Electrical Engineering: (Machine learning project)

PROBLEM STATEMENT NO.41 – POWER SYSTEM FAULT DETECTION AND CLASSIFICATION

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OUTLINE

- **Problem Statement** (Should not include solution)
- **Proposed System/Solution**
- **System Development Approach** (Technology Used)
- **Algorithm & Deployment**
- **Result (Output Image)**
- **Conclusion**
- **Future Scope**
- **References**

PROBLEM STATEMENT

- 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

- This project proposes a machine learning-based solution built using **IBM Cloud and Watsonx.ai** to automatically detect and classify electrical faults in a power distribution system.
- The approach involves collecting voltage and current phasor data under both normal and faulty operating conditions. Using **Watson Studio**, the data is preprocessed, and relevant features such as voltage magnitudes, current magnitudes, rate of change (dV/dt, dI/dt), and phase differences are extracted.
- A classification model is trained in **Watsonx.ai** to distinguish between different types of faults. Once trained, the model is deployed as a **RESTful API** using **Watson Machine Learning**, allowing real-time streaming data to be analyzed on the cloud.

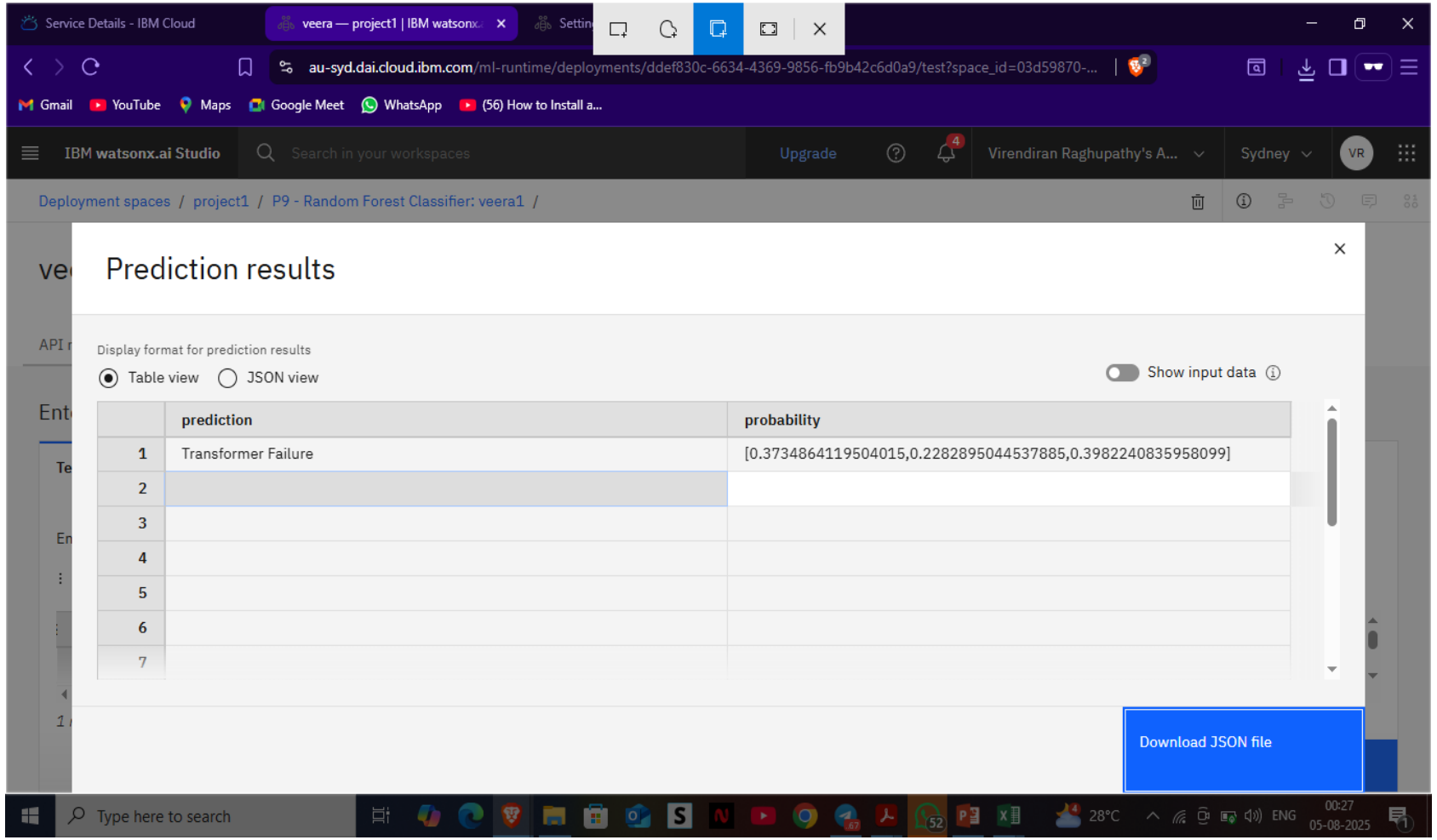
SYSTEM APPROACH

- **System Requirements:**
- Phasor data from sensors (real/simulated)
- Internet access for IBM Cloud
- Python environment for preprocessing
- **Process:**
- Upload and explore dataset
- Preprocess and label data
- Train ML model in Watsonx.ai
- Deploy as real-time API
- Evaluate and monitor performance

ALGORITHM & DEPLOYMENT

- **Model Used:** Random Forest Classifier
- **Justification:** Works well with mixed data, interpretable, handles non-linearity.
- **Input Features:**
- Voltage & current magnitudes (Va, Vb, Vc, Ia, Ib, Ic)
- dV/dt, dI/dt
- Phase angle differences
- **Training Details:**
- 80/20 data split
- 5-fold cross-validation
- Grid search for hyperparameter tuning
- **Deployment:**
- Registered in Watson Machine Learning
- Real-time prediction via REST API endpoint

