Winning Space Race with Data Science

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Outline

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

Executive Summary

- Summary of methodologies
- 1. from problem to approach
- 2. working with the data
- 3. Deriving the answer
- Summary of all results

Introduction

- Project background and context
- The commercial space age is here, companies are making space travel affordable for everyone. The most successful is SpaceX. Now SpaceY want to compete with it.
- Problems you want to find answers

- You will also determine if SpaceX will reuse the first stage.
- Instead of using rocket science to determine if the first stage will land successfully,
- you will train a machine learning model and use public information to predict if SpaceX
- will reuse the first stage.

Section 1

Methodology

Methodology

Executive Summary

- Data collection methodology:
  - Make a get request to SpaceX API
- Perform data wrangling
  - Using Mean value of PayloadMass to replace it's the missing value
- 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.

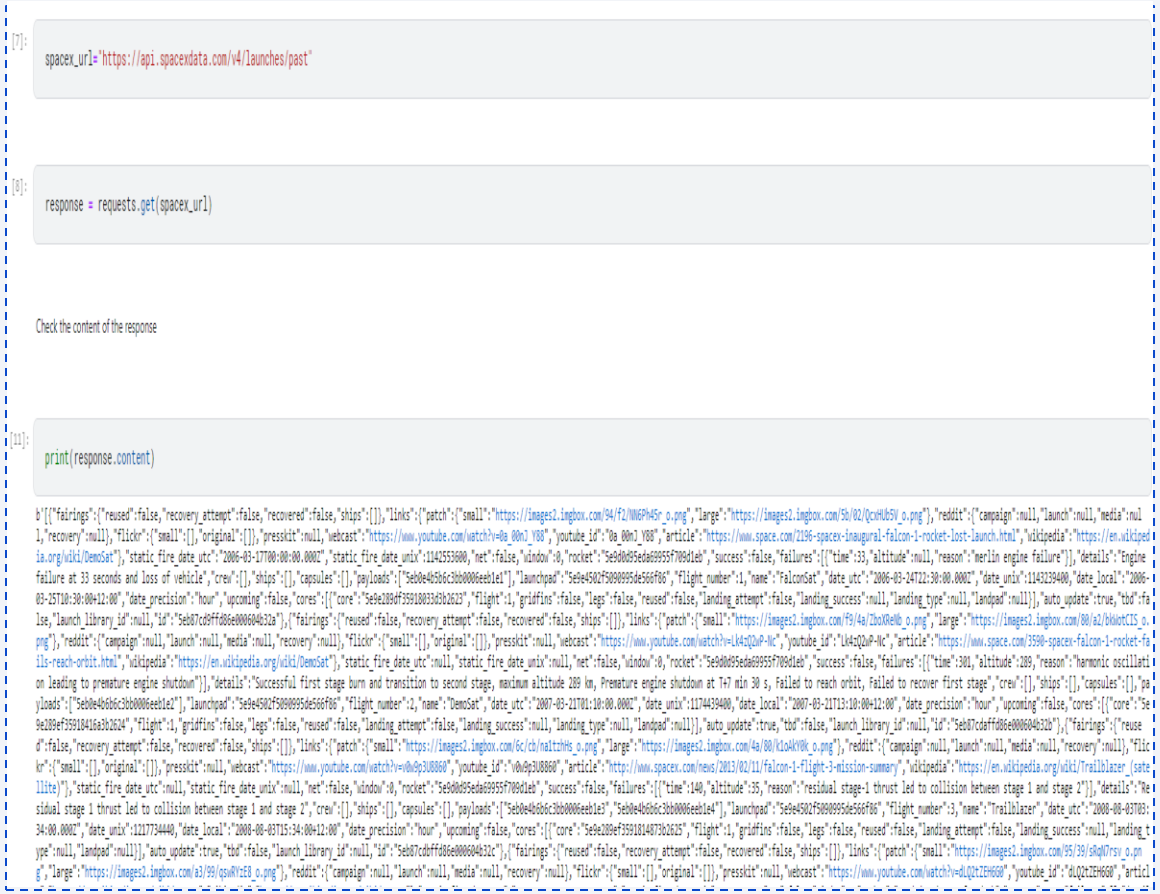
1.Request and parse the SpaceX launch data using the GET request

