IBM Developer
SKILLS NETWORK

Winning Space Race with Data Science

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Outline

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

Executive Summary

- This presentation is regarding the capstone project. The goal of the project is to identify the factors causing the Space X to launch rockets at a very nominal price compared to the other rocket launching firms which can be leveraged by other rocket launching firms.
- As a part of this project I have used multiple algorithms to identify which methodology best fits our analysis of Falcon 9 landing successfully.
- Listed below are the key critical activities performed as a part of this project
  - Data collection methodology
  - Perform data wrangling
  - Perform exploratory data analysis (EDA) using visualization and SQL
  - Perform interactive visual analytics using Folium and Plotly Dash
  - Perform predictive analysis using classification models
- As a part of visualization and analysis, insights were gathered on the relationships between dependent and independent variables in the use case.
- Based on hypertuning the parameters for each model, accuracy of the models were calculated. Decision tree methodology had the highest accuracy results proving it to be the best model to be used for landing Falcon 9 successfully.

Introduction

- In this project ,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 , the goal is to create a machine learning pipeline to predict if the first stage will land given the data. This can help the new rocket launching company to be more cost effective.
- As a part of this project we want to identify what is the relationship between the independent variables or features such as Orbit, Payload mass, landing site, number of flight etc., and dependent variable success of landing which is Class?
- We also want to identify which methodology best fits the use case and provide accuracy in predicting a successful landing for rockets?

Section 1

Methodology

Methodology

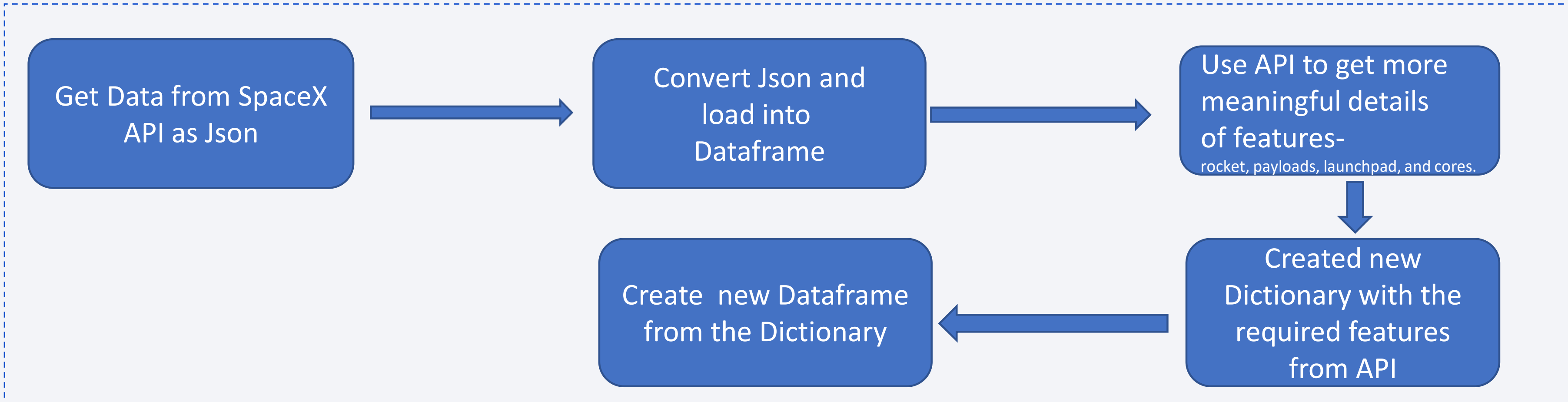
- Data collection methodology:
  - Data was collected using the SpaceX Rest API and
  - Web Scraping
- Perform data wrangling
  - Missing values were handled and classification dependent variable creation
- Perform exploratory data analysis (EDA) using visualization and SQL
- Perform interactive visual analytics using Folium and Plotly Dash
- Perform predictive analysis using classification models
  - Standardizing the data
  - Splitting into training and testing data sets
  - Find the best hyperparameter and predict the accuracy for each Model

Data Collection

- The Data collection included both using API from SpaceX using Rest API's and connecting to Wikipedia and using web Scrapping to collect the SpaceX data from there.
- The two sources combined gave a more comprehensive details of SpaceX project.
- The two data sources had some columns which the other didn’t. Hence combining the two dataset sets added value and helped with analysis.
- In the next two slide you can see in the result sets that some columns which are available in SpaceXAPI dataframe are not present in the Web Scraping dataframe and vice-versa.

Data Collection – SpaceX API

URL :[NewGitHubRepo/DataCollectionAPI.ipynb at main · PriyankaKathira/NewGitHubRepo]

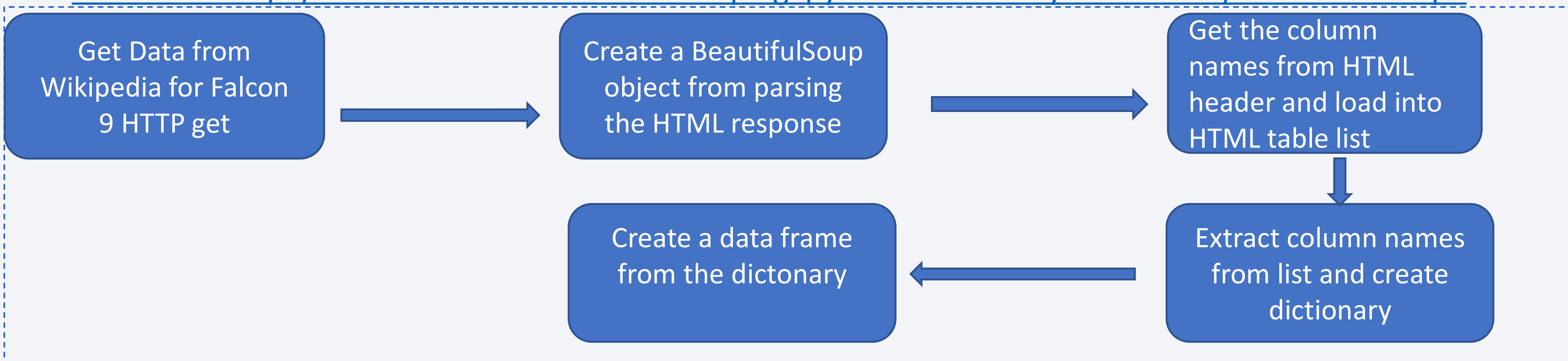


Sample data from result Dataframe

	FlightNumber	Date	BoosterVersion	PayloadMass	Orbit	LaunchSite	Outcome	Flights	GridFins	Reused	Legs	LandingPad	Block	ReusedCount	Serial	Longitude	Latitude
4	1	2010-06-04	Falcon 9	NaN	LEO	CCSFS SLC 40	None None	1	False	False	False	None	1.0	0	B0003	-80.577366	28.561857
5	2	2012-05-22	Falcon 9	525.0	LEO	CCSFS SLC 40	None None	1	False	False	False	None	1.0	0	B0005	-80.577366	28.561857
6	3	2013-03-01	Falcon 9	677.0	ISS	CCSFS SLC 40	None None	1	False	False	False	None	1.0	0	B0007	-80.577366	28.561857
7	4	2013-09-29	Falcon 9	500.0	PO	VAFB SLC 4E	False Ocean	1	False	False	False	None	1.0	0	B1003	-120.610829	34.632093
8	5	2013-12-03	Falcon 9	3170.0	GTO	CCSFS SLC 40	None None	1	False	False	False	None	1.0	0	B1004	-80.577366	28.561857
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
89	86	2020-09-03	Falcon 9	15600.0	VLEO	KSC LC 39A	True ASDS	2	True	True	True	5e9e3032383ecb6bb234e7ca	5.0	12	B1060	-80.603956	28.608058
90	87	2020-10-06	Falcon 9	15600.0	VLEO	KSC LC 39A	True ASDS	3	True	True	True	5e9e3032383ecb6bb234e7ca	5.0	13	B1058	-80.603956	28.608058
91	88	2020-10-18	Falcon 9	15600.0	VLEO	KSC LC 39A	True ASDS	6	True	True	True	5e9e3032383ecb6bb234e7ca	5.0	12	B1051	-80.603956	28.608058
92	89	2020-10-24	Falcon 9	15600.0	VLEO	CCSFS SLC 40	True ASDS	3	True	True	True	5e9e3033383ecbb9e534e7cc	5.0	12	B1060	-80.577366	28.561857
93	90	2020-11-05	Falcon 9	3681.0	MEO	CCSFS SLC 40	True ASDS	1	True	False	True	5e9e3032383ecb6bb234e7ca	5.0	8	B1062	-80.577366	28.561857

