🏗️ Solution Architecture – HealthAI: Intelligent Healthcare Assistant Using IBM Granite

This section outlines the complete solution architecture for **HealthAI**, an AI-powered healthcare assistant built to deliver fast, personalized, and secure medical guidance. The system integrates natural language processing, user authentication, and intelligent disease prediction to enable accessible, real-time healthcare support.

🔄 Architecture Layers & System Components

1. Frontend – User Interface (Streamlit Web App)

- **Role**: Acts as the primary interface between the user and the AI system.
- **Technology**: Built using **Streamlit** for rapid web-based development.
- **Features**:
  - User registration/login forms
  - Chatbot interface for symptom input
  - Display of disease predictions and treatment suggestions

Description: The interface is user-friendly and mobile-compatible, designed to reduce barriers to use. It enables both structured form input and free-text chat to suit different user preferences.

2. User Authentication Module

- **Role**: Ensures secure access and personalized data handling
- **Technology**: **MySQL Database** with encrypted credential storage
- **Features**:
  - Registration and login validation
  - Profile-based data linkage for symptom history
  - Protection of personal health information (PHI)

Description: This layer is essential for maintaining confidentiality and enables user-specific treatment personalization over time.

3. Symptom Input Layer

- **Role**: Collects symptom data from users
- **Modes**:
  - Structured input via dropdowns and checkboxes
  - Free-text entry using chatbot interface

Description: This dual-mode input collection improves both precision and accessibility, especially for users unfamiliar with medical terms.

4. Backend Processing Layer – AI Engine (IBM Granite + Python)

- **Role**: Core intelligence unit that processes and analyzes user input

- **Technologies**:
  - **IBM Granite LLMs** (for symptom interpretation and dialogue)
  - **Python NLP and rule-based logic** for structured diagnosis
- **Components**:
  - **Symptom Interpreter**: Extracts relevant health info from natural language
  - **Disease Predictor**: Suggests probable conditions using transformer-based models
  - **Treatment Planner**: Generates basic guidance based on user profile and diagnosis

Description: The AI engine handles dynamic responses, context-awareness, and medical reasoning using IBM's Granite models as the base foundation.

5. Output Layer – Diagnosis & Advice Display

- **Role**: Presents the AI-generated results to the user in a clean format
- **Technology**: Streamlit-based dynamic output blocks
- **Display Includes**:
  - Suggested diseases
  - Treatment or next-step recommendations
  - Optional confidence score or explanation

Description: Designed for clarity, even non-technical users can understand the AI's suggestions and take appropriate next steps.

6. Feedback Collection System (Planned Extension)

- **Role**: Gathers user feedback to improve future predictions
- **Data Use**:
  - Stored in the database alongside diagnosis history
  - Used for retraining and accuracy tuning of the model

Description: This feature will help evolve the system through real-world input and 🔁

Output Layer: Insights & Explanations

Predicted Diseases

Clear presentation of potential diagnoses, ranked by likelihood.

Treatment Suggestions

Actionable recommendations for next steps, including self-care or professional consultation.

Confidence Scores

Transparency on the AI's certainty for each prediction.

Explanations

Breakdown of how the AI arrived at its conclusions, enhancing trust.