CAPSTONE PROJECT

POWER SYSTEM FAULT DETECTION AND CLASSIFICATION

Presented By:
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OUTLINE

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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

The system detects and classifies power system faults using machine learning to ensure grid reliability.

- Data Collection
  - Use voltage & current phasor data from the Kaggle dataset.
  - Include normal and various fault conditions.
- Preprocessing
  - Clean and normalize data.
  - Extract features like sequence components and phasor angles.
- ML Model
  - Apply models like Random Forest, 1D-CNN, or LSTM.
  - Input: Phasors (Va, Vb, Vc, Ia, Ib, Ic)
  - Output: Fault classification
- Deployment
  - Deploy on IBM Cloud Lite using Watson Studio or Cloud Functions.
  - Real-time fault detection with alerts.
- Evaluation
  - Metrics: Accuracy, Precision, Recall, F1-Score
  - Continuous improvement via feedback and retraining.

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:

System Requirements

Hardware:

- Minimum 4 GB RAM, i5 processor or higher
- GPU

Software/Platform:

- IBM Cloud Lite
- IBM Watson Studio
- IBM Cloud Notebooks for development

Required Libraries:

- IBM-watson-machine-learning – for deploying the model on IBM Cloud

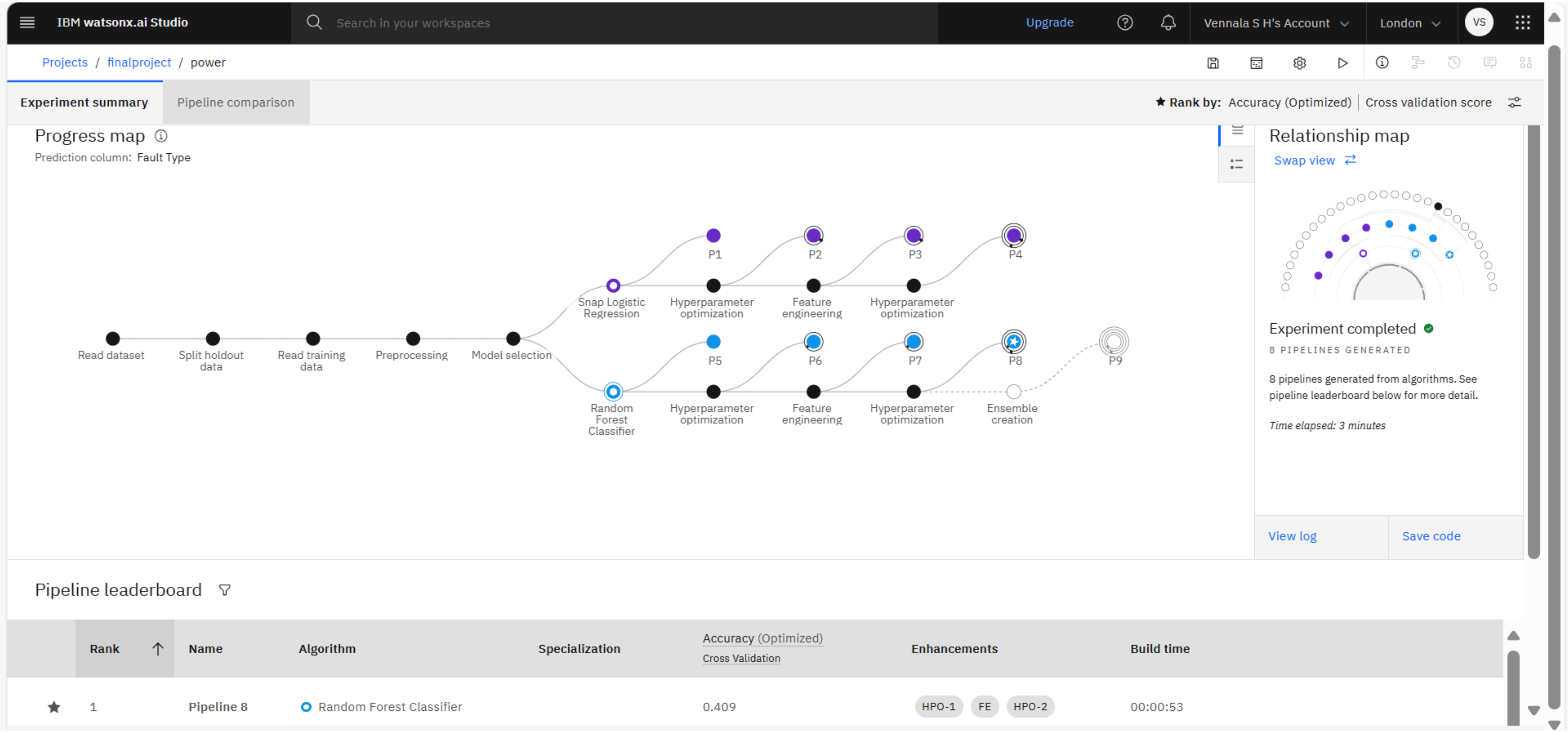
ALGORITHM & DEPLOYMENT

- ## Algorithm Selection:
  - We used a **Random Forest Classifier** because it works well for classification problems and can easily handle different fault types. It's accurate, fast, and avoids overfitting.
- ## Data Input:

From the Kaggle dataset, we used:

  - Voltage (V) and Current (I) values for each phase
  - Real and imaginary parts of phasors
  - Target: Fault type
- ## Training Process:
  - Split data into training and test sets (80/20)
  - Trained the model using Random Forest with 100 trees
  - Used cross-validation and grid search to improve accuracy
  - Evaluated performance using accuracy and confusion matrix
- ## Prediction Process:
  - New input values (V and I) are sent to the model
  - The model predicts the fault type (or "Normal")
  - This helps quickly identify faults in the power system

RESULT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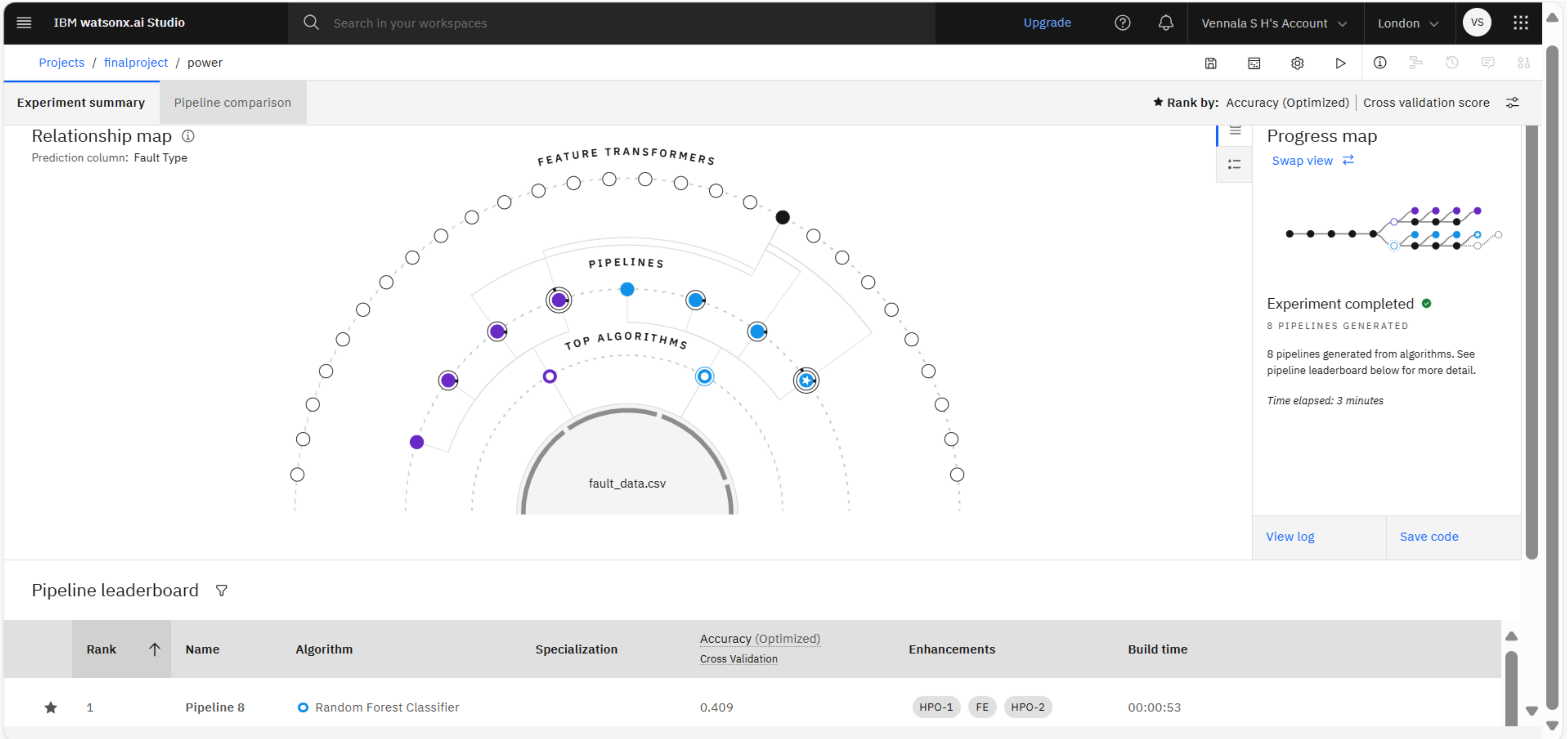
Projects / finalproject / power
Experiment summary
Pipeline comparison
Rank by: Accuracy (Optimized) | Cross validation score
Progress map
Prediction column: Fault Type
Read dataset
Split holdout data
Read training data
Preprocessing
Model selection
Snap Logistic Regression
Hyperparameter optimization
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: 3 minutes
View log
Save code
Pipeline leaderboard
Rank
Name
Algorithm
Specialization
Accuracy (Optimized)
Cross Validation
Enhancements
Build time
1
Pipeline 8
Random Forest Classifier
0.409
HPO-1
FE
HPO-2
00:00:53