2. Filter the DataFrame to only include `Falcon 9` launches

3. Dealing with missing value(using mean value to replace the missing)

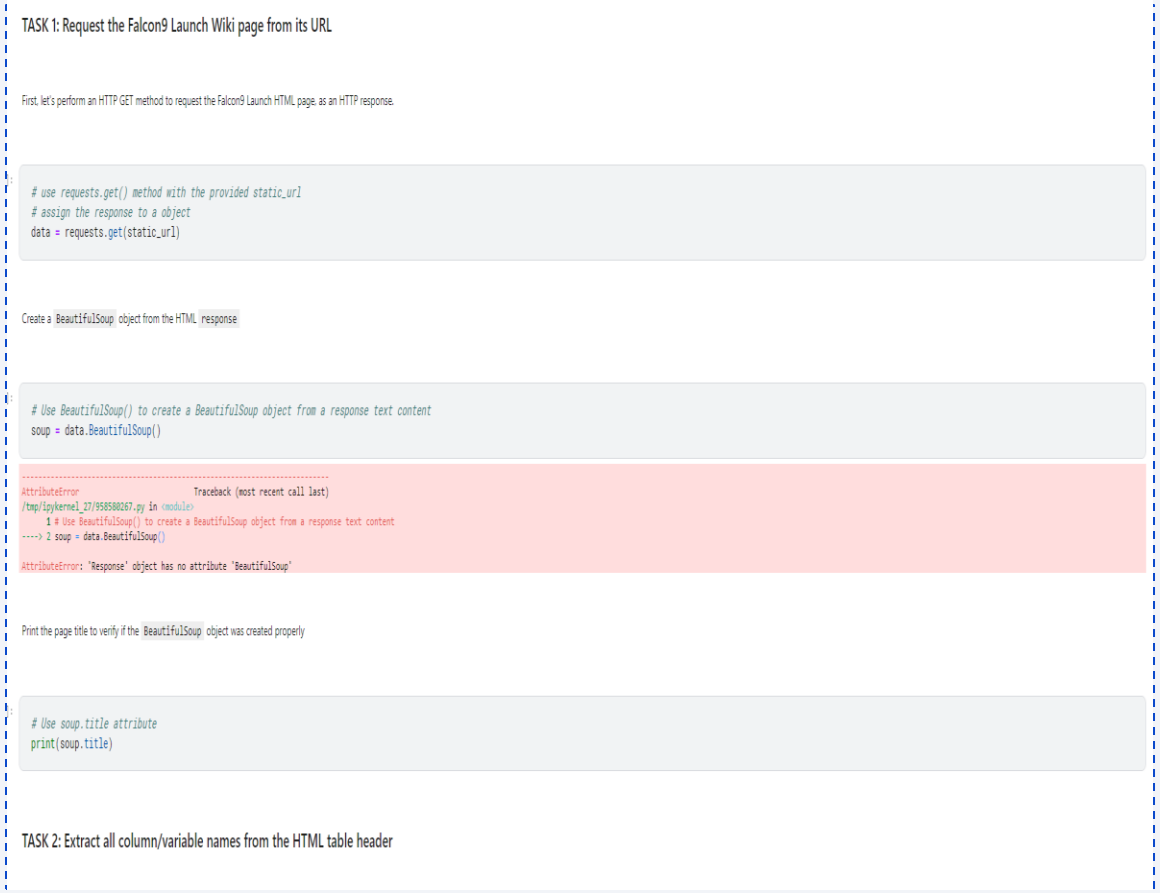
Data Collection – SpaceX API

- Present your data collection with SpaceX REST calls using key phrases and flowcharts
- Add the GitHub URL of the completed SpaceX API calls notebook , as an external reference and peer-review purpose
- https://github.com/tanglily08/IBM-data-science-final-project/blob/c8eb934d06a503b6ea7fb050e491a887669f15bd/spacex-collecting-date-ds-final1%20(2).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/tanglily08/IBM-data-science-final-project/blob/c8eb934d06a503b6ea7fb050e491a887669f15bd/webscraping-datascience-final2.ipynb



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.

```
# use requests.get() method with the provided static_url
# assign the response to a object
data = requests.get(static_url)
```

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

```
# Use BeautifulSoup() to create a BeautifulSoup object from a response text content
soup = data.BeautifulSoup()
```

```
AttributeError                            Traceback (most recent call last)
/tmp/ipykernel_27/958580267.py in <module>
      1 # Use BeautifulSoup() to create a BeautifulSoup object from a response text content
----> 2 soup = data.BeautifulSoup()

AttributeError: 'Response' object has no attribute 'BeautifulSoup'
```

Print the page title to verify if the `BeautifulSoup` object was created properly

```
# Use soup.title attribute
print(soup.title)
```

TASK 2: Extract all column/variable names from the HTML table header

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

- https://github.com/tanglily08/IBM-data-science-final-project/blob/c8eb934d06a503b6ea7fb050e491a887669f15bd/labs-jupyter-spacex-Data%20wrangling.ipynb

EDA with Data Visualization

- Summarize what charts were plotted and why you used those charts

1. Catplot
2. Barplot
3. Scatterplot
4. Lineplot

- Add the GitHub URL of your completed EDA with data visualization notebook, as an external reference and peer-review purpose

- https://github.com/tanglily08/IBM-data-science-final-project/blob/c8eb934d06a503b6ea7fb050e491a887669f15bd/spacex-explor-prepare-data-datascience-final4.ipynb

EDA with SQL

- Using bullet point format, summarize the SQL queries you performed

1. selectQuery = "select launchsite from spacex"
2. selectQuery2 = "select launchsite from spacex where launchsite='CCA%' limit 5"
3. selectQuery3 = "select sum(PAYLOAD_MASS__KG_) as sum_of_payload_mass from spacex_new "
4. selectQuery4 = "select avg(payload_mass__kg_) as average_payload_mass_by_F9v1_1 from spacex_new where booster_version = 'F9 v1.1'"
5. selectQuery5 = "select min(date) as first_success_landing from spacex_new where landingoutcome='Success'"
6. selectQuery6 = "select booster_version from spacex_new where landingoutcome='Success (drone ship)' and (payload_mass__kg_>4000 and payload_mass__kg_<6000)"
7. selectQuery7 = "select mission_outcome, count(mission_outcome) from spacex_new group by mission_outcome"
8. selectQuery8 = "select booster_version from spacex_new where payload_mass__kg_ =(select max(payload_mass__kg_) from spacex_new)"
9. selectQuery9 = "select booster_version,launch_site from spacex_new where YEAR(date)=2015 and landingoutcome= 'Failure (drone ship)'"
10. selectQuery10 = "select landingoutcome as landing_outcome, count(landingoutcome) as count_landing_outcome from spacex_new where date between '2010-06-04' and '2017-03-20' group by landingoutcome order by count(landingoutcome) desc"

