College Admission Prediction using Ensemble Machine Learning Models

Vandit Manish Jain[1], Rihaan Satia[2]

[1]*Student at VIT University, Vellore Pursuing Bachelor's in Computer Science and Engineering*
[2]*Student at VIT University, Vellore Pursuing Bachelor's in Computer Science and Engineering*

---***---

Abstract - *This paper aims to build a model that can help students to pick the right universities based on their profiles. We can judge across a wide variety of domains that include MS (international), M.Tech (India) and MBA (India and International). For the accurate predictions we plan on training a machine learning model in order to provide results. The dataset contains information on the student profile and the university details with a field detailing if the admission was positive or not. Various algorithms have been used i.e. Ensemble Machine Learning and the predictions have been compared using key performance indicators (KPIs). The model performing the best is then used to evaluate the dependent variable i.e. The chances of admit to a university. The chances of admit variable is a variable ranging from 0 to 1 which equates to the predicted probability of successful acceptance to a university. We also aim to create a portal which filters and then provides a list of universities that fall into the profile's acceptance range.*

Key Words*: *Key Performance Indicators, M.Tech, MBA, Ensemble Machine Learning, Dependent Variable.

1. INTRODUCTION

For anyone pursuing their postgraduate studies, it would be difficult for them to find out what college they may join, based on their GPA, Quants, Verbal, TOEFL and AWA Scores. People may apply to many universities that look for candidates with a higher score set, instead of applying to universities at which they have a chance of getting into. This would be detrimental to their future. It is very important that a candidate should apply to colleges that he/she has a good chance of getting into, instead of applying to colleges that they may never get into. There aren't many efficient ways to find out the colleges that one can get into, relatively quickly.

The Education Based Prediction System helps a person decide what colleges they can apply to with their scores. The dataset that is used for processing consists of the following parameters: University name, Quants and Verbal Scores (GRE) TOEFL and AWA Scores. The GRE Test (Graduate Record Examinations) is a standardized test used by many universities and graduate schools around the world as part of the graduate admissions process. Other factors are also taken into consideration while applying to colleges, such as Letter of Recommendation (a formal document that validates someone's work, skills or academic performance), Statement of Purpose (a critical piece of a graduate school application that tells admissions committees who you are, what your academic and professional interests are, and how you'll add value to the graduate program you're applying to), Co-curricular activities and Research papers as well (research papers from journals that are not well known or have a high percentage of plagiarism are not taken into consideration for this case). When a person has completed their undergraduate degree and wants to pursue a Postgraduate degree in a field of their choice, more often than not, it is very confusing for the person to figure out what colleges they should apply to with the scores that they have obtained in GRE and TOEFL, along with their GPA at the time of their graduation. Many candidates may apply to colleges that do not fall under their score requirements and hence waste a lot of time. Applying to many colleges with scores also increases the cost. There are not many efficient methods that are available to help address this issue and hence an Education Predictor System has been developed.

In the system proposed, a person can enter their scores in the respective fields provided. The system then processes the data entered and produces an output of the list of colleges that a person could get into, with their scores. This is relatively quick and helps conserve time and money. In order to achieve this we have proposed a novel method utilising Machine Learning algorithms. To maximize the accuracy of our model, we have taken into consideration not one; but several machine learning algorithms. These algorithms include Neural Networks, Linear Regression, Decision Tree and Random Forest. More about these algorithms will be covered in the Algorithms section of this paper. These Algorithms are then compared and the algorithm which has the best key performance indicators will be used to develop the Prediction System. We also look forward to incorporate clustering of universities based on a profile and then classifying them as less likely, highly likely acceptance etc.

2. PROBLEM STATEMENT

Educational organizations have always played an important and vital role in society for development and growth of any individual. There are different college prediction apps and websites being maintained contemporarily, but using them is tedious to some extent, due to the lack of articulate information regarding colleges, and the time consumed in searching the best deserving college.

The problem statement, hence being tackled, is to design a college prediction/prediction system and to provide a probabilistic insight into college administration for overall rating, cut-offs of the colleges, admission intake and preferences of students. Also, it helps students avoid spending time and money on counsellor and stressful research related to finding a suitable college.

