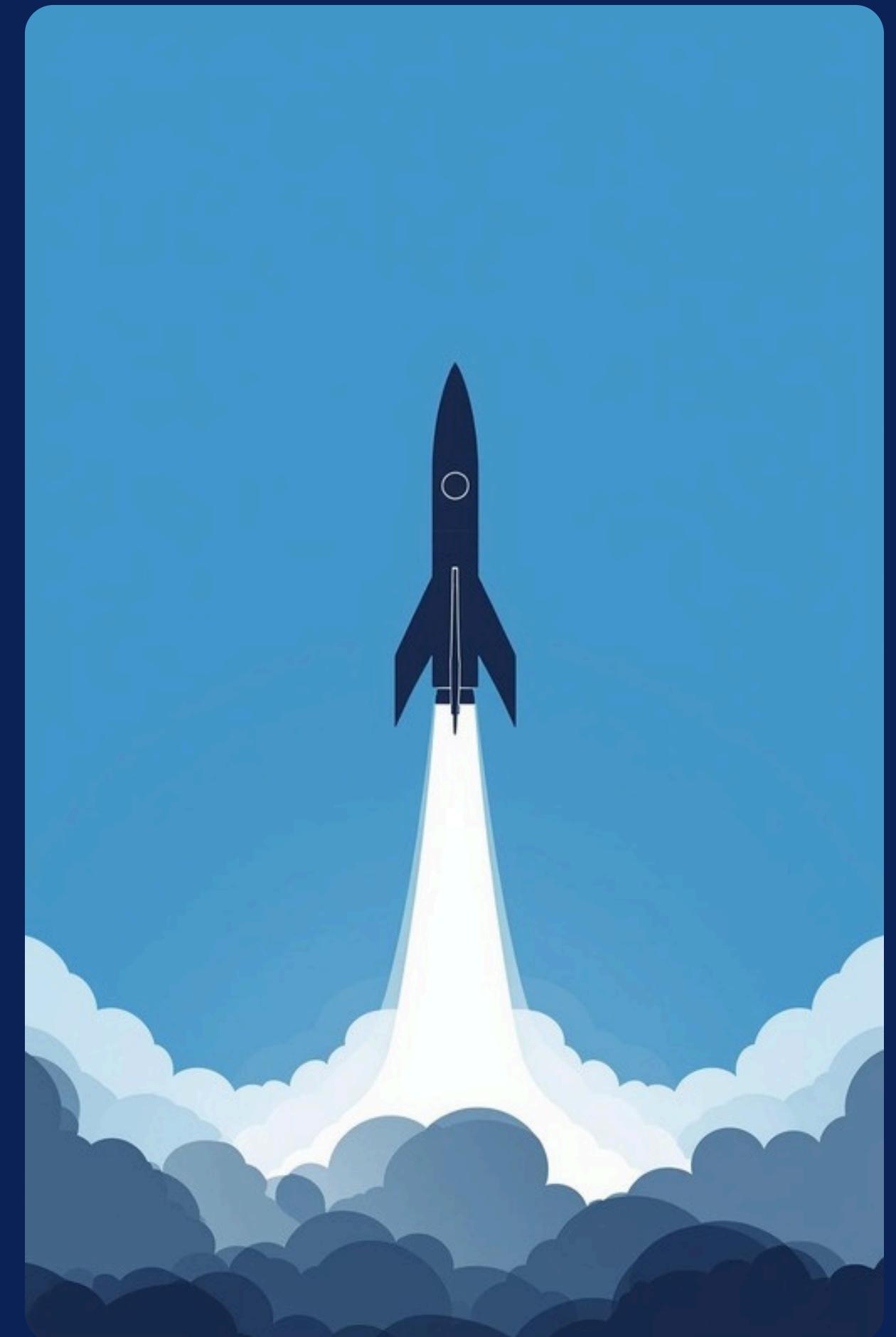
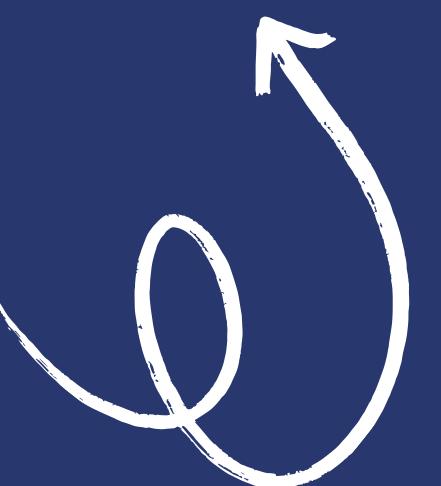


