CAPSTONE PROJECT

PROJECT TITLE: AI AGENT FOR SMART FARMING ADVICE

Presented By:
SAYANTAN GHATAK
College Name- Techno Main Salt Lake
Department- Computer Science & Engineering

edunet foundation

OUTLINE

- Problem Statement
- Proposed Solution
- System Development Approach
- Algorithm & Deployment
- Result
- Conclusion
- Future Scope
- References
- IBM Certifications

PROBLEM STATEMENT

- **The Challenge for Small-Scale Farmers**
- Knowledge Gap: Limited access to timely, scientific, and localized farming data.
- Language Barriers: Most high-quality agricultural advice is not available in local languages like Bengali.
- Information Overload: Data is scattered, making it hard to make quick, informed decisions.
- Economic Risks: Sub-optimal decisions on crops, fertilizer, and market timing lead to reduced yield and lower income.

PROPOSED SOLUTION

- **An AI Agent for Smart Farming Advice**
- A real-time advisory agent powered by Retrieval-Augmented Generation (RAG).
- Core Function: Delivers localized guidance by retrieving trusted data on weather, soil, crops, and market prices.
- Interaction: Farmers can ask questions in their local language (e.g., Bengali).
- Goal: Bridge the knowledge gap, reduce risk, and boost income by enabling data-driven farming.
- Technology: Built on IBM Cloud, using the IBM Granite language model.

SYSTEM APPROACH

- Technology Stack
  - Cloud Platform: IBM Cloud Lite Services
  - Language Model: IBM Granite-3-8B-Instruct via watsonx.ai
  - Data Storage: IBM Cloud Object Storage (for the SF24 dataset)
  - Programming Language: Python
  - Core Libraries: ibm-watsonx-ai, sentence-transformers, pandas, scipy

ALGORITHM & DEPLOYMENT

- The RAG Pipeline
- 1. Knowledge Base: The SF24 dataset is processed into structured text entries.
- 2. Embedding: Each entry is converted into a numerical vector.
- 3. User Query: A farmer asks a question (e.g., "What fertilizer for rice?").
- 4. Retrieve: The system finds the most relevant entries using cosine similarity.
- 5. Augment: The retrieved data is combined with the query to form a detailed prompt.
- 6. Generate: The IBM Granite model uses this prompt to generate a final, human-like answer.

RESULT

```
Agricultural Data Context (from Smart Farming Data 2024):
{context}

Farmer's Question: {query}

Instructions: {user_instruction}
Consider soil conditions, environmental factors, nutrient requirements, and farming practices from the data.

Expert Advice:"""

        # Step 4: Generate response
        try:
            advice = self.granite_model.generate_text(prompt=prompt)

            return {
                "question": query,
                "advice": advice,
                "relevant_crops": [entry['crop'] for entry in relevant_knowledge],
                "confidence": np.mean([entry['relevance_score'] for entry in relevant_knowledge]),
                "data_sources": len(relevant_knowledge),
                "language": language
            }
        except Exception as e:
            return {
                "question": query,
                "advice": f"I apologize, I'm having trouble generating advice right now. Error: {str(e)}",
                "error": True
            }

    def get_crop_recommendation(self, soil_conditions):
        """Get crop recommendations based on soil conditions"""
        query = f"What crop is best for soil with N:{soil_conditions.get('N', 50)}, P:{soil_conditions.get('P', 30)}, K:{soil_conditions.get('K', 40)}, pH:{soil_conditions.get('ph', 6.5)}, moisture:{soil_conditions.get('moisture', 25)}%?"
        return self.generate_farming_advice(query)

# Initialize your Smart Farming AI Agent
farming_agent = SmartFarmingAIAgent(
    knowledge_entries=demo_knowledge,
    embeddings=doc_embeddings,
    embedding_model=embedding_model,
    granite_model=granite_model
)

print("✅ Smart Farming AI Agent initialized successfully!")
```

```
✅ Smart Farming AI Agent initialized successfully!
```

