CAPSTONE PROJECT

MACHINE FAILURE TYPE PREDICTION USING RANDOM FOREST CLASSIFIER IN IBM WATSON STUDIO

Presented By:
Taragesh U K-Madras Institute of Technology, Anna University-
B Tech Artificial Intelligence and Data Science
Git Hub Link:- https://github.com/thortara1812

edunet foundation

OUTLINE

- Problem Statement
- Proposed System/Solution
- System Development Approach
- Algorithm & Deployment
- Result
- Conclusion
- Future Scope
- References

PROBLEM STATEMENT

Manufacturing machines can fail unexpectedly, leading to costly downtime.
Accurately identifying not just if a machine will fail, but what type of failure will occur, is critical for proactive maintenance planning.
Current systems often only detect failure presence, not its cause.

PROPOSED SOLUTION

- Develop a predictive system that classifies the type of machine failure before it happens, not just whether a failure will occur.
- Leverage a public industrial dataset containing machine operating conditions and failure records.
- Use IBM Watson Studio as an integrated platform for:
- Data preprocessing
- Model training and evaluation
- Model deployment and testing
- Apply Random Forest Classifier, known for handling noisy, tabular, and multi-class data effectively.
- Perform data cleaning and feature engineering to improve model performance:
- Encode categorical variables (Type, Product ID)
- Handle imbalance in failure types using techniques like SMOTE or class weights
- Normalize numerical features (e.g., temperatures, torque)
- Integrate the trained model with Watson Machine Learning for API-based testing using new machine data.
- Design a simple interface or notebook workflow in Watson Studio for:
- Real-time failure prediction
- Visualization of input and output

SYSTEM APPROACH

System Requirements:

- Dataset: Predictive Maintenance Dataset from Kaggle
- Platform: IBM Watson Studio
- Programming: Python (via Jupyter Notebook in Watson Studio)

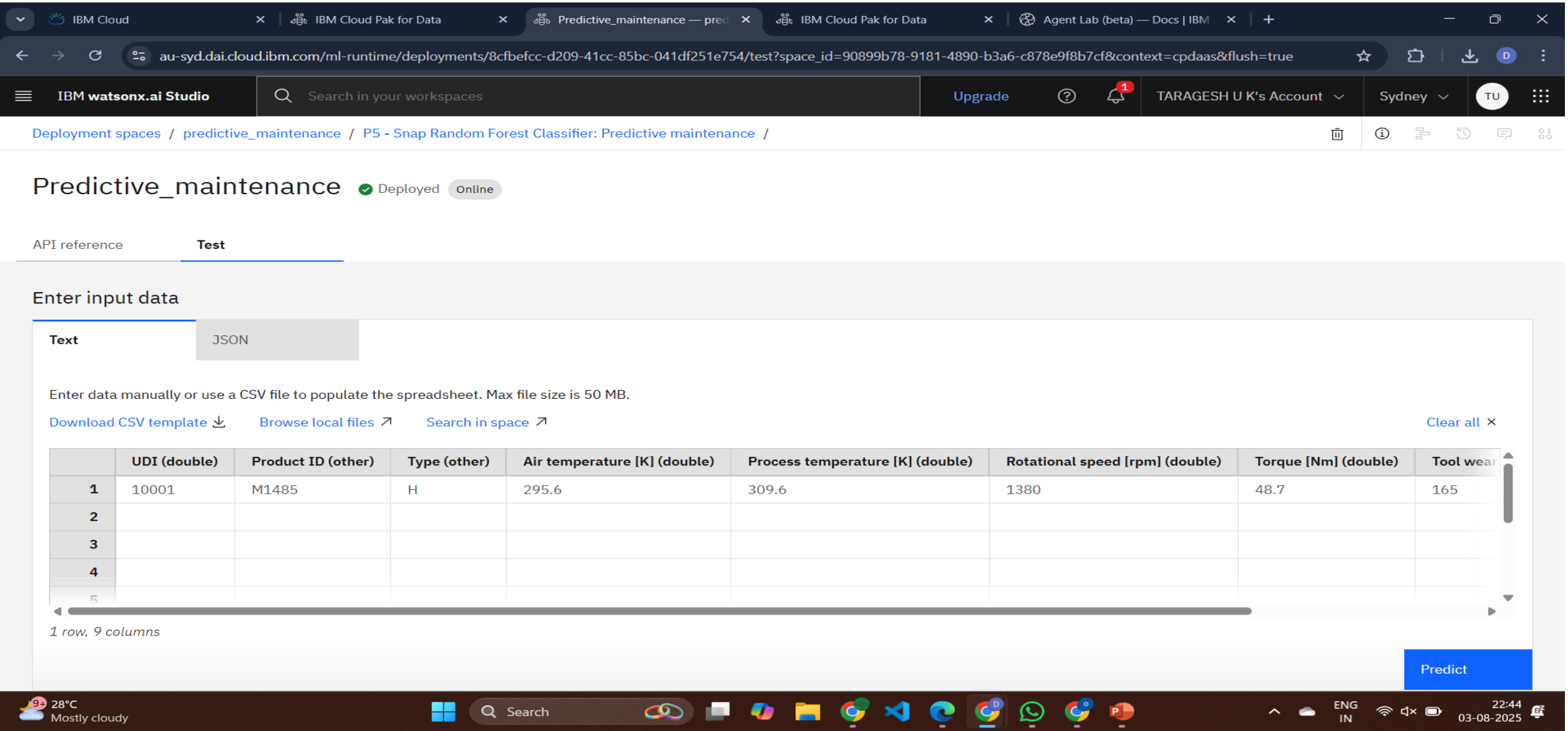
Libraries Used:

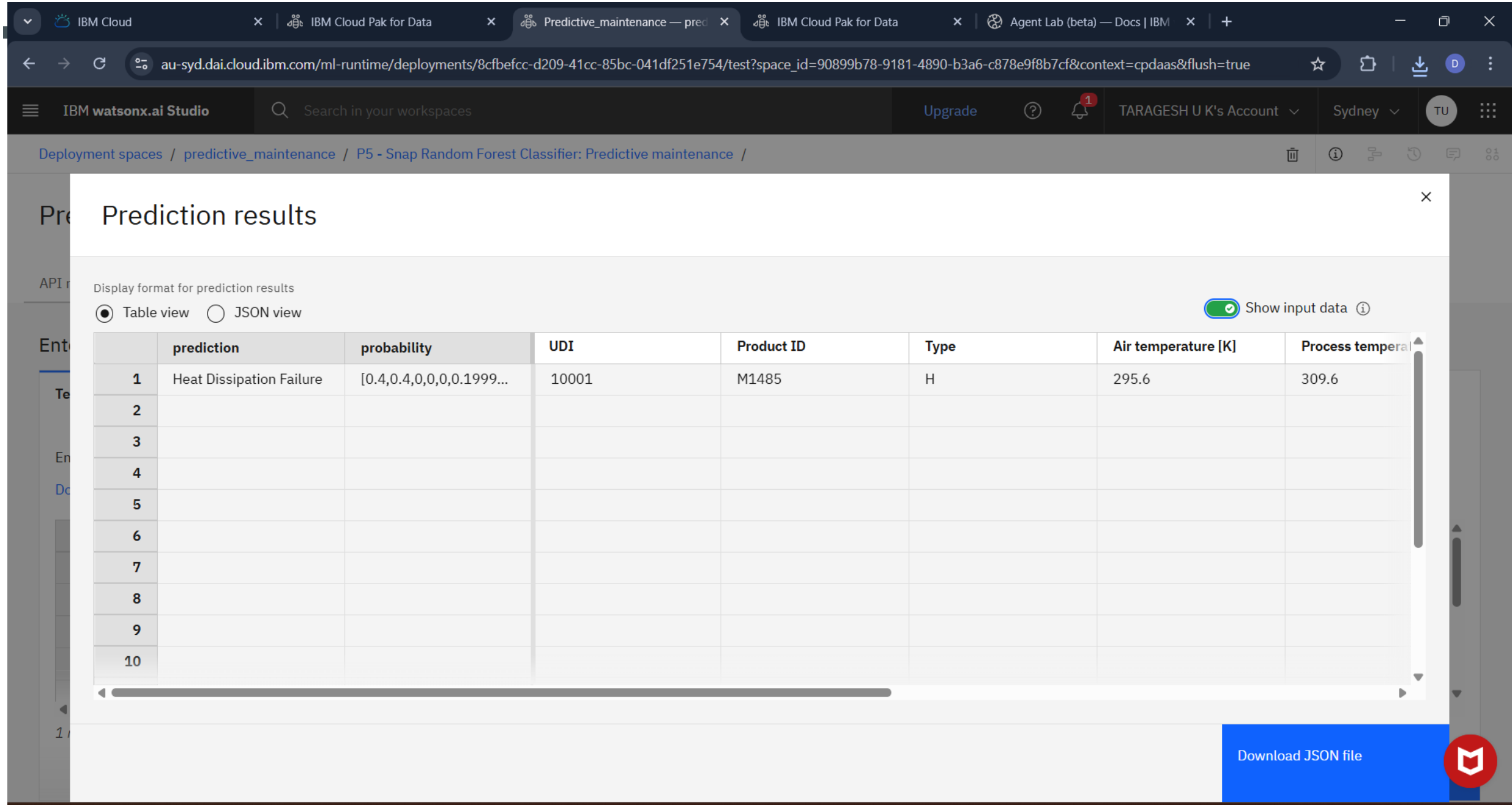
- pandas, numpy, matplotlib, seaborn
- scikit-learn (for preprocessing and Random Forest)
- ibm_watson_machine_learning (for deployment)

