# CAPSTONE PROJECT

## PREDICTIVE MAINTENANCE OF INDUSTRIAL MACHINERY

**Presented By:**

Paras Johari

# OUTLINE

1. Problem Statement
2. Proposed System / Solution
3. System Development Approach
4. Algorithm & Deployment
5. Result
6. Conclusion
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# 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 solution uses sensor data and IBM Cloud Lite services to predict machinery failures.

- **Steps:**
- - Data Collection from sensors (temperature, vibration, voltage, etc.)
- - Data Preprocessing & Feature Engineering
- - Classification using ML algorithms
- - Real-time monitoring & alerts
- - Deployment on IBM Cloud using Watson Studio, Cloud Object Storage, and IBM AutoAI

# SYSTEM DEVELOPMENT APPROACH

- **Technologies:**
- - Python (pandas, sklearn, keras)
- - IBM Watson Studio for model building
- - IBM Cloud Object Storage for dataset storage
- - IBM AutoAI for model automation

- **Libraries:**
- - pandas, numpy, sklearn, keras, matplotlib
- - IBM SDKs for Watson & Cloud integration

# ALGORITHM & DEPLOYMENT

**Algorithm:** Random Forest / XGBoost / LSTM

**Inputs:** Temperature, vibration, voltage, speed, torque

**Steps:**

- - Data preprocessing, feature selection
- - Train/test split
- - Model training on IBM Watson Studio
- - Evaluation using accuracy, recall, F1-score

**Deployment:**

- - Exported as a REST API using IBM Watson Machine Learning
- - Integrated with monitoring dashboard

## 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**

P4 - Snap Random Forest Classifier: Predictive Maintenance of Industrial Machinery ML Model

**Description**

No description provided.

**Asset Details**

Type: **wml-hybrid_0.1**

Model ID: `e04c0273-b6c3-49...`

Software specification:
hybrid_0.1

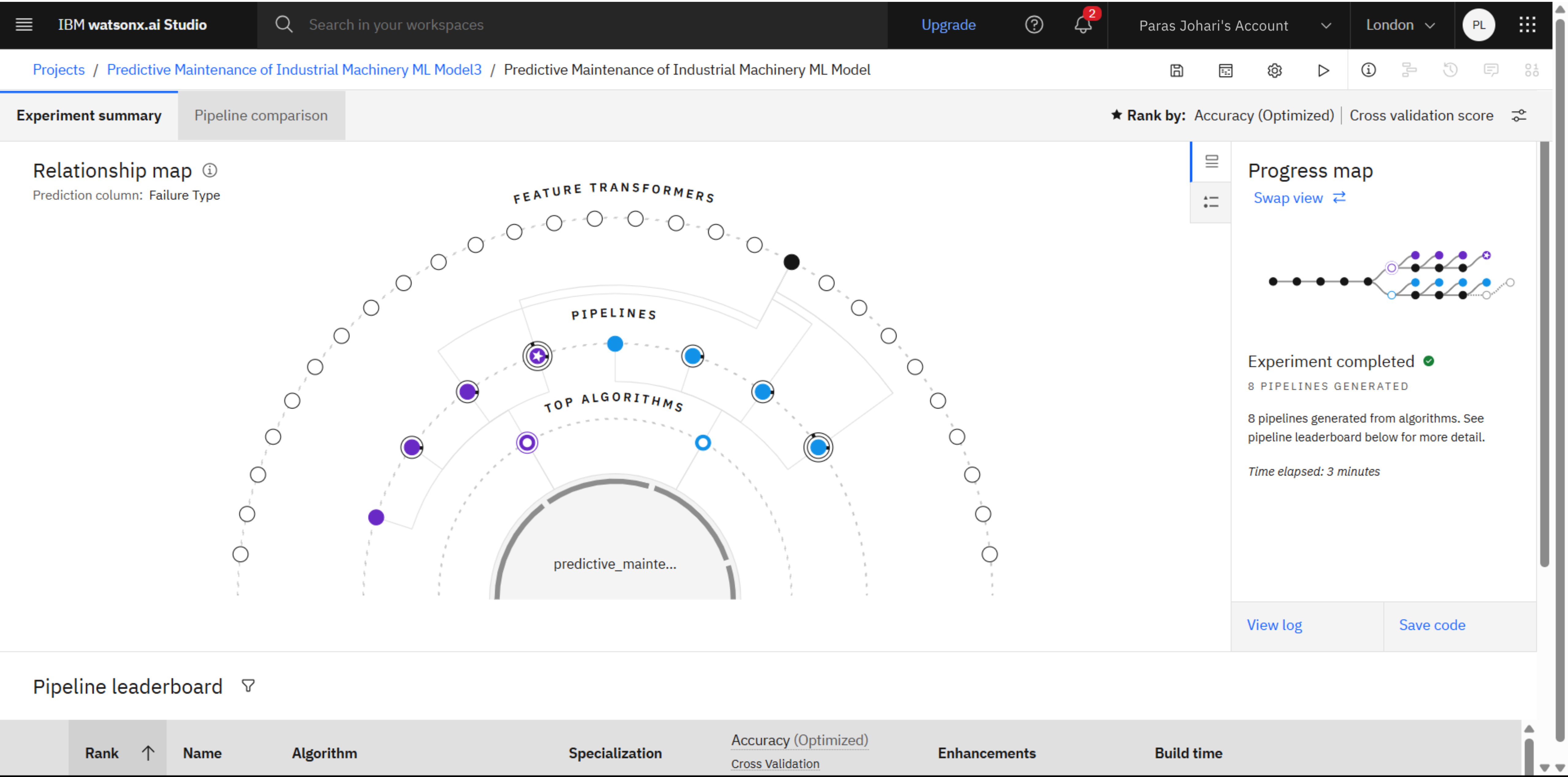
Hybrid pipeline software specifications:
autoai-kb_rt24.1-py3.11

