PREDICTIVE MAINTENANCE OF INDUSTRIAL MACHINERY

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Problem Statement

Modern industrial operations rely on continuous machine uptime.

Unexpected machinery failures can cause:

- Downtime
- Increased operational costs
- Safety risks

Currently, maintenance is often reactive or scheduled, not optimized.

The challenge is to develop a predictive model that anticipates failures using real-time sensor data, identifying issues like:

- Tool wear
- Power failures
- Heat dissipation

Proposed Solution

- The proposed system aims to predict machine failures in advance using sensor data analytics.It involves:
- **Data Collection:**
  - Real-time and historical sensor data (vibration, temperature, voltage, etc.)
  - Used kaggle dataset on predictive maintenance for this project.
- **Data Preprocessing:**
  - Cleaning, normalization and handling missing values.
- **Machine Learning Algorithm:**
  - Implemented Batched Tree Ensemble Classifier to predict failure **type.**
- **Modeling:**
  - Building a classification model to predict failure type.
- **Deployment:**
  - Deployed on IBM cloud as an autoai.

System Approach

This system requires Sensor data collection pipeline, Cloud storage and real-time access.

- **Platform Used :**

  IBM Cloud Lite

- **Dataset Used :**

  Kaggle Dataset on Predictive Maintenance

- **Resources used :**

  IBM Watsonx.ai Studio

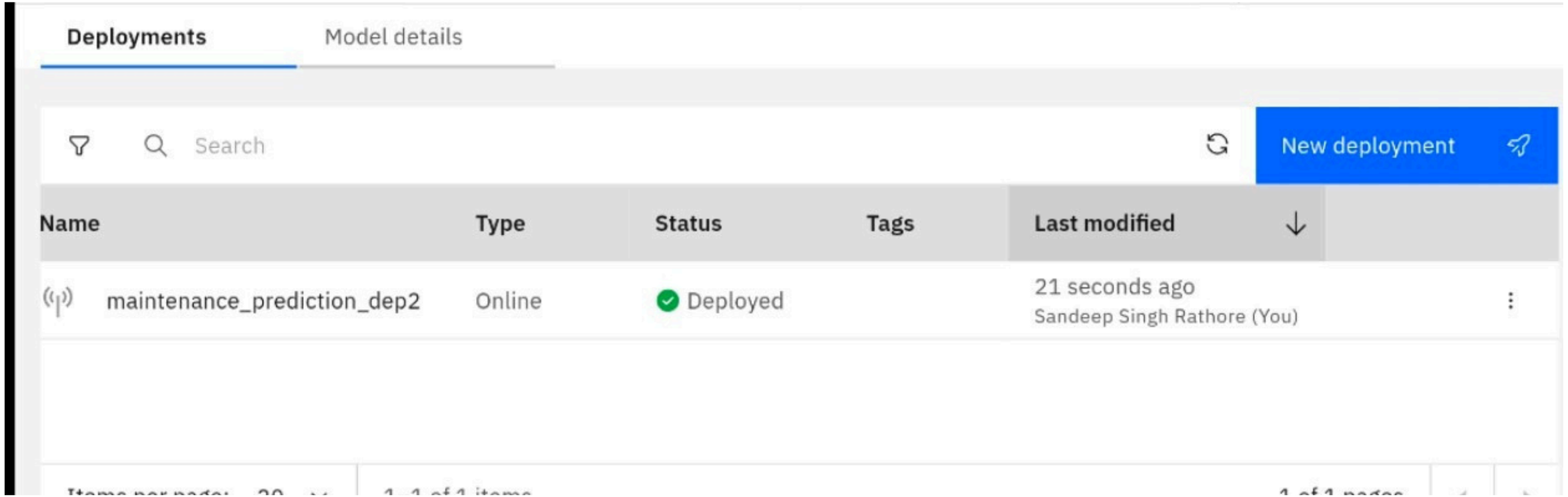
  IBM Cloud Object Storage

  IBM Watsonx.ai Runtime

Algorithm & Deployment

- **Algorithm Selection:**
  - Used Batched Tree Ensemble Classifier because it captures complex relationships in sensor readings, reduces overfitting through ensembling, works well with high-dimensional features and handles noisy and imbalanced data.
- **Data Input:**
  - Sensor readings like air temperature, process temperature, rotational speed, torque, etc.
- **Training Process:**
  - Provided Labeled failure data (tool wear, overheating, etc.) to train the model over a dataset.
- **Prediction Process:**
  - The data is passed through the ensemble and it predicts the type of failure (or "No Failure").

