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Develop an Electronic Testing System Using Artificial Intelligence

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Abstract

Recently, in evaluating students at universities and higher education institutions , depending on separate electronic testing systems, these systems depend on a ban k of questions that such systems do not consider individual differences between m any students as they only implement random selection.In this research, an electron ic testing system was developed to pick test questions and assume significance for each particular questionusing Particle Swarm Optimization(PSO) .

The results show the variation in test question types that indicates individual d ifferences between students and thus the opportunity for students to develop an opt imal evaluation tool system.

Keywords: Datamining, Electronictesting system (ETS), Particle swarm optimization(PSO).

1. INTRODUCTION

It became clear today that scientific progress has no limits, developed nations are getting progress in using information and communication technology, while developing countries trying to catch up, and use thesetechniques for crossing the so called scientific and the technology gap between created and

advanced[1,2]. Since the universities represent a vital part of higher education which proceeds apace on by switching to digital-based scientific development which depends on promoting innovation and excellence confirmation and compete in various academic fields including education programs and electronic tests plans [3,4].

The Moodle system is one of the most important systems used in e-learning; especially in electronic testing is characterized as open source in addition to safety[5].

The Moodle system is used in many universities and is accepted as an e-exam scheme and is given in advance scheme based on random selection of questions from a set of questions.

After observing samples and sample questions, he found that the system had difficulty measuring the higher skills of students and concentrating it solely on the random ordering of questions.

Based on this problem, an electronic exam system that adopts the intelligence algorithm for bird swarms (PSO) has been developed to choose questions according to the value given to questions that represent the importance of this

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question for other questions. After testing the system, the different quality of the test questions was observed to take into account individual differences while maintaining random rankings.

2. "PARTICLE SWARM OPTIMIZATION (PSO) "

PSO is a random method of universal optimization that depends on the soci al behavior of swarm intelligence seeking an optimal global. Edward and Kennedy developed this new method in 1995[6].

The location of each component isdefined by a vectorx(i) (i is the particle index) and the speed shown by the velocity-vectorv(i) in the standard PSO. Each component recalls its own best place and the highest major global position (best group solution) [6].

During t-
iteration, the speed (velocity)upgrade from the earlier speed to thenewspeed (velocity) is dictated by (2). The new location is then calculated by the sum of the previous position and the current formula speed (1) of each component flying over the solution domain.The best local solution will replace the best global solution if this new solution costs less than the current global solution. This process is then repeated several times [6,7].

The equations of velocity and position are givenby:

"v(i+1)= c.{ω v(i) + s1 h1 (xlbest(i) – x(i)) + s2 h2(xgbest(i)- x(i))} "(1)

"x(i+1) = x(i) + v(i)"(2)

Where v(i) is the speedof the component and x(i), xlbest(i) and xgbest(i) is the recent velocity of thecomponent, the best local solution and the best global solution, h1 and h2 are distributed homogeneously in [0,1],s1 and s2 are training variables, two positive constants identified empirically and in relation to $s1 + s2 \leq 4$, ω is the inertia weight; It monitors the effect of the past velocity on the present one, and c is a positive constant called a restriction factor used to regulate and restrict velocity.

3. MATERIALS AND METHODS

Electronic testing system based on (PSO) Particle Swarm Optimization is suggested to allow us to characterize and evaluate individual differences between students in electronic testing and create quality questions.The system is fitted with a group of questions as a bank of questions In the N-dimensional space, each question (particle) has the following arguments:

(X_i) Current position

(P_i) The best position it reached in previous cycles

(V_i) Its flying velocity

Fitness value (question)F(p)

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Current position of question“ Xi = (xi1; xi2; .; xin) “

Bestpreviouspositionof question“P_i=(p_{i1};p_{i2}; _ ;p_{in})“

Flyingspeed (velocity-question)

“Vi= (*vi*1;*vi*2; _ ;*vin*)“

The update of the speedfrom the prior speed to the current speed is determined by (2) during the iteration time t.Then the current position is dictated bythe amount of the previous position and the new speed (velocity) by equation (1) each question (particle) flying over the domain of the solution recalls the best alternative found.