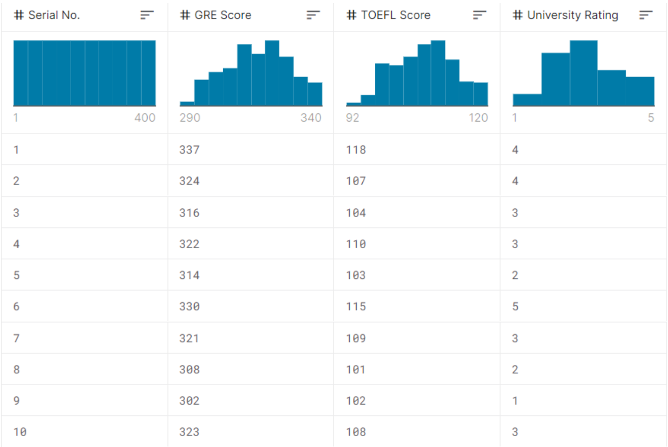
It has always been a troublesome process for students in finding the perfect university and course for their further studies. At times they do know which stream they want to get into, but it is not easy for them to find colleges based on their academic marks and other performances. We aim to develop and provide a place which would give a probabilistic output as to how likely it is to get into a university given upon their details.

3. DATASET

The data set comprises of different factors attributed towards picking the right university. It contains data of 100 different students.

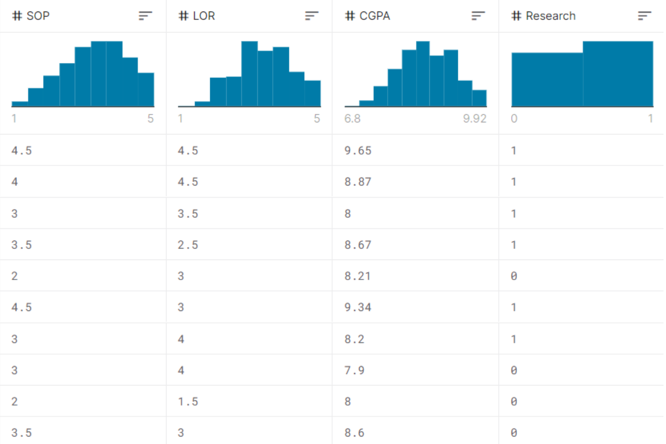
Data set is classified into 9 different parameters which are considered important during the application for Masters.

Those parameters are: gre scores, toefl scores, university rating, statement of purpose, letter of recommendation, undergraduate gpa, research paper, chance of admit.



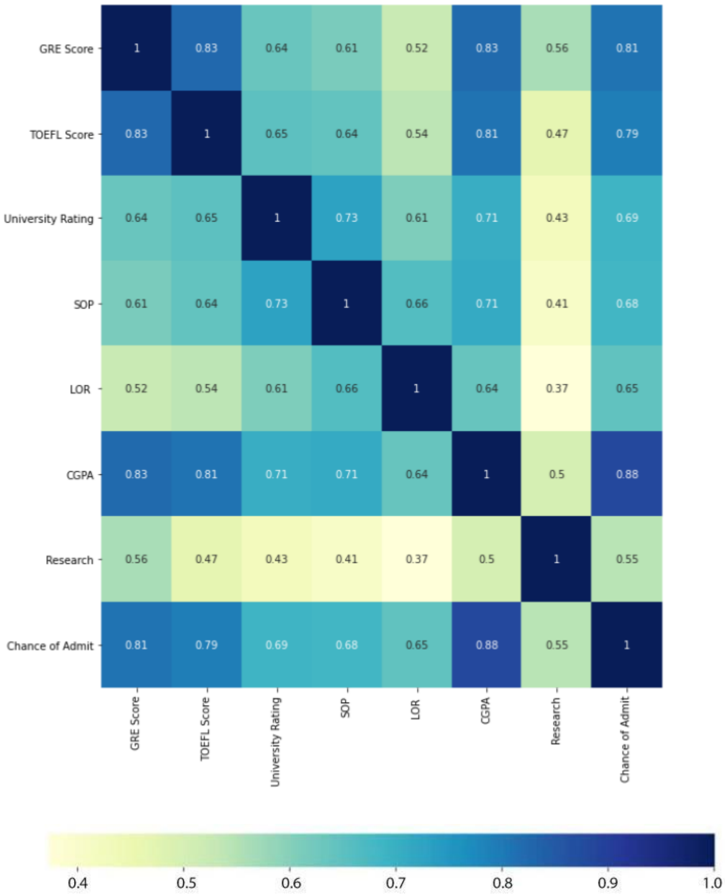
# Serial No.	# GRE Score	# TOEFL Score	# University Rating
1	337	118	4
2	324	107	4
3	316	104	3
4	322	110	3
5	314	103	2
6	330	115	5
7	321	109	3
8	308	101	2
9	302	102	1
10	323	108	3

