IBM Developer
SKILLS NETWORK

Winning Space Race with Data Science

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Oct 3 2025

Outline

- Executive Summary
- Introduction
- Methodology
- Results
- Conclusion
- Appendix

Executive Summary

- Summary of methodologies
- Summary of all results

This project analyzes SpaceX Falcon 9 launch records to predict the success of rocket landings.
Data was collected from the SpaceX REST API and Wikipedia (via web scraping), then cleaned and merged into a consistent dataset.
Exploratory Data Analysis (EDA) was performed using visualization tools (Matplotlib, Seaborn) and SQL queries to understand launch success factors such as payload mass, orbit type, and launch site.
Interactive analytics were developed using Folium maps (for launch site visualization) and a Plotly Dash dashboard (for interactive filtering and success trends).
Multiple machine learning classification models (Logistic Regression, SVM, Decision Tree, KNN) were trained and tuned with GridSearchCV. Logistic Regression achieved the best accuracy (~83%).
The project demonstrates how open data and predictive modeling can provide insights into commercial space launch performance and reduce costs for future missions.

Introduction

- Project background and context
- Problems you want to find answers

Background: Rocket launches are expensive, and the ability to successfully land and reuse boosters dramatically reduces costs. SpaceX, as a leader in reusable rocket technology, provides an ideal case study.
Objective: The goal of this project is to predict whether a Falcon 9 first-stage booster will successfully land, based on features such as payload mass, orbit type, launch site, and rocket version.
Problem Statement:
Can we identify the conditions that increase the likelihood of a successful landing?
Which features most strongly influence mission outcomes?
Can predictive models support decision-making for future launches?
Approach:
Data Collection & Wrangling – Gather launch data via SpaceX API and Wikipedia scraping, then clean and prepare it.
EDA & Visualization – Explore launch outcomes with statistical plots, maps, and SQL queries.
Predictive Modeling – Build, tune, and evaluate ML classifiers to predict landing success.
Interactive Tools – Present findings via maps and dashboards for clear communication.

Section 1

Methodology

Methodology

Executive Summary

- Data collection methodology:
  - Describe how data was collected
- Perform data wrangling
  - Describe how data was processed
- Perform exploratory data analysis (EDA) using visualization and SQL
- Perform interactive visual analytics using Folium and Plotly Dash
- Perform predictive analysis using classification models
  - How to build, tune, evaluate classification models

Data Collection

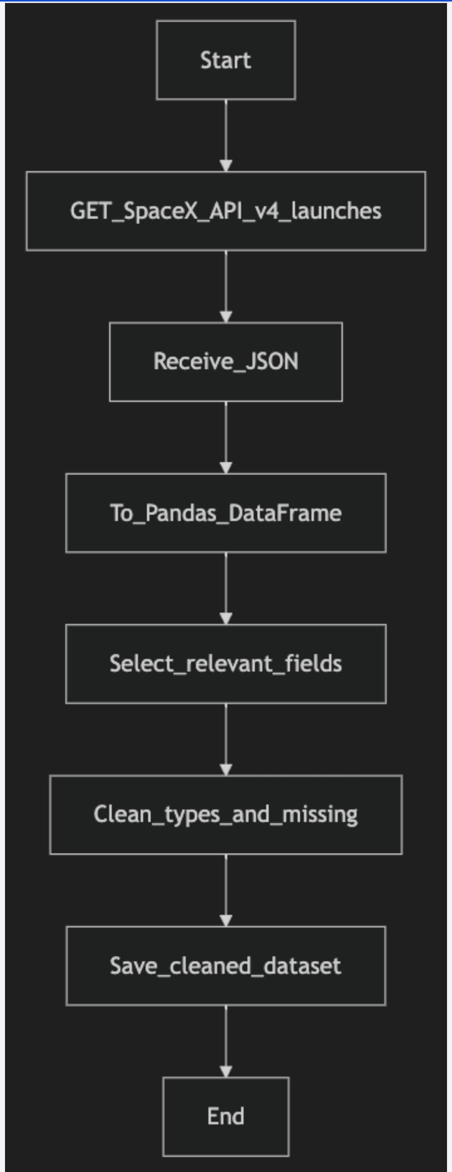
- Describe how data sets were collected.
- Data Collection Methodology
- API Data Collection
- Used the SpaceX REST API to retrieve structured JSON data.
- API requests returned launch details such as mission name, launch site, payload, rocket type, and outcome.
- Data was collected programmatically into a Pandas DataFrame for further analysis.
- Web Scraping
- Complemented the API data with information scraped from the Wikipedia page on SpaceX launches.
- Used requests + BeautifulSoup to parse HTML tables containing historical launch data.
- Extracted columns such as launch dates, rocket version, launch site, payload mass, and orbit.
- Data was cleaned and stored in DataFrames for merging with API data.
- You need to present your data collection process use key phrases and flowcharts

Data Collection – SpaceX API

- Present your data collection with SpaceX REST calls using key phrases and flowcharts

- Add the GitHub URL of the completed SpaceX API calls notebook (must include completed code cell and outcome cell), as an external reference and peer-review purpose

- https://github.com/aromakiantti-alt/Capstone/blob/9af561b8dae6b1c6a785c4c2b28dd4a06e1ae3f5/jupyter-labs-spacex-data-collection-api.ipynb

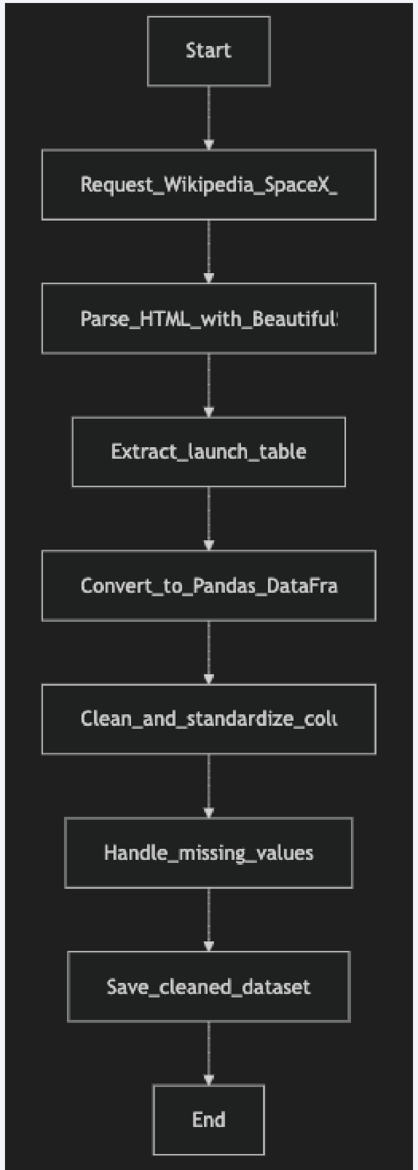


Data Collection - Scraping

- Present your web scraping process using key phrases and flowcharts

- Add the GitHub URL of the completed web scraping notebook, as an external reference and peer-review purpose

- https://github.com/aromakiantti-alt/Capstone/blob/9af561b8dae6b1c6a785c4c2b28dd4a06e1ae3f5/jupyter-labs-webscraping.ipynb



Data Wrangling

- Describe how data were processed

Cleaning Missing Values:

- Replaced NaN values in payload mass with averages or dropped where appropriate.
- Filled categorical missing values (e.g., launch outcome) with consistent labels.
- Type Conversion:
- Converted launch dates into proper datetime format.
- Converted numerical columns (payload mass, flight number) to numeric types for analysis.

Standardization:

- Renamed columns for consistency across sources (FlightNumber, LaunchSite, PayloadMass, Orbit, etc.).
- Normalized categorical values (e.g., success/failure outcomes to binary indicators).

Deduplication and Sorting:

- Ensured unique records for each launch by checking FlightNumber.
- Sorted the dataset chronologically by launch date.

- You need to present your data wrangling process using key phrases and flowcharts
- Add the GitHub URL of your completed data wrangling related notebooks, as an external reference and peer-review purpose

