CAPSTONE PROJECT

PROJECT TITLE

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-Computer Science and Engineering

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OUTLINE

- Problem Statement
- Proposed System/Solution
- System Development Approach
- Algorithm & Deployment
- Result
- Conclusion
- Future Scope
- References

PROBLEM STATEMENT

Electric power systems can experience various types of faults such as line-to-ground, line-to-line, or three-phase faults, which can disrupt the stability and reliability of the grid. Timely and accurate detection and classification of these faults using electrical measurements like voltage and current phasors is critical. Existing systems may be slow, inaccurate, or require manual interpretation, leading to delays in mitigation.

PROPOSED SOLUTION

- The proposed solution utilizes IBM AutoAI to automatically build, train, and optimize a machine learning model for detecting and classifying power system faults. Using phasor measurement data (voltage and current), AutoAI simplifies the process by handling data preprocessing, algorithm selection, feature engineering, and hyperparameter optimization.
- This enables rapid prototyping without manually writing code, making it ideal for students and early-stage developers. The solution is deployed using Watson Machine Learning Lite service, enabling real-time fault classification and contributing to improved grid stability and operational efficiency.

SYSTEM APPROACH

System Requirements:

- IBM Cloud Lite account
- Watson Studio (for launching AutoAI)
- IBM Cloud Object Storage (to store dataset and results)
- Watson Machine Learning (for deployment)

AutoAI Capabilities:

- Automated data preprocessing (handling missing values, scaling, encoding)
- Intelligent feature engineering
- Automatic algorithm selection (e.g., Random Forest, XGBoost, etc.)
- Hyperparameter tuning using model optimization
- Model evaluation and comparison

Steps Followed:

- Uploaded the Kaggle dataset to Cloud Object Storage
- Created a new AutoAI experiment in Watson Studio
- Selected target column (Fault_Type)
- Allowed AutoAI to generate pipelines and select the best model
- Deployed the best-performing pipeline using Watson Machine Learning

ALGORITHM & DEPLOYMENT

AutoAI Pipeline Selection:

AutoAI evaluated multiple classification models including:

- Random Forest
- Logistic Regression
- The best-performing pipeline (e.g., Random Forest with specific preprocessing steps) was selected based on F1-score and accuracy.

Data Input:

