CAPSTONE PROJECT

POWER SYSTEM FAULT DETECTION AND CLASSIFICATION

Presented By:

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OUTLINE

- **Problem Statement** (Should not include solution)
- **Proposed System/Solution**
- **System Development Approach** (Technology Used)
- **Algorithm & Deployment**
- **Result (Output Image)**
- **Conclusion**
- **Future Scope**
- **References**

PROBLEM STATEMENT

Design a machine learning model to detect and classify different types of faults in a power distribution system. Using electrical measurement data (e.g., voltage and current phasors), the model should be able to distinguish between normal operating conditions and various fault conditions (such as line-to-ground, line-to-line, or three-phase faults). The objective is to enable rapid and accurate fault identification, which is crucial for maintaining power grid stability and reliability.

PROPOSED SOLUTION

- **The proposed system aims to develop a machine learning model that classifies power system faults using the dataset provided. The model will process electrical measurements to identify the type of fault rapidly and accurately. This classification will help automate fault detection and assist in quicker recovery actions, ensuring system reliability.**
- **The solution will consist of the following components:**
- **Data Collection:**
  - Utilized the Kaggle dataset regarding power system faults
  - Dataset link – https://www.kaggle.com/datasets/ziya07/power-system faults-dataset **.**
  - Focused on acquiring data that reflects real-world faults occurring in power distribution systems..
- **Data Preprocessing:**
  - Cleaned the dataset to handle missing values, inconsistencies, and outliers in electrical readings..
- **Machine Learning Algorithm:**
  - The Model used is **– Random Forest Classifier** (Based on accuracy and selected the best model).
- **Deployment:**
  - Deployed in Deployment Spaces using the following Model/Algorithm.
  - Used IBM Cloud Object Storage to store and load datasets and artifacts.
- **Evaluation:**
  - Model performance was assessed on unseen fault scenarios.
  - Validate model using accuracy and precision.

SYSTEM APPROACH

The "System Approach" section outlines the overall strategy and methodology for developing and implementing the **Power System Fault Detection & Classification** to detect and classify different types of faults in a power distribution system.

- **System requirements**
- IBM Cloud(mandatory)
- IBM cloud object storage for dataset handling
- IBM Watson studio for model development and deployment

