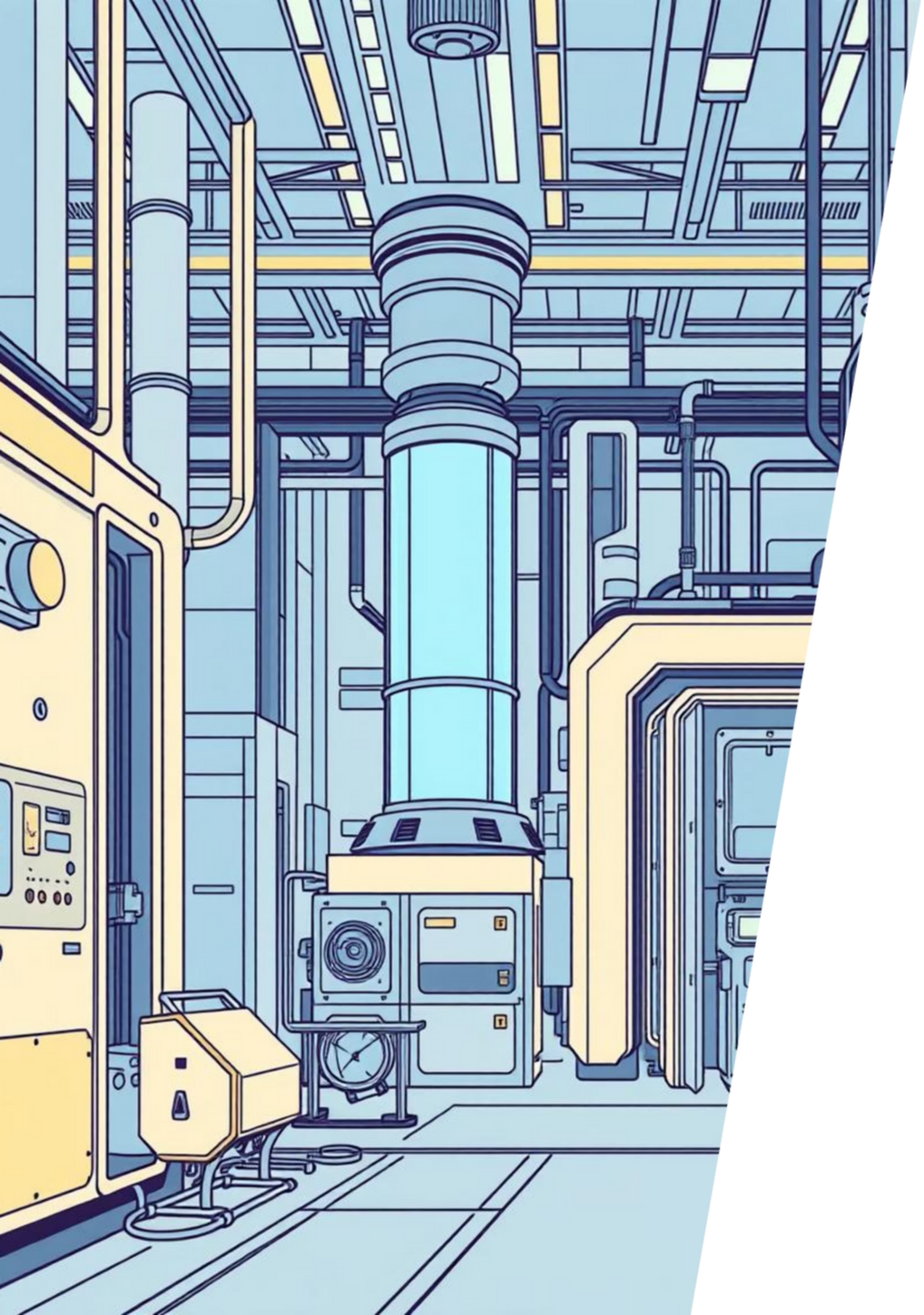

Predictive Maintenance for Industrial Machinery

A Capstone Project

Presented by
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Pallavi Engineering College
CSE (Data Science)

