CAPSTONE PROJECT

NETWORK INTRUSION DETECTION SYSTEM

Presented By:

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OUTLINE

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- Proposed System/Solution
- System Development Approach
- Algorithm & Deployment
- Result (Output Image)
- Conclusion
- Future Scope
- References

PROBLEM STATEMENT

Network Intrusion Detection

Create a robust network intrusion detection system (NIDS) using machine learning. The system should be capable of analyzing network traffic data to identify and classify various types of cyber-attacks (e.g., DoS, Probe, R2L, U2R) and distinguish them from normal network activity. The goal is to build a model that can effectively secure communication networks by providing an early warning of malicious activities.

PROPOSED SOLUTION

- The proposed system addresses the growing challenge of identifying cyber-attacks by analyzing network traffic using machine learning.
- A supervised learning model is built using the KDD-based intrusion detection dataset, which contains both normal and malicious traffic records.
- A Decision Tree Classifier is chosen due to its interpretability and efficiency in handling both numerical and categorical data.
- IBM Watson Studio's AutoAI is used to automate model building, hyperparameter tuning, and pipeline selection without requiring manual coding.
- The system converts raw network traffic attributes (like protocol, bytes sent, connection flags, etc.) into structured features suitable for training.
- The final trained model is deployed using IBM Watson Machine Learning as a REST API for real-time classification.
- The model can predict whether a given network connection is:
  - Normal
  - Or part of a known attack class (e.g., DoS, Probe, etc. if using multi-class).
- IBM Cloud services ensure scalability, reliability, and ease of integration into existing security frameworks.
- This solution enables proactive monitoring of network traffic and early detection of suspicious patterns to prevent system compromise.

SYSTEM APPROACH

Technologies & Services:

- IBM Cloud (Lite Plan)

- IBM Watson Studio

- IBM AutoAI for automated model selection

- Dataset from Kaggle

- No manual coding required (no-code ML pipeline)

Libraries/Tools:

- AutoAI (built-in to Watson Studio)