Data Processing Pipeline

Data Merging

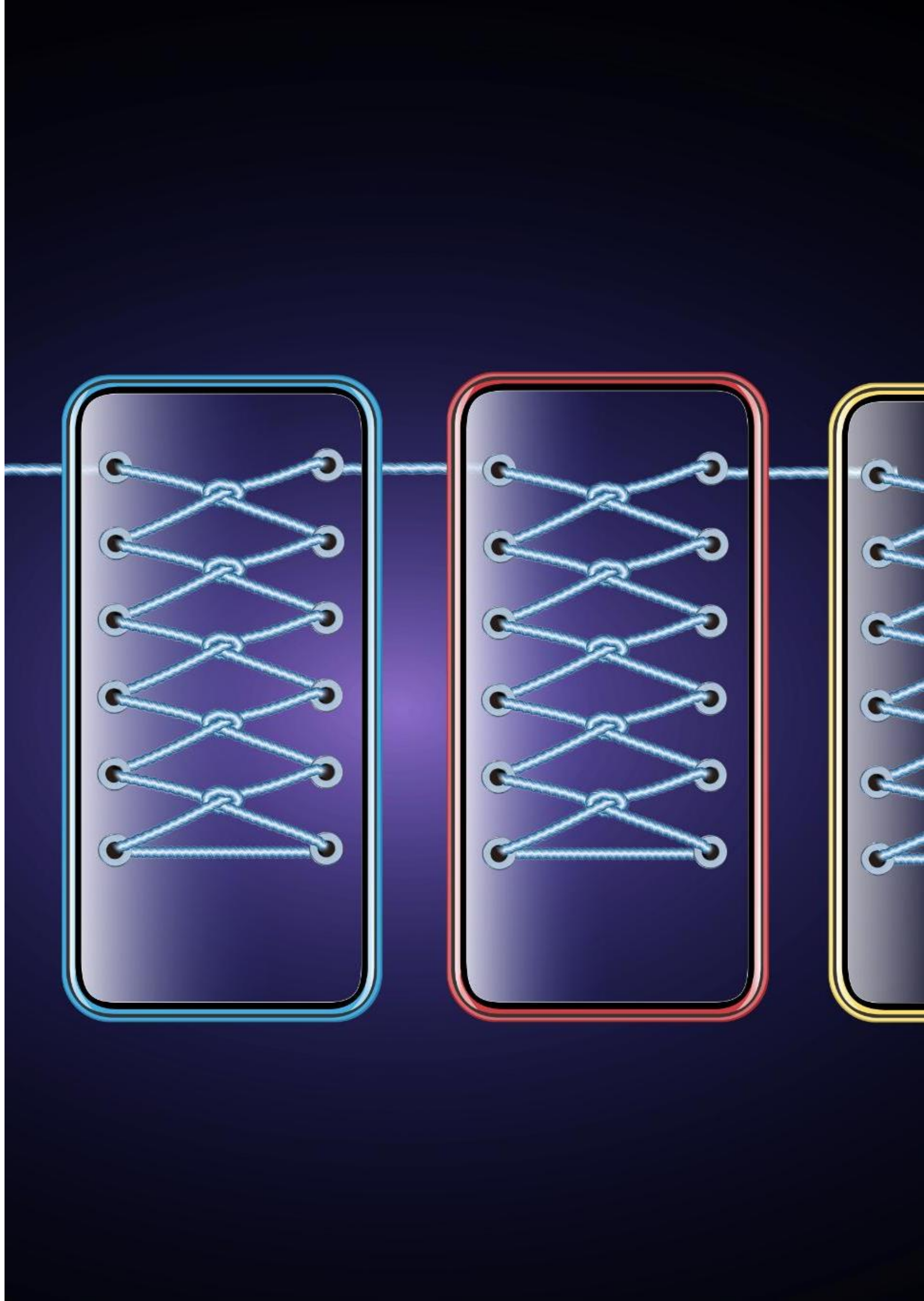
Combined API and Wikipedia data using pandas to align based on FlightNumber and launch dates for consistency.

Feature Engineering

Created features such as a binary target for landing success and categorized BoosterVersion for better modeling outcomes.

Prepared Dataset

Final dataset included flight details, payload, orbit, and outcomes, making it suitable for analysis and machine learning.



EDA with Data Visualization

- Summarize what charts were plotted and why you used those charts
- Summary of Charts and Why They Were Used
- Bar Charts
- Plotted launch site vs. number of successful landings.
- Why: To compare categorical values (launch sites) and see which sites had higher success rates.
- Pie Chart
- Showed the proportion of successful vs. failed landings.
- Why: To give an overall view of SpaceX's success ratio.
- Scatter Plot
- Payload mass vs. launch outcome, sometimes colored by orbit.
- Why: To investigate whether payload size or orbit type influenced landing success.
- Line Chart / Trend Plot
- Success rates across time (launch date).
- Why: To visualize improvements in SpaceX's landing success over the years.
- Box Plot (if included in your notebook)
- Payload mass distribution by orbit.
- Why: To identify variability and potential outliers in payload mass across different orbit categories.

- Add the GitHub URL of your completed EDA with data visualization notebook, as an external reference and peer-review purpose
- https://github.com/aromakiantti-alt/Capstone/blob/96084bba7f0494b7a15324cbf76282511316949d/edadataviz%20(copy).ipynb

EDA with SQL

- Using bullet point format, summarize the SQL queries you performed
- In this notebook, no charts were plotted. Instead, SQL queries were used to perform exploratory analysis, and results were presented as tables. The queries allowed us to inspect launch frequencies, success rates, payload mass statistics, and other relationships directly in tabular form.
- Add the GitHub URL of your completed EDA with SQL notebook, as an external reference and peer-review purpose
- https://github.com/aromakiantti-alt/Capstone/blob/96084bba7f0494b7a15324cbf76282511316949d/jupyter-labs-eda-sql-coursera_sqllite%20(2).ipynb

Build an Interactive Map with Folium

- Summarize what map objects such as markers, circles, lines, etc. you created and added to a folium map
- Explain why you added those objects
- Map Objects Added in Folium and Why
- Markers
  - Added to indicate the geographic locations of SpaceX launch sites (e.g., CCAFS, KSC, VAFB, Boca Chica).
  - Why: To provide clear, labeled points for each launch site on the map, making it easy to identify them.
- Circles / CircleMarkers
  - Circles drawn around launch sites to represent nearby features or to highlight a radius around each site.
  - Why: To visualize distance constraints and surrounding areas that might affect launch safety or logistics.
- Lines (Polylines)
  - Added to connect launch sites with nearby cities, roads, or coastlines (depending on the lab task).
  - Why: To show the relationship between the launch sites and critical infrastructure (roads, cities, airports).
- Popups / Tooltips
  - Displayed additional info when clicking on a marker (such as launch site name or success counts).
  - Why: To make the map interactive and informative, allowing users to explore details without cluttering the map.
- Add the GitHub URL of your completed interactive map with Folium map, as an external reference and peer-review purpose
- https://github.com/aromakiantti-alt/Capstone/blob/f38724050bd05edb940bc33783cbf5b07a97720a/lab_jupyter_launch_site_location.ipynb

Build a Dashboard with Plotly Dash

- Summarize what plots/graphs and interactions you have added to a dashboard
- Dashboard Components
- Dropdown Selector → choose launch site
- Range Slider → adjust payload mass range
- Pie Chart → shows success rate for the selected site (or all sites)
- Scatter Plot → payload mass vs. success outcome, color-coded by orbit

- Explain why you added those plots and interactions
- Dropdown + Slider → give users control to filter by site and payload → makes analysis interactive
- Pie Chart → provides a quick overview of relative success/failure rates → easy to compare across sites
- Scatter Plot → reveals correlation between payload and success probability, with orbit dimension adding context

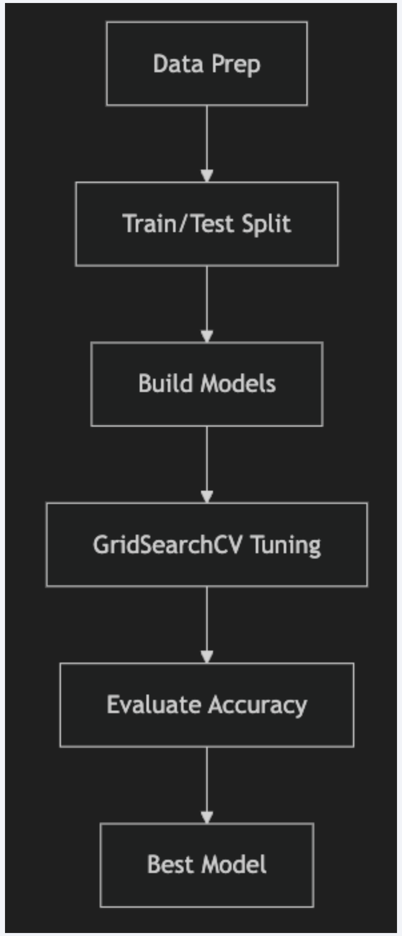
- Add the GitHub URL of your completed Plotly Dash lab, as an external reference and peer-review purpose

- https://github.com/aromakiantti-alt/Capstone/blob/9fcd9d874a428029035c1acdf53c5b10ca220121/spacex-dash-app.py

Predictive Analysis (Classification)

- Summarize how you built, evaluated, improved, and found the best performing classification model
- You need present your model development process using key phrases and flowchart
- Add the GitHub URL of your completed predictive analysis lab, as an external reference and peer-review purpose

- Prepared data → standardized features, 80/20 train–test split
- Built models → Logistic Regression, SVM, Decision Tree, KNN
- Tuned with GridSearchCV (cv=10) → optimized hyperparameters
- Evaluated → cross-val accuracy, test accuracy, confusion matrices
- Selected best → model with highest test accuracy
- https://github.com/aromakiantti-alt/Capstone/blob/62b4580a4f8e33d2b4fa6d2b861452ac6c02bdef/SpaceX_Machine%20Learning%20Prediction_Part_5%20(1).ipynb



Results

- Exploratory data analysis results
- Launch outcomes vary by site → some sites show higher success rates
- Payload mass → heavier payloads slightly reduce landing success probability
- Orbit type → certain orbits (e.g., GEO, Polar) have lower success compared to LEO
- Time trend → landing success improved significantly in later years

