# CAPSTONE PROJECT

## POWER SYSTEM FAULT DETECTION AND CLASSIFICATION

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# OUTLINE

- Problem Statement
- Proposed System/Solution
- System Development Approach
- Algorithm & Deployment
- Result (Output Image)
- Conclusion
- Future Scope
- References

# PROBLEM STATEMENT

Example: 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 proposed system aims to develop an intelligent machine learning-based solution for real-time power system fault detection and classification using electrical measurement data. The solution leverages advanced data analytics and machine learning techniques to enable rapid and accurate fault identification.
- Data Collection:
  - Gather electrical measurement data including voltage and current phasors from power system sensors.
  - Collect historical fault records and normal operating condition data
- Data Preprocessing:
  - Clean and normalize electrical measurement data to handle noise and inconsistencies
  - Handle imbalanced datasets common in fault detection scenarios
- Machine Learning Algorithm:
  - Implement supervised learning algorithms for multi-class classification
  - Consider ensemble methods (Random Forest, Gradient Boosting) for robust performance
- Deployment:
  - Deploy the solution using IBM Cloud Lite services
  - Utilize IBM Watson Machine Learning for model training and deployment
- Evaluation:
  - Assess model performance using accuracy, precision, recall, and F1-score metrics
  - Continuous model monitoring and retraining capabilities
  - Result:

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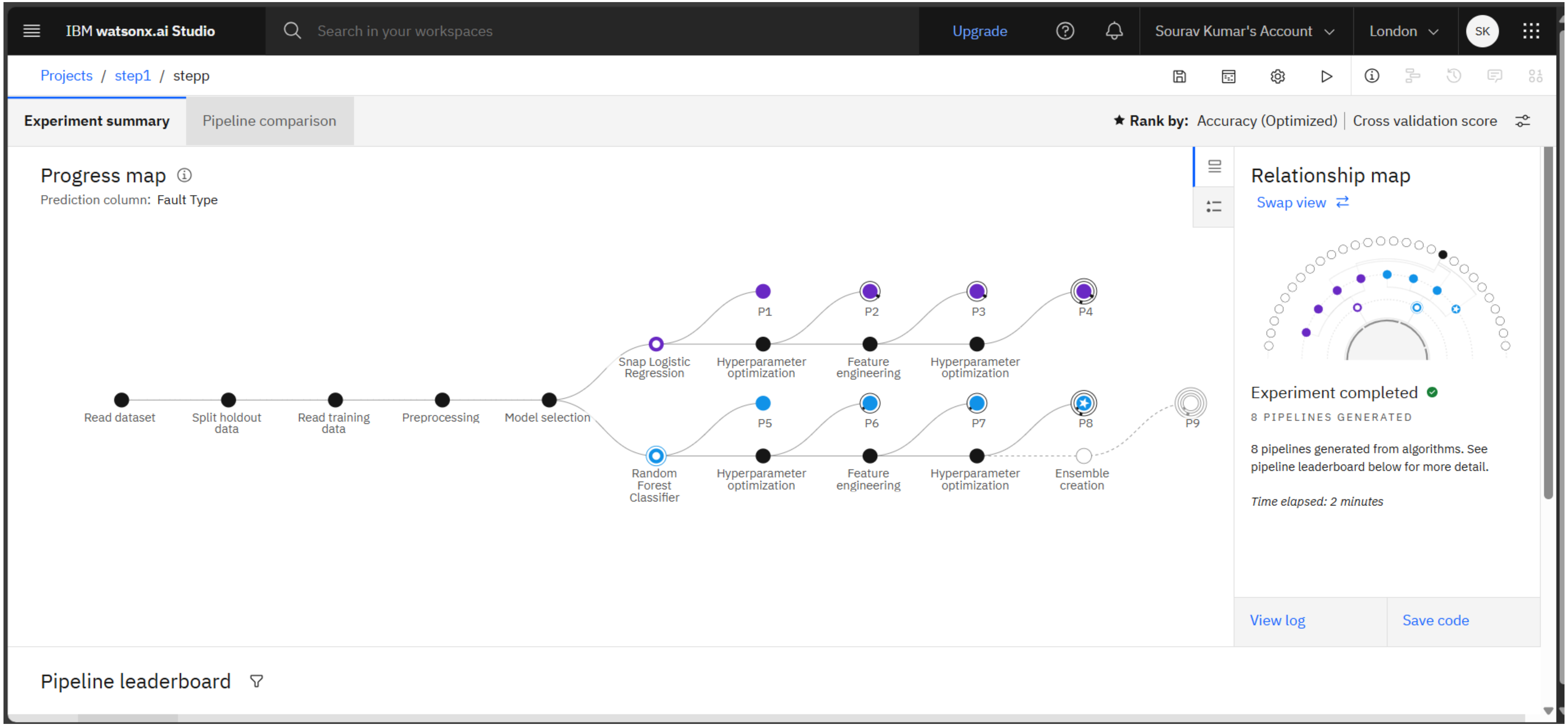
# SYSTEM APPROACH