ALGORITHM & DEPLOYMENT

- **Algorithm Chosen:**
- **Random Forest Classifier**: Chosen for its robustness in handling non-linear relationships and multi-class output.
- **Input Features:**
- Sensor readings: Temperature, Torque, Rotational Speed, Tool Wear
- Machine Type, Product ID, etc.
- **Training Process:**
- Data cleaning and label encoding
- Train-test split (e.g., 80–20%)
- Model trained using cross-validation and tuned using GridSearchCV
- **Deployment:**
- Model deployed using Watson Machine Learning service
- Tested with new machine data to predict failure types in real time

RESULT


IBM Cloud
IBM Cloud Pak for Data
Predictive_maintenance — pred
IBM Cloud Pak for Data
Agent Lab (beta) — Docs | IBM
au-syd.dai.cloud.ibm.com/ml-runtime/deployments/8cfbefcc-d209-41cc-85bc-041df251e754/test?space_id=90899b78-9181-4890-b3a6-c878e9f8b7cf&context=cpdaas&flush=true
IBM watsonx.ai Studio
Search in your workspaces
Upgrade
TARAGESH U K's Account
Sydney
TU
Deployment spaces / predictive_maintenance / P5 - Snap Random Forest Classifier: Predictive maintenance /
Predictive_maintenance
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
1
10001
M1485
H
295.6
309.6
1380
48.7
165
2
3
4
5
1 row, 9 columns
Predict
28°C
Mostly cloudy
Search
ENG
IN
22:44
03-08-2025


IBM Cloud
IBM Cloud Pak for Data
Predictive_maintenance — pred
IBM Cloud Pak for Data
Agent Lab (beta) — Docs | IBM
au-syd.dai.cloud.ibm.com/ml-runtime/deployments/8cfbefcc-d209-41cc-85bc-041df251e754/test?space_id=90899b78-9181-4890-b3a6-c878e9f8b7cf&context=cpdaas&flush=true
IBM watsonx.ai Studio
Search in your workspaces
Upgrade
TARAGESH U K's Account
Sydney
Deployment spaces / predictive_maintenance / P5 - Snap Random Forest Classifier: Predictive maintenance /
Prediction results
Display format for prediction results
Table view
JSON view
Show input data
prediction
probability
UDI
Product ID
Type
Air temperature [K]
Process temperal
1
Heat Dissipation Failure
[0.4,0.4,0,0,0,0.1999...
10001
M1485
H
295.6
309.6
2
3
4
5
6
7
8
9
10
Download JSON file
28°C
Mostly cloudy
Search
ENG
IN
22:43
03-08-2025

predictive_maintenance

Overview | Assets | **Deployments** | Jobs | Manage

Search

Name	Type	Status	Asset	Asset type	Tags	Last modified
Predictive_maintenance	Online	Deployed	P5 - Snap Random Forest Classifier: Predictive maintenance	Model		2 hours ago TARAGESH U K (You)

Items per page: 20 | 1–1 of 1 items | 1 of 1 pages

CONCLUSION

- The Random Forest model effectively predicts machine failure types with high accuracy.
- IBM Watson Studio provided a seamless platform for model development and deployment.
- The system can assist industries in **minimizing unplanned downtimes** through predictive maintenance.

FUTURE SCOPE

- Add time-series modeling to anticipate failure before it happens.
- Incorporate more real-time sensor feeds (vibration, pressure, etc.).
- Extend to anomaly detection and root cause analysis.
- Use other algorithms like XGBoost or Deep Learning for comparative analysis

REFERENCES

- Kaggle Dataset: https://www.kaggle.com/datasets/shivamb/machine-predictive-maintenance-classification
- IBM Watson Studio Documentation
- Scikit-learn Documentation
- Research articles on predictive maintenance

IBM CERTIFICATIONS

In recognition of the commitment to achieve professional excellence

Taragesh U K

Has successfully satisfied the requirements for:

Getting Started with Artificial Intelligence

Issued on: Jul 20, 2025
Issued by: IBM SkillsBuild

Verify: https://www.credly.com/badges/0bb70786-944e-404c-a793-01738c311333

IBM

edunet foundation

IBM CERTIFICATIONS

In recognition of the commitment to achieve professional excellence

Taragesh U K

Has successfully satisfied the requirements for:

Journey to Cloud: Envisioning Your Solution

Issued on: Jul 20, 2025
Issued by: IBM SkillsBuild

Verify: https://www.credly.com/badges/02c8d686-4c86-4eca-bedb-78234cb16b44

IBM

IBM CERTIFICATIONS

IBM **SkillsBuild** Completion Certificate

This certificate is presented to

Taragesh U K

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

edunet foundation

THANK YOU

edunet foundation