# 🏥 AI Medical Chatbot Pro — LLM + LangChain + Pinecone + Flask/Streamlit

An end-to-end **AI-powered Medical Chatbot** built using **Large Language Models (Llama 3.3 70B)**, **LangChain**, **Pinecone vector search**, and **Flask/Streamlit** — deployable on both **AWS (EC2 + ECR)** and **Render.com**.

This project covers every part:
➡ Data ingestion & processing
➡ Embedding + Vector DB with Pinecone
➡ RAG-based chatbot pipeline using LangChain
➡ REST API with Flask + Beautiful UI
➡ Streamlit version for easy deployment
➡ Docker containerization
➡ Multiple deployment options (AWS EC2, Render)
➡ Automated CI/CD with GitHub Actions

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## ✨ Features

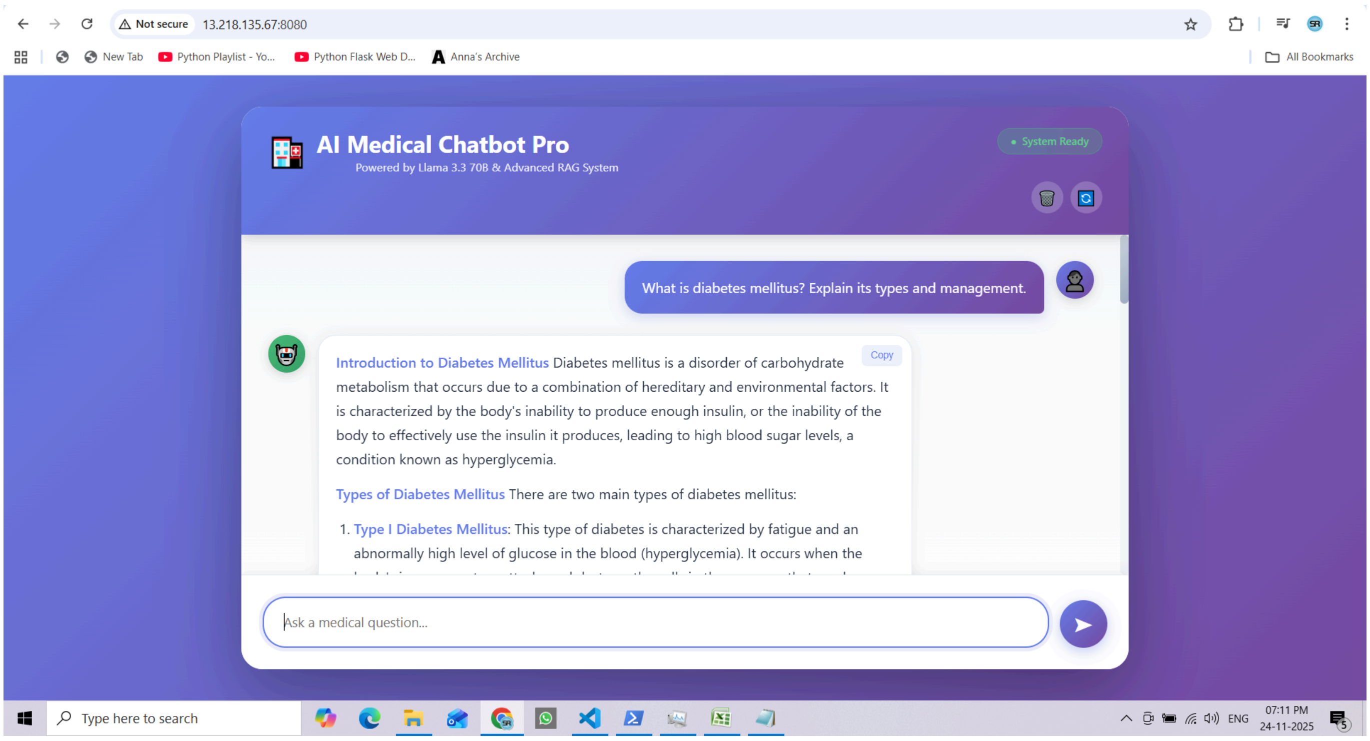
- 🤖 **Powered by Llama 3.3 70B** via Groq (Free API)
- 📚 **Advanced RAG System** - Retrieves relevant medical information
- 💬 **Streaming Responses** - Real-time answer generation
- 🎨 **Two UI Options** - Flask (advanced) or Streamlit (simple)
- 📱 **Responsive Design** - Works on all devices
- 🔒 **Privacy First** - No conversation storage
- 🆓 **Free to Deploy** - Multiple free hosting options