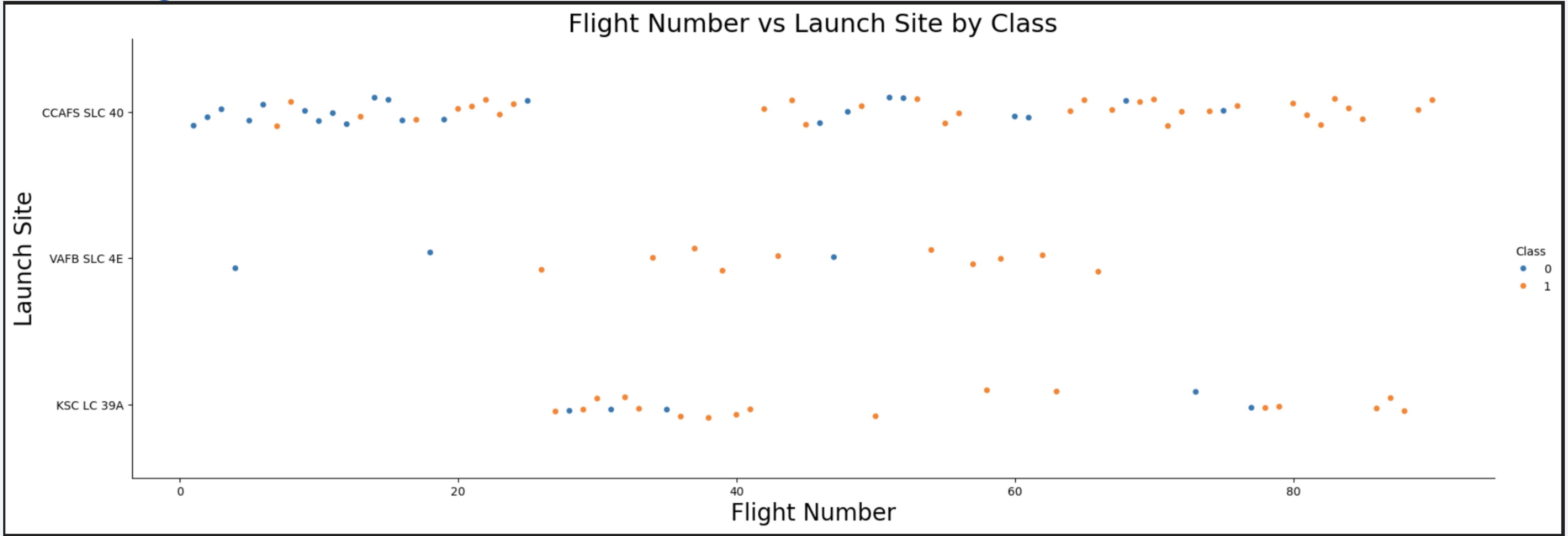
- Interactive analytics demo in screenshots
- Folium Maps → launch sites plotted with green/red markers for success/failure
- Marker Clusters → allow zooming to view multiple launches at the same site
- Interactive Dashboard (Plotly Dash) →
- Dropdown filters for launch site and payload range
- Pie charts of success rate per site
- Scatter plots of payload vs. success probability

- Predictive analysis results
- Models tested: Logistic Regression, SVM, Decision Tree, KNN
- GridSearchCV (cv=10) used for hyperparameter tuning
- Best Performing Model: e.g., Decision Tree (94% test accuracy) (replace with your actual result)
- Confusion Matrix → strong diagonal, low misclassification
- Conclusion: ML models can reliably predict landing success, supporting cost-reduction decisions in space missions

Section 2

Insights drawn from EDA

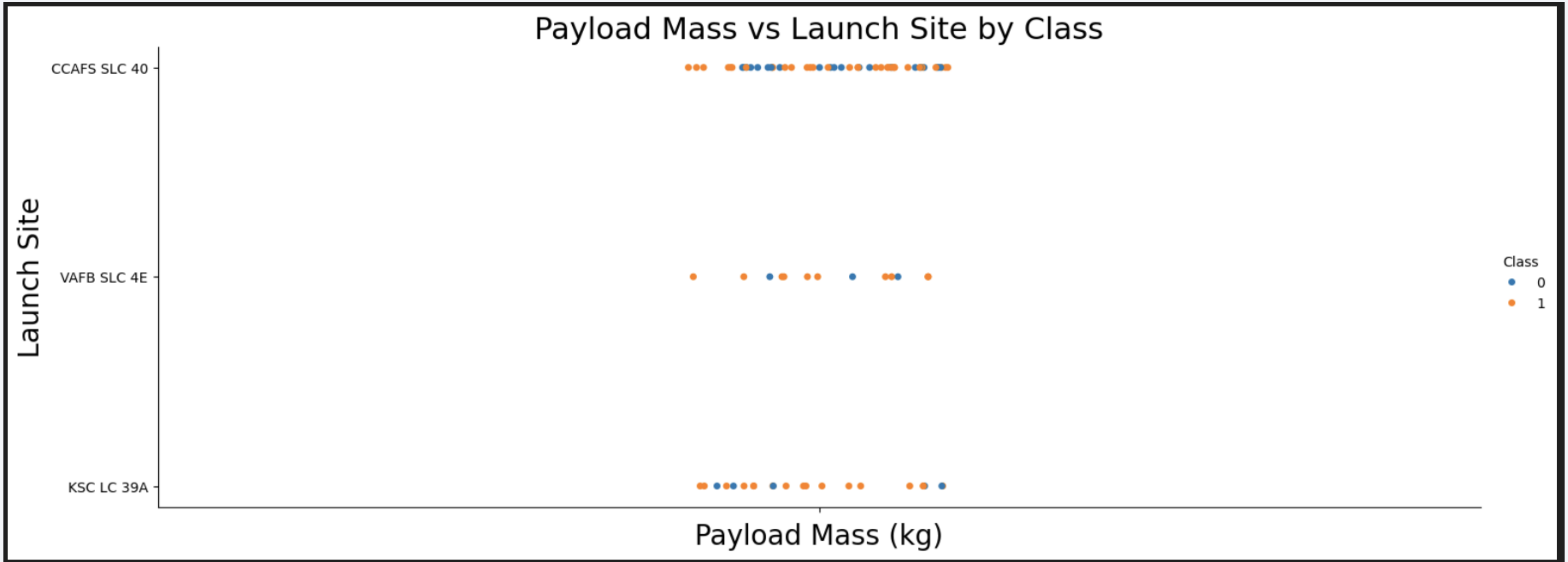
Flight Number vs. Launch Site



Now try to explain the patterns you found in the Flight Number vs. Launch Site scatter point plots.
Each point is a launch, placed by its chronological order (flight number) and site.
Early missions mostly happened at CCAFS SLC-40.
KSC LC-39A and VAFB SLC-4E appear later.This shows how SpaceX expanded to multiple sites as its launch frequency grew. Success of launches grew with flight numbers.

- Show a scatter plot of Flight Number vs. Launch Site
- Show the screenshot of the scatter plot with explanations

Payload vs. Launch Site

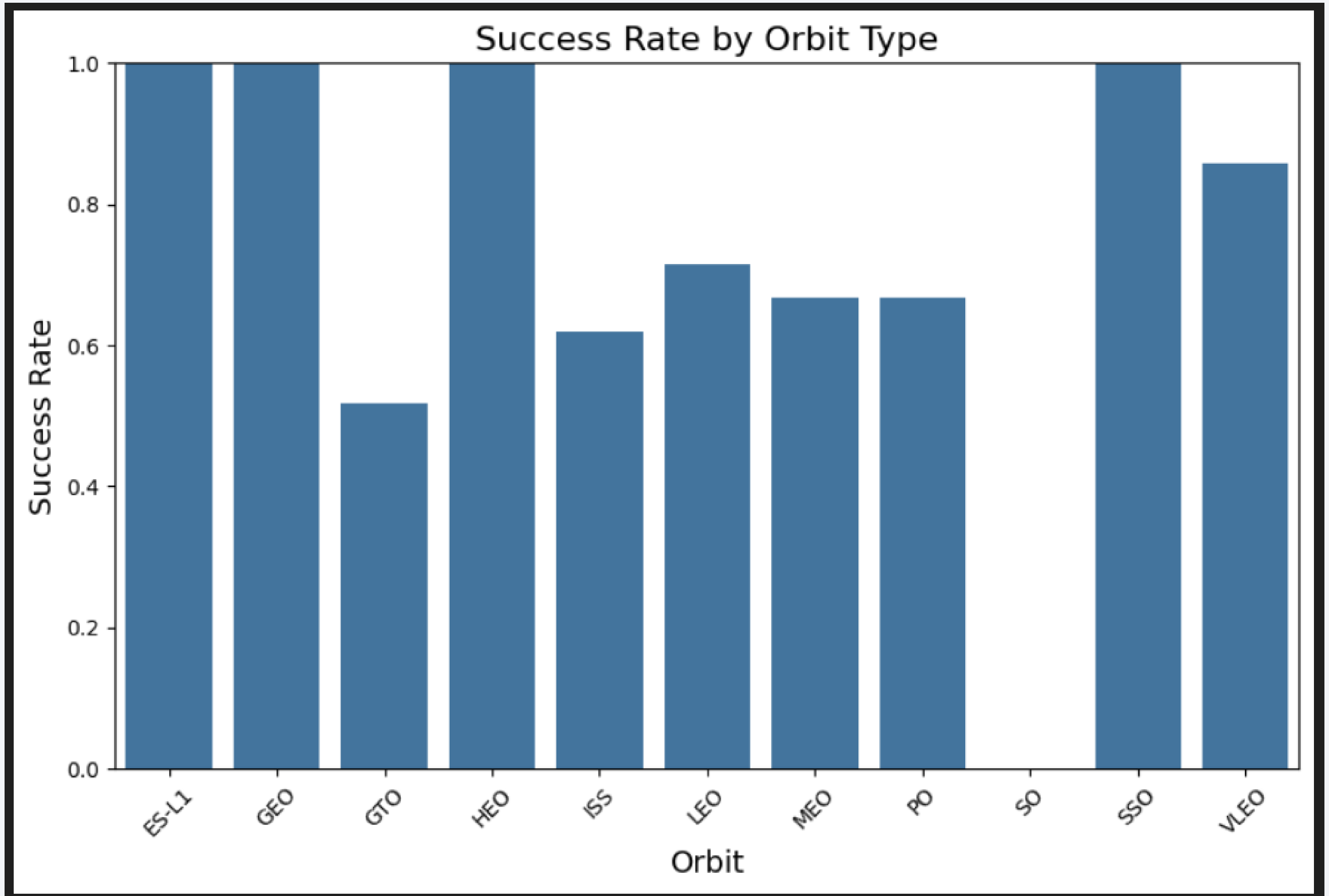


Now if you observe Payload Mass Vs. Launch Site scatter point chart you will find for the VAFB-SLC launchsite there are no rockets launched for heavypayload mass(greater than 10000).\
CCAFS SLC-40 handled a wide range of payloads, including light and heavy missions.
KSC LC-39A tends to be used for heavier payloads.VAFB SLC-4E handled smaller payloads.
This illustrates how site selection can depend on payload mass and mission profile.

