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
  - Web scraping
  - Sql
  - Pandas
- Data visualization whit folium and plotly express
- Machine learning predict

- Summary of all results
  - Interactive visualization
  - Predictive analisys

Introduction

- Project background and context
- space x called us as data science to predict what are the failure factors of a launch and to be able to make space x lose less rockets and money

- Problems you want to find answers
- we will try to understand the rocket's chances of success and their survivability based on a different altitude and predict the chances of success or failure of the rocket

Section 1

Methodology

Methodology

Executive Summary

- Data collection methodology:
  - Using API and web scraping
- Perform data wrangling
  - Hone hot encoding to be used in machine lerning
- 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.
- You need to present your data collection process use key phrases and flowcharts

Json

Pandas

Beatifoulsoup

requests

Data Collection – SpaceX API

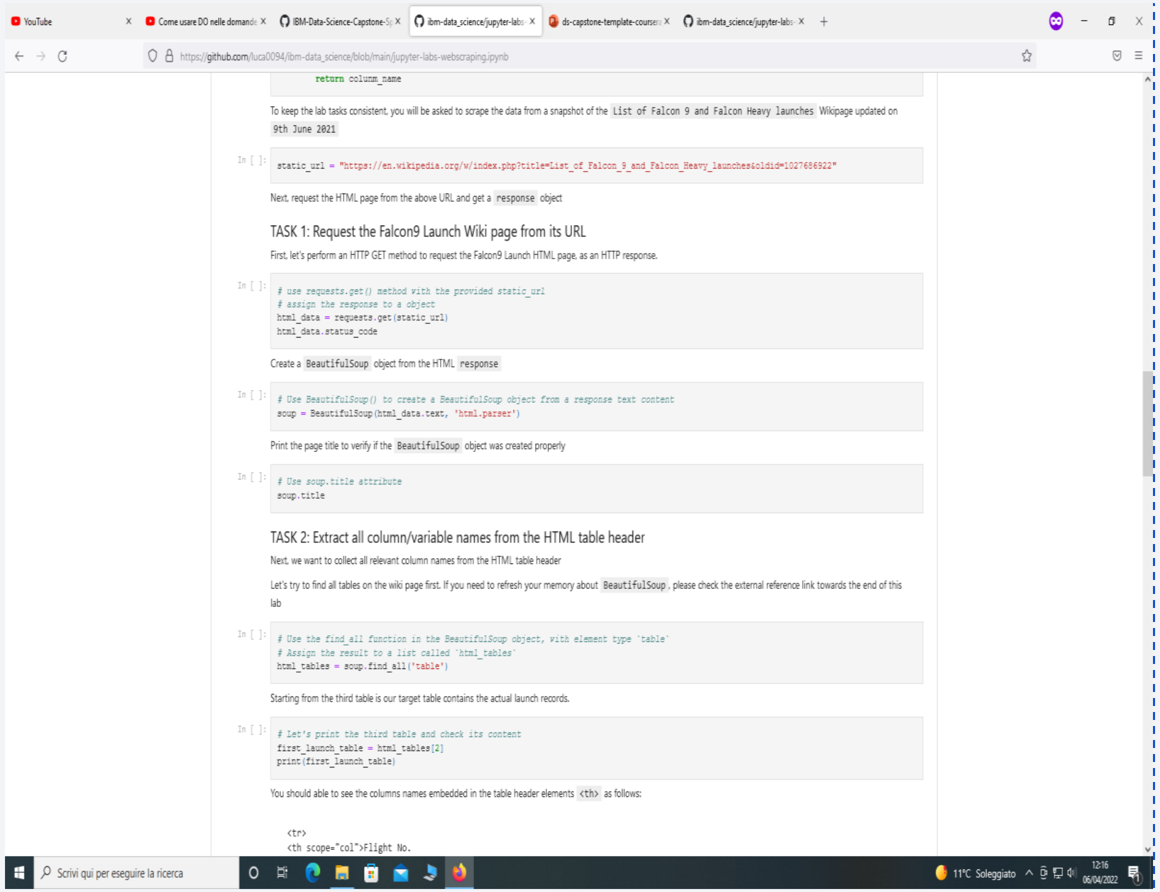
- Present your data collection with SpaceX REST calls using key phrases and flowcharts
- Add the GitHub URL of the completed SpaceX API calls notebook (must include completed code cell and outcome cell), as an external reference and peer-review purpose

Place your flowchart of SpaceX API calls here

Data Collection - Scraping

- `we use the request library to access the api spacex`

- Add the GitHub URL of the completed web scraping notebook, https://github.com/luca0094/ibm-data_science/blob/683d634bad1ce2c1324d3e93c06d579a69daf24b/jupyter-labs-webscraping.ipynb



Data Wrangling

- Describe how data were processed
- data analysis and choice of features
- we calculate the numbers of launches and their orbits
- Trasform the file into a csv file
- Add the GitHub URL of your completed data wrangling related notebooks, as an external reference and peer-review purpose
- https://github.com/luca0094/ibm-data_science/blob/835488a1b0d592d8dfc2e1a2e39c2d3c717844ba/ibm_data_wrangling.ipynb

EDA with Data Visualization

- we relate the various phases of the launches through graphs
- Add the GitHub URL of your completed EDA with data visualization notebook, as an external reference and peer-review purpose
- https://github.com/luca0094/ibm-data_science/blob/683d634bad1ce2c1324d3e93c06d579a69daf24b/Data%20Visualization%20Casptone.ipynb

EDA with SQL

- `we read the database in sql`
- `and we extract the information we need`

- Add the GitHub URL of your completed EDA with SQL notebook, as an external reference and peer-review purpose
- https://github.com/luca0094/ibm-data_science/blob/683d634bad1ce2c1324d3e93c06d579a69daf24b/jupyter-labs-eda-sql-coursera.ipynb

Build an Interactive Map with Folium

- we use colors to assign a failed or successful roll
- we calculate the distance between the launch zones and the main roads and coasts
- we have marked all launch sites on 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/luca0094/ibm-data_science/blob/683d634bad1ce2c1324d3e93c06d579a69daf24b/lab_jupyter_launch_site_location.ipynb

Build a Dashboard with Plotly Dash

- Summarize what plots/graphs and interactions you have added to a dashboard
- Explain why you added those plots and interactions
- Add the GitHub URL of your completed Plotly Dash lab, as an external reference and peer-review purpose

Predictive Analysis (Classification)

