IBM Developer
SKILLS NETWORK

Winning Space Race with Data Science

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Outline

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

Executive Summary

- Summary of methodologies
- Data Collection
- Data Wrangling
- EDA with data visualization
- EDA with SQL
- Building an interactive map with Folium
- Building a Dashboard with Plotly Dash
- Predictive analysis (Classification)
- Summary of all results
- EDA results
- Interactive analysis
- Predictive analysis

Introduction

- Project background and context
- SpaceX advertises Falcon 9 rocket launches on its website, with a cost of 62 million dollars; other providers cost upward of 165 million dollars each, much of the savings is because SpaceX can reuse the first stage
- Problems you want to find answers
- The Project task is to predicting if the first stage of the SpaceX Falcon 9 rocket will land successfully

Section 1

Methodology

Methodology

Executive Summary

- Data collection methodology:
  - In this project data was collected by using the SpaceX API and also using Web Scrapping
- Perform data wrangling
  - The percentage of missing values of each attribute was identified and then calculated the number of launches on each site. Using the .value_count() the number and occurrence on each orbit was calculated.
- Perform exploratory data analysis (EDA) using visualization and SQL
- Perform interactive visual analytics using Folium and Plotly Dash
- Perform predictive analysis using classification models
  - LR, KNN, SVM and DT models have been built and evaluated for the best classifier

Data Collection

- The following data was collected:
  - SpaceX launch data that us gathered from SpaceX REST API
  - This API gives us the data about launches, including information about the rocket used, payload delivered, launch specifications and landing outcome.
  - The SpaceX REST API endpoints, or URL, starts with api.spacexdata.com/v4/.
  - Another popular data source for obtaining Falcon 9 Launch data is web scrapping Wikipedia using BeautifulSoup.

Data Collection – SpaceX API

- Data collection with SpaceX REST API
- 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

Place your flowchart of SpaceX API calls here

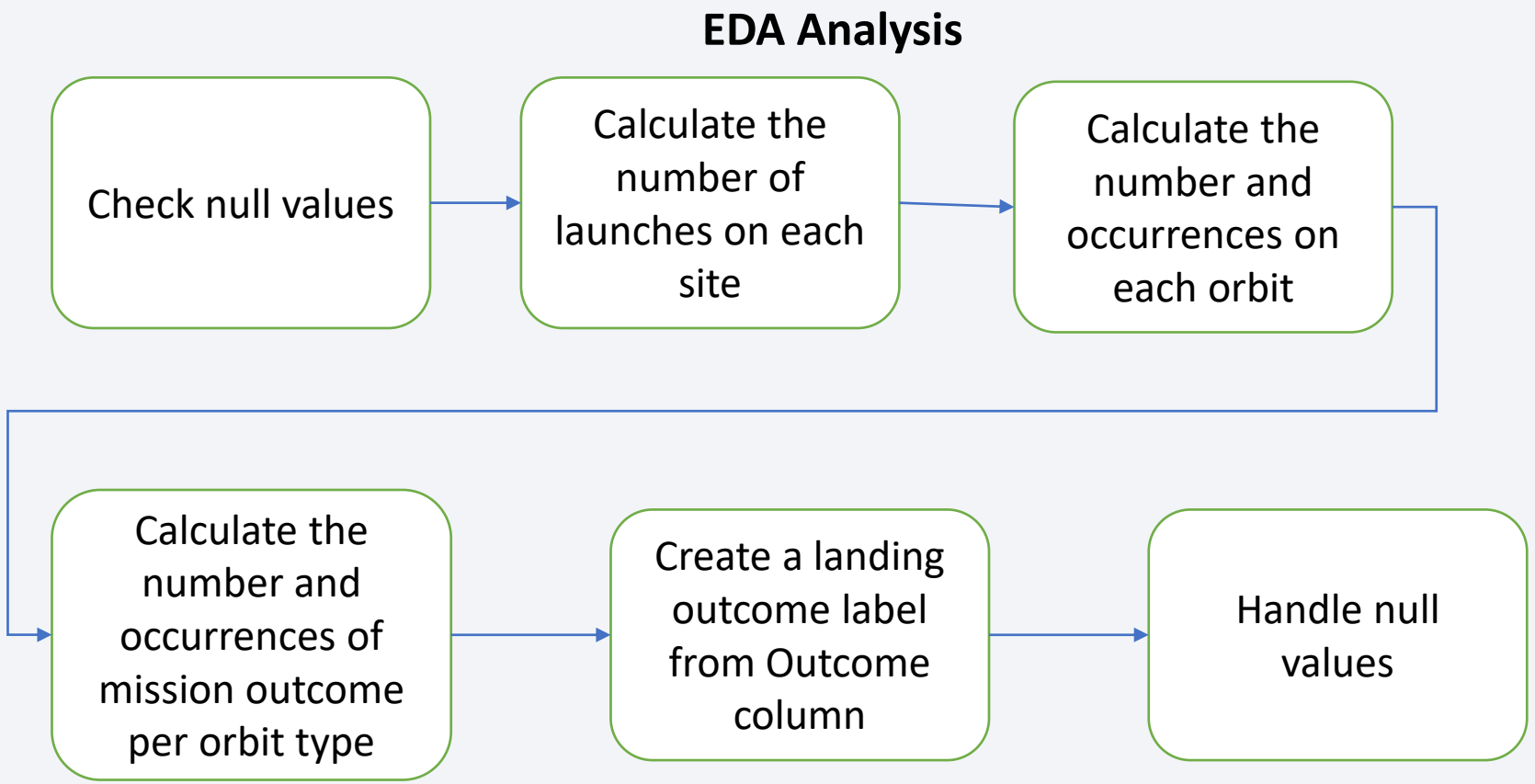
Data Collection - Scraping

- 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

Place your flowchart of web scraping here

Data Wrangling



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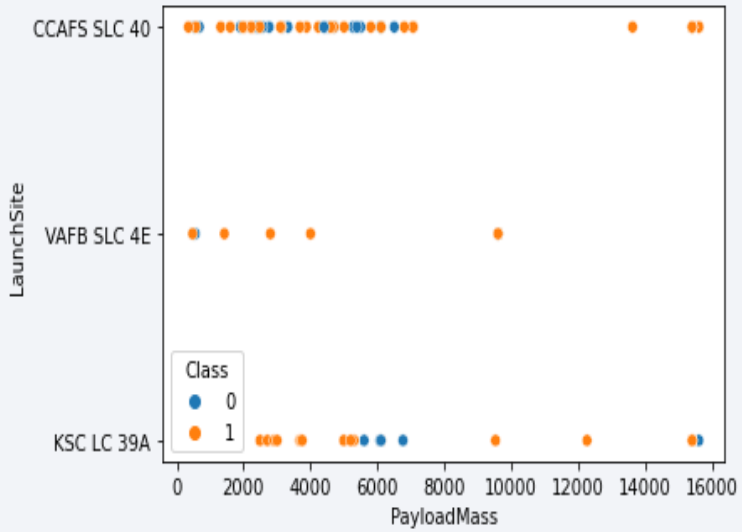
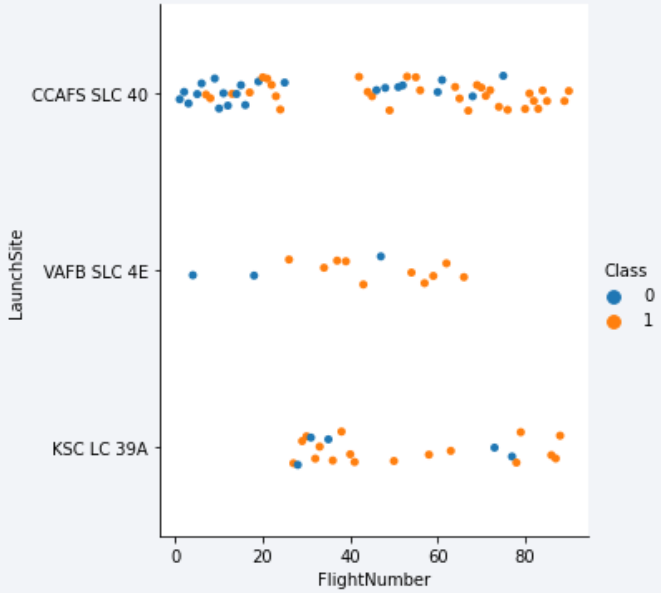
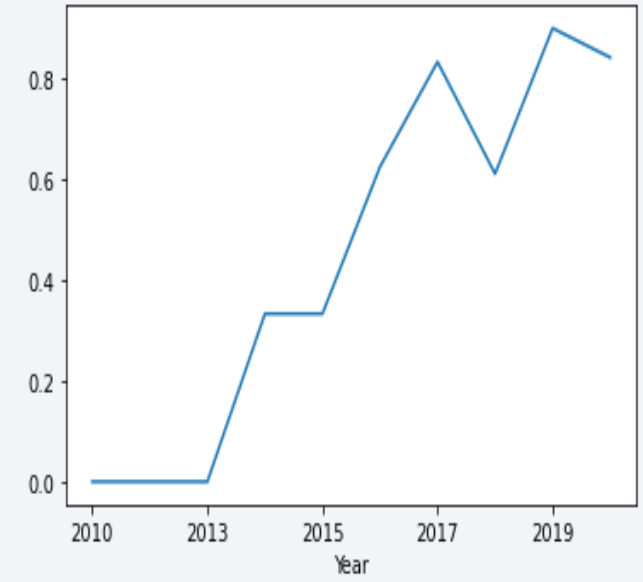
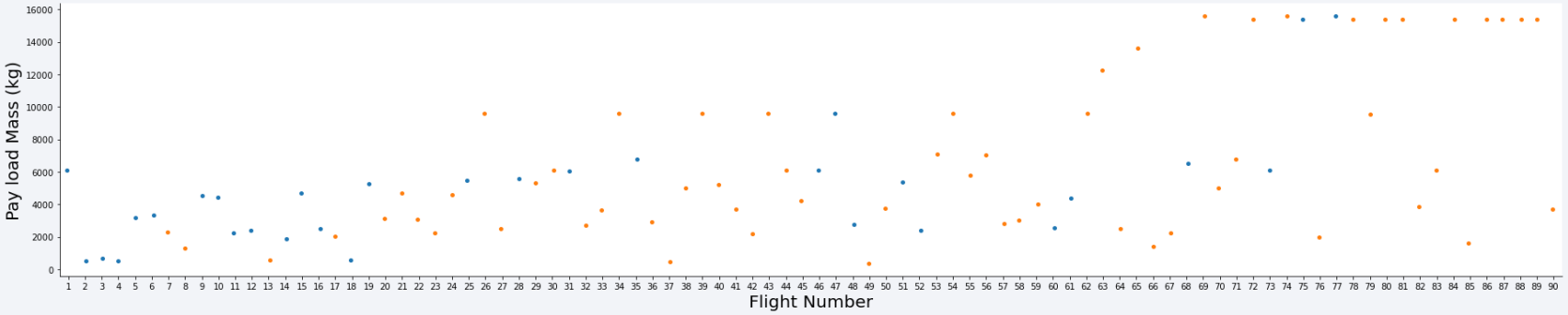
EDA with Data Visualization





