# CAPSTONE PROJECT

# PREDICTIVE MAINTENANCE OF INDUSTRIAL MACHINERY

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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

- Unexpected industrial equipment failures can lead to costly downtime, increased maintenance expenses, and lost output. Potential issues are frequently ignored by traditional reactive maintenance methods until they materialize. This project will create a predictive maintenance model that can anticipate machine faults in advance in order to combat these problems. The model will learn to recognize trends and anomalies that typically indicate upcoming failure types, such as tool wear, heat dissipation failures, or power outages, by using real-time sensor readings from a fleet of industrial machines. The goal is to create a categorization model that can precisely forecast the kind of failure that is about to occur so that maintenance teams can take preventative measures before malfunctions.

# PROPOSED SOLUTION

1. Data Collection

- Collect real-time sensor data from various industrial machines (e.g., temperature, vibration, pressure, current).
- Gather historical maintenance logs and failure records to identify failure patterns.

2. Data Preprocessing

- Clean and normalize sensor data to remove noise, handle missing values, and ensure consistency.
- Perform feature extraction and selection to identify critical indicators related to machine failures.

3. Machine Learning Model

- Develop a classification model  to detect potential failure types such as tool wear, overheating, or power issues.
- Train the model on labeled failure data to learn patterns and predict failures before they occur.

4. System Deployment

- Integrate the model with a real-time monitoring system using dashboards or alert mechanisms.
- Deploy the solution on an edge device or cloud platform for scalable and responsive predictions.

5. Evaluation and Optimization

- Evaluate model performance using metrics such as Accuracy, Precision, Recall, and F1-score.
- Continuously monitor and fine-tune the model based on feedback from actual machine performance and maintenance outcomes.

# SYSTEM APPROACH

- IBM Cloud
- Watsonx.ai studio service
- Snap random forest classifier

# ALGORITHM & DEPLOYMENT

1. Data Collection

- Collect real-time sensor data from various industrial machines (e.g., temperature, vibration, pressure, current).
- Gather historical maintenance logs and failure records to identify failure patterns.

2. Data Preprocessing

- Clean and normalize sensor data to remove noise, handle missing values, and ensure consistency.
- Perform feature extraction and selection to identify critical indicators related to machine failures.

3. Machine Learning Model

- Develop a classification model (e.g., Random Forest, XGBoost, or Deep Learning models) to detect potential failure types such as tool wear, overheating, or power issues.
- Train the model on labeled failure data to learn patterns and predict failures before they occur.

4. System Deployment

- Integrate the model with a real-time monitoring system using dashboards or alert mechanisms.
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# DATA INPUTS

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 | 1 | M14860 | M | 298.1 | 308.6 | 1551 | 42 | 0 |
| 2 | 2 | L47181 | L | 298.2 | 308.7 | 1408 | 46.3 | 3 |
| 3 | 51 | L47230 | L | 298 | 309 | 2861 | 4.6 | 143 |
| 4 | 78 | L47257 | L | 298.8 | 308 | 1455 | 41.3 | 208 |
| 5 | 161 | L47340 | L | 298.4 | 308.4 | 1282 | 60.7 | 216 |
| 6 | 163 | L47342 | L | 298.3 | 308 | 1586 | 35.5 | 0 |
| 7 | 169 | L47348 | L | 298.4 | 308 | 1433 | 62.3 | 20 |