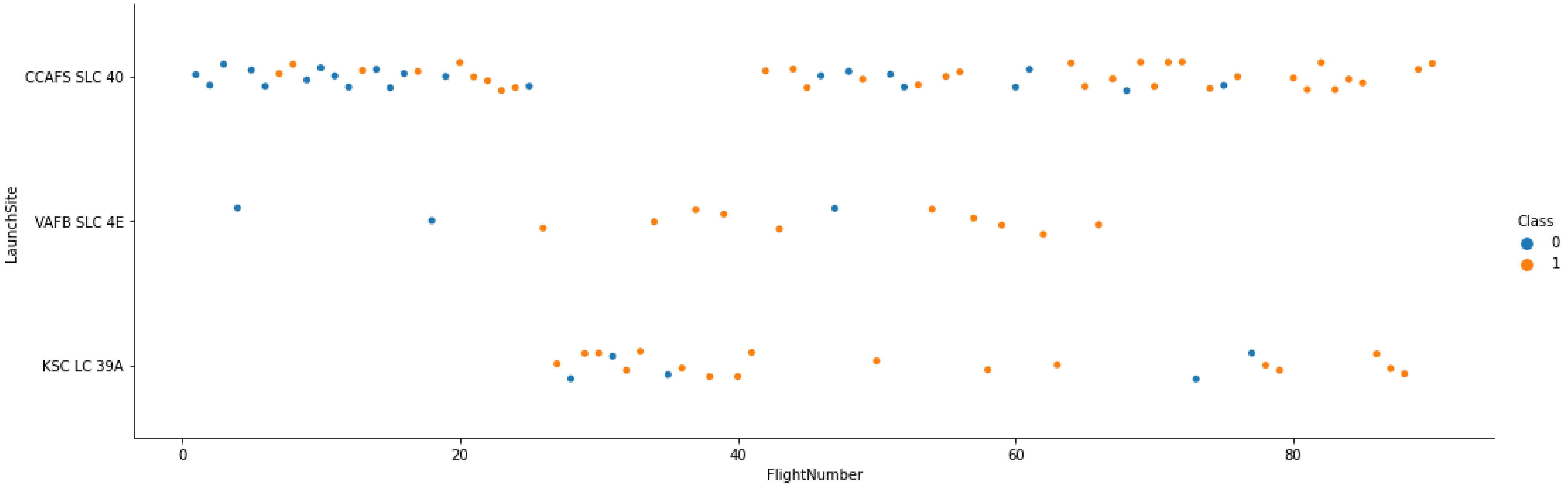
- we use GridSearchCv to find the best parameters to build the model
- found that the best model to use is DecisionTreeClassifier
- we build the model using the Scikit-learn python library and evaluate its accuracy
- Add the GitHub URL of your completed predictive analysis lab, as an external reference and peer-review purpose
- https://github.com/luca0094/ibm-data_science/blob/683d634bad1ce2c1324d3e93c06d579a69daf24b/SpaceX_Machine%20Learning%20Prediction_Part_5.ipynb