- Voltage and current phasor values
- Target: Fault_Type

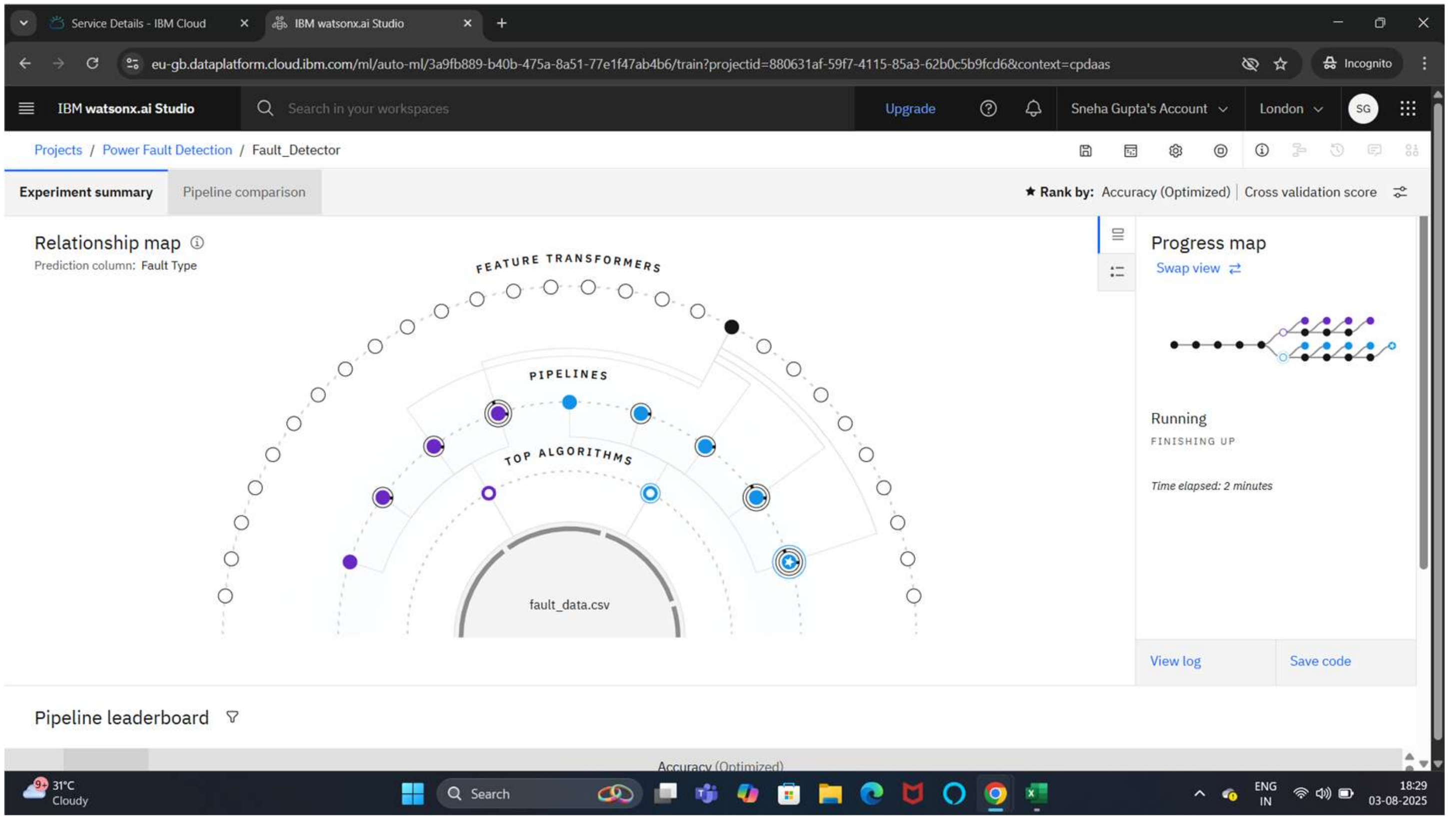
Training Process:

- AutoAI split data into training and validation sets
- Applied automated preprocessing and transformation
- Evaluated multiple pipelines and selected the top performer

Prediction & Deployment:

- The best model pipeline was deployed via Watson Machine Learning
- An endpoint was generated for real-time classification
- Input: Text with voltage/current values → Output: Predicted fault type

RESULT



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Projects / Power Fault Detection / Fault_Detector

