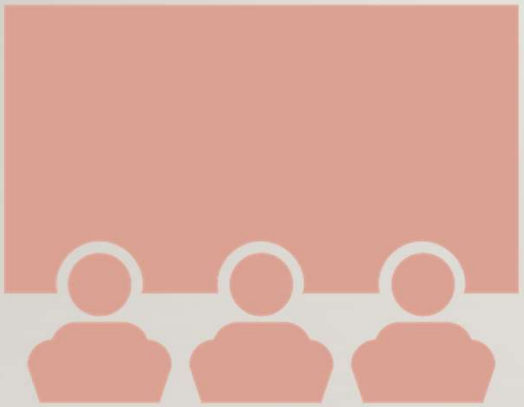
DATA SCIENCE CAPSTONE PROJECT

CHEVIBS1020

2021-08-20

OUTLINE



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

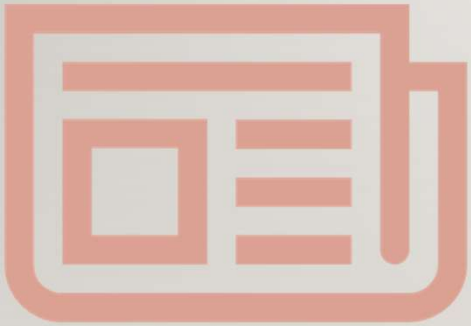
EXECUTIVE SUMMARY

- The methodologies involved in this analysis include using python and sql to clean, manipulate, and analyze the data. Finally applying 4 different machine learning models to predict successful SpaceX Falcon9 landings.
- Machine Learning models used are:
  - Logistic Regression
  - Support Vector Machine
  - Tree Classification
  - K Nearest Neighbor
- All 4 machine learning models yielded the same predictions for a successful landing.

INTRODUCTION

- Space X 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 Space X can reuse the first stage. Therefore if we can determine if the first stage will land, we can determine the cost of a launch. This information can be used if an alternate company wants to bid against space X for a rocket launch

METHODOLOGY



- Data collection methodology:
  - Data were collected from both a SPACE X api and scraping a Wikipedia page using Beautiful Soup
- Perform data wrangling
  - Data Wrangling was performed using python and associated libraries
- Perform exploratory data analysis (EDA) using visualization and SQL
  - SQL magic was used to better analyze the data and visualizations were used to understand the data
- Perform interactive visual analytics using Folium and Plotly Dash
  - Maps were generated to better understand launch locations and surroundings
- Perform predictive analysis using classification models
  - How to build, tune, evaluate classification models

METHODOLOGY

DATA COLLECTION

Data were collected from both a SPACE X API and scraping a Wikipedia page using Beautiful Soup

- API
  - ✓ The SpaceX REST API endpoints, or URL, starts with api.spacexdata.com/v4/
  - ✓ Performed a GET request using the requests library to obtain the launch data, which used to get the data from the API.
  - ✓ The end result is viewed by calling the .json() method.
  - ✓ The response will be in the form of a JSON, specifically a list of JSON objects.

- Web Scraping
  - ✓ Python BeautifulSoup package to web scrape some HTML tables that contain valuable Falcon 9 launch records.
  - ✓ Parsed the data from those tables and converted them into a Pandas data frame for further visualization and analysis.
  - ✓ Next steps will be to transform this raw data into a clean dataset which provides meaningful data on the situation we are trying to address

Now we decode the response content as a Json using `.json()` and turn it into a Pandas dataframe using `.json_normalize()`

```
In [12]: # Use json_normalize meethod to convert the json result into a dataframe
         data = pd.json_normalize(response.json())
```

Using the dataframe `data` print the first 5 rows

```
In [13]: # Get the head of the dataframe
         data.head()
```

Out[13]:

	static_fire_date_utc	static_fire_date_unix	tbd	net	window	rocket	success	details	ships	capsules	
								Engine failure at 33 seconds and loss of vehicle	[]	[]	[5eb0e4b5b6c3bb0
								Successful first stage burn and transition to second stage, maximum altitude 289 km, Premature engine shutdown at T+7 min 30 s, Failed to reach orbit, Failed to recover first stage	[]	[]	[5eb0e4b6b6c3bb0
								Residual stage 1 thrust led to collision	[]	[]	[5eb0e4b6b6c3bb0

Now let's start requesting rocket launch data from SpaceX API with the following URL:

```
In [6]: spacex_url="https://api.spacexdata.com/v4/launches/past"
```

```
In [7]: response = requests.get(spacex_url)
```

Check the content of the response

```
In [8]: print(response.content)
```

```
b'[{"fairings":{"reused":false,"recovery_attempt":false,"recovered":false,"ships":[]},"links":{"patch":{"small":"https
g"},"reddit":{"campaign":null,"launch":null,"media":null,"recovery":null},"flickr":{"small":[],"original":[]},"presski
ttps://www.space.com/2196-spacex-inaugural-falcon-1-rocket-lost-launch.html","wikipedia":"https://en.wikipedia.org/wik
false,"net":false,"window":0,"rocket":"5e9d0d95eda69955f709d1eb","success":false,"details":"Engine failure at 33 secon
e9e4502f5090995de566f86","auto_update":true,"launch_library_id":null,"failures":[{"time":33,"altitude":null,"reason":"
0.000Z","date_unix":1143239400,"date_local":"2006-03-25T10:30:00+12:00","date_precision":"hour","upcoming":false,"core
_attempt":false,"landing_success":null,"landing_type":null,"landpad":null}],"id":"5eb87cd9ffd86e000604b32a"},{"fairing
tps://images2.imgbox.com/4f/e3/I0lkuJ2e_o.png","large":"https://images2.imgbox.com/be/e7/iNqsqVYM_o.png"},"reddit":{"c
t":null,"webcast":"https://www.youtube.com/watch?v=Lk4zQ2wP-Nc","youtube_id":"Lk4zQ2wP-Nc","article":"https://www.spac
moSat"},"static_fire_date_utc":null,"static_fire_date_unix":null,"tbd":false,"net":false,"window":0,"rocket":"5e9d0d95
e, maximum altitude 289 km, Premature engine shutdown at T+7 min 30 s, Failed to reach orbit, Failed to recover first
566f86","auto_update":true,"launch_library_id":null,"failures":[{"time":301,"altitude":289,"reason":"harmonic oscillat
07-03-21T01:10:00.000Z","date_unix":1174439400,"date_local":"2007-03-21T13:10:00+12:00","date_precision":"hour","upcom
d":false,"landing_attempt":false,"landing_success":null,"landing_type":null,"landpad":null}],"id":"5eb87cdaffd86e00060
tch":{"small":"https://images2.imgbox.com/3d/86/cnu0pan8_o.png","large":"https://images2.imgbox.com/4b/bd/d8UxLh4q_o.p
al":[]},"presskit":null,"webcast":"https://www.youtube.com/watch?v=v0w9p3U8860","youtube_id":"v0w9p3U8860","article":"
dia.org/wiki/Trailblazer_(satellite)"},"static_fire_date_utc":null,"static_fire_date_unix":null,"tbd":false,"net":fals
to collision between stage 1 and stage 2","ships":[],"capsules":[],"payloads":["5eb0e4b6b6c3bb0066eeb1e3","5eb0e4b6b6c
lures":[{"time":140,"altitude":35,"reason":"residual stage-1 thrust led to collision between stage 1 and stage 2"}],"c
4440,"date_local":"2008-08-03T15:34:00+12:00","date_precision":"hour","upcoming":false,"cores":[{"core":"5e9e289ef3591
```

You should see the response contains massive information about SpaceX launches. Next, let's try to discover some more relevant information for this project.

https://github.com/chevibs1020/testrepo/blob/master/Complete%20the%20Data%20Collection%20API%20Lab.ipynb

DATA COLLECTION – WEB SCRAPING

TASK 1: Request the Falcon9 Launch Wiki page from its URL

First, let's perform an HTTP GET method to request the Falcon9 Launch HTML page, as an HTTP response.

