CAPSTONE PROJECT

POWER SYSTEM FAULT DETECTION AND CLASSIFICATION USING MACHINE LEARNING

Presented By:
1. PEDDIREDDY MEGHANA-SATHYABAMA INSTITUTE OF SCIENCE AND TECHNOLOGY-COMPUTER SCIENCE AND ENGINEERING

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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

Power distribution systems are highly susceptible to electrical faults that can compromise grid stability and reliability. Rapid identification and classification of these faults is critical to ensuring effective maintenance, minimizing service interruptions, and preventing equipment damage. This project aims to develop a machine learning-based solution ,that can accurately detect and classify various fault types such as line-to-ground,line-to-line,and three-phase faults based on real-time electrical measurements including voltage and current phasors.

PROPOSED SOLUTION

- Develop a machine learning model that detects and classifies power system faults—such as line-to-ground, line-to-line, and three-phase—using voltage and current phasor data. The system should reliably distinguish faults from normal conditions in real time to support stable grid operation.
- DATA COLLECTION : fault detection data from the Power System Faults Dataset on Kaggle.
- PREPROCESSING: Normalize and filter voltage and current phasor data to remove noise and extract key features for fault classification.
- MODEL TRAINING : Train a supervised learning model like Random Forest or LSTM on labeled phasor data to classify fault types based on extracted electrical features.
- EVALUATION: Measure how accurately the model distinguishes fault types using precision, recall, and a confusion matrix to ensure reliable grid diagnostics.

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 dataset handling

ALGORITHM & DEPLOYMENT

- **ALGORITHM SECTION :**

  Random Forest Classifier or SVM based on performance.

- **DATA INPUT :**

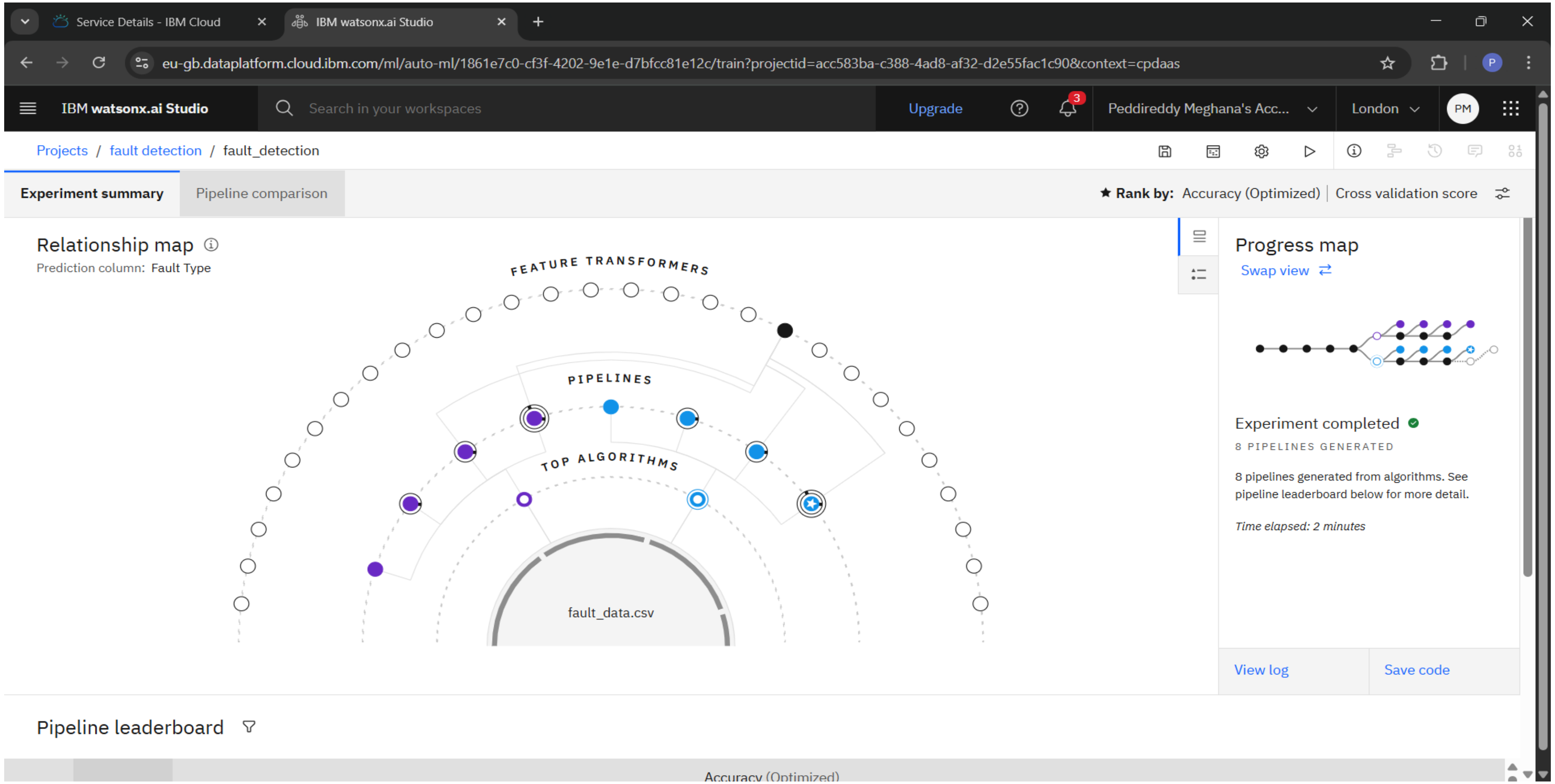
  Voltage, current, and phasor measurements from the dataset.

