Integrating Machine Learning in Outcome-Based Learning Systems: A Predictive Approach

Ellysa Tjandra
Department of Informatics Engineering
University of Surabaya
Surabaya, Indonesia
ellysa@staff.ubaya.ac.id
ORCID: 0000-0001-6511-324X

Noor Akhmad Setiawan
Department of Electrical and Information Engineering
Gadjah Mada University
Yogyakarta, Indonesia
noorwewe@ugm.ac.id
ORCID: 0000-0002-5631-1073

2025 17th International Conference on Information Technology and Electrical Engineering (ICITEE) | 979-8-3315-9926-3/25/$31.00 ©2025 IEEE | DOI: 10.1109/ICITEE66631.2025.11338212

***Abstract*— Outcome-Based Education (OBE) emphasizes achieving measurable learning outcomes as an indicator of academic success. However, conventional evaluation approaches often fail to provide accurate and timely predictions of student performance consistent with these outcomes. This study proposes a new system that utilizes machine learning (ML) methods in an OBE-based education setup to rapidly identify students who may be struggling and provide them with data-driven support. Multiple supervised learning algorithms were trained and evaluated using a dataset that includes student performance indicators based on mid-term assessment scores, including Decision Tree, Random Forest, K-Nearest Neighbor, Support Vector Classification, Naïve Bayes, XGBoost, and AdaBoost. The dataset comprises 2,130 records of students' scores in 14 courses from 7 study programs of a private university in Indonesia. This research finds that XGBoost classification yields the best results in predicting course outcomes for low-participant courses, with a maximum accuracy of 91.36%. In comparison, Naïve Bayes achieves the highest accuracy for high-participant classes (86.89%). This study also examined the relationship between the number of student outcomes, the number of mid-term assessment components, and model accuracy results, and found that the greater the number of student outcomes and mid-term assessments, the lower the model accuracy results.**

Keywords—machine learning, prediction, OBE, learning system

I. Introduction

Dealing with students who fail or drop out of college remains a significant challenge. According to earlier research, many undergraduate students do not complete their studies [1]–[3]. To address this issue, academies should employ various strategies, including enforcing academic rules, monitoring students' academic progress, and implementing initiatives to prevent students from dropping out of university. For these initiatives to be effective, institutions must have robust support mechanisms in place. Graduate skills have become the benchmark for evaluating students' knowledge, leading to several studies on the subject [4]–[6]. Students' academic achievement is measured by how well they meet the set goals in all their classes. To pass, students must get at least the minimum grade in each subject. If they do not, they must retake the course, which can prolong their studies and even lead to them dropping out of school.

Outcome-Based Education (OBE) is a way of designing curriculum that focuses on establishing the precise objectives students should attain by the end of their academic program [7], [8]. These outcomes are usually listed in OBE-based curricula. Course material and assessment criteria are then adjusted to fit the learning outcomes. OBE is highly recommended because it can accurately measure students' performance [9], [10]. Meanwhile, in OBE-based curriculum, the value of student outcomes achievement at the study program level is measured based on the achievement of outcomes at the course level [11]–[13]. Furthermore, predicting student achievement at the course level is crucial as a basis for establishing an early warning system that aims to identify at-risk students who do not meet the student outcomes set by the study program. The early warning system will serve as a reference for study program management to implement follow-up procedures for at-risk students [14]–[16].

Machine learning (ML) is a crucial aspect of academic prediction, particularly when applied to learning analytics for predicting student performance [17], [18]. Currently, academic prediction research frequently employs machine learning to identify at-risk students [16], [19], [20]. These prediction algorithms, which employ several academic indicators, can estimate students' final grades and highlight those likely to perform below expectations [21], [22]. Decision Trees (DT) [23], [24], Random Forests (RF) [25], [26], Support Vector Machine (SVM) [27], [28], Naive Bayes (NB) [29], [30], K-Nearest Neighbors (KNN) [31], [32], XGBoost (XGB) [3], [27], and AdaBoost (AB) [33], [34] classification techniques are some of the ML algorithms that have been utilized in the past to create predictions with decent results.

Previous studies have employed academic data and attributes to establish links between learning outcomes and academic data using ML methods [11], [35], [36]. In previous academic prediction works, it has been proven that midterm scores have significant importance in predicting academic performance [11], [37], [38]. However, previous research has not examined further explanation of the relationship between the number of Student Outcomes, the number of assessment components, and the accuracy of prediction results.

This study aims to examine the best ML classification method to predict student outcomes at the course level using mid-semester scores (assignments, quizzes, case-based projects, etc.) in the course learning plan, as a recommendation for developing an OBE-based early warning academic system. This research also explores further investigation of the relationship between the number of student outcomes, the number of assessment components, and the accuracy of the prediction results.

979-8-3315-9926-3/25/$31.00 ©2025 IEEE

II. Materials and Method

This section provides detailed information about the material and methods, including the dataset, pre-processing methods, and ML algorithms used in this study. In this research, we use purposive sampling [13], [39]. There are two criteria to determine the sample: the course must include comprehensive OBE-based curriculum components and all mid-semester assessments. The curriculum components include student outcome matrices, course learning plans, and course assessment plans. The curriculum dataset is derived from the curricula of seven study programs at a private university in Surabaya. All datasets are retrieved from the university's web-based OBE academic system. There are four steps in this research: data collection, data pre-processing, data modeling and evaluation, and data reporting and recommendation [40], [41]. The overall steps of this research are shown in Fig. 1.

A. Data Collection

The first step is to retrieve the students' score data for all courses opened in the Genap 2023-2024 semester, which have been submitted to the university's web-based OBE academic system.

B. Data Pre-Processing

We clean and prepare the data for analysis by deleting course data that lacks all assessment components and student data values that fall outside the range of 0 to 100. After that, we change the format of all the data to CSV. Next, we select the features that will be used to predict how well students will perform at the end of a semester in a course. Scores for each mid-term assessment component (NTS) are utilized to make predictions. This means that the student's final learning outcome can only be predicted if all of their mid-term scores have been collected. After that, to prevent inadequate prediction results due to overfitting, this research also filters courses with a minimum of 30 dataset records.

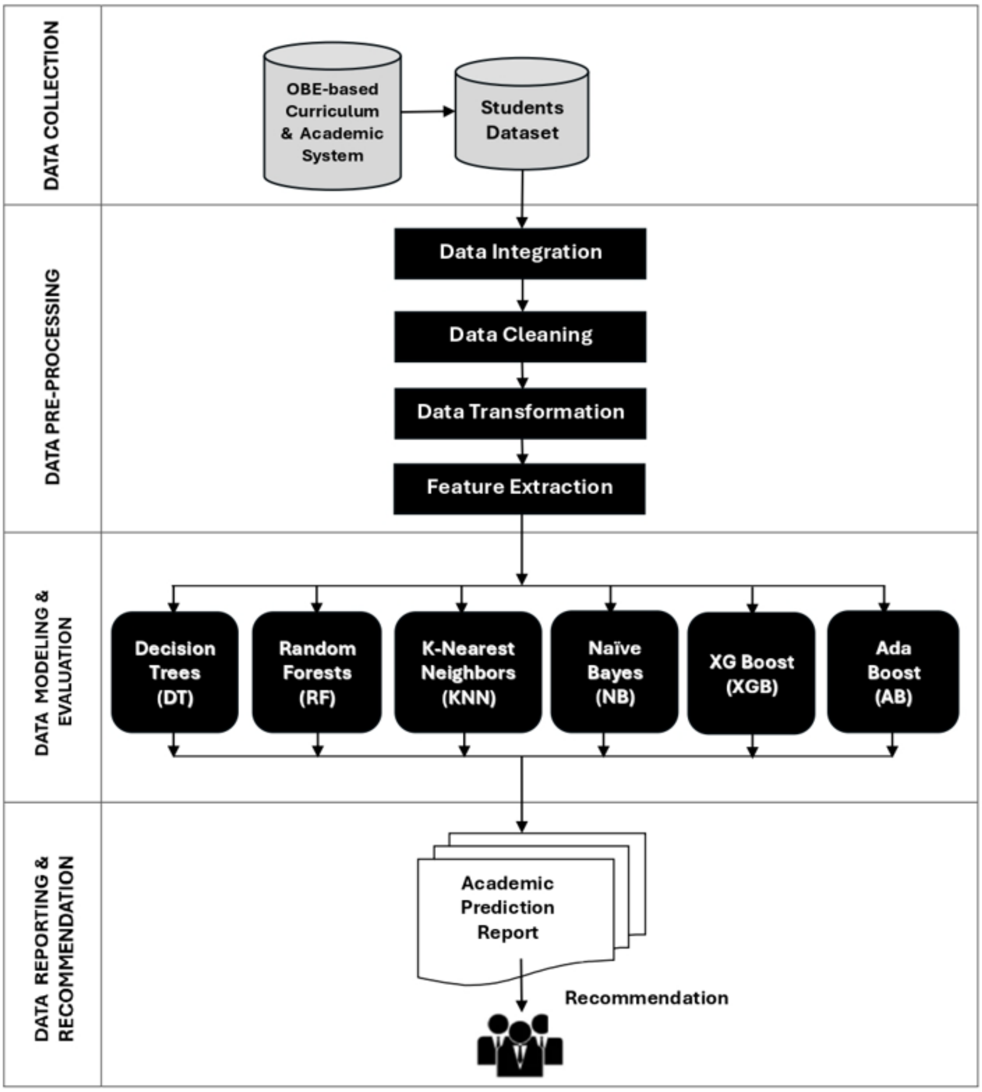


Fig. 1. Research Method

TABLE I. COURSE DATASET

No	Course Name	Mid-Term Components (MTC)	Num of Student Outcome (SO)	Data set	Data Training	Data Testing
1	Intelligent Information Retrieval (IIR)	Mid-Term Exercise, Mid-Term Quiz, Mid-Term Test	4	58	47	11
2	Object Oriented Programming (OOP)	Mid-Term Exercise, Mid-Term Quiz, Mid-Term Test	4	128	103	25
3	Data Structure (DS)	Mid-Term Exercise, Mid-Term Quiz, Mid-Term Test	3	152	122	30
4	Game Concept and Design (GCD)	Mid-Term Project	3	48	39	9
5	Discrete Mathematics (DisMath)	Mid-Term Exercise, Mid-Term Quiz, Mid-Term Test	2	253	203	50
6	Literasi Digital (LD)	Mid-Term Exercise, Mid-Term Test	4	159	128	31
7	Computer Network (ComNet)	Mid-Term Evaluation,Mid-Term Simulation Practice 1,Mid-Term Simulation Practice 2,Mid-Term Test	2	204	164	40
8	Data Mining (DatMin)	Mid-Term Exercise, Mid-Term Quiz, Mid-Term Test	6	56	45	11
9	Full-Stack Programming (FSP)	Mid-Term Project,Quiz 1,Quiz 2,Quiz 3,Mid-Term Test	5	208	167	41
10	Computer Organization and Architecture (COA)	Mid-Term Exercise, Mid-Term Quiz, Mid-Term Test	2	242	194	48
11	Native Mobile Programming (NMP)	Mid-Term Project,Quiz 1,Quiz 2,Quiz 3	6	192	154	38
12	Algorithm and Programming (Alpro)	Mid-Term Exercise, Mid-Term Quiz, Mid-Term Test	4	244	196	48
13	Internet of Things (IOT)	Mid-Term Exercise,Mid-Term Test	3	36	29	7
14	Database (DB)	Mid-Term Exercise, Mid-Term Quiz, Mid-Term Test	5	150	120	30
			TOTAL	**2130**	**1711**	**419**

C. Data Modeling and Evaluation

We utilize 7 ML algorithms (DT, RF, SVC, KNN, NB, XGB, and AB) to make predictions based on the existing data. It is crucial to choose suitable prediction metrics to accurately assess the effectiveness of a prediction model [42], [43]. We will compare these models based on their accuracy, precision, recall, and F1-score. This study combines commonly used indicators to comprehensively assess the predictive capabilities of the models created, with a focus on at-risk students.

1) Accuracy

The number of successfully categorized cases is divided by the total number of samples in the dataset to determine accuracy [44], [45]. Although accuracy is intuitive, it can be deceptive in situations where datasets are unbalanced and the model may be biased in favor of the majority class. The accuracy formula is shown below (1).

$$Accuracy = \frac{TP+TN}{TP+TN+FP+FN} \quad (1)$$

Where TP is correctly predicted positive cases, TN is correctly predicted negative cases, FP is incorrectly predicted positive cases, and FN is incorrectly predicted negative cases.

2) Precision

Precision focuses on the proportion of correct predictions [46], [47]. To calculate the precision, divide the number of correctly detected positive examples (TP) by the total number of positive predictions the model produces (TP + FP), as shown in (2).

$$Precision = \frac{TP}{TP+FP} \quad (2)$$

3) Recall

Recall demonstrates the model's ability to identify all real positive cases [48], [49]. To get this value, divide the number of correctly identified positive cases, which is called TP, by the total number of positive cases in the dataset (TP + FN), as follows (3).

$$Recall = \frac{TP}{TP+FN} \quad (3)$$

4) F1-score

The F1-score is a harmonic mean of precision and recall, providing a more balanced assessment of the model's performance [50], [51]. This is particularly important when working with imbalanced datasets, as relying solely on correctness can be deceptive. The F1-score formula is shown in (4).

$$F1 - score = 2\ x\ \frac{Precision\ x\ Recall}{Precision+Recall} \quad (4)$$

D. Data Reporting and Recommendation

Once the optimal prediction technique has been identified, performance reports and suggestions can be generated. Early student failure detection is made possible by these reports, which provide information on the expected course learning outcomes and the value attained by students.

