CAPSTONE PROJECT

AI AGENT FOR SMART FARMING ADVICE

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OUTLINE

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PROBLEM STATEMENT

Small-scale farmers often lack access to timely, accurate, and personalized agricultural guidance. This leads to poor decision-making, crop loss, and low yields. The challenge is to develop an AI agent that uses Retrieval-Augmented Generation (RAG) to provide real-time, localized information on weather, soil conditions, crop selection, pest control, and market prices through natural language interaction.

PROPOSED SOLUTION

- The proposed system addresses the challenge of empowering small-scale farmers with **timely, localized, and accurate agricultural guidance** using an **AI Agent powered by Retrieval-Augmented Generation (RAG)**. The agent will retrieve real-time agricultural data from trusted sources and generate natural language responses based on user queries.
- **Data Collection:**
  - Collect trusted agricultural data from government sources, weather APIs, and mandi price portals.
  - Include crop guides, pest management resources, and soil condition reports for localized recommendations.
- **Data Preprocessing:**
  - Clean and convert collected documents into structured, searchable formats.
  - Generate embeddings for semantic retrieval using vectorization techniques.
- **Machine Learning Algorithm:**
  - Implement a Retrieval-Augmented Generation (RAG) pipeline combining a retriever and IBM Granite LLM.
  - Use the retriever to fetch relevant data and the LLM to generate natural language responses.

PROPOSED SOLUTION

- **Deployment:**
  - Deploy the AI agent on IBM Cloud Lite with a user-friendly web or chatbot interface..
  - Use IBM Cloud Object Storage for documents and integrate IBM Granite for response generation..
- **Evaluation:**
  - Evaluate the system based on response accuracy, relevance, and user feedback.
  - Continuously improve performance using test queries and real-world farmer interactions.
- **Result :**
  - The AI agent provides accurate, real-time farming advice tailored to user location and needs.
  - It enhances decision-making, improves yield, and bridges the information gap for small-scale farmers.

SYSTEM APPROACH

System Requirements

✅ Hardware Requirements:

- **Local storage:** 2 GB minimum for project files and embeddings
- Minimum 4 GB RAM (8 GB recommended for development)
- Intel i3 or higher processor
- Stable internet connection

✅ Software Requirements:

- **Operating System:** Windows 10 / Ubuntu 20.04 or higher
- Python 3.8 or later
- **Required Libraries:**
  - langchain or haystack (for RAG)
  - transformers, sentence-transformers (for embeddings)
  - streamlit or Flask (for frontend)
  - requests, pandas, openai or ibm-watson SDKs
- **IBM Services:**
  - IBM Granite API access
  - IBM Cloud Lite account
  - (Optional) IBM Watson Language Translator for multilingual support
  - IBM Cloud Object Storage

ALGORITHM & DEPLOYMENT

➢ Algorithm Selection :

The project uses the **Retrieval-Augmented Generation (RAG)** approach combined with **IBM Granite** large language models. RAG is ideal for this application because it grounds the model's output in trusted agricultural data sources, ensuring **factual accuracy** and **contextual relevance** for farmer queries. IBM Granite is chosen for its enterprise-grade performance and seamless integration with IBM Cloud.

➢ Data Input :

The system takes two main types of inputs:

User Query: Natural language questions from farmers (e.g., "What is the mandi price for tomatoes in Guntur today?")

Document Context: Retrieved text chunks from agricultural knowledge bases including crop calendars, soil guides, pest control manuals, weather info, and mandi price databases.

