MACHINE LEARNING PROJECT

PREDICTIVE MAINTENANCE OF INDUSTRIAL MACHINERY

PRESENTED BY:

VENGAL MANIKANT VILAS

VPM’S B.N. BANDODKAR COLLEGE OF SCIENCE

DEPARTMENT - COMPUTER SCIENCE

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.

PROBLEM SOLUTION

To develop a predictive maintenance model for the fleet of industrial machines, we propose a machine learning-based approach that leverages sensor data analytics to identify patterns preceding failures. The solution involves collecting and preprocessing real-time operational data from machinery sensors, followed by feature engineering to extract relevant patterns and anomalies. A classification model, such as a Random Forest or Convolutional Neural Network (CNN), will be trained on historical data to predict the type of failure (e.g., tool wear, heat dissipation, power failure) based on real-time data. The model will be integrated with a dashboard for real-time monitoring and alerts, enabling proactive maintenance and reducing downtime and operational costs. By implementing this solution, the organization can anticipate failures before they occur, minimizing unplanned downtime and optimizing maintenance schedules.

SYSTEM APPROACH

System Requirements

- Hardware Requirements:
    - Servers or cloud infrastructure for data storage and processing
    - IoT devices or sensors for collecting equipment data
- Software Requirements:
    - Cloud platforms: Such as IBM Cloud for scalability and reliability

Library Requirements

- Machine Learning Libraries:
    - Scikit-learn: For traditional machine learning algorithms
    - TensorFlow or Keras: For deep learning models
- Data Visualization Libraries:
    - Matplotlib: For creating static and interactive plots
    - Seaborn: For data visualization

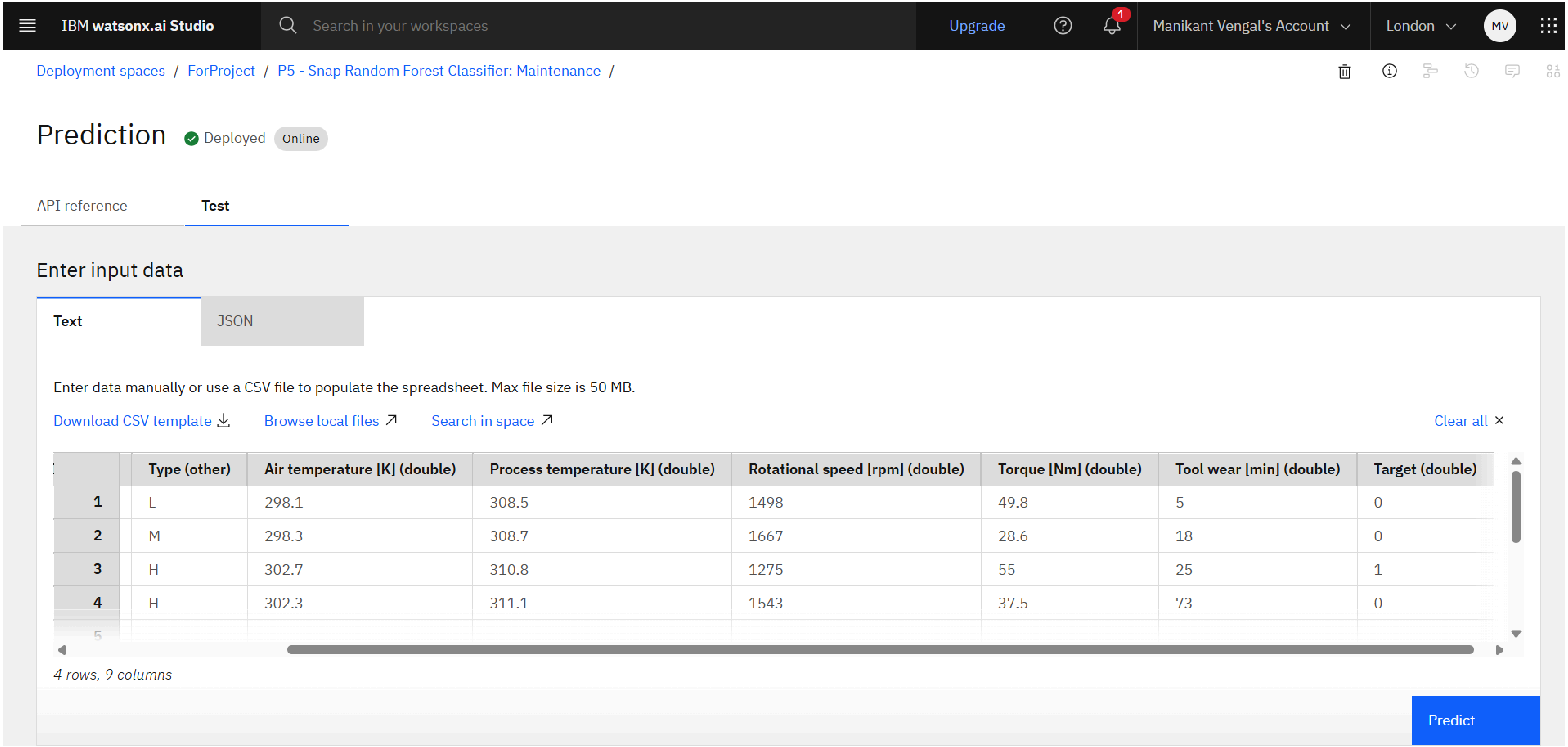
Algorithm & Deployment

Algorithm Selection
- Random Forest Classifier: A type of ensemble learning algorithm suitable for classification tasks.
- Justification: Random Forest can handle high-dimensional data, is robust to overfitting, and provides feature importance scores.

