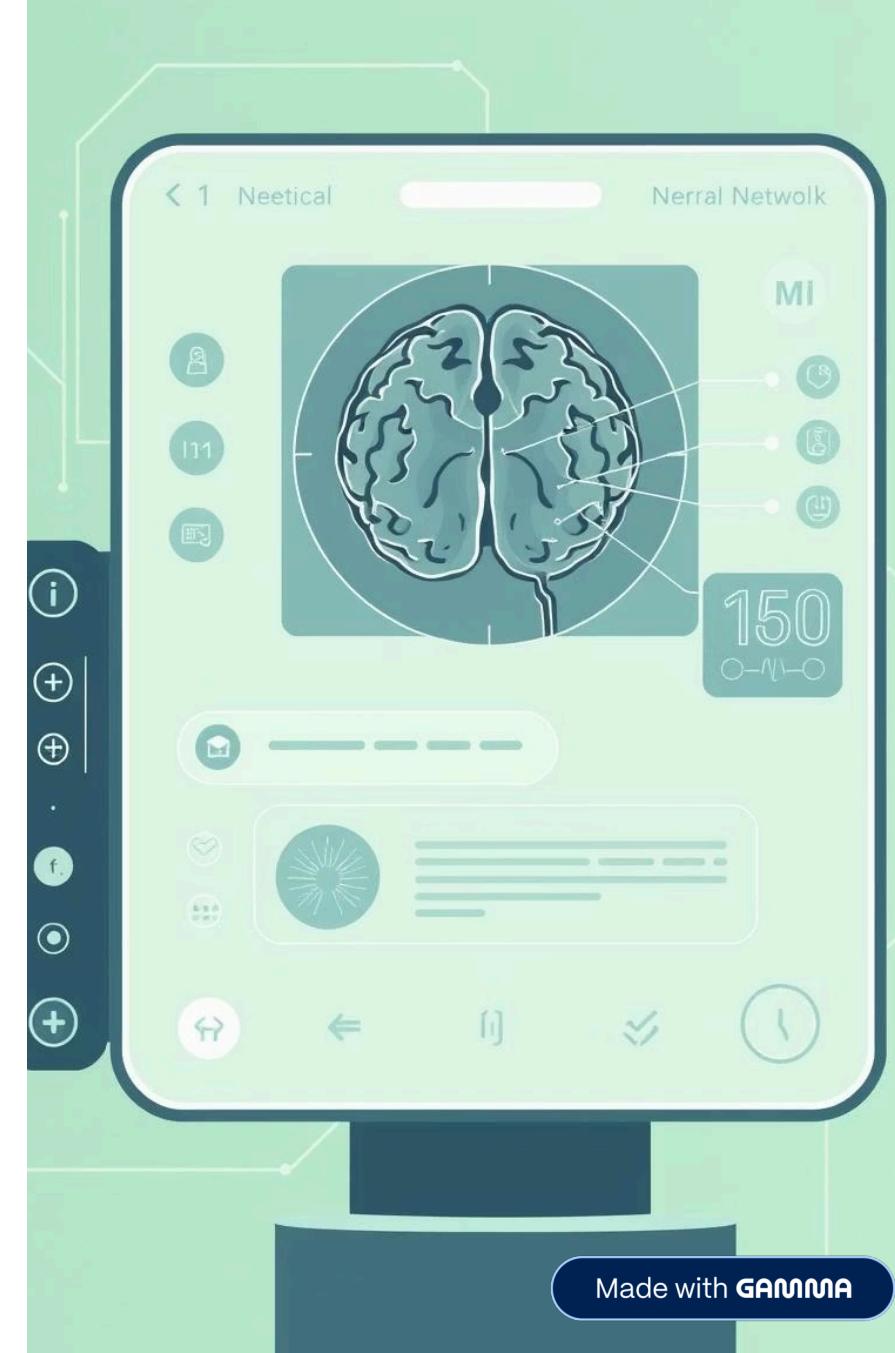


NuitInfo Chatbot: AI-Powered Health Assistant

Bridging the gap between cutting-edge medical diagnostics and intuitive AI education, this project pioneers a dual-functionality chatbot designed for impact.



Project Vision

Innovation at the Intersection

Our mission is to create a powerful AI tool that not only serves as a health assistant but also as an educational platform, demystifying complex AI processes for future innovators.



Dual Functionality

Combining a conversational AI assistant with a specialized medical diagnostic tool for real-world application.



