-sql-explained/> (дата зверн. 23.08.2023).
- [89] K.-C. Wong, “A short survey on data clustering algorithms”, в *2015 Second international conference on soft computing and machine intelligence (ISCFMI)*, IEEE, 2015, с. 64—68.
- [90] L. Lyubchyk, G. Grinberg та K. Yamkovyi, “Integral Indicator for Complex System Building Based on Semi-Supervised Learning”, в *2018 IEEE First International Conference on System Analysis & Intelligent Computing (SAIC)*, 2018, с. 1—5. DOI: [10.1109/SAIC.2018.8516730](https://doi.org/10.1109/SAIC.2018.8516730).
- [91] D. Xu та Y. Tian, “A comprehensive survey of clustering algorithms”, *Annals of Data Science*, т. 2, с. 165—193, 2015.
- [92] L. Lyubchyk, G. Grinberg та K. Yamkovyi, “Machine Learning-Based Predictive Maintenance using Data Aggregation via Regularized Clustering”, в *2023 13th International Conference on Dependable Systems, Services and Technologies (DESSERT)*, IEEE, Афіни, Греція, 2023.
- [93] “Clustering Algorithms”. (2022), url: <https://developers.google.com/machine-learning/clustering/clustering-algorithms> (дата зверн. 23.08.2023).
- [94] R. Y. Rubinstein та D. P. Kroese, *Simulation and the Monte Carlo method*. John Wiley & Sons, 2016.
- [95] E. A. Wan та R. Van Der Merwe, “The unscented Kalman filter for nonlinear estimation”, в *Proceedings of the IEEE 2000 Adaptive Systems for Signal Processing, Communications, and Control Symposium (Cat. No. 00EX373)*, Ieee, 2000, с. 153—158.

- [96] X. Wang, C. Wang та J. Shen, “Semi-supervised K-Means Clustering by Optimizing Initial Cluster Centers”, в *Web Information Systems and Mining*, Z. Gong, X. Luo, J. Chen, J. Lei та F. L. Wang, ред., Berlin, Heidelberg: Springer Berlin Heidelberg, 2011, с. 178–187, ISBN: 978-3-642-23982-3.
- [97] A. E. Bouzenad, M. El Mountassir, S. Yaacoubi, F. Dahmene, M. Koabaz, L. Buchheit та W. Ke, “A Semi-Supervised Based K-Means Algorithm for Optimal Guided Waves Structural Health Monitoring: A Case Study”, *Inventions*, т. 4, № 1, 2019, ISSN: 2411-5134. DOI: 10.3390/inventions4010017. url: <https://www.mdpi.com/2411-5134/4/1/17>.
- [98] E. Bair, “Semi-supervised clustering methods”, *Wiley Interdisciplinary Reviews: Computational Statistics*, т. 5, 2013. url: <https://api.semanticscholar.org/CorpusID:15793664>.
- [99] A. Vouros та E. Vasilaki, “A semi-supervised sparse K-Means algorithm”, *Pattern Recognition Letters*, т. 142, с. 65–71, 2021, ISSN: 0167-8655. DOI: <https://doi.org/10.1016/j.patrec.2020.11.015>. url: <https://www.sciencedirect.com/science/article/pii/S0167865520304268>.
- [100] K. Yamkovyi, “Development and comparative analysis of semi-supervised learning algorithms on a small amount of labeled data”, *Вісник Національного технічного університету «ХПІ». Серія: Системний аналіз, управління та інформаційні технології*, № 1 (5), с. 98–103, 2021.
- [101] L. Kaufman та P. Rousseeuw, *Finding Groups in Data: An Introduction To Cluster Analysis*. січ. 1990, ISBN: 0-471-87876-6. DOI: 10.2307/2532178.
- [102] P. J. Rousseeuw, “Silhouettes: A graphical aid to the interpretation and validation of cluster analysis”, *Journal of Computational and Applied Mathematics*, т. 20, с. 53–65, 1987, ISSN: 0377-0427. DOI: [https://doi.org/10.1016/0377-0427\(87\)90125-7](https://doi.org/10.1016/0377-0427(87)90125-7). url: <https://www.sciencedirect.com/science/article/pii/0377042787901257>.
- [103] D. L. Davies та D. W. Bouldin, “A Cluster Separation Measure”, *IEEE Transactions on Pattern Analysis and Machine Intelligence*, т. PAMI-1, № 2, с. 224–227, 1979. DOI: 10.1109/TPAMI.1979.4766909.

- [104] G. Bortolan ta R. Degani, “A review of some methods for ranking fuzzy subsets”, *Fuzzy sets and Systems*, t. 15, № 1, c. 1–19, 1985.
- [105] J. E. Van Engelen ta H. H. Hoos, “A survey on semi-supervised learning”, *Machine learning*, t. 109, № 2, c. 373—440, 2020.
- [106] M. R. Amini, T. V. Truong ta C. Goutte, “A Boosting Algorithm for Learning Bipartite Ranking Functions with Partially Labeled Data”, в *Proceedings of the 31st Annual International ACM SIGIR Conference on Research and Development in Information Retrieval*, cep. SIGIR ’08, Singapore, Singapore: Association for Computing Machinery, 2008, c. 99—106, ISBN: 9781605581644. DOI: 10.1145/1390334.1390354. url: <https://doi.org/10.1145/1390334.1390354>.
- [107] M. Szummer ta E. Yilmaz, “Semi-supervised learning to rank with preference regularization”, в *International Conference on Information and Knowledge Management*, 2011. url: <https://api.semanticscholar.org/CorpusID:6762253>.
- [108] X. Zhu ta Z. Ghahramani, “Learning from labeled and unlabeled data with label propagation”, *ProQuest Number: INFORMATION TO ALL USERS*, 2002.
- [109] L. Lyubchyk, A. Galuza ta G. Grinberg, “Semi-supervised Learning to Rank with Nonlinear Preference Model”, *Recent Developments in Fuzzy Logic and Fuzzy Sets: Dedicated to Lotfi A. Zadeh*, c. 81—103, 2020.
- [110] X. Guo ta K. Uehara, “Graph-based semi-supervised regression and its extensions”, *International Journal of Advanced Computer Science and Applications*, t. 6, № 6, c. 260—269, 2015.
- [111] D. Cai, X. He ta J. Han, “Semi-supervised regression using spectral techniques”, *Dept. Comput. Sci., Univ. Illinois Urbana-Champaign, Urbana, IL, USA, Tech. Rep. UIUCDCS*, 2006.
- [112] V. Sindhwani, P. Niyogi ta M. Belkin, “Beyond the point cloud: from transductive to semi-supervised learning”, в *Proceedings of the 22nd international conference on Machine learning*, 2005, c. 824—831.