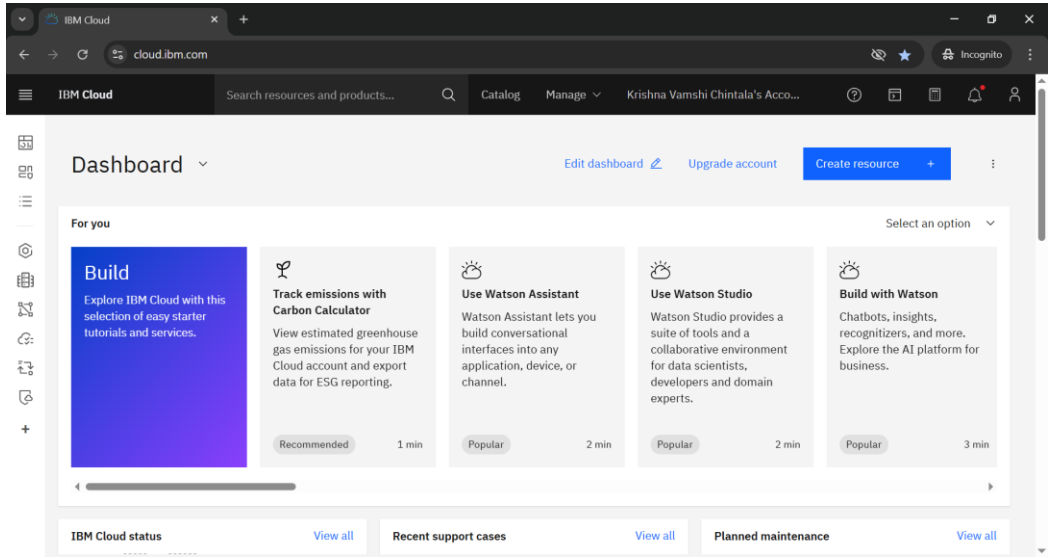
ALGORITHM & DEPLOYMENT

- **Algorithm Selection:**
  - We used the Random Forest Classifier, an ensemble learning algorithm that builds multiple decision trees and combines their outputs to improve accuracy and reduce overfitting.
  - This algorithm was chosen because the dataset contains structured, labeled data with multiple fault categories and Random Forest excels in multi-class classification tasks. Its ability to handle non-linear relationships, noisy measurements, and feature importance ranking makes it highly suitable for electrical fault classification based on voltage and current phasors.

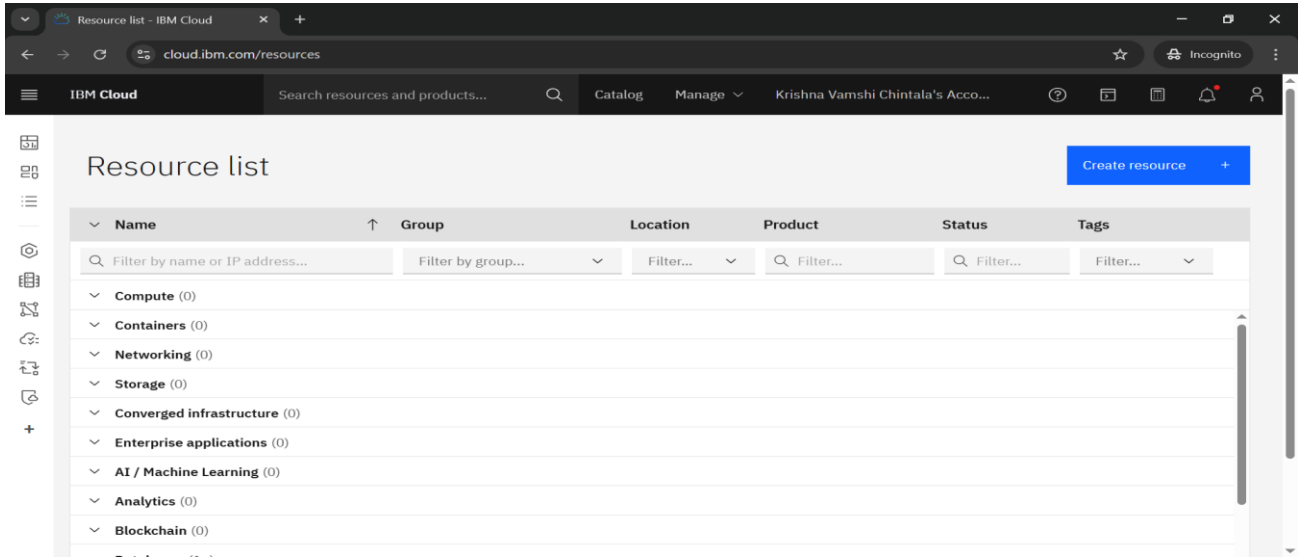
- **Data Input:**
  - Fault Location , Voltage , Current ,Weather condition , Maintenance Status etc..(from features of Dataset).
- **Training Process:**
  - Supervised Learning Using Labeled Fault types
- **Prediction Process:**
  - The Model waws deployed on IBM Watson.ai Studio and used Watson.runtime for realtime predictions

PREDICTION PROCESS

- Dashboard of IBM cloud



- Verify all resources are empty.



