

Appraising the Significance of Self Regulated Learning in Higher Education Using Neural Networks

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Abstract—Students in higher education would aim to achieve good academic performance and good placement before they complete their studies. Academic performance of the students can be achieved by providing them good educational environment. To get a good placement a student needs not only good academic performance but also good attitude towards learning, attitude to adapt to new situation, self efficacy, commitment towards working etc. Educational data mining is a novel technology which can be used to predict the academic performance of the students and help them to achieve their goal. Many classification techniques like decision trees, Bayesian networks, rule based algorithms can be used to predict the student's academic performance. This paper aims to apply neural networks to predict whether the student will achieve his goal using his academic performance and attitude towards self regulated learning. They are also used to analyze the importance of self regulated learning in helping the students to achieve their goal. Two algorithms Multilayer perceptron and SMO are used to analyze the behavior of the student towards achieving his goal. Both the algorithms were compared using the number of instances predicted correctly, the accuracy and error rate. The output is also compared with the original data obtained from the institution. It is proved that SMO performs better than the Multilayer perceptron algorithm. After the analysis of the results, it is observed that self regulated learning plays a vital role in a student's life in achieving his goal

Key Words and Phrases—Self regulated learning, academic performance, Placement, Multilayer perceptron, SMO.

1. INTRODUCTION

Higher Education in India has evolved in distinct and divergent streams to help the students to be employed either in India or abroad. The students joining a higher education course are those who already possess a bachelor's degree and wanted to pursue a Master's degree. These students generally aim at a good placement before they complete the course. To achieve their goal, students should possess good academic record, self confidence, an attitude towards learning new things, adapt themselves to any situation, good behavior etc. Educational institutions provide students with good learning environment and help them to achieve their academic goals. In [25] Cristobal Romero and et al have explained how the data mining techniques can be applied on different educational domains. He has also explained how artificial intelligence can be used to predict student grades using Moodles environment. Data mining techniques can be applied on student data base to identify those students who are self learners by nature and help the tutor to motivate them to reach their goal efficiently. This academic performance of the students can be controlled and measured using various techniques. Apart from teaching, the educational institutions should provide opportunity to the students to develop self learning ability. This can be achieved by providing them some exercises which can help them to learn and improve their self learning capability and build their confidence to reach their goal. The students with good academic results are expected to get placed easily where other students face difficulties in reaching their goal. But there are some situations where some student's with good academic results also struggle to achieve their goal. This paper aims to focus on the importance of that area where the attitude or the behavior of the students plays a major role along with the academic performance of the student to achieve their goal.

Students who are metacognitively, motivationally and behaviorally active participants in their own learning process can be described as self regulated students (Zimmerman, 1986, 1989). Such students personally initiate and direct their own efforts to acquire knowledge and skill rather than relying on teachers, parents, or others for instruction. Students who are qualified as self regulated students must involve the use of specified strategies to achieve their goals on the basis of self efficacy perceptions. From [4, 5] the following elements are identified as a part of self regulated learning

- 1.1 Self regulated learning strategies can be defined as actions and processes directed at acquiring information or skill that involve agency, purpose, and instrumentality perceptions by learners. They include such methods as organizing and transforming information, self-consequating, seeking information, and rehearsing or using memory aids (Zimmerman & Martinez-Pons, 1986).
- 1.2 Self Efficacy is referred as perceptions about one's capabilities to organize and implement actions necessary to attain designated performance of skill for specific tasks. Academic goals such as grades, social esteem, or postgraduation employment opportunities can vary extensively in nature and in time of attainment.
- 1.3 Commitment to academic Goals: Zimmerman explains how learners represent contemporary actions and conditions in terms of strategies for reaching subsequent goals. He assumes a motivational orientation by learners that is sustained by continuing self-perceptions of efficacy when performing a specific task. Thus in order for students' strategic actions to be described as self-regulated, one must know their academic goals and perceptions of efficacy.

This paper aims to appraise the importance of self regulated learning among the students and analyse how self regulated students perform better than others in achieving their goal. This paper is divided into three sections namely (2) Background investigation and related work (3) Application of Neural network and (4) Conclusion.

2. BACKGROUND INVESTIGATION AND RELATED WORK

Education system in India is more centered through the teacher-student relationship. The interaction between the teacher and the student is high even in higher education system where many of the foreign countries have adopted virtual learning system. Due to this type of learning environment it becomes easy for any tutor to interact with the students personally and bring out the talents present in them.

