

University Eligibility Checking System for Sri Lankan State Universities

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Abstract

Primary education, secondary education, and tertiary education are the three major categories of education in Sri Lanka. After completing their primary and secondary education, students' progress to tertiary education. In Sri Lanka, applying to universities is a manual process. The University Grants Commission collects data in order to determine the cut-off marks for each university's degree programs and then publishes an admission handbook for students who wish to apply. When a student applies to a university using the manual method, they face several challenges, including choosing a suitable degree program, obtaining information about degree program details, and the likelihood of being selected for an interesting course because they attempt to find a suitable degree program using the admission handbook. This study addresses a software solution that uses the Machine Learning (ML) to reduce the workload that students face to select a suitable degree program while applying to universities. The solution will go into how to use historical data and determine which university's degree programs are appropriate for a given user. First gathered the data and information and prepared the correct dataset. After that analysed the data, to get an idea about how the system should move. Then pre-processed the dataset to remove noise and implemented the database also. Designed suitable interfaces for the system to display the inputs and outputs. When the user inputs their details, course prediction is done using an exponential linear regression algorithm. Finally, display the eligible courses according to their priority. This paper addresses how the software solution

will aid in the reduction of the traditional university selection process's problems.

Keywords: *Machine Learning (ML), Z-score, Exponential linear regression, Selection prediction*

INTRODUCTION

The evolvement of technology has played a significant role in making people's lives simpler, quicker, and less complicated, as well as making them more and smarter. The computers are cable of performing the main role in the everyday life of humans. A variety of software is being developed to perform different tasks. Various aspects of software engineering, as well as various technologies, are incorporated into the development of such applications. The purpose of this work is to explore the creation of a web-based software application to assist in university eligibility as well as the most suitable course. This study will also explain how technologies such as machine learning can be used in the development of such a system to make future predictions.

Higher education enables us to pursue a career that we are passionate about. We are more likely to appreciate our jobs when we have the freedom to pick them. Higher pay, better benefits, and more growth chances all contribute to greater

job satisfaction (“The Importance of Higher Education in the 21st Century,” 2019). Today's school students are encouraged to consider a variety of factors before starting a four-year degree program. Salary expectations, field employment rates, and advanced degree options are all important factors to consider. Students often select a major based on factors such as job availability and employment rates in their desired field. The type of qualification they study will usually be determined by the subject they chose.

Bachelor's degrees are the most common undergraduate path into higher education, and they include a wide range of topics, including environmental sciences, health, and psychology, as well as law, history, and English literature. Most Bachelor's degrees run three to four years, with written exams, coursework, and group projects used to assess students. In many situations, they will include options with the internship to working in the industry. People frequently seek higher education in order to advance their career specialized in

their desired fields (“Why is Higher Education Important?” 2019), (“How to choose the right degree | Prospects.ac.uk,” n.d.).

The university admissions process entails filling out an online application following the University Handbook issued by the University Grants Commission (UGC) (“University Grants Commission - Sri Lanka,” n.d.), (“ADMISSION TO UNDERGRADUATE COURSES OF THE UNIVERSITIES IN SRI LANKA,” n.d.).

The handbook has a wide number of pages and contains a lot of information about the degrees. We must clarify all of the information following our stream and results when reading the entire book. If we make a minor error during this observation and analysing phase, the possibility to enter for some of the best degree programs of the universities may narrow.

According to the UGC, between 118,000 and 144,000 people have met the minimum criteria for university admission in recent years, but only around 17,000 to 24,000 people have been admitted (“Admission To Undergraduate Courses of The Universities in Sri Lanka 2010 - 2011

| PDF | University And College Admission Master Of Business Administration,” n.d.). The current system gathered information such as each university's student ability and available degree programs. Not only that, but the current system takes into consideration previous data on the number of candidates chosen for each degree program and university. These are some of the most common facts that are taken into consideration when establishing criteria for selecting applicants for government universities (Bandaranaike et al., n.d.).

