CAPSTONE PROJECT

SMART HOME ENERGY ADVISOR AGENT

PROBLEM STATEMENT NO.31

Presented By:
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OUTLINE

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- Proposed System/Solution
- System Development Approach
- Algorithm & Deployment
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- Conclusion
- Future Scope
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PROBLEM STATEMENT

A Smart Home Energy Advisor Agent acts like your personal electricity manager.

It takes information from your smart meter and appliances, analyzes power usage, and gives you tips to save energy.

The agent can answer questions like "Why is my bill so high this month?" or "What time should I run the washing machine to save money?".

It uses AI to understand consumption patterns and provide simple recommendations.

PROPOSED SOLUTION

- The proposed system aims to build an intelligent model to monitor smart home energy consumption, analyse appliance usage, and provide personalized recommendations for reducing electricity costs. The solution will consist of the following components:
- Data Collection:
  - Collect historical electricity usage data from smart meters and IoT-enabled appliances in the household.
  - Supplement with tariff rate information from the local utility provider.
- Data Preprocessing:
  - Clean and preprocess the collected data to handle missing values, outliers, and inconsistent timestamps.
  - Convert raw usage logs into aggregated features such as hourly/daily consumption, peak usage times, and appliance-specific usage patterns.
  - Automate preprocessing using IBM's AutoAI capabilities..
- Machine Learning Algorithm:
  - Implement a regression model to predict future energy consumption and a classification/recommendation model to suggest optimal appliance usage schedules.
  - Use IBM AutoAI to train, compare, and select the best-performing models automatically..
- Deployment:
  - Deploy the final trained model as a real-time web application or chatbot service using IBM watsonx.ai..
- Evaluation:
  - Evaluate model performance using metrics such as Mean Absolute Error (MAE) for consumption predictions and Recommendation Accuracy for schedule suggestions.

Smart Meters / Appliances Data

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Data Preprocessing

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Model Training (AutoAI)

↓

Predictions + Recommendations

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Deployment on watsonx.ai

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Real-time User Interaction

SYSTEM APPROACH

System requirements –

- Hardware: 8 GB RAM, multi-core processor, internet, smart meter, IoT appliances
- Software: Python 3.8+, Jupyter Notebook, IBM watsonx.ai, Windows/macOS/Linux

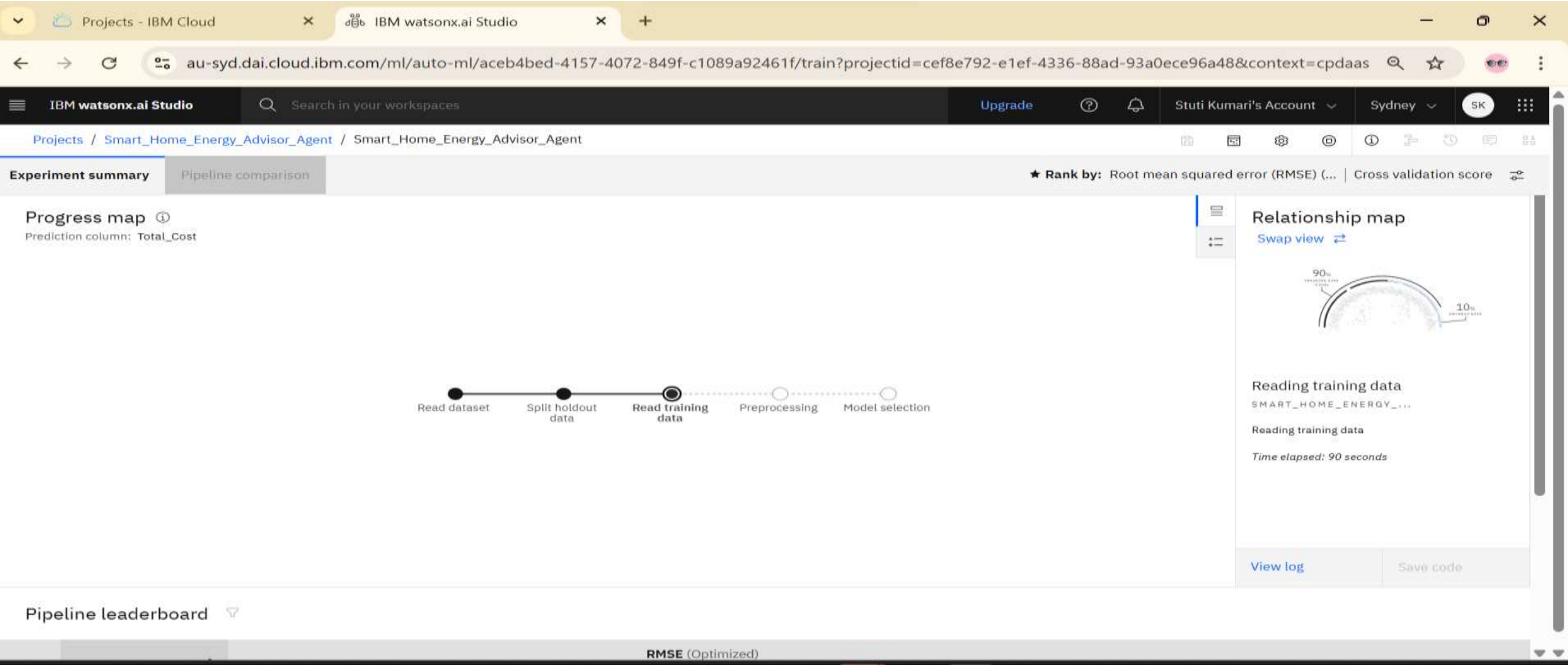
Library required to build the model –

- ibm-watsonx-ai: For interacting with the IBM platform.
- scikit-learn: For machine learning components.
- autoai-libs: For running AutoAI generated pipelines.
- pandas: For data manipulation.

ALGORITHM & DEPLOYMENT

- **Algorithm Selection:**
  - Uses a regression model (AutoAI-selected) to predict energy consumption and detect usage patterns..
- **Data Input:**
  - Features: smart meter readings, appliance logs, time, day, weather, tariff rates.
- **Training Process:**
  - AutoAI handles preprocessing, feature selection, cross-validation, and tuning.
- **Prediction Process:**
  - Forecasts future consumption and identifies peak usage using real-time data.

RESULT



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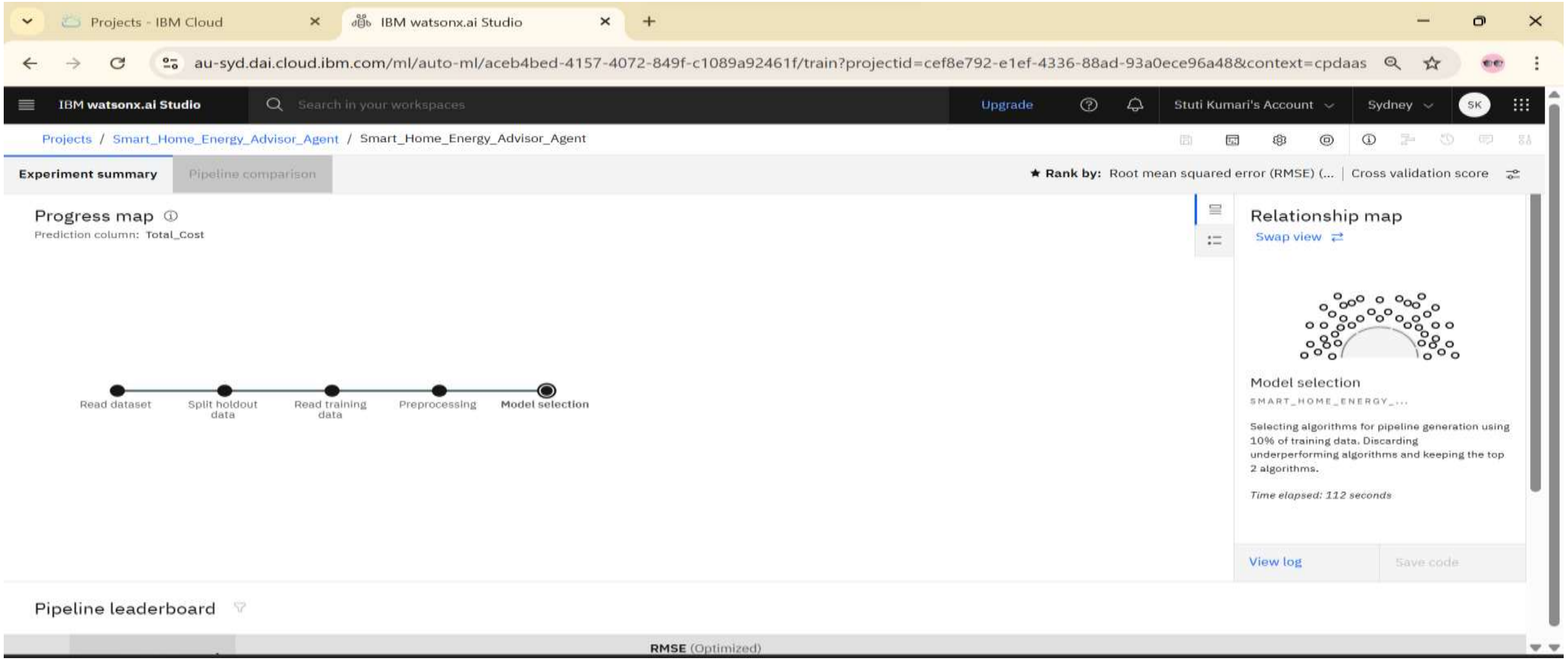

