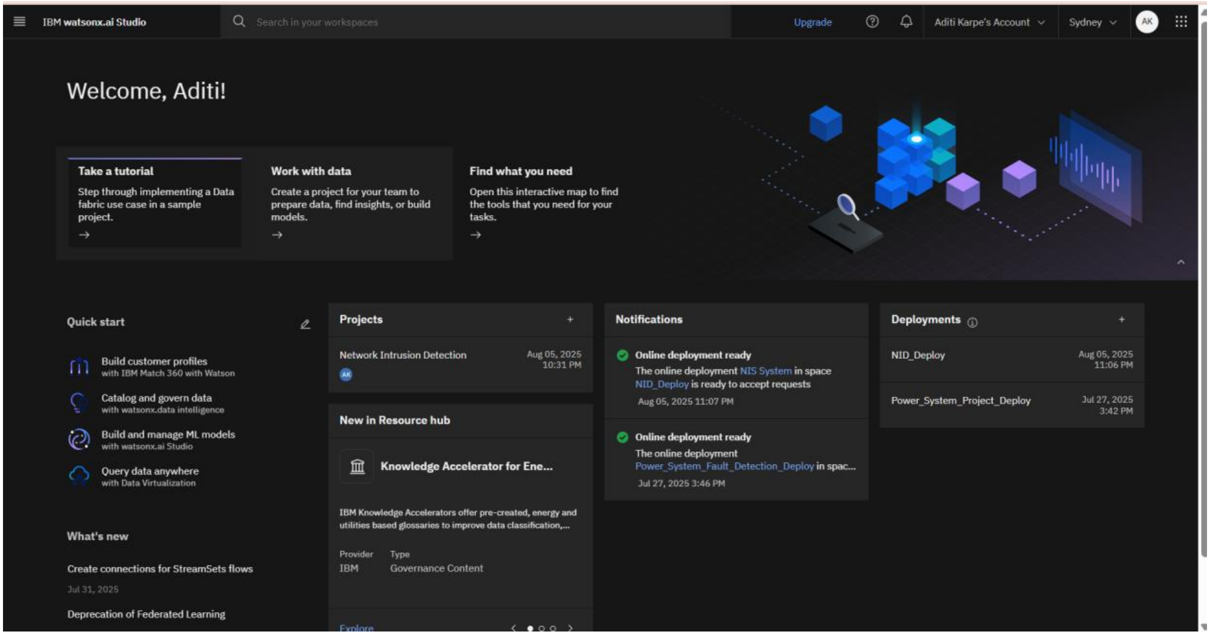
POWER SYSTEM FAULT DETECTION AND CLASSIFICATION

- **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.

Following are the steps and output :

Step 1: Opened the IBM Watsonx.ai dashboard to begin the machine learning model development process.



Welcome, Aditi!

Take a tutorial
Step through implementing a Data fabric use case in a sample project.
→

Work with data
Create a project for your team to prepare data, find insights, or build models.
→

Find what you need
Open this interactive map to find the tools that you need for your tasks.
→

Quick start

Build customer profiles
with IBM Match 360 with Watson

Catalog and govern data
with watsonx.data intelligence

Build and manage ML models
with watsonx.ai Studio

Query data anywhere
with Data Virtualization

What's new

Create connections for StreamSets flows
Jul 31, 2025

Deprecation of Federated Learning

Projects +

Network Intrusion Detection AK	Aug 05, 2025 10:31 PM

New in Resource hub

Knowledge Accelerator for Ene...

IBM Knowledge Accelerators offer pre-created, energy and utilities based glossaries to improve data classification,...

