Machine Learning PROJECT

POWER SYSTEM FAULT DETECTION AND CLASSIFICATION

Presented By:

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OUTLINE

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- System Development Approach
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- Result (Output Image)
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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 sophisticated machine learning model to classify diverse power system faults with high precision and speed.
- This model will meticulously analyze electrical measurements to rapidly identify fault types, significantly automating detection and enabling swift recovery.
- Data Acquisition: Kaggle Dataset for Power System Fault Detection and Classification is used.
- Data Preprocessing:Implement rigorous data cleaning to handle missing values, outliers, and inconsistencies, ensuring data quality. Perform strategic feature engineering, including the derivation of symmetrical components, phase angle differences, and time-domain features (e.g., rate of change) to enhance fault discriminability.
- Model Training:Train a robust multi-class classification model capable of distinguishing between normal operation and various fault conditions
- Model Evaluation & Validation:
  - **Overall Accuracy:** For a general understanding of correct predictions.
  - **Precision, Recall, and F1-score:** Crucial for assessing performance on each specific fault class, especially minority classes, indicating the model's ability to minimize false positives and false negatives.

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
- Watsonx.ai Studio
- IBM Cloud Storage for handling the dataset

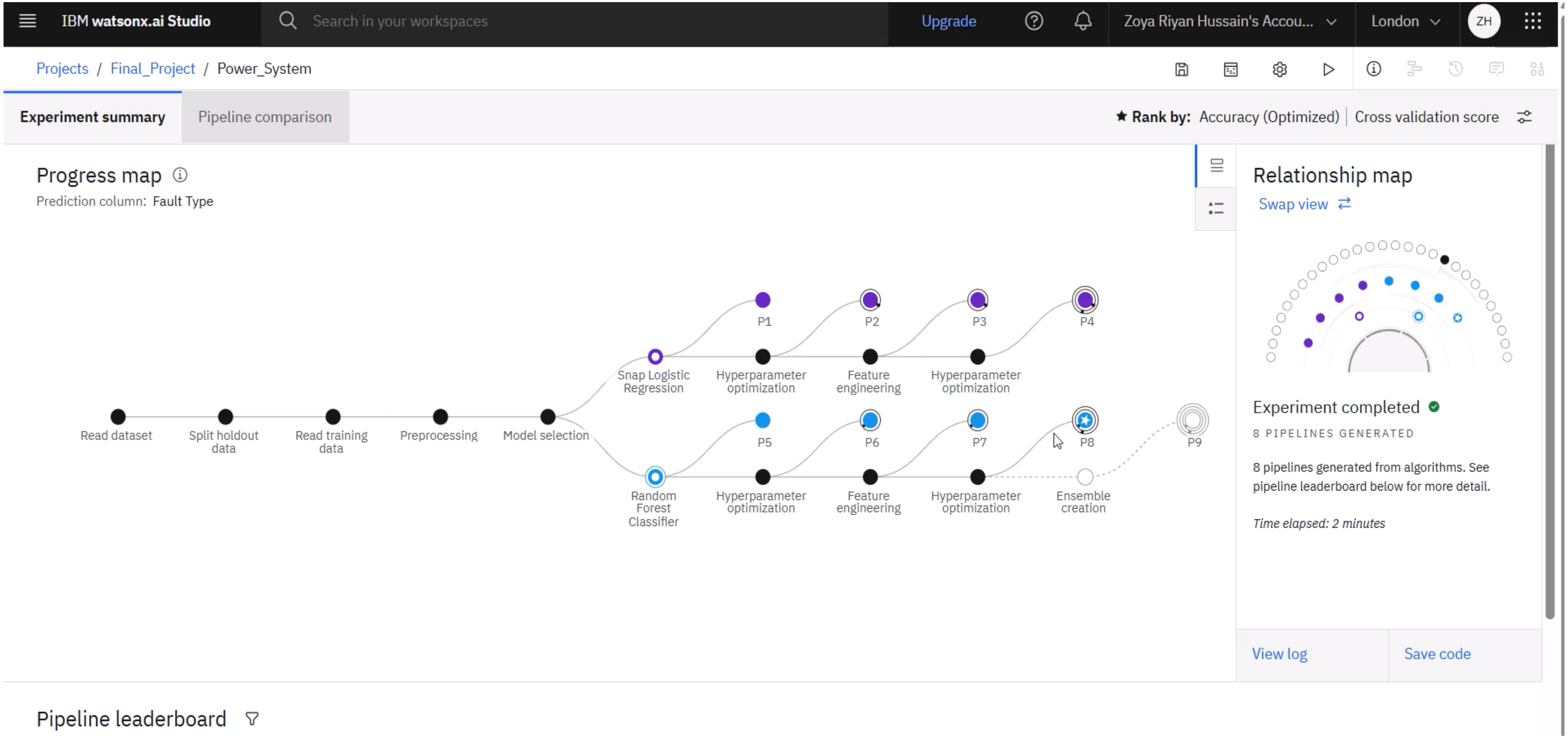
ALGORITHM & DEPLOYMENT

Algorithm Selection:

- Random Forest Classifier.

- **Data Input:**
  - Fault ID, Fault Location (Latitude, Longitude) , Voltage (V) , Current (A) , Power Load (MW) , Temperature (Â°C) , Wind Speed (km/h) , Weather Condition , Maintenance Status , Component Health , Duration of Fault (hrs) , Down time (hrs) .
  - **Training Process:**
    - **Supervised Machine Learning model is used to train the labelled dataset to detect the fault type.**
- **Prediction Process:**
  - **Real-time Model Deployment:** The trained fault detection model will be hosted on a robust cloud platform (e.g., IBM Watson Studio) with a secure and scalable API endpoint, allowing for low-latency, real-time predictions.

RESULT



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RESULT

IBM watsonx.ai Studio | Search in your workspaces | Upgrade | Zoya Riyan Hussain's Acco... | London | ZH

Deployment spaces / Power_Dep1 / P8 - Random Forest Classifier: Power_System /

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 ×

	) (other)	Voltage (V) (double)	Current (A) (double)	Power Load (MW) (double)	Temperature (°C) (double)	Wind Speed (km/h) (double)	Weather Condition (other)	Maintenance Status (other)	Component Health (other)	Duration of Fault (hrs) (double)	Down time (hrs) (double)
1		1868	230	45	31	11	Thunderstorm	Scheduled	Normal	4.1	2.6
2		2184	228	45	37	18	Rainy	Pending	Faulty	3.7	6.3
3		2290	189	49	37	27	Windstorm	Scheduled	Overheated	5.5	5.4
4		2137	246	55	28	24	Rainy	Pending	Normal	2.8	3.1
5											
6											
7											
8											
9											
10											

