CAPSTONE PROJECT

POWER SYSTEM FAULT DETECTION AND CLASSIFICATION

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OUTLINE

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

PROBLEM STATEMENT

Power distribution systems are prone to various types of faults such as line-to-ground, line-to-line, and three-phase faults. These faults can disrupt power supply and reduce system reliability. The challenge lies in accurately detecting and classifying these faults using electrical measurement data (voltage, current, phasors) to differentiate them from normal operating conditions, thereby ensuring the stability of the power grid.

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PROPOSED SOLUTION

- Develop a machine learning model that classifies power system faults using the dataset provided. The model will process electrical measurement to identify the type of faults rapidly and accurately. This classification will help automate fault detection and assist in quicker recovery actions, ensuring system reliability.
- Key Component:

1.Data Collection: Use the Kaggle dataset on power system faults.

2.PreProcessing: Clean and normalise the dataset.

3.Model Training: Train a Classification model (e.g. , Decision Tree , Random Forest, or SVM).

4.Evaluation: Validate the model using accuracy, precision, recall, and F1-Score.

SYSTEM APPROACH

The "System Approach" section outlines the overall strategy and methodology for developing and implementing the rental bike prediction system. Here's a suggested structure for this section:

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

ALGORITHM & DEPLOYMENT

- **Algorithm Selection:**
  - Random Forest Classifier (or SVM based on performance)
- **Data Input:**
  - Voltage, current, and phasor measurement from the dataset.
- **Training Process:**
  - Supervised Learning using Labeled fault types.
- **Prediction Process:**
  - Model Deployed on IBM Watson Studio with API endpoint for real time predictions.

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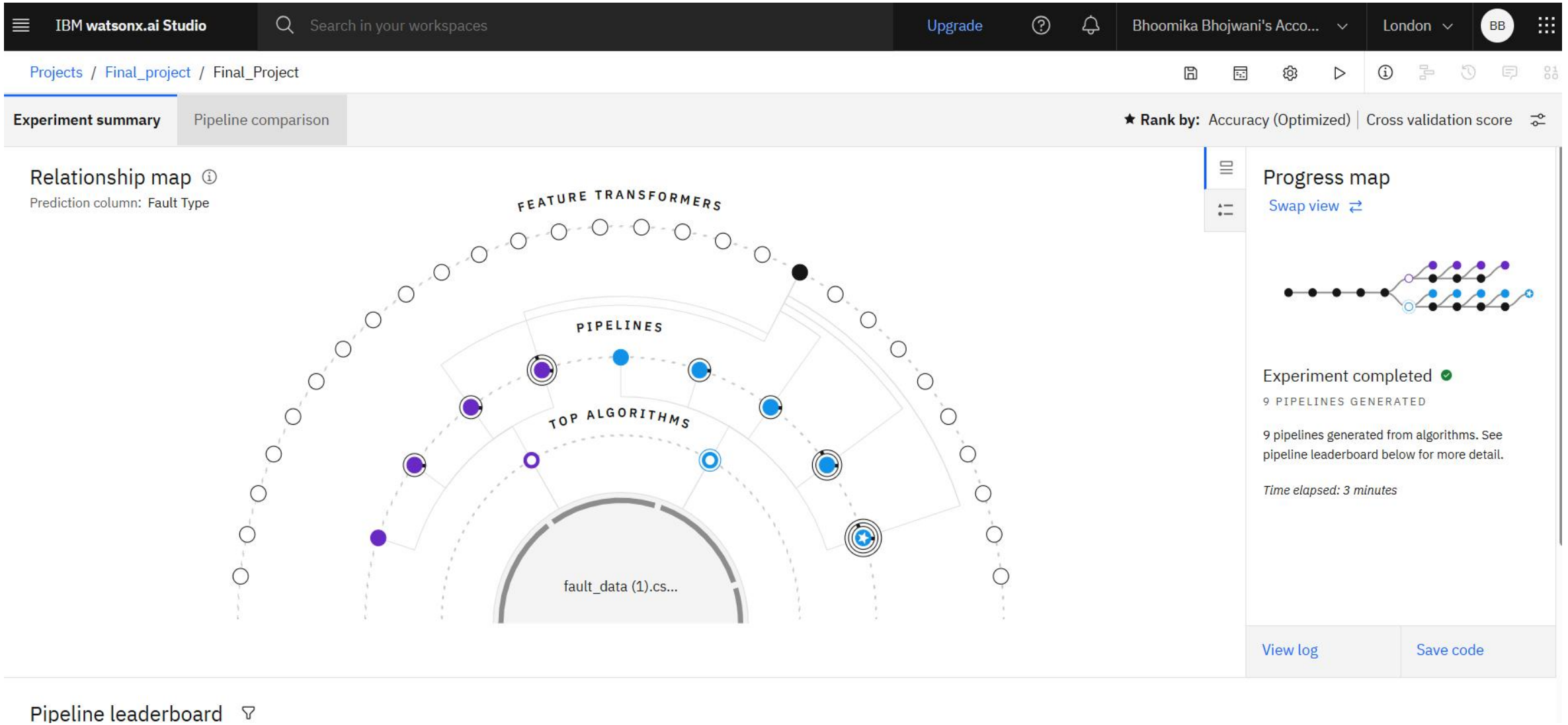
RESULT