RESULT

Test the AI Agent

```
# Test with sample farming questions
test_queries = [
    "What fertilizer should I use for rice cultivation?",
    "My soil has pH 6.2 and 30% moisture. Which crop is best?",
    "How to manage pest pressure in wheat farming?",
    "What is the optimal irrigation frequency for cotton?",
    "আমার ধানের জমিতে কী সার ব্যবহার করব?"  # Bengali query
]

print(" Testing Smart Farming AI Agent:")
print("=" * 60)

for i, query in enumerate(test_queries, 1):
    print(f"\n{i}. Testing Query: {query}")

    # Detect language for Bengali queries
    language = "bengali" if any(char in query for char in ['আ', 'ব', 'ক', 'ম', 'ধ']) else "english"

    result = farming_agent.generate_farming_advice(query, language)

    print(f"   Relevant Crops: {result['relevant_crops']}")
    print(f"   Confidence: {result['confidence']:.3f}")
    print(f"   Advice: {result['advice'][:150]}...")
    print("-" * 40)
```

```
 Testing Smart Farming AI Agent:
============================================================
```

RESULT

Final Result:

```
 Testing Smart Farming AI Agent:
============================================================

1. Testing Query: What fertilizer should I use for rice cultivation?
   Relevant Crops: ['rice', 'rice', 'rice']
   Confidence: 0.791
   Advice:
Based on the Smart Farming Data 2024, you should use a balanced fertilizer that provides Nitrogen, Phosphorus, and Potassium at the optimal levels re...
----------------------------------------

2. Testing Query: My soil has pH 6.2 and 30% moisture. Which crop is best?
   Relevant Crops: ['maize', 'maize', 'maize']
   Confidence: 0.706
   Advice:
Based on the provided data, none of the given maize datasets perfectly match your soil conditions. However, considering your soil pH (6.2) falls with...
----------------------------------------

3. Testing Query: How to manage pest pressure in wheat farming?
   Relevant Crops: ['pigeonpeas', 'pigeonpeas', 'pigeonpeas']
   Confidence: 0.579
   Advice:

To manage pest pressure in wheat farming, consider the following strategies tailored to your local conditions in West Bengal, India:

1. Soil Manage...
----------------------------------------

4. Testing Query: What is the optimal irrigation frequency for cotton?
   Relevant Crops: ['rice', 'rice', 'rice']
   Confidence: 0.608
   Advice:
Based on the provided data, there is no information available specifically for cotton cultivation. However, considering the general trends observed i...
----------------------------------------

5. Testing Query: আমার ধানের জমিতে কী সার ব্যবহার করব?
   Relevant Crops: ['rice', 'rice', 'rice']
   Confidence: 0.431
   Advice:
আপনার ধানের জমিতে নিম্নলিখিত সার ব্যবহার করুন:

1. নাইট্রোজেন (Nitrogen) - 74.5 kg/ha
2. ফসফরাস (Phosphorus) - 74.5 kg/ha
3. পটাশি (Potassium) - 74.5...
```

Here are the links of the Final Project:

IBM Notebook: Link

GitHub: Link
https://github.com/Sayantang8/AI-Agent-for-Smart-Farming-Advice.git

edunet foundation

CONCLUSION

- **Impact and Key Achievements**
- Successfully built an AI-driven assistant that bridges the information gap for farmers.
- Demonstrated the power of IBM Granite and RAG for a specialized, practical application.
- Created a scalable and accessible solution by leveraging IBM Cloud.
- The agent empowers farmers to make informed, data-driven decisions, impacting their livelihood.

