
# Complex Engineering Problem (Report):

# Electronics Engineering GPA Predictor System

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May 28, 2024

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## Abstract

In education system evaluation and prediction of student performance is a challenging task. This research paper proposes a model to predict student achievement in an academic organization.Algorithm uses machine learning. The study examines many traits or "features" to identify those that correspond with student success. Finally, the experiment results demonstrate the effectiveness of machine learning in this application. In perspective of this project we are going to predict the student development and examine the greater result through machine learning algorithm. We foresee the student performance by scanning their previous academic and other details. To execute this prediction we have created a dataset of students, by using datase we can predict student CGPA.

# CHAPTER 1 LITERATURE REVIEW

## 1.1 Project overview

The proposed project involves the development of the machine learning model. The model will utilize the academic,behavioral and demographic results of the students, stored in a CSV format, to predict the GPA of a student. Numerous studies have explored the use of machine learning techniques in education. These studies aim to identify high-risk students and discover factors influencing their performance. Students are the major strength for numerous universities. Universities and students play a significant part in producing graduates of superior calibers with its academic performance accomplishment. However, academic performance achievement changes as various sort of students may have diverse degree of performance achievement.

## 1.2 Traditional approaches

Traditionally, GPA prediction depended on linear and logistic regression models. These models employ prior academic data such as previous grades, attendance records, and demographics. Traditionally, GPA predictions were based on linear and logistic regression models. These models employ historical academic data, such as prior grades,

attendance records, and demographic information, to forecast future academic success.[1] Recent advances in this area have concentrated on ensemble learning methods and deep learning. Ensemble approaches like random forests and gradient boosting machines aggregate predictions from numerous base models to increase accuracy and durability while deep learning approaches, such as convolutional neural networks (CNN) and recurrent neural networks (RNN), are showing ability to effectively identify complexities in educational data.

### 1.3 Machine learnings techniques

Machine learning methods have been more popular for forecasting academic achievement in recent years. Machine learning algorithms excel in capturing complicated, non-linear data relationships, outperforming traditional statistical models, according to studies.Furthermore, hybrid approaches combining ensemble and deep learning have emerged. Stacking is a technique that involves training a meta-learner on the predictions of numerous models (both regular and deep learning models) in order to take use of their diverse capabilities. Furthermore, developments in transfer learning, in which pre-trained models on big datasets are fine-tuned for specific tasks, have sped up progress in sectors with minimal labelled data.

Overall, these developments have enhanced machine learning models' performance while also broadening their applicability to a wide range of complicated real-world issues.[2]

# CHAPTER 2 INTRODUCTION

In the ever-evolving globe of education and technques, the requirement for precise prediction systems to estimate students' GPA has become more vital. Applying the potential of artificial intelligence, this project specifics the creation of an enhanced GPA prediction system that intends to better the academic experience and academic achievement of students. The system will apply machine learning algorithms to forecast students' GPA based on their performance data

## 2.1 Problem objectives

Cumulative Grade Point Average (CGPA) is the aggregate Grade Point Average (GPA) achieved by dividing the total Grade Points (GPs) received in all attempted courses by the total degree-credit hours in those courses. we are required to develop a machine learning system to predict CGPA of a student.

- **Model : Predict CGPA based on acadmic,behavioral and demographic data. .**

## 2.2 Problem description

The cumulative grade point average (CGPA) is a standardized approach for analyzing a student's academic achievement over time. It is frequently used in educational institutions throughout the globe to deliver an objective evaluation of a student's academic achievement.

### Calculation

CGPA is commonly established via finding the weighted average of grade points acquired in all courses for a specific time period, often a semester or a complete academic year .The formula of GPA is:

$$\text{CGPA} = \frac{\sum(\text{Grade points} \times \text{Credit Hours})}{\sum \text{Credit Hours}}$$

where the grade points for each course are multiplied by the amount of credit hours given to the course, and the sum of these products is divided by the student's overall number of credit hours.