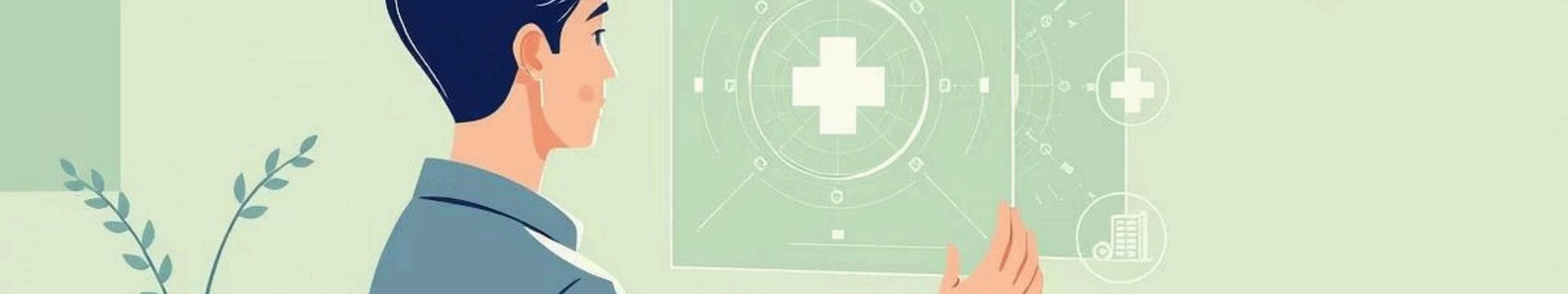
Educational Outreach

Demystifying AI for students by visualizing the internal mechanics of deep learning models.



Technical Integration

Demonstrating the seamless merger of Large Language Models (LLM) with specialized Computer Vision models.



Key Capabilities

Core Features & Benefits

From interactive conversations to critical medical analysis, the NuitInfo Chatbot is packed with features designed for both utility and understanding.



Interactive Chat

Context-aware conversations powered by Google Gemini, offering natural and helpful responses.



Diagnostic Tool

Advanced brain tumor detection from MRI scans, providing rapid preliminary analysis.

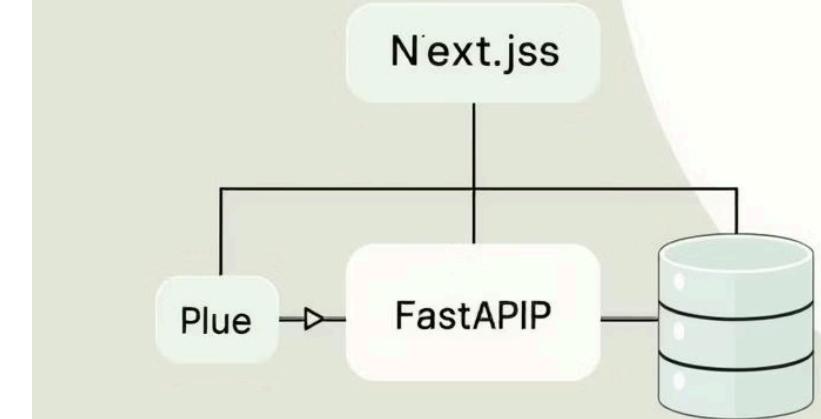


"Glass Box" Demo

Visualizing neural network layers during inference to enhance AI comprehension.

System Architecture & Operation

The application utilizes a modern client-server architecture with asynchronous processing for optimal performance and responsiveness.



The Workflow

From User to Insight



Frontend (Next.js)

- User interacts via Chat UI or File Upload.
- Sends REST API requests to the backend.

Backend (FastAPI)

- Manages Chat Flow with Gemini Client.
- Handles Detection Flow via PyTorch Model.

Data Persistence

- SQLAlchemy Async stores conversation history and summaries.