The UGC and other Government Educational Authorities oversee all of these processes. Following these measures, the UGC publishes an admission handbook for students interested in applying to the university. For each degree program, UGC established a cut-off mark. The z-score, which is used as a key to enter the university, is the cut-off mark. The following formula will be used to measure the z-score (“GCE Advanced Level| Z-score Calculation & university entrance,” n.d.).

$$Z = (X - \bar{X}) / S$$

Where,

Z = Z-score

X = Raw Mark

\bar{X} = Mean Mark

S = Standard Deviation

Students then purchase this admission handbook to obtain their admission cards, which are included in the book. This book aids in determining what degree programs and universities are available based on the cut-off mark. This admission handbook contains all information needed to choose an appropriate degree program, as well as recommendations and other relevant information.

In a manual method, candidates pick courses by prediction according to their knowledge and the previous year's data. In that scenario, there's a possibility that they skip all applicable courses based on z-score. As a result, some students were unable to pursue higher education as their desired streams.

Moreover, there are even vacancies available in some degree programs and there aren't any applicants. This may be happening due to a lack of understanding and the complexity of the current process.

However, this system will guide the students to select the most suitable list of degree programs according to their stream, district, subjects, z-score and preferences. This provides students with a competitive advantage and increased efficiency.

LITERATURE REVIEW

Various studies have been carried out to predict various types of classes, such as courses, student performance, student admission, and student placement eligibility. To achieve their goals and targets, these studies used a variety of approaches.

K-Nearest Neighbour (KNN) algorithm, Multivariate Logistic Regression algorithm, Decision Tree algorithm, Fuzzy algorithm, Data mining techniques, Markov decision process, Neural Network (NN), and Clustering algorithm are among the methods listed. All of these classification approaches have been introduced to reduce the cost and time associated with the manual classification.

M. Backen köhler and others (2018) performed a study that specifically addresses the problem area of this proposal, proposing a data analysis method for determining the best direction for the coming quarter. They employed machine learning techniques to forecast student success in upcoming classes, and these forecasts are incorporated into the Markov Decision Process Transition Probability (MDP), which defines the student's academic route. They did this by analysing the output of 3,889 computer science

students enrolled at the University of Saarland since 2006. They discovered those accurate predictions were possible for large courses offered regularly, but that seems accurate predictions were difficult on rare occasions (Backenköhler and Wolf, 2018).

The K- Nearest Neighbour model used in the Student Admission Predictor method had an overall accuracy of 76%, and the decision tree model used to predict the best university position for the student had an accuracy of 80% (H. Son vane, 2017). Finding a solution to the fact that students assess the likelihood of applying to college is acceptable.

It also aids in the identification of the most appropriate universities for the user's profile and offers comprehensive information on those universities. The CRoss-Industry Standard Process (CRISP) approach is used in this analysis (Azevedo, 2008). The system's drawback is that it only considers data from Indian students pursuing a master's degree in computer science from American universities. The data for the project comes from many places.

The majority of the information comes from publicly available Yocket websites,

while university registration, pricing, and ranking data come from India's top education consultants, Mentors Circle. To create an intermediate data set, the data from the two sources are combined. The final dataset is split into several datasets, each representing a different university, to estimate the probability of a student entering the final list of universities. The system was effective in achieving the study's ultimate objective of saving students time and money spent on highly regarded education consultants and college admissions. It also aids students in making quicker and more informed decisions about university applications (Son wane, n.d.).

The fuzzy approach has been used for the prediction of student's placement eligibility (R. Sangha et al., 2016). They developed a fuzzy algorithm in five steps called define in giusto variables and terms, construct membership functions for the linguistic variables, construct the knowledge base rules, obtain fuzzy values and perform defuzzification. They used fuzzy logic in their research to include a range of options rather than just set values. This gives a range of 0 to 1 for the predicted outcome. At the same time, it is efficient enough to efficiently manage incorrect feedback. Algorithms can be

written with very little detail, so they don't take up a lot of memory. While fuzzy logic, like human outcomes, has limited understanding, it is powerful. Model inequalities and inferences are also handled by Fuzzy.

The ability to work with linguistic variables is the most significant benefit of this strategy. A variable expressed in words is referred to as a language variable. MESCOE Pune was used to evaluate the dataset they used for this algorithm. The training data was also taken from the same source given by the training and application unit's administrator. As a result, the real values and forecasts have been confirmed.

As a result, the method assists students in locating themselves in companies that have their capabilities, thus assisting these institutions in the rate of student placement events, as well as for candidates who wish to study at those universities (Sangha et al., 2016).

