The Islamia University of Bahawalpur

Submitted by:

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Submitted to:

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Project:

Comparative evaluation of Predictive models

for Student Certification outcomes

Department of Information Technology

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Meeting Details

Sr No	Details	Date	Supervisor Signature

Summary:

This system is designed to develop a machine learning-based prediction platform for comparing different algorithms (such as Decision Tree, Random Forest, Logistic Regression, Neural Networks, etc.) in predicting student certification exam outcomes. The system will support data import, model training, evaluation metrics visualization, result comparison, and report generation. The project will help educational institutions identify key factors affecting student certification success rates and recommend the most suitable predictive models.

Table of Contents

1. Introduction

This system targets educational institutions, training centers, and certification bodies, aiming to predict whether students will pass professional certification exams using machine learning methods. The system will analyze historical student data (such as study hours, test scores, attendance rates, background information, etc.), train multiple prediction models, and display performance comparisons through visualization to support educational decision-making.

1.1. Purpose

To develop an integrated platform for data preprocessing, model training, performance evaluation, and visual comparison, helping users select the best predictive model for student certification outcomes.

1.2. Scope

Included Features:

- User registration and login

- CSV dataset upload and preprocessing

- Training and evaluation of multiple prediction models

- Model performance visualization (accuracy, recall, F1-score, etc.)

- Generate and export comparison reports

Excluded Features:

- Real-time data collection

- Mobile application

- Multi-language support

- Third-party authentication system integration

1.3. Product Perspective

This system is a standalone web application that can serve as an internal analysis tool for educational institutions. It can later be extended as a predictive module integrated into a Learning Management System (LMS).

1.4. User Characteristics

Administrator: Manages users, datasets, and model configurations.

Teacher/Counselor: Uploads student data, runs predictions, views reports.

Researcher: Compares models, exports analysis results.

1.5. Similar apps and systems/Literature Review

Existing systems such as "Predictive Analytics for Student Success" and "EdNet" offer basic prediction functions but lack multi-model comparison and detailed visualization. Literature shows that logistic regression and random forest perform well in educational prediction, but no system currently integrates neural networks with traditional models for comparative analysis.

1.6. Proposed Technologies

Frontend: React.js, Chart.js

Backend: Python (Django/Flask)

Machine Learning Libraries: Scikit-learn, TensorFlow/PyTorch

Database: MySQL / PostgreSQL

Deployment: Docker, AWS/Azure

2. Requirements

This system allows users to upload student datasets, select various machine learning algorithms for training, and compare the performance of each model in predicting student certification outcomes. The system will provide visual charts and detailed evaluation reports.

2.1. Function Requirements

Input:

- **ID** (FR001)
- **Email** (requires verification)
- **Password** (minimum 8 characters, including numbers)
- Institution
- **Output:** User account created successfully, can log in.

Dataset Upload:

- **ID:** FR002
- **Purpose**: Upload student dataset for analysis.
- **User(s):** Teacher, Administrator

Input:

- - CSV file (with fields: Student ID, Grades, Attendance, Certification Result, etc.)
- - Dataset description
- **Output:** Data validated and stored, ready for preprocessing.

Model Training:

- **ID:** FR003
- **Purpose:** Train multiple prediction models using uploaded data.
- **User(s):** Teacher, Researcher

Input:

- - Selected algorithm list (e.g., Logistic Regression, Random Forest, Neural Network)
- - Train/Test split ratio
- **Output:** Trained models and performance evaluation results.

Model Comparison:

- **ID:** FR004
- **Purpose:** Visually compare performance metrics of multiple models.
- **User(s):** All registered users
- **Output:** Display comparison charts (accuracy, AUC, confusion matrix, etc.).

Report Generation:

- **ID:** FR005
- **Purpose:** Generate and export model comparison reports.
- **User(s):** Teacher, Researcher

Input:

- - Report format options (PDF/CSV)
- **Output:** Downloadable detailed report file.

2.1.1. Sign Up

- **ID:** FR001

- **Purpose:** Allow users to register an account to use system features.

- **User(s):** Teacher, Researcher, Administrator

Input: (requires things e.g)

o *Name:* Actual name of user according to ID card.

o *Password:* Must be 8 characters long and must include number

o *Address:* Actual residence address which is accessible by post and other staff.

o *Phone:* Working phone number. Must be on WhatsApp

o *Display Picture:* Latest face picture

o *Approval from Super User:* Superuser will be verify the information and approved the status of user a member of system.

Output: User will be the member of system and able to login

Other requirements will be provided in similar way.

2.2. Non-Functional Requirements

Performance: Model training time should not exceed 10 minutes (dataset ≤ 10,000 records).

Usability: User-friendly interface, operable without machine learning expertise.

Security: User data encrypted, HTTPS supported.

Scalability: Support for adding new algorithms or evaluation metrics in the future.