Data Input
- Input Features:
    - Historical sensor data (e.g., temperature, vibration, pressure)
    - Equipment metadata (e.g., equipment type, age, maintenance history)
    - Other relevant factors (e.g., operating conditions, environmental factors)

Training Process
- Training Data: Historical sensor data and equipment metadata
- Techniques:
    - Cross-validation: To evaluate model performance and avoid overfitting
    - Hyperparameter tuning: To optimize model parameters for better performance

Prediction Process
- Real-time Data Inputs: Current sensor data and equipment status
- Prediction Output: Predicted type of failure (e.g., tool wear, heat dissipation, power failure)


IBM watsonx.ai Studio
Search in your workspaces
Upgrade
Manikant Vengal's Account
London
MV
Deployment spaces / ForProject / P5 - Snap Random Forest Classifier: Maintenance /
Prediction
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
Type (other)
Air temperature [K] (double)
Process temperature [K] (double)
Rotational speed [rpm] (double)
Torque [Nm] (double)
Tool wear [min] (double)
Target (double)
1 L 298.1 308.5 1498 49.8 5 0
2 M 298.3 308.7 1667 28.6 18 0
3 H 302.7 310.8 1275 55 25 1
4 H 302.3 311.1 1543 37.5 73 0
4 rows, 9 columns
Predict

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 ×

	Type (other)	Air temperature [K] (double)	Process temperature [K] (double)	Rotational speed [rpm] (double)	Torque [Nm] (double)	Tool wear [min] (double)	Target (double)
1	L	298.1	308.5	1498	49.8	5	0
2	M	298.3	308.7	1667	28.6	18	0
3	H	302.7	310.8	1275	55	25	1
4	H	302.3	311.1	1543	37.5	73	0

4 rows, 9 columns

Predict

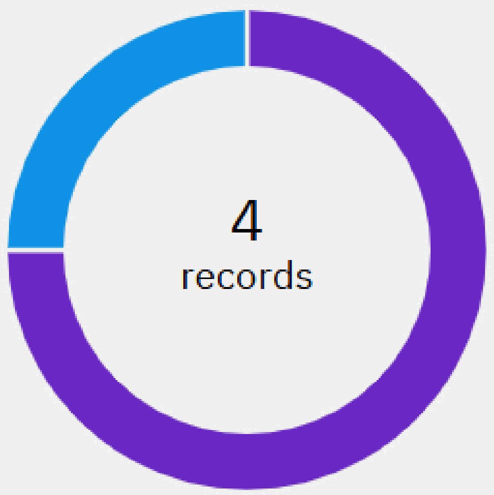
Close ×

Prediction results

Prediction type

Multiclass classification

Prediction percentage



No Failure   Heat Dissipation Failure

Display format for prediction results

(•) Table view ( ) JSON view   Show input data ⓘ

	Prediction	Confidence
1	No Failure	100%
2	No Failure	100%
3	Heat Dissipation Failure	100%
4	No Failure	100%
5		
6		
7		
8		
9		
10		
11		

Download JSON file

CONCLUSION

The proposed predictive maintenance system leverages machine learning algorithms to analyze sensor data from industrial machines, enabling proactive maintenance and reducing equipment downtime. By predicting potential failures before they occur, the system helps optimize maintenance schedules, reduce costs, and improve overall efficiency.

FUTURE SCOPE

The future scope of machine learning is vast and exciting, with potential applications across industries like healthcare, finance, retail, and manufacturing. Advancements in AI and deep learning will drive automation, predictive analytics, and AI-driven solutions, while quantum computing and Edge AI will enable faster and more efficient processing. Emerging job roles like AutoML experts, XAI specialists, and Edge AI developers will be in high demand. As machine learning continues to evolve, it will increase efficiency, improve accuracy, and create new business opportunities, driving innovation and growth in various sectors.

REFERENCES

- IBM Cloud Account for Processing
- Watsonx.ai Studio
- Kaggle for Dataset

In recognition of the commitment to achieve professional excellence

Manikant Vengal

Getting Started with Artificial Intelligence

Has successfully satisfied the requirements for:

Issued on:Jul20, 2025

Issued by:IBM SkillsBuild

Verify: https://www.credly.com/badges/5deb260b-a7b2-4eaa-9212-cfa68abfcbe9

IBM

In recognition of the commitment to achieve professional excellence

Manikant Vengal

Journey to Cloud: Envisioning Your Solution

Has successfully satisfied the requirements for:

Issued on:Jul22, 2025

Issued by:IBM SkillsBuild

Verify: https://www.credly.com/badges/4ac1af4d-2044-424a-9ff2-76810897a456

IBM **SkillsBuild** Completion Certificate

This certificate is presented to

Manikant Vengal

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

THANKYOU