CAPSTONE PROJECT

PREDICTIVE MAINTENANCE OF INDUSTRIAL MACHINERY

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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

Example: Develop a predictive maintenance model for a fleet of industrial machines to anticipate failures before they occur. This project will involve analyzing sensor data from machinery to identify patterns that precede a failure. The goal is to create a classification model that can predict the type of failure (e.g., tool wear, heat dissipation, power failure) based on real-time operational data. This will enable proactive maintenance, reducing downtime and operational costs.

PROPOSED SOLUTION

- Develop a machine learning-powered predictive maintenance system.
- Collect and analyze real-time sensor data (temperature, vibration, voltage, current).
- Detect early warning signs of three failure types:
  - Tool Wear
  - Heat Dissipation Issues
  - Power Failures

- 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 bike demand.
- Machine Learning Algorithm:
  - Implement a machine learning algorithm, such as a time-series forecasting model (e.g., ARIMA, SARIMA, or LSTM), to predict bike counts based on historical patterns.
  - Consider incorporating other factors like weather conditions, day of the week, and special events to improve prediction accuracy.
- Deployment:
  - Develop a user-friendly interface or application that provides real-time predictions for bike counts at different hours.
  - Deploy the solution on a scalable and reliable platform, considering factors like server infrastructure, response time, and user accessibility.

SYSTEM APPROACH

The "System Approach" section outlines the overall strategy and methodology for developing and implementing the . "Predictive Maintenance of Industrial Machinery"Here's a suggested structure for this section:

- **System requirements :-**

  IBM Cloud(mandatory)

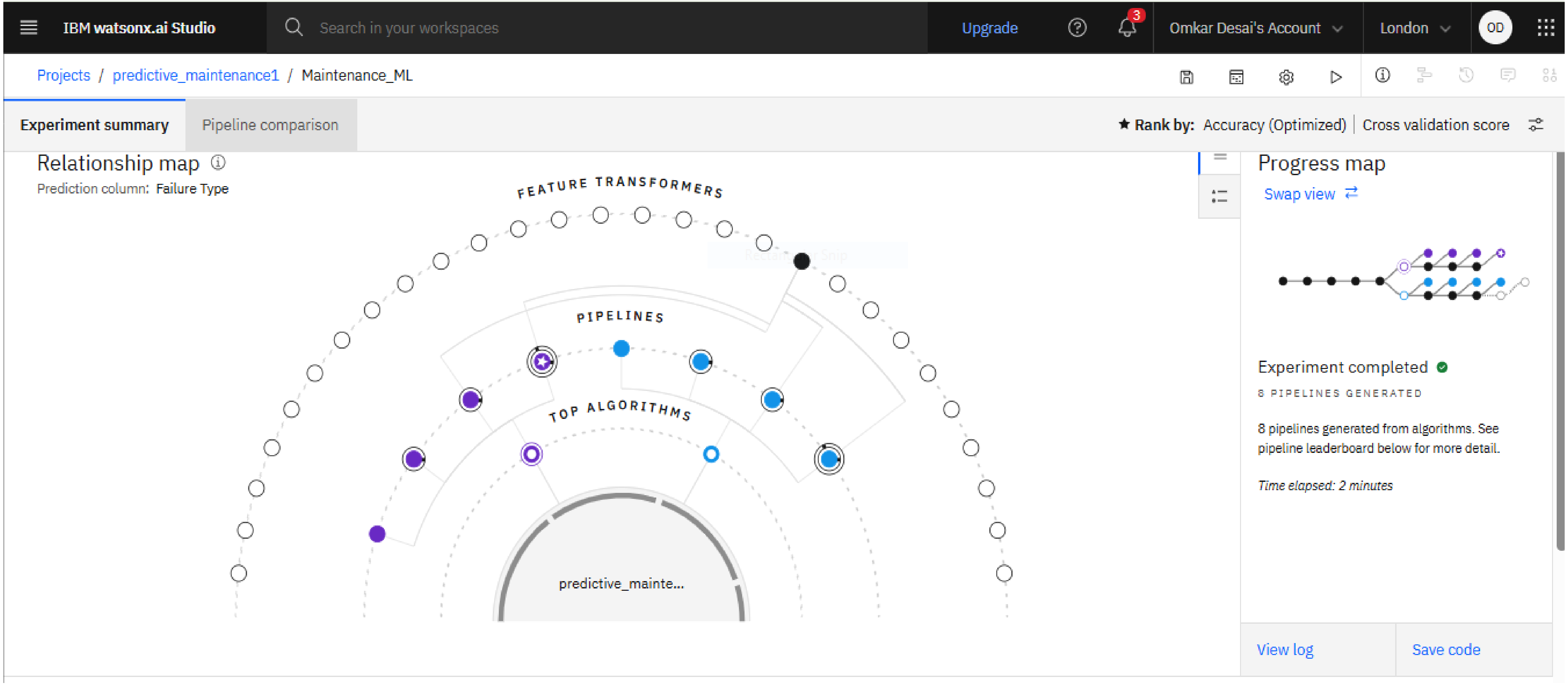
  IBM Watson studio for model development and deployment

