IBM SkillsBuild Project

PREDICTIVE MAINTENANCE OF INDUSTRIAL MACHINERY

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OUTLINE

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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 focuses on the classification of different fault types in a power distribution network using machine learning techniques. The solution involves the collection of electrical measurement data, specifically voltage and current phasors, under both normal and faulty operating conditions. This raw data is then preprocessed to handle missing values, normalize ranges, and prepare it for training.

The solution will consist of the following components:

- **DATA COLLECTION:** Used the Kaggle dataset of Machine Predictive Maintenance Classification.
- **PRE PROCESSING**: Cleaned and by normalizing the dataset.
- **MODEL TRAINING:** Trained a classification model (i.e. Decision Tree, Random Forest and SVM).
- **EVALUATION:** Validated the model using Accuracy, Precision, recall and F1 Score.

SYSTEM APPROACH

Technologies Used:

- Python (IBM Watsonx.ai Notebooks)
- IBM Cloud Object Storage
- Machine Learning Libraries: pandas, matplotlib
- Dataset: Phasor-based voltage and current values with fault labels

System Requirements:

- IBM Cloud
- Watsonx.ai Studio for model development and deployment.
- Clean CSV data with labelled fault types
- IBM WATSONX RUNTIME SERVICE to build, Deploy, Manage, Optimize decision anywhere.
- IBM cloud object storage for dataset handling.

ALGORITHM & DEPLOYMENT

- **Algorithm Selection**:

  Random Forest Classifier, Decision Tree Classifier (or SVM based on performance).

- **Data Input**:

  UDI, Product ID, Type, Air temperature[K], Process temperature[K], Rotational speed[rpm], Torque[Nm], Tool wear[min], Target.

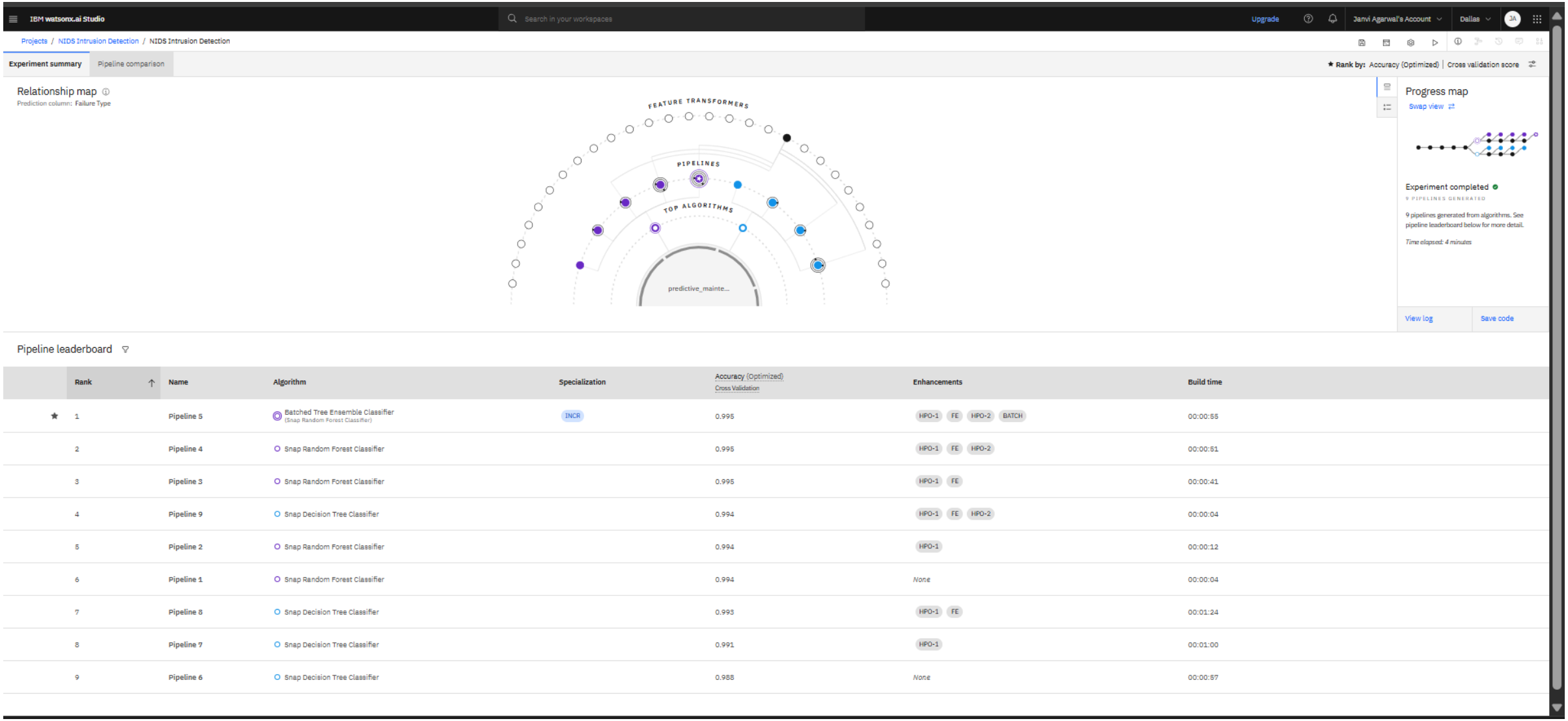
- **Training Process**:

  Supervised learning using labeled sensor data to classify fault types in industrial machines.

- **Prediction Process**:

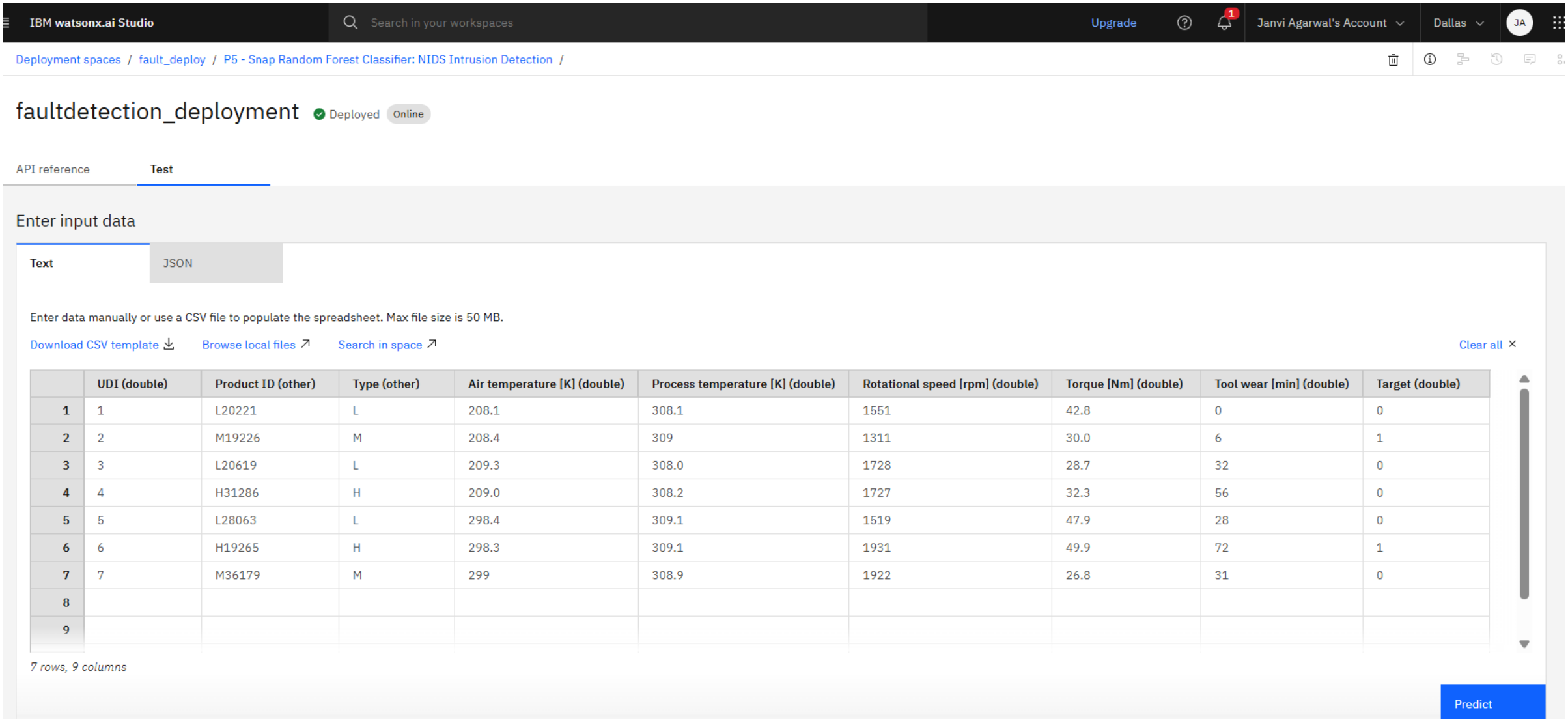
  Model **deployed** on **IBM Watson Studio** with API endpoint for real-time predictions.