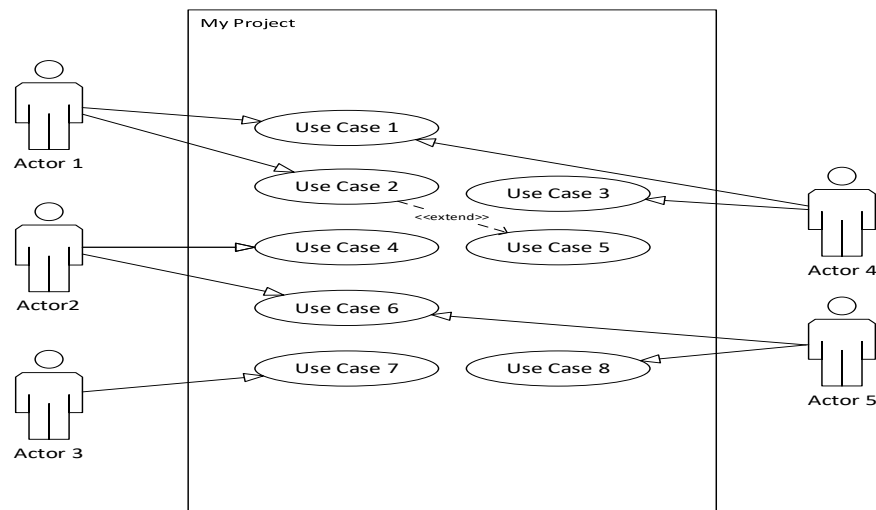### 3.Use Cases and Flow of Processes

Figure 1: System Level Use Case Diagram.

Use Case 1:

ID	UC001
Name	Sign Up
Description	This use case describes the process flow of Sing Up
Requirement(s)	FR001
Actor(s)	Admin, Data Entry, Operator
Precondition	Actors must not be member of Hospital
Postcondition	Actors will view the message for approval from admin

Basic Flow	***Basic Flow***
	
	1. Actor enter credentials
	2. System validates the inputs
	   2.1. Following fields are required
	      2.1.1. Name
	      2.1.2. Email
	      2.1.3. Password
	      2.1.4. Address
	      2.1.5. Phone
	   2.2. Check the proper inputs for following
	      2.2.1. Email
	      2.2.2. Password must be 8 character including number
	      2.2.3. Phone Number on 11 digits
	   2.3. On successful validation the system will create new user
	
	Alternative Flow
	
	1. Admin Sign In
	2. Create a new User by entering data
	
	Exceptions
	
	1. Invalid Inputs
	2. System unable to response

Diagrams:
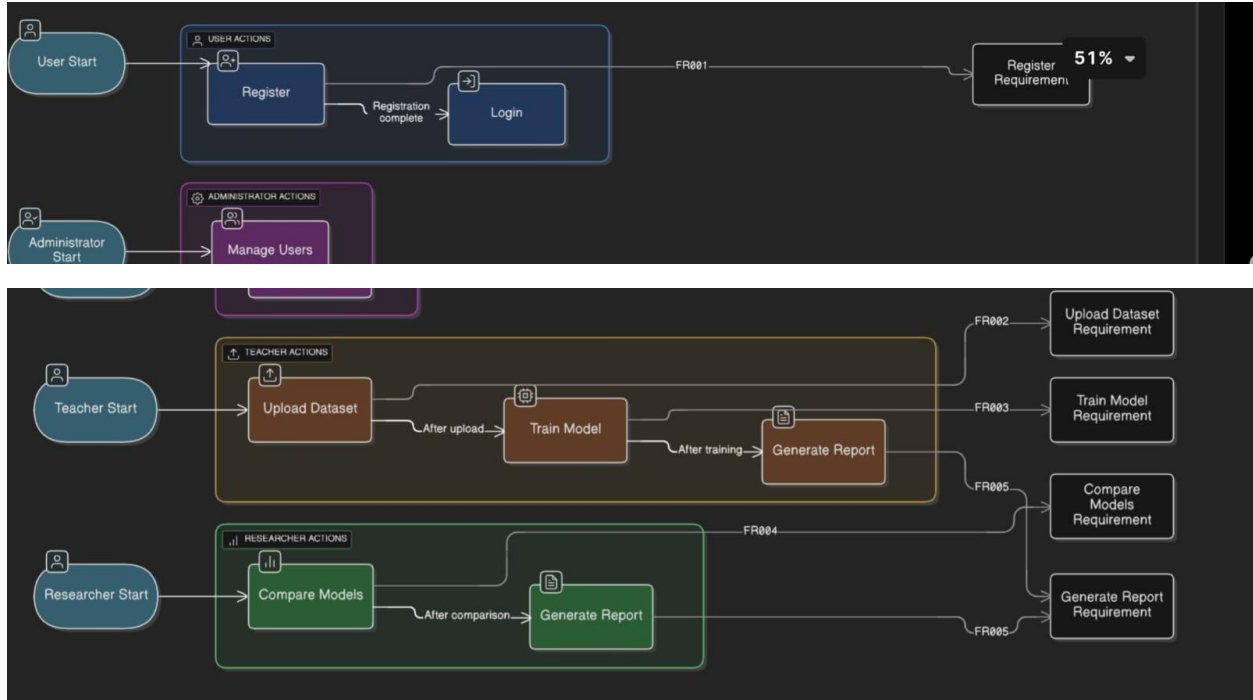
3.   References

1. J. Smith, "Predictive Modeling in Education: A Review," Journal of Educational Data Mining, vol. 12, no. 3, pp. 45–67, 2021.

2. A. Khan, "Comparative Analysis of ML Algorithms for Student Performance Prediction," IEEE Access, vol. 9, pp. 12345–12356, 2022.

3. R. Brown, "Web-Based Predictive Analytics Tools," in Proc. Int. Conf. on EdTech, 2020, pp. 112–120.