- Web UI for testing deployed models

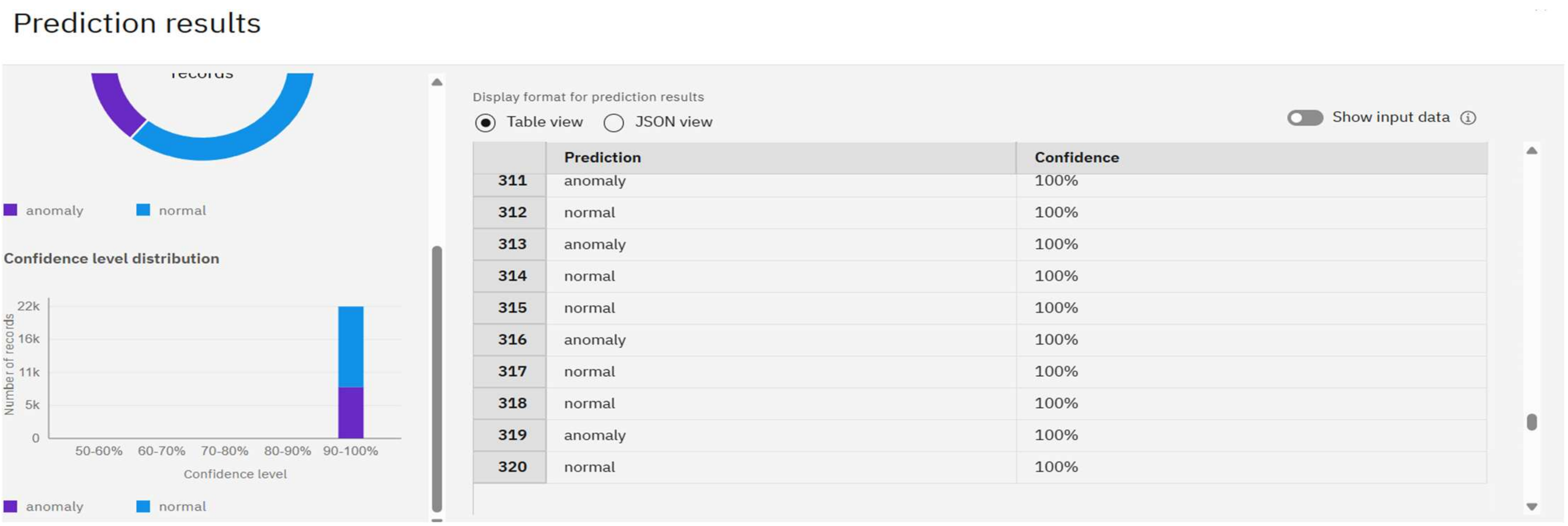
ALGORITHM & DEPLOYMENT

- Algorithm Used:
- - Decision Tree Classifier (selected by AutoAI)
- Input Features:
  - Network traffic attributes: protocol type, service, byte counts, flag, host behavior, etc.
- Training Process:
  - - AutoAI explored multiple pipelines
  - - Best pipeline selected based on accuracy/F1-score
  - - No manual tuning required
- Deployment:
  - Model deployed as an online REST API using IBM Watson Machine Learning
- Tested via UI and ready for integration with other systems

RESULT

Model successfully trained and deployed using IBM Watson Studio.

Prediction interface available for real-time classification of network activity.



Display format for prediction results

● Table view ○ JSON view

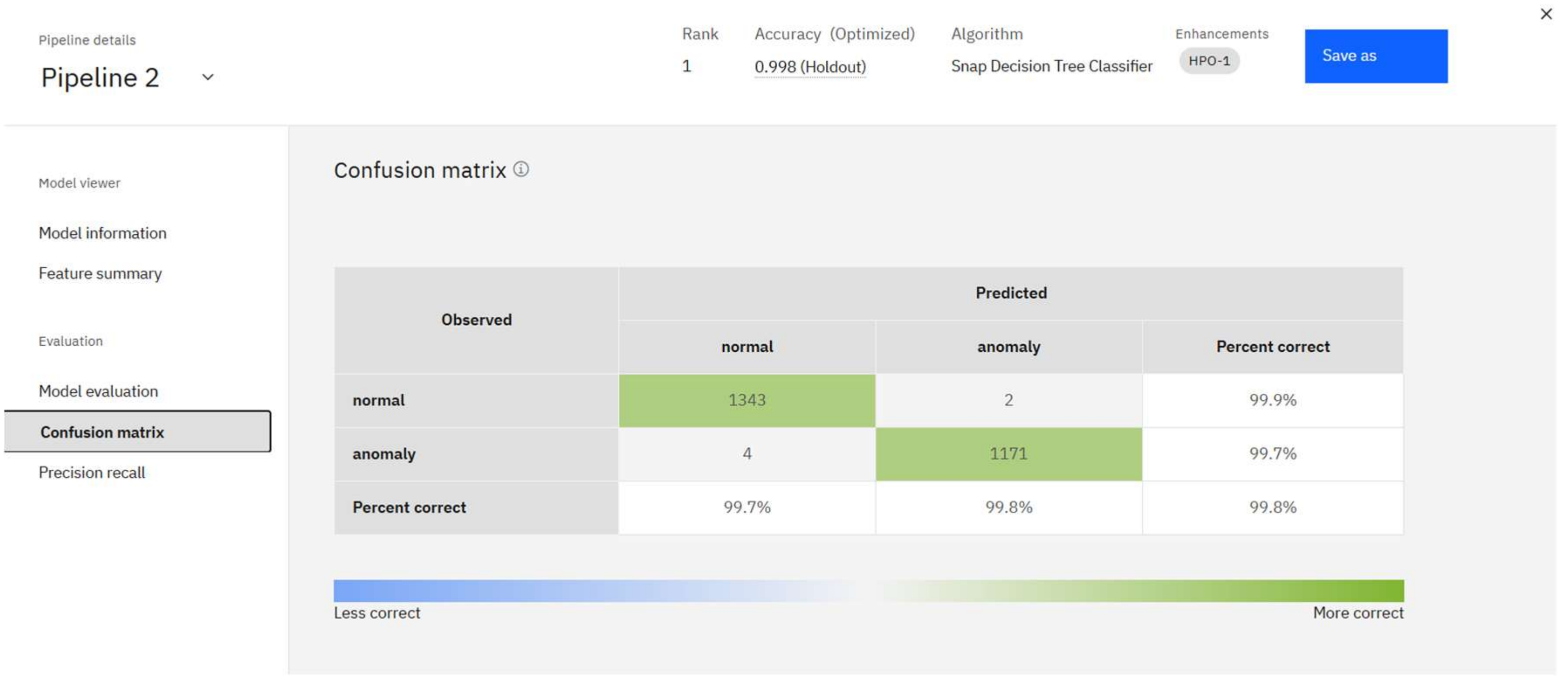
Show input data ⓘ

	Prediction	Confidence
311	anomaly	100%
312	normal	100%
313	anomaly	100%
314	normal	100%
315	normal	100%
316	anomaly	100%
317	normal	100%
318	normal	100%
319	anomaly	100%
320	normal	100%

RESULT

Model successfully trained and deployed using IBM Watson Studio.

