CAPSTONE PROJECT

POWER SYSTEM FAULT DETECTION AND CLASSIFICATION

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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**

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PROBLEM STATEMENT

In modern power distribution systems, timely and accurate detection of electrical faults is essential to ensure reliability, safety, and operational efficiency. Faults like line-to-ground, line-to-line, and three-phase faults can disrupt power supply and cause equipment damage. The challenge lies in detecting and classifying these faults using electrical measurement data, such as voltage and current phasors, to prevent system failures and maintain grid stability.

PROPOSED **SOLUTION**

- The proposed system aims to address the challenge of accurately detecting and classifying faults in a power distribution system to ensure grid reliability and reduce downtime. This is achieved by applying data analytics and machine learning techniques on electrical parameters such as voltage and current phasors. The solution consists of the following components:
- Data Collection:
- Gather historical and simulated data on voltage and current phasors under normal and fault conditions.
- Include data covering various types of faults: line-to-ground, line-to-line, and three-phase faults
- Data Preprocessing:
- Clean and preprocess data to handle missing values, noise, and inconsistencies.
- Perform feature engineering to extract key signal characteristics (e.g., magnitude, angle, frequency components
- Machine Learning Algorithm:
- Implement supervised learning algorithms (e.g., Random Forest, SVM, or ANN) to classify fault types based on input features.
- Use model evaluation metrics like accuracy, precision, recall, and F1-score to validate performance.

SYSTEM APPROACH

- System requirements
- IBM Cloud Lite account
- IBM Watson Studio for data preprocessing, modeling, and experimentation
- IBM Watson Machine Learning for deployment and API integration

- Library required to build the model
- ibm-watson-machine-learning
- Pandas
- numpy

