# 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

**Challenge:** Power distribution systems are vulnerable to various electrical faults.

- Faults include: Line-to-Ground (LG), Line-to-Line (LL), Line-to-Line-to-Ground (LLG), and Three-Phase (LLL).
- These events lead to equipment damage, power outages, and grid instability.

  **Objective:** Design a machine learning model to enable rapid and accurate fault identification.

- **Goal:** Distinguish between normal operating conditions and different fault types.
- **Input Data:** Real-time electrical measurements (voltage and current phasors).

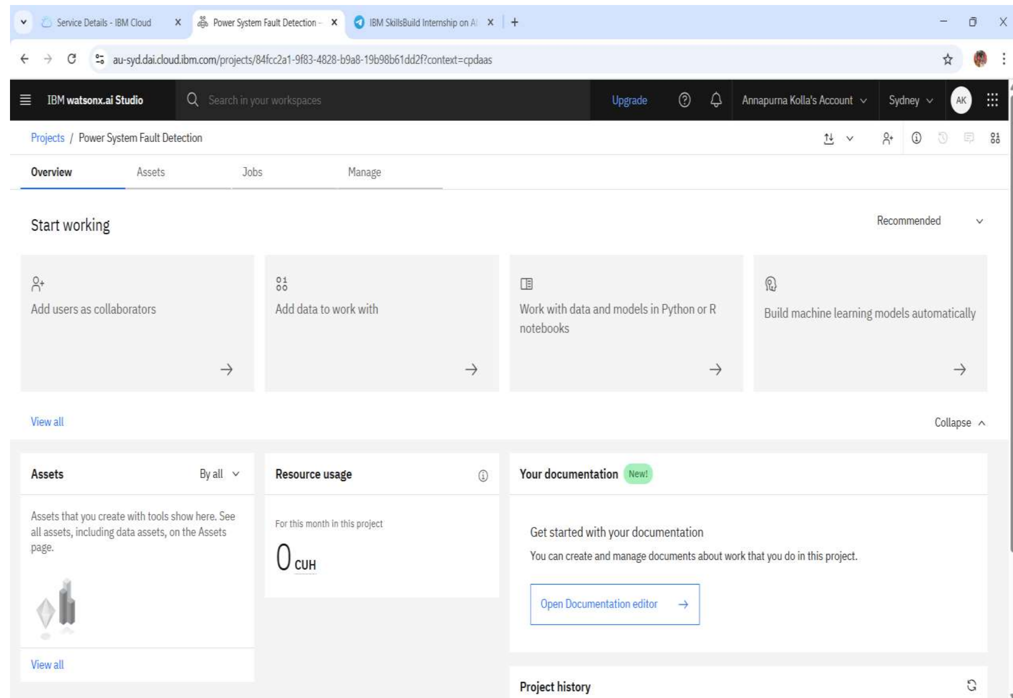
# PROPOSED SOLUTION

- The proposed system aims to predict that enable rapid and accurate fault identification from the data which is given by real –time data sources.
- Data Collection:
  - Gather Real time electrical data from sensors streams into the cloud.
  - Utilize the dataset from kaggle.
- Data Preprocessing:
  - Clean and preprocess the collected data to handle missing values, outliers, and inconsistencies.
  - Feature engineering to extract relevant features from the data that might impact fault demand.
- Machine Learning Algorithm:
  - Implement a machine learning algorithm, such as snap logistic regression and random forest classifier.
  - Consider incorporating other factors like current(A),power load, weather conditions special events to improve prediction accuracy.
- Deployment:
  - Develop a user-friendly interface or application that provides real-time predictions for enable rapid and accurate fault identification.
  - Deploy the solution on a scalable and reliable platform, considering factors like voltage, current,temperature to improve prediction accuracy.
- Evaluation:
  - Assess the model's performance using appropriate real time electrical data and provides accurate result.
  - Fine-tune the model based on feedback and continuous monitoring of prediction accuracy.

