PROJECT TITLE: POWER SYSTEM FAULT DETECTION AND CLASSIFICATION

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

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

Proposed System

The proposed system aims to address the challenge of **detecting and classifying power system faults** to maintain grid stability and reduce downtime. It leverages data analytics and machine learning to automate fault identification. The solution consists of the following components:

🔷 **Data Collection:**

Gather historical data on power distribution faults, including voltage, current, load, temperature, weather conditions, maintenance status, and component health.

🔷 **Data Preprocessing:**

Clean the data to handle missing values and outliers.

Apply feature engineering to extract and encode key features that influence fault types.

🔷 **Machine Learning Algorithm:**

Use **Snap Logistic Regression** to classify faults (e.g., Line Breakage, Overheating, Transformer Failure) based on input features.

Train and optimize the model using AutoML (Watsonx.ai) with feature selection and cross-validation.

🔷 **Deployment:**

Deploy the trained model on IBM Watsonx.ai for real-time or batch inference.

Enable easy integration with grid monitoring systems for proactive maintenance alerts.

SYSTEM APPROACH

- **Platform:** IBM Watsonx.ai Studio (AutoML)
- **Dataset:** Electrical measurement & fault classification data
- **Preprocessing:**
- Feature Engineering (FE)
- Hyperparameter Optimization (HPO)
- **Features Used:**
- Voltage, Current, Power Load
- Temperature, Wind Speed
- Weather Condition, Maintenance Status, Component Health

ALGORITHM & DEPLOYMENT

◆ **Algorithm Selection:**

Snap Logistic Regression was chosen for its speed, simplicity, and effectiveness in multiclass classification. It is ideal for structured electrical fault data and supports fast training with good accuracy.

◆ **Data Input:**

Input features include:

•Voltage (V), Current (A), Power Load (MW)

•Temperature (°C), Wind Speed (km/h)

•Weather Condition, Maintenance Status, Component Health

◆ **Training Process:**

The model was trained using IBM Watsonx.ai AutoML with:

•Cross-validation

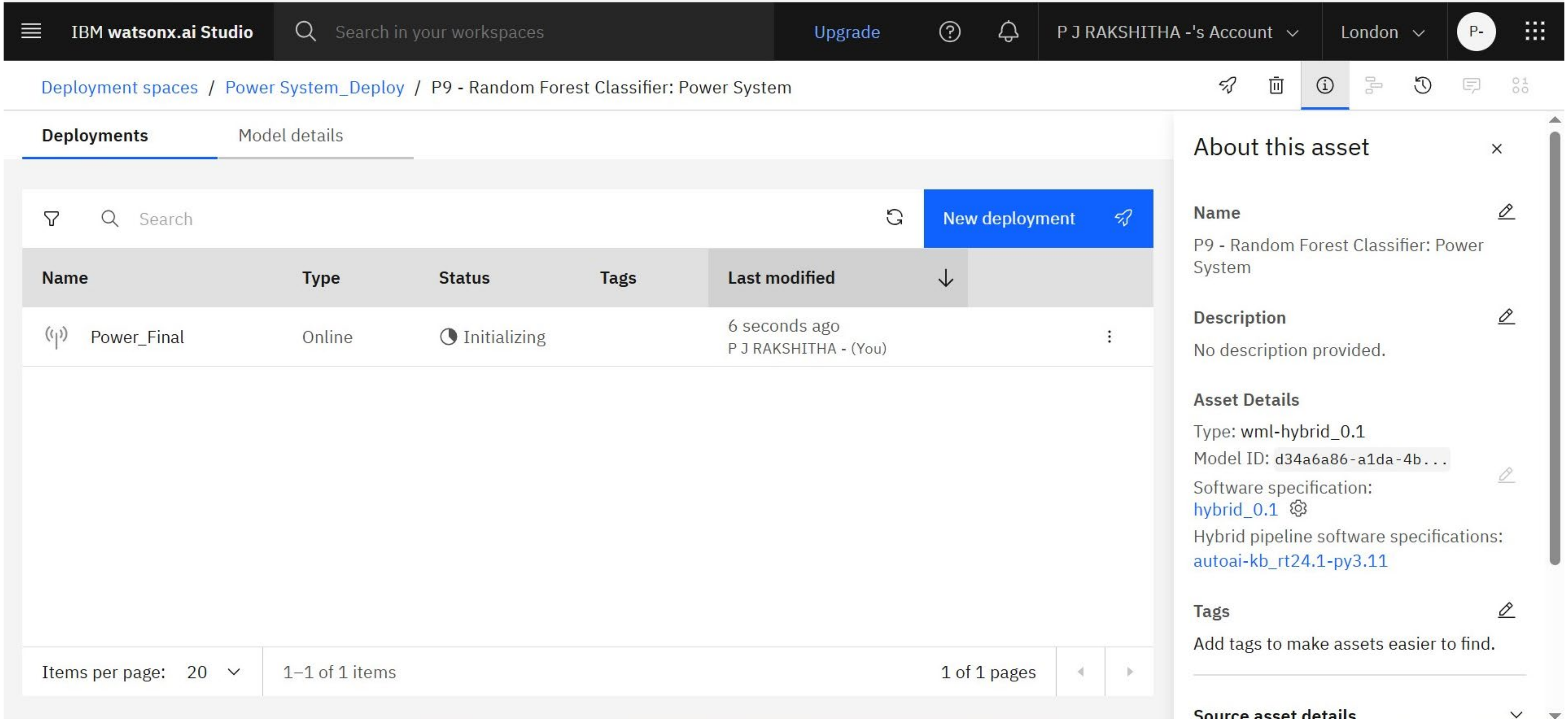
•Feature Engineering (FE)

