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Predictive Analysis of Online Education System after Pandemic based on Machine Learning Ensemble Algorithms

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Abstract: The COVID-19 pandemic has led to the closure of educational establishments all around the world. To keep academic activities alive, most educational organizations have switched to online learning platforms. Since, problems about e-learning readiness, design, and efficacy remain unanswered, particularly in developing countries like India, where technological barriers such as device compatibility and network availability represent a severe issue. Studies suggest that digital learning can be as successful as traditional education that requires appearance, but learners for online training, especially in adapting different learning methods to online mode is very much crucial. Few studies have examined the satisfaction of e-learning[1][2]. According to the data, students' reaction to online teaching depends on their ability to use online tools, their ability to technically access e-learning materials, and their teacher's style of different learning activities. In this paper, we have clearly analyzed, examined and predict the impact of online education system by using different Machine Learning classifier and ensemble algorithms. We have collected some real time data to show some insight reviews on the satisfactory level of e-learners after pandemic.

Keywords: Algorithms, Machine Learning, Online Education, Predictive Analysis.

INTRODUCTION

Artificial Intelligence is the most common factor in e commerce, education, healthcare section, IT section etc. But in education system the use of AI in not that much used by people but this is so important to use of AI in education system[3][4].

The advantages of AI in education system can enhanced the learning process. AI improves the process of education of students via enhancing interaction with teachers.

Artificial Intelligence tools may be applied to improve online study process-

1. Personalize Education

AI helps the student to building a personalized study schedule for each learner considering the learning gap[5].

In such a way, AI tailors studies according to student's specific need, and increasing their efficiency.

2. Produce Smart Content

Digital Lesson

Digital lesson means the customize leaning essentials and student needy digital contents including digital books, bit sized lessons which are generated with the help of AI.

Information Visualization student study through the visualized the study content and understand it with the help of AI[6].

3. Contribute to Task Automation

Administrative task simplification like grading, assessing and replying to student is a time consuming activity that could be optimize by the teacher using AI.

EXPERIMENTAL OBSERVATIONS

In this method we have taken wekato knowledge analysis tool for the analysis of the online education system dataset with showing different algorithms outputs with visualize and threshold curve.

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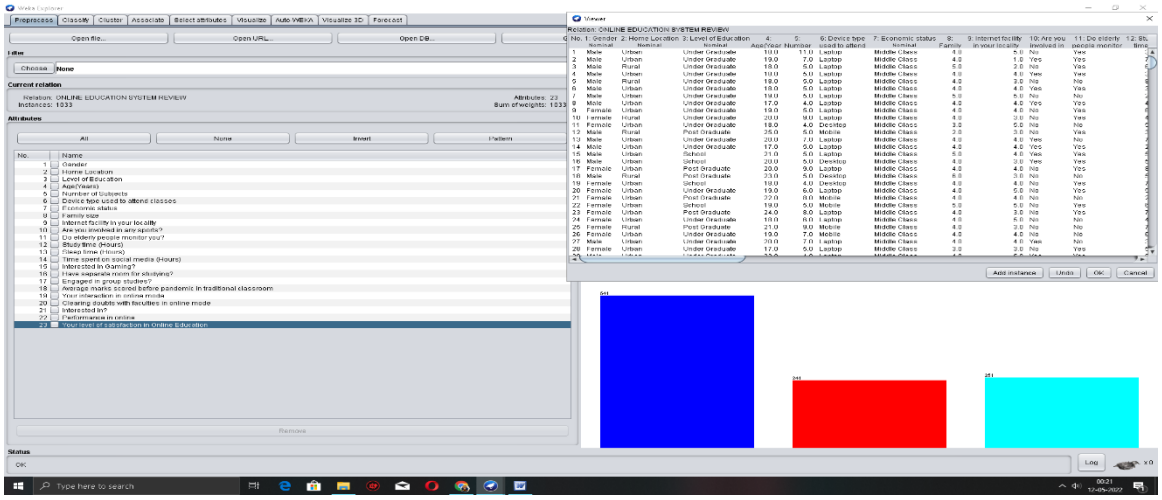