RESULT



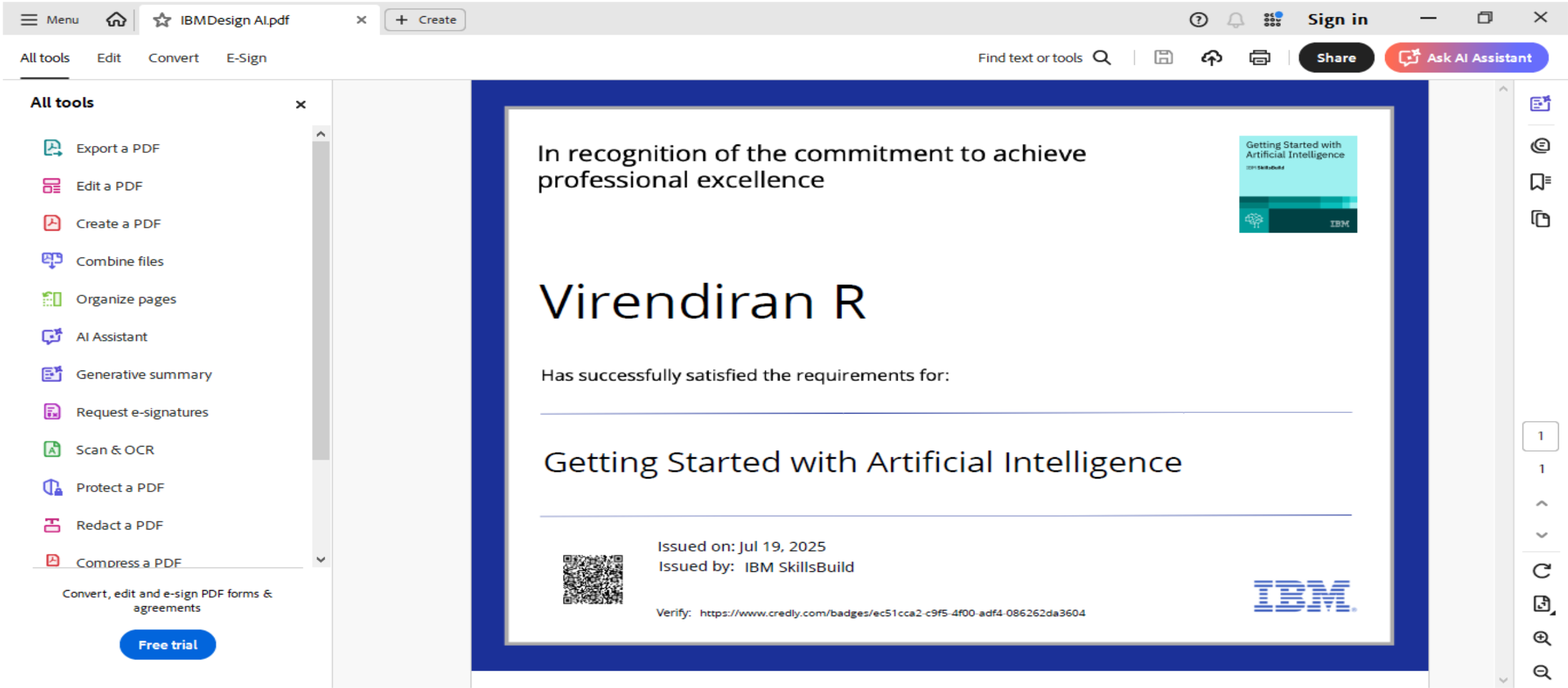
CONCLUSION

- The project proves that machine learning, when deployed with IBM Cloud and Watsonx.ai, can effectively classify faults in power distribution systems. The model provides high accuracy and fast response, enhancing reliability and helping reduce grid downtime.