- Add the GitHub URL of your completed EDA with SQL notebook, as an external reference and peer-review purpose

- https://github.com/tanglily08/IBM-data-science-final-project/blob/c8eb934d06a503b6ea7fb050e491a887669f15bd/sql-notebook-datascience-final.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
- I added markers and cirlcels.
- Explain why you added those objects
- Add the GitHub URL of your completed interactive map with Folium map, as an external reference and peer-review purpose
- https://github.com/tanglily08/IBM-data-science-final-project/blob/c8eb934d06a503b6ea7fb050e491a887669f15bd/interactive-visual-analytics-datascience-final5.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

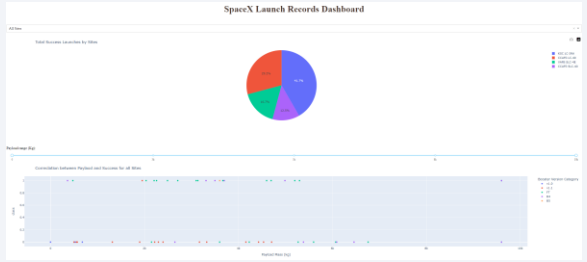
- https://github.com/tanglily08/IBM-data-science-final-project/blob/c8eb934d06a503b6ea7fb050e491a887669f15bd/spacex_dash_app.py

Predictive Analysis (Classification)

- Summarize how you built, evaluated, improved, and found the best performing classification model
- KNN Regression performs best
- 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
- https://github.com/tanglily08/IBM-data-science-final-project/blob/040bb1c94f9eb0da532011ded55c65da144a573f/spacex-ml-prediction-datascience-final7.ipynb

Results

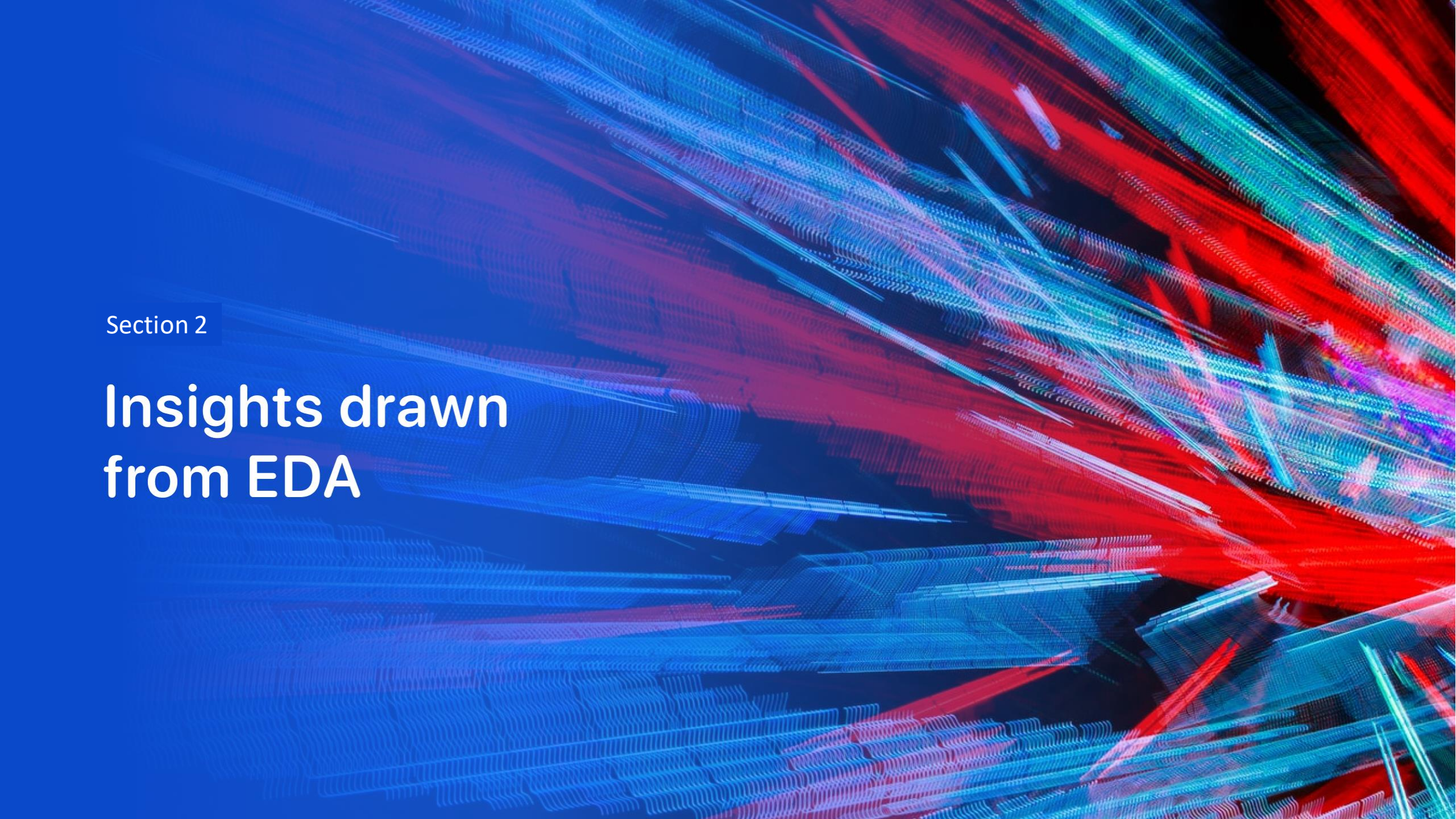
- Exploratory data analysis results
- Logistic Regression performs best, because it got highest score, 1.
- Interactive analytics demo in screenshots