Fig.1. Online Education System Dataset Preprocessing Stage

NAME= weka.classifiers.meta.UltraBoost

Classifier Output

=== Run information ===

Scheme: weka.classifiers.meta.UltraBoost -S 1 -B "weka.classifiers.meta.FilteredClassifier -F \"weka.filters.unsupervised.attribute.RemoveType -V -T nominal\" -S 1 -W weka.classifiers.bayes.NaiveBayes" -B "weka.classifiers.meta.FilteredClassifier -F \"weka.filters.unsupervised.attribute.RemoveType -V -T numeric\" -S 1 -W weka.classifiers.functions.Logistic -- -R 1.0E-8 -M -1 -num-decimal-places 4"

Relation: ONLINE EDUCATION SYSTEM REVIEW

Instances: 1033

Attributes: 23

Gender
Home Location
Level of Education
Age(Years)
Number of Subjects
Device type used to attend classes
Economic status
Family size
Internet facility in your locality
Are you involved in any sports?
Do elderly people monitor you?
Study time (Hours)
Sleep time (Hours)
Time spent on social media (Hours)
Interested in Gaming?
Have separate room for studying?
Engaged in group studies?
Average marks scored before pandemic in traditional classroom
Your interaction in online mode
Clearing doubts with faculties in online mode
Interested in?
Performance in online
Your level of satisfaction in Online Education

Test mode: 10-fold cross-validation

=== Classifier model (full training set) ===

UltraBoost

Base classifiers

FilteredClassifier using weka.classifiers.bayes.NaiveBayes on data filtered through weka.filters.unsupervised.attribute.RemoveType -V -T nominal

Filtered Header

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@relation 'ONLINE EDUCATION SYSTEM REVIEW-weka.filters.unsupervised.attribute.RemoveType-V-Tnominal'
@attribute Gender {Male,Female}
@attribute 'Home Location' {Urban,Rural}
@attribute 'Level of Education' {'Under Graduate','Post Graduate',School}
@attribute 'Device type used to attend classes' {Laptop,Desktop,Mobile}
@attribute 'Economic status' {'Middle Class',Poor,Rich}
@attribute 'Are you involved in any sports?' {No,Yes}
@attribute 'Do elderly people monitor you?' {Yes,No}
@attribute 'Interested in Gaming?' {No,Yes}
@attribute 'Have separate room for studying?' {No,Yes}
@attribute 'Engaged in group studies?' {No,yes}
@attribute 'Average marks scored before pandemic in traditional classroom' {91-100,71-80,81-90,61-70,31-40,41-50,21-30,11-20,51-60,0-10}
@attribute 'Interested in?' {Practical,Theory,Both}
@attribute 'Your level of satisfaction in Online Education' {Average,Bad,Good}

FilteredClassifier using weka.classifiers.functions.Logistic -R 1.0E-8 -M -1 -num-decimal-places 4 on data filtered through weka.filters.unsupervised.attribute.RemoveType -V -T numeric
Filtered Header
@relation 'ONLINE EDUCATION SYSTEM REVIEW-weka.filters.unsupervised.attribute.RemoveType-V-Tnumeric'
@attribute Age(Years) numeric
@attribute 'Number of Subjects' numeric
@attribute 'Family size' numeric
@attribute 'Internet facility in your locality' numeric
@attribute 'Study time (Hours)' numeric
@attribute 'Sleep time (Hours)' numeric
@attribute 'Time spent on social media (Hours)' numeric
@attribute 'Your interaction in online mode' numeric
@attribute 'Clearing doubts with faculties in online mode' numeric
@attribute 'Performance in online' numeric
@attribute 'Your level of satisfaction in Online Education' {Average,Bad,Good}
@data
Classifier Model
Logistic Regression with ridge parameter of 1.0E-8
Coefficients...

