Final Project Report

MathAI - AI Math Problem Solver

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1. Project Overview

Our project, **MathAI**, is a Dockerized full-stack AI agent designed to solve mathematical problems from images. It leverages Optical Character Recognition (OCR) and the Mistral AI model to provide step-by-step solutions, catering primarily to students, teachers, and self-learners. The system operates autonomously, fulfilling the requirement of a goal-driven AI agent in the **Educational Enhancement** domain.

Key Features:

- **Image-Based Input:** Users upload/capture images of math problems.
- **Instant Solutions:** Mistral AI generates step-by-step explanations.
- **User History:** Solutions are logged in a database for future reference.
- **Multi-Topic Support:** Covers arithmetic, algebra, calculus, and more.

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2. Learning Objectives Achieved

1. **Agent-Oriented AI System:** MathAI autonomously processes inputs, solves problems, and delivers results.
2. **Full-Stack Implementation:**
    - **Frontend:** React.js for a responsive UI.
    - **Backend:** Flask (Python) for API handling, OCR, and AI integration.
    - **Database:** MySQL for storing user data and solutions.
3. **Docker Deployment:** The system is containerized for modular deployment.
4. **AI/ML Techniques:** Utilizes LaTeX-OCR for text extraction and Mistral (LLM) for problem-solving.
5. **Ethical AI & Explainability:** Solutions include clear reasoning steps, and user data is stored securely.

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3. Proposal Submission Summary

Domain: Educational Enhancement.
Problem Statement: Addressing the need for quick, accurate math assistance without manual typing.
Wireframes: Included a clean UI design for image uploads and solution displays.

Technology Stack:

- **Frontend:** React.js
- **Backend:** Flask (Python)
- **AI Engine:** Mistral
- **Database:** MySQL
- **OCR:** LaTeX-OCR

Justification:

- React.js ensures a dynamic, mobile-friendly interface.
- Flask provides lightweight backend flexibility.
- Mistral offers cost-effective, privacy-focused math reasoning.

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4. Backend Implementation (Dual AI Approaches)

a) Rule-Based Engine (Heuristic Approach)

- **Logic:** For simple arithmetic, predefined rules (e.g., PEMDAS) were implemented to validate solutions before invoking Mistral.
- **Example:** Directly evaluating expressions like 2 + 2 without AI calls.

b) Machine Learning Engine (Mistral AI)

- **Logic:** Complex problems are sent to Mistral, which uses LLM capabilities to interpret LaTeX-formatted math and generate solutions.
- **Comparison:** The rule-based method is faster for trivial problems, while Mistral handles advanced topics (e.g., integrals) more accurately.

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5. Final Deliverables

1. **Demo:** A 5-minute demo showcasing system functionality.
2. **Docker Container:** Includes all services (frontend, backend, database) on a portable USB.
3. **Presentation Slides:** Covering architecture, AI logic, and live demo.
4. **Source Code & Documentation:** GitHub repository with README, setup guides, and testing instructions.
5. **Final Report:** This document, detailing technical stack, ethical considerations, and testing outcomes.

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6. System Architecture

- **Frontend:** React.js handles image uploads and displays solutions.
- **Backend:** Flask routes images to OCR, then Mistral for solving.
- **Database:** MySQL logs problems/solutions for user history.

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7. Ethical Considerations

- **Data Privacy:** User data is anonymized and stored securely.
- **Bias Mitigation:** Mistral's open-weight design reduces proprietary model biases.
- **Transparency:** Solutions include step-by-step explanations (XAI).

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8. Challenges & Future Work

Challenges:

- Local LLM latency vs. API performance.
- OCR accuracy for handwritten input.

Future Enhancements:

- Cloud-based LLM for scalability.
- Handwritten OCR integration.
- Learning analytics for personalized recommendations.

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9. Conclusion

MathAI successfully demonstrates a Dockerized, full-stack AI agent for education, combining rule-based and ML approaches. The project met all assignment requirements while addressing real-world needs in math learning.

Team Reflection: Effective collaboration and iterative testing were key to overcoming integration hurdles.
