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**
- **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

- 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.
- Key Components
- Data Collection:
  - Use the Kaggle dataset on power system faults.
- Data Preprocessing:
  - Clean and normalize the dataset.
- Machine Learning Algorithm:
  - Train a classification model (e.g., Decision Tree, Random Forest, or SVM).
- Evaluation:
  - Validate the model using accuracy, precision, recall, and F1-score.

SYSTEM APPROACH

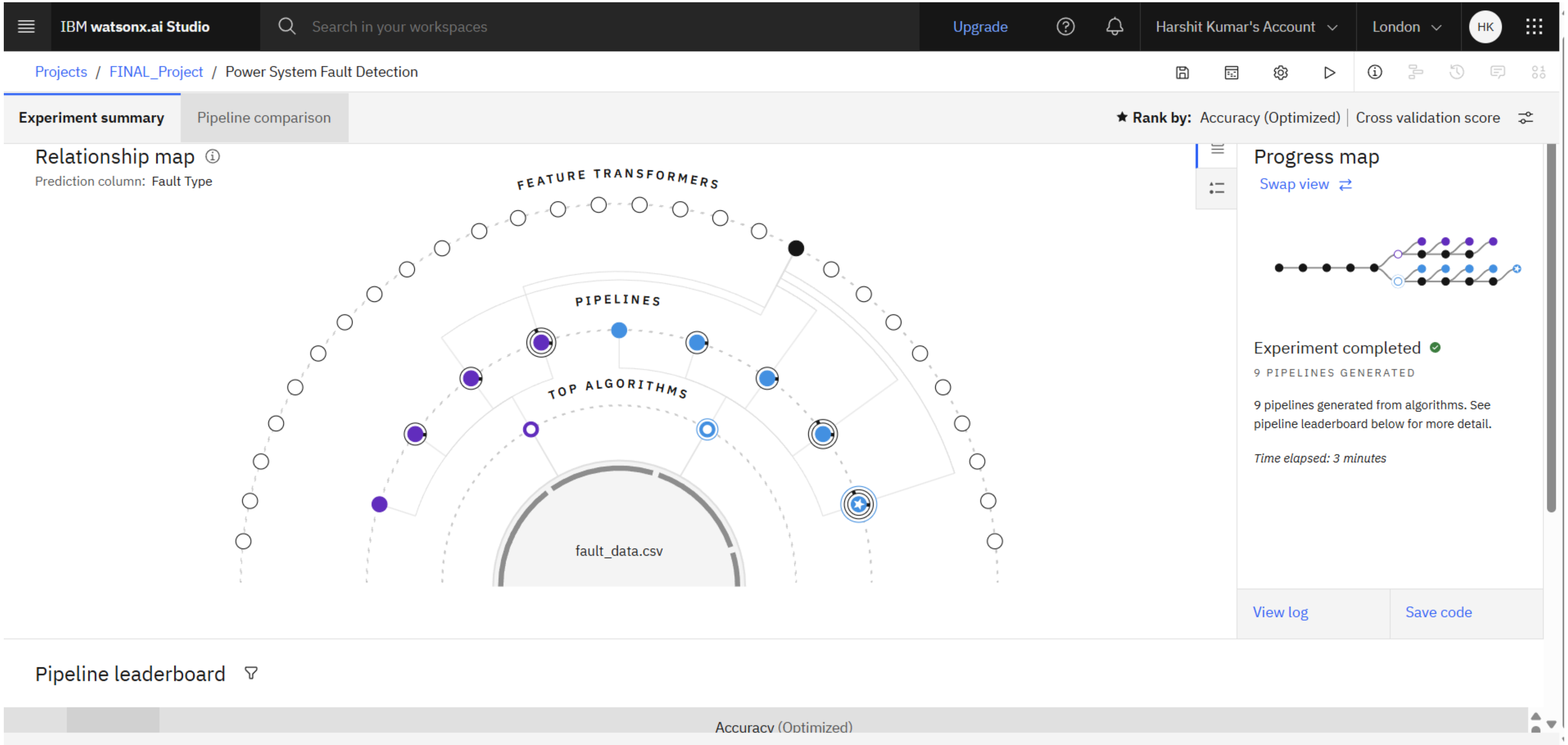
The "System Approach" section outlines the overall strategy and methodology for developing and implementing the power system fault detection and classification . Here's a suggested structure for this section:

- System requirements:
  - IBM CLOUD
  - IBM Watson Studio for model development and deployment
  - IBM Cloud Object Storage for data handling

ALGORITHM & DEPLOYMENT

- Algorithm Selection:
  Random Forest Classifier (or SVM based on performance)
- Data Input:
  Voltage, current, and phasor measurements 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

