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Principles of Large Language Models

Smart MCQ Quiz Generator

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1. Project Overview

The **Smart MCQ Quiz Generator** is an **AI-powered assessment platform** that dynamically generates multiple-choice questions (MCQs) based on user-defined topics and difficulty levels. Built with **Streamlit**, the application integrates **Llama 3 (via Ollama)** and **Google Gemini** models to create **RAG based** structured quizzes with detailed explanations, personalized analytics, and feedback.

The system is designed to support learners, educators, and professionals by providing **adaptive quizzes**, **concept reinforcement**, and **performance analysis**, making it a valuable tool in **education and skill development**.

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2. Objectives

- Automate the generation of **topic-specific MCQs** with accurate explanations.
- Enhance **learning outcomes** through personalized feedback.
- Provide **performance analytics** for self-evaluation and progress tracking.
- Deliver a **scalable, user-friendly platform** adaptable to multiple domains.

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3. Key Features

3.1 Quiz Generation

- Generates quizzes across **three structured categories**:
    - Basic Concepts
    - Advanced Concepts
    - Current Trends
- Supports **custom difficulty levels** (Beginner, Intermediate, Advanced).
- Offers different **question styles** (Conceptual, Application, Scenario-based).
- **RAG based** from the existing question
- Option to include **diagram-based questions**.

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3.2 Question Validation & Parsing

- Ensures each MCQ has:
    - Exactly **4 options**.
    - A clearly marked **correct answer**.
    - A detailed **explanation**.
- Provides **error handling** for malformed questions.

3.3 Performance Analytics

- Displays **section-wise scores, accuracy rates, and performance levels**.
- Interactive **visualizations using Plotly**.
- Tracks **historical performance trends** across multiple quiz sessions.

3.4 Personalized Feedback

- AI-powered analysis of incorrect answers.
- Identifies **weak areas and recurring mistakes**.
- Recommends **study resources and related concepts**.

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4. System Architecture

- **Frontend/UI:** Streamlit (lightweight, interactive dashboards).
- **AI Models:**
    - **Llama 3 (Ollama)** for structured MCQ generation.
    - **Google Gemini (via google-generativeai)** for flexible content creation.
- **Visualization:** Pandas + Plotly for results and analytics.
- **Helper Modules:**
    - helper_functions.py → Question validation, parsing, analytics.
    - model.py → Model initialization and response handling.
    - question_generator.py → Main Streamlit app with UI/UX.