Presentation Outline

- Problem Statement: Unplanned Machine Failures
- Proposed Solution: ML-Driven Prediction
- System Development Approach: Tools & Data
- Algorithm & Deployment: Random Forest on Watsonx
- Results: Prediction Outputs
- Conclusion: Project Success & Impact
- Future Scope: Enhancements & Expansion
- References & Certifications

The Challenge: Unplanned Downtime

High Costs

Unplanned machine failures lead to significant financial losses due to disrupted production and emergency repairs.

Inefficient Maintenance

Traditional methods are either reactive (repair after failure) or time-based (scheduled, but not optimized).

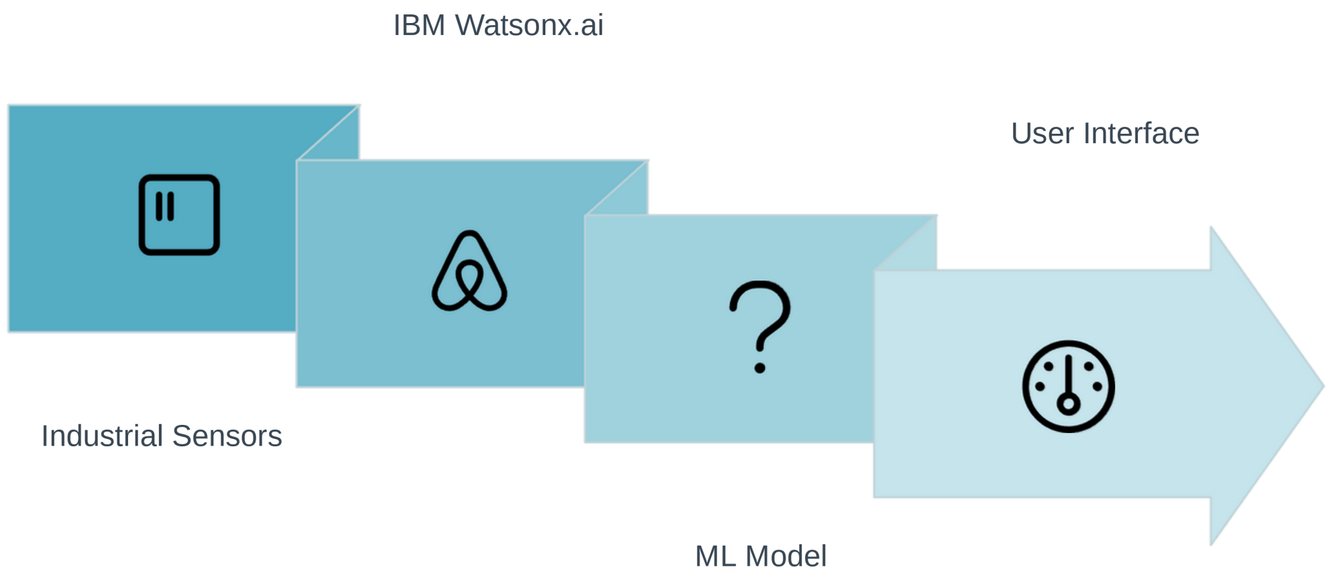
Need for Proactivity

A proactive approach, leveraging sensor data and machine learning, is crucial to prevent failures.

Project Goal

Predict machine failures before they occur to minimize downtime and optimize maintenance schedules.

Our Solution: Predictive ML Pipeline



Our solution involves a robust pipeline for data collection, ML classification, and model deployment.

System Development Approach

Key Tools

- IBM Watsonx.ai
- Python
- scikit-learn
- pandas
- matplotlib

Dataset & Target

- Kaggle's Predictive Maintenance Dataset
- Multi-class classification of distinct failure types (e.g., Tool Wear, Heat Dissipation)

Platform

- IBM Cloud Lite
- Watsonx.ai Studio

Algorithm & Deployment

1 Algorithm Selection

Random Forest Classifier chosen for its interpretability and efficiency in handling diverse industrial data.