★ Rank by: Accuracy (Optimized) | Cross validation score

Relationship map

Prediction column: Fault Type

Progress map

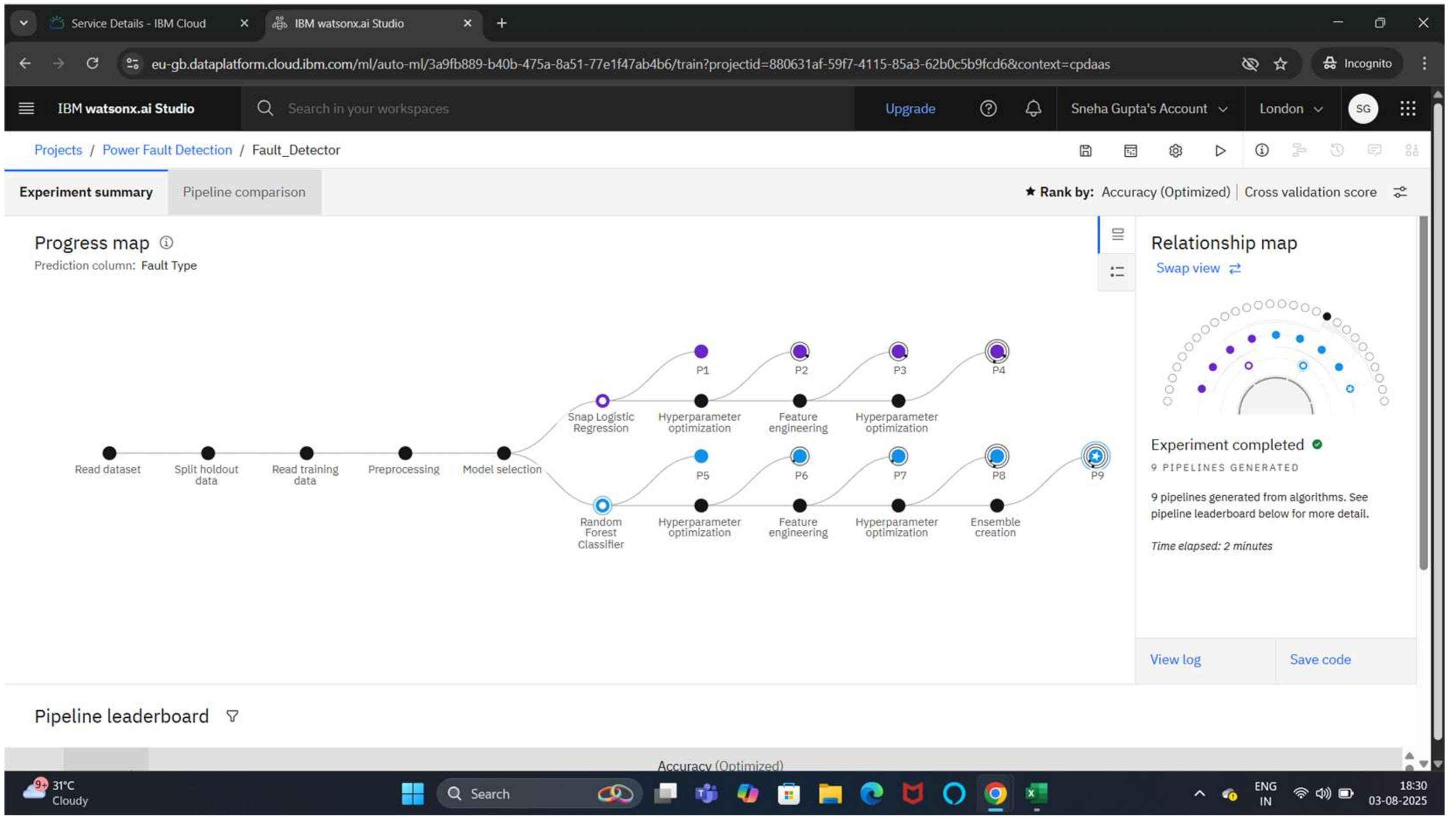
Running

FINISHING UP

Time elapsed: 2 minutes

Pipeline leaderboard

RESULT



Service Details - IBM Cloud

IBM watsonx.ai Studio

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Incognito

IBM watsonx.ai Studio

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Projects / Power Fault Detection / Fault_Detector

Experiment summary

Pipeline comparison

★ **Rank by:** Accuracy (Optimized) | Cross validation score

Progress map

Prediction column: Fault Type

Relationship map

Swap view ⇄

Experiment completed ✓

9 PIPELINES GENERATED

9 pipelines generated from algorithms. See pipeline leaderboard below for more detail.

Time elapsed: 2 minutes

View log

Save code

Pipeline leaderboard

Accuracy (Optimized)