# SYSTEM APPROACH

## Model Building :

- Using Ibm cloud application to build the project.
- In Ibm cloud using watsonx.ai studio resource to build an auto ai and machine learning algorithm.
- In watsonx.ai studio we can build and deploy machine learning models as platform.
- Work with foundation models on watsonx as a service.
- Create a new project after associate runtime service.

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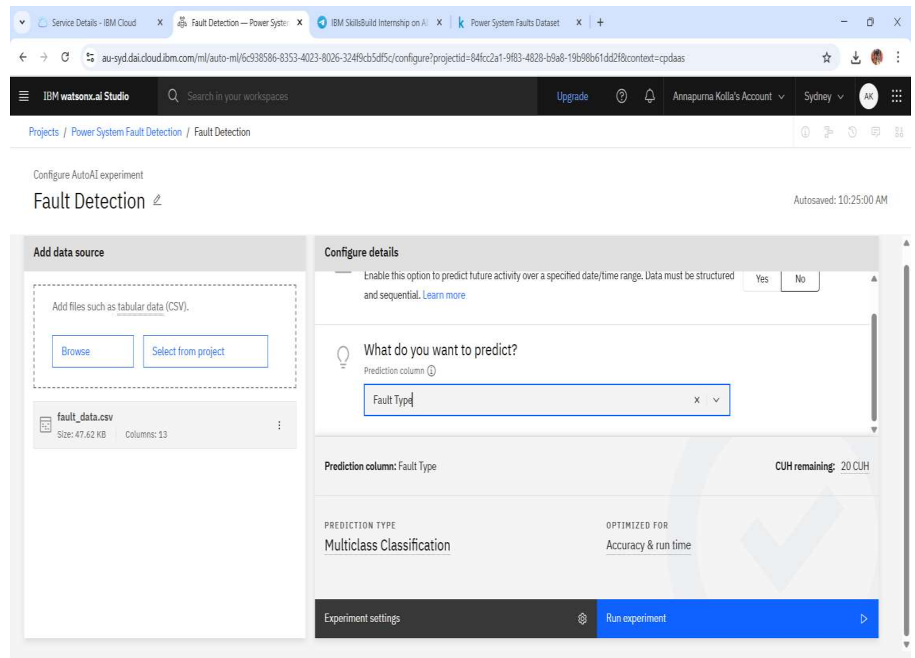
# SYSTEM APPROACH

## Model Training :

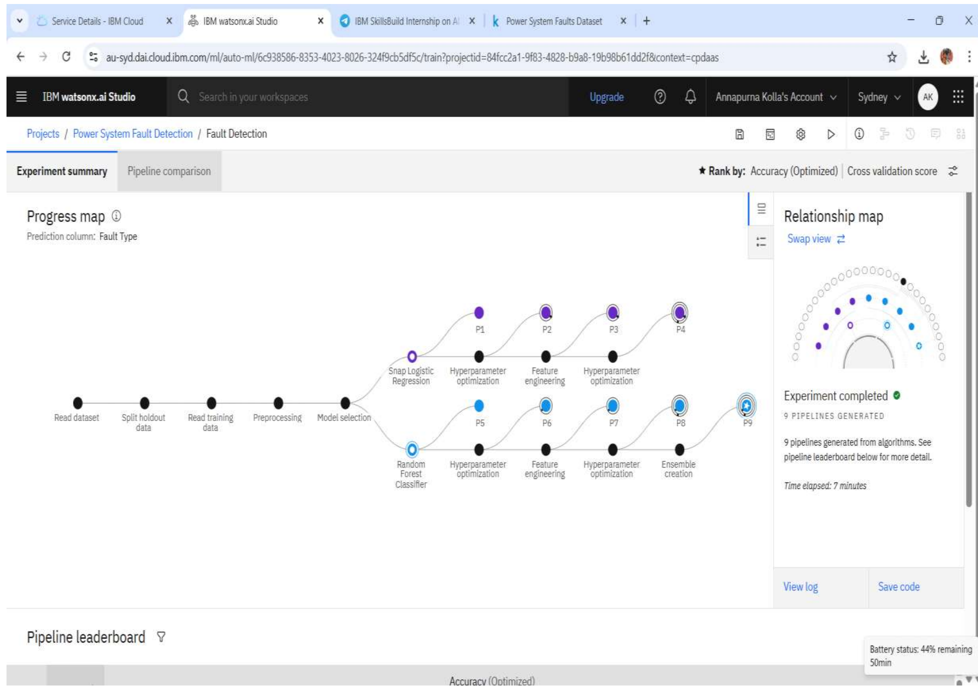
- Train chosen model on the preprocessed dataset.
- I also used the scalable compute resources of watsonx.ai to handle large datasets efficiently.
- I use dataset from kaggle.
- It provides appropriate and clean data like which are required voltage , current, weather , etc
- From received data we can predict the result.