- Predictive analysis results

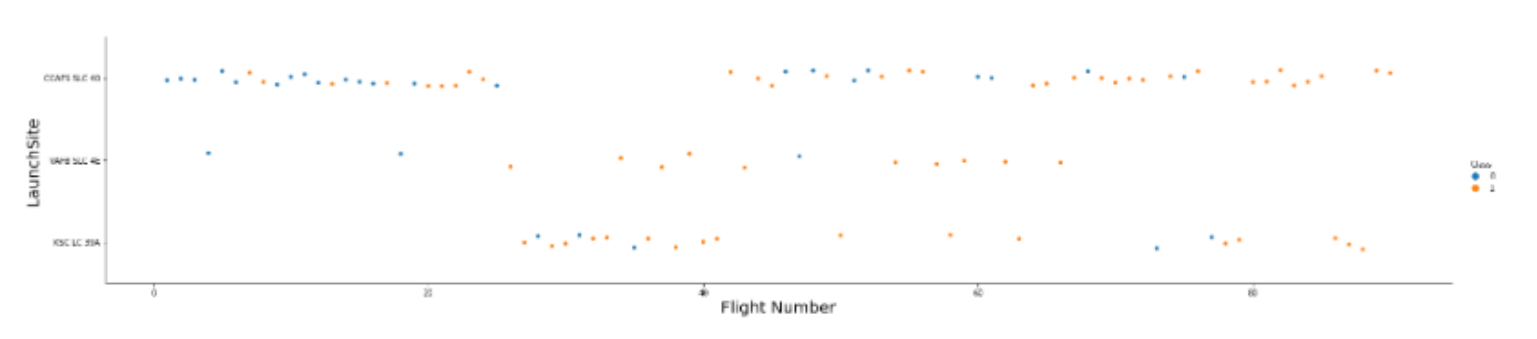
Section 2

Insights drawn from EDA



Flight Number vs. Launch Site

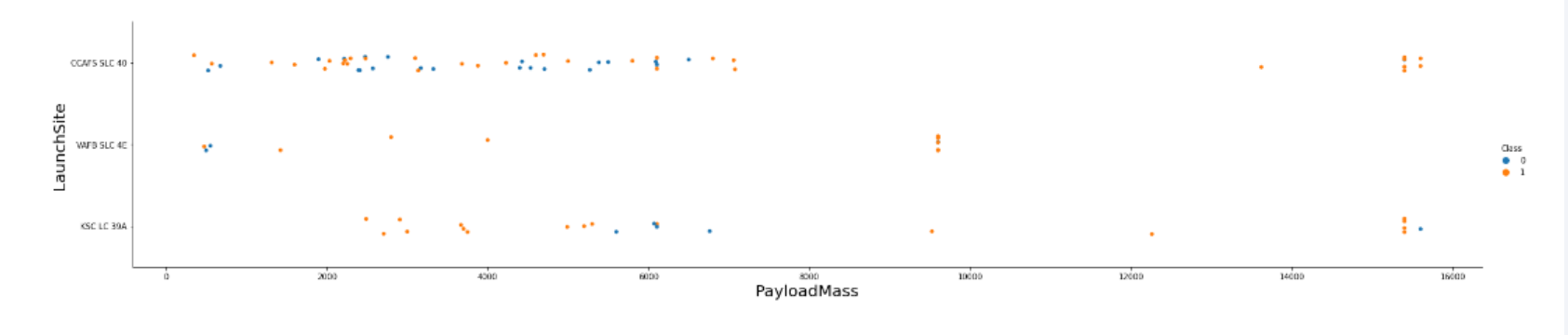
- Show a scatter plot of Flight Number vs. Launch Site



- Show the screenshot of the scatter plot with explanations

Payload vs. Launch Site

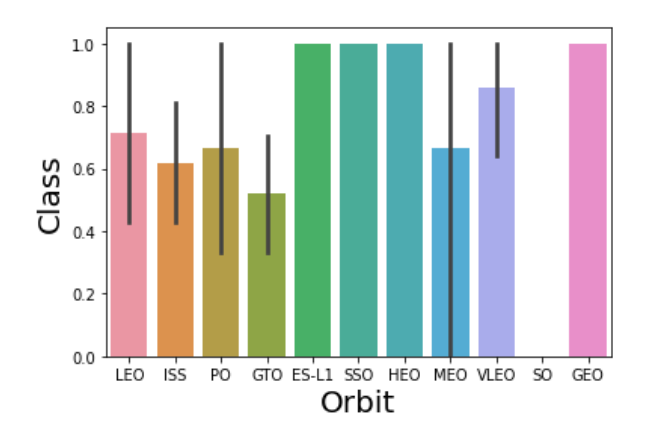
- Show a scatter plot of Payload vs. Launch Site



