Generative AI with IBM Cloud

Project Documentation: Edu-Tutor AI

1. Introduction

Project Title: EduTutor AI: Personalized Learning with Generative AI and LMS Integration

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2. Project Overview

Purpose: The Edu-Tutor AI project is designed to offer an all-around personal learning aid. Its function is to increase user knowledge in a range of subjects, enhance writing capabilities, broaden vocabulary, enable language translation, and enable self-evaluation using interactive quizzes, making the learning more immersive and effective.

Features:

Chat with Edu-Tutor: A general question-and-answer AI chatbot.

Text Summarizer & Explainer: Summarizes text to varying lengths (short, detailed) or simplifies complex ideas.

Text Refiner: Refines text by grammar checking, spelling, clarity, and conciseness checks.

Word Meaning & Usage: Gives definitions and sample sentences for given words.

Sentence Translator: Translates English sentences into a given target language.

Generate Quiz: Automatically generates customizable multiple-choice quizzes from user-given topics or uploaded PDF files, with varying difficulty levels.

Quiz Scoring & Feedback: Grades submitted quizzes and provides detailed feedback including correct answers and explanations.

Performance Dashboard: Tracks quiz history, identifies "weak areas" based on past scores, and suggests personalized next steps for improvement.

PDF Support: Ability to extract text from PDF files for summarization or quiz generation.

3. Architecture

The Edu-Tutor AI is a monolithic system deployed mainly in Python using a Gradio interface for the frontend and an embedded AI model for primary functions.

Frontend:

Gradio is used to create the user interface. Gradio generates an interactive web-based UI automatically from Python functions with interactive elements like textboxes, buttons, radio buttons, file upload, dataframes, and a chatbot interface. This enables fast prototyping and deployment of machine learning models and data science applications as interactive web applications.

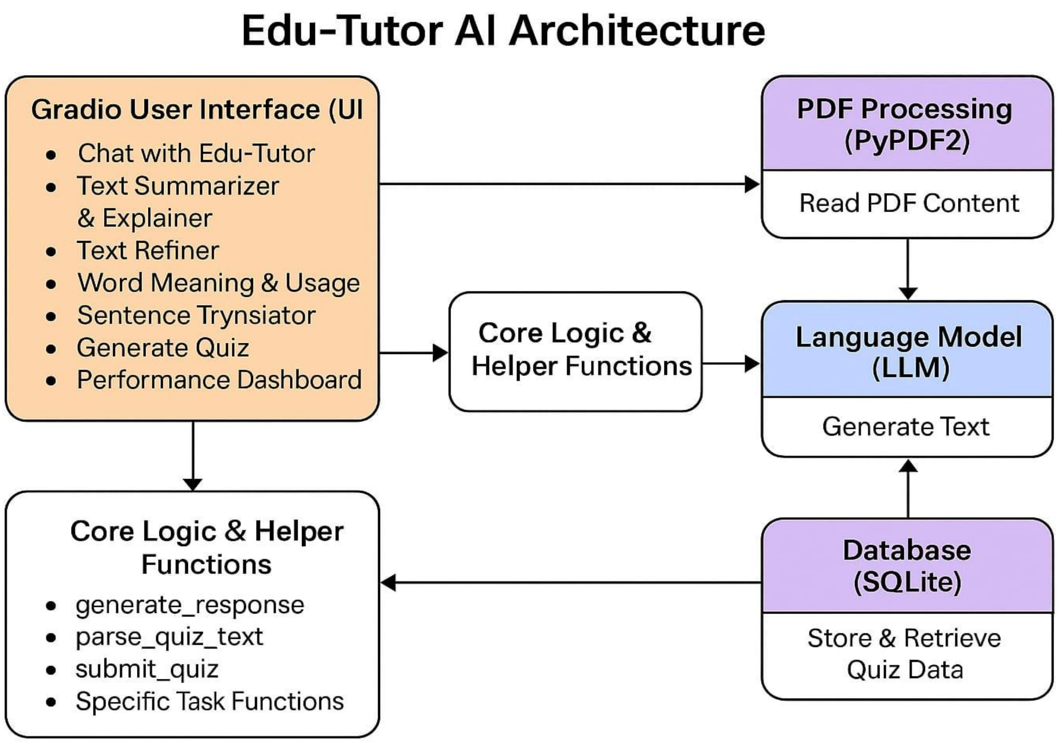
Backend:

- Python does the core logic and processing. This encompasses:
- Interaction with the big language model (IBM Granite).
- Text processing operations (summarization, refinement, translation, word lookup).
- Quiz generation logic, prompt engineering, and parsing AI output.
- Database interactions to store and retrieve quiz results.
- PyPDF2-based PDF text extraction.
- Coordination of all functions displayed in the Gradio UI.

Database:

SQLite3 is employed to persist data locally. The main database (edututor.db) maintains quiz results in a quiz_results table with the following schema:

- **timestamp (TEXT):** On which the quiz was taken.
- **topic (TEXT):** On which the quiz was conducted.
- **difficulty (TEXT):** How hard the quiz was.
- **score (INTEGER):** Number of correct answers.
- **num_questions (INTEGER):** The total number of questions that were being asked in the quiz.



4. Setup Instructions

Prerequisites:

- Python 3.8+
- pip (Python package installer)
- Availability of a machine with adequate RAM and possibly a GPU for best performance with the IBM Granite model.

Installation:

- **Clone the Repository:**

  Bash

  # If the project was in a GitHub repository:

  # git clone [Your GitHub Repository URL]

  # cd edu-tutor-ai # Or whatever the cloned directory is called

- **Install Dependencies:**

  CD into the directory with edututor_ai.py and execute the following commands to install the Python libraries:

  Bash

  pip install -q PyPDF2 transformers accelerate bitsandbytes gradio google-search-results

  pip install -q --upgrade PyPDF2 transformers accelerate bitsandbytes gradio

  pip install gradio transformers torch accelerate PyPDF2 # Make sure all are installed and up-to-date

- **Environment Variables (Optional/Not explicitly used):**

No special environment variables are needed for normal operation according to the given script. Model paths and database names are hard-coded.

5. Folder Structure

```
/EduTutor-AI/
|
├── edututor_ai_personalized_learning_with_generative_ai_and_lms_integration.py  # Main Colab Notebook/Script
|
├── /models/
|   └── (Downloaded automatically via HuggingFace API)
|
├── /database/
|   └── edututor.db            # SQLite database for storing quiz results
|
├── /pdf_uploads/
```

```
|   └── (Uploaded PDFs for quiz generation — temporary in Colab)
|
├── /outputs/
|   └── (Quiz results, weak areas, etc. rendered via Gradio)
|
└── /gradio_ui/
    ├── Chat with Edu-Tutor
    ├── Text Summarizer & Explainer
    ├── Text Refiner
    ├── Word Meaning & Usage
    ├── Sentence Translator
    ├── Generate Quiz
    └── Performance Dashboard
```

6. Running the Application

To run EduTutor AI in **Google Colab**:

1. **Open the Colab Notebook**
   Either from your Google Drive or by uploading the `.py` or `.ipynb` file.
2. **Install Dependencies**
   Automatically handled by the script:

   ```
   python
   CopyEdit
   !pip install -q PyPDF2 transformers accelerate bitsandbytes
   gradio
   ```

3. **Run All Cells**
   Use `Runtime > Run All` to initialize the app. This:
   - Sets up the database (`edututor.db`)
   - Loads the IBM Granite or mock model
   - Launches the full **Gradio interface**
4. **Launch the Interface**
   At the bottom of the Colab output, a `gradio.live` or `localhost` link will appear.
   Click it to access the interactive web app.