III. Results and Discussion

Data collection steps comprise 5,523 original records from 56 courses in the university's OBE-based academic system. After performing data cleaning, the final dataset consisted of 2,130 records from 14 courses, comprising 1,711 records for training (80%) and 419 records for testing (20%). The first data cleaning step involves excluding student data values that fall outside the range of 0 to 100. Accuracy results in classification are often irrelevant due to data overfitting, which requires data cleaning of the dataset [40]. For this reason, this study also excluded results for courses with fewer than 30 participants. The research utilizes data from seven study programs: Informatics Engineering (IF), Digital Media Technology (DMT), Network & Cyber Security (NCS), Game Development (GD), Data Science & Artificial Intelligence, Information Management & Enterprise Systems (IMES), and Business Information Systems (SIB). The curriculum framework for each program is distinct. The entire dataset for the course is presented in Table I.

All data is collected and converted to CSV format. After that, the Python ML Scikit-learn module is used to make predictions. Decision Tree Classifier, Random Forest Classifier, Gaussian NB, SVC, K Neighbors, XGBoost, and AdaBoost Classifier are among the libraries utilized. This study utilizes the default hyperparameter values from the Python library for each ML model and employs k-fold cross-validation (k=5). Accuracy, precision, recall, and F1-score were computed, and the best method (highest accuracy) in each course is displayed in Table II.

As shown in Table II, the highest accuracy method for course with low participants (up to 60 students) is XGBoost (91.36%), with an F1-Score of 0.9189, derived from the Intelligent Information Retrieval (IIR) course, and the lowest is KNN (72.14%), from the Internet of Things (IOT) course, with an F1-Score of 0.6869. In high-participant courses (more than 60 students), the best method is Naive Bayes, with 86.89% accuracy and an F1-score of 0.8654, derived from the Object-Oriented Programming (OOP) course. The overall average accuracy of all courses was quite good, reaching 77.77%. Furthermore, this study also finds that the XGB method produced the highest accuracy the most frequently (3 times), followed by KNN, DVM, AB, NB, RF, and DT (2 times), and DT (1 time).

This study also conducts a deeper investigation into the relationship between the number of Student Outcomes (SOs), the number of mid-term assessment components, and the accuracy of the results. The number of SOs has a significant negative correlation with the accuracy results, with the Pearson correlation coefficient results: -0.42 with a p-value of 0.000035, which means there is a moderate negative correlation between the number of Student Outcomes (SOs) and model accuracy. Meanwhile, the number of mid-term components also shows a significant negative correlation (-0.4633) with the model accuracy results (p-value 0.00000425). In other words, the greater the number of SOs and the number of midterm components, the more they will tend to decrease the accuracy of the prediction model.

IV. Conclusions and Future Works

From the results of this study, the XGB model can be used to predict student outcomes in low-participant courses with high accuracy, and NB is the best method for high-participant classes. Furthermore, it is also concluded that the number of SO and mid-term assessment components has a significant effect on the prediction accuracy results, where the greater the number of SO and mid-term assessment components, the lower the likelihood of achieving accurate results. However, although perfect accuracy was achieved in this study, this result was only achieved in one course. Future research requires additional models that can produce more stable results.

A limitation of our study is that predictions are made after all components of the mid-term grade have been obtained, allowing preventive measures to be implemented no earlier than mid-semester. Future research may include additional predictors of final CLO achievement, enabling the faster identification of at-risk students and allowing study program management and faculty more time to take proactive action.

TABLE II. Prediction Results

No	Course	Num of Students	Best Method	Accuracy	Precision	Recall	F1-Score
Num of Students > 60 :							
1	OOP	128	NB	86.89%	0.8678	0.8689	0.8654
2	DS	152	NB	81.59%	0.8246	0.8159	0.8146
3	LD	159	AB	81.19%	0.8414	0.8119	0.8047
4	DisMath	253	SVM	81.01%	0.8170	0.8101	0.8100
5	ComNet	204	RF	77.51%	0.7855	0.7751	0.7748
6	FSP	208	RF	73.98%	0.7545	0.7398	0.7402
7	COA	242	SVM	73.17%	0.7442	0.7317	0.7324
8	NMP	192	XGB	72.40%	0.7327	0.7240	0.7180
9	Alpro	244	KNN	70.90%	0.7284	0.7090	0.7114
10	DB	150	AB	66.67%	0.7086	0.6667	0.6591
Num of Students <= 60 :							
11	IIR	58	XGB	91.36%	0.9381	0.9136	0.9189
12	GCD	48	DT	83.33%	0.8405	0.8333	0.8123
13	DatMin	56	XGB	76.67%	0.8346	0.7667	0.7592
14	IOT	36	KNN	72.14%	0.7061	0.7214	0.6869

REFERENCES

[1] E. Ismanto, H. A. Ghani, N. I. M. Saleh, J. Al Amien, and R. Gunawan, "Recent systematic review on student performance prediction using backpropagation algorithms," *Telkomnika (Telecommunication Comput. Electron. Control.*, vol. 20, no. 3, pp. 597–606, 2022, doi: 10.12928/TELKOMNIKA.v20i3.21963.

[2] H. A.-M. Gerlache, P. M. Ger, and L. F. Valentín, "Towards the Grade's Prediction. A Study of Different Machine Learning Approaches to Predict Grades from Student Interaction Data," *Int. J. Interact. Multimed. Artif. Intell.*, vol. 7, no. 4, pp. 196–204, 2022, doi: 10.9781/ijimai.2021.11.007.

[3] J. H. Guanin-Fajardo, J. Guaña-Moya, and J. Casillas, "Predicting Academic Success of College Students Using Machine Learning Techniques," *Data*, vol. 9, no. 4, pp. 1–27, 2024, doi: 10.3390/data9040060.

[4] B. Mathew, M. E. A. Ismail, J. S. Sathyendra, and T. G. Sambanthan, "Techniques for Measuring Attitudinal Learning Outcomes in Computer Science and Engineering," *Int. J. Eng. Res. Technol.*, vol. 13, no. 9, pp. 2395–2401, 2020, [Online]. Available: https://www.scopus.com/inward/record.uri?eid=2-s2.0-85093858894&doi=10.37624%2Fijert%2F13.9.2020.2395-2401&partnerID=40&md5=0cb1de36419725720a98248c1baa66d3.

[5] C. Lavanya and J. N. Murthy, "Assessment and Attainment of Course Outcomes and Program Outcomes," *J. Eng. Educ. Transform.*, vol. 35, no. 4, pp. 104–111, 2022, doi: 10.16920/jeet/2022/v35i4/22109.

[6] E. K. Bone and P. M. Ross, "Rational curriculum processes: revising learning outcomes is essential yet insufficient for a twenty-first century science curriculum," *Stud. High. Educ.*, vol. 46, no. 2, pp. 394–405, 2021, [Online]. Available: https://www.scopus.com/inward/record.uri?eid=2-s2.0-85068615096&doi=10.1080%2F03075079.2019.1637845&partnerID=40&md5=9b844bad410312a54bdc924a34cba054.

[7] W. G. Spady, *Outcome-Based Education: Critical Issues and Answers*, vol. 7, no. 1. 1994.

[8] S. Mohamad, Z. Tukiran, R. M. Hanifa, A. Ahmad, and M. Som, "An Evaluation of Assessment Tools in Outcome-based Education : A Way Forward," *J. Educ. Vocat. Res.*, vol. 3, no. 11, pp. 336–343, 2012.

[9] V. Upadhye, S. Madhe, and A. Joshi, "Project Based Learning as an Active Learning Strategy in Engineering Education," *J. Eng. Educ. Transform.*, vol. 36, no. Special Issue 1, pp. 18–24, 2022, [Online]. Available: https://www.scopus.com/inward/record.uri?eid=2-s2.0-85146825796&partnerID=40&md5=770ad87eb0a68d144d1328ed37f25373.

[10] A. A. Jadhav, D. A. Suryawanshi, S. S. Ahankari, and S. B. Zope, "A technology-enabled assessment and attainment of desirable competencies," *Educ. Chem. Eng.*, vol. 39, pp. 67–83, 2022, doi: 10.1016/j.ece.2022.02.005.

[11] E. Tjandra, R. Ferdiana, and N. A. Setiawan, "OBE-Based Course Outcomes Prediction Using Machine Learning Algorithms," *2024 Int. Conf. Intell. Cybern. Technol. Appl. ICICyTA 2024*, pp. 197–202, 2024, doi: 10.1109/ICICYTA64807.2024.10913307.

[12] M. Neville-Norton and S. Cantwell, "Curriculum Mapping in Nursing Education: A Case Study for Collaborative Curriculum Design and Program Quality Assurance," *Teach. Learn. Nurs.*, vol. 14, no. 2, pp. 88–93, 2019, doi: 10.1016/j.teln.2018.12.001.

[13] M. A. Chowdhury, K. K. S. Chisty, H. Tushar, K. M. F. Ahmed, and S. S. A. Waliullah, "Automating assessment and evaluation for a bachelor's degree program," *Int. J. Eval. Res. Educ.*, vol. 12, no. 4, pp. 2037–2044, 2023, doi: 10.11591/ijere.v12i4.25479.

[14] M. Yağcı, "Educational data mining: prediction of students' academic performance using machine learning algorithms," *Smart Learn. Environ.*, vol. 9, no. 1, 2022, doi: 10.1186/s40561-022-00192-z.

[15] S. Fan, Y. Xu, B. Zhu, and L. Chen, "Student Behavior Analysis Research of based on Data Mining," in *Proceedings - 2022 2nd International Conference on Big Data, Artificial Intelligence and Risk Management, ICBAR 2022*, 2022, pp. 130–134, doi: 10.1109/ICBAR58199.2022.00032.

[16] H. Waheed *et al.*, "Predicting Academic Performance of Students from the Assessment Submission in Virtual Learning Environment," in *Springer Proceedings in Complexity*, 2023, pp. 417–424, doi: 10.1007/978-3-031-19560-0_33.

[17] R. Azuma, "Effectiveness of Comments on Self-reflection Sheet in Predicting Student Performance," in *International Conference on Operations Research and Enterprise Systems*, 2021, pp. 394–400, doi: 10.5220/0010197503940400.

[18] V. Heredia-Jimenez *et al.*, "An early warning dropout model in higher education degree programs: A case study in Ecuador," in *CEUR Workshop Proceedings*, 2020, vol. 2704, pp. 58–67, [Online]. Available: https://www.scopus.com/inward/record.uri?eid=2-s2.0-85095968225&partnerID=40&md5=1cbf6f7fa11f03822ed5fdbad20a9171.

[19] J. A. Martínez-Carrascal, D. Márquez Cebrián, T. Sancho-Vinuesa, and E. Valderrama, "Impact of early activity on flipped classroom performance prediction: A case study for a first-year Engineering course," *Comput. Appl. Eng. Educ.*, vol. 28, no. 3, pp. 590–605, 2020, doi: 10.1002/cae.22229.

[20] L. Cagliero, L. Canale, L. Farinetti, E. Baralis, and E. Venuto, "Predicting student academic performance by means of associative classification," *Appl. Sci.*, vol. 11, no. 4, pp. 1–22, 2021, doi: 10.3390/app11041420.

[21] N. Hunt-Isaak, P. Cherniavsky, M. Snyder, and H. Rangwala, "Using online textbook and in-class poll data to predict in-class performance," in *Proceedings of the 13th International Conference on Educational Data Mining, EDM 2020*, 2020, pp. 438–443, [Online]. Available: https://www.scopus.com/inward/record.uri?eid=2-s2.0-85174854848&partnerID=40&md5=d9f2789cca6d4e48995b5e43d0c82302.

[22] N. U. R. Junejo *et al.*, "SAPPNet: students' academic performance prediction during COVID-19 using neural network," *Sci. Rep.*, vol. 14, no. 1, p. 24605, 2024, doi: 10.1038/s41598-024-75242-2.

[23] A. H. Nabizadeh, D. Goncalves, S. Gama, and J. Jorge, "Early Prediction of Students' Final Grades in a Gamified Course," *IEEE Trans. Learn. Technol.*, vol. 15, no. 3, pp. 311–325, 2022, doi: 10.1109/TLT.2022.3170494.

[24] A. F. Meghji, N. A. Mahoto, Y. Asiri, H. Alshahrani, A. Sulaiman, and A. Shaikh, "Early detection of student degree-level academic performance using educational data mining," *PeerJ Comput. Sci.*, vol. 9, 2023, doi: 10.7717/PEERJ-CS.1294.

[25] H. Dasi and S. Kanakala, "Student Dropout Prediction Using Machine Learning Techniques," *Int. J. Intell. Syst. Appl. Eng.*, vol. 10, no. 4, pp. 408–414, 2022, [Online]. Available: https://www.scopus.com/inward/record.uri?eid=2-s2.0-85161957845&partnerID=40&md5=578e1d6ea1d968a1fcf29517911c0252.