- [113] A. Pozdnoukhov та S. Bengio, “Semi-supervised kernel methods for regression estimation”, в *2006 IEEE International Conference on Acoustics Speech and Signal Processing Proceedings*, IEEE, т. 5, 2006, с. V—V.
- [114] U. Fayyad, G. Piatetsky-Shapiro та P. Smyth, “From Data Mining to Knowledge Discovery in Databases”, *AI Magazine*, т. 17, № 3, с. 37, беп. 1996. DOI: 10.1609/aimag.v17i3.1230. url: <https://ojs.aaai.org/aimagazine/index.php/aimagazine/article/view/1230>.
- [115] A. Guerra-Hernández, R. Mondragón-Becerra та N. Cruz-Ramírez, “Explorations of the BDI Multi-agent support for the Knowledge Discovery in Databases Process”, *Research in Computing Science*, т. 39, с. 221—238, січ. 2008.
- [116] P. Chapman, J. Clinton, R. Kerber, T. Khabaza, T. P. Reinartz, C. Daimlerchrysler, R. Shearer та Wirth, “CRISP-DM 1.0: Step-by-step data mining guide”, 2000. url: <https://api.semanticscholar.org/CorpusID:59777418>.
- [117] K. Sigit, A. Dewi, G. Windu, Nurmalaasi, T. Muhamad та N. Kadinar, “Comparison Of Classification Methods On Sentiment Analysis Of Political Figure Electability Based On Public Comments On Online News Media Sites”, *IOP Conference Series: Materials Science and Engineering*, т. 662, с. 042003, листоп. 2019. DOI: 10.1088/1757-899X/662/4/042003.
- [118] G. Van Rossum та F. L. Drake, *Python 3 Reference Manual*. Scotts Valley, CA: CreateSpace, 2009, ISBN: 1441412697.
- [119] F. Pedregosa, G. Varoquaux, A. Gramfort та ін., “Scikit-learn: Machine Learning in Python”, *Journal of Machine Learning Research*, т. 12, с. 2825—2830, 2011.
- [120] K. Yamkovi. “composite-indicators”. (2023), url: <https://github.com/klymya/composite-indicators> (дата зверн. 26.09.2023).
- [121] T. Kluyver, B. Ragan-Kelley, F. Pérez та ін., “Jupyter Notebooks – a publishing format for reproducible computational workflows”, в *Positioning and Power in Academic Publishing: Players, Agents and Agendas*, F. Loizides та B. Schmidt, ред., IOS Press, 2016, с. 87—90.

- [122] D. Bommavaram. “Laptop Ranked Specifications”. (2022), url: <https://www.kaggle.com/dhanushbommavaram/laptop-ranked-dataset> (дата зверн. 07.09.2023).
- [123] P. McCullagh, “Regression Models for Ordinal Data”, *Journal of the Royal Statistical Society. Series B (Methodological)*, т. 42, № 2, с. 109—142, 1980, ISSN: 00359246. url: <http://www.jstor.org/stable/2984952> (дата зверн. 19.07.2023).
- [124] F. Pedregosa, F. Bach та A. Gramfort, “On the Consistency of Ordinal Regression Methods”, *Journal of Machine Learning Research*, т. 18, № 55, с. 1—35, 2017. url: <http://jmlr.org/papers/v18/15-495.html>.
- [125] M. S. Diallo, S. A. Mokeddem, A. Braud, G. Frey та N. Lachiche, “Identifying Benchmarks for Failure Prediction in Industry 4.0”, *Informatics*, т. 8, № 4, 2021, ISSN: 2227-9709. DOI: 10.3390/informatics8040068. url: <https://www.mdpi.com/2227-9709/8/4/68>.
- [126] T. N. Tengku Asmawi, A. Ismail та J. Shen, “Cloud failure prediction based on traditional machine learning and deep learning”, *Journal of Cloud Computing*, т. 11, № 1, с. 47, 2022.
- [127] C. Ferreira та G. Gonçalves, “Remaining Useful Life prediction and challenges: A literature review on the use of Machine Learning Methods”, *Journal of Manufacturing Systems*, т. 63, с. 550—562, 2022, ISSN: 0278-6125. DOI: <https://doi.org/10.1016/j.jmsy.2022.05.010>. url: <https://www.sciencedirect.com/science/article/pii/S0278612522000796>.
- [128] *AI4I 2020 Predictive Maintenance Dataset*, UCI Machine Learning Repository, DOI: <https://doi.org/10.24432/C5HS5C>, 2020.
- [129] M. McCann та A. Johnston, *SECOM*, UCI Machine Learning Repository, DOI: <https://doi.org/10.24432/C54305>, 2008.