	Class	
Variable	Average	Bad
Age(Years)	-0.0713	-0.0791
Number of Subjects	0.0068	0.0316
Family size	-0.1462	-0.0901
Internet facility in your locality	0.1971	0.1857
Study time (Hours)	0.0306	0.0298
Sleep time (Hours)	0.0759	0.1914
Time spent on social media (Hours)	-0.0886	-0.1683
Your interaction in online mode	-0.3648	-0.7567
Clearing doubts with faculties in online mode	-0.292	-0.9326
Performance in online	-0.3768	-0.557
Intercept	4.2605	6.552

Odds Ratios...

	Class	
Variable	Average	Bad
Age(Years)	0.9311	0.924
Number of Subjects	1.0068	1.0321
Family size	0.864	0.9139
Internet facility in your locality	1.2178	1.204
Study time (Hours)	1.031	1.0303

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Sleep time (Hours) 1.0788 1.211
Time spent on social media (Hours) 0.9152 0.8451
Your interaction in online mode 0.6943 0.4692
Clearing doubts with faculties in online mode 0.7468 0.3935
Performance in online 0.686 0.5729
Time taken to build model: 0.08 seconds
=== Stratified cross-validation ====== Summary ===
Correctly Classified Instances 456 44.1433 %
Incorrectly Classified Instances 577 55.8567 %
Kappa statistic 0.1834
Mean absolute error 0.3935
Root mean squared error 0.4462
Relative absolute error 96.371 %
Root relative squared error 98.7667 %
Total Number of Instances 1033
=== Detailed Accuracy By Class ===

	TP Rate	FP Rate	Precision	Recall	F-Measure	MCC	ROC Area	PRC Area	Class
	0.279	0.248	0.553	0.279	0.371	0.035	0.580	0.579	Average
	0.336	0.062	0.623	0.336	0.437	0.350	0.822	0.607	Bad
	0.892	0.519	0.356	0.892	0.509	0.328	0.802	0.557	Good
Weighted Avg.	0.441	0.270	0.521	0.441	0.420	0.180	0.690	0.580	

=== Confusion Matrix ===

a	b	c	<-- classified as
151	42	348	a = Average
102	81	58	b = Bad
20	7	224	c = Good