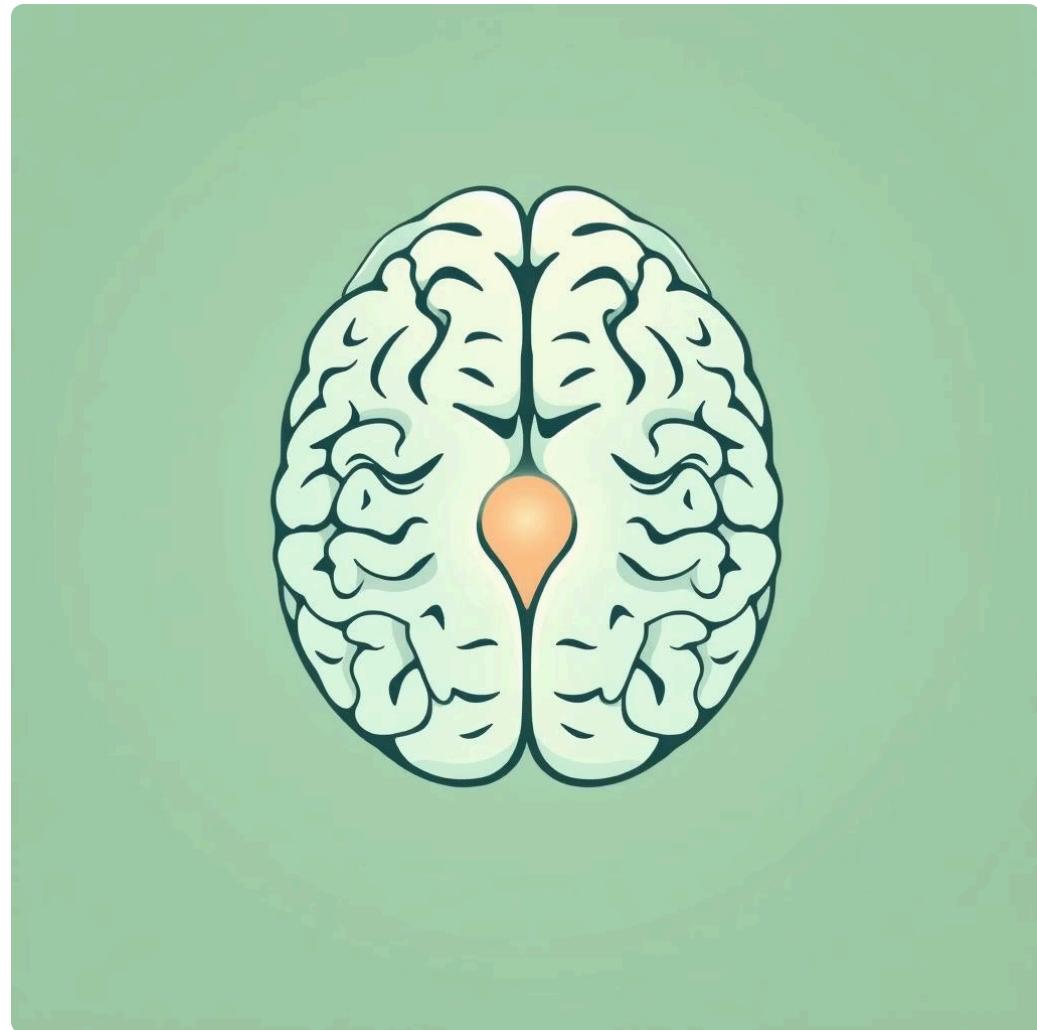
This streamlined process ensures efficient data handling and rapid response times.

AI Models in Action

Two powerful AI models drive the core functionalities: a specialized Brain Tumor Detector and Google's advanced Gemini LLM.