31°C
Cloudy

Search

ENG
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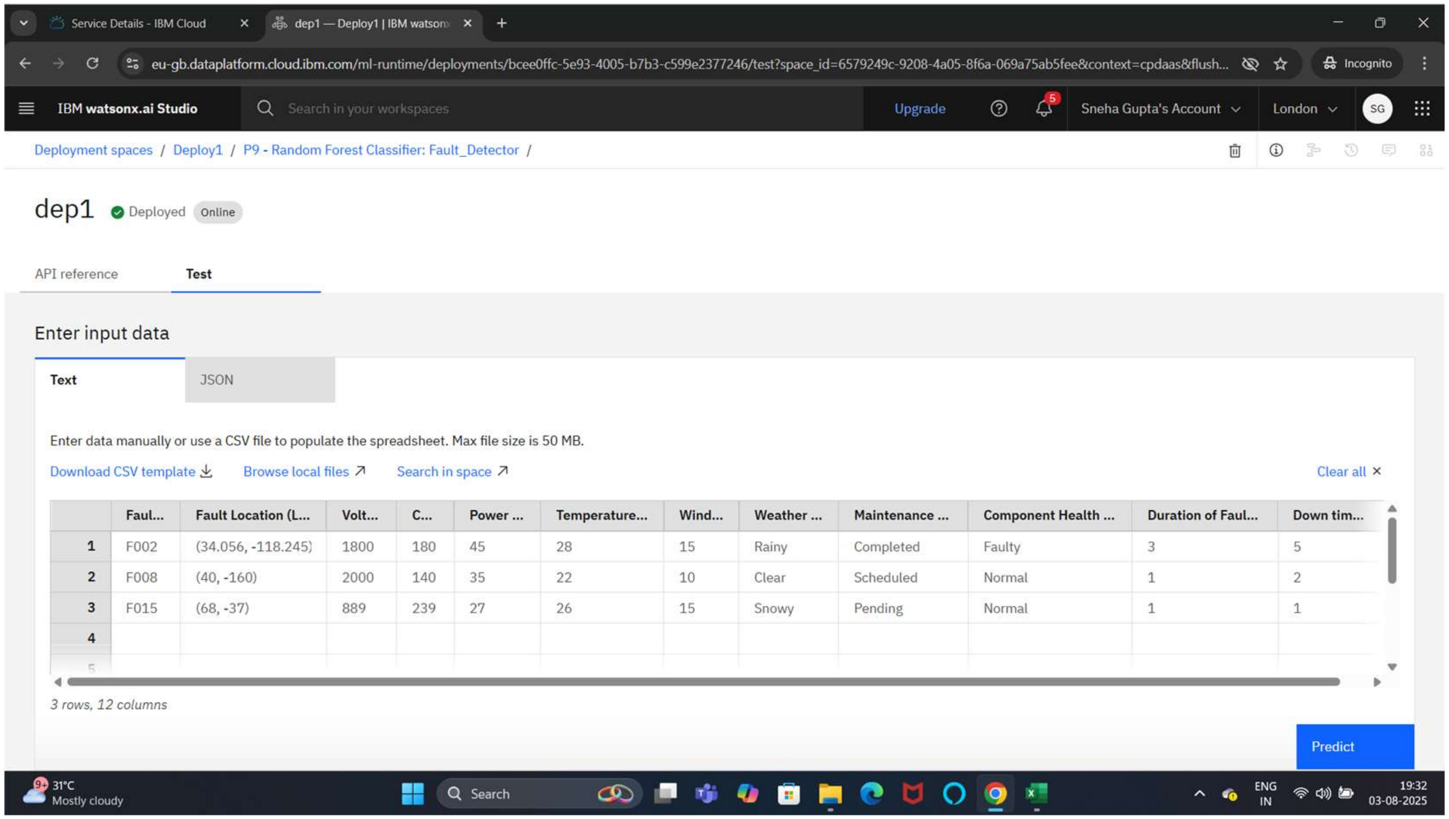
RESULT



eu-gb.dataplatform.cloud.ibm.com/ml-runtime/deployments/bcee0ffc-5e93-4005-b7b3-c599e2377246/test?space_id=6579249c-9208-4a05-8f6a-069a75ab5fee&context=cpdaas&flush...