Prediction interface available for real-time classification of network activity.



Rank	Accuracy (Optimized)	Algorithm	Enhancements
1	0.998 (Holdout)	Snap Decision Tree Classifier	HPO-1

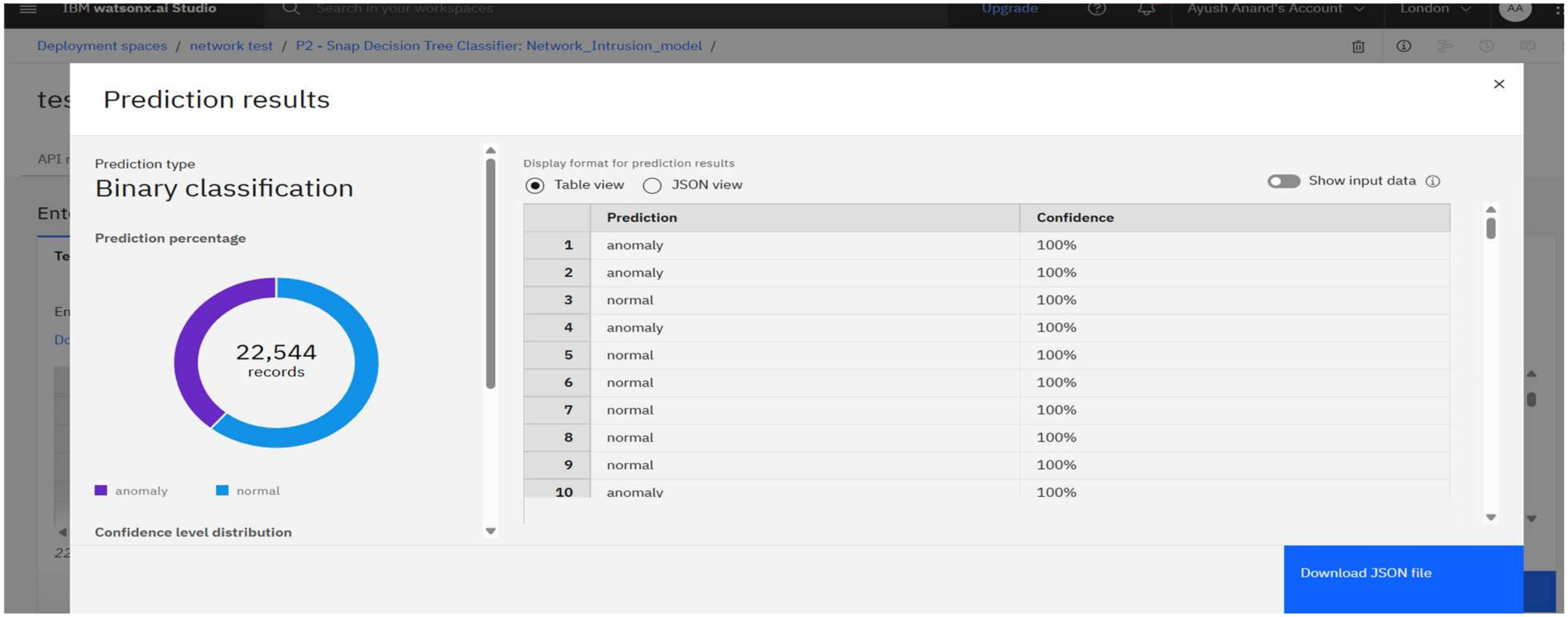
Confusion matrix ⓘ

Observed	Predicted		
	normal	anomaly	Percent correct
normal	1343	2	99.9%
anomaly	4	1171	99.7%
Percent correct	99.7%	99.8%	99.8%

RESULT

Model successfully trained and deployed using IBM Watson Studio.