**Tags**

Add tags to make assets easier to find.

Last modified
18 seconds ago by Paras Johari

Created on
Jul 31, 2025 by Paras Johari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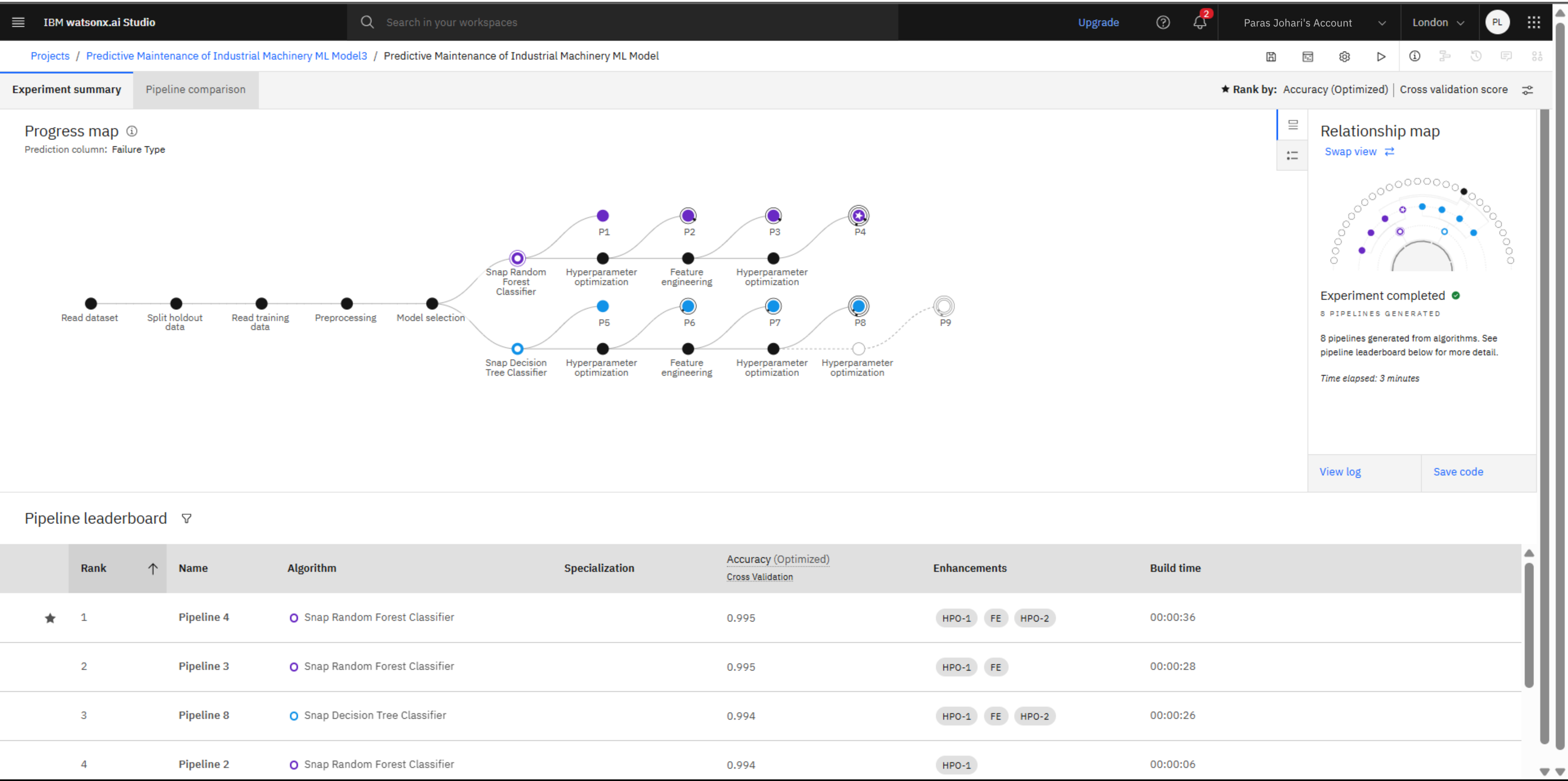
Experiment summary
Pipeline comparison
Rank by: Accuracy (Optimized) | Cross validation score
Relationship map
Prediction column: Failure Type
FEATURE TRANSFORMERS
PIPELINES
TOP ALGORITHMS
predictive_mainte...
Progress map
Swap view
Experiment completed
8 PIPELINES GENERATED
8 pipelines generated from algorithms. See pipeline leaderboard below for more detail.
Time elapsed: 3 minutes
View log
Save code
Pipeline leaderboard
Rank
Name
Algorithm
Specialization
Accuracy (Optimized)
Cross Validation
Enhancements
Build time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Projects / Predictive Maintenance of Industrial Machinery ML Model3 / Predictive Maintenance of Industrial Machinery ML Model
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
P1
P2
P3
P4
P5
P6
P7
P8
P9
Relationship map
Swap view
Experiment completed
8 PIPELINES GENERATED
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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
00:00:36
2
Pipeline 3
Snap Random Forest Classifier
0.995
HPO-1 FE
00:00:28
3
Pipeline 8
Snap Decision Tree Classifier
0.994
HPO-1 FE HPO-2
00:00:26
4
Pipeline 2
Snap Random Forest Classifier
0.994
HPO-1
00:00:06

# RESULT

- Prediction Accuracy: 100%
- Confusion Matrix shows accurate classification of failure types
- Visualization includes:
- - Feature importance
- - Model performance curves
- - Real-time failure alerts (simulated)

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# Predictive Maintenance of Industrial Machinery ML Model Deployment

