Technical Note — Math Adventures: Adaptive Learning Prototype

Objective

The goal of this project is to design a **minimal adaptive math learning system** that dynamically adjusts puzzle difficulty based on learner performance. It uses **rule-based AI logic** to personalize difficulty, keeping children (ages 5–10) in their optimal challenge zone — not too easy, not too hard.

System Overview

This prototype helps children practice **basic arithmetic** (addition, subtraction, multiplication, and division).
The system performs the following:

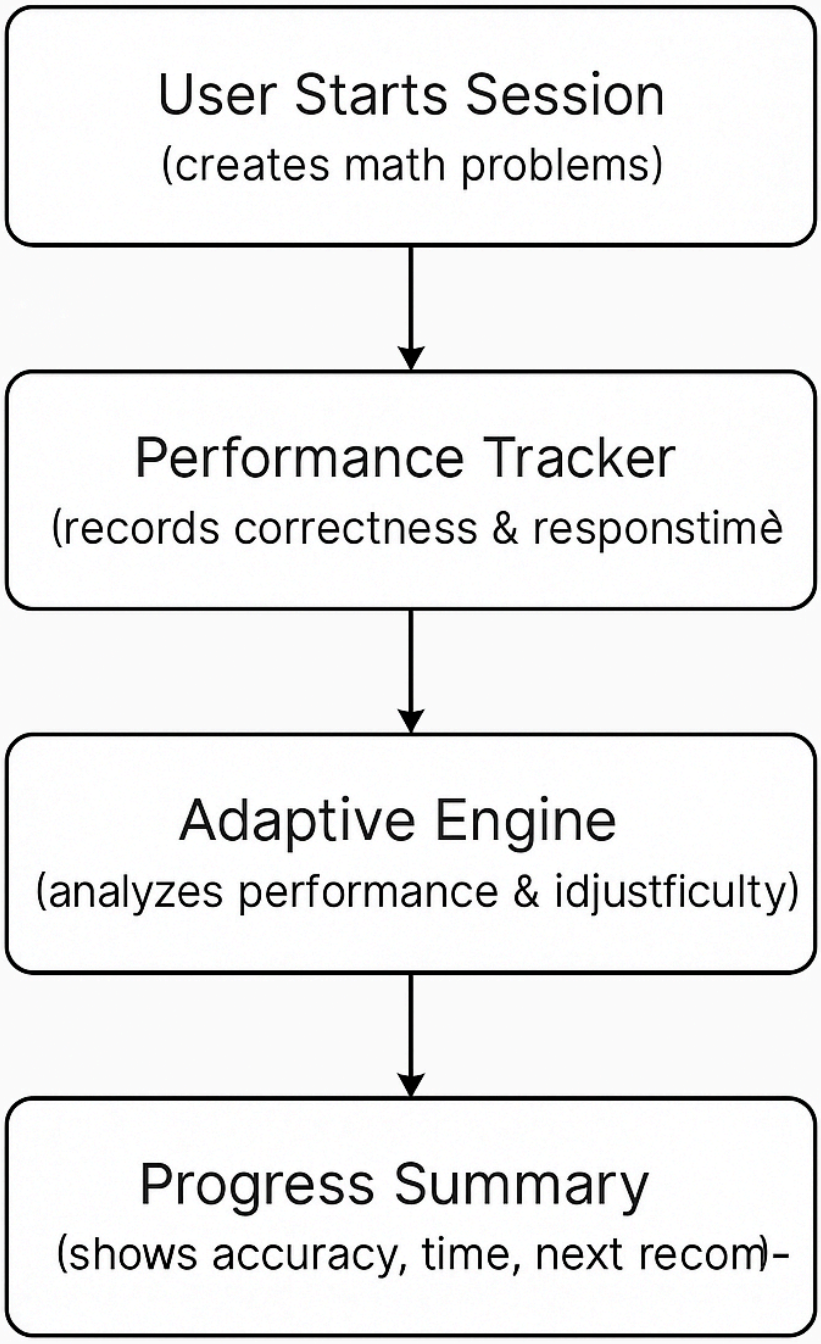
1. Generates math puzzles dynamically based on the chosen difficulty (Easy, Medium, Hard).

2. Tracks learner performance — correctness and response time.

3. Adapts the next puzzle's difficulty automatically based on accuracy and time.

4. Displays an end-of-session summary and logs results in a file.

Architecture Flow



Adaptive Logic

The system uses **rule-based logic**:

- If **accuracy > 80%** and **average time < 5 seconds**, increase difficulty.
- If **accuracy < 50%** or **average time > 10 seconds**, decrease difficulty.
- Otherwise, keep the same level.

This ensures learners remain at an appropriate challenge level.

Key Metrics

Metric	Description
Accuracy (%)	Measures how many puzzles were solved correctly.
Average Time (s)	Tracks how long the learner took per puzzle.
Difficulty Transition	Shows change in difficulty (e.g., Easy → Medium).

Why Rule-Based Instead of ML

Since this is a small-scale prototype, **rule-based AI** was chosen for its simplicity and clarity.
A machine learning approach (Decision Tree or Logistic Regression) can be integrated later once sufficient training data is collected.

Performance Logging

After each session, results are saved in a file named **`session_log.txt`**, containing:

- Student name
- Date and time
- Starting and recommended level
- Accuracy and average time

This allows for progress tracking over time.

Future Enhancements

- Add ML model for smarter difficulty prediction.
- Build a Streamlit web interface.
- Store progress data in a database.

Conclusion

This adaptive learning prototype demonstrates how **AI-driven personalization** can enhance math learning.
It successfully adjusts difficulty, tracks performance, and encourages continuous improvement — all while being simple, effective, and learner-centered.

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