

# Teacher Learning Algorithm And Linear Regression Based Student Grade Prediction For IT Course

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**Abstract**—Data of any field is good source of information for analysis of any happening. This analysis lead to the development of prediction model as well. Student of school / college depends on instructor observation, many of researchers are working to optimize this work by different mining techniques. This paper has developed grade prediction model for IT course analysis of college student pursuing professional degrees. Student has variety of features that directly or indirectly affects its grade. So selection of optimize feature set is done by teacher learning genetic algorithm. Dynamic nature of teacher learning algorithm increase flexibility of work to select features without any guidance. Selected features were used for the training of linear regression model. Trained model takes student feature as input predict grade of student. Experiment was done on real dataset collect from Madhya Pradesh IT college. Result shows that proposed model has increase the grade prediction accuracy of the work.

**Keywords:** Data Analysis, Feature Selection, Neural Network, Genetic Algorithm.

## I. INTRODUCTION

Educational guidance is a key to institutes and a necessary tool to raise the level of qualification of the human element and to rationalize choices by placing the right person in the right place. It is an ongoing process in the student's school life. Their education or training choices and this is a process that requires learners, families and institutions to participate in a number of processes. These processes require studies, arrangements and classification as well as a contract for the councils have pre-screened people and routes with limited access. So the most exciting tasks in the education sector in India is to predict student's performance due to a huge volume of student data. Educational institution has their own criteria for analyzing the performance of the students. Due to the lack of study on existing prediction techniques there is a need to find the best prediction methodology for predicting the student academic performance. The reason behind the lack in studying the suitable factors which affect the academic performance [1].

The prediction analysis is the approach which can predict future possibilities from the current information. The prediction analysis can be done with the techniques of classification. Educational Data Mining (EDM)

is an emerging field of data mining. The purpose of EDM is to collect data on the learners, their learning environment and new approaches to specify useful patterns. Education institutions have always been interested in collecting data about their students. Processing these data can be significant and identify the areas where it exists and the institutions that are in need of progress. This interest in data collection and processing has increased with the emergence of big data analysis, and online learning has increased the environment for collecting and analyzing data from learners and their environment and supporting and gaining insight into students' learning activities seems useful [2]. One of the significant areas of using EDM is to develop models that predict student performance that predict student performance in education. Institutions are based on some basic factors presented as inputs and timely interventions could assist students enhance their performance.

There are multiple data classification techniques used for predicting the results each one having its own advantages and disadvantages [3]. Some of techniques uses for the prediction of student grades were decision tree, Naïve Bayes', Support Vector Machine techniques, etc. [4].

## II. RELATED WORK

In [5] uses the student event stream sequence, such as whether the student submits an assignment at a certain time, whether the student asks a question at a certain time, whether the student completes the exam at a certain time, etc., to build a Grit Net model to predict the student's final performance. Modern data mining and machine learning techniques are used for predicting student performance in small student cohorts.

In [6] compare the effect of supervised learning algorithms for student performance prediction. References [7] build a decision tree-based algorithm, Logistic Model Trees (LMT) to learn the intrinsic relationship between the identified feature, which are identification of academic and socio-economic features, and students' academic grades.

In [8] apply a transfer learning methodology using deep learning and traditional modeling techniques to study high and low representations of unproductive persistence.

In [9] extend the deep knowledge tracing model, which is a state-of-the-art sequential model for knowledge tracing, to consider forgetting by incorporating multiple types of information related to forgetting.

Nurul ,, Ulyani, et.al in [10] presented that the major factor that leaves a huge impact on the behavioral intentions of student is the service quality performance. Within seven Malaysian public and private universities the paper-and-pencil questionnaires were distributed [11]. The descriptive statistics and covariance-based structural equation modeling were used to analyze the data. The least likely execution of favorable behavioral intentions was influenced by the freedom, serenity, management dimensions as well as aesthetic factors. A positive behavior towards the student housing was seen as per the results achieved when students adapted to live in multi-cultural community in which they would have access to good hospitality, personal privacy and appropriate building ambiance.