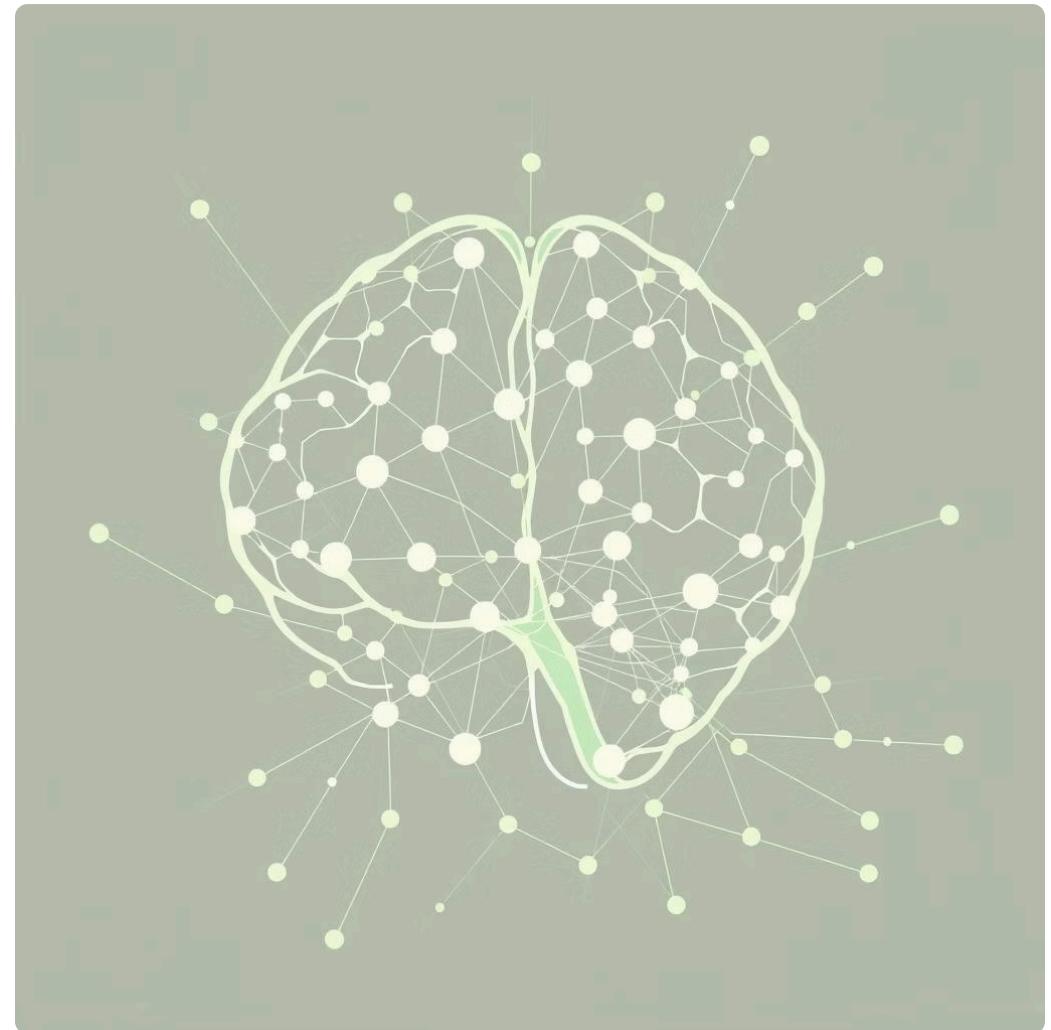
1. Brain Tumor Detector

A PyTorch-based Convolutional Neural Network (CNN) specifically trained for medical image analysis.



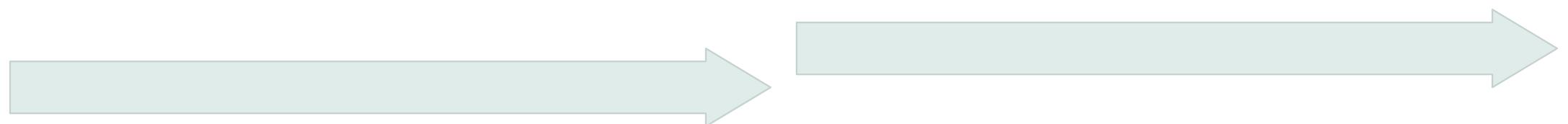
2. Conversational Intelligence

Powered by the Google Gemini API, providing advanced natural language understanding and generation.



Beyond the "Black Box"

Our "How it Works" demo allows students to explore the intricate mechanisms of deep learning, transforming opaque AI into an understandable process.



Neural Level Visualization

Moved beyond simple predictions to show the internal workings of the neural network.

Feature Extraction

Visualized how convolution layers detect simple edges and gradients within complex images.



Activation Maps

Demonstrated which specific parts of the MRI scan triggered neurons, highlighting critical regions.

Inference Process

Traced the journey: Image -> Tensor -> Layers -> Classification for a complete understanding.



Implementation Challenges

Developing a sophisticated AI system comes with unique technical hurdles, especially when integrating multiple complex models and asynchronous operations.

→ Async Complexity

Managing SQLAlchemy session lifecycles without connection leaks in an asynchronous environment was a critical optimization.

→ Inference Management

Ensuring thread safety for CPU/GPU intensive PyTorch models running concurrently with async API endpoints required careful design.

→ Explainability

Creating intuitive visualizations that could make complex tensor operations easily understandable for a student audience was a significant design challenge.

Evolving for Impact

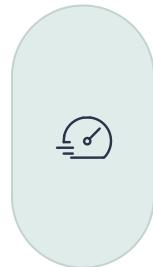
Our journey doesn't end here. The next steps focus on rigorous validation, enhanced user experience, and robust deployment strategies to bring the NuitInfo Chatbot to its full potential.



Clinical Validation



Conducting rigorous clinical validation of the tumor detection model (currently for demonstration purposes only) to ensure real-world accuracy.



User Experience Enhancements



Implementing streaming responses for faster and more fluid chat feedback, significantly improving user interaction.



Robust Deployment



Developing containerization (Docker) and CI/CD pipelines for automated testing, deployment, and scalability.



Shaping the Future of AI in Healthcare

The NuitInfo Chatbot represents a significant step towards accessible, intelligent, and transparent AI solutions in the medical field. We envision a future where AI empowers both medical professionals and aspiring data scientists.

"Bringing clarity to complexity, and intelligence to care."