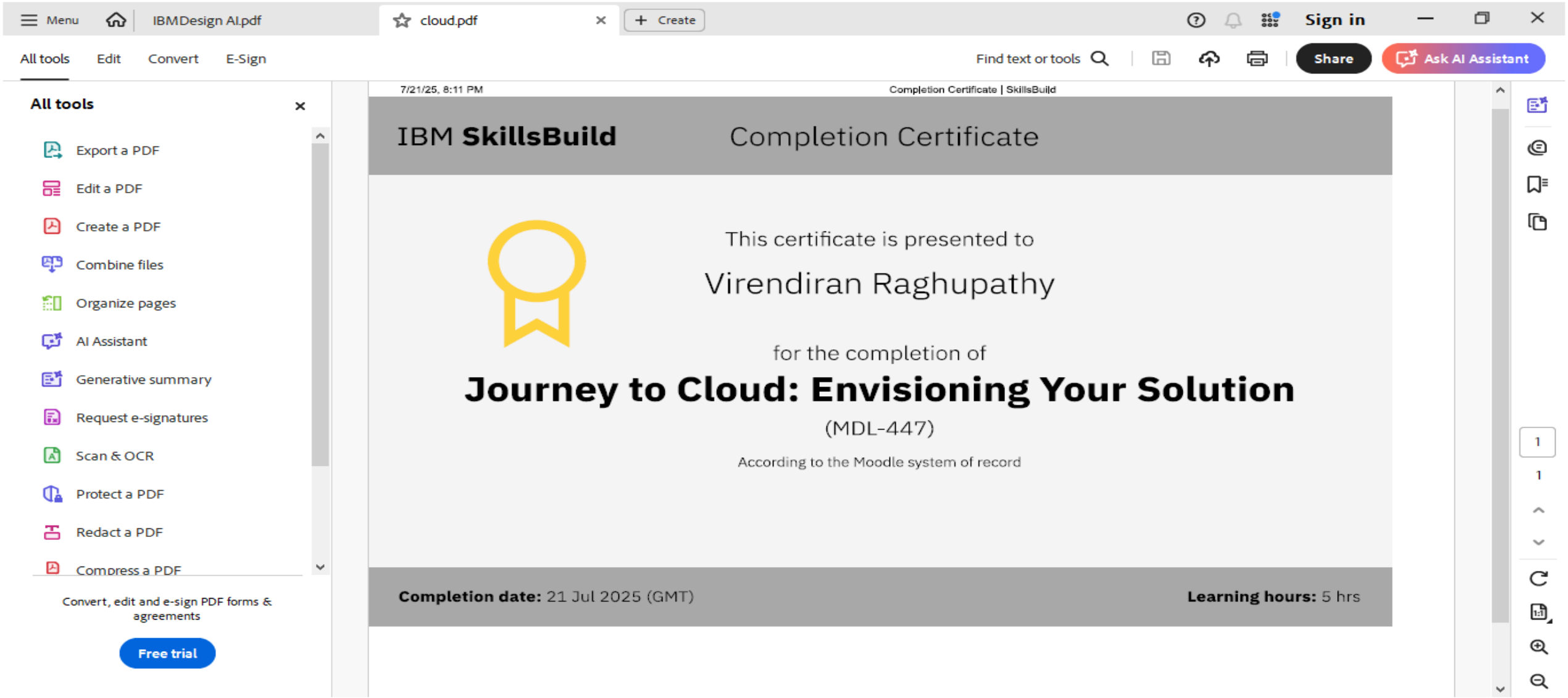
FUTURE SCOPE

- Add fault **location prediction**
- Integrate with **real-time IoT sensors**
- Use **deep learning** (e.g., LSTM) for sequential time-series analysis
- Deploy to **edge devices** for low-latency fault detection
- Build a **fault dashboard** with real-time alerts and analytics