Buenaño Fernández [11] proposed the usage of ML methods for the final grades prediction of students by using the historical data. They applied the historical data of computer engineering from the universities of Ecuador. One of the strategic aims of this research was to cultivate extensive yet comprehensive data. Their implementation had yielded a panoptic amount of data which can be converted into several useful education related applications if processed appropriately. This paper proposed a novel technique for pre-processing and

grouping of students having the same patterns. Afterward, they applied many supervised learning methods to identify the students who had similar patterns and their predicted final grades. Finally, the results from ML methods were analyzed and compared with the previous state of art methods. They claimed 91.5% accuracy with ensemble techniques, which shows the effectiveness of ML methods to estimate the performance of students.

Reddy and Rohith [12] discussed that many researchers had utilized the advanced ML algorithms to predict the student's performance effectively; however, they did not provide any competent leads to under-performing students. They aimed to beat the limitation and worked to identify the explainable human characteristics that may determine the student will have poor tutorial performance. They used the data from the University of Minnesota and applied SVM, RF, Gradient Boosting, and Decision Trees. They claimed more than 75% accuracy to identify the factors which are generic enough to spot out which students will be failing this term.

### **III. TLLRGP METHODOLOGY**

Explanation of proposed teacher learning based feature selection and linear regression based Grade Prediction model was done in this section of paper. Methodology of Teacher Learning Linear Regression Grade prediction (TLLRGP) is divide into two heading first include input raw dataset processing which select few features as per performance of scholars. Second include training of mathematical linear regression by filter dataset features. Graphical flow of proposed model is shown in fig. 1. Outcome of this model is trained regression that takes selected student features as input and predict its performance.

#### **Dataset Processing**

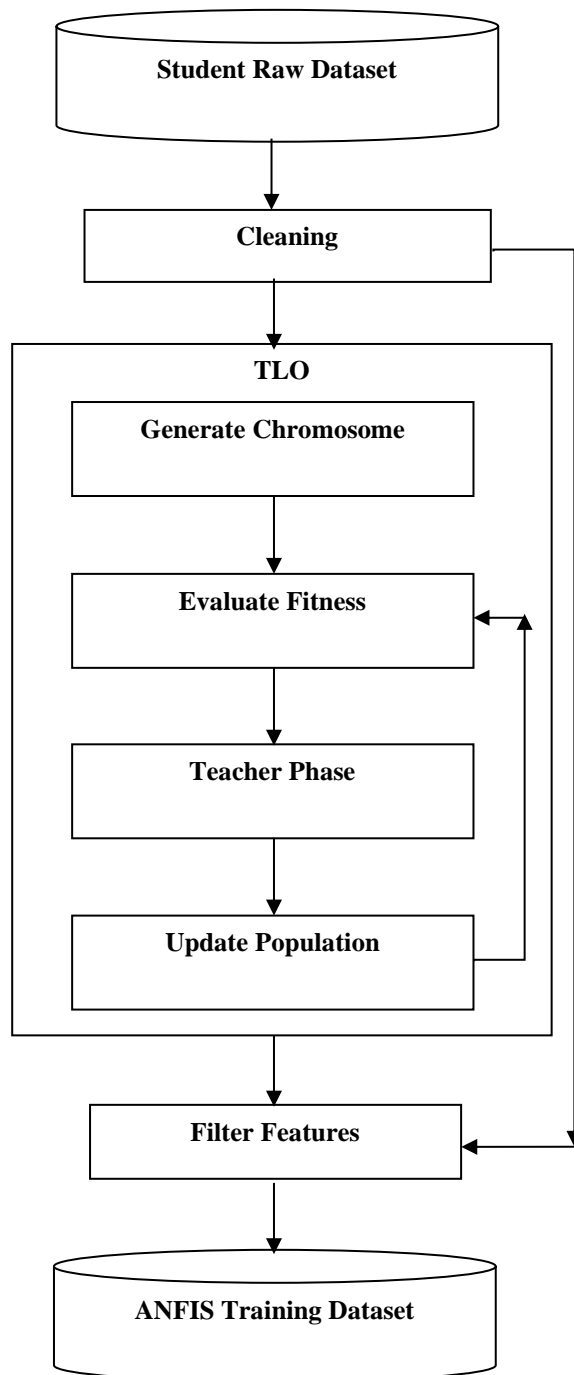
Input raw dataset need some preprocessing for getting better results. This paper has apply cleaning for pre-processing of dataset and Frog leaping for feature selection.

