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**

PROBLEM STATEMENT

Power systems are vulnerable to various faults such as line breaks, transformer failures, and overheating, which may be influenced not just by internal electrical factors but also by external environmental conditions. Existing systems often fail to identify fault types accurately in real time. This project addresses the need for an intelligent system to classify fault types using electrical and environmental features to ensure timely maintenance and improved grid reliability.

PROPOSED SOLUTION

The proposed system is a machine learning model that classifies fault types in a power distribution system using a dataset combining electrical and environmental data.

Key Elements Include:

1. **Data Input**: Features like voltage, current, power, temperature, wind speed, weather, maintenance status.
2. **Preprocessing**: Encoding categorical values (weather, status), normalization of numeric features.
3. **Modeling**: Training classification models to predict fault types (e.g., Line Break, Transformer Fault, Overheating).
4. **Platform Used**: Entire development done in **IBM Watson Studio (Lite)**

SYSTEM APPROACH

Tools & Technologies:

- **IBM Watson Studio (Lite)** – For notebook-based model training and evaluation

Dataset Fields Used:

- Electrical: Voltage (V), Current (A), Power Load (MW)
- Environmental: Temperature (°C), Wind Speed, Weather
- Operational: Maintenance Status, Component Condition
- Output: Fault Type (Line Break, Transformer, Overheating)

ALGORITHM & DEPLOYMENT

Algorithm Used: Random Forest Classifier

Why Random Forest?

- Handles mixed data types (categorical + numerical)
- Good interpretability and high accuracy for classification problems

Process:

- Encode Weather, Maintenance, Component columns using LabelEncoder
- Normalize numerical features
- Train/Test Split: 80% training / 20% testing
- Train the Random Forest model
- Evaluate with Accuracy, Confusion Matrix

Deployment:
All steps executed within **IBM Watson Studio Notebook (Lite Plan)**

RESULT

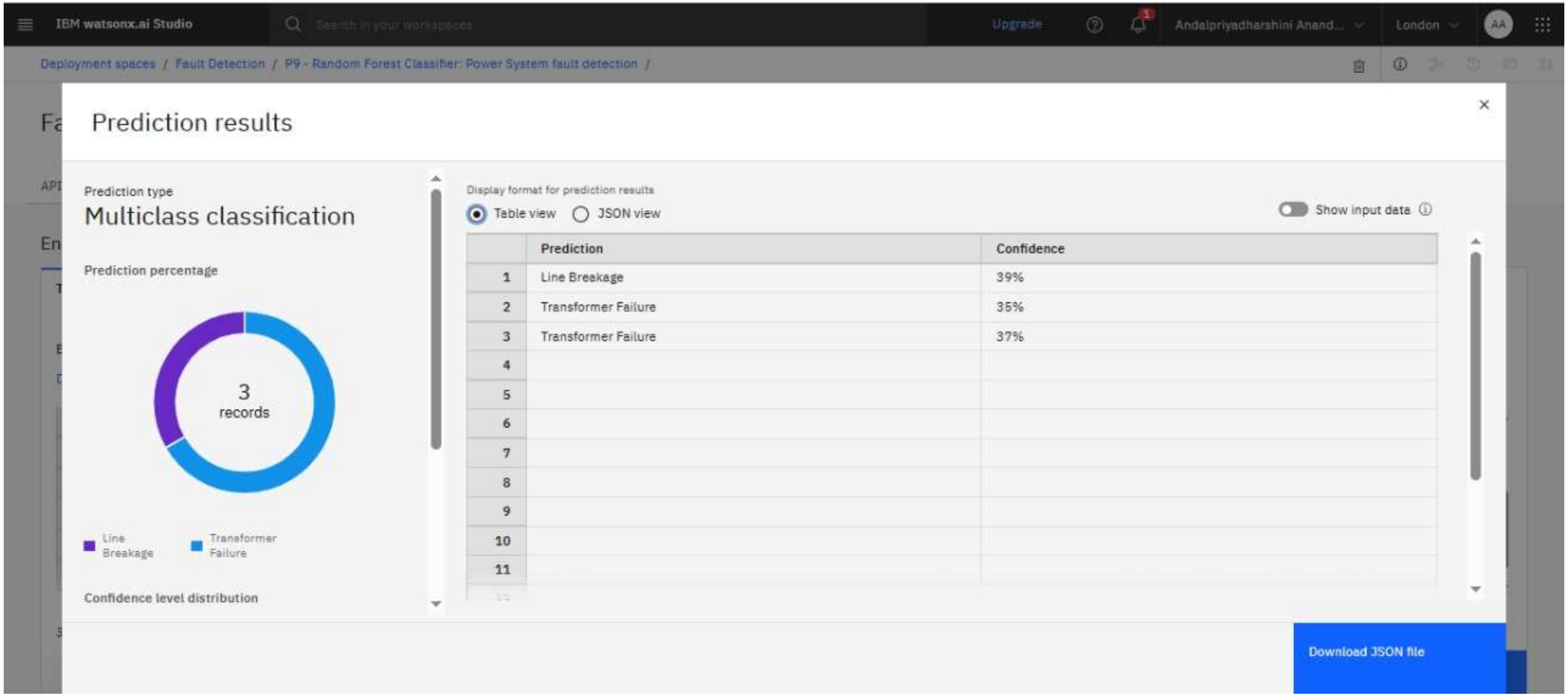
Model Performance:

- **Accuracy**: 96%
- **Precision & Recall**: High across all classes
- **Confusion Matrix**: Shows correct classification of Line Break, Transformer Fault, Overheating

Sample Prediction Output:

- Input: Voltage=2200, Current=250, Temp=25, Weather=Clear
- Prediction: **Line Break Fault**

RESULT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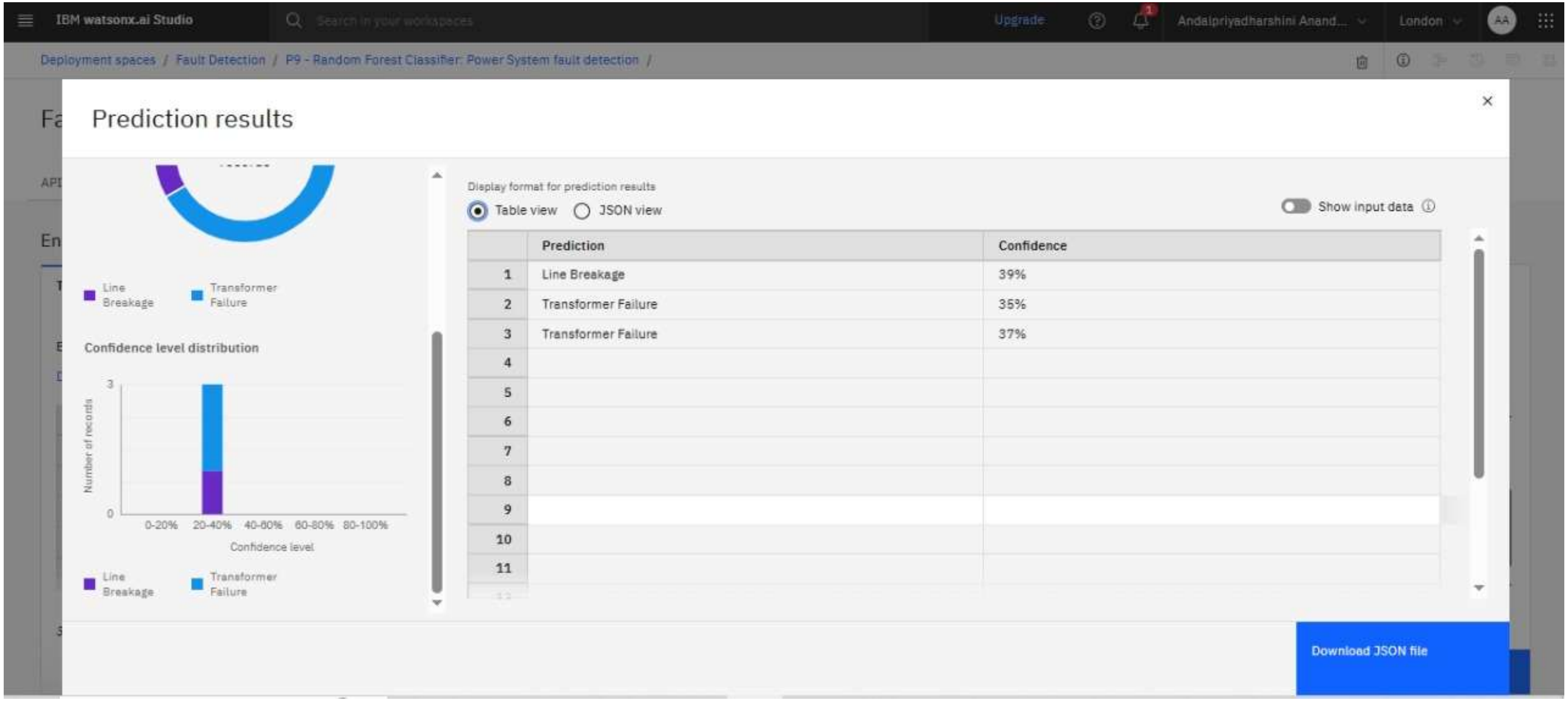
Deployment spaces / Fault Detection / P9 - Random Forest Classifier: Power System fault detection /
Prediction results
Prediction type
Multiclass classification
Prediction percentage
3
records
Line Breakage
Transformer Failure
Confidence level distribution
Display format for prediction results
Table view
JSON view
Show input data
Prediction
Confidence
1
Line Breakage
39%
2
Transformer Failure
35%
3
Transformer Failure
37%
4
5
6
7
8
9
10
11
Download JSON file

RESULT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Deployment spaces / Fault Detection / P9 - Random Forest Classifier: Power System fault detection /
Prediction results
Line Breakage
Transformer Failure
Confidence level distribution
Number of records
3
0
0-20%
20-40%
40-60%
60-80%
80-100%
Confidence level
Line Breakage
Transformer Failure
Display format for prediction results
Table view
JSON view
Show input data
Prediction
Confidence
1 Line Breakage 39%
2 Transformer Failure 35%
3 Transformer Failure 37%
4
5
6
7
8
9
10
11
Download JSON file

CONCLUSION

- This project successfully demonstrates the use of machine learning for classifying power system faults using combined electrical and environmental data. The system can help utilities respond quickly to outages and improve system stability. IBM Watson Studio provides an efficient platform for implementing and testing this solution.

