SpaceX project

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SKILLS NETWORK

OUTLINE

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- Discussion
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EXECUTIVE SUMMARY

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  - Predictive Analysis

- Summary of Result

  Exploratory Data Analysis result

INTRODUCTION

- We predicted if the Falcon 9 first stage will land successfully. SpaceX advertises Falcon 9 rocket launches on its website, with a cost of 62 million dollars; other providers cost upward of 165 million dollars each, much of the savings is because SpaceX can reuse the first stage.
- 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 SpaceX for a rocket launch

METHODOLOGY

- The following datasets was collected by
- We worked with SpaceX launch data that is gathered from the SpaceX REST API.
- This API will give us data about launches, including information about the rocket used, payload delivered, launch specifications, landing specifications, and landing outcome.
- Our goal is to use this data to predict whether SpaceX will attempt to land a rocket or not.
- The SpaceX REST API endpoints, or URL, starts with api.spacexdata.com/v4/.
- Another popular data source for obtaining Falcon 9 Launch data is web scraping Wikipedia using BeautifulSoup.

Data Collection

1 .Getting Response from API

```
spacex_url="https://api.spacexdata.com/v4/launches/past"
response = requests.get(spacex_url).json()
```

2. Converting Response to a .json file

```
response = requests.get(static_json_url).json()
data = pd.json_normalize(response)
```

3. Apply custom functions to clean data

4. Assign list to dictionary then dataframe

5. Filter dataframe and export to flat file (.csv)

Data Wrangling

Introduction

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.
We mainly convert those outcomes into Training Labels with 1 means the booster successfully landed 0 means it was unsuccessful.

EDA With Data Visualization

Scatter Graphs being drawn:

- Flight Number VS. Payload Mass
- Flight Number VS. Launch Site
- Payload VS. Launch Site
- Orbit VS. Flight Number
- Payload VS. Orbit Type
- Orbit VS. Payload Mass

Scatter plots show how much one variable is affected by another. The relationship between two variables is called their correlation . Scatter plots usually consist of a large body of data.

Bar Graph being drawn:

Mean VS. Orbit

A bar diagram makes it easy to compare sets of data between different groups at a glance. The graph represents categories on one axis and a discrete value in the other. The goal is to show the relationship between the two axes. Bar charts can also show big changes in data over time.

Line Graph being drawn:

Success Rate VS. Year

Line graphs are useful in that they show data variables and trends very clearly and can help to make predictions about the results of data not yet recorded

EDA With SQL

- Displaying the names of the unique launch sites in the space mission
- Displaying 5 records where launch sites begin with the string 'KSC'
- Displaying the total payload mass carried by boosters launched by NASA (CRS)
- Displaying average payload mass carried by booster version F9 v1.1
- Listing the date where the successful landing outcome in drone ship was achieved.
- Listing the names of the boosters which have success in ground pad and have payload mass greater than 4000 but less than 6000

Listing the total number of successful and failure mission outcomes

Listing the names of the booster_versions which have carried the maximum payload mass.

Listing the records which will display the month names, successful landing_outcomes in ground pad ,booster versions, launch_site for the months in year 2017

- Ranking the count of successful landing_outcomes between the date 2010-06-04 and 2017-03-20 in descending order.

Building an interactive map with Folium

To visualize the Launch Data into an interactive map. We took the Latitude and Longitude Coordinates at each launch site and added a *Circle Marker around each launch site with a label of the name of the launch site.*

We assigned the dataframe launch_outcomes(failures, successes) to

classes 0 and 1 with Green and Red markers on the map in a MarkerCluster()

Using Haversine's formula we calculated the distance from the Launch Site to various landmarks to find various trends about what is around the Launch Site to measure patterns. **Lines** are drawn on the map to measure distance to landmarks

