Machine Learning Project

PREDICTIVE MAINTENANCE OF INDUSTRIAL MACHINERY

Presented By: Vivek Chauhan
World College of Technology and Management
Artificial Intelligence and Machine Learning

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OUTLINE

- **Problem Statement**
- **Proposed System/Solution**
- **System Development Approach** (Technology Used)
- **Algorithm & Deployment**
- **Result (Output Image)**
- **Conclusion**
- **Future Scope**
- **References**

PROBLEM STATEMENT

Example:Unexpected failure of industrial machinery leads to unplanned downtime, costly repairs, and financial losses. Traditional maintenance methods are either schedule-based (which might waste resources) or reactive (after failure).

The challenge is to develop a predictive maintenance model that analyzes machinery sensor data and predicts the type of failure (e.g., tool wear, heat dissipation, power failure) before it occurs, enabling proactive action.

PROPOSED SOLUTION

- Goal: Use machine learning to anticipate machinery failures using real-time sensor data.
- Approach:
  - Collect and preprocess historical sensor data from industrial machines.
  - Train a classification model to identify failure patterns and predict failure types.
  - Deploy the model using IBM Cloud Lite services for real-time prediction and alerting.
- Modules:
  - Data Collection: Gather sensor data (temperature, vibration, pressure, etc.).
  - Preprocessing: Clean, handle missing values, and feature engineer the data.
  - Model Building: Use Random Forest/XGBoost for multiclass classification.
  - Deployment: Model deployed on IBM Watson Machine Learning via Watson Studio.
  - Alerts: Trigger proactive maintenance notifications

SYSTEM APPROACH

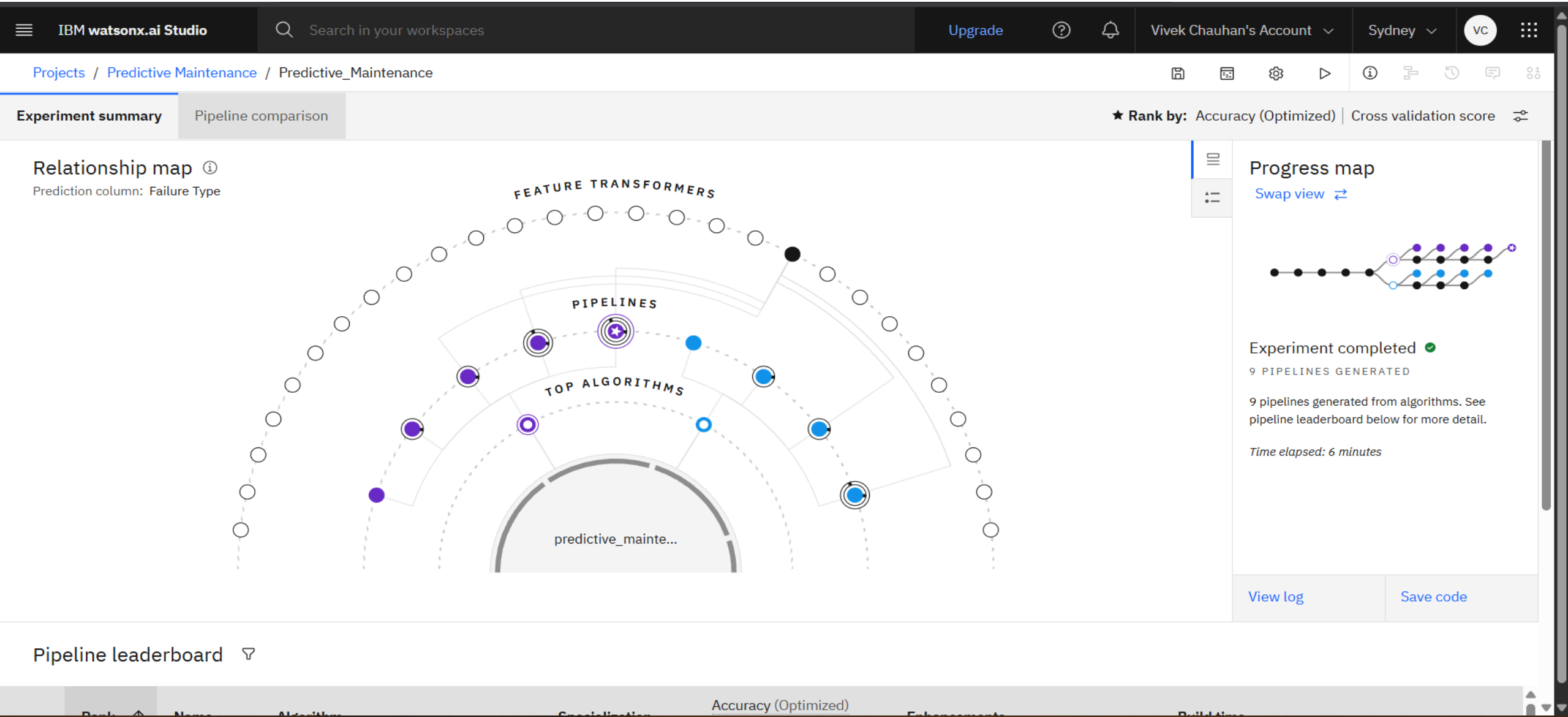
- IBM Cloud Lite Services:
  - IBM Watson Studio (data analysis, model development)
  - IBM Cloud Object Storage (data storage)
  - IBM Watson Machine Learning (model deployment)
  - IBM Cloud services for dashboard/notification (optional)
- Libraries Required:
  - Pandas, NumPy (data processing)
  - Scikit-learn, XGBoost (machine learning)
  - Matplotlib/Seaborn (visualizations)
  - IBM Watson SDKs (cloud integration)
- System Requirements:
  - Internet, modern browser
  - IBM Cloud Lite account

