CAPSTONE PROJECT

PREDICTIVE MAINTENANCE OF INDUSTRIAL MACHINERY

Presented By:

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OUTLINE

- **Problem Statement** (Should not include solution)
- **Proposed System/Solution**
- **System Development Approach** (Technology Used)
- **Algorithm & Deployment**
- **Result (Output Image)**
- **Conclusion**
- **Future Scope**
- **References**

PROBLEM STATEMENT

Industrial machinery often suffers from unexpected failures, leading to costly downtime and production losses.

Traditional **scheduled maintenance** either over-maintains machines (increasing costs) or under-maintains them (causing breakdowns).

Need: A predictive system that analyzes sensor data (temperature, torque, rotational speed, etc.) to forecast failures before they occur and optimize maintenance schedules.

PROPOSED SOLUTION

We propose a **Predictive Maintenance AI system** that:

- Uses historical machine sensor data to train a classification model.
- Predicts **failure types** (e.g., Heat Dissipation Failure, Tool Wear, Power Failure).
- Provides **early alerts** to maintenance teams.
- Built and deployed using **IBM Cloud AutoAI** for rapid, automated ML pipeline creation.

System Development Approach (Technology Used)

Tools & Services:

- **IBM Cloud Object Storage** – Store dataset.
- **IBM Watson Studio (AutoAI)** – Train and optimize ML model automatically.
- **IBM Watson Machine Learning** – Deploy best model as REST API for predictions.
- **Dataset** – Kaggle's Predictive Maintenance Classification dataset.

Process:

1. Upload dataset to IBM COS.
2. Launch AutoAI → Select classification task.
3. AutoAI generates pipelines → choose highest accuracy.
4. Deploy model as API endpoint → test predictions.

ALGORITHM & DEPLOYMENT

Algorithm:

- AutoAI tested multiple models (Random Forest, Decision Trees, Ensembles).
- Best performing pipeline: **Batched Tree Ensemble Classifier (Snap Random Forest)**.

Input Features:

- Air temperature [K], Process temperature [K], Rotational speed [rpm], Torque [Nm], Tool wear [min].

Target Output:

- Failure Type (multi-class: Heat Dissipation Failure, Power Failure, Overstrain Failure, etc.).

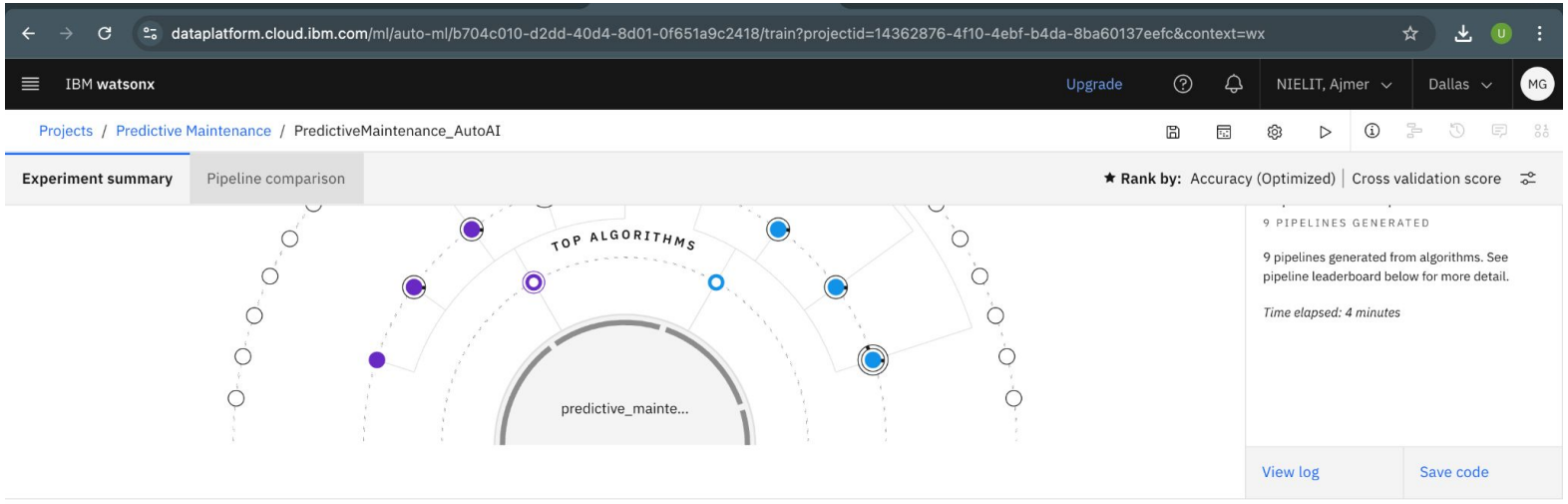
Deployment:

- Saved pipeline → Deployed via Watson Machine Learning → REST API endpoint generated for integration.

RESULT

Performance:

- Accuracy (Cross Validation): **99.5%**
- 9 pipelines generated; top 3 pipelines performed equally well.



Pipeline leaderboard

	Rank	Name	Algorithm	Specialization	Accuracy (Optimized) Cross Validation	Enhancements	Build time
★	1	Pipeline 5	Batched Tree Ensemble Classifier (Snap Random Forest Classifier)	INCR	0.995	HPO-1 FE HPO-2 BATCH	00:00:46
	2	Pipeline 4	Snap Random Forest Classifier		0.995	HPO-1 FE HPO-2	00:00:43
	3	Pipeline 3	Snap Random Forest Classifier		0.995	HPO-1 FE	00:00:33
	4	Pipeline 9	Snap Decision Tree Classifier		0.994	HPO-1 FE HPO-2	00:00:05

CONCLUSION

- Predictive maintenance system achieved **high accuracy (99.5%)** using AutoAI.
- Automating model training and deployment on IBM Cloud **reduced development time**.
- Proactive maintenance can **reduce downtime, cut costs, and improve machine reliability**.

FUTURE SCOPE

Integrate **real-time IoT sensor data** for continuous monitoring.

Add **explainable AI (feature importance, SHAP)** to highlight failure causes.

Extend solution to **multiple factories/machine types**.

Combine with **alert systems (SMS/Email/IoT dashboards)** for immediate actions.

REFERENCES

- Kaggle Dataset: Predictive Maintenance Classification
- IBM Watson Studio & AutoAI Documentation
- Research articles on predictive maintenance in manufacturing

IBM CERTIFICATIONS

IBM **SkillsBuild** Completion Certificate

This certificate is presented to

Mahesh Gurjar

for the completion of

Introduction to Artificial Intelligence

(MDL-211)

According to the Moodle system of record

Completion date: 25 Jul 2025 (GMT)

Learning hours: 1 hr 15 mins

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Completion date: 28 Jul 2025 (GMT)

Learning hours: 20 mins

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Thank You!

- **Project:** Predictive Maintenance of Industrial Machinery
- **Internship:** IBM SkillsBuildXEdunet Internship
- **Submitted By:** Mahesh Gurjar
- **Institute:** National Institute of Electronics and Information Technology, Ajmer – CSE

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"Looking forward to your feedback and suggestions."

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