- Show the screenshot of the scatter plot with explanations

Success Rate vs. Orbit Type

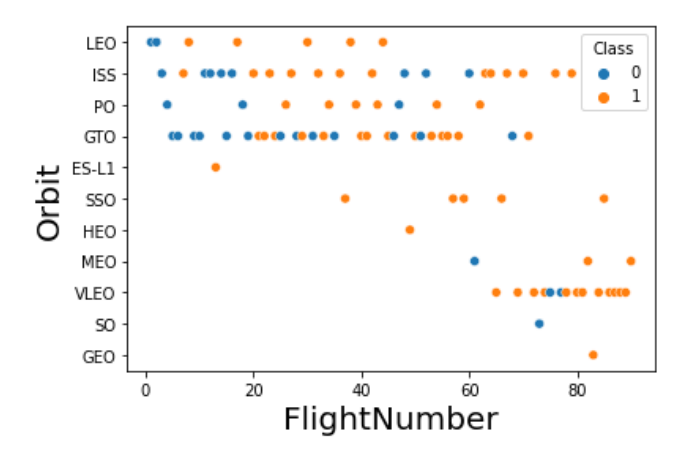
- Show a bar chart for the success rate of each orbit type



- Show the screenshot of the scatter plot with explanations

Flight Number vs. Orbit Type

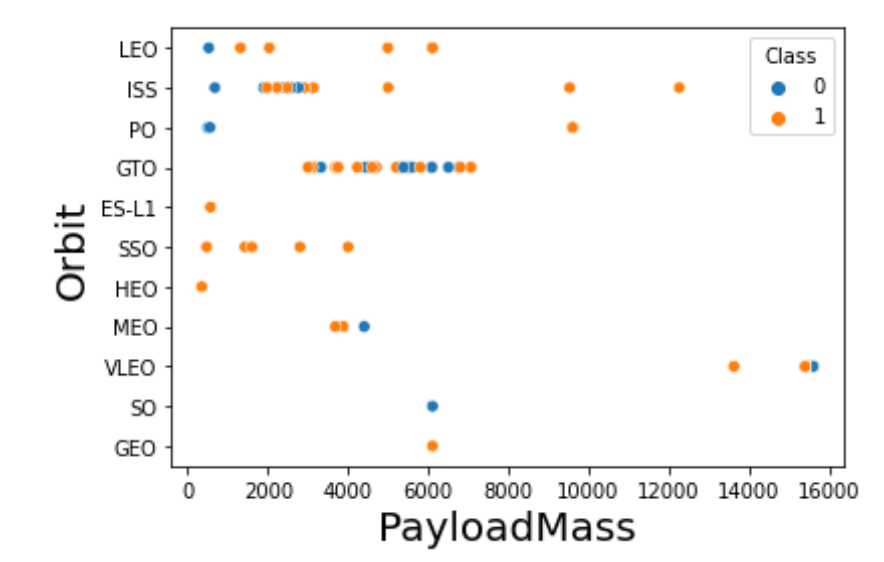
- Show a scatter point of Flight number vs. Orbit type



- Show the screenshot of the scatter plot with explanations

Payload vs. Orbit Type

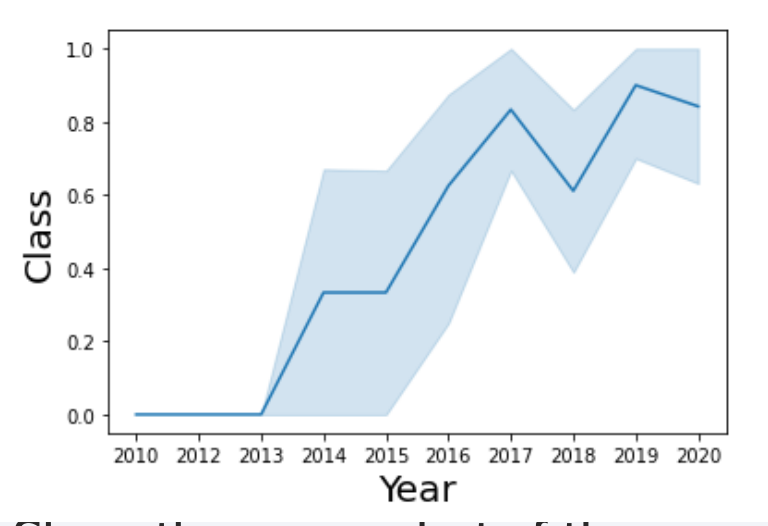
- Show a scatter point of payload vs. orbit type



- Show the screenshot of the scatter plot with explanations

Launch Success Yearly Trend

- Show a line chart of yearly average success rate



- Show the screenshot of the scatter plot with explanations

All Launch Site Names

- Find the names of the unique launch sites

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

- Present your query result with a short explanation here

Launch Site Names Begin with 'CCA'

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

17]:

	DATE	TIME_UTC_	BOOSTER_VERSION	LAUNCH_SITE	PAYLOAD	PAYLOAD_MASS__KG_	ORBIT	CUSTOMER	MISSION_OUTCOME	LANDINGOUTCOME
0	1974-04-02	18:45:00	F9 v1.0 B0003	CCAFS LC-40	Dragon Spacecraft Qualification Unit	0	LEO	SpaceX	Success	Failure (parachute)
1	2002-04-04	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	7:44:00	F9 v1.0 B0005	CCAFS LC-40	Dragon demo flight C2	525	LEO (ISS)	NASA (COTS)	Success	No attempt
3	1931-04-11	0:35:00	F9 v1.0 B0006	CCAFS LC-40	SpaceX CRS-1	500	LEO (ISS)	NASA (CRS)	Success	No attempt
4	1977-04-12	15:10:00	F9 v1.0 B0007	CCAFS LC-40	SpaceX CRS-2	677	LEO (ISS)	NASA (CRS)	Success	No attempt