Data Collection – Web Scraping

URL :NewGitHubRepo/Data Collection with Web Scraping.ipynb at main · PriyankaKathira/NewGitHubRepo



Sample data from result DataFrame

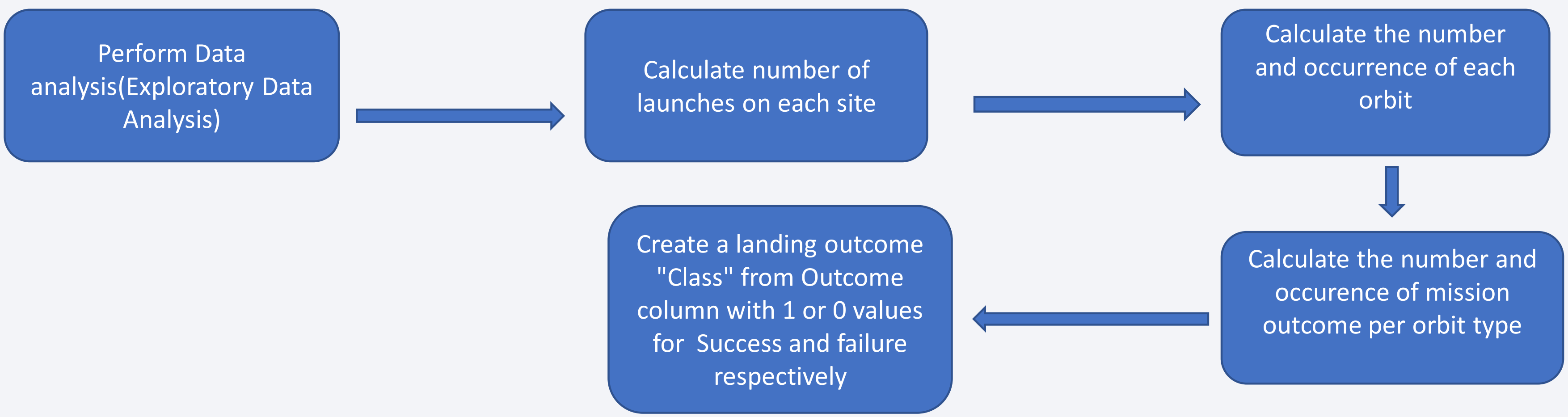
	Flight No.	Launch site	Payload	Payload mass	Orbit	Customer	Launch outcome	Version Booster	Booster landing	Date	Time
0	1	CCAFS	Dragon Spacecraft Qualification Unit	0	LEO	SpaceX	Success\n	F9 v1.0B0003.1	Failure	4 June 2010	18:45
1	2	CCAFS	Dragon	0	LEO	NASA	Success	F9 v1.0B0004.1	Failure	8 December 2010	15:43
2	3	CCAFS	Dragon	525 kg	LEO	NASA	Success	F9 v1.0B0005.1	No attempt\n	22 May 2012	07:44
3	4	CCAFS	SpaceX CRS-1	4,700 kg	LEO	NASA	Success\n	F9 v1.0B0006.1	No attempt	8 October 2012	00:35
4	5	CCAFS	SpaceX CRS-2	4,877 kg	LEO	NASA	Success\n	F9 v1.0B0007.1	No attempt\n	1 March 2013	15:10
...	...	...	...	...	...	...	...	...	...	...	...
116	117	CCSFS	Starlink	15,600 kg	LEO	SpaceX	Success\n	F9 B5B1051.10	Success	9 May 2021	06:42
117	118	KSC	Starlink	~14,000 kg	LEO	SpaceX	Success\n	F9 B5B1058.8	Success	15 May 2021	22:56
118	119	CCSFS	Starlink	15,600 kg	LEO	SpaceX	Success\n	F9 B5B1063.2	Success	26 May 2021	18:59
119	120	KSC	SpaceX CRS-22	3,328 kg	LEO	NASA	Success\n	F9 B5B1067.1	Success	3 June 2021	17:29
120	121	CCSFS	SXM-8	7,000 kg	GTO	Sirius XM	Success\n	F9 B5	Success	6 June 2021	04:26

121 rows × 11 columns

Data Wrangling

- Exploratory Data Analysis (EDA) is used to find some patterns in the data and determine what would be the label for training supervised models.
- In the project for Space X Falcon 9, landing was attempted but failed due to an accident multiple times.
- We converted Outcomes into Training Label "Class" with 1 means the booster successfully landed 0 means it was unsuccessful.

URL : [NewGitHubRepo/Data Wrangling.ipynb at main · PriyankaKathira/NewGitHubRepo]()



Data Wrangling-Contd.,

Sample data from result DataFrame

	FlightNumber	Date	BoosterVersion	PayloadMass	Orbit	LaunchSite	Outcome	Flights	GridFins	Reused	Legs	LandingPad	Block	ReusedCount	Serial	Longitude	Latitude	Class
0	1	2010-06-04	Falcon 9	6104.959412	LEO	CCAFS SLC 40	None None	1	False	False	False	NaN	1.0	0	B0003	-80.577366	28.561857	0
1	2	2012-05-22	Falcon 9	525.000000	LEO	CCAFS SLC 40	None None	1	False	False	False	NaN	1.0	0	B0005	-80.577366	28.561857	0
2	3	2013-03-01	Falcon 9	677.000000	ISS	CCAFS SLC 40	None None	1	False	False	False	NaN	1.0	0	B0007	-80.577366	28.561857	0
3	4	2013-09-29	Falcon 9	500.000000	PO	VAFB SLC 4E	False Ocean	1	False	False	False	NaN	1.0	0	B1003	-120.610829	34.632093	0
4	5	2013-12-03	Falcon 9	3170.000000	GTO	CCAFS SLC 40	None None	1	False	False	False	NaN	1.0	0	B1004	-80.577366	28.561857	0

EDA with Data Visualization

- Summarize what charts were plotted and why you used those charts
- Performed Exploratory Data Analysis and Feature Engineering.
- Created plots for the following to visualize relationships as a part of analysis
  - FlightNumber vs. PayloadMass and overlay the outcome of the launch.
  - FlightNumber vs LaunchSite
  - Payload and Launch Site
  - Success rate of each orbit type
  - FlightNumber and Orbit type
  - Payload and Orbit type
  - Launch success yearly trend

EDA with Data Visualization-Contd.,

- Scatter plots helped gain insight in relationship between various variables.
- The Barcharts helped analyze the multiple category values within an independent variable
- Line charts showed launch success yearly trend.
- Depending on their relationships , features are included in a model
- Feature Engineering
  - Created Features dataframe
  - Using get_dummies and fratures dataframe all the categorical columns were converted float values.