In [33]:
```
# use requests.get() method with the provided static_url
# assign the response to a object
response = requests.get(static_url)
print(response.status_code)
print(response.headers)
# print(response.content)
```

```
200
{'Date': 'Mon, 23 Aug 2021 03:09:46 GMT', 'Server': 'mw2338.codfw.wmnet', 'X-Content-Type-Options': 'nosniff', 'P3p':
'CP="See https://en.wikipedia.org/wiki/Special:CentralAutoLogin/P3P for more info."', 'Content-Language': 'en', 'Var
y': 'Accept-Encoding,Cookie,Authorization', 'Expires': 'Mon, 23 Aug 2021 03:09:46 GMT', 'Last-Modified': 'Sat, 21 Aug
2021 12:18:39 GMT', 'Content-Type': 'text/html; charset=UTF-8', 'Content-Encoding': 'gzip', 'Age': '0', 'X-Cache': 'c
p1089 miss, cp1085 pass', 'X-Cache-Status': 'pass', 'Server-Timing': 'cache;desc="pass", host;desc="cp1085"', 'Strict
-Transport-Security': 'max-age=106384710; includeSubDomains; preload', 'Report-To': '{ "group": "wm_nel", "max_age":
86400, "endpoints": [{ "url": "https://intake-logging.wikimedia.org/v1/events?stream=w3c.reportingapi.network_error&s
chema_uri=/w3c/reportingapi/network_error/1.0.0" }] }', 'NEL': '{ "report_to": "wm_nel", "max_age": 86400, "failure_f
raction": 0.05, "success_fraction": 0.0}', 'Permissions-Policy': 'interest-cohort=()', 'Set-Cookie': 'WMF-Last-Access
=23-Aug-2021;Path=/;HttpOnly;secure;Expires=Fri, 24 Sep 2021 00:00:00 GMT, WMF-Last-Access-Global=23-Aug-2021;Path=/;
Domain=.wikipedia.org;HttpOnly;secure;Expires=Fri, 24 Sep 2021 00:00:00 GMT, GeoIP=US:::37.75:-97.82:v4; Path=/; secu
re; Domain=.wikipedia.org', 'X-Client-IP': '169.60.36.47', 'Cache-Control': 'private, s-maxage=0, max-age=0, must-rev
alidate', 'Accept-Ranges': 'bytes', 'Transfer-Encoding': 'chunked', 'Connection': 'keep-alive'}
```

Create a `BeautifulSoup` object from the HTML `response`

In [35]:
```
# Use BeautifulSoup() to create a BeautifulSoup object from a response text content
html_file = BeautifulSoup(response.text, 'html.parser')
print(html_file.prettify())
```

```
<!DOCTYPE html>
<html class="client-nojs" dir="ltr" lang="en">
 <head>
  <meta charset="utf-8"/>
  <title>
   List of Falcon 9 and Falcon Heavy launches - Wikipedia
  </title>
  <script>
   document.documentElement.className="client-js";RLCONF={"wgBreakFrames":!1,"wgSeparatorTransformTable":["",""],"wgD
igitTransformTable":["",""],"wgDefaultDateFormat":"dmy","wgMonthNames":["","January","February","March","April","Ma
y","June","July","August","September","October","November","December"],"wgRequestId":"941c15f0-9d1e-4454-b423-2aaf3e2
```

https://github.com/chevibs1020/testrepo/blob/master/Data%20Collection%20with%20Web%20Scraping.ipynb

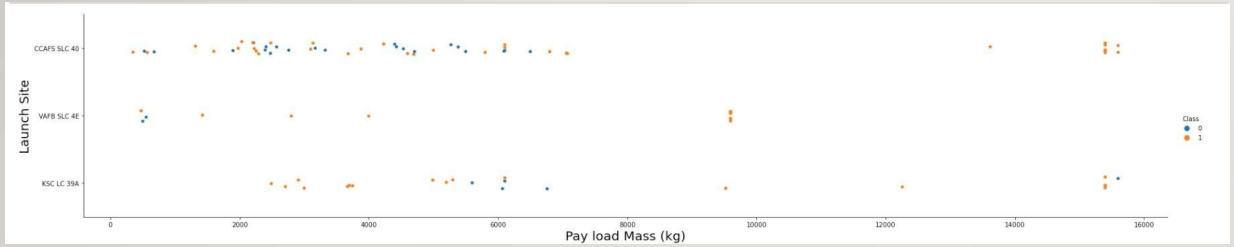
DATA WRANGLING

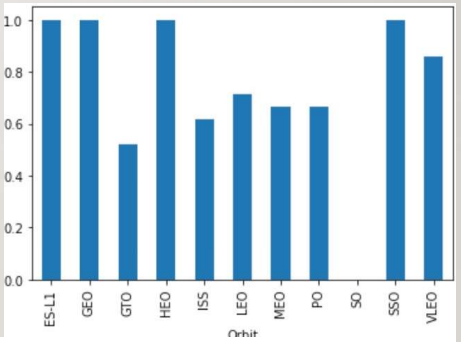
- Performed some Exploratory Data Analysis (EDA) to find some patterns in the data and determine what would be the label for training supervised models.
- In the data set, there are several different cases where the booster did not land successfully. Sometimes a landing was attempted but failed due to an accident; for example, True Ocean means the mission outcome was successfully landed to a specific region of the ocean while False Ocean means the mission outcome was unsuccessfully landed to a specific region of the ocean. True RTLS means the mission outcome was successfully landed to a ground pad False RTLS means the mission outcome was unsuccessfully landed to a ground pad.True ASDS means the mission outcome was successfully landed on a drone ship False ASDS means the mission outcome was unsuccessfully landed on a drone ship.

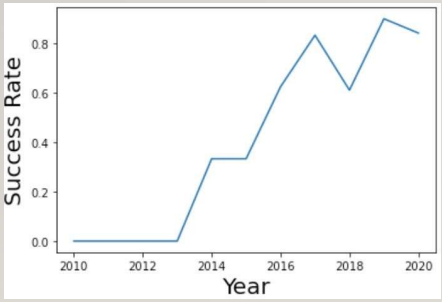
https://github.com/chevibs1020/testrepo/blob/master/Data%20Collection%20with%20Web%20Scraping.ipynb

EDA WITH DATA VISUALIZATION

- In the EDA with Data Visualization step, created many different scatter plots, bar graphs, line graphs and crosstabs to visualize the data. Below are some examples.







	FlightNumber	PayloadMass	Orbit	LaunchSite	Flights	GridFins	Reused	Legs	LandingPad	Block	ReusedCount	Serial
0	1	6104.959412	LEO	CCAFS SLC 40	1	False	False	False	NaN	1.0	0	B0003
1	2	525.000000	LEO	CCAFS SLC 40	1	False	False	False	NaN	1.0	0	B0005
2	3	677.000000	ISS	CCAFS SLC 40	1	False	False	False	NaN	1.0	0	B0007
3	4	500.000000	PO	VAFB SLC 4E	1	False	False	False	NaN	1.0	0	B1003
4	5	3170.000000	GTO	CCAFS SLC 40	1	False	False	False	NaN	1.0	0	B1004

https://github.com/chevibs1020/testrepo/blob/master/EDA%20with%20Visualization%20lab.ipynb

EDA WITH SQL

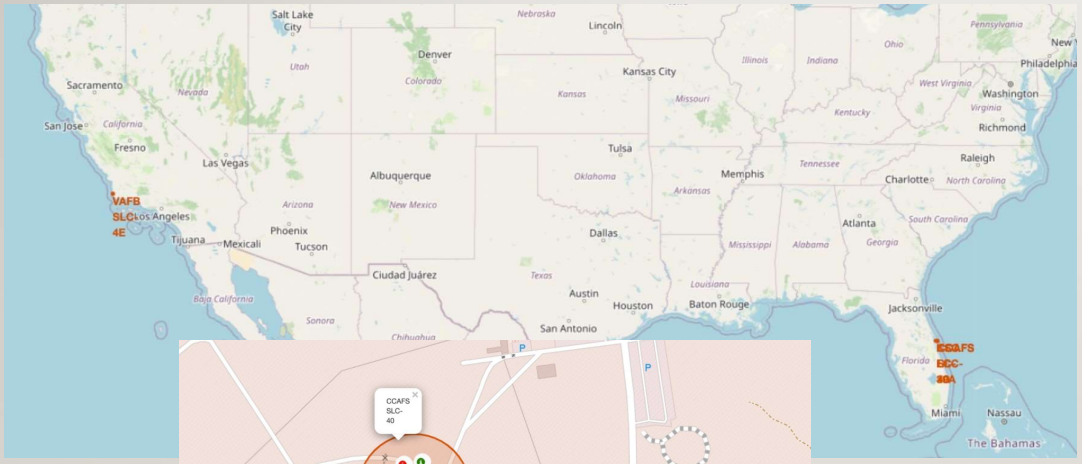
- Exploratory Data Analysis is the first step of any data science project.
- Use these features with machine learning to automatically predict if the first stage can land successfully.
- See that different launch sites have different success rates. As a result, it can be used to help determine if the first stage will land successfully.
- CCAFS LC-40 has a success rate of 60%, while KSC LC-39A and VAFB SLC 4E have a success rate of around 77%.
- Combining attributes also gives us more information.
- If we overlay the result of the landing outcomes as a color we see that CCAFS LC- 40, has a success rate of 60%, but if the mass is above 10,000 kg the success rate is 100%.
- Therefore, we will combine multiple features using SQL
- https://github.com/chevibs1020/testrepo/blob/master/EDA%20with%20SQL%20lab.ipynb

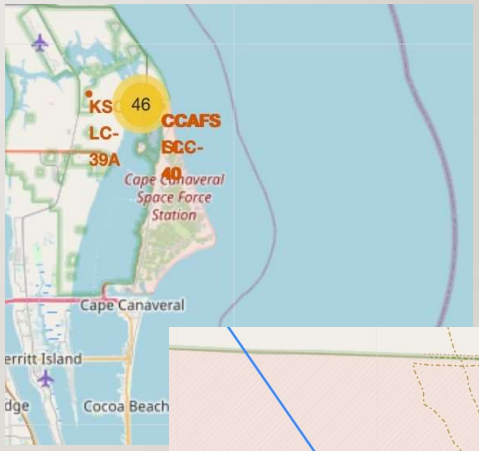
BUILD AN INTERACTIVE MAP WITH FOLIUM

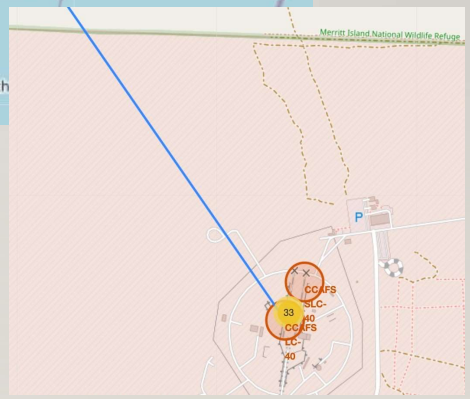
- The launch success rate may depend on many factors such as payload mass, orbit type, and so on. It may also depend on the location and proximities of a launch site, i.e., the initial position of rocket trajectories. Finding an optimal location for building a launch site certainly involves many factors and hopefully we could discover some of the factors by analyzing the existing launch site locations.
- Using Folium I will mark all Launch Sites on a map, mark the successful/failed launches for each site on the map, and calculate the distances between a launch site to its proximities.