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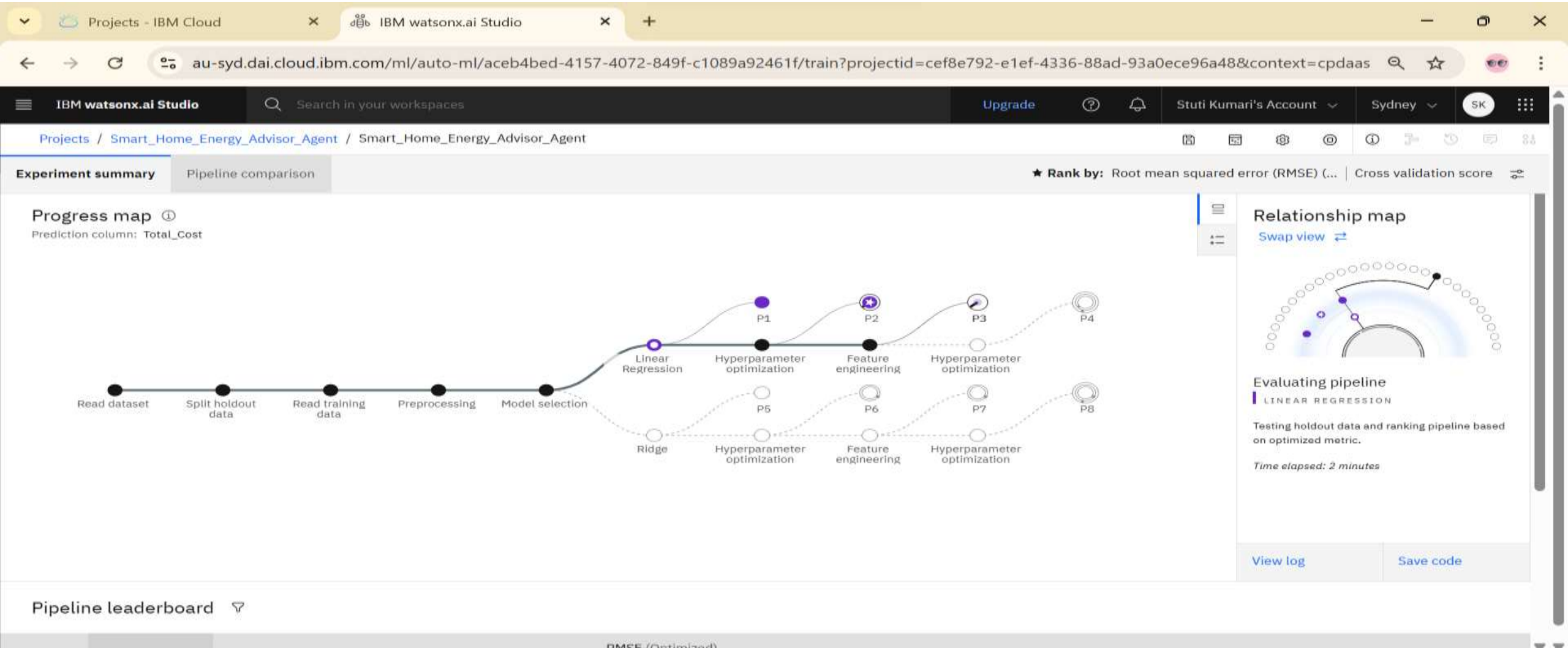

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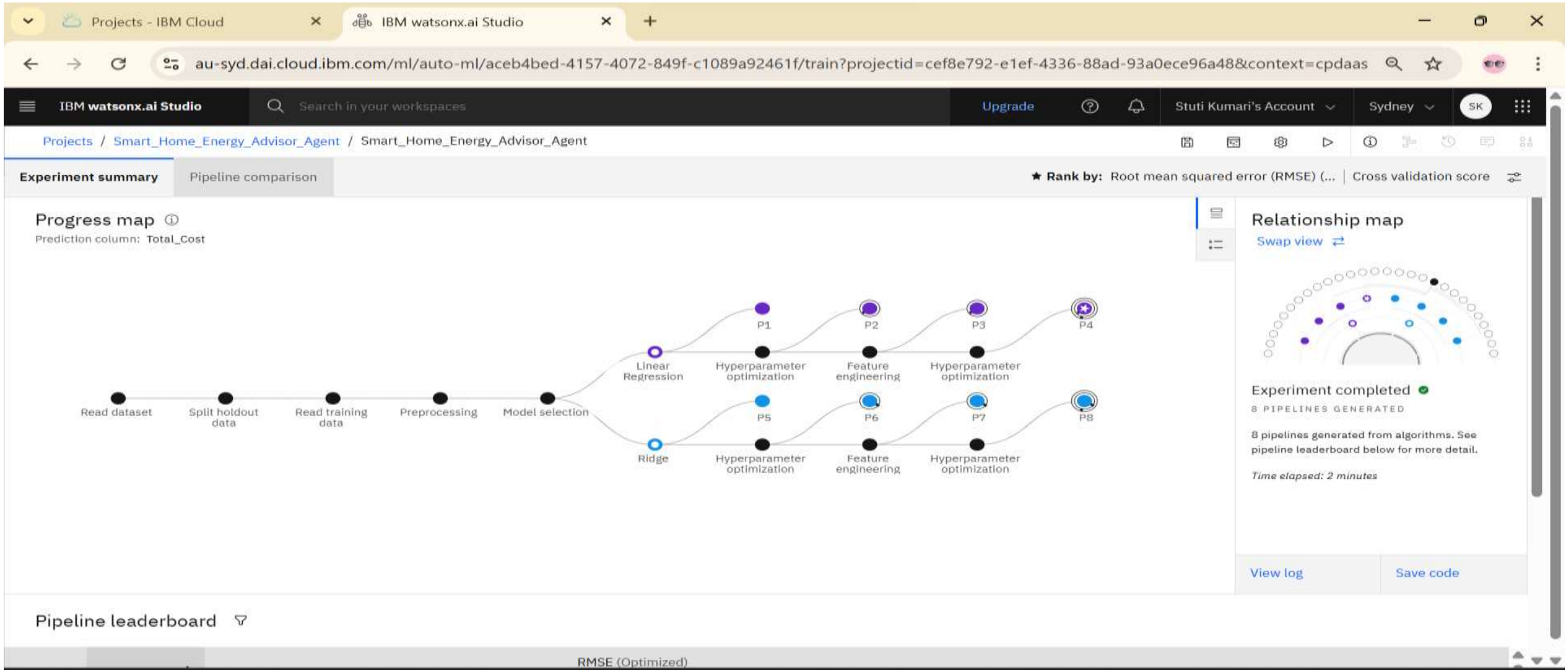

