Pythia: An Integrated Large Language Model Platform for Enhanced Radiology Reporting

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Background/Problem Being Solved

Large language models (LLMs) show significant promise in enhancing various aspects of radiology reporting, from clinical history synthesis and proofreading to differential diagnosis assistance. At our institution, access to LLM capabilities during reporting was previously limited to chat interfaces, which are cumbersome and inefficient. The lack of a centralized platform that efficiently integrates relevant clinical information with LLM tools reduces the potential impact of LLM tools in clinical practice.

Intervention(s)

We developed Pythia, a comprehensive platform that integrates multiple LLM-powered tools to enhance radiology reporting. Built using Python Flask, an institutionally approved Azure OpenAI GPT-4 instance for prompt completions, and ChromaDB vector database, the platform accepts structured inputs including exam type, current report drafts, relevant prior reports, and clinical notes (Figure 1). Key functions include automated clinical history generation, proofreading, prior report comparison, and differential diagnosis assistance (Figure 2). Current implementation utilizes hotkey macros for data input; however, the architecture is designed for future automation and integration with radiology applications.

Barriers/Challenges

Development required navigating several challenges including operating within the constraints of hospital firewall restrictions, which limited available technical tools and necessitated careful architecture design. The user interface needed optimization to present information without overwhelming radiologists' attention. Prompt engineering with ensemble techniques was necessary to achieve high accuracy while limiting computational costs and response times.

Outcome

Pythia has been successfully implemented as a unified platform for integrating LLM-powered tools into radiology workflows. It is undergoing continued addition and refinement of features.

Conclusion/Statement of Impact/Lessons Learned

Pythia represents a significant step toward unified LLM integration in radiology workflow. By consolidating multiple reporting enhancement tools into a single platform, it has the potential to improve report quality and consistency while reducing radiologists' cognitive load. The platform's current implementation using hotkey macros is compatible with any

reporting software stack but also maintains a framework for future direct system integration. This flexibility in deployment, combined with the platform's extensible design, creates a foundation for continuous improvement and adaptation to evolving needs in radiology reporting.

Figure(s)

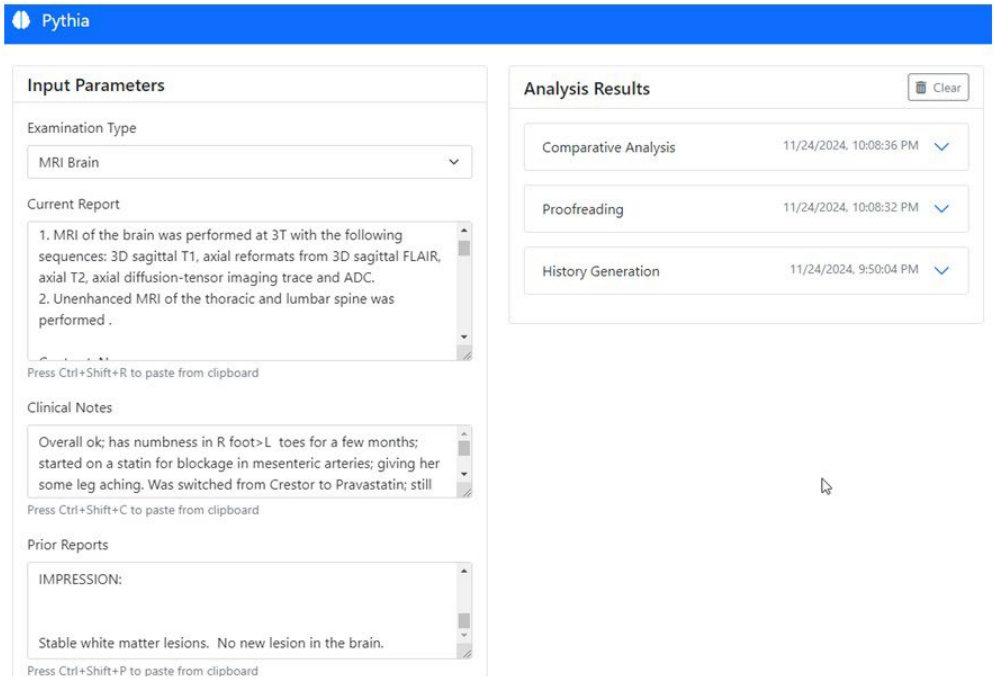

Figure 1. A screenshot of the Pythia interface. The Pythia platform interface is shown, with the input parameters section on the left, where users can specify examination type, current report details, clinical notes, and prior reports. On the right is the analysis results section, displaying tools such as "Comparative Analysis," "Proofreading," and "History Generation," with time-stamped outputs. The interface demonstrates a streamlined workflow for integrating multiple tools to enhance radiology reporting.

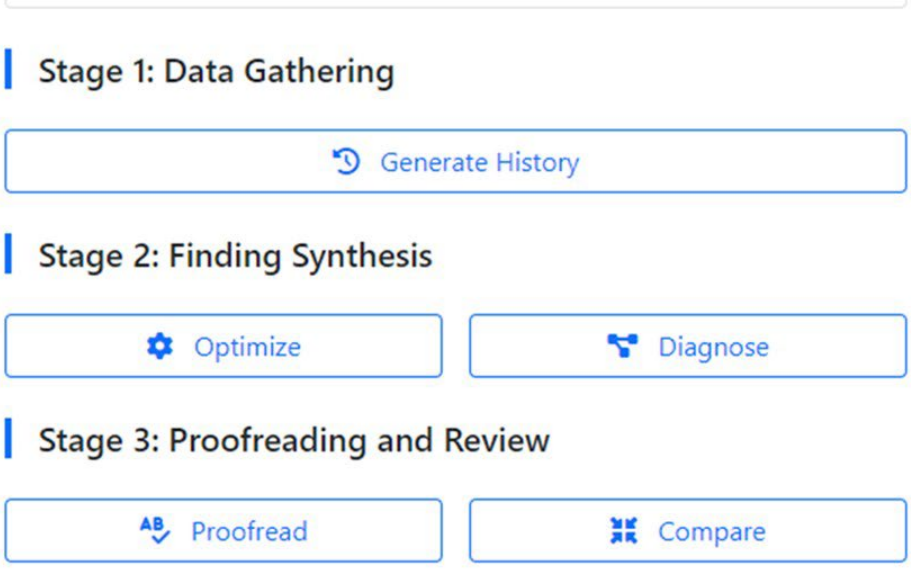

Figure 2. A screenshot of the button interface currently used to trigger LLM functions. The interface is organized by stages of the reporting workflow starting with synthesizing clinical histories during data gathering; finding synthesis, which includes tools for optimizing and generating differential diagnoses; and proofreading and review, which features functions for comparative analysis and proofreading. The design organizes the platform's functionalities into logical stages to streamline the radiology reporting process but is also designed for potential future automation.

Keywords

Applications; Artificial Intelligence/Machine Learning; Clinical Workflow & Productivity; Emerging Technologies; Provider Experience; Quality Improvement & Quality Assurance