- **TRAINING PROCESS :**

  A machine learning model is trained using labelled fault types.

- **PREDICTION PROCESS :**
- Real-time fault prediction is performed on IBM Cloud by deploying a trained model to classify incoming phasor signals into fault types.

RESULT



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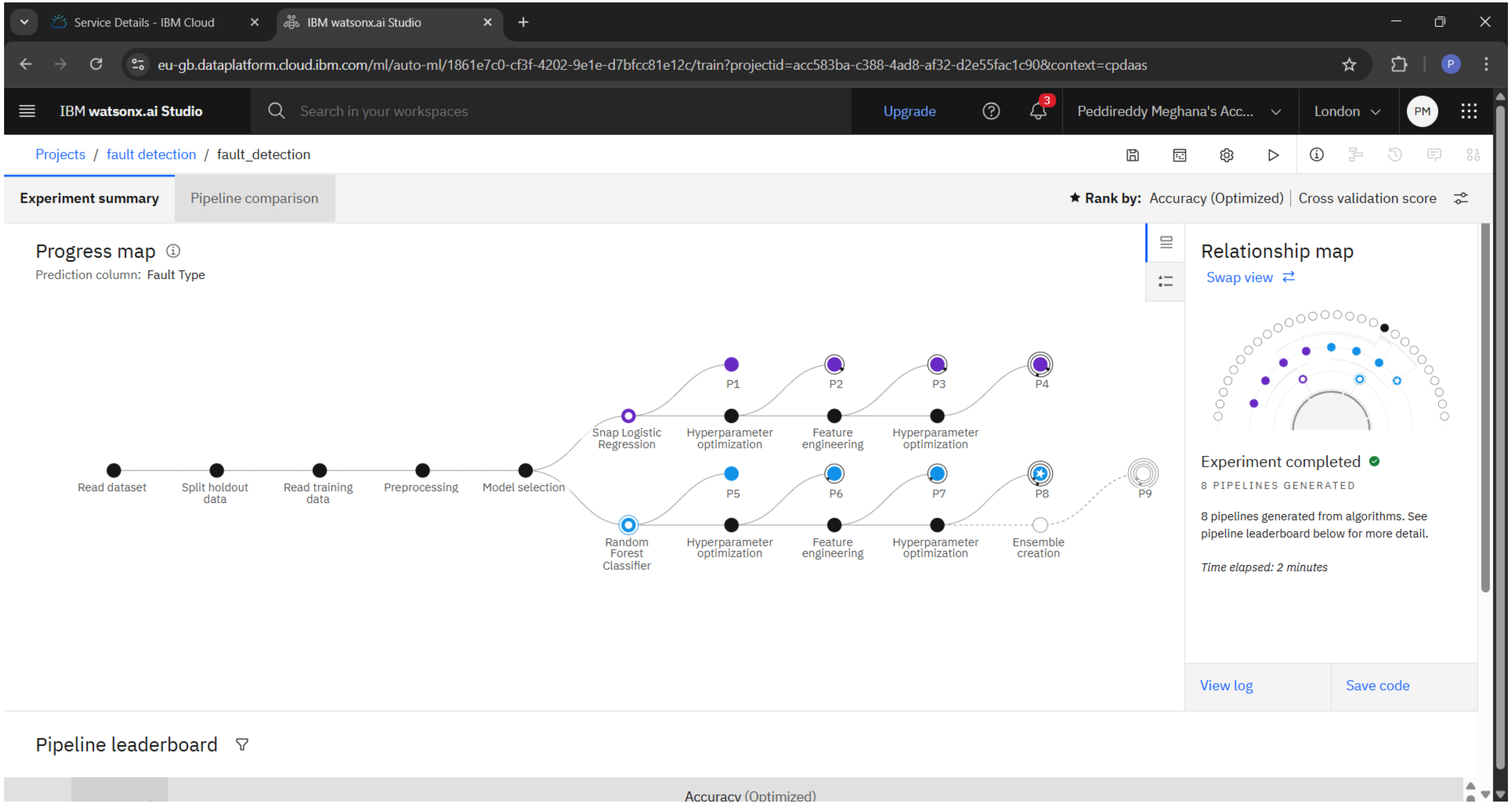
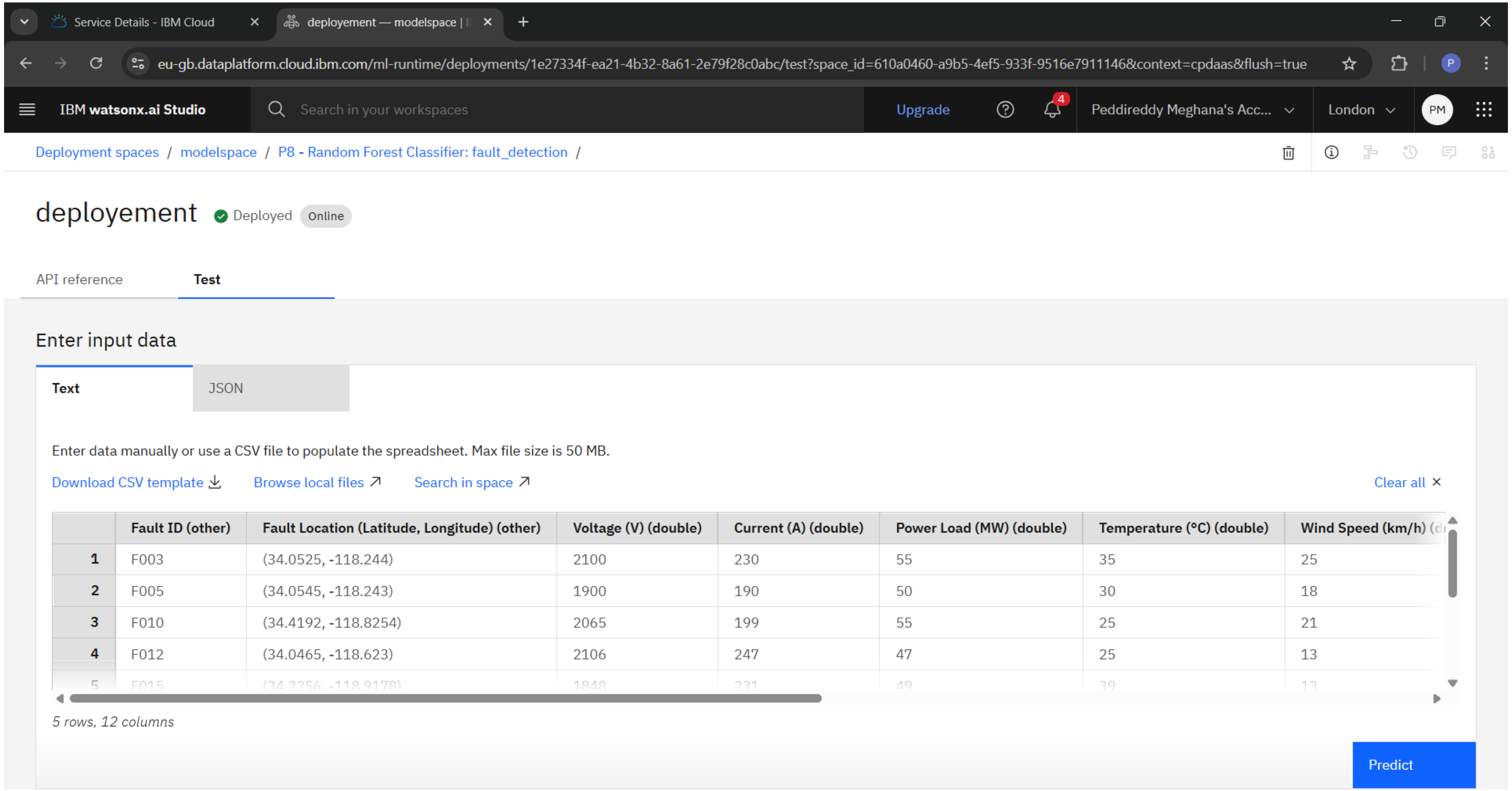
RESULT