RESULT



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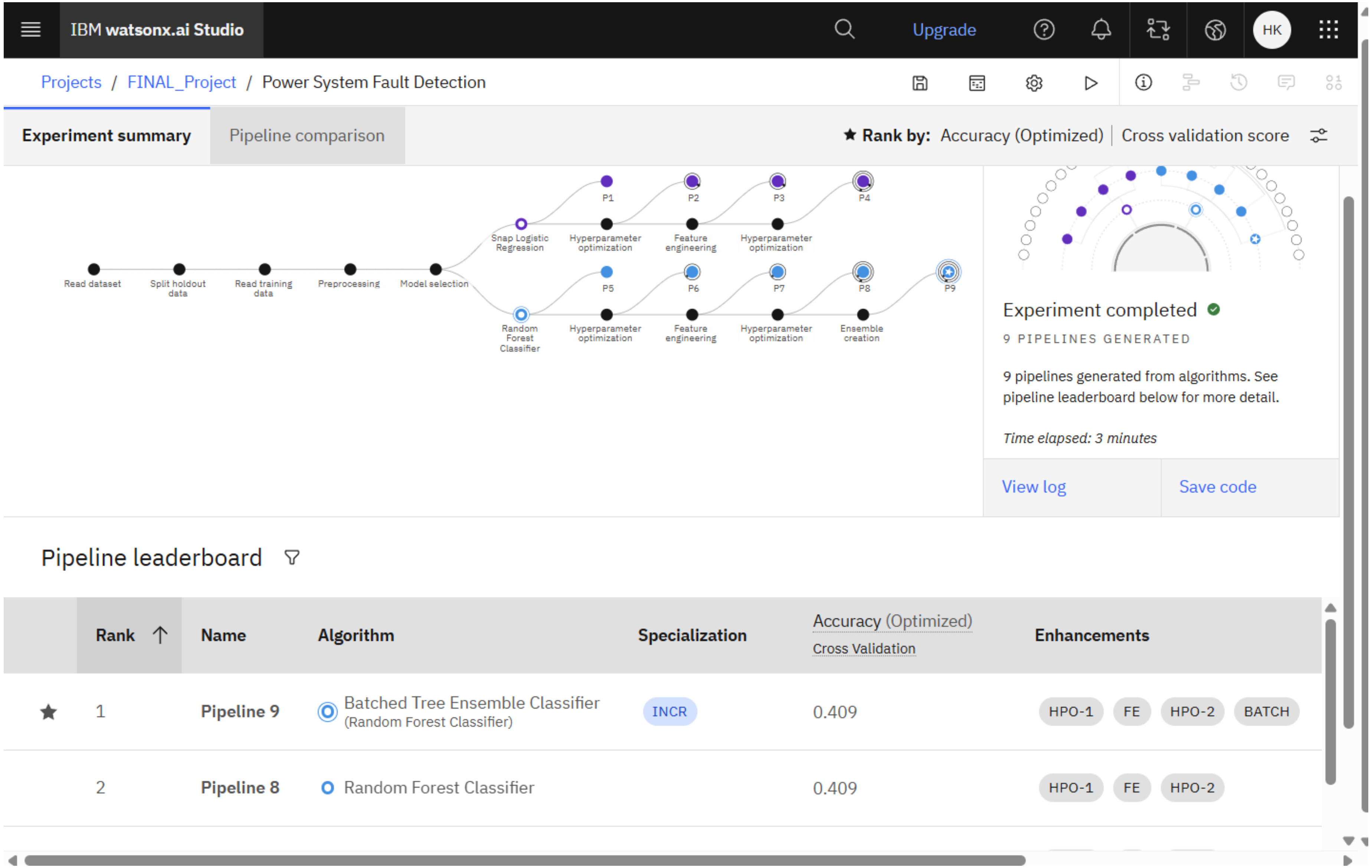
Projects / FINAL_Project / Power System Fault Detection
Experiment summary
Pipeline comparison
Rank by: Accuracy (Optimized) | Cross validation score
Relationship map
Prediction column: Fault Type
FEATURE TRANSFORMERS
PIPELINES
TOP ALGORITHMS
fault_data.csv
Progress map
Swap view
Experiment completed
9 PIPELINES GENERATED
9 pipelines generated from algorithms. See pipeline leaderboard below for more detail.
Time elapsed: 3 minutes
View log
Save code
Pipeline leaderboard
Accuracy (Optimized)

