CAPSTONE PROJECT

PROJECT TITLE

Presented By:

1. Student Name : CHIRAKALA HARITHA
2. College Name : Vignan's Lara Institute Of Technology and Science
3. Department : Computer Science and Engineering

OUTLINE

- Problem Statement
- Proposed System/Solution
- System Development Approach
- Algorithm & Deployment
- Result (Output Image)
- Conclusion
- Future Scope
- References

PROBLEM STATEMENT

- Small-scale farmers often lack access to real-time, localized agricultural advice, leading to suboptimal crop choices and lower yields. Challenges include understanding soil health, unpredictable weather, pest outbreaks, and fluctuating market prices.
- With increasing climate unpredictability, soil degradation, pest outbreaks, and volatile market prices, making the right farming decisions has become more critical than ever. Farmers need timely, localized recommendations that consider multiple factors such as soil health (NPK levels, pH), weather conditions, rainfall, humidity, and temperature, along with market trends.
- This project aims to bridge this knowledge gap using AI to offer personalized crop recommendations and smart farming advice.

PROPOSED SOLUTION

- The proposed system aims to address the challenge of helping small-scale farmers make data-driven crop selection decisions. This involves leveraging machine learning, weather data, and cloud deployment to provide accurate and personalized crop recommendations. The solution consists of the following components:
- Data Collection:
- Gather historical agricultural data, including soil nutrient values (N, P, K), pH levels, temperature, humidity, and rainfall.
- Incorporate real-time data sources such as weather APIs to enhance the relevance and accuracy of predictions.
- Data Preprocessing:
- Clean and preprocess the dataset to handle missing values, remove inconsistencies, and normalize numerical features.
- Perform feature engineering to extract meaningful insights that influence crop suitability and yield.
- Machine Learning Algorithm:
  - Use IBM Watson AutoAI to automate model selection, testing multiple classification algorithms (e.g., Random Forest, Decision Tree).Select the best model based on accuracy and confidence metrics for predicting the most suitable crop.
- Deployment:
- Deploy the trained model using IBM Watson Machine Learning as a REST API.Allow real-time predictions through a web interface or chatbot by sending input values and retrieving crop recommendations.
- Evaluation:
- Measure model performance using accuracy and confidence percentage for multiclass classification.Continuously improve the system based on validation results and real-time testing with user inputs.

SYSTEM APPROACH

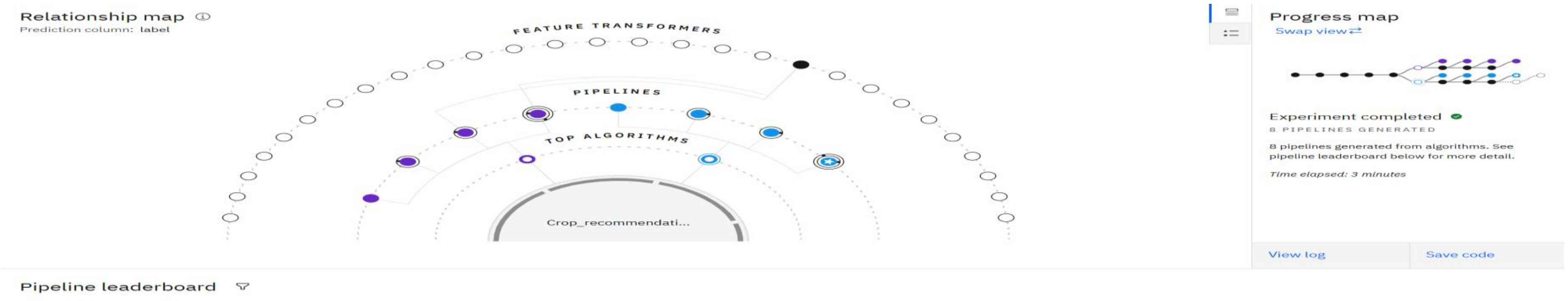
The system approach outlines the strategy and methodology used to design, develop, train, and deploy the AI-powered crop recommendation system on IBM Cloud. It ensures seamless integration of data processing, machine learning, and cloud deployment.

