
CAPSTONE PROJECT

POWER SYSTEM FAULT DETECTION AND CLASSIFICATION

– Presented By –

Student Name - Shivam Laxman Dhamankar

College Name - Wainganga College of Engineering, Nagpur

Department - Computer Science & Engineering

OUTLINE

- Problem Statement
- Proposed Solution
- System Approach
- Process (Auto AI)
- Deployment
- Result
- Conclusion
- Future Scope
- References
- IBM Certifications

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

- **Fault Pattern Analysis :-**

- 1) Use clustering (e.g., K-Means) on fault types with environmental and load data to identify risk zones.
- 2) Analyze correlation between high temperature, load, and specific fault types (e.g., Overheating).

- **Predictive Maintenance System :-**

- 1) Train a classification model using features like temperature, current, and component health to predict fault likelihood.
- 2) Use anomaly detection for identifying abnormal readings.

SYSTEM APPROACH

- IBM Cloud Lite Services
- Watsonx AI Studio (Service)
- Watson.ai Runtime
- IBM Cloud Object Storage
- IBM Cloud Tools (Auto AI)
- Windows 11

PROCESS (AUTO AI)

IBM Cloud

Search resources and products...

Q

Catalog

Manage

Shivam Dhamankar's Account

?

Catalog /

watsonx.ai Studio

(Formerly known as Watson Studio) Develop powerful AI solutions with an integrated collaborative studio and industry-standard APIs and SDKs.

Create

About

Type
Service

Provider
IBM

Last updated
05/06/2025

Category
AI / Machine Learning

Compliance
HIPAA Enabled
IAM-enabled

Location
Sydney (au-syd)
Frankfurt (eu-de)
London (eu-gb)
Tokyo (jp-tok)
Dallas (us-south)
Toronto (ca-tor)

Select a location

Sydney (au-syd)

Select a pricing plan

Prices shown are for country or location: [United States](#)

Plan	Features and capabilities	Pricing
Lite	1 authorized user 10 capacity unit-hours monthly limit Environment = # of capacity units required per hour <ul style="list-style-type: none">1 vCPU + 4 GB RAM = 0.52 vCPU + 8 GB RAM = 14 vCPU + 16 GB RAM = 2 Decision Optimization + Watson NLP = Environment + 5 Synthetic Data Generator, 2 vCPU + 8 GB RAM = 7 (requires	Free

Summary

watsonx.ai Studio **Free**

Location: Sydney (au-syd)
Plan: Lite
Service name: watsonx.ai Studio-rh
Resource group: Default

☒ I have read and agree to the following license agreements:
[Terms](#)

Create

Add to estimate


IBM watsonx.ai Studio

Search in your workspace

Upgrade

Shivam Dhamankar's Account

Sydney

 **watsonx.ai Runtime**

Author: IBM • Date of last update: Jul 23, 2025 • [Docs](#) • [API Docs](#)

Create

About

Select a region

Select a region

Sydney

Pricing plan

Displayed prices do not include tax. Monthly prices shown are for country or region: United States

Plan	Features	Pricing
Lite	<div>Service instance</div> <div>Instance includes:</div> <ul style="list-style-type: none">• 20 capacity unit-hours (CUH) per month• 50,000 tokens/data points per month• 100 pages per month <div>-----</div> <div>Foundation models:</div> <ul style="list-style-type: none">• Inferencing for text generation consumes tokens (as Resource Units)	Free

Close

Summary

watsonx.ai Runtime

Region: Sydney

Plan: Lite

Service name: watsonx.ai Runtime-sv

Resource group: Default

Create

View terms

Cancel

IBM watsonx.ai Studio

Search in your workspaces


Upgrade

Shivam Dhamankar's Accou...

Sydney

SD

Services catalog /

 Cloud Object Storage

Author: IBM • Date of last update: Apr 15, 2025 • Docs • API Docs

CreateAbout

Pricing plan

Displayed prices do not include tax. Monthly prices shown are for country or region: United States