Provider	Type
IBM	Governance Content

Explore

Notifications

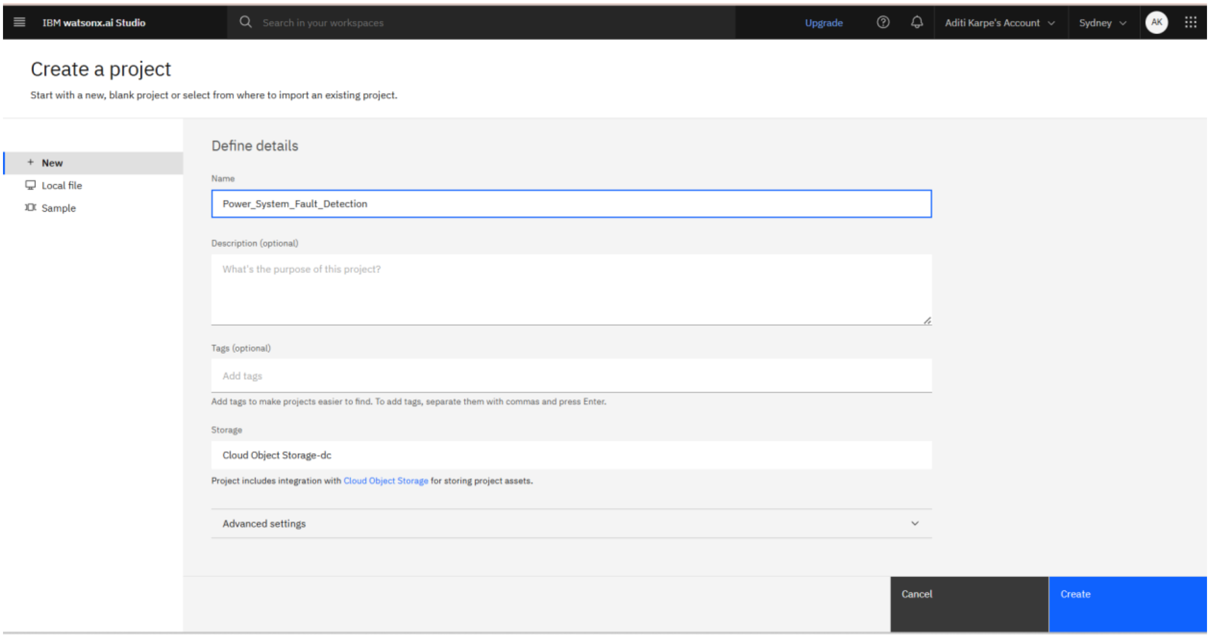
Online deployment ready
The online deployment NIS System in space NID_Deploy is ready to accept requests
Aug 05, 2025 11:07 PM

Online deployment ready
The online deployment Power_System_Fault_Detection_Deploy in spac...
Jul 27, 2025 3:46 PM

Deployments +

NID_Deploy	Aug 05, 2025 11:06 PM
Power_System_Project_Deploy	Jul 27, 2025 3:42 PM

Step 2: Created a new project and named it **Power_System_Fault_Detection** to organize all related assets and experiments.



Create a project

Start with a new, blank project or select from where to import an existing project.

Define details

Name: Power_System_Fault_Detection

Description (optional): What's the purpose of this project?

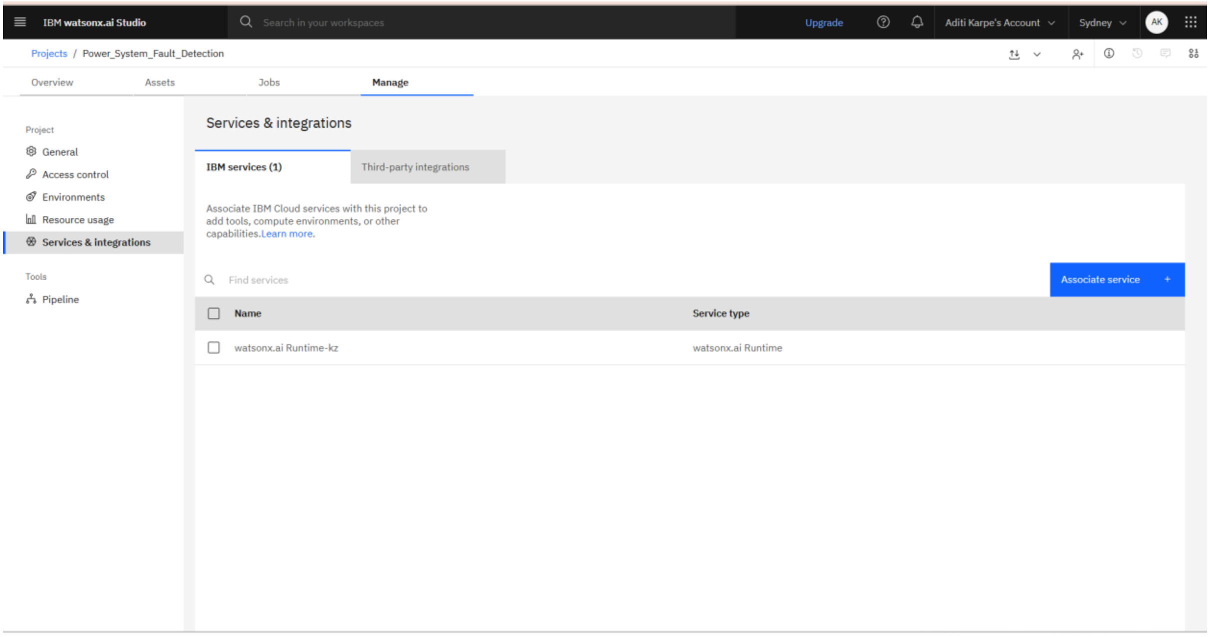
Tags (optional): Add tags

Add tags to make projects easier to find. To add tags, separate them with commas and press Enter.

Storage: Cloud Object Storage-dc

Project includes integration with Cloud Object Storage for storing project assets.

Step 3: Associated the project with the Watson Machine Learning Runtime service to enable model training and deployment capabilities.