Fig -1: Data set containing *Gre score, Toelf score and university ranking*



# SOP	# LOR	# CGPA	# Research
4.5	4.5	9.65	1
4	4.5	8.87	1
3	3.5	8	1
3.5	2.5	8.67	1
2	3	8.21	0
4.5	3	9.34	1
3	4	8.2	1
3	4	7.9	0
2	1.5	8	0
3.5	3	8.6	0

Fig -2: Data set containing *SOP, LOR, CGPA, research*



	GRE Score	TOEFL Score	University Rating	SOP	LOR	CGPA	Research	Chance of Admit
GRE Score	1	0.83	0.64	0.61	0.52	0.83	0.56	0.81
TOEFL Score	0.83	1	0.65	0.64	0.54	0.81	0.47	0.79
University Rating	0.64	0.65	1	0.73	0.61	0.71	0.43	0.69
SOP	0.61	0.64	0.73	1	0.66	0.71	0.41	0.68
LOR	0.52	0.54	0.61	0.66	1	0.64	0.37	0.65
CGPA	0.83	0.81	0.71	0.71	0.64	1	0.5	0.88
Research	0.56	0.47	0.43	0.41	0.37	0.5	1	0.55
Chance of Admit	0.81	0.79	0.69	0.68	0.65	0.88	0.55	1

Fig -3: Correlation matrix

4. ALGORITHM USED

A. Linear Regression

Regression models are used to describe a relation between different variables by using the observed data into a line. Straight lines are used in linear regression models, whereas curved line is used in logistic and non-linear regression models. Linear regression model is a method used as response for only a single feature, it is based on supervised learning. Regression models always target a prediction value which is based on independent variables. It is used to calculate the relationship between two quantitative variables. Regression models differ upon – the type of relation between independent and dependent variables, the number of variables being used and the ones they are considering. It is taken under assumption that these variables are linearly related. Henceforth, we try to define a linear function that predicts the response value(y) as accurately as possible as a function of the feature or independent variable(x).cut-offs of the colleges, admission intake and preferences of students. Also, it helps students avoid spending time and money on counsellor and stressful research related to finding a suitable college.

B. Artificial Neural Network

Neural networks are a series of algorithms which try to recognize relationships that are underlying in a dataset through a process which imitates the way human brain operates. Neural networks are referred as a system of neurons.

Neural networks are systems that are artificial and they were inspired from biological neural networks. They learn to complete the task from different data sets and from examples without any specific rules assigned for the task. The main inspiration behind is that the system will automatically generate identification characters from the data that has already been passed through without being programmed and basic understanding of these data sets. Artificial Neural Networks have various neurons which are artificial and they are called as units. The units arrange themselves in a series of layers which all together make up as artificial Neural Networks. Any layer is supposed to have only a millions of units or dozen units as it depends upon the complexity of the system.

These units are arranged in a series of layers that together constitute the whole Artificial Neural Networks in a system. A layer can have only a dozen units or millions of units as this depends on the complexity of the system. Commonly, Artificial Neural Network has an input layer, output layer as well as hidden layers. The input layer receives data from the outside world which the neural network needs to analyze or learn about. Then this data passes through one or multiple hidden layers that transform the input into data that is valuable for the output layer. Finally, the output layer provides an output in the form of a response of the Artificial Neural Networks to input data provided.

