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

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

- The project aims to build a predictive maintenance model for industrial machines using sensor data. By analyzing real-time operational data, the model will classify and predict failure types (e.g., tool wear, overheating, power issues) before they happen. This will support proactive maintenance, reducing machine downtime and lowering costs.
- Key Components:-

- **Data Collection:-** Using the kaggle dataset on Maintenance of Industrial Machinery.
- **Data Preprocessing:-** Clean and preprocess the collected data to handle missing values,and inconsistencies.
- **Deployment:-** Developed a user-friendly interface or application that predict the type of failure based on real-time operational data.
- **Evaluation:-** Assess the model's performance using appropriate metrics such as Mean Absolute Error, or other relevant metrics.

SYSTEM APPROACH

The "System Approach" section outlines the overall strategy and methodology for developing and implementing the rental bike prediction system. Here's a suggested structure for this section:

System requirements

- IBM Cloud
- IBM Watsonx.studio for model development
- IBM Runtime environment
- IBM Cloud object storage for dataset handling

ALGORITHM & DEPLOYMENT

- Algorithm chosen for Predictive Maintenance of Industrial Machinery.
- **Algorithm Selection:**

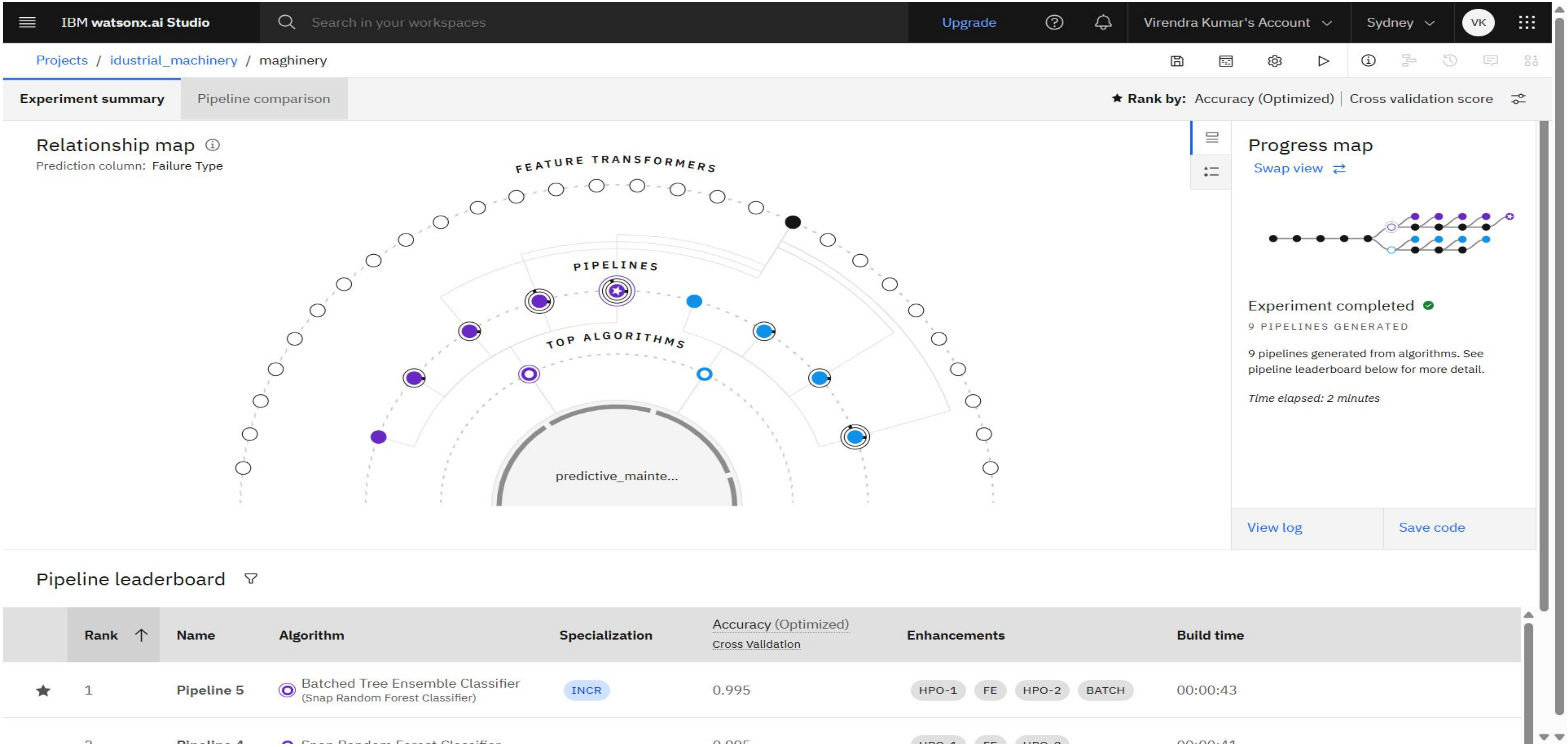
  Random Forest Classifier(or SVM Based on performance)
- **Data Input:**