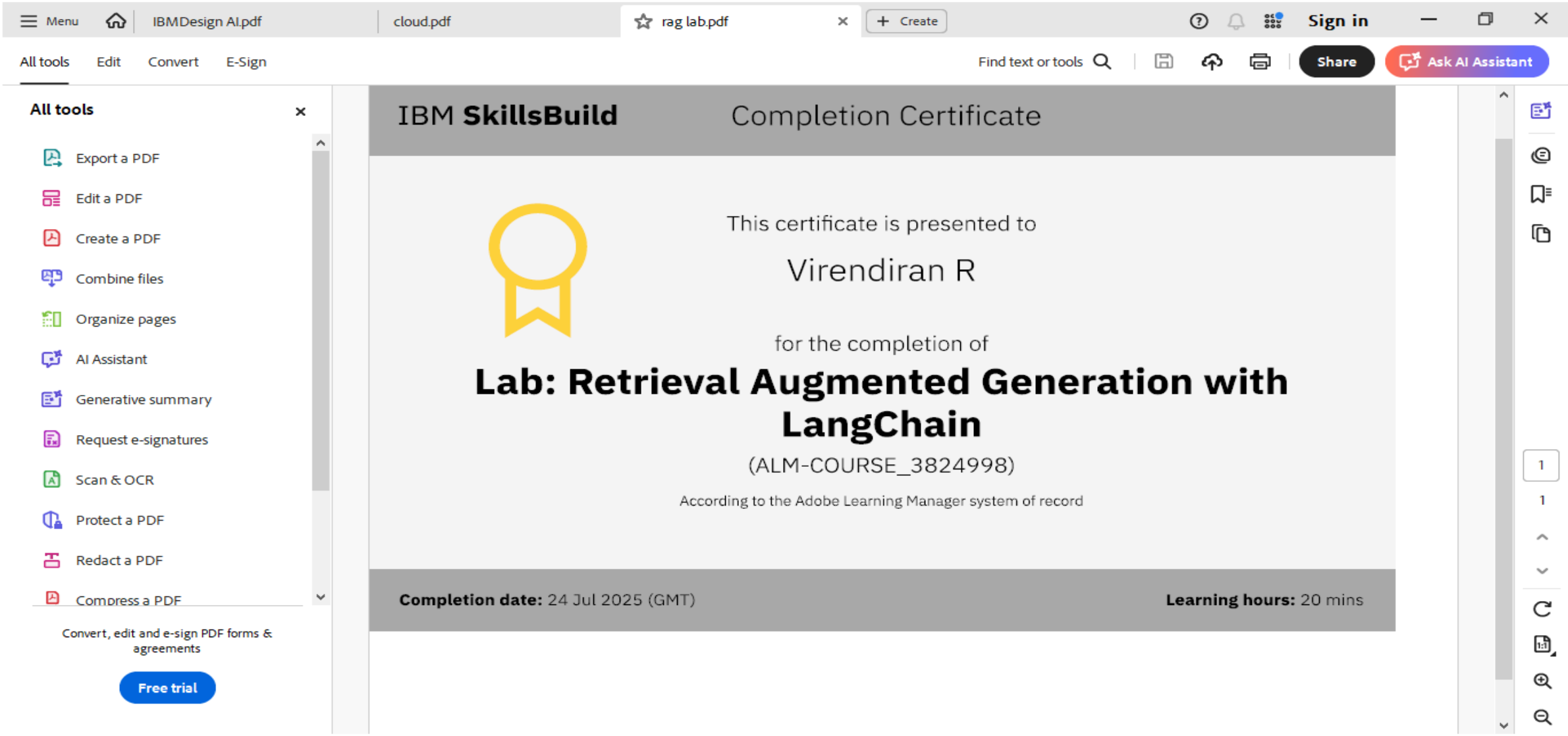
IBM CERTIFICATIONS



IBM CERTIFICATIONS



IBM CERTIFICATIONS



THANK YOU

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