2 Feature Engineering

Utilized critical sensor parameters: Air Temperature, Process Temperature, Rotational Speed, Torque, and Tool Wear.

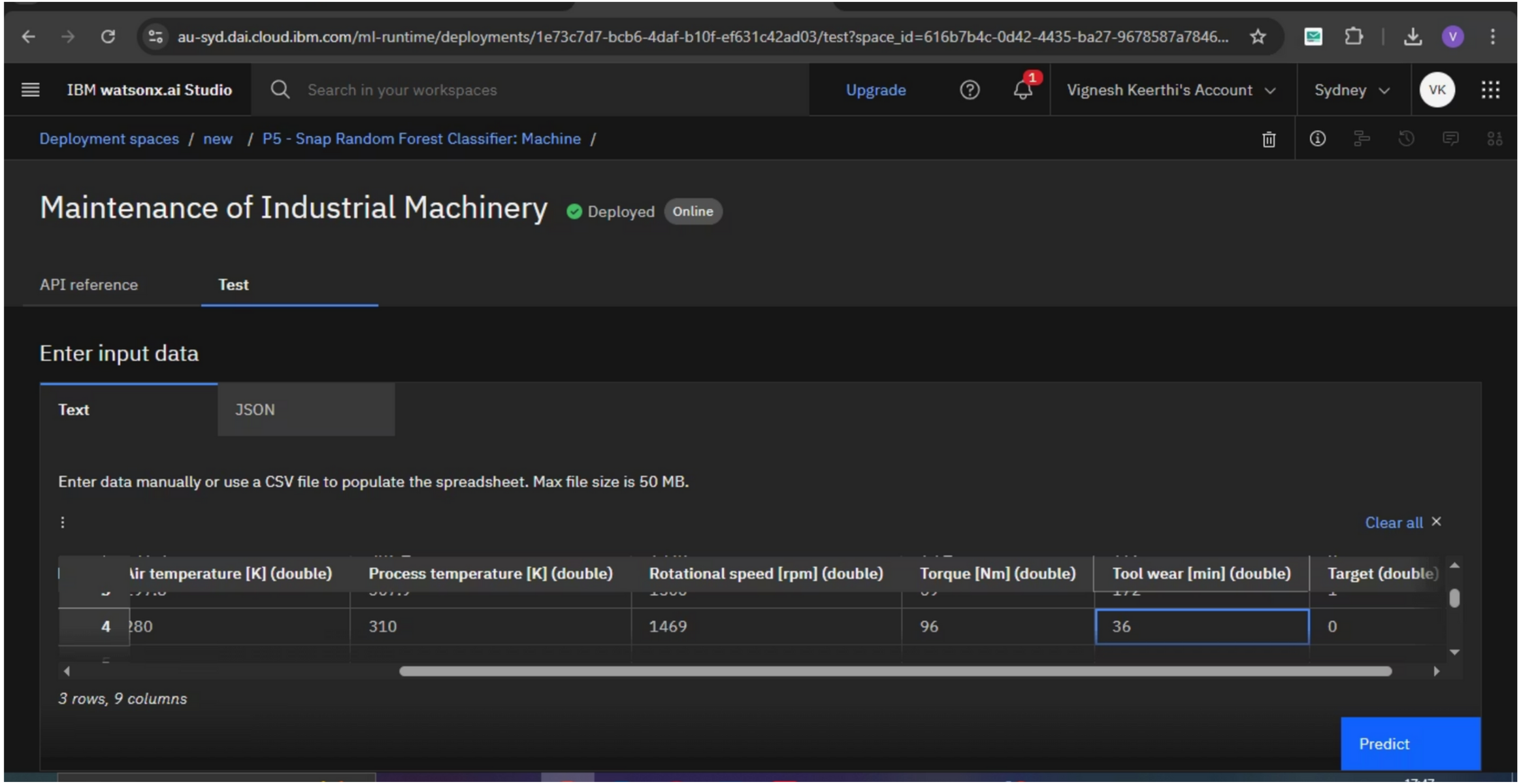
3 Model Workflow

Rigorous process: Data cleaning, normalization, training, and evaluation for optimal performance.