Predictive Analysis

BUILDING MODEL

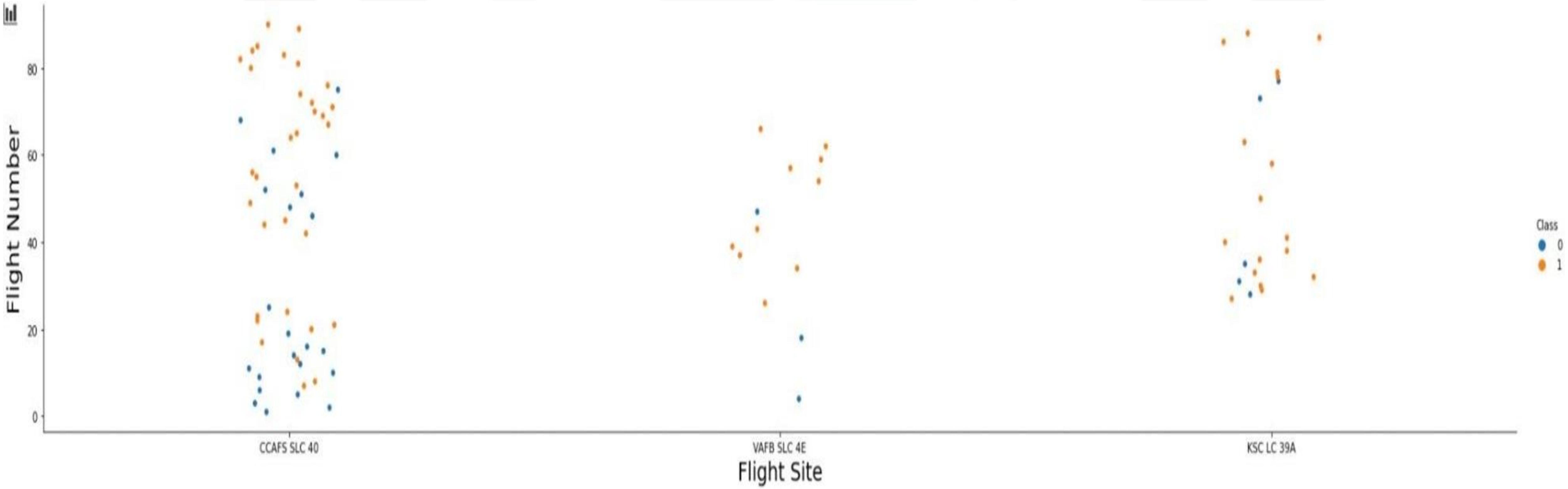
- Load our dataset into NumPy and Pandas
- Transform Data
- Split our data into training and test data sets
- Check how many test samples we have
- Decide which type of machine learning algorithms we want to use
- Set our parameters and algorithms to GridSearchCV
- Fit our datasets into the GridSearchCV objects and train our dataset.
-