FUTURE SCOPE

- **Enhancements and Next Steps**

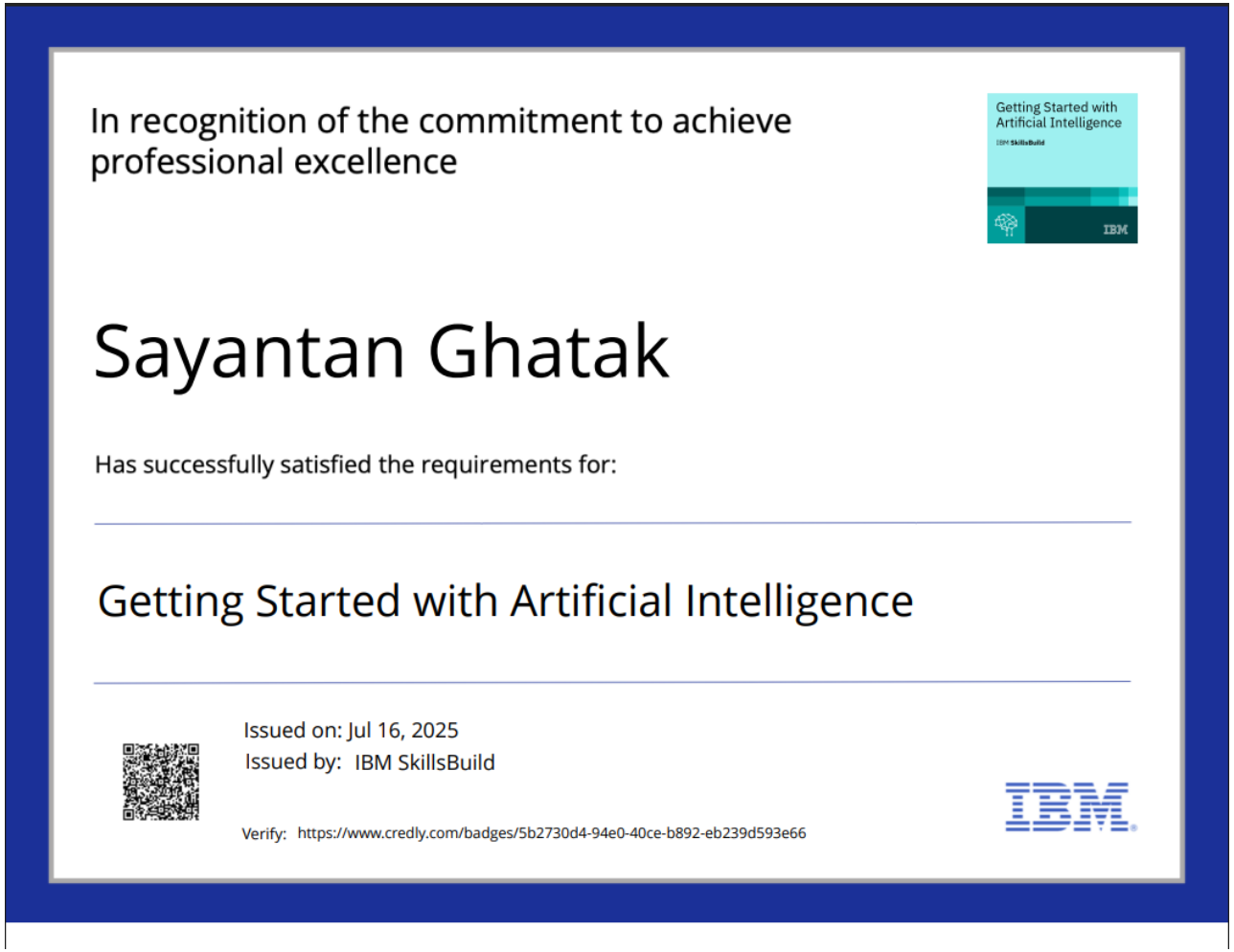
- Integrate Real-Time Data: Connect to live weather APIs and market price feeds.
- Add Voice Support: Enable farmers to ask questions via voice in their local dialect.
- Expand Knowledge Base: Include more crops, regions, and government schemes.
- Develop Mobile App: Create a user-friendly app for easy access on smartphones.
- Fine-Tune Model: Further train the Granite model on a larger agricultural corpus.