In [9] the author Dominik has explained about the project DISUM used in developing and investigating corresponding instructional conceptions, based on an intensive analysis of modelling tasks and of students' learning processes in Germany. Jong-Ki Lee [19] has explained the effects of self regulated learning in an e-learning system by a developing a model and proved the model to be satisfactory using empirical methods. In [11] Retta Sweat Guy and et al has explained the importance of self efficacy beliefs and demonstrated it for computer skills. The research has been done by measuring ability of the student's computer skills using questionnaires and simple correlation techniques. In [13] the author has explained a study conducted in a 5th grade science classroom, and presented a model derived from the students' activity sequences. He also interpreted the model structure as aggregate patterns of their learning behaviors, and links these patterns to students' use of self-regulated learning strategies. The results illustrates that those who teach an agent demonstrate better learning performance and better use of metacognitive monitoring behaviors than students who only learn for themselves. Mark McMahon & Joe Luca in [15] have described a model in assessing students' self-regulatory skills by developing an online conceptual frame work. Teresa Hurley[26] has explained how data mining techniques can be used effectively to motivate the students in an online environment.

Students who join higher education are more interested in getting a placement before they complete the course. To get a good placement, possessing consistently good academic record is very important. Therefore it becomes important for the tutors to monitor and control the academic performance of the students. This can be achieved by predicting the performance of the students before they attend the university examination and help them if they tend to get a lower percentage. In [23, 24], the author has explained the importance of prediction of students percentage and the role of data mining in doing the same.

Students who are identified as good performers are definitely self regulated learners. They know how to manage their time and plan their studies accordingly. To achieve their goal they should also possess good communication skill, self confidence, attitude towards learning etc. This paper aims at measuring the importance of these skills along with the academic performance in helping the students to achieve their goal.

Neural networks are applied to analyse the behaviour the students and predict whether the students are able to achieve their goal in this paper. Two algorithms like Multilayer perceptron and SMO are applied to analyse the student's records.

3. APPLICATION OF NEURAL NETWORKS

Neural Networks is a field of Artificial Intelligence (AI) where, by inspiration from the human brain, find data structures and algorithms for learning and classification of data. Using this technique a neural network algorithm can learn by examples, and create an internal structure of rules to classify different inputs and produce one target output. Neural Networks are successfully being used in many areas often in connection with the use of their AI techniques. They can also be used a predictive analytics tool for classification problems. In [22] the author has explained how neural networks can be used to predict the student's performance in higher language in association with clustering. The various types of neural networks include Probabilistic Neural Networks, General Regression Neural Networks, Radial Basis Function Networks, Cascade Correlation, Functional Link Networks, Kohonen networks, Gram-Charlier networks, Learning Vector Quantization, Hebb networks, Adaline networks, Heteroassociative networks, Recurrent Networks and Hybrid Networks. In this paper Multilayer perceptron algorithm and SMO are used to assess the importance of self regulated learning among students to reach their goal.

The following procedures are encountered while implementing the neural network algorithms.

3.1 Selection of Data Set

Student's joining a Master's degree programme would be aiming to get a placement before the end of the course. To get a placement, students with consistently good academic record and a higher attitude towards learning would be the choice for any organization. Therefore it is important for a student to hold a good academic record and has an attitude towards learning. Students with high percentage of marks would be definitely self regulated learners and good planners. To appraise the behavior of a student towards learning, data pertaining to their self regulated learning activities should be taken. A student data base for a group of 112 students has been taken from a master's degree programme. The attributes comprises of the academic performance of the students in the examination and data pertaining to self regulated academic activities conducted for the student. The academic performance of the student comprises of the percentage of marks

obtained by the student from his 10th standard to under graduation as well the percentage of marks of the student in the first IV semesters of the master's course as it is considered for checking the consistency in the academic performance of the student. The students are recruited to do a project for a period of six months in an industry. This project would be jointly guided by the faculty members of the department where they are studying and by project head of the organization where they the project is assigned to them. The project is also jointly evaluated by both the internal and external guide of the student. Therefore the student has to co-ordinate with both the guides to complete the project and submit it in the end of the course.

The table 1 describes the data set used in this research.

