IBM Developer
SKILLS NETWORK

# Winning Space Race with Data Science

<Name>
<Date>

# Outline

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

# Executive Summary

- Summary of methodologies
- Summary of all results

# Introduction

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

Section 1

# Methodology

# Methodology

## Executive Summary

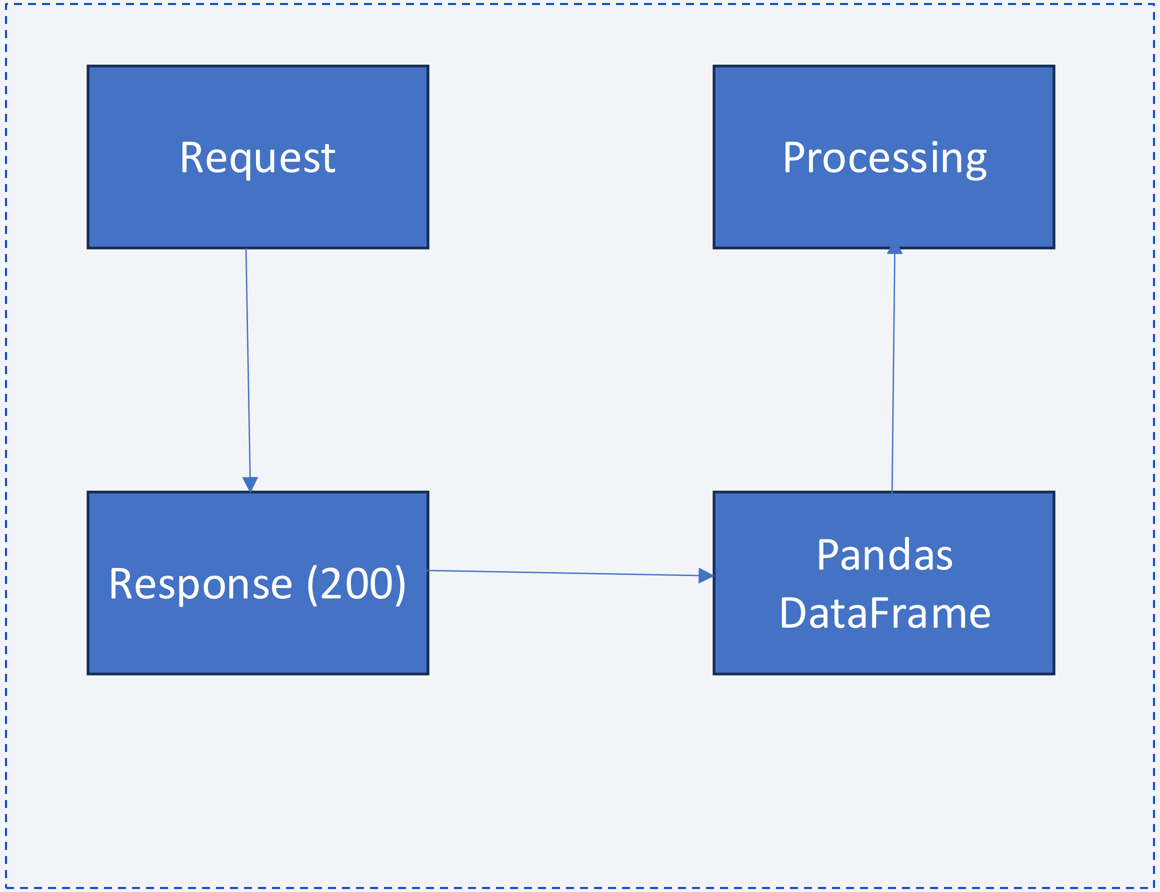
- Data collection methodology:
  - Describe how data was collected
- Perform data wrangling
  - Describe how data was processed
- Perform exploratory data analysis (EDA) using visualization and SQL
- Perform interactive visual analytics using Folium and Plotly Dash
- Perform predictive analysis using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

# Data Collection

- SpaceX data was collected using
    - SpaceX rest api
    - Wikipedia (Web scraping)

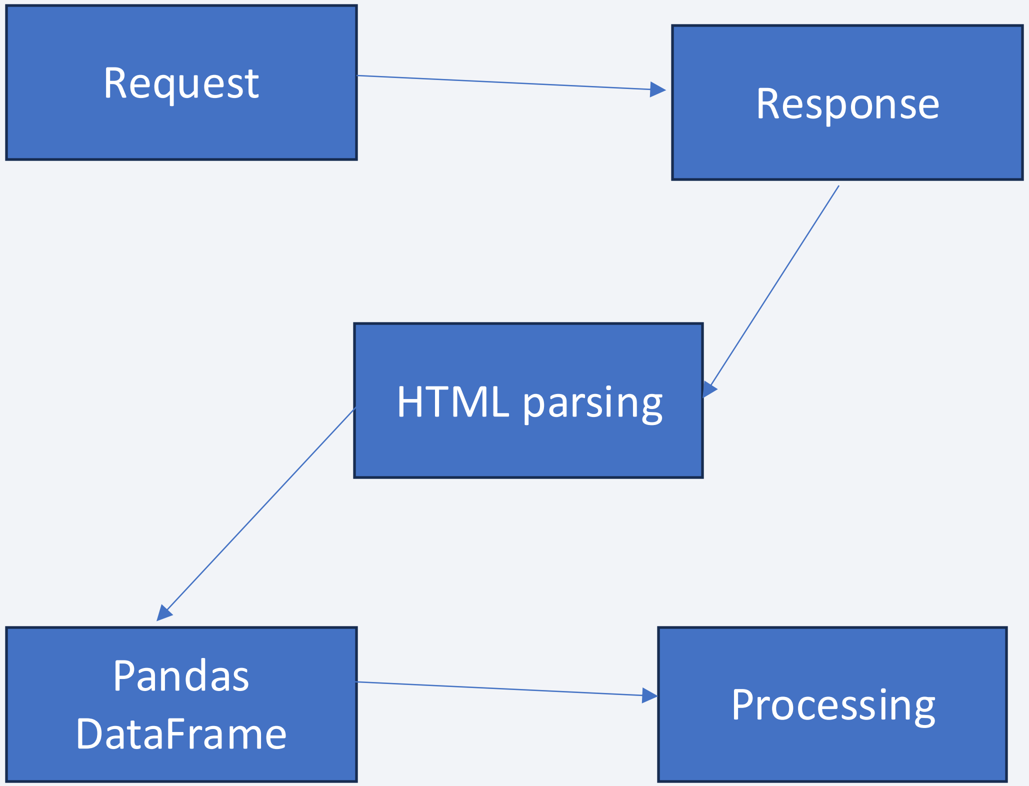
# Data Collection – SpaceX API

- Data was requested from SPaceX RestAPI
- SpaceX rest api response was then loaded into pandas dataframe
- Pandas DataFrame was then analyzed and processed for the future usage
- https://github.com/haapsee/SpaceY/blob/main/JupyterLabs/jupyter-labs-spacex-data-collection-api-v2.ipynb



