CAPSTONE PROJECT

POWER SYSTEM FAULT DETECTION AND CLASSIFICATION

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https://github.com/divyansh124/IBM-Cloud-Project

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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

41.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 detect and classify different types of faults in a power distribution system using electrical measurement data. It leverages data analytics and machine learning techniques to distinguish between normal and various fault conditions, enabling rapid and accurate fault identification to ensure power grid stability and reliability. The solution will consist of the following components:

- **Data Collection**:
  - Use Kaggle dataset on Power System Faults.
- **Data Preprocessing:**
  - Clean and preprocess the collected data to handle missing values, outliers, and inconsistencies.
- **Machine Learning Algorithm:**
  - Train a classification model (e.g., SVM, Random Forest, LSTM) to detect and label fault types.
- **Deployment:**
  - Deploy using IBM watsonx.ai Studio and Runtime on IBM Cloud.
- **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:

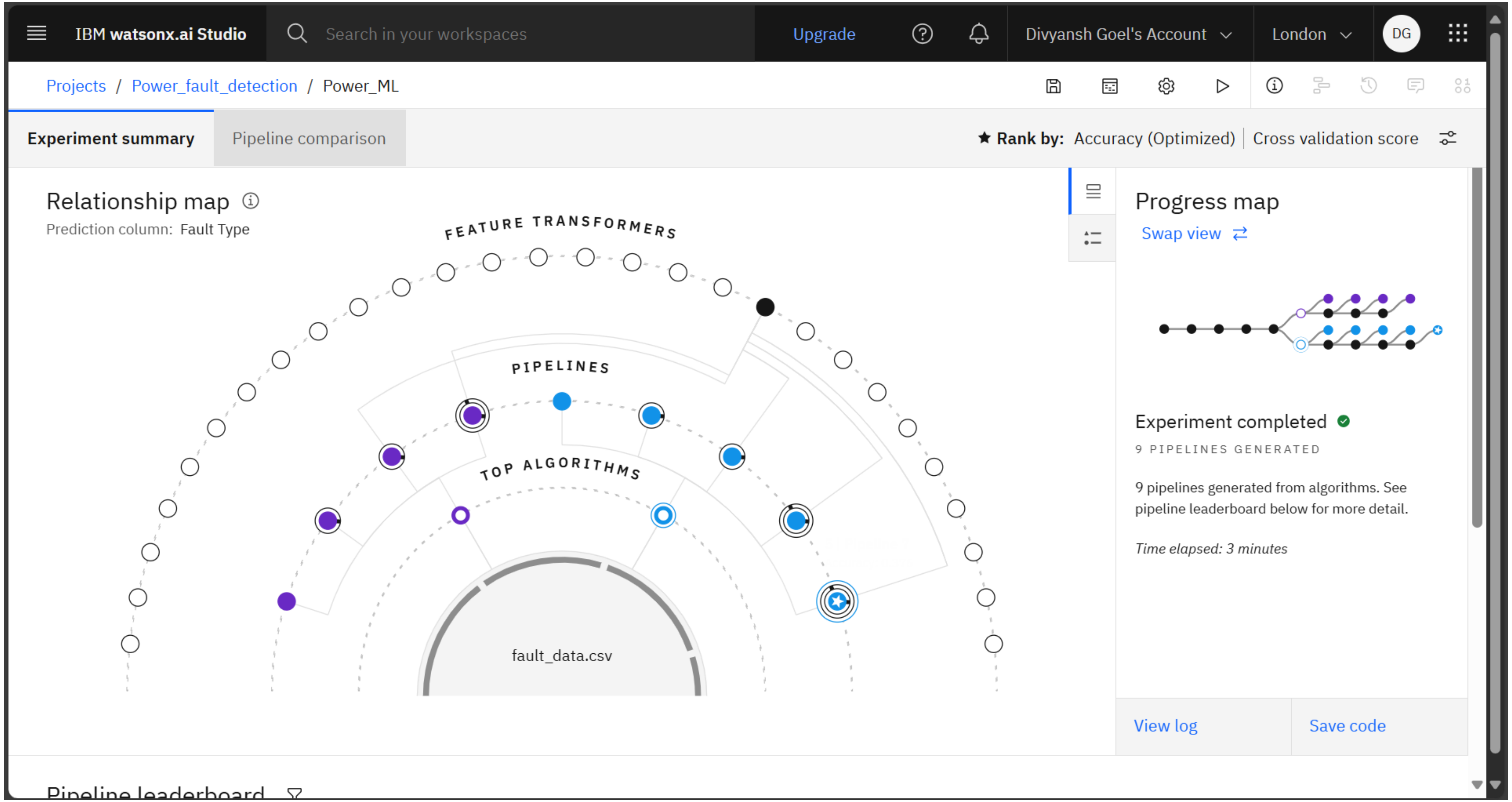
- System requirements:
  - IBM Cloud(mandatory)
  - IBM watson.ai studio for model development and deployment
  - IBM Cloud Object Storage for dataset handling
  - IBM watsonx.ai Runtime for executing and maintaining AI model.