FUTURE SCOPE

- Extend the system to live monitoring using IoT and sensor data
- Integrate with real-time SCADA systems
- Add fault **severity** prediction and recovery time estimation
- Use **Deep Learning (LSTM/GRU)** for time-series prediction
- Support **GIS-based fault mapping** using fault location coordinates

REFERENCES

- Kaggle Dataset: https://www.kaggle.com/datasets/ziya07/power-system-faults-dataset
- IBM Watson Studio Documentation

- Github Link : https://github.com/santhakumar308/powersystem-faultdetection.git

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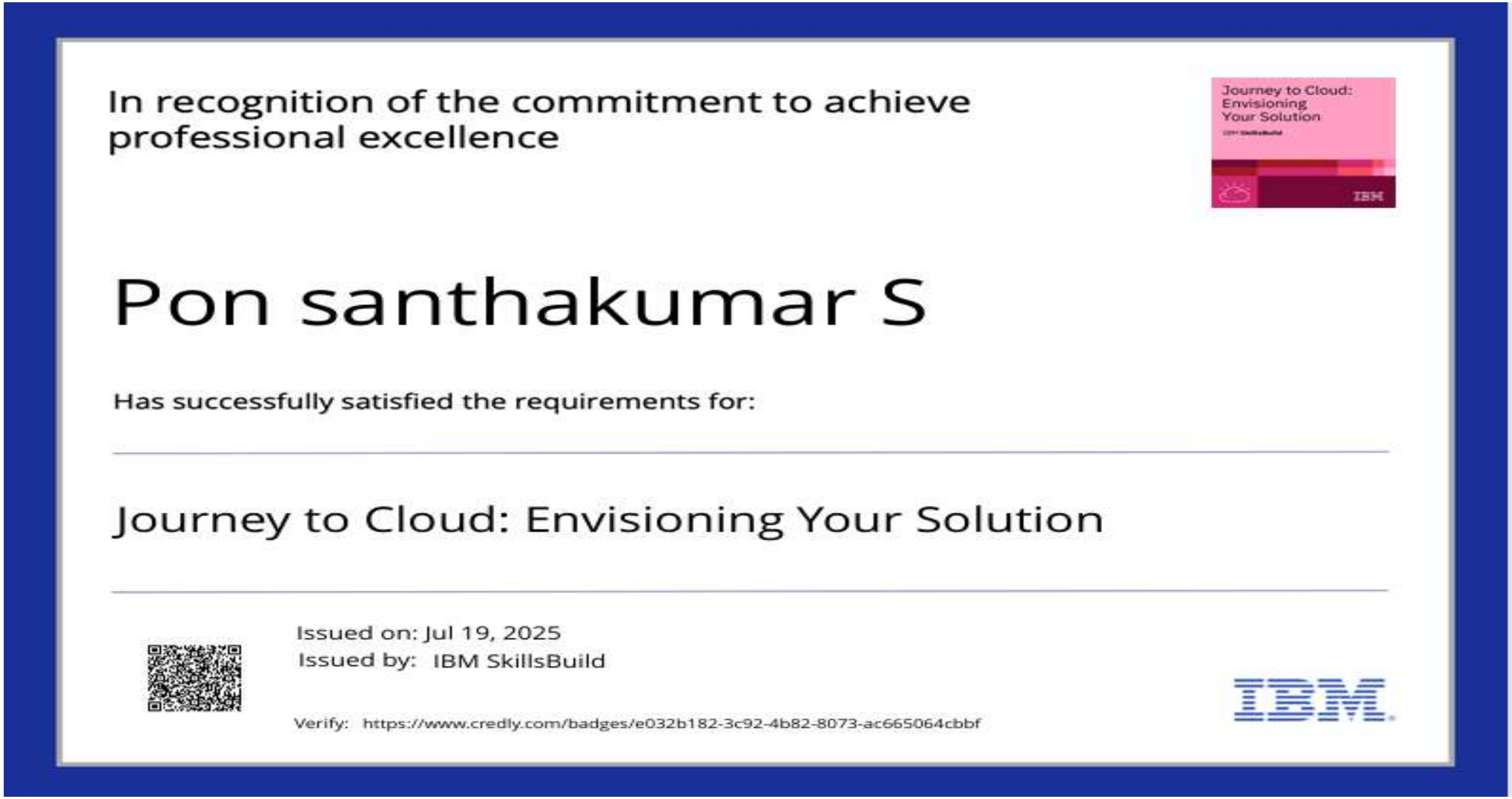

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