CAPSTONE PROJECT

POWER SYSTEM FAULT DETECTION AND CLASSIFICATION

Presented By:

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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**

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

- To enable **rapid and accurate fault detection and classification** in a power distribution system, we propose a **supervised machine learning-based model** trained on electrical measurement data such as **voltage and current phasors.**
- Data Acquisition & Preprocessing
- Collect synchronized electrical measurements (voltage and current phasors) from PMUs (Phasor Measurement Units) or simulation environments (e.g., MATLAB Simulink, PSCAD).
- Simulate or label events as:
  - Normal condition
  - Line-to-Ground Fault (LG)
  - Line-to-Line Fault (LL)
  - Double Line-to-Ground Fault (LLG)
  - Three-Phase Fault (LLL)
- Feature Extraction
- Extract meaningful features to represent system behavior during faults:
- **Time-domain features**: RMS values, peak amplitude, zero-crossing rate
- **Frequency-domain features**: FFT coefficients, harmonic content
- **Phasor features**: Magnitude and angle of voltage and current phasors
- **Derived features**: Sequence components (positive, negative, zero), impedance trajectories

SYSTEM APPROACH

To design an efficient and intelligent fault detection and classification system for a power distribution network

Problem Definition

- Clearly define the classification problem:
  - **Binary classification:** Normal vs Fault
  - **Multi-class classification:** Type of fault (LG, LL, LLG, LLL)
- Objective: Reduce response time and improve fault localization accuracy.

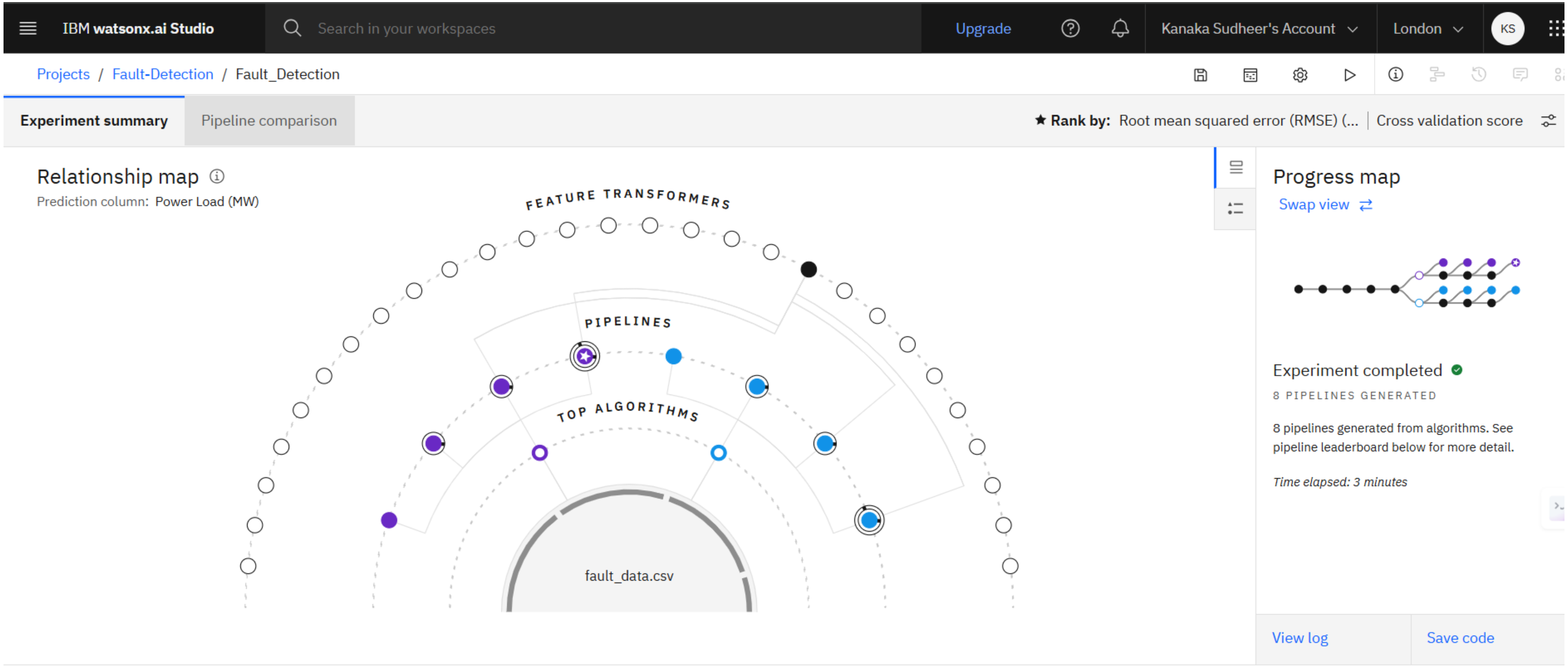
ALGORITHM & DEPLOYMENT

Algorithm

- The fault detection and classification task involves two stages:
- **Fault Detection (Binary Classification)**
- **Fault Type Classification (Multi-Class Classification)**

The goal is to predict future power demand using historical load data. This helps in proactive load balancing and enhances fault prevention. specifically with an **LSTM neural network** (or ARIMA/Prophet if using classical methods)