ALGORITHM & DEPLOYMENT

- **Algorithm Selection:**
  - A Random Forest classifier is used for its high accuracy, noise tolerance, and ability to handle non-linear patterns in multivariate tabular data—ideal for fault classification without sequence modeling.

  Data Input:
  - Voltage, Current, Power Load, Temperature, Wind Speed, Weather Condition, Maintenance Status, Component Health, Fault Duration, and Downtime from dataset.
- **Training Process:**
  - The model is trained using supervised learning with labeled fault types. Key techniques include Hyperparameter tuning, Feature engineering ,Batch processing, Ensemble creation
- **Prediction Process:**
  - Model deployed on IBM Watson Studio with API endpoint for real-time predictions.

RESULT



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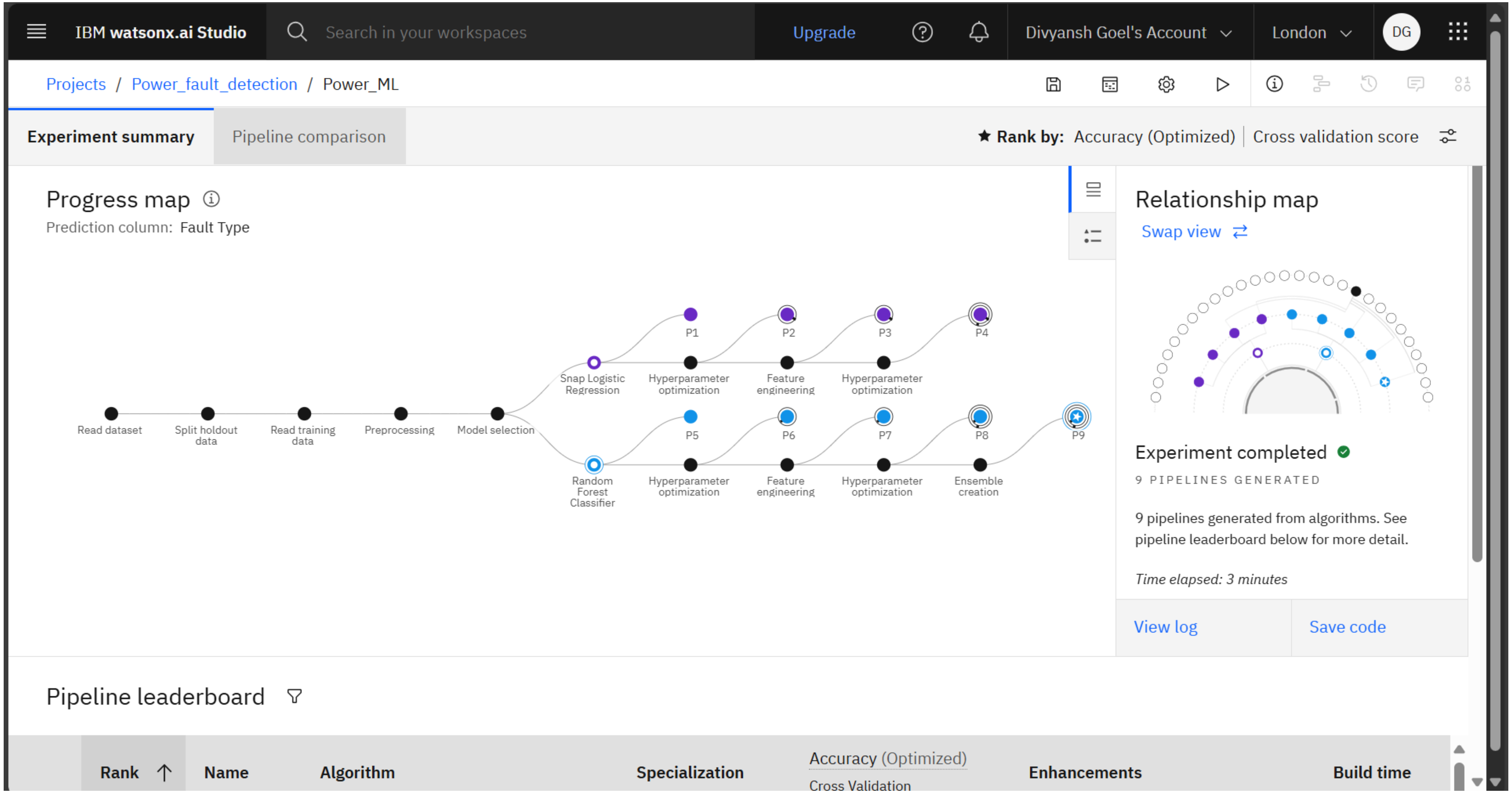
RESULT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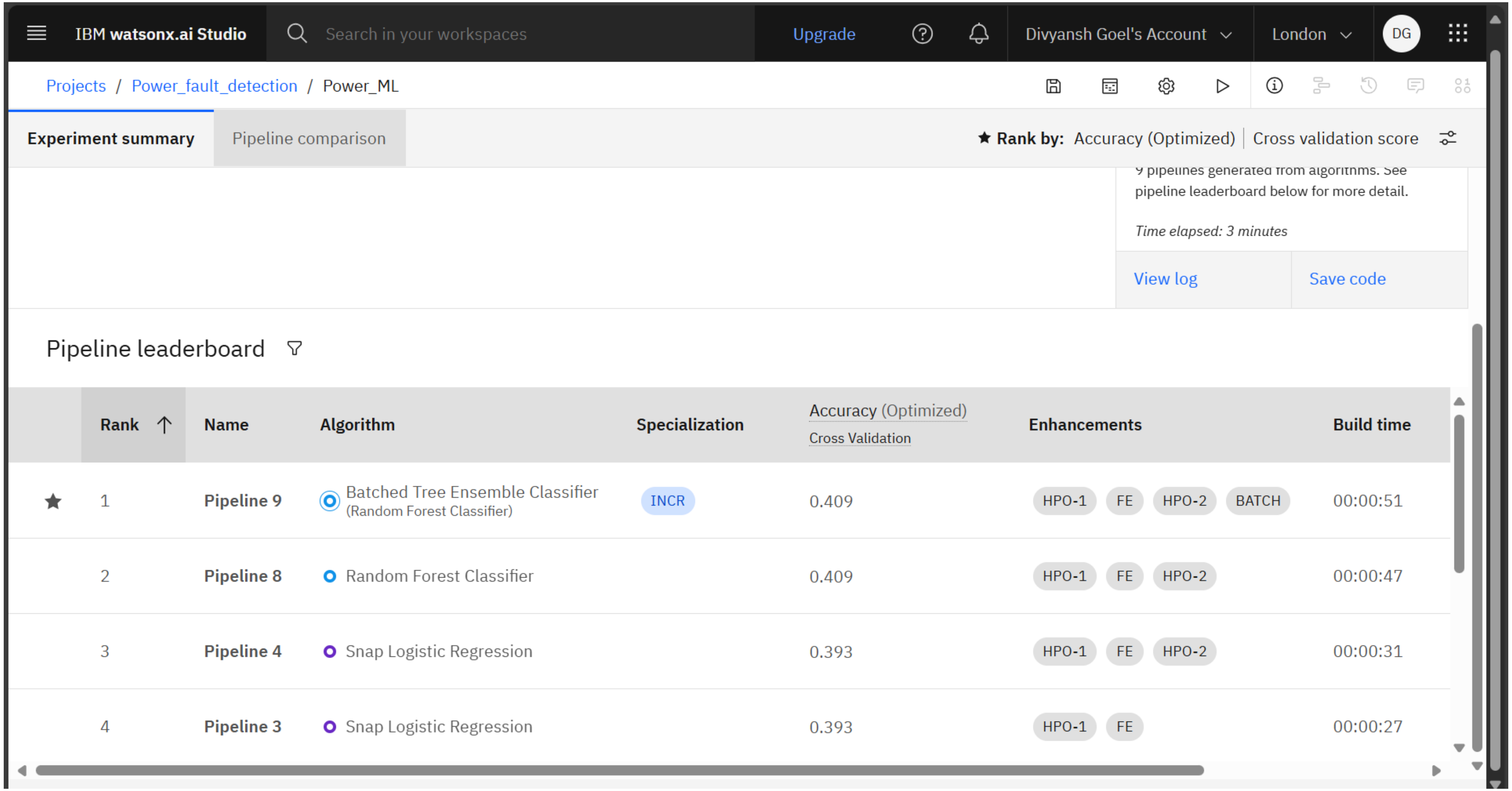
Experiment summary
Pipeline comparison
Rank by: Accuracy (Optimized) | Cross validation score
Progress map
Prediction column: Fault Type
Read dataset
Split holdout data
Read training data
Preprocessing
Model selection
Snap Logistic Regression
Random Forest Classifier
Hyperparameter optimization
Feature engineering
Ensemble creation
P1
P2
P3
P4
P5
P6
P7
P8
P9
Relationship 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
Rank
Name
Algorithm
Specialization
Accuracy (Optimized)
Cross Validation
Enhancements
Build time