EVALUATING MODEL

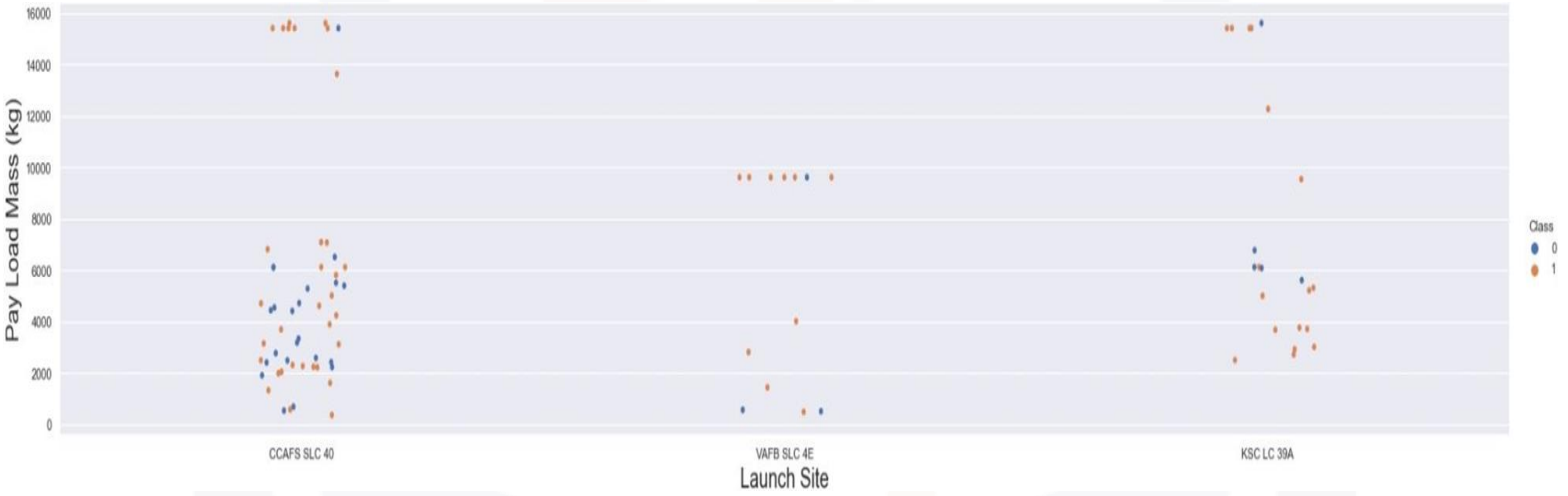
- Check accuracy for each model
- Get tuned hyperparameters for each type of algorithms
- Plot Confusion Matrix