Result



Result

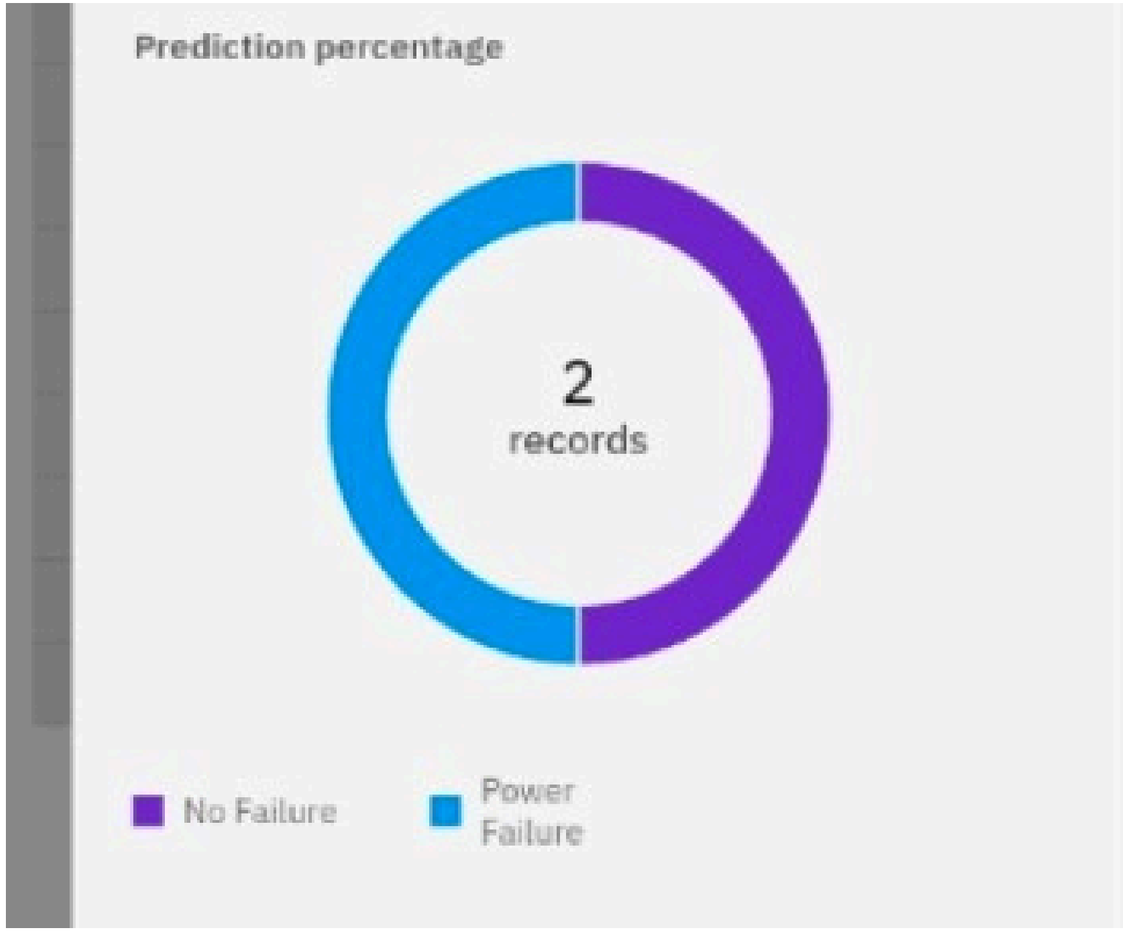
Text JSON

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

Clear al

	UDI (double)	Product ID (other)	Type (other)	Air temperature [K] (double)	Process temperature [K
1	1	M14860	M	298.1	308.6
2	51	L47230	L	521	700
3					
4					
5					

Result



	Prediction	Confidence
1	No Failure	100%
2	Power Failure	90%
3		
4		
5		
6		
7		
8		
9		
10		

Conclusion

- The Batched Tree Ensemble Classifier successfully predicts failure events before occurrence.
- The use of IBM Cloud enables scalable, real-time prediction services.
- Model can be easily extended to multiple machines and data sources.
- Predictive maintenance using AI is not only possible but also practical and cost-saving for industrial systems.