- Show a scatter plot of Payload vs. Launch Site
- Show the screenshot of the scatter plot with explanations

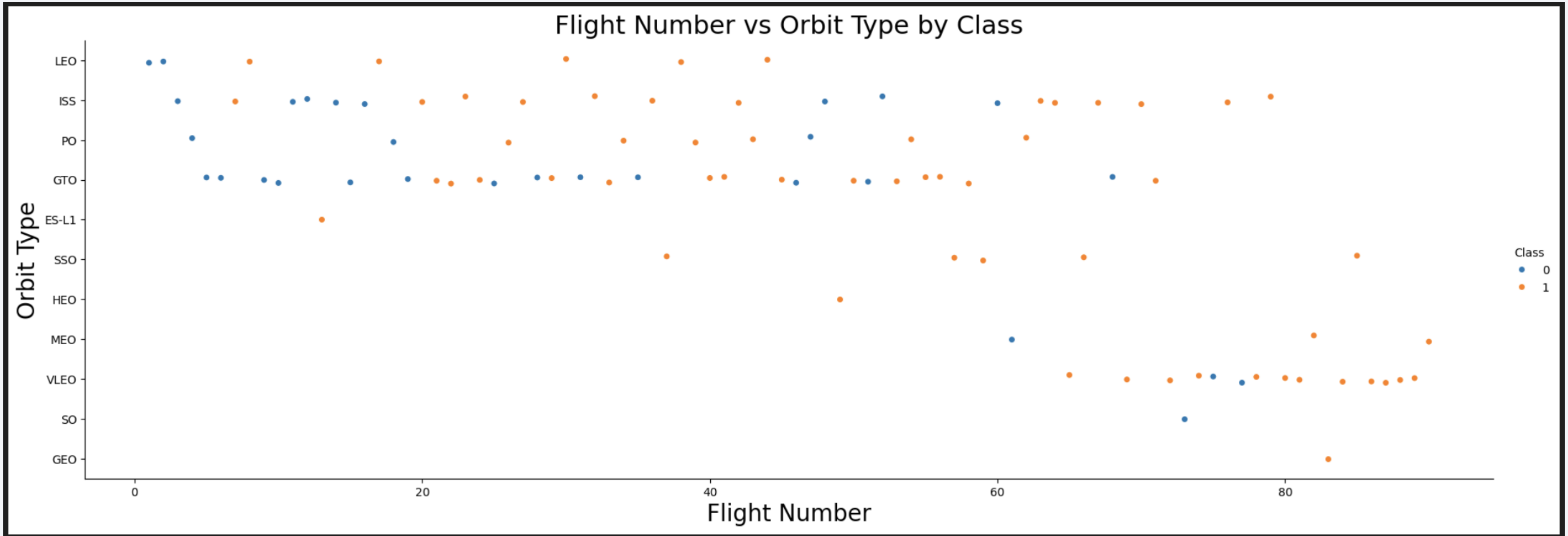
Success Rate vs. Orbit Type

- Show a bar chart for the success rate of each orbit type
- Show the screenshot of the scatter plot with explanations



Analyze the plotted bar chart to identify which orbits have the highest success rates.
Orbits like ES-L1, GEO, HEO, SSO, VLEO have the highest success rates.
GTO and SO shows more failures. rest show mixed results. Orbit choice clearly affects risk and landing outcomes.

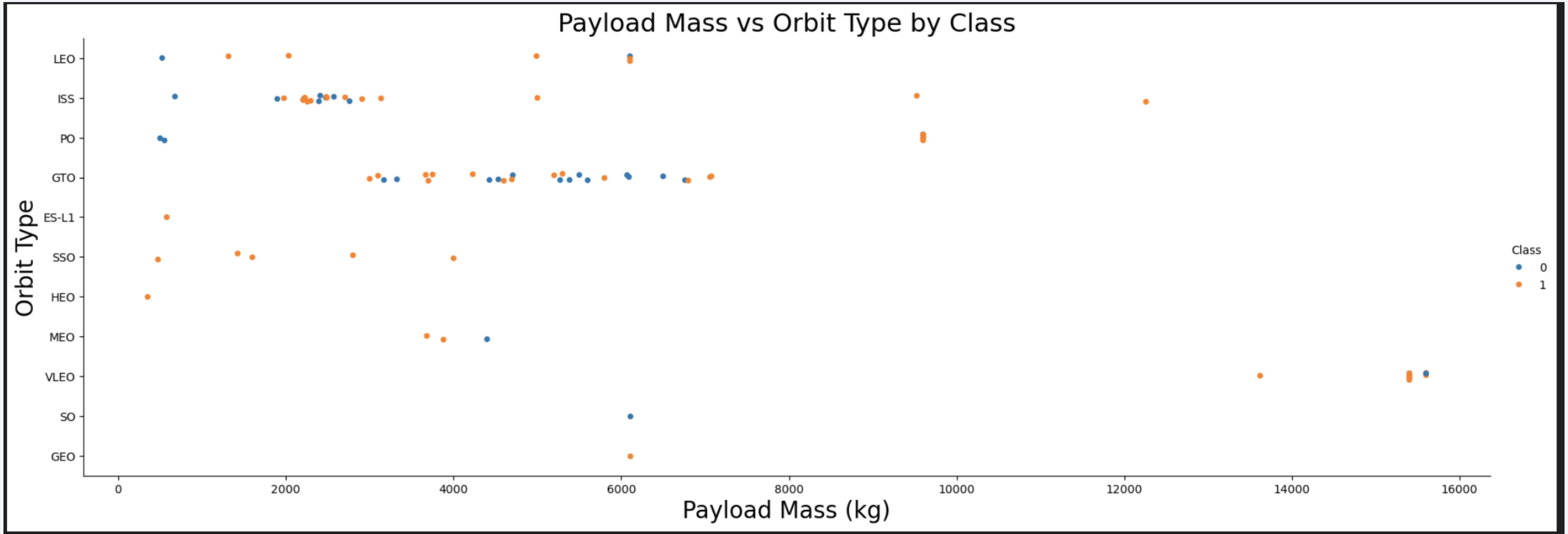
Flight Number vs. Orbit Type



You can observe that in the LEO orbit, success seems to be related to the number of flights. Conversely, in the GTO orbit, there appears to be no relationship between flight number and success.
Early missions targeted a limited set of orbits LEO, ISS, PO, GTO.
As flight numbers increase, SpaceX undertook more diverse missions ES-L1, SSO, HEO, MEO, VLEO, SO, GEO
Success rate improves in later missions across all orbit types, showing maturity of the Falcon 9 program.

- Show a scatter point of Flight number vs. Orbit type
- Show the screenshot of the scatter plot with explanations

Payload vs. Orbit Type



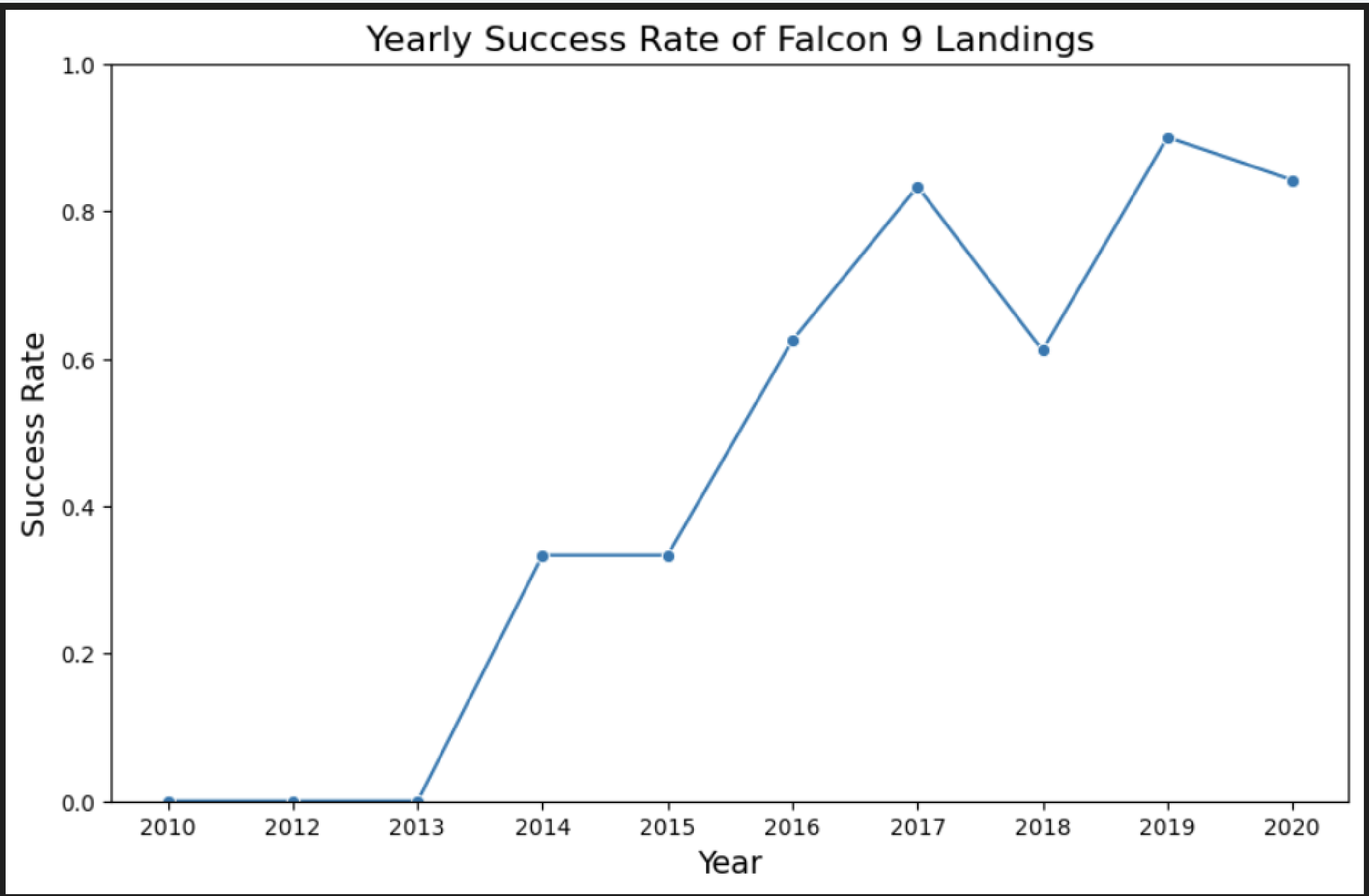
With heavy payloads the successful landing or positive landing rate are more for Polar,LEO and ISS.
However, for GTO, it's difficult to distinguish between successful and unsuccessful landings as both outcomes are present.
LEO missions carry a wide range of payloads. GTO missions consistently medium payloads (big comm satellites).
Specialized orbits (like SSO/polar) are mostly light payloads. SO is mainly very heavy loads
This shows the technical relationship between orbit type and payload requirements.