Plan	Features	Pricing
One-Rate	One-Rate Plan is a Pay-as-You-Go option with a single, flat monthly rate (\$/GB) that includes storage, API operations, retrieval, and outbound bandwidth—making it ideal for high-activity workloads with frequent access and data transfer, such as analytics, media, and web apps. The plan includes built-in allowances that scale with stored capacity and offers automatic volume discounts as usage grows	
Lite(deprecated)	<div>Lite plan instance is free to use for Storage capacity up to 25 GB per month. Lite plan instance is used for trial, and can be easily upgraded to Standard plan for unlimited scalability and full functionality.</div> <div>None</div> <div>Lite plan services are deleted after 30 days of inactivity.</div>	Free
Standard	<div>Standard Plan is a flexible Pay-as-You-Go option with no minimum fee—ideal for workloads with large storage needs but low or infrequent access and outbound traffic. It includes a Free Tier with 5GB of Smart Tier storage for 12 months. Charges are based on actual usage, with separate billing for storage, outbound bandwidth, API operations, and data retrieval. Multiple storage classes help you optimize costs based on how often data is accessed.</div> <div>Free Tier allowance: Storage up to 5GB/month Up to 2000 Class A requests/month Up to 20,000 Class B requests/month Up to 10GB/month of data retrieval Up to 5GB/month of egress Applies to aggregate total across all smart tier buckets in your account</div>	

Summary

Cloud Object Storage

Region: Global

Plan: Lite(deprecated)

Service name: Cloud Object Storage-ay

Resource group: Default

Create

View terms

Cancel

Overview

Assets

Jobs

Manage

Start working

Recommended

Add users as collaborators

Add data to work with

Work with data and models in Python or R notebooks

Build machine learning models automatically

[View all](#)

Collapse

Assets

By all

Assets that you create with tools show here. See all assets, including data assets, on the Assets page.



[View all](#)

Resource usage



For this month in this project

0 CUH

Your documentation New!

Get started with your documentation

You can create and manage documents about work that you do in this project.

[Open Documentation editor](#)

Project history



<https://au-svd.dai.cloud.ibm.com/home?context=cndaas>

Configure AutoAI experiment

Power_Systems1 


Autosaved: 10:43:00 AM

Add data source

Add files such as tabular data (CSV).

Browse

Select from project


 fault_data.csv

Size: 47.62 KB

Columns: 13

⋮

Configure details


 Create a time series analysis?

Enable this option to predict future activity over a specified date/time range. Data must be structured and sequential.

[Learn more](#)

Yes

No

 What do you want to predict?