ALGORITHM & DEPLOYMENT

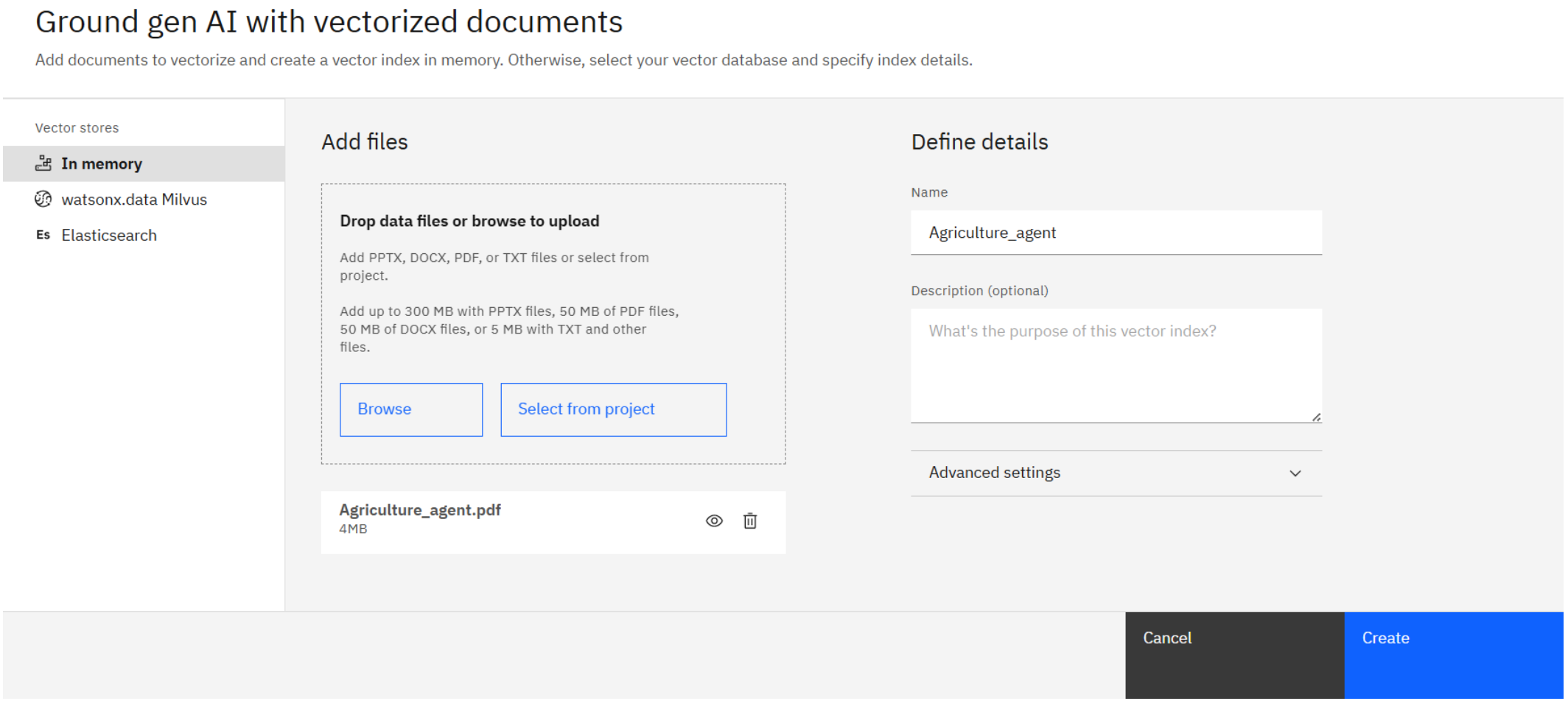
➢ Training Process:

As this system uses a **pre-trained IBM Granite model**, there is no model training from scratch. However, domain-specific documents (PDFs, FAQs, etc.) are embedded using **sentence-transformers**, and stored in a **vector database** like FAISS or ChromaDB. These embeddings are optimized for semantic search using cosine similarity. Data preprocessing ensures content is clean, well-chunked, and context-rich.

➢ Prediction Process:

When a user submits a query, the retriever component searches the vector database to find the most relevant text passages. The query and retrieved context are combined and passed to the IBM Granite model, which generates a precise and natural-language answer. The response is then displayed through a web/chat interface in English or translated into the user's preferred local language.

