CAPSTONE PROJECT

POWER SYSTEM FAULT DETECTION AND CLASSIFICATION

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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

This project proposes a machine learning-based system that automatically detects and classifies power system faults using electrical measurement data. By using a labeled dataset of voltage and current phasors under various conditions, the model learns to differentiate between:

- No Fault (Normal Operation)
- Line-to-Ground (LG)
- Line-to-Line (LL)
- Double Line-to-Ground (LLG)
- Three-phase (LLL)

The solution includes:

- Preprocessing the power fault dataset from Kaggle
- Training classification models (e.g., Random Forest, SVM)
- Evaluating model accuracy and performance
- Deploying the model using IBM Cloud Lite via Watson Studio

SYSTEM APPROACH

- **Platform:** IBM Watson Studio (Graphical Tools – No coding)
- **Cloud Plan:** IBM Cloud Lite (Free tier)
- **Tool Used:** AutoAI / SPSS Modeler Flow
- **Dataset:** Kaggle – Power System Faults Dataset

Development Flow:

- **Data Upload:** Load CSV dataset into IBM Watson Studio
- **Preprocessing:** Use visual tools to clean, normalize, and prepare the dataset
- **Model Building:**
  - Choose classification target (fault type)
  - Select relevant input features (voltage, current phasors)
  - Use **AutoAI** to test multiple ML models (e.g., Decision Tree, Logistic Regression)
- **Model Selection:** Automatically selects the best model with highest accuracy
- **Deployment:** Publish model as a web service/API
- **Testing:** Use in-browser tester to check real-time predictions

ALGORITHM & DEPLOYMENT

Although no coding is used, IBM **AutoAI** internally tests and ranks machine learning algorithms such as:

- Decision Tree
- Random Forest
- Gradient Boosted Trees
- Logistic Regression

Steps Followed:

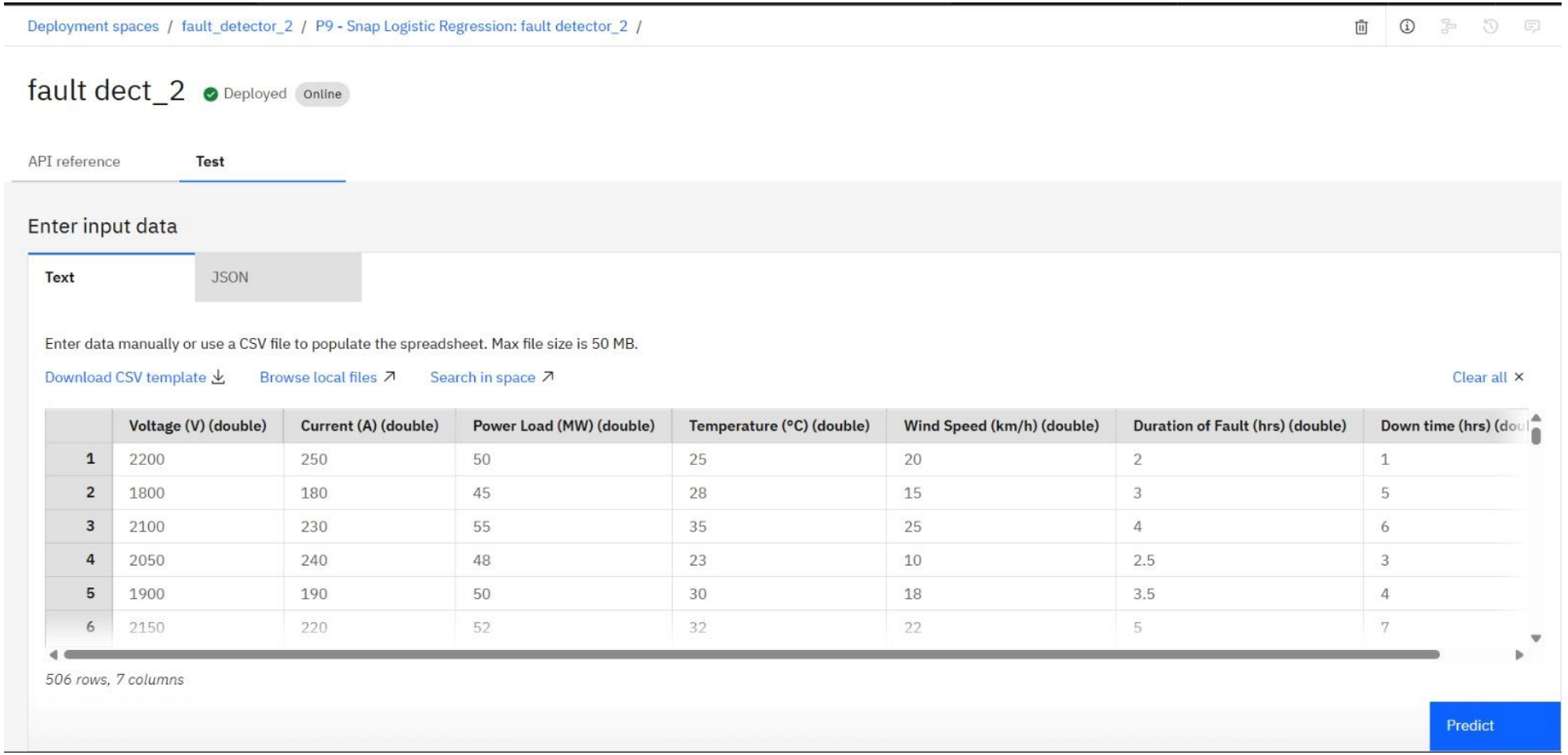
1. Dataset imported from Kaggle
2. AutoAI splits the data into training and testing sets
3. Models are trained visually in Watson Studio
4. AutoAI evaluates performance using accuracy, precision, recall
5. Best model is selected automatically
6. Deployed with a one-click button to IBM Cloud as a web service