REFERENCES

- Dataset: Smart Farming Data 2024 (SF24)(Kaggle)
- Technology: IBM watsonx.ai Documentation, IBM Granite Model Card
- Libraries: Sentence-Transformers Documentation
- Concept: "Retrieval-Augmented Generation for Knowledge-Intensive NLP Tasks" (Lewis et al., 2020)

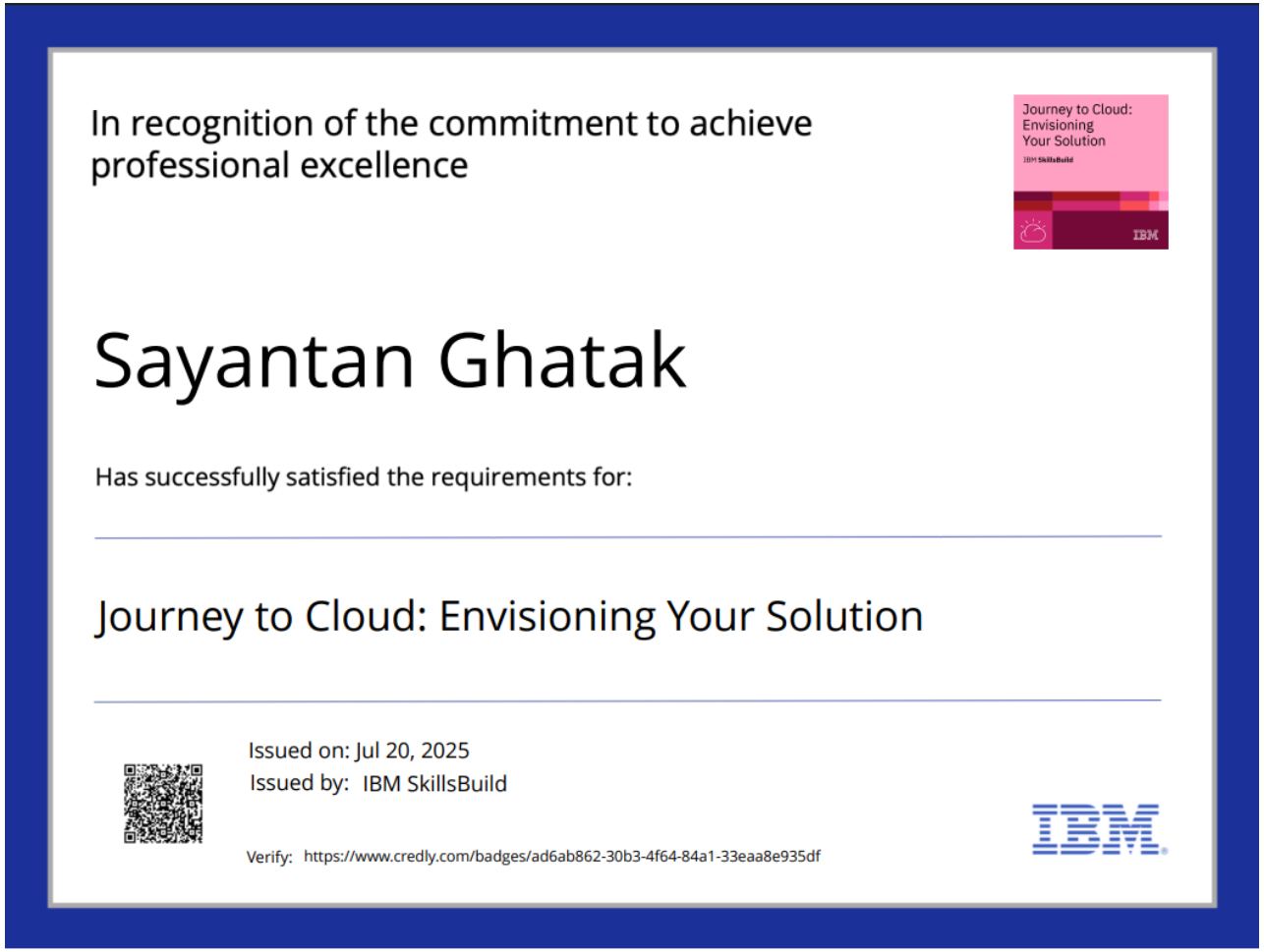
IBM CERTIFICATIONS