RESULT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Experiment summary
Pipeline comparison
Rank by: Accuracy (Optimized) | Cross validation score
9 pipelines generated from algorithms. See pipeline leaderboard below for more detail.
Time elapsed: 3 minutes
View log
Save code
Pipeline leaderboard
Rank | Name | Algorithm | Specialization | Accuracy (Optimized) Cross Validation | Enhancements | Build time
1 | Pipeline 9 | Batched Tree Ensemble Classifier (Random Forest Classifier) | INCR | 0.409 | HPO-1 FE HPO-2 BATCH | 00:00:51
2 | Pipeline 8 | Random Forest Classifier | | 0.409 | HPO-1 FE HPO-2 | 00:00:47
3 | Pipeline 4 | Snap Logistic Regression | | 0.393 | HPO-1 FE HPO-2 | 00:00:31
4 | Pipeline 3 | Snap Logistic Regression | | 0.393 | HPO-1 FE | 00:00:27

RESULT

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Deployment spaces / Power_fault_dep / P9 - Random Forest Classifier: Power_ML /

Power_DEP1

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) (doubl
1	F001	(34.0522, -118.2437)	2200	250	50	25	20
2	F002	(34.056, -118.245)	1800	180	45	28	15
3	F004	(34.055, -118.242)	2050	240	48	23	10
4	F006	(34.05, -118.24)	2150	220	52	32	22
5	F003	(34.0525, -118.244)	2100	230	55	35	25
6	F032	(34.5078, -118.5804)	2228	212	50	22	10
7	F019	(34.5459, -118.8822)	1943	245	50	30	15
8	F073	(34.9502, -118.4453)	2054	205	47	36	11