Deployed Online

API reference | Test

## Enter input data

Text | JSON

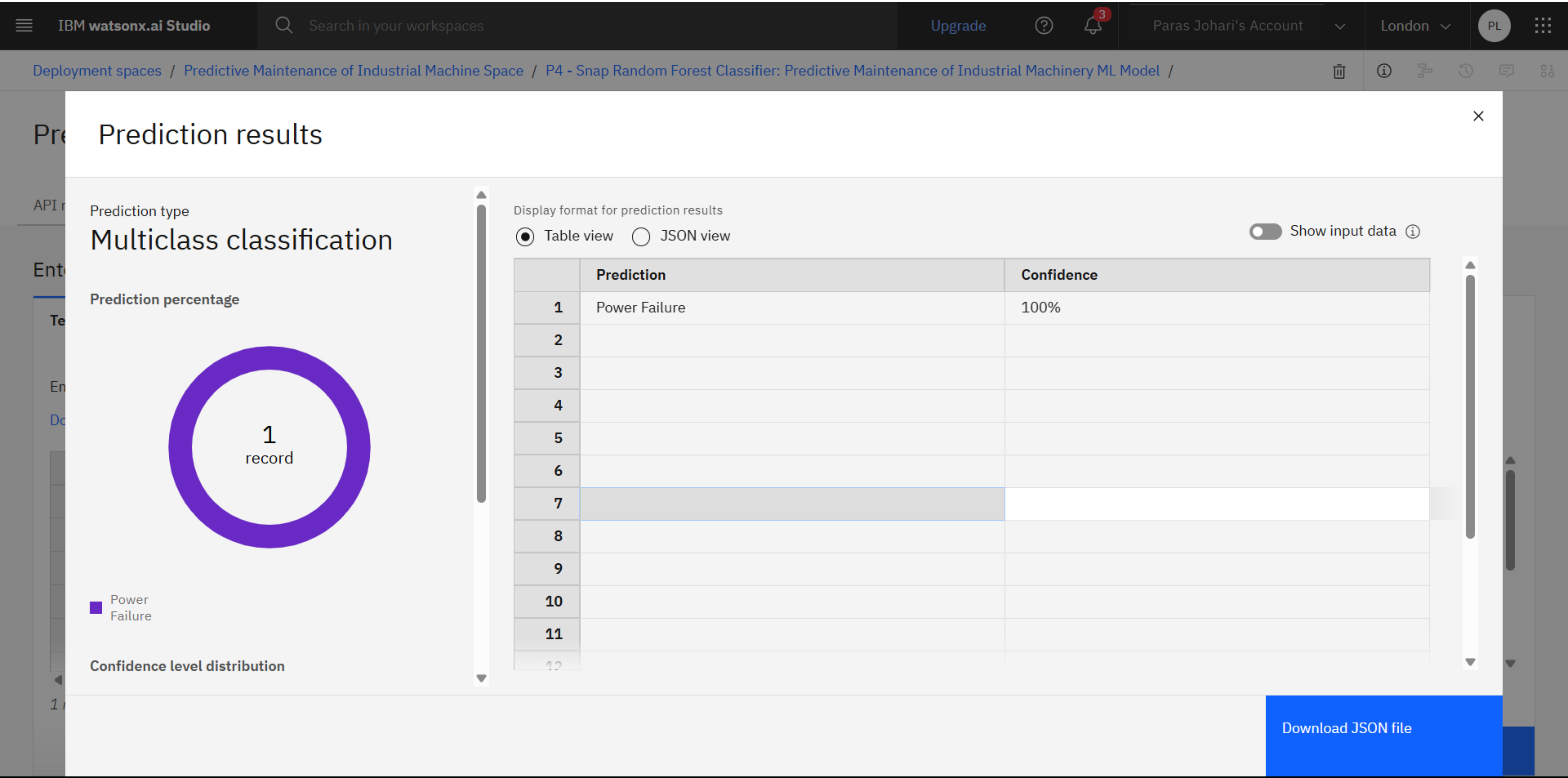
Enter data manually or use a CSV file to populate the spreadsheet. Max file size is 50 MB.

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

| | UDI (double) | 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 | 51 | L47230 | L | 298.9 | 309.1 | 2861 | 4.6 | 143 | 1 |
| 2 | | | | | | | | | |
| 3 | | | | | | | | | |
| 4 | | | | | | | | | |
| 5 | | | | | | | | | |
| 6 | | | | | | | | | |
| 7 | | | | | | | | | |
| 8 | | | | | | | | | |
| 9 | | | | | | | | | |
| 10 | | | | | | | | | |