4 Deployment

Model successfully tested and deployed on IBM Watsonx, accepting JSON/CSV inputs for real-time predictions.

Result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Deployed
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API reference
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Enter input data
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JSON
Enter data manually or use a CSV file to populate the spreadsheet. Max file size is 50 MB.
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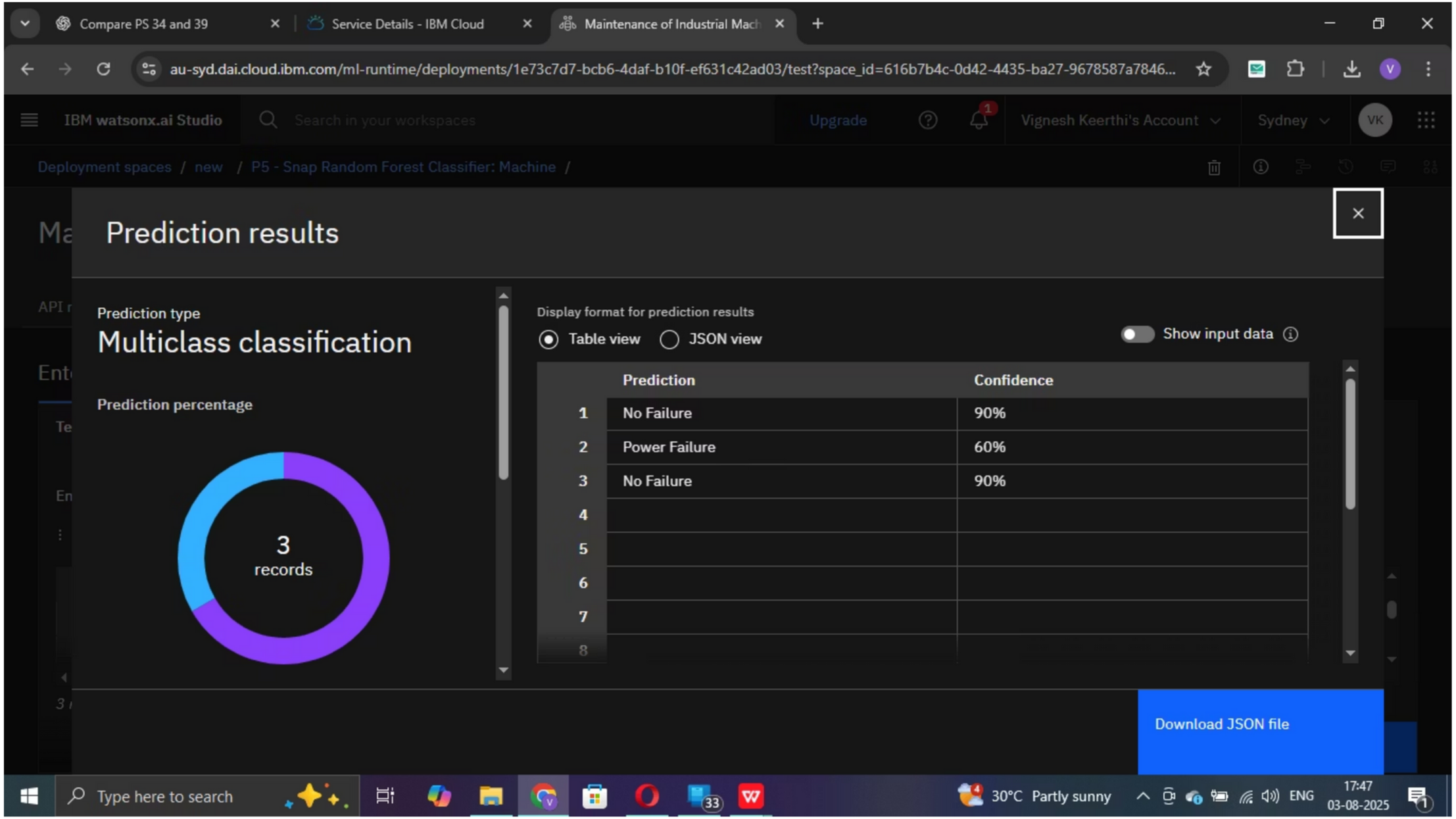
Process temperature [K] (double)
Rotational speed [rpm] (double)
Torque [Nm] (double)
Tool wear [min] (double)
Target (double)
4
310
1469
96
36
0
3 rows, 9 columns
Predict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Prediction results
Prediction type
Multiclass classification
Prediction percentage
3
records
Display format for prediction results
Table view
JSON view
Show input data
Prediction
Confidence
1 No Failure 90%
2 Power Failure 60%
3 No Failure 90%
4
5
6
7
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Compare PS 34 and 39 | Service Details - IBM Cloud | Maintenance of Industrial Mach