•Hyperparameter Optimization (HPO-1, HPO-2)

◆ **Prediction Process:**

The trained model predicts the fault type (e.g., Line Breakage, Overheating) based on real-time input data, enabling quick fault classification for power system reliability

RESULT


IBM watsonx.ai Studio
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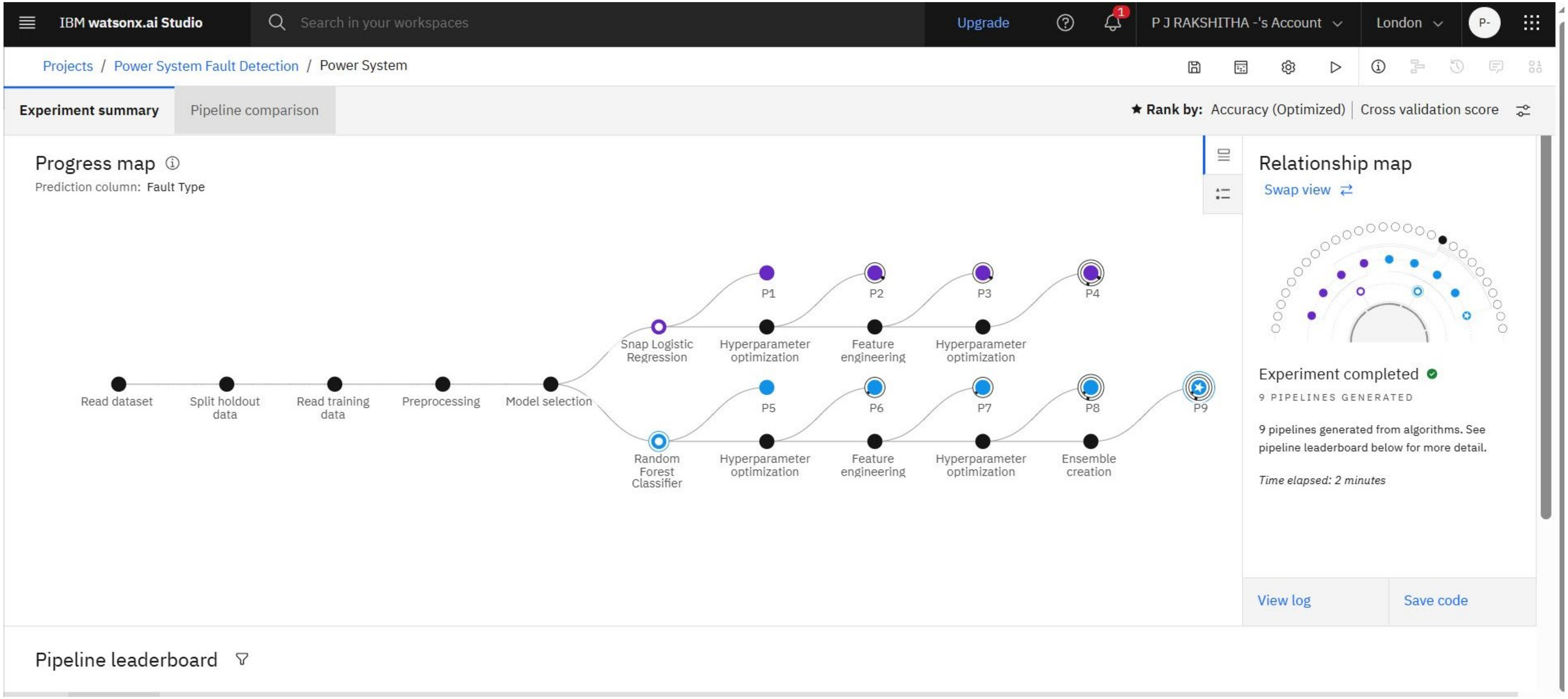
Deployment spaces / Power System_Deploy / P9 - Random Forest Classifier: Power System
Deployments
Model details
Search
New deployment
Name
Type
Status
Tags
Last modified
Power_Final
Online
Initializing
6 seconds ago
P J RAKSHITHA - (You)
Items per page: 20
1–1 of 1 items
1 of 1 pages
About this asset
Name
P9 - Random Forest Classifier: Power System
Description
No description provided.
Asset Details
Type: wml-hybrid_0.1
Model ID: d34a6a86-a1da-4b...
Software specification:
hybrid_0.1
Hybrid pipeline software specifications:
autoai-kb_rt24.1-py3.11
Tags
Add tags to make assets easier to find.
Source asset details