URL :NewGitHubRepo/EDA with Data Visualization.ipynb at main · PriyankaKathira/NewGitHubRepo

EDA with SQL

- Ran multiple SQL queries to gain insight into the dataset. Listed below are the points summarizing the queries.
  - Displayed the names of the unique launch sites in the space mission
  - Displayed 5 records where launch sites begin with the string 'CCA'
  - Displayed the total payload mass carried by boosters launched by NASA (CRS)
  - Displayed average payload mass carried by booster version F9 v1.1
  - Listed the date when the first successful landing outcome in ground pad was acheived.
  - Listed the names of the boosters which have success in drone ship and have payload mass greater than 4000 but less than 6000
  - Listed the total number of successful and failure mission outcomes
  - Listed the names of the booster_versions which have carried the maximum payload mass. Use a subquery

EDA with SQL-Contd.,

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

URL :https://github.com/PriyankaKathira/NewGitHubRepo/blob/main/EDA%20with%20SQL.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.
- Interactive visual analytics was performed using Folium.
- Mark all launch sites on a map
    - Created a folium Map object, with an initial center location to be NASA Johnson Space Center at Houston, Texas. Used folium. Circle to add a highlighted circle area with a text label on a specific coordinate
    - Created a folium Map object, with an location for all launch sites using their latitude and longitude co-odinates and check how close there are to the coast and equator. Used folium. Circle to add a highlighted blue circle area with a text label on a specific coordinate
- Mark the success/failed launches for each site on the map-Used Folium_Marker and Marker cluster to add color to identify which sites have high Success and Failures
- Calculate the distances between a launch site to its proximities- Added colored lines to identify proximity to railroads, highway and closest city. This can help point out danger to the publish in case if Failure in launch

URL :[NewGitHubRepo/Interactive Visual Analytics with Folium lab 2.ipynb at main · PriyankaKathira/NewGitHubRepo]

Build a Dashboard with Plotly Dash

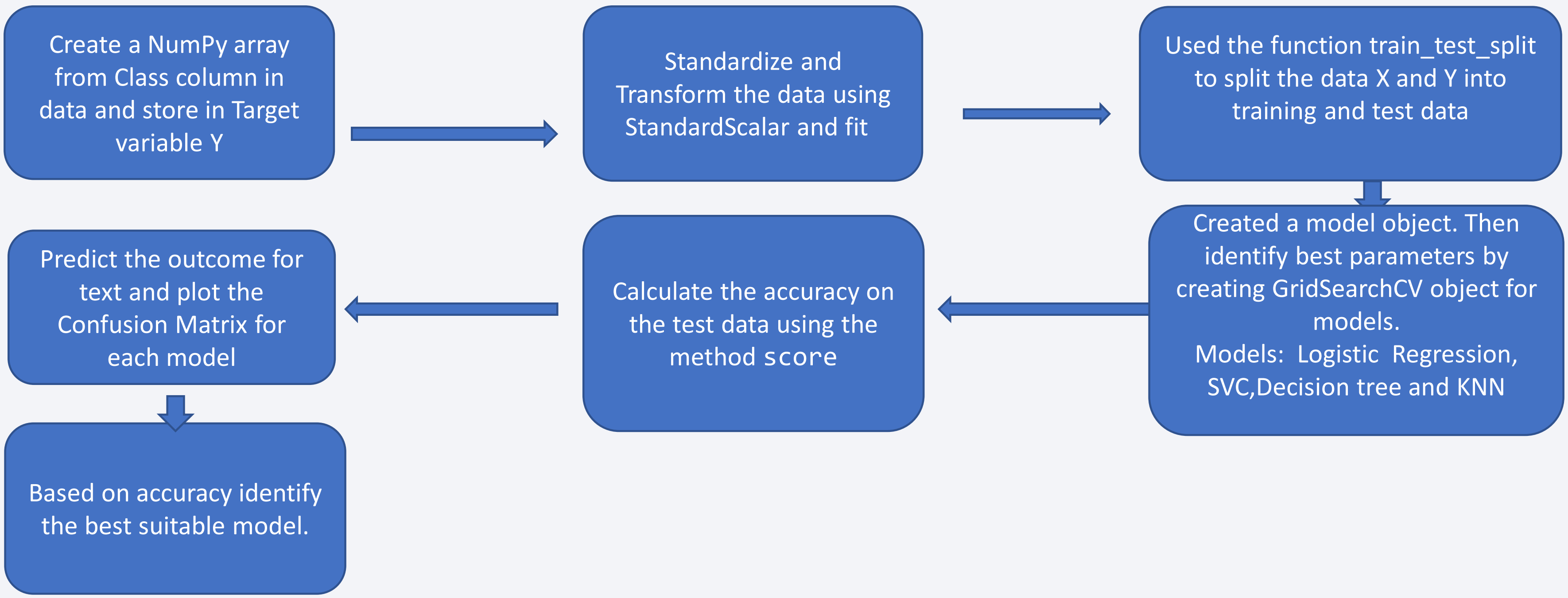
- Summarize what plots/graphs and interactions you have added to a dashboard
- Added dropdownlist for Launch sites to select 1 Launch site at a time for analysis
- To show successful launches a Pie chart was created which is linked to the selection from drop down. The Pie chart shows the number of success and failure launches
- Created a slider to select the Payload Mass range and see how it impacts the success and Failure launch rates.
- Created a Scatter chart for Payload mass against Success rate for various booster versions.

URL :NewGitHubRepo/spacex_dash_app.py at main · PriyankaKathira/NewGitHubRepo

Predictive Analysis (Classification)

- As a part of Predictive analysis, a machine learning pipeline was created to predict if the first stage will land successfully.

URL :[NewGitHubRepo/spacex_dash_app.py at main · PriyankaKathira/NewGitHubRepo]