*8 rows, 9 columns*

Predict

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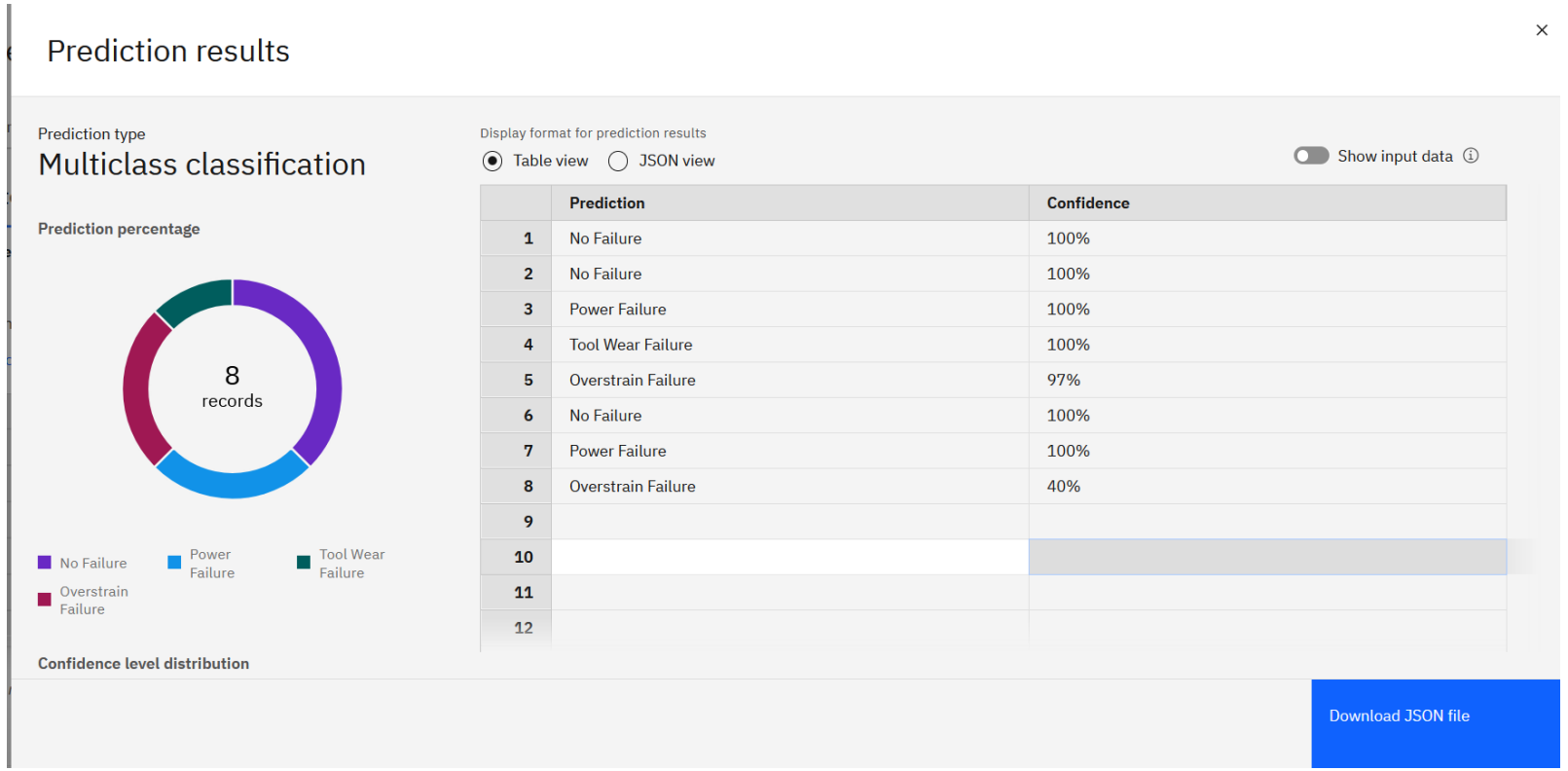
# RESULT



# CONCLUSION

- This project focuses on building a predictive maintenance model for industrial machines using real-time sensor data. By identifying patterns that precede failures, the model will classify potential issues like tool wear or power failure in advance. This enables proactive maintenance, reducing downtime, improving machine reliability, and lowering operational costs.

# FUTURE SCOPE

- **IoT Integration**: Connect the model with IoT-enabled machines for real-time monitoring and instant failure alerts
- **Model Generalization**: Expand the model to support different types of industrial machines and failure modes across industries.
- **Advanced AI Techniques**: Incorporate deep learning methods like LSTM or CNN for better accuracy in complex failure pattern detection.
- **Automated Maintenance Scheduling**: Link predictions to automated maintenance planning systems to optimize downtime and resource allocation.
- **Scalable Cloud Deployment**: Deploy the system on cloud platforms to monitor and manage large fleets of machines from a centralized dashboard.

# REFERENCES


- https://www.kaggle.com/datasets/shivamb/machine-predictive-maintenance-classification?resource=download

# GITHUB REPOSITORY

- https://www.kaggle.com/datasets/shivamb/machine-predictive-maintenance-classification?resource=download

# IBM CERTIFICATIONS

- certificate( Getting started with AI)

# IBM CERTIFICATIONS

- certificate( Journey to Cloud)

# IBM CERTIFICATIONS

- certificate( RAG Lab)

IBM **SkillsBuild** Completion Certificate

This certificate is presented to

ATHARV UGALE

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

# THANK YOU

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