[26] A. Nabil, M. Seyam, and A. Abou-Elfetouh, "Prediction of Students' Academic Performance Based on Courses' Grades Using Deep Neural Networks," *IEEE Access*, vol. 9, pp. 140731–140746, 2021, doi: 10.1109/ACCESS.2021.3119596.

[27] T. Zhang, Z. Zhong, W. Mao, Z. Zhang, and Z. Li, "A New Machine-Learning-Driven Grade-Point Average Prediction Approach for College Students Incorporating Psychological Evaluations in the Post-COVID-19 Era," *Electron.*, vol. 13, no. 10, pp. 1–19, 2024, doi: 10.3390/electronics13101928.

[28] Y. Gao, Z. Pan, and X. Xu, "Research on Teaching Effect Evaluation Model of Single Chip Microcomputer Principle Based on Fruit Fly Optimization Algorithm," in *Proceedings - 2022 7th International Conference on Information and Network Technologies, ICINT 2022*, 2022, pp. 103–107, doi: 10.1109/ICINT55083.2022.00024.

[29] H. Kaur, T. Kaur, and R. Garg, "A Prediction Model for Student Academic Performance Using Machine Learning," *Inform.*, vol. 47, no. 1, pp. 97–108, 2023, doi: 10.31449/inf.v47i1.4297.

[30] M. F. Yacoub, H. A. Maghawry, N. A. Helal, T. F. Gharib, and S. Ventura, "An Enhanced Predictive Approach for Students' Performance," *Int. J. Adv. Comput. Sci. Appl.*, vol. 13, no. 4, pp. 879–883, 2022, doi: 10.14569/IJACSA.2022.01304101.

[31] N. Sharma, S. Appukutti, U. Garg, J. Mukherjee, and S. Mishra, "Analysis of Student's Academic Performance based on their Time Spent on Extra-Curricular Activities using Machine Learning Techniques," *Int. J. Mod. Educ. Comput. Sci.*, vol. 15,

no. 1, pp. 46–57, 2023, doi: 10.5815/ijmecs.2023.01.04.

[32] T. A. Kustitskaya, A. A. Kytmanov, and M. V Noskov, "Early Student-at-Risk Detection by Current Learning Performance and Learning Behavior Indicators," *Cybern. Inf. Technol.*, vol. 22, no. 1, pp. 117–133, 2022, doi: 10.2478/cait-2022-0008.

[33] J. Pecuchova and M. Drlik, "Predicting Students at Risk of Early Dropping Out from Course Using Ensemble Classification Methods," in *Procedia Computer Science*, 2023, vol. 225, pp. 3223–3232, doi: 10.1016/j.procs.2023.10.316.

[34] Y. Zou, Z. Zhu, Y. Liu, and Z. Li, "A Novel Learning Early-Warning Model Based on Knowledge Points and Question Types," in *2021 9th International Conference on Information and Education Technology, ICIET 2021*, 2021, pp. 68–72, doi: 10.1109/ICIET51873.2021.9419649.

[35] A. W. Clemmons, J. Timbrook, J. C. Herron, and A. J. Crowe, "Bioskills guide: Development and national validation of a tool for interpreting the vision and change core competencies," *CBE Life Sci. Educ.*, vol. 19, no. 4, pp. 1–19, 2020, doi: 10.1187/cbe.19-11-0259.

[36] E. Tjandra, S. S. Kusumawardani, and R. Ferdiana, "Competencies Measurement Framework Using Course Scoring Sheet (CSS) and Course Competencies Score (CCS)," *2021 13th Int. Conf. Inf. Technol. Electr. Eng. ICITEE 2021*, pp. 127–132, 2021, doi: 10.1109/ICITEE53064.2021.9611961.

[37] T. Hongsuwan, N. Serirat, N. Panlutan, T. Danpattanachaikul, and C. Jinjakam, "Outcome Based Education: An Evaluation from SOs to PLOs," 2022, doi: 10.1109/JCSSE54890.2022.9836307.

[38] D. Alboaneen, M. Almelihi, R. Alsubaie, R. Alghamdi, L. Alshehri, and R. Alharthi, "Development of a Web-Based Prediction System for Students' Academic Performance," *Data*, vol. 7, no. 2, 2022, doi: 10.3390/data7020021.

[39] F. Herliana, I. M. Astra, Y. Supriyati, and H. Mazlina, "The differences in physics learning outcomes based on gender after using blended problem-based learning model," in *Journal of Physics: Conference Series*, 2020, vol. 1460, no. 1, doi: 10.1088/1742-6596/1460/1/012125.

[40] S. A. A. Rahim, F. Sidi, L. S. Affendey, I. Ishak, and A. Y. Nurlankyzy, "Leveraging Data Lake Architecture for Predicting Academic Student Performance," *Int. J. Adv. Sci. Eng. Inf. Technol.*, vol. 14, no. 6, pp. 2121–2129, 2024, doi: 10.18517/ijaseit.14.6.12408.

[41] A. M. Olalekan, O. S. Egwuche, and S. O. Olatunji, "Performance Evaluation of Machine Learning Techniques for Prediction of Graduating Students in Tertiary Institution," 2020, doi: 10.1109/ICMCECS47690.2020.240888.

[42] V. Puyana-Romero, C. M. Larrea-Álvarez, A. M. Díaz-Márquez, R. Hernández-Molina, and G. Ciaburro, "Developing a Model to Predict Self-Reported Student Performance during Online Education Based on the Acoustic Environment," *Sustain.*, vol. 16, no. 11, 2024, doi: 10.3390/su16114411.

[43] J. Kabathova and M. Drlik, "Towards predicting student's dropout in university courses using different machine learning techniques," *Appl. Sci.*, vol. 11, no. 7, 2021, doi: 10.3390/app11073130.

[44] M. Riestra-González, M. D. P. Paule-Ruíz, and F. Ortin, "Massive LMS log data analysis for the early prediction of course-agnostic student performance," *Comput. Educ.*, vol. 163, 2021, doi: 10.1016/j.compedu.2020.104108.

[45] D. Kumar, C. Verma, P. K. Singh, M. S. Raboaca, R. A. Felseghi, and K. Z. Ghafoor, "Computational statistics and machine learning techniques for effective decision making on student's employment for real-time," *Mathematics*, vol. 9, no. 11, 2021, doi: 10.3390/math9111166.

[46] A. B. Altamimi, "Big Data in Education: Students at Risk as a Case Study," *Eng. Technol. Appl. Sci. Res.*, vol. 13, no. 5, pp. 11705–11714, 2023, doi: 10.48084/etasr.6190.

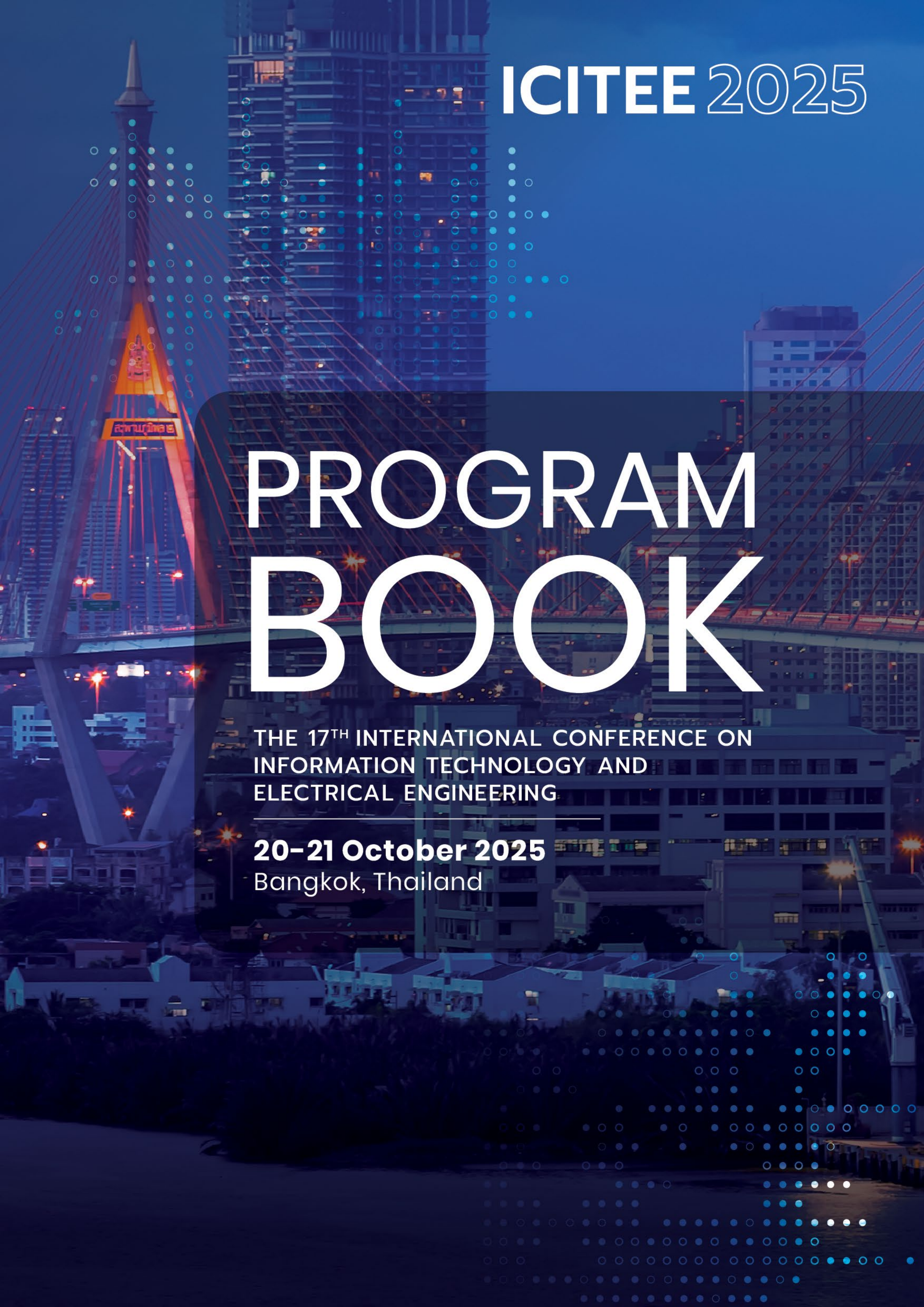
[47] C. H. Chen, S. J. H. Yang, J. X. Weng, H. Ogata, and C. Y. Su, "Predicting at-risk university students based on their e-book reading behaviours by using machine learning classifiers," *Australas. J. Educ. Technol.*, vol. 37, no. 4, pp. 130–144, 2021, doi: 10.14742/ajet.6116.

[48] N. Z. Salih and W. Khalaf, "Improving Students Performance Prediction Using Machine Learning and Synthetic Minority Oversampling Technique," *J. Eng. Sustain. Dev.*, vol. 25, no. 6, pp. 56–64, 2021, doi: 10.31272/jeasd.25.6.6.

[49] T. M. N. Sagala, S. D. Permai, A. A. S. Gunawan, R. O. Barus, and C. Meriko, "Predicting Computer Science Student's Performance using Logistic Regression," in *2022 5th International Seminar on Research of Information Technology and Intelligent Systems, ISRITI 2022*, 2022, pp. 817–821, doi: 10.1109/ISRITI56927.2022.10052968.

[50] H. Mi, Z. Gao, Q. Zhang, and Y. Zheng, "Research on Constructing Online Learning Performance Prediction Model Combining Feature Selection and Neural Network," *Int. J. Emerg. Technol. Learn.*, vol. 17, no. 7, pp. 94–111, 2022, doi: 10.3991/ijet.v17i07.25587.

[51] M. R. Borna, H. Saadat, A. T. Hojjati, and E. Akbari, "Analyzing click data with AI: implications for student performance prediction and learning assessment," *Front. Educ.*, vol. 9, no. December, 2024, doi: 10.3389/feduc.2024.1421479.



ICITEE 2025

PROGRAM BOOK

THE 17TH INTERNATIONAL CONFERENCE ON INFORMATION TECHNOLOGY AND ELECTRICAL ENGINEERING

20-21 October 2025

Bangkok, Thailand

Organizer

IEEE Thailand Section

IEEE Computational Intelligence Society (CIS) Thailand Chapter

Co-Organizer

King Mongkut's Institute of Technology Ladkrabang (KMITL), Thailand.

School of Information Technology, King Mongkut's Institute of Technology Ladkra-bang (KMITL),Thailand.

Department of Electrical Engineering and Information Technology, Universitas Gadjah Mada (UGM), Indonesia.

Musashino University, Japan.

Table of Content

Welcome Message

Message from the Chair of IEEE CIS Thailand Chapter

Kuntpong Woraratpanya

Chair, IEEE CIS Thailand Chapter

On behalf of the IEEE Computational Intelligence Society (CIS) Thailand Chapter, I am delighted to welcome you to the 17th International Conference on Information Technology and Electrical Engineering (ICITEE 2025), to be held on 20–21 October 2025 in Bangkok, Thailand.

As the flagship sponsor of ICITEE 2025, IEEE CIS Thailand Chapter is committed to supporting the advancement of computational intelligence, information technology, and electrical engineering research in both academic and industrial communities. We are proud to collaborate with King Mongkut's Institute of Technology Ladkrabang (KMITL) and Universitas Gadjah Mada (UGM) in bringing together a global network of scholars and practitioners.