  IBM cloud object storage for dataset handling.

ALGORITHM & DEPLOYMENT

- **Algorithm Selection:**
  - Random Forest Classifier(or SVM based on performance).
- **Data Input:**
  - Air temperature [K] , Process temperature [K], Torque [Nm] and many more..
- **Training Process:**
  - Supervised learning using labelled fault types..
- **Prediction Process:**
  - Model deployed on IBM Watson Studio with API endpoint for real-time predictions.

RESULT



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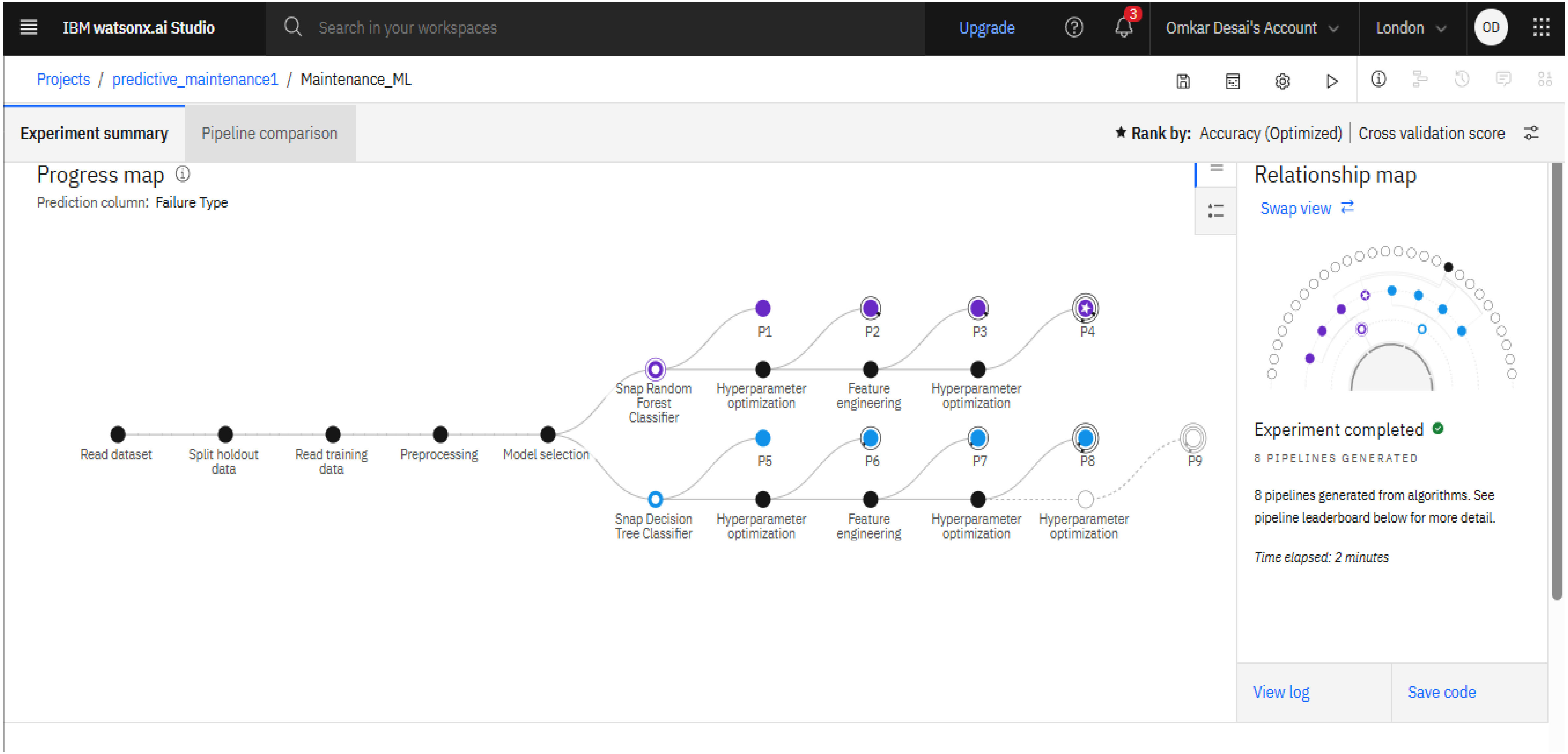
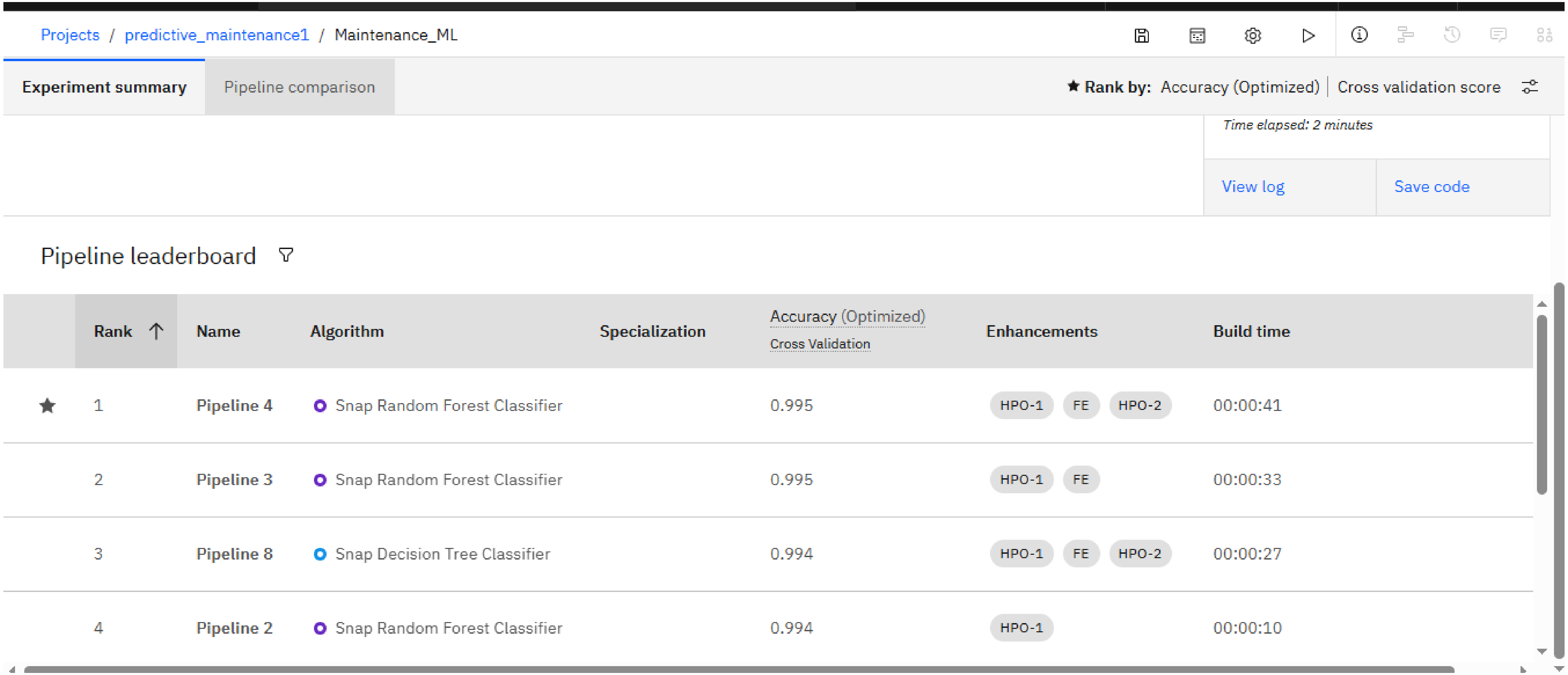