# Data Collection - Scraping

- Web scraping data was requested from the Wikipedia
- Wikipedia page received as a response was then parsed using BeautifuloSoup
- Parsed data from HTML was loaded into pandas DataFrame and saved for the future use.
- https://github.com/haapsee/SpaceY/blob/main/JupyterLabs/jupyter-labs-webscraping.ipynb



# Data Wrangling

- Describe how data were processed
- 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

# EDA with Data Visualization

- Scatter Point Plot was used for visualizing for how 2 different features affected Success
- Bar Chart was used to visualize success rate for different orbits
- Line chart was used to visualize how success rate has changed over the years.
- https://github.com/haapsee/SpaceY/blob/main/JupyterLabs/jupyter-labs-eda-dataviz-v2.ipynb

# EDA with SQL

- SQL queries was used to find:
  - Unique values in columns (filtered and not-filtered)
  - Sum of column
  - Average of column
  - Minimum values
  - Counts
- https://github.com/haapsee/SpaceY/blob/main/JupyterLabs/jupyter-labs-eda-sql-coursera_sqllite.ipynb

# Build an Interactive Map with Folium

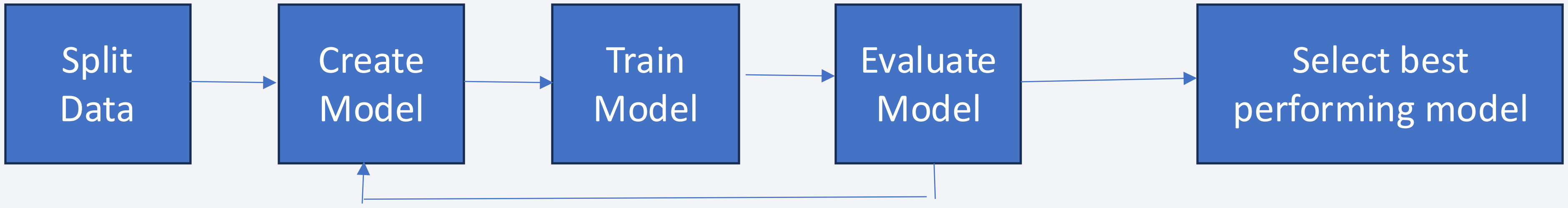
- Folium map object used are:
    - Markers for marking launches, grouped by Marker CLuster
    - Circles for marking launch site
    - Popup for showing launch site name
    - PolyLine for distance between objects
- https://github.com/haapsee/SpaceY/blob/main/JupyterLabs/lab-jupyter-launch-site-location-v2.ipynb

# Build a Dashboard with Plotly Dash

- Summarize what plots/graphs and interactions you have added to a dashboard
- Used Plots/Graphs are:
  - Pie Chart for success/failure rate visualization
  - Scatter plot to show the correlation between payload, booster version and launch success
- Graphs can be interacted with
  - Dropdown to select launch site
  - Slider to adjust payload (Scatter plot only)
- https://github.com/haapsee/SpaceY/blob/main/spacex_dash_app.py

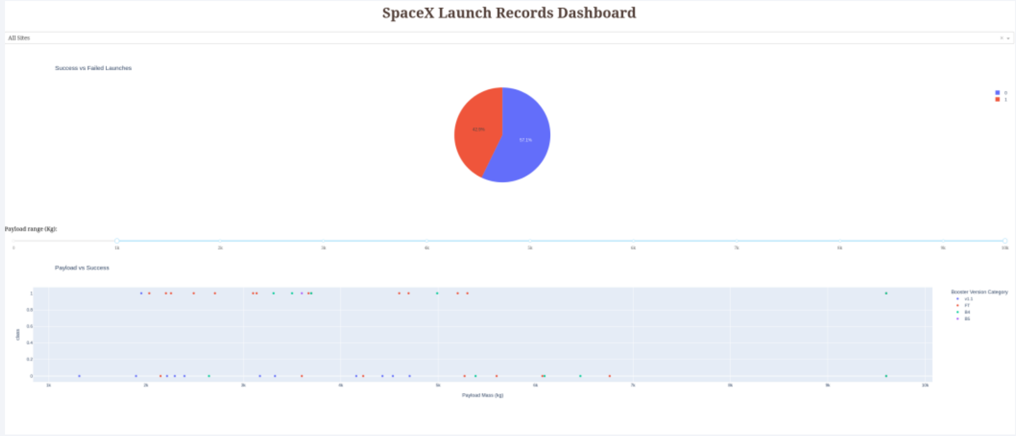
# Predictive Analysis (Classification)