ICITEE 2025 continues its tradition of academic excellence, and this year's adoption of a Rolling Review and Open Review Policy ensures a fair, transparent, and constructive review process. We believe this will further enhance the quality of accepted papers and foster stronger engagement between authors and reviewers.

I sincerely thank all authors, reviewers, speakers, and organizing partners for their contributions to making ICITEE 2025 possible. I warmly welcome all participants and hope this conference will inspire meaningful collaborations, fruitful discussions, and innovative ideas that will shape the future of technology and engineering.

Sincerely,

Kuntpong Woraratpanya

Welcome Message

Message from the Conference Chair

Kuntpong Woraratpanya

Conference Chair, ICITEE 2025

Guntur Dharma Putra

Conference Co-Chair, ICITEE 2025

It is my great pleasure to welcome you to the 17th International Conference on Information Technology and Electrical Engineering (ICITEE 2025), to be held on 20–21 October 2025 in Bangkok, Thailand.

Since its inception, ICITEE has served as an international platform for researchers, academics, and industry professionals to exchange ideas, share innovations, and discuss emerging challenges in the fields of information technology, electrical engineering, artificial intelligence, and related disciplines.

This year, ICITEE 2025 introduces a Rolling Review Process with an Open Review Policy, ensuring that the review cycle is timely, transparent, and constructive. This approach not only enhances the quality of accepted papers but also provides authors with the opportunity to improve their work through valuable feedback and rebuttals. Our commitment is to maintain the highest academic standards while fostering collaboration and knowledge sharing.

We are also delighted to host an excellent lineup of keynote speakers, invited talks, technical sessions, and networking opportunities, creating a rich environment for academic exchange and professional growth.
I would like to extend my heartfelt thanks to all authors, reviewers, Technical Program Committee members, keynote and invited speakers, and organizing partners for their dedication and contributions. Without your support, this conference would not be possible.

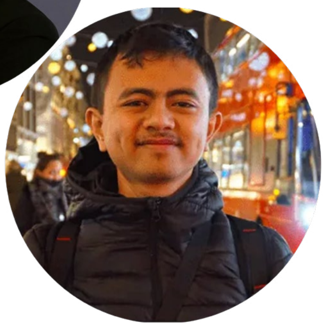
On behalf of the organizing committee, I warmly welcome you to ICITEE 2025 and hope this conference will inspire meaningful discussions, foster new collaborations, and leave you with memorable experiences in the vibrant city of Bangkok.

Sincerely,
Kuntpong Woraratpanyam
Guntur Dharma Putra

Welcome Message

Message from the Technical Program Chairs

Praphan Pavarangkoon
Technical Program Chairs, ICITEE 2025



Ahmad Ataka Awwalur Rizqi
Technical Program Co-Chairs, ICITEE 2025

It is our privilege to present the ICITEE 2025 technical program. These proceedings reflect the work of a dedicated community advancing information technology and electrical engineering in both theory and practice.

For ICITEE 2025, we received 164 submissions across 8 tracks. We used a rolling review process to ensure timely and constructive feedback. Each submission was evaluated by three independent reviewers with oversight from area chairs. The acceptance rate is 62.2 percent, yielding 102 accepted papers. All accepted contributions use a single paper format, which maintains a clear and consistent standard of quality.

Our editorial priorities were rigor, clarity, and reproducibility. We encouraged sufficient methodological detail and, where appropriate, artifacts that enable verification and follow-on work. The program reflects the conference breadth across Information Technology, Signal Processing and Machine Intelligence, Communication and Network Technologies, Electronics, Power Systems, and Control Systems, with special sessions on Agentic AI in Business Applications and Digital Transformation, and the Joint Symposium on Computational Intelligence.

This program is the product of broad collaboration. We thank all authors for entrusting ICITEE with their latest findings and for engaging constructively during review. We are grateful to our reviewers and the Technical Program Committee for their expertise and timeliness, and to our track and session chairs for shaping the sessions with care. We also appreciate the organizing team and student volunteers for steady coordination from submission to publication.

We invite you to explore papers beyond your primary area of interest, start new conversations, and form collaborations that continue after the conference concludes. We hope these proceedings will serve as a useful reference for your research, teaching, and practice.

In Memoriam

This program is dedicated to the memory of our friend and colleague, **Taib Ibrahim, Technical Program Co-chair**, whose contributions were invaluable.

Sincerely,
Praphan Pavarangkoon
Ahmad Ataka Awwalur Rizqi

Committees

Advisory Boards
Frederic Merienne (UTP, Malaysia)
Hanung Adi Nugroho (UGM, Indonesia)
Jonathan Hoyin Chan
(KMUTT, IEEE CIS Thailand Chapter, Thailand)
Lila Iznita Izhar (UTP, Malaysia)
Loo Chu Kiong (UM, Malasia)
Lukito Edi (UGM, Indonesia)
Masanori Sugimoto (HU, Japan)
M Naufal M Saad (UTP, Malaysia)
Ruttikorn Varakulsiripunth
(PlanetComm, Thailand)
Sarjiya (UGM, Indonesia)
Supavadee Aramvith (IEEE Thailand Section)
Virach Sornlertlamvanich (MU, Japan)
Worapoj Kreesuradej (KMITL, Thailand)
Yasushi Kiyoki (MU, Japan)

Steering Committee
Asako Uraki (MU, Japan)
Chayanon Sub-r-pa (CYUT, Taiwan)
Chitsutha Soomlek (KKU, Thailand)
David Klotz (HdM, Germany)
I Wayan Mustika (UGM, Indonesia)
Jan Kirenz (HdM, Germany)
Phayung Meesad (KMUTNB, IEEE CIS Thailand Chapter)
Pornchai Mongkolnam (KMUTT, IEEE CIS Thailand
Chapter)
Shigeru KUCHII (NIT, Kitakyushu College, Japan)
Shiori Sasaki (MU, Japan)
Sigit B. Wibowo (UGM, Indonesia)
Syukron Abu Ishaq Alfarozi (UGM, Indonesia)
Thatsanee Charoenporn (MU, Japan)
Teerapong Leelanupab (UQ, Australia)
Ungsumalee Suttapakti (BUU, Thailand)
Wanthanee Rathasamuth (UDRU, Thailand)
Yasuhiro Hayashi (MU, Japan)
Yoshimitsu Kuroki (NIT, Kurume College, Japan)
Local Organizing Committee

Conference Chair
Kuntpong Woraratpanya
(IT-KMITL, IEEE CIS Thailand Chapter)

Conference Co-chair
Guntur Dharma Putra (UGM, Indonesia)
Ramani Kannan (UTP, Malaysia)

Technical Program Chair
Praphan Pavarangkoon (IT-KMITL, Thailand)

Technical Program Co-chair
Ahmad Ataka Awwalur Rizqi (UGM, Indonesia)
Taib Ibrahim (UTP, Malaysia)

Senior TPC
Ataka Ahmad (UGM,Indonesia)
Annop Monsakul (PIM, Thailand)
Chanboon Sathitwiriyawong
(IT-KMITL, CIS Thailand Chapter)
Chotipat Pornavalai (IT-KMITL, Thailand)
Chuwong Phongcharoenpanich (KMITL, Thailand)
Hasanah Rini (UB, Indonesia)
Iswandi Iswandi (UGM, Indonesia)
Kanokwan Atchariyachanvanich (IT-KMITL, Thailand)
Kitsuwan Nattapong (UEC, Japan)
Kobayashi Kazuki (Shindai, Japan)
Maleerat Sodanil (KMUTNB, IEEE CIS Thailand Chapter)
Nat Dilokthanakul (IT-KMITL, Thailand)
Nasikun Ahmad (UGM, Indonesia)
Nont Kanungsukkasem (IT-KMITL, Thailand)
Olarn Wongwirat (IT-KMITL, Thailand)
Olarik Surinta (MSU, Thailand)
Pratama Azkario Rizky (UGM, Indonesia
Pornsuree Jamsri (IT-KMITL, Thailand)
Pramuk Boonsieng (TNI, Thailand)
Putra Guntur (UGM, Indonesia)
Sarayut Nonsiri (TNI, IEEE CIS Thailand Chapter)
Setyawan Iwan (UKSW, Indonesia)
Sirion Vittayakorn (IT-KMITL, Thailand)
Soradech Krootjohn (KMUTNB, IEEE CIS Thailand
Chapter)
Sudchai Boonto (KMUTT, Thailand)
Sudiro (UGM, Indonesia)
Sumet Prabhavat (IT-KMITL, Thailand)
Suvit Poomrittigul (IT-KMITL, Thailand)
Taravichet Titijaroenroj (IT-KMITL, Thailand)
Timotius Ivanna (UKSW, Indonesia)
Thitiporn Lertrusdachakul (TNI, Thailand)
Tuchsanai Ploysuwan (IT-KMITL, Thailand)
Wijaya Yudha Atmaja (UGM, Indonesia)
Ridwan Wicaksono (UGM, Indonesia)
Sutthiphong Srigrarom (NUS, Singapore)
Unger Herwig (FeU Germany)

Publication Chair
Samart Moodleah (IT-KMITL, Thailand)

Local Arrangement Chair
Nont Kanungsukkasem (IT-KMITL, Thailand)

Registration Chair
Issarapong Khuankrue (IT-KMITL, Thailand)

Financial Chair
Warune Buavirat (IT-KMITL, Thailand)

Conference Secretariat
Kitsuchart Pasupa (IT-KMITL, IEEE CIS Thailand Chapter)

Schedule and Program

Day 1 - Monday 20th October 2025 (UTC+07:00)
- start Registartion 08:30

SESSION 1

08:45 - 09:10 **Opening Ceremony** - Jubilee

09:10 - 09:55 **Plenary Session I** - Jubilee
Keynote Speaker: Prof. Dr. Jaime Lloret
Title: Intelligent collaborative sensor networks for Precision Agriculture

10:00 - 10:45 **Plenary Session II** - Jubilee
Keynote Speaker: Assoc. Prof. Dr. Adhistya Erna Permanasari
Title: Beyond the Screen: Unlocking Immersive Tech for Effective Learning Media

10:50 - 11:10 **Coffee break**
Coffee Break Area

11:10 - 11:55 **Plenary Session III** - Jubilee
Keynote Speaker: Prof. Dr. Masanori Sugimoto
Title: Emerging Trends and Future Perspectives on Indoor Positioning Technologies

12:00 - 13:00 **Lunch Break**
The Berkeley Dining Room 10th floor

SESSION 2

13:00 - 14:40 **Oral Session I**
Room: Jubilee A, Topic: Signal Processing & Machine Learning 1
Room: Jubilee B, Topic: Information Technology 1
Room: Chelsea Room A, Topic: Power Systems 1

14:40 - 15:00 **Coffee break**
Coffee Break Area

SESSION 3

15:00 - 17:00 **Oral Session II**
Room: Jubilee A, Topic: Signal Processing & Machine Learning 2
Room: Jubilee B, Topic: Information Technology 2
Room: Chelsea Room A, Topic: Power Systems 2

17:00 - 18:00 **Free Time**

18.00 - 22.00 **Banquet/Best Paper Award**
Mayfair Ballroom A

Schedule and Program

Day 2 - Tuesday 21st October 2025 (UTC+07:00)
- start Registartion 08:30

SESSION 1

09:00 - 10:40 **Oral Session III**
Room: Chelsea Room A, Topic: Signal Processing & Machine Learning 3
Room: Somerset Room A, Topic: Information Technology 3
Room: Somerset Room B, Topic: Communication & Network Technologies 1
Room: Kensington Room B, Topic: Information Technology 5

10:40 - 11:00 **Coffee break**
Coffee Break Area

SESSION 2

11:00 - 12:20 **Oral Session IV**
Room: Chelsea Room A, Topic: Signal Processing & Machine Learning 4
Room: Somerset Room A, Topic: Information Technology 4
Room: Somerset Room B, Topic: Signal Processing & Machine Learning 7
Room: Kensington Room B, Topic: Information Technology 6

12:20 - 13:20 **Lunch Break**
The Berkeley Dining Room 10th floor

SESSION 3

13:20 - 14:00 **Plenary Session IV** - Somerset Room A
Invited Speaker: Prof. Dr. Emi Yuda
Title: Biomedical signal processing and bio-medical big data analysis

13:20 - 15:00 **Oral Session IV**
Room: Chelsea Room A, Topic: Signal Processing & Machine Learning 5
Room: Somerset Room A, Topic: The 16th Joint Symposium on Computational Intelligence 1 , start 14:00
Room: Somerset Room B, Topic: Control Systems 1
Room: Kensington Room B, Topic: Communication & Network Technologies 2

15:00 - 15:20 **Coffee break**
Coffee Break Area

SESSION 4

15:20 - 17:00 **Oral Session IV**
Room: Chelsea Room A, Topic: Signal Processing & Machine Learning 6
Room: Somerset Room A, Topic: Control Systems 2
Room: Somerset Room B, Topic: The 16th Joint Symposium on Computational Intelligence 2 & Special Session
Room: Kensington Room B, Topic: Electronics, Circuits, and Systems