Deployment spaces / Deploy1 / P9 - Random Forest Classifier: Fault_Detector /

dep1 Deployed Online

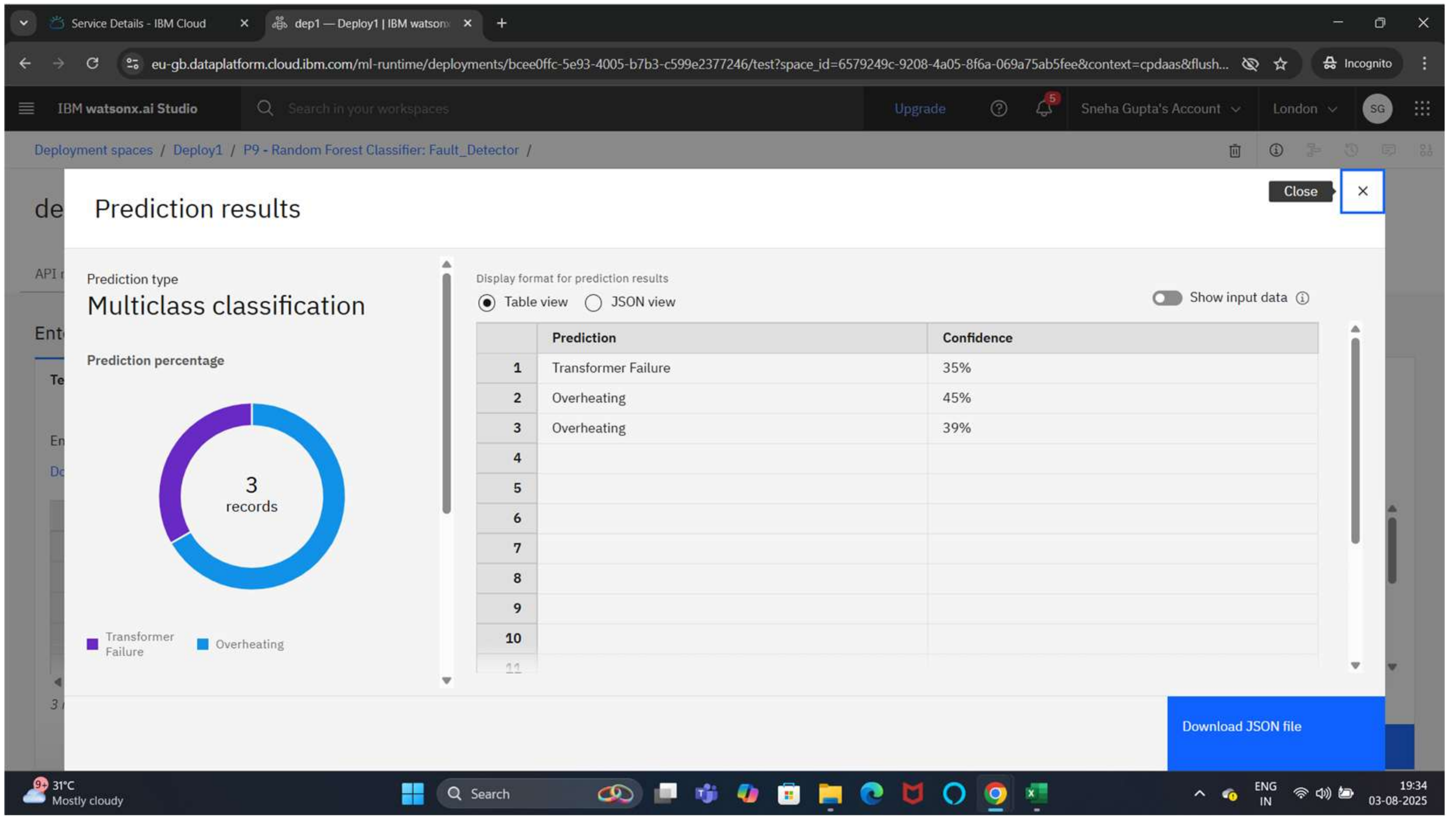
Enter input data

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

	Faul...	Fault Location (L...	Volt...	C...	Power ...	Temperature...	Wind...	Weather ...	Maintenance ...	Component Health ...	Duration of Faul...	Down tim...
1	F002	(34.056, -118.245)	1800	180	45	28	15	Rainy	Completed	Faulty	3	5
2	F008	(40, -160)	2000	140	35	22	10	Clear	Scheduled	Normal	1	2
3	F015	(68, -37)	889	239	27	26	15	Snowy	Pending	Normal	1	1
4												