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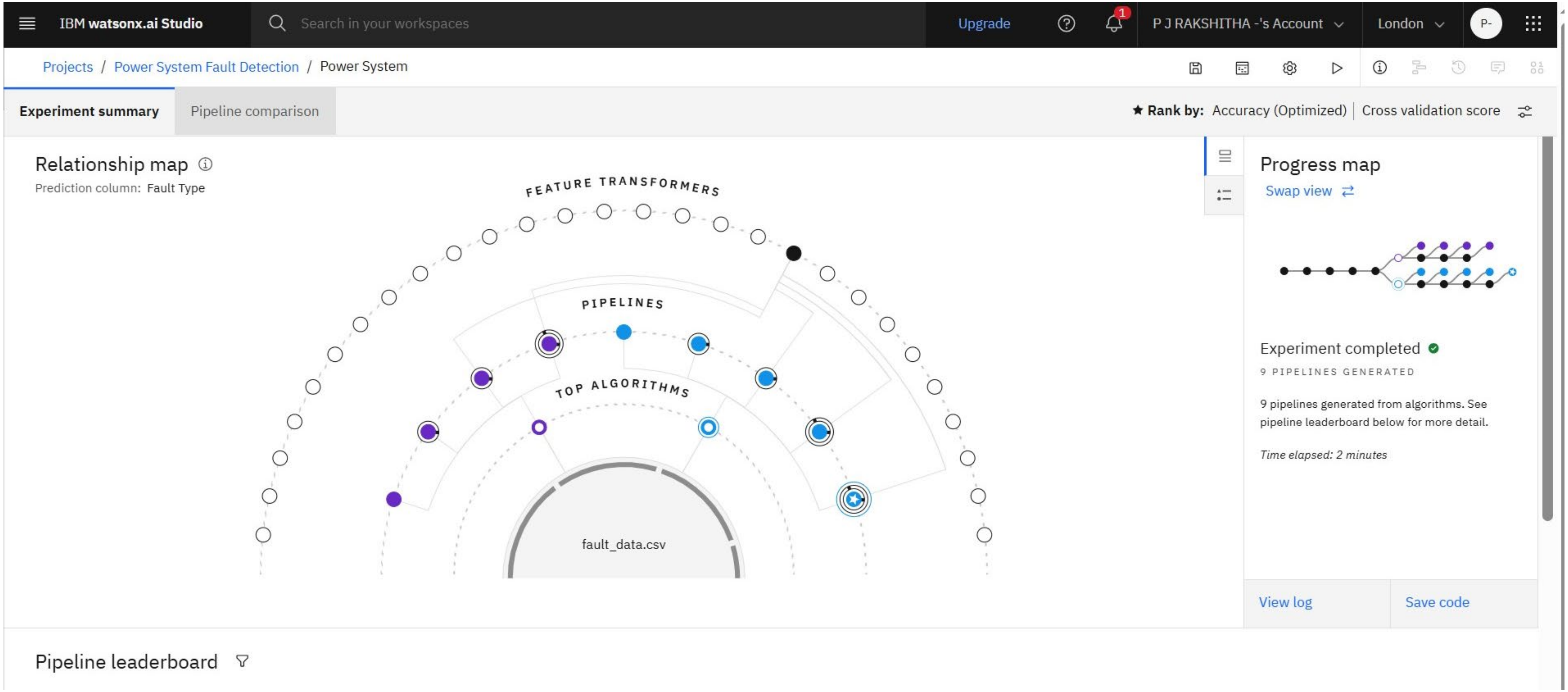