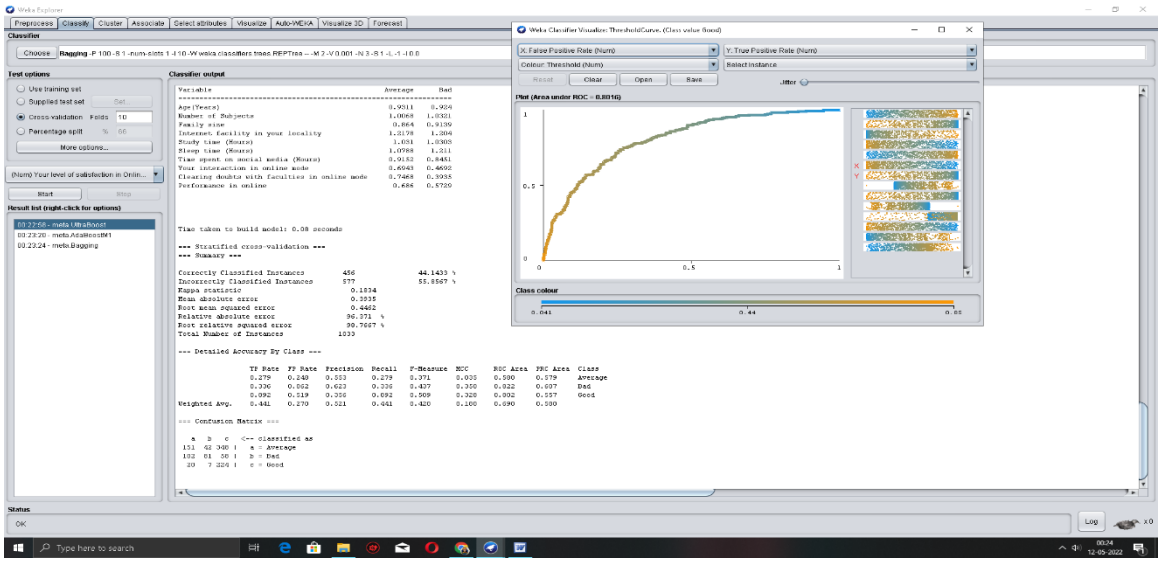

Fig.2. UltraBoost Algorithm output with Threshold curve

NAME= weka.classifiers.meta.AdaBoost
Classifier Output
=== Run information ===
Scheme: weka.classifiers.meta.AdaBoostM1 -P 100 -S 1 -I 10 -W weka.classifiers.trees.DecisionStump
Relation: ONLINE EDUCATION SYSTEM REVIEW
Instances: 1033
Attributes: 23
Gender
Home Location
Level of Education
Age(Years)

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Number of Subjects
Device type used to attend classes
Economic status
Family size
Internet facility in your locality
Are you involved in any sports?
Do elderly people monitor you?
Study time (Hours)
Sleep time (Hours)
Time spent on social media (Hours)
Interested in Gaming?
Have separate room for studying?
Engaged in group studies?
Average marks scored before pandemic in traditional classroom
Your interaction in online mode
Clearing doubts with faculties in online mode
Interested in?
Performance in online
Your level of satisfaction in Online Education

Test mode: 10-fold cross-validation
=== Classifier model (full training set) ===
AdaBoostM1: Base classifiers and their weights:
Decision Stump
Classifications
Clearing doubts with faculties in online mode <= 2.5 : Bad
Clearing doubts with faculties in online mode > 2.5 : Average
Clearing doubts with faculties in online mode is missing : Average
Class distributions
Clearing doubts with faculties in online mode <= 2.5
Average Bad Good
0.43915343915343913 0.48148148148148145 0.07936507936507936
Clearing doubts with faculties in online mode > 2.5
Average Bad Good
0.5725190839694656 0.0900763358778626 0.3374045801526718
Clearing doubts with faculties in online mode is missing
Average Bad Good
0.5237173281703775 0.23330106485963215 0.24298160696999033
Weight: 0.16
Decision Stump
Classifications
Clearing doubts with faculties in online mode <= 2.5 : Average
Clearing doubts with faculties in online mode > 2.5 : Average
Clearing doubts with faculties in online mode is missing : Average
Class distributions
Clearing doubts with faculties in online mode <= 2.5
Average Bad Good
0.4722171150742577 0.4424424424424426 0.08534044248329974
Clearing doubts with faculties in online mode > 2.5
Average Bad Good
0.5336961071578114 0.09825689170603255 0.368047001136156
Clearing doubts with faculties in online mode is missing
Average Bad Good
0.5109945234826461 0.225350014332482 0.26365546218487207
Weight: 0.04
Number of performed Iterations: 2
Time taken to build model: 0.04 seconds
=== Stratified cross-validation ====== Summary ===
Correctly Classified Instances 557 53.9206 %

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Incorrectly Classified Instances 476 46.0794 %
Kappa statistic 0.209
Mean absolute error 0.4351
Root mean squared error 0.4624
Relative absolute error 106.5719 %
Root relative squared error 102.3652 %
Total Number of Instances 1033
=== Detailed Accuracy By Class ===

TP Rate	FP Rate	Precision	Recall	F-Measure	MCC	ROC Area	PRC Area	Class
0.693	0.569	0.573	0.693	0.627	0.129	0.540	0.545	Average
0.755	0.247	0.481	0.755	0.588	0.446	0.733	0.412	Bad
0.000	0.000	?	0.000	?	?	0.457	0.224	Good
Weighted Avg. 0.539	0.356	?	0.539	?	?	0.565	0.436	