Winning Space Race

Koussay Khammassi, 16 Nov
2025



Executive Summary

Project Goals and Key Results

Predict Landing Success

The primary goal of this project is to **accurately predict** the Falcon 9 first-stage landing success, which helps in estimating overall launch costs and improving planning.

Data Collection

We utilized various methods for data collection, including **API integration** and **web scraping**, to gather comprehensive datasets essential for cleaning, visualizing, and analyzing landing outcomes.

Decision Tree Accuracy

The machine learning model achieved an impressive accuracy of **94.44%** using a Decision Tree approach, identifying critical factors such as launch site and payload mass for success predictions.



Introduction to SpaceX

Competitive Advantage



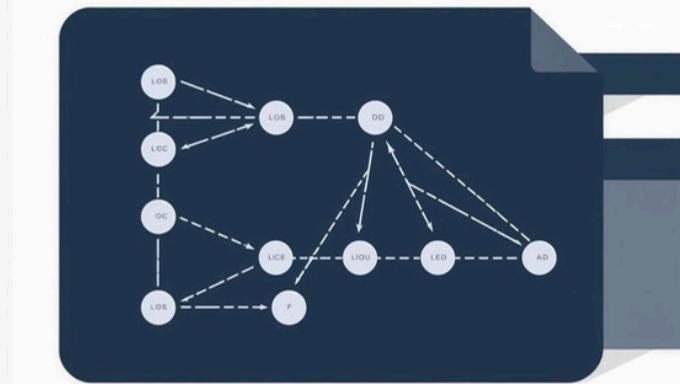
SpaceX's approach emphasizes **cost-effectiveness** and reusability, setting it apart in the space industry.

Influencing Factors



Key factors include **payload mass**, launch site conditions, and environmental influences on landings.

Best-Performing Model



The **Decision Tree model** outperforms others, providing accurate predictions for landing success.

Methodology Overview

Data Collection and Wrangling Techniques

Data Collection

The project utilized the SpaceX API and web scraping from Wikipedia to gather comprehensive datasets, ensuring a rich source of information for analysis and modeling.

Data Cleaning

Cleaning involved standardizing data formats and feature engineering, including year extraction and payload normalization, to create a unified DataFrame suitable for further analysis.