RESULTS

EDA with Visualization



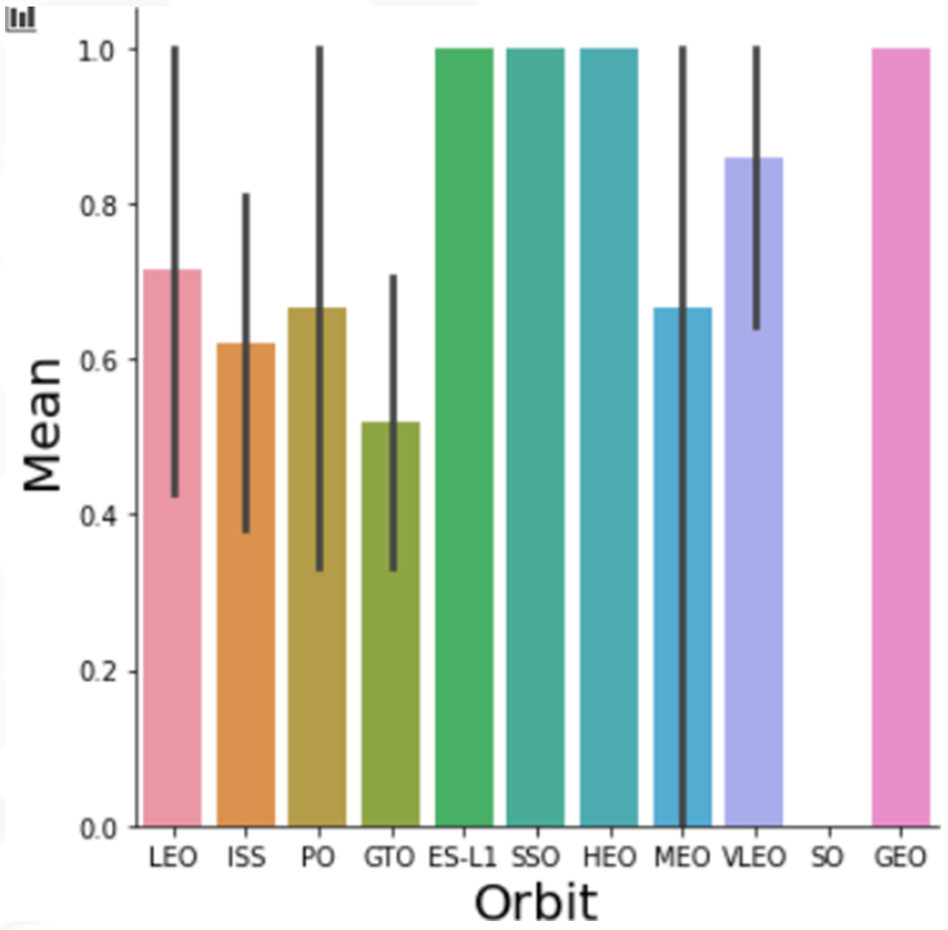
RESULTS -Visualization



The greater the payload mas for Launch Site CCAFS SLC 40 the higher the succes rate for the Rocket. There is not quite a clear pat ern to be found using this visualization to make a decision if the Launch Site is dependant on Pay Load Mas for a succes launch.