  Air temperature,Rotational speed,Torque,Tool wear.
- **Training Process:**

  Supervised Learning using Failure Type.
- **Prediction Process:**

  Model deployed on IBM Watsonx.studio with API endpoint for real time predictions.

RESULT



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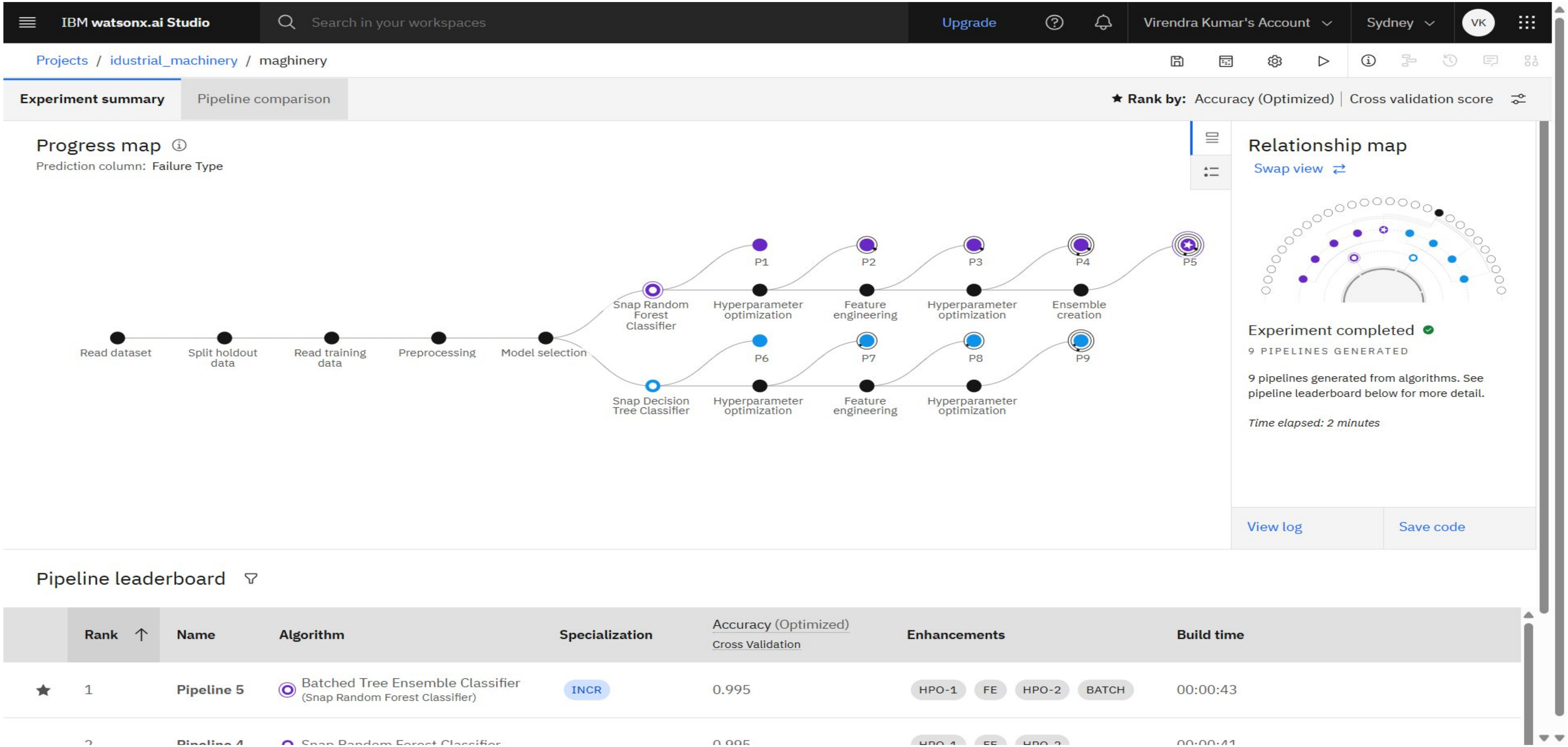
RESULT