*1 row, 9 columns*

Predict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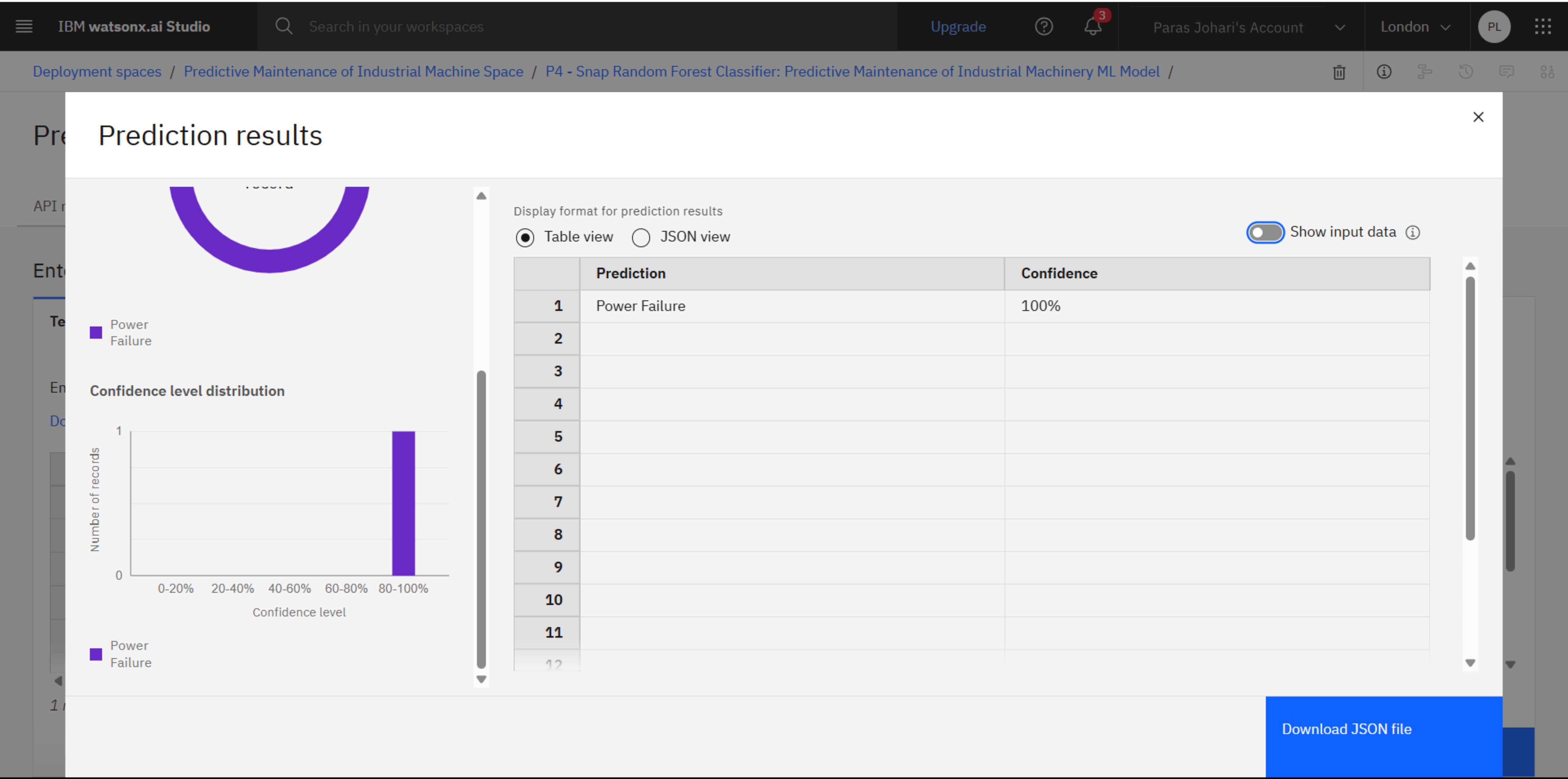
Prediction results
Prediction type
Multiclass classification
Prediction percentage
1
record
Power Failure
Confidence level distribution
Display format for prediction results
Table view
JSON view
Show input data
Prediction
Confidence
1
Power Failure
100%
2
3
4
5
6
7
8
9
10
11
Download JSON file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Prediction results
Power Failure
Confidence level distribution
Number of records
1
0
0-20%
20-40%
40-60%
60-80%
80-100%
Confidence level
Power Failure
Display format for prediction results
Table view
JSON view
Show input data
Prediction
Confidence
1
Power Failure
100%
2
3
4
5
6
7
8
9
10
11
Download JSON file