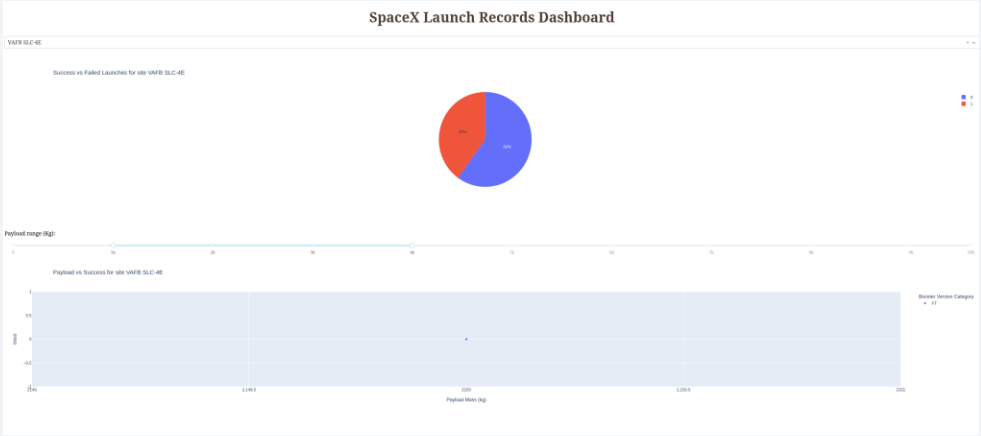
- Model was built and trained using Scikit Learn
- Data was split into test and training data
- Model was evaluated using test data
- Best performing model was found using confusion matrix, score function and best_score_ parameter
- https://github.com/haapsee/SpaceY/blob/main/JupyterLabs/SpaceX-Machine-Learning-Prediction-Part-5-v1.ipynb



# Results

- Exploratory data analysis results tells that success rate has improved over the years
- Predictive analysis results tells that DecisionTree would be the best fit for analysing coming up success

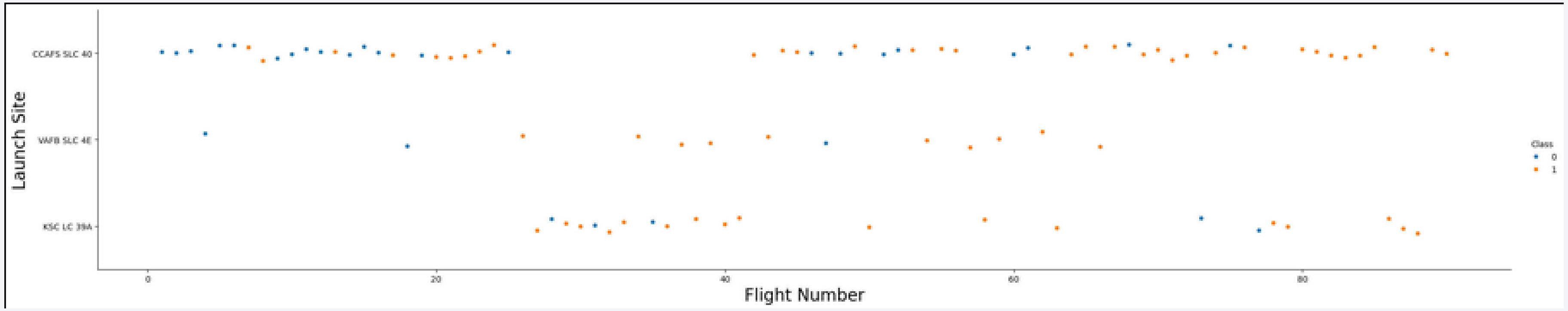


Section 2

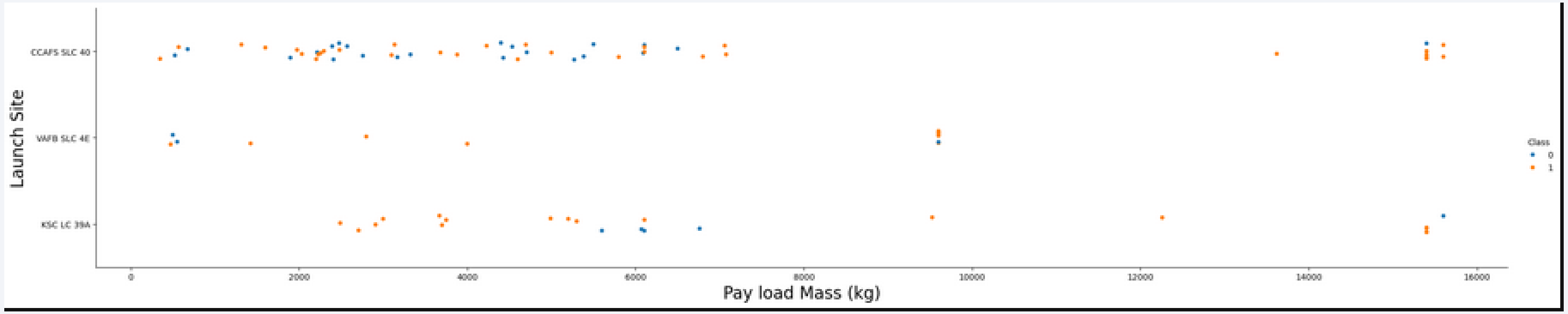
# Insights drawn from EDA

# Flight Number vs. Launch Site




- Scatter plot of Success rate between flight number and launch site
- Launch site on y-axis
- Flight number on x-axis
- Blue = Failure
- Orange = Success