C. Decision Trees

Classification is a two step process, learning and prediction. At first, model is developed based upon the given training data in its learning step. Then the model is used to predict response for the given data in prediction step. One of the most popular classification algorithms and easiest to learn and understand in decision tree. Decision tree algorithm is also used for solving classification and regression problems. Decision trees use a class label for predicting, for a record it starts from the root of tree. Then compare the values of the root with its record attribute. After the comparison, it follows the branch which is corresponding to the value and jump upon to the next node. There are two types of decision trees, Categorical variable and continuous variable. Categorical variable has a categorical target variable and continuous variable has a continuous target variable. Decision tree has three types of nodes, decision nodes, chance nodes and end nodes. Decision tree assigns a class label for each leaf node. Even the non-terminal nodes, the root and internal nodes, also contain attribute test conditions to separate records that have different characteristics.

D. Random Forests

The random forest is a machine learning algorithm which is widely used in regression and classification problems. Decision trees are built upon multiple different samples and then take their majority vote for average and bifurcation in case of regression. Random forest has the ability to handle a data set which contains continuous variables in case of regression and categorical variables in case of classification. Hence, it provides good results for classification problems. In industry lingo, reason behind forest works algorithm works so well is:

Any huge quantity of moderately uncorrelated trees working as a body will outperform any of the individual constituent models.

5. METHODOLOGY AND IMPLEMENTATION

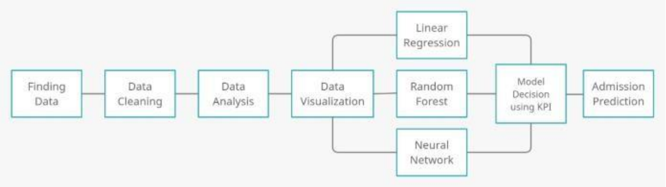


Fig -4: Block diagram

The primitive step to building a model for our use case is choosing the right dataset. For our predictions, we chose a dataset which contains all the important attributes that would affect the chances of admit. This is followed by data cleaning where we handle missing values present in various fields. Once the data is ready to be analyzed, we use various tools and libraries to visualize the data and perform analysis. This includes visualizing bar graphs and the correlation matrix.

Once the data is ready to be processed, we split it into training and testing data. For this, we will be using 3 machine learning algorithms; linear regression, random forest and neural network. Once these models are built over the dataset, we compare them using key performance indicators. These indicators help us choose the right model for predicting whether an applicant has chances of admission.

6. RESULTS AND CONCLUSION

Every year millions of students apply to universities to begin their educational life. Most of them don't have proper resources, prior knowledge and are not cautious, which in turn creates a lot of problems as applying to the wrong university/college, which further wastes their time, money and energy. With the help of our project, we have tried to help out such students who are finding difficulty in finding the right university for them. It is very important that a candidate should apply to colleges that he/she has a good chance of getting into, instead of applying to colleges that they may never get into. This will help in reduction of cost as students will be applying to only those universities that they are highly likely to get into.Our prepared models work to a satisfactory level of accuracy and may be of great assistance to such people. This is a project with good future scope, especially for students of our age group who want to pursue their higher education in their dream college.