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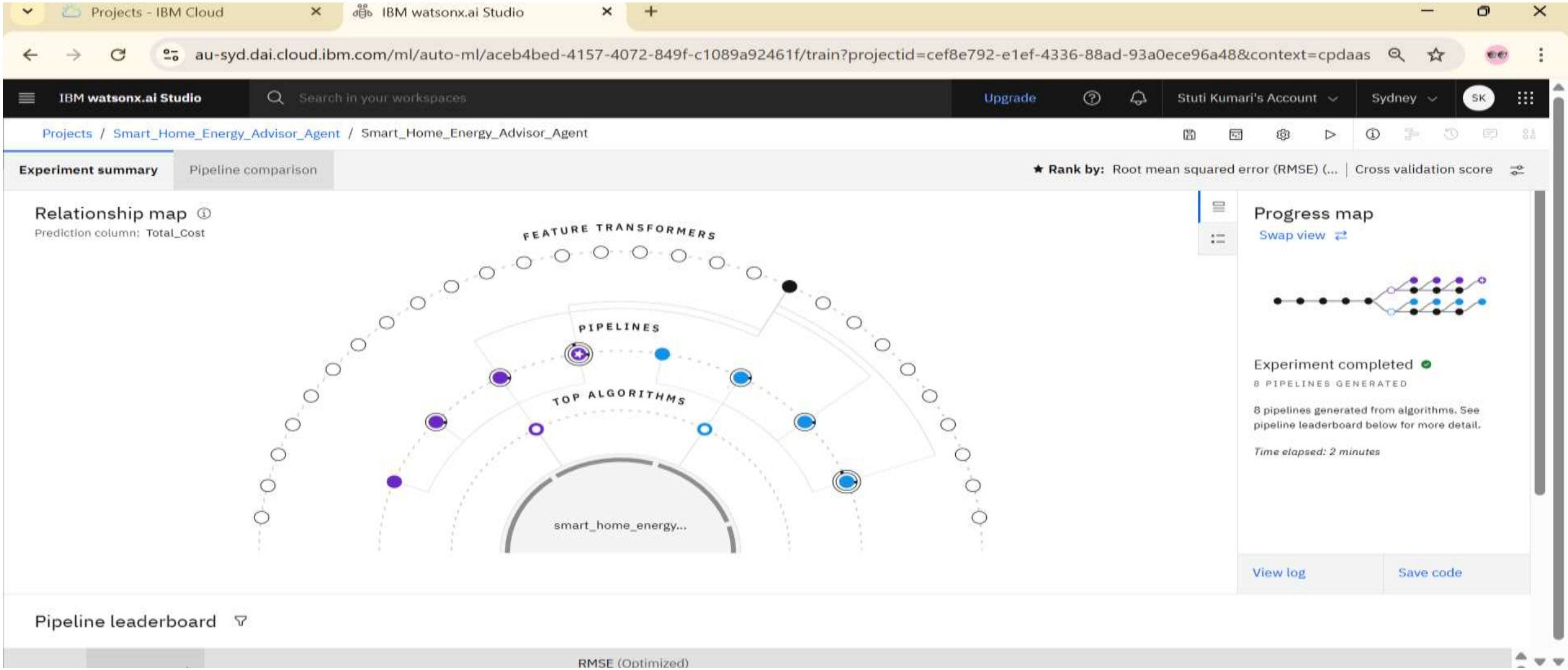

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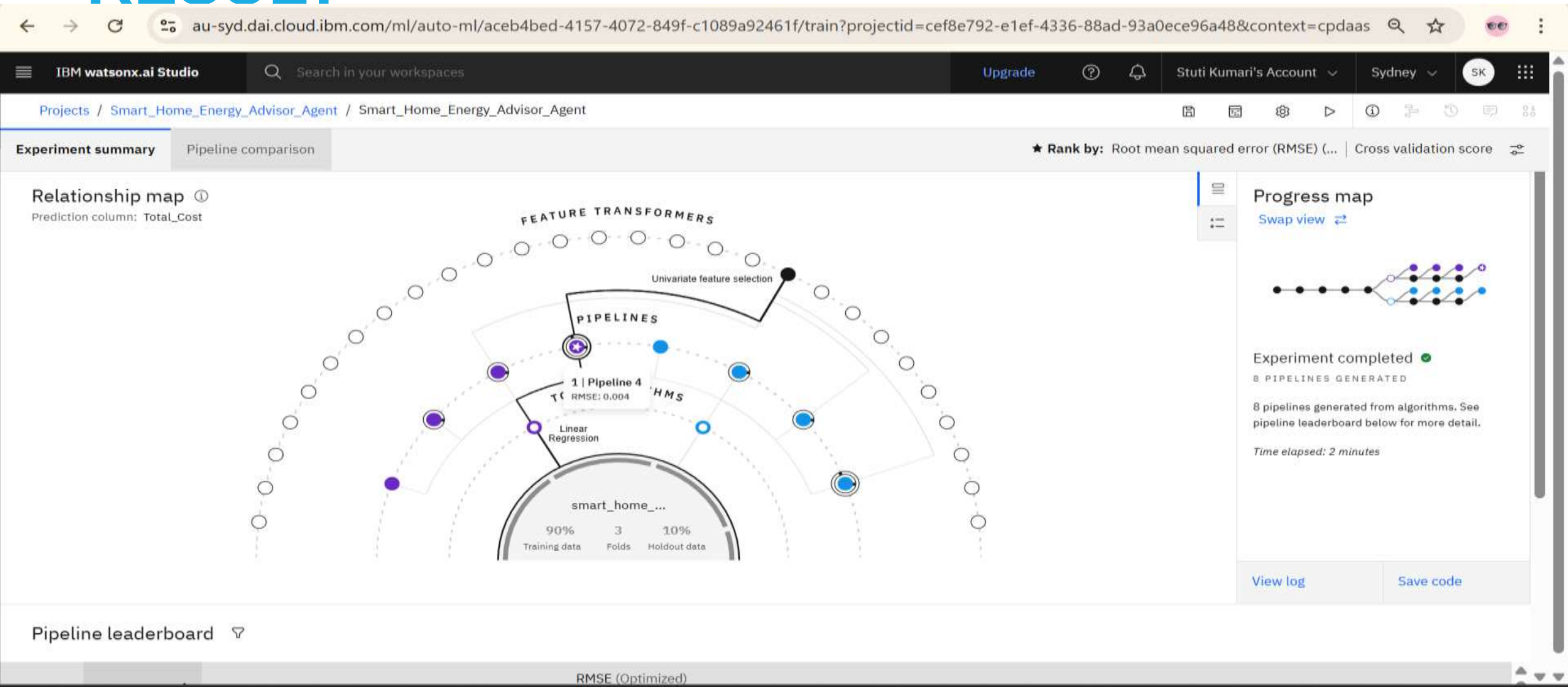

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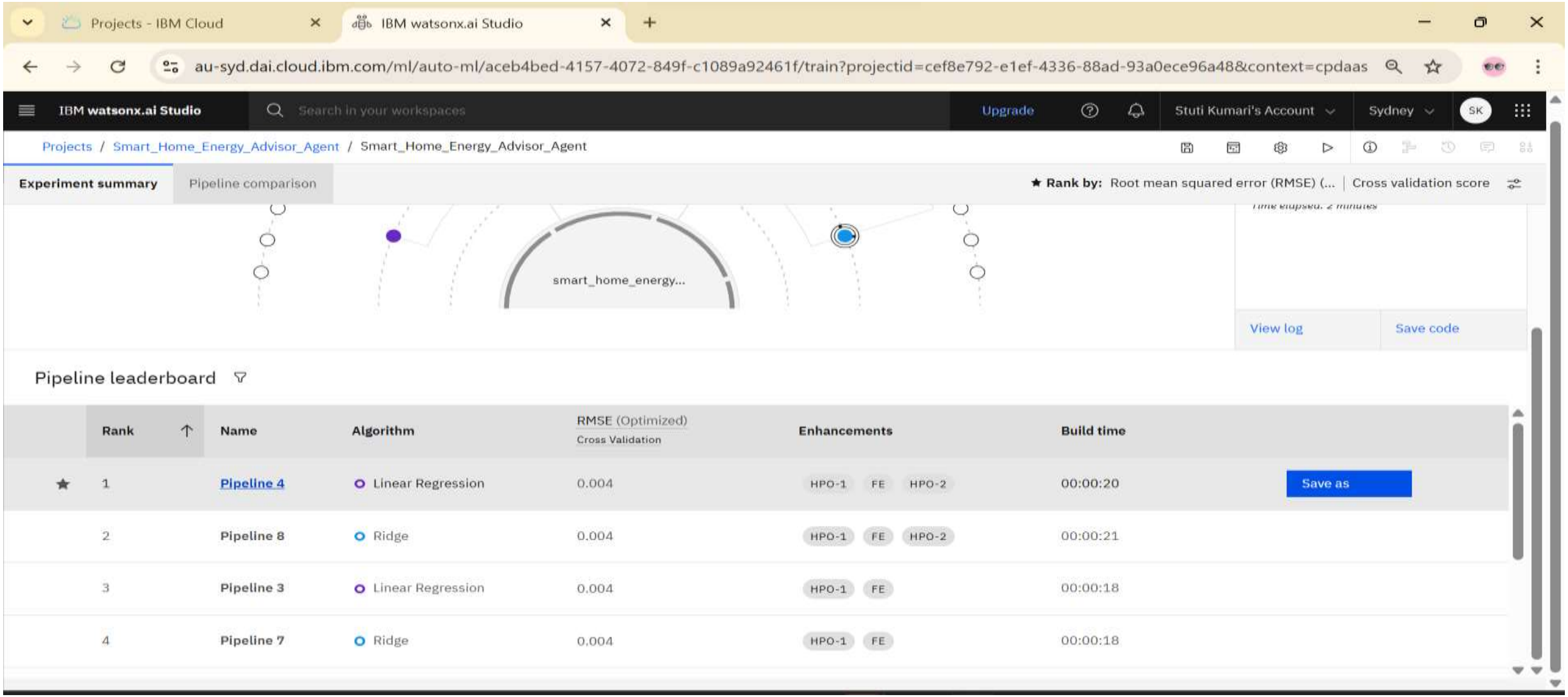