https://github.com/chevibs1020/testrepo/blob/master/Interactive%20Visual%20Analytics%20with%20Folium%20lab.ipynb

BUILD AN INTERACTIVE MAP WITH FOLIUM



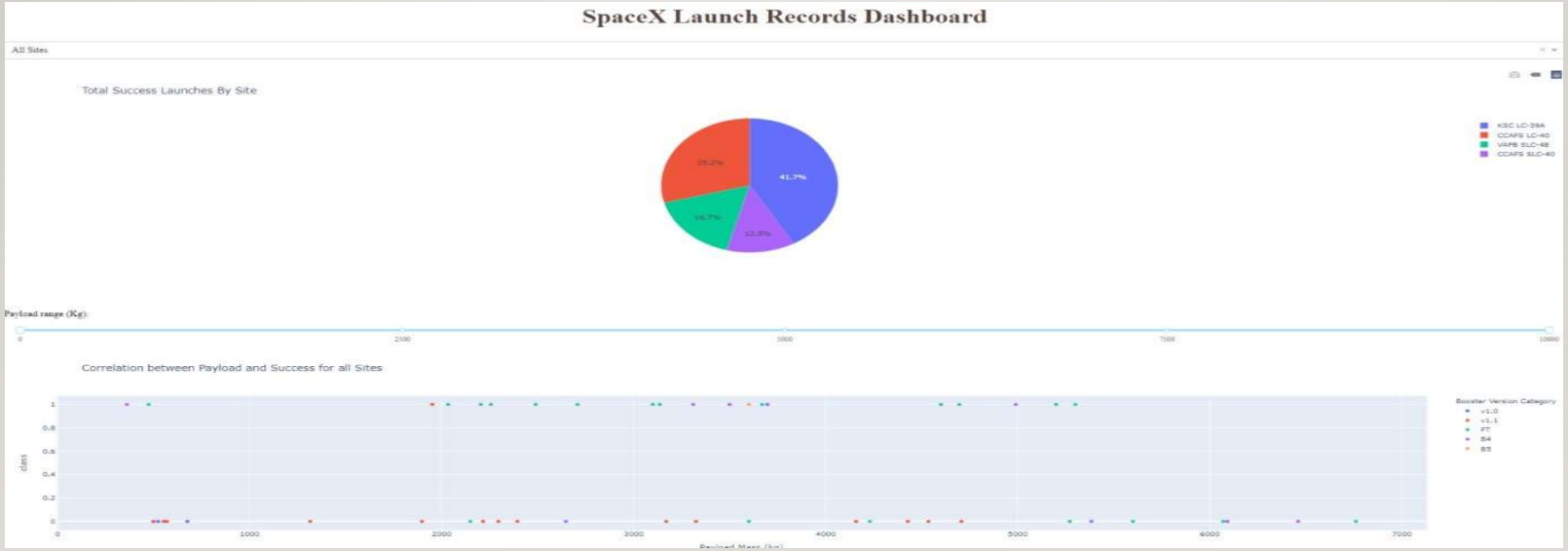




https://github.com/chevibs1020/testrepo/blob/master/Interactive%20Visual%20Analytics%20with%20Folium%20lab.ipynb

BUILD A DASHBOARD WITH PLOTLY DASH

- This dashboard application contains input components of the site list and a range slider to interact with a pie chart and a scatter point chart. We can drill into the visuals to better understand successful launches, success rate at each site, and which payload ranges have the highest success rates.



PREDICTIVE ANALYSIS (CLASSIFICATION)

BUILT A MACHINE LEARNING PIPELINE TO PREDICT IF THE FIRST STAGE OF THE FALCON 9 LANDS SUCCESSFULLY.

This included Preprocessing, standardizing the data, Train_test_split, in order to split data into training and testing data.

I trained the model and perform Grid Search, allowing to find the hyperparameters that allow a given algorithm to perform best.

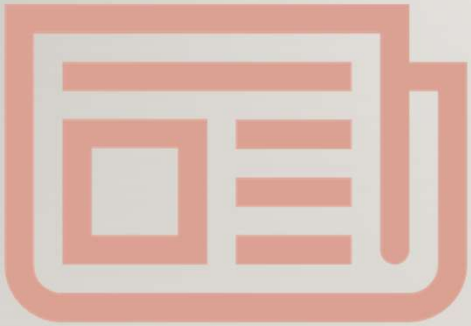
Using the best hyperparameter values, I determine the model with the best accuracy using the training data.

The following Machine Learning techniques were applied:

- Logistic Regression
- Support Vector machines
- Decision Tree Classifier
- K-nearest neighbors.

https://github.com/chevibs1020/testrepo/blob/master/Machine%20Learning%20Prediction%20lab.ipynb

RESULTS

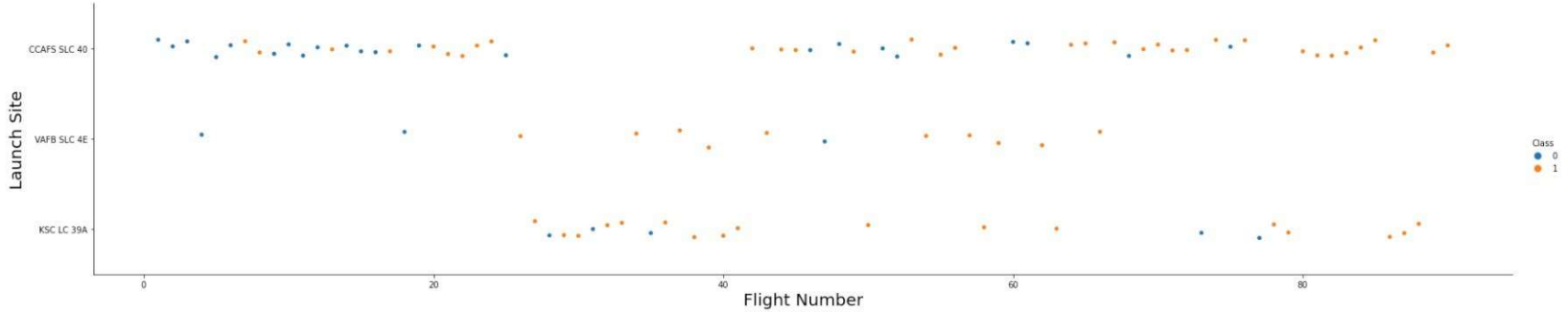


- Exploratory data analysis results
- Interactive analytics demo in screenshots
- Predictive analysis results

EDA WITH VISUALIZATION

FLIGHT NUMBER VS. LAUNCH SITE

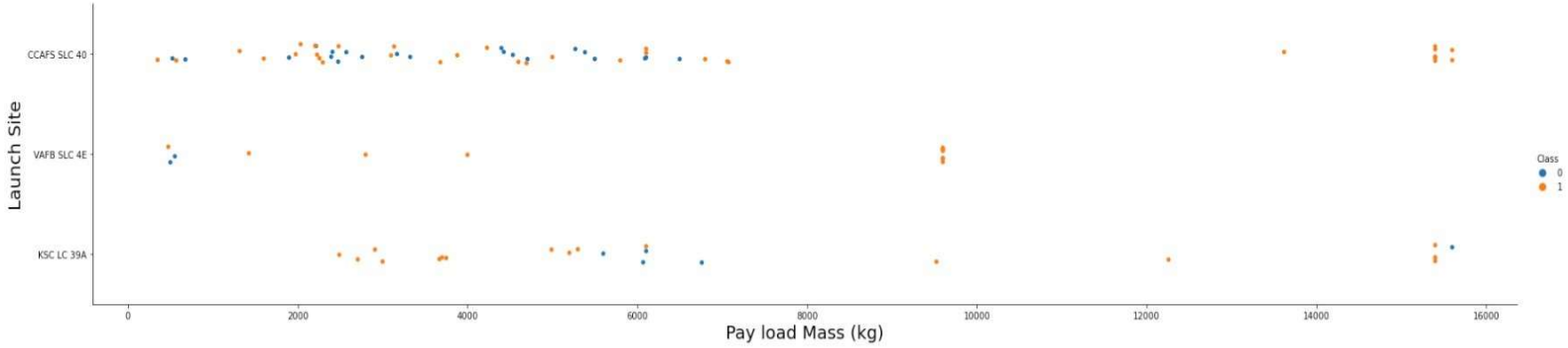
In [4]:
```
# Plot a scatter point chart with x axis to be Flight Number and y axis to be the launch site, and hue to be the class value
sns.catplot(y="LaunchSite", x="FlightNumber", hue="Class", data=df, aspect = 5)
plt.xlabel("Flight Number",fontsize=20)
plt.ylabel("Launch Site",fontsize=20)
plt.show()
```