#### **Dataset Cleaning**

In this step some of column that may not be required for the learning of mathematical model are removed from the dataset. Some of redundant information present in the dataset are also removed from the dataset [13]. Example of such redundant information like (City, Country, Pincode) as pincode is sufficient to get city, state, country name so pincode is taken for processing and other information is removed. Similarly some of column may have student personal details like name, contact details, email id etc. need of such information in learning or analysis is not required in the model at any stage, so such information is also removed [14].

#### **Teacher Learning Optimization**

This algorithm was inspired by teacher leaning based optimization algorithm [15]. Proposed model has modified the previous genetic algorithm by involving the crossover operation in teacher phase and mutation operation in student leaning. So in this modified version of the TLBO algorithm chromosome modify itself by mutation operation instead of other student chromosome.



**Fig. 1 Block diagram of grade prediction TLLRGP model.**

**Generate Chromosome:** In this work set of feature is consider as chromosome and collection of student is population in the algorithm. Student is a feature identified by its position number in dataset. Random set of features were prepared by the work to create a student group or chromosome. Population is denote by  $P_{SG}$ , where  $SG$  (Student Group) is chromosome having vector of  $f$  number of binary elements. Binary value 1 means feature present in the student group and 0 means feature is absent. For random population generation Gaussian noise function was used.

$P_{SG} \leftarrow \text{Gaussian\_Student\_Group}(f, m)$

In above function  $m$  is number of SG generate in the  $P_{SG}$  matrix.

**Fitness Function:** As model need to train the neural network from selected feature set, hence testing accuracy as per student group feature training is consider as fitness value. Feature values of pre-processed dataset use if student presence is 1 in the vector and if student presence is 0 then feature value is also 0 for all set of students.

### Teacher Learning

Student population has probable set of solutions and each set cluster feature matrix into cluster. In this step of modified teacher learning genetic algorithm fitness value of each chromosome. As per fitness value best chromosome was identified and other set of chromosomes were modified as per best chromosome cluster center feature terms. Paper has modified the chromosomes values randomly by replacing same position cluster value from best chromosome.

**Crossover:** Genetic algorithm is unsupervised in nature and for getting better solution some weak chromosomes modify in the population. This modification or generating new student group operation is crossover. SG goes under crossover operation, as per  $Sc$  value dominating parent is select that make change in other SG. In crossover random position student is select in dominating SG, and as per its status present / absent same status maintain in other set SG.

**Population Update:** Involvement of new chromosome in the population by crossover increases size of population. As crossover operation execute in each step, size of population increases linearly. To control population size this step remove chromosome from the population having lower  $Sc$  value after  $n$  number of chromosomes. So after crossover operation fitness value of child student group need to be calculate. This step check max iteration count as well. After fix number of  $t$  iterations of fitness value, memplex, crossover, population update function break the algorithm and provide its final set of best feature set for student performance prediction.

### Adaptive Neural Fuzzy Interference System

In 1990 [16] ANFIS neural learning model was proposed. As this Uses concept of neural network and fuzzy logic so it terms as ANFIS. Learning of neural network was improved by use of logical operators IF Else, as this help in remembering rules in the dataset. This logical operator improves the neural learning for non-linear data as well.

Learning of malicious tenant behavior is done by Adaptive Neural Fuzzy Interference System. Features of each tenant collect to train this mode. Input training vector is set of  $\{L, R, D\}$ . For training malicious tenants were identified by 0 and real tenants were identified by 1.

In this learning model five layers of neurons were present [17]. In first layer membership function is identify as per the input value set. This is an fuzzification layer used in the work. As per the premise parameters membership function is select. Second neural layer used for the firing of neuron from the input, so this second

layer is named as rule layer. After this data is normalized as some of values are dominating others, hence third layer was used for the normalization of model. This normalization distributes computing firing strength of neurons. Fourth layer takes normalized values and consequence parameters to defuzzified values and finally pass to the fifth and final layer.

**Fuzzification layer** In ANFIS model activation function is not a sigmoid nor a step but work apply some data processing methods to convert values into fuzzy format.