### Significance

CGPA, which averages scores across numerous courses and semesters, provides a more complete picture of a student's success than individual marks. It is widely used for:

- **Acadmic Evaluation** Institutions apply CGPA to evaluate a student's academic standing, eligibility for honors or prizes, and to identify individuals who may need academic support.
- **Admissions**CGPA is an essential requirement in entrance to higher studies or professional programs since it shows a student's total academic achievement.
- **Employment:** Employers may use CGPA to assess a candidate's diligence, consistency, and long-term academic performance.

### Conversions and comparisons

For students who switch between universities with different grading systems, CGPA transformation tools and standardization methods are employed to convert grades

into an identical format. This provides neutrality when judging academic performance across educational systems.

Overall, CGPA is a significant gauge in academic settings, providing information about a student's performance and potential for future accomplishments.[3]Figure 2.1 illustrates the flow chart of the GPA predictor system. The system's workflow is graphically illustrated, highlighting the numerous phases and activities involved in forecasting GPA. Each component and its linkages are depicted, offering a detailed picture of the system's operation. The flow chart acts as a vital reference for understanding the system's functioning and assists in presenting its complexity in a clear and straightforward way.

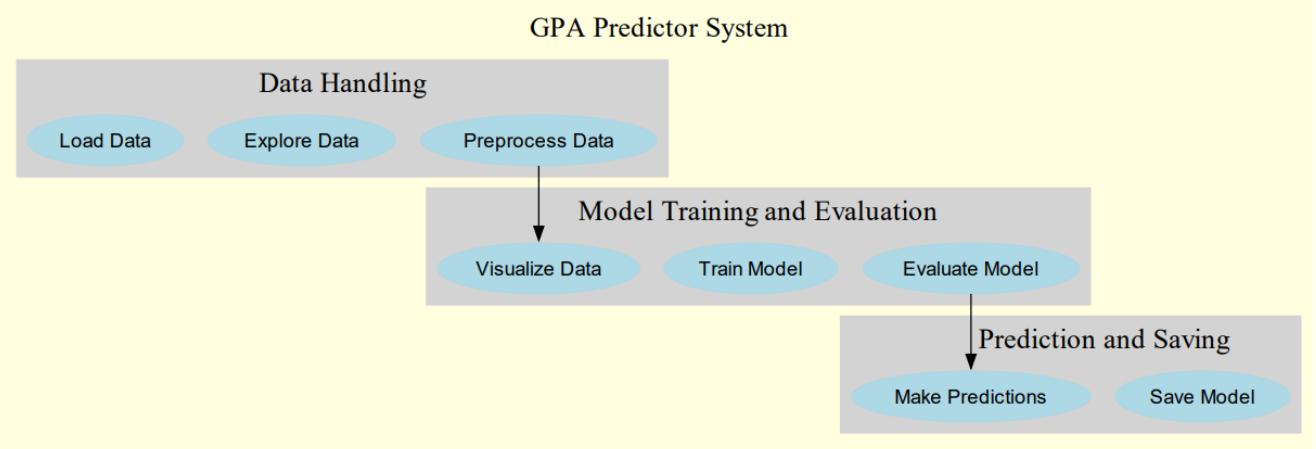


Figure 2.1. Flow chart of CGPA predictor system:

# CHAPTER 3 SYSTEM ARCHITECTURE AND DESIGN

## 3.1 Data collection

Data collecting is a vital part of the GPA prediction system. The system collects data from a variety of sources, including academic records, demographic information, and other pertinent elements. The key data sources are:

- **Acadmic records**:GPA,Course load,entrance exam score ,Matric and inter marks.
- **Behavioral data**:Character status,parental education,access to resources and health.
- **Demographic data**:Age,gender and participation in different activities

## 3.2 Data exploration

First,we import all the necessary libraries and load our dataset named `students_data.csv`. We then explore it using the `head()` function to inspect the first few rows, followed by the `info()` function to gather insights about the dataset's structure. Additionally, we check for missing values in the dataset using the `isnull().sum()` function.[4]