ALGORITHM & DEPLOYMENT

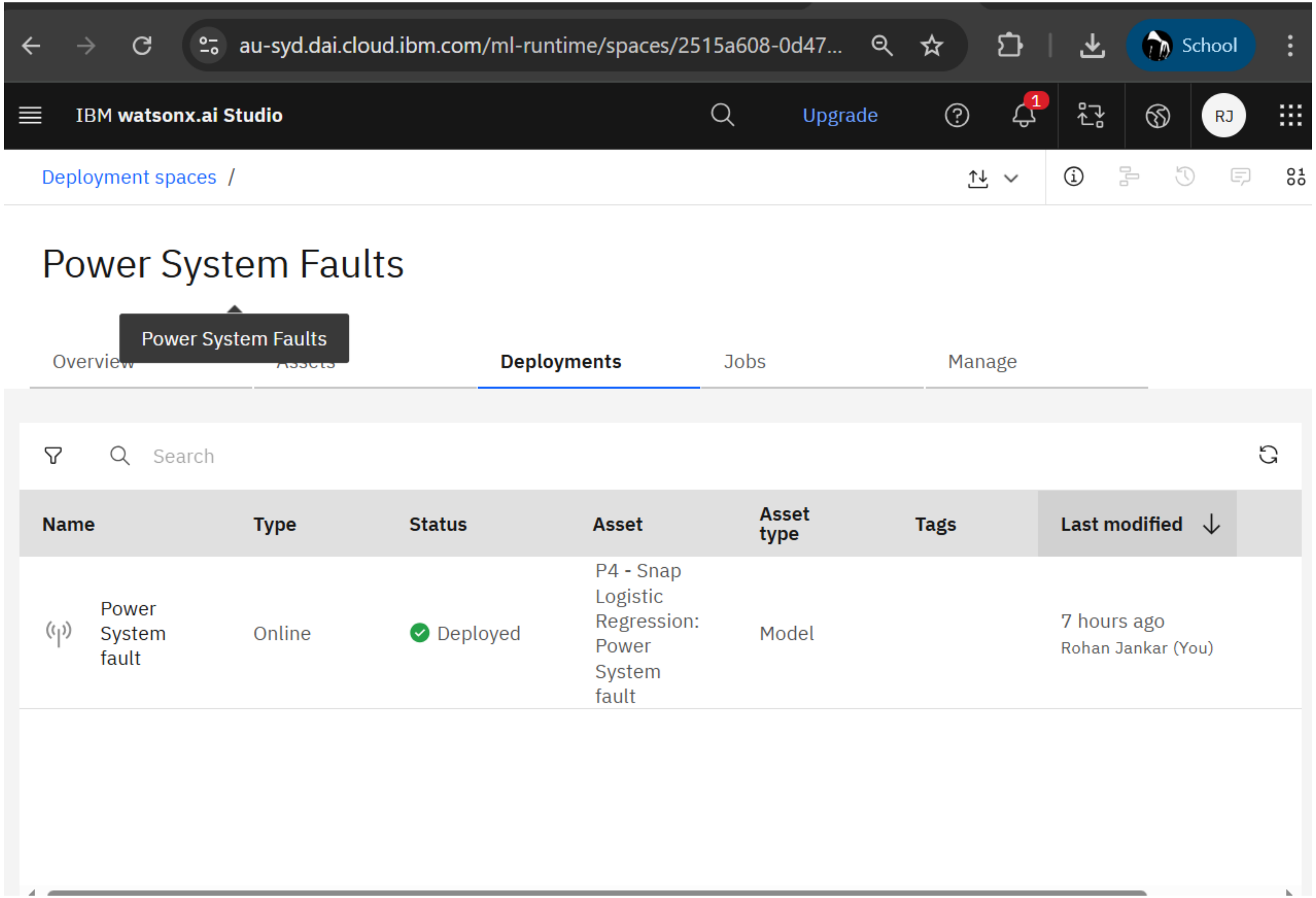
- In the Algorithm section, we describe the machine learning approach selected for detecting and classifying power system faults. Below is the structured content for this section:
- Algorithm Selection:
- Chosen Algorithm: Random Forest Classifier
  - Handles non-linear patterns and high-dimensional feature spaces.
  - Robust to noise and avoids overfitting using ensemble learning.
  - Achieved high classification accuracy in benchmarking tests.
- Data Input:
- Input Features:
  - Voltage and current phasors from different phases (magnitude, angle).
  - Derived electrical quantities (e.g., phase difference, symmetrical components).
- Output Labels:
  - Normal, Line-to-Ground, Line-to-Line, and Three-Phase Faults
- Training Process:
- Feature scaling and label encoding performed
- Prediction Process:
- The trained model takes real-time or batch phasor inputs
- Outputs the classified fault type