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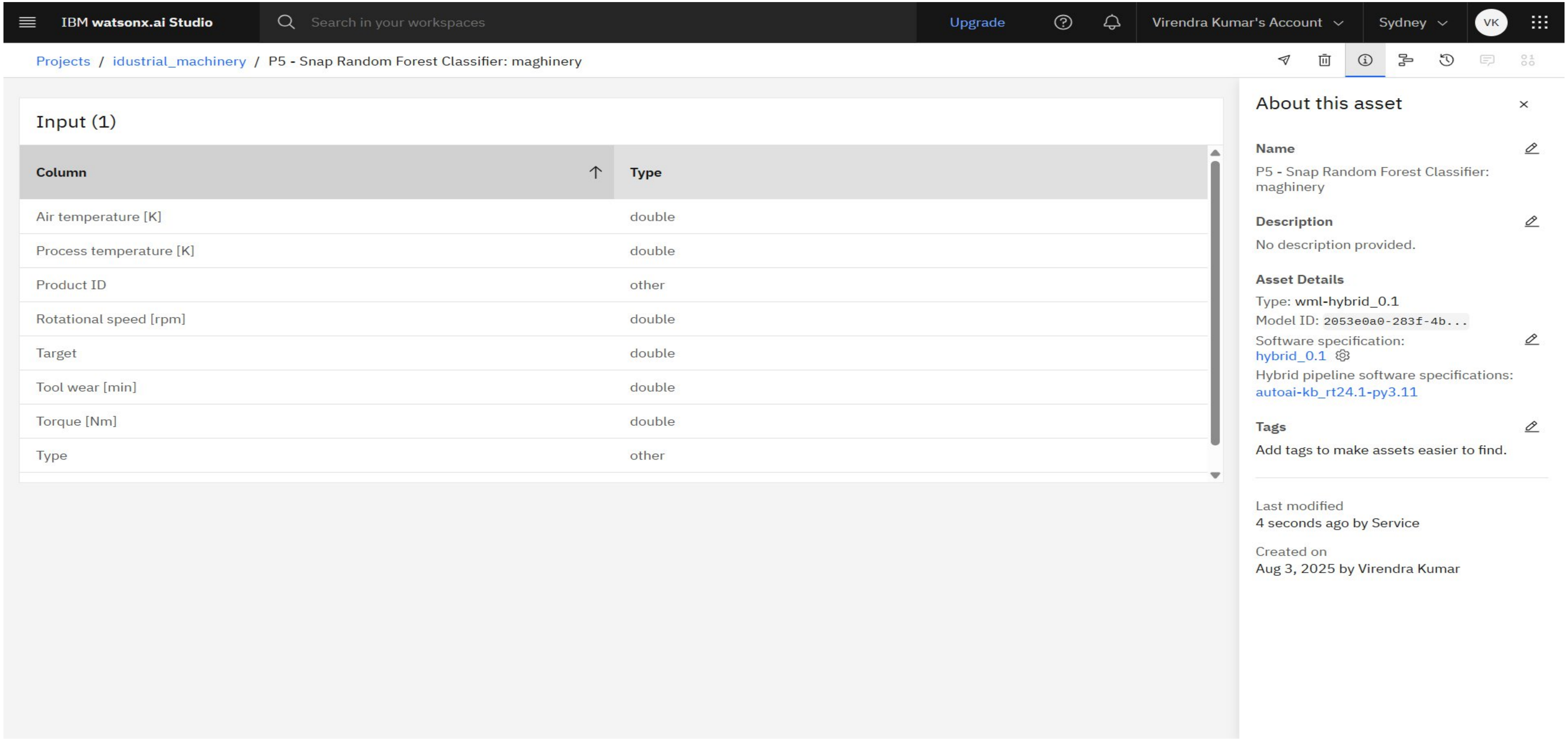
Projects / idustrial_machinery / maghinery
Experiment summary
Pipeline comparison
Rank by: Accuracy (Optimized) | Cross validation score
Progress map
Prediction column: Failure Type
Read dataset
Split holdout data
Read training data
Preprocessing
Model selection
Snap Random Forest Classifier
Snap Decision Tree Classifier
Hyperparameter optimization
Feature engineering
Hyperparameter optimization
Ensemble creation
P1
P2
P3
P4
P5
P6
P7
P8
P9
Relationship map
Swap view
Experiment completed
9 PIPELINES GENERATED
9 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 5
Batched Tree Ensemble Classifier
(Snap Random Forest Classifier)
INCR
0.995
HPO-1
FE
HPO-2
BATCH
00:00:43