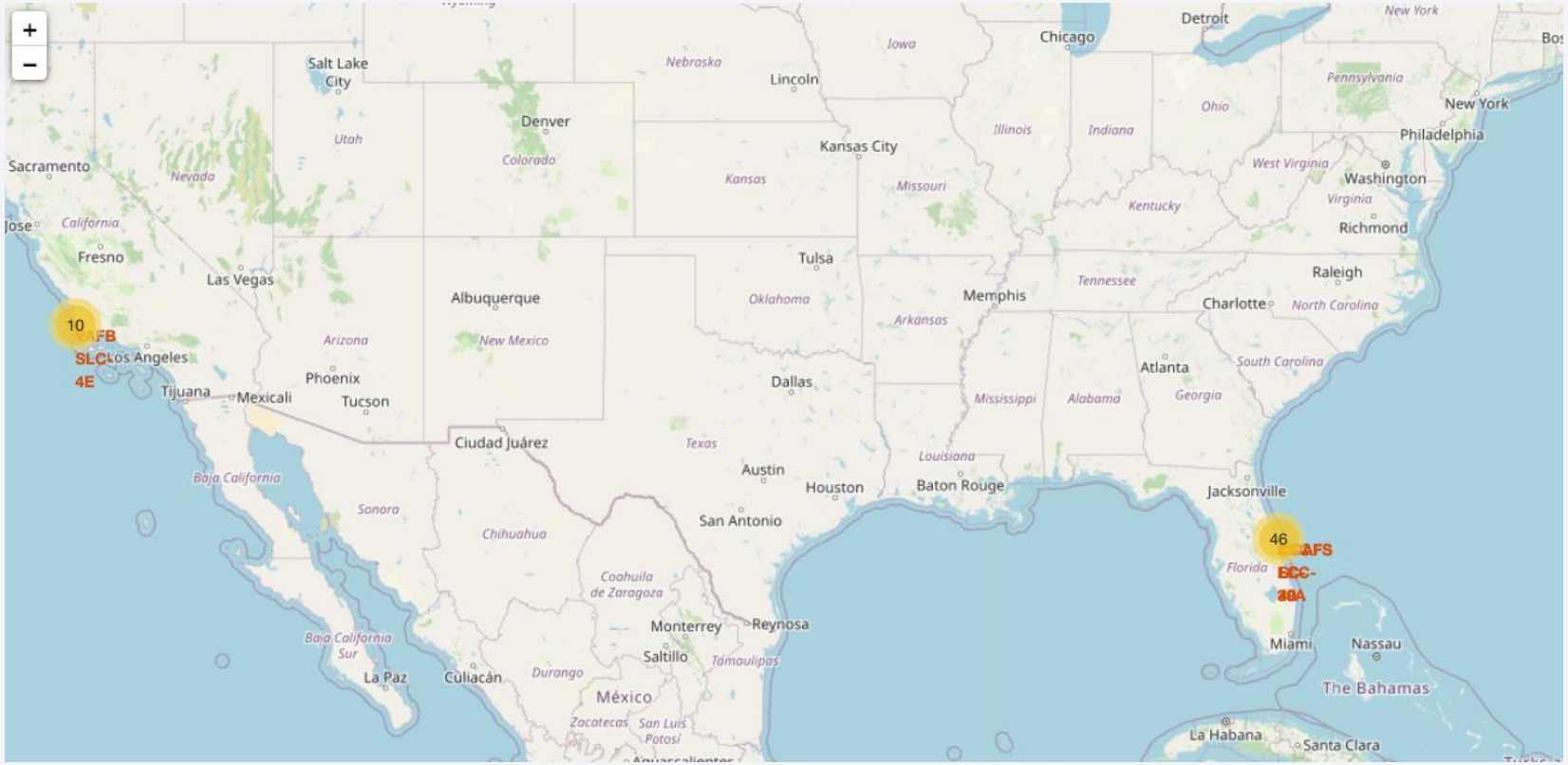




EDA with SQL

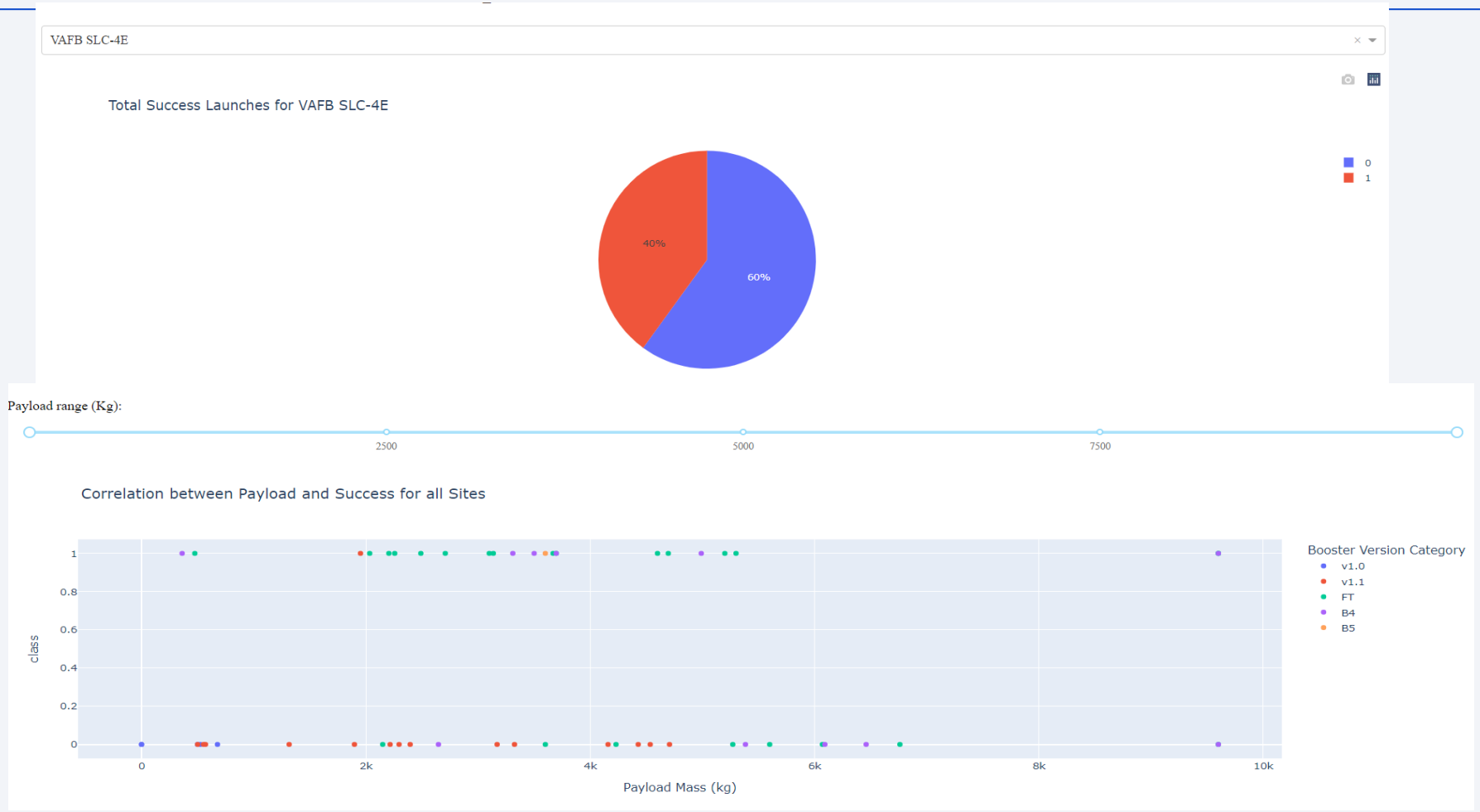
- SQL queries performed includes
  - Display the name of the unique launch sites in the space mission
  - Display 5 records where launch sites begin with the string “KSC”
  - Display the total payload mass carried by boosters launched by NASA (CRS)
  - Display average payload mass carried by booster version F9 v1.1
  - Listing the date where the successful landing outcome in drone ship was achieved.
  - Listing the names of the boosters which have success in ground pad and have payload mass greater than 4000 but less than 6000.
  - Listing the total number of successful and failure mission outcomes
  - Listing the names of the booster_version which have carried the maximum payload mass.
  - Ranking the count of successful outcomes between the date 2010 06 04 and 2017 03 20 in descending order.