- Show a scatter point of payload vs. orbit type
- Show the screenshot of the scatter plot with explanations

Launch Success Yearly Trend

- Show a line chart of yearly average success rate

- Show the screenshot of the scatter plot with explanations




```
you can observe that the sucess rate since 2013 kept increasing till 2020
Early years (2010–2012) had 0 success.From ~2015 onwards, the success rate rises sharply.
After 2018, success stabilizes closer to 100%, reflecting Falcon 9 Block 5 improvements and operational maturity.
Clear evidence of SpaceX learning curve and technology evolution.
```

All Launch Site Names

- Find the names of the unique launch sites
- Present your query result with a short explanation here
- CCAFS SLC 40, VAFB SLC 4E, KSC LC39A
- Was displayed with command .unique()

```
features['LaunchSite'].unique()
```

```
array(['CCAFS SLC 40', 'VAFB SLC 4E', 'KSC LC 39A'], dtype=object)
```

Launch Site Names Begin with 'CCA'

- Find 5 records where launch sites begin with `CCA`
- Present your query result with a short explanation here
- %%sql
- SELECT *
- FROM SPACEXTABLE
- WHERE "Launch_Site" LIKE 'CCA%'
- LIMIT 5;

Date	Time (UTC)	Booster_Version	Launch_Site	Payload	PAYLOAD_MASS__KG_	Orbit	Customer	Mission_Outcome	Landing_Out
2010-06-04	18:45:00	F9 v1.0 B0003	CCAFS LC-40	Dragon Spacecraft Qualification Unit	0	LEO	SpaceX	Success	Failure (parac
2010-12-08	15:43:00	F9 v1.0 B0004	CCAFS LC-40	Dragon demo flight C1, two CubeSats, barrel of Brouere cheese	0	LEO (ISS)	NASA (COTS) NRO	Success	Failure (parac
2012-05-22	7:44:00	F9 v1.0 B0005	CCAFS LC-40	Dragon demo flight C2	525	LEO (ISS)	NASA (COTS)	Success	No att
2012-10-08	0:35:00	F9 v1.0 B0006	CCAFS LC-40	SpaceX CRS-1	500	LEO (ISS)	NASA (CRS)	Success	No att
2013-03-01	15:10:00	F9 v1.0 B0007	CCAFS LC-40	SpaceX CRS-2	677	LEO (ISS)	NASA (CRS)	Success	No att

Total Payload Mass

- Calculate the total payload carried by boosters from NASA
- 45596kg
- Present your query result with a short explanation here
- %%sql
- SELECT SUM("PAYLOAD_MASS__KG_") AS TotalPayloadMass
- FROM SPACEXTABLE
- WHERE "Customer" = 'NASA (CRS)';

```
* sqlite:///my_data1.db
Done.
```

TotalPayloadMass
45596

Average Payload Mass by F9 v1.1

- Calculate the average payload mass carried by booster version F9 v1.1
- 2928.4kg
- Present your query result with a short explanation here
- %%sql
- SELECT AVG("PAYLOAD_MASS__KG_") AS AvgPayloadMass
- FROM SPACEXTABLE
- WHERE "Booster_Version" = 'F9 v1.1';

```
* sqlite:///my_data1.db
Done.
```

AvgPayloadMass
2928.4

First Successful Ground Landing Date

- Find the dates of the first successful landing outcome on ground pad
- 2015-12-22
- Present your query result with a short explanation here
- %%sql
- SELECT MIN("Date") AS FirstGroundPadLanding
- FROM SPACEXTABLE
- WHERE "Landing_Outcome" = 'Success (ground pad)';

```
* sqlite:///my_data1.db
Done.
```

FirstGroundPadLanding
2015-12-22

Successful Drone Ship Landing with Payload between 4000 and 6000

- List the names of boosters which have successfully landed on drone ship and had payload mass greater than 4000 but less than 6000
- F9 FT B1022
- F9 FT B1026
- F9 FT B1021.2
- F9 FT B1031.2
- Present your query result with a short explanation here
- %%sql
- SELECT DISTINCT "Booster_Version"
- FROM SPACEXTABLE
- WHERE "Landing_Outcome" = 'Success (drone ship)'
- AND "PAYLOAD_MASS__KG_" > 4000
- AND "PAYLOAD_MASS__KG_" < 6000;

```
* sqlite:///my_data1.db
Done.
```

Booster_Version
F9 FT B1022
F9 FT B1026
F9 FT B1021.2
F9 FT B1031.2

Total Number of Successful and Failure Mission Outcomes

- Calculate the total number of successful and failure mission outcomes
- Success 98, Failure 1, Unclear 1
- Present your query result with a short explanation here
- %%sql
- SELECT "Mission_Outcome", COUNT(*) AS OutcomeCount
- FROM SPACEXTABLE
- GROUP BY "Mission_Outcome";

```
 * sqlite:///my_data1.db
Done.
```

Mission_Outcome	OutcomeCount
Failure (in flight)	1
Success	98
Success	1
Success (payload status unclear)	1

Boosters Carried Maximum Payload

- List the names of the booster which have carried the maximum payload mass
- F9 B5 B1048.4
- F9 B5 B1049.4
- F9 B5 B1051.3
- F9 B5 B1056.4
- F9 B5 B1048.5
- F9 B5 B1051.4
- F9 B5 B1049.5
- F9 B5 B1060.2
- F9 B5 B1058.3
- F9 B5 B1051.6
- F9 B5 B1060.3
- F9 B5 B1049.7

- Present your query result with a short explanation here
- %%sql
- SELECT DISTINCT "Booster_Version"
- FROM SPACEXTABLE
- WHERE "PAYLOAD_MASS__KG_" = (
-     SELECT MAX("PAYLOAD_MASS__KG_")
-     FROM SPACEXTABLE
-);

```
 * sqlite:///my_data1.db
Done.
```

Booster_Version
F9 B5 B1048.4
F9 B5 B1049.4
F9 B5 B1051.3
F9 B5 B1056.4
F9 B5 B1048.5
F9 B5 B1051.4
F9 B5 B1049.5
F9 B5 B1060.2
F9 B5 B1058.3
F9 B5 B1051.6
F9 B5 B1060.3
F9 B5 B1049.7

2015 Launch Records

- List the failed landing_outcomes in drone ship, their booster versions, and launch site names for in year 2015
- 01 Failure (drone ship) F9 v1.1 B1012 CCAFS LC-40
- 04 Failure (drone ship) F9 v1.1 B1015CCAFS LC-40
- Present your query result with a short explanation here
- %%sql
- SELECT
- substr("Date", 6, 2) AS Month,
- "Landing_Outcome",
- "Booster_Version",
- "Launch_Site"
- FROM SPACEXTABLE
- WHERE substr("Date", 1, 4) = '2015'
- AND "Landing_Outcome" LIKE 'Failure (drone ship)%';

```
 * sqlite:///my_data1.db
Done.
```

Month	Landing_Outcome	Booster_Version	Launch_Site
01	Failure (drone ship)	F9 v1.1 B1012	CCAFS LC-40
04	Failure (drone ship)	F9 v1.1 B1015	CCAFS LC-40

Rank Landing Outcomes Between 2010-06-04 and 2017-03-20

- Rank the count of landing outcomes (such as Failure (drone ship) or Success (ground pad)) between the date 2010-06-04 and 2017-03-20, in descending order

Landing_Outcome	OutcomeCount
No attempt	10
Success (drone ship)	5
Failure (drone ship)	5
Success (ground pad)	3
Controlled (ocean)	3
Uncontrolled (ocean)	2
Failure (parachute)	2
Precluded (drone ship)	1

```
* sqlite:///my_data1.db
Done.
```


Landing_Outcome	OutcomeCount
No attempt	10
Success (drone ship)	5
Failure (drone ship)	5
Success (ground pad)	3
Controlled (ocean)	3
Uncontrolled (ocean)	2
Failure (parachute)	2
Precluded (drone ship)	1

- Present your query result with a short explanation here

- %%sql
- SELECT
-     "Landing_Outcome",
-     COUNT(*) AS OutcomeCount
- FROM SPACEXTABLE WHERE "Date" BETWEEN '2010-06-04' AND '2017-03-20' GROUP BY "Landing Outcome" ORDER BY Outcome Count DESC;