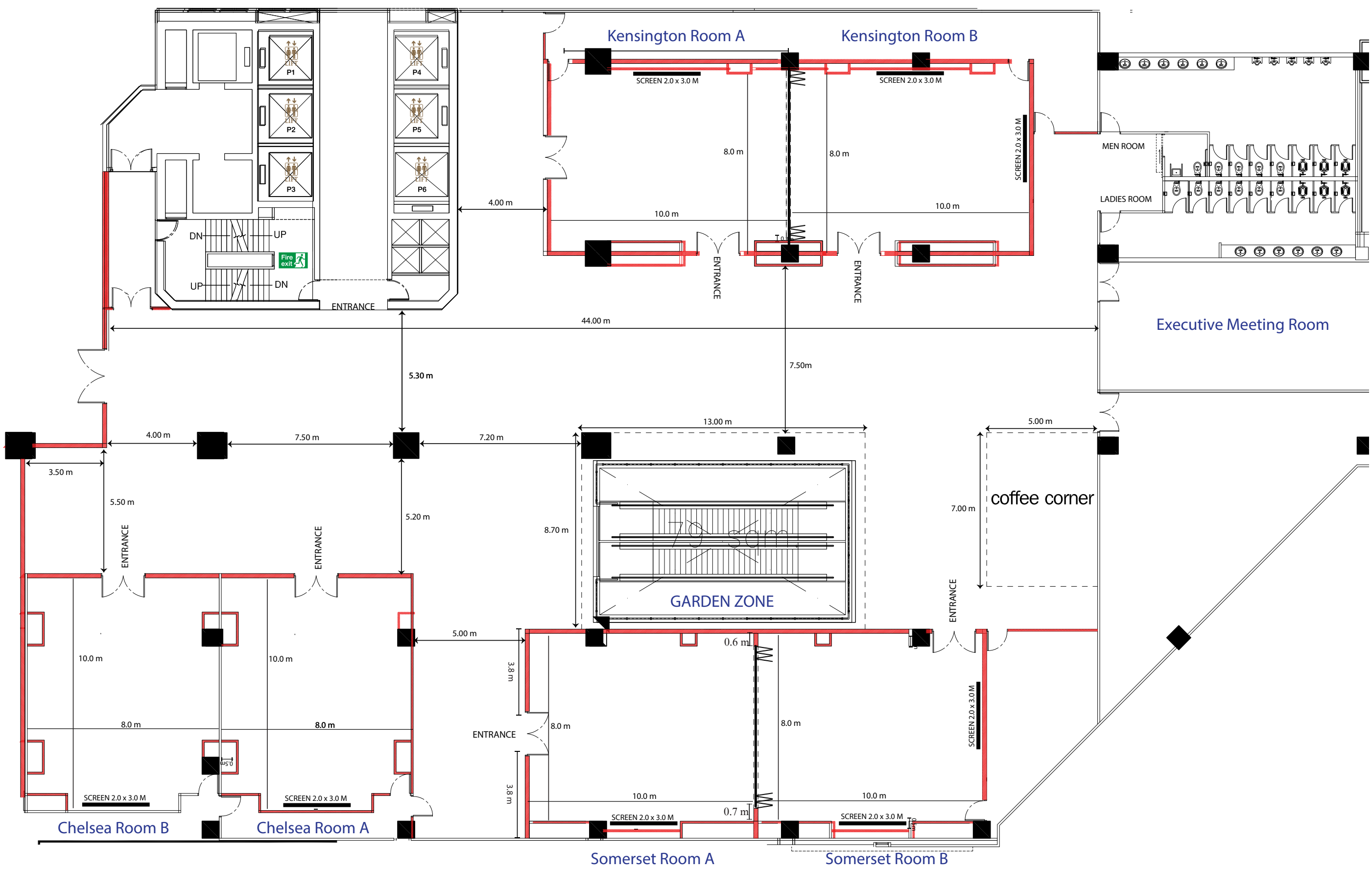
17:00 - 19:30 **The transfer for the Cruise Dinner**
To invite all delegates to gather at the meeting point (at Hotel Lobby) for the transfer from the hotel to the pier.

19.45 – 21.45 **Dinner Cruise**

Floor Plan

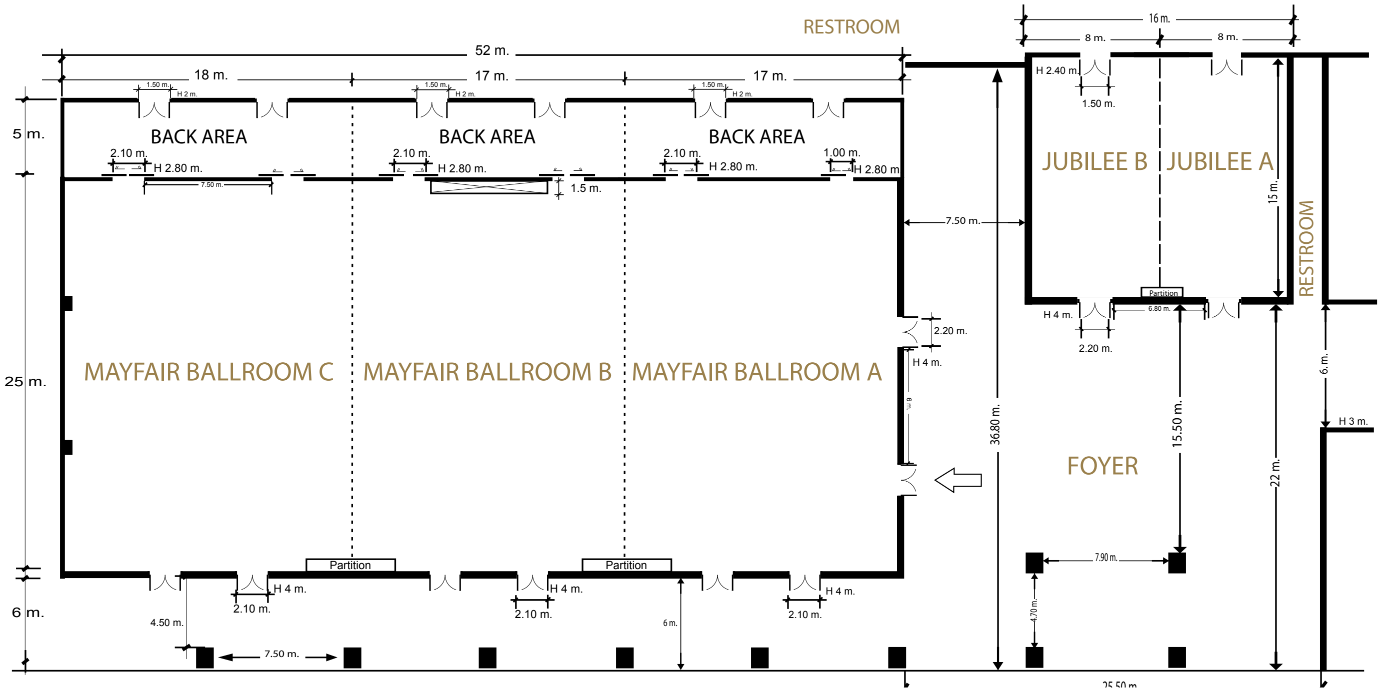
5th Floor

Room
Chelsea A, Chelsea B, Kensington A, Kensington B,
Somerset A, Somerset B



11th Floor

Room
Jubilee A, Jubilee B



Plenary Session

Prof. Jaime Lloret

Polytechnic University of Valencia

Topic

Intelligent Collaborative Sensor Networks for Precision Agriculture advanced sensor networks and sustainability.

Biography

Prof. Lloret has extensive professional certifications, including Cisco Certified Network Professional Instructor and Hewlett-Packard IT Architect Certification. With an extensive career, he has led numerous national and European projects, authored 15 books, over 800 research papers, and 4 patents.

He has chaired some working groups of IEEE Standard and played leadership roles in international committees. His editorial contributions include being Editor-in-Chief of renowned journals such as Ad Hoc and Sensor Wireless Networks and advisory roles for prestigious publications. Prof. Lloret is also an IEEE Senior Member, ACM Senior Member, IARIA Fellow, and EAI Fellow.

Prof. Jaime Lloret is a distinguished academic and researcher in telecommunications, currently serving as full Professor at the Polytechnic University of Valencia. He is the Chair of the Integrated Management Coastal Research Institute (IGIC). He holds a Ph.D. in Telecommunication Engineering. Recognized for his significant research impact, he is ranked among the top 2% of scientists world wide and is the Spanish researcher with the highest h-index in telecommunications since 2016.

Assoc. Prof. Dr. Adhistya Erna Permanasari
Universitas Gadjah Mada (UGM)

Topic
Beyond the Screen: Unlocking Immersive Tech for Effective Learning Media.

Abstract

The recent trends of information technology and immersive media is reshaping the educational landscape, with Virtual Reality (VR) and Augmented Reality (AR) emerging as transformative tools in higher education.

These technologies offer interactive, engaging, and highly visual learning experiences that significantly enhance the delivery and comprehension of complex subject matter. Moreover, they provide safe, cost-effective, and widely accessible alternatives to traditional learning environments, such as physical laboratories. Our research has explored the use of immersive technologies across diverse fields, including medical, biomedical, and accounting study programs, to support deeper understanding and active learning. In anatomy education, for example, Hanamy (Heart Anatomy) and Gama Cardiac AR, which use augmented reality and 3D visuals to focus on the heart's anatomy. Anaries (Anatomy Stories) application, leverages VR and AR to simulate cranial anatomy and includes a mini quiz designed to boost learning interactivity. Whilst, Kadavee models the human skeleton, including the head, torso, arms, and legs, in 3D visualization and virtual reality. This application enhances spatial awareness beyond what traditional cadaver-based methods typically offer. Augmented reality further enriches learning by overlaying digital content on physical models, creating interactive, and hands-on experiences

Biography

Adhistya Erna Permanasari is an Associate Professor in the Department of Electrical and Information Engineering at Universitas Gadjah Mada (UGM) in Yogyakarta, Indonesia. She earned her B.S. in Electrical Engineering at UGM in 2002 and her M.Tech in Electrical Engineering from the same university in 2006, before completing her Ph.D. in Computer and Information Science at Universiti Teknologi PETRONAS, Malaysia, in 2010. Her research interests encompass decision support systems, forecasting, health informatics, educational informatics, artificial intelligence, and immersive technologies. She has published extensively over 160 works on topics ranging from forecasting disease incidence and network management to AR based learning tools and healthcare information systems. She has led and co-led several interdisciplinary projects, particularly on immersive technology initiatives. At UGM, she is an active member of the Intelligent Systems Research Group. She supervises graduate students working on projects in health informatics, immersive learning environments, decision-support systems, and more.

Prof. Dr. Masanori Sugimoto
Hokkaido University

Topic
Emerging Trends and Future Perspectives on Indoor Positioning Technologies.

Abstract

Technologies for accurately recognizing the positions of people and objects are essential for realizing applications such as the Internet of Things (IoT), cyber-physical systems (CPS), augmented reality (AR), and digital twins. While Global Navigation Satellite System (GNSS) is the standard positioning technology in outdoor environments, there is still no such universally accepted technology for indoor settings, and various approaches have been proposed so far. Some market research reports predict that the market related to indoor positioning technologies is expected to grow at a compound annual growth rate (CAGR) exceeding 40%, reaching USD 150 billion by 2030. In light of the social background, this talk will first introduce recent research trends in indoor positioning technologies. Then, some of the research achievements from the speaker group indoor positioning research project will be presented. The talk will describe indoor positioning systems realized using smartphone built-in sensors and provide examples of their applications. Finally, future prospects for research in indoor positioning will be discussed.

Biography

Masanori Sugimoto received the B.E., M.E., and D.E. degrees in aeronautics and astronautics from the University of Tokyo, Tokyo, Japan, in 1990, 1992 and 1995, respectively. He is currently a Professor with the Graduate School of Information Science and Technology, Hokkaido University, Sapporo, Japan. His research interests include acoustic engineering, signal processing, artificial intelligence, and human-computer interaction technologies for designing smart systems and environments

Prof. Dr. Emi Yuda
Mie University

Topic
Biomedical signal processing and bio-medical big data analysis.

Abstract

Heart rate variability (HRV) has long been used as a non-invasive indicator of autonomic nervous system activity, and it has become widely adopted in fields ranging from human interface design to human-robot interaction. However, misinterpretations and methodological pitfalls in HRV analysis remain widespread, often leading to erroneous conclusions about autonomic function. Our landmark paper, "Pitfalls of assessment of autonomic function by heart rate variability" (2019), has been cited more than 370 times in just five years, reflecting the growing concern and interest in improving the scientific rigor of HRV-based assessments.

