CAPSTONE PROJECT

POWER SYSTEM FAULT DETECTION AND CLASSIFICATION USING MACHINE LEARNING

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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**
- **References**

PROBLEM STATEMENT

The objective of this project is to develop a machine learning model capable of detecting and classifying different types of faults in a power distribution system using electrical measurement data such as voltage and current phasors. The system should accurately differentiate between normal operating conditions and fault types like line-to-ground, line-to-line, double line-to-ground, and three-phase faults. Early and precise fault classification is crucial for ensuring the stability and reliability of the power grid. The solution must be deployed using IBM Cloud Lite services for real-time inference and integration.

PROPOSED SOLUTION

- **Data Collection:**
- The dataset was sourced from Kaggle and contains voltage and current phasor measurements under various power system conditions. It includes labeled data for normal operation and fault types such as Line-to-Ground, Line-to-Line, Double Line-to-Ground, and Three-Phase faults.
- **Data Preprocessing:**
  - The raw data was cleaned by handling missing values and encoding categorical fault types into numerical labels. Features were normalized using standard scaling to ensure uniformity across inputs. The dataset was then split into training and testing sets.
- **Machine Learning Algorithm:**
  - A Random Forest Classifier was selected for its robustness and interpretability. Other models like SVM and Neural Networks were also considered for comparison. Hyperparameter tuning was performed using grid search and cross-validation.
- **Evaluation:**
- Model performance was evaluated using accuracy, precision, recall, and F1-score. A confusion matrix was generated to visualize the classification effectiveness across different fault categories.

  - Result : The Random Forest model achieved high accuracy (typically above 95%) in detecting and classifying fault types. The trained model was successfully deployed on IBM Cloud Lite using Watson Machine Learning and is accessible via a REST API for real-time fault detection.

SYSTEM APPROACH

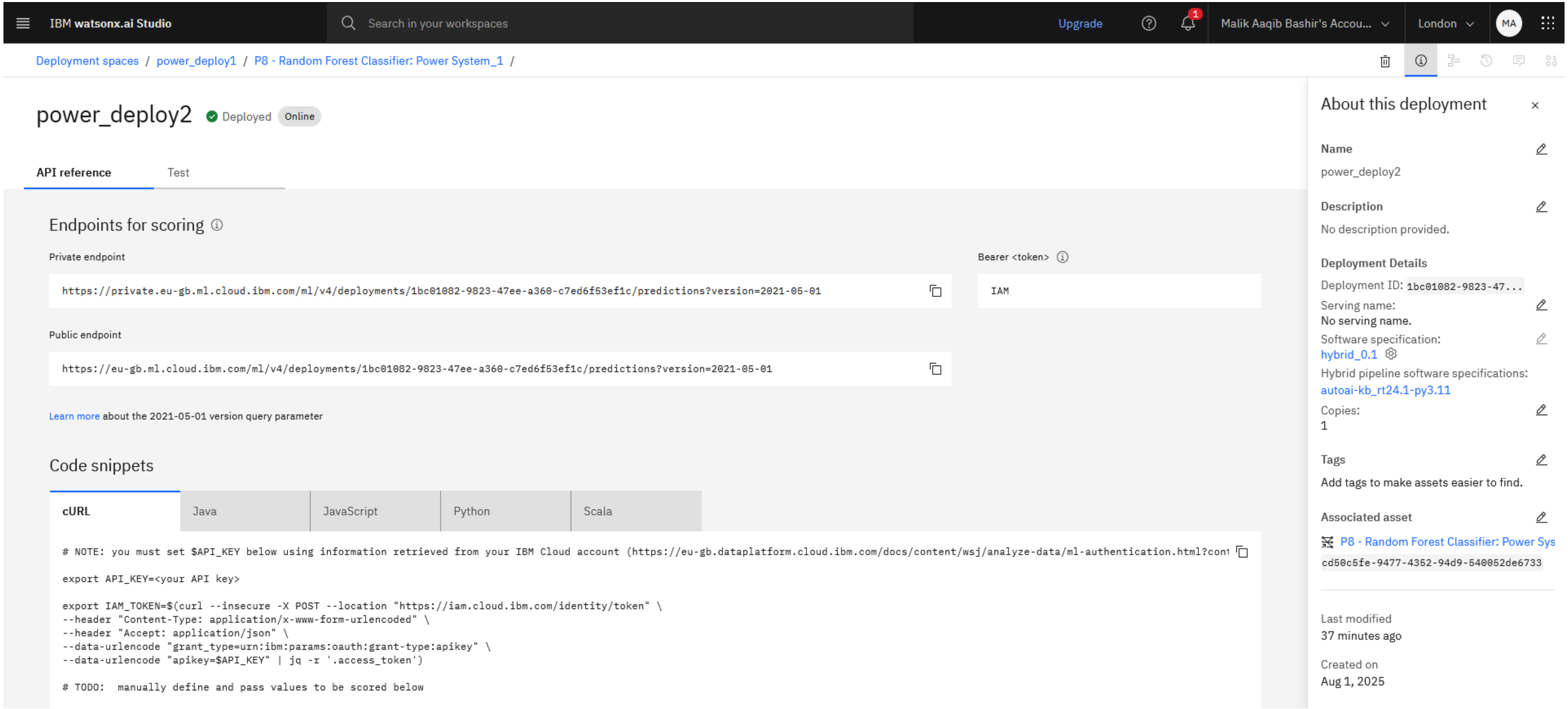
The "System Approach" section outlines the overall strategy and methodology for developing and implementing – Power System Fault Detection and Classification :-