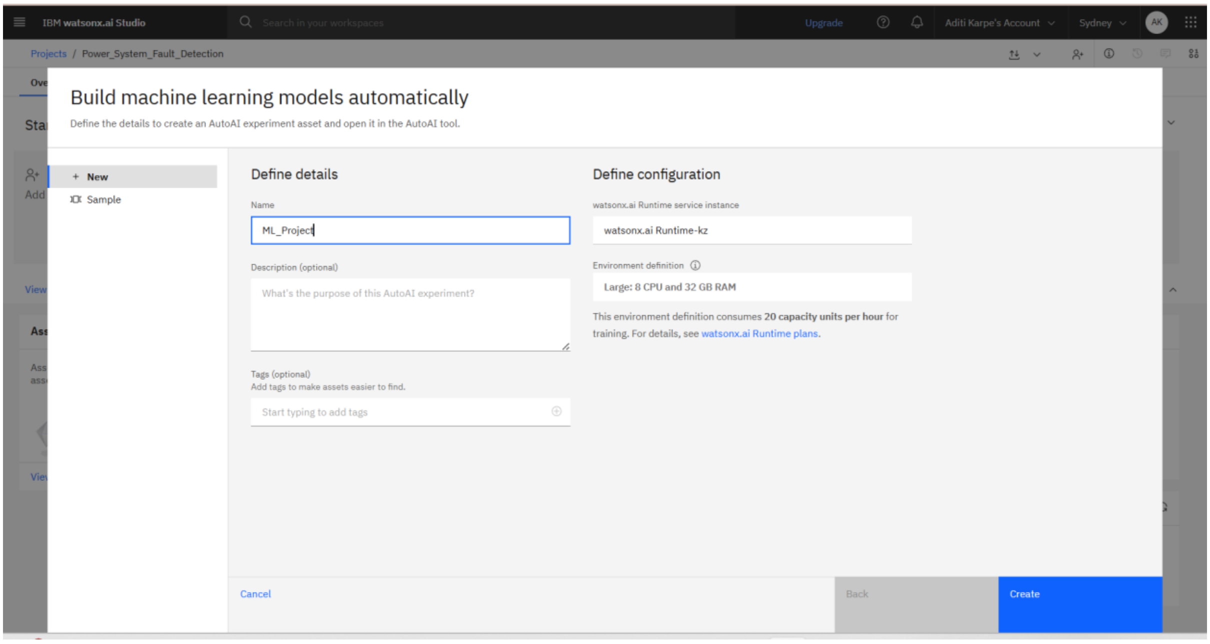


Services & integrations

Associate IBM Cloud services with this project to add tools, compute environments, or other capabilities.Learn more.

□	Name	Service type
□	watsonx.ai Runtime-kz	watsonx.ai Runtime

Step 4: Created and named the machine learning model as **ML_Project** to perform fault detection and classification tasks.



Build machine learning models automatically

Define the details to create an AutoAI experiment asset and open it in the AutoAI tool.

Define details

Name: ML_Project

Description (optional): What's the purpose of this AutoAI experiment?