In this talk, I will discuss the physiological basis of HRV, clarify common misunderstandings in its interpretation, and demonstrate why certain HRV metrics fail to reflect autonomic balance under conditions involving speech, motion, or cognitive load. Using evidence from both experimental and clinical studies, I will outline appropriate methods for extracting meaningful physiological information from HRV and related bio-signals. Furthermore, I will introduce practical applications of refined HRV analysis in the context of real-world systems, such as driver monitoring, fatigue detection, and affective computing. Emphasis will be placed on aligning signal processing techniques with physiological principles to ensure robust and interpretable outcomes. This presentation aims to promote more accurate and effective use of bio-signal analysis in modern human-centered technologies

Biography

Prof. Dr. Emi Yuda is a professor specializing in biomedical signal processing and bio-medical big data analysis. Her obtained her PhD in Engineering from Niigata University, and served as an assistant professor and associate professor at Tohoku University, before becoming a professor at Mie University in 2024. Her research interests span a wide range of fields, from biomedical engineering to health sciences, including autonomic nerve interpretation using heart rate variability (HRV) analysis extracted from electrocardiograms (ECGs), as well as multimodal analysis centered on time series data from wearable sensors. She has contributed to the development of advanced algorithms for detecting human cardiac diseases, sleep apnea, fatigue, drowsiness, and posture changes. Recent research has utilized bio-signal analysis for ensuring the safety of elderly people and drivers. In biomedical big data analysis, she integrates the analysis using machine learning. She has published numerous papers in peer-reviewed journals and international conferences, and is actively engaged in collaborative research with industry and medical institutions.

Conference Sessions
Paper Session Schedule

Monday 20th October 2025 (UTC+07:00)		
IT-1 : Information Technology 1 **Jubilee B** start 13:00 - 14:40	Chaired by **Maleerat Maliyaem**	
1	**Development of a Predictive Water Consumption Model for Durian Cultivation Using VPD and ETc Parameters** Jakkrapan Sreekajon, Pattharaporn Thongnim, Phaitoon Srinil, Sueppong Mueanchamnong	21
2	**Predicting 2-Year Risk of End-Stage Kidney Disease in Thai Patients Using Cox Proportional Hazards and Random Survival Forest Models** Weerapat Srikongpan, Pitchaya Wiratchotisatian, Sirirat Anutrakulchai, Cholatip Pongskul Pongskul, Eakalak Lukkanalikitkul	27
3	**Intelligent Anomaly Detection Framework for Ship Navigation Using Multi-Source Heterogeneous Data** I-Lun Huang, Juan-Chen Huang, Wen-Jer Chang	33
4	**Abnormality Detection in Smart Home Energy Consumption by Statistical, Machine Learning, and Deep Learning Approaches** Yamini Kodali, Venkata Pavan Kumar Yellapragada	39
5	**Integrating Machine Learning in Outcome-Based Learning Systems: A Predictive Approach** Ellysa Tjandra, Noor Akhmad Setiawan	45
IT-2 : Information Technology 2 **Jubilee B** start 15:00 - 17:00	Chaired by **Sirion Vittayakorn**	
1	**Countering Deepfakes: Optimizing Convolutional Networks and Vision Transformer with ECA and SE Block** Satya Helfi Agustianto, Andi Prademon Yunus, Wahyu Andi Saputra	110
2	**Convolutional Variational Autoencoder-UNet with Adaptive Loss Weight for Facial Image Reconstruction Under Gaussian Noise** Thossapon Charenrpat, Siriporn Supratid	116
3	**Weighted Multi-Loss Convolutional Autoencoder-UNet for Flower Image Reconstruction Under Speckle Noise Conditions** Jeerawitch Threesukon, Siriporn Supratid	121
4	**Enhancement Techniques in CT Scan Image for Lung Disease Detection: A Systematic Review** Diah Rahayu Ningtias, Igi Ardiyanto, Indah Soesanti, Hanung Adi Nugroho	127
5	**Hevea Clone Identification Using Deep Learning** Thiraphat Romruensukharom, Sarayut Nonsiri	133
6	**Voltage Control Using Long-Short-Term Memory (LSTM) for Dual-Active-Bridge (DAB) Converter** ThiLathief Nurmahmudi Wijaya, Yohan Fajar Sidik, Fransisco Danang Wijaya, Krishna Laksheta	139

Conference Sessions
Paper Session Schedule

Monday 20th October 2025 (UTC+07:00)		
PS-1 : Power Systems 1 **Chelsea Room A** start 13:00 - 14:40	Chaired by **Kamol Wasapinyokul**	
1	**Ratio Optimization of Dynamic Fluid Continuity Implementation for Hydrokinetic Power Plants** Arkan Pradipta, Dzuhri Radityo Utomo, Husni Rois Ali	51
2	**Optimization Model for Energy Consumption Efficiency in Industrial Sector Based on Demand Response** Elizabeth Devina Maharani, Lesnanto Multa Putranto, Sarjiya Sarjiya, Heri Dwi Sulistyo	57
3	**Optimization Technologies for Wind Farm-a Review** Mohamad Isnaeni Romadhon, Roni Irnawan, Mokhammad Isnaeni Bambang Setyonegoro	63
4	**Optimization of Electric Vehicle Charging Based on Time-of-Use Tariffs with Distribution Transformer Capacity Limits** Tasya Khairuna Nadhila, Lesnanto Multa Putranto, Fransisco Danang Wijaya, Yanty Rumengan, Wijaya Yudha Atmaja	69
5	**Data-Driven Stability Evaluation for Grid-Following Inverter-Based Power Systems** Nur Milati, Sarjiya Sarjiya, Husni Rois Ali, Yohan Fajar Sidik, Joymala Moirangthem, Xia Yang, Niels De Boer	75
PS-2 : Power Systems 2 **Chelsea Room A** start 15:00 - 17:00	Chaired by **Venkata Pavan Kumar Yellapragada**	
1	**Recent Developments in MT-HVDC Protection and Trends Toward Hybrid Strategies: A Review** Novia Khoirul Annisa, Roni Irnawan, Mokhammad Isnaeni Bambang Setyonegoro	145
2	**Implications of the Early Decommissioning of Coal-Fired Power Plants on Generation Cost and System Reliability** Putra Anas Ashari, Avrin Nur Widiastuti, Lesnanto Multa Putranto, Sarjiya Sarjiya, Tumiran Tumiran	151
3	**Nonlinear Modeling and Forecasting of Solar Irradiance and Temperature Using Extended Kalman Filter** Asdaqul Khair, Lesnanto Multa Putranto, Dyonisius Dony Ariananda, Sudiro Sudiro	157
4	**Study on the Planning of Renewable Energy Power Plants in Praing Kareha Village, East Sumba Regency** Maycshall Dwi Putra Lay Kanny, Fransisco Danang Wijaya, Yohan Fajar Sidik	163
5	**Comparison of Balanced and Unbalanced Conditions in Microgrid Test Bed** Rakka Bhakti Lugina, Fransisco Danang Wijaya, Yohan Fajar Sidik	169
6	**Analysis of Power Plant Construction Delay on Sumbawa Electric Power Systems** Lesnanto Multa Putranto, Aqshanda Rafi Firdito, Yusuf Wijoyo, Tumiran Tumiran, Amira Hanun, Wa Ode Astuty H	175

Conference Sessions
Paper Session Schedule

Monday 20th October 2025 (UTC+07:00)

SPML-1 : Signal Processing & Machine Learning 1 **Jubilee A** start 13:00 - 14:40	Chaired by **Taravichet Titijaroonroj**	
1	**Hiding Clinical Information in Medical Image Based on Difference Expansion and Modulus Function** Aulia Arham, Syukron Abu Ishaq Alfarozi, Hanung Adi Nugroho	81
2	**A Comparative Analysis of UNet-Based and YOLO-Based Architectures for Lesion Segmentation in Breast Ultrasound Images** Muhammad Ridho Ramadhan, Ahmad Ataka Awwalur Rizqi, Hanung Adi Nugroho	87
3	**Context-Aware Thresholding for Ultrasound Breast Image Segmentation Using Intensity Statistics and Regression Learning** Pichet Wayalun, Kanuengnij Kubola, Ungsumalee Suttapakti, Nonthachai Yodsuban, Wich Chanchalermchai	93
4	**Diabetic Retinopathy Classification in Retinal Images Using Noise Injection** Ungsumalee Suttapakti, Aekapop Bunpeng, Pichet Wayalun, Wich Chanchalermchai, Donyarut Kakanopas	98
5	**TLFungID: Transfer Learning for Invasive Fungal - Aspergillus Spp. - Identification** Chollanant Khattiyawech, Pradya Prempraneerach, Worada Samosornsuk, Panarat Hematulin, Prawit Boonmee, Seksun Samosornsuk	104
SPML-2 : Signal Processing & Machine Learning 2 **Jubilee A** start 15:00 - 16:40	Chaired by **Sarayut Nonsiri**	
1	**A Two-Stage Stacked Convolutional Neural Network for Static Hand Gesture Recognition** Mallika Garg, Debashis Ghosh, Pyari Mohan Pradhan	181
2	**Accurate Anemia Disease Detection Using Eye Conjunctiva Features with Improved YOLOv9** Muntasir Momtaz, Md. Nawshin Navin, Raiyan Zayed Rakin, Kamruddin Nur, Shahnaj Parvin	187
3	**Pothole Size Estimation and Classification Using YOLOv12 and Geometric Feature Thresholding** Shahnaj Parvin, Sadik Saleh, Shraboni Biswas Naboni, Moumitu Tasnim, Aminun Nahar, Kamruddin Nur	193
4	**SE-ResNet: An Attention-Enhanced CNN for Classification of Indonesian Medicinal Plants** Muhammad Abdillah Rahmat, Elly Warni, A. Ichsan Mudatsir Lukman	199
5	**Oil Palm Condition Monitoring via UAV Imagery Using YOLOv11 Enhanced for Class Imbalance** Muhammad Alfhi Saputra, Haryono Soeparno, Yulyani Arifin, Widodo Budiharto	205

Conference Sessions
Paper Session Schedule

Tuesday 21st October 2025 (UTC+07:00)

CNT-1 : Communication & Network Technologies 1
Somerset Room B
start 09:00 - 10:40

Chaired by **Gerino Mappatao**

1	**IRS-Enabled Intelligent Transportation Using a Retransmission Mechanism and Reserved Bandwidth for B5G/6G URLLC** Shatubdi Roy Tithi; Md. Wahiduzzaman Chy; Binodon Mia; MD. Amirul Hasan Shanto; Amit Karmaker; Md. Abir Hossain	211
2	**ASMI: Adaptive Slot Management for Efficient RAW Operation in IEEE 802.11ah** Sayma Siddiqa, Ronita Akter, Amit Karmaker, Md. Abir Hossain	217
3	**OTSM: PAPR Reduction Using μ-Law Companding Transform** Hanumantharao Bitra, Kasturi Suhash	223
4	**Allocation Scheme for Elastic Optical Networks with Slicers Considering Best-Fit Approach** Duy-Phuong Trinh, Hieu The Tran, Nattapong Kitsuwan	229
5	**Packet Size and Penalty-Based Traffic Splitting Method for Minimizing Transmission Time** Ryouji Hamada, Nattapong Kitsuwan	234

CNT-2 : Communication & Network Technologies 2
Kensington Room B
start 13:20 - 15:00

Chaired by **Hanumantharao Bitra**

1	**A Study on Frame Synchronization Techniques for Low-Cost Visible Light Communication** Ubai Ubai, Dzuhri Radityo Utomo	419
2	**Development of Direction-Finding, Tracking, and Alarm System of an AIS Unit** Gerino P Mappatao, Ira Third Burgos, Michael Angelo Obciana, Michaello Hermogenes, Alfred Felix Daanoy	425
3	**Towards Efficient Node Localization in WSNs: Classification, Performance Metrics, and Emerging Approaches** Goldendeep Kaur, Kiran Jyoti	431
4	**A Signal Processing Algorithm for Heart Rate Estimation Using a Multi-Antenna Radar** Ichsan Dwinanda Handika, Iswandi Iswandi, Sigit Basuki Wibowo	437
5	**Matlab Aided Software for Coverage Optimization of Dual-Sites High Frequency Radars** Iswandi Iswandi, Risanuri Hidayat, Eny Sukani Rahayu	443

CS-1 : Control Systems 1
Somerset Room B
start 13:20 - 14:40

Chaired by **D. John Pradeep**

1	**Robust 3D LIDAR Point Cloud Registration Using Uncertainty-Aware Generalized Iterative Closest Point with Voxel-Based Efficiency** Igi Ardiyanto	448
2	**Vision-Based MPC Trajectory Planning and Gain-Scheduled PID Control for Pick-and-Place Operation of an Autonomous Excavator** Diamond Azzukhruf Muzayin, Ahmad Ataka, Dzuhri Radityo Utomo	454
3	**Analytical Simulation of Dynamic Center-of-Mass (CoM) Shifting in a Multi-Configuration Tricopter with Mid-Air Reconfiguration for Passive Perching** Azfar A Arfakhsyad, Ahmad Ataka, Adha Imam Cahyadi	460