## 3.3 Data processing

After exploring the data, it's essential to preprocess it to ensure it's suitable for model training. This involves handling missing values, distrencoding categorical variables, and scaling numerical features.Figure 3.6 depicts the distribution of CGPA (Cumulative Grade Point Average) among the students. The histogram depicts the frequency

distribution of CGPA values, offering insights into the general performance distribution among the student population.[5]

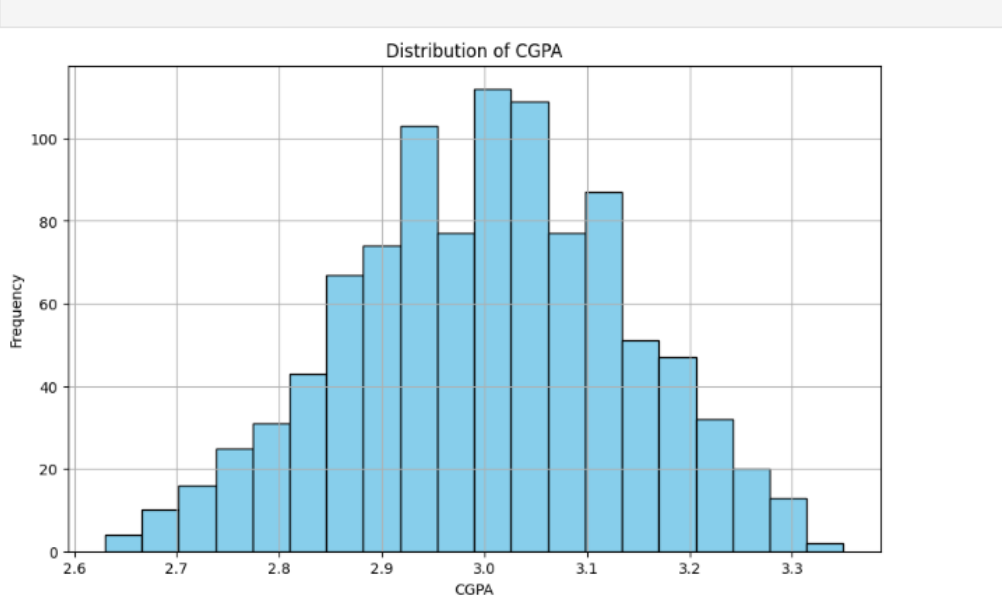


Figure 3.1. CGPA distribution

And now we will see relationship of study hours for male and female .The distribution is depicted in histogram shown below in Figure3.6.

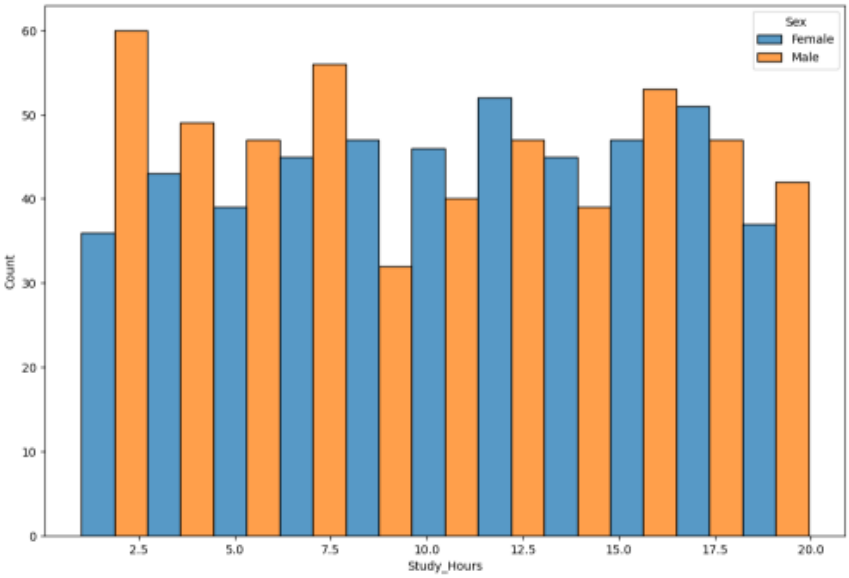


Figure 3.2. Distribution of study hours by gender

We will look at the figure below to see where students tend to get higher CGPA values. This density plot gives information about the distribution of CGPA values across the dataset, indicating places where students succeed academically.