RESULT



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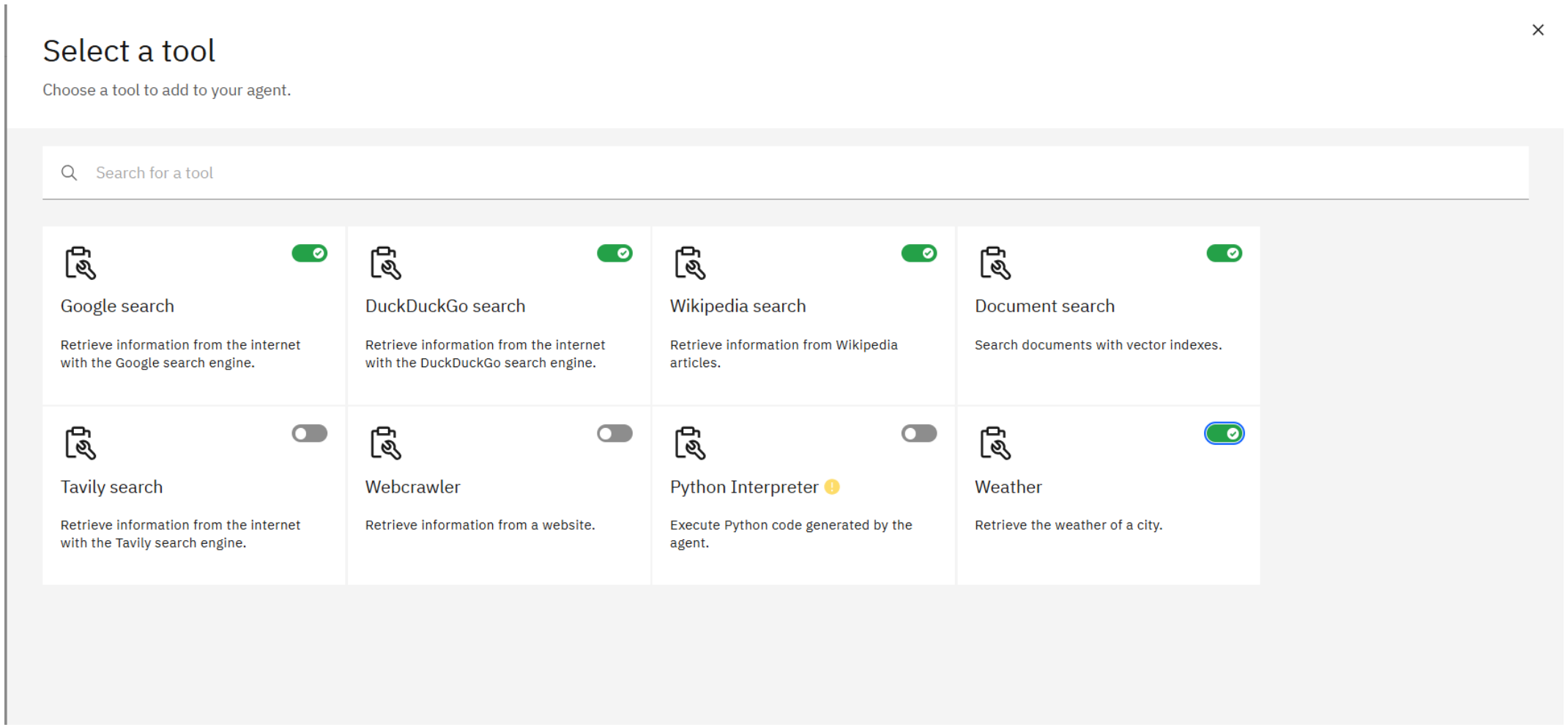


Projects / Farming_Agent / Agent Lab

Share feedback β | Unsaved | New agent + | Deploy

Build

AI Model: llama-3-3-70b-instruct

Setup

Configuration

Framework: LangGraph

Architecture: ReAct

Instructions — Advanced configuration

You are a smart agriculture assistant for Indian farmers. Based on the user's query and the provided context, generate accurate, localized, and easy-to-understand agricultural advice. Use trusted information only, and answer in a helpful tone. If the user asks in a regional language, respond in the same language. Answer should be short, relevant, and practical

Knowledge

Vector index: Agriculture_agent

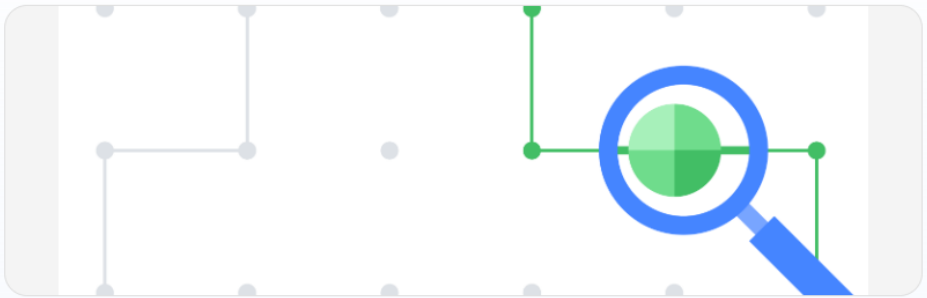
A vector index searches documents for relevant information to ground the model. Upload the files to index or select an existing index.