Conference Sessions

Paper Session Schedule

Tuesday 21st October 2025 (UTC+07:00)		
4	**Moving Object Detection and Interception System** Tammarat Shubanchong, Thammanithi Vijithumpanee, Thirachot Chalarak, Napaworn Thongsan, Werapon Chiracharit, Pinet Sriyotha	466
CS-2 : Control Systems 2 **Somerset Room A** start 15:20 - 16:40	Chaired by **Igi Ardiyanto**	
1	**Hungarian Algorithm for Drone Swarm Formation and Energy Optimization** Daqi Huang, Ruochen Qi, Sutthiphong Srigrarom	519
2	**Optimization of PID Control Design Using Reinforcement-Enhanced QACGWO Algorithm** Khomkrit Satitkowitchai, Wudhichai Assawinchaichote	525
3	**An Imitation Learning Approach to Needle Picking Task Automation on SurRoL Platform** Sefvia Lie, Ahmad Ataka, Adha Imam Cahyadi	531
4	**Speed Control System Design of an Autonomous Electric Vehicle Using Type-2 Fuzzy Logic Based on Computer Vision** Regita Fortuna Sinulingga, Oyas Wahyunggoro, Dzuhri Radityo Utomo, Firly Rafliansyah, Bhakti Yudho Suprapto	537
ESC : Electronics, Circuits, and Systems **Kensington Room B** start 15:20 - 16:40	Chaired by **Prapto Nugroho**	
1	**Design of ECG Signal Generator** Enas Dhuhri Kusuma, Ridwan Wicaksono, Atthaullah Reyhan Pratama	542
2	**Voltage-Mode First-Order Multifunction Filter with Electronic Controllability Using VDDDA** Nitchakan Chaleekrua, Montree Siripruchyanun, Winai Jaikla, Amornchai Chaichana, Peerawut Suwanjan, Suchin Adhan	548
3	**Reconfigurable Biopotential Amplifier Circuit Design and Experiments** Mohammad Luthfi Dhiaz Prayudi, Prapto Nugroho, Sohiful Anuar Bin Zainol Murad	554
4	**Low-Resource Approximate Multiplier for Neural Network Acceleration on NIOS V-Based FPGA** Nur Cahyo Ihsan Prastyawan, Agus Bejo, Risanuri Hidayat	560
IT-3 : Information Technology 3 **Somerset Room A** start 09:00 - 10:40	Chaired by **Thananop Thongthavorn**	
1	**Web Application Security Vulnerability Score Conversion Evaluation: A Case Study** Dani Adhipta, Nindya Fathul Risya, Silmi Fauziati	238
2	**Explainable Proactive Cybersecurity: A Technically Validated Enhancement of the Cyber Crime Triangle Framework** Naughtakid Phromchan, Pongsarun Boonyopakorn	242
3	**A Decade of Code Smells Detection: Evolution, Challenges, and Optimization Strategies** Argo Wibowo, Adhistya Erna Permanasari, Teguh Bharata Adji	246

Conference Sessions
Paper Session Schedule

Tuesday 21st October 2025 (UTC+07:00)		
4	**Using RWL Design to Support BPA Software Development: A Study on Team Performance** Paulo Henrique de Sousa, Pedro Henrique dos Santos Iunes, Weverton Freitas Perdigão, Eduardo Pinto Padilha, Brenno dos Santos Fernandes, Thiago Vinicius Costa Guimarães, Thiago Medeiros de Menezes	252
5	**Critical Determinants of E-Wallet Pre-Adoption: Evidence from SMEs in Indonesia** Hendro Gunawan, Yong Wee Sek, Raja Rina Raja Ikram	258
IT-4 : Information Technology 4 **Somerset Room A** start 11:00 - 12:20	Chaired by **Guntur Dharma Putra**	
1	**Developing a RAG-Based Application for Industrial Process Question Answering for Android Development: A Case Study** Thiago Medeiros de Menezes, Paulo Henrique de Sousa, Brenno dos Santos Fernandes, Wanderson Oliveira da Silva	324
2	**Quantitative Assessment of Retrieval Strategies in RAG Architectures: A Comparative Study Across Multiple Knowledge Domains Using Standardized Performance Metrics** Tinnarat Aromsuk, Supakit Nootyaskool, Ponrudee Netisopakul	330
3	**The Impact of Appearance and Task Outcome on User Psychology in Interactions with LLM-Based Agents** Kazunari Yoshiwara, Akihiro Mino, Kazuki Kobayashi	336
4	**Benchmarking Cloud-Based Speech-to-Text APIs for Multilingual Meetings: A Comparative Study on English, Thai, and Malay** Ampuan Zuhairah Ampuan Haji Zainal, Vajirasak Vanijja, Arif Bramantoro	342
IT-5 : Information Technology 5 **Kensington Room B** start 09:00 - 10:40	Chaired by **Sally Goldin**	
1	**User-Centered Interface Design Process for Carify: Student Burnout Measurement App** Steven Christianto, Twin Yoshua R. Destyanto, Julius Galih Prima Negara	264
2	**Designing Adoption: An Intervention-Augmented UTAUT for AI Use Across Generations** Bu-nga Chaisuwan, Marissa Chantamas, Panpilas Kuldilok, Chachaya Sakuna, Thitirat Chanesirirattanakorn	270
3	**Augmented Reality-Based Serious Game for Speech Delay Therapy** Aditya Ramadhan, Ahmad Nasikun, Ridi Ferdiana	276
4	**Beyond the Swipe: How Short-Form Video Shape Engagement and Impact Memory Capability** Flourensia Sapty Rahayu, Kristina Wulandari, Steven Christianto, Ivan Haryanto, Aprillian Josua Marcelino	282
5	**Key Factors Affecting the Success of the Sihalal Information System** Rahmat Musfikar, Dana I. Sensuse, Eko Yon Handri, Deden Sumirat Hidayat	288

Conference Sessions
Paper Session Schedule

Tuesday 21st October 2025 (UTC+07:00)		
IT-6 : Information Technology 6 **Kensington Room B** start 11:00 - 12:20	Chaired by **Nattapong Kitsuwan**	
1	**Unknown-Class Road Damage Classification with Optimal Transport** Takeshi Uratsuka, Masahiro Iwahashi, Ryosuke Harakawa, Kousuke Matsushima	348
2	**Spatiotemporal Analysis of Traffic Patterns on Malioboro Street Using Mobile Positioning Data** Rizky Intan Nurlita, Arkham Zahri Rakhman, Azkario Rizky Pratama, Widy Widyawan	354
3	**Vehicle Travel Time Estimation in Transportation Network Using Random Forest and Neural Network** Shuya Nakano, Sooksan Panichpapiboon, Elis Kulla	360
4	**Automated Annotation of Eye Tracking Heatmaps Using Perception Encoder** Kristian Adi Nugraha, Igi Ardiyanto, Sunu Wibirama	366
JSCI-1 : The 16th Joint Symposium on Computational Intelligence 1 **Somerset Room A** start 13:20 - 15:00	Chaired by **Pornchai Mongkolnam**	
1	**Benchmarking Transformers and Baselines for Multi-Horizon Stock Return Prediction with Technical and Earnings Features** Nelson Siu, Jonathan H. Chan	501
2	**Integrating Recurrent Neural Networks and Deep Q-Networks for Precision Irrigation Control** Fransiskus Serfian Jogo, Oyas Wahyunggoro, I Wayan Mustika, Kuntpong Woraratpanya	507
3	**MS-PatchTST: Leveraging Multi-Scale Temporal Features for Water Level Forecasting** Dong Zhang, Kitsuchart Pasupa, Zongying Liu, Mingyang Pan	513
JSCI-2 : The 16th Joint Symposium on Computational Intelligence 2 **Somerset Room B** start 15:20 - 16:20	Chaired by **Pradeep Reddy Gogulamudi**	
1	**Fourier Latent Transformer for Anomaly Signal with High-Frequency Reconstruction** Thasorn Chalongvorachai, Kuntpong Woraratpanya	566
2	**Performance Evaluation of FastICA as a Blind Source Separation Approach for Current-Based Load Disaggregation** Noor Siti Halimah, I Wayan Mustika, Dyonisius Dony Ariananda, Fransisco Danang Wijaya, Kuntpong Woraratpanya	572
3	**Vision Transformer with Fractal Dimension Transformation: Effects of Resolution and Patch Size** Woramat Ngamkham, Kuntpong Woraratpanya, Yoshimitsu Kuroki	578
SPML-3 : Signal Processing & Machine Learning 3 **Chelsea Room A** start 09:00 - 10:40	Chaired by **Kousuke Matsushima**	
1	**Optimized Gradient Boosting for Chronic Kidney Disease Detection: a Comprehensive Comparative Framework for Clinical Decision Support** Ishtiak Al Mamoon, Sharmin Sultana Akhi, Md. Samiul Alom, Farzana Bente Alam, Afsah Sharmin, Kamruddin Nur	294

Conference Sessions
Paper Session Schedule

Tuesday 21st October 2025 (UTC+07:00)		
2	**Hybrid CNN and Machine Learning Classifiers for Chronic Neck Pain Recognition** Agritian Sevty Fiddariani, Oyas Wahyunggoro, Hanung Adi Nugroho	300
3	**CNN-LSTM Framework for Multimodal Sleep Apnea Identification from ECG and EMG Signals** Yossi Hasanah Putri, Ahmad Ataka Awwalur Rizqi, Hanung Adi Nugroho	306
4	**GradG-AttnSleep: Dual-Mode GradCAM for Interpretable Sleep Staging with an Attention-Based CNN** Syed Naveed Mahmood, Tasnim Ferdous, Aniqua Nusrat Zereen	312
5	**ATM-FraudPrev: An Iris Recognition Framework for Fraud Prevention in Automated Teller Machines** Shafwan Ahmed Dehan, Md. Saeedullah Azim, Adnan Sadat, Sadia Islam Zerin, Sumit Kanti Sarker, Shahnaj Parvin, Kamruddin Nur	318
SPML-4 : Signal Processing & Machine Learning 4 **Chelsea Room A** start 11:00 - 12:20	Chaired by **Twin Yoshua Destyanto**	
1	**Retrieval Augmented Generation Approach for Developing Indonesian Local Wisdom Disaster Early Warning System** Lukito Edi Nugroho, Mutiara Auliya Khadija, Michael Stephen Moses Pakpahan, Ery Permana Yudha, Muhammad Firas Zahid, Renista Isnaini Nurul Azizah	372
2	**Design and Implementation of an AI Agent for Educational Applications via Retrieval-Augmented Generation and Local Language Models on Messaging Platforms** Anawin Pechbooranin, Chulaluk Inchana, Vasin Charoensak, Theeraphiboon Termprommarat, Kontorn Chamniprasart, Jittima Varagul	378
3	**Color-Aware Structured Parsing and Self-Consistent Reasoning for Chart Question Answering** Supasate Vorathammathorn, Wassana Sintarasirikulchai, Theerat Sakdejayont, Sooksan Panichpapiboon	383
4	**Enhancing Indonesian Formality Style Transfer Using Synthetic Data Pretraining** Ahmad Zidan, Syukron Abu Ishaq Alfarozi, Teguh Bharata Adji	389
SPML-5 : Signal Processing & Machine Learning 5 **Chelsea Room A** start 13:20 - 15:00	Chaired by **Risanuri Hidayat**	
1	**Multiscale Entropy Constrained Decomposition for Time-Frequency Enhancement in Industrial Machinery Vibration Signals** K Krishnendu, Pyari Mohan Pradhan	472
2	**Improving Dynamic Task Performance with Distributional Reinforcement Learning: A Real-Time Fruit Slicing Control Case Study** V. Sudesh Chandra, K. Venkata Sudhanva, S. R. Kishore Kumar, D. John Pradeep, Venkata Pavan Kumar Yellapragada, Pradeep Reddy Gogulamudi	478
3	**Generalized Category Discovery with a Self-Organizing Classifier Through Prototype Merging** Rintaro Akashi, Kousuke Matsushima	484
4	**Association Rules Analysis for Enhanced Signal Evaluation: Uncovering Exclusive Patterns in Identifying Reinforced Concrete Parameters** Pawel Karol Frankowski	490
5	**Tracking Attention: Pupillary Cues for Recognizing Computer Interaction Modes** Twin Yoshua R. Destyanto, Steven Christianto, Chandra Dewi Kurnianingtyas	496

Conference Sessions
Paper Session Schedule

Tuesday 21st October 2025 (UTC+07:00)		
SPML-6 : Signal Processing & Machine Learning 6 **Chelsea Room A** start 15:20 - 16:40	Chaired by **Syukron Abu Ishaq Alfarozi**	
1	**Skew-Symmetric Error Distribution Analysis of Elasticity Dynamics of Firm Financial Statement Components: A Case Study in Indonesian Stock Markets Using the Cobb-Douglas Linearized Log Form** Galvin A.D Nadapdap, Alexander Benedick, Sasya Sabrina	583
2	**Thai Generalized Alignment Task (TGAT): A Corpus and Comparative Study for Hallucination Detection in Thai** Sivakorn Wangwon, Rapepong Pitijaroonpong, Piyawat Chuangkrud, Chaianun Damrongrat, Sarawoot Kongyoung, Nont Kanungsukkasem	589
3	**Robustness of Gaussian Naive Bayes to Non-Gaussian and Correlated Features** Ausaina Niyomdecha, Adoon Pansuwan, Patchanok Srisuradetchai	595
4	**Synthetic Speech Detection via Multi-Generator GANs with Anomaly Detection Architectures** Thanakrit Damduan, Pasatorn Soikiri, Vetit Kanjaras, Rujipas Varathikul, Kanes Sumetpipat	601
SPML-7 : Signal Processing & Machine Learning 7 **Somerset Room B** start 11:00 - 12:20	Chaired by **Kamruddin Nur**	
1	**Mitigating Ethnic Bias in Algorithmic Facial Beauty Prediction Through Dataset Composition** Lea Ernst, David Klotz	395
2	**Orthomosaic Aerial Imagery Instance Segmentation Using Cascade Mask-DS** Pramudya Kusuma Hardika, Wisnu Agung Hardiansyah, Syukron Abu Ishaq Alfarozi	401
3	**Multi-Dimensional Road Extraction from Medium Resolution Imagery Using U-Net and YOLO Concepts** Chutchatut Sutichavengkul, Sally Goldin	407
4	**Comparative Analysis of Facial Landmark-Based Geometric Features for Gender Classification** Risanuri Hidayat, Muhammad Ridho, Refni Arianti	413
SS : Special Session **Somerset Room B** start 16:20 - 17:00	Chaired by **Pradeep Reddy Gogulamudi**	
1	**The Influence of Trust, Usability, and Risk on the Intention to Adopt Cryptocurrency as a Digital Investment** Muhammad Afif Afif Kamali, Yulius Lie	607
2	**Reinforcement Learning for Optimizing Advertisement Selection in Digital Marketing: A Study of Multi-Armed Bandit Algorithms** Pujyam Sathvika, D. John Pradeep, Venkata Pavan Kumar Yellapragada	613