Build an Interactive Map with Folium



- Map markers have been added to the map with the aim to find an optimal site for a launch.
- Add the GitHub URL of your completed interactive map with Folium map, as an external reference and peer-review purpose

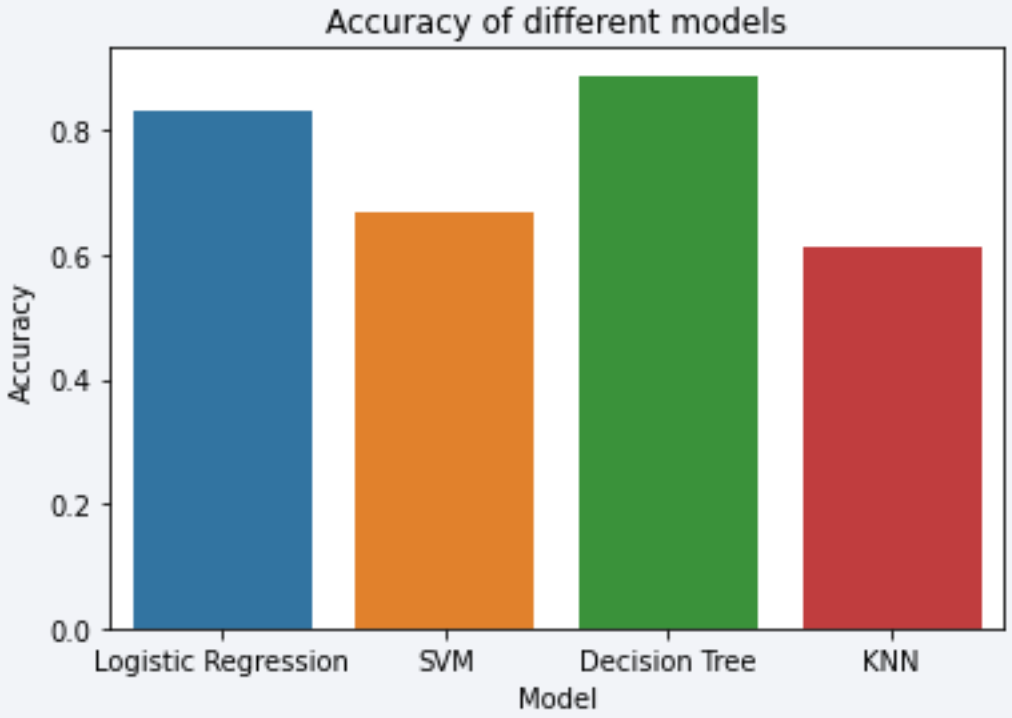
Build a Dashboard with Plotly Dash

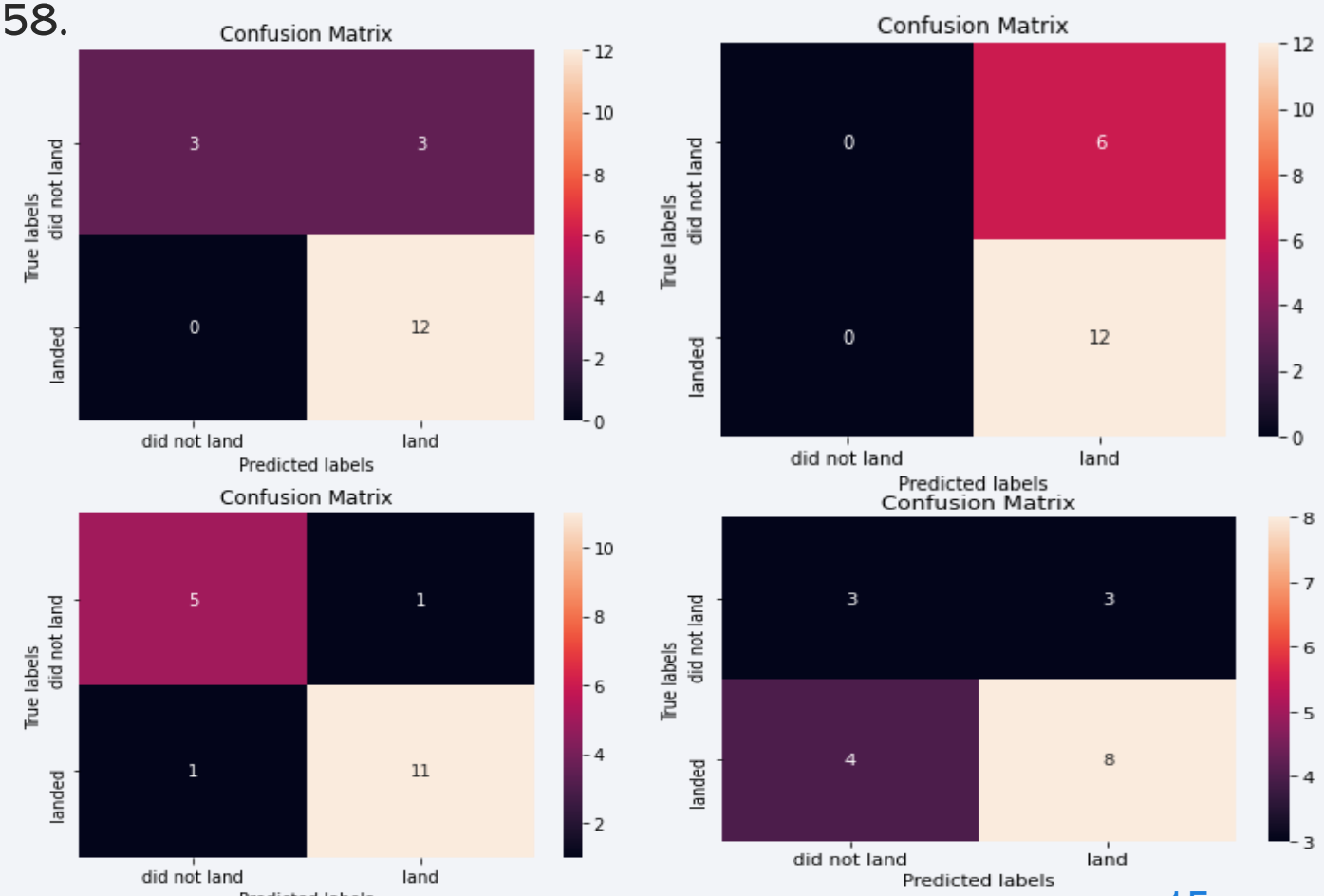


- Add the GitHub URL of your completed Plotly Dash lab, as an external reference and peer-review purpose

Predictive Analysis (Classification)

- The SVM, KNN, and LR models achieved the highest accuracy at 83.3%, while the SVM performs the best in terms of Area Under Curve at 0.958.

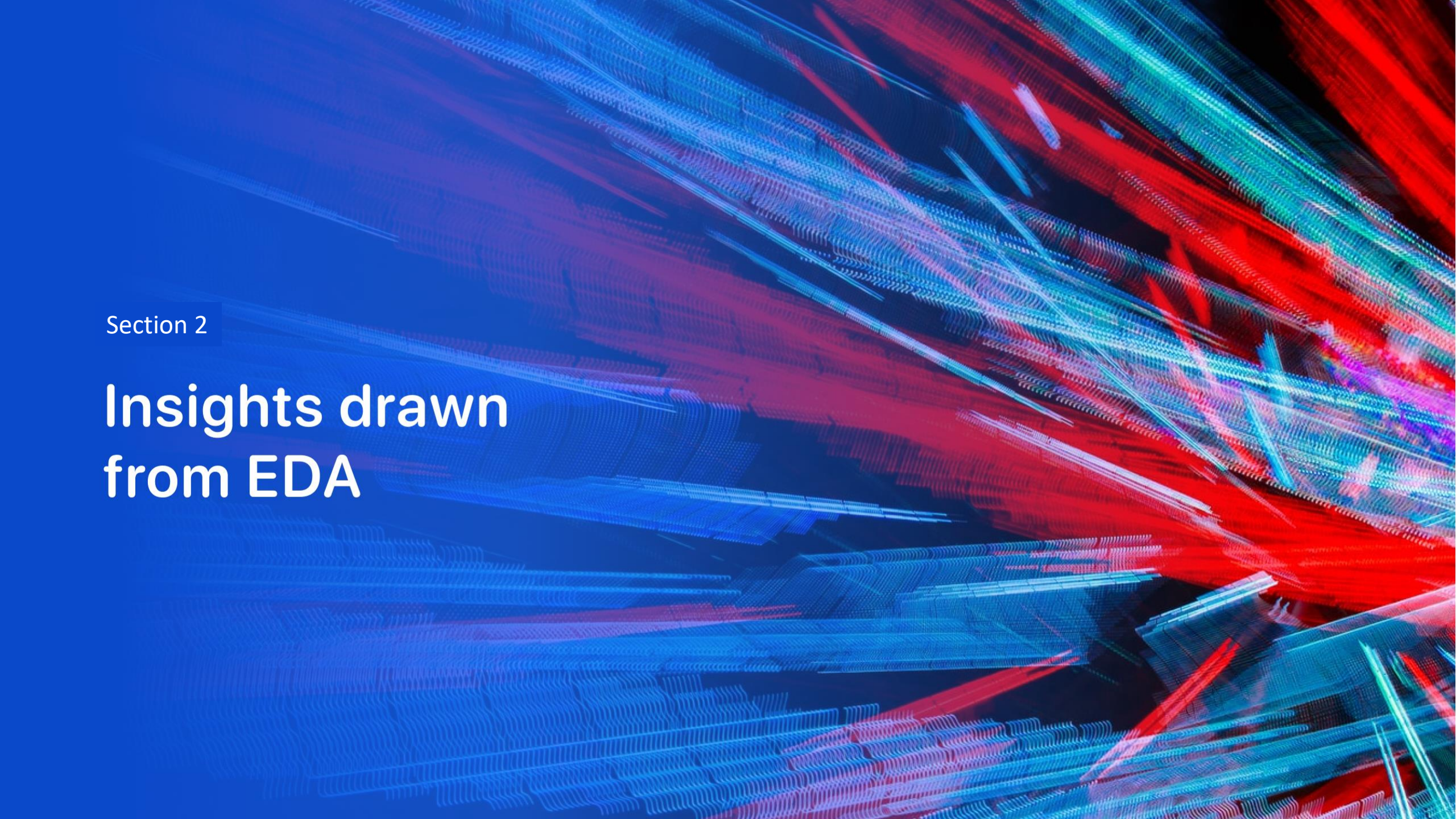




- Add the GitHub URL of your completed predictive analysis lab, as an external reference and peer-review purpose