7. API Documentation

EduTutor AI uses **internal Python functions** rather than REST APIs, but here's a breakdown of key callable components:

1. `generate_quiz_for_display()`

- **Purpose:** Generates a multiple-choice quiz from a topic or uploaded PDF.
- **Inputs:**
  - `quiz_topic` *(str)*: e.g., "Photosynthesis"
  - `num_quiz_questions_str` *(str/int)*: Number of questions (1–20)
  - `difficulty` *(str)*: `easy`, `medium`, or `hard`
  - `pdf_file` *(file)*: Optional, overrides topic
- **Returns:** A tuple of UI component updates (via `gr.update()`)

2. `submit_quiz(*user_answers)`

- **Purpose:** Evaluates quiz answers and updates UI with feedback
- **Inputs:** User-selected answers (A/B/C/D options)
- **Returns:** Tuple of UI updates for score, feedback, and controls

3. `get_performance_insights()`

- **Purpose:** Analyzes historical quiz performance
- **Returns:**
  - `data`: Raw results from SQLite DB
  - `markdown`: Weak areas in quiz topics
  - `suggestions`: Next steps for learning

4. `summarize_text(input_text, summary_length)`

- **Purpose:** Summarizes or explains text
- **Inputs:**
  - `input_text` *(str)*
  - `summary_length` *(str)*: `short`, `detailed`, or `simple_explanation`
- **Returns:** Streaming markdown output

5. `refine_text(input_text)`

- **Purpose:** Improves grammar, clarity, and style of input text
- **Returns:** Refined text with improvements

6. `get_word_meaning_and_usage(word)`

- **Purpose:** Provides definition and two usage examples
- **Returns:** Text output in markdown format

7. `translate_sentence(sentence, target_language)`

- **Purpose:** Translates input English sentence to selected language
- **Supported Languages:** Hindi, Spanish, French, German, Japanese, Tamil
- **Returns:** Translated sentence

8. Authentication

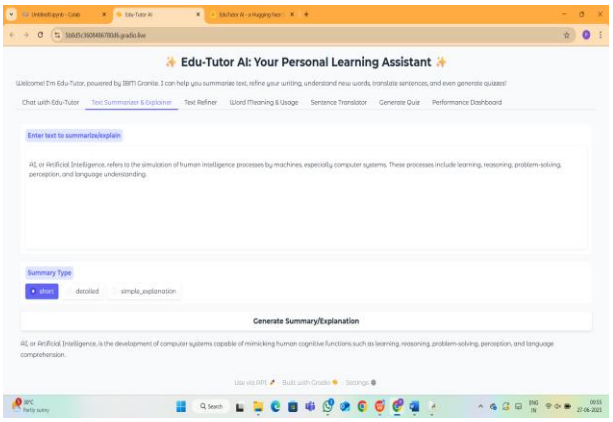
The current version of Edu-Tutor AI does not implement any user authentication or authorization. All functionalities are openly accessible to anyone running the application. There are no user accounts, sessions, or token-based authentication mechanisms.

9. User Interface

The Edu-Tutor AI features a clean, tab-based user interface provided by Gradio.

Main Structure:

The application is separated into some clear-cut tabs so that navigation between functionalities is smooth.



✨ Edu-Tutor AI: Your Personal Learning Assistant ✨

Welcome! I'm Edu-Tutor, powered by IBM Granite. I can help you summarize text, refine your writing, understand new words, translate sentences, and even generate quizzes!

Enter text to summarize/explain

AI, or Artificial Intelligence, refers to the simulation of human intelligence processes by machines, especially computer systems. These processes include learning, reasoning, problem-solving, perception, and language understanding.

Summary Type: [✓ short] detailed simple_explanation

AI, or Artificial Intelligence, is the development of computer systems capable of mimicking human cognitive functions such as learning, reasoning, problem-solving, perception, and language comprehension.

It is the "Chat with Edu-Tutor" tab, where a user has inquired "what is ai" and the AI responded with a thorough answer explaining Artificial Intelligence.

Key UI Elements:

Chatbot: A gr.Chatbot element shows conversational history.

Text Input/Output: gr.Textbox elements for input by users (e.g., questions, text to summarize, words) and gr.Markdown elements to output AI-generated text or answers.

Selection Controls: gr.Radio buttons for choosing summary types, quiz difficulty, or quiz options; gr.Dropdown to choose translation languages.

File Upload: gr.File element to upload PDF files.

Buttons: gr.Button to trigger action such as generating quizzes, submitting answers, or refreshing performance figures.

Dynamic Display of Quiz: Quiz question and options are dynamically displayed with gr.Markdown and gr.Radio components depending upon the output of the AI.