- Present your query result with a short explanation here

Total Payload Mass

- Calculate the total payload carried by boosters from NASA

SUM_OF_PAYLOAD_MASS
619967

- Present your query result with a short explanation here

Average Payload Mass by F9 v1.1

- Calculate the average payload mass carried by booster version F9 v1.1

AVERAGE_PAYLOAD_MASS_BY_F9V1_1
2928

- 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

FIRST_SUCCESS_LANDING
2018-03-12

- Present your query result with a short explanation here

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

- Present your query result with a short explanation here

Total Number of Successful and Failure Mission Outcomes

- Calculate the total number of successful and failure mission outcomes

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

- Present your query result with a short explanation here

Boosters Carried Maximum Payload

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

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

- Present your query result with a short explanation here

2015 Launch Records

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

BOOSTER_VERSION	LAUNCH_SITE
F9 v1.1 B1015	CCAFS LC-40

- 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

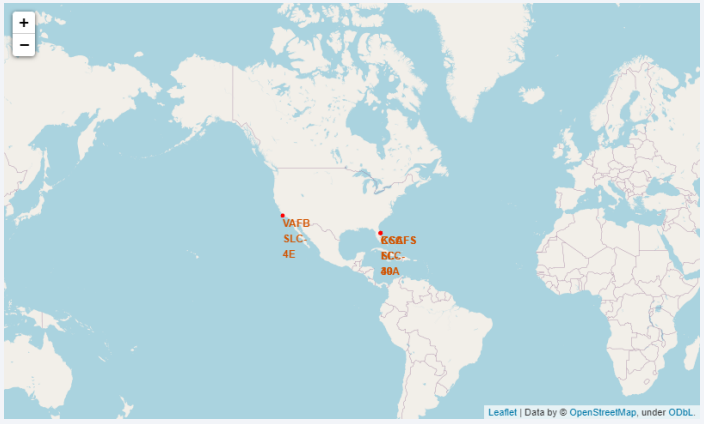
	LANDING_OUTCOME	COUNT_LANDING_OUTCOME
0	Failure (drone ship)	3
1	No attempt	3
2	Success (drone ship)	3
3	Success (ground pad)	3
4	Controlled (ocean)	2
5	Uncontrolled (ocean)	2
6	Precluded (drone ship)	1

- Present your query result with a short explanation here


Section 3
Launch Sites
Proximities Analysis

<All US Launchsite>

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

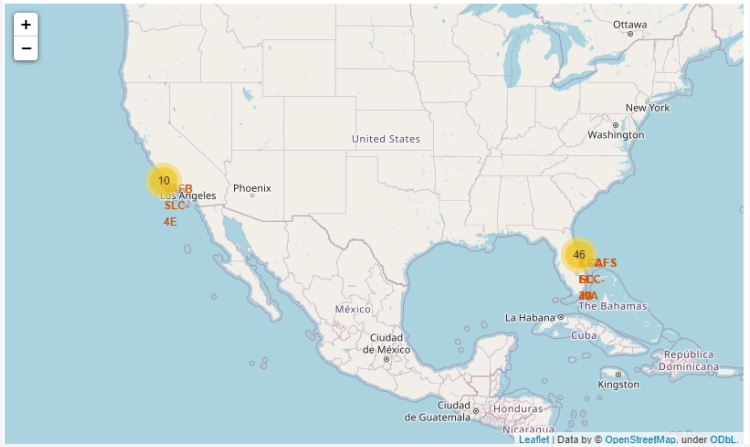


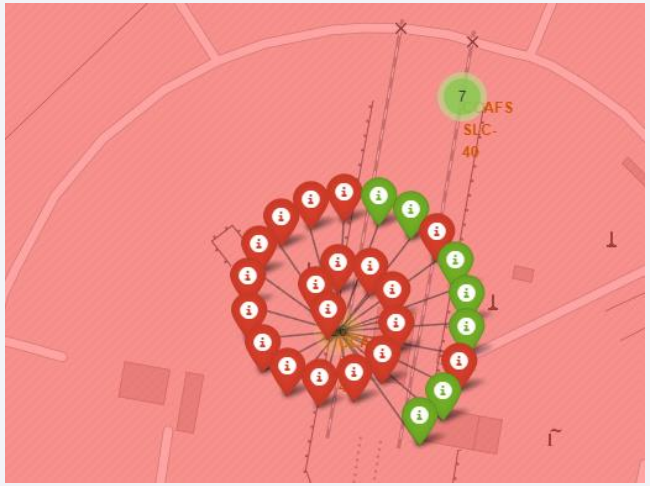
- Explain the important elements and findings on the screenshot

- All launch sites are close to ocean.

<Launch sites with success marker>

- Explore the folium map and make a proper screenshot to show the color-labeled launch outcomes on the map