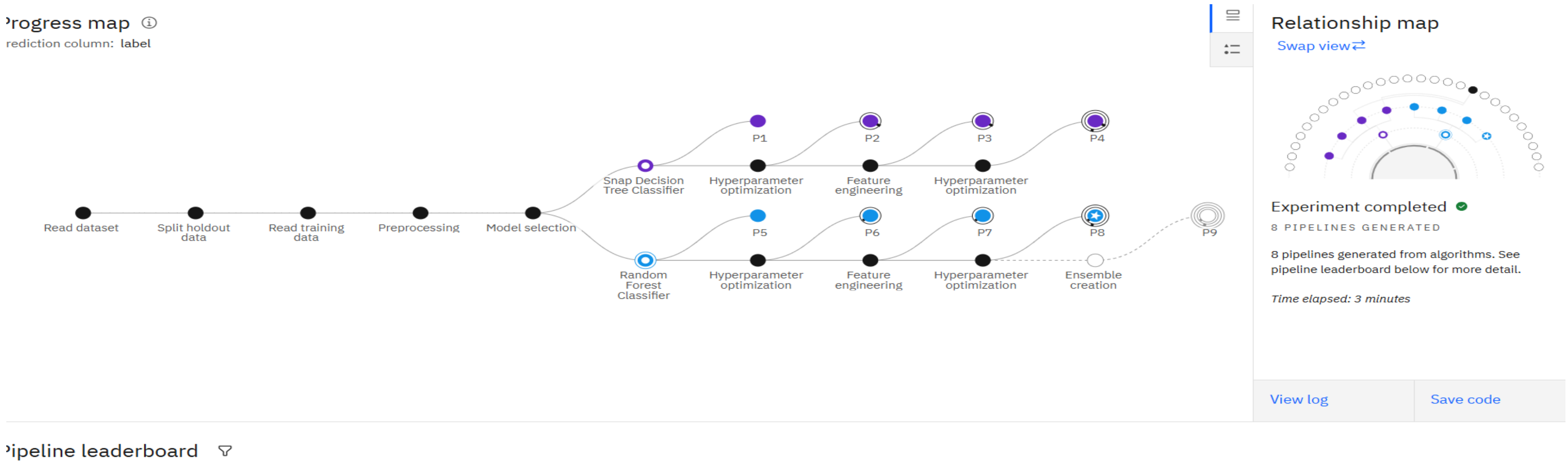
- System requirements
- Hardware: Internet-connected device (Laptop/Desktop), minimum 4GB RAM
- Platform: IBM Cloud Lite (free tier)
- Services Used : IBM Watson Studio, IBM Watson Machine Learning , Cloud Object Storage
- Library required to build the model
- IBM AutoAI (No manual coding required – automated pipeline generation)
- Watson Machine Learning SDK (for deployment and API usage)
- Python (optional for testing):requests (to call REST API)
- pandas and numpy (for dataset handling in local tests)
- matplotlib or seaborn (for any visualization)
- Postman (for API testing)
- Jupyter Notebook (for model evaluation and local tests, if applicable)

ALGORITHM & DEPLOYMENT

- Algorithm Selection:
  - The AutoAI feature in IBM Watson Studio was used to automatically train and evaluate multiple classification algorithms including Decision Trees, Random Forest, Gradient Boosting, and Logistic Regression. Based on performance metrics such as accuracy and confidence, the best model was selected. Since the task involves recommending one crop from multiple options, a multiclass classification approach was appropriate..
- Data Input:
  - The following features were used as input to train the model:N (Nitrogen content in soil),P (Phosphorus content in soil),K (Potassium content in soil),Temperature (in °C),Humidity (in %),pH level of the soilRainfall (in mm).
  - These input features were selected as they are critical environmental factors that influence the suitability of a crop for a given region..
- Training Process:
- The AutoAI pipeline automatically split the dataset into training and validation sets. It performed data preprocessing (handling missing values, encoding), model selection, and hyperparameter optimization. The model was trained using historical agricultural data from a crop recommendation dataset, ensuring it could generalize well to new inputs.
- Prediction Process:
  - Once the best-performing model was selected, it was deployed as a REST API using IBM Watson Machine Learning. Real-time crop predictions are generated when the model receives input data (e.g., NPK, temperature, rainfall, etc.). The model returns the most suitable crop label (e.g., rice, mothbeans) along with confidence scores..

