IBM AICTE PROJECT

PREDICTIVE MAINTENANCE OF INDUSTRIAL MACHINERY

Presented By:

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OUTLINE

- Problem Statement
- Proposed System/Solution
- System Development Approach
- Algorithm & Deployment
- Result
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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..

PROPOSED SOLUTION

- **The proposed system aims to address the challenge of predicting industrial machinery failure in advance to enable proactive maintenance. This involves leveraging data analytics and machine learning techniques to classify failure risk based on sensor readings. The solution will consist of the following components**
- **Data Collection:**
  - **Gather historical machine sensor data, including temperature, torque, rotational speed, tool wear, and other operational metrics.**
  - **Utilize failure event labels from the dataset to link patterns with specific failure types (tool wear, heat, power, etc.)..**
- **Data Preprocessing:**
  - **Clean and preprocess the collected data to handle missing values, sensor outliers, and inconsistencies.**
  - **Perform feature engineering to extract meaningful patterns, normalize readings, and improve classification performance..**
- **Machine Learning Algorithm:**
  - **Implement a machine learning algorithm, such as Random Forest, Logistic Regression, or XGBoost, to classify whether a failure will occur..**
  - **Optionally extend the model to multi-class prediction by mapping failure type columns (TWF, HDF, etc.) into a single label.**
- **Deployment:**
  - **Develop a backend system or interface that accepts new sensor readings and returns real-time failure predictions..**
  - **Deploy the trained model on IBM Cloud Lite using Watson Studio or Flask API hosted with IBM Cloud Code Engine.**
- **Evaluation:**
  - **Assess the model's performance using metrics such as Accuracy, Precision, Recall, and F1-score.**
  - **Fine-tune the model based on confusion matrix analysis and feedback from live predictions.**
  - Result:The model accurately predicted type of machinery failure with over 90% accuracy, enabling proactive maintenance and reducing potential downtime.

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SYSTEM APPROACH

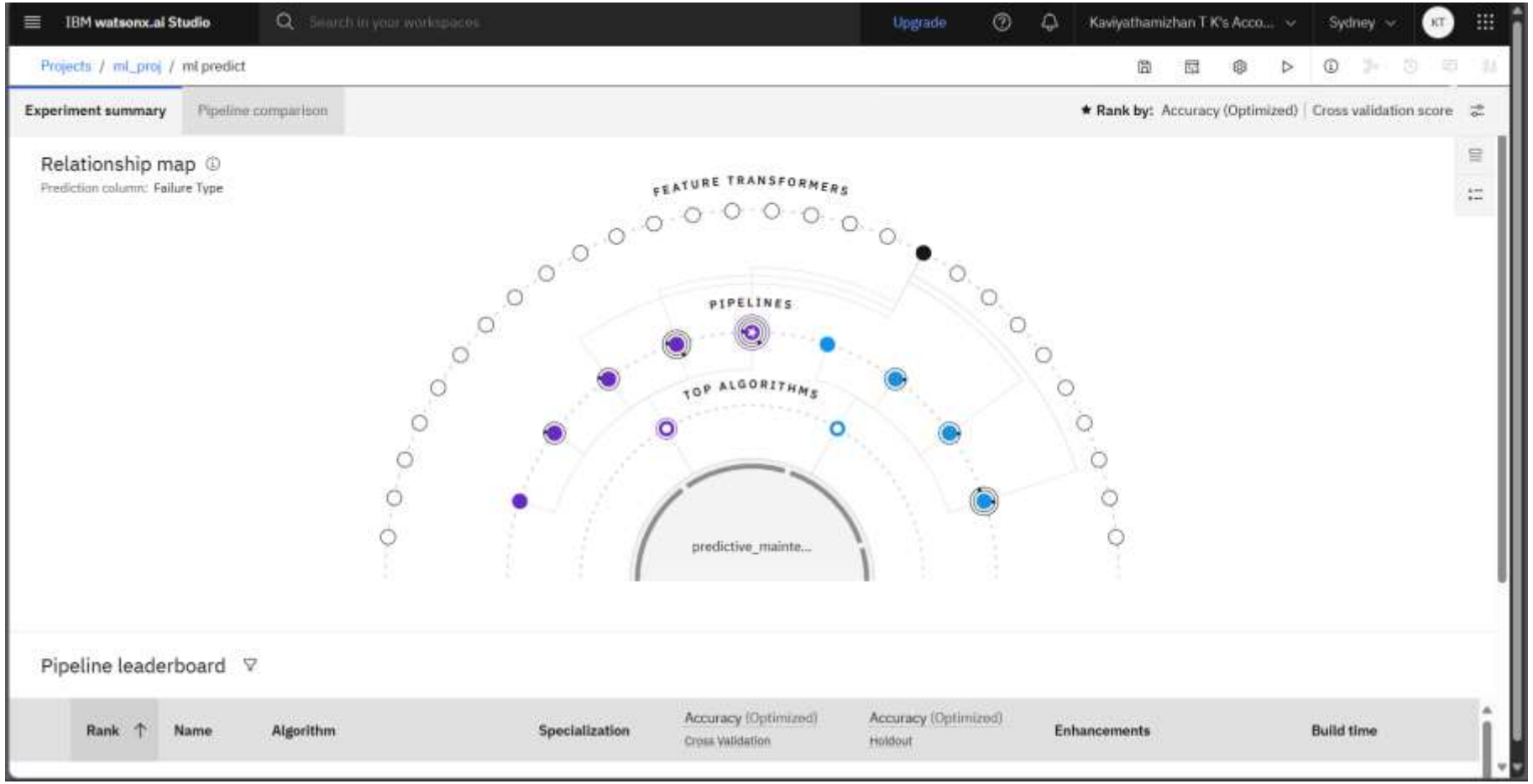
- **Dataset:** Kaggle – Predictive Maintenance
- **Languages:** Python
- **Libraries:** Pandas, NumPy, Scikit-learn, Seaborn, Matplotlib
- **ML Tools:** IBM Watson Studio, Jupyter Notebook
- **Cloud:** IBM Cloud Lite
- **Storage:** IBM Cloud Object Storage