It appears the launch sites all have more successful landings as the flight number increases

PAYLOAD VS. LAUNCH SITE

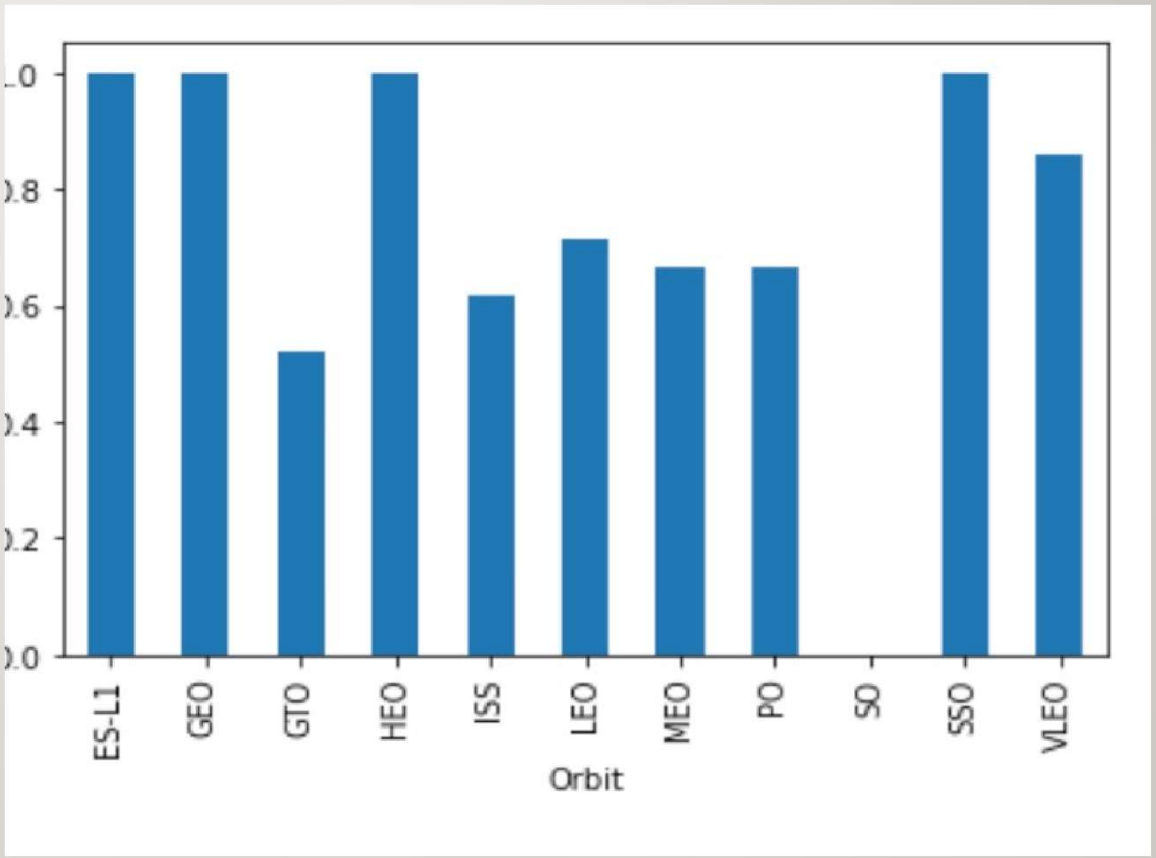
In [5]:
```
# Plot a scatter point chart with x axis to be Pay Load Mass (kg) and y axis to be the launch site, and hue to be the class value
sns.catplot(y="LaunchSite", x="PayloadMass", hue="Class", data=df, aspect = 5)
plt.xlabel("Pay load Mass (kg)",fontsize=20)
plt.ylabel("Launch Site",fontsize=20)
plt.show()
```



It is very clear that the more heavy the payload, the more successful the landing

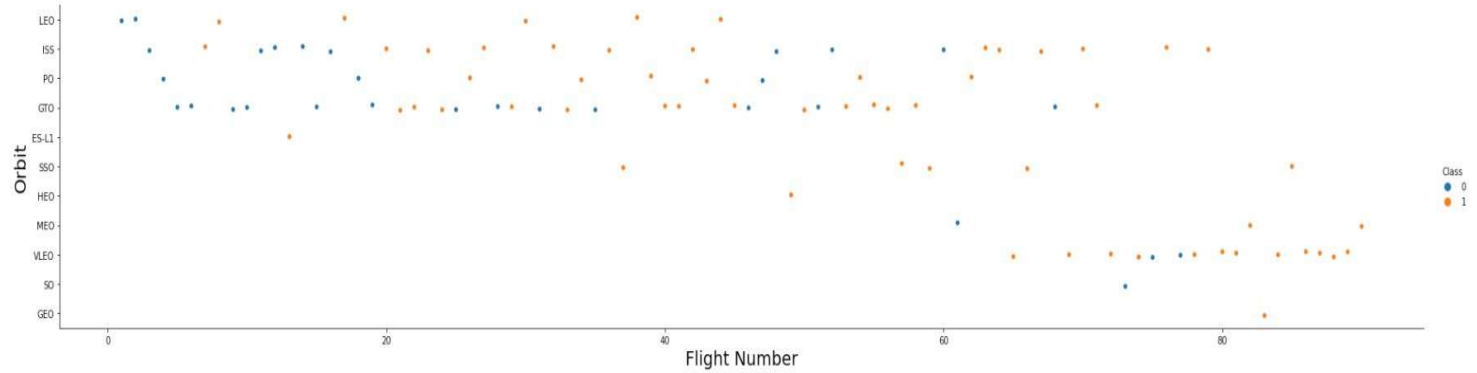
SUCCESS RATE VS. ORBIT TYPE

GTO orbits have the lowest success rates while 4 of the orbits have a perfect success rate of 100%



FLIGHT NUMBER VS. ORBIT TYPE

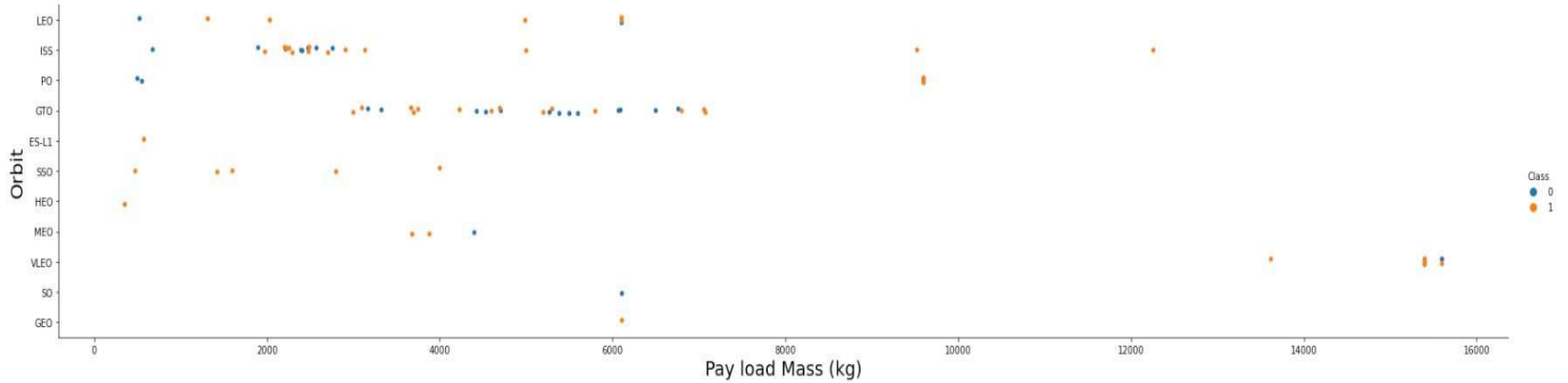
In [11]:
```
# Plot a scatter point chart with x axis to be FlightNumber and y axis to be the Orbit, and hue to be the class value
sns.catplot(y="Orbit", x="FlightNumber", hue="Class", data=df, aspect = 5)
plt.xlabel("Flight Number",fontsize=20)
plt.ylabel("Orbit",fontsize=20)
plt.show()
```



The LEO orbit the Success appears related to the number of flights; on the other hand, there seems to be no relationship between flight number when in GTO orbit.

PAYLOAD VS. ORBIT TYPE

```
# Plot a scatter point chart with x axis to be Payload and y axis to be the Orbit, and hue to be the class value
sns.catplot(y="Orbit", x="PayloadMass", hue="Class", data=df, aspect = 5)
plt.xlabel("Pay load Mass (kg)",fontsize=20)
plt.ylabel("Orbit",fontsize=20)
plt.show()
```



Heavy payloads have a negative influence on GTO orbits and positive on GTO and Polar LEO (ISS) orbits.