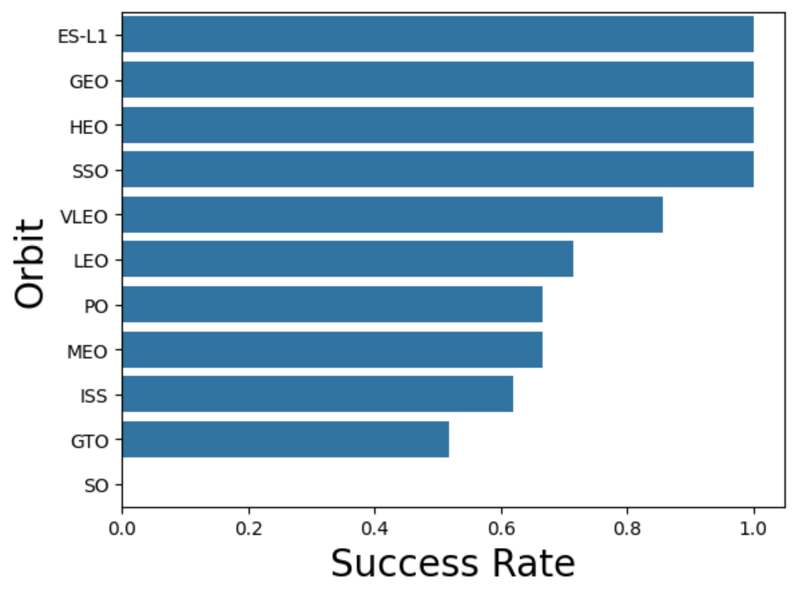
# Payload vs. Launch Site



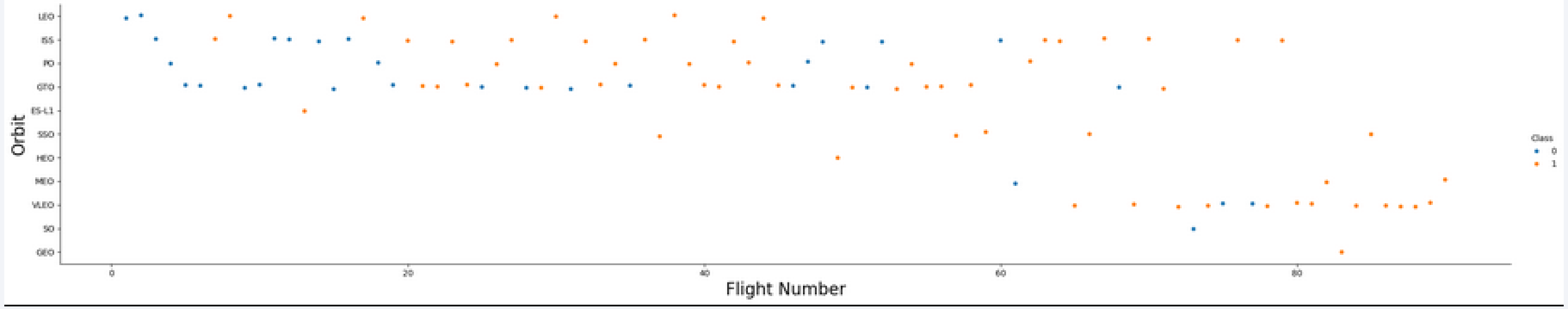

- Scatter plot of Success rate between payload and launch site
- Launch site on y-axis
- Payload on x-axis
- Blue = Failure
- Orange = Success

# Success Rate vs. Orbit Type

- Bar plot of Success rate between orbit types
- Orbit type on y-axis
- Success rate on x-axis

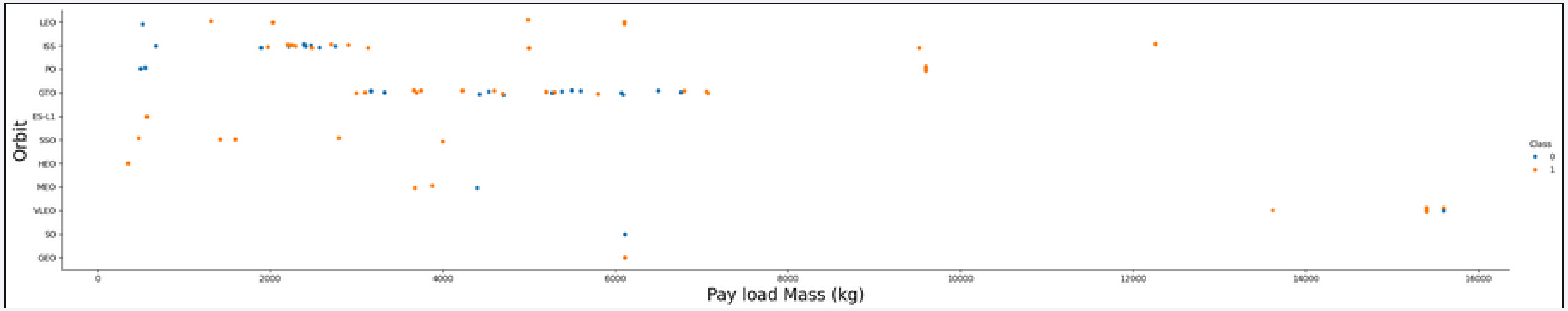


# Flight Number vs. Orbit Type




- Scatter plot of Success rate between orbit and flight number
- orbit on y-axis
- Flight number on x-axis
- Blue = Failure
- Orange = Success

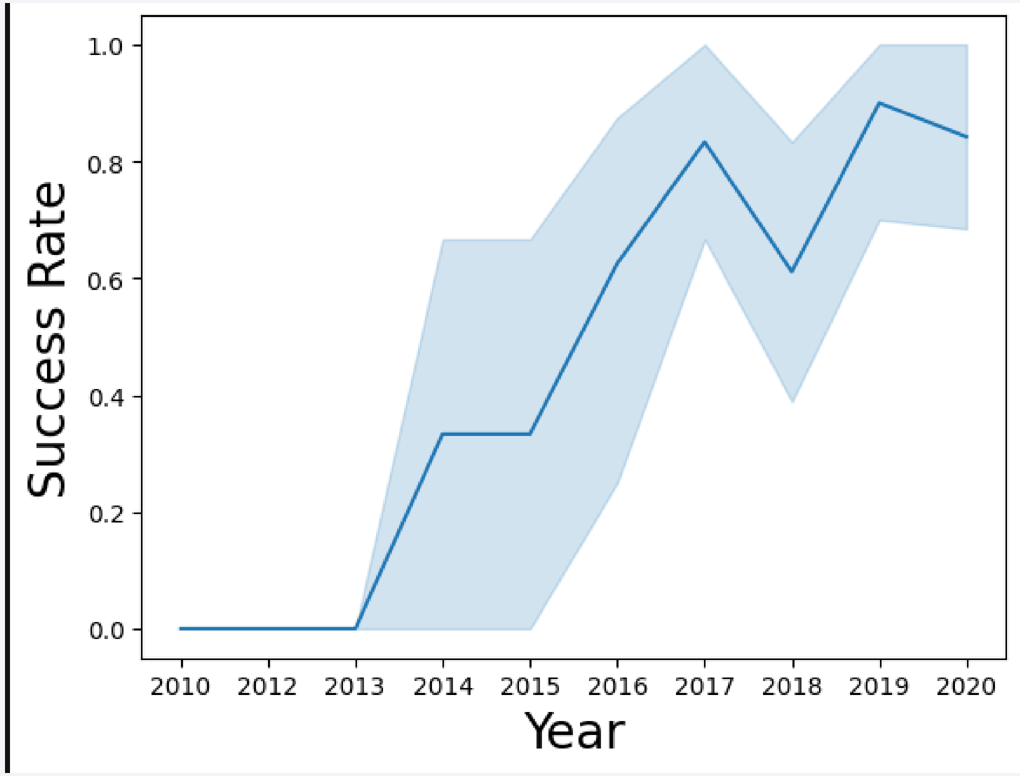
# Payload vs. Orbit Type




- Scatter plot of Success rate between orbit and payload
- orbit on y-axis
- payload on x-axis
- Blue = Failure
- Orange = Success