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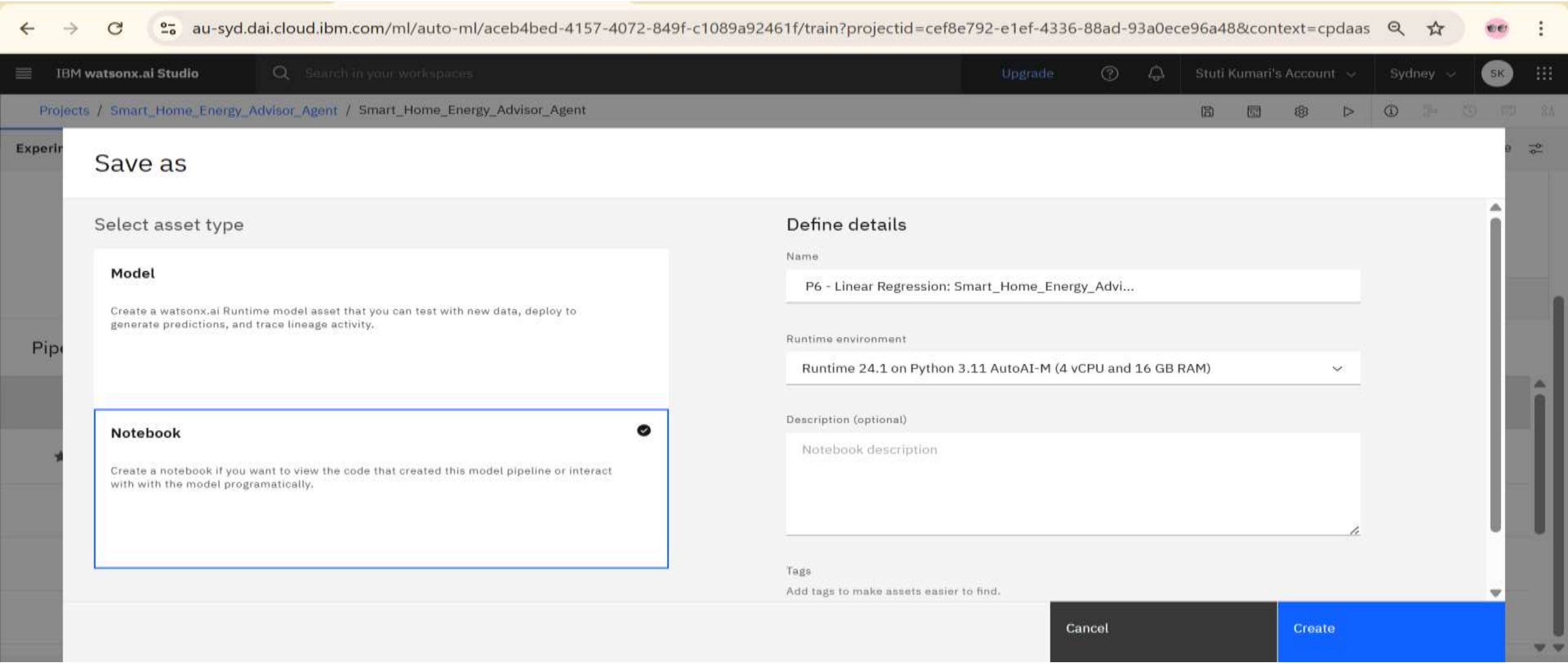