#### IV. EVALUATION PARAMETER

Experimental and analysis work was done on MATLAB software 2016A version. Model was run on machine having I3 processor, 4GB RAM. Proposed TLLRGP model is compared with existing technique proposed in [18]. Experimental values were extracted from dataset obtained by Madhya Pradesh IT course conducting college. Detail description of dataset shown in table 1.

**Table 1 Student dataset overview.**

Parameters	Description
Features	17
Rows	389
Cities	47
Colleges	5
Courses	7

#### Results

**Table 2 Grade prediction model accuracy value based comparison.**

Testing Students Data	TLLRGP	Effort Learning Ability [16]
100	0.51	0.31
175	0.5086	0.3116
250	0.508	0.436
350	0.48	0.457

Accuracy value of comparing models were shown in table. It was obtained that use of teacher learning algorithm for feature selection increase the accuracy value of student grade prediction by 24.519% as

compared to effort learning model [18]. Dynamic nature of teacher learning genetic algorithm not only reduce the input data quality but also select features that mostly affect the performance of student.

**Table 3 Grade prediction model precision value based comparison.**

Testing Students Data	Grade	TLLRGP	Effort Learning Ability [16]
100	A	0.6429	0.5
	B	0.5243	0.44
	C	0.5377	0.2513
175	A	0.5882	0.5111
	B	0.5169	0.4779
	C	0.5249	0.2764
250	A	0.5798	0.4412
	B	0.5138	0.4128
	C	0.5195	0.236
350	A	0.5439	0.549
	B	0.4844	0.5182
	C	0.4888	0.2965

Students grades were divide into three class A, B and C. As per class precision values of different models were extracted by varying student dataset size. Result shows that use of linear regression model for learning of teacher algorithm based selected features improved the performance by 24.04% as compared to effort learning ability model [18]. It was shows that A grade student grade prediction is higher in both algorithms as compared to B and C grade.

**Table 4 Grade prediction model recall value based comparison.**

Testing Students Data	Grade	TLLRGP	Effort Learning Ability [18]
100	A	0.5	0.2955
	B	0.5	0.246
	C	0.274	0.167
175	A	0.5376	0.2584
	B	0.4894	0.267
	C	0.2646	0.178
250	A	0.5111	0.1786
	B	0.4833	0.2394
	C	0.2608	0.16
350	A	0.5196	0.301

	B	0.4790	0.27
	C	0.2514	0.186

Recall result show in table 4 validate that use of linear regression model for learning of teacher algorithm based selected features improved the performance by 45.82% as compared to effort learning ability model [18]. It was shows that A grade student grade prediction is higher in both algorithms as compared to B and C grade.

**Table 5 Grade prediction model f-measure value based comparison.**

Testing Students Data	Grade	TLLRGP	Effort Learning Ability [18]
100	A	0.5625	0.3714
	B	0.5118	0.3168
	C	0.363	0.2008
175	A	0.5618	0.343
	B	0.5027	0.3429
	C	0.3519	0.2165
250	A	0.5433	0.2542
	B	0.4981	0.3030
	C	0.3473	0.1911
350	A	0.5314	0.3889
	B	0.4817	0.3551
	C	0.3321	0.2287

F-measure value of comparing models were shown in table. It was obtained that use of teacher learning algorithm for feature selection increase the f-measure value of student grade prediction by 37.13% as compared to effort learning model [18]. Dynamic nature of teacher learning genetic algorithm not only reduce the input data quality but also select features that mostly affect the performance of student.

## V. CONCLUSIONS

In this paper student performance was analyzed for identifying the features of the scholar that affect the performance. This model college, institute to improve the teaching skill as well as major affecting features were identify for enhancing the student understanding. Features were select by the teacher learning genetic algorithm. Selected features that are set of binary values were passed in the linear regression mathematical model, that learns student grade with different feature set. Experiment was perform online test perform in IT course colleges. Students grades were divide into three class A, B and C. As per class precision values of different models were extracted by varying student dataset size. Result shows that proposed model has increases the accuracy of grade prediction by 24.51%, f-measure by 37.13% as compared to other predicting model. In future scholar can apply same model on different dataset for analysis.



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