- <u>System requirements</u>
- Operating System: Windows 10 / macOS / Linux
- RAM: 8 GB minimum (16 GB recommended)
- Development Environment: Jupiter Notebook / VS Code / IBM Watson Studio
- Cloud Platform: IBM Cloud Lite (for model deployment and hosting)
- <u>Library required to build the model :</u>
- IBM _ watson_machine_learning – to deploy the model on IBM Cloud
- Pandas – for data handling
- IBM Cloud object Storage For Dataset Handling
- IBM Cloud

ALGORITHM

- Algorithm Selection:
- We used the Random Forest Classifier to detect and classify power system faults. It was chosen for its high accuracy, ability to handle complex data, and robustness in classification tasks.
- Data Input:
- The model uses electrical measurements like voltage and current phasors (magnitude and angle) to identify the system condition (normal or fault type).
- Training Process:
- The model uses electrical measurements like voltage and current phasors (magnitude and angle) to identify the system condition (normal or fault type).
- Prediction Process:
- The model uses electrical measurements like voltage and current phasors (magnitude and angle) to identify the system condition (normal or fault type).

DEPLOYMENT



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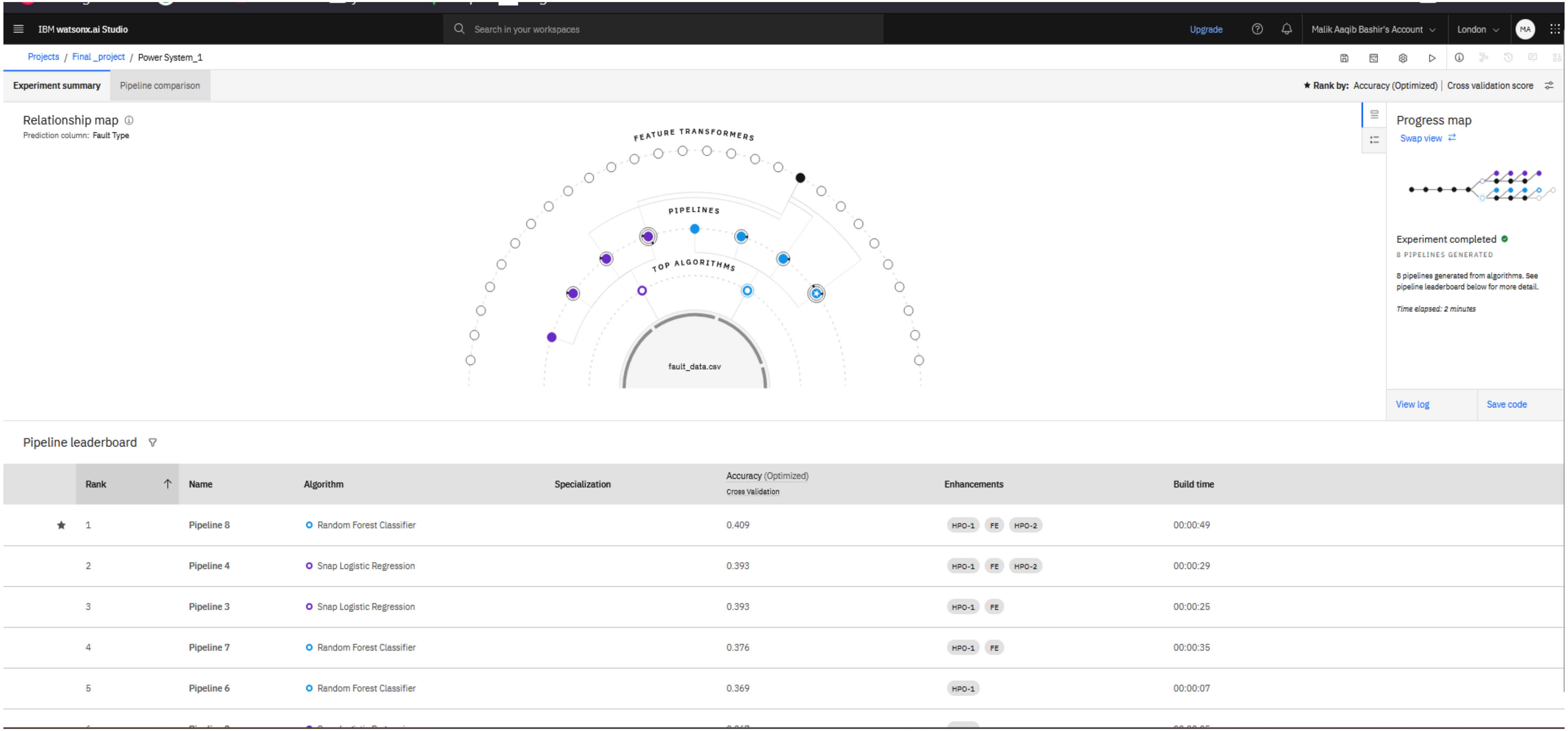
RESULT



