

DAFTAR PUSTAKA

- [1] “Rata-rata IPK Sarjana Indonesia di Bawah 3,5.” [Online]. Available: <https://databoks.katadata.co.id/infografik/2024/04/23/rata-rata-ipk-sarjana-indonesia-di-bawah-3-5>
- [2] “Tingkat Drop Out Mahasiswa di Indonesia pada 2022,” 2023, [Online]. Available: <https://goodstats.id/article/tingkat-drop-out-mahasiswa-di-indonesia-kembali-turun-pada-2022-4gr2P>
- [3] L. R. Pelima, Y. Sukmana, and Y. Rosmansyah, “Predicting University Student Graduation Using Academic Performance and Machine Learning: A Systematic Literature Review,” *IEEE Access*, 2024, doi: 10.1109/ACCESS.2024.3361479.
- [4] A. Kord, A. Aboelfetouh, and S. M. Shohieb, “Academic course planning recommendation and students’ performance prediction multi-modal based on educational data mining techniques,” *J. Comput. High. Educ.*, 2025, doi: 10.1007/s12528-024-09426-0.
- [5] F. Yu and X. Liu, “Research on Student Performance Prediction Based on Stacking Fusion Model,” *Electron.*, 2022, doi: 10.3390/electronics11193166.
- [6] B. Sameephet *et al.*, “A Comparative Analysis of Machine Learning Models for Predicting EFL Student Language Performance in Smart Learning Environments,” *Emerg. Sci. J.*, vol. 9, no. 2, pp. 615–639, 2025, doi: 10.28991/ESJ-2025-09-02-07.
- [7] V. Vimbi, N. Shaffi, and M. Mahmud, “Interpreting artificial intelligence models: a systematic review on the application of LIME and SHAP in Alzheimer’s disease detection,” *Brain Informatics*, vol. 11, no. 1, 2024, doi: 10.1186/s40708-024-00222-1.
- [8] L. C. Nnadi, Y. Watanobe, M. M. Rahman, and A. M. John-Otumu, “Prediction of Students’ Adaptability Using Explainable AI in Educational Machine Learning Models,” *Appl. Sci.*, vol. 14, no. 12, 2024, doi: 10.3390/app14125141.
- [9] C. H. Cho, Y. W. Yu, and H. G. Kim, “A Study on Dropout Prediction for University Students Using Machine Learning,” *Appl. Sci.*, vol. 13, no. 21, 2023, doi: 10.3390/app132112004.
- [10] A. Villar and C. R. V. de Andrade, “Supervised machine learning algorithms for predicting student dropout and academic success: a comparative study,” *Discov. Artif. Intell.*, vol. 4, no. 1, 2024, doi: 10.1007/s44163-023-00079-z.
- [11] N. G. Canto, M. A. De Oliveira, and G. De Mattos Veroneze, “Supervised Learning Applied to Graduation Forecast of Industrial Engineering Students,” *Eur. J. Educ. Res.*, 2022, doi: 10.12973/eu-jer.11.1.325.

- [12] H. Xue and Y. Niu, "Multi-Output Based Hybrid Integrated Models for Student Performance Prediction," *Appl. Sci.*, 2023, doi: 10.3390/app13095384.
- [13] Z. Mingyu, W. Sutong, W. Yanzhang, and W. Dujuan, "An interpretable prediction method for university student academic crisis warning," *Complex Intell. Syst.*, 2022, doi: 10.1007/s40747-021-00383-0.
- [14] G. Ramaswami, T. Susnjak, and A. Mathrani, "On Developing Generic Models for Predicting Student Outcomes in Educational Data Mining," *Big Data Cogn. Comput.*, 2022, doi: 10.3390/bdcc6010006.
- [15] M. A. Baig, S. A. Shaikh, K. K. Khatri, M. A. Shaikh, M. Z. Khan, and M. A. Rauf, "Prediction of Students Performance Level Using Integrated Approach of ML Algorithms," *Int. J. Emerg. Technol. Learn.*, 2023, doi: 10.3991/ijet.v18i01.35339.
- [16] A. Siddique, A. Jan, F. Majeed, A. I. Qahmash, N. N. Quadri, and M. O. A. Wahab, "Predicting academic performance using an efficient model based on fusion of classifiers," *Appl. Sci.*, vol. 11, no. 24, 2021, doi: 10.3390/app112411845.
- [17] T. Tong and Z. Li, "Predicting learning achievement using ensemble learning with result explanation," *PLoS One*, vol. 20, no. 1, 2025, doi: 10.1371/journal.pone.0312124.
- [18] H. Sahlaoui, E. A. A. Alaoui, S. Agoujl, and A. Nayyar, "An empirical assessment of smote variants techniques and interpretation methods in improving the accuracy and the interpretability of student performance models," *Educ. Inf. Technol.*, 2024, doi: 10.1007/s10639-023-12007-w.
- [19] R. A. N. Al-Tameemi *et al.*, "Determinants of poor academic performance among undergraduate students—A systematic literature review," *Int. J. Educ. Res. Open*, 2023, doi: 10.1016/j.ijedro.2023.100232.
- [20] E. A. Brew, B. Nketiah, and R. Koranteng, "A Literature Review of Academic Performance, an Insight into Factors and their Influences on Academic Outcomes of Students at Senior High Schools," *OALib*, 2021, doi: 10.4236/oalib.1107423.
- [21] G. Stavropoulou, A. Daniilidou, and K. Nerantzaki, "Exploring the Interplay of Motivation, Self-Efficacy, Critical Thinking, and Self-Regulation in Predicting Academic Achievement Among University Students," *F1000Research*, vol. 14, 2025, doi: 10.12688/f1000research.161821.2.
- [22] B. Lu, Y. Deng, X. Yao, and Z. Li, "Learning Goal Orientation and Academic Performance: A Dynamic model," *J. Career Assess.*, 2022, doi: 10.1177/10690727211043437.
- [23] S. Wang and B. Luo, "Academic achievement prediction in higher education through interpretable modeling," *PLoS One*, vol. 19, no. 9