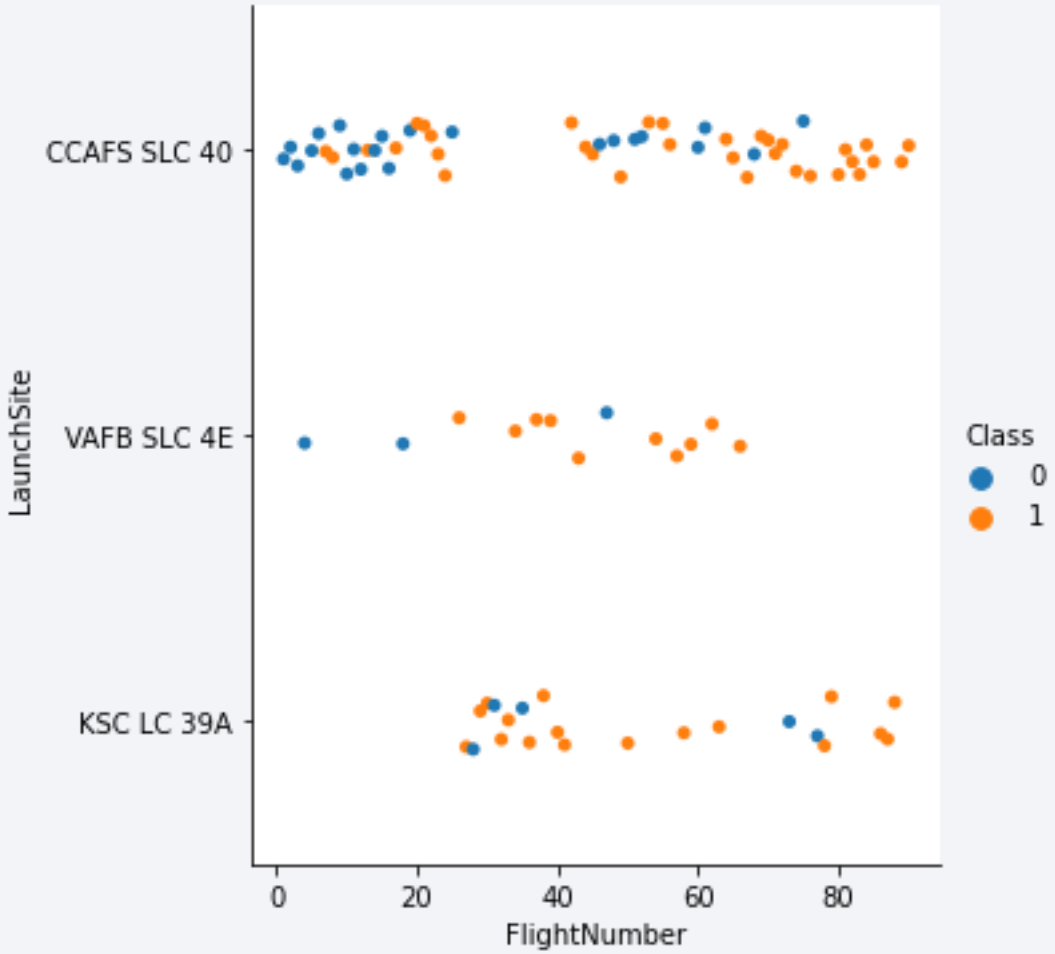
Results

- The SVM, KNN, and Logistic Regression models are the best in terms of prediction accuracy for this dataset.
- Low weighted payloads perform better than the heavier payloads.
- The success rates for SpaceX launches is directly proportional time in years they will eventually perfect the launches.
- KSC LC 39A had the most successful launches from all the sites.
- Orbit GEO, HEO, SSO, ES L1 has the best Success Rate.