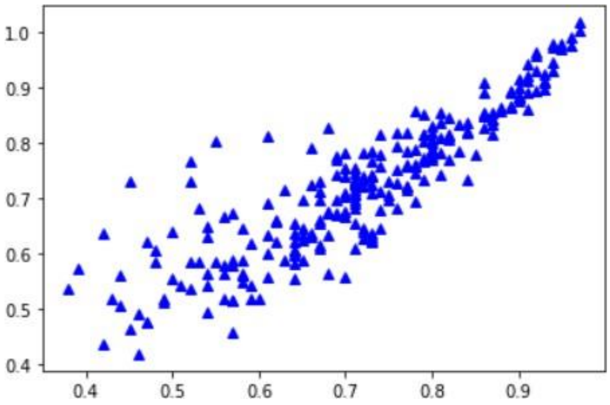


Fig -5 (a): Linear Regression

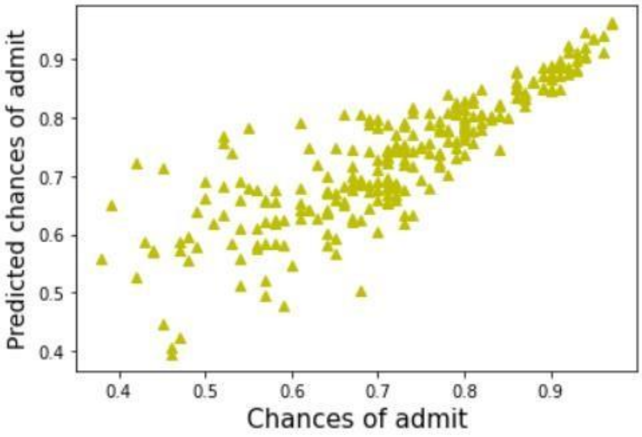


Fig -5 (b): Neural Networks

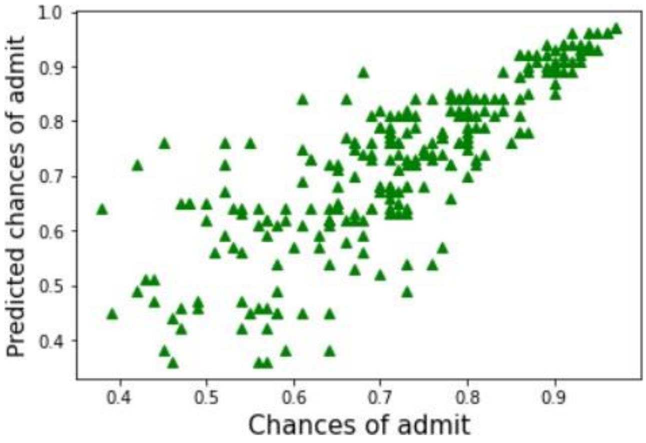


Fig -5 (c): Decision Trees

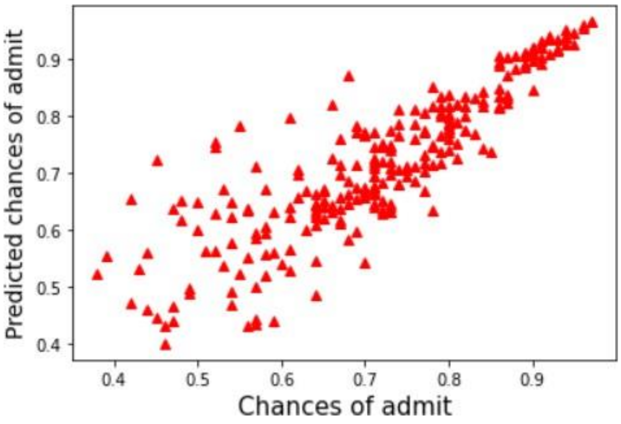


Fig -5 (d): Random Forests

The graphs illustrate the chances of getting an admit against the predicted chances of getting an admit using different algorithms. Comparison in each of these models is done by evaluating Key Performance Indicators (KPI). With the help of this, it provides a cleaner output and helps in comparing the indicators like Root Mean Square Error, Mean Square Error, Mean Absolute Error and Adjusted R-Squared of an algorithm. At times accuracy provides ambiguous results if there are unequal observations or multiple classes are present in the dataset.

Results show us that the highest accuracy is achieved through the linear regression model and the decision tree has the lowest accuracy.

MODEL	ACCURACY
Linear Regression	0.8212
Neural Networks	0.7447
Decision Trees	0.6588
Random Forests	0.7909

Table -1: Accuracy of models

This information can be visualized through the abovementioned graphs. Graphs that are not spread out and are closer to the line x=y have higher accuracy. The linear regression line graph is surrounded around this line and hence has the highest accuracy. The decision tree model has the lowest accuracy and is spread out with a lot of outliers, hence depicting that getting an accurate result using this model would be inaccurate.