Results

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

Section 2

Insights drawn from EDA

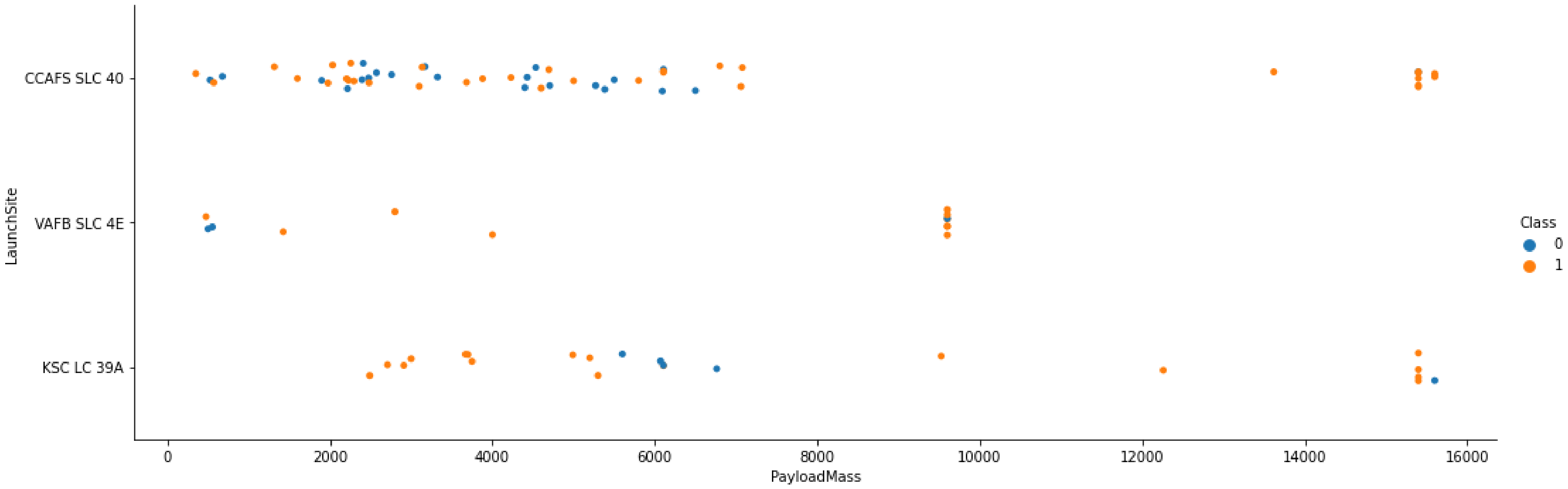


Flight Number vs. Launch Site

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

Payload vs. Launch Site

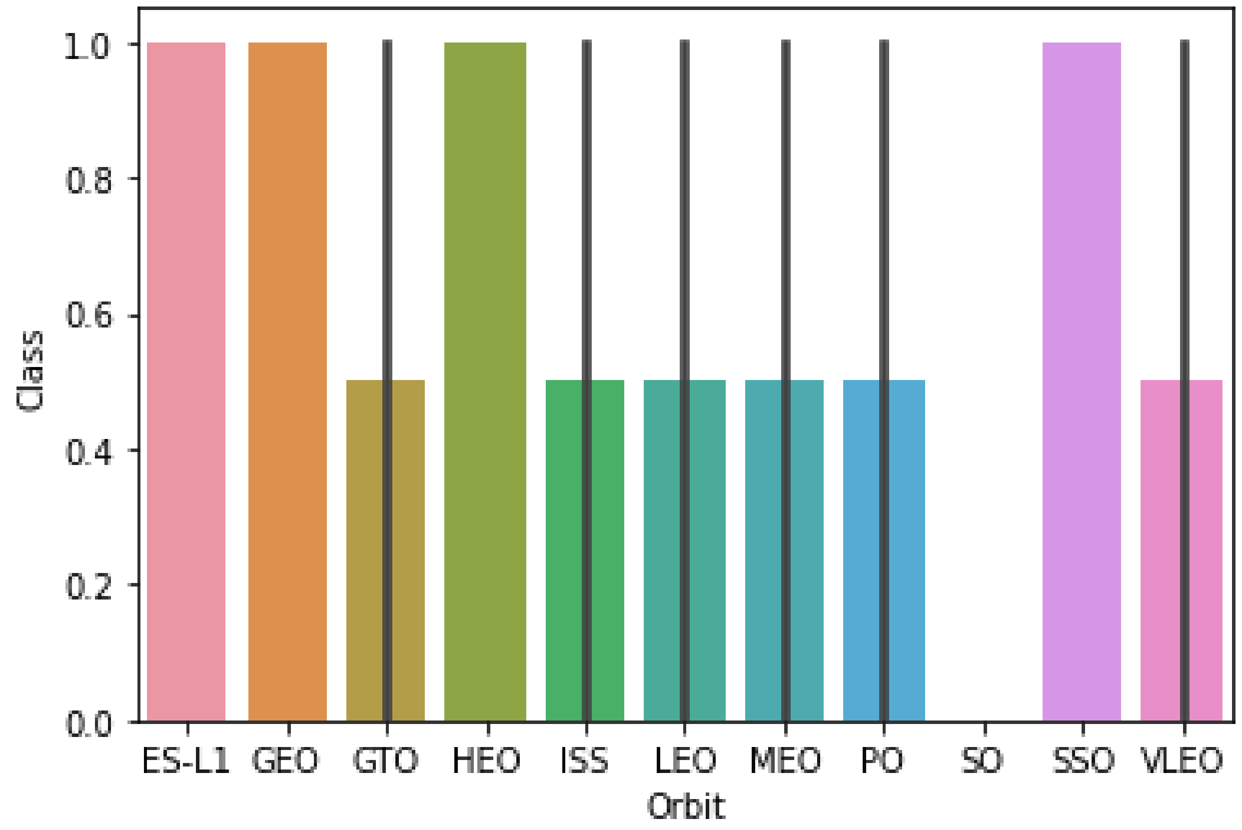
- Show a scatter plot of Payload vs. Launch Site
- Show the screenshot of the scatter plot with explanations



