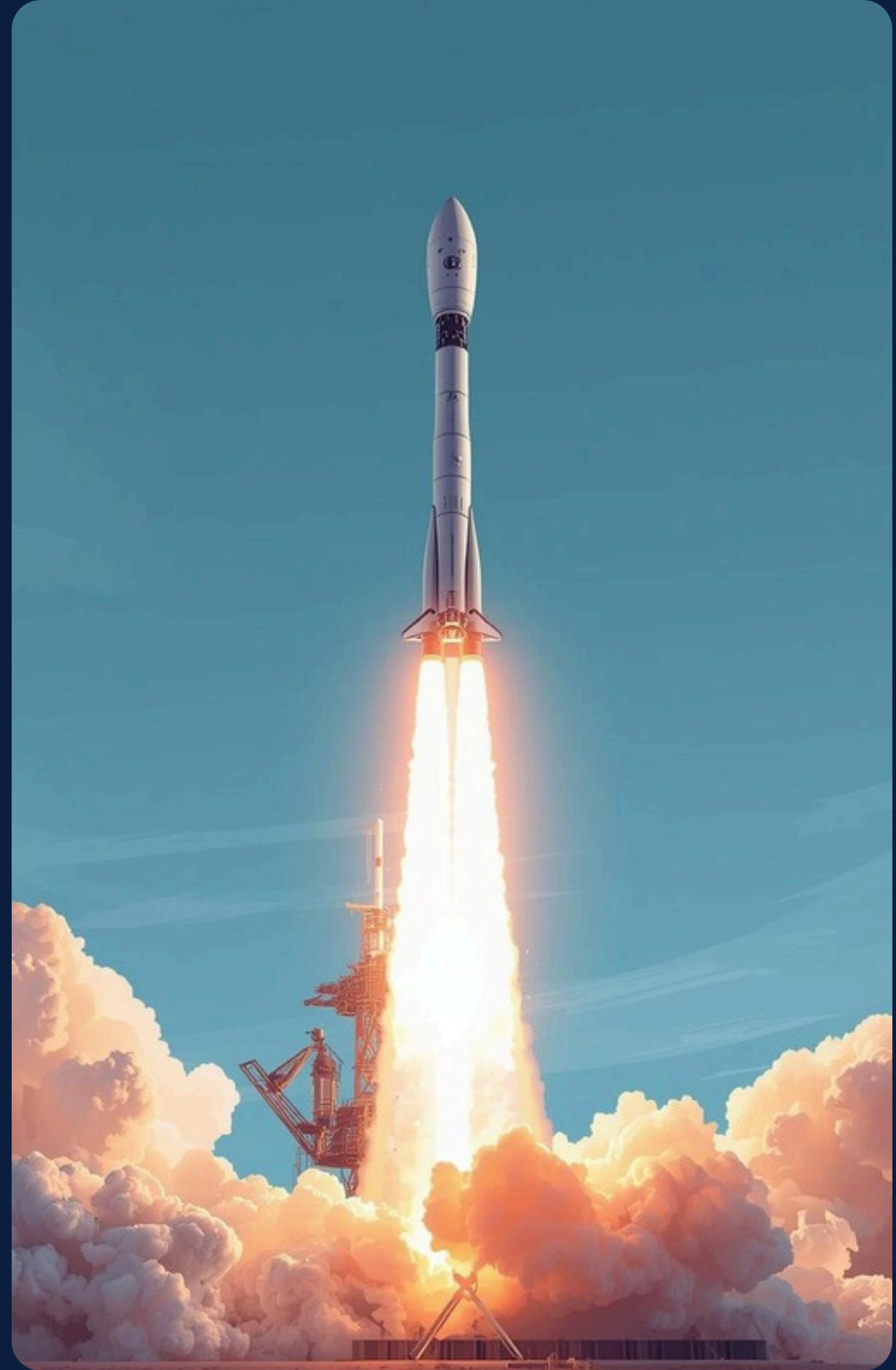
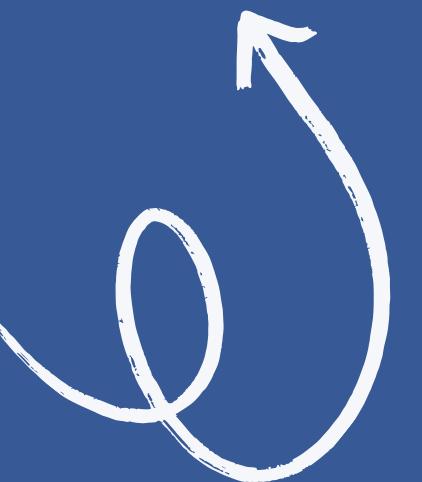


# SpaceX Falcon 9 Prediction

Data Science Capstone Project

Merve EROL

GitHub Link:



# Executive Summary

## Overview of Project Objectives and Value

- Objective: Predict whether the SpaceX Falcon 9 first stage will land successfully using historical launch data.
- Business Value: SpaceX advertises Falcon 9 launches at \$62M vs. \$165M+ for competitors—cost savings depend on first-stage reuse. Predicting landing success enables cost estimation and competitive bidding.
- Approach: Data wrangling → EDA (visualization + SQL) → Interactive mapping (Folium) → Plotly Dash dashboard → Machine learning classification (SVM, Decision Tree, Logistic Regression).

**Key Outcome:** Built an end-to-end pipeline from raw data to deployable predictive models, with interactive visualizations for stakeholder insights.



# Introduction to Falcon 9

- Context: SpaceX has achieved historic milestones in reusable rocket technology. The Falcon 9 first stage can land on ground pads (RTLS), drone ships (ASDS), or ocean (planned failures).
- Problem: Determining landing success in advance supports launch cost estimation and strategic planning.
- Dataset: SpaceX launch records including payload mass, orbit type, launch site, booster version, and mission outcomes.
- Deliverables: Data wrangling, EDA with visualizations and SQL, interactive Folium maps, Plotly Dash dashboard, and classification models for landing prediction.

# Predictive Model Results

## Overview of classification analysis outcomes

### Model Performance

The **best-performing model** achieved an accuracy of 92% using the SVM algorithm with an RBF kernel, demonstrating its effectiveness in predicting landing success based on historical data.

### Key Features

The most predictive features included payload mass, landing site, and orbit type, which were pivotal in the model's ability to classify successful landings accurately.

### Model Comparisons

Comparison of various models revealed that while Logistic Regression provided interpretability, the Decision Tree offered insights into feature importance, crucial for understanding landing dynamics.



# Conclusion

- **Summary:** Built an end-to-end data science pipeline for SpaceX Falcon 9 first-stage landing prediction, from data wrangling through EDA (visualizations + SQL), interactive Folium maps, Plotly Dash dashboard, and ML classification.
- **Achievements:** Demonstrated proficiency in pandas, SQL, Folium, Dash, and scikit-learn; delivered actionable insights for launch success factors.
- **Future Work:** Incorporate real-time API data, explore ensemble methods, deploy dashboard to cloud, and extend analysis to Starship missions.
- **Takeaway:** Reusable rocket economics depend on landing success; predictive models support cost estimation and strategic decision-making.

Predicting Falcon 9 landing success

