CAPSTONE PROJECT

POWER SYSTEM FAULT DETECTION AND CLASSIFICATION

Presented By:
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OUTLINE

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

PROBLEM STATEMENT

- The Challenge:

Design a machine learning model to detect and classify different types of faults in a power distribution system. Using electrical measurement data (e.g., voltage and current phasors), the model should be able to distinguish between normal operating conditions and various fault conditions (such as line-to-ground, line-to-line, or three-phase faults). The objective is to enable rapid and accurate fault identification, which is crucial for maintaining power grid stability and reliability.

PROPOSED SOLUTION

- The project aims to develop a machine learning model to detect and classify power system faults (e.g., short circuit, line-to-ground faults) using real-time power signal data. The solution includes:
- **Data Collection:** Using labeled datasets simulating various types of faults in electrical networks.
- **Preprocessing:** Normalization, noise reduction, and feature extraction from current and voltage signals.
- **Model Training:** Applying classification algorithms to learn fault signatures.
- **Deployment:** Hosting the model on IBM Cloud for scalable real-time predictions via a REST API or web interface.

SYSTEM APPROACH

The "System Approach" section outlines the overall strategy and methodology for developing and implementing the power fault detection. Here's a suggested structure for this section:

1. System requirements

- **Platform:** IBM Cloud
- **Tools Used:** IBM Watson Studio, IBM Cloud Object Storage
- **Languages:** Python

2. Library required to build the model

- **Libraries:** scikit-learn, pandas, NumPy, matplotlib
- **Dataset:** NSL-KDD / synthetic fault datasets (using Kaggle or simulated data)
- **Model Type:** Supervised learning (e.g., Decision Trees, Random Forest, SVM)

ALGORITHM & DEPLOYMENT

- **Algorithm Selection:**

  Random Forest Classifier – chosen for its robustness and ability to handle multi-class fault classification.

- **Inputs:**

  Voltage, current; temperatures; power; fault id; wind speed; weather condition; Maintenance Status; Component Health ; Duration of Faults ; Down time ;fault type labels; fault location;