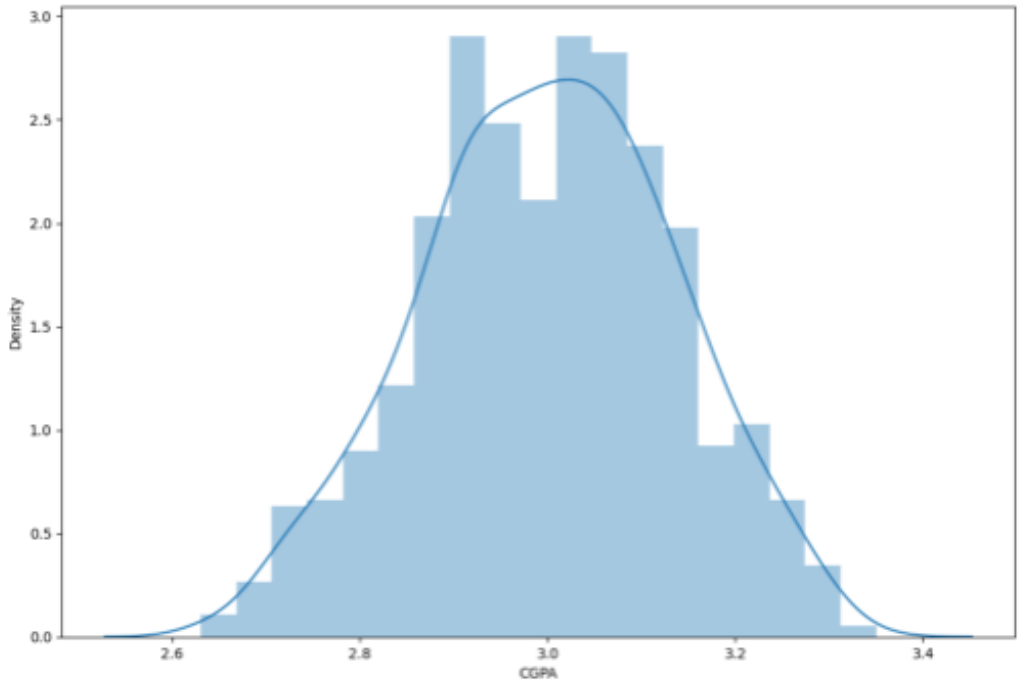


Figure 3.3. Density plot of CGPA distribution

For a student to succeed academically, attendance and CGPA (Cumulative Grade Point Average) are essential components of their academic path. .The scatter plot 3.6 below visualizes the association between students' attendance and their corresponding CGPA (Cumulative Grade Point Average). Each data point represents an individual student, with their attendance percentage plotted against their CGPA score.A clear pattern can often be noticed, showing that better attendance rates connect with higher CGPA scores. This shows that students who attend classes regularly tend to perform better academically. Regular presence ensures that students are more involved with the course material, join in conversations, and receive quick comments on their progress. Conversely, students with lower attendance may miss important knowledge

and fall behind, badly impacting their CGPA.

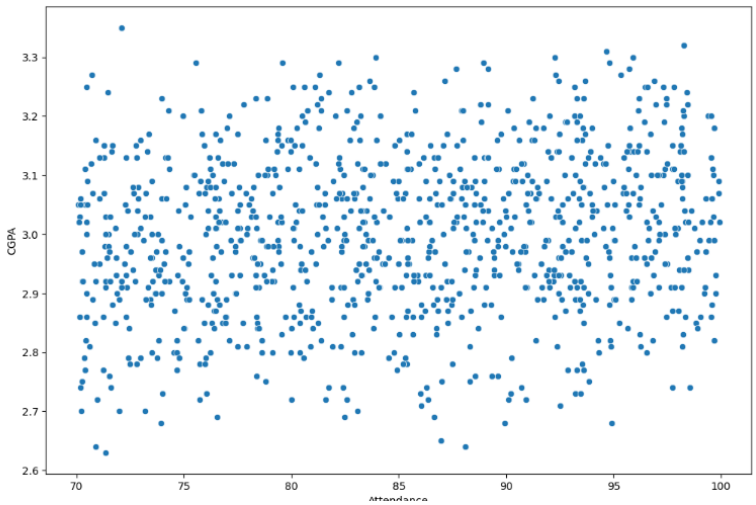


Figure 3.4. Scatter plot of attendence vs CGPA

### 3.4 Model selection and training

The model's performance is summarized with the training score, testing score, and root mean square error (RMSE) displayed in the table below.

