CAPSTONE PROJECT

POWER SYSTEM FAULT DETECTION AND CLASSIFICATION (MACHINE LEARNING)

Presented By:

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GITHUB LINK - https://github.com/Shivamjoshi14

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.

- Preprocessing: Clean and normalize the dataset.

- Model Training: 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(mandatory)
  - IBM Watson studio for model development and deployment
  - IBM cloud object storage for dataset handling

ALGORITHM & DEPLOYMENT

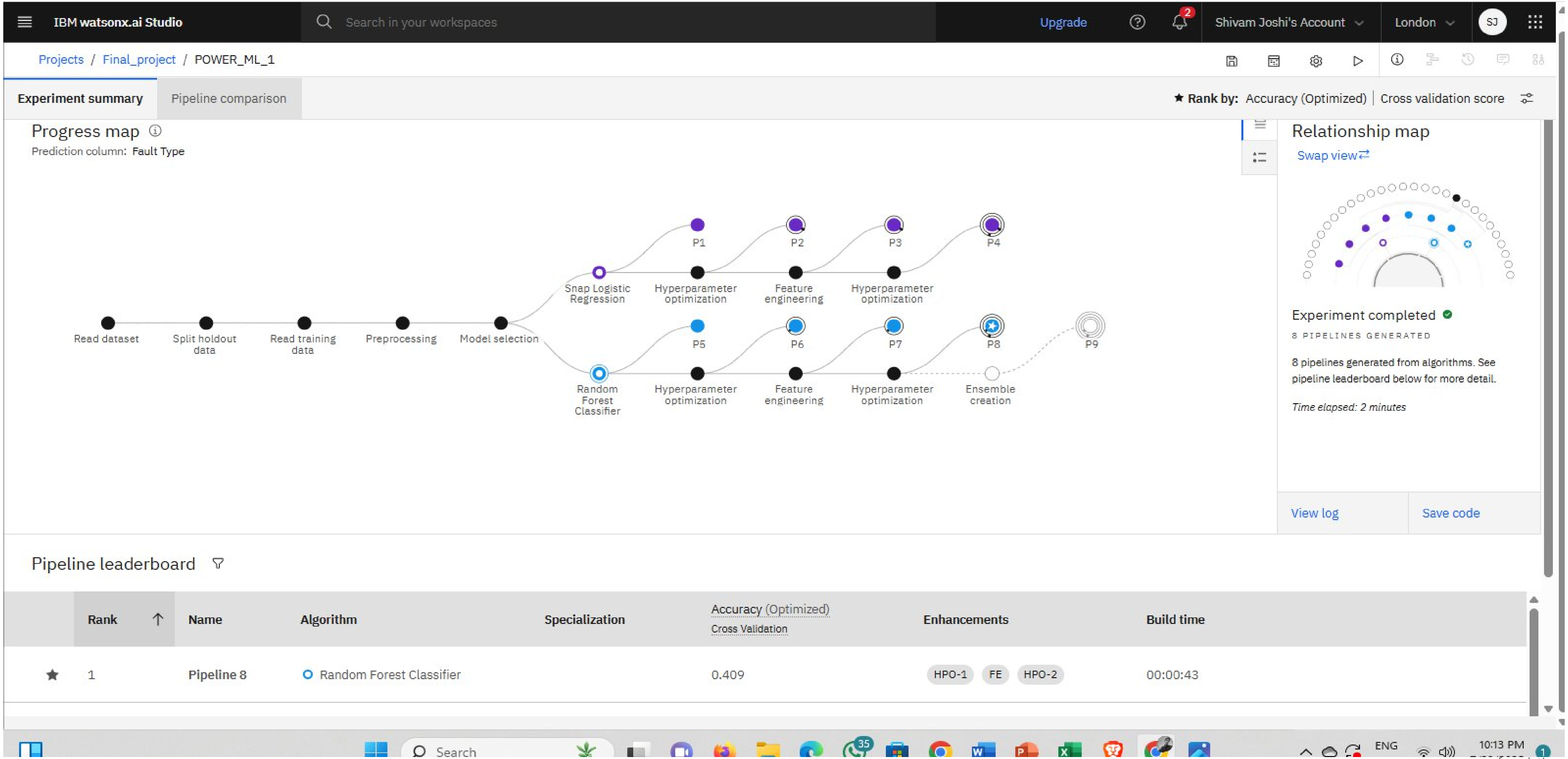
- **Algorithm Selection:**
  Random Forest Classifier (or SVM based on performance)