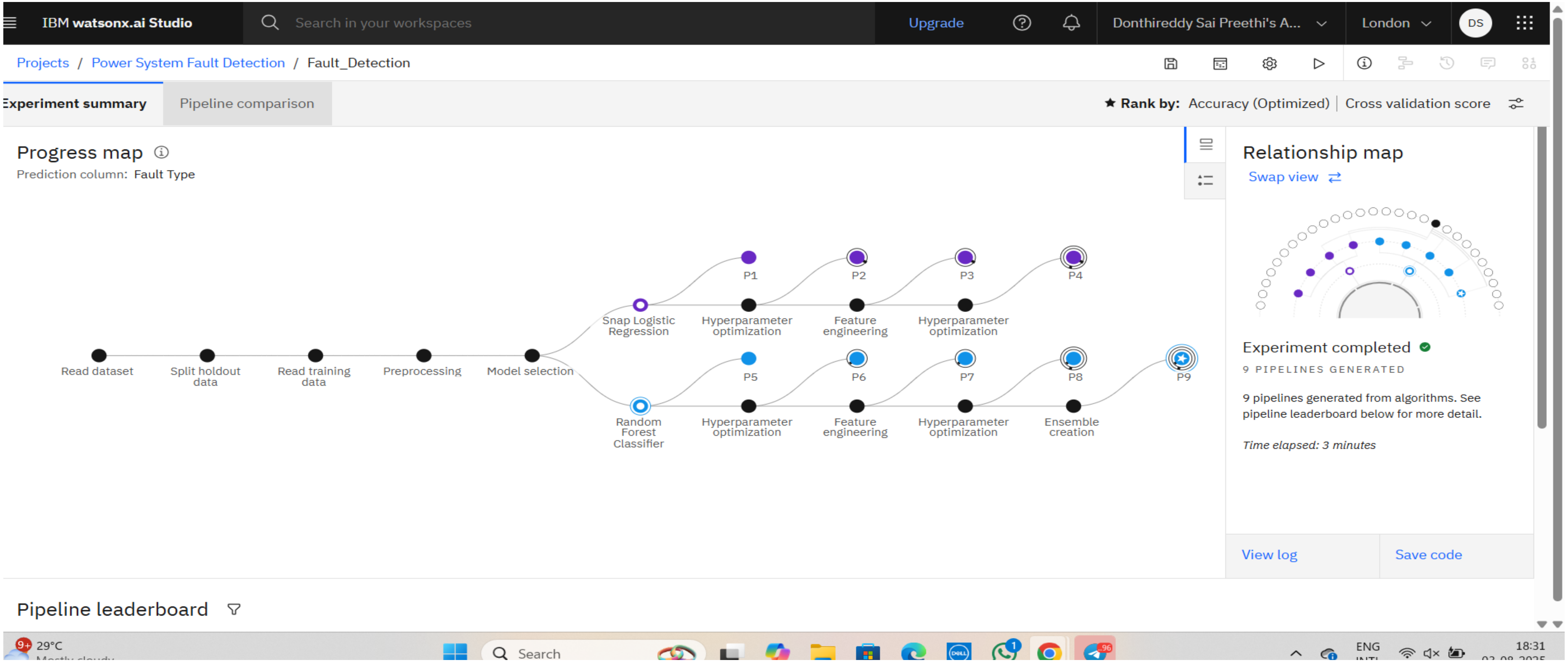
- **Training:**

  Data split into training and test sets; cross-validation applied

- **Deployment:**

  Preparing an online deployment space in IBM cloud and deploying it.

RESULT



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RESULT

Pipeline leaderboard

	Rank	Name	Algorithm	Specialization	Accuracy (Optimized) Cross Validation	Enhancements	Build time
★	1	Pipeline 9	Batched Tree Ensemble Classifier (Random Forest Classifier)	INCR	0.409	HPO-1 FE HPO-2 BATCH	00:00:50
	2	Pipeline 8	Random Forest Classifier		0.409	HPO-1 FE HPO-2	00:00:47
	3	Pipeline 4	Snap Logistic Regression		0.393	HPO-1 FE HPO-2	00:00:34
	4	Pipeline 3	Snap Logistic Regression		0.393	HPO-1 FE	00:00:30

RESULT

deploy1 Deployed Online

API reference Test

Enter input data

Text JSON

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

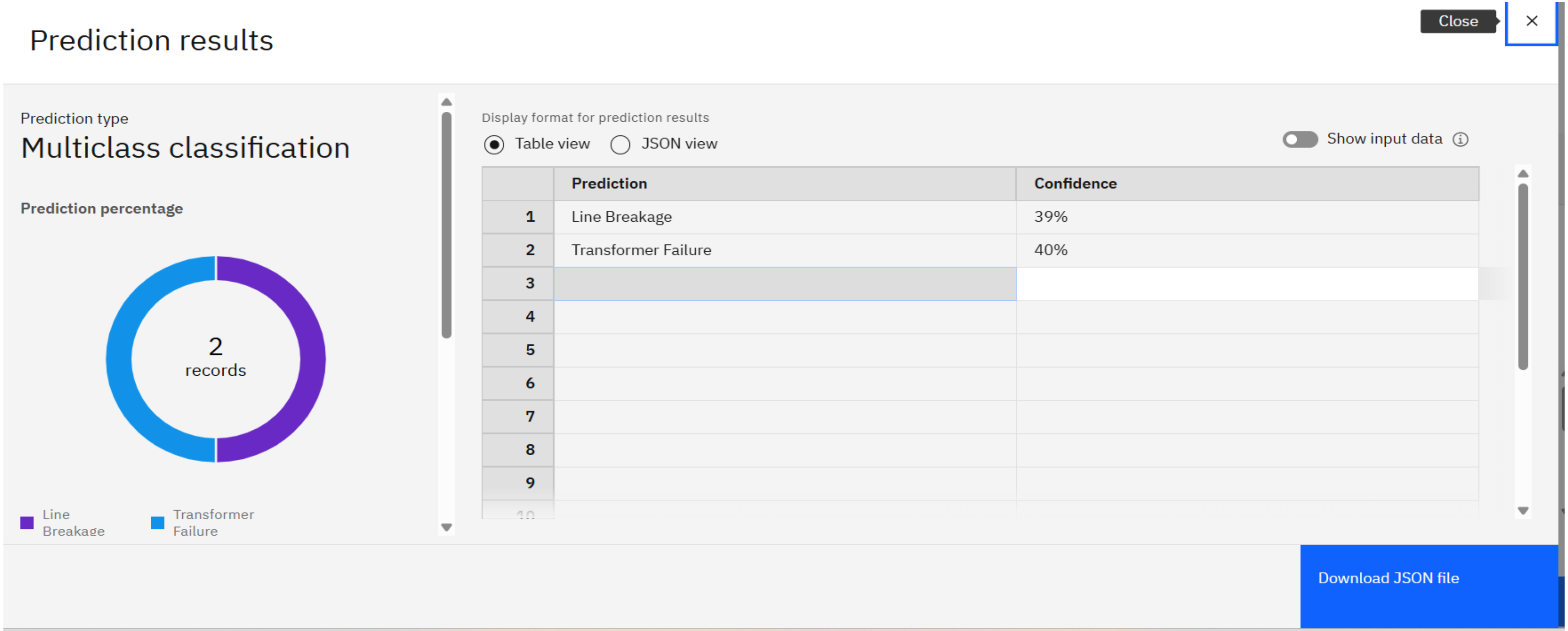
Download CSV template Browse local files Search in space Clear all ×