Prediction interface available for real-time classification of network activity.


IBM watsonx.ai Studio
Search in your workspaces
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London
AA
Deployment spaces / network test / P2 - Snap Decision Tree Classifier: Network_Intrusion_model /
22,544
records
anomaly
normal
Download JSON file

Prediction results

Prediction type

Binary classification

Prediction percentage

Confidence level distribution

Display format for prediction results

● Table view ○ JSON view

Show input data

	Prediction	Confidence
1	anomaly	100%
2	anomaly	100%
3	normal	100%
4	anomaly	100%
5	normal	100%
6	normal	100%
7	normal	100%
8	normal	100%
9	normal	100%
10	anomaly	100%

CONCLUSION

- The Decision Tree model deployed on IBM Cloud successfully detects network intrusions.
- AutoAI simplified the entire ML lifecycle, from training to deployment.
- This solution provides a foundational step toward intelligent and scalable intrusion detection systems.

FUTURE SCOPE

- Upgrade to ensemble models like Random Forest or XGBoost

- Real-time data streaming and alert generation

- Integration with dashboards or SIEM tools

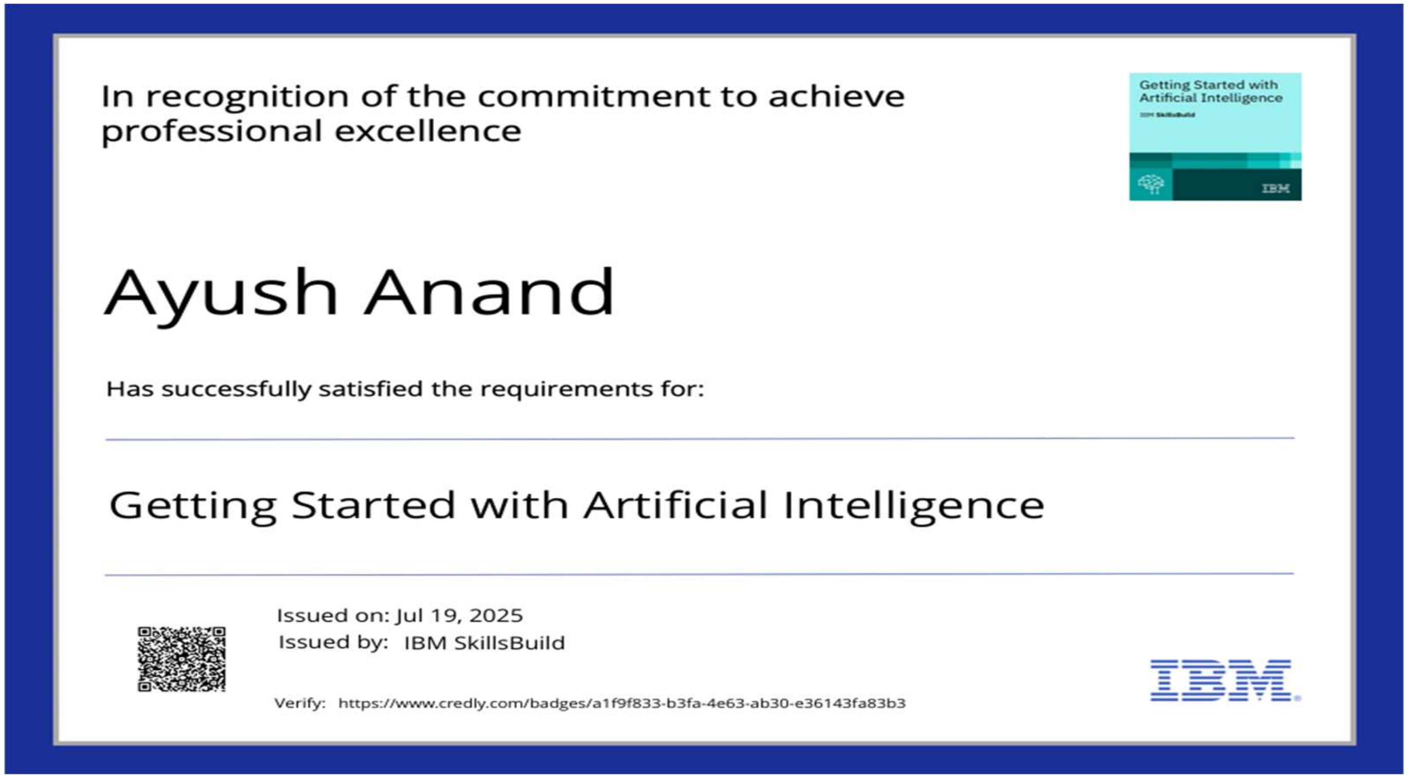
- Fine-grained classification of individual attack types (DoS, R2L, etc.)