Table 1: Data Set of Students

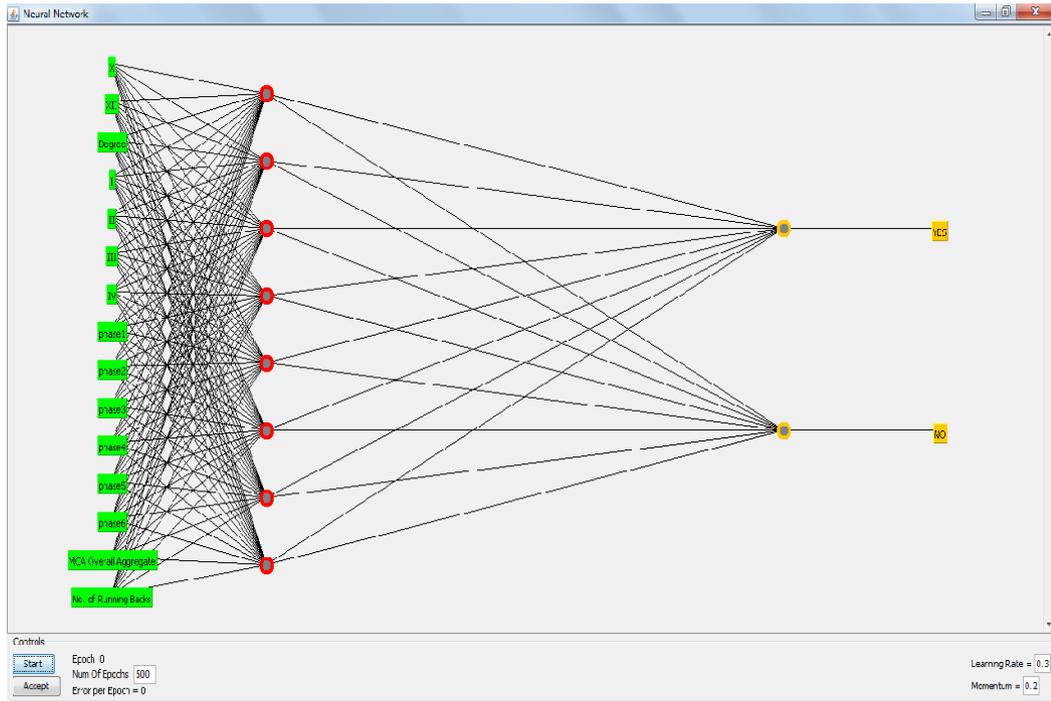
S. No	Attribute	Information	Category
1	UID	University id	Numeric
2	X percentage	% of marks obtained	Numeric
3	XII percentage	% of marks obtained	Numeric
4	Degree percentage	% of marks obtained	Numeric
5	I sem Percentage	% of marks obtained	Numeric
6	II sem Percentage	% of marks obtained	Numeric
7	III sem percentage	% of marks obtained	Numeric
8	IV sem percentage	% of marks obtained	Numeric
9	Overall aggregate	% of marks obtained	Numeric
10	No. of running backs	No. of subjects where the student has a back up	Numeric
11	Phase 1	Submission of synopsis in time	Nominal
12	Phase 2	Submission of SRS in time	Nominal
13	Phase 3	Presentation on SRS	Nominal
14	Phase 4	Submission of design	Nominal
15	Phase 5	Presentation on design	Nominal
16	Phase 6	Submission of report and final presentation	Nominal
17	Predicted achievement	Prediction by the miner depending upon the academic and project data	Nominal

The first attribute UID is the university seat No of the student which is ignored while calculating the target variable. The attributes 1-10 defines the academic performance of the students and the attributes from 11-16 explains the data related to the self regulated learning activities .The attributes 11-16 are nominal attributes where the student will be awarded with a grade (G/N) in each phase jointly by both the guides depending on his performance and attitude towards doing the work where "G" indicates the performance of the student as "Good and Satisfactory " and "N" indicates the "Student needs to Improve". The 17th attribute is the target variable which is predicted by the miner upon which the algorithms are implemented. This target variable is set as (YES/NO) stating whether the student has achieved his goal or not.

3.2 Implementation of Multilayer Perceptron:

Multilayer perceptron algorithm is one of the widely used algorithms in neural network. The algorithm is developed using three layer architecture. They are the input layers, the hidden layers and the output layer. The input layer consists of the input attributes and the output layer consists of the target attribute.

Fig 1: Evaluation of Multilayer Perceptron



The above Fig 1 explains the working of the Multi layer perceptron algorithm. The input layers are fed to the system and connected to the hidden layer and the hidden layer is connected to the output layer. The input layers are represented in green color and the hidden layers are formed using the red color. The output nodes are represented using the points in the orange color and the target attributes are set in the square boxes. The lines between the nodes explain the flow of the input nodes towards the target variable with the help of hidden layers. Each hidden layer is connected to the previous and next layer nodes and the edges are associated with weights. The number of hidden layers to be assigned is calculated using $(\text{no. of attributes} + \text{classes})/2$. The learning algorithm is an essential part of the neural network. The learning algorithm rate can be increased or decreased depending on the need of the system. The learning rate is set to 0.3 to achieve better results. At each node and layer weights are assigned to each attribute. The entire hidden layer will assign weight to the attributes. These values depend on the learning rate given to the algorithm. Table 2 explains the assignement of weights to each attribute at node 2.