Success Rate vs. Orbit Type

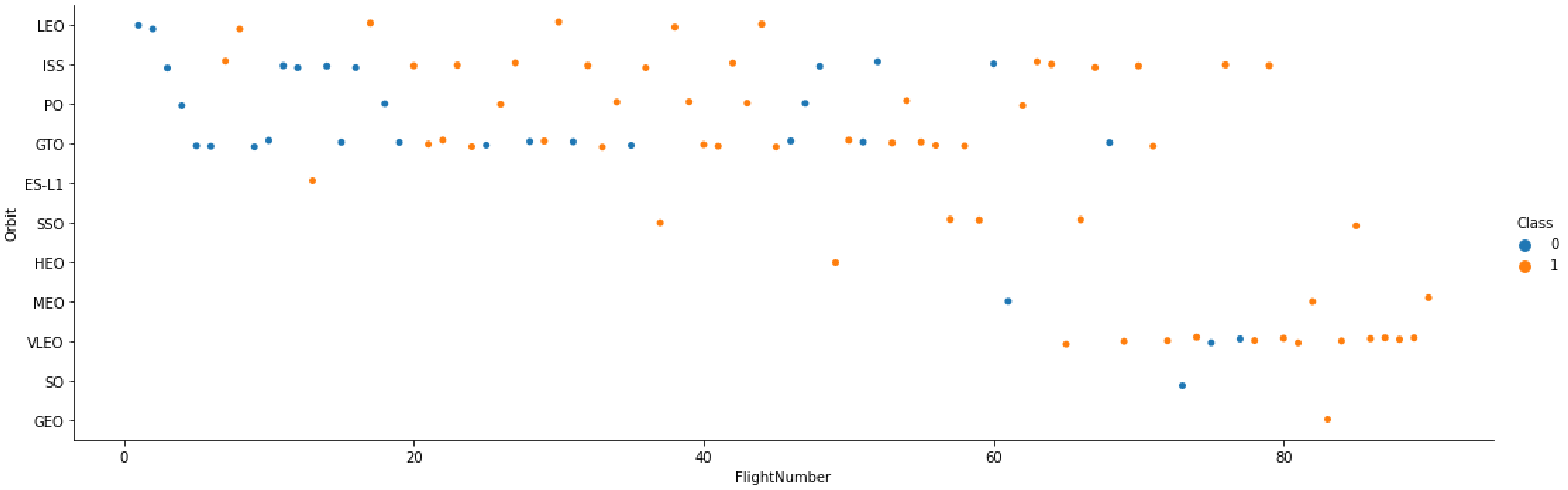
- ES-L1,GEO,HEO,SSO are the best orbits

- Show the screenshot of the scatter plot with explanations



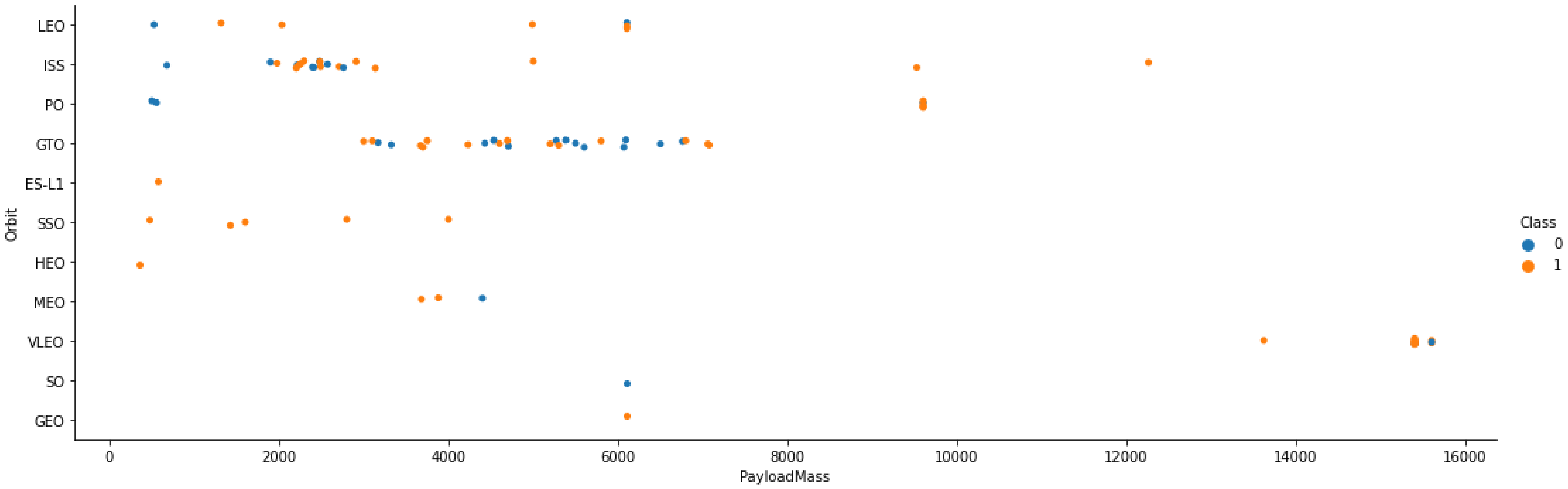
Flight Number vs. Orbit Type

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



Payload vs. Orbit Type

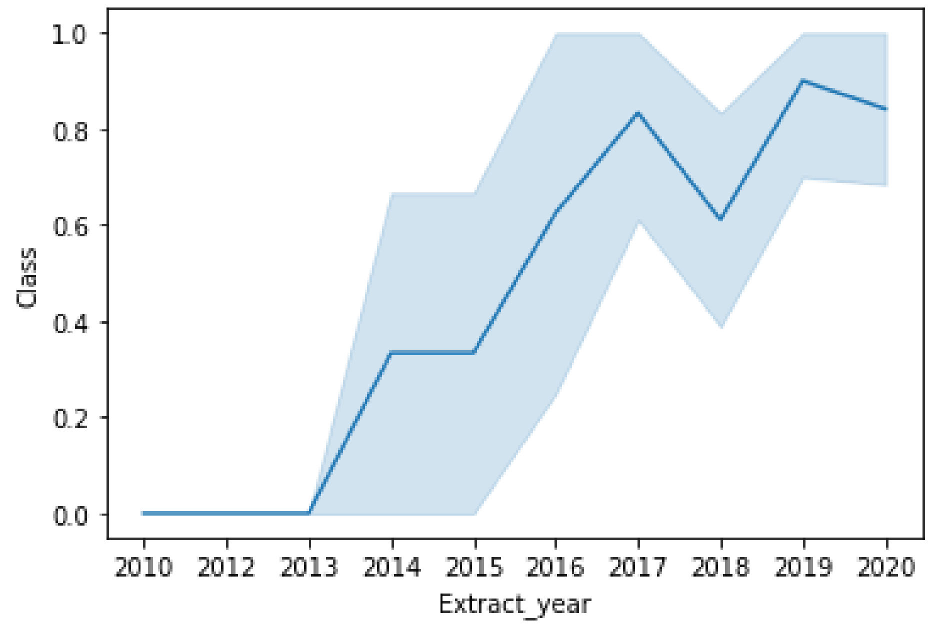
- Show a scatter point of payload vs. orbit type
- Show the screenshot of the scatter plot with explanations



Launch Success Yearly Trend

- the success of the launches has always been increasing except in 2018 but has immediately started to grow again

- Show the screenshot of the scatter plot with explanations



All Launch Site Names

- Find the names of the unique launch sites
- Present your query result with a short explanation here

	launchsite
0	KSC LC-39A
1	CCAFS LC-40
2	CCAFS SLC-40
3	VAFB SLC-4E

Launch Site Names Begin with 'CCA'

- Find 5 records where launch sites begin with `CCA`
- Present your query result with a short explanation here

	date	time	boosterversion	launchsite	payload	payloadmasskg	orbit	customer	missionoutcome	landingoutcome
0	2010-04-06	18:45:00	F9 v1.0 B0003	CCAFS LC-40	Dragon Spacecraft Qualification Unit	0	LEO	SpaceX	Success	Failure (parachute)
1	2010-08-12	15:43:00	F9 v1.0 B0004	CCAFS LC-40	Dragon demo flight C1, two CubeSats, barrel of...	0	LEO (ISS)	NASA (COTS) NRO	Success	Failure (parachute)
2	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
3	2012-08-10	00:35:00	F9 v1.0 B0006	CCAFS LC-40	SpaceX CRS-1	500	LEO (ISS)	NASA (CRS)	Success	No attempt
4	2013-01-03	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
- Present your query result with a short explanation here

	total_payloadmass
0	45596

Average Payload Mass by F9 v1.1

	avg_payloadmass
0	2928.4

- Calculate the average payload mass carried by booster version F9 v1.1
- Present your query result with a short explanation here

First Successful Ground Landing Date

- Find the dates of the first successful landing outcome on ground pad
- Present your query result with a short explanation here

	firstsuccessfull_landing_date
0	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
- Present your query result with a short explanation here

	boosterversion
0	F9 FT B1022
1	F9 FT B1026
2	F9 FT B1021.2
3	F9 FT B1031.2

Total Number of Successful and Failure Mission Outcomes

- Calculate the total number of successful and failure mission outcomes
- Present your query result with a short explanation here

```
The total number of successful mission outcome is:
```

	successoutcome
0	100

```
The total number of failed mission outcome is:
```

	failureoutcome
0	1

Boosters Carried Maximum Payload

- List the names of the booster which have carried the maximum payload mass
- Present your query result with a short explanation here

	boosterversion	payloadmasskg
0	F9 B5 B1048.4	15600
1	F9 B5 B1048.5	15600
2	F9 B5 B1049.4	15600
3	F9 B5 B1049.5	15600
4	F9 B5 B1049.7	15600
5	F9 B5 B1051.3	15600
6	F9 B5 B1051.4	15600
7	F9 B5 B1051.6	15600
8	F9 B5 B1056.4	15600
9	F9 B5 B1058.3	15600
10	F9 B5 B1060.2	15600
11	F9 B5 B1060.3	15600

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

	boosterversion	launchsite	landingoutcome
0	F9 v1.1 B1012	CCAFS LC-40	Failure (drone ship)
1	F9 v1.1 B1015	CCAFS LC-40	Failure (drone ship)

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

- Present your query result with a short explanation here

	landingoutcome	count
0	No attempt	10
1	Success (drone ship)	6
2	Failure (drone ship)	5
3	Success (ground pad)	5
4	Controlled (ocean)	3
5	Uncontrolled (ocean)	2
6	Precluded (drone ship)	1
7	Failure (parachute)	1