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Prediction results

×

Display format for prediction results

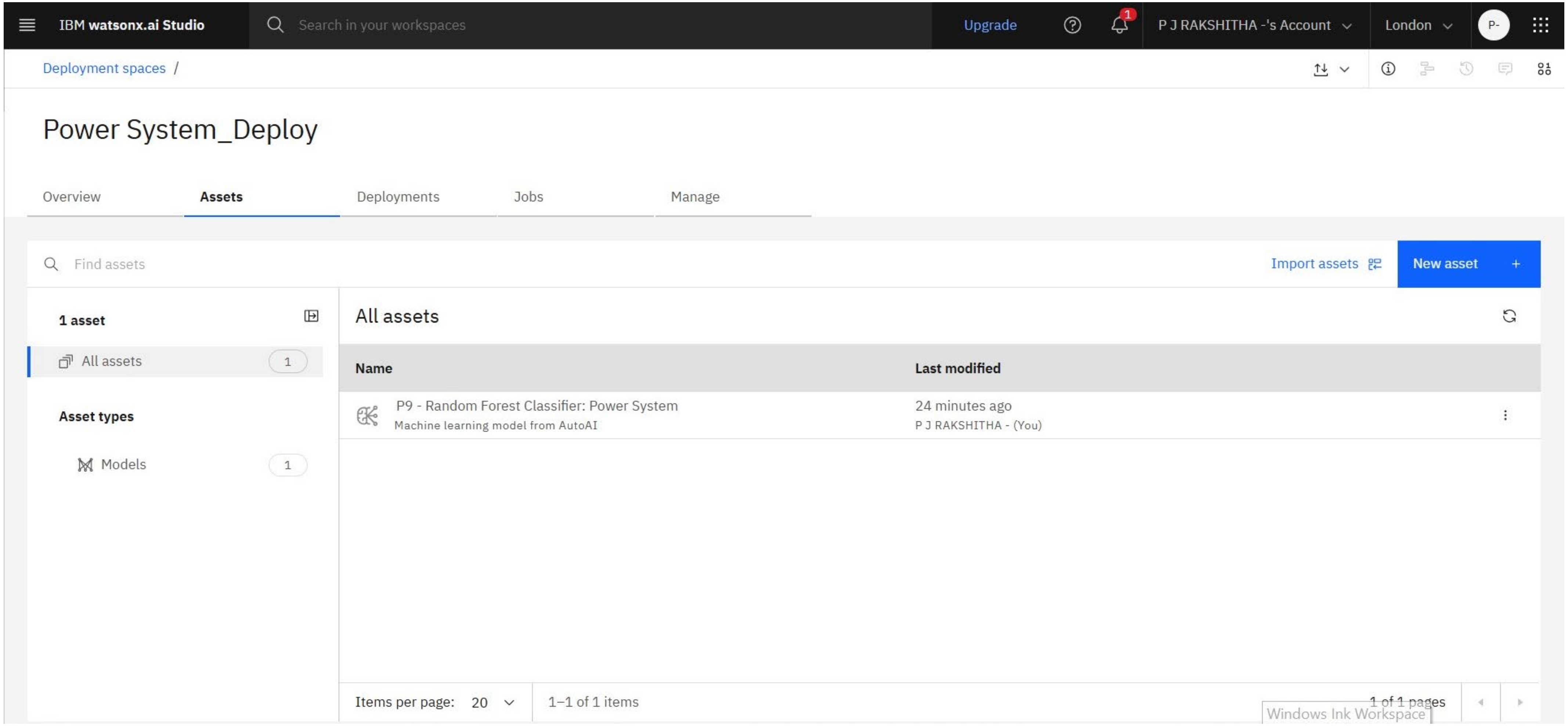
Table view JSON view

Show input data

	prediction	probability
1	Overheating	[0.28970419343567033,0.3839578339127503,0.32633797265157927]
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		

Download JSON file

Windows Ink Workspace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Deployment spaces /