ALGORITHM & DEPLOYMENT

- In the Algorithm section, describe the machine learning algorithm chosen for predicting bike counts. Here's an example structure for this section:
- Algorithm Selection:
- Random Forest Classifier, XGBoost, Logistic Regression.
- Random Forest chosen due to its effectiveness in handling multiclass tabular data, and ability to interpret feature importance
- Data Input:
  - Sensor readings (temperature, vibration, voltage, etc.), machine ID, age, failure labels..
- Training Process:
- Data split into train/test sets.
- Data preprocessing: Imputation, scaling, encoding.
- Model trained with cross-validation and hyperparameter tuning.

- Prediction Process:
- Model exported and uploaded to IBM Watson Machine Learning.
- Exposed as REST API for real-time predictions on incoming sensor data.

RESULT


IBM watsonx.ai Studio
Search in your workspaces
Upgrade
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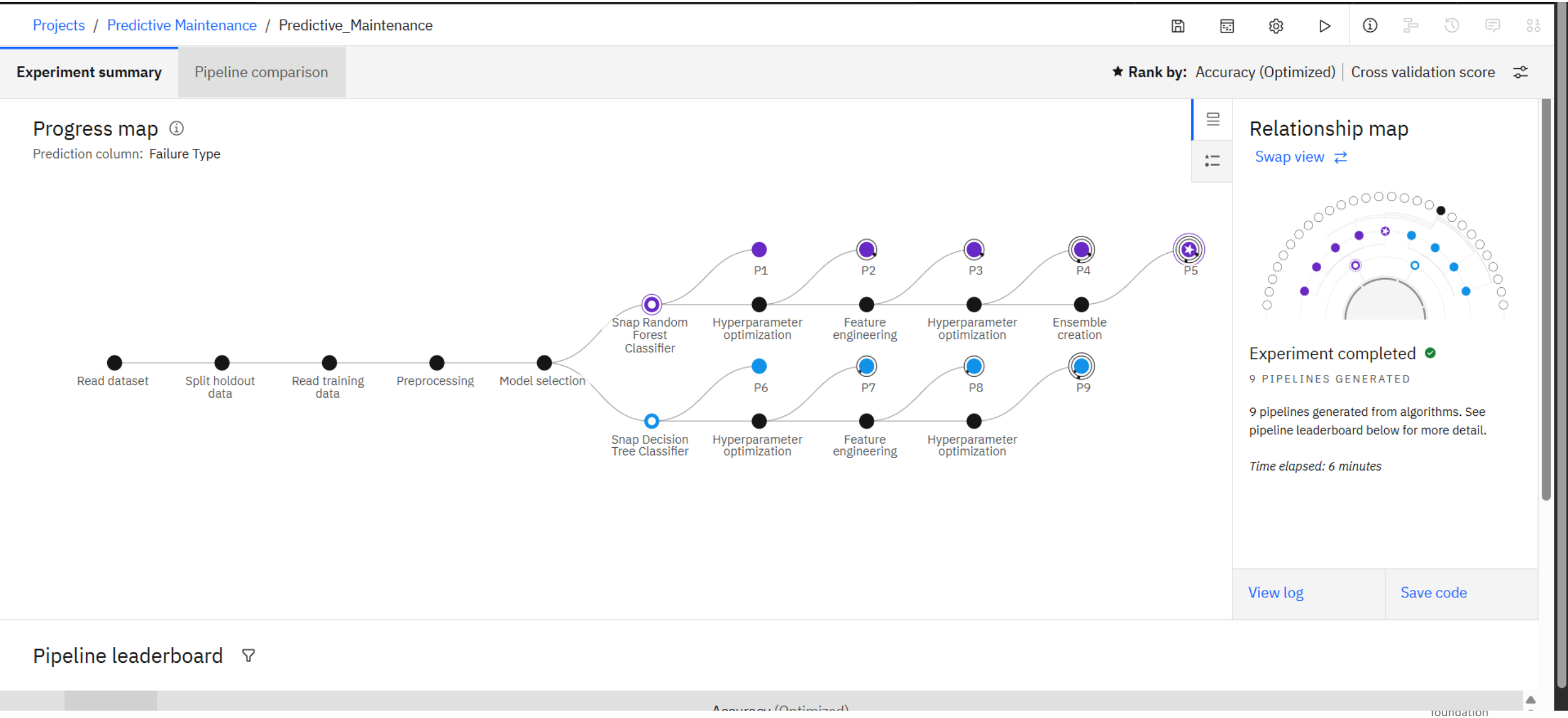
Sydney
VC
Projects / Predictive Maintenance / Predictive_Maintenance
Experiment summary
Pipeline comparison
Rank by: Accuracy (Optimized) | Cross validation score
Relationship map
Prediction column: Failure Type
FEATURE TRANSFORMERS
PIPELINES
TOP ALGORITHMS
predictive_mainte...
Progress map
Swap view
Experiment completed
9 PIPELINES GENERATED
9 pipelines generated from algorithms. See pipeline leaderboard below for more detail.
Time elapsed: 6 minutes
View log
Save code
Pipeline leaderboard
Accuracy (Optimized)

RESULT


Projects / Predictive Maintenance / Predictive_Maintenance
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
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Time elapsed: 6 minutes
View log
Save code
Pipeline leaderboard

RESULT

Predictive_Maintenance2

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.