=== Confusion Matrix ===

a	b	c	<-- classified as
375	166	0	a = Average
59	182	0	b = Bad
221	30	0	c = Good

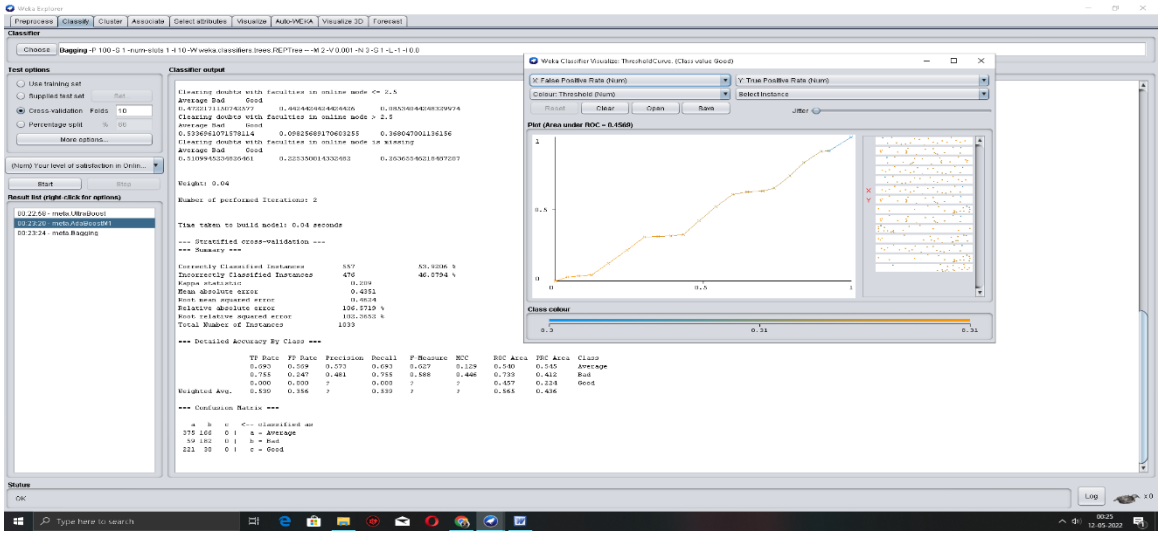

Fig.3. AdaBoost Algorithm output with Threshold curve

NAME= weka.classifiers.meta.Bagging
Classifier Output
=== Run information ===
Scheme: weka.classifiers.meta.Bagging -P 100 -S 1 -num-slots 1 -I 10 -W weka.classifiers.trees.REPTree -- -M 2 -V 0.001 -N 3 -S 1 -L -1 -I 0.0
Relation: ONLINE EDUCATION SYSTEM REVIEW
Instances: 1033
Attributes: 23
Gender
Home Location
Level of Education
Age(Years)
Number of Subjects
Device type used to attend classes
Economic status
Family size
Internet facility in your locality
Are you involved in any sports?

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Do elderly people monitor you?
Study time (Hours)
Sleep time (Hours)
Time spent on social media (Hours)
Interested in Gaming?
Have separate room for studying?
Engaged in group studies?
Average marks scored before pandemic in traditional classroom
Your interaction in online mode
Clearing doubts with faculties in online mode
Interested in?
Performance in online
Your level of satisfaction in Online Education

Test mode: 10-fold cross-validation
=== Classifier model (full training set) ===
Bagging with 10 iterations and base learner
weka.classifiers.trees.REPTree -M 2 -V 0.001 -N 3 -S 1 -L -1 -I 0.0
Time taken to build model: 0.16 seconds
=== Stratified cross-validation ====== Summary ===

Correctly Classified Instances	616	59.6321 %
Incorrectly Classified Instances	417	40.3679 %
Kappa statistic	0.3082	
Mean absolute error	0.329	
Root mean squared error	0.4154	
Relative absolute error	80.5858 %	
Root relative squared error	91.9493 %	
Total Number of Instances	1033	

