EduBot: Deliverable 1

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System Vision

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Problem Statement

Over the past 4 years, using chat-bots and Large Language Models (ChatGPT, Gemini, Claude, etc.) with different kinds has become more popular and mainstream between people across different disciplines and fields. Students across various level academic levels tend to use them more often as such chat-bots can help with their learning process, assignments, projects, and giving them tips and support to increase their academic performance. However, most chat-bots have some short-comings:

1. They cannot give statistically based predictions for test scores as an example, as LLMs cannot reason in general and, generally speaking, are just probabilistic next word predictors.

2. Most LLMs aren't trained for a specific domain and are more general case usage, so most answers they generate have tendency to be broad and general in meaning, words, etc. And most domain specific LLMs have pricey subscriptions which would be difficult for students to afford with little to no presence of LLMs trained or fine-tuned specifically for providing academic-assistance to students.

EduBot can provide students with personalized recommendations to help them improve their academic performance and study habits. EduBot uses an actual Machine Learning Statistical Model to give accurate predictions for inquiries about tests, exams, and assignments scores.

System Capabilities

Results Prediction

If a student asked for a test score prediction and provided related details such as their study per week time, teacher and course's quality, previous scores, their personal motivation level, sleep hours, etc, EduBot uses a Machine Learning Model that utilizes such features to make a statistically accurate prediction of the students' results and scores in the future.

Academic Performance Improvement

EduBot utilizes a powerful LLM which is continuously fine-tuned specifically to give each student personalized recommendations based on their desired goals and targets, whether it is to help them pass through a course, ace a course, or even assistance with their thesis!

User Stories

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Student

"As a student, I want to get accurate predictions for my future exams' scores, so that I know if my study habits are good or bad."

- **Acceptance Criteria:**
    1. Ensure the Machine Learning model to be trained on high quality data.
    2. The model must be frequently optimized on fresh new data from the users.

"As a student, I want to get recommendations for different study techniques and tools, so that I can improve my study effectiveness."

- **Acceptance Criteria:**
    1. The LLM should be fine-tuned on data specialized in studying, academic performance improvement, mental health, and latest technologies, tools and study techniques.

"As a student, I want to get personalized recommendations based on my past performance and habits, so that I can improve my course grades and scores."

- **Acceptance Criteria:**
    1. The LLM should retain chat memory and use it.
    2. The LLM should be frequently fine-tuned on it's users' data.

"As a student, I want assistance with my assignments and reports, so that I can get higher marks."

- **Acceptance Criteria:**
    1. The LLM should be able to assist with writing, problem solving, and analysis.

Academic Advisor

"As an academic advisor, I want to access insights on my students study habits individually, so that I can provide better guidance."

- **Acceptance Criteria:**
    1. The chatbot should be able to display a student study habits and details given the Student ID.

Professor/Teacher

"As a professor/teacher, I want to view information of the students in my class, so I can adjust my teaching approach if needed."

- **Acceptance Criteria:**
    1. The chatbot should be able to display a student study habits and details given the Student ID.

"As a professor/teacher, I want to view aggregated data on study habits and opinions of the students in my class, so I can adjust my teaching approach if needed."

- **Acceptance Criteria:**
    1. The chatbot should be able to view aggregated student data in certain class given the Class ID.

Event Decomposition

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Event Decomposition Step by Step

1. Student Provides Their Information

"This is an external event where the student provides their personal information to be stored in the system."

- **Checklist Verification:**
  1. External agent wants something resulting in a transaction.
  2. Data has changed and needs to be updated.
- **Type**: External
- **Actor**: Student
- **Trigger**: Student submits information for the first time or during interactions with the bot.
- **Use Case**: Storing student information.

2. Student Provides New Information

"This event occurs when a student updates their existing information in the system."

- **Checklist Verification:**
  1. External agent wants some information.
  2. Data has changed and needs to be updated.
- **Type**: External
- **Actor**: Student
- **Trigger**: Student updates their existing information.
- **Use Case**: Updating student information.

3. Student Asks for Score Prediction

"The student requests a prediction of their exam or test score based on their provided details."