| Metric | Value |
|---|---|
| Training Score | 0.99 |
| Testing Score | 0.99 |
| RMSE | 0.002895 |

Table 3.1. Model performance metrics

```
from sklearn.preprocessing import LabelEncoder
data['Sex']=LabelEncoder().fit_transform(data['Sex'])
target = 'CGPA'
# X will be the features
X = data.drop(target,axis=1)
#y will be the target variable
y = data[target]
from sklearn.model_selection import train_test_split
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.1, random_state=42)
from sklearn.linear_model import LinearRegression
model = LinearRegression()
model.fit(X_train, y_train)
```

```
LinearRegression
LinearRegression()
```

Figure 3.5. Model selection

The dataset's correlation analysis provides useful information on the connections

between different numerical features. We are able to comprehend the interconnections between these features on a deeper level by computing the correlation matrix and visualizing it as a heatmap.[6] Figure 3.6 shows the correlation heatmap below.

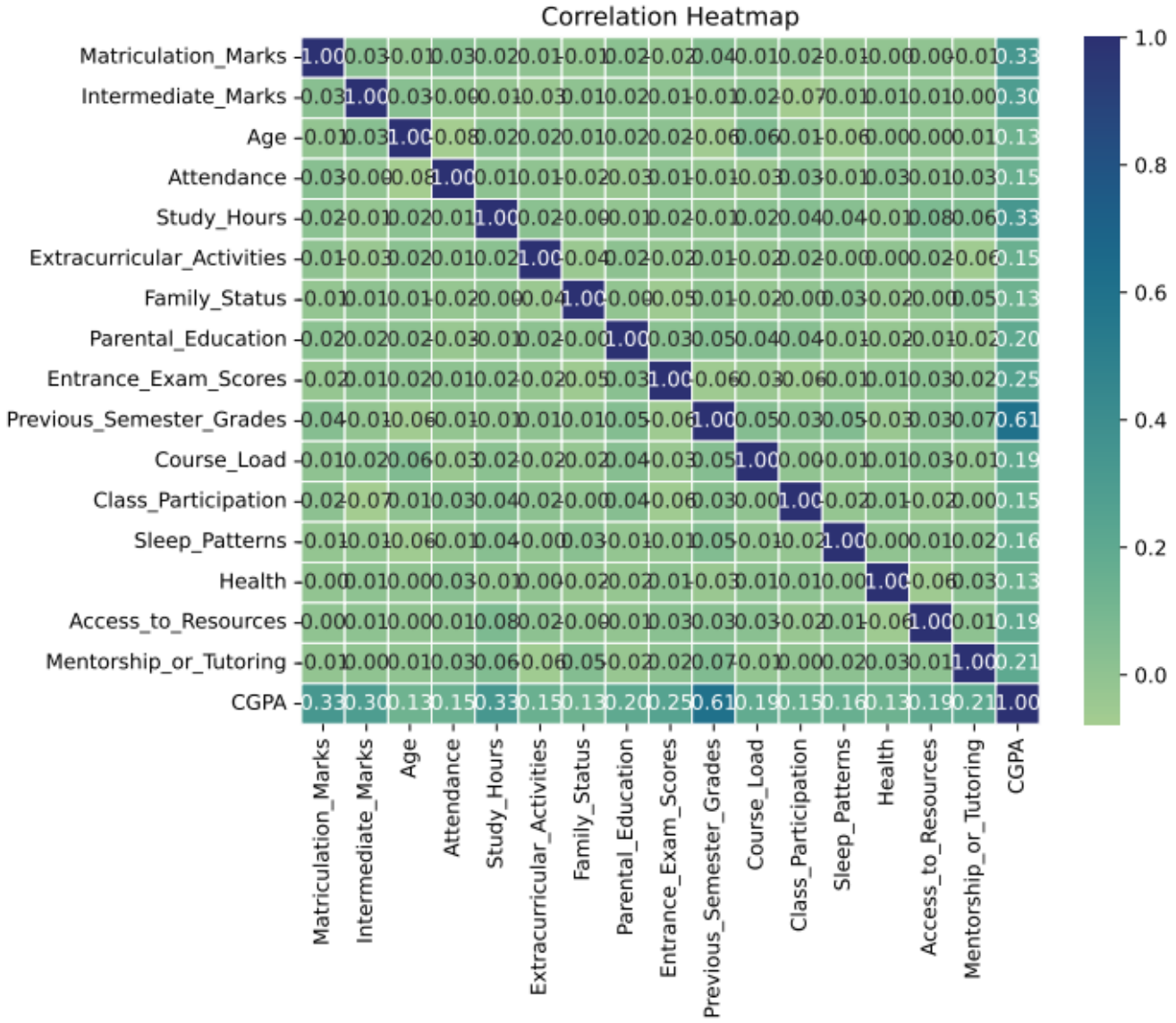


Figure 3.6. Correlation heatmap

# CHAPTER 4 RESULTS AND DISCUSSION

## 4.1 Actual vs predicted CGPA

Based on multiple criteria the proposed GPA predictor method that uses linear regression shows promising perforvmance in predicting students' CGPA. It's crucial to remember that the accuracy and applicability of the input data may have an impact on the model's predictions. For practical application in educational institutions, the model's accuracy and dependability can be improved through ongoing validation and refining using more data.The outcomes are shown in the histogram below.

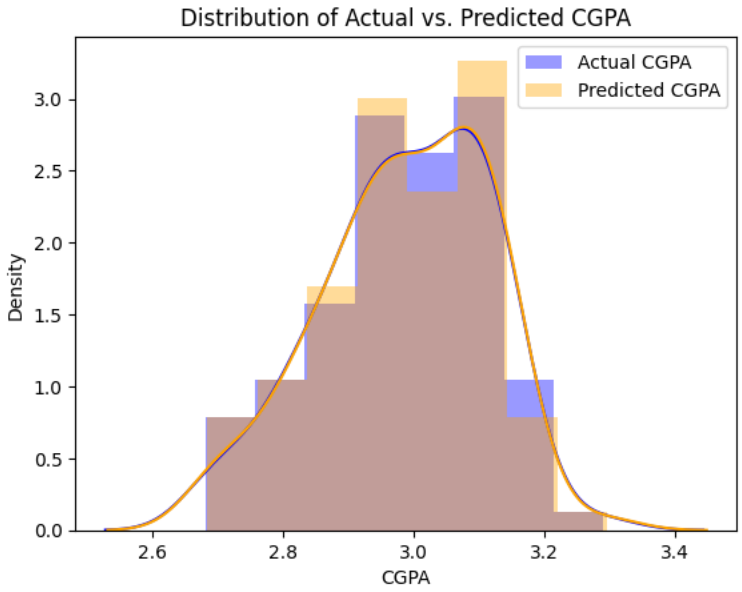


Figure 4.1. Distribution of actual vs predicted CGPA

## 4.2 Deployment

We can finally use the Spyder for Flask app to deploy our system after a successful evaluation.The Gui interface for web application is shown below.