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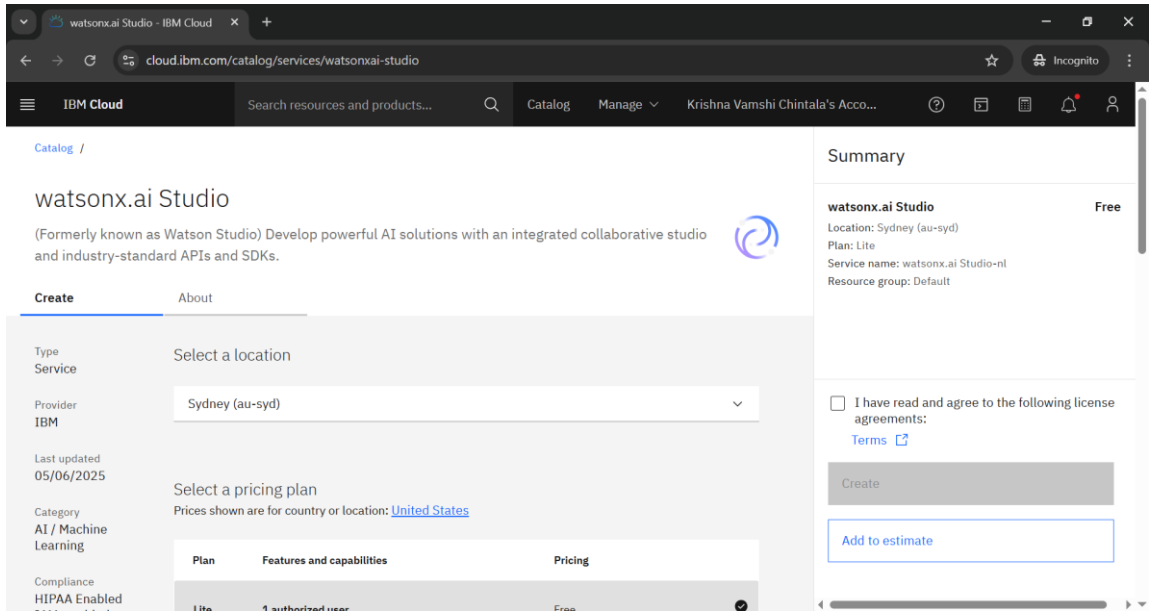
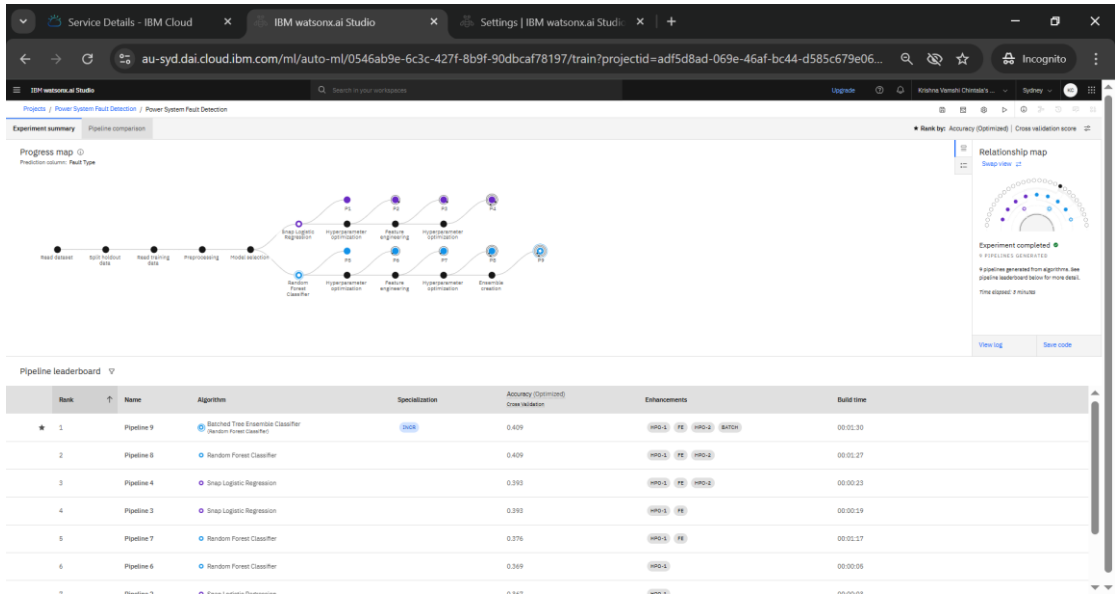
PREDICTION PROCESS