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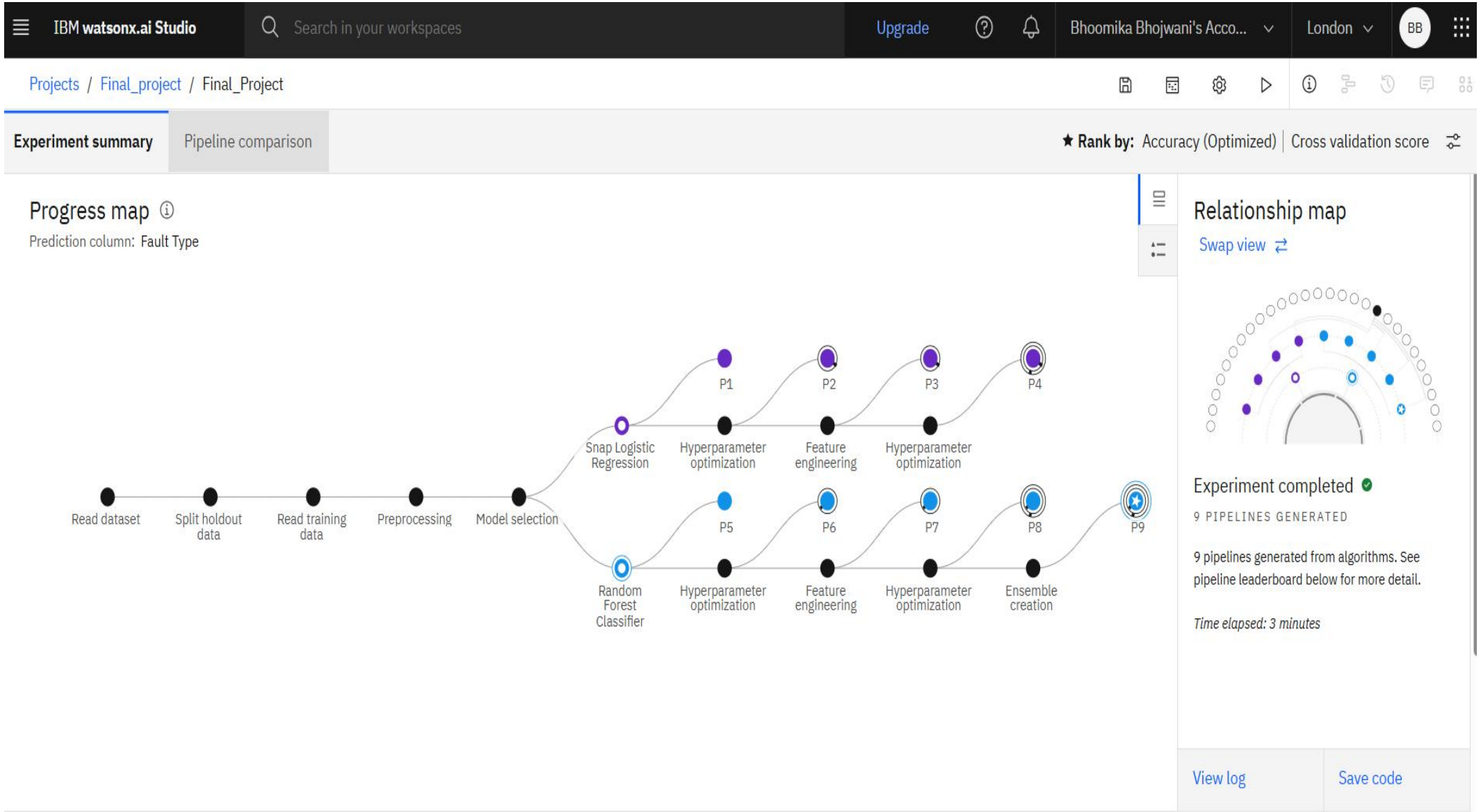