8 rows, 12 columns

Predict

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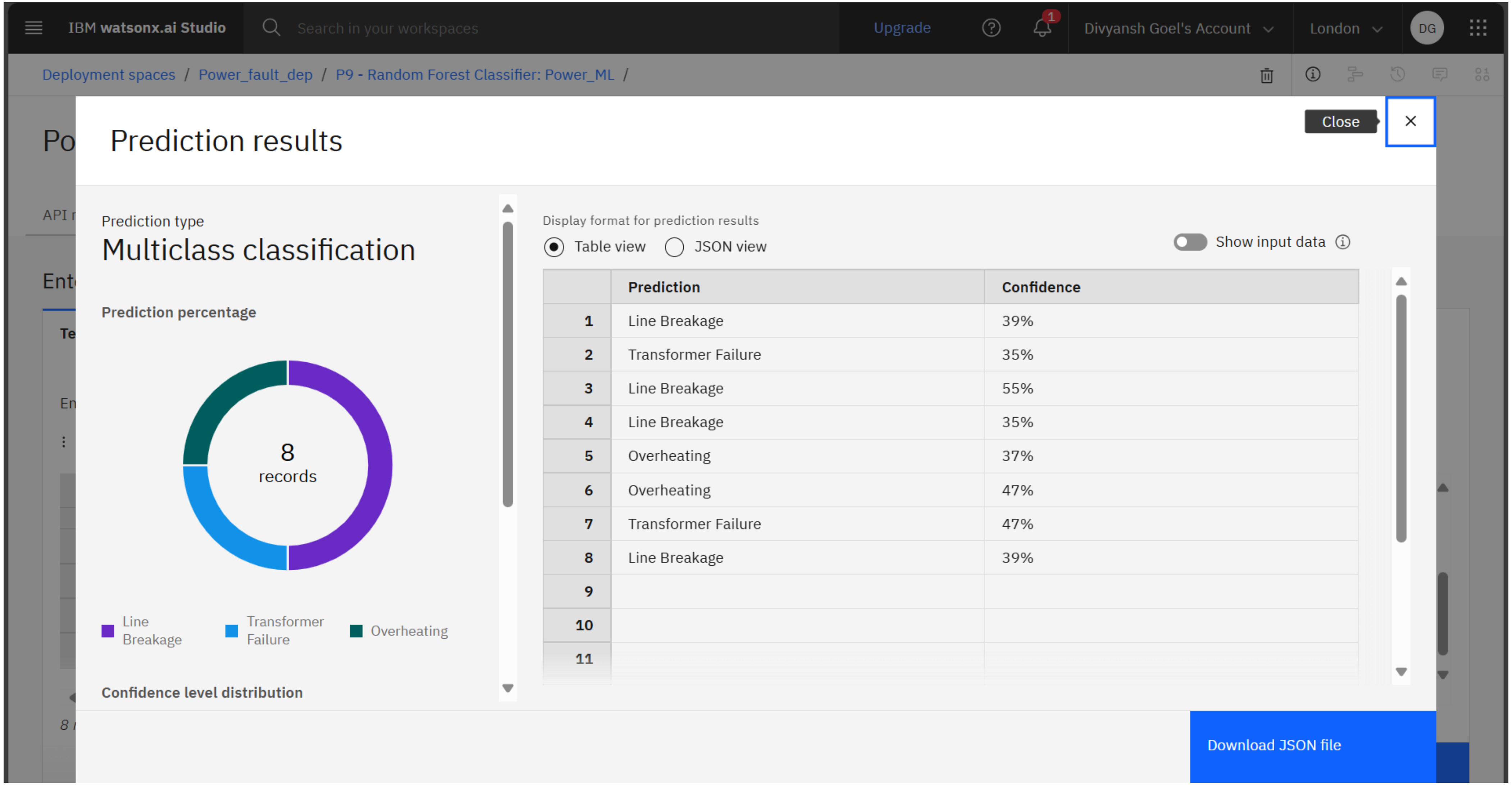
RESULT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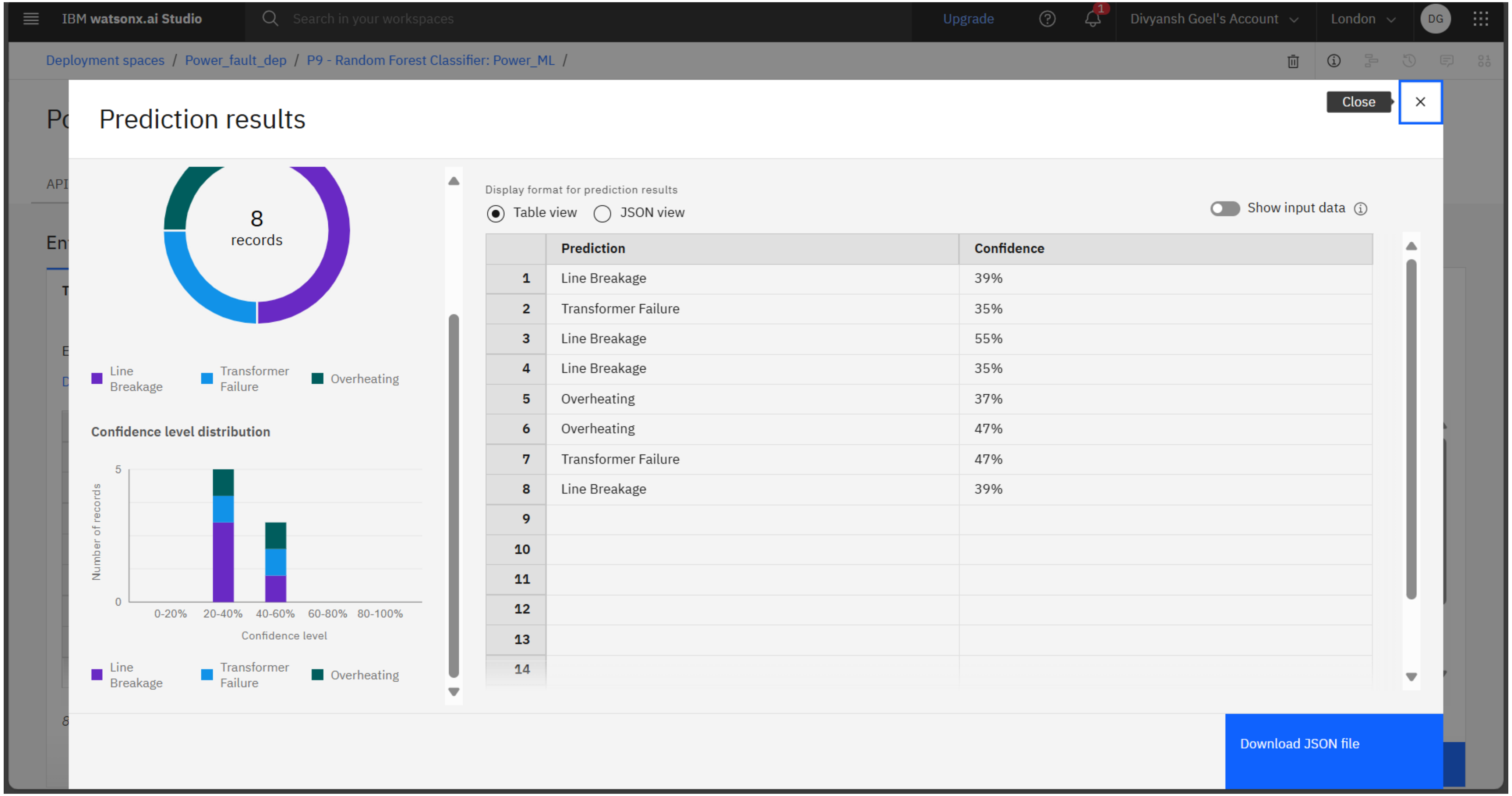
Close
Prediction results
Prediction type
Multiclass classification
Prediction percentage
8 records
Line Breakage
Transformer Failure
Overheating
Confidence level distribution
Display format for prediction results
Table view
JSON view
Show input data
Prediction | Confidence
1 Line Breakage 39%
2 Transformer Failure 35%
3 Line Breakage 55%
4 Line Breakage 35%
5 Overheating 37%
6 Overheating 47%
7 Transformer Failure 47%
8 Line Breakage 39%
9
10
11
Download JSON file