- Create Watsonx.ai studio and manage with Watsonx.runtime

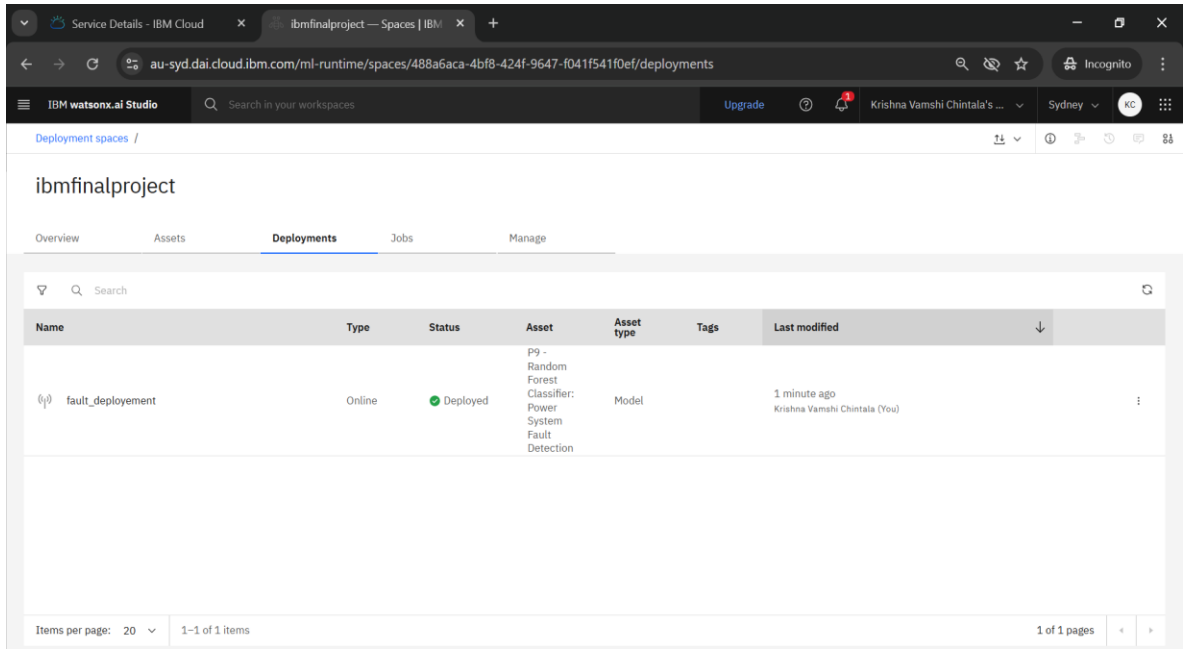


- Pipeline for selecting model

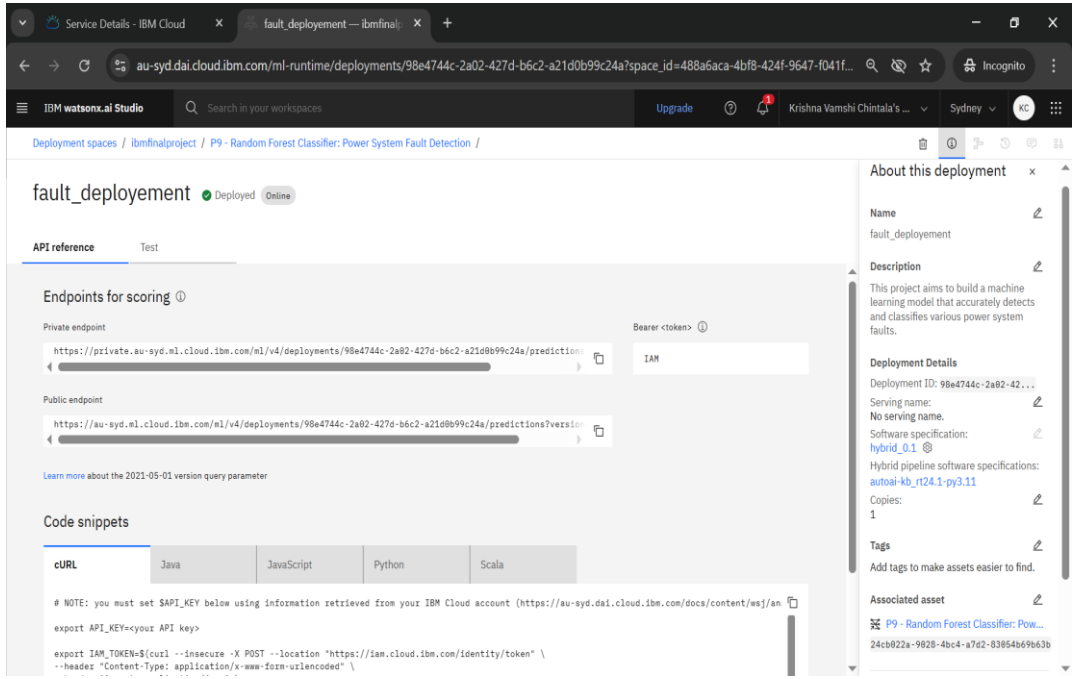


PREDICTION PROCESS