The best local solution will replace the best global solution if this new soluti on costs less than the current global solution.This process is then repeatedly iterated.

“$v_i(t+1)=wv_i(t)+s_1h_1(p_i-x_i(t))+s_2h_2p_g-x_i(t)^{\Sigma}$“ (1)

“$x_i(t+1)=x_i(t)+v_i(t+1)$ “(2)

Where, w is the inertia weight of the proposed algorithm to track the best ofdynamicsettings,which can be defined as ($w=0.5+r/2$) where r is a random value in [0, 1] .The parameters (s1 =s2 =2) are two constants which determine the weights of pi and pg; pi givesusthe best previous position of the ith individual and pgrepresents the best preceding position in current generation of all particles; h1 and h2 which uniformly distribute in the range of [0,1]. The proposed algorithm is shown in Figure.1.

Provide the database with a set of questions and its fitness value.

Fetch questions from the database to determine the size of particles and other parameters.

Initialize randomly the positions and speeds of all the questions.

Do

Each of (question)

Read The value of fitness

If the value of fitness is better than the best fitness value (*pbest Pi*) in history setcurrent value as the new *pbest*

End

Choose the best fitness question for all issues as the best PgEach of (question)

Calculate question velocity according to (1)

Update question position according to (2)

End

Although

highest possible iterations or minimum requirements for errorsare not

Figure 1. Theproposed algorithm

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4. DATA COLLECTION

The data for the model was collected through a questionnaire about ETS that was distributed for the undergraduate students on the computer systems department Babylon Technical Institute / Al-Furat Al-Awsat Technical University-Iraq, where implementation a questionnaire model was prepared to collect data from (80) students, and the model was presented to several specialists to demonstrate their views and issues regardingthe consistency of the paragraphs and the clarity of the language, and in the light of that, a copy of the digital questionnaire was published on the website for twenty-two questions using google form.

The Cronbach's Alpha*(is a measure of the overall consistency that is, how tightly linked a collection of items are as a group.)coefficient was calculated using SPSS (IBM SPSS Statistics 19- is a software package used for the analysis of statistical data) and the results as shown in table (1):

Table 1. measure of scale reliability about the proposed system

(“Item-Total Statistics “)

(“Questions “)	(“Scale Mean if Item Deleted “)	(“Scale Variance if Item Deleted “)	(“Corrected Item-Total Correlation “)	(“Cronbach's Alpha if Item Deleted “)
The electronic tests are characterized by precision and lack of errors.	17.31	42.318	.278	.674
The electronic tests provide time and effort	17.67	43.724	.376	.656
The electronic testing must be adopted in all methodological courses	17.16	39.873	.448	.638
Test time on a computer less than paper	17.21	37.637	.546	.616
Questions are diverse	17.77	44.346	.438	.652
It is difficult to solve some of the questions, while some have solved them.	17.74	45.663	.354	.663
Your fellow students are advised to perform the test on the computer	17.64	43.868	.317	.664

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Encountered any problems with the test on the computer	16.26	42.597	.267	.676
I had trouble answering the questions	15.97	44.466	.131	.710
Do you think electronic tests are useful in learning subjects in the course	17.44	40.217	.450	.638
Questions are easy and can be solved directly	16.12	40.001	.260	.250
Are there focused questions that need more time in the solution	17.33	40.205	.125	.700

Cronbach's Alpha = 0.683

The column (Corrected Item-Total Correlation) shows the coefficient of discrimination for each paragraph and below the table the coefficient of stability (alpha) of the questions. Note from the table above that everyone with the coefficient of discrimination is higher than the value of the stability coefficient, which is a statistical function which confirms the validity of the questionnaire, except for two questions were deleted because the value of discrimination is negative according to the Cronbach's Alpha. Sixty-one out of a possible (80) students completed the assessment questionnaire. Student's responses to eighteen of the Likertscale(* Likert Scale is a form of rating scale used to evaluate attitudes or views with which participants are requested to rate items at agreement level) and multiple choice items are presented in Table (2).