3 rows, 12 columns

RESULT



Service Details - IBM Cloud
dep1 — Deploy1 | IBM watsonx
eu-gb.dataplatform.cloud.ibm.com/ml-runtime/deployments/bcee0ffc-5e93-4005-b7b3-c599e2377246/test?space_id=6579249c-9208-4a05-8f6a-069a75ab5fee&context=cpdaas&flush...
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Deployment spaces / Deploy1 / P9 - Random Forest Classifier: Fault_Detector /

Prediction results

Prediction type

Multiclass classification

Prediction percentage

3
records
Transformer Failure
Overheating

Display format for prediction results

● Table view ○ JSON view

Show input data

	Prediction	Confidence
1	Transformer Failure	35%
2	Overheating	45%
3	Overheating	39%
4		
5		
6		
7		
8		
9		
10		

CONCLUSION

Using IBM AutoAI, a powerful and accessible ML model was developed without manual coding. The system accurately detects and classifies power faults based on phasor data and is deployed for real-time usage via Watson Machine Learning.

Key Outcomes:

- AutoAI simplified the model-building process
- Fast development and deployment

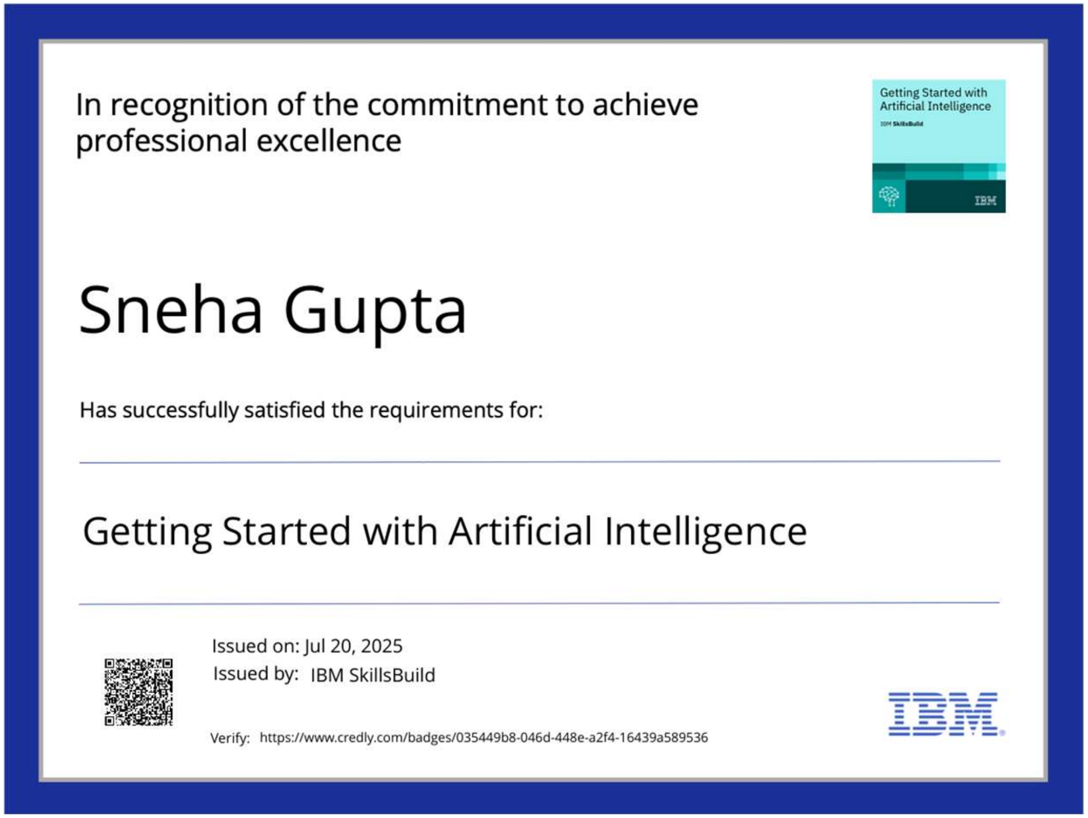
FUTURE SCOPE

- **Data Enhancement:** Include real-time sensor streams or waveform data
- **AutoAI Expansion:** Customize pipelines post-generation for greater control
- **Deployment Scaling:** Upgrade from Lite to Standard for multiple concurrent deployments
- **Edge Deployment:** Export trained models for deployment on edge devices for smart grid fault detection
- **Explainability:** Integrate Watson OpenScale for model monitoring and bias detection

REFERENCES

- Kaggle Dataset - Power System Faults
  https://www.kaggle.com/datasets/ziya07/power-systemfaults-dataset
- IBM AutoAI Documentation
  https://www.ibm.com/docs/en/cloud-paks/cp-data/4.6.x?topic=services-autoai
- IBM Watson Studio (AutoAI Platform)
  https://dataplatform.cloud.ibm.com

IBM CERTIFICATIONS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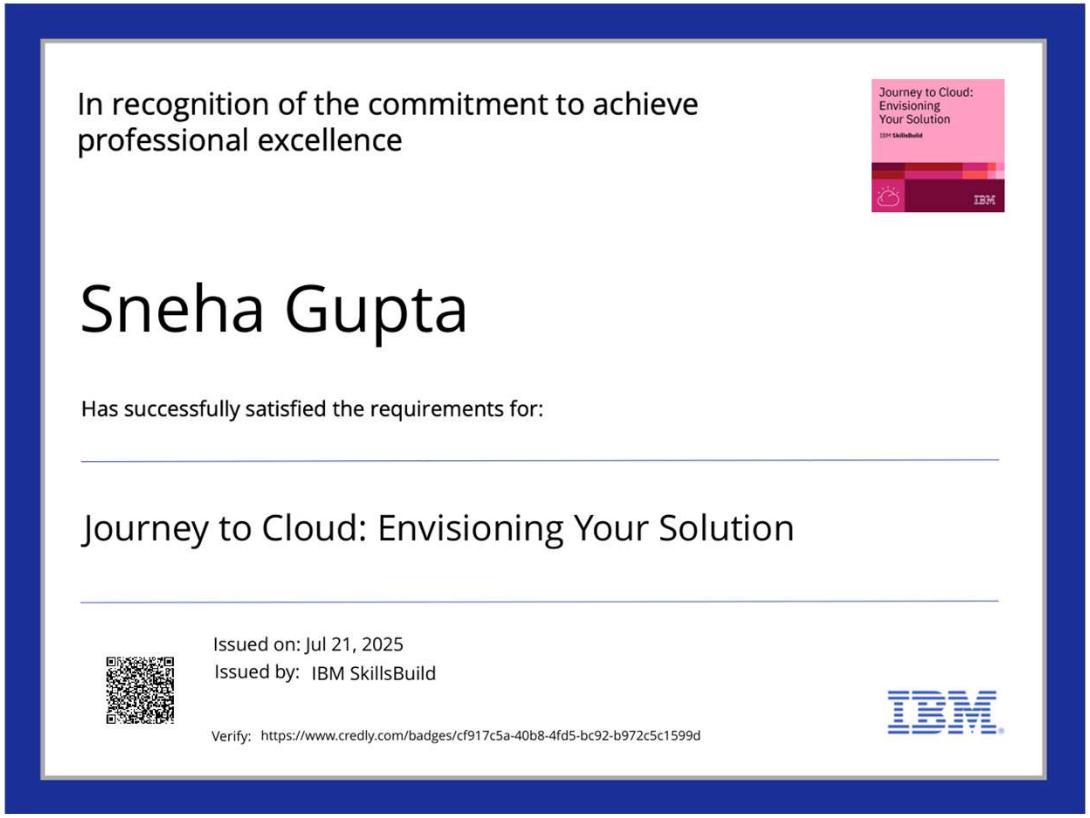