Deploy in Deployment Spaces and execute for prediction



Deploy in Deployment Spaces and Test for test cases of model prediction



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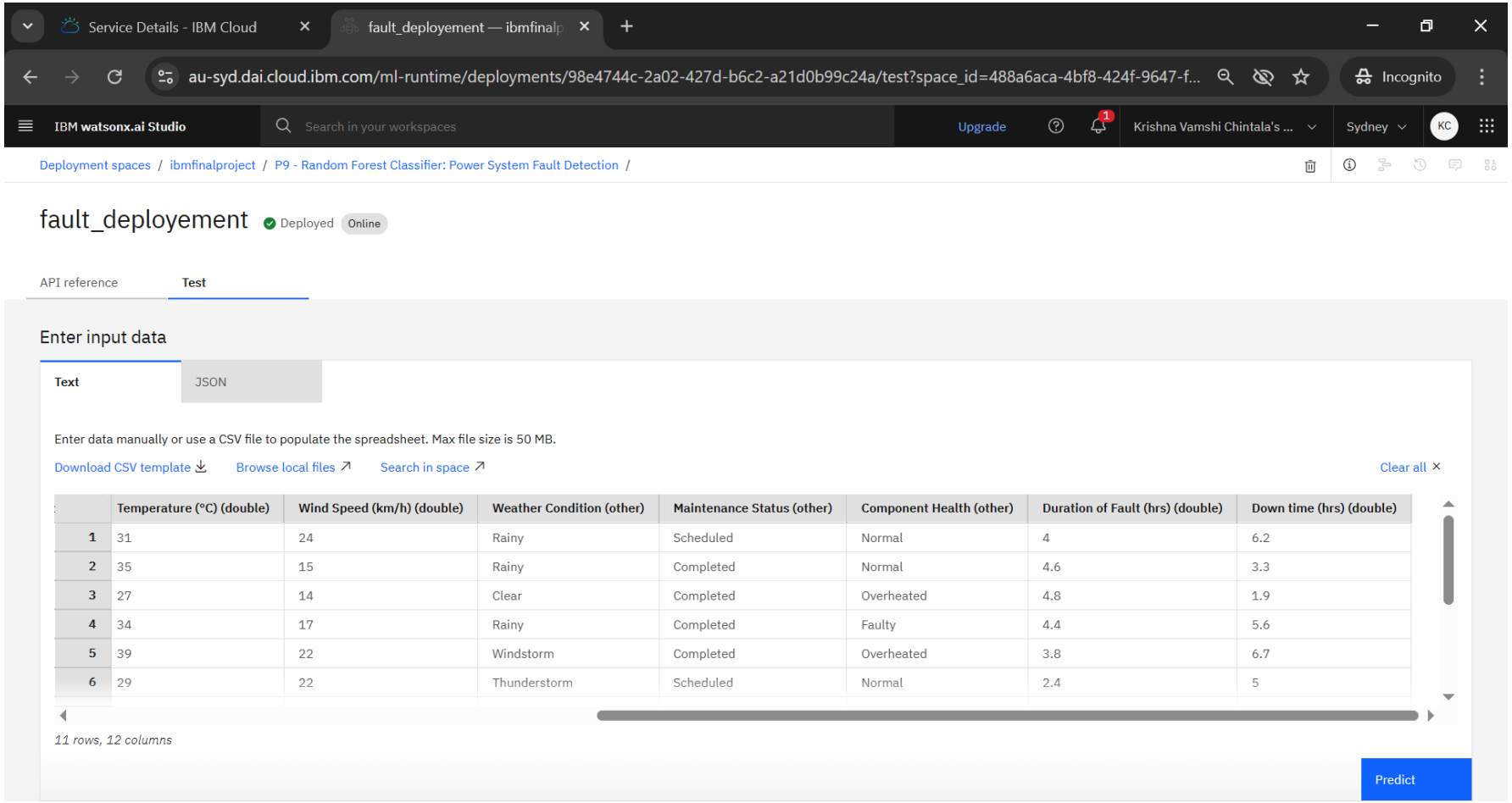
RESULT