Section 2
Insights drawn from EDA

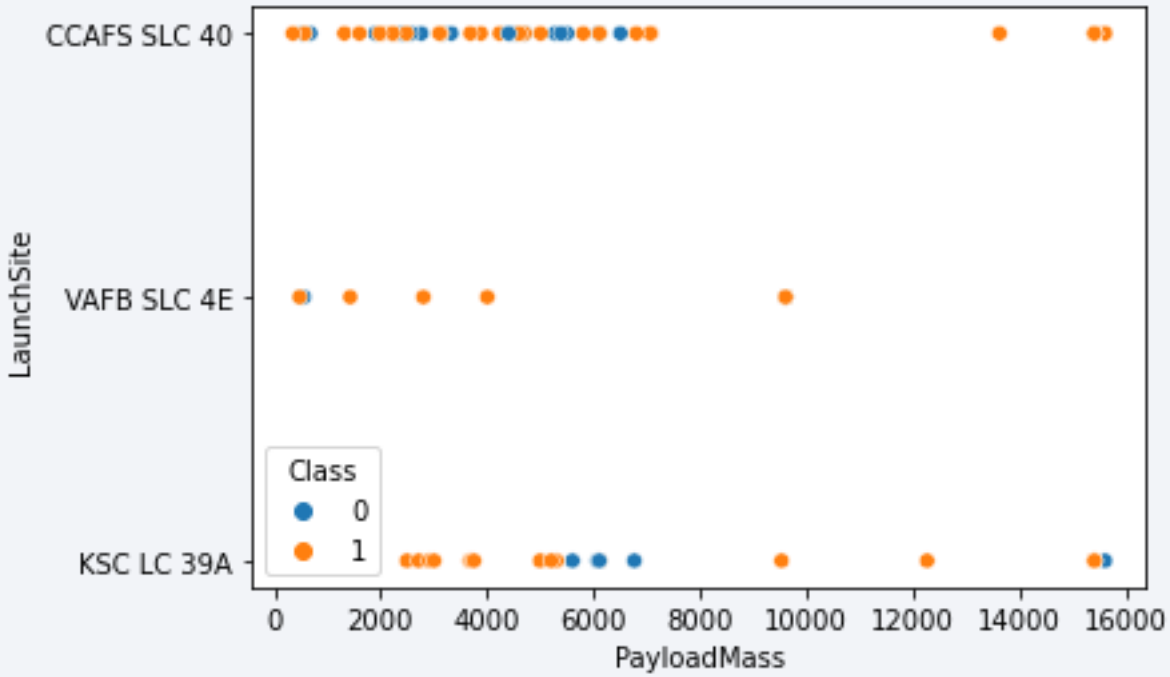
Flight Number vs. Launch Site

- Show a scatter plot of Flight Number vs. Launch Site



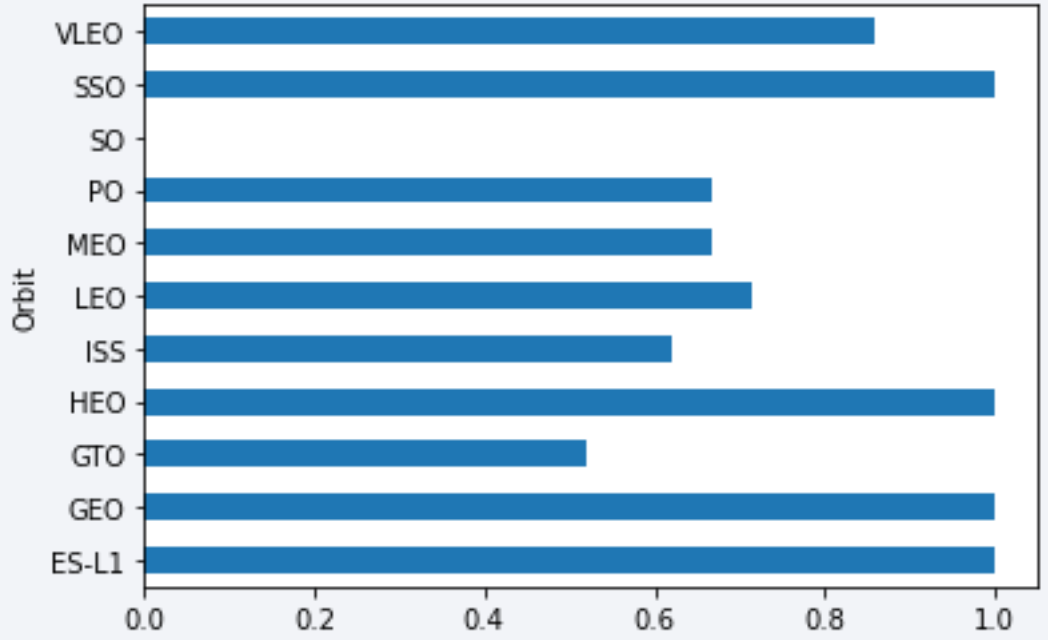
Payload vs. Launch Site

- Show a scatter plot of Payload vs. Launch Site



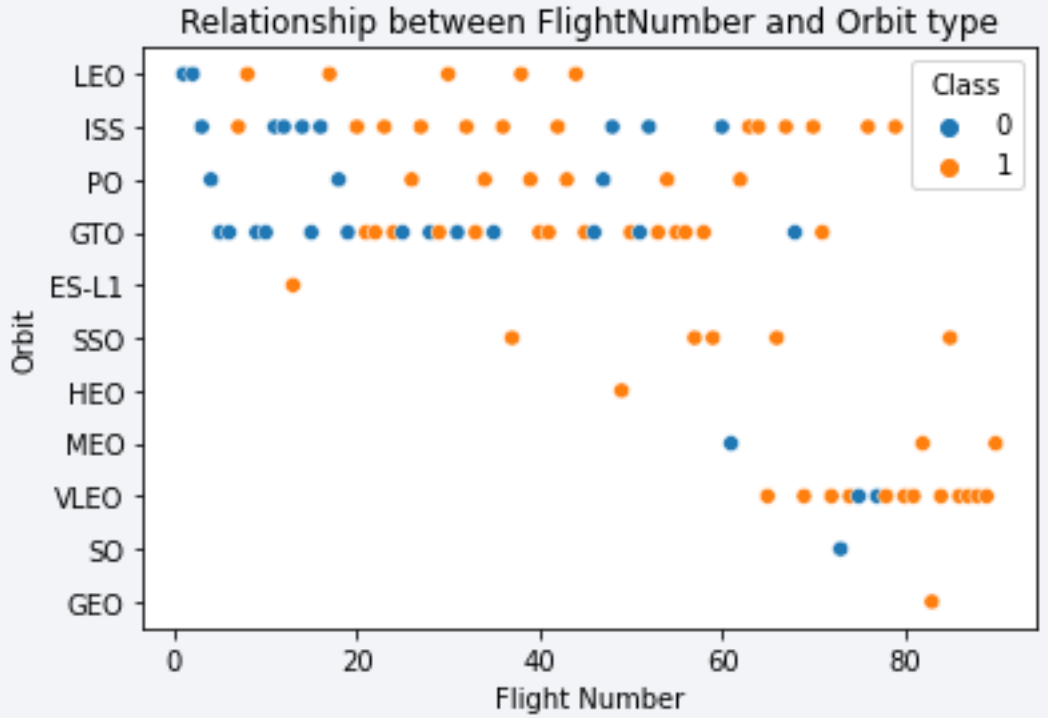
Success Rate vs. Orbit Type

- Show a bar chart for the success rate of each orbit type



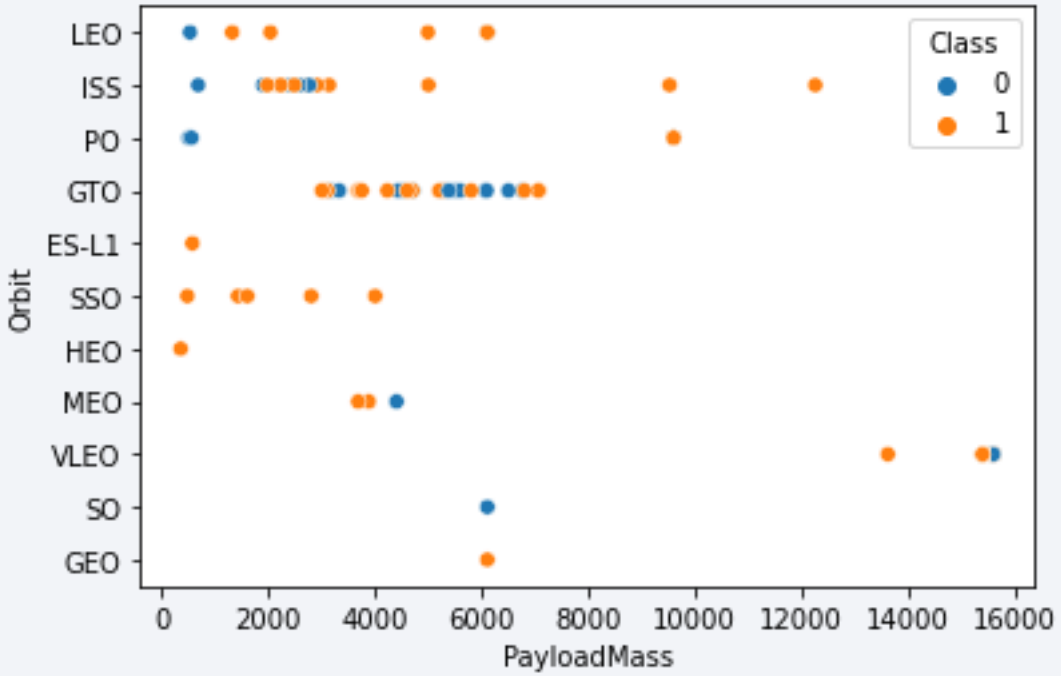
Flight Number vs. Orbit Type

- Show a scatter point of Flight number vs. Orbit type



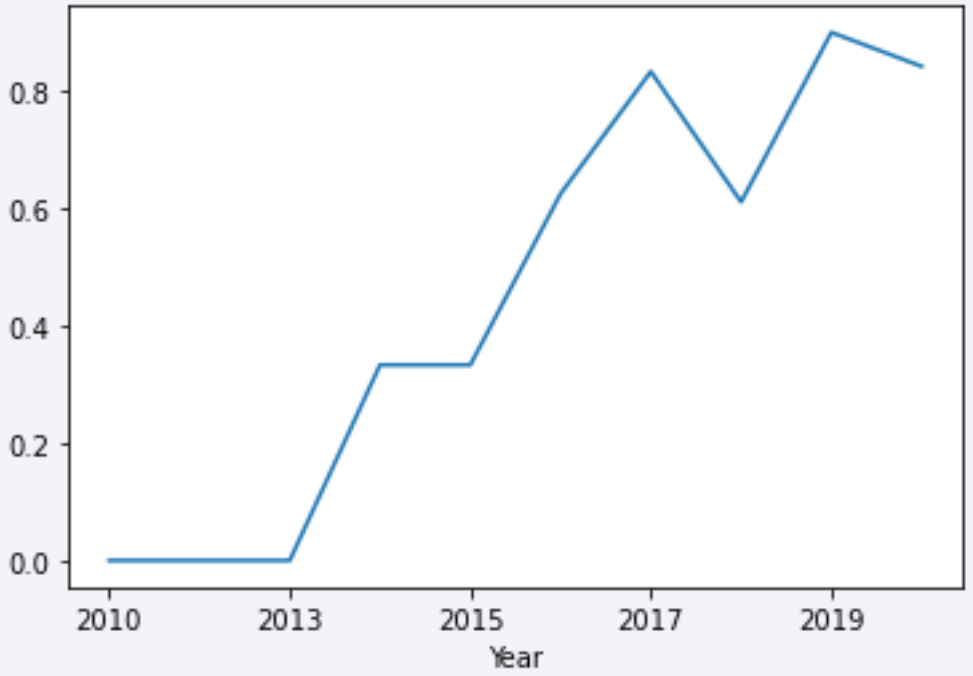
Payload vs. Orbit Type

- Show a scatter point of payload vs. orbit type



Launch Success Yearly Trend

- Show a line chart of yearly average success rate



All Launch Site Names

- Find the names of the unique launch sites

	Launch Site	Lat	Long
0	CCAFS LC-40	28.562302	-80.577356
1	CCAFS SLC-40	28.563197	-80.576820
2	KSC LC-39A	28.573255	-80.646895
3	VAFB SLC-4E	34.632834	-120.610746

Launch Site Names Begin with 'CCA'

- Find 5 records where launch sites begin with `CCA`

DATE	time__utc_	booster_version	launch_site	payload	payload_mass__kg_	orbit	customer	mission_outcome	landing__outcome
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	07:44:00	F9 v1.0 B0005	CCAFS LC-40	Dragon demo flight C2	525	LEO (ISS)	NASA (COTS)	Success	No attempt
2012-10-08	00:35:00	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	No attempt

Total Payload Mass

- Calculate the total payload carried by boosters from NASA
- Boosters from NASA carried a total payload of 45596

Average Payload Mass by F9 v1.1

- Calculate the average payload mass carried by booster version F9 v1.1
- The Average payload mass carried by Booster version F9 v1.1 is 2928.400000

First Successful Ground Landing Date

- Find the dates of the first successful landing outcome on ground pad
- The date of the first successful landing is 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

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
- Total number of successful and failure mission is 100.

Boosters Carried Maximum Payload

- List the names of the booster which have carried the maximum payload mass

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

- Present your query result with a short explanation here

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

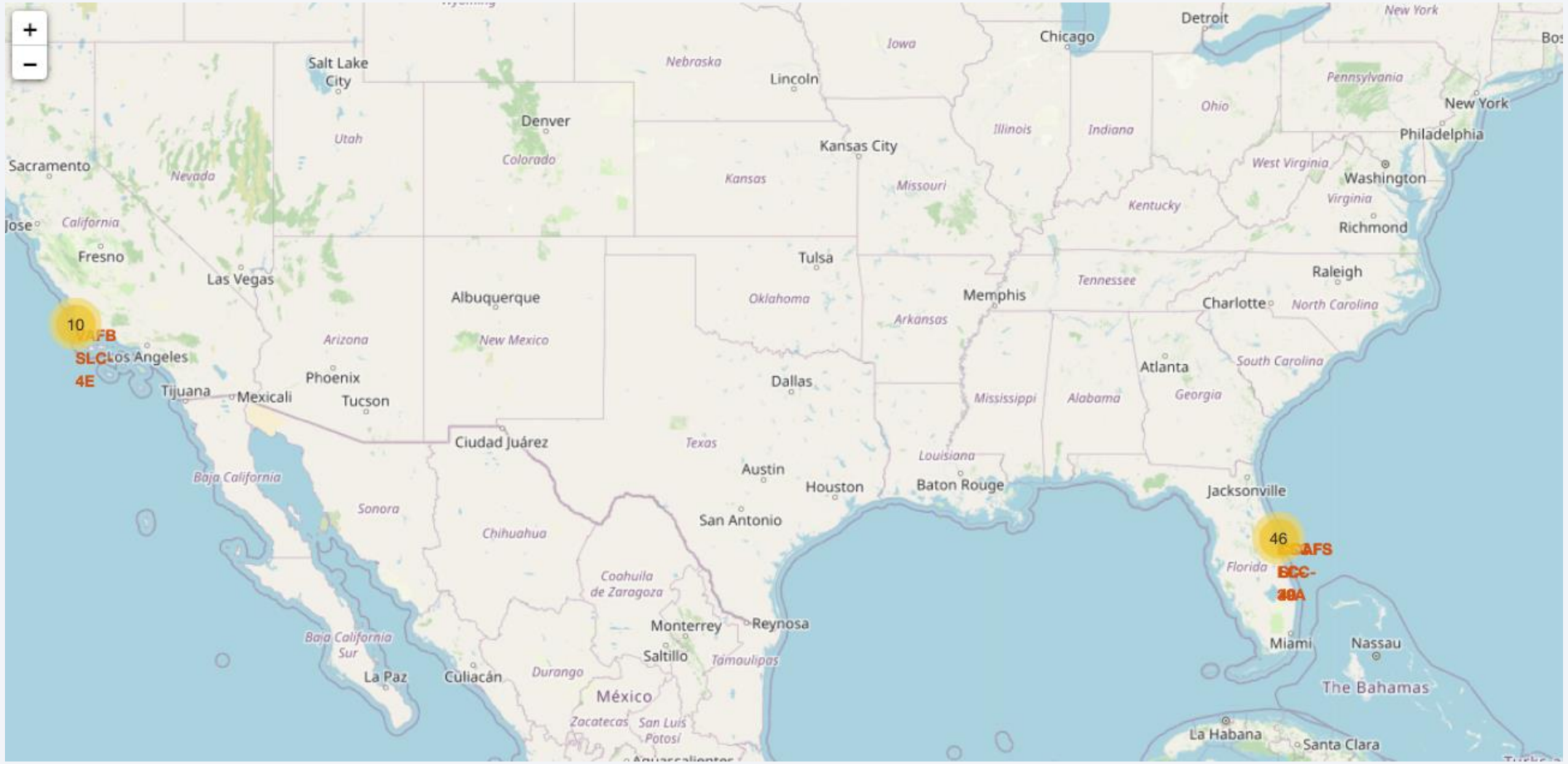
- Rank the count of landing outcomes (such as Failure (drone ship) or Success (ground pad)) between the date 2010-06-04 and 2017-03-20, in descending order