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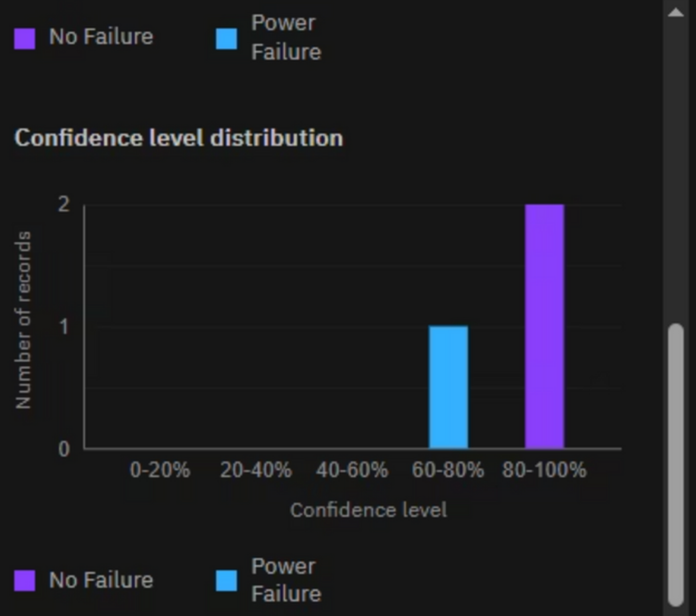
Prediction results



Display format for prediction results

Table view | JSON view

Show input data

	Prediction	Confidence
1	No Failure	90%
2	Power Failure	60%
3	No Failure	90%
4		
5		
6		
7		
8		

Download JSON file

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Conclusion & Impact

Successful Prediction: Our model effectively predicted machine failures using real-time sensor data.

High Confidence: The Random Forest Classifier achieved approximately 90% confidence in most prediction cases.

Real-time Insights: IBM Watsonx enabled seamless real-time testing and visualization of predictions.

ML in Action: This project provides a strong demonstration of machine learning's practical application in industrial maintenance.

Future Scope & Enhancements

Live IoT Integration

Incorporate real-time IoT sensor streams for continuous data input and immediate predictions.

Advanced Time-Series Models

Explore and implement LSTM or other sequential models for enhanced pattern recognition in time-series data.

Alerting & Dashboard UI

Develop a robust alerting system and intuitive dashboard for real-time notifications and operational oversight.

Expand Industrial Application

Extend the solution to a wider range of industrial equipment and diverse datasets for broader applicability.

References & Certifications

- Kaggle: Machine Predictive Maintenance Classification Dataset
- IBM Watsonx.ai Documentation
- scikit-learn Machine Learning Library
- Key Research Articles on AI-powered Predictive Maintenance

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Learning hours: 20 mins

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