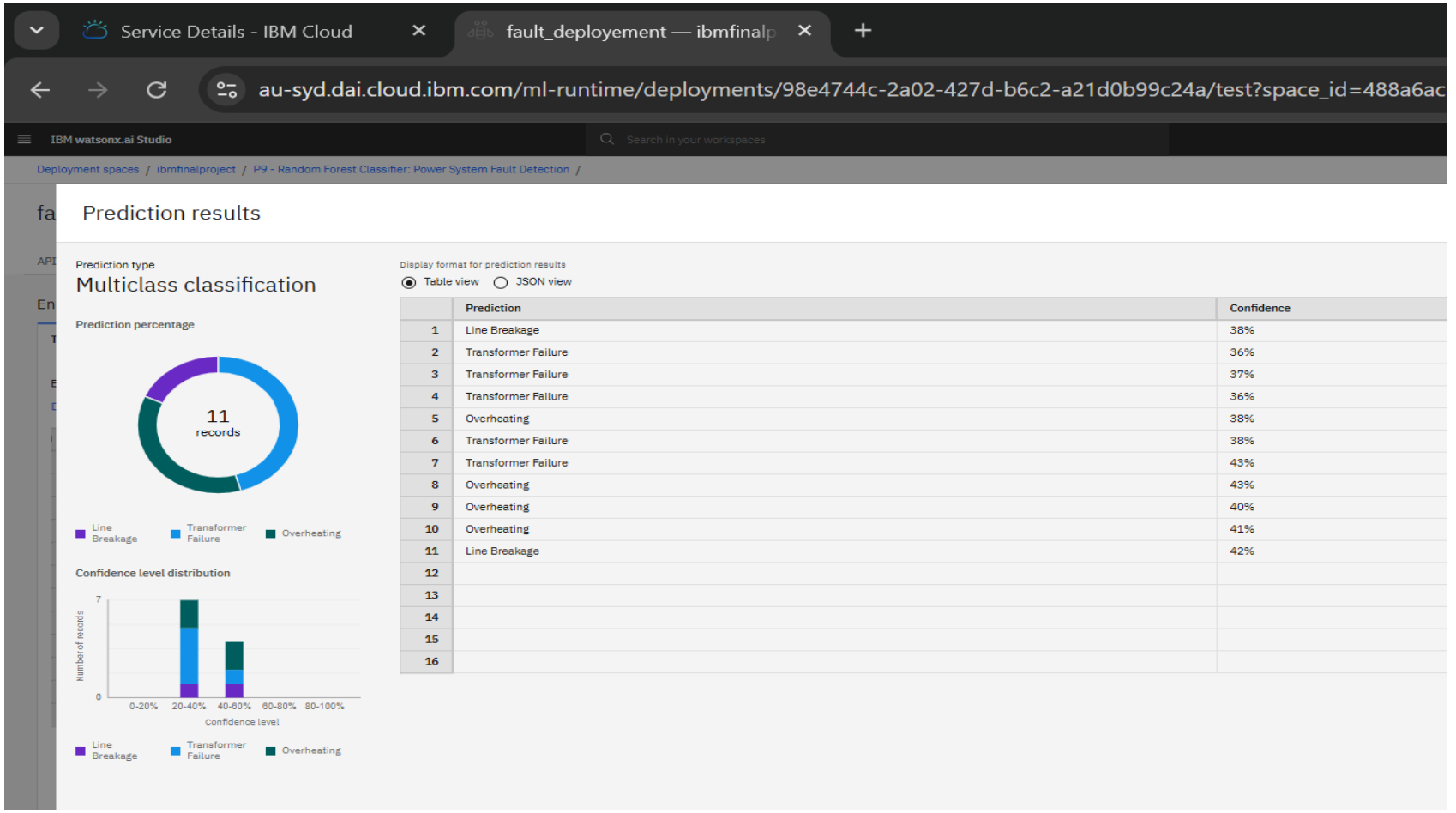
INPUT : Testing data given as input



	Temperature (°C) (double)	Wind Speed (km/h) (double)	Weather Condition (other)	Maintenance Status (other)	Component Health (other)	Duration of Fault (hrs) (double)	Down time (hrs) (double)
1	31	24	Rainy	Scheduled	Normal	4	6.2
2	35	15	Rainy	Completed	Normal	4.6	3.3
3	27	14	Clear	Completed	Overheated	4.8	1.9
4	34	17	Rainy	Completed	Faulty	4.4	5.6
5	39	22	Windstorm	Completed	Overheated	3.8	6.7
6	29	22	Thunderstorm	Scheduled	Normal	2.4	5