RESULT


Relationship map
Prediction column: label
FEATURE TRANSFORMERS
PIPELINES
TOP ALGORITHMS
Crop_recommendati...
Progress map
Swap view
Experiment completed
8 PIPELINES GENERATED
8 pipelines generated from algorithms. See pipeline leaderboard below for more detail.
Time elapsed: 3 minutes
View log
Save code
Pipeline leaderboard


Progress map
Prediction column: label
Read dataset
Split holdout data
Read training data
Preprocessing
Model selection
Snap Decision Tree Classifier
Random Forest Classifier
P1
P2
P3
P4
P5
P6
P7
P8
P9
Hyperparameter optimization
Feature engineering
Ensemble creation
Relationship map
Swap view
Experiment completed
8 PIPELINES GENERATED
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Time elapsed: 3 minutes
View log
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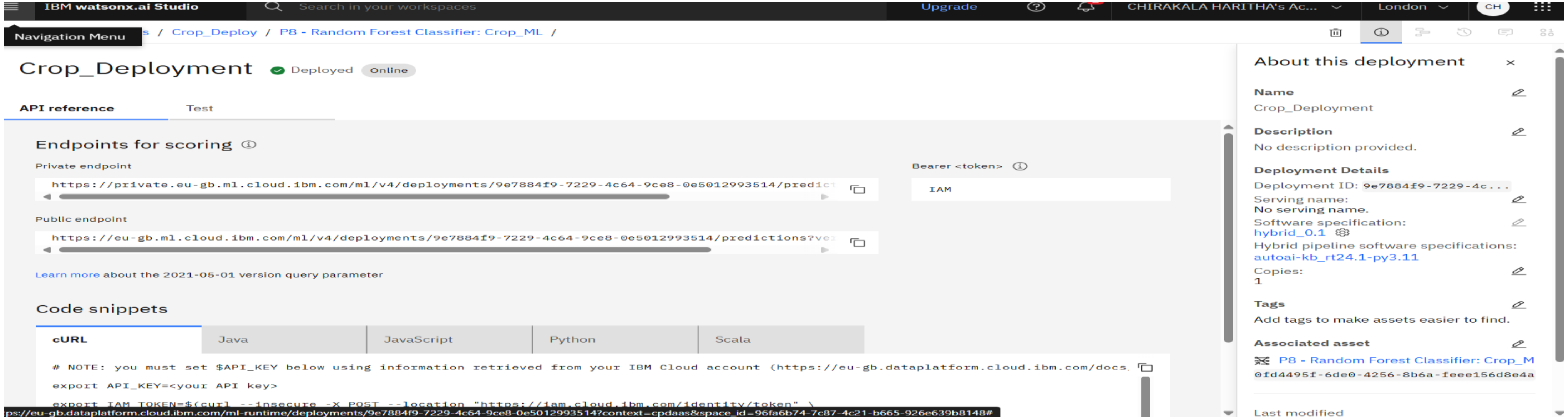
RESULT