Section 3

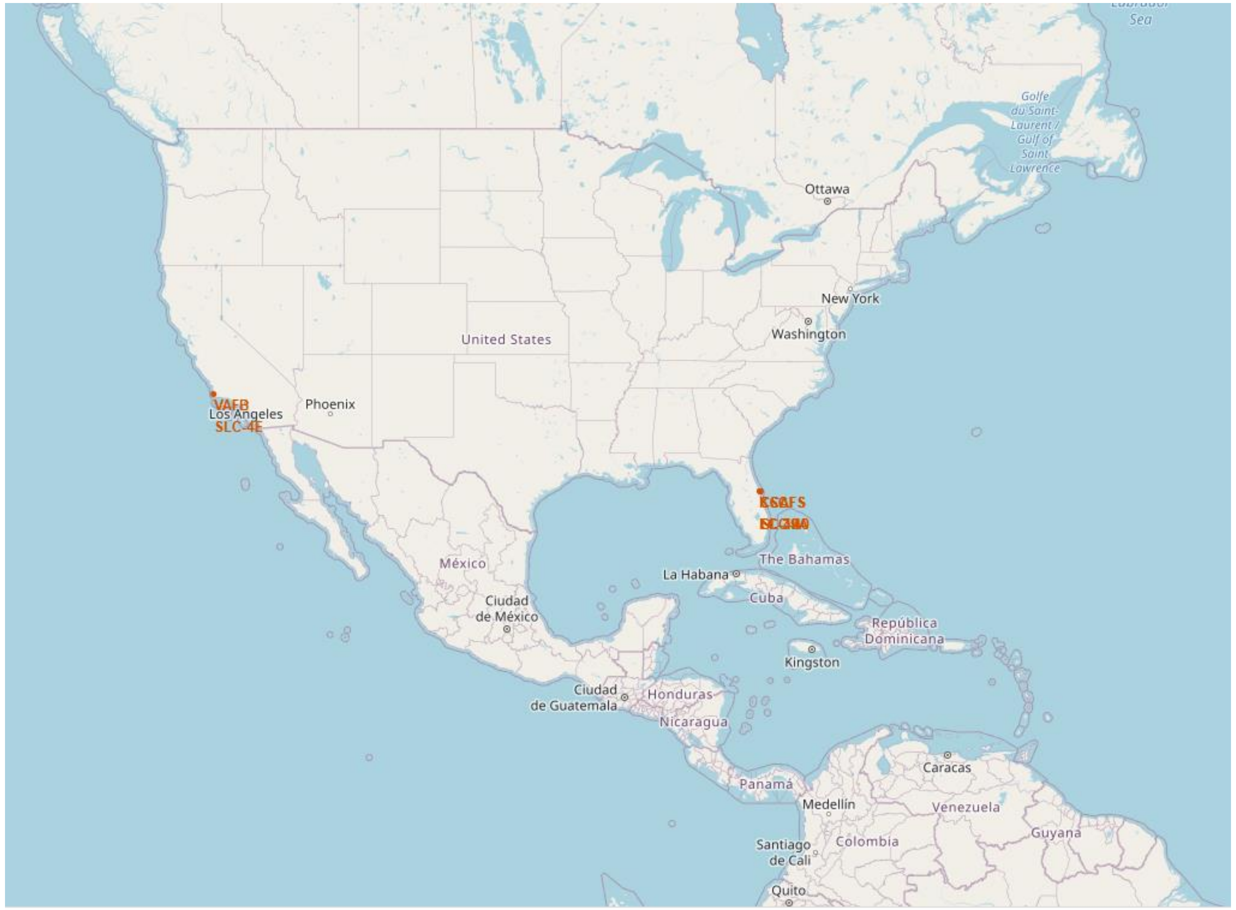
Launch Sites Proximities Analysis

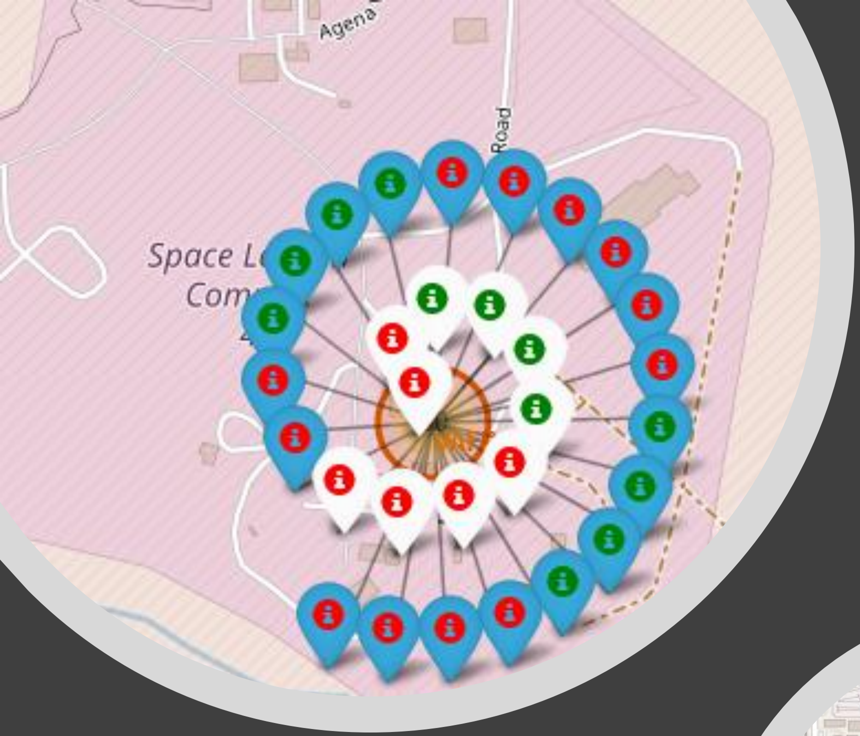
Launch site space x

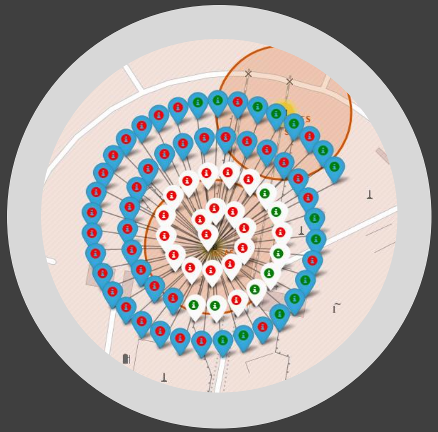
- Replace <Folium map screenshot 1> title with an appropriate title

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

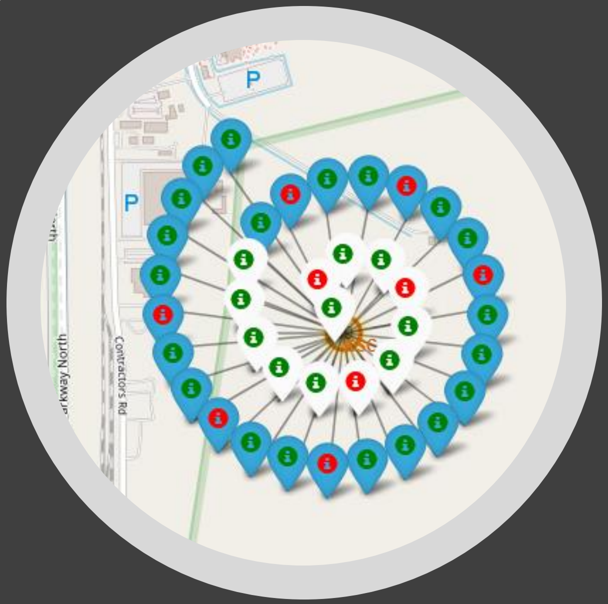
- Explain the important elements and findings on the screenshot