=== Detailed Accuracy By Class ===

	TP Rate	FP Rate	Precision	Recall	F-Measure	MCC	ROC Area	PRC Area	Class
	0.730	0.510	0.611	0.730	0.666	0.227	0.650	0.652	Average
	0.519	0.124	0.561	0.519	0.539	0.406	0.818	0.542	Bad
	0.382	0.087	0.585	0.382	0.463	0.347	0.775	0.585	Good
Weighted Avg.	0.596	0.317	0.593	0.596	0.587	0.298	0.720	0.610	

=== Confusion Matrix ===

a	b	c	<-- classified as
395	83	63	a = Average
111	125	5	b = Bad
140	15	96	c = Good

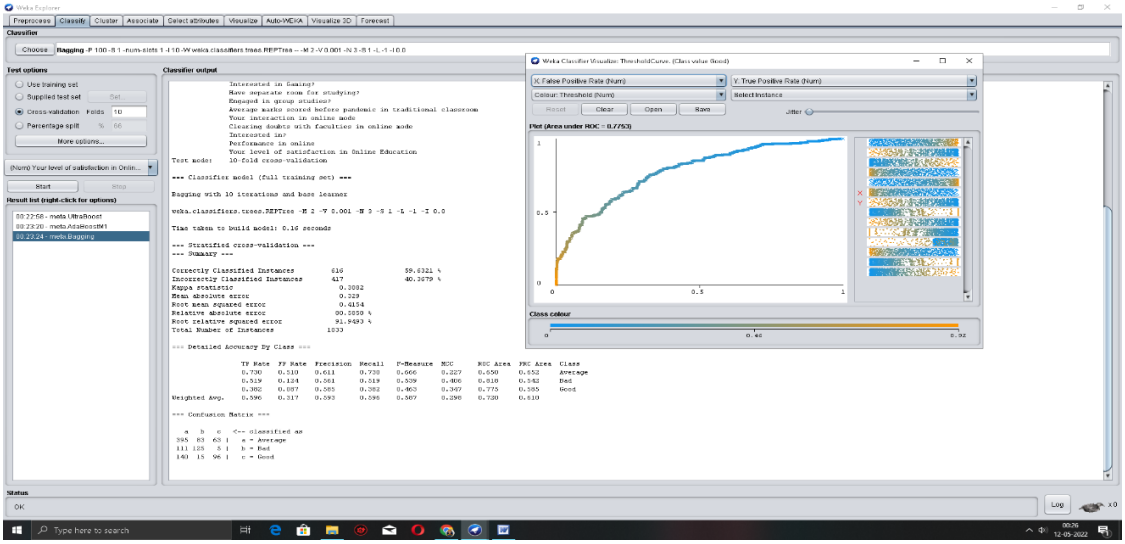

Fig.4. Meta Bagging Algorithm output with Threshold curve

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DISCUSSION

As the pandemic has led to the closure of educational establishments all around the world. To keep academic activities alive, most educational organizations have switched to online learning platforms. Since, problems about e-learning readiness, design, and efficacy remain unanswered, particularly in developing countries like India, where technological barriers such as device compatibility and network availability represent a severe issue[7]. Studies suggest that digital learning can be as successful as traditional education that requires appearance, but learners for online training, especially in adapting different learning methods to online mode is very much crucial. Few studies have examined the satisfaction of e-learning[8]. According to the data, students' reaction to online teaching depends on their ability to use online tools, their ability to technically access e-learning materials, and their teacher's style of different learning activities. In this paper, we have clearly analyzed, examined and predict the impact of online education system by using different Machine Learning classifier and ensemble algorithms. We have collected some real time data to show some insight reviews on the satisfactory level of e-learners after pandemic.

CONCLUSION

In this day and age, understudies are excessively upheld for their schooling by coaches and speakers. The lessons , as well as attention to COVID-19 and lockdown measures. the primary obligations of a tutor are to help understudies in easing pressure and giving twofold companionship to their profound sentiments. because of COVID-19, the vulnerabilities related with their assessments and development way via entry level positions, occupations, and so on, are a not kidding reason for mental pressure for the understudies. The outcomes show that the researcher accepts that a web-based class can be utilized to enhance information yet can't supplant homeroom learning because of one-on-one communication.

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