Data Display: gr.DataFrame to display quiz history as tabular data in the Performance Dashboard.

10. Testing

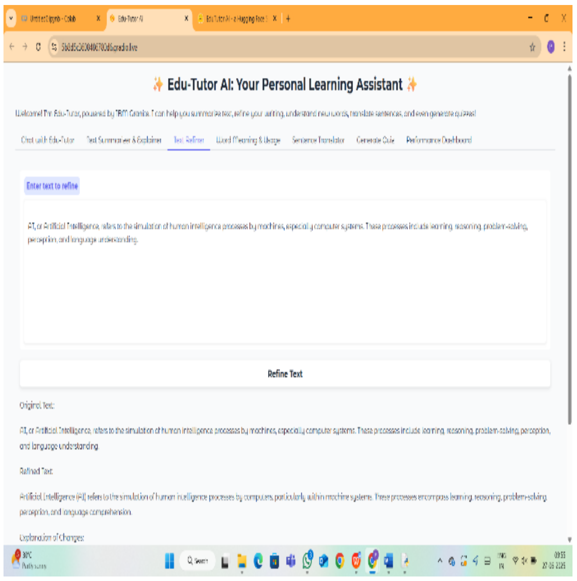
Testing for this project was largely done through:

Manual Testing: The developers interacted manually with the Gradio interface, testing each function (chat, summarization, quiz generation, submission, etc.) to ensure its correctness and functionality.

Observational Debugging: Through print statements and by using the debug=True parameter in demo.launch(), developers watched the output of the script and internal states to discover and fix problems, especially in parsing AI-generated quiz text.

Ad-hoc Script Testing: Each function was probably tested separately when developing to make sure they worked as intended prior to inclusion in the complete application.

11. Screenshots or Demo



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Refine Text

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Refined Text:

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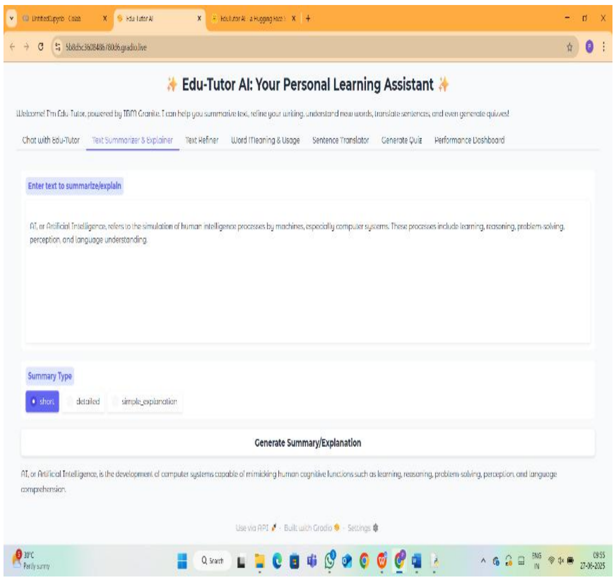
Explanation of Changes:



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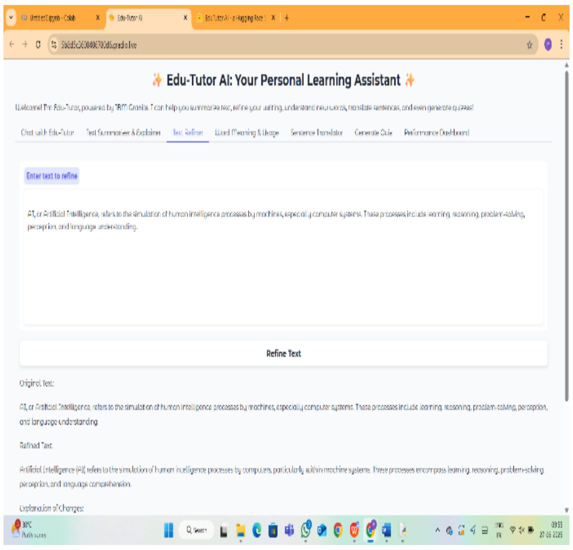
Use via API · Built with Gradio · Settings