- Getting Started with AI



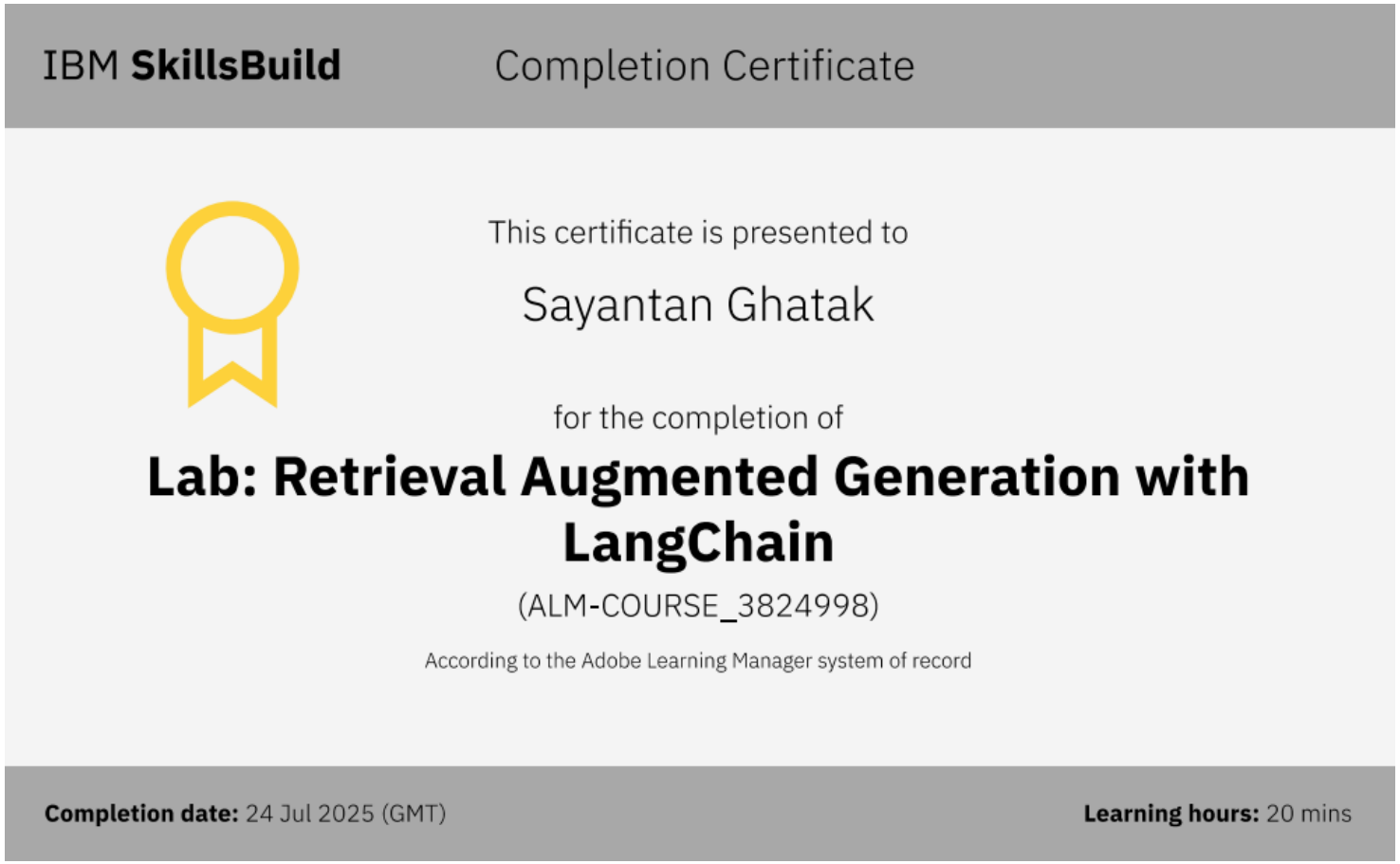
IBM CERTIFICATIONS

- Journey to Cloud



IBM CERTIFICATIONS

- RAG Lab Completion



IBM **SkillsBuild** Completion Certificate

This certificate is presented to

Sayantan Ghatak

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

THANK YOU

edunet foundation