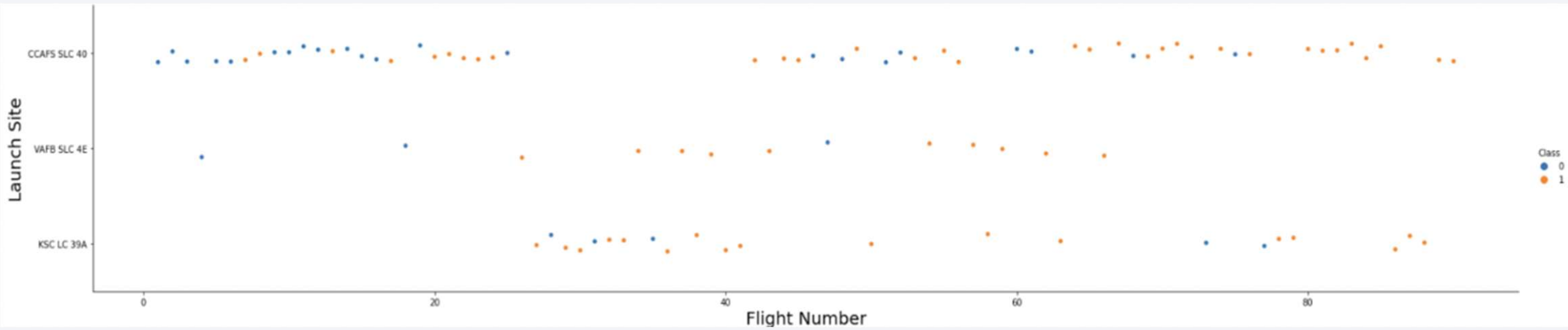
Results

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

Section 2

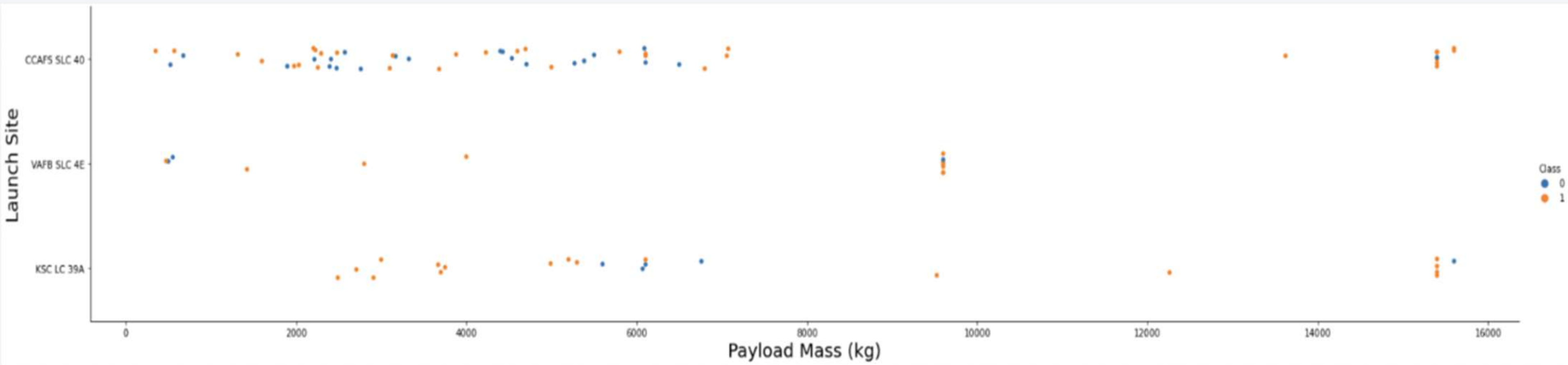
Insights drawn from EDA

Flight Number vs. Launch Site



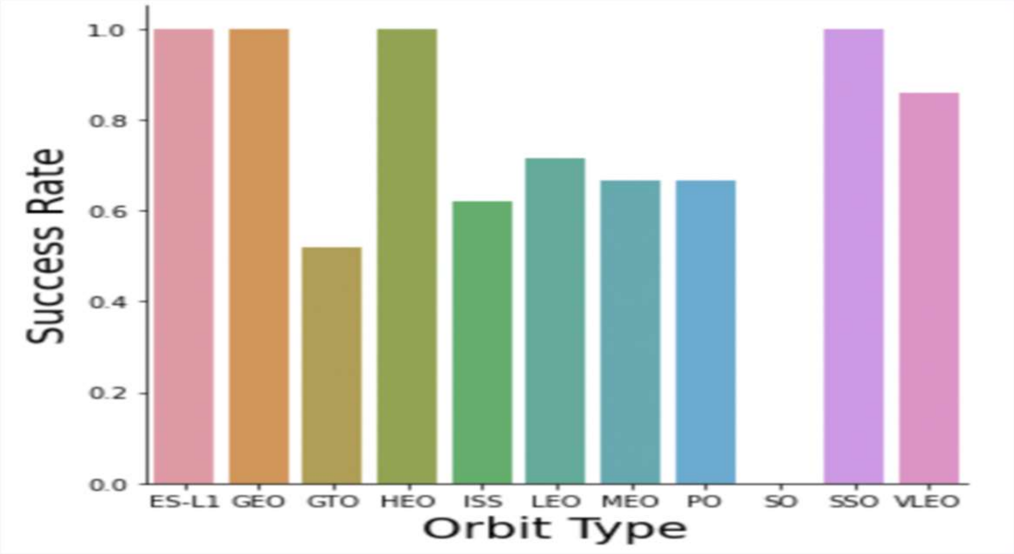
- We can notice from this scatter plot that Flight Number more than 80 have 100% success rate.
- Launch site VAFB SLC 4E has higher success rate than the other two sites
- Launch site CCAFS SLC 40 has the highest number of launches

Payload vs. Launch Site



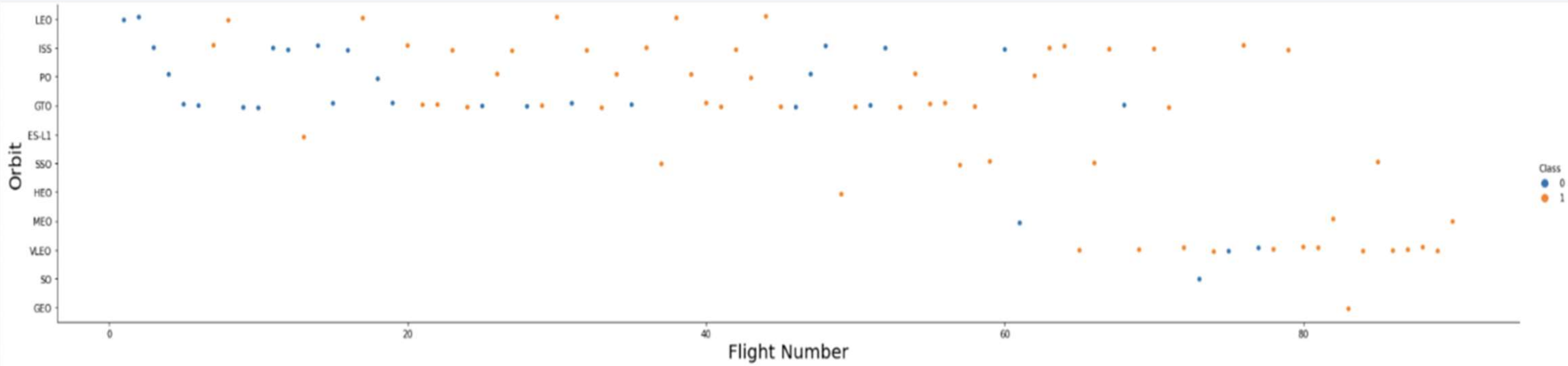
- KSC LC 39A launch site has full 100 % success rate for Payload Mass less than 5000 kg
- Across all launch sites , majority of the launches were successful over 8000 kg Payload Mass
- VAFB SLC 4E had 100% success rate between payload mass 1000 kg and 4000 Kg

Success Rate vs. Orbit Type



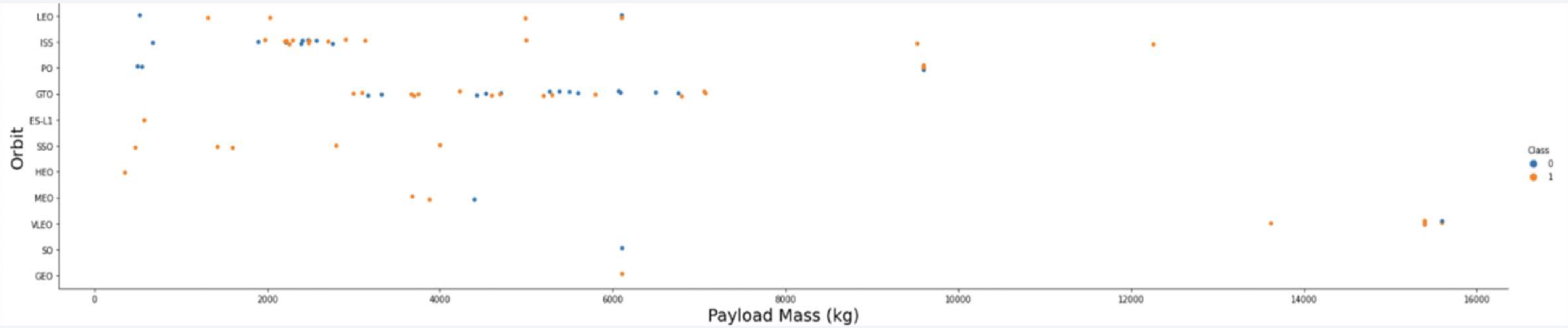
- Orbit Type ES-L1,GEO,HEO ad SSO have nearly 100% success rate
- Orbit Type SO has the least success rate 0%.