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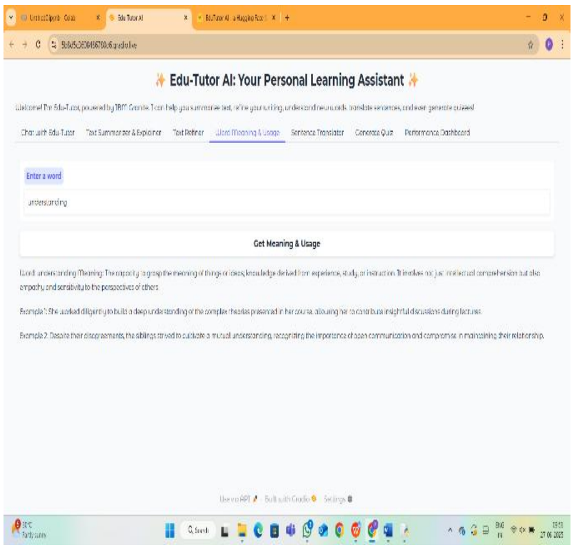

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Enter a word

understanding

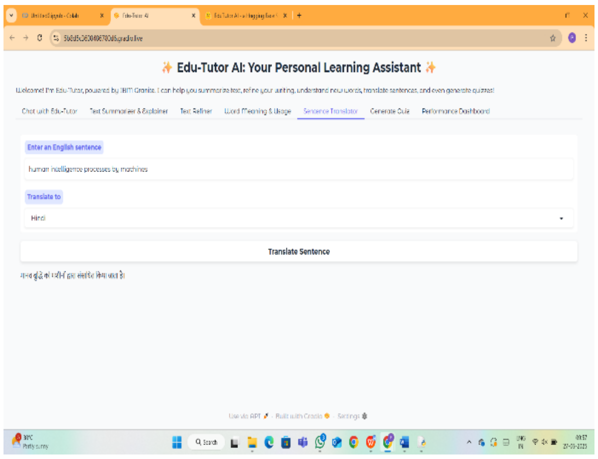
Get Meaning & Usage

Word: understanding Meaning: The capacity to grasp the meaning of things or ideas; knowledge derived from experience, study, or instruction. It involves not just intellectual comprehension but also empathy and sensitivity to the perspectives of others.

Example 1: She worked diligently to build a deep understanding of the complex theories presented in her course, allowing her to contribute insightful discussions during lectures.

Example 2: Despite their disagreements, the siblings strived to cultivate a mutual understanding, recognizing the importance of open communication and compromise in maintaining their relationship.

Use via API · Built with Gradio · Settings



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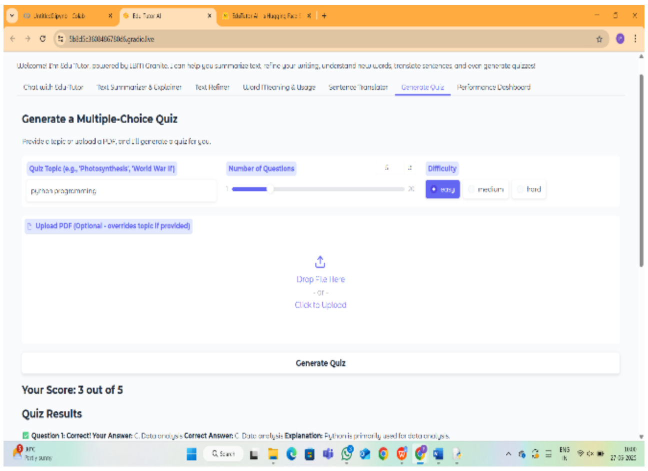
Enter an English sentence: human intelligence processes by machines

Translate to: Hindi

मानव बुद्धि को मशीनों द्वारा संसाधित किया जाता है।



Generate a Multiple-Choice Quiz

Provide a topic or upload a PDF, and I'll generate a quiz for you.