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IBM watsonx.ai Studio | Search in your workspaces | Upgrade | 1 | Bhoomika Bhojwani's Acco... | London | BB

Deployment spaces / Final_Deploy / P9 - Random Forest Classifier: Final_Project /

Final_Deploy

Deployed | Online

API reference | **Test**

Enter input data

Text | JSON

Enter data manually or use a CSV file to populate the spreadsheet. Max file size is 50 MB.

Download CSV template | Browse local files | Search in space | Clear all

	Fault ID (other)	Fault Location (Latitude, Longitude) (other)	Voltage (V) (double)	Current (A) (double)	Power Load (MW) (double)	Temperature (°C) (double)	Wind Speed (km/h) (d
2	F171	(34.646, -118.2446)	1880	210	54	36	19
3	F182	(34.5485, -118.7316)	2201	192	55	33	16
4	F224	(34.7943, -118.1529)	2141	221	48	27	24
5	F390	(34.5186, -118.4941)	2091	236	50	26	21

5 rows, 12 columns

Predict

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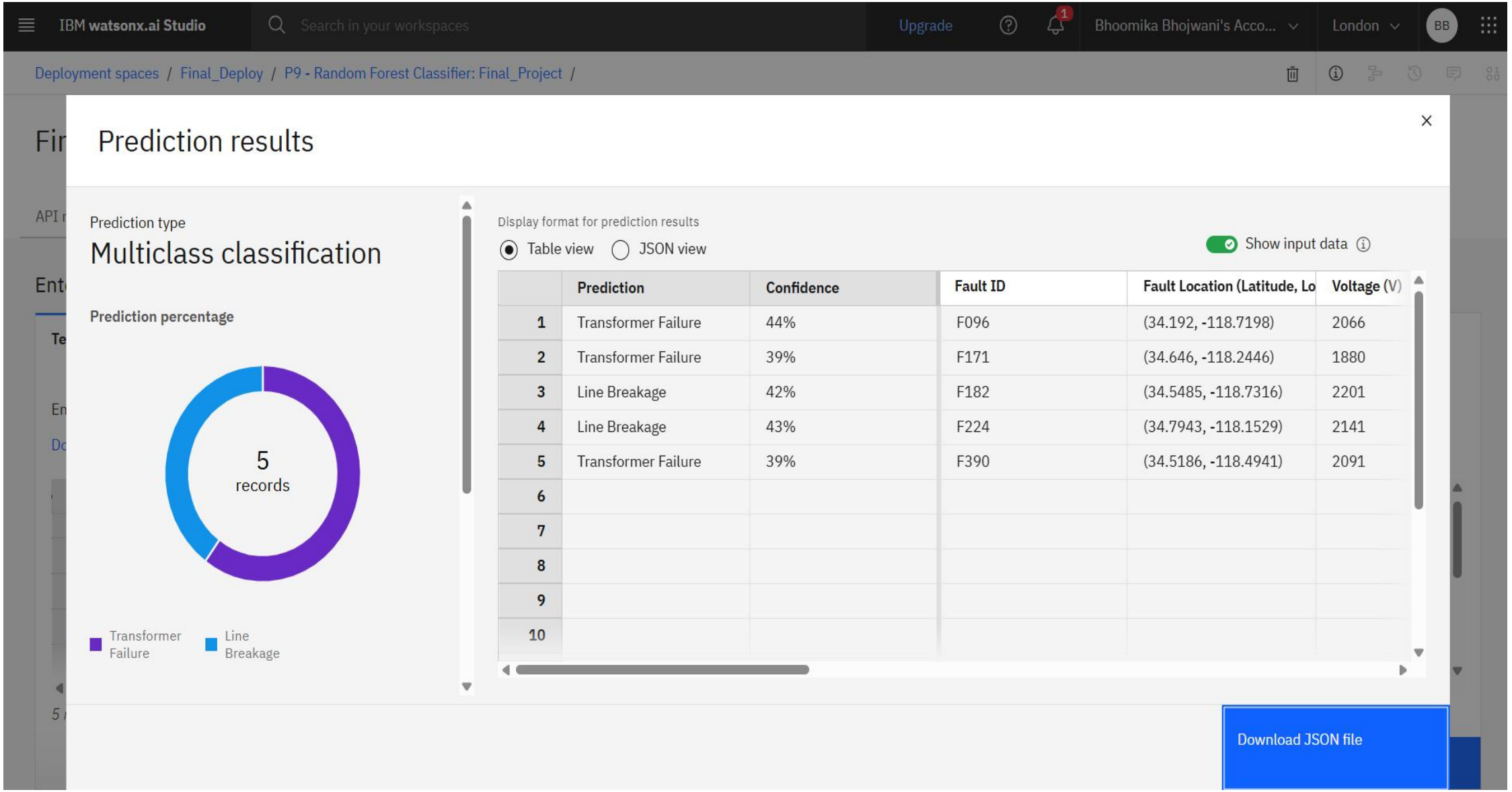

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CONCLUSION

- In this machine learning project, we successfully built and deployed a multiclass classification model using IBM Watsonx.ai Studio to predict different types of electrical faults. The model was trained on a dataset containing key electrical parameters such as voltage, current, power load, temperature, and wind speed, along with the geographic location of the fault.
- After experimenting with multiple pipelines and algorithms, the **Random Forest Classifier** emerged as the top-performing model, optimized through hyperparameter tuning and feature engineering. The final model demonstrated good predictive capabilities, distinguishing between three fault types: **Line Breakage**, **Transformer Failure**, and **Overheating**, with varying confidence levels.

FUTURE SCOPE

- **Real-time Fault Detection :** Integrate the model with live sensor data from the grid to enable real-time fault prediction and quicker response.
- **Enhanced Data Collection :** Expand the dataset with more fault types, seasons, and geographical diversity to improve the model's generalization and accuracy.
- **Edge Deployment :** Deploy the trained model on edge devices (e.g., smart meters or IoT devices) for faster, localized fault detection without cloud dependency.
- **Explainable AI Integration :** Implement explainability tools (like SHAP or LIME) to help operators understand why a specific fault was predicted.