Service Details - IBM Cloud
IBM watsonx.ai Studio
eu-gb.dataplatform.cloud.ibm.com/ml/auto-ml/1861e7c0-cf3f-4202-9e1e-d7bfcc81e12c/train?projectid=acc583ba-c388-4ad8-af32-d2e55fac1c90&context=cpdaas
IBM watsonx.ai Studio
Search in your workspaces
Upgrade
Peddireddy Meghana's Acc...
London
PM
Projects / fault detection / fault_detection
Experiment summary
Pipeline comparison
Rank by: Accuracy (Optimized) | Cross validation score
Progress map
Prediction column: Fault Type
Read dataset
Split holdout data
Read training data
Preprocessing
Model selection
Snap Logistic Regression
Hyperparameter optimization
Feature engineering
Hyperparameter optimization
P1
P2
P3
P4
Random Forest Classifier
Hyperparameter optimization
Feature engineering
Hyperparameter optimization
Ensemble creation
P5
P6
P7
P8
P9
Relationship map
Swap view
Experiment completed
8 PIPELINES GENERATED
8 pipelines generated from algorithms. See pipeline leaderboard below for more detail.
Time elapsed: 2 minutes
View log
Save code
Pipeline leaderboard
Accuracy (Optimized)

RESULT



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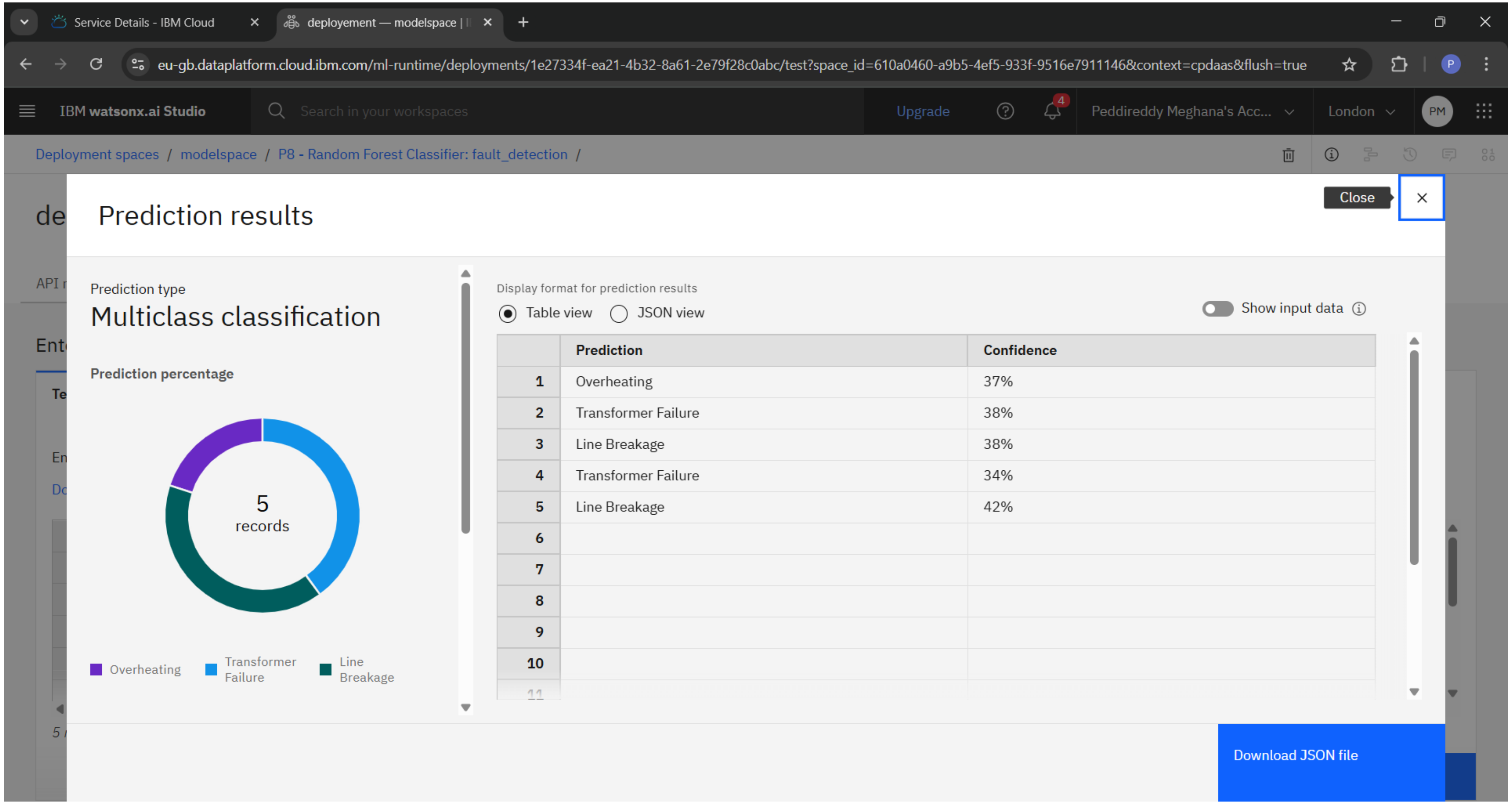
RESULT



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CONCLUSION

The fault detection model successfully leverages phasor signal data to identify and classify power system faults in real-time. By deploying the solution on IBM Cloud, the project ensures scalable, reliable, and efficient performance offering a robust framework for enhancing the stability and resilience of modern power grids. This implementation not only demonstrates the practical value of cloud-based AI models in power systems but also opens doors for future integration of advanced analytics and automated response systems.

FUTURE SCOPE

- **Smart Grid Integration**
  The model can be embedded within intelligent grid systems to automatically detect faults, isolate affected segments, and reroute power enhancing system reliability and reducing downtime.
- **Advanced Fault Classification**
  By training on more granular fault data, the model can evolve to distinguish between diverse fault type and patterns, allowing for precise diagnostics and faster restoration strategies.
- **Cloud Scalability**
  Leveraging IBM Cloud's flexible architecture, the solution can be scaled across regions and power networks to support high availability, real-time analytics, and seamless integration with large infrastructure.

REFERENCES

Power System Fault Detection Dataset. Retrieved from :

https://www.Kaggle.com/datasets/ziya07/power-system-faults-dataset

IBM Watson Studio Documentation. Retrieved from :

https://www.ibm.com/docs/en/Watson-studio

IBM Cloud – Build and Deploy AI Models. Retrieved from :

https://www.ibm.com/cloud

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Learning hours: 20 mins

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