EduTutor AI: Personalized Learning with Generative AI and LMS Integration

1. Project Title

EduTutor AI: Personalized Learning with Generative AI and LMS Integration

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2. Introduction

Purpose:
EduTutor-AI is designed to enhance the learning experience of students by providing AI-powered explanations of complex concepts and generating quizzes for self-assessment. The system leverages IBM Granite LLM with Gradio to deliver a user-friendly, interactive educational platform.

Features:

- **Concept Explanation**: Provides detailed explanations of academic topics with real-world examples.

- **Quiz Generator**: Creates quizzes with mixed question types and answers for practice.

- **Conversational Interface**: Natural language interaction between students and AI.

- **Interactive UI**: Intuitive Gradio-based interface with tabs for different modules.

- **Custom Styling**: A visually engaging experience with gradient backgrounds and modern UI design.

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3. Architecture

Frontend (Gradio):

- Built using Gradio Blocks for interactivity.

- Provides tabs for "Concept Explanation" and "Quiz Generator."

- Implements custom CSS for a modern, student-friendly look.

Backend (Transformers + PyTorch):

- Uses Hugging Face's transformers library to load IBM Granite LLM.

- Responsible for text generation (explanations, quizzes).

- Utilizes PyTorch for GPU acceleration where available.

Model Integration (IBM Granite LLM):

- Model used: ibm-granite/granite-3.2-2b-instruct.

- Provides natural language understanding and generation.

- Handles prompt engineering to generate detailed, contextual responses.

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4. Setup Instructions

Prerequisites:

- Python 3.9 or later

- pip and virtual environment tools

- Internet connection (to download model and run app)

Installation Process:

1. Clone the project repository.

2. Install dependencies:

3. pip install transformers torch gradio

4. Run the script:

5. python EduTutor-AI.py

6. Access the Gradio interface through the local or shared link.

5. Folder Structure

EduTutor-AI/

|— EduTutor-AI.ipynb   # Main notebook script

|— requirements.txt   # Dependencies

|— /assets   # (Optional) Screenshots or UI assets

6. Running the Application

- Launch the script (python EduTutor-AI.py).

- Open the Gradio app in your browser.

- Navigate between tabs:

    o **Concept Explanation** → Enter a concept and get a detailed explanation.

    o **Quiz Generator** → Enter a topic and receive a quiz with answers.

- Responses are generated in real time using IBM Granite LLM.

7. API Documentation

(Currently, the project does not expose separate APIs — interaction is done via Gradio UI. Future versions may include REST API endpoints for integration with LMS platforms.)

8. User Interface

- **Tabs**:

    o Concept Explanation

    o Quiz Generator

- **Styling**: Gradient background (black to green), glowing buttons, modern text boxes.

- **Footer**: "Powered by IBM Granite LLM & Gradio."

- **Interactive Outputs**: Explanations and quizzes displayed in styled textboxes.

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9. Testing

- **Unit Testing**: Validated prompt generation and model outputs.

- **Manual Testing**: Checked user input edge cases (empty input, long prompts).

- **UI Testing**: Verified that tabs, buttons, and outputs render correctly in Gradio.

- **Performance Testing**: Ensured responses are generated within reasonable time on both CPU and GPU.

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10. Known Issues

- Requires internet connection to download IBM Granite model initially.

- Performance may be slow on CPU-only machines.

- Limited to two main features (explanations + quizzes) in current version.

- No user authentication or history tracking yet.

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11. Screenshot

🧠 **Educational AI Assistant** 🧠

📚 Concept Explanation   📄 Quiz Generator

Enter a concept

data science

Explain Concept

Explanation

Data science is an interdisciplinary field that combines domain expertise, statistical knowledge, machine learning algorithms, and computational power to extract meaningful insights, make predictions, and support decision-making processes from complex and often unstructured data sets. It's a modern approach to understanding and utilizing data as a strategic asset. Here's a detailed breakdown of its key components and components, along with examples:

1. **Domain Expertise**: Data scientists need a deep understanding of the subject matter or industry they work in. For instance, in healthcare, this could mean knowing medical terminologies, treatment protocols, patient demographics, and regulatory standards. An example of this would be a data scientist working on predictive analytics for patient readmissions, where they must comprehend healthcare processes and terminologies to develop accurate models.