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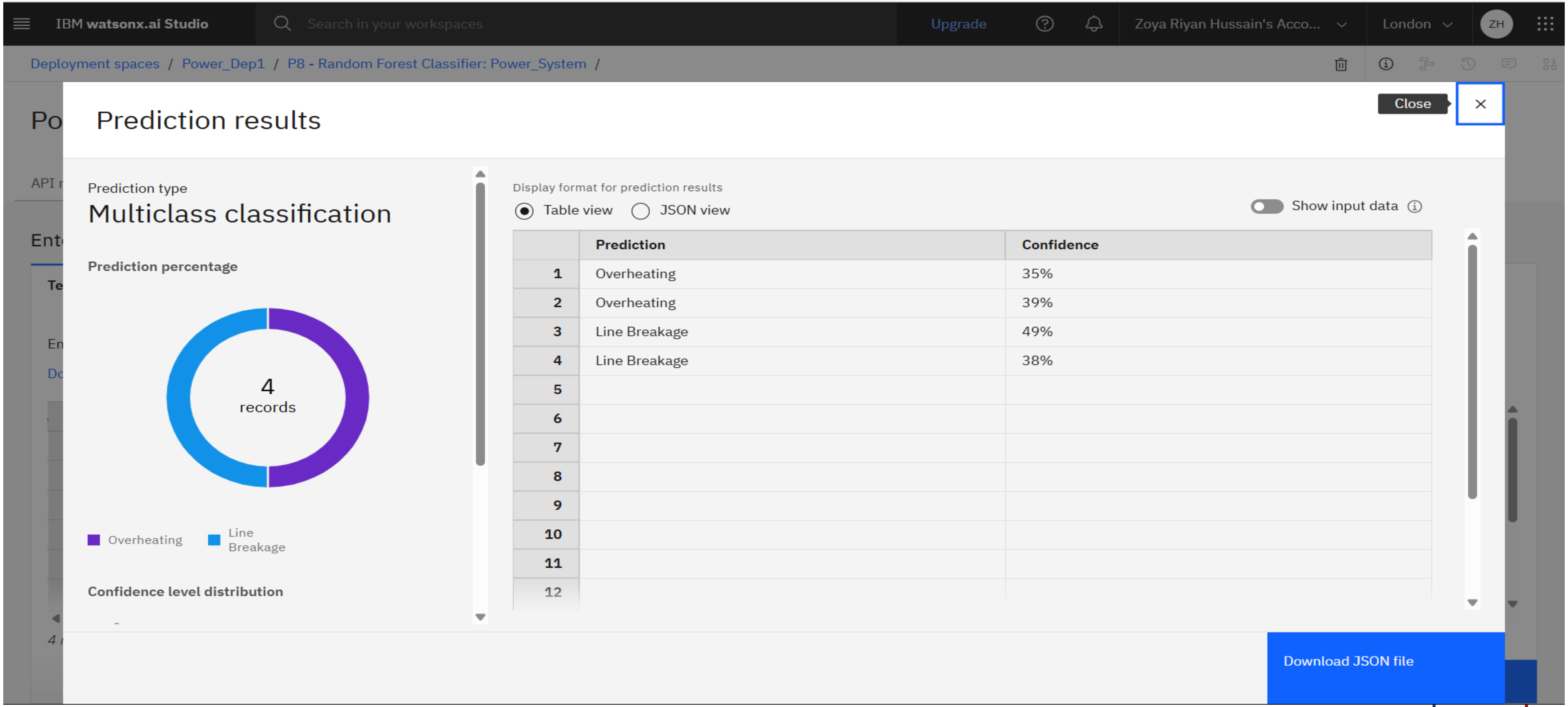
RESULT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Deployment spaces / Power_Dep1 / P8 - Random Forest Classifier: Power_System /
Close
Prediction results
Prediction type
Multiclass classification
Prediction percentage
4
records
Overheating
Line Breakage
Confidence level distribution
Display format for prediction results
Table view
JSON view
Show input data
Prediction
Confidence
1 Overheating 35%
2 Overheating 39%
3 Line Breakage 49%
4 Line Breakage 38%
5
6
7
8
9
10
11
12
Download JSON file

CONCLUSION

- The IBM Watson Studio environment successfully demonstrates the full lifecycle of a power system fault classification model, from automated pipeline generation and training (primarily using Random Forest) to its deployment for real-time predictions. While currently identifying "Overheating" and "Line Breakage" faults, further refinement could enhance prediction confidence for more robust fault management.

FUTURE SCOPE

- The future scope involves enhancing model accuracy and confidence through advanced deep learning and continuous data integration, alongside exploring real-time fault localization capabilities. Furthermore, the system can evolve to predict potential faults proactively, leveraging predictive maintenance for increased grid resilience.

REFERENCES

- Used Kaggle for **Power System Faults Dataset**
- Includes fault types, environmental conditions, and system performance data
- Implemented this dataset on IBM Cloud to detect the fault type.

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