# Launch Success Yearly Trend

- Line chart of success rate development over the years
- Success rate (0-1) on y-axis
- Year on x-axis
- Line = Average
- Area = Variation



# All Launch Site Names

- All Launch site names found in the dataset
- CCAFS LC-40
- VAFB SLC-4E
- KSC LC-39A
- CCAFS SLC-40

# Launch Site Names Begin with 'CCA'

- 5 records where launch sites begin with `CCA`

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 2010-06-04 | 18:45:00 | F9 v1.0 B0003 | CCAFS LC-40 | Dragon Spacecraft Qualification Unit | 0 | LEO | SpaceX | Success | Failure (parachute) |
| 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 (parachute) |
| 2012-05-22 | 7:44:00 | F9 v1.0 B0005 | CCAFS LC-40 | Dragon demo flight C2 | 525 | LEO (ISS) | NASA (COTS) | Success | No attempt |
| 2012-10-08 | 0:35:00 | F9 v1.0 B0006 | CCAFS LC-40 | SpaceX CRS-1 | 500 | LEO (ISS) | NASA (CRS) | Success | No attempt |
| 2013-03-01 | 15:10:00 | F9 v1.0 B0007 | CCAFS LC-40 | SpaceX CRS-2 | 677 | LEO (ISS) | NASA (CRS) | Success | |

# Total Payload Mass

- Calculated the total payload carried by boosters from NASA
- 45596kg

# Average Payload Mass by F9 v1.1

- Calculated the average payload mass carried by booster version F9 v1.1
- 2928.4kg

# First Successful Ground Landing Date

- The first successful landing outcome on ground pad
- 2015-12-22

# Successful Drone Ship Landing with Payload between 4000 and 6000

- List of the names of the 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

# Total Number of Successful and Failure Mission Outcomes

- Total number of successful and failure mission outcomes

| | |
|---|---|
| Failure (in flight) | 1 |
| Success | 98 |
| Success | 1 |
| Success (payload status unclear) | 1 |

# Boosters Carried Maximum Payload

- List of 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

# 2015 Launch Records

- List the failed landing_outcomes in drone ship, their booster versions, and launch site names for in year 2015

| 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 |

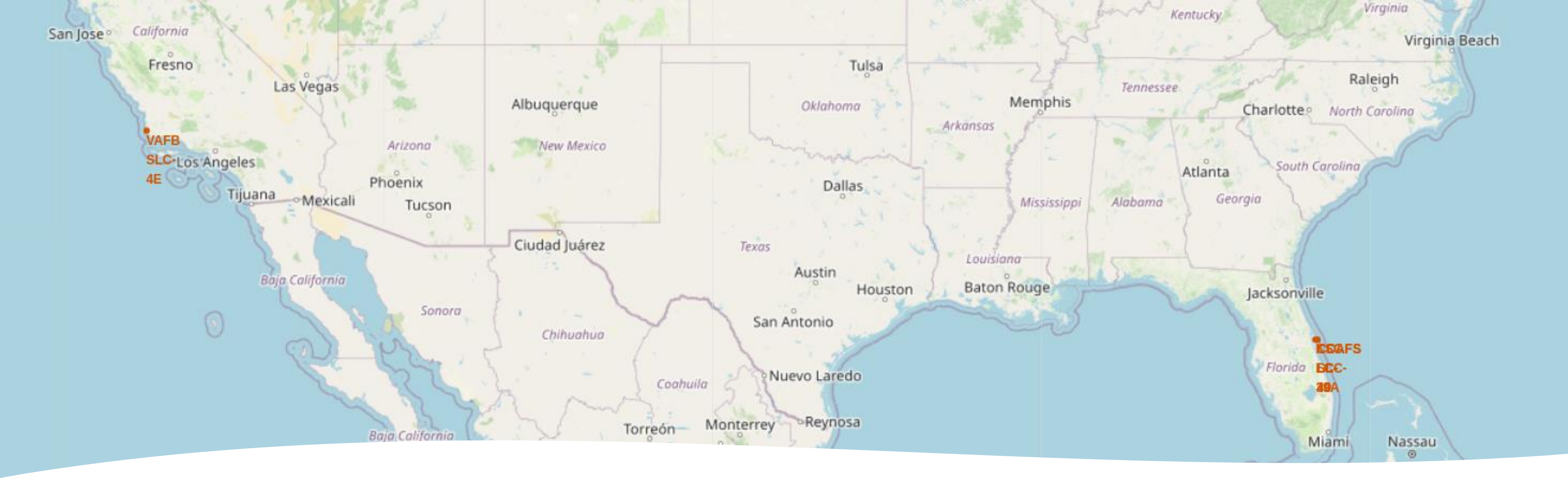
# Rank Landing Outcomes Between 2010-06-04 and 2017-03-20

- 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 | COUNT |
|---|---|
| Success | 38 |
| No attempt | 21 |
| Success (drone ship) | 14 |
| Success (ground pad) | 9 |
| Failure (drone ship) | 5 |
| Controlled (ocean) | 5 |
| Failure | 3 |
| Uncontrolled (ocean) | 2 |
| Failure (parachute) | 2 |
| Precluded (drone ship) | 1 |
| No attempt | 1 |