REFERENCES

[1] [1] Subba Reddy.Y and Prof. P. Govindarajulu," A survey on data mining and machine learning techniques for internet voting and product/service selection", IJCSNS International Journal of Computer Science and Network Security, VOL.17 No.9 September 2017.

[2] Zhibo Wang, Jilong Liao, Qing Cao, Hairong Qi, and Zhi Wang, "Friend book: A Semanticbased Friend Recommendation System for Social Networks IEEE Transactions on Mobile Computing.

[3] J. Bobadilla et al. "Knowledge-Based System" Elsevier B.V.

[4] Hector Nunez, Miquel sanchez-Marre, Ulises Cortes, Joaquim Comas, Montse Martinez, Ignasi Rodriguez-Roda, Manel Poch, "A Comaprative study on the use of similarity measure in case based reasoning to improve the classification of environmental system situations,", ELSEVIER, Environmental Modeling and Software (2003)

[5] DINO IENCO, RUGGERO G. PENSA and ROSA MEO, "From Context to Distance: Learning Dissimilarity for categorical Data Clustering," Journal Vol. X. 10 2009, pages 1- 10.

[6] Duc Thang Nguyen, Lihui Chen, Chee keong Chan, "Clustering with Multi viewpoint Based Similarity Measure," IEEE Transactions on Knowledge and Data Engineering. Vol. 24. No. 6. June 2012.

[7] Elham S.Khorasani, Zhao Zhenge, and John Champaign. AMarkov Chain Collaborative Filtering Model for Course Enrollment Recommendations: 2016, "IEEE International Conference on Big Data (Big Data)", P. 3484 – 3490.

[8] Hana Bydžovská. Course Enrollment Recommender System: Proceeding of the 9th International Conference on Educational Data Mining, P. 312 – 317.

[9] Jamil Itmazi and Miguel Megias (2008), Using recommendation Systems in Course Management Systems to Recommend Learning Objects, P. 234 – 240.

[10] Queen Esther Booker (2009). A Student Program Recommendation System Prototype: Issues in Information Systems, P. 544 - 551.

[11] Akrivi Vlachou, Christos Doulkerids, Kjetil Norvag, and Yannis Kotidis, "Identifying the Most Influential Data Objects with Reverse Top-k Queries," Proceedings of the VLDB Endowment, Vol. 3, No. 1, Copy right 2010 VLDB Endowment 2150-8097/10/09.

[12] Usue Mori, Alexander Mendiburu, and Jose A.Lozano, "Similarity Measure Selection for Clustering Time Series databases," IEEE Transactions on Knowledge and Data Engineering. Vol. 28. No. 1. January 2016.

[13] Yung-Shen Lin, Jung-Yi Jiang, and Shie-Jue Lee, "A Similarity Measure for Text Classification and Clustering," IEEE Transactions on Knowledge and Data Engineering. Vol. 26. No. 7. July 2014.

[14] Charif Haydar, Anne Boyer, "A New Statistical Density Clustering Algorithm based on Mutual Vote and Subjective Logic Applied to Recommender Systems", UMAP 2017 Full Paper UMAP'17, July 9- 12, 2017, Bratislava, Slovakia.

[15] Reddy, M. Y. S., & Govindarajulu, P. (2018). College Recommender system using student'preferences/voting: A system development with empirical study. INTERNATIONAL JOURNAL OF COMPUTER SCIENCE AND NETWORK SECURITY, 18(1), 87-98.

[16] Deokate monali, Gholave Dhanashri, Jarad Dipali, Khomane Tejaswini (2018). College Recommendation System for Admission. International Research Journal of Engineering and Technology, 9(3), 187-175.

[17] Qazanfari, K., Youssef, A., Keane, K., & Nelson, J. (2017, October). A novel recommendation system to match college events and groups to students. In IOP Conference Series: Materials Science and Engineering (Vol. 261, No. 1, p. 012017). IOP Publishing

BIOGRAPHIES

Vandit Manish Jain is a Final Year Student at VIT University pursuing bachelor's in Computer Science and Engineering.

Rihaan Satia is a Final Year Student at VIT University pursuing bachelor's in Computer Science and Engineering.