Flight Number vs. Orbit Type



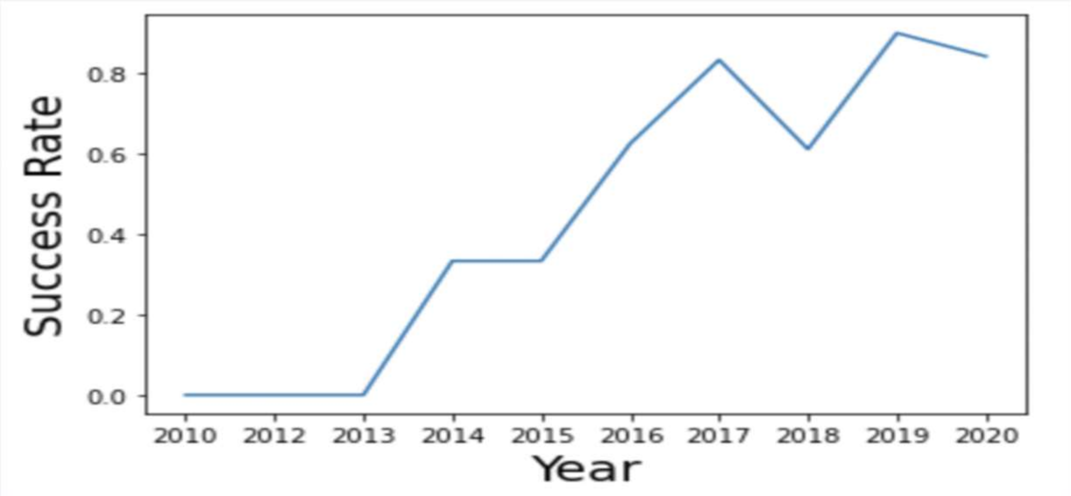
- Flight Number greater than 80 has 100% success rate for all Orbit types
- SSO and HEO Orbit type have 100% success rate but HEO seems to have only 1 launch

Payload vs. Orbit Type



- SSO has 100% success rate

Launch Success Yearly Trend



- The success rate keeps increasing from 2013 onwards with a small dip in 2018

All Launch Site Names

- Listed below is the unique list of launch sites in the SpaceX project

```
[6]: %sql SELECT DISTINCT LAUNCH_SITE as "Launch_Sites" FROM SPACEXTBL;

 * ibm_db_sa://yyq30344:***@b70af05b-76e4-4bca-a1f5-23dbb4c6a74e.c1ogj3sd0tgtu0lqde00.databases.appdomain.cloud:32716/BLUDB
Done.
```

[6]:

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

Launch Site Names Begin with 'CCA'

- Listed below are the 5 records where launch sites begin with `CCA`

```
[7]: %sql SELECT * FROM SPACEXTBL WHERE LAUNCH_SITE LIKE 'CCA%' LIMIT 5;

 * ibm_db_sa://yyq30344:***@b70af05b-76e4-4bca-a1f5-23dbb4c6a74e.c1ogj3sd0tgtu0lqde00.databases.appdomain.cloud:32716/BLUDB
Done.
```

[7]:

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	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	No attempt

Total Payload Mass

- Total payload carried by boosters from NASA is 45596 kg

```
[11]: %sql SELECT SUM(PAYLOAD_MASS_KG_) AS "Total payload mass by NASA (CRS)" FROM SPACEXTBL WHERE CUSTOMER = 'NASA (CRS)';

 * ibm_db_sa://yyq30344:***@b70af05b-76e4-4bca-a1f5-23dbb4c6a74c.c1ogj3sd0tgtu0lqde00.databases.appdomain.cloud:32716/BLUDB
Done.
```

[11]:

Total payload mass by NASA (CRS)
45596

Average Payload Mass by F9 v1.1

- Average payload mass carried by booster version F9 v1.1 is 2928 kg

[13]:
```
%sql SELECT AVG(PAYLOAD_MASS_KG_) AS "Average payload mass by Booster Version F9 v1.1" FROM SPACEXTBL WHERE BOOSTER_VERSION = 'F9 v1.1';
```

```
 * ibm_db_sa://yyq30344:***@b70af05b-76e4-4bca-a1f5-23dbb4c6a74e.c1ogj3sd0tgtu0lqde00.databases.appdomain.cloud:32716/BLUDB
Done.
```

[13]:

Average payload mass by Booster Version F9 v1.1
2928

First Successful Ground Landing Date

- The first successful landing outcome on ground pad for the Space X project was on 2015-12-22

```
[14]: %sql SELECT MIN(DATE) AS "Date of first successful landing outcome in ground pad" FROM SPACEXTBL WHERE LANDING_OUTCOME = 'Success (ground pad)';

 * ibm_db_sa://yyq30344:***@b70af05b-76e4-4bca-a1f5-23dbb4c6a74e.c1ogj3sd0tgtu0lqde00.databases.appdomain.cloud:32716/BLUDB
Done.
```

[14]:

Date of first successful landing outcome in ground pad
2015-12-22

Successful Drone Ship Landing with Payload between 4000 and 6000

- Listed below are the names of boosters which have successfully landed on drone ship and had payload mass greater than 4000 but less than 6000

[15]:
```
%sql SELECT BOOSTER_VERSION FROM SPACEXTBL WHERE LANDING_OUTCOME = 'Success (drone ship)' AND PAYLOAD_MASS_KG_ BETWEEN 4000 AND 6000;
```

```
 * ibm_db_sa://yyq30344:***@b70af05b-76e4-4bca-a1f5-23dbb4c6a74e.c1ogj3sd0tgtu0lqde00.databases.appdomain.cloud:32716/BLUDB
Done.
```

[15]:

booster_version
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 in the SpaceX project launches are listed below .

[16]:
```
%sql SELECT sum(case when Mission_Outcome in ('Success','Success (payload status unclear)') then 1 else 0 end ) as Success_Outcome_Cnt,sum(case when Mission_Outcome='Failure (in flight)' then 1 else 0 end) as Failure_Outcome_Cnt  FROM SPACEXTBL
```

```
 * ibm_db_sa://yyq30344:***@b70af05b-76e4-4bca-a1f5-23dbb4c6a74e.c1ogj3sd0tgtu0lqde00.databases.appdomain.cloud:32716/BLUDB
Done.
```

[16]:

success_outcome_cnt	failure_outcome_cnt
100	1

Boosters Carried Maximum Payload

- Listed below are the unique list of names of the booster which have carried the maximum payload mass

```
[17]: %sql SELECT DISTINCT BOOSTER_VERSION FROM SPACEXTBL WHERE PAYLOAD_MASS_KG_ =(SELECT MAX(PAYLOAD_MASS_KG_) FROM SPACEXTBL);

 * ibm_db_sa://yyq30344:***@b70af05b-76e4-4bca-a1f5-23dbb4c6a74e.c1ogj3sd0tgtu0lqde00.databases.appdomain.cloud:32716/BLUDB
Done.
```