Modeling Techniques

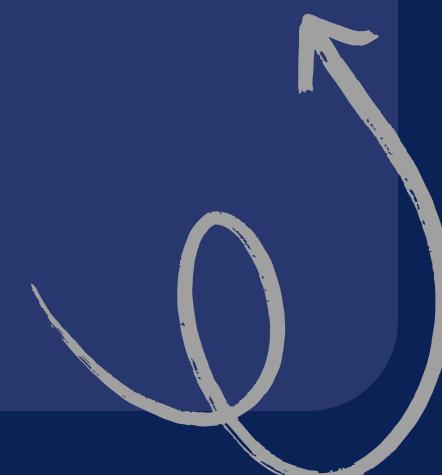
SVM, KNN, and Decision Tree Approaches

Support Vector Machine

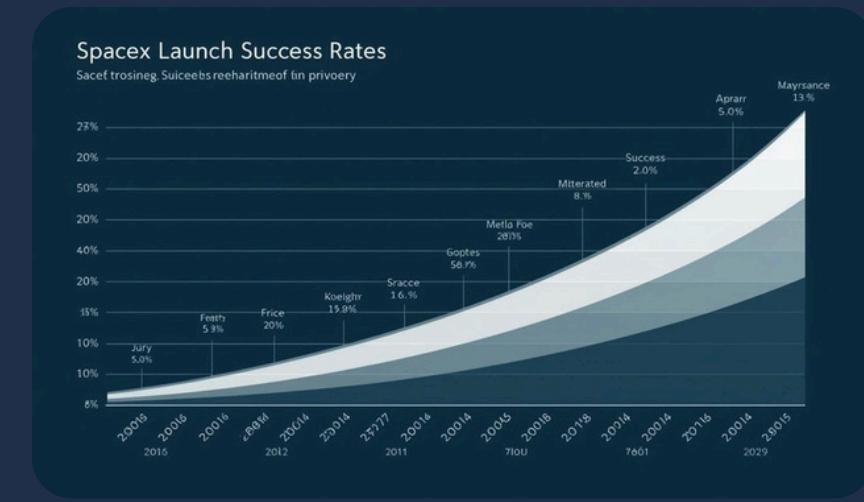
The Support Vector Machine (SVM) model was utilized for its effectiveness in high-dimensional spaces, aiming to classify landing success based on various features extracted from the dataset.

Decision Tree

The Decision Tree algorithm demonstrated remarkable accuracy, achieving 94.44% in predicting landing success, making it the preferred model after thorough tuning and validation processes.

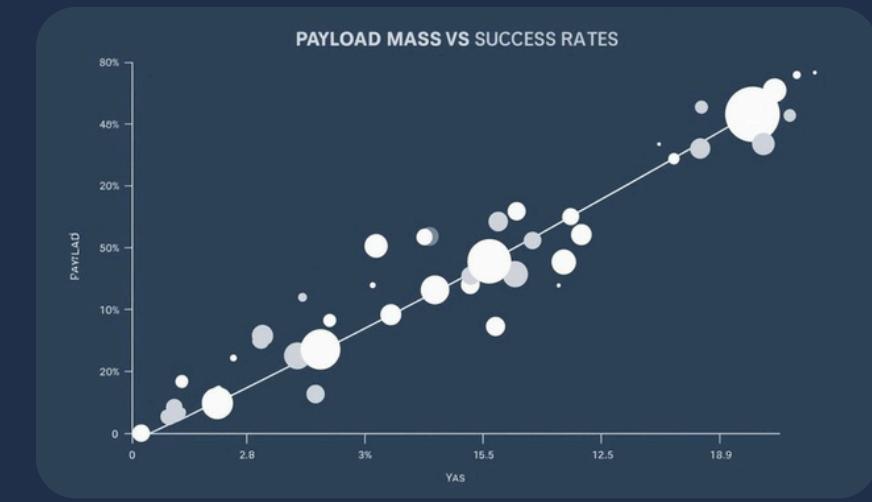


Insights from Exploratory Data Analysis



Launch Trends

Launch success rates have improved steadily over time.



Payload Impact

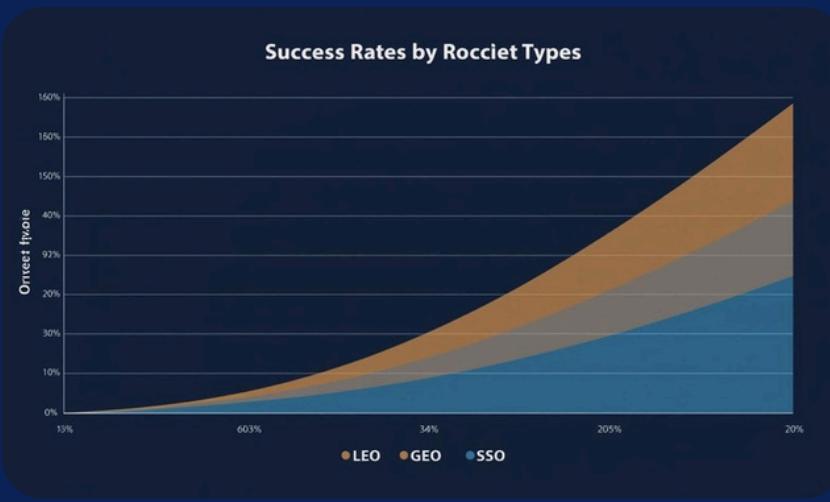
Heavier payloads are linked to reduced success rates.