## 🎯 Live Demo

- **Render Deployment:** [Your Render URL]
- **AWS Deployment:** [Your AWS URL]

## 📷 Screenshots

Deployment Page



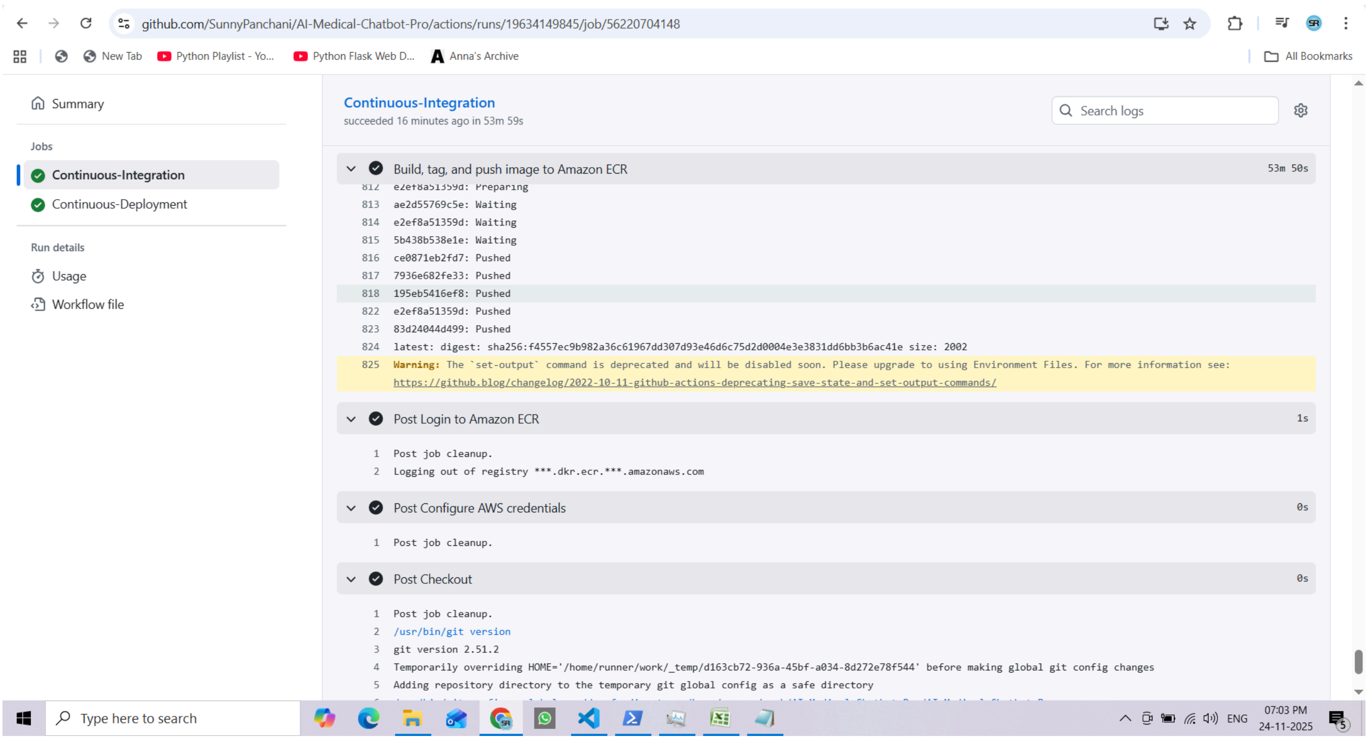
What is diabetes mellitus? Explain its types and management.

Introduction to Diabetes Mellitus Diabetes mellitus is a disorder of carbohydrate metabolism that occurs due to a combination of hereditary and environmental factors. It is characterized by the body's inability to produce enough insulin, or the inability of the body to effectively use the insulin it produces, leading to high blood sugar levels, a condition known as hyperglycemia.