Section 3

# Launch Sites Proximities Analysis

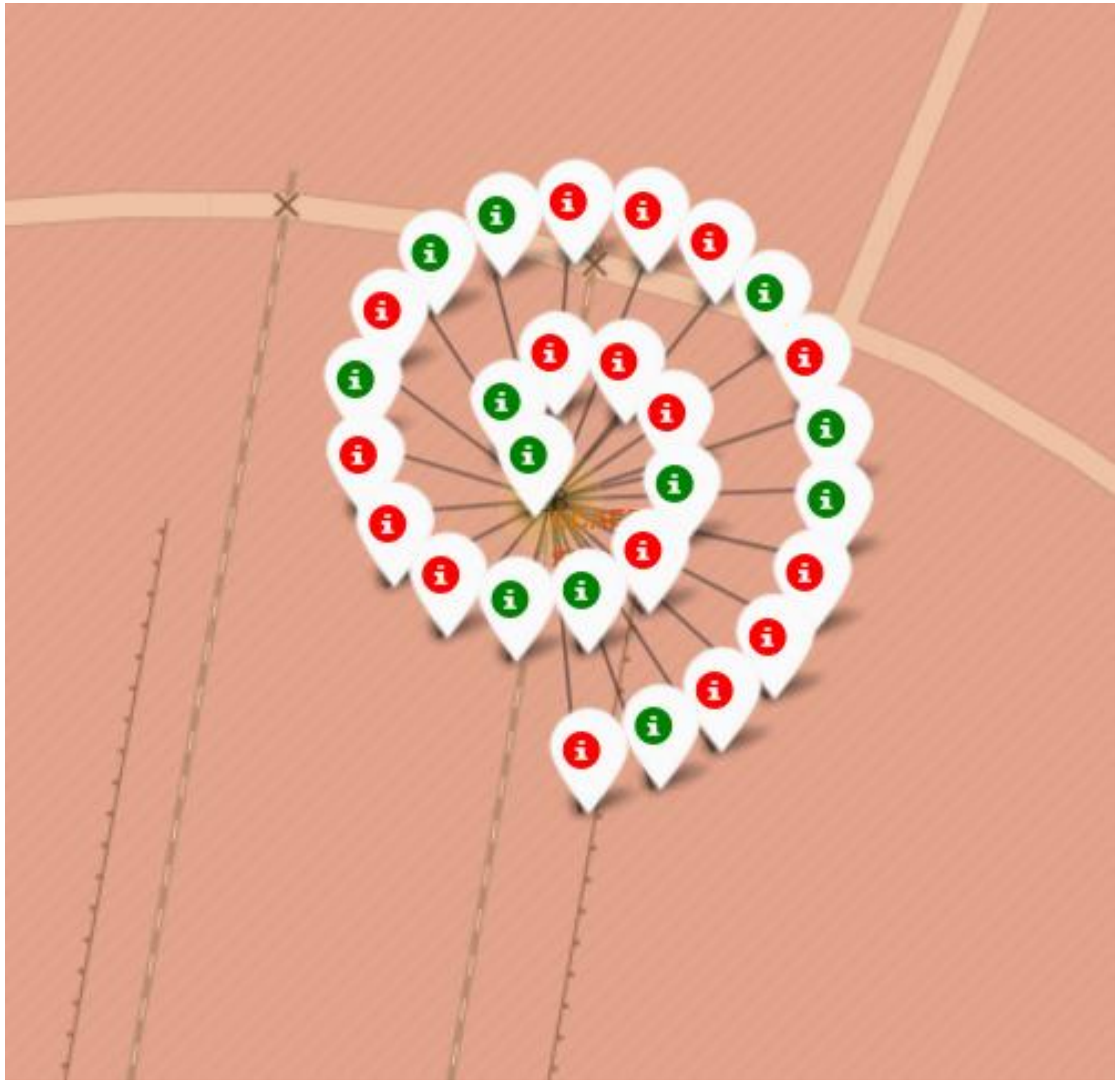



# Launch site locations

- Launch site locations marked with red

# Launch outcomes

- Launch outcomes labeled with red and green markers
- Red = Failure
- Green = Success




# Distance on map

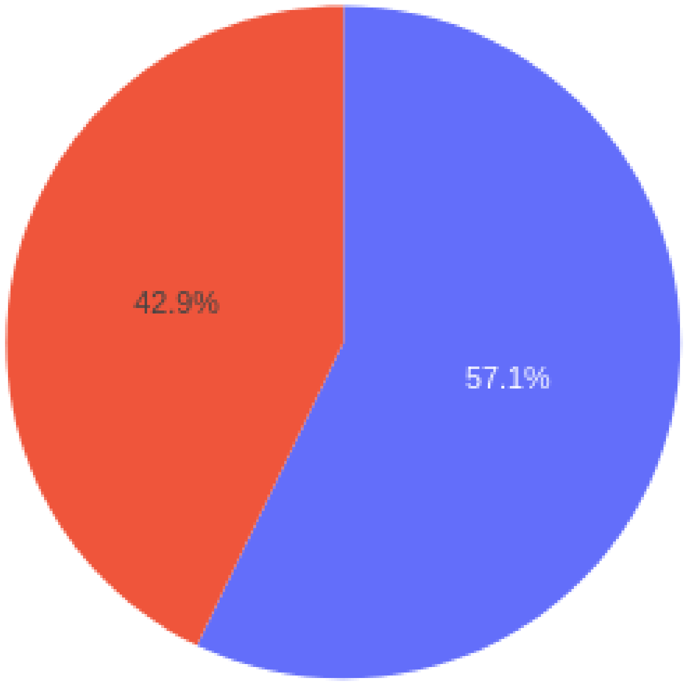
Distance from CCAFS SLC 40 to coast line