To predict the master course selection, P.S. Patel and others (2020) modelled a Fuzzy Inference System (FIS) using a hybrid neural network and fuzzy system based on student academic performance and psychological factors. The questionnaire

was made based on the rational and empirical factors that influence students' decision to choose graduate courses for data collection. The questionnaire included socio-demographic indicators (gender, geographical location, family qualifications, parental income, caste), educational factors (high school grade, degree, type of university/ board, course study, time spent studying, attendance, etc.), psychological factors (knowledge acquisition, learning patterns, higher education goals, knowledge of ICT, etc.).

The required student information is presented manually and digitally (Google forms) and all required information is converted into a digital table. They used 12 steps to model the Course Prediction System (CPS) model and used the Rstudio tool to predict success rate results after selecting a student's graduate course. 75% of the records were used to train the proposed model. The result of the model proposed by CPS was 97.33% when testing 15% of the records. The result for the CPS model is 25% of the data from the tests performed, with an accuracy of 97.5%.

With the improvement of test logs, almost 98% accuracy is achieved. They also saw a

lower error rate in this experiment (Patel et al., 2020).

A.A. Kardan and others (2013) developed a model to predict the course selection in online higher education institutes for the students who are required to choose courses for the coming semester. The main goal of this project is to identify factors that potentially influence student satisfaction with selected on line courses, model student selection behaviour, and use a neural network approach to map features to training data.

Also applying the obtained function to predict the final number of registrations for all courses after dropping out and advertising period. The experimental sample consisted of 714 online postgraduate courses over 16 semesters from 2005 to 2012.

The data required to calculate the element values were taken from an online questionnaire completed by students who completed the course in the previous semester. The questions will cover various aspects such as course characteristics, instructor characteristics, student workload, course grade, course type, course time, amount of conflict time, final exam time student needs, and others. It is classified in

the group to be assessed. For this task, they used a multilayer neural network of perception, due to its structural flexibility, superior expressiveness, and the availability of a variety of training algorithms. They have achieved high accuracy in predicting student recruitment at the E-Learning Centre of the Amir Kabir Institute of Technology. This configuration may not be optimal for other institutions (Kardan et al., 2013).

In research conducted by S.D. A and others (2012), they idle of course selection was predicted using a combination of data mining algorithms. They presented how a combination of a clustering gorithm (Simple K-means algorithm) and association rule algorithm(Apriority Association Rule) can help in a courser commendation system.

They examined sample data taken from a Model data base containing 45 students and 15 courses. However, after processing the initial data, there are 8 courses and 38 students. C-programming (C), Visual Basic (VB), Active Server Pages (ASP), Computer Networks (CN), Network Engineering (NE), Operating System (OS), Distributed System (DS), and Data Structure (DS-I) are those courses. They got association rules that contain only "no"

before processing the data. However, after processing the association rule the result contains only "yes". The idea behind the association rules $DS = \text{yes} \rightarrow OS = \text{yes}$ is the system can be recommended for freshmen who have just enrolled in the DS course, used as a course to take the operating system.

For a combination of clustering and association rules, the data does not need to be pre-processed first. For the data from the Model course, they used a simple K-means clustering algorithm. They used two clusters called 0 and 1. They applied Apriority Association rule mining to these two clusters. However, with cluster 1 they got the association rule correctly because the association rule only contains "yes". After the Apriori association rule algorithm was applied, cluster 0 was ignored because the association rule also contained a "no".

They used a combination of clustering algorithms Simple –mean sand correlation rule as Apriority association rule algorithm to improve the strength of association rule. Since the association rule includes "no", the result for cluster 0 is wrong and the usage results in Cluster 1 were all "yes", they used them to recommend the course to students (B.A her and Lobo, 2012).

Using Primitive Cognitive Network Process (P-CNP) (Q. Hu et al., 2017) developed a recommended approach for university program selection. The methods presented in this article are intended for students who have chosen a college program or received multiple offers to decide which program to choose.

P-CNP uses the Analytical Hierarchy Process (AHP), a revised version of the general decision-making method introduced by Saaty. They followed five steps to implement this approach, including a problem identification process, a cognitive assessment process, a cognitive prioritization process, information integration, and classification.