Prediction column ⓘ

Fault Type

×

⌵

Prediction column: Fault Type

CUH remaining: 20 CUH

PREDICTION TYPE

Multiclass Classification

OPTIMIZED FOR

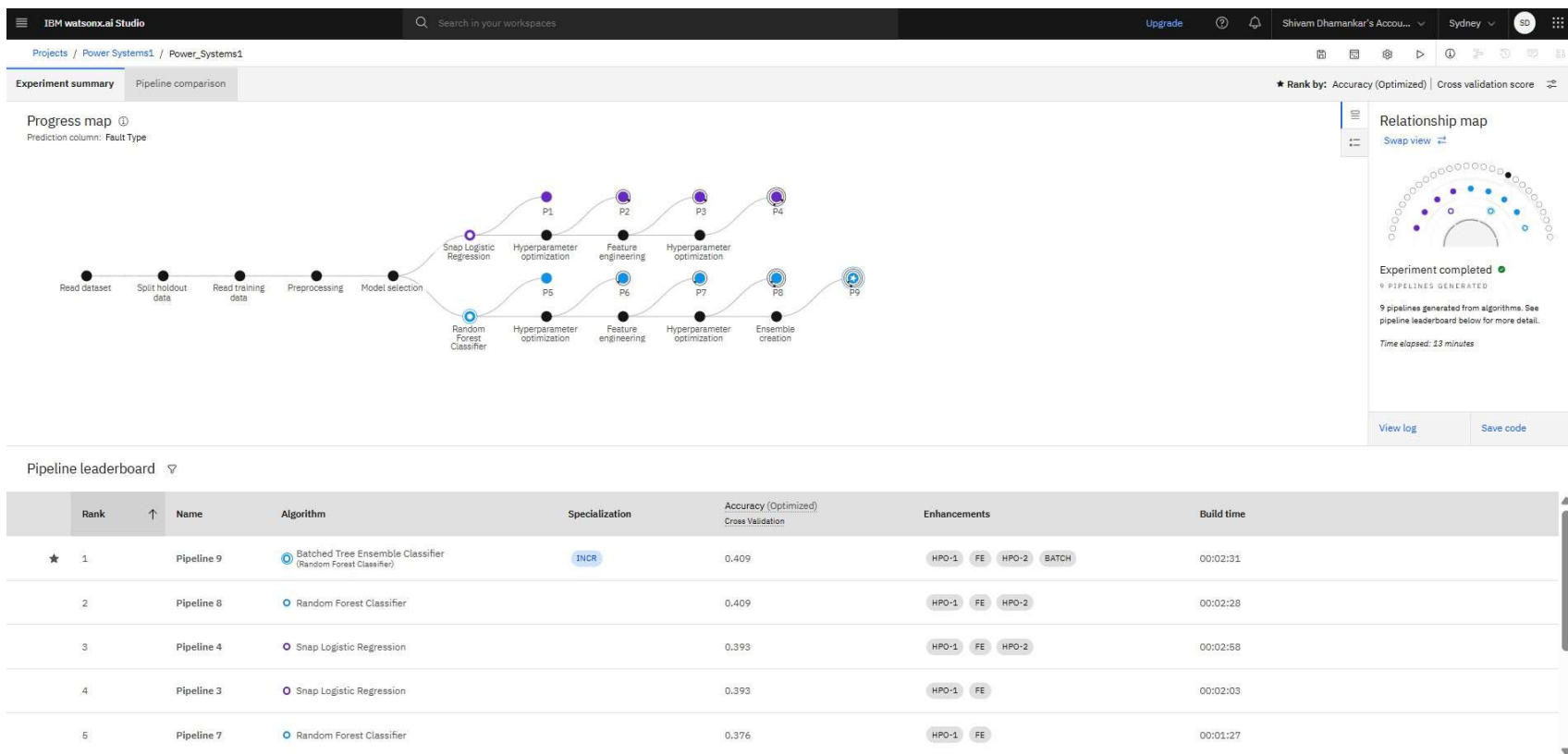
Accuracy & run time

Experiment settings

⚙️

Run experiment

▶



DEPLOYMENT

The screenshot shows the 'Create a deployment' window in IBM Watson AI Studio. The interface includes a top navigation bar with the IBM Watson AI Studio logo, a search bar, and user account information. The main content area is titled 'Create a deployment' and contains a 'Define details' section. This section includes an 'Associated asset' dropdown set to 'P9 - Random Forest Classifier: Power_Systems1', a 'Deployment type' section with 'Online' selected, and input fields for 'Name' (containing 'Power_System1') and 'Serving name' (containing 'deployment serving name'). A 'Create' button is visible at the bottom right.

IBM watsonx.ai Studio

Search in your workspaces

Upgrade ?

Shivam Dhamankar's Acco... Sydney SD

Deployment spaces / Power_Systems1 / P9 - Random Forest Classifier: Power_Systems1

Create a deployment

Define details

☒ Associated asset
P9 - Random Forest Classifier: Power_Systems1

Deployment type

Online
Run the model on data in real-time, as data is received by a web service.

Batch
Run the model against data as a batch process.

Name
Power_System1

Serving name
deployment serving name

Enter a short name to be used as the serving name for the deployment. The name must be unique to be valid.

Cancel Create

Search in your workspaces

Upgrade ? 1

Shivam Dhamankar's Acco...

Sydney

SD

Deployment spaces / Power_Systems1 / P9 - Random Forest Classifier: Power_Systems1 /

Power_System1

Deployed

Online

API reference

Test

Endpoints for scoring

Private endpoint

https://private.au-syd.ml.cloud.ibm.com/ml/v4/deployments/16788fa8-2aaa-46c5-aeac-60ca0d9d0cc5/predictions?version=2021-05-01

Bearer <token>

IAM

Public endpoint

https://au-syd.ml.cloud.ibm.com/ml/v4/deployments/16788fa8-2aaa-46c5-aeac-60ca0d9d0cc5/predictions?version=2021-05-01

Learn more about the 2021-05-01 version query parameter

Code snippets

cURL

Java

JavaScript

Python

Scala

```

import requests

# NOTE: you must manually set API_KEY below using information retrieved from your IBM Cloud account (https://au-syd.dai.cloud.ibm.com/docs/content/wsj/analyze-data)
API_KEY = "<your API key>"
token_response = requests.post('https://iam.cloud.ibm.com/identity/token', data={"apikey": API_KEY, "grant_type": 'urn:ibm:params:oauth:grant-type:apikey'})
mltoken = token_response.json()["access_token"]

header = {'Content-Type': 'application/json', 'Authorization': 'Bearer ' + mltoken}

# NOTE: manually define and pass the array(s) of values to be scored in the next line

```

About this deployment

Name

Power_System1

Description

No description provided.

Deployment Details

Deployment ID: 16788fa8-2aaa-46...