Table 2: Weights assigned to Attributes at Node2

S. No	Attribute	Weight
2	X percentage	-0.18
3	XII percentage	-0.39
4	Degree percentage	-0.92
5	I sem Percentage	-1.48
6	II sem Percentage	-0.26
7	III sem percentage	-0.75
8	IV sem percentage	-0.83
9	Overall aggregate	-0.39
10	No. of running backs	2.01
11	Phase 1	1.40
12	Phase 2	0.61
13	Phase 3	0.3
14	Phase 4	-0.21
15	Phase 5	-0.6
16	Phase 6	1.81

3.3 Implementation of SMO:

SMO is one of the simplest algorithms implemented with support vector machines. The algorithm is built using statistical methods and uses logistic regression to predict the target variable. A linear kernel model is implemented to classify the classifiers YES/NO. A threshold value is calculated at every step for optimizing the output. The following table 3 gives the threshold value and the weights assigned for each attribute.

Table 3: Weights assigned by SMO

S. No	Attribute	Weight
2	X percentage	-0.2059
3	XII percentage	0.5073
4	Degree percentage	-0.407
5	I sem Percentage	-1.0627
6	II sem Percentage	-0.784
7	III sem percentage	-0.038
8	IV sem percentage	-0.7512
9	Overall aggregate	-0.2544
10	No. of running backs	1.5953
11	Phase 1	1.3368
12	Phase 2	0.9876
13	Phase 3	0.8344
14	Phase 4	0.5366
15	Phase 5	-0.0678
16	Phase 6	1.0916

3.4 Comparison of Multilayer Perceptron and SMO:

When both the algorithms are executed for the given data set, the following points are observed

1. Both the algorithms classified 108 instances correctly
2. They classified 4 instances incorrectly.

Table 4: Confusion Matrix obtained by Multilayer perceptron and SMO

Total No of Instances:112	No of instances classified correctly	No of instances classified incorrectly
Classified as YES(Achieving goal)	64	2
Classified as NO (Not achieving the goal)	2	44

3. The accuracy of the algorithms can be measured using the classification accuracy. It is defined using the proportion of correctly classified rows in a set r . The classification error rates can be verified using the true positive and false negative rates of the algorithm. From the table 5 it is clear that both the algorithms possess equal TP and FP rate. The Recall and F-Measure values are also same for both the algorithms. ROC area measures discrimination, that is, the ability of the test to correctly classify the instances whether they achieve the goal or not. SMO's ROC area is less than the Multilayer perceptron which reveals that the algorithm is better than the multilayer perceptron.

Table 5: Comparison of Multilayer perceptron and SMO

Algorithm	TPRate	FPRate	Precision	Recall	F-Measure	ROC area
Multilayer perceptron	0.964	0.038	0.964	0.964	0.964	0.972
SMO	0.964	0.038	0.964	0.964	0.964	0.963

4. The confusion matrix obtained reveals that 64 students are able to achieve their goal while 44 students struggle to achieve their goal. This is compared against the original data received from the educational institution. The original data reveals that 66 students have achieved their goal while 46 students could not achieve the goal. From the data it is clear that the algorithm is 97.9% accurate for the given data set.

3.5 Analysis Of Self Regulated Learning:

The aim of this paper is not only to predict the student's achievement but also to analyze the importance of self regulated learning among the students. Students with high academic record may easily achieve their goal while other may struggle to get it. The students with an average academic performance may also have a good attitude towards self learning. Therefore it becomes important to identify the students with good motivation and self learning attitude and help them to achieve their goals. Therefore the data pertaining to the academic performance of the students were chosen and both the algorithms were implemented using that data. The table6 reveals the list of students who tend to achieve/fail their goal only using the academic performance.

Table 6: Confusion matrix obtained using attributes (2-10)

Total No of Instances	No of instances classified correctly	No of instances classified incorrectly
Classified as YES(Achieving goal)	58	8
Classified as NO (Not achieving the goal)	8	38

From the original data it is clear that 66 students achieved their goal while the table6 reveals that only 58 students who are high academic performers tend to achieve their goal. Therefore self learning has definitely helped students with an average performance also to achieve their goal.

4. CONCLUSION

The multilayer perceptron and SMO were used to predict whether the student can achieve their goal or not. The academic performances of the student and his self regulated learning skills have been taken to analyze the behavior of the student towards his goal. It is proved that student with self regulated learning skills achieve high academic performance and a good placement before they complete the course. It is also proved that some students with average performance but with good attitude towards learning are also able to achieve their goal. Data mining techniques have been useful not only in predicting the academic performance of the student but also analyze the behavior of the student towards reaching his goal. Further the techniques can also be used to explore the various other domains of education and bring out the hidden knowledge from it.

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