Tags (optional)
Add tags to make assets easier to find.
Start typing to add tags

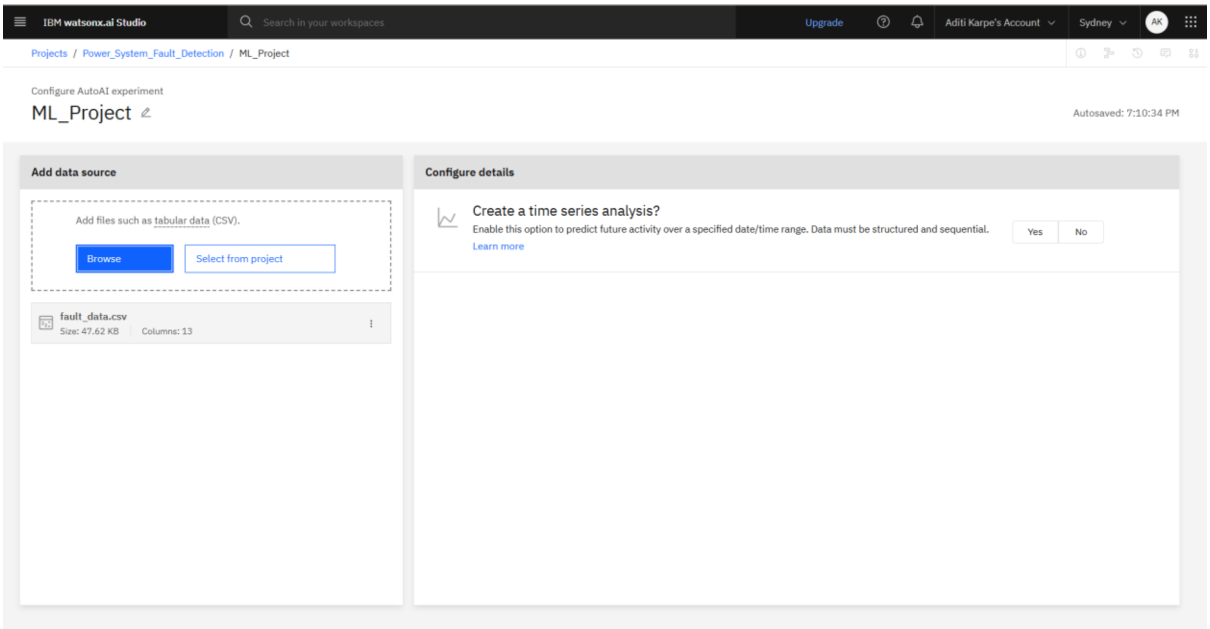
Define configuration

watsonx.ai Runtime service instance: watsonx.ai Runtime-kz

Environment definition: Large: 8 CPU and 32 GB RAM

This environment definition consumes **20 capacity units per hour** for training. For details, see watsonx.ai Runtime plans.

Step 5: Uploaded fault_data.csv as the dataset in IBM Watsonx.ai Studio.



Configure AutoAI experiment

ML_Project

Autosaved: 7:10:34 PM

Add data source

Add files such as tabular data (CSV).

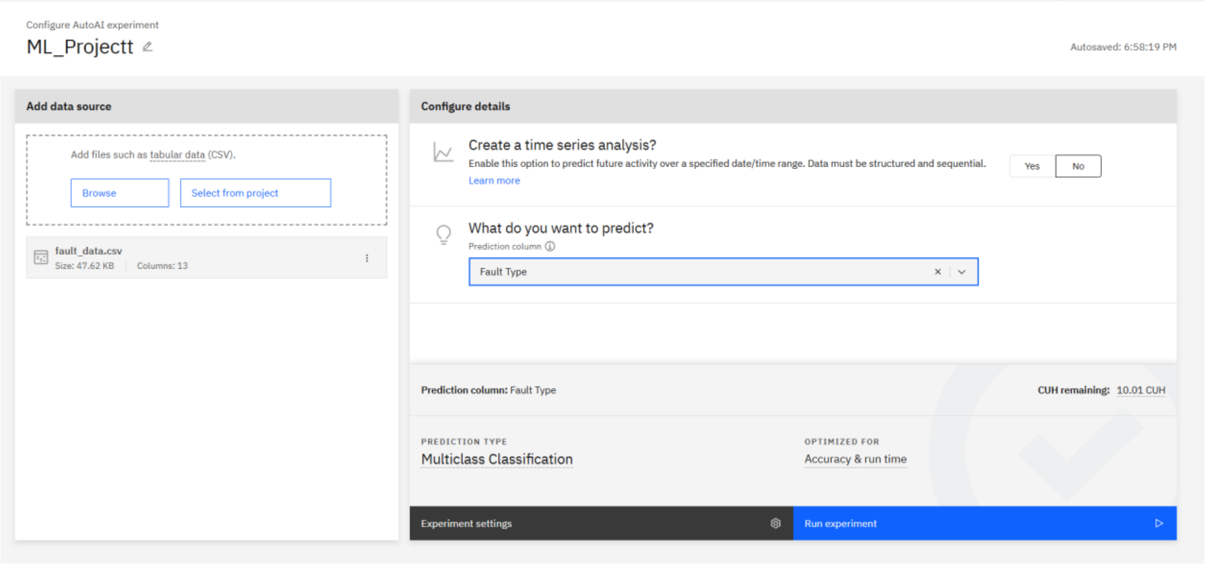
fault_data.csv
Size: 47.62 KB | Columns: 13

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.

Step 6: Selected **Fault Type** as the prediction column and initialized the AutoAI experiment for multiclass classification.



Configure AutoAI experiment

ML_Projectt

Autosaved: 6:58:19 PM

Add data source

Add files such as tabular data (CSV).

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.