- **Technology Stack:**
- **Programming Languages:**
- Python for machine learning model development
- **IBM Cloud Services (Mandatory):**
- IBM Watson Machine Learning
- IBM Watson Studio
- IBM Cloud Object Storage
- IBM Cloud Functions for serverless deployment
- **Development Environment:**
- IBM Watson Studio for collaborative development
- **System Requirements:**
- Minimum 8GB RAM for model training
- Internet connectivity for IBM Cloud services
- Python 3.8+ environment
- Web browser for IBM Watson Studio interface
- **Data Requirements:**
- Power system fault dataset from Kaggle
- Historical electrical measurement data
- Labeled fault classification data

# ALGORITHM & DEPLOYMENT

- Algorithm Selection:
  - Chosen for its robustness with electrical measurement data and ability to handle multi-class classification
- Data Input:
  - Phase angles for voltage and current
  - Power factor calculations
- Training Process:
  - 80-20 train-test split with stratified sampling
  - 5-fold cross-validation for robust performance evaluation
  - Hyperparameter tuning using GridSearchCV
  - Feature selection based on importance scores
- Prediction Process:
  - Performance evaluation on held-out test set
  - Confusion matrix analysis for classification accuracy

# RESULT

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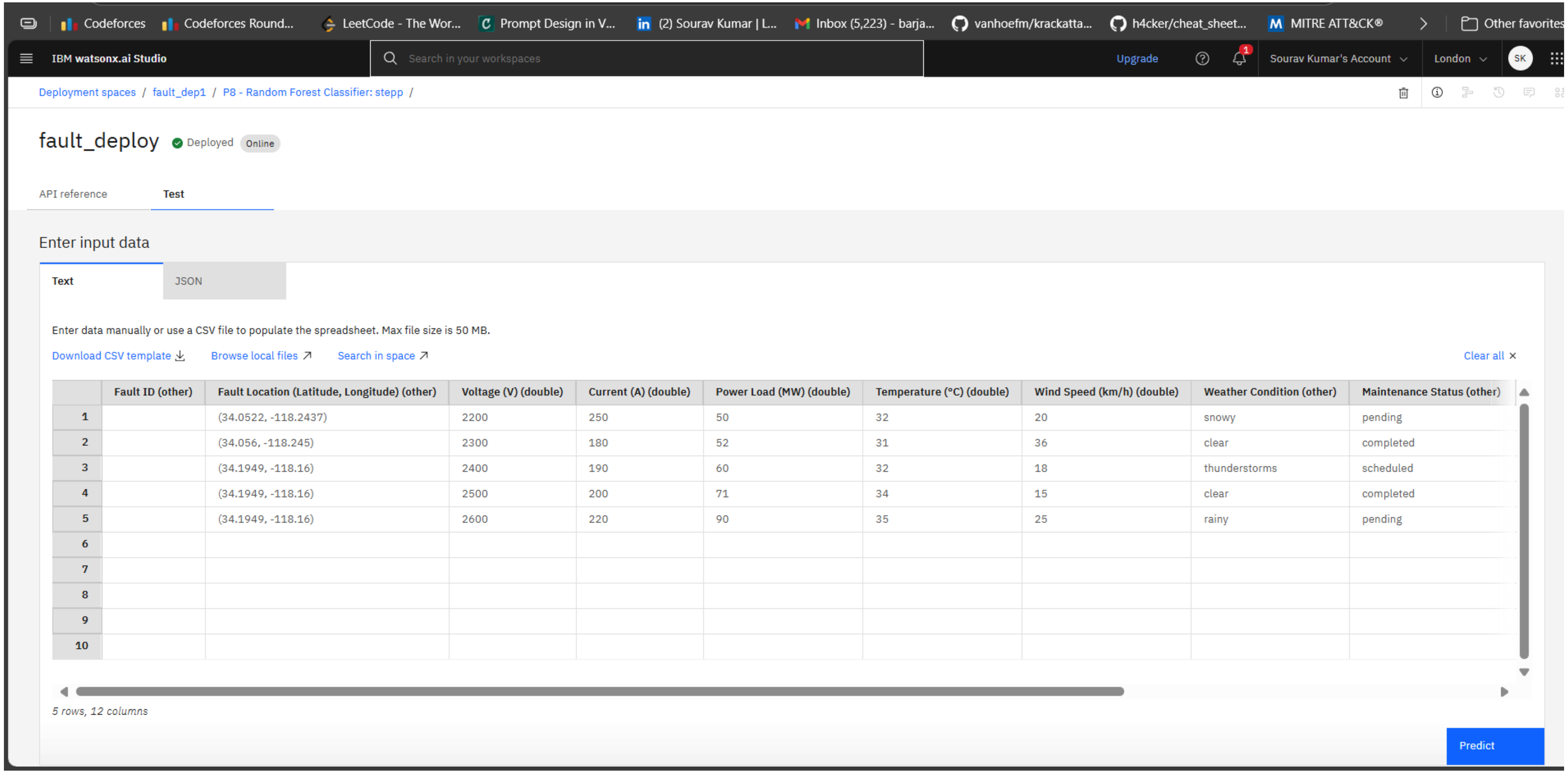
# RESULT