IBM watsonx.ai Studio
Search in your workspaces
Upgrade
3
Omkar Desai's Account
London
OD
Projects / predictive_maintenance1 / Maintenance_ML
Experiment summary
Pipeline comparison
Rank by: Accuracy (Optimized) | Cross validation score
Progress map
Prediction column: Failure Type
Read dataset
Split holdout data
Read training data
Preprocessing
Model selection
Snap Random Forest Classifier
Hyperparameter optimization
Feature engineering
Hyperparameter optimization
P1
P2
P3
P4
Snap Decision Tree Classifier
Hyperparameter optimization
Feature engineering
Hyperparameter optimization
Hyperparameter optimization
P5
P6
P7
P8
P9
Relationship map
Swap view
Experiment completed
8 PIPELINES GENERATED
8 pipelines generated from algorithms. See pipeline leaderboard below for more detail.
Time elapsed: 2 minutes
View log
Save code

PIPELINE LEADERBOARD



	Rank ↑	Name	Algorithm	Specialization	Accuracy (Optimized) Cross Validation	Enhancements	Build time
★	1	Pipeline 4	Snap Random Forest Classifier		0.995	HPO-1 FE HPO-2	00:00:41
	2	Pipeline 3	Snap Random Forest Classifier		0.995	HPO-1 FE	00:00:33
	3	Pipeline 8	Snap Decision Tree Classifier		0.994	HPO-1 FE HPO-2	00:00:27
	4	Pipeline 2	Snap Random Forest Classifier		0.994	HPO-1	00:00:10

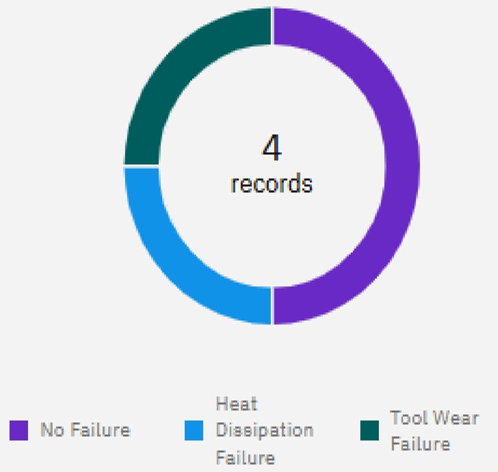
Prediction results

×

Prediction type

Multiclass classification

Prediction percentage



Confidence level distribution

4

Display format for prediction results

Table view JSON view

Show input data

	Prediction	Confidence
1	No Failure	100%
2	Heat Dissipation Failure	90%
3	Tool Wear Failure	90%
4	No Failure	100%
5		
6		
7		
8		
9		
10		
11		
12		
13		