# SYSTEM APPROACH

## Model Evalution :

- Create deployment space for the model.
- Start the experiment with click on run experiment.
- After this we can promote deployment space and predict fault identification.
- After completion of experiment we can see decision tree of Random forest model.

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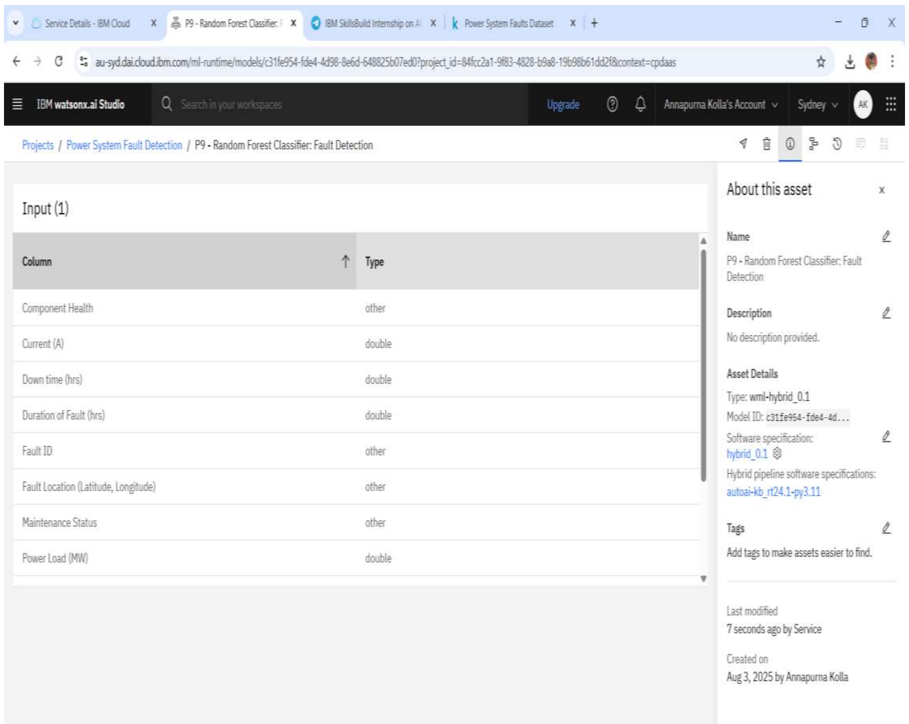
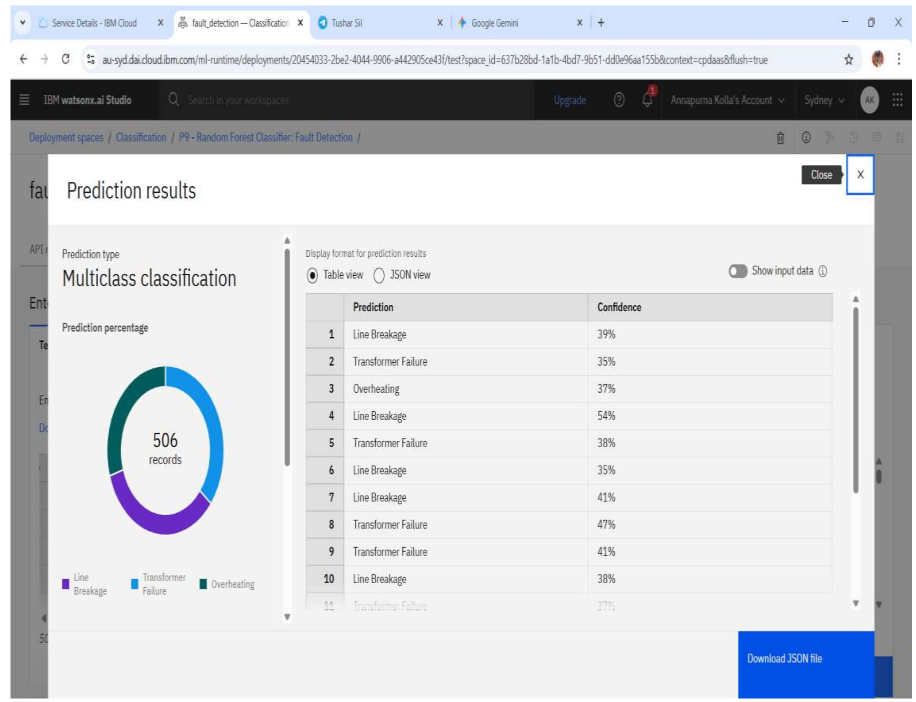
# ALGORITHM & DEPLOYMENT