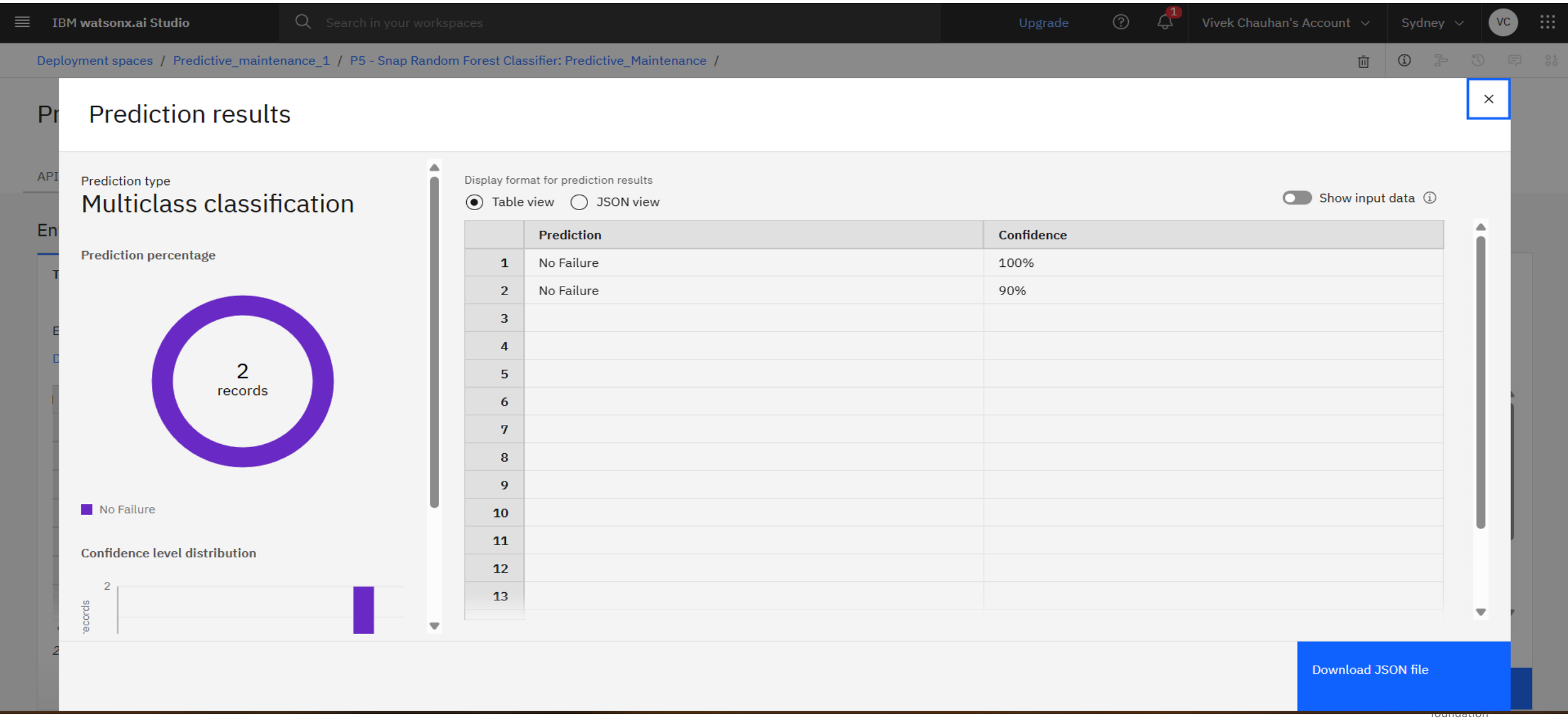
Download CSV template | Browse local files | Search in space | Clear all

	Product ID (other)	Type (other)	Air temperature [K] (double)	Process temperature [K] (double)	Rotational speed [rpm] (double)	Torque [Nm] (double)	Tool wear [min] (double)	Target (double)
1	M14860	M	298.1	308.6	1551	42.8	0	0
2	m1098	f	890.5	789	446	987	8	6
3								
4								
5								
6								
7								

2 rows, 9 columns

Predict

RESULT


IBM watsonx.ai Studio
Search in your workspaces
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Sydney
VC
Deployment spaces / Predictive_maintenance_1 / P5 - Snap Random Forest Classifier: Predictive_Maintenance /
Prediction results
Prediction type
Multiclass classification
Prediction percentage
2
records
No Failure
Confidence level distribution
2
records
Display format for prediction results
Table view
JSON view
Show input data
Prediction
Confidence
1 No Failure 100%
2 No Failure 90%
3
4
5
6
7
8
9
10
11
12
13
Download JSON file

CONCLUSION

- Developed a robust predictive maintenance solution leveraging IBM Cloud and machine learning.
- Achieved high accuracy in predicting and classifying failure types.
- Enables maintenance teams to act proactively, thereby reducing downtime and cost.
- IBM Cloud Lite proved scalable and simple for deployment.

FUTURE SCOPE

- Integrate the solution with IoT platforms for seamless real-time data ingestion.
- Use advanced models (e.g., LSTM for time series).
- Expand to more failure types and equipment.
- Add dashboard and mobile app notifications for maintenance staff.

REFERENCES

- Kaggle Predictive Maintenance Dataset
- IBM Cloud Documentation
- Research papers on predictive maintenance and machine learning in industry

IBM CERTIFICATIONS

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IBM CERTIFICATIONS

In recognition of the commitment to achieve professional excellence

Vivek Chauhan

Has successfully satisfied the requirements for:

Journey to Cloud: Envisioning Your Solution

Issued on: Jul 19, 2025
Issued by: IBM SkillsBuild

Verify: https://www.credly.com/badges/fcf987c9-2874-4b09-9b44-8749d25d3364

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IBM CERTIFICATIONS

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IBM **SkillsBuild** Completion Certificate

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According to the Adobe Learning Manager system of record

Completion date: 24 Jul 2025 (GMT)

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THANK YOU

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