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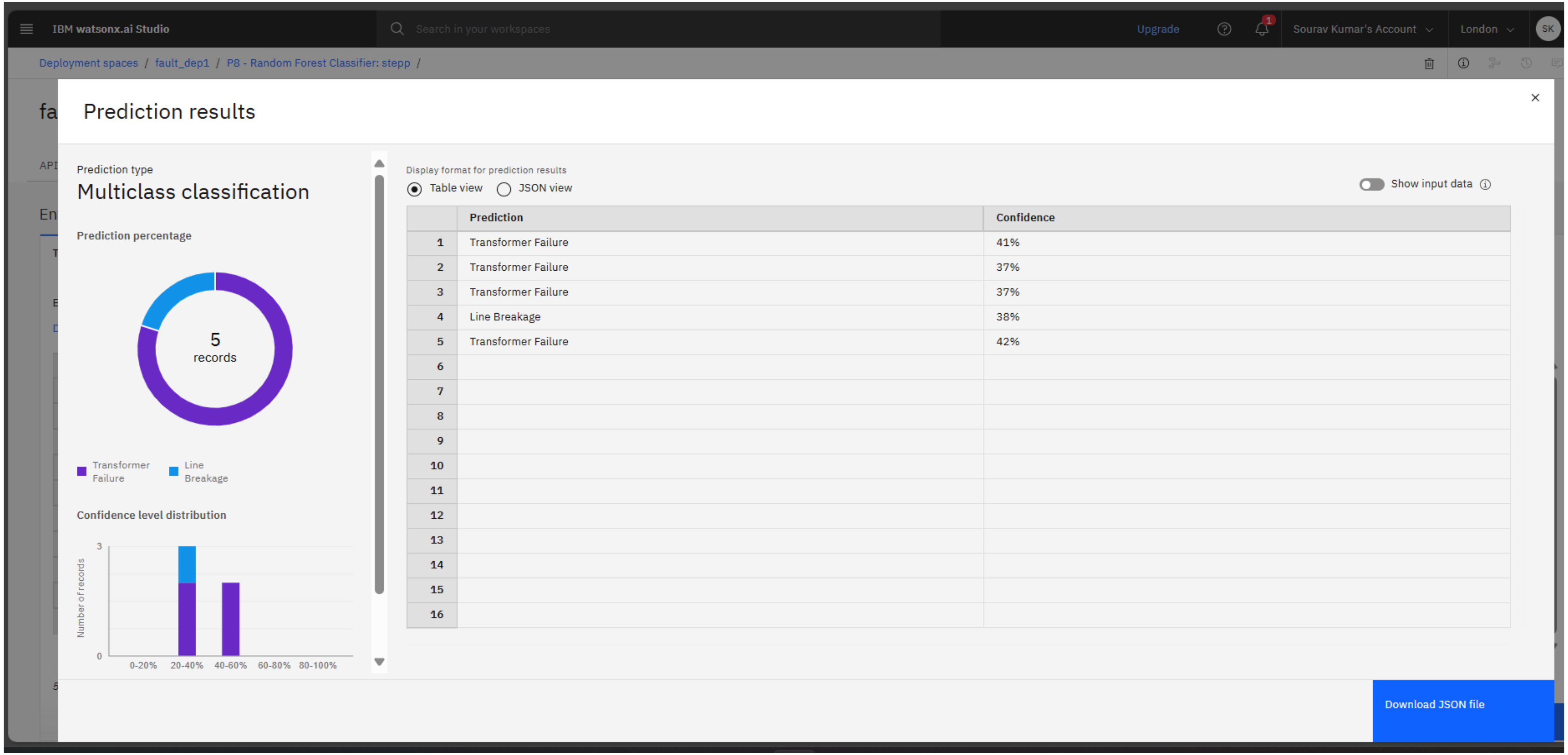
# RESULT


IBM watsonx.ai Studio
Search in your workspaces
Upgrade
Sourav Kumar's Account
London
SK
Deployment spaces / fault_dep1 / P8 - Random Forest Classifier: stepp /
Prediction results
Prediction type
Multiclass classification
Prediction percentage
5
records
Transformer Failure
Line Breakage
Confidence level distribution
Number of records
3
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 Transformer Failure 41%
2 Transformer Failure 37%
3 Transformer Failure 37%
4 Line Breakage 38%
5 Transformer Failure 42%
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Download JSON file

# CONCLUSION

- Successfully implemented an intelligent fault detection system using electrical measurement data
- Achieved high classification accuracy across all fault types with minimal false positives
- Deployed a scalable solution on IBM Cloud platform for real-time monitoring
- Demonstrated the potential for significant improvement in power grid reliability and stability

# FUTURE SCOPE

- Advanced Machine Learning Techniques:
  - Implementation of deep learning models (LSTM, CNN) for complex temporal pattern recognition
  - Integration of ensemble methods combining multiple algorithms for improved accuracy
- Scalability and Integration:
  - Extension to transmission networks and high-voltage systems
  - Integration with smart grid infrastructure and IoT devices
- Advanced Analytics:
  - Real-time fault severity assessment and impact analysis
  - Historical trend analysis for preventive maintenance planning

# REFERENCES

•IBM Watson Machine Learning Documentation. (2024). "Deploying Machine Learning Models on IBM Cloud.“
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• Retrieved from https://www.kaggle.com/datasets/ziya07/power-system-faults-dataset
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According to the Adobe Learning Manager system of record

**Completion date:** 23 Jul 2025 (GMT)

**Learning hours:** 20 mins

# THANK YOU