The solution problem consists of a series of measurable structural evaluations. Six universities were designated as T1, T2, T3, T4, T5, T6, and the five criteria were study location (C1), cost (C2), program (C3), employer reputation (C4), and the university level (C5). Rating scale: $\{-8, \dots, -1, 0, 1, \dots, 8\}$ is {"a lot less important than", ..., "marginally less important than", "equal to", "weekly more important than", ..., "a lot more important than"}.

The top three universities, 1, 5, and 6, correspond to student preferences, based

on pair wise comparisons. Recommended results are validated correctly for students at which are asked to explain the key criteria for each university. The result showed that the university preferences of these students are prioritized. The proposed method differs between students.

It takes into account important considerations, making it an ideal solution if decision-makers have difficulty making decisions or need extra effort to organize the assessment. They realized that this method allows students to study at university and find the most suitable requirements for university based on importance relative factors determined by the user (cost, location, position, etc.) (Hu, Fung Yuen and Craig, 2017).

METHODOLOGY

The concept and execution of the University Eligibility Checking system, which is being built utilizing unsupervised learning techniques, are covered in this section. The major goal of this project is to create a website for students who apply to government colleges that use machine learning algorithms to forecast which degree program at which university is appropriate for them. The University Eligibility Checking system's general system design can be summarized as

follows: problem identification, data collecting, algorithm selection, prediction, and interaction with the online application.

1) Problem Identification

After doing a survey, have identified the problems of the existing system and features for the system. Done a literature review to get an idea about how other countries solve this kind of problem.

2) Data Collection

One of the major challenges in ML, along with other issues, is data gathering. The majority of the effort is spent designing the set of data for executing machine learning from start to finish. Because the acquired data is submitted to predict the next year z-score values. The system's accuracy is mostly determined on the predicted dataset.

The predictions would be inaccurate if the dataset used is insufficient. There will be no use in using the constructed algorithm if it is unable to make accurate predictions. Furthermore, the size of the dataset has a direct impact on the system's accuracy. When the dataset is huge, the algorithm may team formulates more quickly and with more accuracy than if the dataset is small.

The dataset was initially gathered utilizing the UGC admission guide. The cut-off marks to each degree programs in each university are used for that. There are more than 1000 records totally. The dataset is collected under several categories called district, degree, university, subjects, and z-score. And created a CSV file including the dataset.

3) Pre-processing the Dataset

Next step is pre-processing the initial dataset. String object type data has been read from the CSV file. Then converted those values into float points. After that removed some rows which all the z-scores are having null values and if some data points are available and some data points are missing in a row, then used median value as to replace those missing values. Then using one hot encoding mechanism converted categorical variable into numerical variable because stream, degree, university, and district are categorical variables.

4) Development of Value Prediction Algorithm

Using an exponential linear regression algorithm predicted the 2020 z-score value. To achieve the proposed solution there can't use any model because there isn't any data to use as the training dataset. Also,

it should predict the future value and therefore, can't use supervised learning models. And it can't be categorized under classification also.

First assigned the variables to x-axis and y-axis when using the exponential linear regression algorithm to predict the 2020 z-score values. 0, 1, 2, 3, 4 numbers are assigned to x-axis and 2015, 2016, 2017, 2018, 2019 z-scores are assigned to y-axis. Then using those data, it predicted the 5th point as the 2020 z-score values.

5) Database Development

After the value prediction the results should be stored in the database because the proposed solution needs to predict the next year z-score values only one time. Then created a new database including those details into one table and another table is created including subject details.

A foreign table is created using those two tables including which subjects are allowed to eligible for each degree program. Because there are number of subjects in one stream and different degree programs are allowed different subjects to do if applicants want to eligible for that degree program. The user details and user comments are stored in the database because users need to login to the website

if they want to access the data on the website. Preferences details are stored in the database using foreign tables also.

6) Development of Degree Prediction Algorithm

The degree prediction is the last part of the backend development. To achieve that challenge using the python language developed an algorithm. First accessed the database and get the subject details and then accessed the district, stream, and z-score. When consider about the z-score it defined in a range because we can't guarantee that our predicted value is 100% correct. Then predicted the degrees according to the subjects that did in A/L.

Also, users can check their eligibility according to their university and specialized area preferences. It's an optional area for the users. Using the python language developed an algorithm to achieve this task. Then wrote an API to connect the back end and front end.