RESULT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Projects / idustrial_machinery / P5 - Snap Random Forest Classifier: maghinery
Input (1)
Column
Type
Air temperature [K]
double
Process temperature [K]
double
Product ID
other
Rotational speed [rpm]
double
Target
double
Tool wear [min]
double
Torque [Nm]
double
Type
other
About this asset
Name
P5 - Snap Random Forest Classifier: maghinery
Description
No description provided.
Asset Details
Type: wml-hybrid_0.1
Model ID: 2053e0a0-283f-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.
Last modified
4 seconds ago by Service
Created on
Aug 3, 2025 by Virendra Kumar

RESULT

IBM **watsonx.ai Studio** Search in your workspaces Upgrade 1 Virendra Kumar's Account Sydney VK

Deployment spaces / dep_machi / P5 - Snap Random Forest Classifier: maghinery /

depl_machine

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.

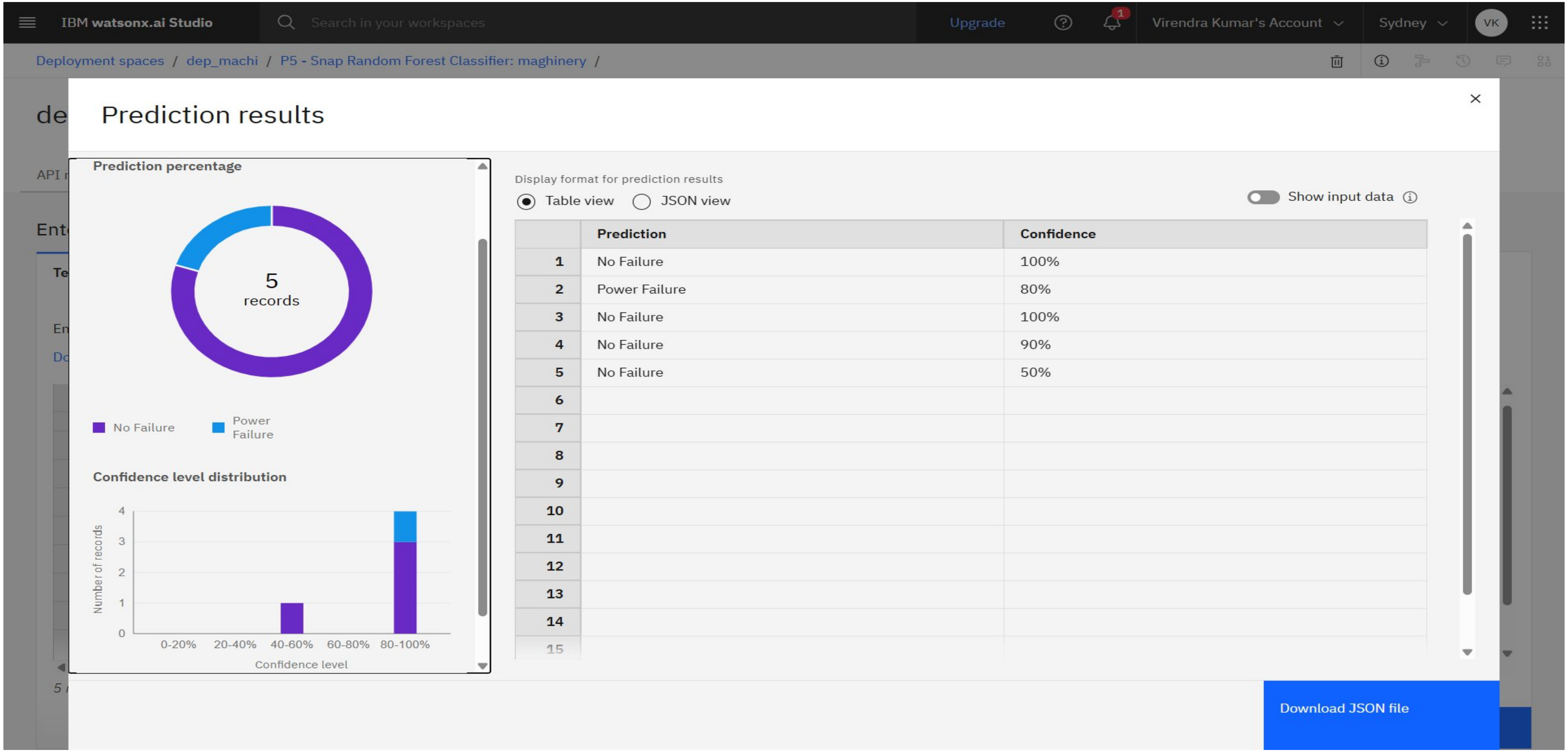
Download CSV template Browse local files Search in space Clear all ×

	UDI (...	Product ID...	Type (ot...	Air temperature [K] (d...	Process temperature [K] (...	Rotational speed [rpm]...	Torque [Nm] (d...	Tool wear [mi...	Target (double)
1	5	M14860	M	296.4	306.4	1523	42.6	5	0
2	115	L47194	L	298.6	309.6	1954	49.8	167	1
3	50	M14879	M	301.9	305.5	2546	65.2	213	0
4	45	H29434	H	302.2	311.2	2589	65.7	114	0
5	15	H29441	H	297.5	312.8	2846	75.2	54	1
6									
7									
8									
9									

5 rows, 9 columns

Predict

RESULT



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CONCLUSION