What do you want to predict?
Prediction column: Fault Type

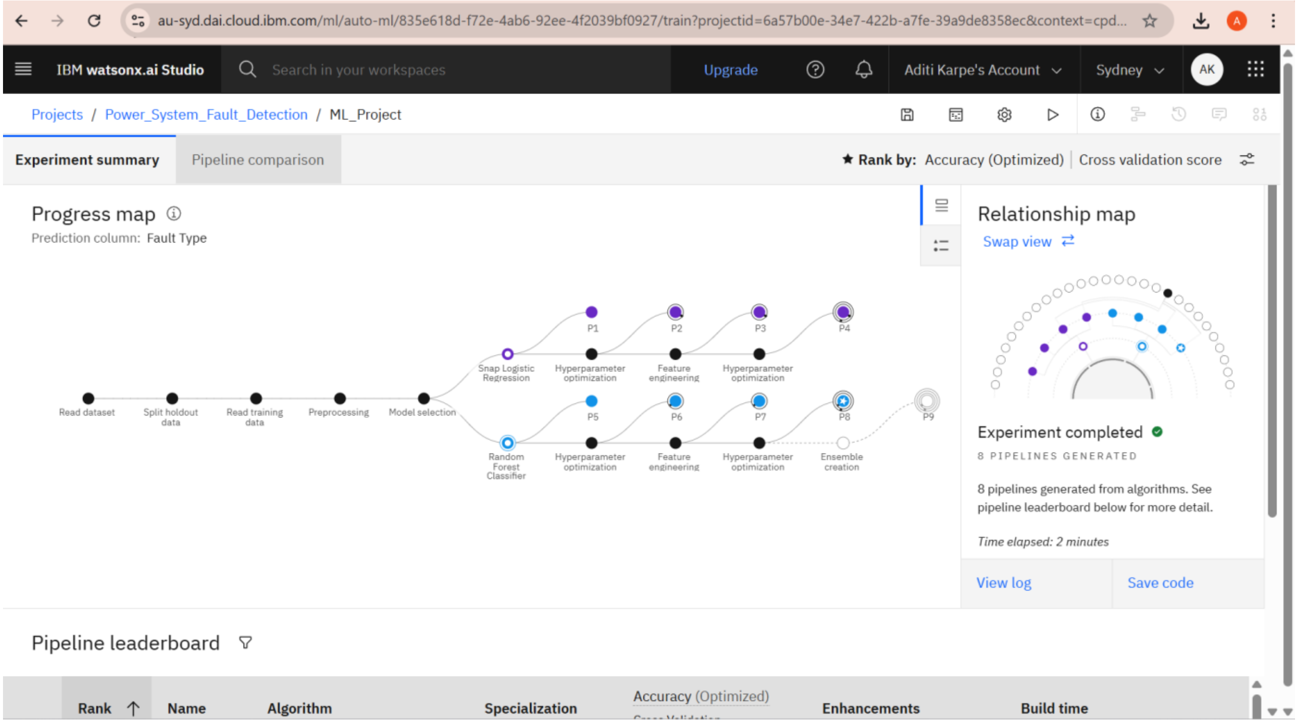
Prediction column: Fault Type

CUH remaining: 10.01 CUH

PREDICTION TYPE
Multiclass Classification

OPTIMIZED FOR
Accuracy & run time

Step 7: AutoAI generated 8 machine learning pipelines using different algorithms and feature transformers.



au-syd.dai.cloud.ibm.com/ml/auto-ml/835e618d-f72e-4ab6-92ee-4f2039bf0927/train?projectid=6a57b00e-34e7-422b-a7fe-39a9de8358ec&context=cpd...

IBM watsonx.ai Studio

Aditi Karpe's Account | Sydney

Projects / Power_System_Fault_Detection / ML_Project

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

Progress map
Prediction column: Fault Type

Relationship map

Experiment completed
8 PIPELINES GENERATED

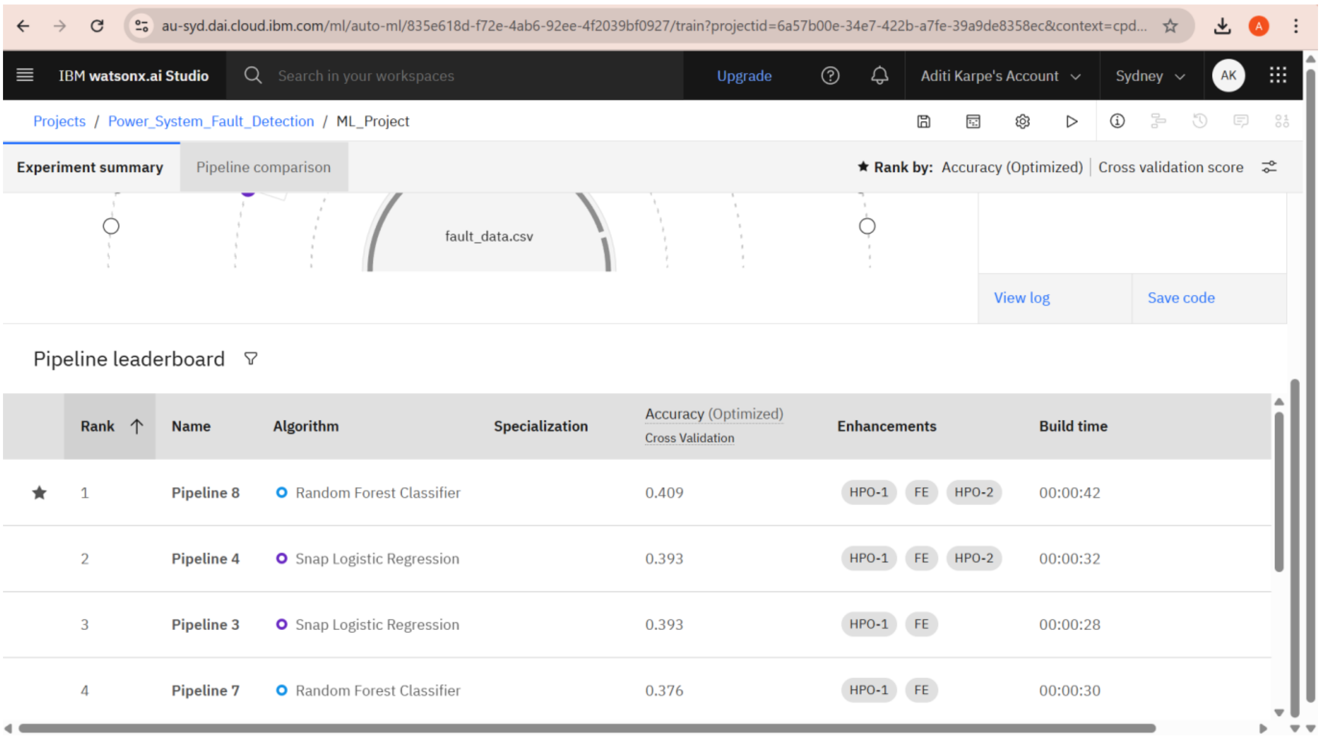
8 pipelines generated from algorithms. See pipeline leaderboard below for more detail.