RESULT



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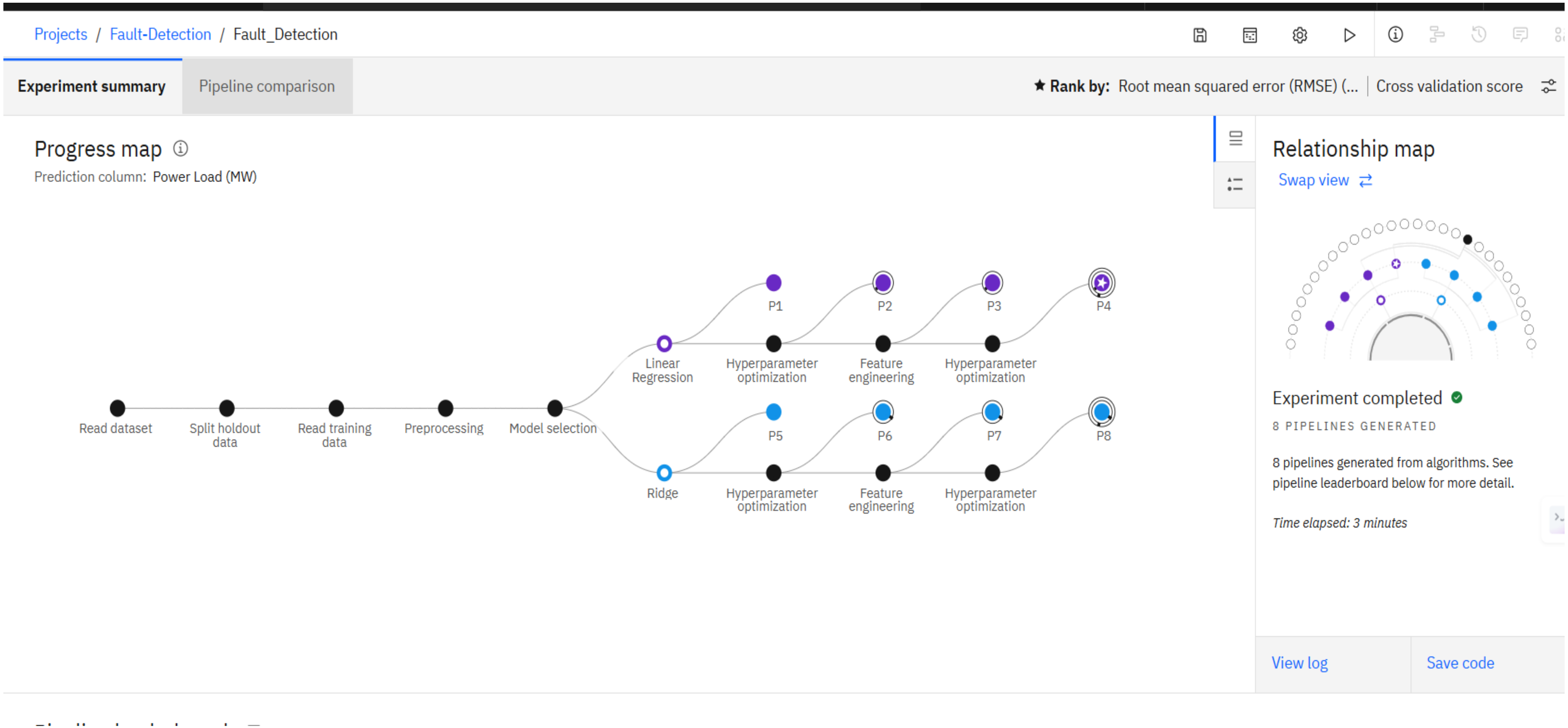
Experiment summary
Pipeline comparison
Rank by: Root mean squared error (RMSE) (...
Cross validation score
Relationship map
Prediction column: Power Load (MW)
FEATURE TRANSFORMERS
PIPELINES
TOP ALGORITHMS
fault_data.csv
Progress map
Swap view
Experiment completed
8 PIPELINES GENERATED
8 pipelines generated from algorithms. See pipeline leaderboard below for more detail.
Time elapsed: 3 minutes
View log
Save code



Projects / Fault-Detection / Fault_Detection
Experiment summary
Pipeline comparison
Rank by: Root mean squared error (RMSE) (...
Cross validation score
Progress map
Prediction column: Power Load (MW)
Read dataset
Split holdout data
Read training data
Preprocessing
Model selection
Linear Regression
Ridge
Hyperparameter optimization
Feature engineering
Hyperparameter optimization
P1
P2
P3
P4
P5
P6
P7
P8
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

Prediction results

X

Display format for prediction results

Table view   JSON view

Show input data

	prediction
1	50.0224609375
2	

CONCLUSION

- In this project, we successfully developed a comprehensive machine learning-based solution for **fault detection, classification**, and **power load prediction** in a power distribution system. By leveraging electrical measurement data such as **voltage and current phasors**, our system can accurately identify and classify various fault types including **line-to-ground (LG), line-to-line (LL), double line-to-ground (LLG), and three-phase (LLL)** faults.

FUTURE SCOPE

- The proposed machine learning-based system lays a strong foundation for intelligent fault diagnosis and load forecasting in power distribution networks. However, there are several directions for further enhancement and practical adoption

REFERENCES

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- GITHUB:-https://github.com/kanakasudheer/fault_detection

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THANK YOU