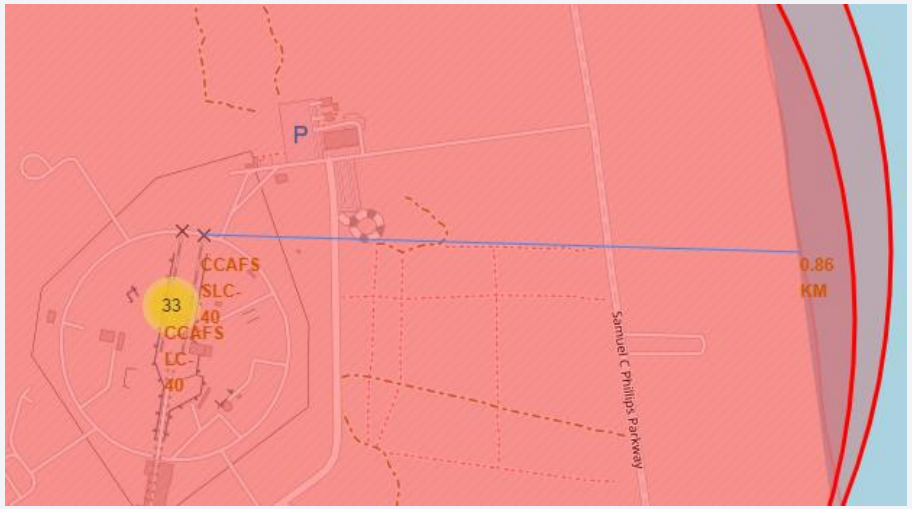


- Explain the important elements and findings on the screenshot

- KCFS-39 site has the most success rate

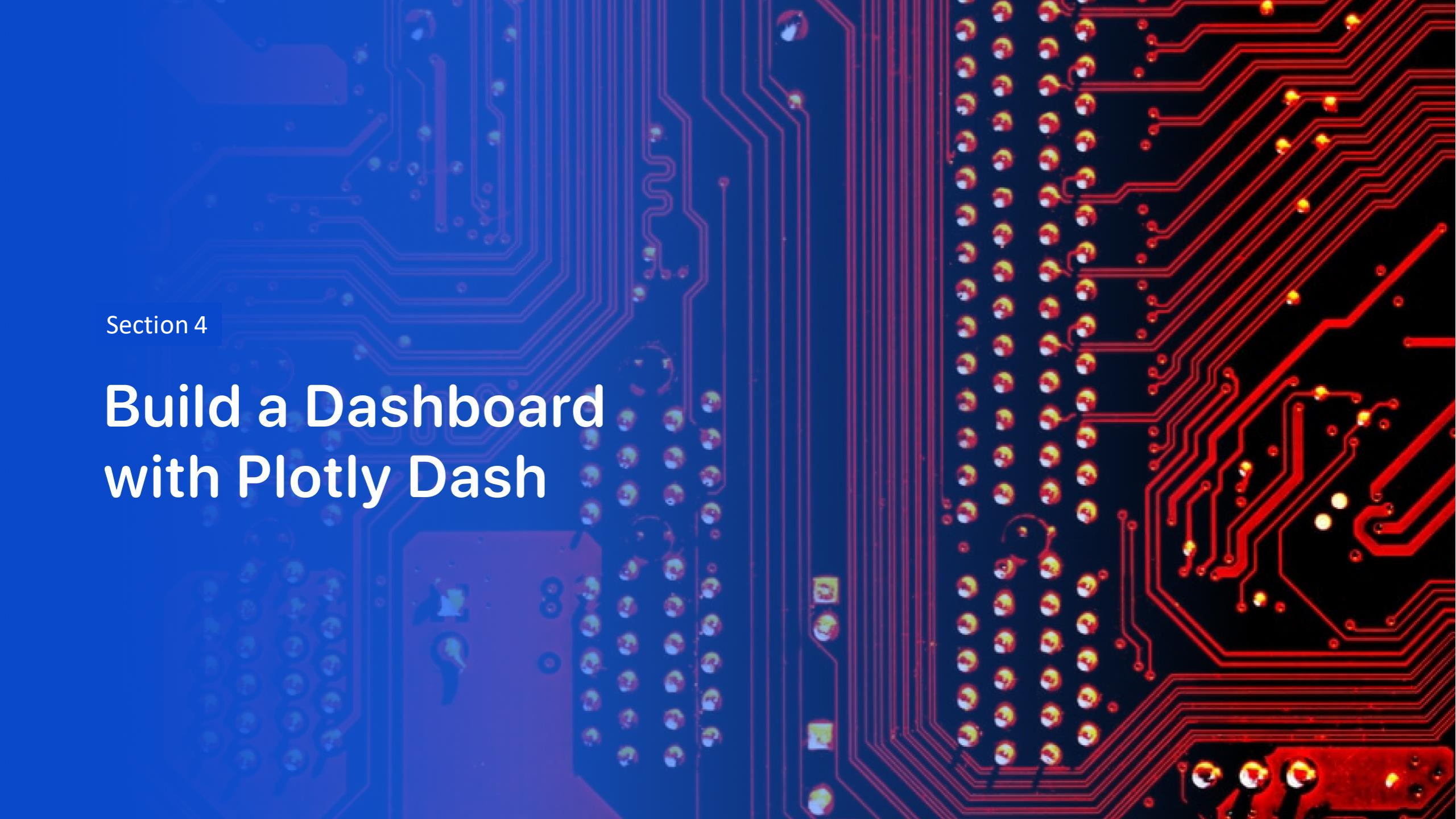
<Launch site distance from ocean>

- 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



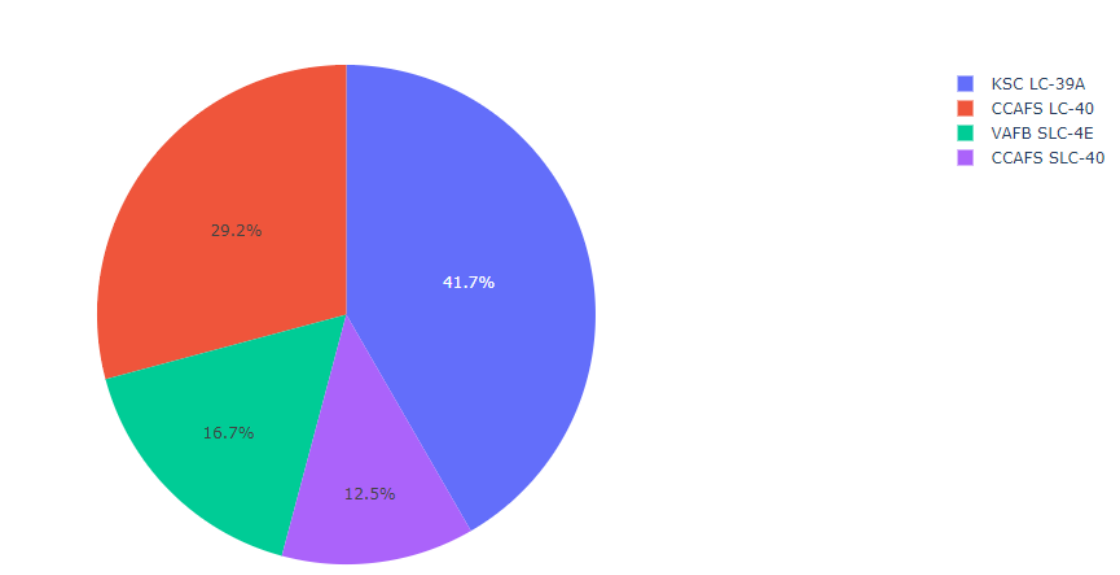
- Explain the important elements and findings on the screenshot

- All launch sites are close to ocean, railway and highway. I think it is for safety and easy to transport.


Section 4
Build a Dashboard with Plotly Dash

<Launch success count for all sites>

- Show the screenshot of launch success count for all sites, in a piechart

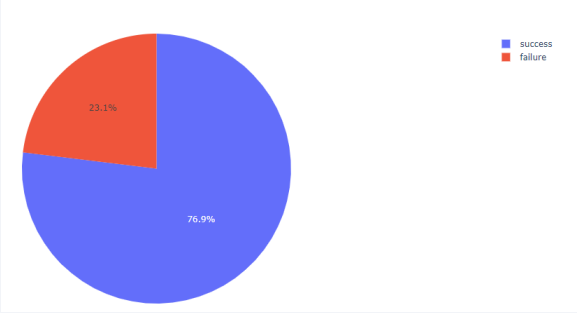


- Explain the important elements and findings on the screenshot

- KSC LX-39A got the most success rate.

<success rate for KSC LC-39A>

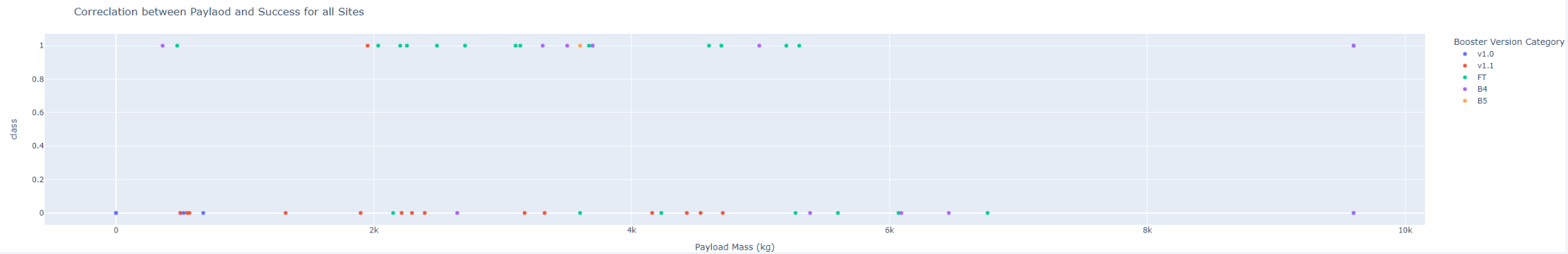
- Show the screenshot of the piechart for the launch site with highest launch success ratio