Agent preview

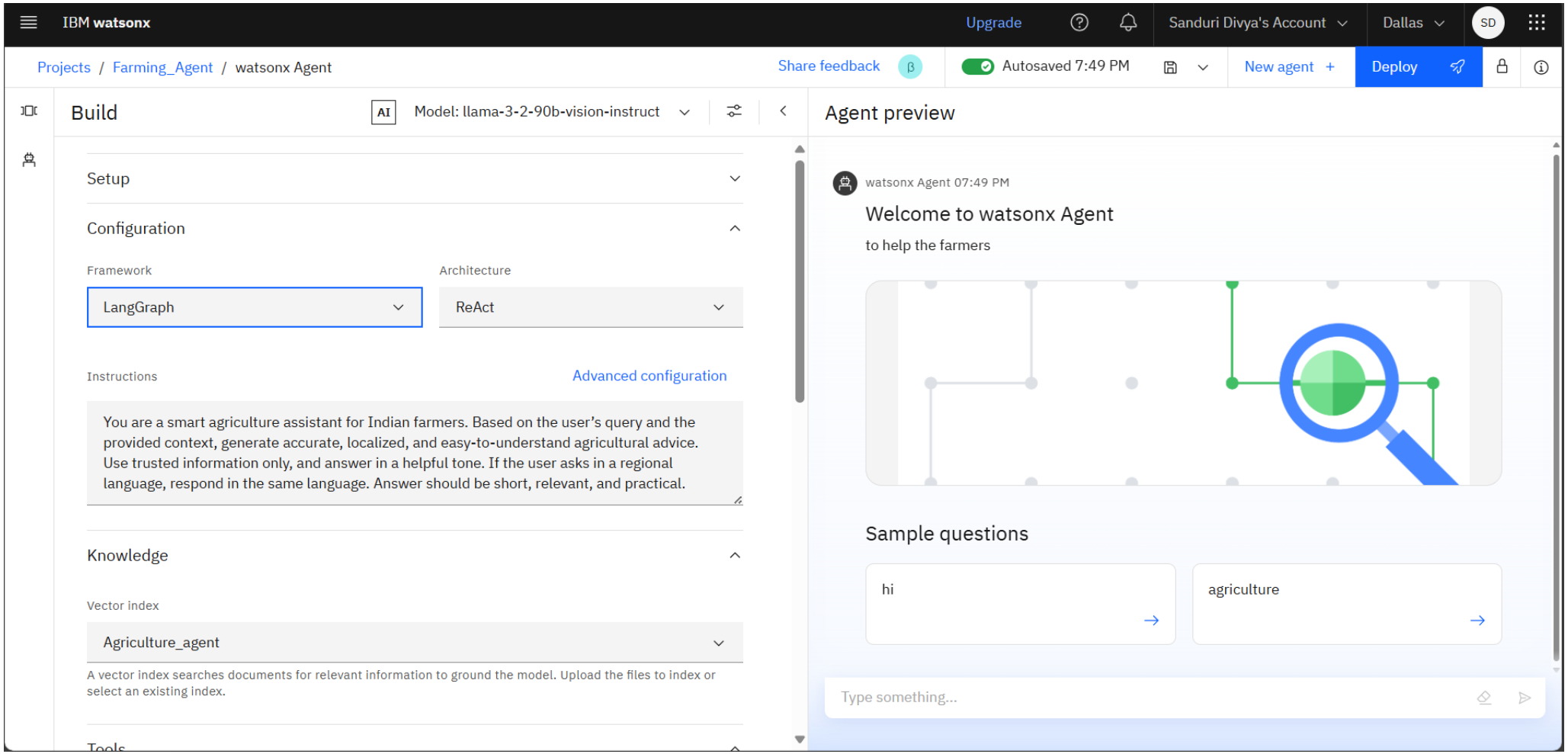
watsonx Agent 07:27 PM

Welcome to watsonx Agent

Change this description to reflect your particular agent



Type something...



CONCLUSION

- The AI Agent for Smart Farming Advice successfully delivers real-time, personalized agricultural guidance to small-scale farmers using Retrieval-Augmented Generation (RAG) and IBM Granite. By integrating trusted data sources, semantic retrieval, and natural language generation, the system empowers farmers to make informed decisions on crop planning, pest control, and market trends. Deployed on IBM Cloud, the solution is scalable, multilingual, and accessible—bridging the knowledge gap in grassroots farming and contributing to improved yield, reduced risk, and increased income.

