
CAPSTONE PROJECT

POWER SYSTEM FAULT DETECTION AND CLASSIFICATION USING MACHINE LEARNING

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

Power distribution systems are vulnerable to different types of faults, including line-to-ground, line-to-line, and three-phase faults. These disturbances can interrupt power delivery and compromise the reliability of the system. The main challenge is to precisely detect and classify these faults using electrical parameters such as voltage, current, and phasor data. Accurately distinguishing faults from normal operating conditions is crucial for maintaining the stability and efficiency of the power grid.

Proposed Solution

A machine learning-based approach is proposed to detect and classify power system faults using the given dataset. The model will analyze electrical measurement data to accurately identify the type of fault. This automated fault classification enhances fault detection efficiency and supports faster recovery actions, thereby improving system stability.

- Main steps include:
- Data Collection: Utilize a relevant dataset available on Kaggle.
- Preprocessing: Clean and normalize the data to prepare it for training.
- Model Training: Use a classification algorithm (e.g., Decision Tree, Random Forest, or SVM) to train the model for fault detection.
- Evaluation: Assess the model's performance using metrics like accuracy, precision, recall, and F1-score.

System Approach

This section presents the overall strategy and methodology for building and deploying the power system fault detection and classification solution. Below is a proposed framework for implementation:

System Requirements:

Basic Requirement: IBM Cloud (mandatory)

Development Environment: IBM Watson Studio for model development and deployment

Data Storage: IBM Cloud Object Storage for managing datasets

Algorithm & Deployment

Algorithm Selection:

Random Forest Classifier (or SVM, depending on performance metrics)

Data Input:

Electrical parameters such as voltage, current, and phasor readings extracted from the dataset

Training Process:

Supervised learning approach using labeled data that corresponds to different types of faults

Prediction Process:

The trained model is deployed on IBM Watson Studio and integrated with an API endpoint to enable real-time fault predictions

Result

IBM watsonx.ai Studio

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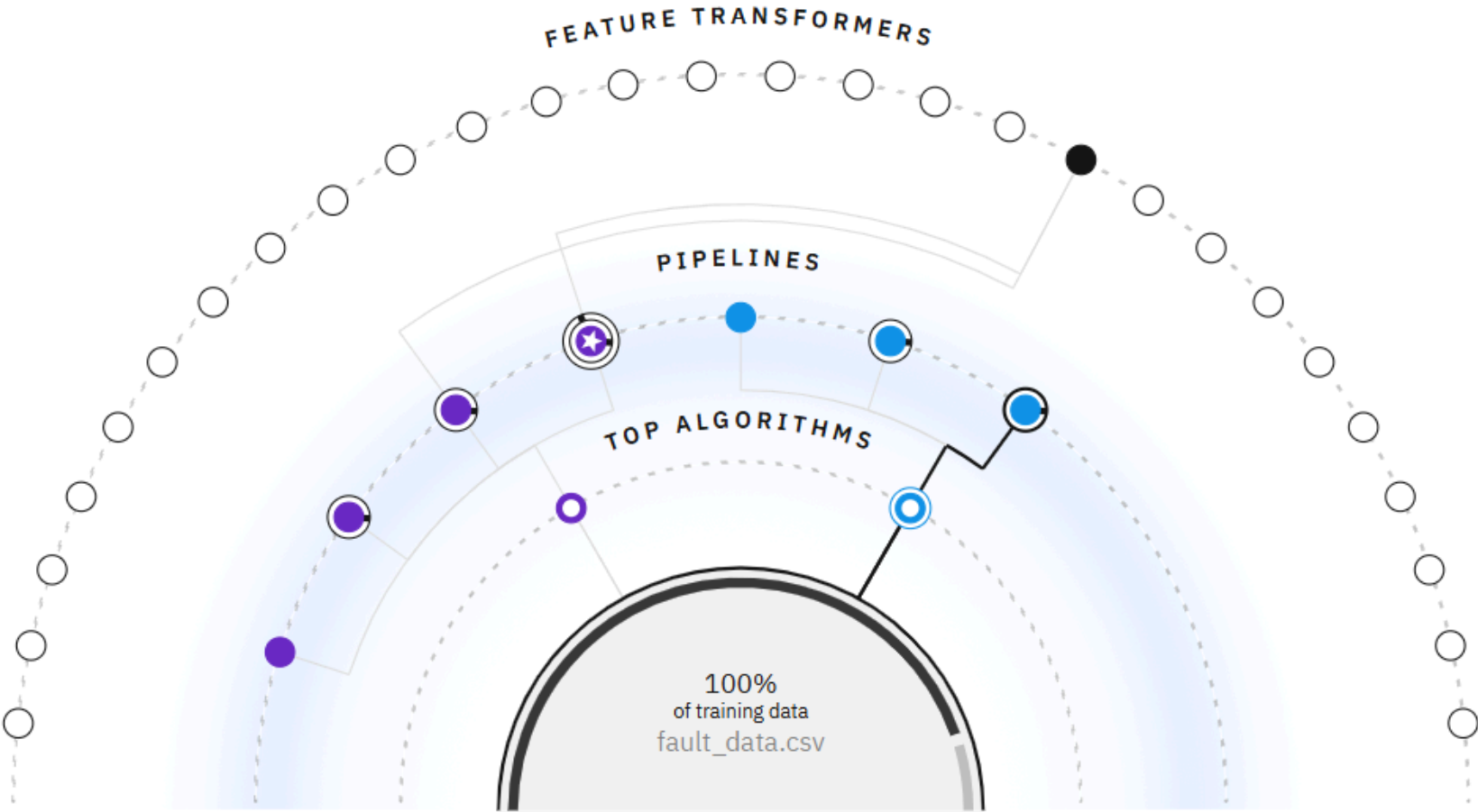
Experiment summary