RESULT



	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	00:00:55
	2	Pipeline 4	Snap Random Forest Classifier		0.995	HPO-1 FE HPO-2	00:00:51
	3	Pipeline 3	Snap Random Forest Classifier		0.995	HPO-1 FE	00:00:41
	4	Pipeline 9	Snap Decision Tree Classifier		0.994	HPO-1 FE HPO-2	00:00:04
	5	Pipeline 2	Snap Random Forest Classifier		0.994	HPO-1	00:00:12
	6	Pipeline 1	Snap Random Forest Classifier		0.994	None	00:00:04
	7	Pipeline 8	Snap Decision Tree Classifier		0.993	HPO-1 FE	00:01:24
	8	Pipeline 7	Snap Decision Tree Classifier		0.991	HPO-1	00:01:00
	9	Pipeline 6	Snap Decision Tree Classifier		0.988	None	00:00:57

RESULT



	UDI (double)	Product ID (other)	Type (other)	Air temperature [K] (double)	Process temperature [K] (double)	Rotational speed [rpm] (double)	Torque [Nm] (double)	Tool wear [min] (double)	Target (double)
1	1	L20221	L	208.1	308.1	1551	42.8	0	0
2	2	M19226	M	208.4	309	1311	30.0	6	1
3	3	L20619	L	209.3	308.0	1728	28.7	32	0
4	4	H31286	H	209.0	308.2	1727	32.3	56	0
5	5	L28063	L	298.4	309.1	1519	47.9	28	0
6	6	H19265	H	298.3	309.1	1931	49.9	72	1
7	7	M36179	M	299	308.9	1922	26.8	31	0
8									
9									

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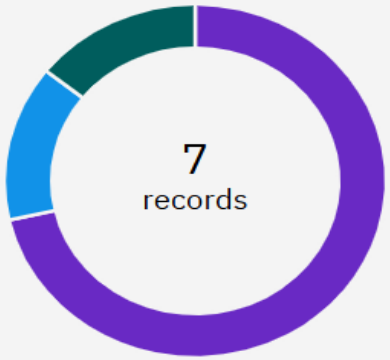
RESULT

rediction results

iction type

ulticlass classification

iction percentage



o Failure Heat Dissipation Power ..

Display format for prediction results

(•) Table view ( ) JSON view

Show input data

	Prediction	Confidence
1	No Failure	80%
2	Heat Dissipation Failure	90%
3	No Failure	80%
4	No Failure	80%
5	No Failure	100%
6	Power Failure	90%
7	No Failure	100%
8		
9		

Download JSON file

CONCLUSION

•The machine learning-based fault classification model successfully identified and distinguished between various fault types, including heat dissipation failure, power failure, and no failure conditions.

•IBM Watsonx.ai AutoAI efficiently automated the model training process, selecting the best-performing algorithm with **99.5% accuracy**, ensuring high reliability.

•The deployed model responded accurately to real-time input data with confidence levels reaching **100%**, demonstrating its potential for use in industrial or power monitoring applications.

•The overall system proves that integrating AI with real-world sensor data can lead to fast, scalable, and precise fault detection — essential for maintaining stability in power or manufacturing environments.

FUTURE SCOPE

To improve the accuracy, scalability, and real-time responsiveness of the **Predictive Maintenance Classification System**, several enhancements and future directions can be explored:

- **Environmental Data**: Integrate external data such as humidity, ambient temperature, or vibration from nearby machinery to capture indirect failure causes.
- **Operator Logs**: Use human-generated logs or maintenance notes to correlate observed behavior with actual faults.
- **Machine Usage History**: Incorporate operational context like usage intensity, shift timings, or historical fault patterns for deeper insight

REFERENCES

- Kaggle dataset for machine predictive maintenance classification:- https://www.kaggle.com/datasets/shivamb/machine-predictive-maintenance-classification.