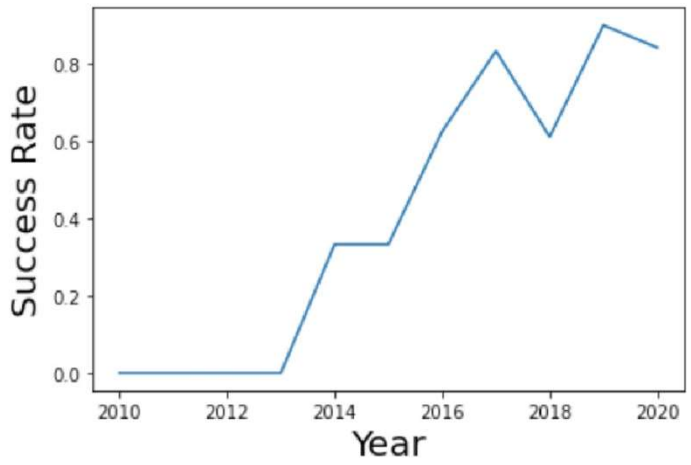
The sucess rate since 2013 kept increasing till 2020

```
# A function to Extract years from the date
year=[]
def Extract_year(date):
    for i in df["Date"]:
        year.append(i.split("-")[0])
    return year
```

```
# Plot a line chart with x axis to be the extracted year and y axis to be the success
df['Year'] = pd.DataFrame(Extract_year(df['Date'])).astype('int')

sns.lineplot(x = df['Year'].unique() , y = df.groupby(['Year'])['Class'].mean())


plt.xlabel("Year",fontsize=20)
plt.ylabel("Success Rate",fontsize=20)
plt.show()
```



EDA WITH SQL

ALL LAUNCH SITE NAMES

Task 1

Display the names of the unique launch sites in the space mission

In [17]:
```
%sql SELECT launch_site FROM SPACEXTBL GROUP BY launch_site
```

```
 * ibm_db_sa://zxk37793:***@54a2f15b-5c0f-46df-8954-7e38e612c2bd.c1ogj3sd0t
3/bludb
Done.
```

Out[17]:

launch_site
CCAFS LC-40
CCAFS SLC-40
KSC LC-39A
VAFB SLC-4E

LAUNCH SITE NAMES BEGIN WITH `CCA`

Task 2

Display 5 records where launch sites begin with the string 'CCA'

In [19]:
```
%sql SELECT * FROM SPACEXTBL WHERE launch_site LIKE 'CCA%' LIMIT 5
```

```
 * ibm_db_sa://zxk37793:***@54a2f15b-5c0f-46df-8954-7e38e612c2bd.c1ogj3sd0tgtu0lqde00.databases.appdomain.cloud:3273
3/bludb
Done.
```

Out[19]:

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

Task 3

Display the total payload mass carried by boosters launched by NASA (CRS)

In [25]:
```
%sql SELECT SUM(payload_mass__kg_) FROM SPACEXTBL WHERE customer = 'NASA (CRS)'
```

```
 * ibm_db_sa://zxk37793:***@54a2f15b-5c0f-46df-8954-7e38e612c2bd.c1ogj3sd0tgtu0lqde
3/bludb
Done.
```

Out[25]:

1
45596

AVERAGE PAYLOAD MASS BY F9 V1.1

Task 4

Display average payload mass carried by booster version F9 v1.1

In [29]:
```
# %sql SELECT * FROM SPACEXTBL WHERE booster_version = 'F9 v1.1'
%sql SELECT AVG(payload_mass__kg_) FROM SPACEXTBL WHERE booster_version = 'F9 v1.1'
```

```
 * ibm_db_sa://zxk37793:***@54a2f15b-5c0f-46df-8954-7e38e612c2bd.c1ogj3sd0tgtu0lqde00.data
3/bludb
Done.
```

Out[29]:

1
2928

FIRST SUCCESSFUL GROUND LANDING DATE

Task 5

List the date when the first succesful landing outcome in ground pad was acheived.

Hint:Use min function

In [33]:
```
# %sql SELECT * FROM SPACEXTBL
%sql SELECT MIN(DATE) FROM SPACEXTBL WHERE landing__outcome = 'Success (ground pad)'
```

```
 * ibm_db_sa://zxk37793:***@54a2f15b-5c0f-46df-8954-7e38e612c2bd.c1ogj3sd0tgtu0lqde00.database
3/bludb
Done.
```

Out[33]:

1
2015-12-22

SUCCESSFUL DRONE SHIP LANDING WITH PAYLOAD BETWEEN 4000 AND 6000

Task 6

List the names of the boosters which have success in drone ship and have payload mass greater than 4000 but less than 6000

In [58]:
```
%sql SELECT booster_version FROM SPACEXTBL where landing__outcome = 'Success (drone ship)' AND payload_mass__kg_ BETWEEN 4000 and 6000
```

```
 * ibm_db_sa://zxk37793:***@54a2f15b-5c0f-46df-8954-7e38e612c2bd.c1ogj3sd0tgtu0lqde00.databases.appdomain.cloud:32733/bludb
Done.
```

Out[58]:

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

TOTAL NUMBER OF SUCCESSFUL AND FAILURE MISSION OUTCOMES

Task 7

List the total number of successful and failure mission outcomes

In [38]:
```
%sql SELECT mission_outcome, count(*) FROM SPACEXTBL GROUP BY mission_outcome
```

```
 * ibm_db_sa://zxk37793:***@54a2f15b-5c0f-46df-8954-7e38e612c2bd.c1ogj3sd0tgtu0lqde00.databases
Done.
```

Out[38]:

mission_outcome	2
Failure (in flight)	1
Success	99
Success (payload status unclear)	1

BOOSTERS CARRIED MAXIMUM PAYLOAD

Task 8

List the names of the booster_versions which have carried the maximum payload mass. Use a subquery

In [43]:
```
%sql SELECT booster_version, payload_mass__kg_ FROM SPACEXTBL
    WHERE payload_mass__kg_ = (SELECT max(payload_mass__kg_) FROM SPACEXTBL)
    GROUP BY booster_version, payload_mass__kg_ ORDER BY booster_version ASC
```

```
 * ibm_db_sa://zxk37793:***@54a2f15b-5c0f-46df-8954-7e38e612c2bd.c1ogj3sd0tgtu0lqde00.databases.appdomai
Done.
```

Out[43]:

booster_version	payload_mass__kg_
F9 B5 B1048.4	15600
F9 B5 B1048.5	15600
F9 B5 B1049.4	15600
F9 B5 B1049.5	15600
F9 B5 B1049.7	15600
F9 B5 B1051.3	15600
F9 B5 B1051.4	15600
F9 B5 B1051.6	15600
F9 B5 B1056.4	15600
F9 B5 B1058.3	15600
F9 B5 B1060.2	15600
F9 B5 B1060.3	15600

2015 LAUNCH RECORDS

Task 9

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

In [54]:
```
# %sql SELECT DATE FROM SPACEXTBL
%sql SELECT landing__outcome, booster_version, launch_site FROM SPACEXTBL
     WHERE  landing__outcome = 'Failure (drone ship)' AND DATE BETWEEN '2015-01-01' AND '2015-12-31'
```

```
 * ibm_db_sa://zxk37793:***@54a2f15b-5c0f-46df-8954-7e38e612c2bd.c1ogj3sd0tgtu0lqde00.databases.appc
Done.
```

Out[54]:

landing__outcome	booster_version	launch_site
Failure (drone ship)	F9 v1.1 B1012	CCAFS LC-40
Failure (drone ship)	F9 v1.1 B1015	CCAFS LC-40

RANK SUCCESS COUNT BETWEEN 2010-06-04 AND 2017-03-20

Task 10

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

In [57]:
```
# %sql SELECT * FROM SPACEXTBL
%sql SELECT landing__outcome, count(*) AS counts FROM SPACEXTBL
     WHERE DATE BETWEEN '2010-06-04' AND '2017-03-20' GROUP BY landing__outcome ORDER BY counts DESC
```