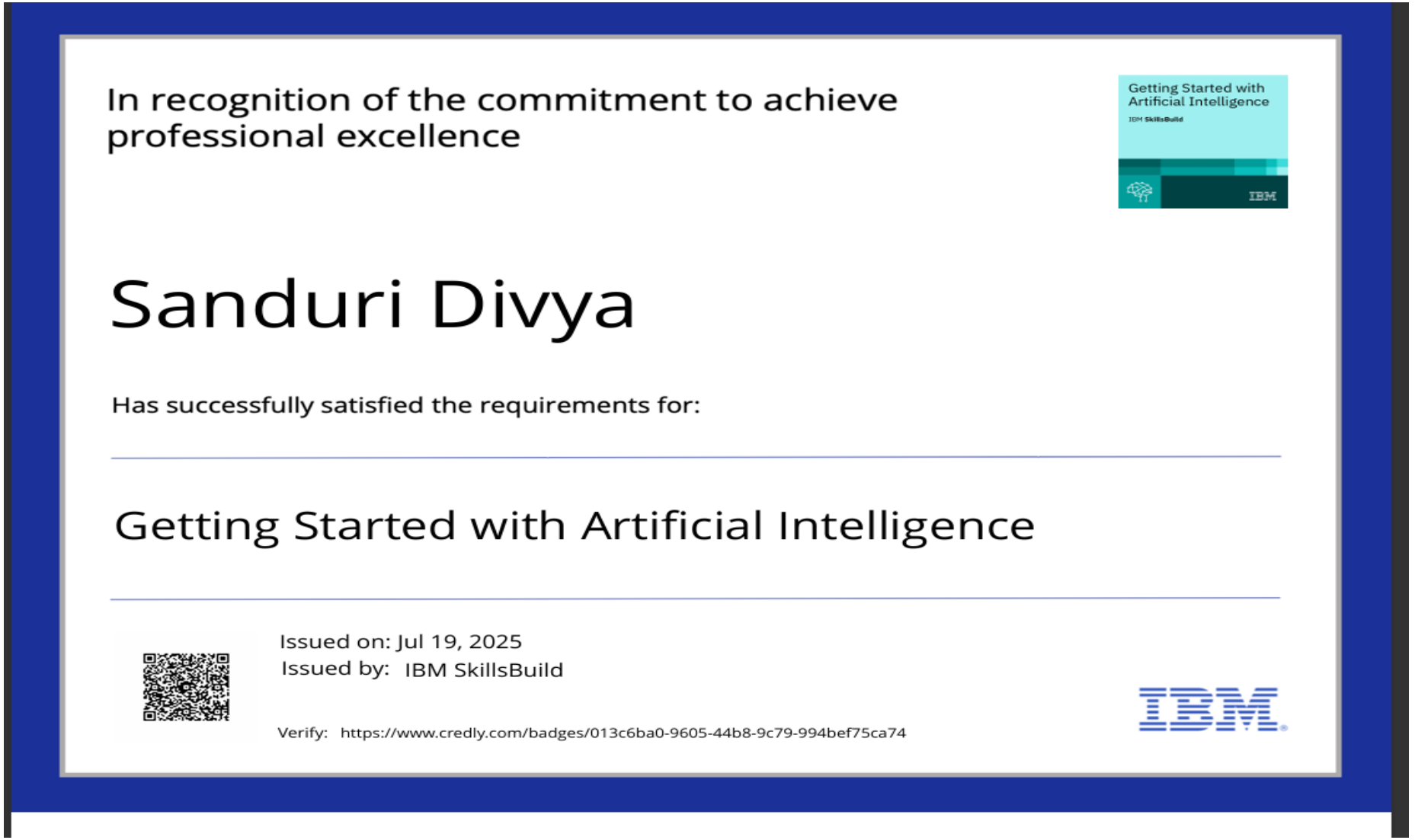
FUTURE SCOPE

- In the future, the AI Agent for Smart Farming Advice can be enhanced by integrating **voice-based interaction**, allowing farmers to speak their queries in local languages, making the system more accessible to illiterate users. The agent can also be extended to work in **offline or low-connectivity environments** through **SMS-based communication**. Incorporating **image-based crop disease detection** using computer vision would allow farmers to get treatment suggestions simply by uploading photos of affected plants. The system can further be integrated with **IoT sensors** for real-time soil and climate monitoring, enabling hyper-local and automated recommendations. With the addition of **user-specific profiling**, the agent can deliver more **personalized guidance** based on crop history and farm conditions. Developing a **dedicated mobile application** with regional language support and daily alerts would increase adoption. Finally, the solution can be expanded beyond crops to include **livestock, aquaculture, and organic farming**, making it a comprehensive smart agriculture assistant.

REFERENCES

- This project is based on the concept of Retrieval-Augmented Generation (Lewis et al., 2020) and uses IBM Granite models via IBM Cloud services.
  Agricultural data was sourced from ICAR, IMD, Agmarknet, and KVK portals for region-specific recommendations.
  Machine learning and data preprocessing practices were guided by research on AI in agriculture and tools like LangChain and Sentence-Transformers.

IBM CERTIFICATIONS



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IBM **SkillsBuild** Completion Certificate

This certificate is presented to

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for the completion of

Lab: Retrieval Augmented Generation with LangChain

(ALM-COURSE_3824998)

According to the Adobe Learning Manager system of record

Completion date: 24 Jul 2025 (GMT) **Learning hours:** 20 mins

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THANK YOU

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