2. **Statistical Knowledge**: This forms the foundation for data science, enabling accurate interpretation and analysis of data. Statistical methods help in understanding variability, establishing relationships between variables, and drawing valid conclusions. In the field of marketing, data scientists might use statistical techniques like regression analysis to model customer churn or identify the impact of marketing campaigns.

3. **Machine Learning Algorithms**: These are computational methods that allow systems to learn and improve from experience without being explicitly programmed. They include supervised learning (predicting future outputs based on historical inputs), unsupervised learning (discovering hidden structures in unlabeled data), reinforcement learning (making decisions based on rewards or penalties), and deep learning (using neural networks with multiple layers to analyze complex data). For example, in finance, machine learning can be used to detect fraudulent transactions by identifying anomalous patterns in transaction data.

4. **Computational Power**: Big data necessitates high-performance computing, distributed systems, and advanced data processing tools. Data scientists employ various programming languages (like Python, R, SQL, or specialized libraries for machine learning) and use platforms such as Hadoop, Spark, or cloud services (e.g., AWS, Google Cloud, or Microsoft Azure) to handle massive datasets efficiently. An example would be using Python libraries (e.g., pandas, NumPy, scikit-learn, or TensorFlow) and these platforms to process and analyze gigantic social media data for sentiment analysis.

5. **Data Visualization**: Effective communication of analytical findings is crucial for influencing decision-makers. Data visualization tools help translate complex data insights into easily digestible visuals, charts, and graphs. For example, a data science team might create interactive dashboards to monitor real-time sales data across multiple stores, allowing business stakeholders to quickly identify trends or issues.

6. **Data Wrangling and Preprocessing**: Cleaning, transforming, and integrating data from various sources to make it suitable for analysis is a significant part of data science. This might entail handling missing values, outliers, or

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🧠 **Educational AI Assistant** 🧠

📚 Concept Explanation   📄 Quiz Generator

Enter a topic

data science

Generate Quiz

Quiz Questions

1. **Quantitative (Multiple Choice)**
   Which of the following metrics is NOT typically used to evaluate the performance of a classification model in data science?
   A) Precision
   B) Recall
   C) F1 Score
   D) Mean Squared Error

2. **Qualitative (Short Answer)**
   Explain why feature scaling is crucial in machine learning algorithms, especially when dealing with algorithms sensitive to feature scales like k-nearest neighbors (k-NN) and support vector machines (SVM).

3. **Mixed (True/False)**
   In a supervised learning setting, feature selection techniques aim to identify and minimize the number of irrelevant features. This results in:
   A) Improved model interpretability
   B) Better model performance
   C) Both A and B
   D) Neither A nor B

4. **Quantitative (Fill in the Blank)**
   To compute the covariance between two features, X and Y, having a mean of 5 and 7 respectively, with a standard deviation of 2 and 3, respectively, fill in the blank with the correct formula:
   Covariance(X,Y) = _ _ * 2 + _ _ * 3 - 5 * 7

11. Future Enhancements

- Add support for **voice-based interaction**.

- Enable **REST API endpoints** for LMS integration.

- Expand **quiz customization** (difficulty levels, MCQs, fill-in-the-blanks, etc.).

- Store **user learning history** for personalized recommendations.

- Include **multilingual support** for global learners.

- Deploy on **cloud platforms** (AWS, IBM Cloud, etc.) for scalability.

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13. Conclusion

EduTutor-AI demonstrates the potential of combining large language models with intuitive user interfaces to transform the way students learn and practice. By offering detailed explanations of complex concepts and generating interactive quizzes, the system enhances self-paced learning and promotes better understanding. With its simple architecture, scalable backend, and user-friendly Gradio interface, EduTutor-AI serves as a foundation for building smarter educational tools.

Although the current version focuses on concept explanation and quiz generation, future enhancements such as voice interaction, multilingual support, and integration with learning management systems will further expand its capabilities. Ultimately, EduTutor-AI aims to empower learners with personalized, accessible, and intelligent educational assistance.