September, 2024, doi: 10.1371/journal.pone.0309838.

- [24] L. Gong, “Construction and Application Research of University Academic Early Warning System Based on AIGC Technology,” *2025 IEEE Int. Conf. Electron. Energy Syst. Power Eng. EESPE 2025*, pp. 283–291, 2025, doi: 10.1109/EESPE63401.2025.10986983.
- [25] F. Cabezas, L. Burgos, J. Darrigol, and M. Zúñiga, “Implementation of an early alert system in quizzes of a high complexity subject in higher education: Improvement of student performance and teacher perception,” *Educ. Inf. Technol.*, 2024, doi: 10.1007/s10639-024-12610-5.
- [26] J. Olufemi Ogunleye, “The Concept of Data Mining,” 2022. doi: 10.5772/intechopen.99417.
- [27] S. Gupta, C. Sc, I. Tech, and G. Era, “A Comparative Study of Data Mining Techniques for Predictive Analytics,” *Neuroquantology*, vol. 17, no. 03, pp. 145–151, 2023, doi: 10.48047/nq.2019.17.03.2014.
- [28] Chubukova, Ponomarenko, and Nedbailo, “Using data mining to process business data,” *Probl. Innov. Invest. Dev.*, 2020, doi: 10.33813/2224-1213.23.2020.8.
- [29] A. Sánchez, C. Vidal-Silva, G. Mancilla, M. Tupac-Yupanqui, and J. M. Rubio, “Sustainable e-Learning by Data Mining—Successful Results in a Chilean University,” *Sustain.*, 2023, doi: 10.3390/su15020895.
- [30] F. Martinez-Plumed *et al.*, “CRISP-DM Twenty Years Later: From Data Mining Processes to Data Science Trajectories,” *IEEE Trans. Knowl. Data Eng.*, 2021, doi: 10.1109/TKDE.2019.2962680.
- [31] M. Hajihosseini, A. Maghsoudi, and R. Ghezelbash, “A Novel Scheme for Mapping of MVT-Type Pb–Zn Prospectivity: LightGBM, a Highly Efficient Gradient Boosting Decision Tree Machine Learning Algorithm,” *Nat. Resour. Res.*, 2023, doi: 10.1007/s11053-023-10249-6.
- [32] X. Sun, “Application of an improved LightGBM hybrid integration model combining gradient harmonization and Jacobian regularization for breast cancer diagnosis,” *Sci. Rep.*, vol. 15, no. 1, 2025, doi: 10.1038/s41598-025-86014-x.
- [33] R. Narimani, C. Jun, A. Saedi, S. M. Bateni, and J. Oh, “A multivariate decomposition–ensemble model for estimating long-term rainfall dynamics,” *Clim. Dyn.*, 2023, doi: 10.1007/s00382-022-06646-x.
- [34] A. Paleczek, D. Grochala, and A. Rydosz, “Artificial breath classification using xgboost algorithm for diabetes detection,” *Sensors*, 2021, doi: 10.3390/s21124187.
- [35] B. Öztornaci, A. Baris, and K. Sertan, “Analysing Household Food Consumption in Turkey Using Machine Learning Techniques,” 2024, doi: 10.7160/aol.2024.160207.