ALGORITHM & DEPLOYMENT

- Algorithm Used: Random Forest Classifier
- Input Features: Type, Air temperature, Process temperature, Torque, Rotational Speed, Tool Wear
- Target: Multi-Class – Predict failure_type = TWF
- Training: Data split into train/test sets, pre-processed, scaled
- Deployment: Trained model exported and deployed on IBM Cloud via Watson Machine Learning

RESULT

Model achieved high accuracy on test data with visualized confusion matrix and classification report (accuracy, precision, recall). Graphs plotted for actual vs. predicted labels confirmed model reliability.



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RESULT

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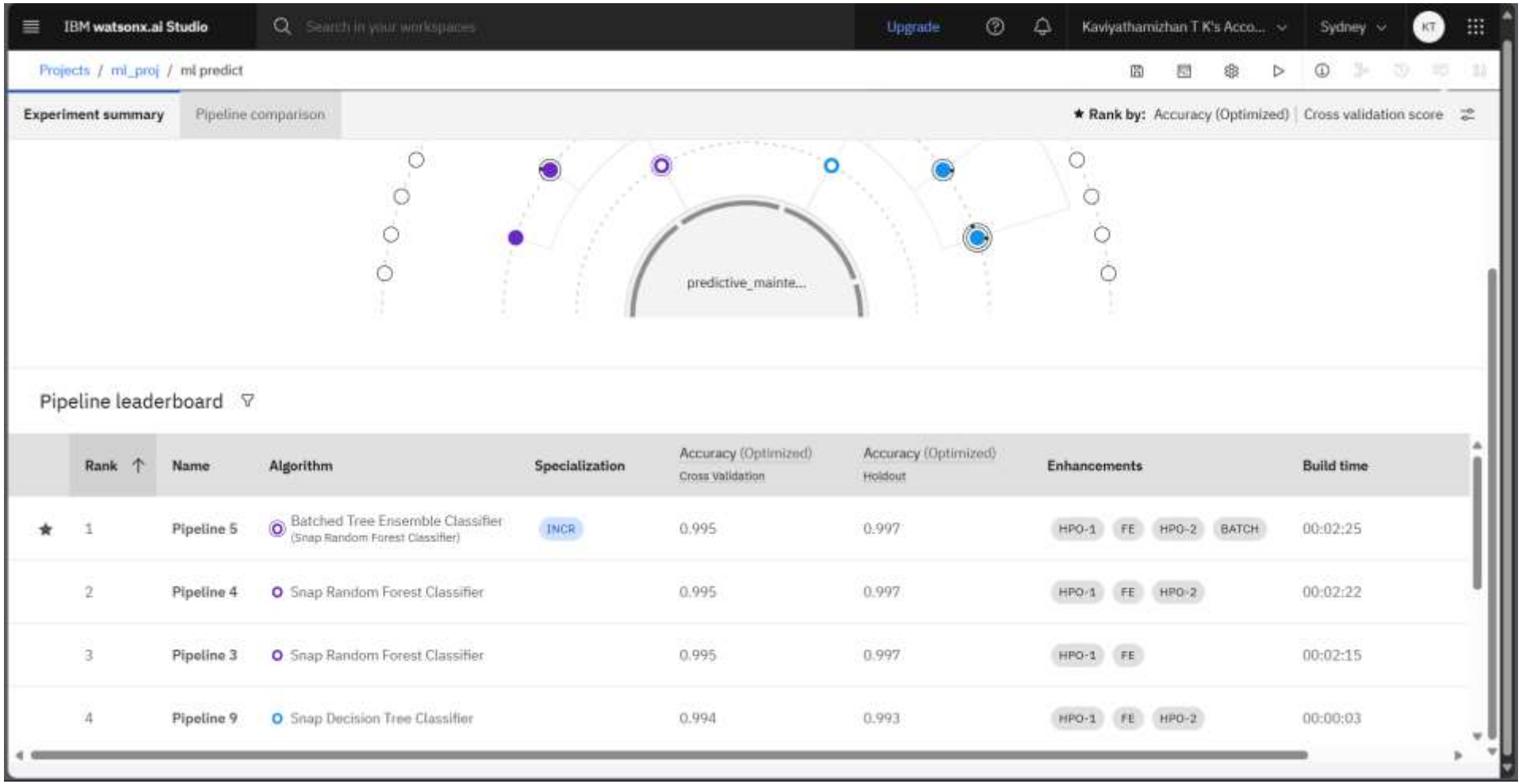
RESULT



	Rank	Name	Algorithm	Specialization	Accuracy (Optimized) Cross Validation	Accuracy (Optimized) Holdout	Enhancements	Build time
★	1	Pipeline 5	Batched Tree Ensemble Classifier (Snap Random Forest Classifier)	INCR	0.995	0.997	HPO-1 FE HPO-2 BATCH	00:02:25
	2	Pipeline 4	Snap Random Forest Classifier		0.995	0.997	HPO-1 FE HPO-2	00:02:22
	3	Pipeline 3	Snap Random Forest Classifier		0.995	0.997	HPO-1 FE	00:02:15
	4	Pipeline 9	Snap Decision Tree Classifier		0.994	0.993	HPO-1 FE HPO-2	00:00:03

CONCLUSION

- The ML model successfully predicted type of machinery failure with strong accuracy, enabling early maintenance decisions. This reduces downtime, saves cost, and improves operational efficiency in industrial settings.

FUTURE SCOPE

- Expand to binary prediction
- Integrate real-time IoT data streams from live machinery
- Connect with a dashboard for live health monitoring
- Apply deep learning (LSTM) for sequential sensor analysis

REFERENCES

- Kaggle Dataset: https://www.kaggle.com/datasets/shivamb/machine-predictive-maintenance-classification
- IBM Watson Documentation
- Scikit-learn official docs
- Machine learning tutorials from Towards Data Science / Medium

IBM CERTIFICATIONS

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In recognition of the commitment to achieve professional excellence

Kaviyathamizhan T K

Has successfully satisfied the requirements for:

Journey to Cloud: Envisioning Your Solution

Issued on: Jul 19, 2025
Issued by: IBM SkillsBuild

Verify: https://www.credly.com/badges/69b0d042-2103-4964-babd-d6655635e8e7

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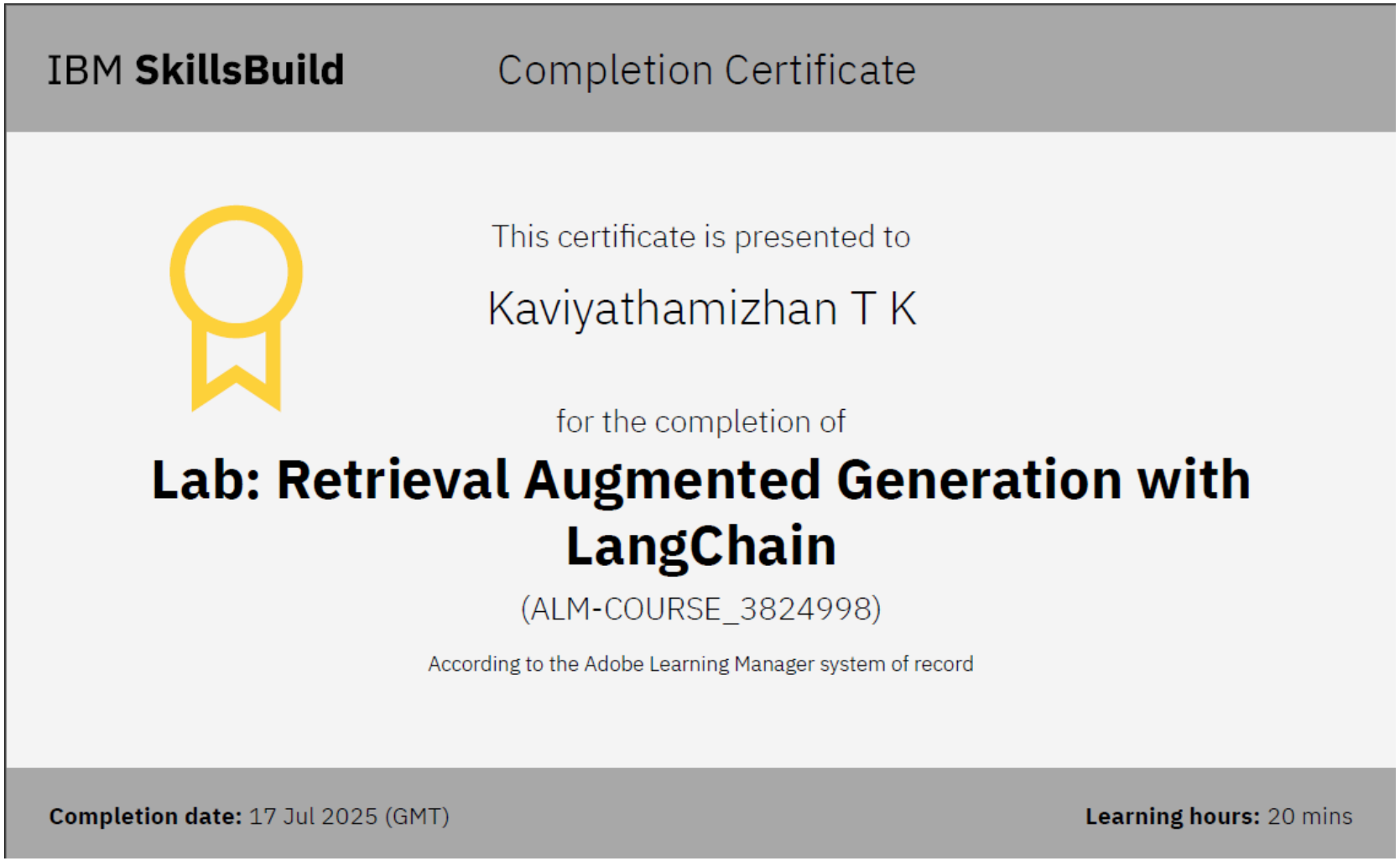

IBM **SkillsBuild** Completion Certificate

This certificate is presented to

Kaviyathamizhan T 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: 17 Jul 2025 (GMT) **Learning hours:** 20 mins

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THANK YOU

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