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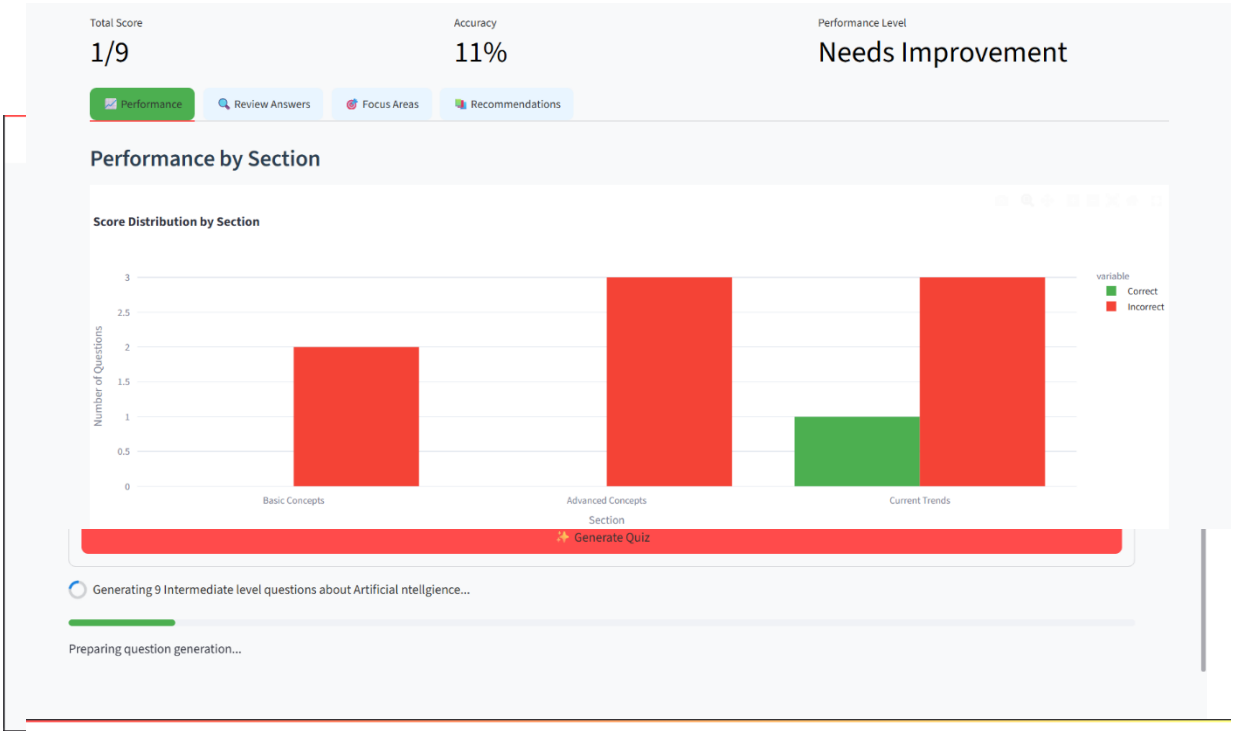
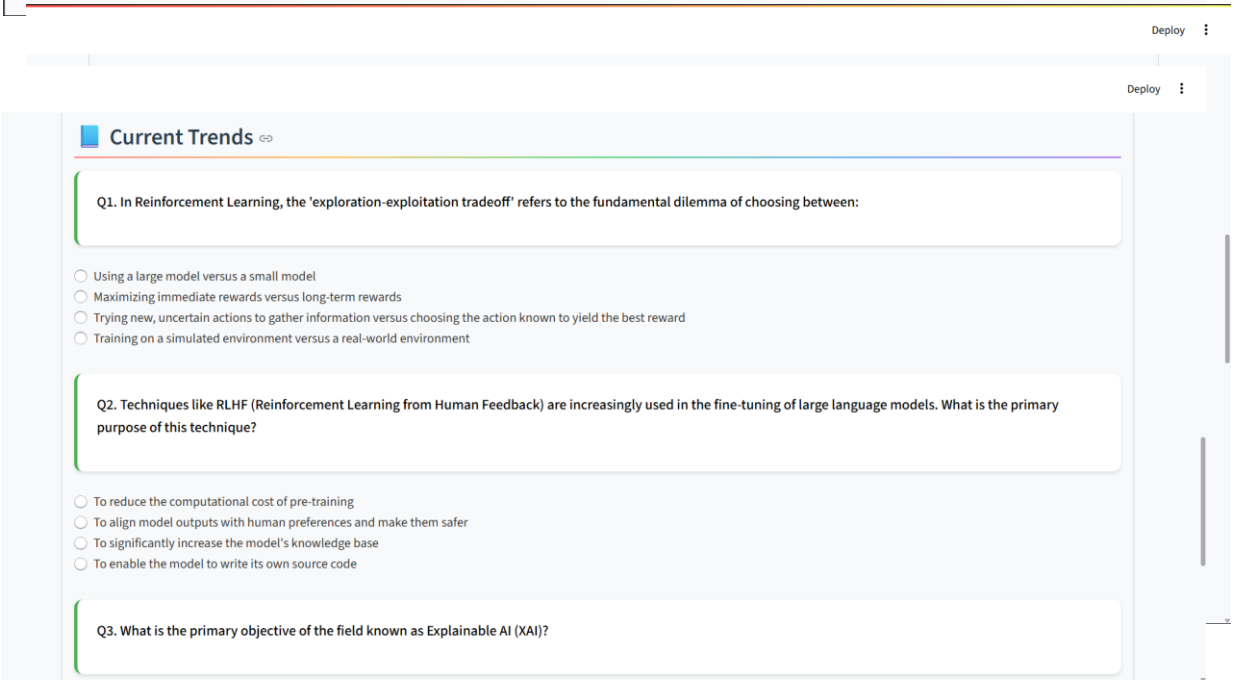
5. Workflow

1. **User Input:** Topic, difficulty, number of questions, model choice, and style.

2. **Prompt Creation:** System generates structured prompts for the selected AI model.
3. **AI Response Parsing:** Output is validated and parsed into sections.
4. **Quiz Interaction:** Users attempt questions via the interactive Streamlit interface.
5. **Result Processing:** Scores, accuracy, and performance metrics are calculated.





6. **Feedback & Recommendations:** AI analyzes wrong answers and suggests improvements.