Time elapsed: 2 minutes

Pipeline leaderboard

Rank	Name	Algorithm	Specialization	Accuracy (Optimized)	Enhancements	Build time

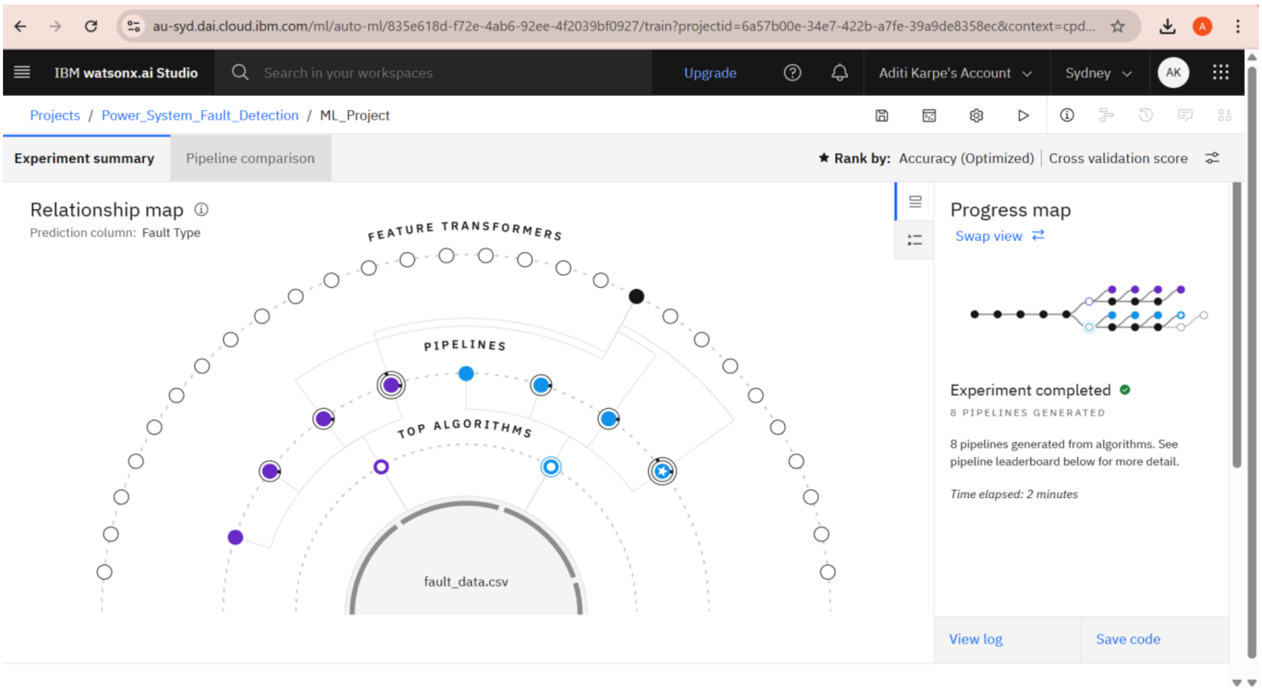
Step 8: Pipelines were ranked based on optimized accuracy using cross-validation.


au-syd.dai.cloud.ibm.com/ml/auto-ml/835e618d-f72e-4ab6-92ee-4f2039bf0927/train?projectid=6a57b00e-34e7-422b-a7fe-39a9de8358ec&context=cpd...
IBM watsonx.ai Studio
Search in your workspaces
Upgrade
Aditi Karpe's Account
Sydney
AK
Projects / Power_System_Fault_Detection / ML_Project
Experiment summary
Pipeline comparison
★ Rank by: Accuracy (Optimized) | Cross validation score
fault_data.csv
View log
Save code