REFERENCES

- Random Forest Classifier
- Multiclass Classification
- Feature Selection & Engineering
- Fault Detection in Power Systems
- IBM Watsonx.ai Studio
- Model Evaluation Metrics

IBM CERTIFICATIONS

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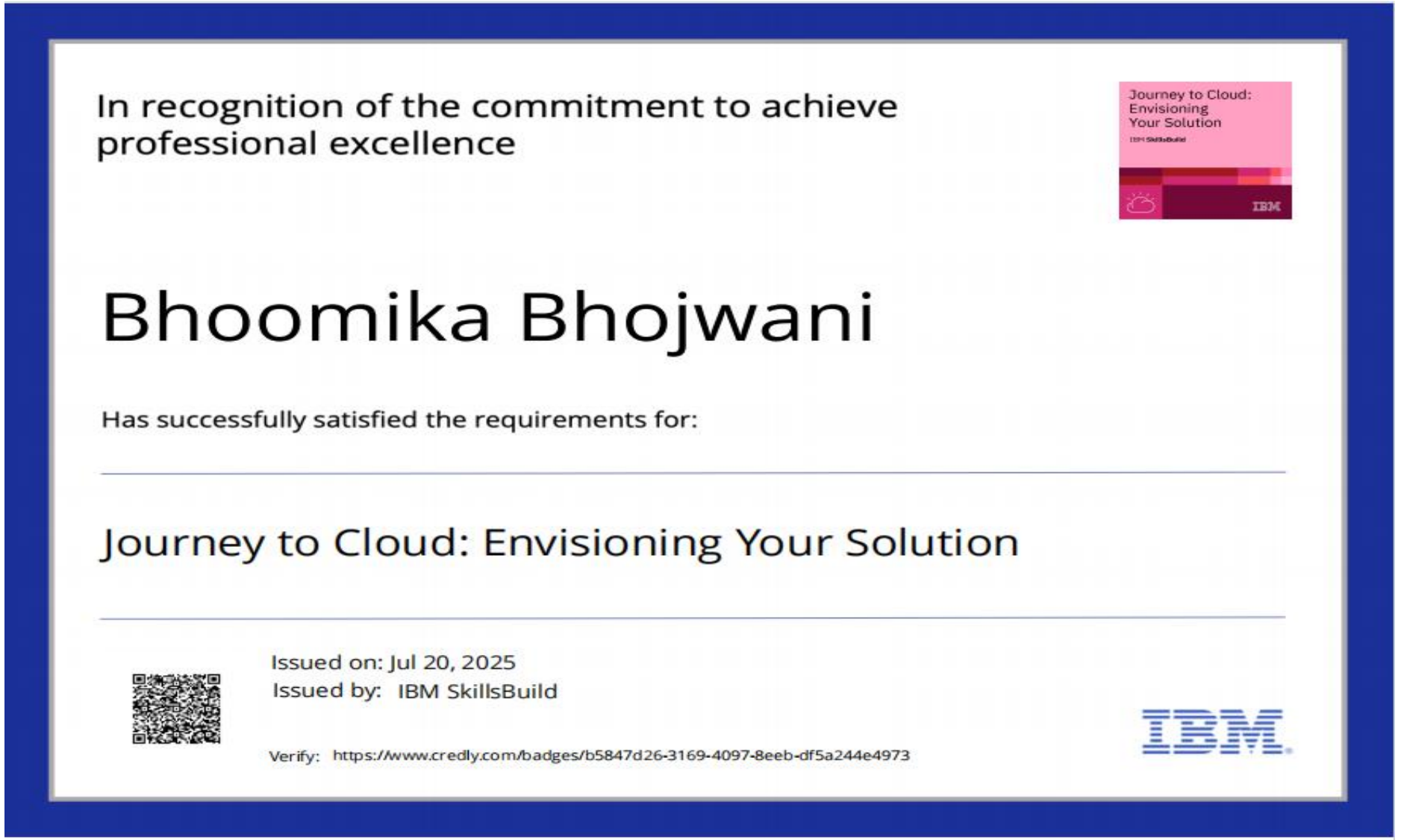
IBM CERTIFICATIONS



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