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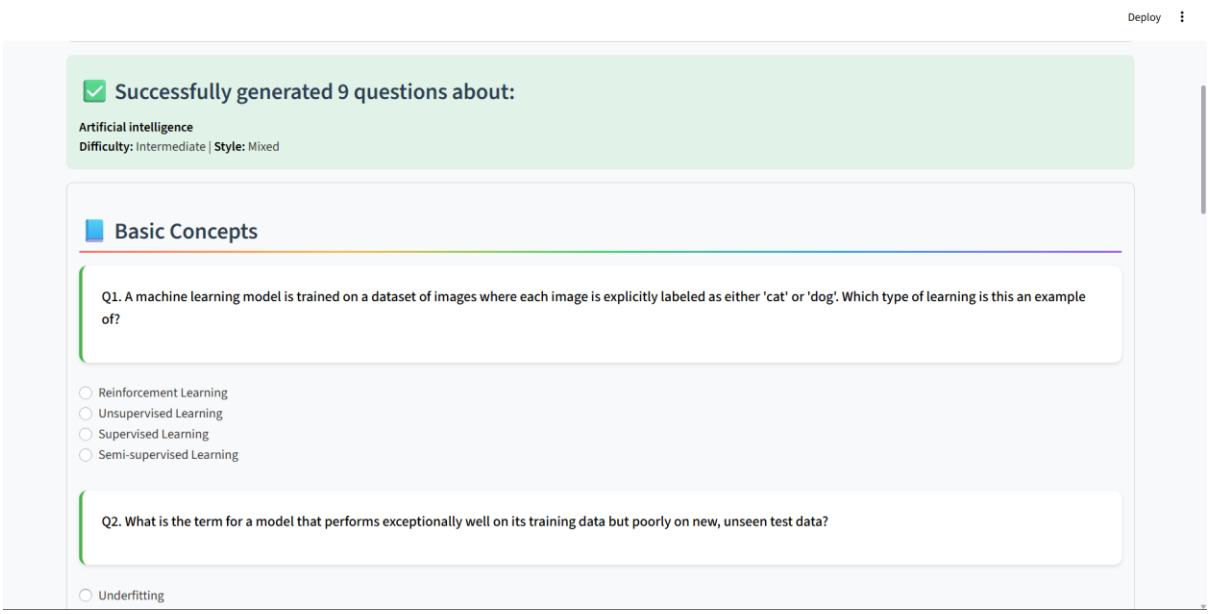

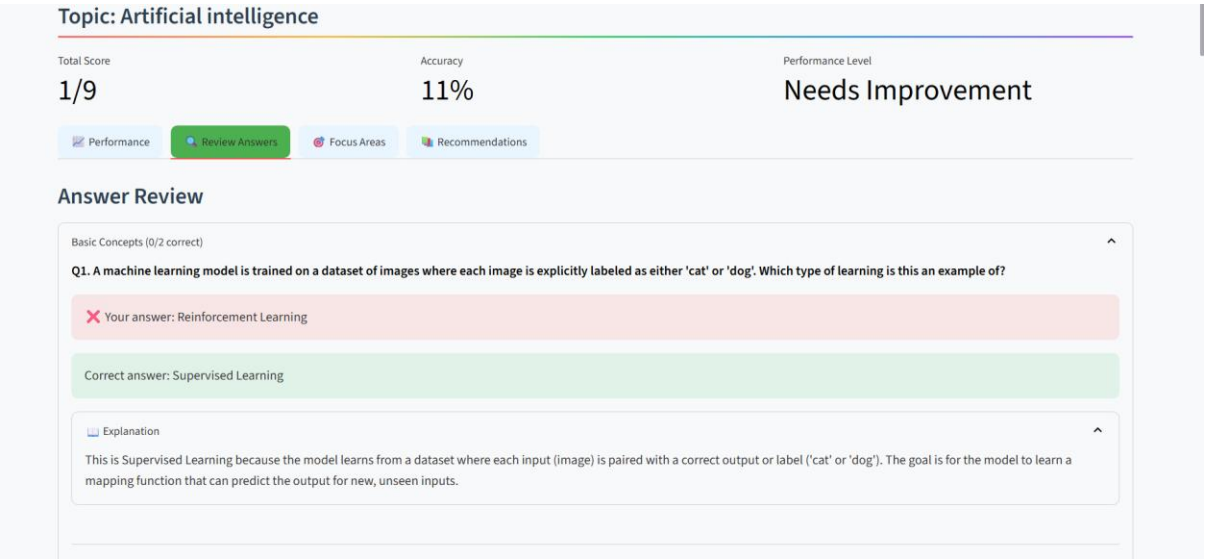

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6. Tech Stack

- **Programming Language:** Python
- **Libraries/Frameworks:** Streamlit, Pandas, Plotly, Streamlit Extras
- **AI Models:** Llama 3 (Ollama), Google Gemini
- **Others:** AsyncIO (for non-blocking generation), Regex (for parsing)

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7. Limitations

- Relies on **AI model consistency** — occasionally outputs may deviate from expected format.

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- Currently limited to **MCQs** (no short-answer or case-based questions).
- Lacks **persistent user accounts** (progress is session-based).

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8. Future Enhancements

- **Adaptive Quizzing:** Adjust difficulty based on learner performance.
- **Gamification:** Add streaks, levels, and badges.
- **Content Authoring:** Generate quizzes from user-uploaded documents.
- **Multilingual Support:** Expand quiz generation into non-English languages.
- **Voice-Based Interaction:** Allow spoken questions/answers.

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9. Conclusion

The **Smart MCQ Quiz Generator** demonstrates how **LLMs can transform learning and assessment** by generating personalized, structured, and interactive quizzes. With its **blend of AI-powered question creation and real-time analytics**, the platform bridges traditional testing with modern adaptive learning. Future enhancements will further expand its potential into **multilingual, voice-based, and collaborative education platforms**.