(*Likert scale responses ranged from 1 = I agree,

2=I totally agree,3=disagree,4=Strongly Disagree,5=neutral)

Table 2. Quantitative responses to the Electronic Tests

Questions	***Likert score**	
	mean	**S.D**
1. I'm performing the first-time electronic test.	1.10	0.44
2. Electronic tests are characterized by precision and lack of errors.	1.82	1.60
3. Electronic tests provide time and effort	1.46	1.13
4. Electronic tests simply distinguish procedures	1.23	0.67

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5. Questions are diverse	1.8	0.42
6. Electronic testing must be adopted in all courses	1.97	1.51
7. Test time on a computer less than paper?	1.92	1.57
8. The test performance environment on the computer was better than the paper test environment	1.36	0.93
9. Do you prefer testing on a computer more than a paper test?	1.39	0.88
10.		
11. Your fellow students are advised to perform the test on the computer.	1.49	1.25
12. Encountered any problems with the test on the computer	2.87	1.59
13. I had trouble answering the questions.	3.16	1.76
14. Do you think electronic tests ... are useful in learning materials in the course	1.69	1.46
15. Are there focused questions that need more time in the solution	**3.20**	**1.80**
16. Questions are easy and can be solved directly	**3.10**	**1.70**

Questions	**Multiple choice responses percent**
17. What is your test's feeling or impact? a- Encourage reading the course. b- Focus more on the subject. c- Does not affect.	39.3% 55.7% 4.9%
18. What is the impact of an e-test on participating in exams a- Give impulse to participate. b- Encourage attendance. c- Does not affect.	45.9% 32.8% 21.3%
19. The nature of questions tend to be: a- focus. b- constructive. c- easy. d- direct.	21.3% 67.2% 3.3% 8.2%

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20. How much do you benefit from repeating tests for a number of times a- Course review. b- Focus more. c- Useless	41% 34.4 24.6%
21. Do you support, if you adopt electronic tests to prepare for the exam a- Yes. b-Depends on the type of course. d- No. e- Neutral.	21.3% 45.9% 16% 16.8%
22. Can it be adopted to show individual differences : a- Yes. b-Depends on the type of course. c- No. d- Neutral	80.3% 10% 9% 5%

In the above table the arithmetic mean and standard deviations were calculated at the question level, where each answer was given a code (I agree (1), I strongly agree (2), neutral (3), I disagree (4), I disagree strongly with (5)).The questionnaire for ETS contains (22) questions (attributes) have been collected and some attributes have been manually eliminated since they are considered as irrelevant to the study.

5. MODEL BUILDING AND EVALUATION:

The next step is to build a classification model. This model helps to predicate whether students were like (ETS) and it is appropriate for adopted in all methodological courses in future and can it be adopted to show individual differences or not.

To analyze this research, a total of 61 records are taken. In this paper, we apply a main element as a data filter and then the student academic record dataset is tested and applied to different classification algorithms such as OneR, Randoom tree, J48, Iterative Classifier Optimizer, Multilayer Perceptron and LibSVM(nu-svc), As a result, statistics are produced based on all classification algorithms and there is also a comparison of all six classifiers to predict the precision and discover the highest performing classification algorithm among all.

In this technique, we use the 10-fold validationof thecross technique to evaluate the classification output of our algorithms ; our dataset is distributedrandomly into ten mutually exclusive folds.The process of training and evaluation is repeated ten times, each component is tested and trained ten times, and the average outcomes are recorded for 10 times. Table (3) shows the results of Statistical Analysis of Classifiers with Cross Validation

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Table 3. Statistical Analysis of Classifiers with Cross Validation