REFERENCES

- - https://www.kaggle.com/datasets/sampadab17/networkintrusion-detection
- - IBM Watson Studio documentation
- - IBM Cloud Machine Learning Services
- - Scikit-learn documentation (for Decision Tree concepts)

IBM CERTIFICATIONS

Getting Started with Artifical Intelligence



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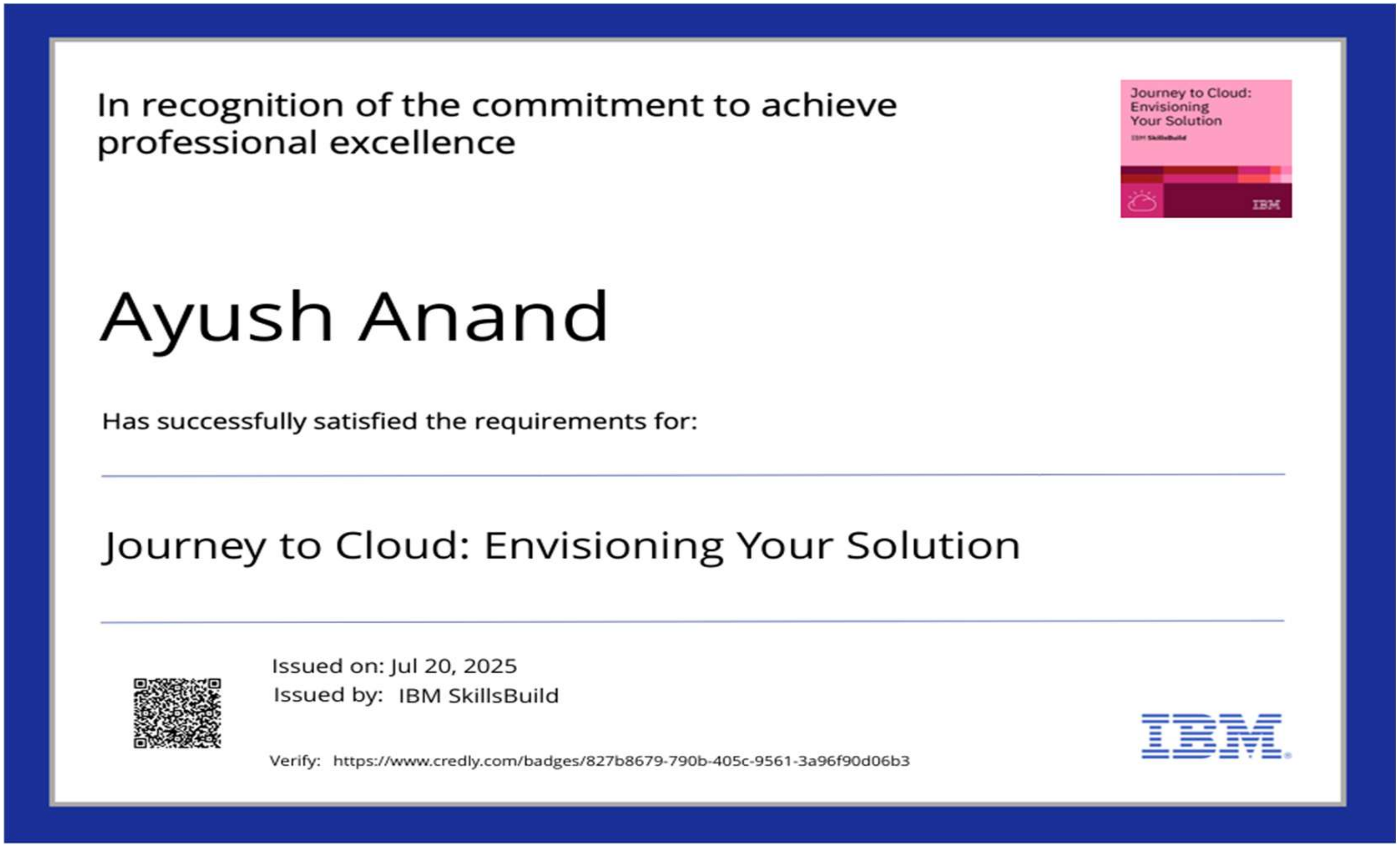