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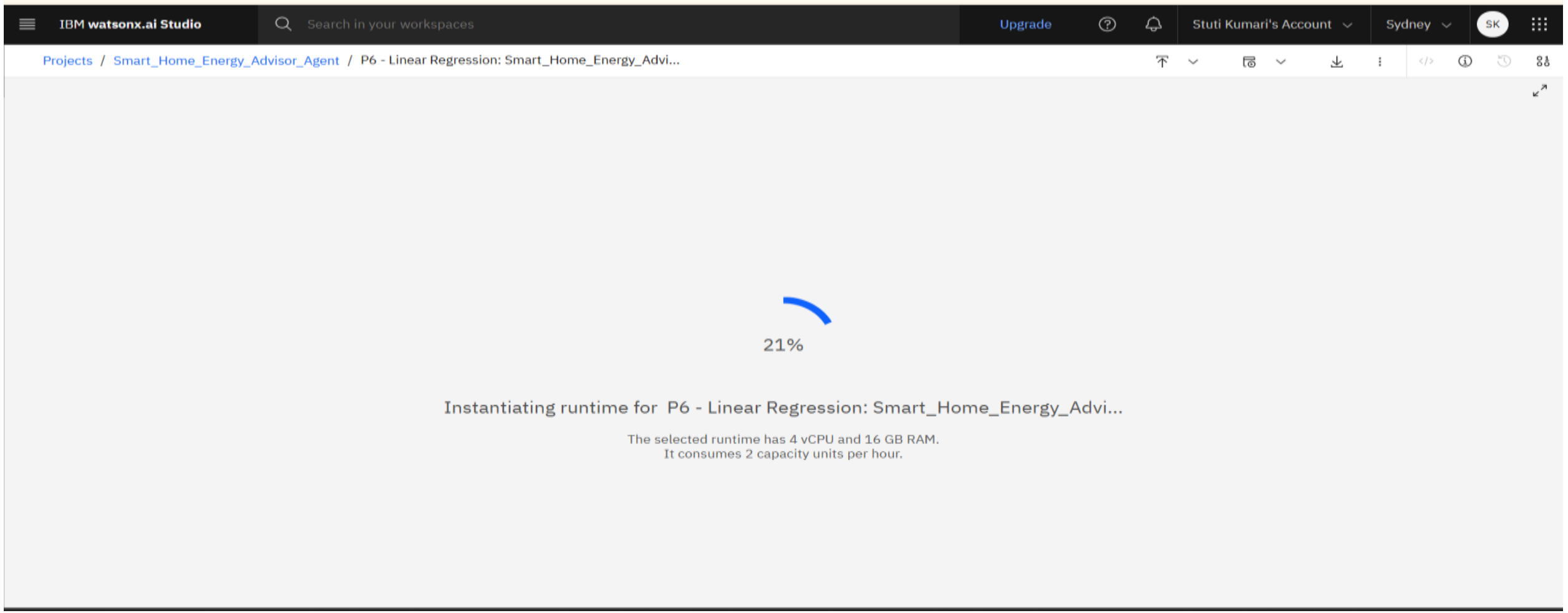
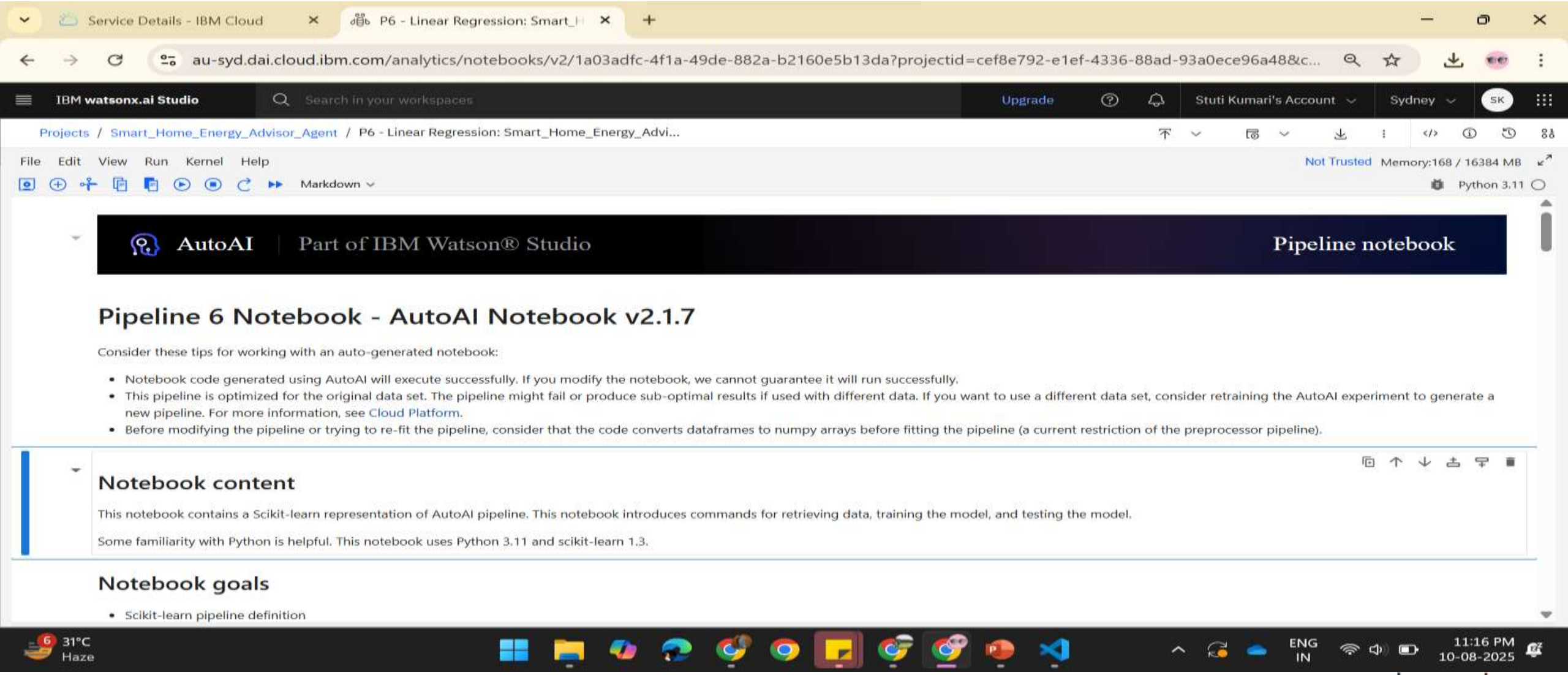

IBM watsonx.ai Studio
Search in your workspaces
Upgrade
Stuti Kumari's Account
Sydney
SK
Projects / Smart_Home_Energy_Advisor_Agent / P6 - Linear Regression: Smart_Home_Energy_Advi...
21%
Instantiating runtime for P6 - Linear Regression: Smart_Home_Energy_Advi...
The selected runtime has 4 vCPU and 16 GB RAM.
It consumes 2 capacity units per hour.

RESULT



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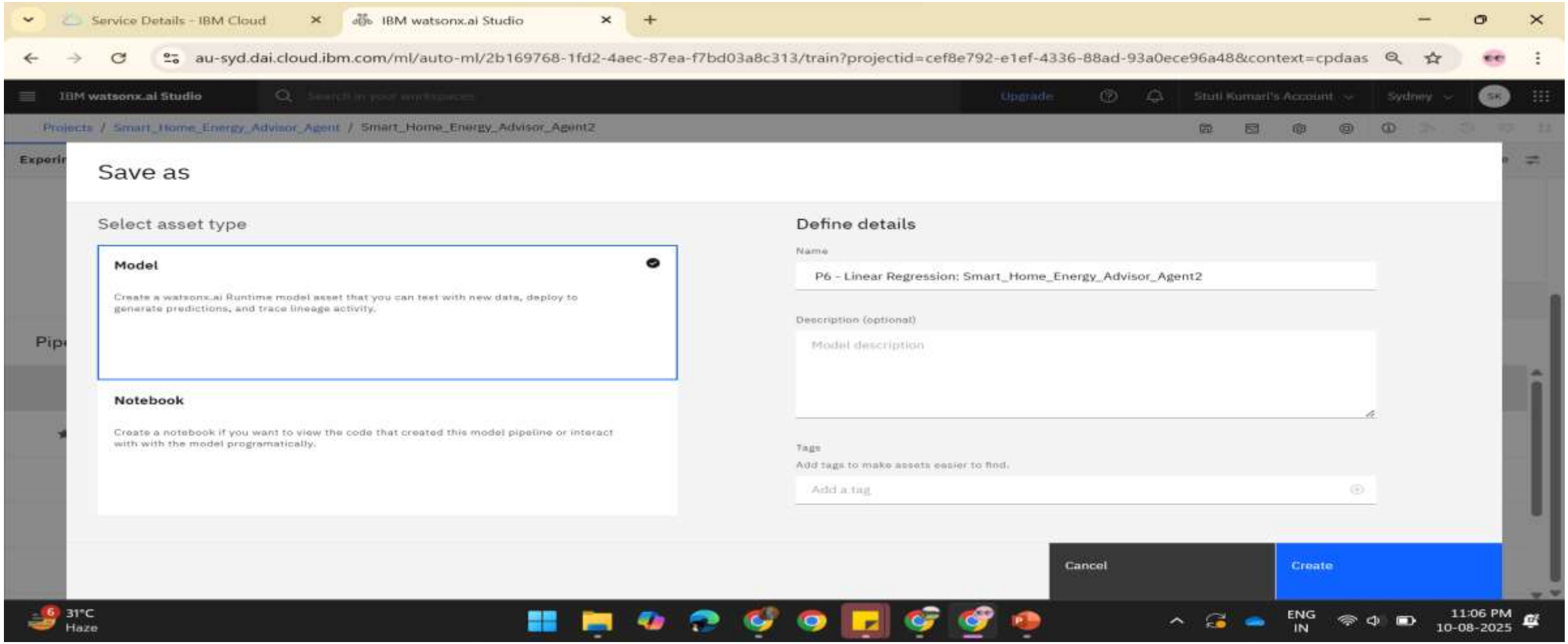