Serving name: No serving name.

Software specification: hybrid_0.1

Hybrid pipeline software specifications: autoai-kb_rt24.1-py3.11

Copies: 1

Tags

Add tags to make assets easier to find.

Associated asset

P9 - Random Forest Classifier: Powe...

5db4b540-7867-466a-9879-2e33168294d6

Last modified

2 minutes ago

Created on

Aug 4, 2025

RESULT

IBM watsonx.ai Studio

Search in your workspaces

Upgrade

Shivam Dhamankar's Acco...

Sydney

SD

Deployment spaces / Power_Systems1 / P9 - Random Forest Classifier: Power_Systems1 /

Power_System1 Deployed Online

API reference **Test**

Enter input data

Text

JSON

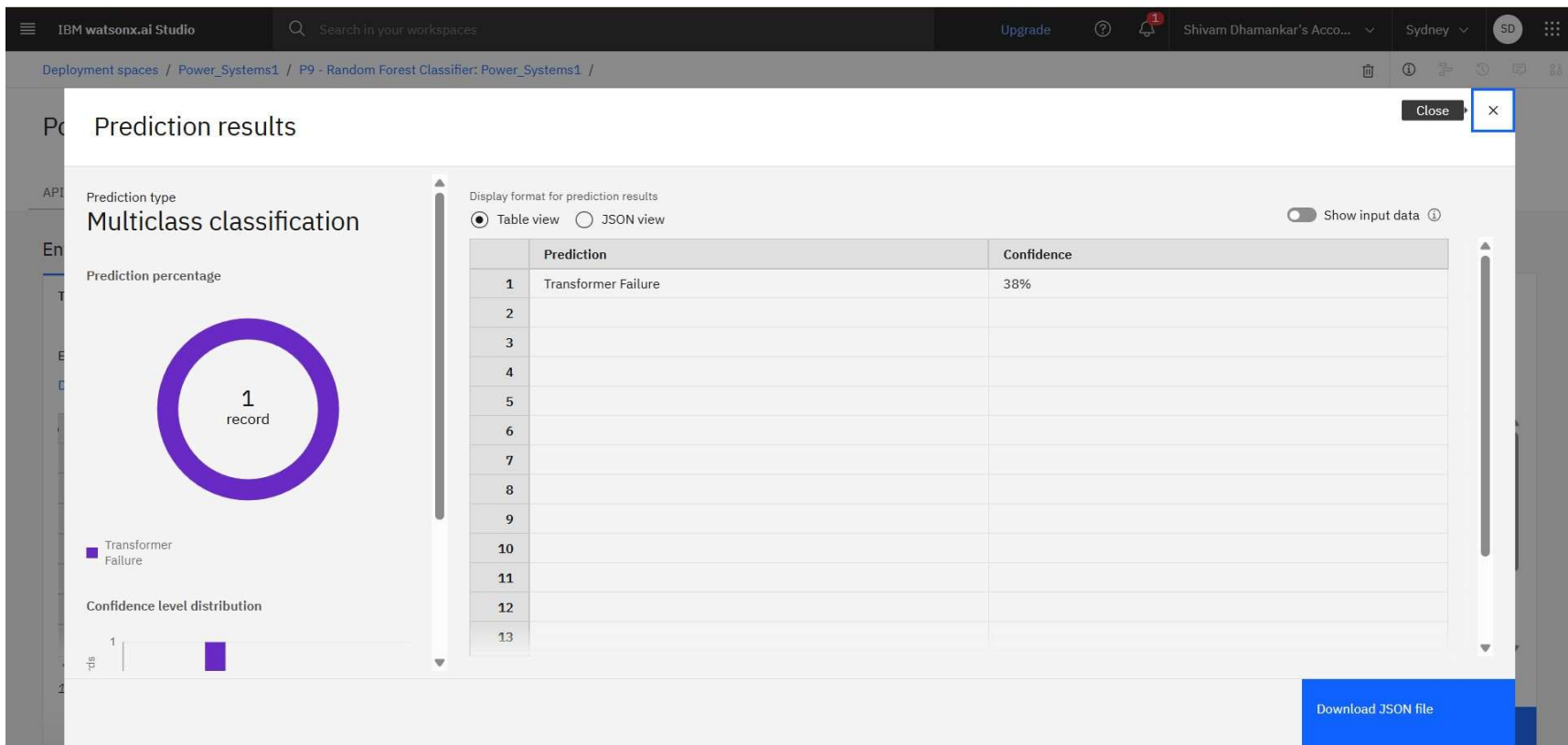
Enter data manually or use a CSV file to populate the spreadsheet. Max file size is 50 MB.