- **Checklist Verification:**
  1. External agent wants some information.
- **Type**: External
- **Actor**: Student
- **Trigger**: Student requests score prediction.
- **Use Case**: Predicting exam/test scores.

4. Student Asks for Study Recommendation/Tool/Technique

"The student seeks recommendations to improve their study techniques and performance."

- **Checklist Verification:**
  1. External agent wants some information.
- **Type**: External
- **Actor**: Student
- **Trigger**: Student requests study recommendations.
- **Use Case**: Recommending tools/techniques/tips.

5. Student Asks for Academic Assistance

"The student requests help with specific academic tasks like assignments or reports."

- **Checklist Verification:**
  1. External agent wants some information.
- **Type**: External
- **Actor**: Student
- **Trigger**: Student requests assistance with assignments.
- **Use Case**: Writing/Reporting/Solving assistance.

6. Academic Advisor/Professor Asks for a Student's Study Information/Details

"An academic advisor or professor requests specific study details of a student for guidance purposes."

- **Checklist Verification:**
  1. External agent wants some information.
  2. Management requires specific information.
- **Type**: External
- **Actor**: Academic Advisor/Professor
- **Trigger**: Advisor/professor queries a specific student's details.
- **Use Case**: Displaying student information.

7. Professor Asks for Class Statistics/Reviews

"A professor requests aggregate data on students in a class to adjust teaching methods."

- **Checklist Verification:**
  1. External agent wants some information.
  2. Management requires specific information.
- **Type**: External
- **Actor**: Professor
- **Trigger**: Professor requests class aggregate data.
- **Use Case**: Displaying class statistics/reviews.

8. Time for Machine Learning Model Optimization

"This temporal event triggers the scheduled optimization of the Machine Learning model."

- **Checklist Verification:**
    1. Internal outputs needed.
- **Type**: Temporal
- **Trigger**: Scheduled optimization time.
- **Use Case**: Retraining/optimizing Machine Learning model.

9. Time for the LLM Fine-Tuning

"This temporal event triggers the fine-tuning of the LLM based on new data."

- **Checklist Verification:**
    1. Internal outputs needed.
- **Type**: Temporal
- **Trigger**: Scheduled fine-tuning time.
- **Use Case**: Fine-Tuning LLM on new data.

10. Label Training Data as Used

"This state event updates the training data's status after it has been processed."

- **Checklist Verification:**
    1. Change in the system's data state.
- **Type**: State
- **Trigger**: New data processed.
- **Use Case**: Updating training data labels.

Events & Use-Cases Table

Table 1: Events and their respective use cases for Edubot

Event	**Event Type**	**Source**	**Use Case**
Student provide their information	External	Student	Storing students information
Student provides new information	External	Student	Updating student information
Student asks for score prediction	External	Student	Predicting exam/test scores
Student asks for study recommendation/tool/technique	External	Student	Recommending tools/techniques/tips
Student asks for academic assistance	External	Student	Writing/Reporting/Solving assistance
Academic Advisor/professor asks for a student study information/details	External	Academic Advisor/Professor	Displaying students information
Professor asks for a students details/statistics in a specific class	External	Professor	Displaying class statistics/reviews
Time for the Machine Learning model optimization	Temporal		Retraining/optimizing Machine Learning model on new data
Time for the LLM Fine-Tuning	Temporal		Fine-Tuning LLM on new data
Label training data as used	State		Updating training data labels

Use-Case Description

Table 2: Each use case and a brief description for it

Use Case	**Description**
Storing students information	Edubot extract the student information from input and store it in the database
Updating student information	Edubot extract the student information from input and update it in the database
Predicting exam/test scores	Edubot predicts the student exam score
Recommending tools/techniques/tips	Edubot provides recommendations aiming to improve the student's study habits and performance
Writing/Reporting/Solving assistance	Edubot assistance to the students in their reports/assignments/problems
Displaying students information	Edubot retrieve the student information from the database and display it to the academic advisor/professor
Displaying class statistics/reviews	Edubot retrieve and aggregate the students in a specific class information from the database and display it to the professor
Retraining/optimizing Machine Learning model on new data	Edubot retrieve new training data from the database and feeds it into the Machine Learning model once every specific period of time
Fine-Tuning LLM on new data	Edubot retrieve new training data from the database and feeds it into the LLM for fine-tuning once every specific period of time
Updating training data labels	Edubot update training data from "unused" to "used"