DATE	time_utc_	booster_version	launch_site	payload	payload_mass_kg_	orbit	customer	mission_outcome	landing_outcome
2017-02-19	14:39:00	F9 FT B1031.1	KSC LC-39A	SpaceX CRS-10	2490	LEO (ISS)	NASA (CRS)	Success	Success (ground pad)
2017-01-14	17:54:00	F9 FT B1029.1	VAFB SLC-4E	Iridium NEXT 1	9600	Polar LEO	Iridium Communications	Success	Success (drone ship)
2016-08-14	05:26:00	F9 FT B1026	CCAFS LC-40	JCSAT-16	4600	GTO	SKY Perfect JSAT Group	Success	Success (drone ship)
2016-07-18	04:45:00	F9 FT B1025.1	CCAFS LC-40	SpaceX CRS-9	2257	LEO (ISS)	NASA (CRS)	Success	Success (ground pad)
2016-05-27	21:39:00	F9 FT B1023.1	CCAFS LC-40	Thaicom 8	3100	GTO	Thaicom	Success	Success (drone ship)
2016-05-06	05:21:00	F9 FT B1022	CCAFS LC-40	JCSAT-14	4696	GTO	SKY Perfect JSAT Group	Success	Success (drone ship)
2016-04-08	20:43:00	F9 FT B1021.1	CCAFS LC-40	SpaceX CRS-8	3136	LEO (ISS)	NASA (CRS)	Success	Success (drone ship)
2015-12-22	01:29:00	F9 FT B1019	CCAFS LC-40	OG2 Mission 2 11 Orbcomm-OG2 satellites	2034	LEO	Orbcomm	Success	Success (ground pad)