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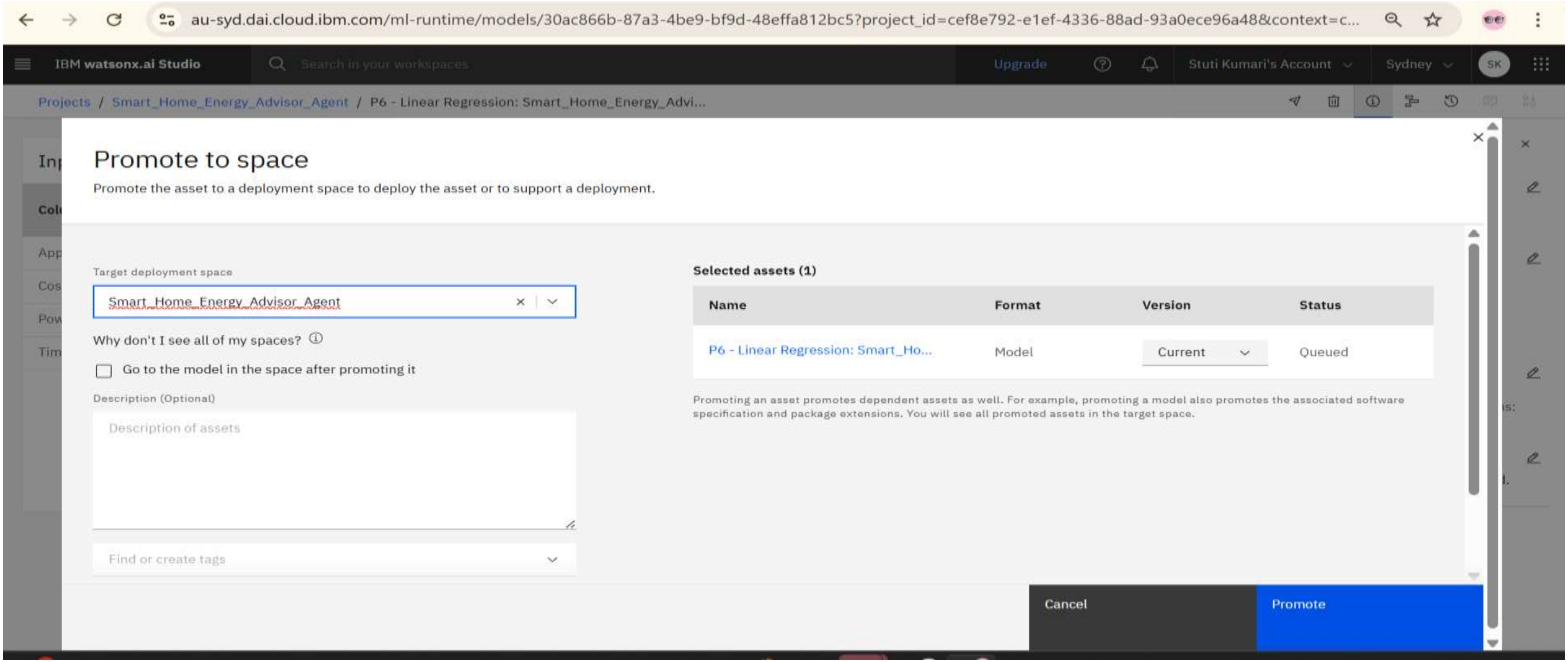

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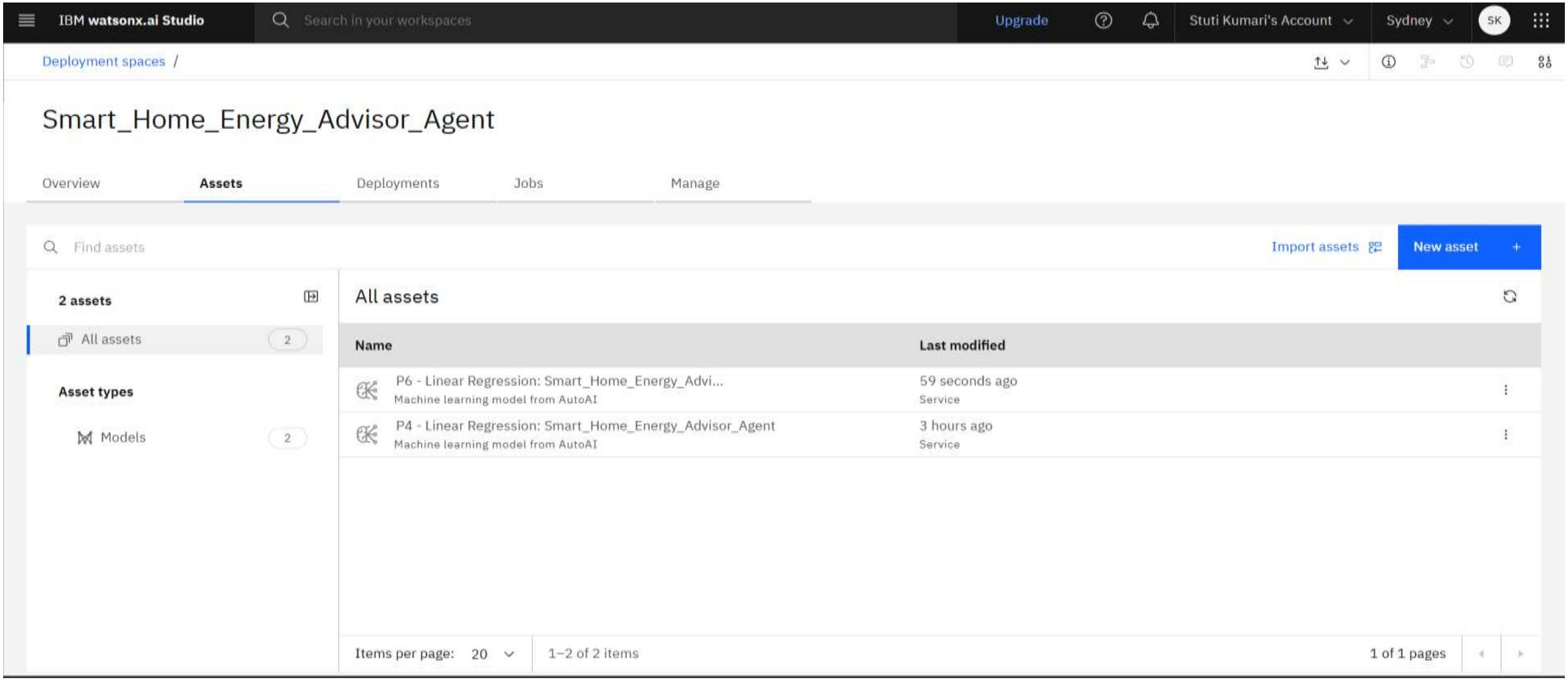

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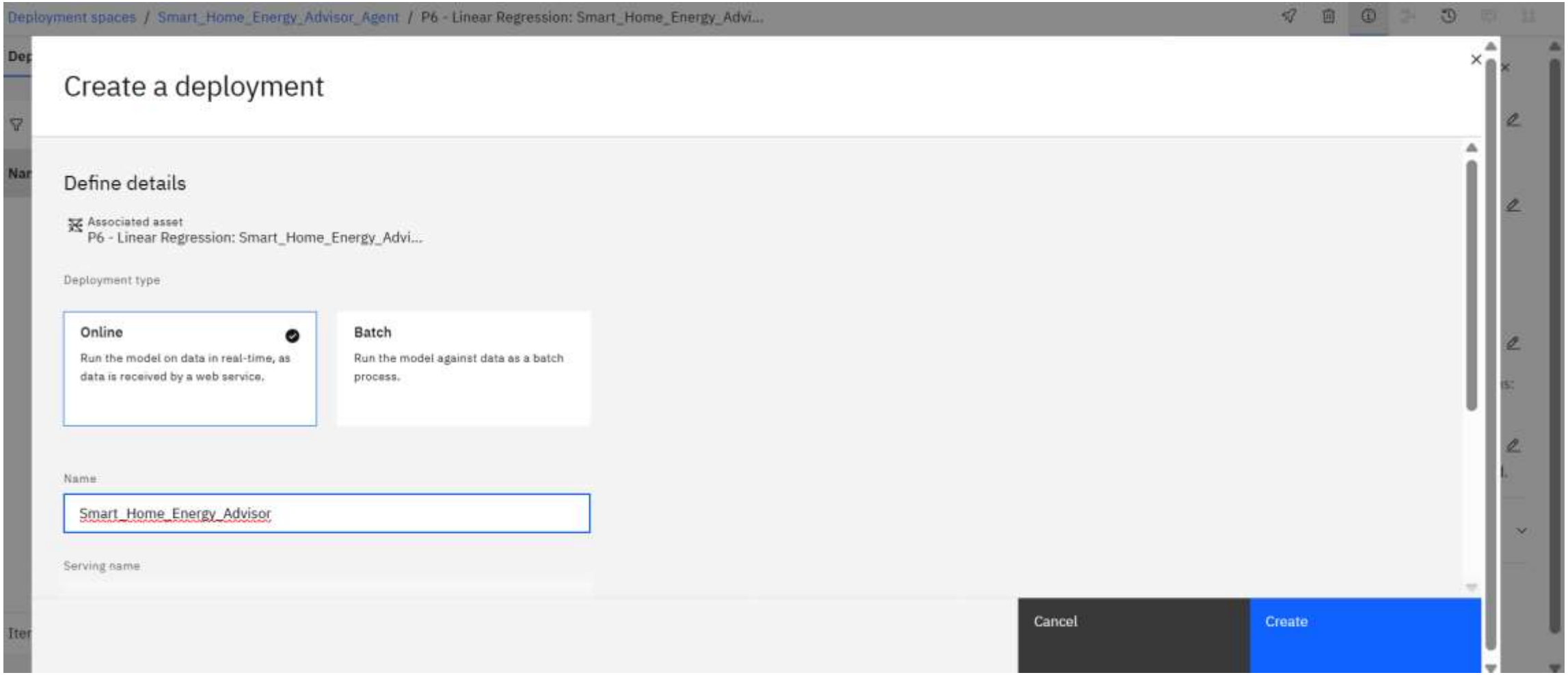