Pipeline leaderboard

	Rank ↑	Name	Algorithm	Specialization	Accuracy (Optimized) Cross Validation	Enhancements	Build time
★	1	Pipeline 8	Random Forest Classifier		0.409	HPO-1 FE HPO-2	00:00:42
	2	Pipeline 4	Snap Logistic Regression		0.393	HPO-1 FE HPO-2	00:00:32
	3	Pipeline 3	Snap Logistic Regression		0.393	HPO-1 FE	00:00:28
	4	Pipeline 7	Random Forest Classifier		0.376	HPO-1 FE	00:00:30

Step 9: Visualized the relationship map showing connections between the dataset, algorithms, and transformers.


au-syd.dai.cloud.ibm.com/ml/auto-ml/835e618d-f72e-4ab6-92ee-4f2039bf0927/train?projectid=6a57b00e-34e7-422b-a7fe-39a9de8358ec&context=cpd...
IBM watsonx.ai Studio
Search in your workspaces
Upgrade
Aditi Karpe's Account
Sydney
AK
Projects / Power_System_Fault_Detection / ML_Project
Experiment summary
Pipeline comparison
★ Rank by: Accuracy (Optimized) | Cross validation score
Relationship map
Prediction column: Fault Type
FEATURE TRANSFORMERS
PIPELINES
TOP ALGORITHMS
fault_data.csv
Progress map
Swap view
View log
Save code

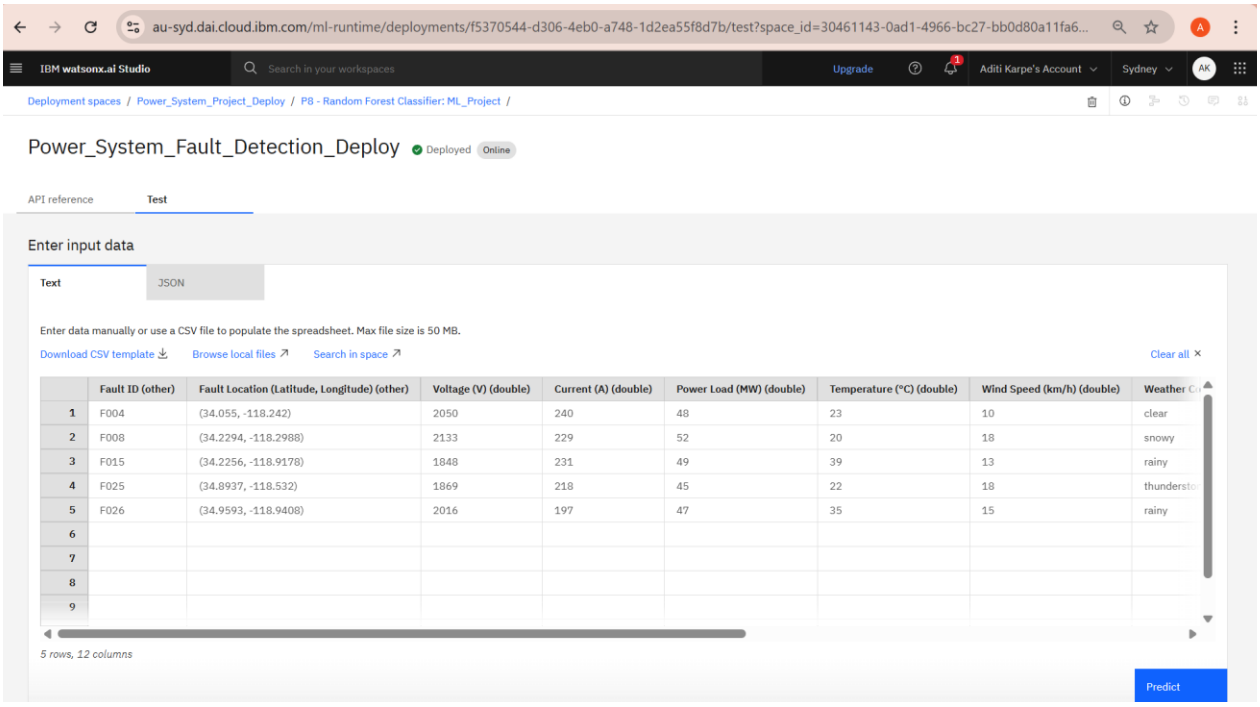
Experiment completed

8 PIPELINES GENERATED

8 pipelines generated from algorithms. See pipeline leaderboard below for more detail.