Section 3

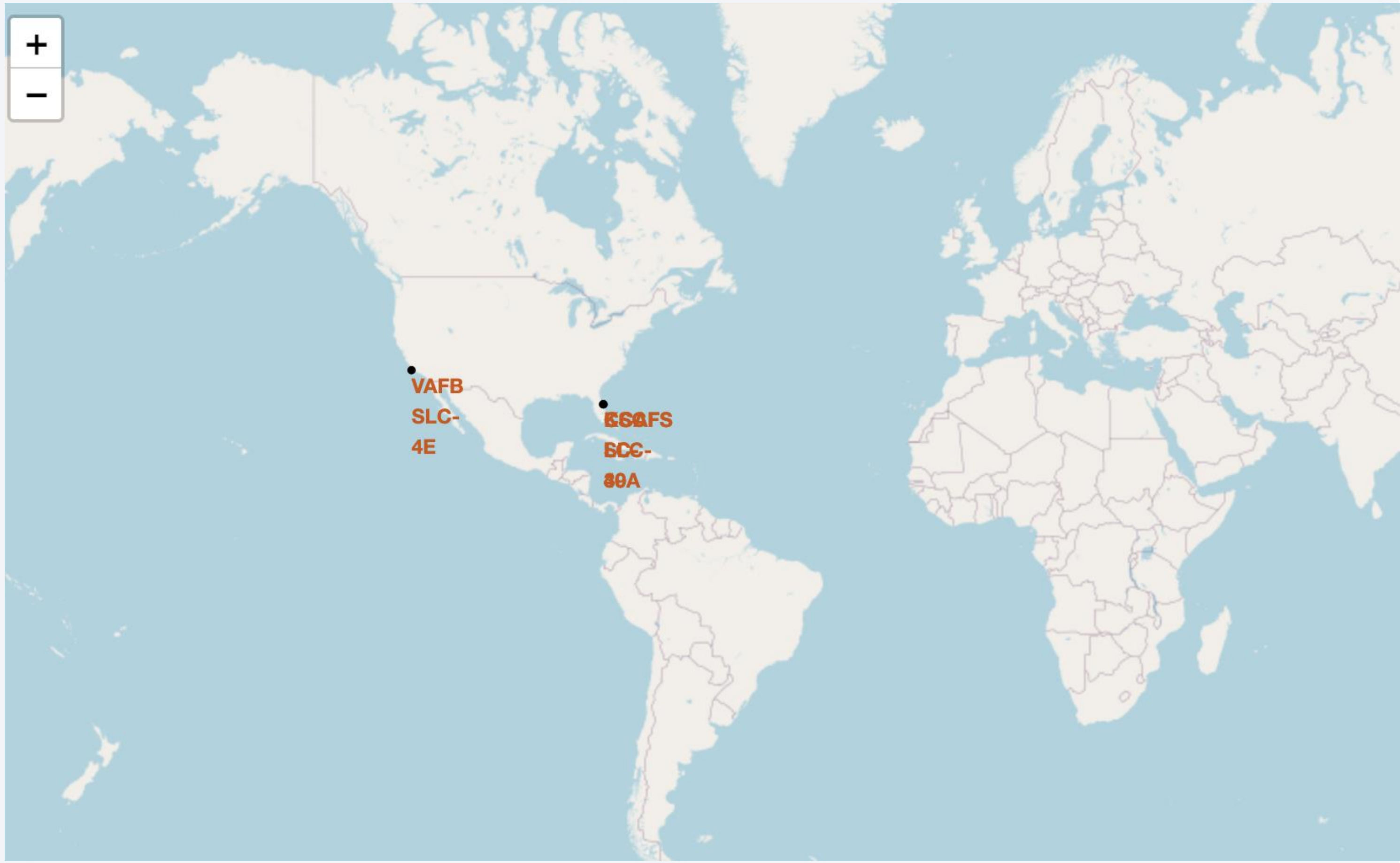
Launch Sites Proximities Analysis

Launch Sites on a Global Map

- Replace <Folium map screenshot 1> title with an appropriate title

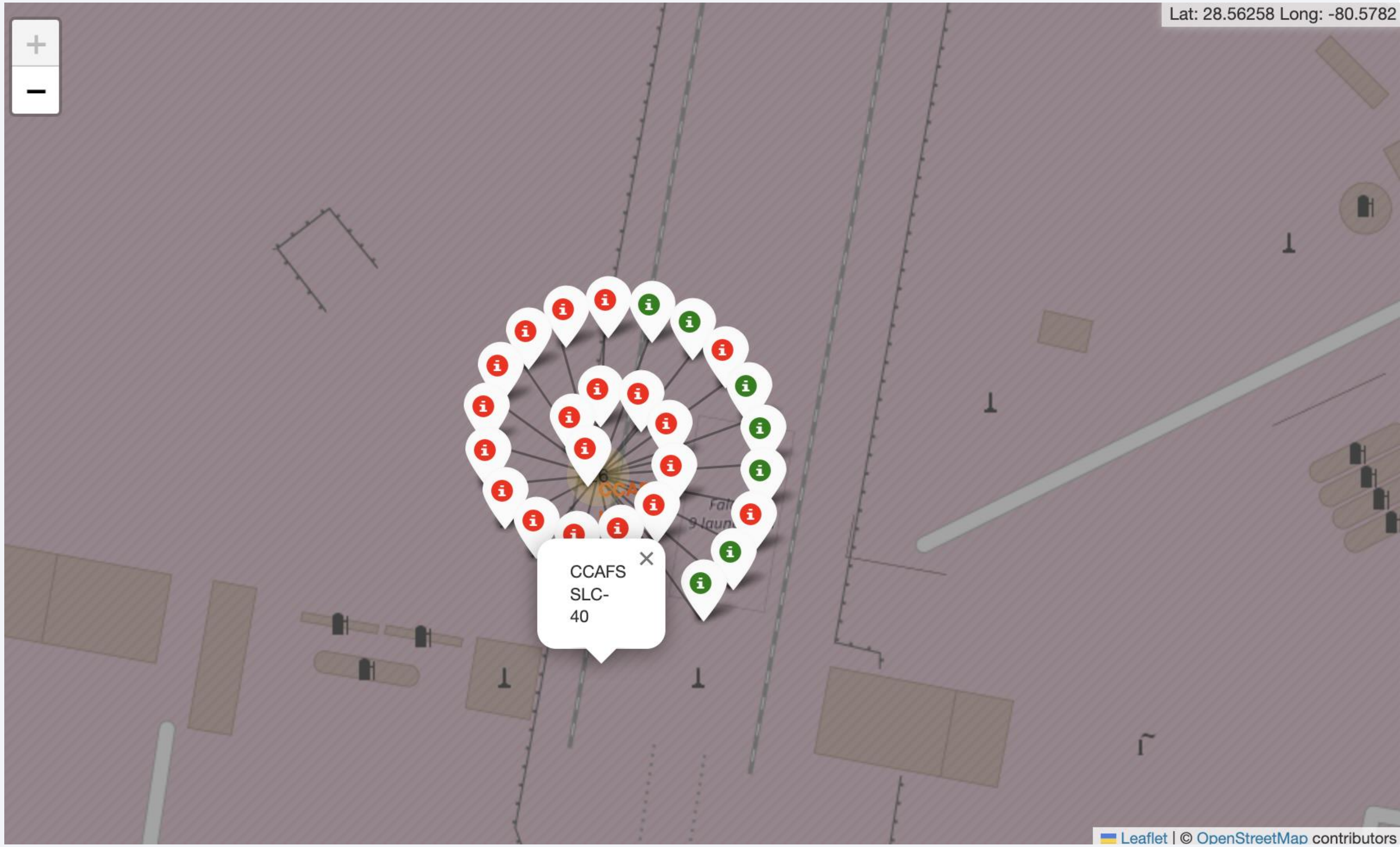
- Explore the generated folium map and make a proper screenshot to include all launch sites' location markers on a global map

- Explain the important elements and findings on the screenshot
- The Launch sites are next to the sea
- California and Florida



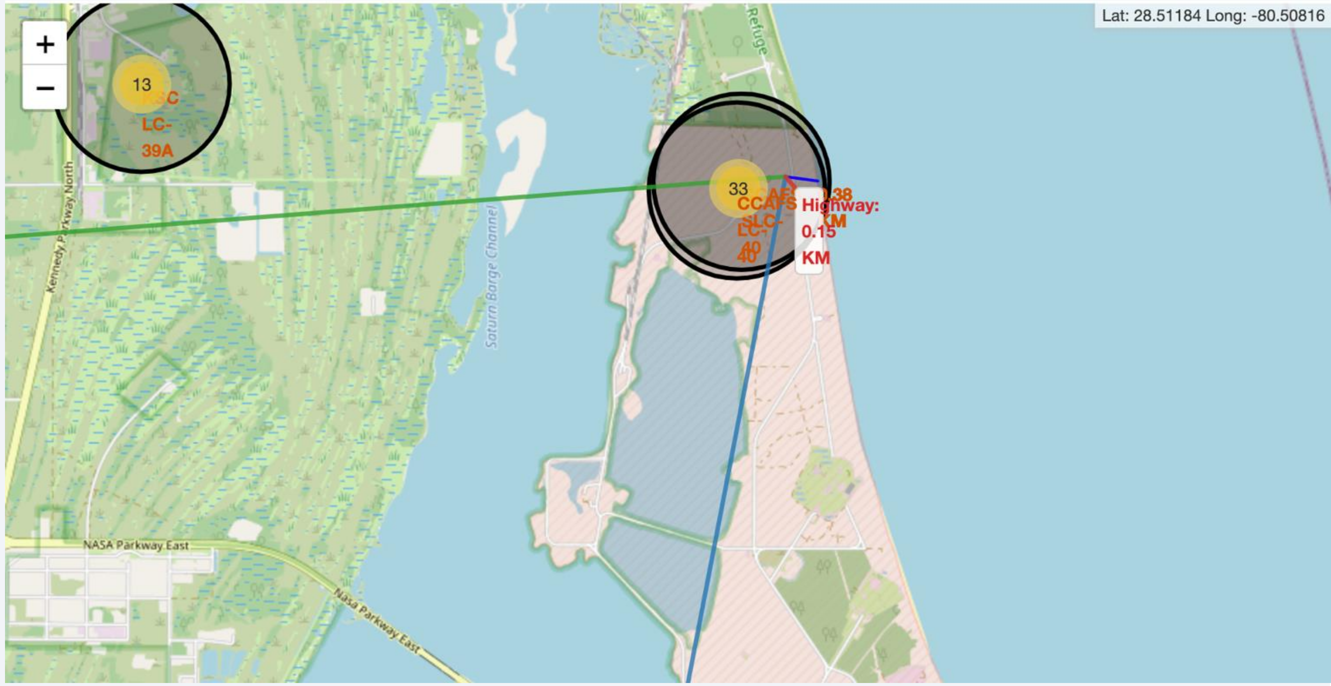
CCAFS SLC 40 Launch Site Successful and Failed Launches