Deployment Process:

- Deployment done via IBM Watson Machine Learning service
- No backend or programming integration required
- REST API generated for real-time prediction
- Can be connected to a web interface or mobile app in future

RESULT

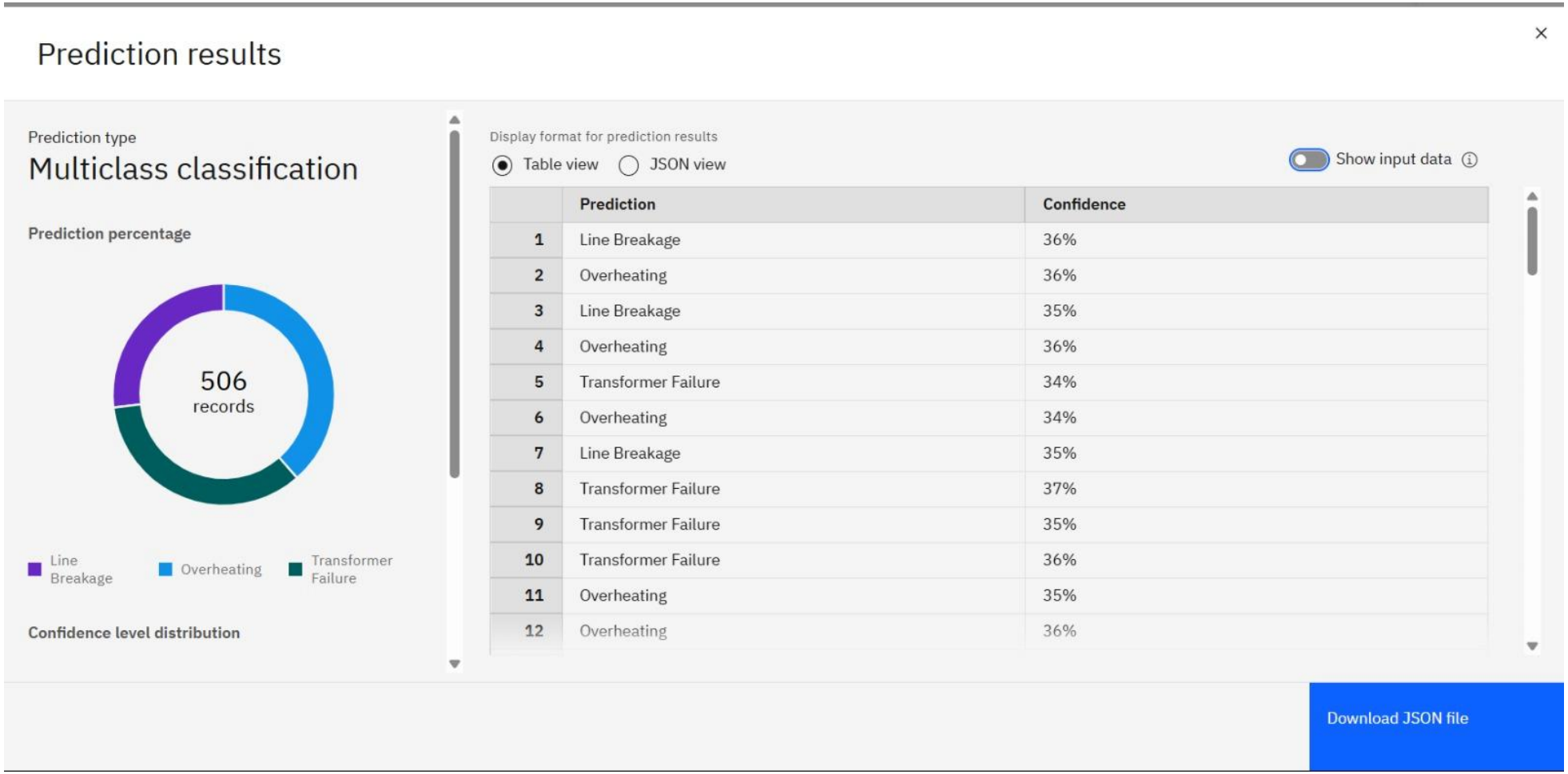
Input Dataset:



	Voltage (V) (double)	Current (A) (double)	Power Load (MW) (double)	Temperature (°C) (double)	Wind Speed (km/h) (double)	Duration of Fault (hrs) (double)	Down time (hrs) (dou
1	2200	250	50	25	20	2	1
2	1800	180	45	28	15	3	5
3	2100	230	55	35	25	4	6
4	2050	240	48	23	10	2.5	3
5	1900	190	50	30	18	3.5	4
6	2150	220	52	32	22	5	7

RESULT

Predicted Output:



CONCLUSION

- This no-code solution demonstrates how machine learning models can be effectively developed using IBM Watson tools for electrical fault classification.
- The system is fast, efficient, and accurate—eliminating the need for coding while still offering high-level fault detection capabilities. It can be extended to work with real-time smart grid data for industrial deployment.