7) Web Application Development

The last part of the project is to develop a web application. Using html, CSS, JavaScript, and bootstrap developed a web application and backend part connected calling an API. If a new user wants to access the website, then he/she must

register into the website first and then they can access the data on the website. Already registered users can login to the website and access the data because their details are stored in the database. Users can check which degree programs in which university is eligible to apply them. For that they need to enter their district, stream, subjects, and z-score in the form that given on the website. Also, if they want, they can give their preferences to filter the degree programs. Users can give their comments for us using the comment section also.

8) Evaluation

Using Root Mean Square Error (RMSE) and Mean Absolute Error (MAE) calculated the error value of the system. The square root of the mean of the square of all the errors is the RMSE. The RMSE error measurement is widely used, and it is regarded as a good general-purpose error meter for numerical forecasts. RMSE is a strong indicator of accuracy.

$$RMSE = \sqrt{\frac{1}{n} \sum_{i=1}^n (S_i - O_i)^2}$$

Where,

O_i= Observations

S_i = Variable values that are predicted

n = the number of observations that can be analysed

MAE is the most basic measure of prediction accuracy. The MAE is just the average of the absolute mistakes, as the title indicates. The absolute error is defined as the absolute amount of the variance in between predicted and actual value. MAE is a metric that assesses the accuracy of continuous variables. The MAE shows us how large of an error we may assume on average from the prediction. The MAE measures the average size of errors in a series of forecasts without considering its distribution. The MAE is the average of all absolute differences among forecast and

actual observation over the sample set, in which all individual deviations are given equal weight. The average model forecasting error is expressed as the number of the variable of interest for both MAE and RMSE. The MAE can be anywhere between 0 and ∞ and is unconcerned about the source of errors.

