

Contents

Title	Content	Pg.No.
	Declaration by the Candidate	I
	Certificate of Supervisor	II
	Thesis Approval Form	III
	Declaration of Research Scholar - Submission of Thesis	IV
	Acknowledgement	V
	Contents	VII
	List of Figures	X
	List of Tables	XI
	Abstract	XII
Chapter: 1	Introduction	1
	1.1 Introduction	1
	1.2 Overview of Online Programming Education	2
	1.2.1 Importance of Online Programming Education	2
	1.2.2 Limitations of Online Programming Education	3
	1.2.3 Future Direction for Online Programming Education	4
	1.3 Overview of Machine Learning	5
	1.3.1 Supervised Learning Algorithms	5
	1.3.2 Unsupervised Learning Algorithms	8
	1.3.3 Semi-Supervised Learning Algorithms	10
	1.3.4 Reinforcement Learning Algorithms	12
	1.3.5 Neural Networks and Deep Learning	13
	1.3.6 Ensemble Learning	14
	1.4 Research Motivation	15
	1.5 Problem Statement	16
	1.6 Research Objective	17
	1.7 Research Contribution	18
	1.8 Scope of the Study	19
	1.9 Organization of Thesis	21
Chapter: 2	Literature Review	23
	2.1 Online Coding Platform for Learner	23

	2.2 Security Concerns in Remote Code Execution	25
	2.3 Collecting Learners' Programming Data	27
	2.4 Feature Engineering on Dataset	28
	2.5 Applying Different Machine Learning Algorithms	29
	2.6 Proposed Solutions and Recommendations	32
Chapter: 3	Dataset Preparation	39
	3.1 Programming Assignment Designing	39
	3.2 Programming Environment Setup	40
	3.3 Dataset Field Finalization and Data Collection	40
	3.4 Feature Engineering	42
	3.4.1 Mathematical model-based evaluation	44
Chapter: 4	Existing Methodology	49
	4.1 Data Preparation	49
	4.1.1 Data Preprocessing	50
	4.1.2 Data Splicing	51
	4.2 Existing Machine Learning Algorithm	52
	4.2.1 KNN Algorithm	53
	4.2.2 Decision Tree Algorithm	53
	4.2.3 Random Forest Algorithm	54
	4.2.4 XGBoost Algorithm	54
	4.3 Tools and Library Used	54
Chapter: 5	Development of proposed Machine Learning Algorithm	60
	5.1 The AECW Algorithm	60
	5.2 Comparison of AECW with Traditional ML Algorithms	63
	5.2.1 K-Nearest Neighbors (KNN) vs. AECW	63
	5.2.2 Decision Tree vs. AECW	64
	5.2.3 Random Forest vs. AECW	65
	5.2.4 XGBoost vs. AECW	65
	5.2.5 Applications and Practical Advantages	67
Chapter: 6	Results and Discussion	68
	6.1 Results	68
	6.1.1 Performance Analysis Parameters	68
	6.1.2 Results of KNN algorithm	69

	6.1.3 Results of Decision Tree algorithm	69
	6.1.4 Results of Random Forest algorithm	70
	6.1.5 Results of XGBoost algorithm	70
	6.1.6 Results of AECW algorithm	71
	6.2 Discussion	71
	6.3 Conclusion	78
	6.4 Limitations of the Study	80
	6.5 Future Scope of the study	81
	Bibliography	84
Appendix A	Plagiarism Report	92
Appendix B	Publication	93

List of Figures

Figure No.	Name of the Figure	Pg. No.
Figure 3.1	Programming environment setup using Wamp Server	40
Figure 3.2	Code did not pass all test cases	45
Figure 3.3	Code passed all test cases	45
Figure 3.4	Correctness Score, $f_c(S)$	46
Figure 3.5	Error Score, $f_e(S)$	47
Figure 3.6	Performance Score, $p(S)$, for all 30 learners	47
Figure 3.7	Specific Student's Performance in all topics	48
Figure 4.1	Workflow of study	49
Figure 4.2	Colab Environment Setup	55
Figure 5.1	AECW Algorithm	61
Figure 5.2	Comparison of AECW with traditional algorithms	66
Figure 6.1	Performance analysis parameters	68
Figure 6.2	Result of KNN algorithm	69
Figure 6.3	Result of Decision Tree algorithm	69
Figure 6.4	Result of Random Forest algorithm	70
Figure 6.5	Result of XGBoost algorithm	70
Figure 6.6	Result of AECW algorithm	71
Figure 6.7	Comparison of F1-Score	74
Figure 6.8	Comparison of Accuracy	74
Figure 6.9	Precision and Recall comparison	75
Figure 6.10	All Learner performance	76
Figure 6.11	Learner classification	77
Figure 6.12	Fast Learner	77
Figure 6.13	Medium Learner	77
Figure 6.14	Slow Learner	78

List of Tables

Table No.	Name of Table	Pg. No.
Table 1.1	Supervised Machine Learning Algorithms	7
Table 1.2	Unsupervised Machine Learning Algorithms	8
Table 1.3	Semi-supervised Machine Learning Algorithms	10
Table 1.4	Reinforcement Learning Algorithms	12
Table 1.5	Neural Networks and Deep Learning Algorithms	13
Table 1.6	Ensemble Learning Algorithms	15
Table 3.1	IF-ELSE statement different complexity level Problem Set	39
Table 3.2	Initial dataset fields	41
Table 6.1	General comparison of algorithms	76