Power System_Deploy
Overview
Assets
Deployments
Jobs
Manage
Find assets
Import assets
New asset
1 asset
All assets 1
Asset types
Models 1
All assets
Name
Last modified
P9 - Random Forest Classifier: Power System
Machine learning model from AutoAI
24 minutes ago
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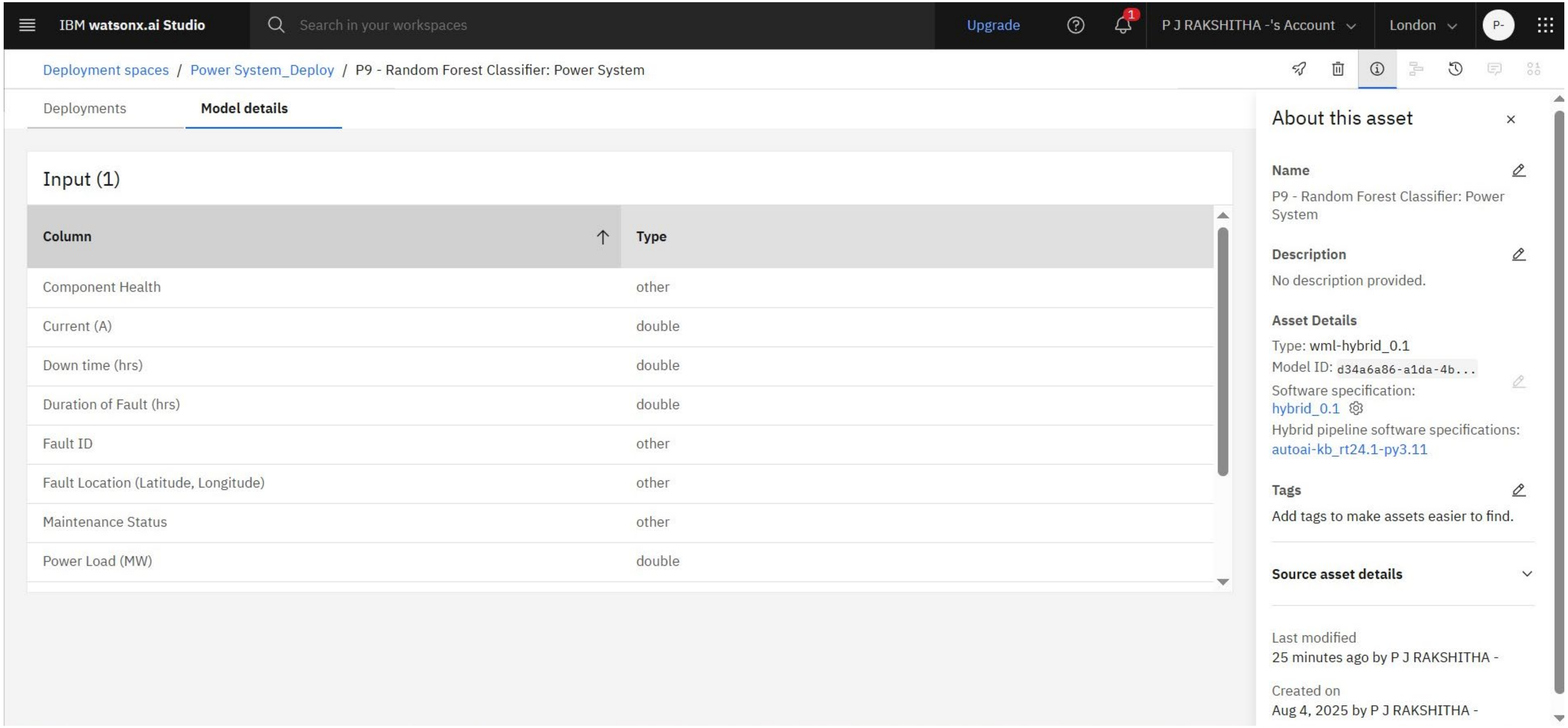
Items per page: 20
1–1 of 1 items
1 of 1 pages
Windows Ink Workspace