Pipeline comparison

★ Rank by: Accuracy (Optimized) | Cross validation score


Relationship map

Prediction column: Fault Type



Progress map

Swap view



Feature engineering

RANDOM FOREST CLASSIFIER

Started feature engineering for pipeline P7

Time elapsed: 3 minutes

View log

Save code

Pipeline leaderboard

Rank	Name	Algorithm	Specialization	Accuracy (Optimized) Cross Validation	Enhancements	Build time
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Result

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Rank by: Accuracy (Optimized) | Cross validation score

Experiment summary

Pipeline comparison

Progress map ⓘ
Prediction column: Fault Type

```
graph LR; A[Read dataset] --> B[Split holdout data]; B --> C[Read training data]; C --> D[Preprocessing]; D --> E[Model selection]; E --> F[Snap Logistic Regression]; E --> G[Random Forest Classifier]; F --> H[P1]; F --> I[Hyperparameter optimization]; I --> J[P2]; J --> K[Feature engineering]; K --> L[P3]; L --> M[Hyperparameter optimization]; M --> N[P4]; G --> O[P5]; G --> P[Hyperparameter optimization]; P --> Q[P6]; Q --> R[Feature engineering]; R --> S[P7]; S --> T[Hyperparameter optimization]; T --> U[P8]; U --> V[P9];
```

Relationship map

Swap view ↔

Experiment completed ✓
9 PIPELINES GENERATED
9 pipelines generated from algorithms. See pipeline leaderboard below for more detail.
Time elapsed: 5 minutes

View log

Save code

Pipeline leaderboard ▾

Rank	Name	Algorithm	Specialization	Accuracy (Optimized) Cross Validation	Enhancements	Build time
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Result

Service Details - IBM CloudPOWER_DP7 — POWER_DP8 ||Settings | IBM watsonx.ai StudioIBM TermsSupport - IBM Cloud

au-syd.dai.cloud.ibm.com/ml-runtime/deployments/844683d5-2809-4351-84fb-1fb51ebd430c/test?space_id=d5ef3558-fe90-40ae-8ca9-edf7dbe26725&context=cpdaas&flush=true

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Deployment spaces / POWER_DP8 / P9 - Random Forest Classifier: power_ma3 /

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API

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Prediction results

Display format for prediction results

☒ Table view☐ JSON view

☐ Show input data ⓘ

	prediction	probability
1	Line Breakage	[0.3903001601394518,0.2418251292774404,0.36787471058310767]
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		

Download JSON file

Conclusion

- This project successfully demonstrates the application of machine learning techniques for accurate and efficient detection and classification of power system faults. By leveraging electrical parameters such as voltage, current, and phasor measurements, the model effectively distinguishes between various fault types. The integration of tools like IBM Watson Studio and cloud-based deployment enables real-time predictions, contributing to quicker response times and improved grid reliability. Overall, the solution offers a scalable and intelligent approach to fault management, which can significantly enhance the stability and resilience of modern power distribution systems.