Integrating Machine Learning in Outcome-Based Learning Systems: A Predictive Approach

Publisher: IEEE Cite This PDF

Ellysa Tjandra ; Noor Akhmad Setiawan **All Authors**

Abstract:
Outcome-Based Education (OBE) emphasizes achieving measurable learning outcomes as an indicator of academic success. However, conventional evaluation approaches often fail to provide accurate and timely predictions of student performance consistent with these outcomes. This study proposes a new system that utilizes machine learning (ML) methods in an OBE-based education setup to rapidly identify students who may be struggling and provide them with data-driven support. Multiple supervised learning algorithms were trained and evaluated using a dataset that includes student performance indicators based on mid-term assessment scores, including Decision Tree, Random Forest, K-Nearest Neighbor, Support Vector Classification, Naïve Bayes, XGBoost, and AdaBoost. The dataset comprises $2,130$ records of students' scores in 14 courses from 7 study programs of a private university in Indonesia. This research finds that XGBoost classification yields the best results in predicting course outcomes for lowparticipant courses, with a maximum accuracy of 91.36%. In comparison, Naïve Bayes achieves the highest accuracy for high-participant classes (86.89%). This study also examined the relationship between the number of student outcomes, the number of mid-term assessment components, and model accuracy results, and found that the greater the number of student outcomes and mid-term assessments, the lower the model accuracy results.

Published in: 2025 17th International Conference on Information Technology and Electrical Engineering (ICITEE)

Date of Conference: 20-22 October 2025

Date Added to IEEE *Xplore*: 20 January 2026

ISBN Information:

ISSN Information:

DOI: 10.1109/ICITEE66631.2025.11338212

Publisher: IEEE

Conference Location: Bangkok, Thailand

Authors

Figures

References

Keywords

ICITEE 2025

ICITEE 2025

#174 (1571199821): Integrating Machine Learning in Outcome-Based Learning Systems: A Predictive Approach

#174 (1571199821): *Integrating Machine Learning in Outcome-Based Learning Systems: A Predictive Approach*

Hide details

BibTeX

Authors

Drag to change order	Author name	Author affiliation (edit for paper)	Author email	Email	Delete
	Ellysa Tjandra	University of Surabaya, Indonesia	ellysa@staff.ubaya.ac.id		
	Noor Akhmad Setiawan	Universitas Gadjah Mada, Indonesia	noorwewe@ugm.ac.id		

Paper title *Integrating Machine Learning in Outcome-Based Learning Systems: A Predictive Approach* Only the chairs can edit

Conference and track **2025 17th International Conference on Information Technology and Electrical Engineering (ICITEE)** - *Information Technology*

Abstract Only the chairs can edit Outcome-Based Education (OBE) emphasizes achieving measurable learning outcomes as an indicator of...

Keywords machine learning; prediction; OBE; learning system Only the chairs can edit

Topics Distance Learning and E-learning; Decision Support System; Knowledge Discovery (Only the chairs can edit)

Personal notes

Roles You are an author for this paper.
You have authored an accepted paper in this conference.

Status Accepted

Copyright IEEE; IEEE completed Sep 8, 2025

Visa letter Need to pay for registration first.

Presented by not specified in session IT-1: *Information Technology 1* chaired by Maleerat Maliyaem from Mon, October 20, 2025 13:00 +07 until 14:40 (5th paper) in Jubilee B (20 min.)

Review manuscript	
Camera Ready	
Presentation	
Stamped for attendee proceedings	
Stamped for IEEE Xplore	
Auxiliary files	

Review

Relevance to ICITEE 2025 Topics	Technical Content and Scientific Rigor	Originality and Novelty	Clarity and Quality of Writing	Experimental Validation	Methodological Soundness	Impact and Contribution to the Research Community	Figures, Tables, and References Quality	Overall Recommendation
Excellent. 5	Valid work with a reasonable contribution, though somewhat limited. 3	Some interesting ideas on a well-explored topic. 3	Readable, but revision is needed in some parts. 3	Good. 3	Good. 3	Good. 3	Good. 3	Accept. 4

Summary of the Paper (Brief Description)

The paper investigates the use of machine learning (ML) methods to predict student performance in an Outcome-Based Education (OBE) system. The authors use mid-term assessment data from 2,130 records across 14 courses at a private university in Indonesia. Seven ML algorithms were tested: Decision Tree, Random Forest, K-Nearest Neighbor, Support Vector Classification, Naïve Bayes, XGBoost, and AdaBoost.

Key findings:
- XGBoost achieved the best results for low-participant courses (up to 60 students) with a maximum accuracy of 91.36%.
- Naïve Bayes performed best for high-participant courses with an accuracy of 86.89%.
- Statistical analysis showed a negative correlation between the number of Student Outcomes (SOs) / mid-term components and prediction accuracy.
- The study concludes that ML models, particularly XGBoost and Naïve Bayes, can enhance early warning systems in OBE-based education, though predictions are only possible after all mid-term assessments are completed.

Strengths of the Paper

- Relevance and Practical Impact: The study addresses a real educational challenge by proposing an ML-based system for early detection of at-risk students in OBE frameworks.
- Expanded Model Set: The revised paper includes additional ML models (XGBoost, AdaBoost), which strengthens the experimental design.
- Improved Rigor: The authors added k-fold cross-validation, preventing overfitting issues that were present in the original version.
- Transparency: Hyperparameters and dataset details are now provided, improving reproducibility.
- Statistical Validation: The inclusion of significance testing adds credibility to the reported performance differences.
- Critical Reflection: Limitations, dataset bias, and generalizability issues are now explicitly discussed.
- Formatting and Presentation: The paper has been revised to comply with IEEE formatting, with improved tables, figures, and grammar.

Relevance to ICITEE 2025 Topics	Technical Content and Scientific Rigor	Originality and Novelty	Clarity and Quality of Writing	Experimental Validation	Methodological Soundness	Impact and Contribution to the Research Community	Figures, Tables, and References Quality	Overall Recommendation

Weaknesses and Areas for Improvement

Based on the rebuttal letter and the revised manuscript, the authors have adequately addressed most reviewer comments:
- Grammar and clarity issues → corrected using Grammarly.
- Overfitting and 100% accuracy problem → resolved via k-fold cross-validation; unrealistic results were eliminated.
- Model choice explanation → expanded, with XGBoost and AdaBoost added.
- Figures and tables → reformatted and annotated for readability.
- Dataset bias and limitations → now included in Results/Conclusion sections.
- Statistical significance tests → added to evaluate differences in model performance.
- Hyperparameters and methodology details → now provided for reproducibility.
- IEEE formatting compliance → revisions made accordingly.
- Figure quality → improved with higher-resolution images.

Good. 3	Valid work with a reasonable contribution, though somewhat limited. 3	Some interesting ideas on a well-explored topic. 3	Readable, but revision is needed in some parts. 3	Good. 3	Good. 3	Good. 3	Good. 3	Accept. 4

Summary of the Paper (Brief Description)

The manuscript has been substantially improved in response to the reviewers' comments. Major revisions include thorough language editing to correct grammar and formatting issues, full compliance with the IEEE template, and enhancements to tables and figures for improved readability. Additional technical details on the dataset, preprocessing, and model parameters have been provided for reproducibility. Furthermore, two ensemble methods (XGBoost and AdaBoost) have been added to strengthen the experimental design and broaden the comparison. The discussion section has been expanded to cover dataset bias, study limitations, and generalisability of findings.

Strengths of the Paper

The paper addresses an important and timely problem in educational data mining, which is predicting student academic performance, by systematically comparing both traditional machine learning methods and modern ensemble techniques. This aligns closely with the conference's themes of applying intelligent systems to real-world educational challenges.

Weaknesses and Areas for Improvement

The study does not fully explore feature importance or interpretability, which could provide valuable insights for educators on which factors most strongly influence student performance. Third, while statistical testing has been introduced, a more detailed explanation of the chosen tests and their results would enhance methodological transparency. Additionally, although language editing has been conducted, certain sections could still benefit from further refinement to improve readability and precision of expression.

Finally, the discussion of practical applications could be expanded with more concrete examples of how institutions or educators might implement the findings in real-world educational settings.

Good. 3	Valid work with a	Some interesting	Readable, but	Good. 3	Good. 3	Good. 3	Good. 3	Accept. 4

Relevance to ICITEE 2025 Topics	Technical Content and Scientific Rigor	Originality and Novelty	Clarity and Quality of Writing	Experimental Validation	Methodological Soundness	Impact and Contribution to the Research Community	Figures, Tables, and References Quality	Overall Recommendation
	reasonable contribution, though somewhat limited. 3	ideas on a well-explored topic. 3	revision is needed in some parts. 3					

Summary of the Paper (Brief Description)

This study applied machine learning algorithms (eXtreme Gradient Boosting (XGBoost), AdaBoost, Decision Tree, Random Forest, K-Nearest Neighbor, Support Vector Classification, and Naive Bayes) integrated into an Outcome-Based Education (OBE) to predict student performance in an Outcome-Based Education (OBE) system. The goal is to develop an early warning system that identifies students at risk of not meeting course outcomes. As a result, XGBoost classification algorithm yields the best results in predicting course outcomes for low participant courses.

Strengths of the Paper

The idea of this paper is interesting. This work can address the challenge of student failure and dropout rates by creating an early warning system.

Weaknesses and Areas for Improvement

The authors have addressed all my comments in the revised manuscript as follows:

- Two new algorithms have been included in the experiment for a more comprehensive analysis.
- K-fold cross-validation has been added to the experiment to prevent overfitting.
- The details of the hyperparameter settings have been provided for reproducibility.
- The study's limitations have also been added to the conclusion.
- The manuscript has been modified to follow the IEEE standard format.

Therefore, this paper can be accepted for the ICITEE 2025 International Conference.

Search mail

99+

Compose

Mail

Inbox 1,366
Starred
Snoozed
Important
Sent
Drafts 319
Categories
Social 26
Updates 246
Forums 172
Promotions 26
More

2

Chat

Meet

Labels

Email Mhs 221

[ICITEE 2025] #1571199821 has been uploaded

External Inbox ×

ICITEE 2025 <icitee2025-chair@edas.info>
to me, Noor

Dear Mr. Kuntpong Woraratpanya:

Thank you for uploading your final for paper 1571199821 (*Integrating Machine Learning in Outcome-Based Learning System* **Information Technology and Electrical Engineering (ICITEE)**. The paper is of type application/pdf and has a length of 463

You can modify your paper at 1571199821 and see all your submissions at https://edas.info/index.php?c=33533 using the ED

Regards,
Chair of ICITEE 2025

Reply Reply all Forward

icitee

99+

Compose

Mail

2

Inbox 1,366
Starred
Snoozed
Important
Sent
Drafts 319
Categories
Social 26
Updates 246
Forums 172
Promotions 26
More

Chat

Meet

Labels

Email Mhs 221

ICITEE 2025 Paper Decision – Revise & Resubmit Invitation (Paper ID: 1571

icitee2025-chair@edas.info
to me, Noor

Dear Mrs. Ellysa Tjandra:

Thank you for submitting your paper to ICITEE 2025. After careful review, we regret to inform you that the current version of y

However, this is **NOT** a final rejection. Following evaluation through our Rolling Review Process, the reviewers and track cha revision before it can be considered for publication and presentation. Therefore, we would like to invite you to submit a revise

Due to system limitations in EDAS, this invitation appears as a 'Reject' decision. Please note, however, that in accordance wi (R&R) opportunity. You are welcome to submit a revised manuscript that addresses the reviewers' concerns in full.

Next Steps for Resubmission

- Revision Deadline: Please submit your revised paper within 4 weeks of the date of this notification.
- Resubmission Portal: https://icitee2025.it.kmitl.ac.th/paper-submission-guidelines

Materials Required:

- A revised manuscript with all major changes clearly highlighted (e.g., using tracked changes or color).
- A detailed rebuttal letter that responds to each reviewer comment, explaining how each point has been addressed.
- The rebuttal letter must be bound together with the revised manuscript in a single PDF file for upload. Note: Submis

Instructions for the Rebuttal Letter
Please structure your rebuttal as follows:

Reviewer 1 – Comment 1: "[Reviewer comment]" Author Response: [Explain your change or provide justification]

Reviewer 2 – Comment 1: "[Reviewer comment]" Author Response: [Explain your change or provide justification]