[17]:

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

2015 Launch Records

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

```
[19]: %sql SELECT DATE, BOOSTER_VERSION, LAUNCH_SITE FROM SPACEXTBL WHERE year(DATE) = '2015' AND LANDING_OUTCOME = 'Failure (drone ship)';
```

```
 * ibm_db_sa://yyq30344:***@b70af05b-76e4-4bca-a1f5-23dbb4c6a74e.c1ogj3sd0tgtu0lqde00.databases.appdomain.cloud:32716/BLUDB
Done.
```

[19]:

DATE	booster_version	launch_site
2015-01-10	F9 v1.1 B1012	CCAFS LC-40
2015-04-14	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

```
[23]: %sql  SELECT LANDING_OUTCOME, COUNT(LANDING_OUTCOME) AS Landing_Count, RANK() OVER( ORDER BY COUNT(LANDING_OUTCOME) desc ) rank  FROM SPACEXTBL WHERE DATE BETWEEN '2010-06-04' AND '2017-03-20' GROUP BY  LANDING_OUTCOME

 * ibm_db_sa://yyq30344:***@b70af05b-76e4-4bca-a1f5-23dbb4c6a74e.c1ogj3sd0tgtu0lqde00.databases.appdomain.cloud:32716/BLUDB
Done.
```

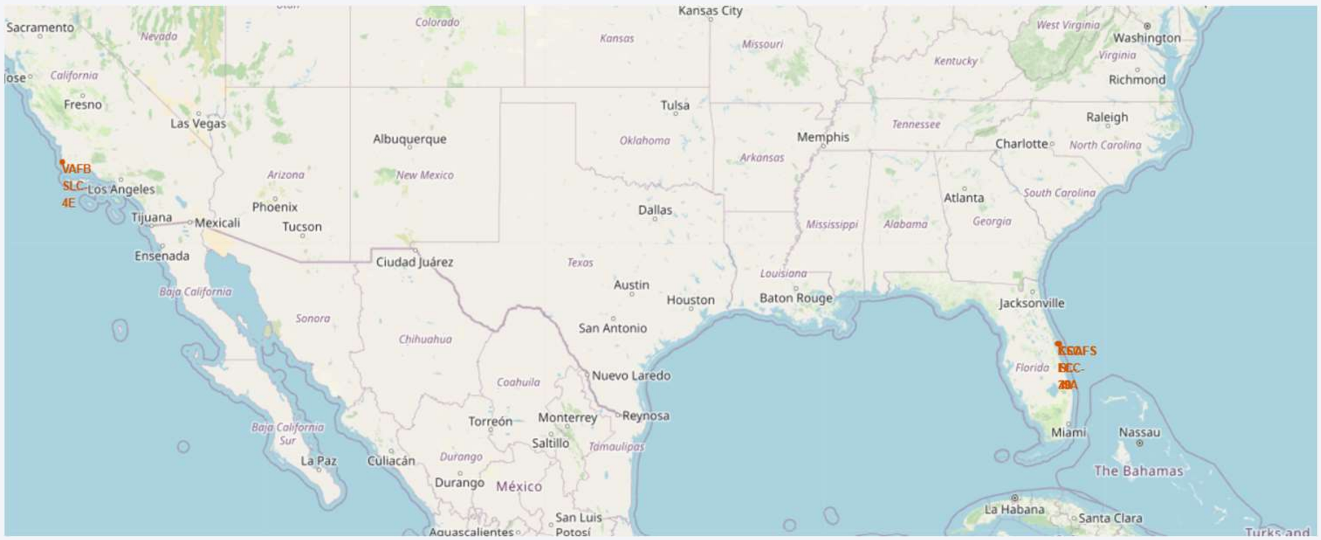
[23]:

landing outcome	landing count	RANK
No attempt	10	1
Failure (drone ship)	5	2
Success (drone ship)	5	2
Controlled (ocean)	3	4
Success (ground pad)	3	4
Failure (parachute)	2	6
Uncontrolled (ocean)	2	6
Precluded (drone ship)	1	8