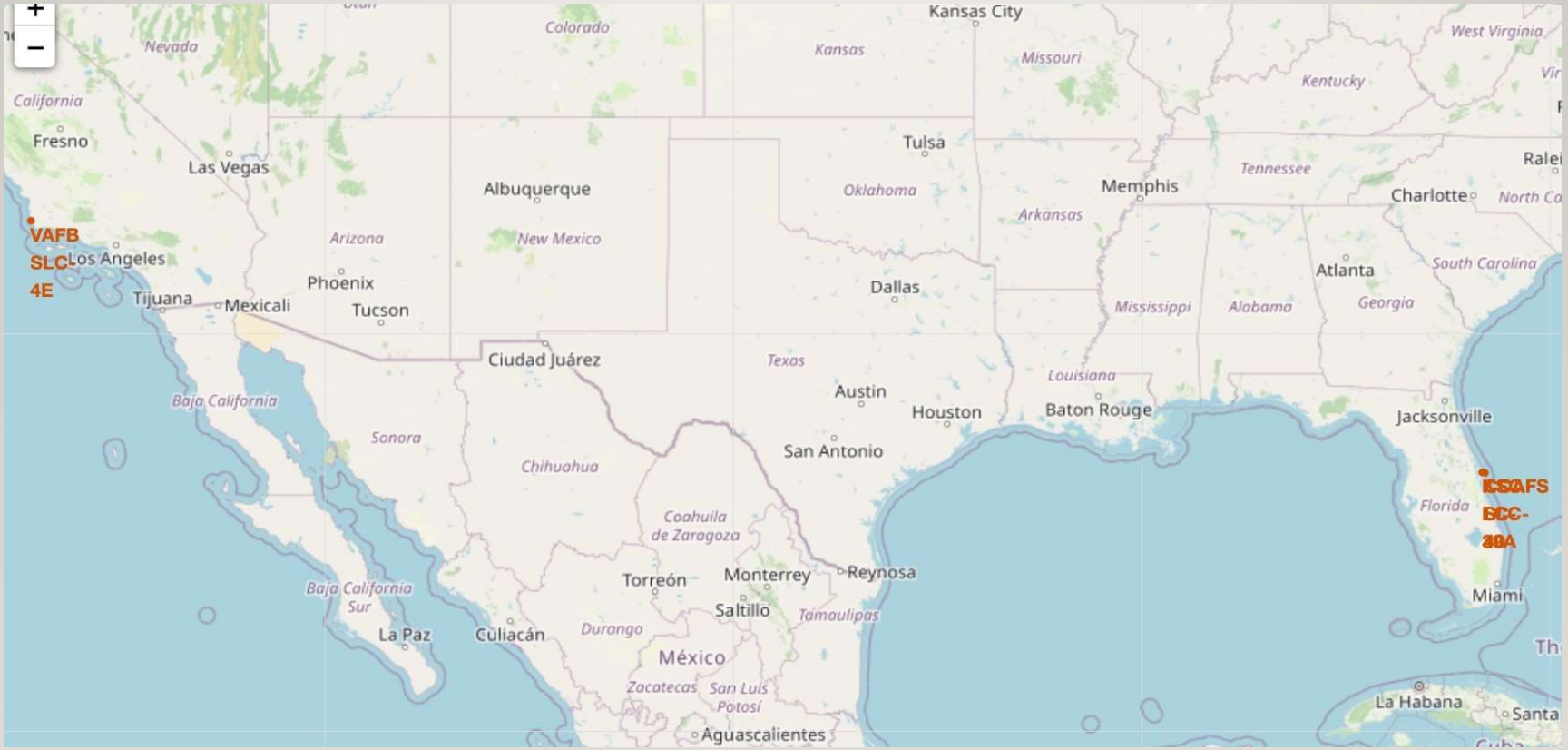
```
 * ibm_db_sa://zxk37793:***@54a2f15b-5c0f-46df-8954-7e38e612c2bd.c1ogj3sd0tgtu0lqde00.databases.appdomain.cloud:32733/bludb
Done.
```

Out[57]:

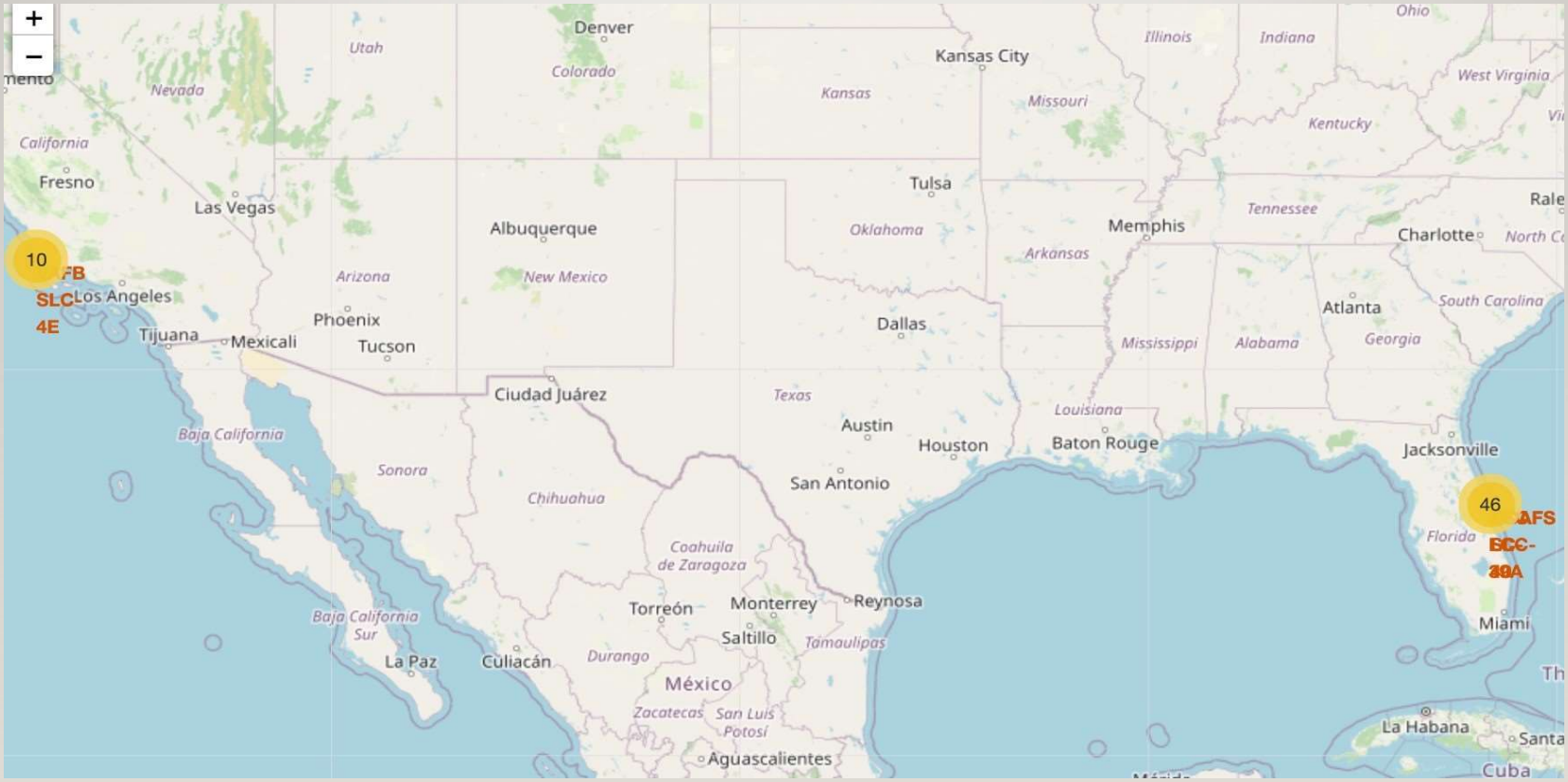
landing__outcome	counts
No attempt	10
Failure (drone ship)	5
Success (drone ship)	5
Controlled (ocean)	3
Success (ground pad)	3
Failure (parachute)	2
Uncontrolled (ocean)	2
Precluded (drone ship)	1