Section 4

# Build a Dashboard with Plotly Dash

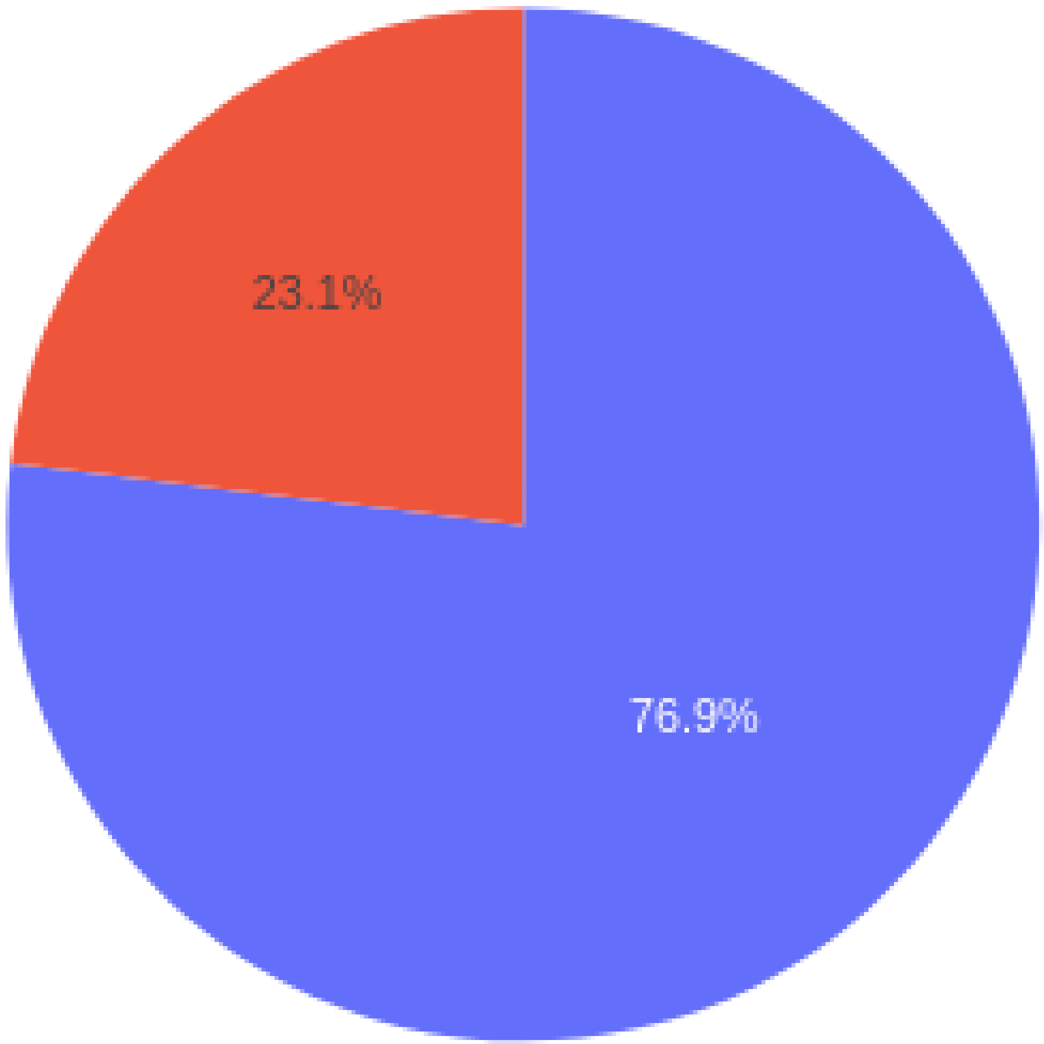
# Pie chart success/Failure

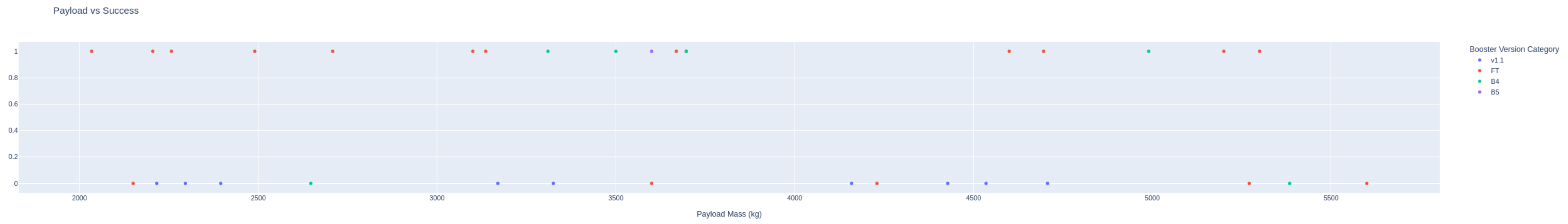
- On pie chart you can see success failure rate on all launch sites.
- Red = Failure
- Blue = Success



# Highest success rate

- Highest success rate found on landing site KSC LC-39A






# Payload vs success

- On the plot you can see different booster versions with payload mass between 2000 and 6000
- Color indicates Booster version
- Bottom = Failure, top = Success
- Mass on x-axis