IBM watsonx.ai Studio
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London
Deployment spaces / Power System_Deploy / P9 - Random Forest Classifier: Power System
Deployments
Model details
Input (1)
Column
Type
Component Health
other
Current (A)
double
Down time (hrs)
double
Duration of Fault (hrs)
double
Fault ID
other
Fault Location (Latitude, Longitude)
other
Maintenance Status
other
Power Load (MW)
double
About this asset
Name
P9 - Random Forest Classifier: Power System
Description
No description provided.
Asset Details
Type: wml-hybrid_0.1
Model ID: d34a6a86-a1da-4b...
Software specification:
hybrid_0.1
Hybrid pipeline software specifications:
autoai-kb_rt24.1-py3.11
Tags
Add tags to make assets easier to find.
Source asset details
Last modified
25 minutes ago by P J RAKSHITHA -
Created on
Aug 4, 2025 by P J RAKSHITHA -

CONCLUSION

The proposed machine learning-based system effectively automates the **detection and classification of power distribution faults**, improving the speed and accuracy of fault diagnosis. By using Snap Logistic Regression and IBM Watsonx.ai's AutoML capabilities, the model successfully classifies different fault types based on electrical and environmental inputs. Although the initial accuracy is modest, the system demonstrates strong potential for real-time deployment, contributing to enhanced grid reliability, reduced downtime, and smarter energy management. Continuous data updates and model refinements can further improve system performance over time.

FUTURE SCOPE

- **Model Enhancement:**
  Improve prediction accuracy by using advanced algorithms like Random Forest, XGBoost, or deep learning models (e.g., LSTM, CNN).
- **Fault Localization:**
  Extend the system to not just classify but also **pinpoint the exact location** of faults in the grid.
- **Integration with SCADA/IoT Systems:**
  Connect the model with real-time monitoring systems for **automated fault alerts** and proactive maintenance.
- **Time-Series & Streaming Data:**
  Incorporate live data streams to enable **real-time fault detection and continuous learning.**
- **Mobile & Web Interface:**
  Develop a dashboard or mobile app for engineers to view predictions, alerts, and analytics on the go.
- **Scalability & Cloud Deployment:**
  Deploy the solution on scalable cloud platforms for **wider geographic coverage** and reliability.

REFERENCES

- IBM Watsonx.ai Documentation – https://www.ibm.com/products/watsonx-ai
- Scikit-learn: Machine Learning in Python – https://scikit-learn.org
- IEEE Papers on Power System Fault Classification
- “Introduction to Machine Learning” by Andreas C. Müller & Sarah Guido
- Project Dataset – *Custom fault data collected for power distribution analysis*

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