Download JSON file

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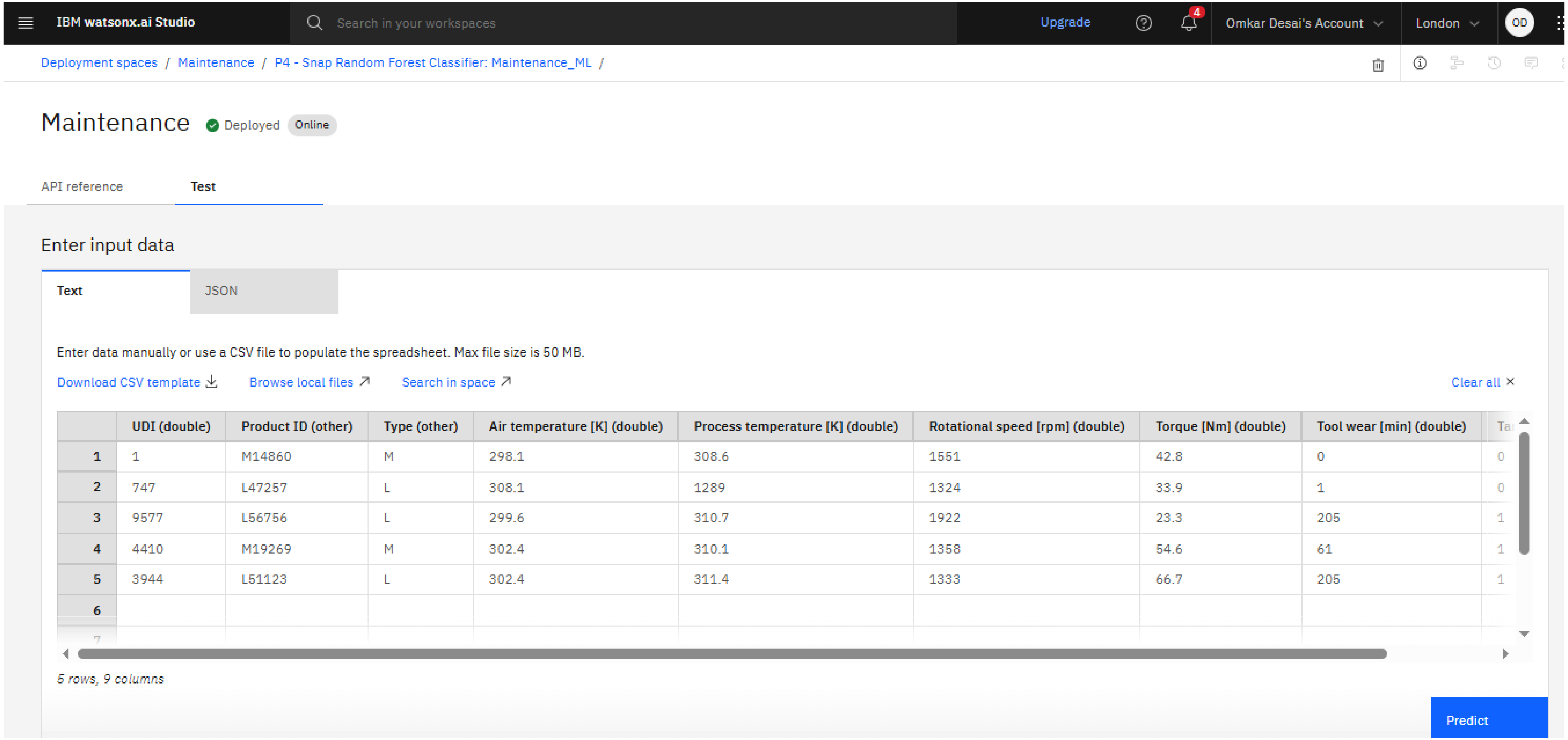
DATA INPUT



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OUTPUT

Prediction results

Display format for prediction results

- Table view
- JSON view

Show input data

	prediction	probability
1	No Failure	[0,1,0,0,0,0]
2	No Failure	[0.4,0.5,0,0,0,0.09999999999999998]
3	Tool Wear Failure	[0,0.1,0,0,0,0.9]
4	Heat Dissipation Failure	[0.7000000000000001,0.2,0.1,0,0,-2.220446049250313e-16]
5	Power Failure	[0.1,0,0,0.9,0,0]
6		
7		

CONCLUSION

The **predictive maintenance model** helps **anticipate machine failures** (tool wear, heat dissipation, power issues) before they occur.

FUTURE SCOPE

- **Integrate Deep Learning models** (LSTM, Transformers) for more accurate **time-series predictions** of failures.
- **Mobile Application Development** to provide real-time alerts and remote monitoring for operators.
- **Automated Maintenance Scheduling** – directly trigger work orders and manage spare part inventory.
- **Cloud Integration** for scalable data storage, model deployment, and analytics across multiple sites.
- **Cross-Industry Expansion** – adapt the solution for sectors like manufacturing, energy, transportation, and smart factories.

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THANK YOU