	ıble)	Wind Speed (km/h) (double)	Weather Condition (other)	Maintenance Status (other)	Component Health (other)	Duration of Fault (hrs) (double)	Down time (hrs) (double)
1		20	Clear	Scheduled	Normal	2	1
2							
3							

1 row, 12 columns

Predict

RESULT


Prediction results
Close
Prediction type
Multiclass classification
Prediction percentage
2
records
Line Breakage
Transformer Failure
Display format for prediction results
Table view
JSON view
Show input data
Prediction
Confidence
1 Line Breakage 39%
2 Transformer Failure 40%
3
4
5
6
7
8
9
Download JSON file

CONCLUSION

- The ML model effectively classifies different power system faults in real time.
- IBM Cloud provided a scalable and reliable environment for hosting and serving the model.
- The approach reduced fault detection time significantly compared to manual/legacy systems.
- Limitations include reliance on simulated data and lack of real-time sensor inputs.

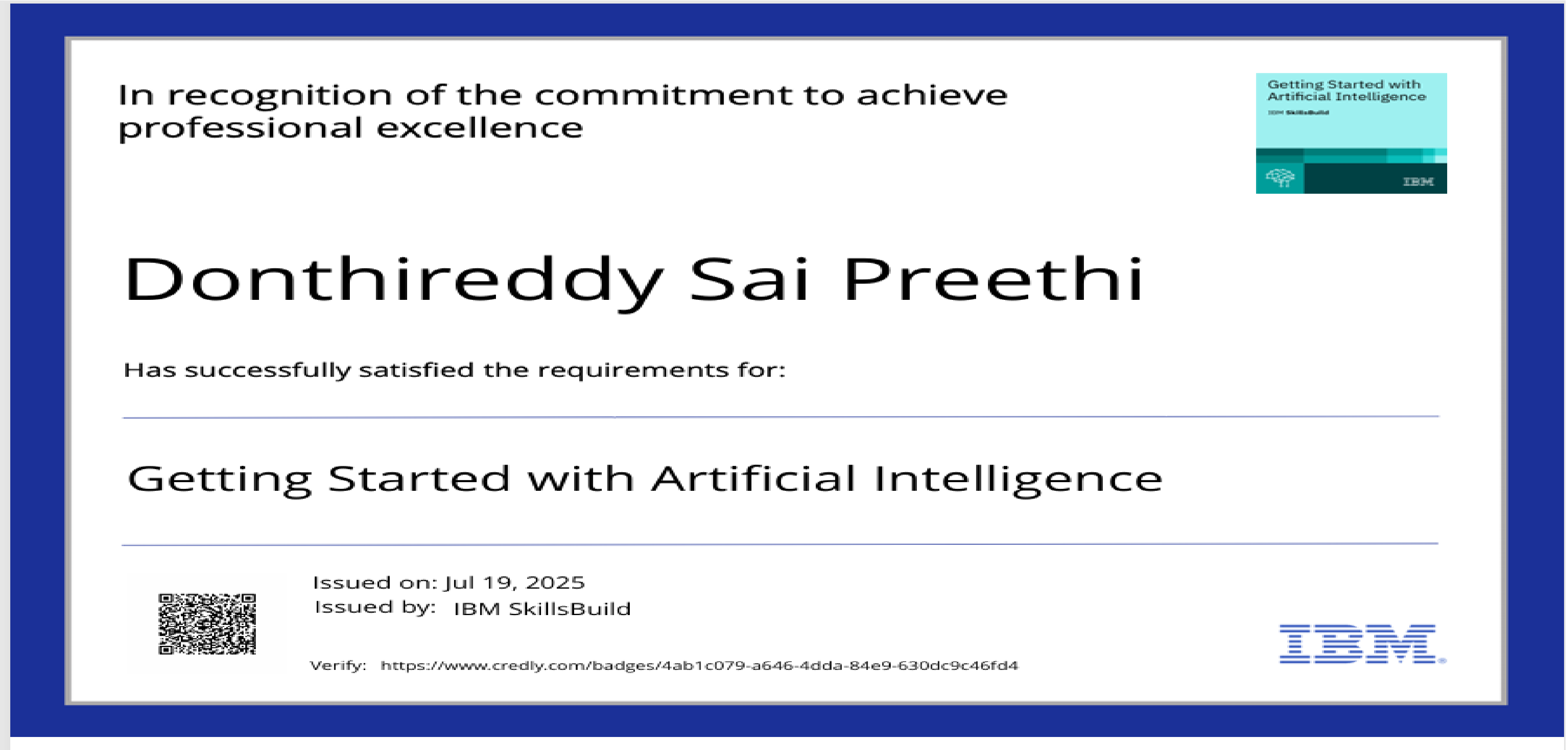
FUTURE SCOPE

- Incorporate real-time IoT sensor data from smart grids.
- Expand to include predictive maintenance for transformers and circuit breakers.
- Use deep learning models (e.g., LSTM, CNN) for waveform analysis.
- Integrate with edge devices for fault detection at the grid periphery.