- In this it taken random forest classifier algorithm to classification the fault types.
- **Algorithm Selection:**
  - We using watsonx ai for model evalution its auto ai select machine learning nodel algorithm for classification.
  - After the algorithm it ganerates 9 pipelines .
- **Data Input:**
  - The algorithm used  such as Current , weather conditions, voltage of electric device, and some relevant factors which is from provided dataset.
  - After all of data we can conclude one higher pipeline for deployment space.
- **Training Process:**
  - From this deployment we can promote space for prediction.
  - In deployment we can read the data types of provided data. In promote space sector we provide details of data.
  - After we can predict the fault type.
- **Prediction Process:**
- In this process we can input required data then after all inputing then we can predict the result.
- In this project we can only predict its not a accurate result.
- Auto ai only provide only predictions.

# RESULT

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# CONCLUSION

**Summary:**

- Our AI-powered fault detection model on **IBM Cloud** provides a robust, scalable, and intelligent solution for grid management.
- We move beyond traditional methods to a future of proactive, AI-driven grid resilience.
- Future work could focus on deploying this model in real-time environments and exploring more advanced deep learning architectures to improve its performance and adaptability further.
- **Call to Action:**
- Let's partner to pilot this solution on your network.
- Build a smarter, more reliable grid for a sustainable future.
- The high accuracy and low false-positive rate achieved by our model confirm that machine learning is a viable and potent solution for enhancing network security in an increasingly complex threat landscape.

# FUTURE SCOPE

- **Time-Series Analysis:** Develop and train Recurrent Neural Networks (RNNs) or Transformers using TensorFlow or PyTorch on **IBM Cloud's GPU-accelerated infrastructure.** These models can analyze the sequence of phasor data to detect subtle, pre-fault anomalies and predict fault type with greater accuracy.
- **Transfer Learning:** Use pre-trained deep learning models and fine-tune them on your specific grid data, accelerating the development process.
- **Data Ingestion:** Use **IBM Event Streams (Apache Kafka)** to ingest high-velocity data from PMUs and other IoT sensors. This creates a robust, scalable data backbone.
- **Stream Processing:** Process the incoming data in real-time using services like **IBM Streams** or custom code in **IBM Cloud Functions.** This allows for immediate feature extraction and model inference.

# REFERENCES

- [Power System Faults Dataset]
-  This is the only resource that I used during this project. In this website they provide me two data, one for trained my ML project , and another for the evaluation of the prediction.