- Explain the important elements and findings on the screenshot

<Payload vs launch Outcome>

- 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.

- Between 2K-5K payload, FT have the most success rate.

Section 5

Predictive Analysis (Classification)

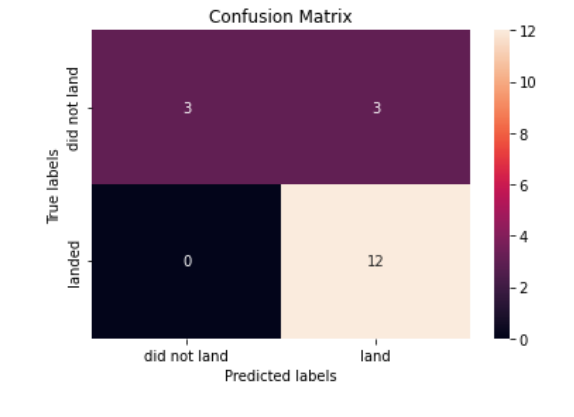
Classification Accuracy

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

- Find which model has the highest classification accuracy

Confusion Matrix

- Show the confusion matrix of the best performing model with an explanation
- K Means Clustering is the best model.



Conclusions

- 1. ES-L1, SSO, HEO, GEO orbits have the most success rate.
- 2. All launch sites are close to ocean. KCFS-39 has the most success rate.
- 3. Between 2K-5K payload mass, Booster version FT has the most success rate
- 4. K means clustering provide the best 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!