Journey to Cloud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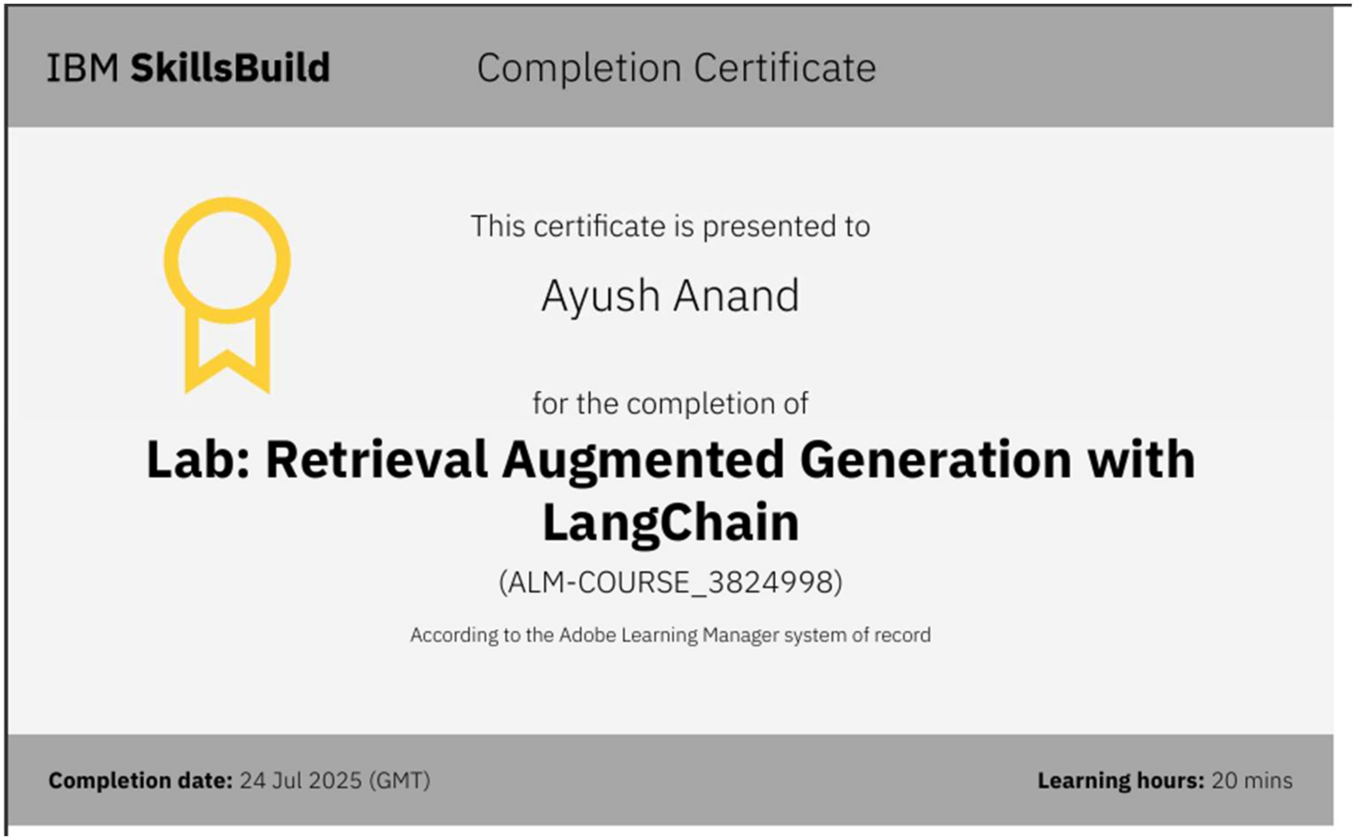

IBM **SkillsBuild** Completion Certificate

This certificate is presented to

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According to the Adobe Learning Manager system of record

Completion date: 24 Jul 2025 (GMT)

Learning hours: 20 mins

THANK YOU