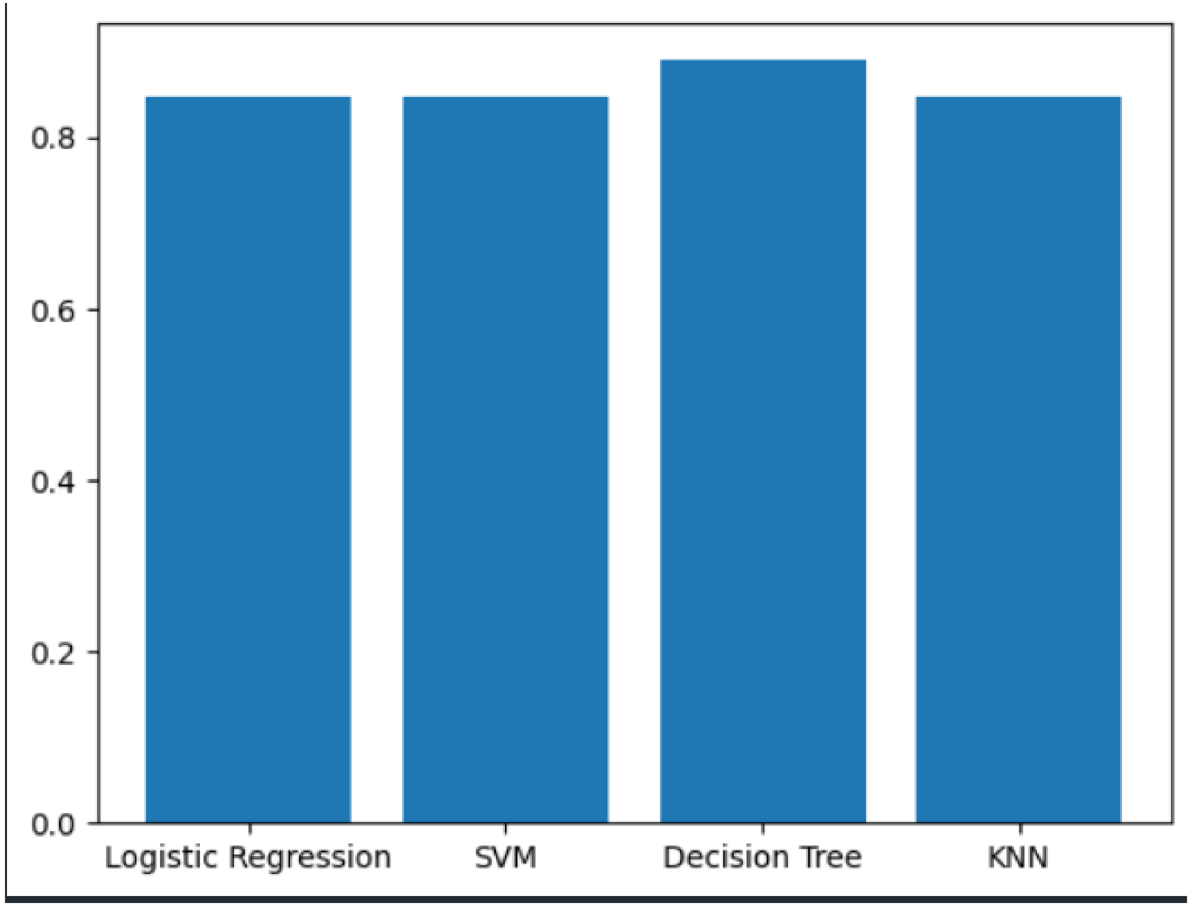
Section 5

# Predictive Analysis (Classification)

# Classification Accuracy

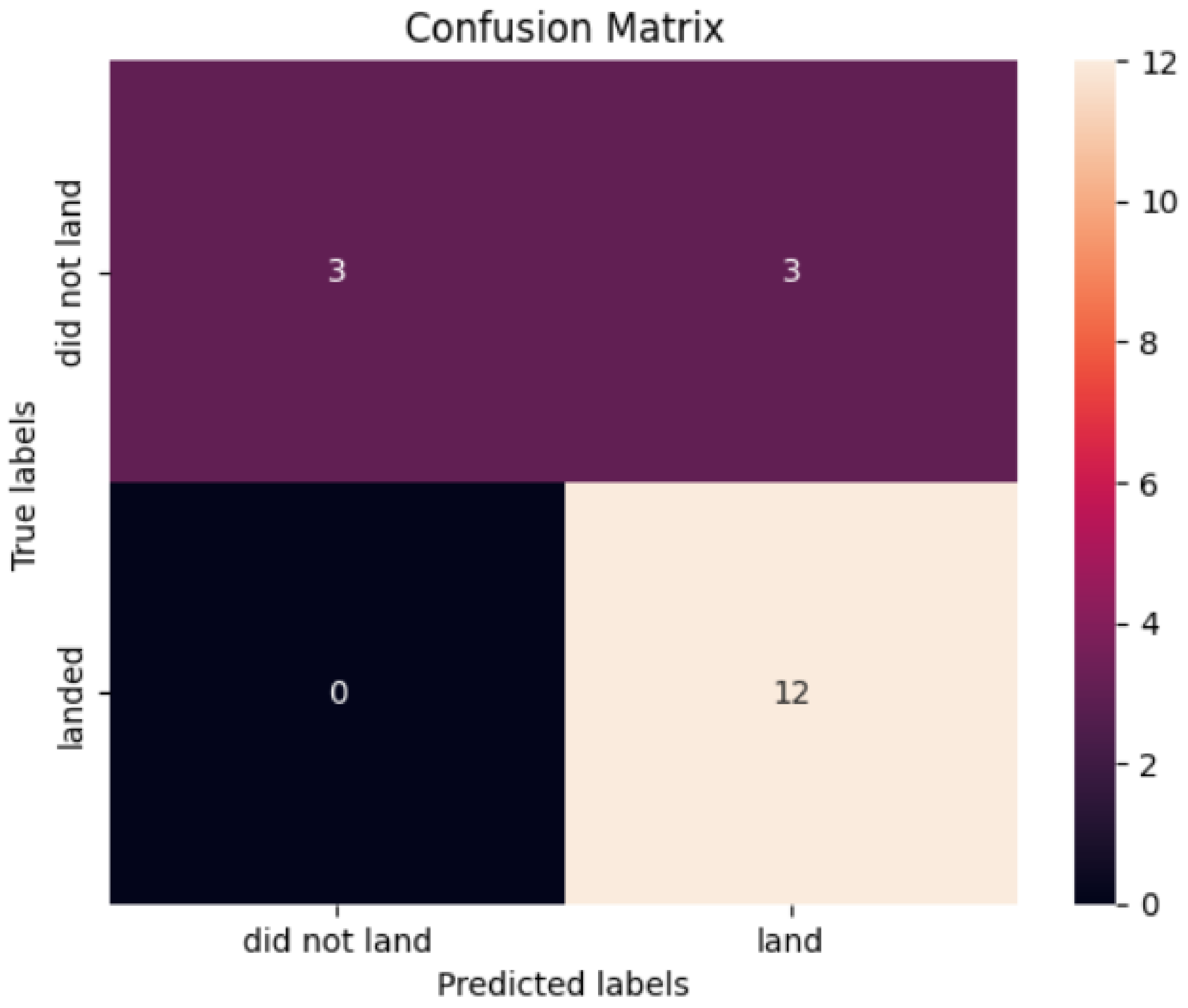
- Visualize the built model accuracy for all built classification models, in a bar chart

- Best accuracy model: Decision Tree



# Confusion Matrix

Best performing model got 12 true positives and 3 false positives.



# Conclusions

- Success more common when time passes by
- Launch site, Payload, orbit target and other parameters may affect success
- Mission success can be predicted from given data (not with 100% accuracy)

# 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!