Types of Diabetes Mellitus There are two main types of diabetes mellitus:

1. Type I Diabetes Mellitus: This type of diabetes is characterized by fatigue and an abnormally high level of glucose in the blood (hyperglycemia). It occurs when the

## CI/CD Pipline



Continuous-Integration
succeeded 16 minutes ago in 53m 59s

Build, tag, and push image to Amazon ECR 53m 50s

```
e2ef8a51359d: Preparing
ae2d55769c5e: Waiting
e2ef8a51359d: Waiting
5b438b538e1e: Waiting
ce0871eb2fd7: Pushed
7936e682fe33: Pushed
195eb5416ef8: Pushed
e2ef8a51359d: Pushed
83d24044d499: Pushed
latest: digest: sha256:f4557ec9b982a36c61967dd307d93e46d6c75d2d0004e3e3831dd6bb3b6ac41e size: 2002
Warning: The `set-output` command is deprecated and will be disabled soon. Please upgrade to using Environment Files. For more information see:
https://github.blog/changelog/2022-10-11-github-actions-deprecating-save-state-and-set-output-commands/
```

Post Login to Amazon ECR 1s

```
Post job cleanup.
Logging out of registry ***.dkr.ecr.***.amazonaws.com
```

Post Configure AWS credentials 0s

```
Post job cleanup.
```

Post Checkout 0s

```
Post job cleanup.
/usr/bin/git version
git version 2.51.2
Temporarily overriding HOME='/home/runner/work/_temp/d163cb72-936a-45bf-a034-8d272e78f544' before making global git config changes
Adding repository directory to the temporary git global config as a safe directory
```

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## 🚀 Quick Start - Local Development

### STEP 01 — Clone the Repository

```
git clone https://github.com/SunnyPanchani/AI-Medical-Chatbot-Pro.git
cd AI-Medical-Chatbot-Pro
```

### STEP 02 — Create Virtual Environment

**Using Conda:**

```
conda create -n medibot python=3.11 -y
conda activate medibot
```

**Or using venv:**

```
python -m venv env
source env/bin/activate  # On Windows: env\Scripts\activate
```

### STEP 03 — Install Dependencies

```
pip install -r requirements.txt
```

### STEP 04 — Set Up Environment Variables

Create a `.env` file in the root directory:

```
# Pinecone Vector Database
PINECONE_API_KEY=xxxxxxxxxxxxxxxxxxxxxxxxxxxxx

# Groq LLM API (FREE - get from https://console.groq.com)
GROQ_API_KEY=gsk_xxxxxxxxxxxxxxxxxxxxxxxxxxxxx
```

**Get Your Free API Keys:**

- **Pinecone:** https://www.pinecone.io/ (Free tier: 100K vectors)
- **Groq:** https://console.groq.com/ (Free tier: Very generous limits)

### STEP 05 — Create Vector Store

**Important:** Run this once to create your Pinecone index:

```
python store_index.py
```

This will:

- Load PDFs from `data/` folder
- Create embeddings
- Store vectors in Pinecone

- Create index: `medical-chatbot`

### STEP 06 — Test the Setup

```
python test_chatbot.py
```

This runs test queries to verify everything works.

### STEP 07 — Run the Application

#### Option A: Flask Application (Advanced UI)

```
python app.py
```

Then open: http://localhost:8080

#### Option B: Streamlit Application (Simple UI)

```
streamlit run streamlit_app.py
```

Then open: http://localhost:8501

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## 🛠 Tech Stack

| Component | Technology | Purpose |
|---|---|---|
| **LLM** | Llama 3.3 70B (Groq) | Answer generation |
| **Framework** | LangChain | RAG pipeline |
| **Vector DB** | Pinecone | Semantic search |
| **Embeddings** | Sentence Transformers | Text embeddings |
| **Backend** | Flask | REST API |
| **UI** | Flask + Streamlit | User interfaces |
| **Deployment** | AWS EC2, Render | Cloud hosting |
| **CI/CD** | GitHub Actions | Automation |
| **Containerization** | Docker | Packaging |

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## 📁 Project Structure

```
AI Medical Chatbot Pro/
├── .github/
│   └── workflows/
│       └── cicd.yaml           # CI/CD pipeline
├── .streamlit/
│   └── config.toml             # Streamlit config
├── data/
│   └── Medical_book.pdf        # Medical knowledge base
├── src/
│   ├── __init__.py
│   ├── helper.py               # Core functions
│   └── prompt.py               # Prompt templates
├── static/
│   ├── style.css               # Flask UI styles
│   └── script.js               # Flask UI scripts
├── templates/
│   └── index.html              # Flask UI template
├── research/
│   └── trails.ipynb            # Development notebook
├── app.py                      # Flask application
├── streamlit_app.py            # Streamlit application
├── store_index.py              # Vector store creation
├── test_chatbot.py             # Test script
├── requirements.txt            # Dependencies
├── render.yaml                 # Render config
├── Dockerfile                  # Docker config
├── setup.py                    # Package setup
├── .env                        # Environment variables (not in git)
├── .gitignore                  # Git ignore
└── README.md                   # This file
```