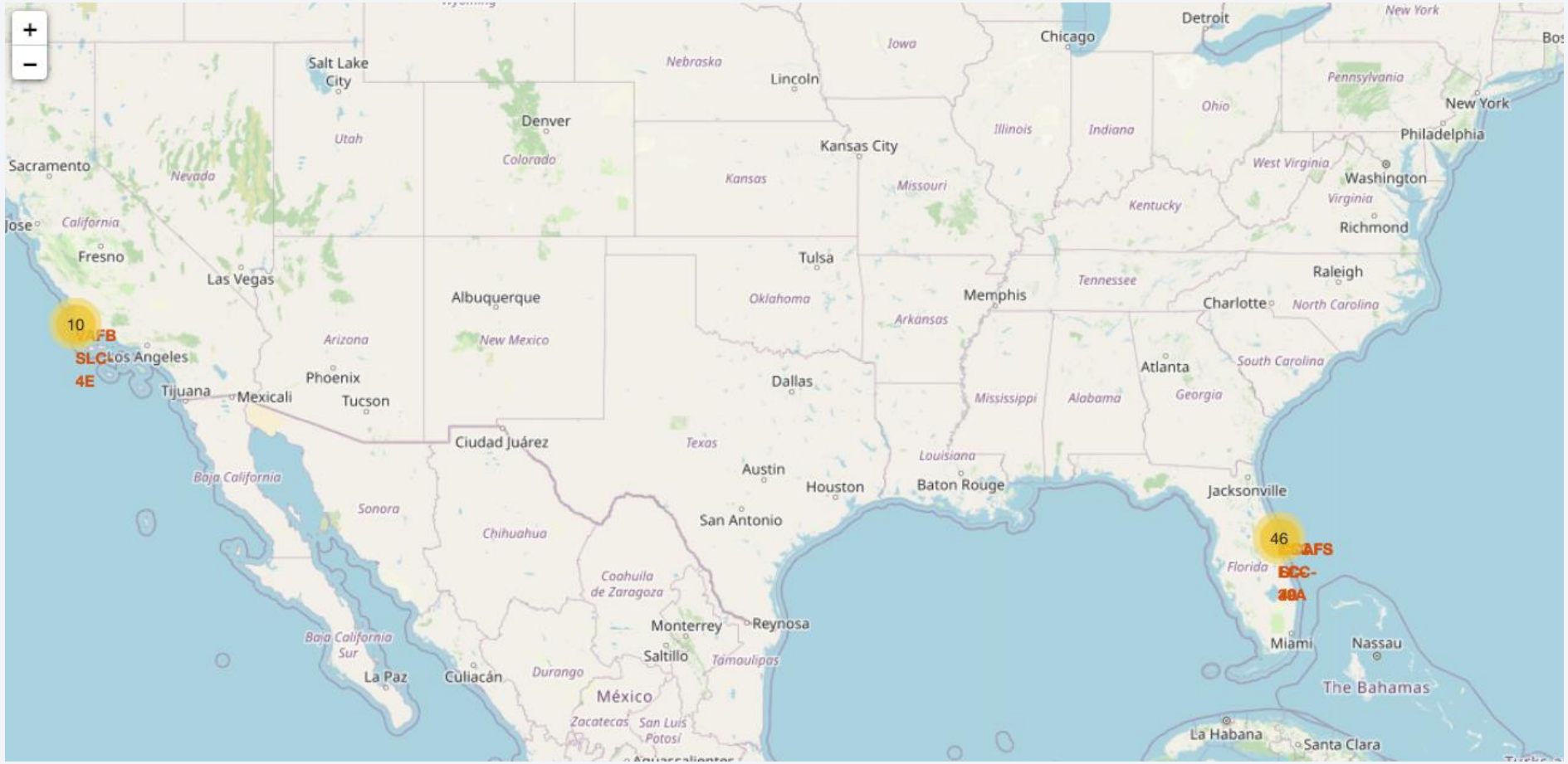
Section 3

Launch Sites Proximities Analysis

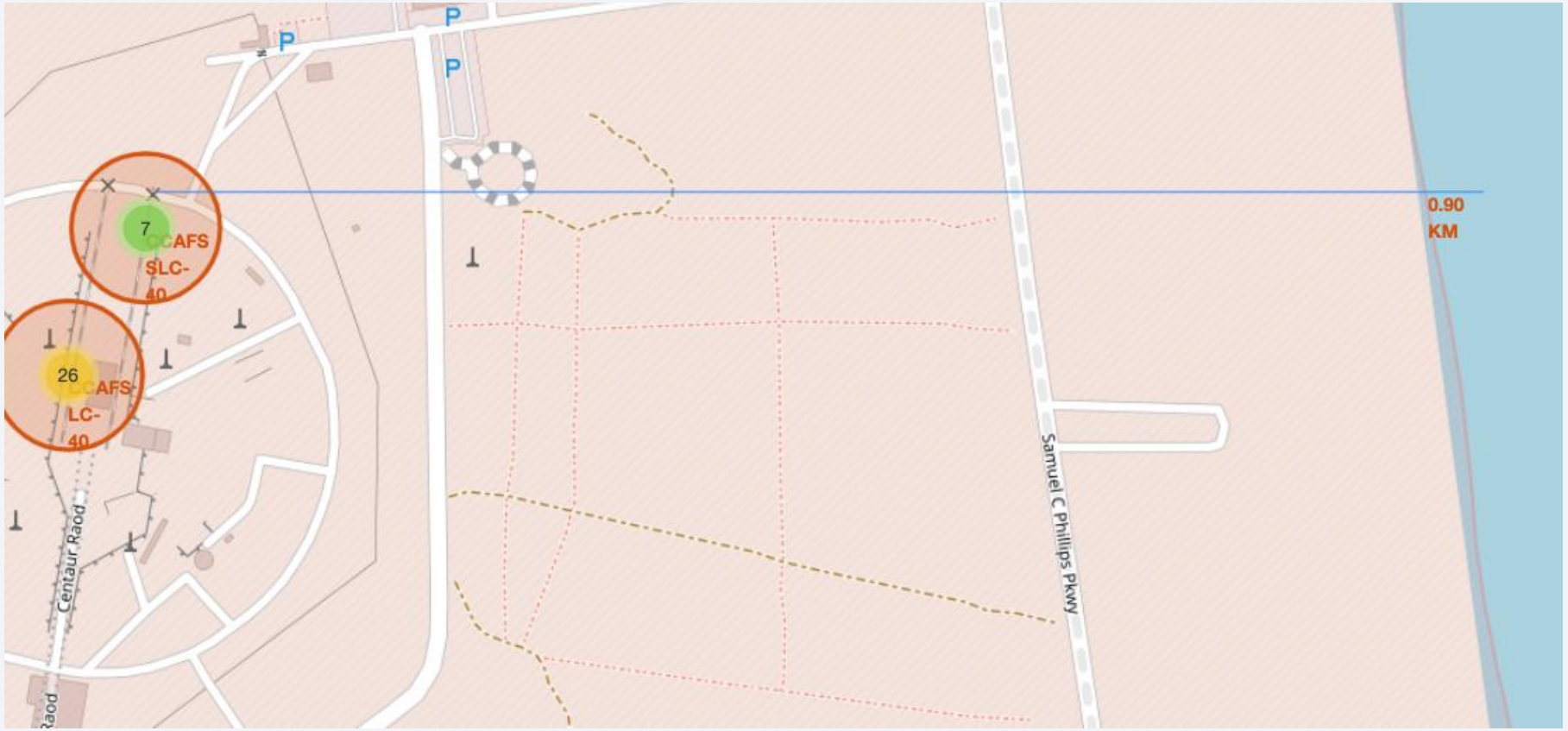
Launch Sites with Folium

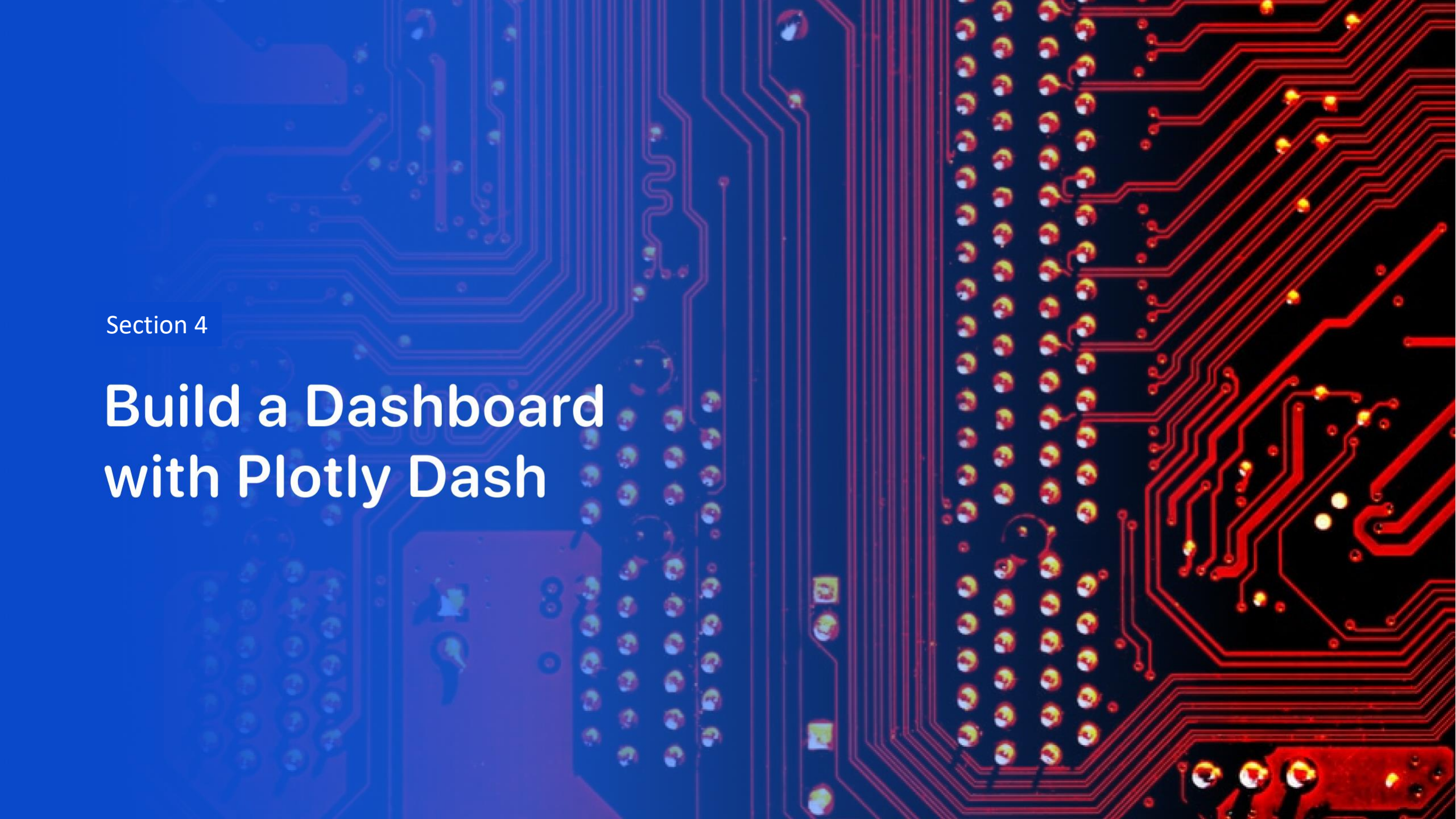


Launch Sites and Ocean proximity

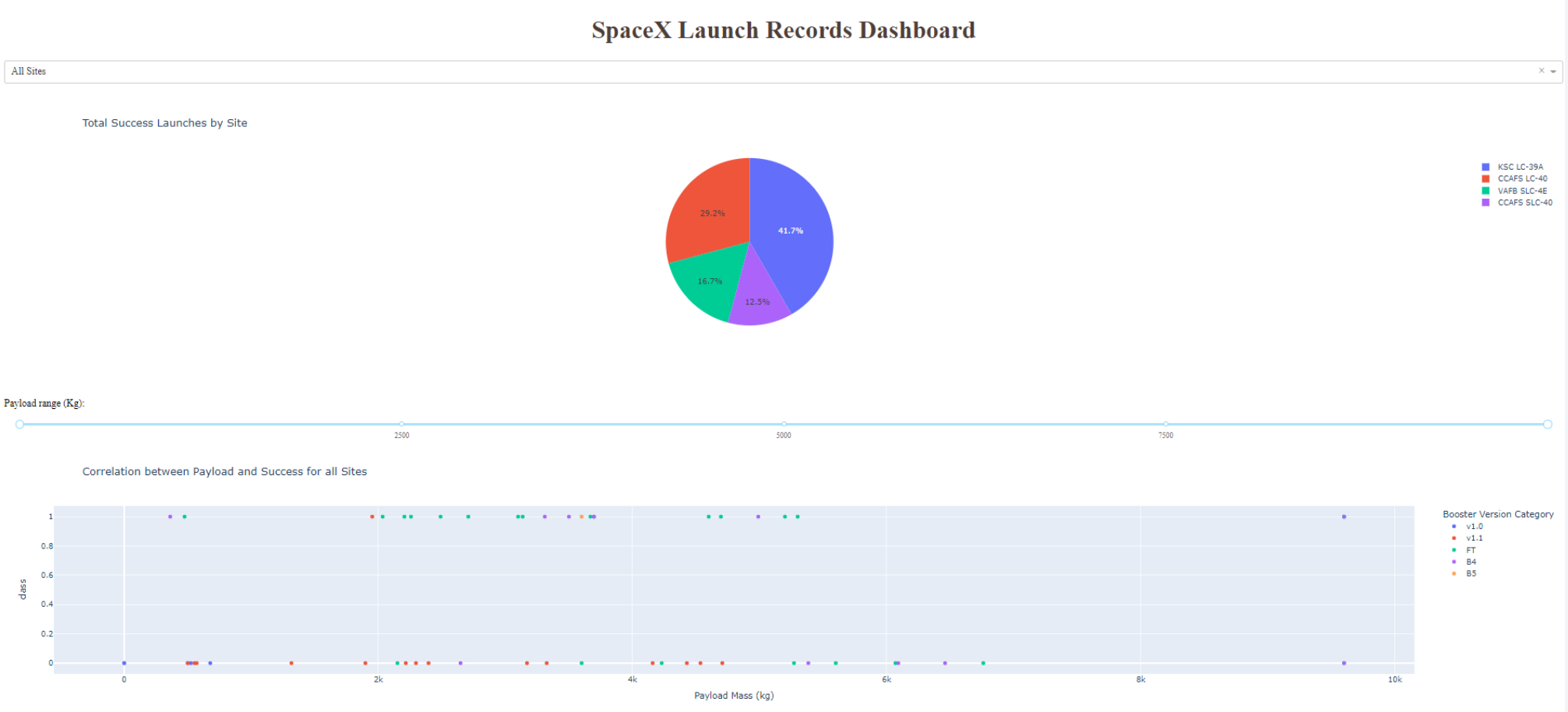


Launch Site Proximities

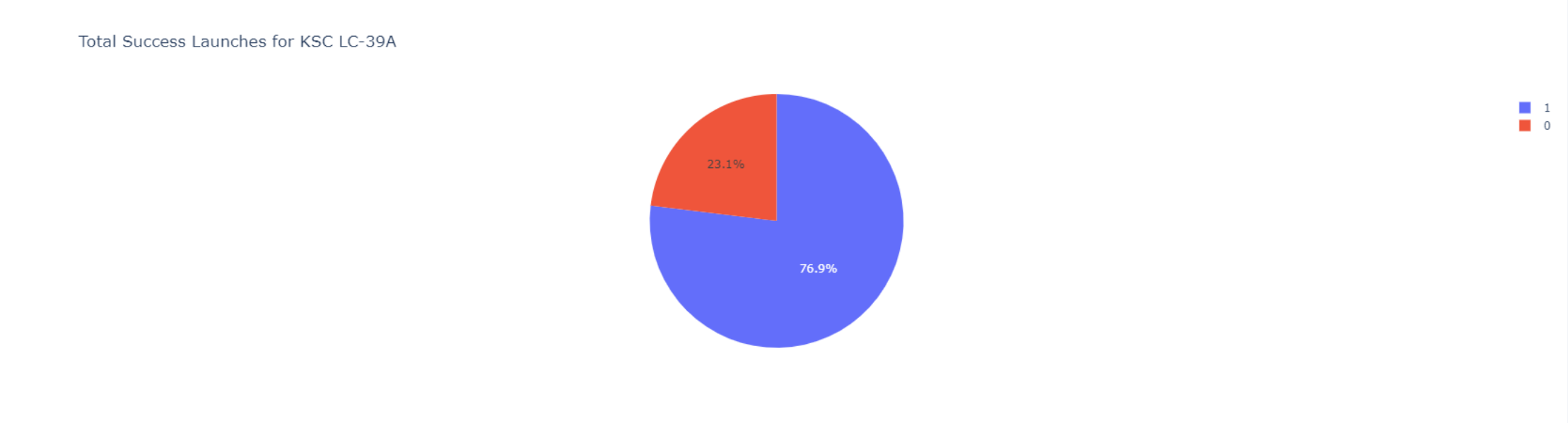



Section 4
Build a Dashboard with Plotly Dash

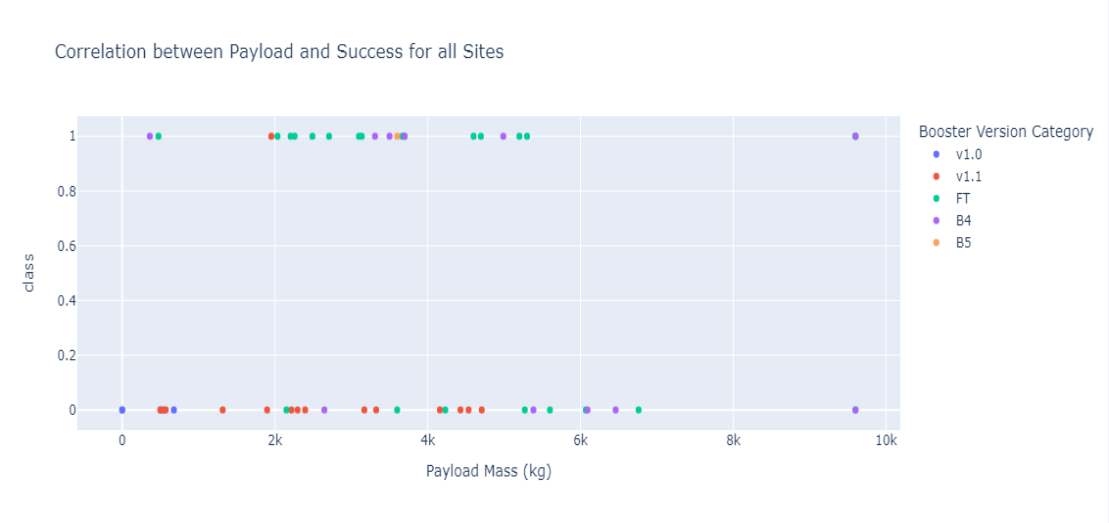
All site plotly

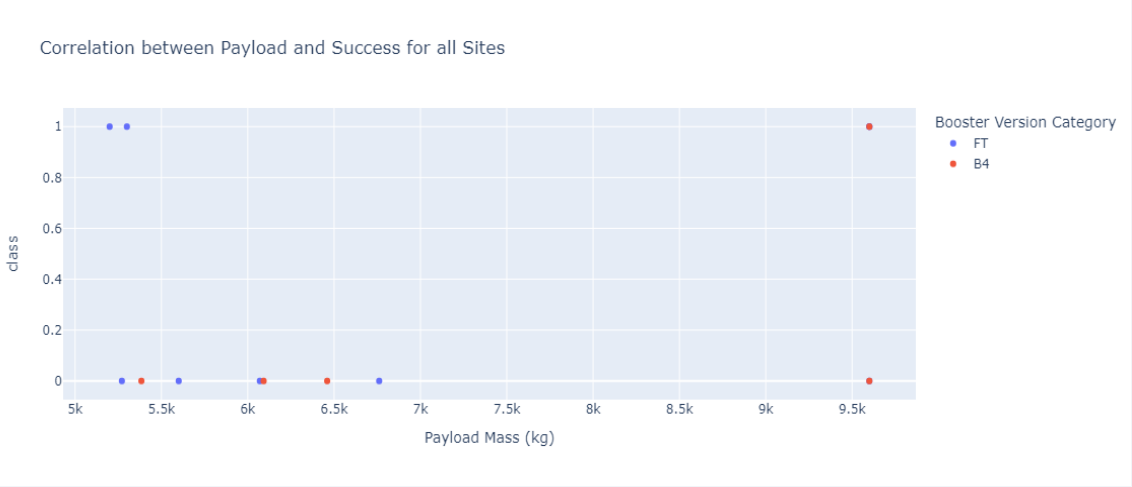


Launch site with high success rate



Payload vs launch Outcome



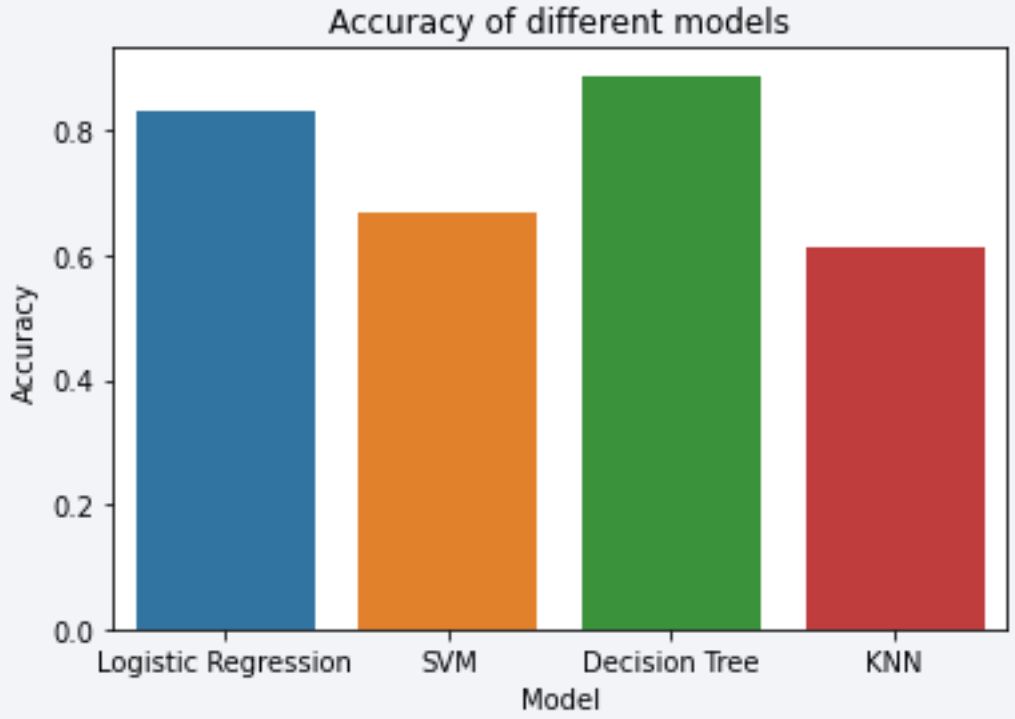


Section 5

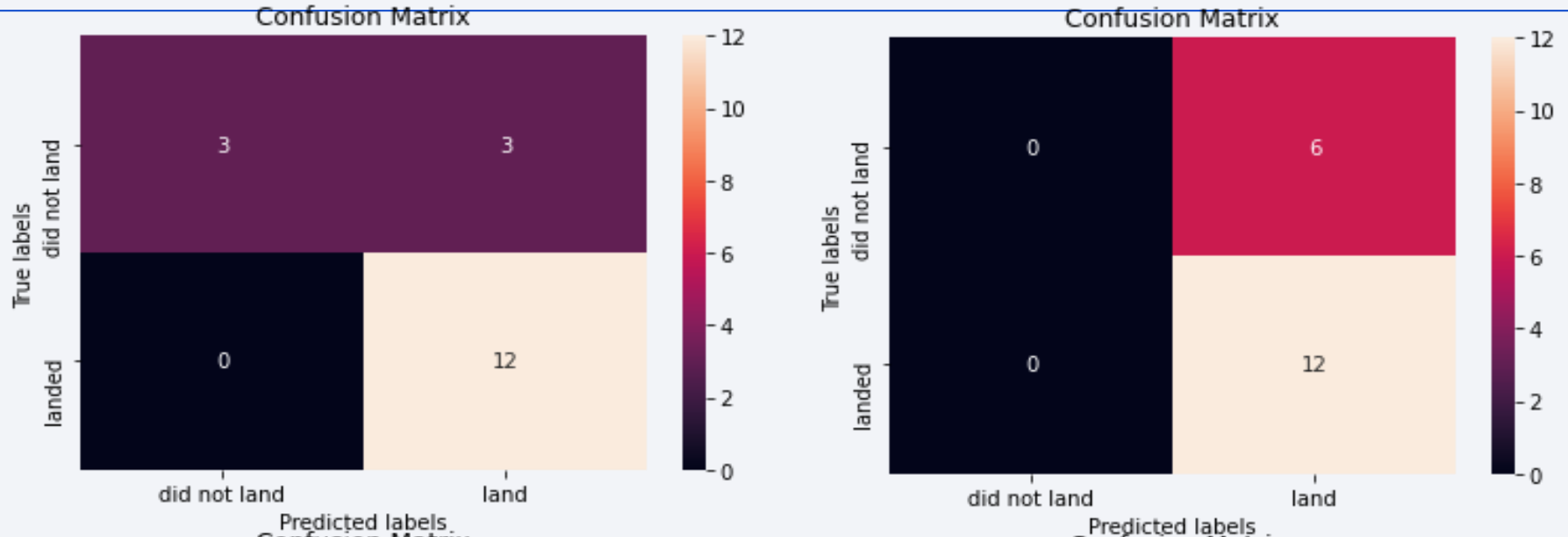