- Replace <Folium map screenshot 2> title with an appropriate title
- Explore the folium map and make a proper screenshot to show the color-labeled launch outcomes on the map
- Explain the important elements and findings on the screenshot
- Red coded are the failed launces, and green are the successful launches



Distance to Important Proximities

- Replace <Folium map screenshot 3> title with an appropriate title
- Explore the generated folium map and show the screenshot of a selected launch site to its proximities such as railway, highway, coastline, with distance calculated and displayed
- Explain the important elements and findings on the screenshot
- Coast 0.38km, Highway 0.15km, railway 22.14km, City 18.42
- The location of launch site requires careful consideration
    - Logistics for supplies and personnel
    - Safety distance to population centers and safe landing and air traffic if something goes wrong

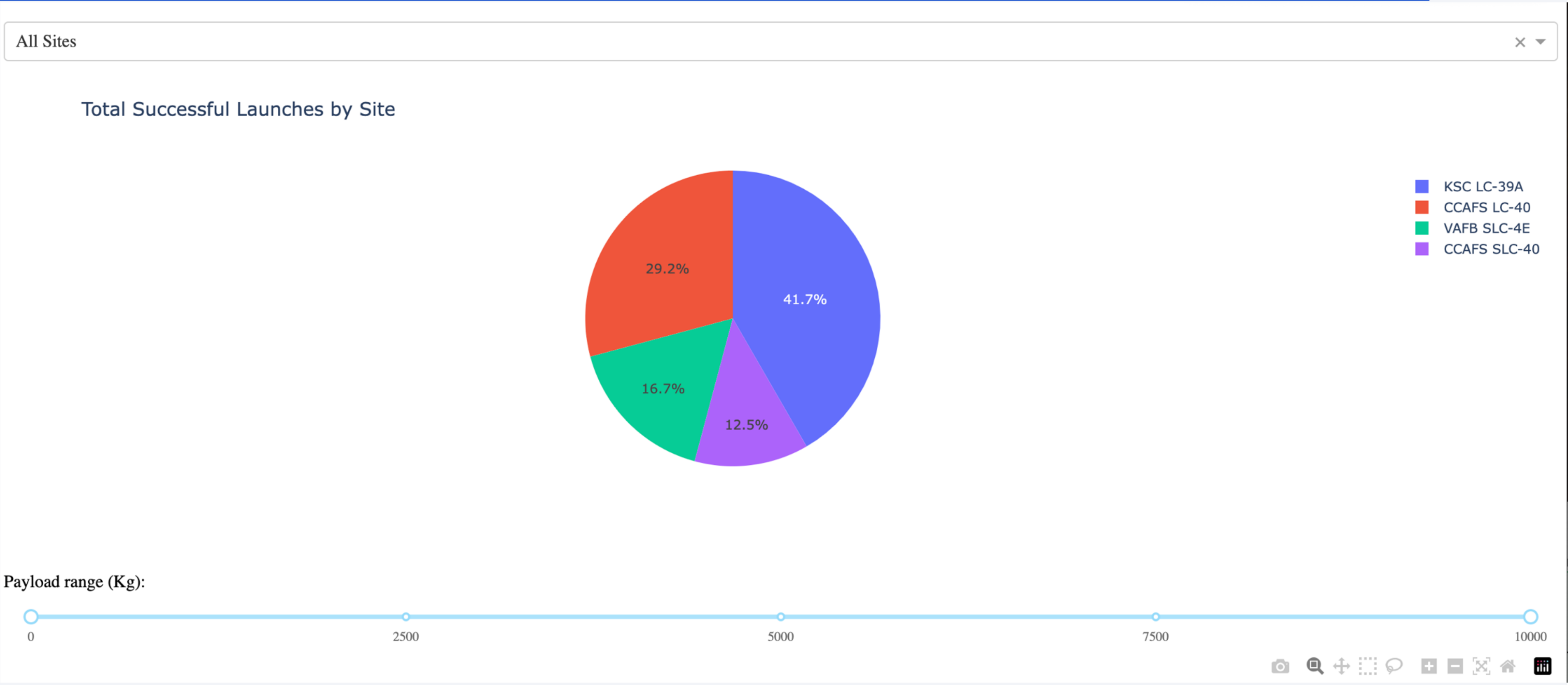


Section 4

Build a Dashboard with Plotly Dash

Total Successful Launches by Site

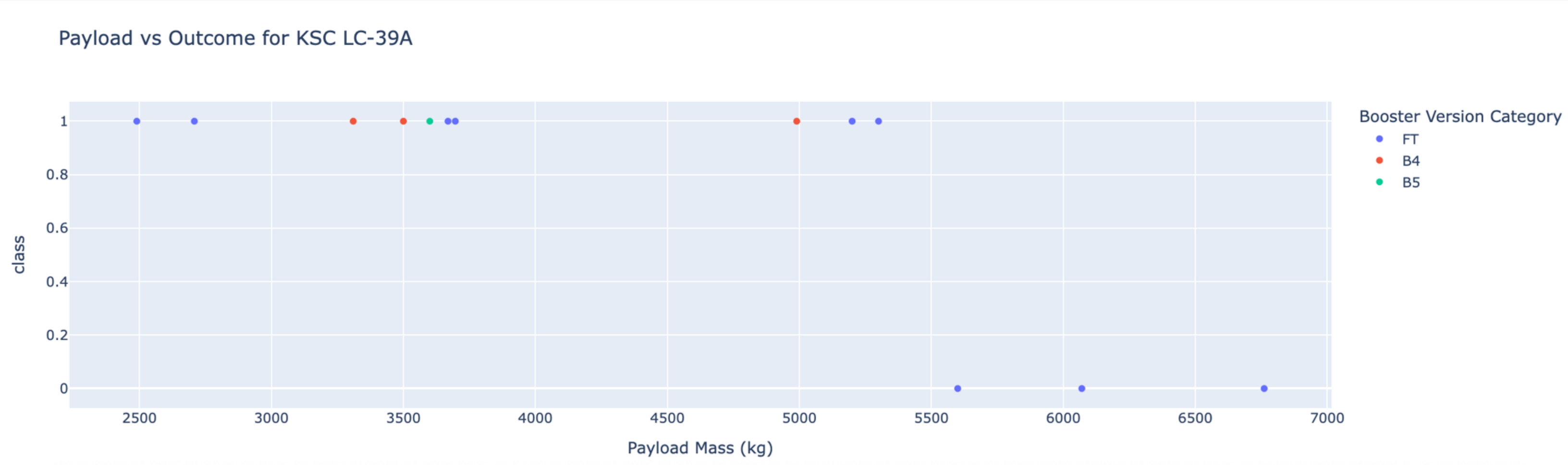
- Replace <Dashboard screenshot 1> title with an appropriate title
- Show the screenshot of launch success count for all sites, in a piechart
- Explain the important elements and findings on the screenshot



KSC LC 39A is the most successful launch site. CCAFS LC-40 coming as second.

Payload vs Outcome for KSC LC 39A

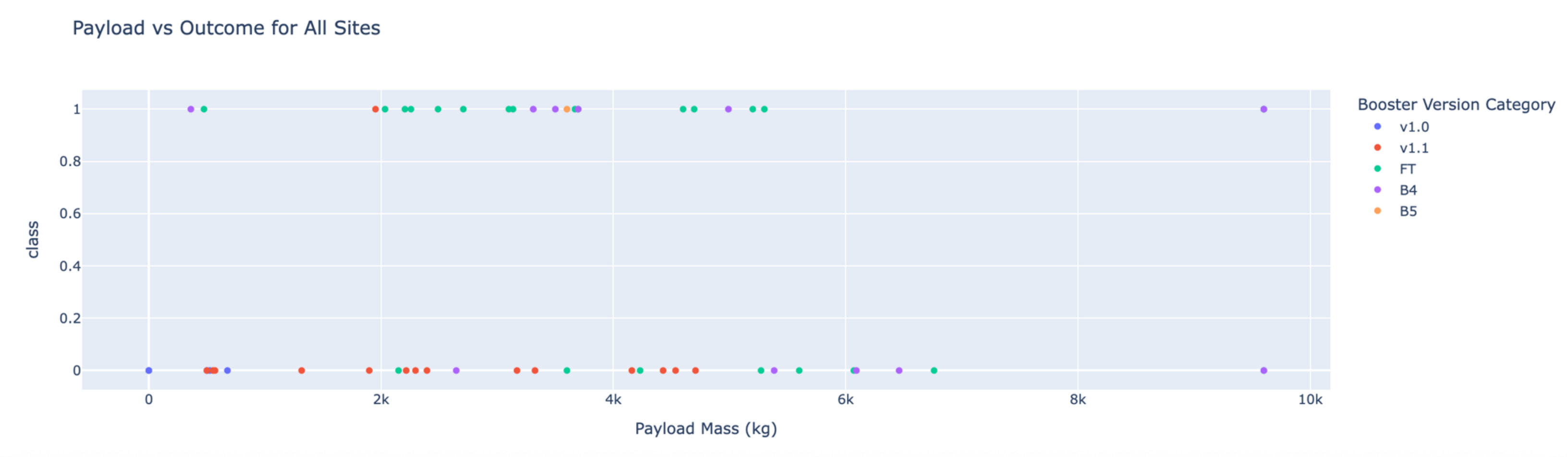
- Replace <Dashboard screenshot 2> title with an appropriate title
- Show the screenshot of the piechart for the launch site with highest launch success ratio
- Explain the important elements and findings on the screenshot



KSC LC 39A is the most successful launch site. Having FT as the most successful launches and most failures. B4 and B5 have no Failures at this site.