Time elapsed: 2 minutes

Step 10: After completing the experiment, input data was provided to the best-performing pipeline for prediction.


au-syd.dai.cloud.ibm.com/ml-runtime/deployments/f5370544-d306-4eb0-a748-1d2ea55f8d7b/test?space_id=30461143-0ad1-4966-bc27-bb0d80a11fa6...
IBM watsonx.ai Studio
Search in your workspaces
Upgrade
Aditi Karpe's Account
Sydney
AK
Deployment spaces / Power_System_Project_Deploy / P8 - Random Forest Classifier: ML_Project /

Power_System_Fault_Detection_Deploy ● Deployed Online

Enter input data

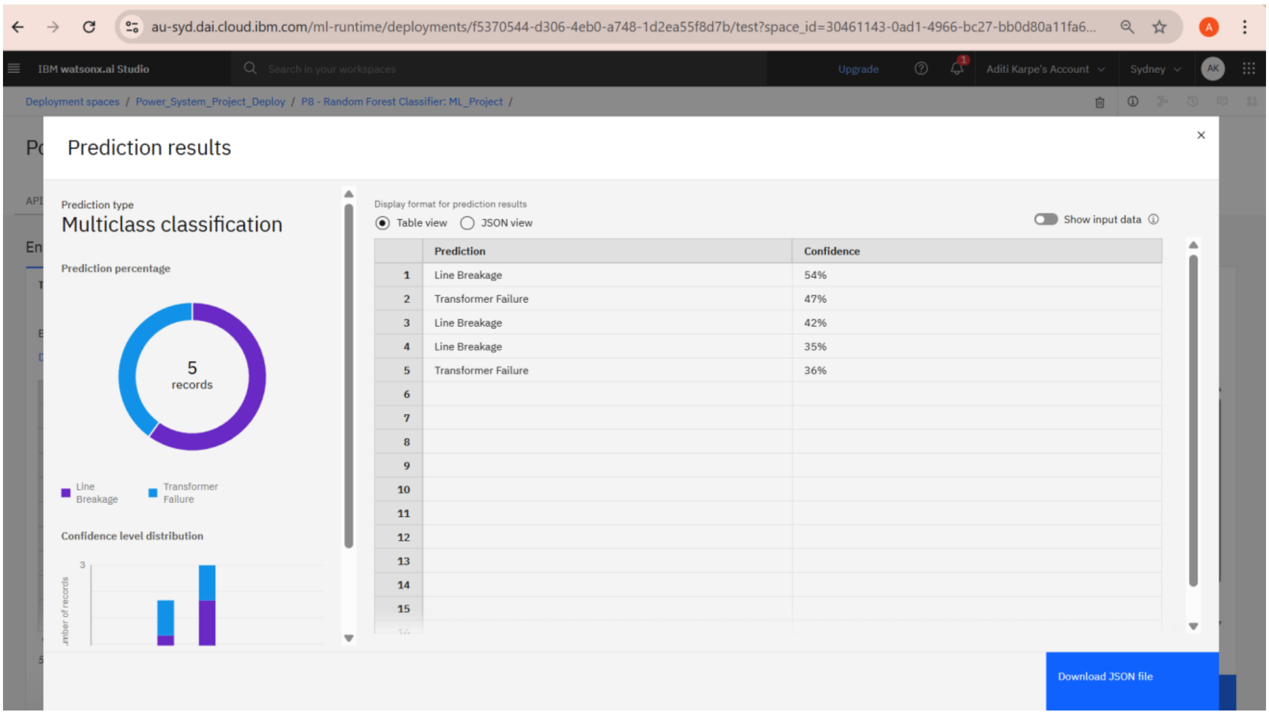
Enter data manually or use a CSV file to populate the spreadsheet. Max file size is 50 MB.

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 C
1	F004	(34.055, -118.242)	2050	240	48	23	10	clear
2	F008	(34.2294, -118.2988)	2133	229	52	20	18	snowy
3	F015	(34.2256, -118.9178)	1848	231	49	39	13	rainy
4	F025	(34.8937, -118.532)	1869	218	45	22	18	thundersto
5	F026	(34.9593, -118.9408)	2016	197	47	35	15	rainy
6								
7								
8								
9								

5 rows, 12 columns

Step 11: The system successfully predicted the **Fault Type** based on the input data using the trained model.


au-syd.dai.cloud.ibm.com/ml-runtime/deployments/f5370544-d306-4eb0-a748-1d2ea55f8d7b/test?space_id=30461143-0ad1-4966-bc27-bb0d80a11fa6...
IBM watsonx.ai Studio
Search in your workspaces
Upgrade
Aditi Karpe's Account
Sydney
AK
Deployment spaces / Power_System_Project_Deploy / P8 - Random Forest Classifier: ML_Project /
×

Prediction results

Prediction type

Multiclass classification

Prediction percentage

5
records
Line Breakage
Transformer Failure
Confidence level distribution
3
umber of records

Display format for prediction results

● Table view ○ JSON view

	Prediction	Confidence
1	Line Breakage	54%
2	Transformer Failure	47%
3	Line Breakage	42%
4	Line Breakage	35%
5	Transformer Failure	36%
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		