$$MAE = \frac{1}{n} \sum_{i=1}^n |S_i - O_i|$$

Where,

O_i = Observations

S_i = Variable values that are predicted

n = The number of observations that can be analysed

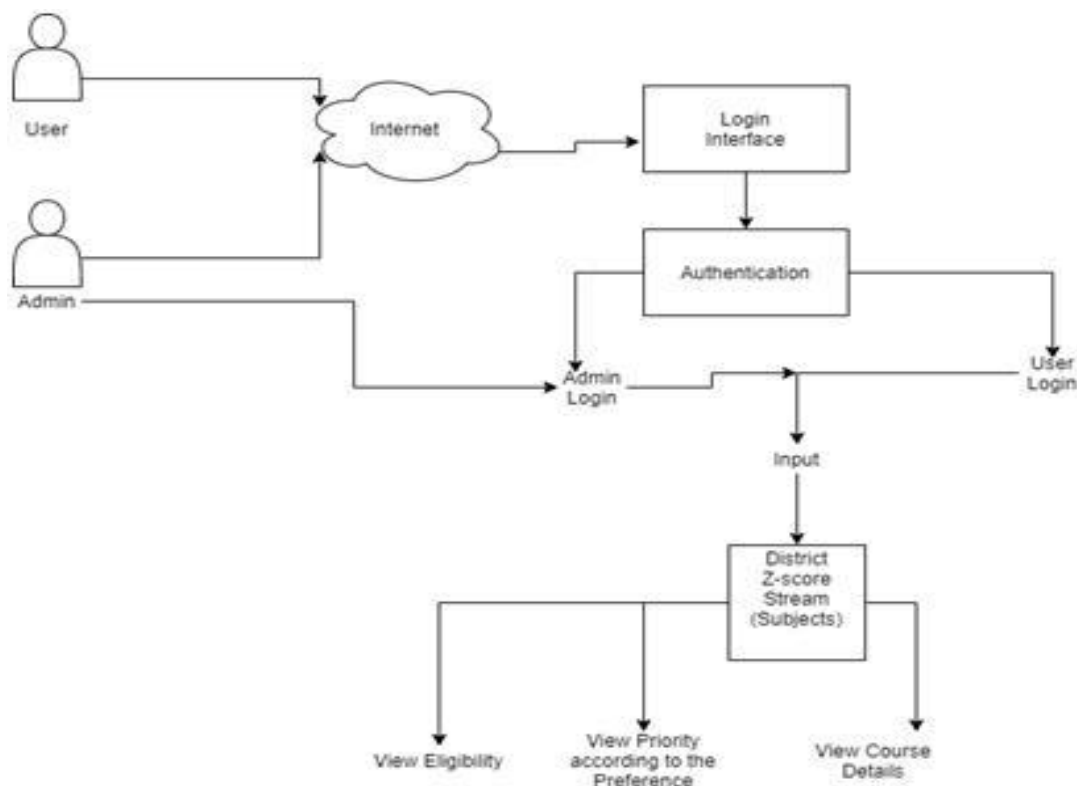


Figure 1 Top Level Architecture Diagram of the System

This top-level architecture diagram shows that how the system is working briefly.

RESULTS AND EVALUATION

Using exponential linear regression algorithm predicted the 2020 z-score values.

District_Puttalam	District_Ratnapura	District_Trincomalee	District_Vavuniya	2019Z-Score	2020Zscore
0	0	0	0	2.0630	1.966897
0	0	0	0	1.9771	1.893448
0	0	0	0	1.8596	1.529188
0	0	0	0	2.1944	2.089449
0	0	0	0	1.8628	1.752201

Figure 2 Predicted 2020 Z-score Values

During the evaluation process various results obtained based on the stream, district, subjects, z-score, and preferences.

Using the actual 30 dataset did the result evaluation. Then all of the results were corrected according to the users.

The figure 3 display the degree list following the details in the below.

Z-score - 1.9675

District – Colombo

Stream – Physical Science

Subjects – Combined Mathematics, Chemistry, Physics

University Preferences -University of Colombo, University of Kelaniya, University of Moratuwa
Specialized Area Preferences – Engineering, IT

Degree	University	Z-score 2019	Z-score 2020
Engineering	University of Moratuwa	2.1944	2.089449049
Engineering (EM)	University of Moratuwa	1.8628	1.752201284
Engineering (TM)	University of Moratuwa	1.8473	1.758518077
Computer Science	University of Kelaniya	1.702	1.587967807
Computer Science	University of Colombo School of Computing	1.7533	1.679135863
Transport & Logistics Management	University of Moratuwa	1.7772	1.673382154

Figure 3 Predicted Results In terms of RMSE, calculating the square

Root of the average squared errors does have some intriguing consequences because the errors are squared before being averaged; the RMSE provides huge errors are given a lot of weight. As a result, the RMSE should be much more effective when huge errors are extremely undesired. RMSE has the advantage of treating large errors more severely, which makes it more suitable in some situations. To calculate the error value first predicted the 2019 z-score values. Then calculated the error value for 2019 z-score values. The calculated RMSE is 0.282554 and MAE is 0.131141.

$[MAE] \leq [RMSE]$. The RMSE value would always be greater than or equal to the MAE value. $RMSE=MAE$ if all of mistakes were from the same amount.

Furthermore, RMSE values among 0.2 and 0.5 indicate that the model can reasonably forecast the data, according to a rule of thumb. Also, in MAE if the error value is between 0 and ∞ , then that model is acceptable. Therefore, this system is acceptable.

CONCLUSION

University Eligibility Checking System is developed with the aim of design a website for the students who apply for the

government universities to predict which degree program of which university is eligible for the user by using the ML. This would result in traditional document creations and candidates can choose a degree according to their favour. Also assisting parties in saving the time and other essential resources.

The proposed solution is developed using exponential linear regression algorithm. Python libraries like pandas and Num Payer used to implement the proposed solution and it's an acceptable because the RMSE value is 0.282554.

The proposed solution will be provided efficient results and will be cost effective to the users through predicted z-score values and automated university eligibility results.

The limitation of this project is there is only 5 years past data therefore some newly introduced degree programs haven't enough dataset.

The system is set up as a web application, allowing users to access it quickly. But most of the students don't have a laptop or desktop to access this web application. Therefore, for the future enhancement in addition to the web application mobile app

will develop. Then most of the student can access this system and use it effectively.

The proposed system is considered only the student's z-score and their preferences. But in the current process UGC consider about the extra-curricular achievements like national level achievements in sports and dharma chary examination achievements. Therefore, if one student's z-score is low and he/she is not eligible for any university, then they can earn more marks from their achievements. This fact will consider in the future development of the proposed solution.

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