Section 3

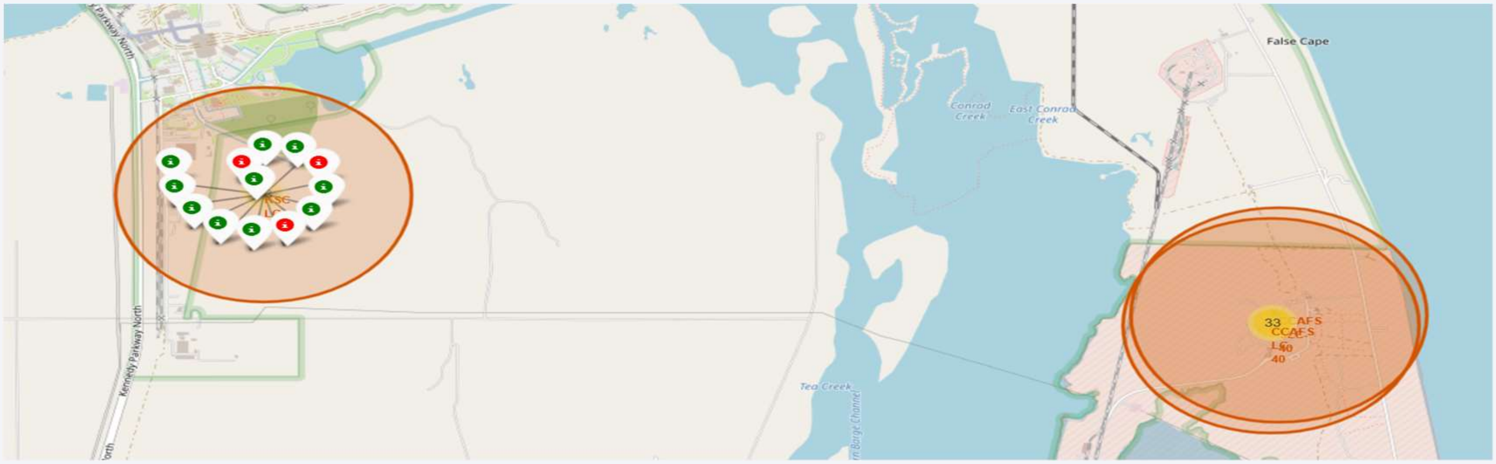
Launch Sites Proximities Analysis

Launch Site Markers in the Map



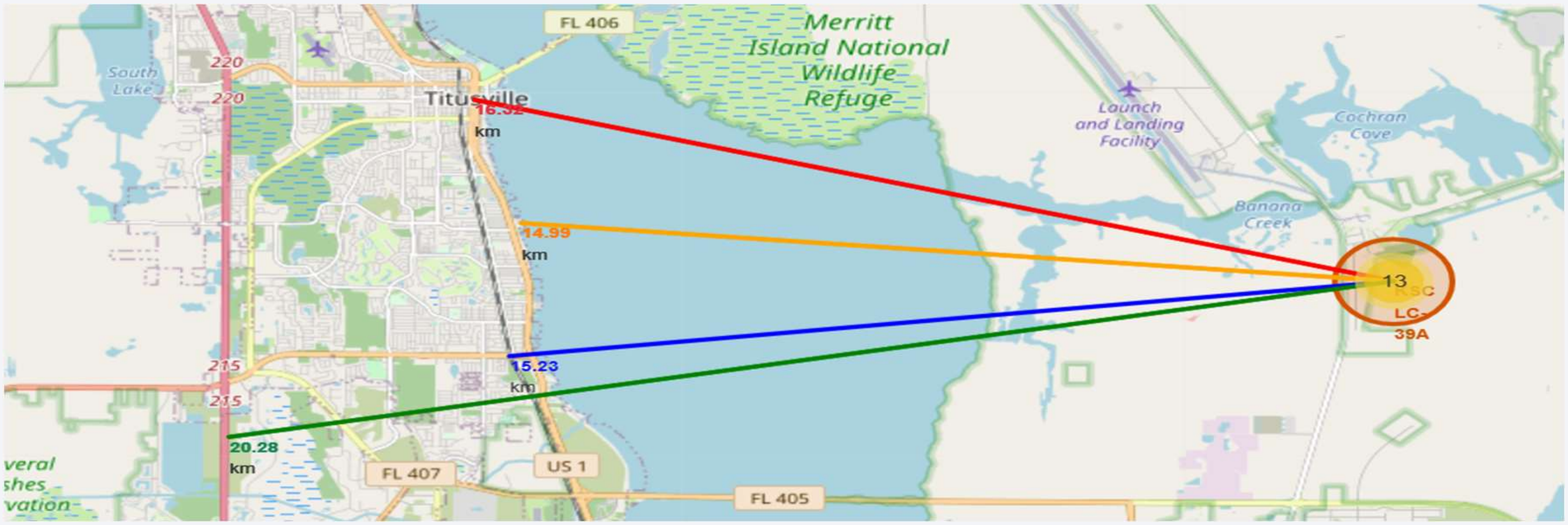
- The Launch sites are very close to the coastal area. These locations were probably picked because the impact on public should be low
- The launch sites are also close to the equator.

Success/Failed launches for all site on the map

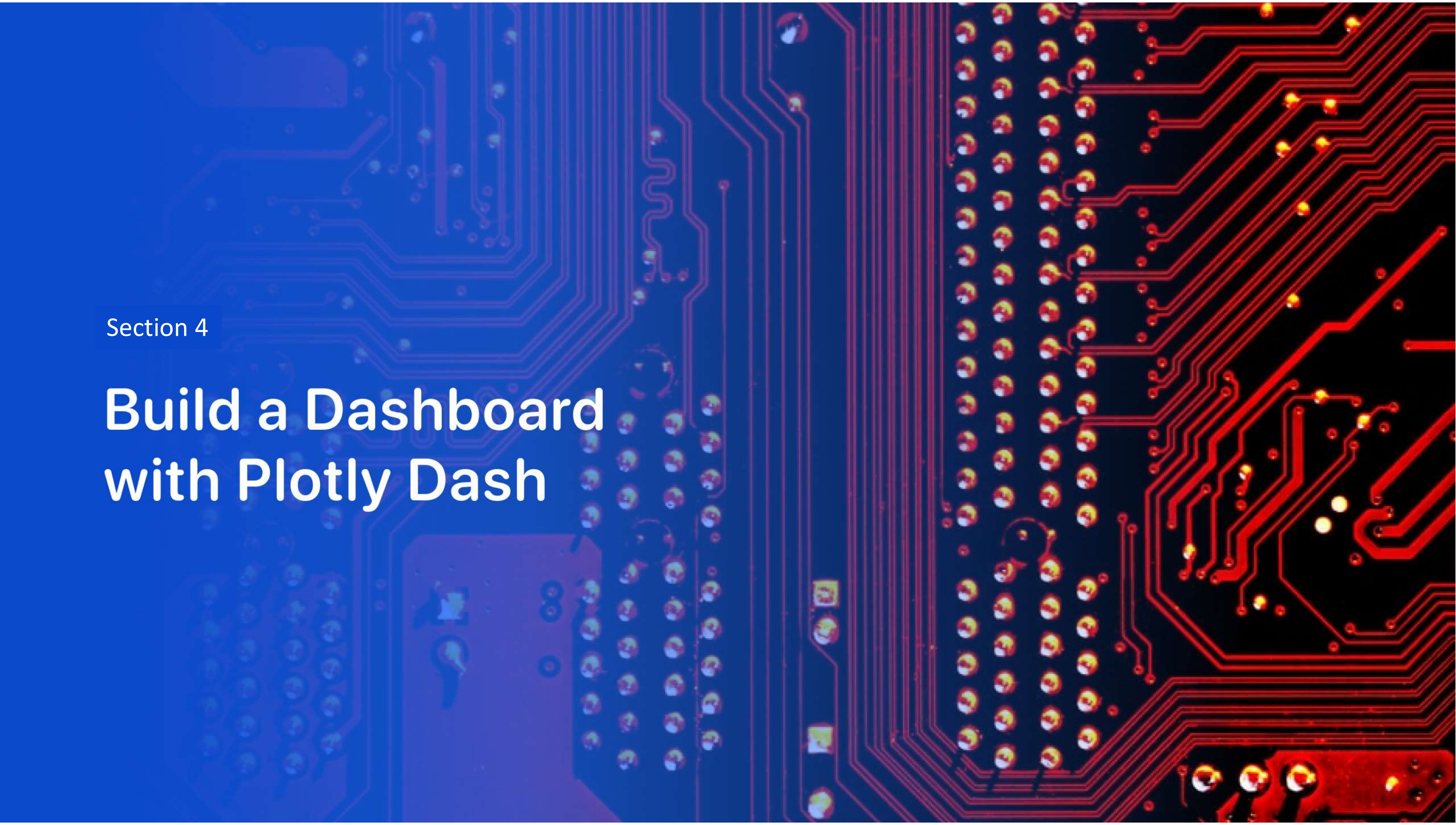


- When we click in the circle on the yellow dot, we can see the success and failures of launches for that site
- Green color is for Success and Red color represents failure.
- KSC-LC 39A has the highest success rate compared to other sites.

KSC LC-39A proximity to Railway, Highway and Coastline



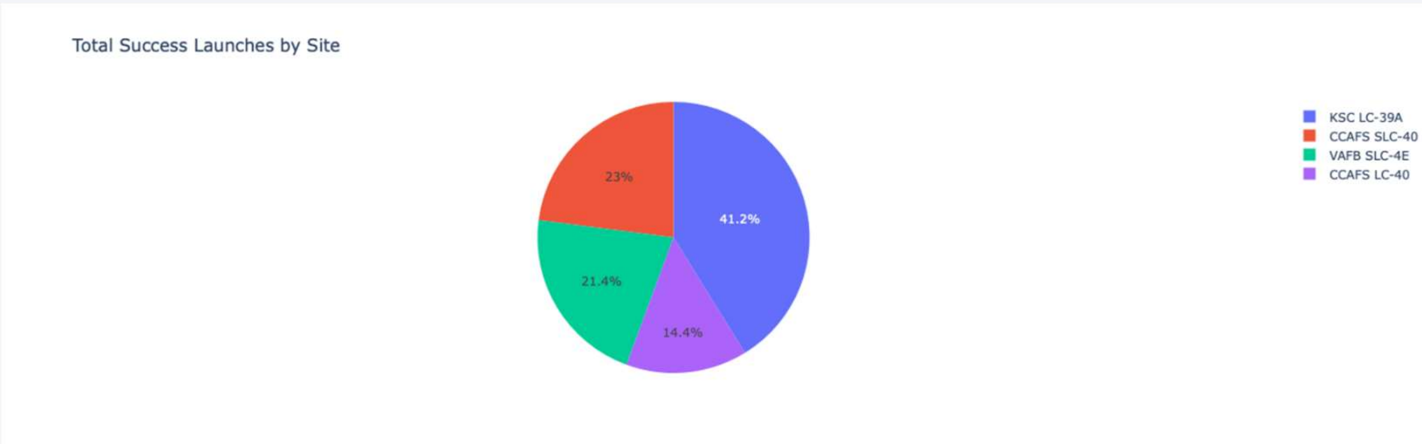
- The railway, city and highway are not too far away from the launch site KSC LC-39A which could potentially be dangerous for the public in cause of launch failure