Payload vs Outcome for All Sites

- Replace <Dashboard screenshot 3> title with an appropriate title
- Show screenshots of Payload vs. Launch Outcome scatter plot for all sites, with different payload selected in the range slider
- Explain the important elements and findings on the screenshot, such as which payload range or booster version have the largest success rate, etc.



V1.0, V1.1 has the lowest success rate with V1.1 having Highest rate of failures.

FT, B4, B5 have the highest success rate.

FT and B4 tops the payloads

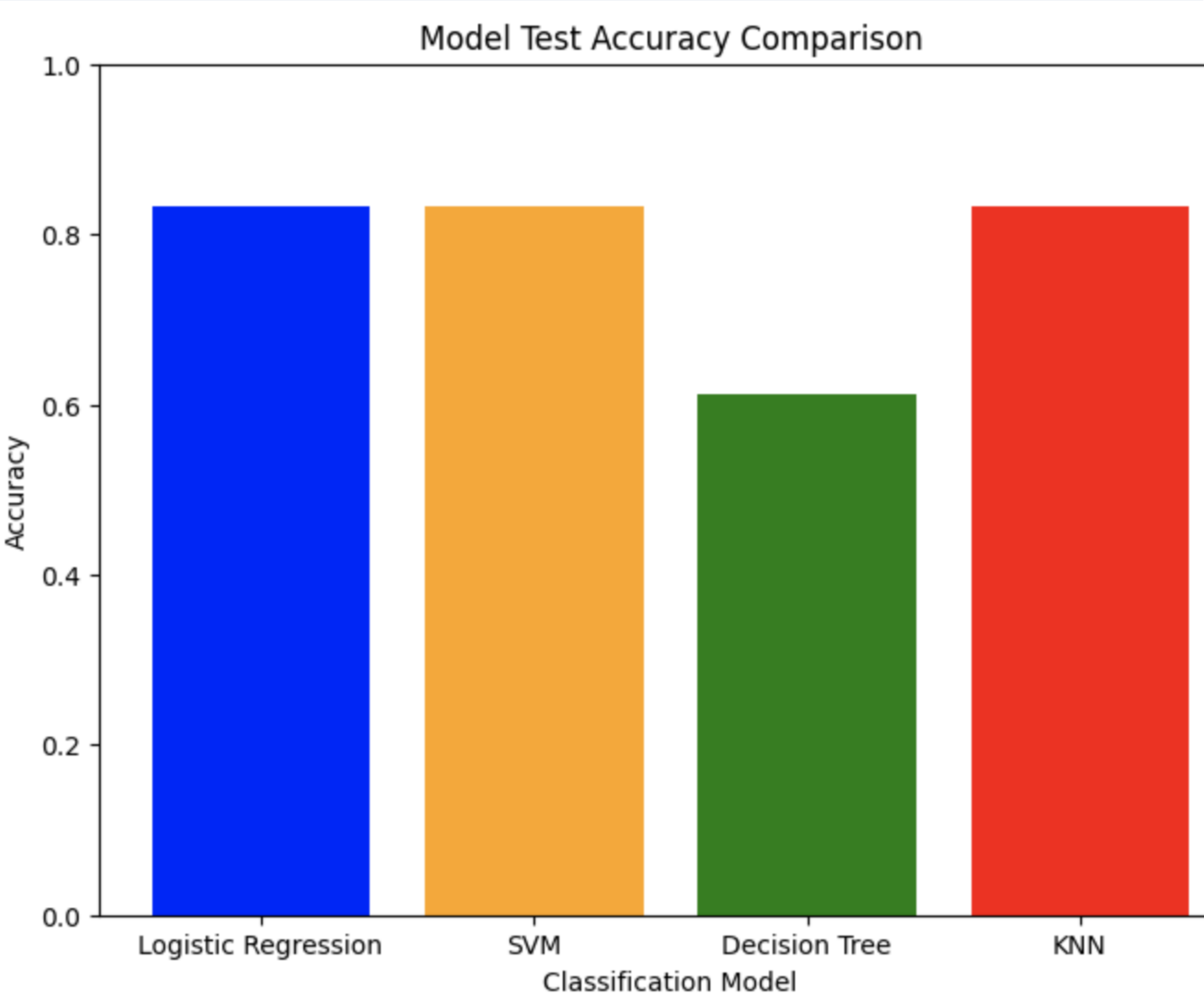
Section 5

Predictive Analysis (Classification)

Classification Accuracy

- Visualize the built model accuracy for all built classification models, in a bar chart

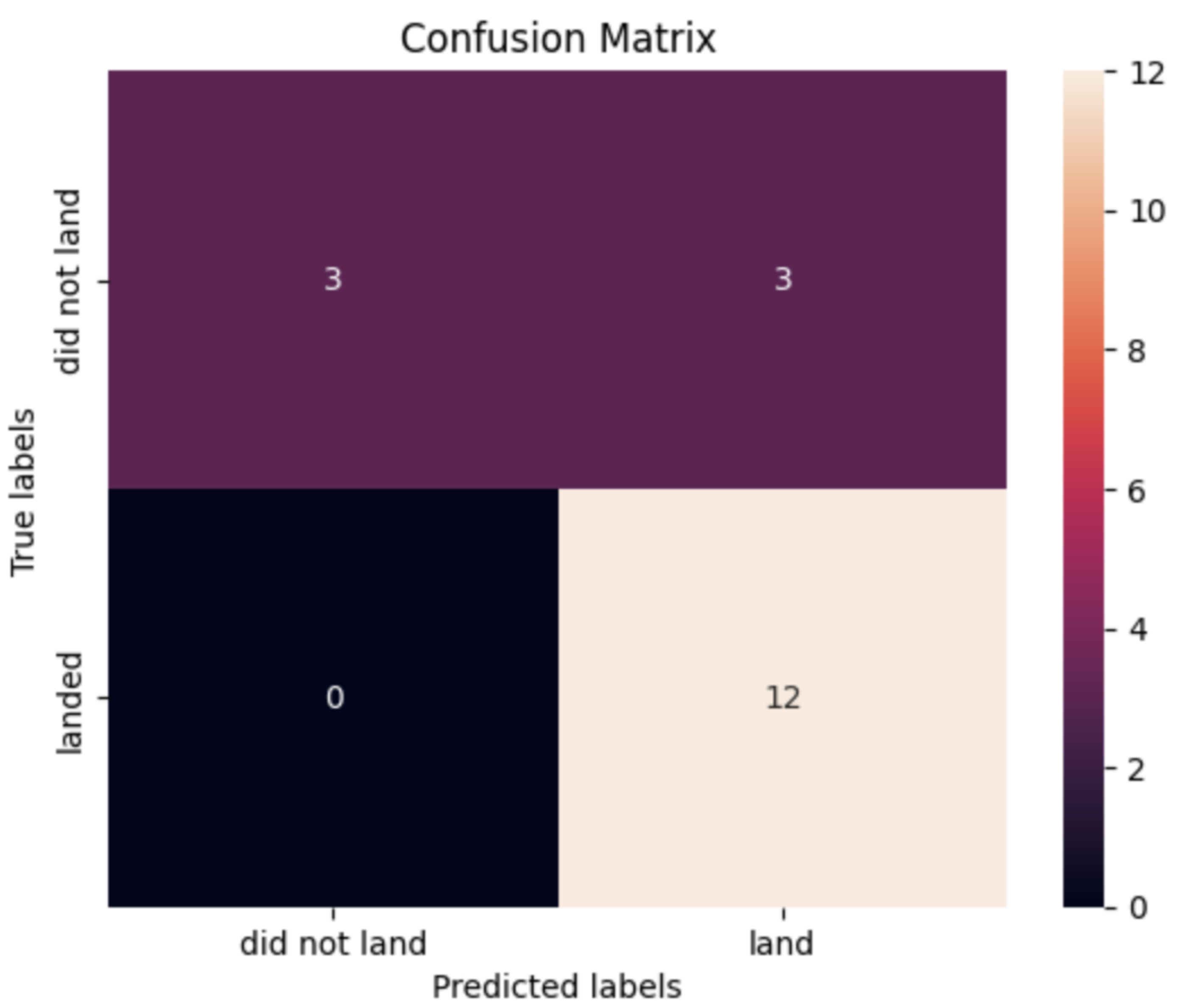
- Find which model has the highest classification accuracy
- Logistic Regression with 83%




```
Best performing model: Logistic Regression with accuracy: 0.8333333333333334
```

Confusion Matrix

- Show the confusion matrix of the best performing model with an explanation
- Top-left cell (True Negative): Number of rockets correctly predicted as not landed.
- Bottom-right cell (True Positive): Number of rockets correctly predicted as landed.
- Top-right cell (False Positive): Rockets predicted as landed but actually did not land (type I error).
- Bottom-left cell (False Negative): Rockets predicted as not landed but actually landed (type II error).
-



Conclusions

- Point 1: SpaceX Falcon 9 landing success is strongly influenced by launch site, payload mass, and orbit type.
- Point 2: Interactive analytics (maps, filters, scatter plots, pie charts) help visualize success patterns and make insights more accessible.
- Point 3: Machine learning models can accurately predict landing outcomes; tuning with GridSearchCV improved results.
- Point 4: Among tested models, the best performing classifier achieved the highest test accuracy and provides a reliable predictive tool.
- Point 5: The project demonstrates how data-driven analysis supports cost reduction and decision-making in commercial space launches.

Appendix

- Include any relevant assets like Python code snippets, SQL queries, charts, Notebook outputs, or data sets that you may have created during this project

Thank you!