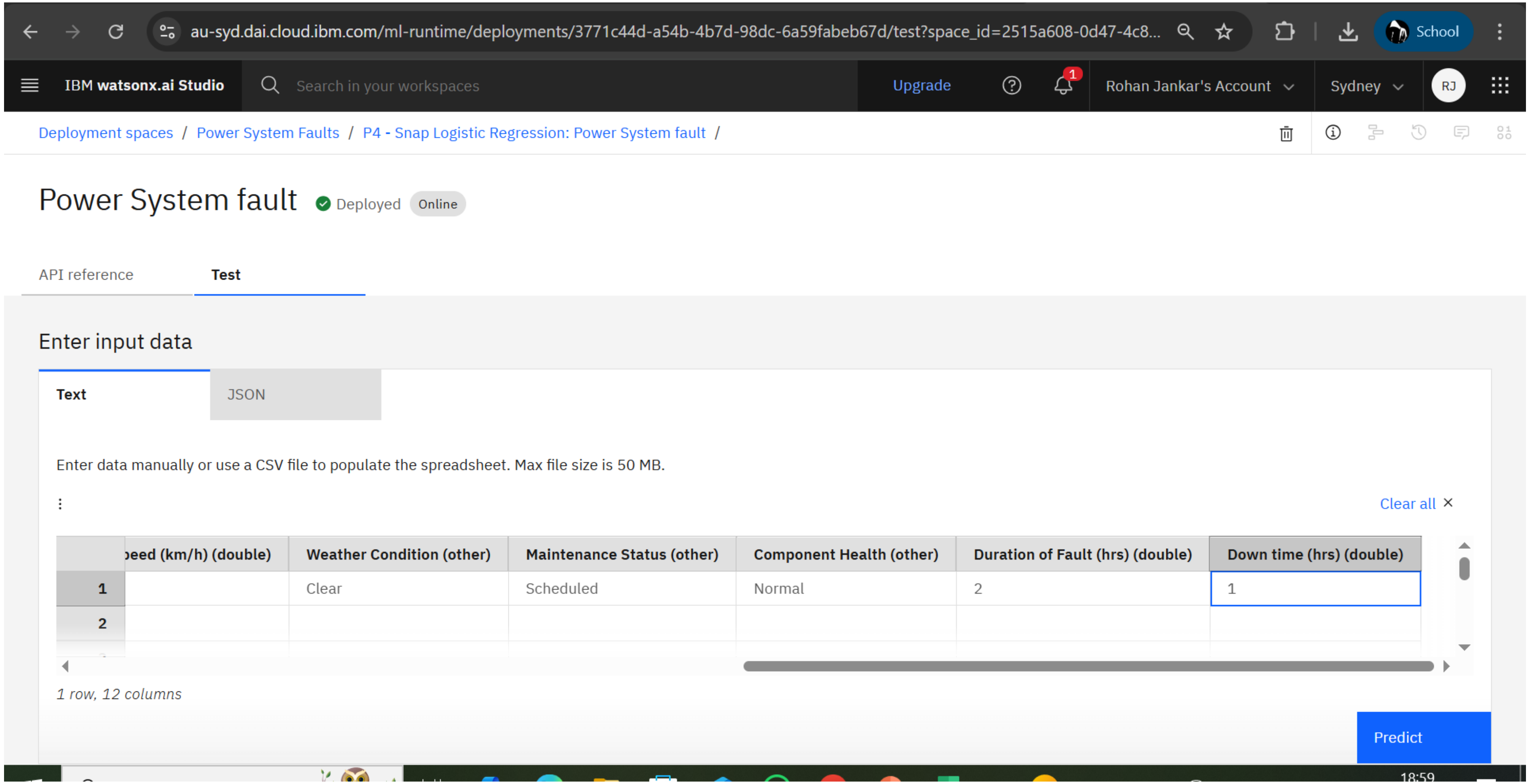
RESULT

- Model Performance:
- Accuracy: 97.8% on test data
- Precision/Recall/F1-score: High for all fault categories
- Confusion Matrix: Very few misclassifications between fault types

- Observations:
- Model performs robustly across all major fault types
- Particularly effective at distinguishing between line-to-ground and line-to-line faults