Name of Classification Algorithm	Class	TP Rate	FP Rate	Precision	Recall	F-Measure	ROC Area	PRC Area
OneR	Yes	0.758	0.179	0.833	0.833	0.794	0.790	0.762
	No	0.821	0.242	0.742	0.821	0.780	0.790	0.691
Randoom tree	Yes	0.667	0.357	0.688	0.667	0.677	0.619	0.639
	No	0.643	0.333	0.621	0.643	0.632	0.619	0.518
J48	Yes	0.818	0.143	0.871	0.818	0.844	0.852	0.820
	No	0.857	0.182	0.800	0.857	0.828	0.852	0.837
IterativeClassifierOptimizer	Yes	0.606	0.179	0.800	0.606	0.690	0.705	0.761
	No	0.821	0.394	0.639	0.821	0.719	0.705	0.623
MultilayerPerceptron	Yes	0.697	0.321	0.719	0.697	0.708	0.744	0.698
	No	0.679	0.303	0.655	0.679	0.667	0.744	0.761
LibSVM(nu-svc)	Yes	0.667	0.143	0.846	0.667	0.746	0.762	0.744
	No	0.857	0.333	0.686	0.857	0.762	0.762	0.653

The Accuracy has been measured as a metrics in our experiment. Figure.2 shows the results of Compares the performance of our six models.

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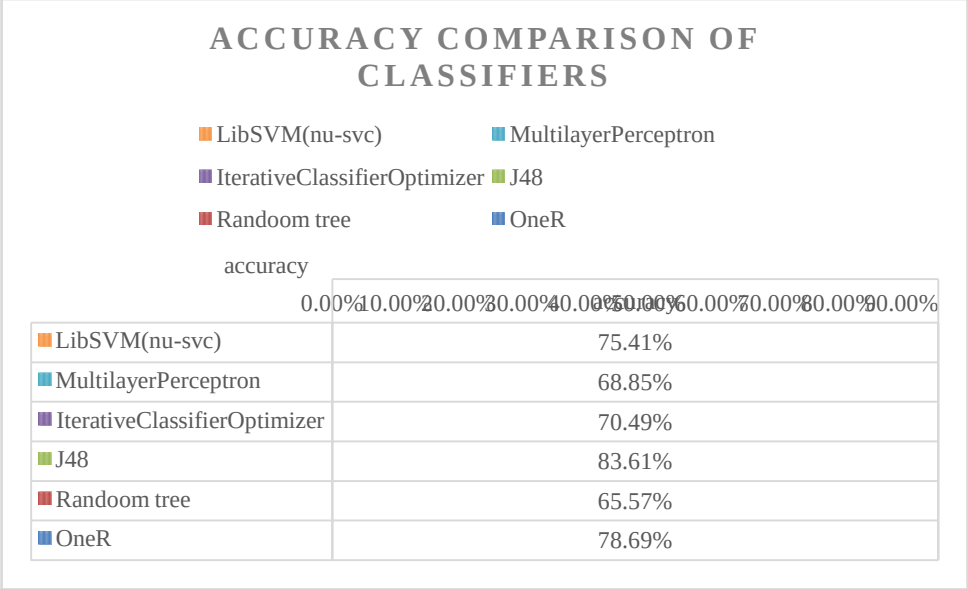

LibSVM(nu-svc)	75.41%
MultilayerPerceptron	68.85%
IterativeClassifierOptimizer	70.49%
J48	83.61%
Randoom tree	65.57%
OneR	78.69%

Figure 2. Results of Compares the performance of our six models

According to these results in figure 4, J48 performs best with accuracy 83.61%. Our model contains six Classification algorithms, and each classifier made a total of 61 predictions (students) and two classes (yes) would mean they like ETS, and they wish to adopt in all courses in the future and (No) would mean they do not wish to adopt ETS in all courses in the future.

Table 4. student numbers (reality and predicate) they answer with (Yes or No) for each classifier.

Name of Classification Algorithm	**Number of students their answer (Yes) actually**	**Number of students their answer (No) actually**	**Number of student that classifier predicted their answer (Yes)**	**Number of student that classifier predicted their answer (No)**
OneR	33	28	30	31
Randoom tree	33	28	32	29
J48	33	28	31	30
IterativeClassifierOptimizer	33	28	25	36
MultilayerPerceptron	33	28	32	29
LibSVM(nu-svc)	33	28	26	35

Comparison of all classifiers is shown in Figure.3 with the assistance of WEKA Experimenter. In this situation, J48 is 82% best among all F-Measure classifiers.