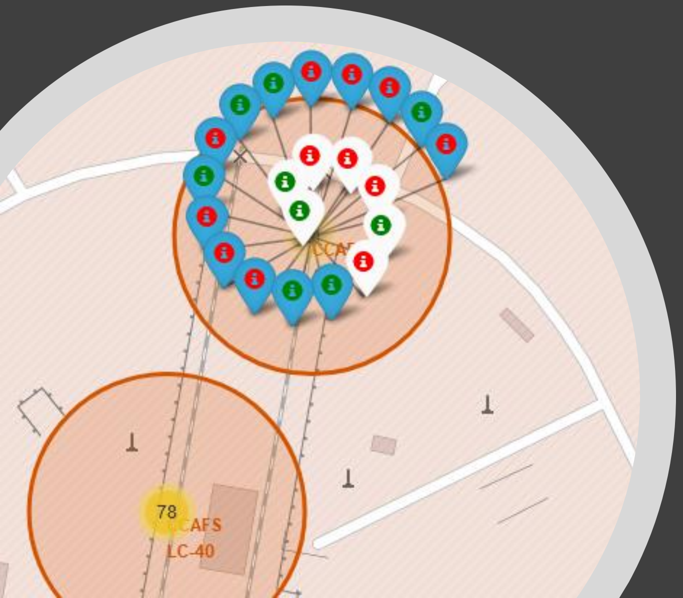




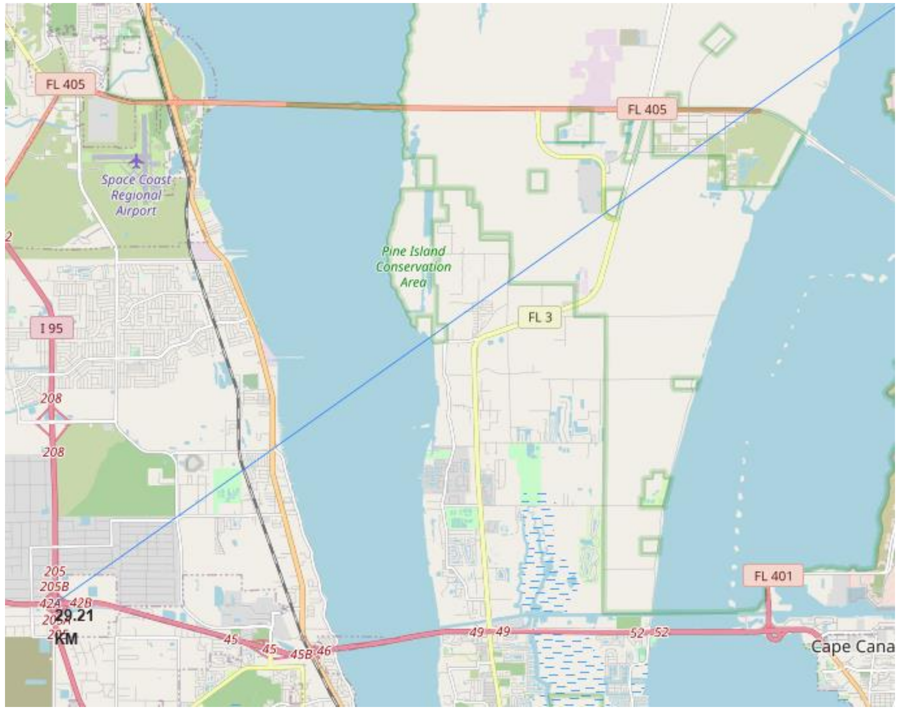


color-labeled launch outcomes on the map





- 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



launch site to its proximities such as railway

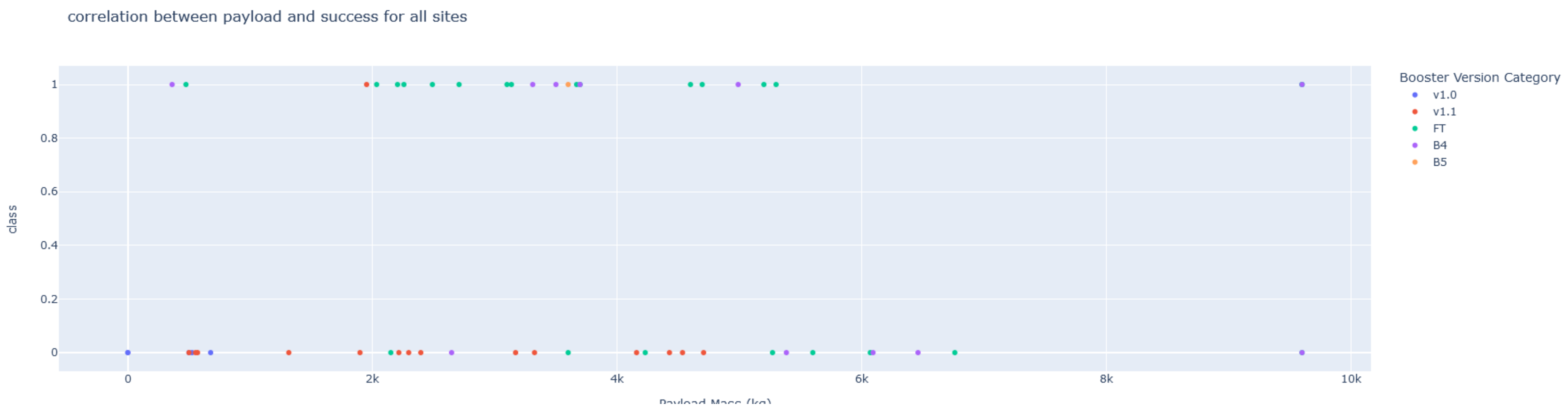
- Replace <Folium map screenshot 3> title with an appropriate title
- Explore the generated folium map and show the screenshot of a selected launch site to its proximities such as railway, highway, coastline, with distance calculated and displayed
- Explain the important elements and findings on the screenshot