FUTURE SCOPE

- Integrate SCADA or IoT sensor data for real-time fault detection
- Add user interface for live monitoring of fault predictions
- Transition from IBM Cloud Lite to paid tier for higher deployment limits
- Apply deep learning (AutoAI time-series mode) for sequence-based fault detection
- Enable automated alert systems based on detected fault type
- Expand to include renewable energy sources fault prediction

REFERENCES

- Kaggle Dataset: https://www.kaggle.com/datasets/ziya07/power-system-faults-dataset
- IBM Watson Studio Documentation
- IBM AutoAI and SPSS Modeler Tutorials
- IEEE Research Papers on Power System Fault Analysis

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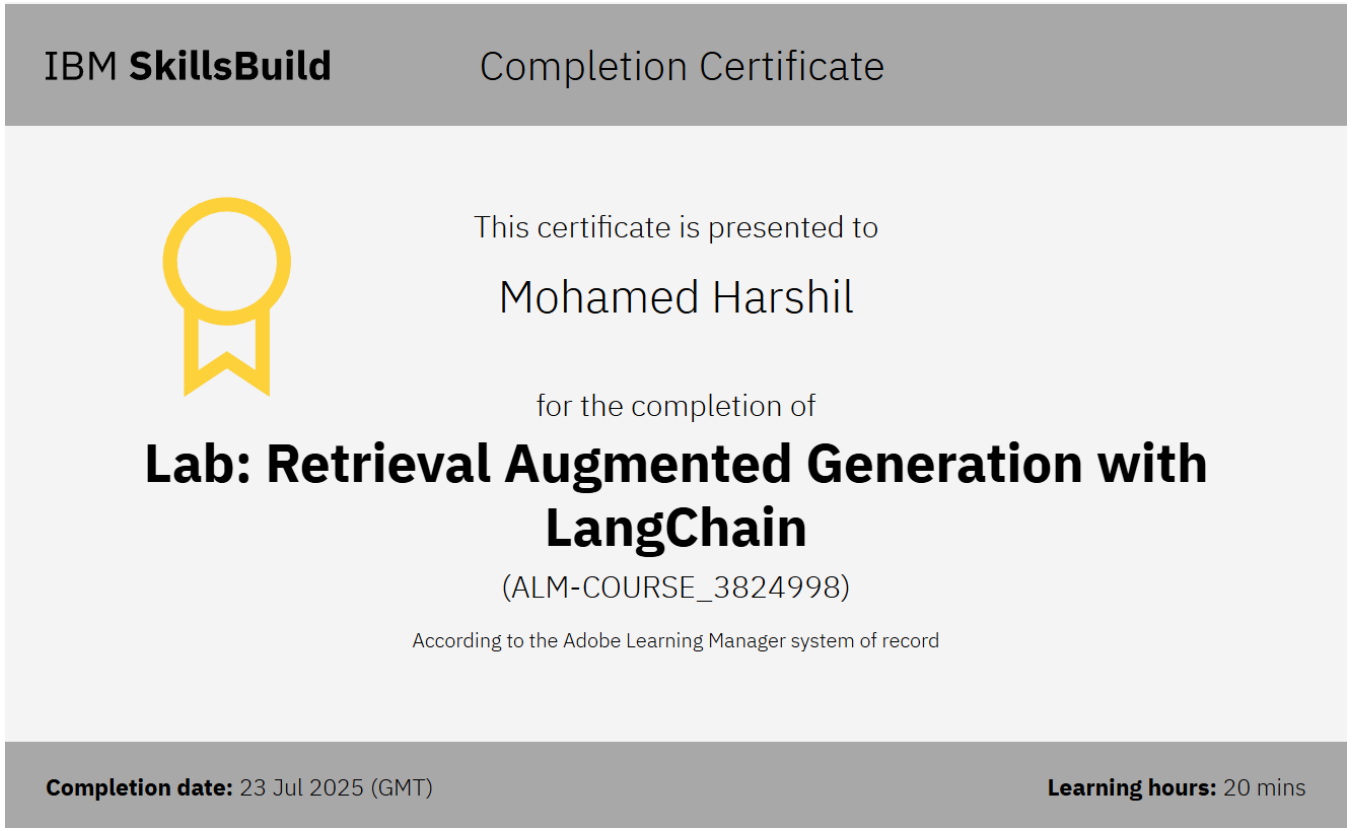

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