REFERENCES

- NSL-KDD Dataset – Kaggle
- Scikit-learn Documentation
- IBM Watson Studio & Cloud Docs
- Videos on power fault classification using ML

IBM CERTIFICATIONS



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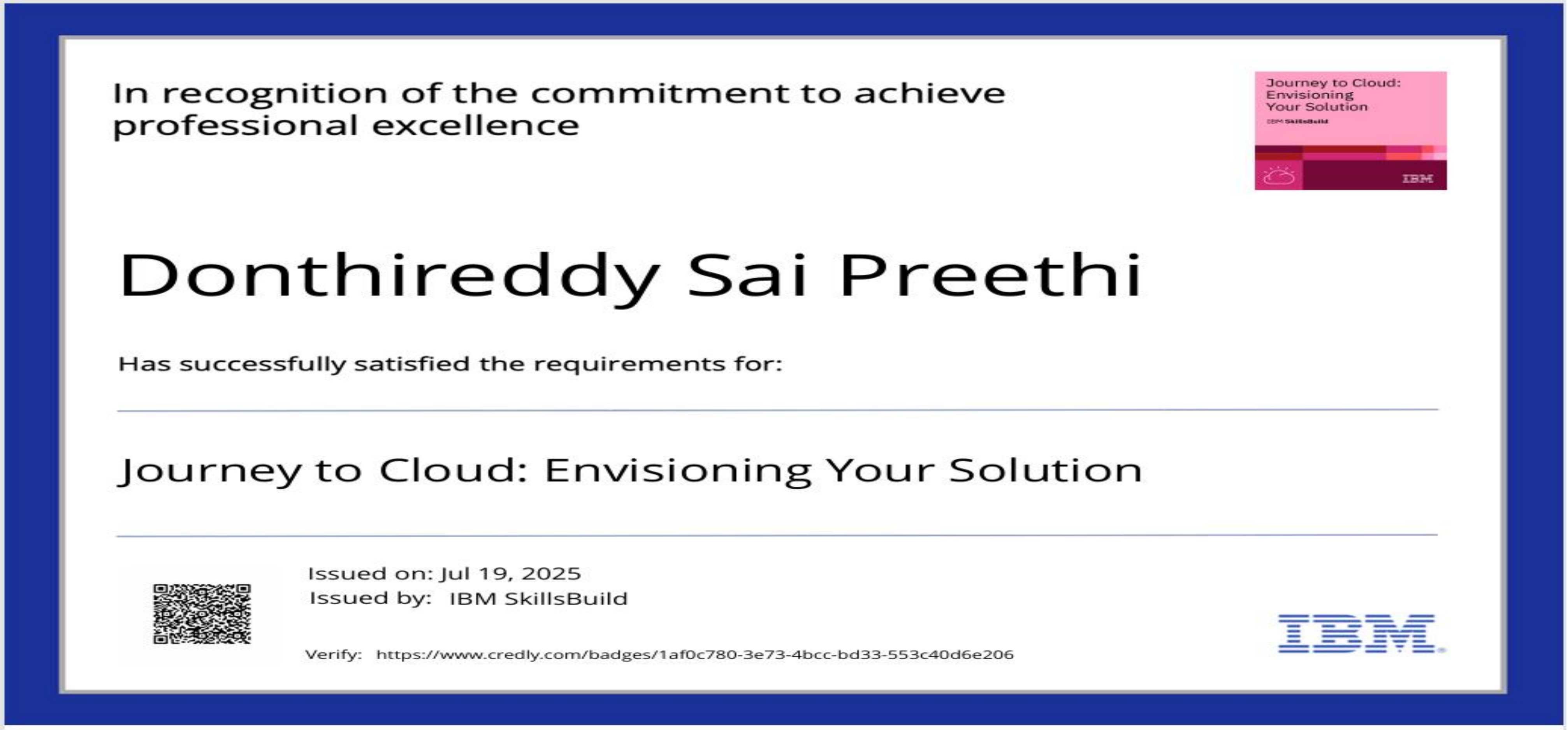

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