RESULT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Experiment summary
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Relationship map
Prediction column: Fault Type
FEATURE TRANSFORMERS
PIPELINES
TOP ALGORITHMS
fault_data.csv
Progress map
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Experiment completed
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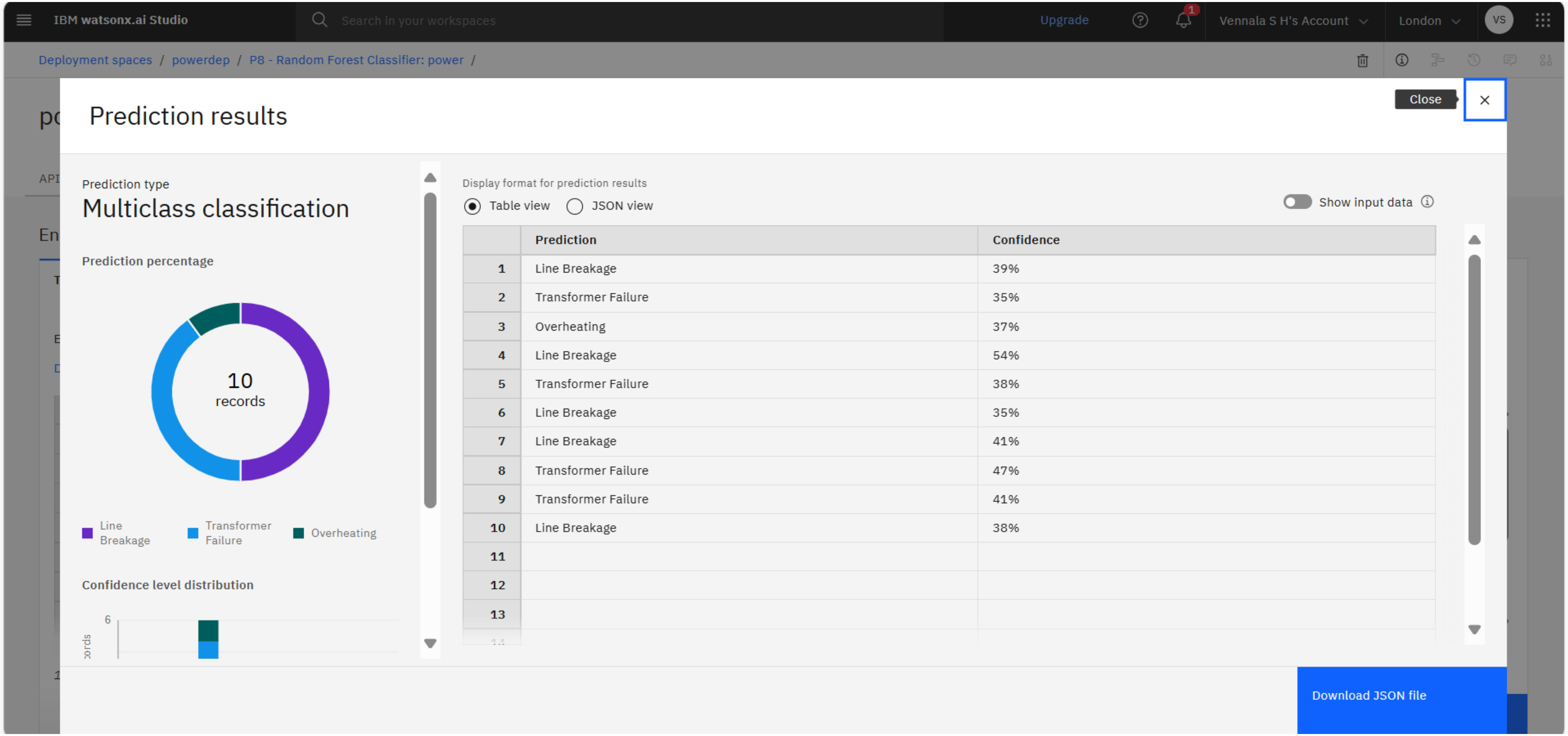

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CONCLUSION

The machine learning model we built can successfully detect and classify different types of power system faults using voltage and current data. It worked well when tested and was easy to deploy on IBM Cloud Lite. Some challenges we faced included cleaning the data and adjusting the model to handle all fault types. In the future, the model can be improved by using time-based data to catch faults earlier. In a similar way, predicting bike counts is also important. Accurate predictions help make sure bikes are available when people need them, which keeps the rental system running smoothly and makes users happy.

FUTURE SCOPE

In the future, the system can be enhanced by adding more data sources such as weather conditions, grid topology, and real-time sensor data to improve fault detection accuracy. The algorithm can be further optimized using advanced machine learning techniques like deep learning or time-series models to detect faults earlier and more precisely. The system can also be scaled to cover multiple cities or regions, making it useful for large power grids. Integrating emerging technologies like edge computing would allow real-time processing close to the data source, reducing response time during faults. These improvements will make the system smarter, faster, and more reliable for real-world power grid applications.

REFERENCES

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