## 🌐 Deployment Options

### Option 1: Deploy on Render (Easiest - Free Tier Available)

**Perfect for:** Quick deployment, testing, demos

1. **Prerequisites:**
    - GitHub account
    - Render account (free)
    - API keys (Pinecone, Groq)
2. **Deploy Steps:**

```
# 1. Create vector store locally (one time only)
python store_index.py

# 2. Push to GitHub
```

```
git add .
git commit -m "Deploy to Render"
git push

# 3. On Render.com:
- New Web Service
- Connect GitHub repository
- Add environment variables:
  * PINECONE_API_KEY
  * GROQ_API_KEY
- Deploy!
```

**Your app will be live at:** `https://your-app.onrender.com`

**Detailed Guide:** See RENDER_DEPLOYMENT.md

**Render Features:**

- ✅ Free tier available
- ✅ Auto-deploy on git push
- ✅ HTTPS included
- ✅ Easy setup (5 minutes)

## Option 2: Deploy on AWS EC2 (Production - Full Control)

**Perfect for:** Production, custom domains, full control

**Prerequisites**

1. **AWS Account**
2. **IAM User with Permissions:**
   - `AmazonEC2ContainerRegistryFullAccess`
   - `AmazonEC2FullAccess`

**Deployment Steps**

**1. Login to AWS Console**

**2. Create IAM User for Deployment**

Create user with these policies:

- `AmazonEC2ContainerRegistryFullAccess`
- `AmazonEC2FullAccess`

**3. Create ECR Repository**

```
# Create ECR repository to store Docker image
Repository Name: medicalbot
Region: us-east-1
```

```
# Save the URI:
994626601219.dkr.ecr.us-east-1.amazonaws.com/medicalbot
```

#### 4. Create EC2 Instance

- AMI: Ubuntu 22.04 LTS
- Instance Type: t2.medium (recommended) or t2.micro (free tier)
- Storage: 20 GB
- Security Group: Allow ports 22 (SSH), 80 (HTTP), 8080 (App)

#### 5. Install Docker on EC2

SSH into your EC2 instance:

```
# Update system
sudo apt-get update -y
sudo apt-get upgrade -y

# Install Docker
curl -fsSL https://get.docker.com -o get-docker.sh
sudo sh get-docker.sh

# Add user to docker group
sudo usermod -aG docker ubuntu
newgrp docker

# Verify Docker installation
docker --version
```

#### 6. Configure EC2 as Self-Hosted Runner

In your GitHub repository:

1. Go to: Settings → Actions → Runners
2. Click: New self-hosted runner
3. Choose: Linux
4. Run commands on EC2 instance

#### 7. Setup GitHub Secrets

Add these secrets in: Repository Settings → Secrets and variables → Actions

```
AWS_ACCESS_KEY_ID=your_access_key
AWS_SECRET_ACCESS_KEY=your_secret_key
AWS_DEFAULT_REGION=us-east-1
ECR_REPO=994626601219.dkr.ecr.us-east-1.amazonaws.com/medicalbot
PINECONE_API_KEY=your_pinecone_key
GROQ_API_KEY=your_groq_key
```

#### 8. Create Vector Store

**Important:** Before deploying, create the vector store:

```
# Run locally or on EC2
python store_index.py
```

#### 9. Deploy with GitHub Actions

```
# Push to main branch
git add .
git commit -m "Deploy to AWS"
git push origin main

# GitHub Actions will automatically:
# 1. Build Docker image
# 2. Push to ECR
# 3. Deploy to EC2
```

#### 10. Access Your Application

```
http://your-ec2-public-ip:8080
```

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## 🐳 Docker Commands

### Build Docker Image

```
docker build -t medicalbot .
```

### Run Docker Container

```
docker run -p 8080:8080 \
  -e PINECONE_API_KEY=your_key \
  -e GROQ_API_KEY=your_key \
  medicalbot
```

### Push to ECR

```
# Login to ECR
aws ecr get-login-password --region us-east-1 | \
  docker login --username AWS --password-stdin \
  994626601219.dkr.ecr.us-east-1.amazonaws.com

# Tag image
docker tag medicalbot:latest \
  994626601219.dkr.ecr.us-east-1.amazonaws.com/medicalbot:latest

# Push image
docker push 994626601219.dkr.ecr.us-east-1.amazonaws.com/medicalbot:latest
```