Future scope

- **Edge Deployment**: Run the model directly on edge IoT devices for real-time actions.
- **AutoML**: Use IBM AutoAI to find better models automatically.
- **Deep Learning**: Implement LSTM or Transformer-based models for sequential time-series data.
- **Integration**: Connect with ERP or CMMS systems for automatic work order creation.
- **Adaptive Models**: Allow continuous learning as more failure data becomes available.

References

- IBM Watson Studio Documentation
- Research paper: "Machine Learning for Predictive Maintenance: A Review"
- Kaggle Dataset for predictive maintenance

IBM Certifications

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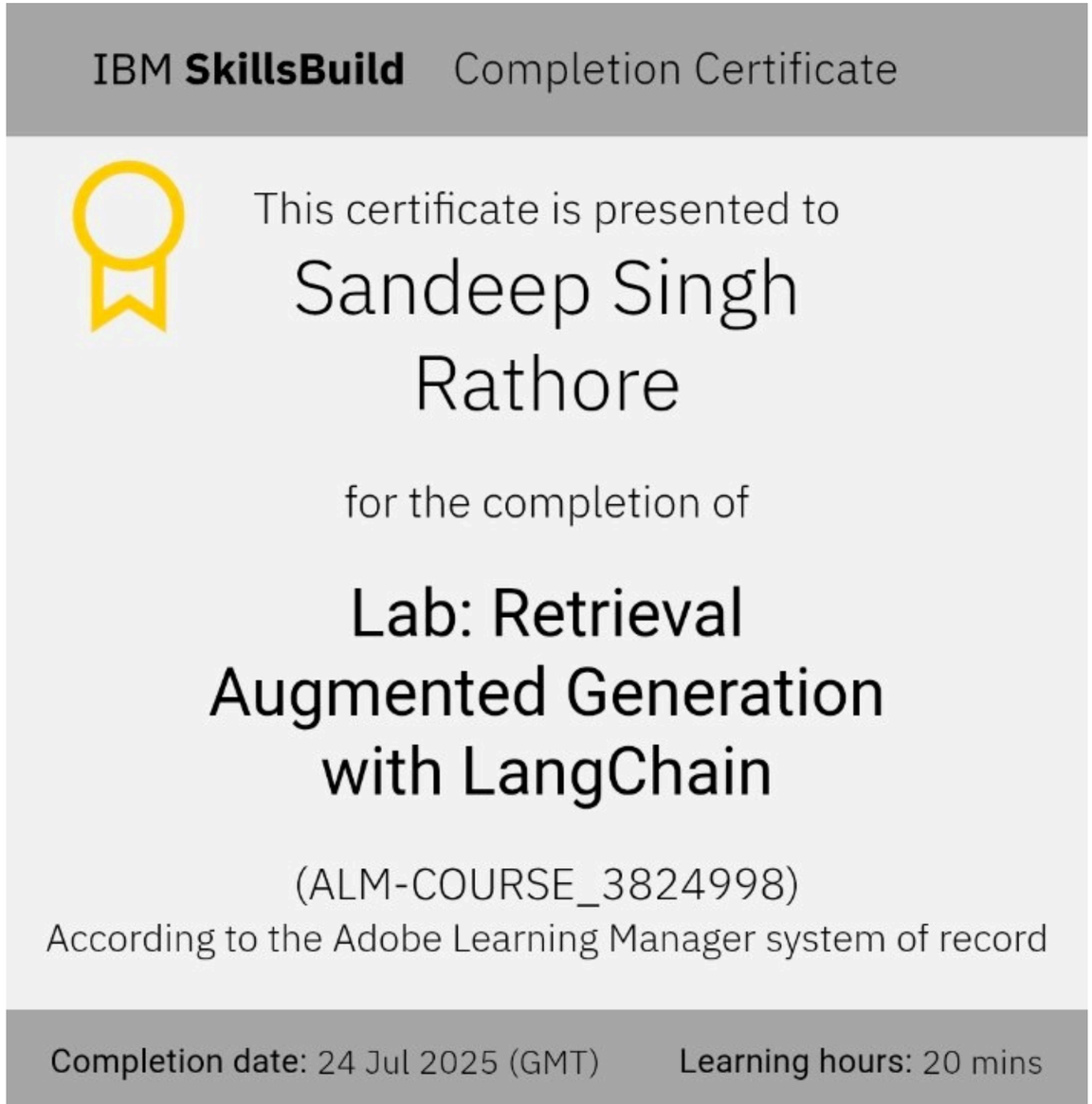

IBM **SkillsBuild** Completion Certificate

This certificate is presented to

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According to the Adobe Learning Manager system of record

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