Section 4

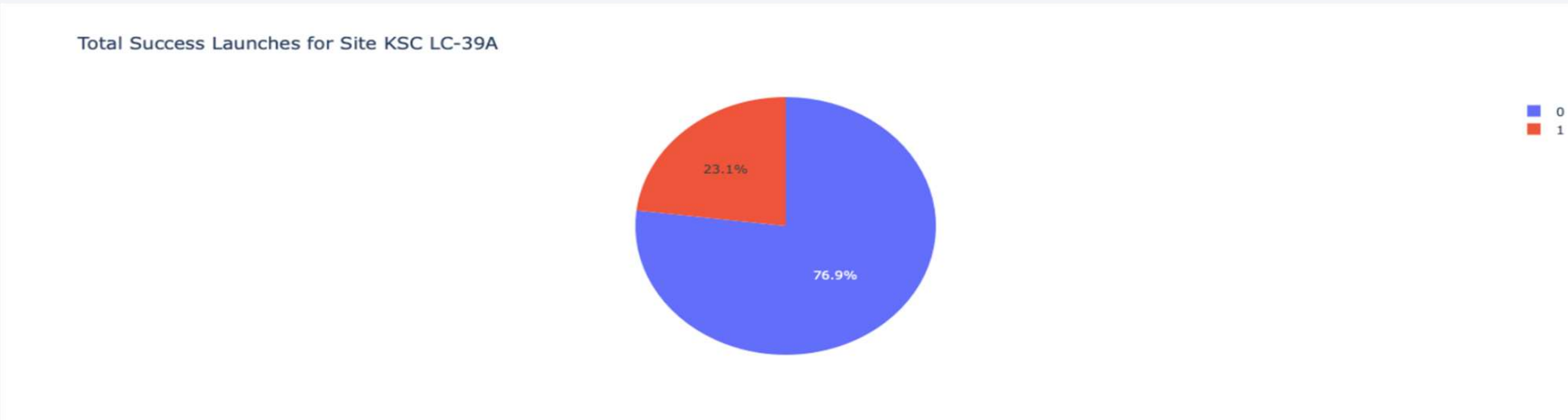
Build a Dashboard with Plotly Dash

Launch sites Success rate



- Based on the Pie chart, it is evident that highest success rate is in the Launch site KSC LC-39A

KSC LC-39A Success rate



- 1 represents failure and 0 represents success rate here
- KSC LC-39A has more than 75% success rate

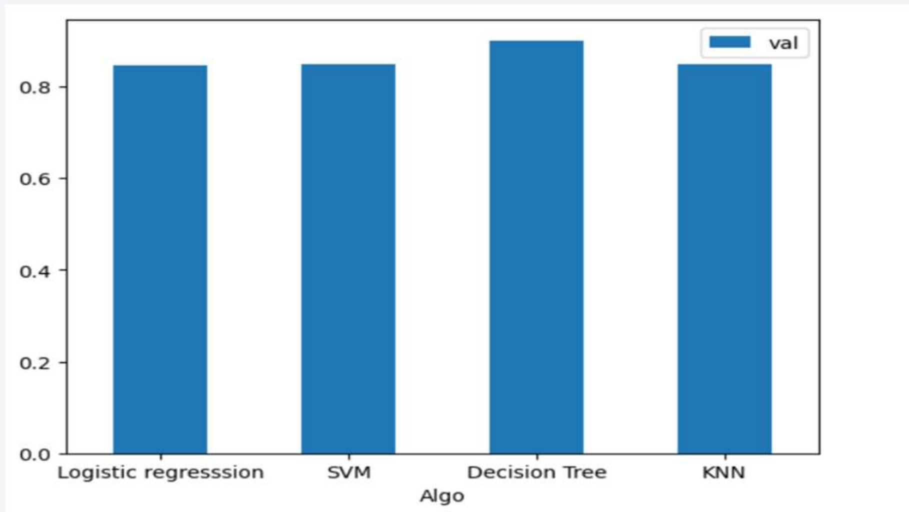
Payload vs Launch outcome by Booster category

- Booster version category FT seems to have the highest success rate

Section 5

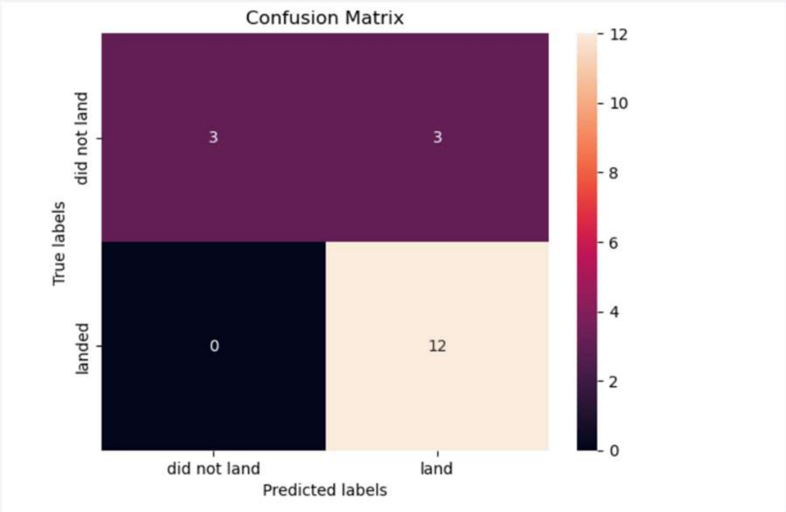
Predictive Analysis (Classification)

Classification Accuracy



- The x-axis shows the algorithms and the y-axis shows the Accuracy with 1 equal to 100%
- Above is the bar chart listing the accuracies of all the Models.
- Decision tree has the highest accuracy as we can see in the bar chart of the accuracy of each of the models above.

Confusion Matrix



- Decision tree model has the highest accuracy with only 3 False positives.

Conclusions

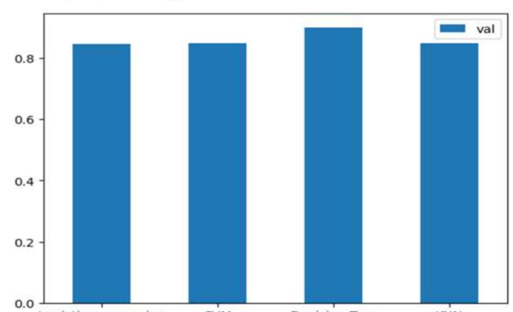
- KSC LC-39A has the highest success rate compared to other Launch sites
- The rate of successful launches increased significantly over the years
- The Launch sites are in close proximity to Coast and Equator.
- Booster version category FT seems to have the highest success rate
- Decision tree model has the highest accuracy with only 3 False positives.

Appendix

- [Coursera | Online Courses & Credentials From Top Educators. Join for Free]
- [IBM - United States]
- Code snippet to create bar chart for the accuracy of each model.

```
df = pd.DataFrame({'Algo':['Logistic regresssion', 'SVM', 'Decision Tree','KNN'],'val':[logreg_cv.best_score_, svm_cv.best_score_,tree_cv.best_score_,knn_cv.best_score_]
#best_method_accuracy = df['Best scores'].max()
#df
df.plot.bar(x='Algo', y='val', rot=0)
```

```
1]: <AxesSubplot:xlabel='Algo'>
```



Thank you!