Future scope

This project can be extended by integrating real-time data from smart grids, exploring advanced deep learning models for higher accuracy, and deploying the system on a larger scale. Additionally, user-friendly interfaces and automation can enhance practical implementation in modern power distribution systems.

IBM Certifications

The screenshot displays the edunet foundation dashboard. On the left, a dark sidebar contains navigation links: Dashboard, Recommended Courses (with a dropdown arrow), Guided Learning Experience (GLEs), Download Offer Letter, and Raise a Ticket. The main content area shows a 'Submit' button at the top left. The central focus is a large blue-bordered box representing a digital credential. This box contains the text 'In recognition of the commitment to achieve professional excellence' and a small IBM SkillsBuild badge titled 'Getting Started with Artificial Intelligence'. Below this, the name 'PREETHI MURALI' is prominently displayed. Further down, it states 'Has successfully satisfied the requirements for:' followed by the title 'Getting Started with Artificial Intelligence'. At the bottom of the box, there is a QR code, the issuance date 'Issued on: Jul 20, 2025', the issuer 'Issued by: IBM SkillsBuild', and a verification URL: 'Verify: https://www.credly.com/badges/fdd4040b-27c8-46a7-a0fb-1a120a371e5e'. The IBM logo is also present in the bottom right corner of the box. To the right of the box, a partially visible text snippet reads 'd digital credential called Getting Started' and 'and ways that AI makes predictions from data'. The top right of the dashboard shows the user's profile 'PREETHI M' with a dropdown arrow. At the bottom left, social media icons for Facebook, Twitter, Instagram, and LinkedIn are listed under 'Follow us on:'. An upward arrow icon is located at the bottom right of the main content area.

edunet foundation

Submit

In recognition of the commitment to achieve professional excellence

Getting Started with Artificial Intelligence

PREETHI MURALI

Has successfully satisfied the requirements for:

Getting Started with Artificial Intelligence

Issued on: Jul 20, 2025
Issued by: IBM SkillsBuild

Verify: <https://www.credly.com/badges/fdd4040b-27c8-46a7-a0fb-1a120a371e5e>

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Completion Certificate



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AB1 -27-M.PREETHI

for the completion of

Journey to Cloud: Envisioning Your Solution

(PLAN-32CB1E21D8B4)

According to the Your Learning Builder - Plans system of record

Completion date: 20 Jul 2025 (GMT)

IBM Certifications

The screenshot displays the edunet foundation dashboard. On the left, a dark sidebar contains navigation links: Dashboard, Recommended Courses (with a dropdown arrow), Guided Learning Experience (GLEs), Download Offer Letter, and Raise a Ticket. The main content area is titled 'Upload Achievements/Credentials' and features a file upload section with a 'Choose File' button and a 'No file chosen' status. Below this is a 'Submit' button. A large, semi-transparent certificate is overlaid on the dashboard. The certificate is from IBM SkillsBuild and is a 'Completion Certificate'. It states: 'This certificate is presented to AB1 -27-M.PREETHI for the completion of Lab: Retrieval Augmented Generation with LangChain (ALM-COURSE_3824998)'. It also mentions 'According to the Adobe Learning Manager system of record'. At the bottom of the certificate, it shows 'Completion date: 25 Jul 2025 (GMT)' and 'Learning hours: 20 mins'. The user's name 'PREETHI M' is visible in the top right corner of the dashboard.

edunet foundation

Dashboard

Recommended Courses

Guided Learning Experience (GLEs)

Download Offer Letter

Raise a Ticket

Upload Achievements/Credentials

File upload only pdf/png/jpeg

Choose File No file chosen

Submit

IBM SkillsBuild Completion Certificate

This certificate is presented to
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According to the Adobe Learning Manager system of record

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