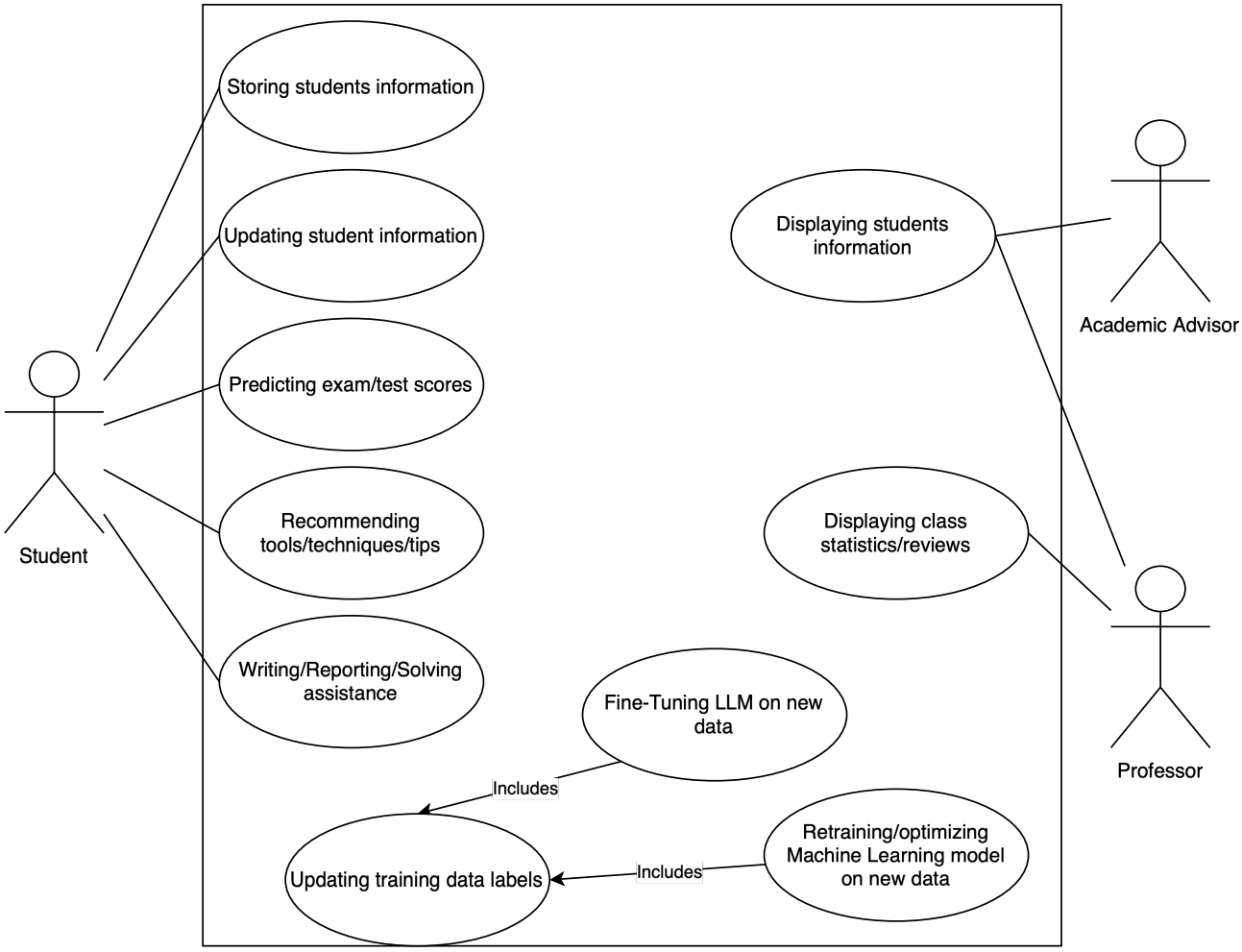

Figure 1: Use Case Diagram