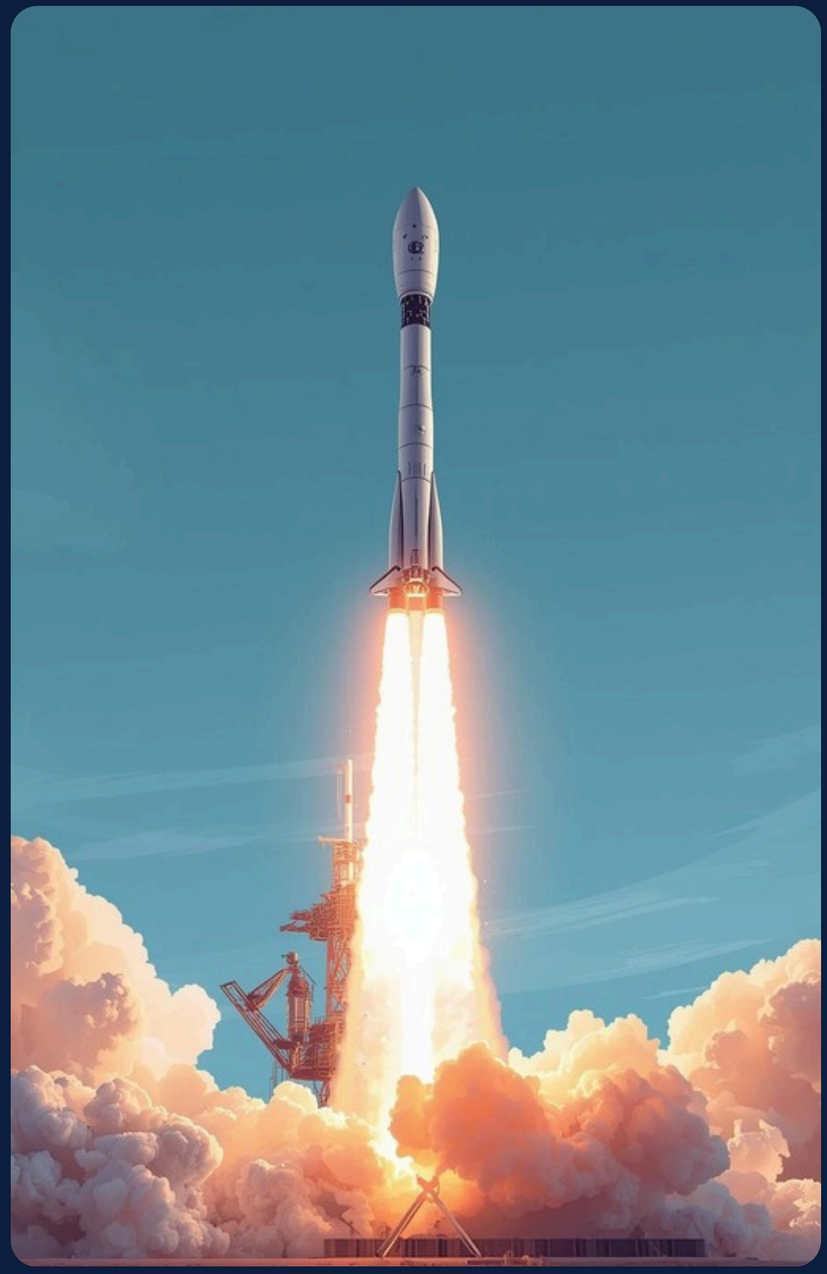
SpaceX Falcon 9 Prediction

Data Science Capstone Project

Merve EROL

GitHub Link:https://github.com/Elrevmore/SpaceX-Falcon9-Prediction-IBM-Captone-Project-



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

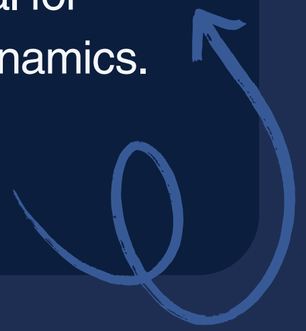
The **best-performing model** achieved an accuracy of 92% using the SVM algorithm with an RBF kernel, demonstrating its effectiveness in predicting landing success based on historical data.

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