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## 🧪 Testing

### Run Test Script

```
python test_chatbot.py
```

### Test in Notebook

```
jupyter notebook research/trails.ipynb
```

### Manual Testing

```
from src.helper import setup_medical_chatbot, ask_question

# Initialize
rag_chain, retriever, docsearch = setup_medical_chatbot()

# Ask question
result = ask_question(
    rag_chain,
    "What is diabetes?",
    retriever=retriever
)
```

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## 🔧 Configuration

### Adjust Model Parameters

Edit `src/helper.py`:

```
chatModel = initialize_groq_llm(
    model_name="llama-3.3-70b-versatile",  # Model choice
    temperature=0.3,                    # 0 = focused, 1 = creative
    max_tokens=1024                     # Response length
)
```

### Change Retrieved Documents

```
rag_chain, retriever = create_rag_chain(
    docsearch,
    chatModel,
    num_documents=5  # Number of sources (3-7 recommended)
)
```

### Customize Prompts

Edit `src/prompt.py` to modify system prompts.

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## 📊 Performance Metrics

| Metric | Value |
|---|---|
| Average Response Time | 2-5 seconds |
| Vectors in Database | 5,859 chunks |
| Documents Retrieved | 5 per query |
| Model | Llama 3.3 70B |
| Embedding Dimension | 384 |
| Cost | $0 (Free APIs) |

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## 🔒 Security & Privacy

- ✅ No conversation storage
- ✅ API keys in environment variables
- ✅ HTTPS supported (on Render/AWS)
- ✅ No user tracking
- ✅ Data processed in memory only
- ✅ `.env` file excluded from git

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## ⚠️ Important Notes

### Medical Disclaimer

This chatbot provides **informational content only**. It is **NOT a substitute for professional medical advice, diagnosis, or treatment**. Always seek the advice of your physician or other qualified health provider with any questions you may have regarding a medical condition.

### API Usage

- **Groq:** Free tier with generous limits
- **Pinecone:** Free tier (100K vectors, 1 index)
- Monitor your usage in respective dashboards

### Data Privacy

- Conversations are NOT stored
- Data is processed in real-time
- No personal information is collected

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## 🐛 Troubleshooting

### Common Issues

#### 1. ModuleNotFoundError

```
pip install -r requirements.txt
```

#### 2. Pinecone Index Not Found

```
python store_index.py
```

#### 3. GROQ_API_KEY Not Found

- Check `.env` file exists
- Verify key is correct
- Restart application

#### 4. Out of Memory (Render Free Tier)

- Upgrade to paid tier
- Or reduce `num_documents` to 3

#### 5. Slow Response

- Check internet connection
- Verify API keys are valid
- Try reducing retrieved documents

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## 🤝 Contributing

Contributions are welcome! Please:

1. Fork the repository
2. Create a feature branch (`git checkout -b feature/YourFeature`)
3. Commit changes (`git commit -m 'Add YourFeature'`)
4. Push to branch (`git push origin feature/YourFeature`)
5. Open a Pull Request

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## 📝 License

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## 🙏 Acknowledgments

- **Groq** - For free Llama 3.3 70B API access
- **Pinecone** - For vector database
- **LangChain** - For RAG framework
- **Streamlit** - For UI framework
- **Flask** - For web framework

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## 📧 Contact

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## 🌟 Star This Project

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## 📈 Roadmap

- ☑ Basic chatbot with RAG
- ☑ Flask web interface
- ☑ Streamlit interface
- ☑ Docker deployment
- ☑ AWS deployment
- ☑ Render deployment
- ☐ Multi-language support
- ☐ Voice input/output
- ☐ Mobile app version
- ☐ Chat history export
- ☐ More medical specialties

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## 💡 Tips for Best Results

1. **Ask Specific Questions:** "What are the symptoms of Type 2 diabetes?" instead of just "diabetes"
2. **Check Sources:** Review cited documents for verification
3. **Consult Professionals:** Always verify with healthcare providers
4. **Report Issues:** Use GitHub issues for bugs or suggestions

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## 📚 Documentation

- Render Deployment Guide
- Deployment Checklist
- Streaming Guide
- API Documentation (coming soon)

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**Made with ❤️ by Sunny Panchani**

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