RESULT



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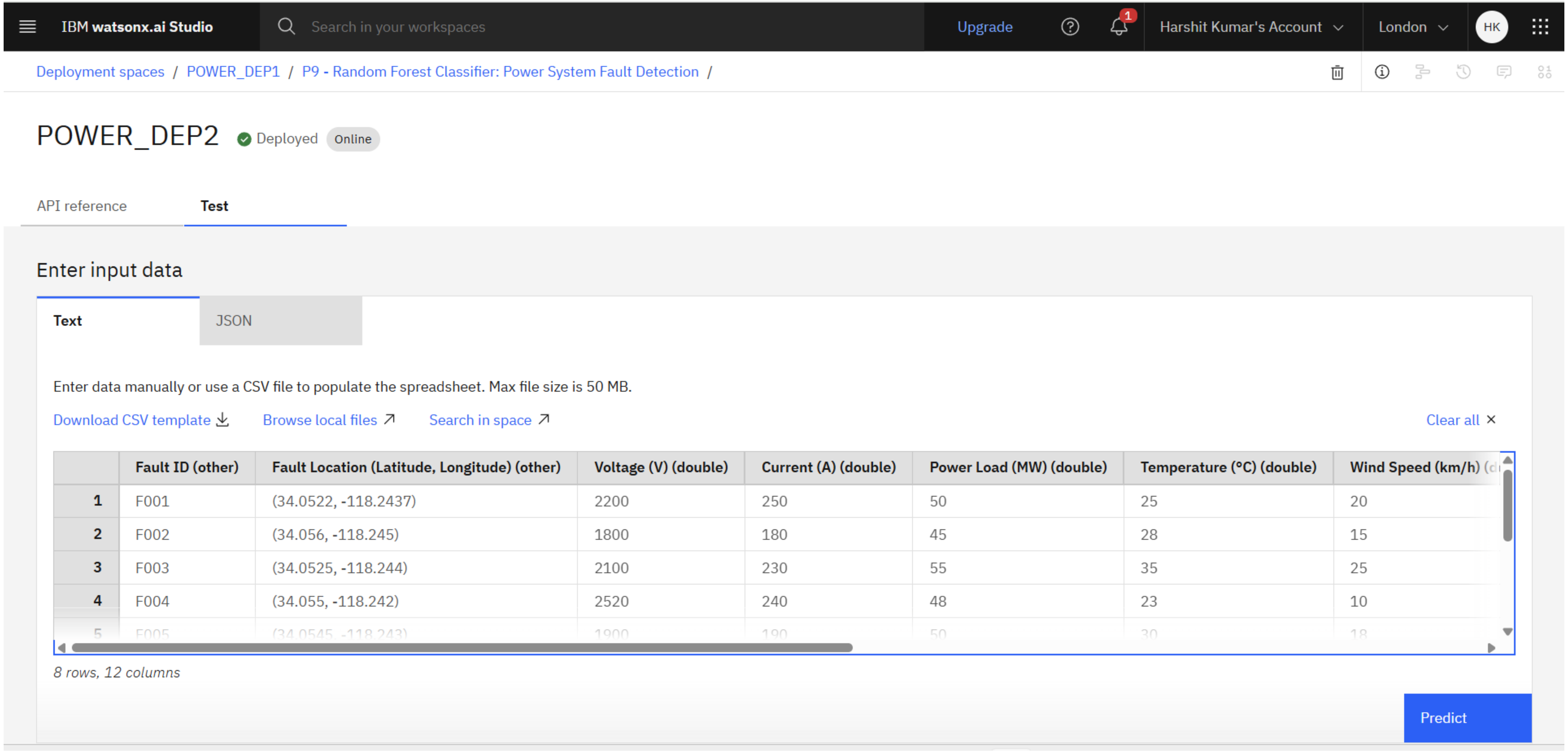
RESULT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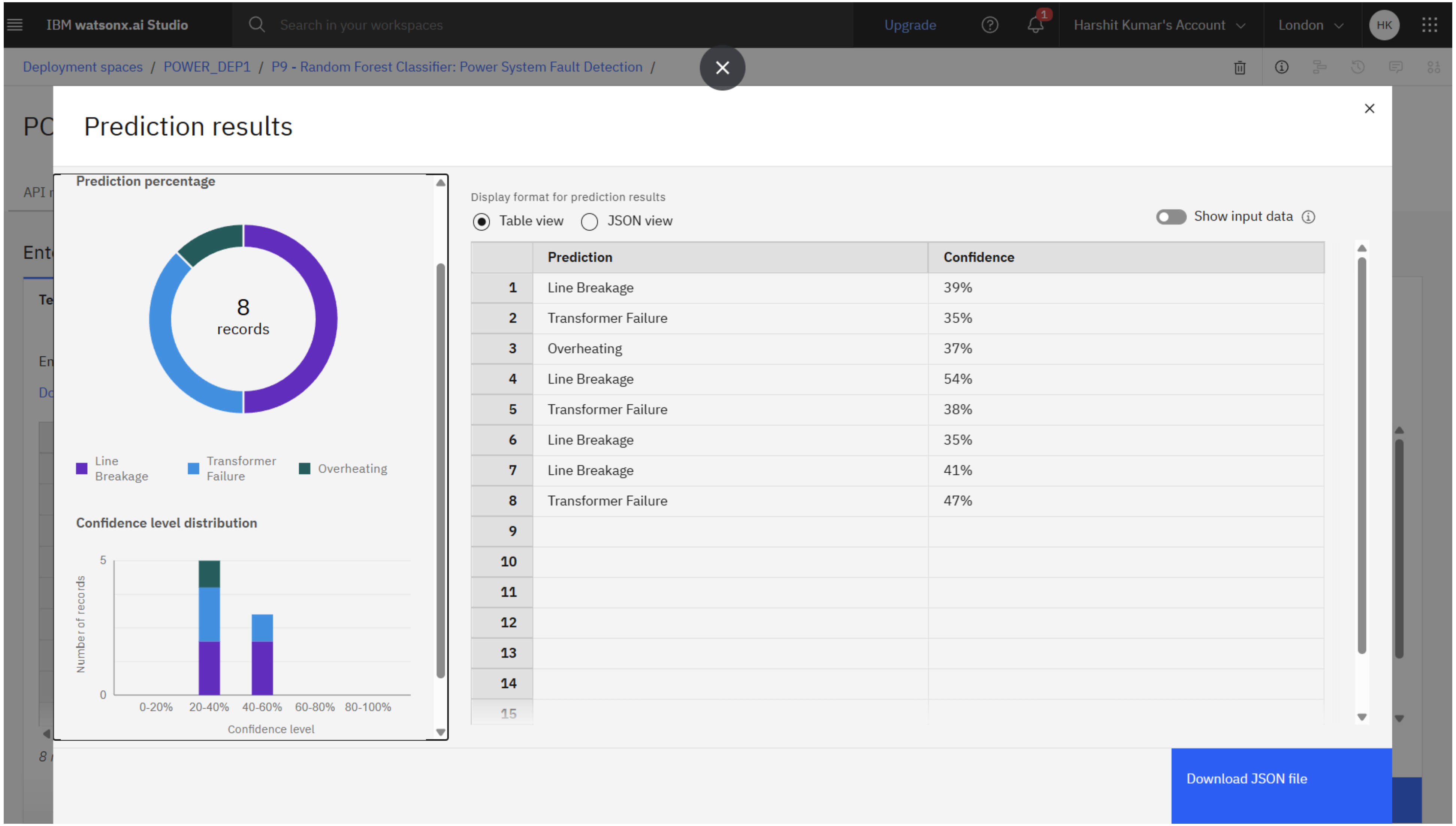
Deployment spaces / POWER_DEP1 / P9 - Random Forest Classifier: Power System Fault Detection /
POWER_DEP2
Deployed
Online
API reference
Test
Enter input data
Text
JSON
Enter data manually or use a CSV file to populate the spreadsheet. Max file size is 50 MB.
Download CSV template
Browse local files
Search 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)
1 | F001 | (34.0522, -118.2437) | 2200 | 250 | 50 | 25 | 20
2 | F002 | (34.056, -118.245) | 1800 | 180 | 45 | 28 | 15
3 | F003 | (34.0525, -118.244) | 2100 | 230 | 55 | 35 | 25
4 | F004 | (34.055, -118.242) | 2520 | 240 | 48 | 23 | 10
8 rows, 12 columns
Predict

RESULT



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CONCLUSION

- The developed machine learning model successfully detects and classifies different types of faults in a power distribution system using electrical measurement data such as voltage and current phasors. By applying supervised learning techniques like **Random Forest** or **SVM**, the model demonstrates high accuracy in identifying fault types, enabling rapid and reliable response to power system anomalies.

FUTURE SCOPE

- Integration with Smart Grids
  - Extend the model to work with large-scale smart grid systems for real-time, distributed fault monitoring.’
- Incorporation of Deep Learning
  - Explore advanced models like **LSTM**, **CNN**, or hybrid deep learning architectures for improved accuracy in complex fault scenarios.
- Edge Deployment
  - Implement the model on **edge devices** (like embedded systems or IoT gateways) for faster fault detection closer to the source

REFERENCES

- **References**

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- Abhishek, K., & Singh, D. (2021). “Fault Detection in Power Systems using Machine Learning Techniques.” *International Journal of Electrical Power & Energy Systems*, 129, 106825.

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