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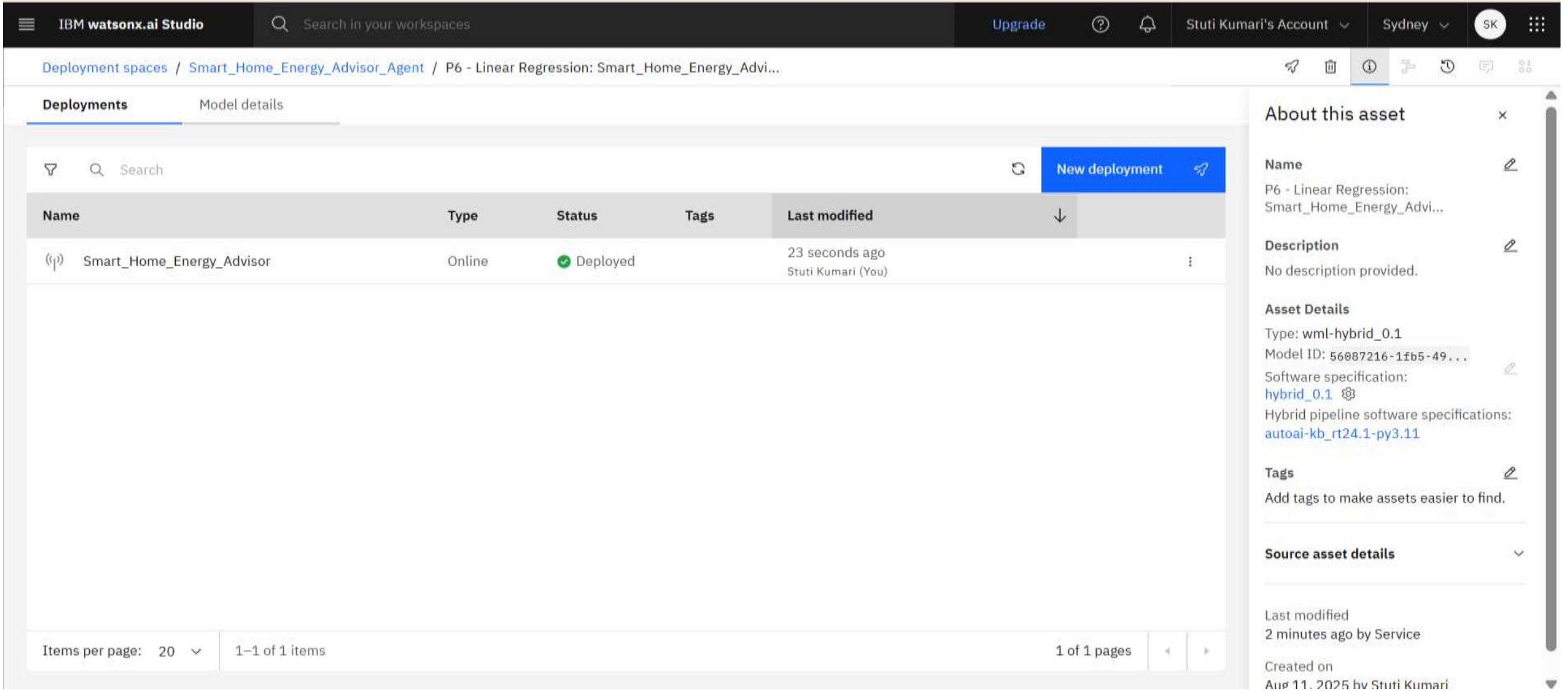

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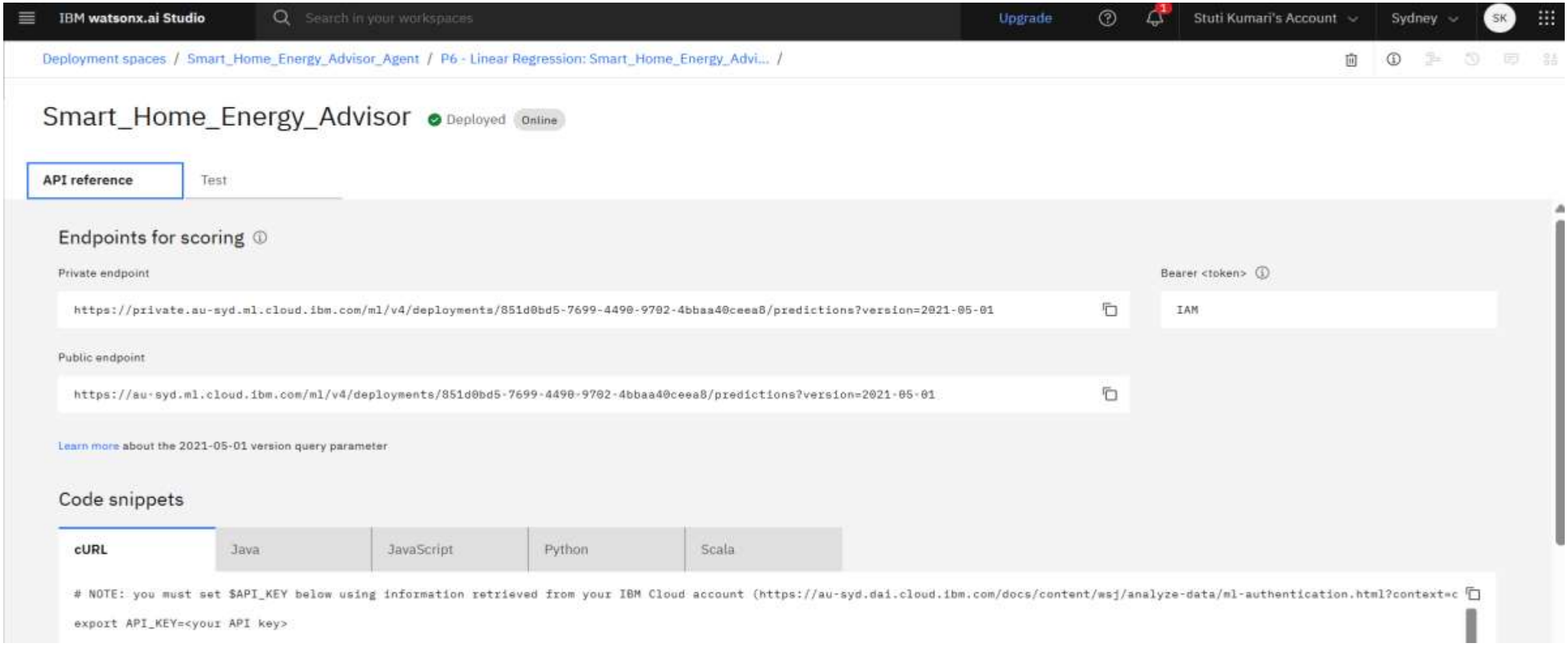