INTERACTIVE MAP WITH FOLIUM

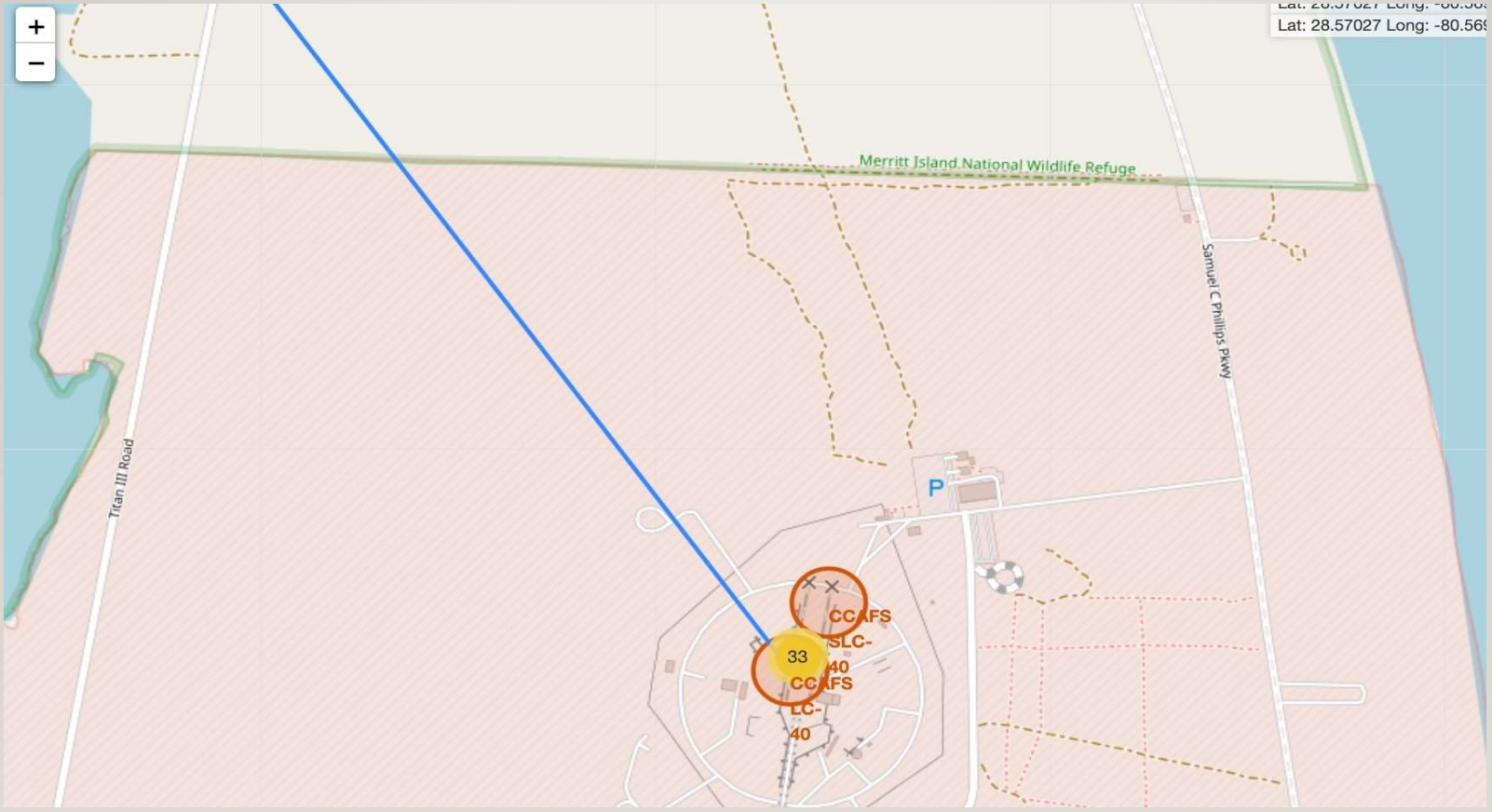
ALL LAUNCH SITES



NUMBER OF LAUNCHES AT EACH SITE

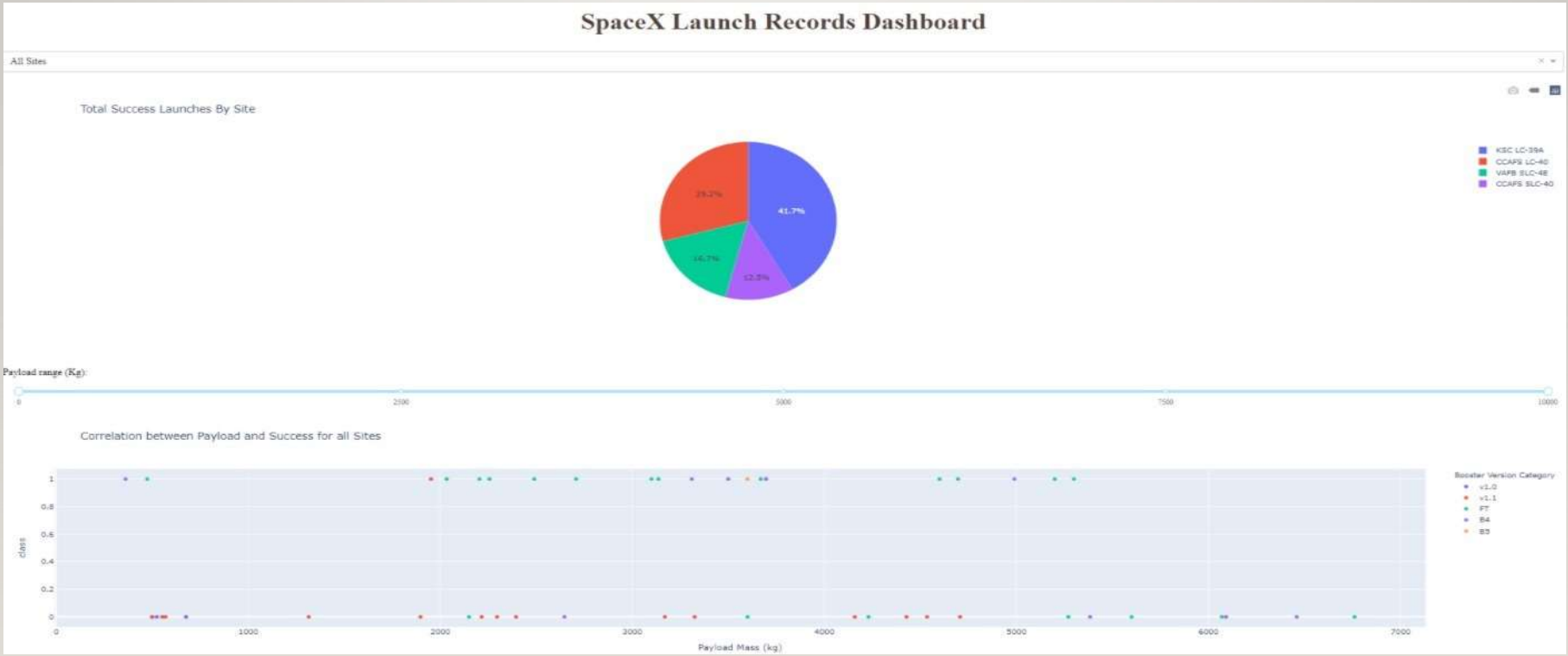


LAUNCH SITE PROXIMITY TO RAIL LINE

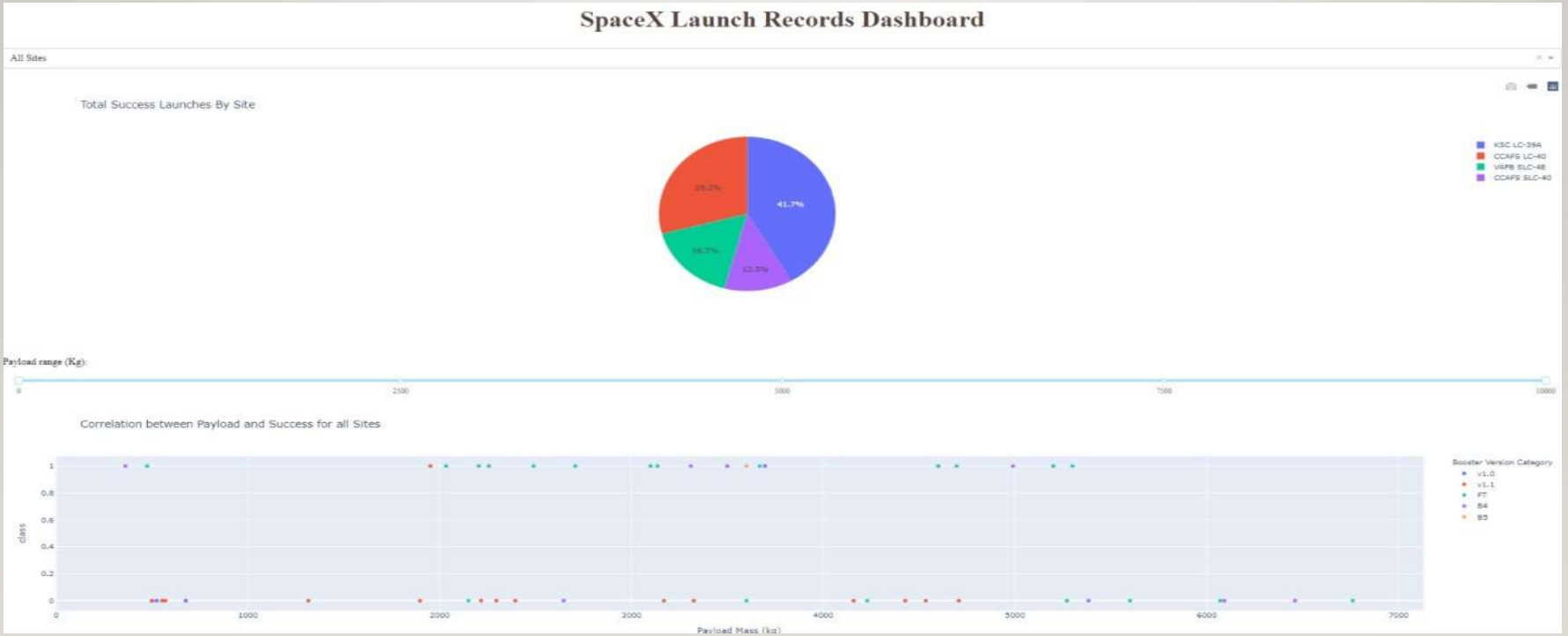


BUILD A DASHBOARD WITH PLOTLY DASH

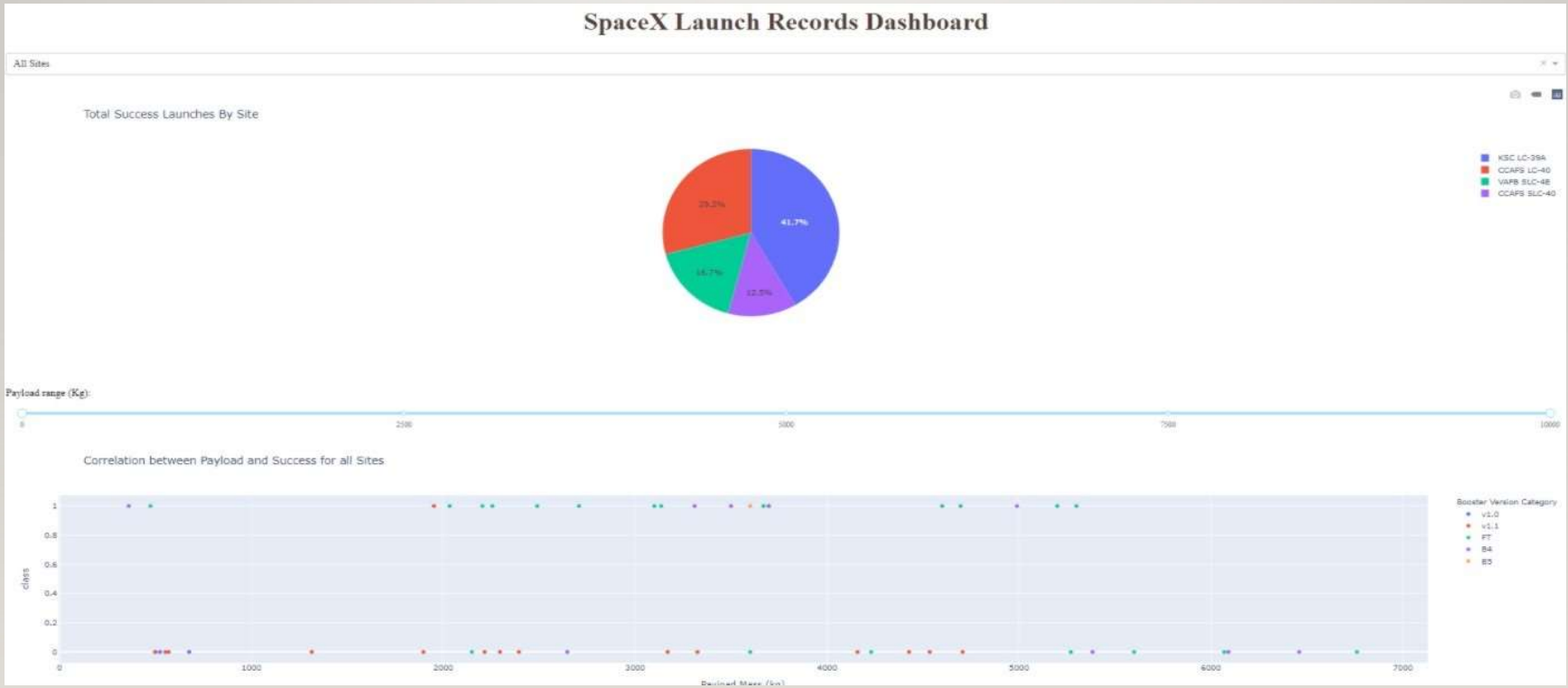
PLOTLY LAUNCH RECORDS



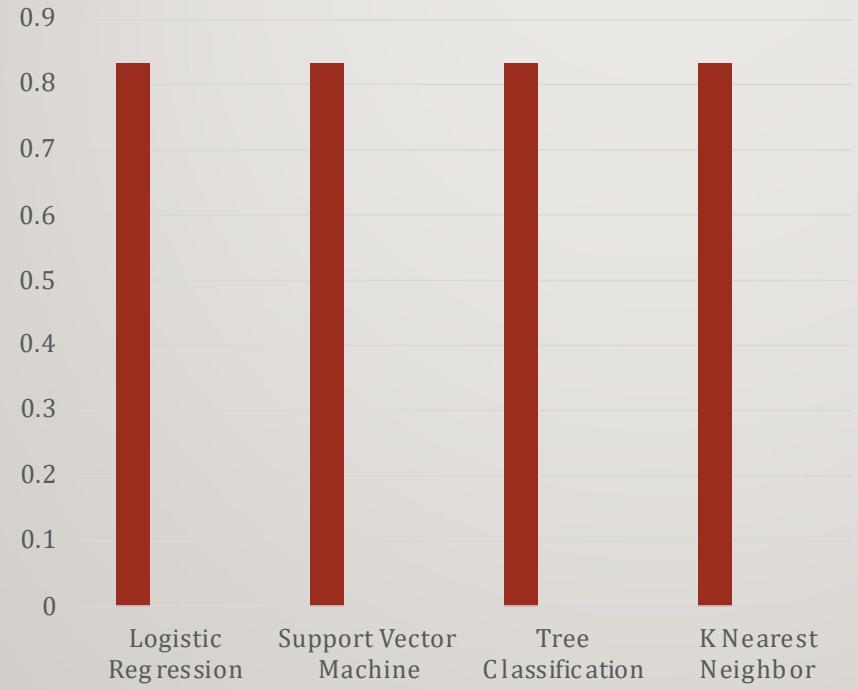
HIGHEST LAUNCH SUCCESS RATIO



PAYLOAD VS. LAUNCH OUTCOME SCATTER PLOT

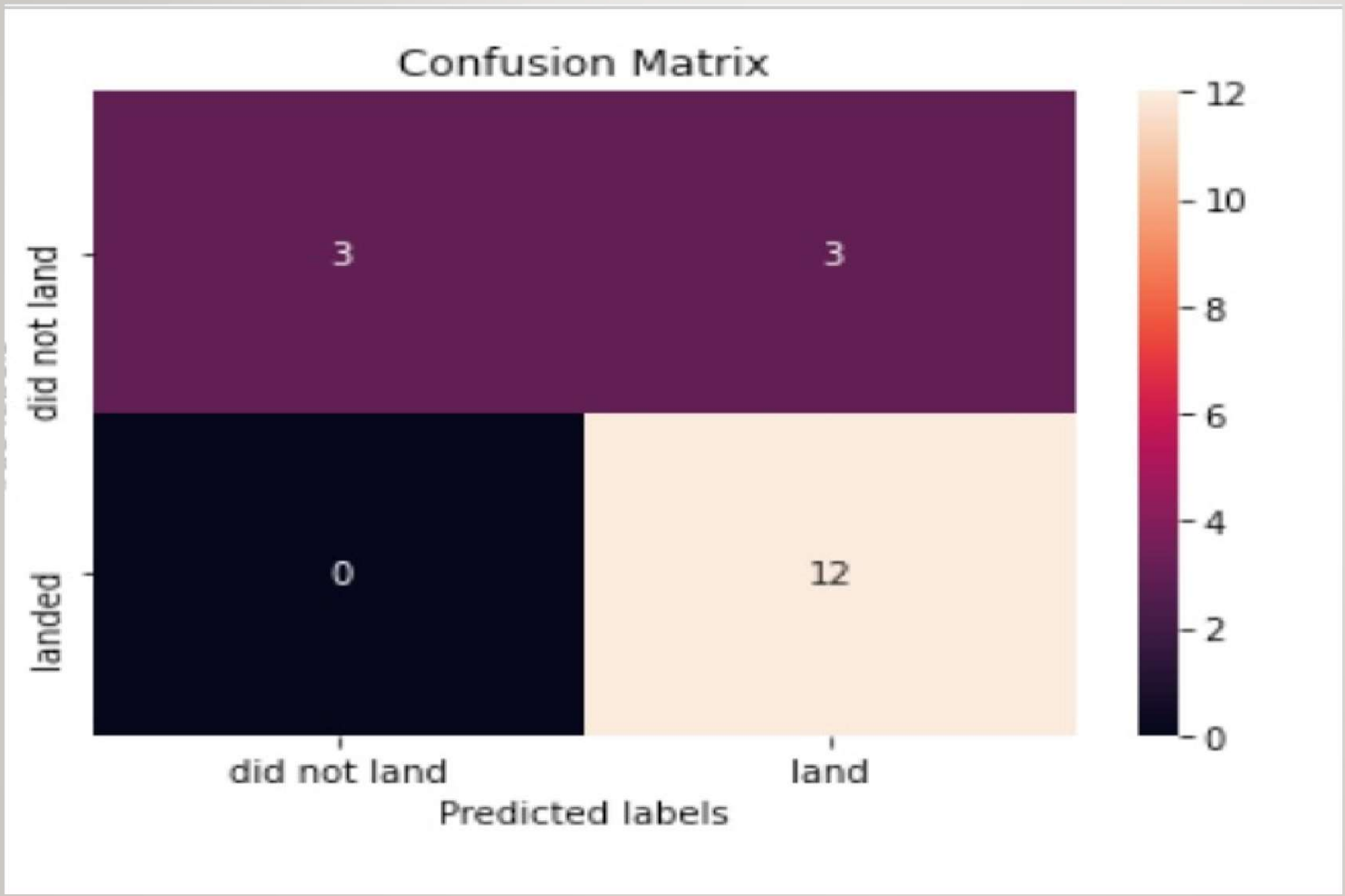


PREDICTIVE ANALYSIS (CLASSIFICATION)



CLASSIFICATION ACCURACY

All of the models have the same accuracy score of 0.8333333333

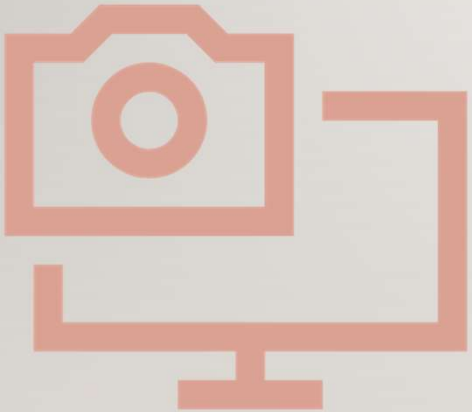


CONFUSION MATRIX

CONCLUSION

- In conclusion, all of the models found there is a 83.33% probable success rate of the first stage of the rocket landing.
- Using this prediction we can estimate the cost of a launch and have strong leverage against competitors

APPENDIX



- https://github.com/chevibs1020/testrepo/tree/master