[Download CSV template](#) [Browse local files](#) [Search in space](#) [Clear all](#)

	Fault ID (other)	Fault Location (Latitude, Longitude) (other)	Voltage (V) (double)	Current (A) (double)	Power Load (MW) (double)	Temperature (°C) (double)	Wind Speed (km/h) (double)	Weather Co
1	F015	(34.2256, -118.9178)	1848	231	49	39	13	Rainy
2								
3								
4								
5								
6								
7								

1 row, 12 columns

Predict



CONCLUSION

- In this project, a machine learning-based approach was designed and implemented to rapidly detect and classify faults in a power distribution system using electrical measurement data, such as voltage and current phasors.
- The model was trained to distinguish between normal operation and various types of faults — including line-to-ground (LG), line-to-line (LL), double line-to-ground (LLG), and three-phase faults (LLL, LLLG).
- These measurements serve as critical indicators of the operating state of power systems and are essential for making timely decisions during fault conditions.

FUTURE SCOPE

- The future of power system fault detection lies in the integration of intelligent, adaptive, and explainable ML solutions that operate in real-time, across distributed networks, and in concert with other smart grid technologies.
- By extending the model's scope to include localization, adaptive learning, real-time deployment, and cybersecurity, this research can play a foundational role in building the next-generation resilient and intelligent power grid.
- Fault Localization

REFERENCES

- IBM Cloud - <https://cloud.ibm.com/>
- Watsonx AI Studio – <https://cloud.ibm.com/catalog/services/watsonxai-studio>
- Data Sets - <https://www.kaggle.com/datasets/ziya07/power-system-faults-dataset>

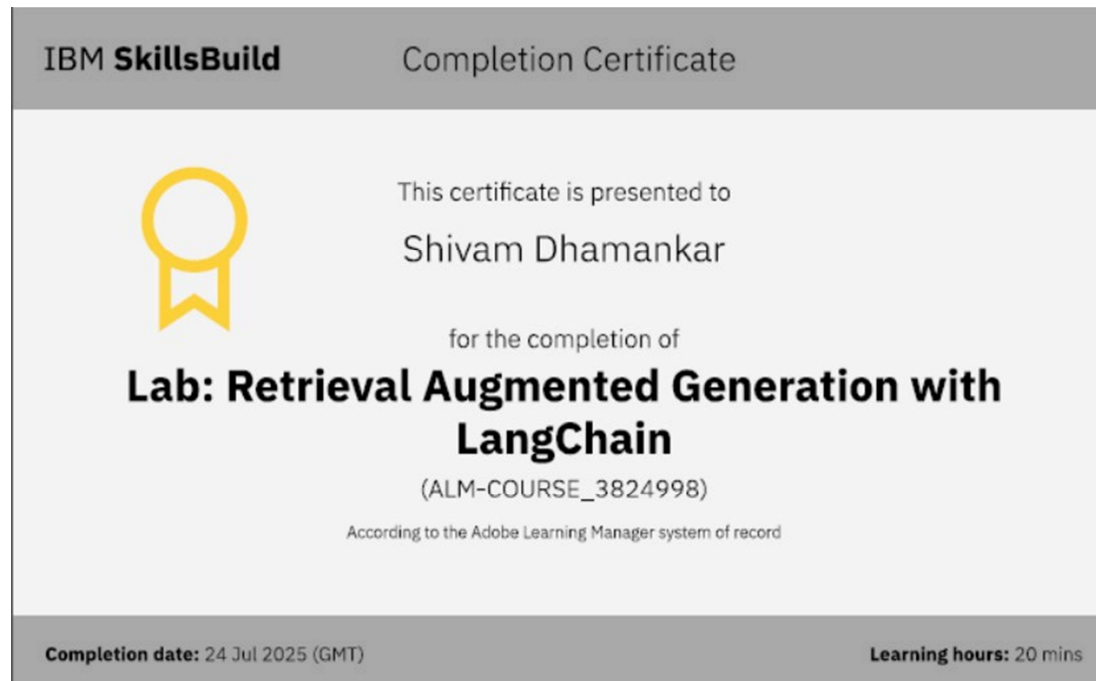
IBM CERTIFICATIONS



IBM CERTIFICATIONS



IBM CERTIFICATIONS



THANK YOU