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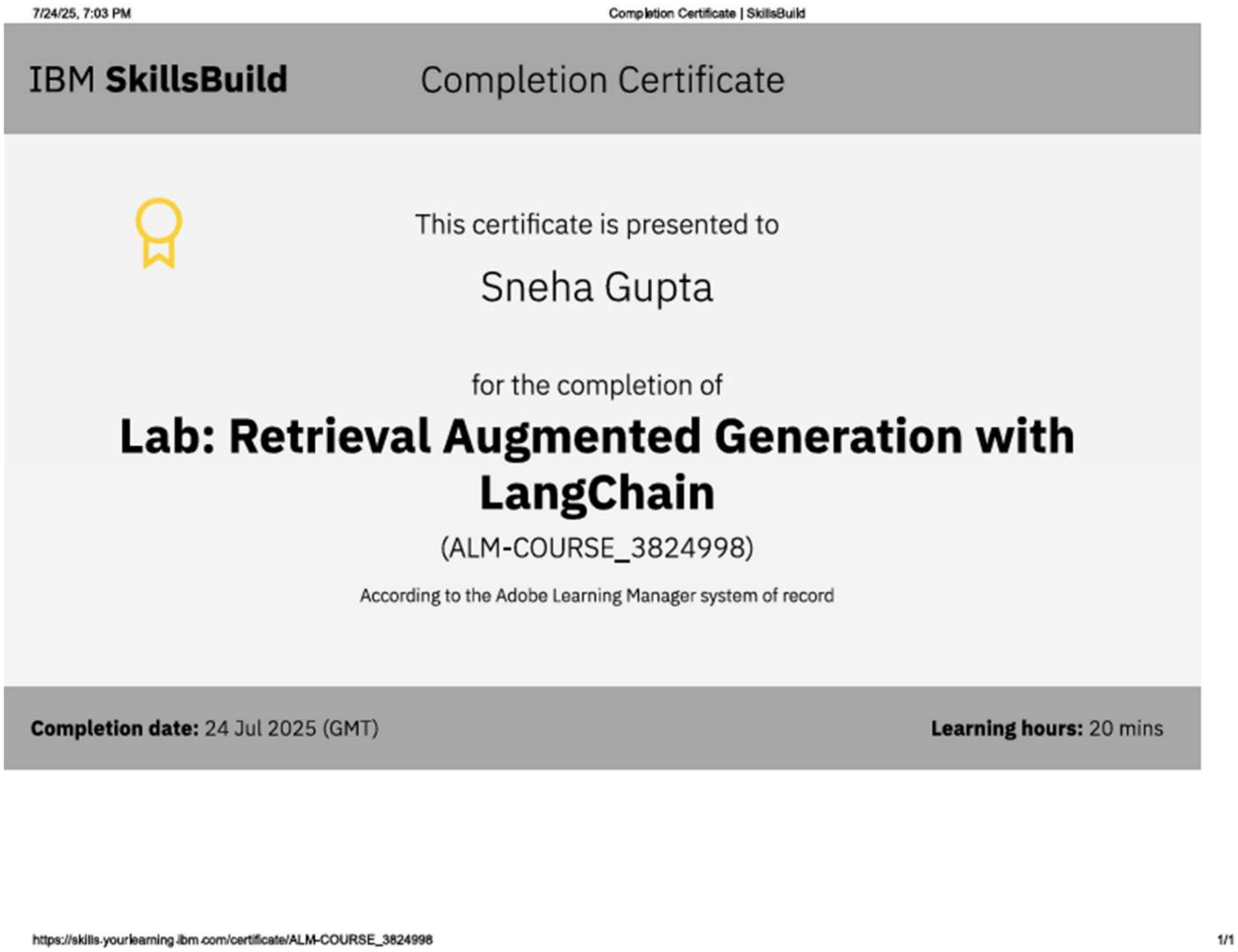

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