RESULT

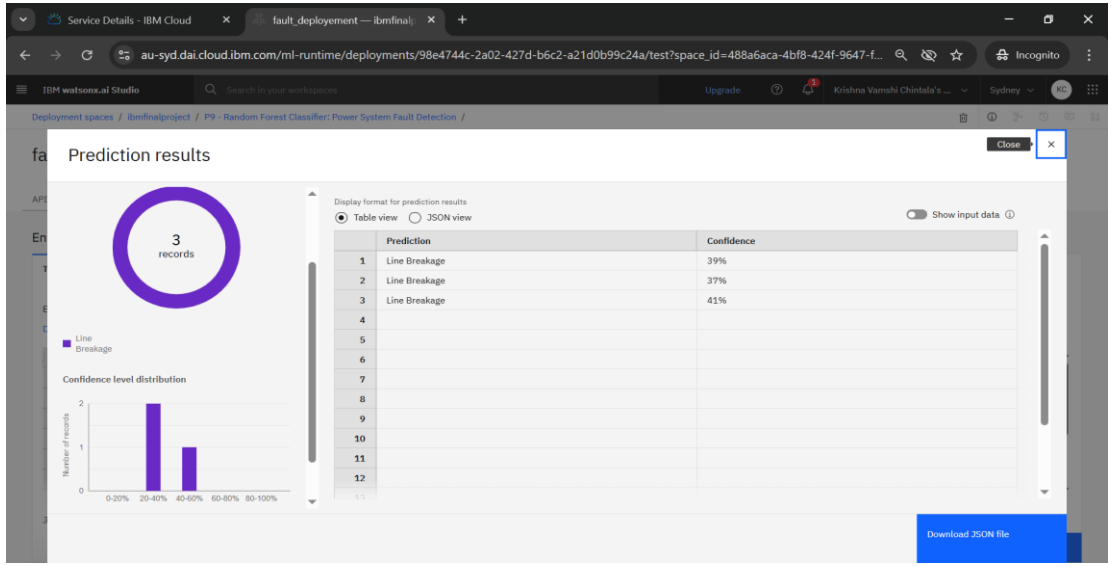
Prediction Result

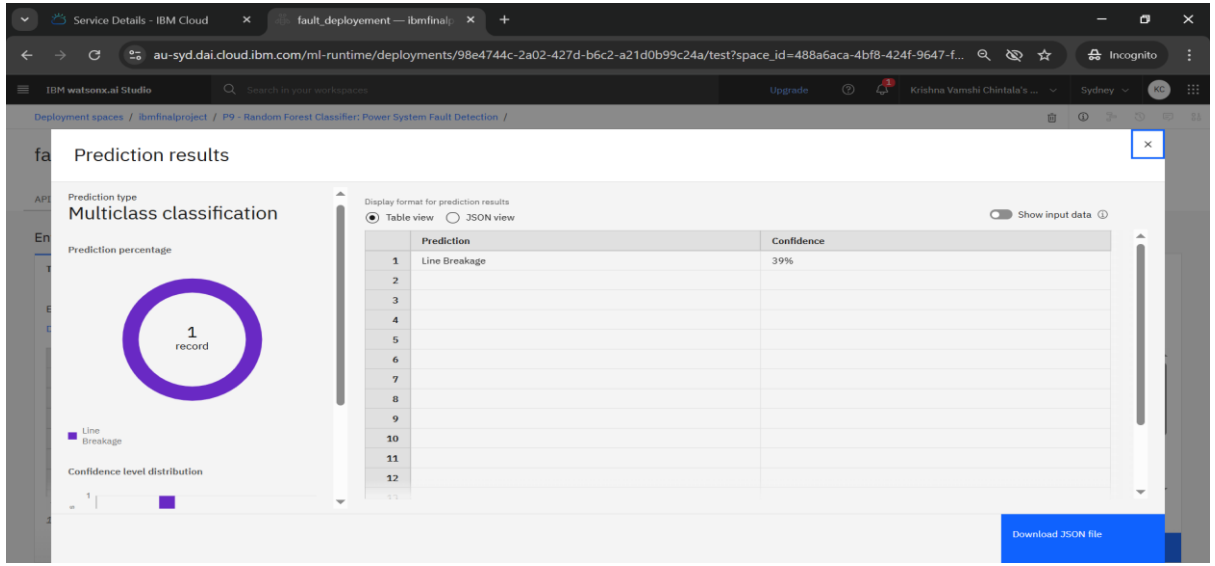


	Prediction	Confidence
1	Line Breakage	38%
2	Transformer Failure	36%
3	Transformer Failure	37%
4	Transformer Failure	36%
5	Overheating	38%
6	Transformer Failure	38%
7	Transformer Failure	43%
8	Overheating	43%
9	Overheating	40%
10	Overheating	41%
11	Line Breakage	42%
12		
13		
14		
15		
16		

RESULT

Test Cases





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CONCLUSION

- This project successfully demonstrates an effective ML-based solution for detecting and classifying power system faults.
- The integration with IBM Cloud allows for scalable, cloud-based deployment for real-time fault monitoring in smart grids.

FUTURE SCOPE

Further Enhancement can be :

- Include real-time streaming data using edge devices or IoT sensors
- Extend the model to cover high-voltage transmission faults
- Integrate advanced deep learning models (e.g., LSTM for time-series phasors)
- Visual dashboard with alerting system for control rooms

REFERENCES

- https://www.kaggle.com/datasets/ziya07/power-system-faults-dataset
- IBM Cloud & Watsonx.ai Documentation
- Research papers on ML for power fault classification

IBM CERTIFICATIONS

Getting started with AI

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IBM CERTIFICATIONS

Journey to cloud

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IBM CERTIFICATIONS

RAG LAB

IBM **SkillsBuild** Completion Certificate

This certificate is presented to

Krishna Vamshi

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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