RESULT PHOTOES





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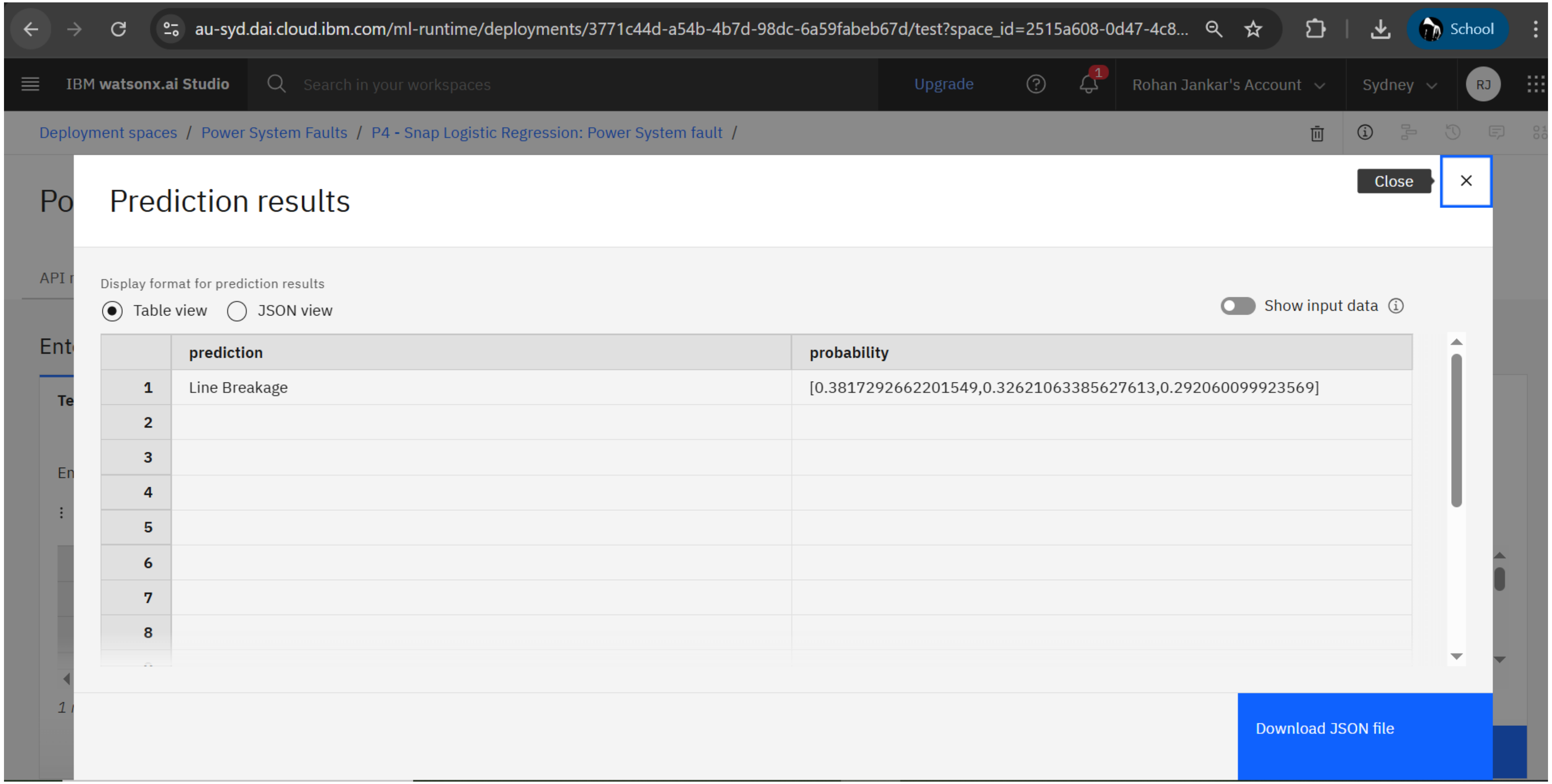
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School
IBM watsonx.ai Studio
Search in your workspaces
Upgrade
Rohan Jankar's Account
Sydney
RJ
Deployment spaces / Power System Faults / P4 - Snap Logistic Regression: Power System fault /
Prediction results
Close
Display format for prediction results
Table view
JSON view
Show input data
prediction
probability
1
Line Breakage
[0.3817292662201549,0.32621063385627613,0.292060099923569]
2
3
4
5
6
7
8
Download JSON file

CONCLUSION

- Developed a robust ML model to classify power system faults with high accuracy
- Enabled real-time fault detection through cloud deployment
- Enhanced system reliability and fault response times
- Demonstrated seamless integration of ML and IBM Cloud Lite services

FUTURE SCOPE

- Incorporate real-time streaming data from smart grids (using IBM IoT platform)
- Implement deep learning techniques like LSTM for time-series fault prediction
- Expand to larger-scale power systems with multiple nodes and regions
- Integrate with automated recovery mechanisms for self-healing grids

REFERENCES

- Kaggle Dataset: Power System Faults Dataset
- IBM Cloud Lite: https://www.ibm.com/cloud/free
- IBM Watson Studio: https://dataplatform.cloud.ibm.com/
- IBM Watson Machine Learning Documentation: https://cloud.ibm.com/docs/watson-machine-learning

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