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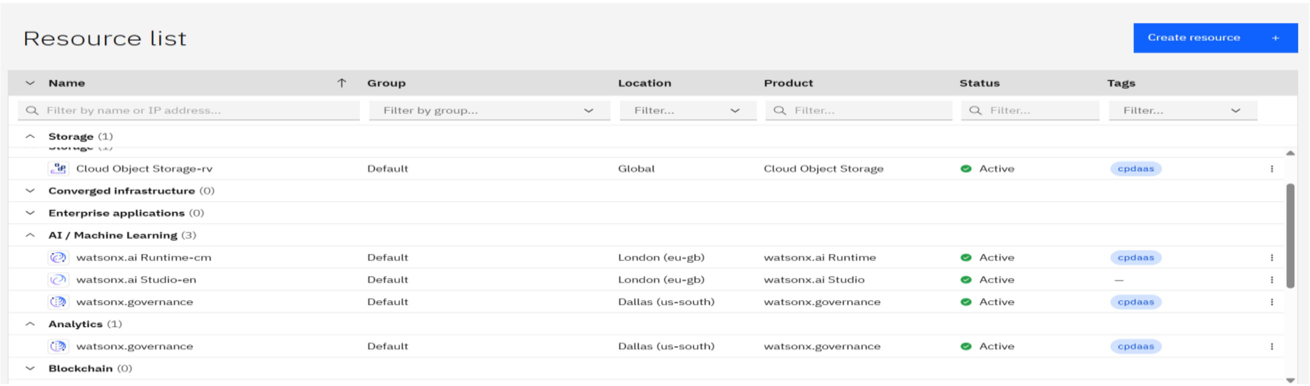
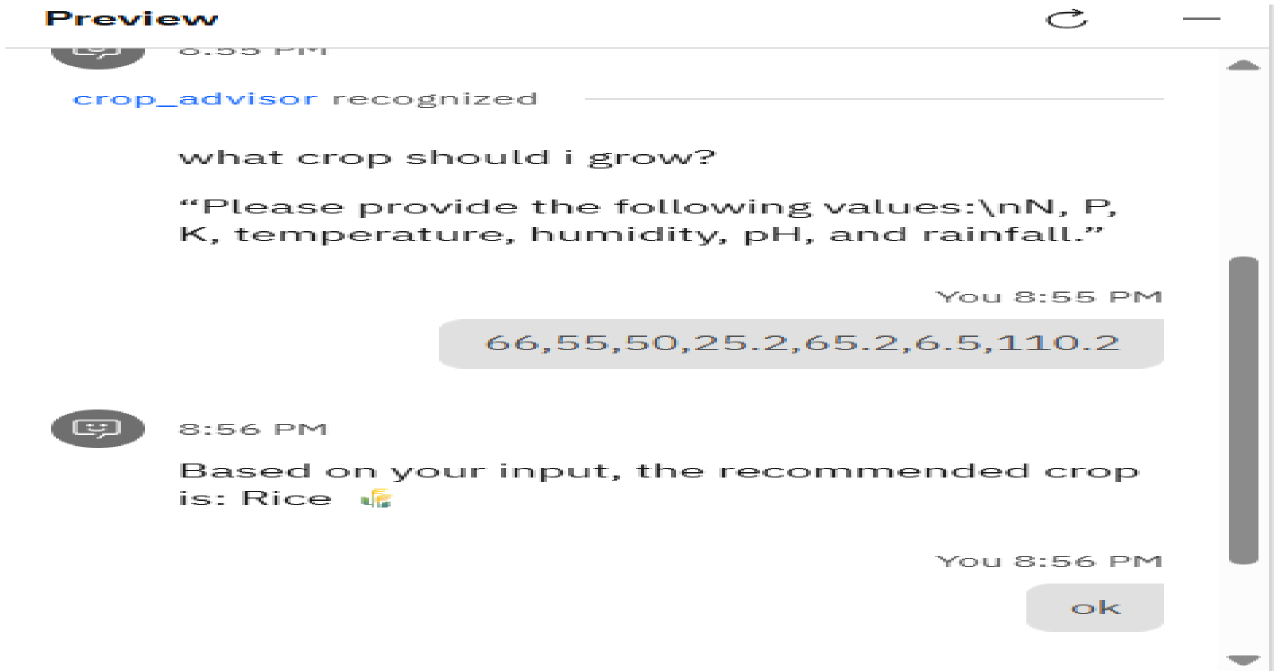
RESULT