- **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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RESULT

IBM watsonx.ai Studio | Search in your workspaces | Upgrade | Shivam Joshi's Account | London | SJ

Deployment spaces / Power_DEP1 / P7 - Random Forest Classifier: POWER_ML_1 /

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.

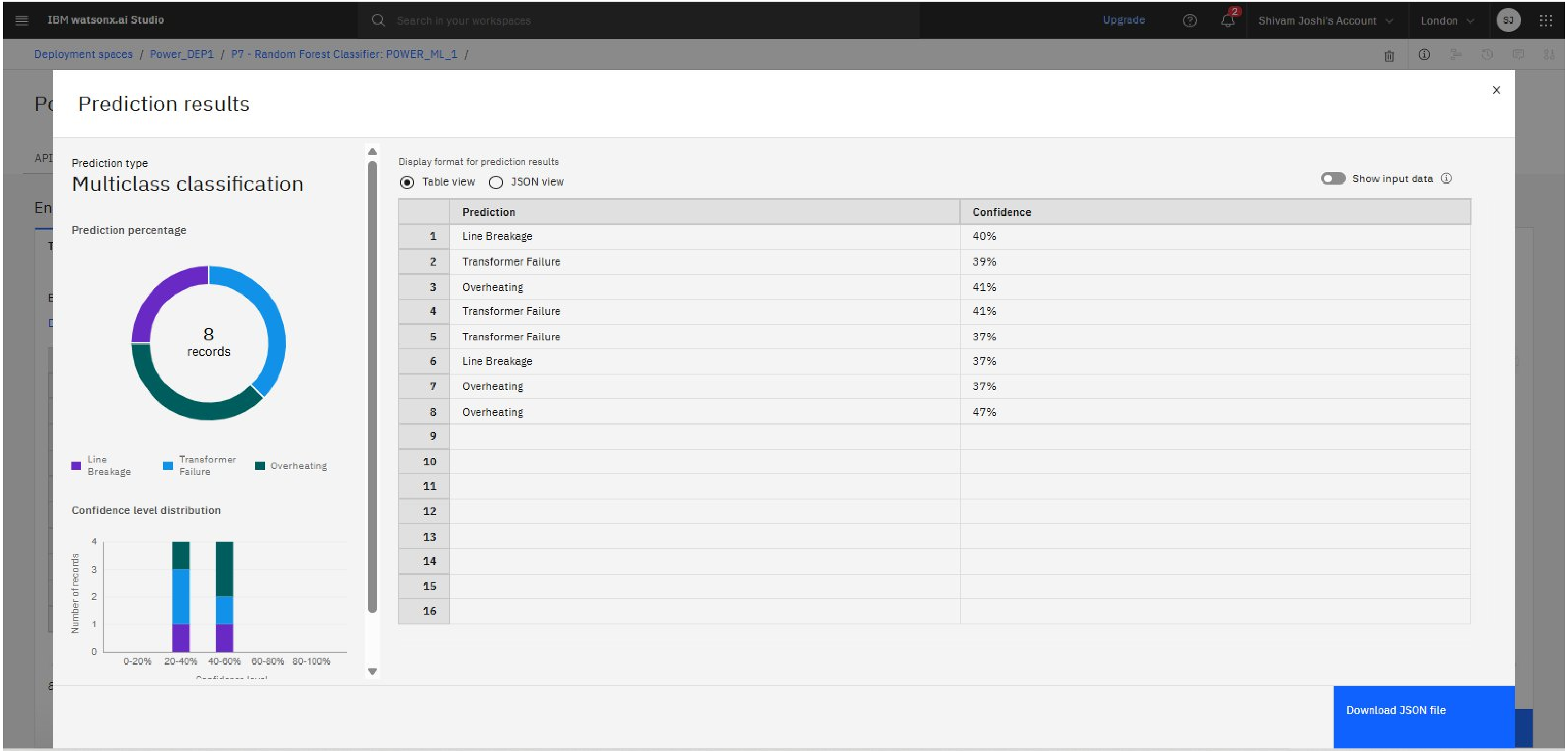
Download CSV template | Browse local files | Search in space | Clear all ×