- The development of a predictive maintenance model for industrial machinery marks a significant step toward improving operational efficiency and minimizing unplanned downtime. By leveraging real-time sensor data and machine learning techniques, the model can accurately predict various types of failures such as tool wear, heat dissipation issues, and power failures. This proactive approach allows maintenance teams to address potential issues before they escalate, resulting in reduced maintenance costs, improved machine longevity, and optimized production schedules. As the model continues to learn from new data, its accuracy and reliability will improve, further enhancing the effectiveness of maintenance strategies across the fleet.

FUTURE SCOPE

- The predictive maintenance model can be expanded for use across various industries and integrated with IoT for real-time monitoring. It holds potential for large-scale deployment, ERP/EAM integration, and advanced features like root cause analysis and self-learning. Over time, it can enhance machine efficiency, reduce downtime, and support sustainability by optimizing maintenance and resource use.

REFERENCES

- Zhang et al. (2019) – Survey on data-driven predictive maintenance
- NASA (n.d.) – Prognostics Data Repository
- Tsui et al. (2015) – Data-driven PHM approaches
- Scikit-learn – Machine learning library in Python
- TensorFlow – Open-source ML platform.

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In recognition of the commitment to achieve professional excellence

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for the completion of

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(ALM-COURSE_3824998)

According to the Adobe Learning Manager system of record

Completion date: 24 Jul 2025 (GMT) **Learning hours:** 20 mins

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