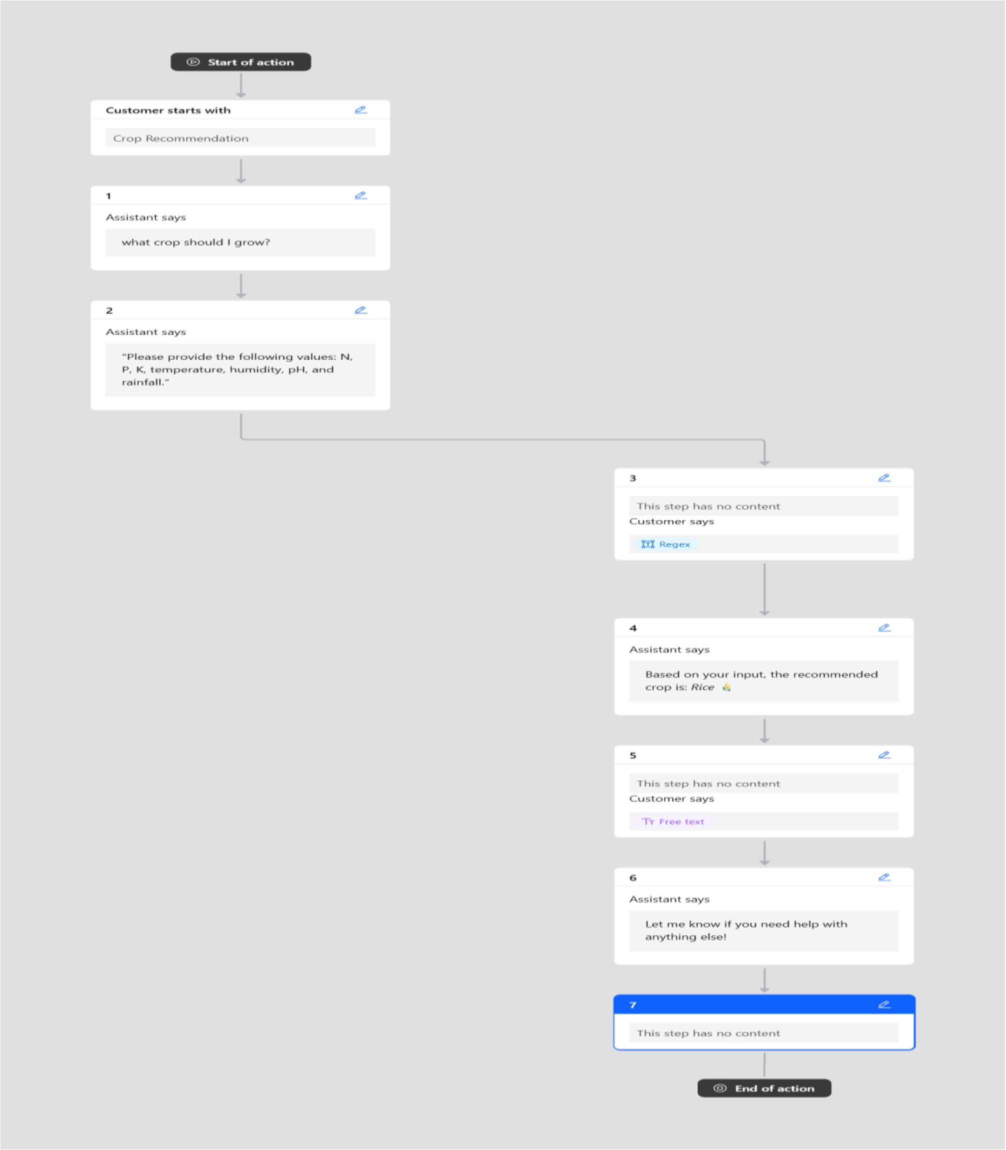


Resource list

Create resource +

Name	Group	Location	Product	Status	Tags
Storage (1)					
Cloud Object Storage-rv	Default	Global	Cloud Object Storage	Active	cpdaas
Converged infrastructure (0)					
Enterprise applications (0)					
AI / Machine Learning (3)					
watsonx.ai Runtime-cm	Default	London (eu-gb)	watsonx.ai Runtime	Active	cpdaas
watsonx.ai Studio-en	Default	London (eu-gb)	watsonx.ai Studio	Active	—
watsonx.governance	Default	Dallas (us-south)	watsonx.governance	Active	cpdaas
Analytics (1)					
watsonx.governance	Default	Dallas (us-south)	watsonx.governance	Active	cpdaas
Blockchain (0)					





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CONCLUSION

- This AI-driven crop recommendation system provides real-time, personalized agricultural guidance to small-scale farmers using IBM Cloud services. By integrating machine learning, natural language processing, and cloud deployment, it empowers farmers to make informed decisions based on soil conditions, weather, and other environmental factors.
- The solution is scalable, modular, and designed for multilingual interaction through Watson Assistant. Deployed as a cloud-based API, it ensures accessibility and ease of use, even in remote areas. This system not only enhances productivity and profitability but also lays the foundation for future expansion into pest control, price forecasting, and sensor-based smart farming.

FUTURE SCOPE

- Integrate real-time soil sensors to capture live data such as moisture, pH, and temperature for dynamic, hyperlocal crop recommendations.
- Add pest and disease detection using CNNs, allowing farmers to upload crop images and receive instant diagnostic advice.
- Enhance RAG (Retrieval-Augmented Generation) to include real-time market prices, government advisories, local weather alerts, and pest warnings for smarter, context-aware responses.
- Develop a mobile-friendly chatbot or progressive web app with voice input and multilingual support for ease of use in rural areas.