Quiz Topic (e.g., 'Photosynthesis', 'World War II'): python programming

Number of Questions: 5

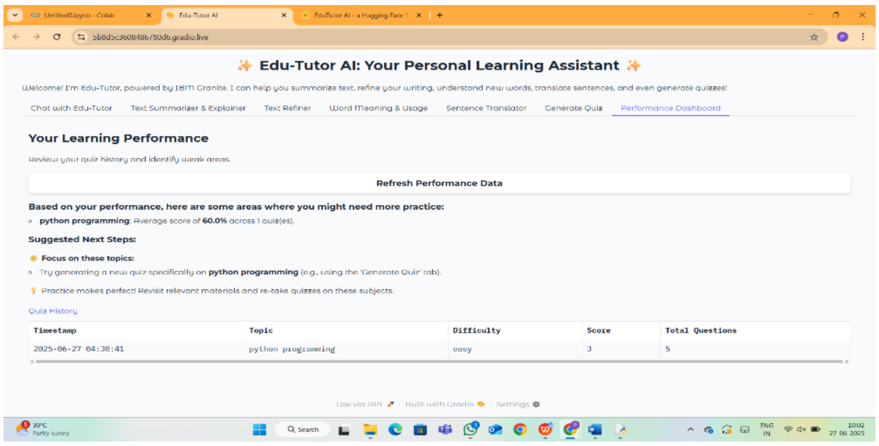
Difficulty: [✓ easy] medium hard

Upload PDF (Optional - overrides topic if provided)

Your Score: 3 out of 5

Quiz Results

✅ **Question 1: Correct! Your Answer:** C. Data analysis **Correct Answer:** C. Data analysis **Explanation:** Python is primarily used for data analysis.



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Your Learning Performance

Review your quiz history and identify weak areas.

Based on your performance, here are some areas where you might need more practice:

- **python programming**: Average score of **60.0%** across 1 quiz(es).

Suggested Next Steps:

🌟 **Focus on these topics:**

- Try generating a new quiz specifically on **python programming** (e.g., using the 'Generate Quiz' tab).

💡 Practice makes perfect! Revisit relevant materials and re-take quizzes on these subjects.

Quiz History

Timestamp	Topic	Difficulty	Score	Total Questions
2025-06-27 04:38:41	python programming	easy	3	5

Demo link : https://drive.google.com/file/d/1T3GJBJtv7A4EPl9aeLxu73ycRnGXFNO5/view?usp=sharing

GitHub link:

https://github.com/Likhitha-Gunneri/EduTutor-AI-Personalized-Learning-with-Generative-AI-and-LMS-Integration

12. Known Issues

Resource Intensiveness: Execution of the ibm-granite/granite-3.3-2b-instruct model might be memory-hungry and need a GPU for best performance and quicker inference time. Users lacking enough resources may incur sluggish response or Out-Of-Memory errors.

Quiz Parsing Brittleness: The parsing of quiz text generated by AI is based on regular expressions. If the language model significantly diverges from the expected output format, the parsing will break and result in "Could not generate a valid quiz" errors.

Limited Scalability: Being an application of a single script, it is largely suited for personal use or internal deployment on non-major scales. It is not designed to be used in high concurrency or large-scale simultaneous users without additional infrastructure layers.

No User Accounts: Not having authentication, quiz performance data is kept locally and cannot be linked to individual users, nor can multiple users' performance data be easily shared.

13. Future Enhancements

Advanced Performance Analytics: Improve more advanced data analysis for quiz scores, such as trend analysis, historical improvement, and more detailed insights into weak sub-topics.

Adaptive Learning Paths: Create functionality that dynamically recommends learning content or topics based on determined weak areas and the user's progress.

Multi-modal Interaction: Investigate adding voice input/output or image analysis support for educational content.

User Profiles and Authentication: Add a user login functionality to enable personalized experiences, long-term performance tracking across different devices, and support for multiple users.

External Learning Platform Integration: Integrate with educational resource APIs (e.g., learning management systems, online courses) to retrieve content or push progress.

Strong Quiz Parsing: Explore fine-tuning the model or applying stronger natural language understanding methods to enhance the parsing of quizzes to be more robust to different AI outputs.

Cloud Deployment: Host the application on a more scalable cloud platform (e.g., Google Cloud, AWS, Azure) to support more users and offer greater availability.