Section 4

Build a Dashboard with Plotly Dash

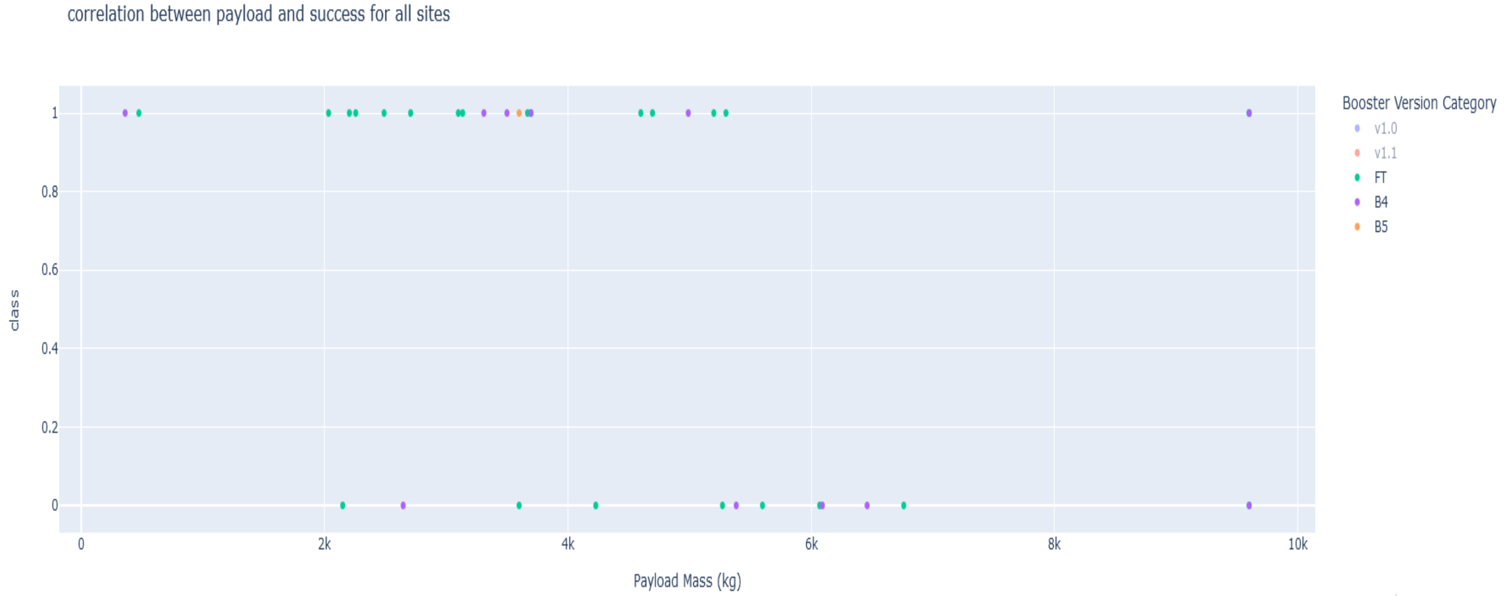
Launch success for all site

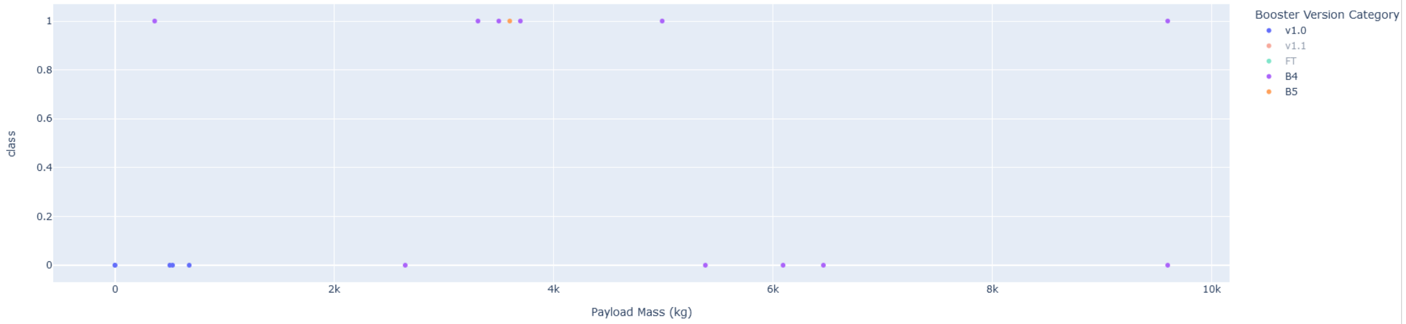
- Replace <Dashboard screenshot 1> title with an appropriate title
- Show the screenshot of launch success count for all sites, in a piechart
- KSC is the best site



launch site with highest launch success ratio

- 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



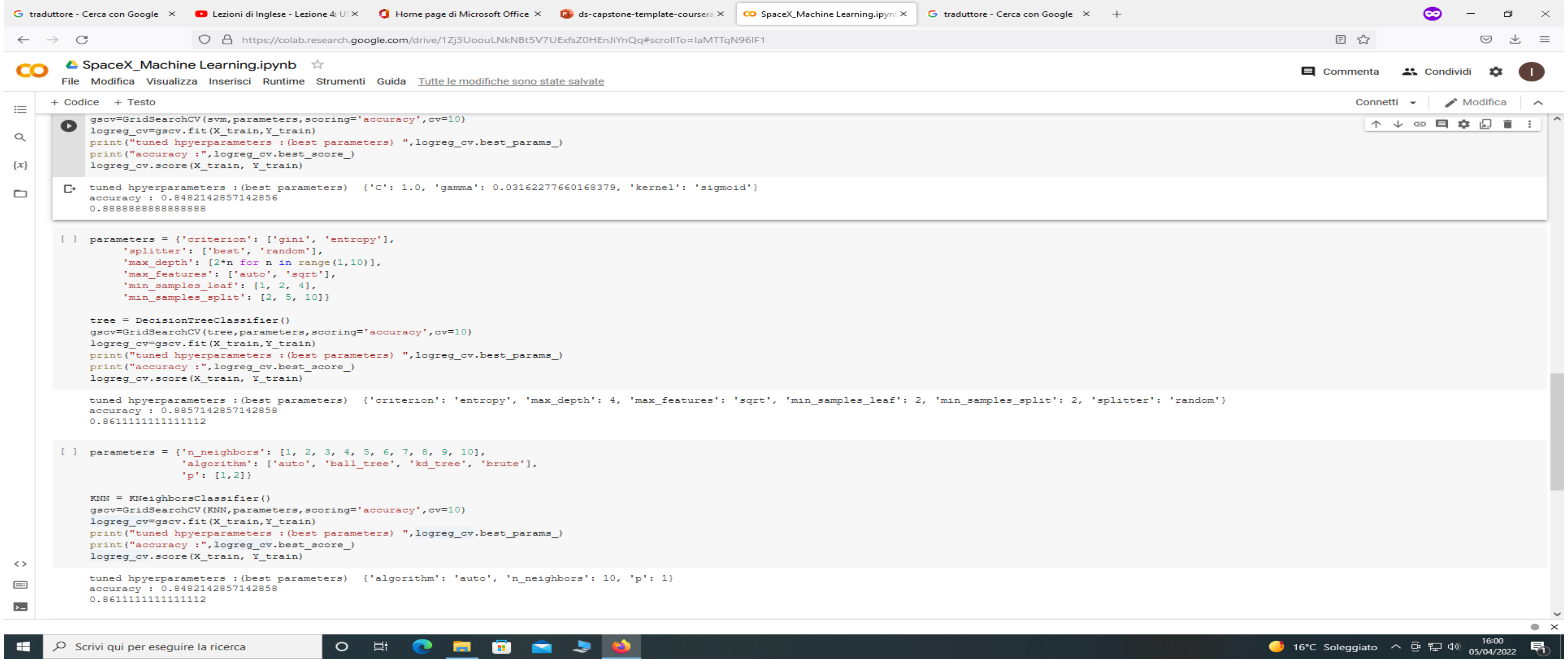


- **payload selected in the range slider**

- 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.