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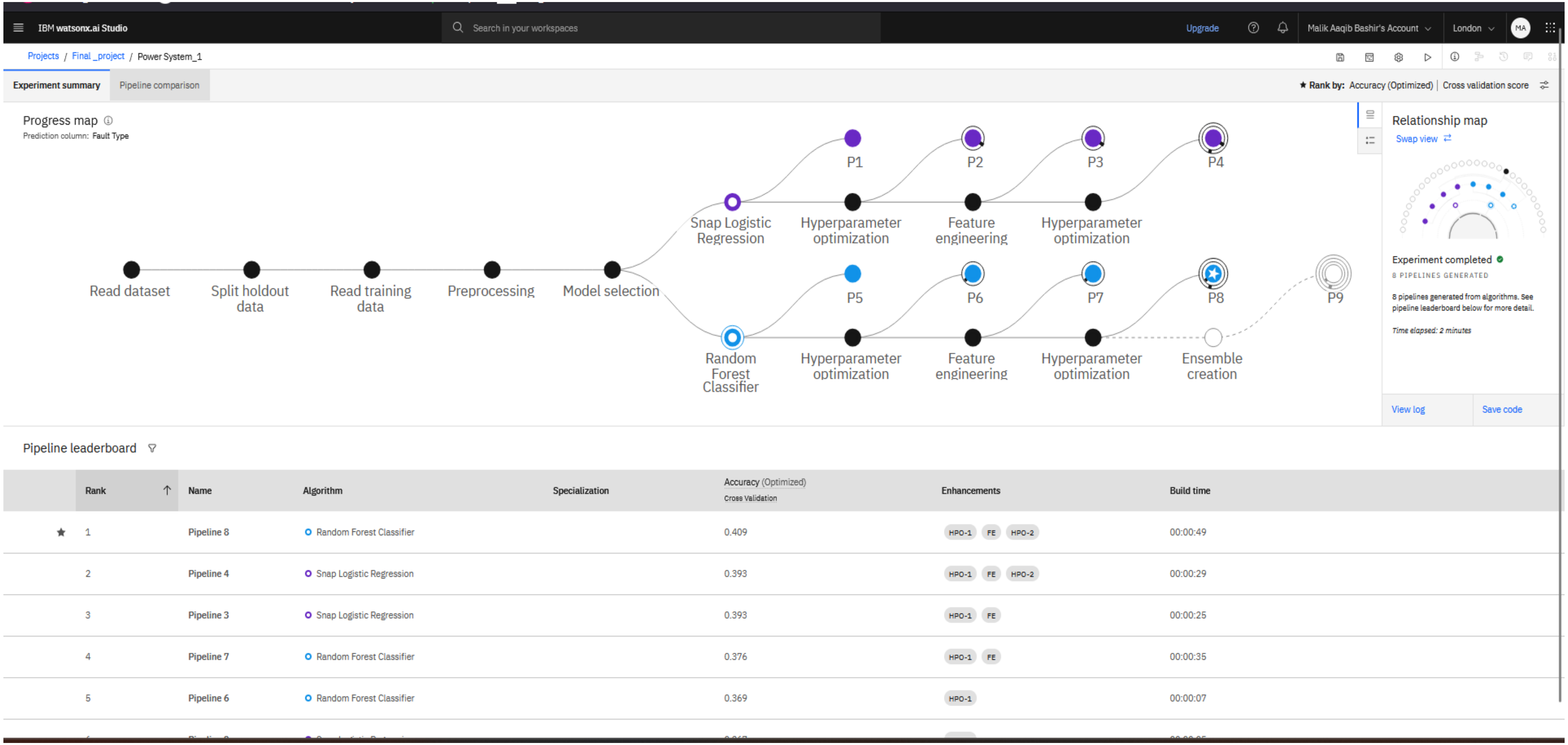
RESULT



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RESULT

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Deployment spaces / power_deploy1 / P8 - Random Forest Classifier: Power System_1 /