Predictive Analysis (Classification)

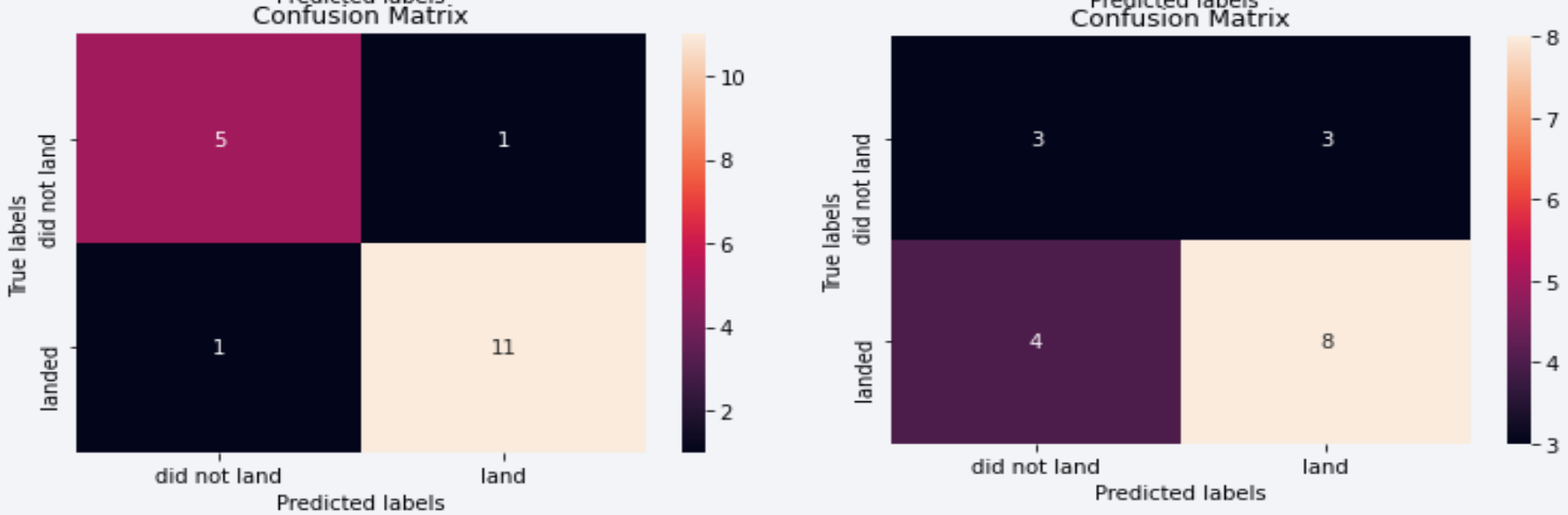
Classification Accuracy

- Decision Tree is the best model.



Confusion Matrix





Conclusions

- The SVM, KNN, and Logistic Regression models are the best in terms of prediction accuracy for this dataset.
- Low weighted payloads perform better than the heavier payloads.
- The success rates for SpaceX launches is directly proportional time in years they will eventually perfect the launches.
- KSC LC 39A had the most successful launches from all the sites.
- Orbit GEO, HEO, SSO, ES L1 has the best Success Rate.

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!