Section 5

Predictive Analysis (Classification)



```
gscv=GridSearchCV(svm,parameters,scoring='accuracy',cv=10)
logreg_cv=gscv.fit(X_train,Y_train)
print("tuned hpyerparameters :(best parameters) ",logreg_cv.best_params_)
print("accuracy :",logreg_cv.best_score_)
logreg_cv.score(X_train, Y_train)
```

```
tuned hpyerparameters :(best parameters)  {'C': 1.0, 'gamma': 0.03162277660168379, 'kernel': 'sigmoid'}
accuracy : 0.8482142857142856
0.8888888888888888
```

```
parameters = {'criterion': ['gini', 'entropy'],
     'splitter': ['best', 'random'],
     'max_depth': [2*n for n in range(1,10)],
     'max_features': ['auto', 'sqrt'],
     'min_samples_leaf': [1, 2, 4],
     'min_samples_split': [2, 5, 10]}

tree = DecisionTreeClassifier()
gscv=GridSearchCV(tree,parameters,scoring='accuracy',cv=10)
logreg_cv=gscv.fit(X_train,Y_train)
print("tuned hpyerparameters :(best parameters) ",logreg_cv.best_params_)
print("accuracy :",logreg_cv.best_score_)
logreg_cv.score(X_train, Y_train)
```

```
tuned hpyerparameters :(best parameters)  {'criterion': 'entropy', 'max_depth': 4, 'max_features': 'sqrt', 'min_samples_leaf': 2, 'min_samples_split': 2, 'splitter': 'random'}
accuracy : 0.8857142857142858
0.8611111111111112
```

```
parameters = {'n_neighbors': [1, 2, 3, 4, 5, 6, 7, 8, 9, 10],
              'algorithm': ['auto', 'ball_tree', 'kd_tree', 'brute'],
              'p': [1,2]}

KNN = KNeighborsClassifier()
gscv=GridSearchCV(KNN,parameters,scoring='accuracy',cv=10)
logreg_cv=gscv.fit(X_train,Y_train)
print("tuned hpyerparameters :(best parameters) ",logreg_cv.best_params_)
print("accuracy :",logreg_cv.best_score_)
logreg_cv.score(X_train, Y_train)
```

```
tuned hpyerparameters :(best parameters)  {'algorithm': 'auto', 'n_neighbors': 10, 'p': 1}
accuracy : 0.8482142857142858
0.8611111111111112
```

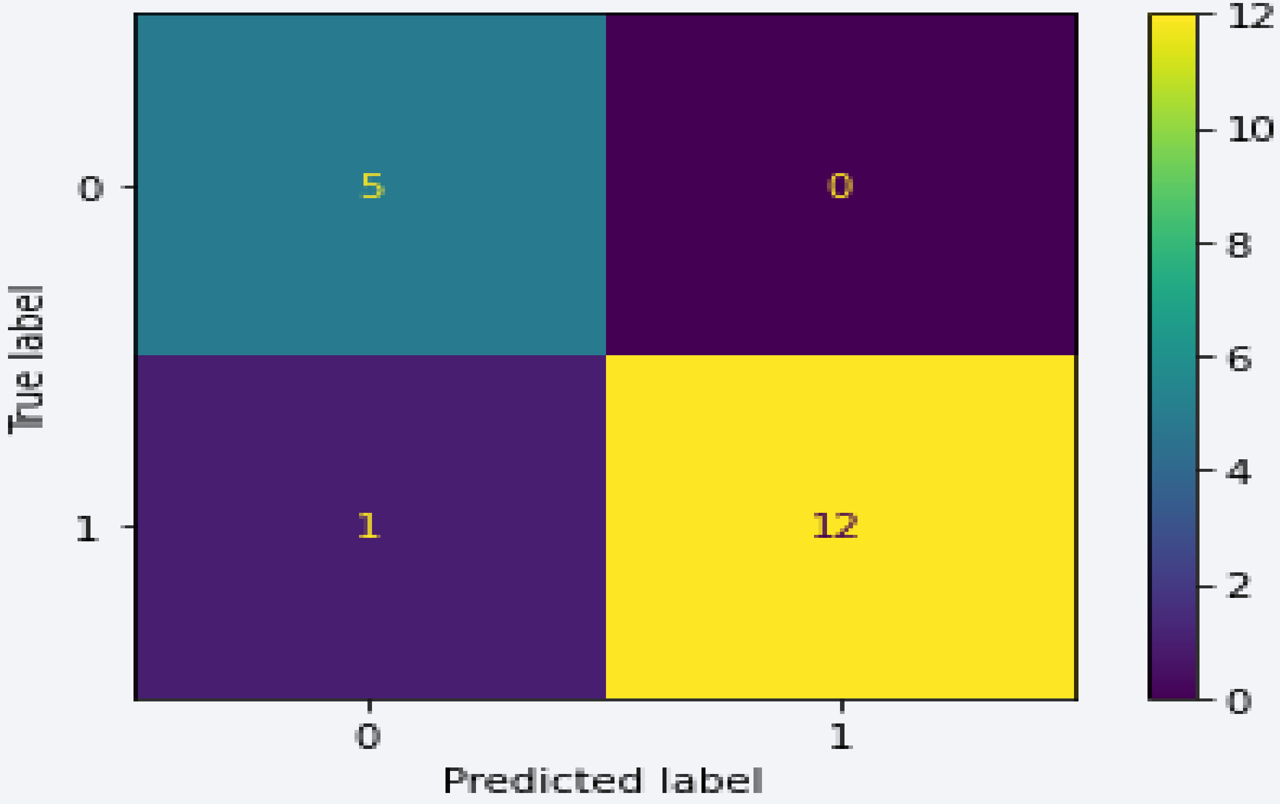
Classification Accuracy

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

- The best accuracy is DecisionTreeClassifier with an accuracy of 0.8857142857142858

Confusion Matrix

- Show the confusion matrix of the best performing model with an explanation



Conclusions

- space x has been increasing its successful rocket launch since 2013
- KSC LC-39A is the best site for successful launches
- Es-L1,GEO,HEO,SSO are the best orbits
- Decision Tree classifier is the best algorithm for this situation

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!