	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) (double)	Weather Condition (other)	Maintenance Status (other
1	F001	(34.0522, -118.2437)	2200	250	50	25	20	Clear	Scheduled
2	F009	(34.056, -118.245)	2155	240	45	21	29	Rainy	Pending
3	F011	(34.3732, -118.1586)	2118	221	45	20	20	Clear	Completed
4	F040	(34.3129, -118.5028)	1970	225	54	37	17	Snowy	Completed
5	F069	(34.6804, -118.2898)	2261	219	48	40	18	Windstorm	Scheduled
6	F128	(34.0919, -118.6397)	1982	223	46	33	20	Clear	Completed
7	F153	(34.0966, -118.1855)	1812	182	45	29	13	Rainy	Scheduled
8	F218	(34.8045, -118.6639)	2106	221	54	32	12	Clear	Scheduled
9									
10									

8 rows, 12 columns

Predict

RESULT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Deployment spaces / Power_DEP1 / P7 - Random Forest Classifier: POWER_ML_1 /
Prediction results
Prediction type
Multiclass classification
Prediction percentage
8 records
Line Breakage
Transformer Failure
Overheating
Confidence level distribution
Number of records
4
3
2
1
0
0-20%
20-40%
40-60%
60-80%
80-100%
Display format for prediction results
Table view
JSON view
Show input data
Prediction
Confidence
1 Line Breakage 40%
2 Transformer Failure 39%
3 Overheating 41%
4 Transformer Failure 41%
5 Transformer Failure 37%
6 Line Breakage 37%
7 Overheating 37%
8 Overheating 47%
9
10
11
12
13
14
15
16
Download JSON file

CONCLUSION

- In this project, we successfully developed a machine learning model for the detection and classification of power system faults using electrical measurement data. By leveraging voltage and current phasor inputs from the provided dataset, the model accurately distinguished between normal operating conditions and various types of faults, including line-to-ground, line-to-line, and three-phase faults.
- The implementation of the model on IBM Cloud Lite ensured scalability, accessibility, and ease of deployment in a cloud-based environment, aligning with real-world applications in smart grid systems. The model’s high accuracy and speed in fault detection highlight its potential to enhance grid stability and minimize downtime by enabling rapid fault response.
- This solution demonstrates the effectiveness of combining machine learning techniques with cloud computing to build intelligent, real-time monitoring systems for modern electrical power infrastructure.

FUTURE SCOPE

The application of machine learning in power system fault detection presents vast potential for further research and development. Some key areas for future work include:

- **Real-Time Deployment**: Integrating the trained model with real-time data acquisition systems for live fault monitoring and response in actual power grids.
- **Advanced Deep Learning Models**: Exploring deep learning techniques such as LSTM, CNN, or hybrid models to improve fault classification accuracy, especially under noisy or incomplete data conditions.
- **Multi-Fault Detection**: Enhancing the system to detect and classify multiple simultaneous faults or evolving faults that change type over time.
- **Scalability to Large-Scale Grids**: Adapting the model for deployment across large and complex grid networks, including smart grids and microgrids.
- **Integration with IoT and Edge Devices**: Deploying lightweight versions of the model on IoT sensors or edge devices for decentralized and faster decision-making.
- **Predictive Maintenance**: Extending the system to not only detect faults but also predict potential failures based on historical trends and anomaly detection.

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