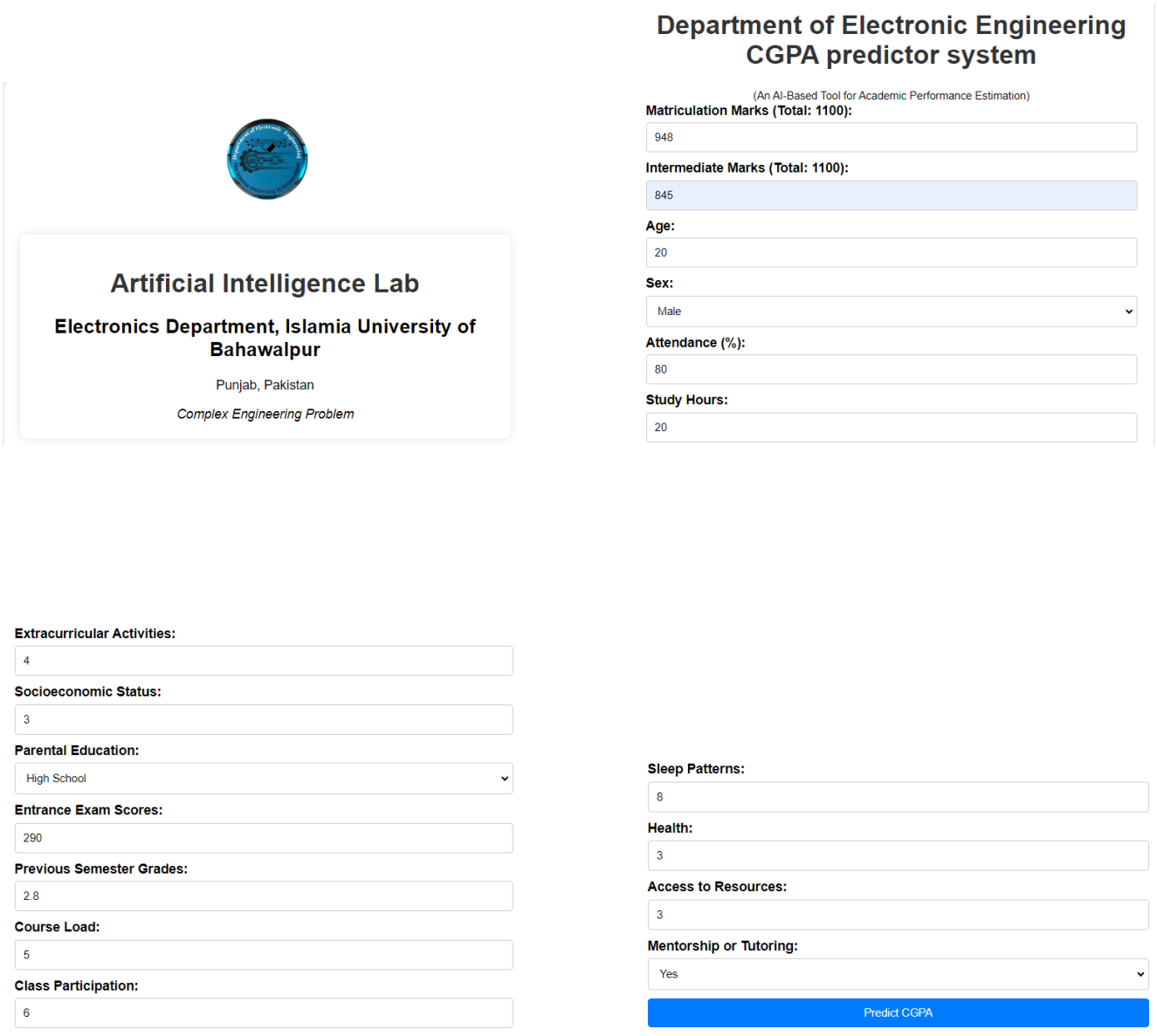


Figure 4.2. Gui interphase of CGPA predictor system

# CHAPTER 5 CONCLUSION

In conclusion, a big step toward using artificial intelligence for academic performance has been taken with the creation of an Electronics Engineering GPA Predictor System. The system combines historical data, machine learning models, and semester-specific performance measurements in an effort to give educators, students, and educational institutions insightful forecasts and insights. The project's goal is to provide a reliable and user-friendly system that improves students' academic performance and experience through diligent planning, research, and implementation.The analysis of students' academic progress using machine learning approaches is the main emphasis of this system. This procedure can make it easier for the teacher to assess each student's performance and plan a more effective study plan. .

## Bibliography


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