Key Locations

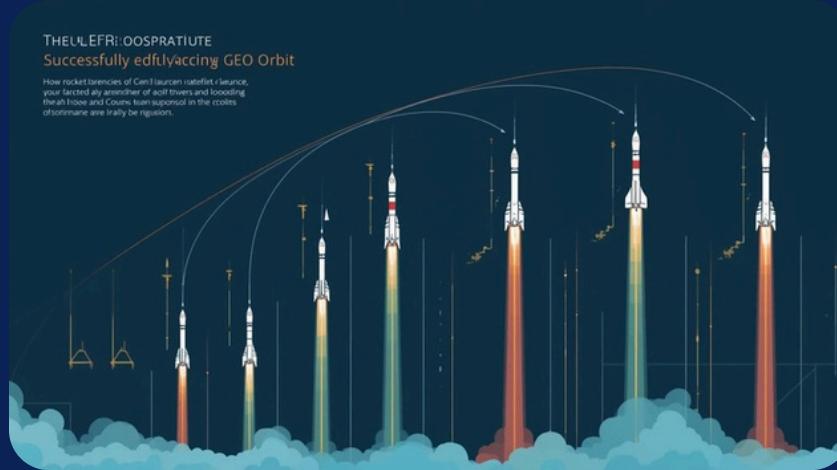
KSC LC-39A shows the highest success rate.

Success Rates by Orbit Type: Insights Unveiled



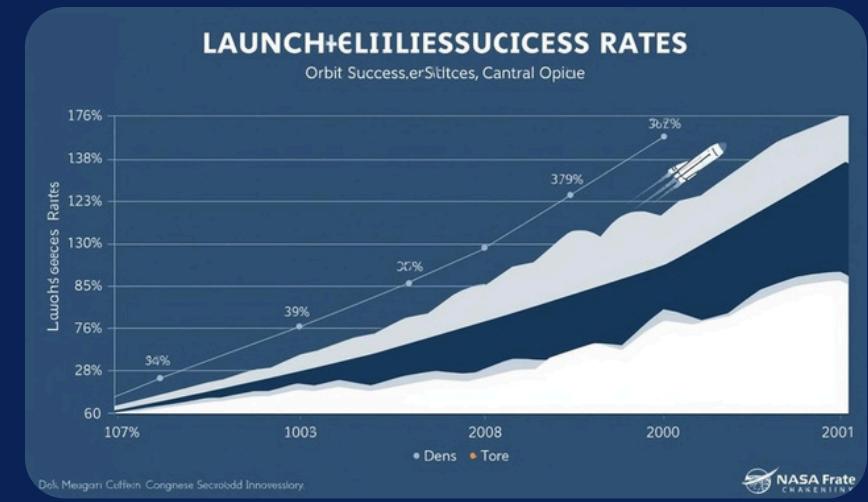
VLEO

Higher success rates observed in VLEO launches.