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API reference | Test

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Text | JSON

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

| | UDI (double) | 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 | 1 | M14860 | M | 298.1 | 308.6 | 1551 | 42.8 | 0 | 0 |
| 2 | 70 | L47249 | L | 298.9 | 309 | 1410 | 65.7 | 191 | 1 |
| 3 | 71 | M14930 | M | 298.9 | 309 | 1924 | 22.6 | 193 | 0 |
| 4 | 72 | L47251 | L | 298.9 | 309.1 | 1452 | 45.5 | 196 | 0 |
| 5 | 73 | L47252 | L | 298.9 | 309.1 | 1369 | 44.4 | 198 | 0 |
| 6 | 74 | L47253 | L | 299 | 309.1 | 1592 | 35 | 200 | 0 |
| 7 | 75 | L47254 | L | 298.9 | 309 | 1601 | 32.3 | 202 | 0 |
| 8 | 76 | L47255 | L | 298.8 | 308.9 | 1379 | 46.7 | 204 | 0 |
| 9 | 77 | L47256 | L | 298.8 | 308.9 | 1461 | 47.9 | 206 | 0 |
| 10 | 78 | L47257 | L | 298.8 | 308.9 | 1455 | 41.3 | 208 | 1 |
| 11 | 79 | L47258 | L | 298.8 | 308.9 | 1398 | 51.5 | 0 | 0 |
| 12 | 80 | L47259 | L | 298.8 | 308.9 | 1402 | 37.9 | 2 | 0 |

*94 rows, 9 columns*

Predict

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# 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 | Power Failure | [0,0,0,1,0,0] |
| 3 | No Failure | [0,0.9998846590518952,0,0,0.00011534024961292744,6.984919309616089e-10] |
| 4 | No Failure | [0,1,0,0,0,0] |
| 5 | No Failure | [0,0.9988764047622681,0,0,0.001123595517128706,-2.793969500203275e-10] |
| 6 | No Failure | [0,0.9998846590518952,0,0,0.00011534024961292744,6.984919309616089e-10] |
| 7 | No Failure | [0,1,0,0,0,0] |
| 8 | No Failure | [0,1,0,0,0,0] |
| 9 | No Failure | [0,0.9997901380062104,0,0,0.00020986357703804971,-1.5832484212552345e-9] |
| 10 | Tool Wear Failure | [0,0,0,0,0,1] |
| 11 | No Failure | [0,1,0,0,0,0] |

Download JSON file

# CONCLUSION

- Developed a working predictive maintenance model
- Integrated IBM cloud services for scalability and real-time deployment
- Reduced potential downtime and operational cost

## Challenges:

- Data imbalance
- Noise in sensor data

# FUTURE SCOPE

- - Integration with edge devices for real-time decision making
- - Use of deep learning models like LSTM and transformers
- - Expansion to multi-site industrial setups
- - Predict Remaining Useful Life (RUL) of components

# REFERENCES


- IBM Watson Studio Documentation
- IEEE papers on predictive maintenance
- Kaggle: Predictive Maintenance datasets
- Scikit-learn & TensorFlow Docs

# IBM CERTIFICATIONS

- Getting started with AI

Getting Started with Artificial Intelligence
IBM SkillsBuild

In recognition of the commitment to achieve professional excellence

Paras Johari

Has successfully satisfied the requirements for:

Getting Started with Artificial Intelligence

Issued on: Jul 21, 2025
Issued by: IBM SkillsBuild

Verify: https://www.credly.com/badges/67230287-e13c-4cf9-8c4b-5eccbe846891

IBM

# IBM CERTIFICATIONS

- Journey to Cloud

# IBM CERTIFICATIONS

- RAG Lab

IBM **SkillsBuild** Completion Certificate

This certificate is presented to

Paras Johari

for the completion of

**Lab: Retrieval Augmented Generation with LangChain**

(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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