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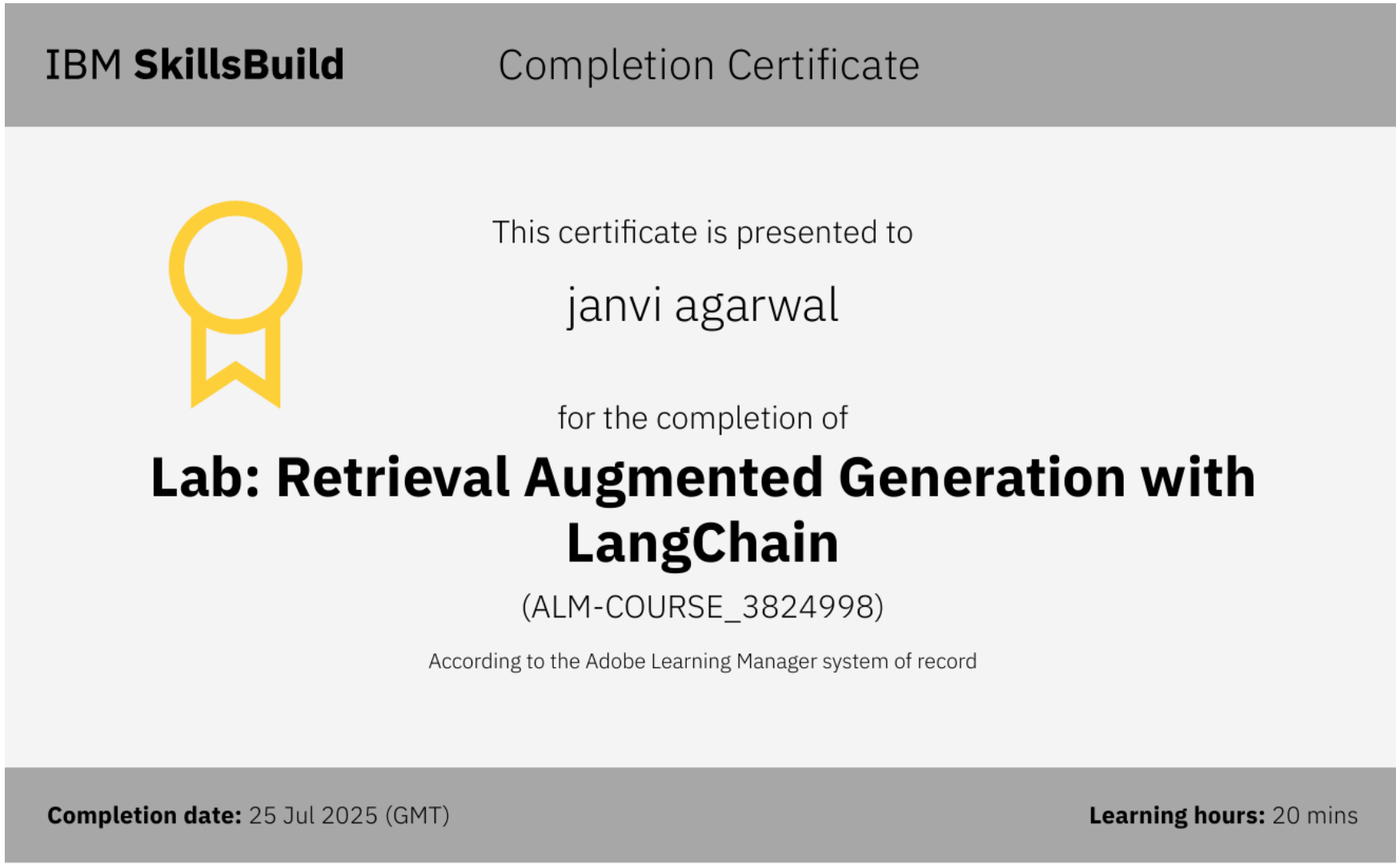

IBM **SkillsBuild** Completion Certificate

This certificate is presented to

janvi agarwal

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(ALM-COURSE_3824998)

According to the Adobe Learning Manager system of record

Completion date: 25 Jul 2025 (GMT) **Learning hours:** 20 mins

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GITHUB LINK

- https://github.com/janviagarwal28/IBM-cloud-project

THANK YOU

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