AI Research Assistant: Design Overview

The proposed AI research assistant is designed to help researchers quickly generate, assess, and validate research ideas based on a natural language problem description. The system integrates a OpenAI API to propose research ideas, and assess their novelty. Additionally, the assistant provides practical suggestions for experiments or validation techniques for each idea.

Core Workflow:

1. **Problem Input:** The user provides a description of a research problem (e.g., "How can I improve battery life in IoT devices using machine learning?").
2. **Idea Generation:** The system utilizes an LLM (GPT-4) to generate multiple distinct research ideas addressing the problem. This step encourages creative, out-of-the-box thinking.
3. **Novelty Assessment:** For each generated idea, the system queries GPT-4 too, to assess how novel the idea is relative to existing literature. The novelty check is based on the LLM ranking the idea according to three different levels based on its knowledge of existing literature up to today.
4. **Experiment Suggestion:** The system also provides suggestions for experiments to validate the proposed ideas. These suggestions are based on the research problem and the specific nature of the idea, using the LLM to suggest feasible and practical experimental designs.

Design Choices:

- **Modularity:** The system is built with modular functions, each responsible for a distinct step (idea generation, novelty check, experiment suggestion). This makes the system easy to expand or modify in the future.
- **Use of LLMs:** OpenAI's GPT models are leveraged for idea generation, novelty assessment and experiment suggestion, as they are well-suited for creativity and problem-solving in research contexts.
- **Simplicity & Efficiency:** While the system could be expanded with more complex features (e.g., in-depth paper citation analysis, ranking of ideas by originality), the current version focuses on delivering a quick, straightforward experience.

Assumptions:

- Use of python 3.11 (convenient for openai module use), API keys for OpenAI provided.
- The novelty check rely solely on the model's knowledge up to its training cutoff—while GPT-4 can judge originality broadly, it may miss very recent or niche publications.
- The experiment suggestions are general and may need to be adapted for specific research fields.
- Each component is modular, so I can swap out the novelty or experiment logic later if I need more specialized tools or data sources.
- GenAI used for function description (for better readability), for one prompt (flagged in the code) and to format this document.