- Implement offline-first access to ensure the assistant works even in areas with poor or intermittent internet connectivity, syncing data when a connection becomes available.

REFERENCES

- 1. Crop Recommendation Dataset – Kaggle:

https://www.kaggle.com/datasets/atharvaingle/crop-recommendation-dataset

- 2. IBM Watson Studio Documentation – AutoAI:

https://dataplatform.cloud.ibm.com/docs/content/wsj/autoai/overview-autoai.html

- 3. IBM Watson Assistant Documentation:

https://cloud.ibm.com/docs/assistant

- 4. IBM Weather Company Data API:

https://www.ibm.com/weather/weather-data/

- 5. IBM Cloud – Watson Machine Learning:

https://cloud.ibm.com/catalog/services/machine-learning

- 6. Credly Certifications – IBM: Getting Started with AI, Journey to Cloud, RAG Lab:

https://www.credly.com/organizations/ibm/badges

- 7. Research Paper – "Machine Learning Approaches for Smart Agriculture: A Survey

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GITHUB LINK

- Github Link:https://github.com/chirakalaharitha/IBM-cloud-project

IBM CERTIFICATIONS

IBM **SkillsBuild** Completion Certificate

This certificate is presented to

Haritha Chirakala

for the completion of

Introduction to Artificial Intelligence

(MDL-211)

According to the Moodle system of record

Completion date: 15 Jul 2025 (GMT)

Learning hours: 1 hr 15 mins

IBM CERTIFICATIONS

This certificate is presented to

Haritha Chirakala

for the completion of

Journey to Cloud: Envisioning Your Solution

(MDL-447)

According to the Moodle system of record

Completion date: 16 Jul 2025 (GMT)

Learning hours: 5 hrs

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IBM CERTIFICATIONS

IBM **SkillsBuild** Completion Certificate

This certificate is presented to

Haritha Chirakala

for the completion of

Lab: Retrieval Augmented Generation with LangChain

(ALM-COURSE_3824998)

According to the Adobe Learning Manager system of record

Completion date: 25 Jul 2025 (GMT)

Learning hours: 20 mins

THANK YOU