RESULT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Prediction results
Close
8 records
Line Breakage
Transformer Failure
Overheating
Confidence level distribution
Number of records
5
0
0-20%
20-40%
40-60%
60-80%
80-100%
Confidence level
Line Breakage
Transformer Failure
Overheating
Display format for prediction results
Table view
JSON view
Show input data
Prediction
Confidence
1 Line Breakage 39%
2 Transformer Failure 35%
3 Line Breakage 55%
4 Line Breakage 35%
5 Overheating 37%
6 Overheating 47%
7 Transformer Failure 47%
8 Line Breakage 39%
9
10
11
12
13
14
Download JSON file

CONCLUSION

- The proposed system successfully detects and classifies various power distribution faults using electrical data and machine learning, enabling rapid and accurate fault identification. This contributes to improved grid stability and operational reliability.

FUTURE SCOPE

- **Utilize real-time data sources** instead of static datasets for improved accuracy and responsiveness.
- **Integrate with smart grid systems** to enable automated, intelligent fault management.
- **Enhance model robustness** to handle noisy, incomplete, or missing data scenarios.
- **Deploy edge AI models** for faster, on-site fault detection with minimal latency

REFERENCES

- **Kaggle Dataset** –Power System *Faults Dataset*
  https://www.kaggle.com/datasets/ziya07/power-system-faults-dataset
- **IBM Cloud**– For Model Development, Storage, Execution, and Deployment

  https://cloud.ibm.com

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IBM SkillsBuild

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This certificate is presented to

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According to the Adobe Learning Manager system of record

Completion date: 23 Jul 2025 (GMT)

Learning hours: 20 mins

THANK YOU

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