SSO

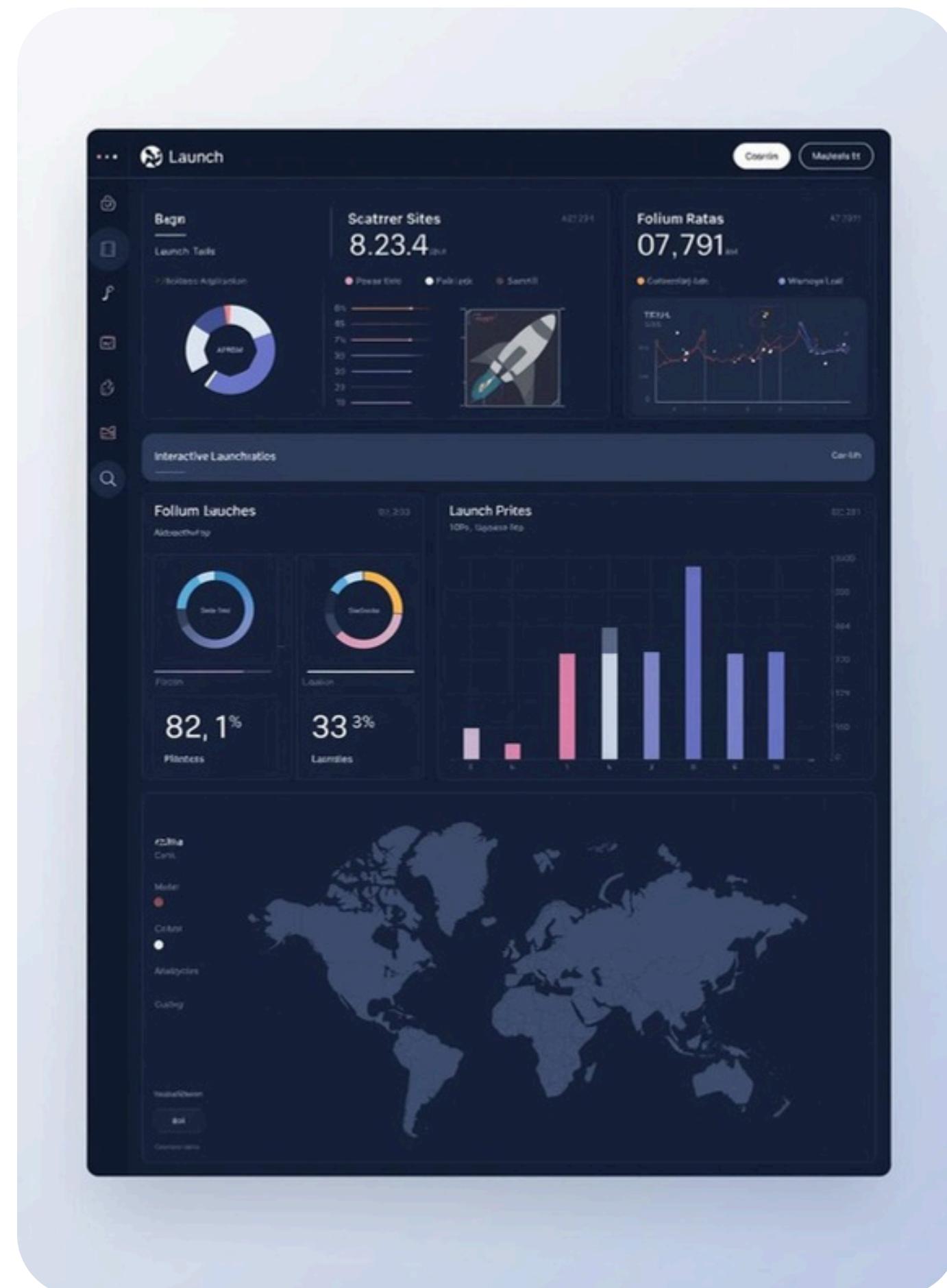
SSO launches demonstrate reliability in outcomes.



GEO

GEO launches show consistent performance metrics.