# IBM CERTIFICATIONS


In recognition of the commitment to achieve professional excellence

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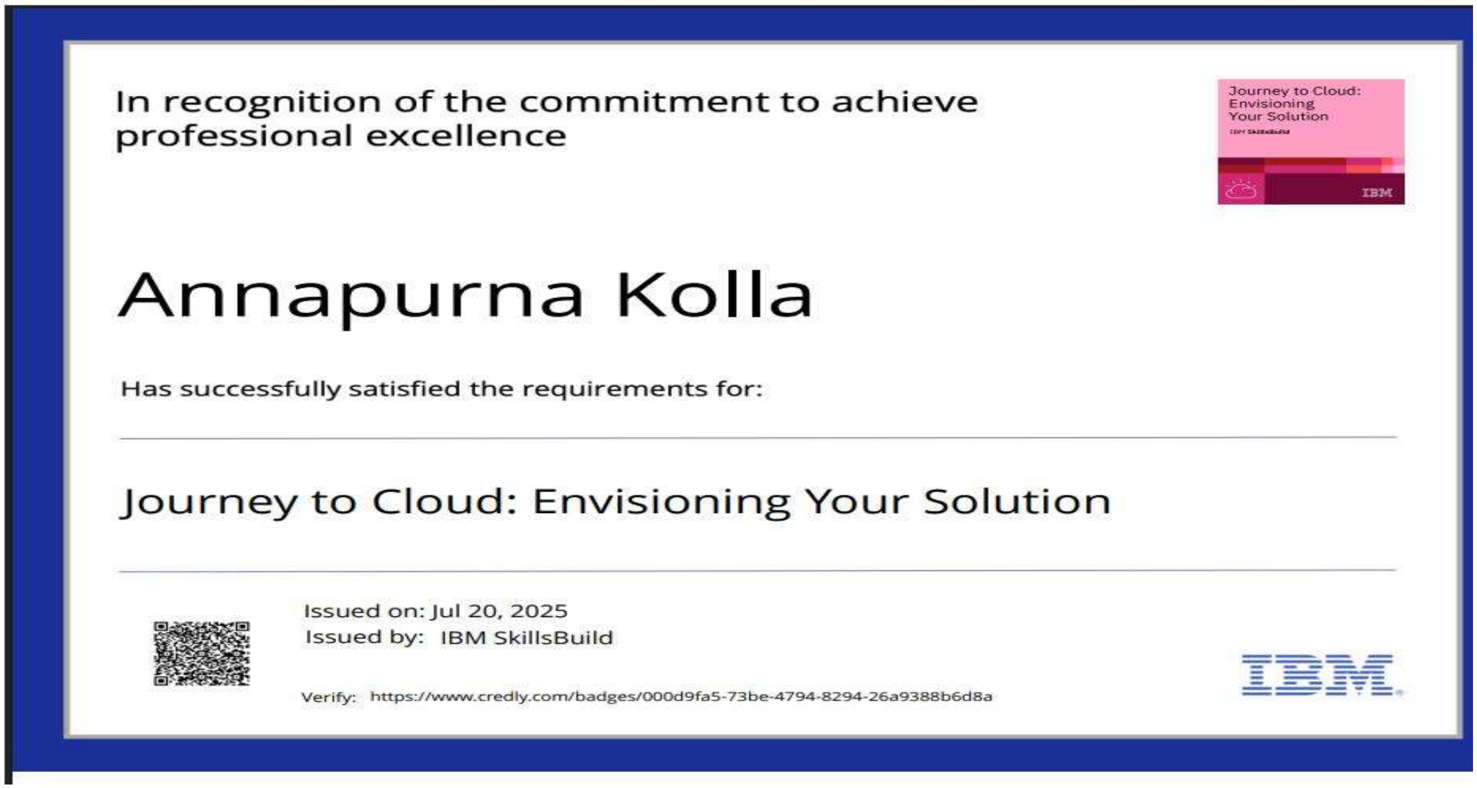

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IBM **SkillsBuild** Completion Certificate

This certificate is presented to

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for the completion of

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According to the Adobe Learning Manager system of record

**Completion date:** 24 Jul 2025 (GMT)

**Learning hours:** 20 mins

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