- [36] A. Samat, E. Li, W. Wang, S. Liu, C. Lin, and J. Abuduwaili, "Meta-XGBoost for hyperspectral image classification using extended MSER-guided morphological profiles," *Remote Sens.*, 2020, doi: 10.3390/rs12121973.
- [37] J. T. Hancock and T. M. Khoshgoftaar, "CatBoost for big data: an interdisciplinary review," *J. Big Data*, 2020, doi: 10.1186/s40537-020-00369-8.
- [38] M. Luo *et al.*, "Combination of feature selection and catboost for prediction: The first application to the estimation of aboveground biomass," *Forests*, 2021, doi: 10.3390/f12020216.
- [39] S. Paul, P. Das, A. Kashem, and N. Islam, "Sustainable of rice husk ash concrete compressive strength prediction utilizing artificial intelligence techniques," *Asian J. Civ. Eng.*, 2024, doi: 10.1007/s42107-023-00847-3.
- [40] M. Savargiv, B. Masoumi, and M. R. Keyvanpour, "A new random forest algorithm based on learning automata," *Comput. Intell. Neurosci.*, 2021, doi: 10.1155/2021/5572781.
- [41] J. S. Rhodes, A. Cutler, and K. R. Moon, "Geometry- and Accuracy-Preserving Random Forest Proximities," *IEEE Trans. Pattern Anal. Mach. Intell.*, 2023, doi: 10.1109/TPAMI.2023.3263774.
- [42] X. Yuan, S. Liu, W. Feng, and G. Dauphin, "Feature Importance Ranking of Random Forest-Based End-to-End Learning Algorithm," *Remote Sens.*, 2023, doi: 10.3390/rs15215203.
- [43] M. Y. Khan, A. Qayoom, M. S. Nizami, M. S. Siddiqui, S. Wasi, and S. M. K. U. R. Raazi, "Automated Prediction of Good Dictionary EXamples (GDEX): A Comprehensive Experiment with Distant Supervision, Machine Learning, and Word Embedding-Based Deep Learning Techniques," *Complexity*, 2021, doi: 10.1155/2021/2553199.
- [44] M. Azad, T. H. Nehal, and M. Moshkov, "A novel ensemble learning method using majority based voting of multiple selective decision trees," *Computing*, vol. 107, no. 1, 2025, doi: 10.1007/s00607-024-01394-8.
- [45] P. Bansal *et al.*, "GGA-MLP: A Greedy Genetic Algorithm to Optimize Weights and Biases in Multilayer Perceptron," *Contrast Media Mol. Imaging*, 2022, doi: 10.1155/2022/4036035.
- [46] R. Lin, Z. Zhou, S. You, R. Rao, and C. C. Jay Kuo, "Geometrical Interpretation and Design of Multilayer Perceptrons," *IEEE Trans. Neural Networks Learn. Syst.*, 2024, doi: 10.1109/TNNLS.2022.3190364.
- [47] P. Giribone, "Mathematical modeling in Quantitative Finance and Computational Economics," 2021, [Online]. Available: https://tesidottorato.depositolegale.it/handle/20.500.14242/101760%0Ahttps://tesidottorato.depositolegale.it/bitstream/20.500.14242/101760/2/phdunige_2730862_2.pdf