Interactive Visualizations



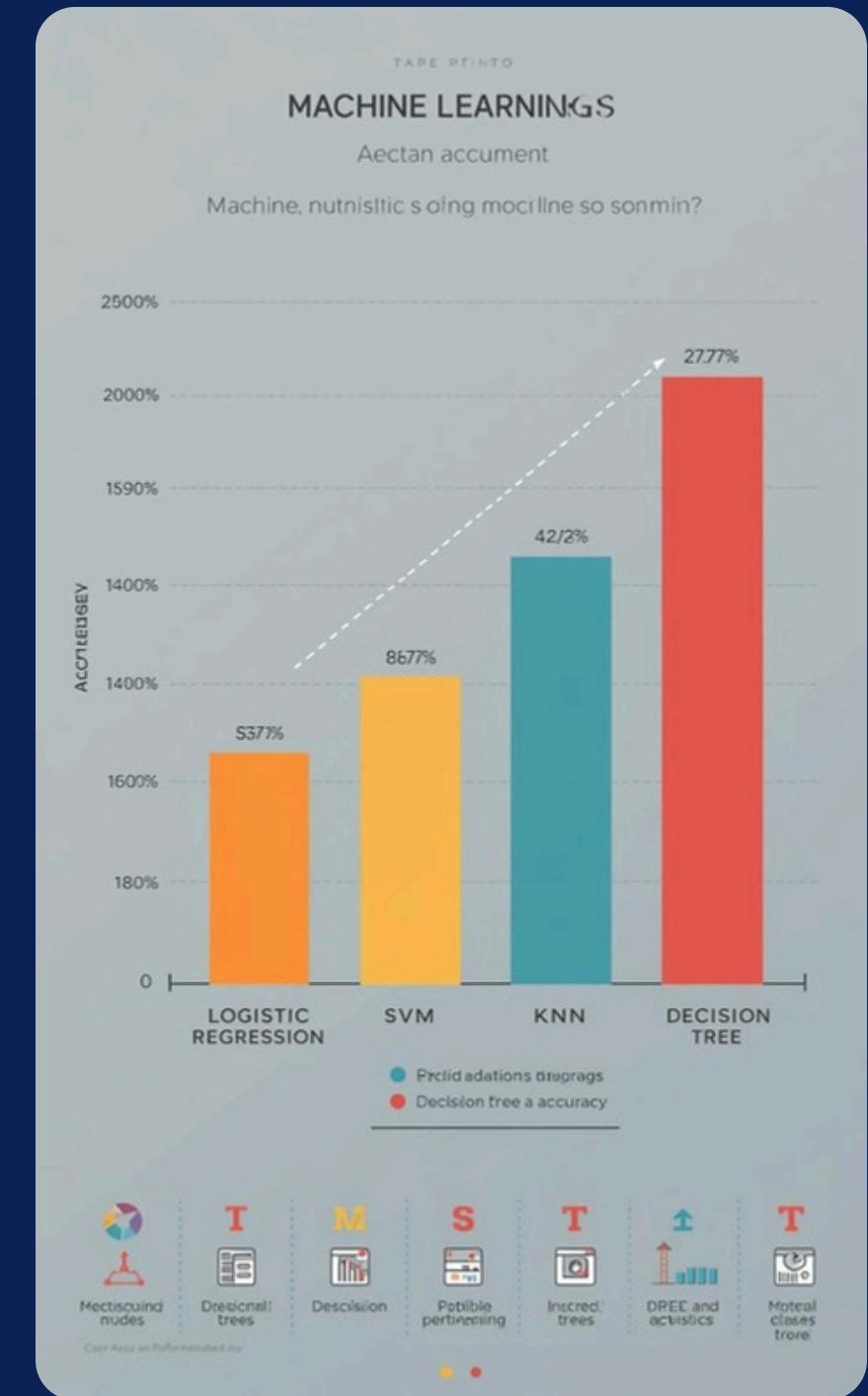
This section highlights the **dynamic tools** used to visualize launch site data. Folium maps and Plotly Dash dashboards empower users to explore success rates and analyze key insights visually, enhancing decision-making processes.

Predictive Modeling: Analyzing Success Rates



Decision Tree

Best model with 94.44% accuracy.



Model Comparisons

Evaluated multiple algorithms for predictive performance.

Key Findings and Project Impact



Success Rate

CCAFS LC-40 achieved **highest success rate** of 43.7%.



Project Impact

Findings support **cost estimation** and mission planning strategies.

Benefits of Predictive Modeling

Supporting mission planning and cost efficiency

Cost Estimation

Predictive modeling significantly enhances **cost estimation** for launches, allowing SpaceX to forecast expenses accurately and optimize resources for each mission, ultimately leading to better financial planning.

Mission Planning

By analyzing data trends, SpaceX can improve **mission planning** strategies, ensuring that launch sequences are efficient and maximizing the chances of successful landings while minimizing risks.

Resource Allocation

Data-driven insights facilitate better **resource allocation**, ensuring that time and materials are effectively distributed among various projects, contributing to overall operational efficiency within the company.



Interactive Decision-Making

Enhanced Insights



Decision trees simplify complex data into actionable insights for improved outcomes.

Data Visualization



Visualizations enable stakeholders to grasp critical data trends at a glance and make informed decisions.

User Interaction



Engaging interfaces allow users to manipulate data for personalized insights, enhancing decision-making processes.



Future Improvements

The project aims to refine predictive models, enhance data collection methods, and explore additional features. By integrating more diverse datasets, we can improve accuracy and support future missions more effectively.



Thank You