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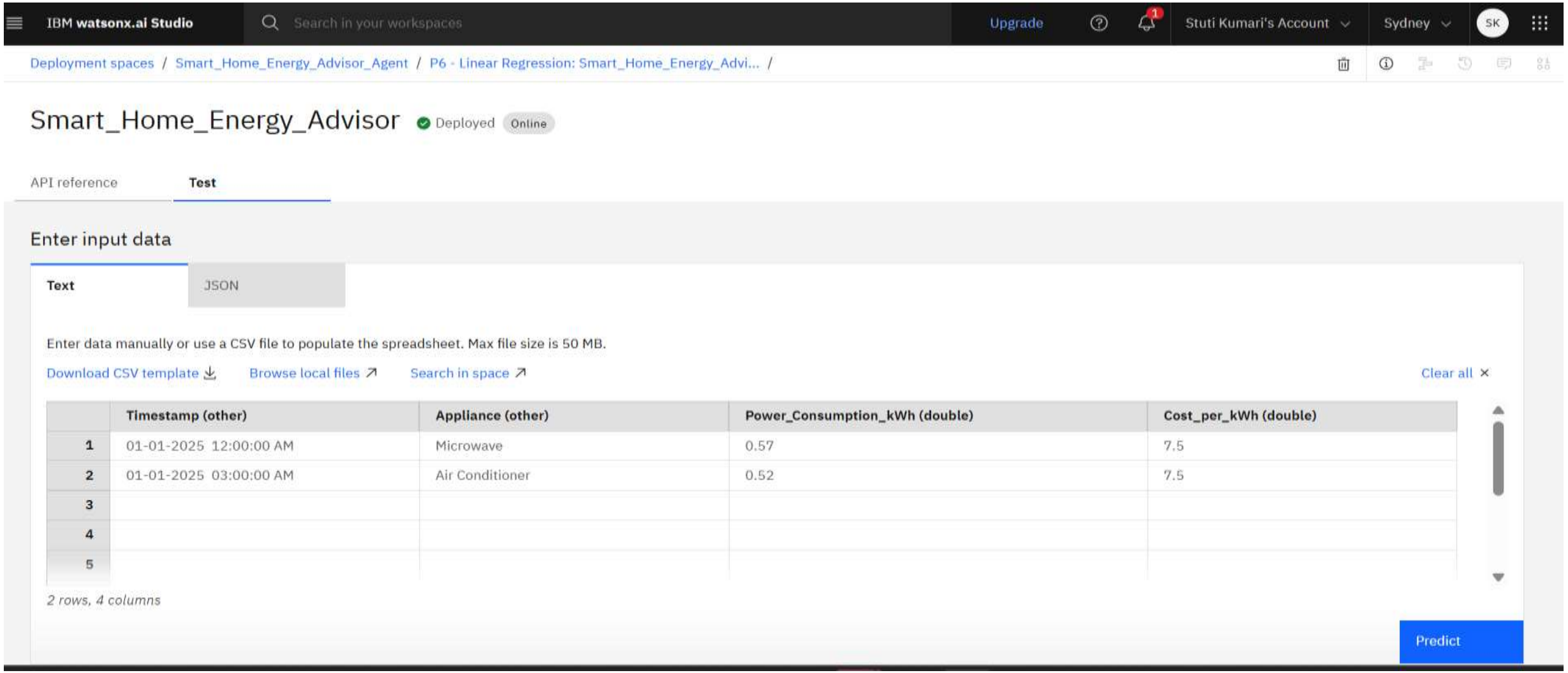

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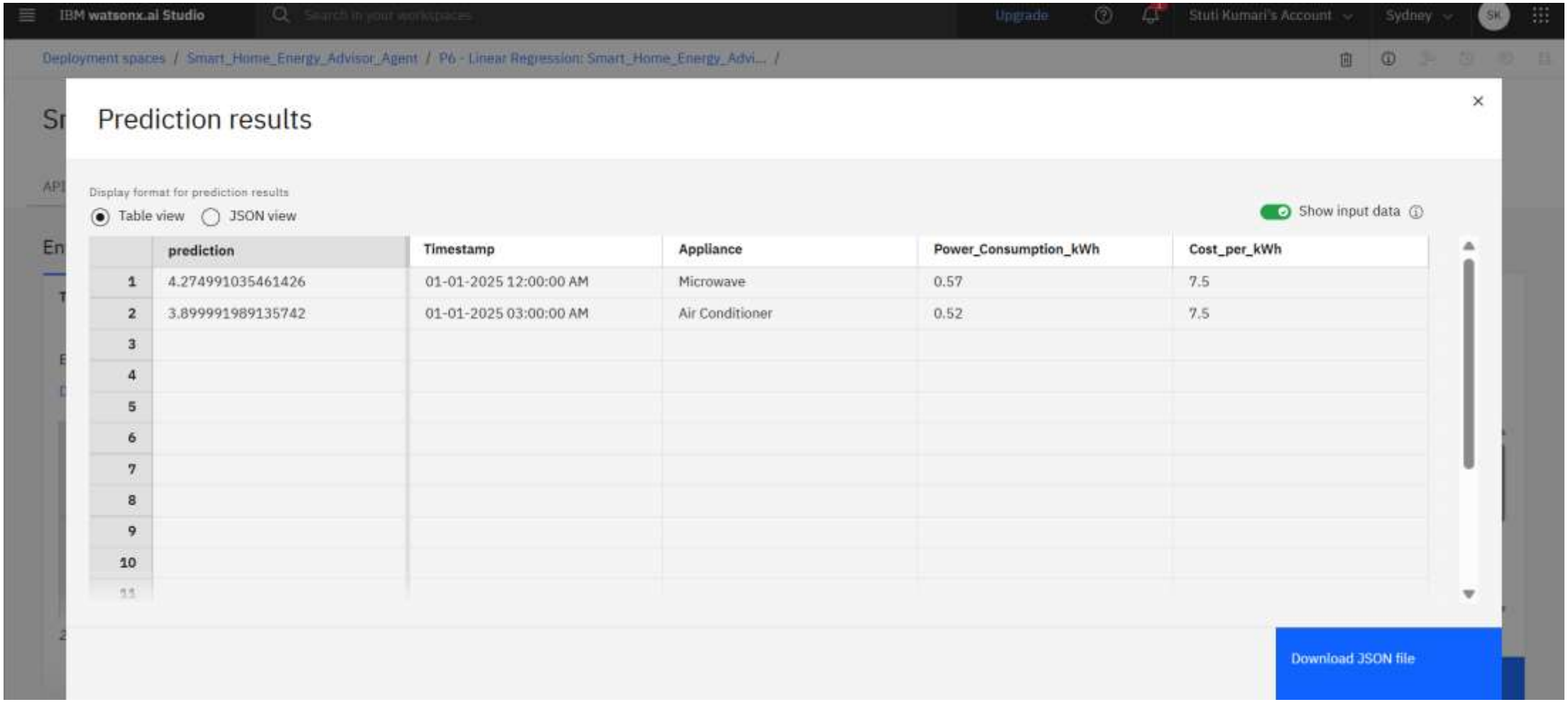

	prediction	Timestamp	Appliance	Power_Consumption_kWh	Cost_per_kWh
1	4.274991035461426	01-01-2025 12:00:00 AM	Microwave	0.57	7.5
2	3.899991989135742	01-01-2025 03:00:00 AM	Air Conditioner	0.52	7.5
3					
4					
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CONCLUSION

- The proposed Smart Home Energy Advisor effectively analyzes household energy consumption and provides actionable recommendations for reducing costs and improving efficiency. The model demonstrated good accuracy in identifying high-usage patterns and suggesting optimal appliance usage times. Key challenges included handling irregular consumption patterns and integrating data from diverse smart devices. Future improvements could involve adding more real-time data streams, personalized user preferences, and predictive maintenance alerts. Accurate energy insights are essential for lowering bills, promoting sustainability, and enhancing user comfort.

FUTURE SCOPE

- The system can be improved by adding data from solar panels, battery storage, and real-time electricity pricing. Algorithm optimization could provide more precise energy-saving tips. Expansion to support multiple households or smart communities is possible. Integration with edge computing and advanced AI models could enable faster, on-device analysis and real-time recommendations.
- The Smart Home Energy Advisor can evolve into a full home energy management system, integrating data from renewable sources, energy storage units, and electric vehicles. It could connect with utility providers for demand-response programs, enabling users to earn by shifting usage during peak times. Expansion to community-level energy optimization and integration with smart city infrastructure can further enhance energy efficiency and sustainability.

REFERENCES

- AutoAI implementation details and notebooks (IBM docs). IBM cloud pak for data
- RAG pattern examples and AutoAI integration (IBM example notebooks).
- Surveys / tutorials on NILM and energy disaggregation (various review pages).

IBM CERTIFICATIONS

IBM CERTIFICATIONS

In recognition of the commitment to achieve professional excellence

Journey to Cloud: Envisioning Your Solution

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Has successfully satisfied the requirements for:

Journey to Cloud: Envisioning Your Solution

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IBM **SkillsBuild** Completion Certificate

This certificate is presented to

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THANK YOU

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