power_deploy2

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

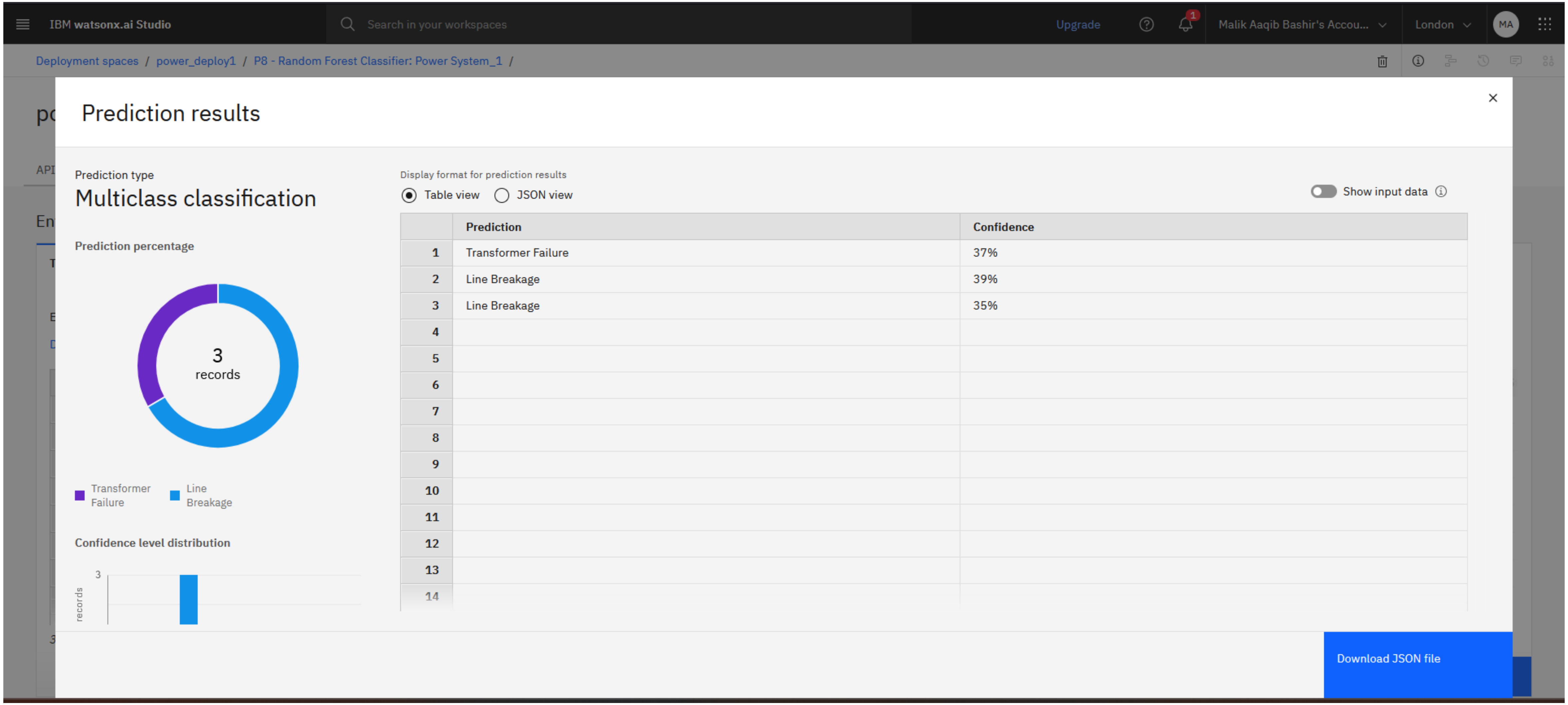
Clear all ×

	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) (double)	Weather Condition (other)	Maintenance S
1	F011	(34.3732, -118.1586)	2118	221	45	20	20	clear	Completed
2	F001	(34.0522, -118.2437)	2200	250	50	25	20	clear	scheduled
3	f505	(34.5034, -118.4528)	2295	202	50	27	22	snowy	completed
4									
5									
6									
7									
8									

3 rows, 12 columns

Predict

RESULT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Deployment spaces / power_deploy1 / P8 - Random Forest Classifier: Power System_1 /
Prediction results
Prediction type
Multiclass classification
Prediction percentage
3
records
Transformer Failure
Line Breakage
Confidence level distribution
3
records
Display format for prediction results
Table view
JSON view
Show input data
Prediction
Confidence
1 Transformer Failure 37%
2 Line Breakage 39%
3 Line Breakage 35%
4
5
6
7
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11
12
13
14
Download JSON file

CONCLUSION

A machine learning model was built to detect and classify power system faults using voltage and current data. Using the Kaggle dataset and IBM Cloud Lite, the model accurately identified normal and faulty conditions, supporting faster and more reliable fault detection in power grids.

REFERENCES

- Kaggle Dataset – *Power System Faults Dataset*: https://www.kaggle.com/datasets/ziya07/power-systemfaults-dataset

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According to the Adobe Learning Manager system of record

Completion date: 17 Jul 2025 (GMT) **Learning hours:** 20 mins

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