- [48] K. Ostad-Ali-Askari and M. Shayannejad, "Computation of subsurface drain spacing in the unsteady conditions using Artificial Neural Networks (ANN)," *Appl. Water Sci.*, 2021, doi: 10.1007/s13201-020-01356-3.
- [49] R. Sewada, A. Jangid, P. Kumar, and N. Mishra, "Explainable Artificial Intelligence (XAI)," *J. Nonlinear Anal. Optim.*, 2023, doi: 10.36893/jnao.2022.v13i02.041-047.
- [50] S. Ali *et al.*, "Explainable Artificial Intelligence (XAI): What we know and what is left to attain Trustworthy Artificial Intelligence," *Inf. Fusion*, 2023, doi: 10.1016/j.inffus.2023.101805.
- [51] L. Longo *et al.*, "Explainable Artificial Intelligence (XAI) 2.0: A manifesto of open challenges and interdisciplinary research directions," 2024. doi: 10.1016/j.inffus.2024.102301.
- [52] W. Samek, G. Montavon, S. Lapuschkin, C. J. Anders, and K. R. Müller, "Explaining Deep Neural Networks and Beyond: A Review of Methods and Applications," *Proc. IEEE*, 2021, doi: 10.1109/JPROC.2021.3060483.
- [53] O. O. Bifarin, "Interpretable machine learning with treebased shapley additive explanations: Application to metabolomics datasets for binary classification," *PLoS One*, 2023, doi: 10.1371/journal.pone.0284315.
- [54] G. D. Pelegriana, L. T. Duarte, and M. Grabisch, "A k-additive Choquet integral-based approach to approximate the SHAP values for local interpretability in machine learning," *Artif. Intell.*, 2023, doi: 10.1016/j.artint.2023.104014.
- [55] L. Antwarg, R. M. Miller, B. Shapira, and L. Rokach, "Explaining anomalies detected by autoencoders using Shapley Additive Explanations[Formula presented]," *Expert Syst. Appl.*, 2021, doi: 10.1016/j.eswa.2021.115736.
- [56] S. K. Ray, "Performance Analysis of Online Machine Learning Frameworks for Anomaly Detection in IoT Data Streams," no. November, 2024, doi: 10.1109/ICCCNT61001.2024.10724326.
- [57] C. K. I. Williams, "The Effect of Class Imbalance on Precision-Recall Curves," *Neural Comput.*, vol. 33, no. 4, pp. 853–857, 2021, doi: 10.1162/neco_a_01362.
- [58] Z. DeVries *et al.*, "Using a national surgical database to predict complications following posterior lumbar surgery and comparing the area under the curve and F1-score for the assessment of prognostic capability," *Spine J.*, vol. 21, no. 7, pp. 1135–1142, 2021, doi: 10.1016/j.spinee.2021.02.007.
- [59] C. Ozgur, T. Colliau, G. Rogers, and Z. Hughes, "MatLab vs. Python vs. R," *J. Data Sci.*, 2021, doi: 10.6339/jds.201707_15(3).0001.
- [60] Ajay Rawat, "A Review on Python Programming," *Int. J. Res. Eng. Sci.*

Manag., vol. 3, no. 12, pp. 2581–5792, 2020.

- [61] D. S. R. Sukhdeve and S. S. Sukhdeve, *Google Cloud Platform for Data Science*. 2023. doi: 10.1007/978-1-4842-9688-2.
- [62] D. Ifenthaler, C. Schumacher, and J. Kuzilek, “Investigating students’ use of self-assessments in higher education using learning analytics,” *J. Comput. Assist. Learn.*, 2023, doi: 10.1111/jcal.12744.
- [63] F. A. Setiawati, T. Widyastuti, K. N. Fathiyah, and T. S. Nabila, “Minimizing Social Desirability in Questionnaires of Non-Cognitive Measurements,” *Eur. J. Psychol. Educ. Res.*, 2024, doi: 10.12973/ejper.7.1.33.
- [64] D. Tempelaar, B. Rienties, and Q. Nguyen, “Subjective data, objective data and the role of bias in predictive modelling: Lessons from a dispositional learning analytics application,” *PLoS One*, 2020, doi: 10.1371/journal.pone.0233977.
- [65] D. Elreedy, A. F. Atiya, and F. Kamalov, “A theoretical distribution analysis of synthetic minority oversampling technique (SMOTE) for imbalanced learning,” *Mach. Learn.*, 2024, doi: 10.1007/s10994-022-06296-4.
- [66] Y. Li, Y. Yang, P. Song, L. Duan, and R. Ren, “An improved SMOTE algorithm for enhanced imbalanced data classification by expanding sample generation space,” *Sci. Rep.*, 2025, doi: 10.1038/s41598-025-09506-w.
- [67] M. Mujahid *et al.*, “Data oversampling and imbalanced datasets: an investigation of performance for machine learning and feature engineering,” *J. Big Data*, 2024, doi: 10.1186/s40537-024-00943-4.
- [68] Azal Ahmad Khan, Omkar Chaudhari, and Rohitash Chandra, “A review of ensemble learning and data augmentation models for class imbalanced problems: combination, implementation and evaluation,” *Expert Syst. Appl.*, 2023.
- [69] M. V. Martins, L. Baptista, J. Machado, and V. Realinho, “Multi-Class Phased Prediction of Academic Performance and Dropout in Higher Education,” *Appl. Sci.*, 2023, doi: 10.3390/app13084702.
- [70] M. R. Alzahrani, “Predicting Student Performance Using Ensemble Models and Learning Analytics Techniques,” *Preprints.org*, p. 202406.1100.v1, 2024, [Online]. Available: <https://app.dimensions.ai/details/publication/pub.1173123597%0Ahttps://www.preprints.org/manuscript/202406.1100/v1/download>
- [71] R. Rismayati, I. Ismarmiaty, and S. Hidayat, “Ensemble Implementation for Predicting Student Graduation with Classification Algorithm,” *Int. J. Eng. Comput. Sci. Appl.*, 2022, doi: 10.30812/ijecsa.v1i1.1805.