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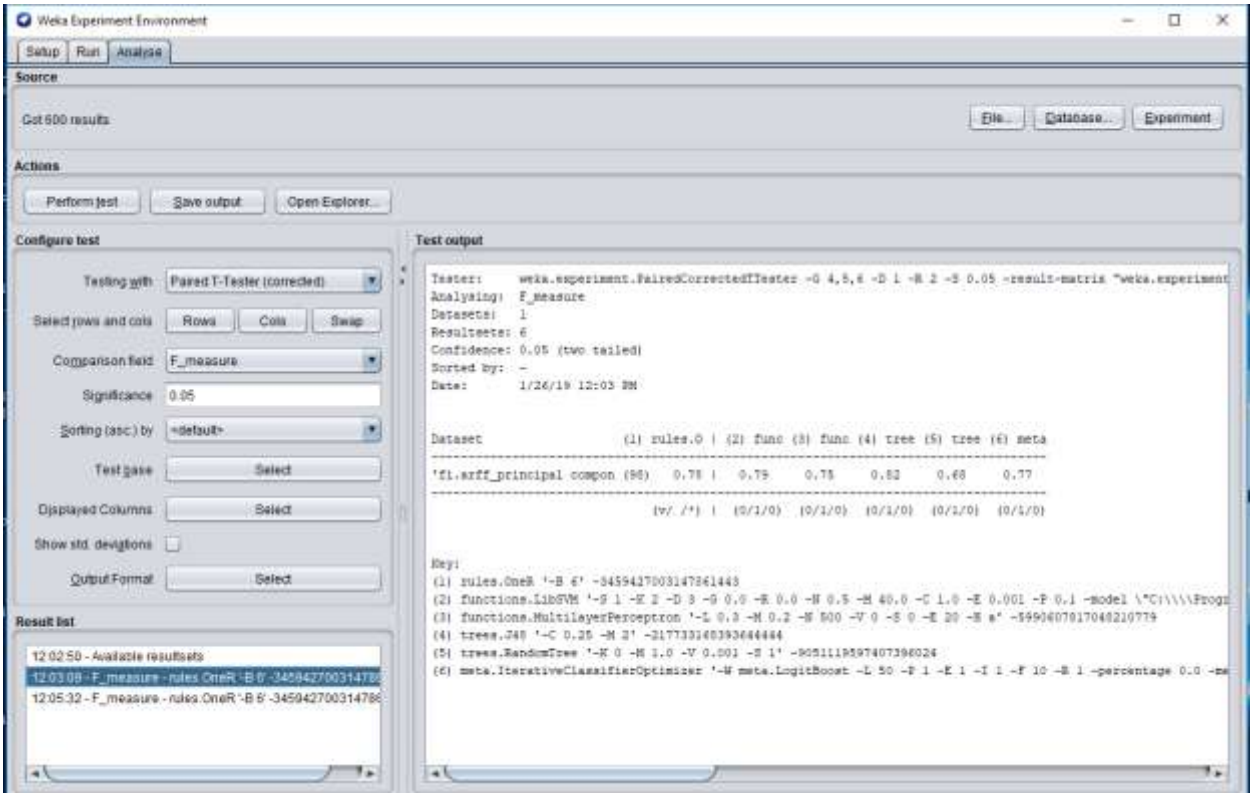

Figure 3. Comparison of WEKA Experimenter Classifiers

6. CONCLUSION

Through the development of an electronic testing system using intelligent techniques and the implementation of the system proposed in the research and the results obtained from the practical implementation, six classification algorithms were used to predict the students' views ontheproposedsystem.J48 works bestwith 83.61%using a principalas filter among all data mining componentclassifiers.

Students getonwellwiththe ability of the suggested system to distinguishthe differences between students by selecting the type of questions in th e choice of test questions. It is possible to develop the system by adopting a test result prior to the student (Pre.Test) to determine the type of questions near the level to achieve higher success rates.

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