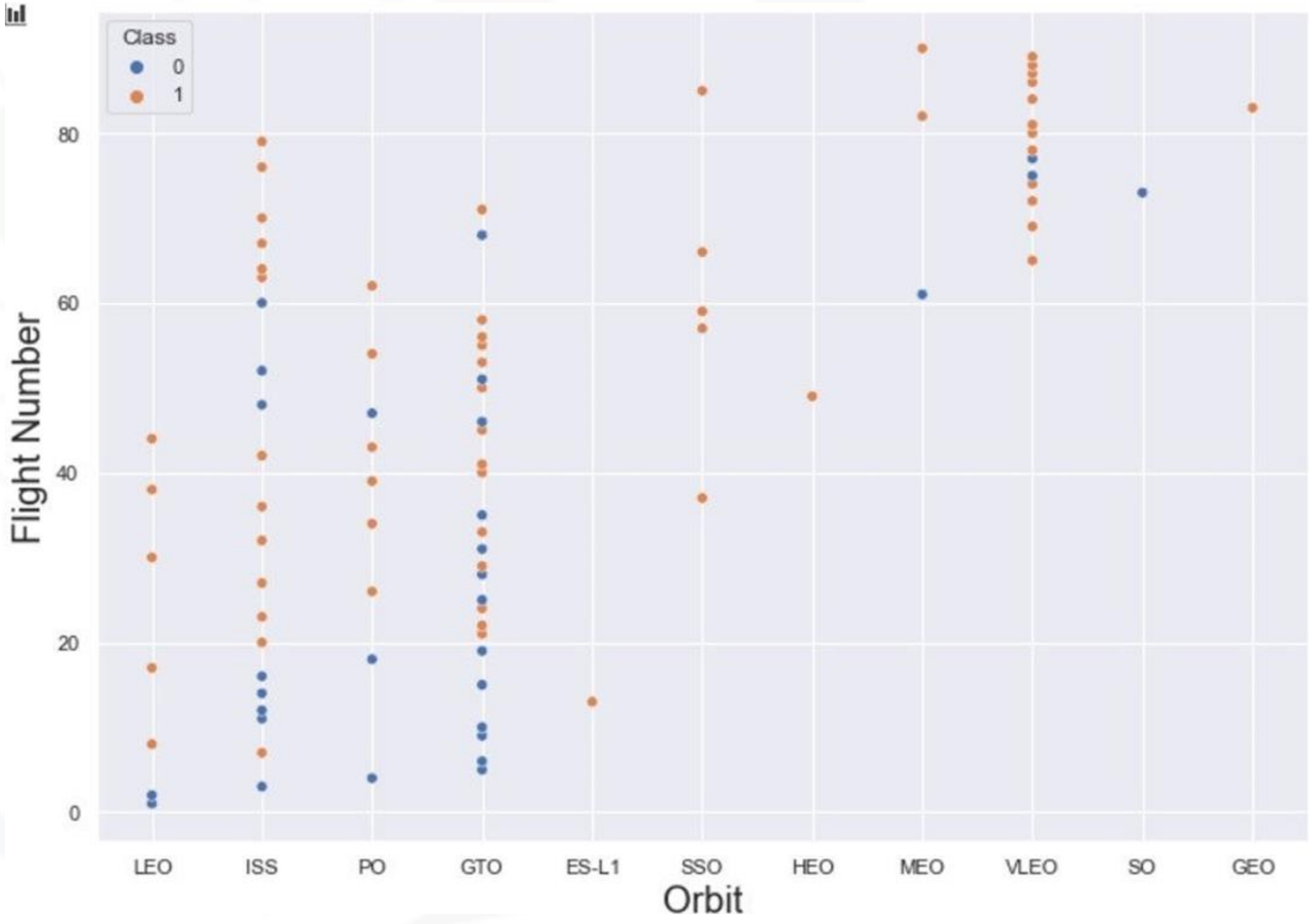
RESULT – Success Rate vs Orbit Rate

Orbit GEO,HEO,SSO,ES-L1
has the best Succes Rate



RESULT – Flight Number vs Orbit Type

You should see that in the LEO orbit the Succes appears related to the number of flights; on the other hand, there seems to be no relationship between flight number when in GTO orbit.



RESULT – SQL Queries

SQL QUERY

select DISTINCT Launch_Site from tblSpaceX

QUERY EXPLAINATION

Using the word ***DISTINCT*** in the query means that it will only show Unique values in the ***Launch_Site*** column from ***tblSpaceX***

Unique Launch Sites
CCAFS LC-40
CCAFS SLC-40
CCAFS SLC-40
KSC LC-39A
VAFB SLC-4E

SQL RESULT- Launch site names begin with `CCA`

SQL QUERY

select TOP 5 * from tblSpaceX WHERE Launch_Site LIKE 'KSC %'

Using the word ***TOP 5*** in the query means that it will only show 5 records from ***tblSpaceX*** and ***LIKE*** keyword has a wild card with the words ***'KSC%'*** the percentage in the end suggests that the Launch_Site name must start with KSC.

	Date	Time_UTC	Booster_Version	Launch_Site	Payload	PAYLOAD_MASS_KG_	Orbit	Customer	Mission_Outcome	Landing_Outcome
0	19-02-2017	2021-07-02 14:39:00.0000000	F9 FT B1031.1	KSC LC-39A	SpaceX CRS-10	2490	LEO (ISS)	NASA (CRS)	Success	Success (ground pad)
1	16-03-2017	2021-07-02 06:00:00.0000000	F9 FT B1030	KSC LC-39A	EchoStar 23	5600	GTO	EchoStar	Success	No attempt
2	30-03-2017	2021-07-02 22:27:00.0000000	F9 FT B1021.2	KSC LC-39A	SES-10	5300	GTO	SES	Success	Success (drone ship)
3	01-05-2017	2021-07-02 11:15:00.0000000	F9 FT B1032.1	KSC LC-39A	NROL-76	5300	LEO	NRO	Success	Success (ground pad)
4	15-05-2017	2021-07-02 23:21:00.0000000	F9 FT B1034	KSC LC-39A	Inmarsat-5 F4	6070	GTO	Inmarsat	Success	No attempt

SQL RESULTS(Total Payload Mass by Customer NASA (CRS)

SQL QUERY

select SUM(PAYLOAD_MASS_KG_) TotalPayloadMass from tblSpaceX where Customer = 'NASA (CRS)'"','TotalPayloadMass

	Total Payload Mass
0	45596

QUERY EXPLAINATION

Using the function ***SUM*** summates the total in the column ***PAYLOAD_MASS_KG_***

The ***WHERE*** clause filters the dataset to only perform calculations on ***Customer NASA (CRS)***

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SQL RESULTS(

SQL QUERY

SELECT DATENAME(month,
DATEADD(month, MONTH(CONVERT(date, Date, 105)), 0) - 1) AS
Month,
Booster_Version, Launch_Site, Landing_Outcome
FROM tblSpaceX
WHERE (Landing_Outcome LIKE N'%Success%')
AND (YEAR(CONVERT(date, Date, 105)) = '2017')

QUERY EXPLAINATION

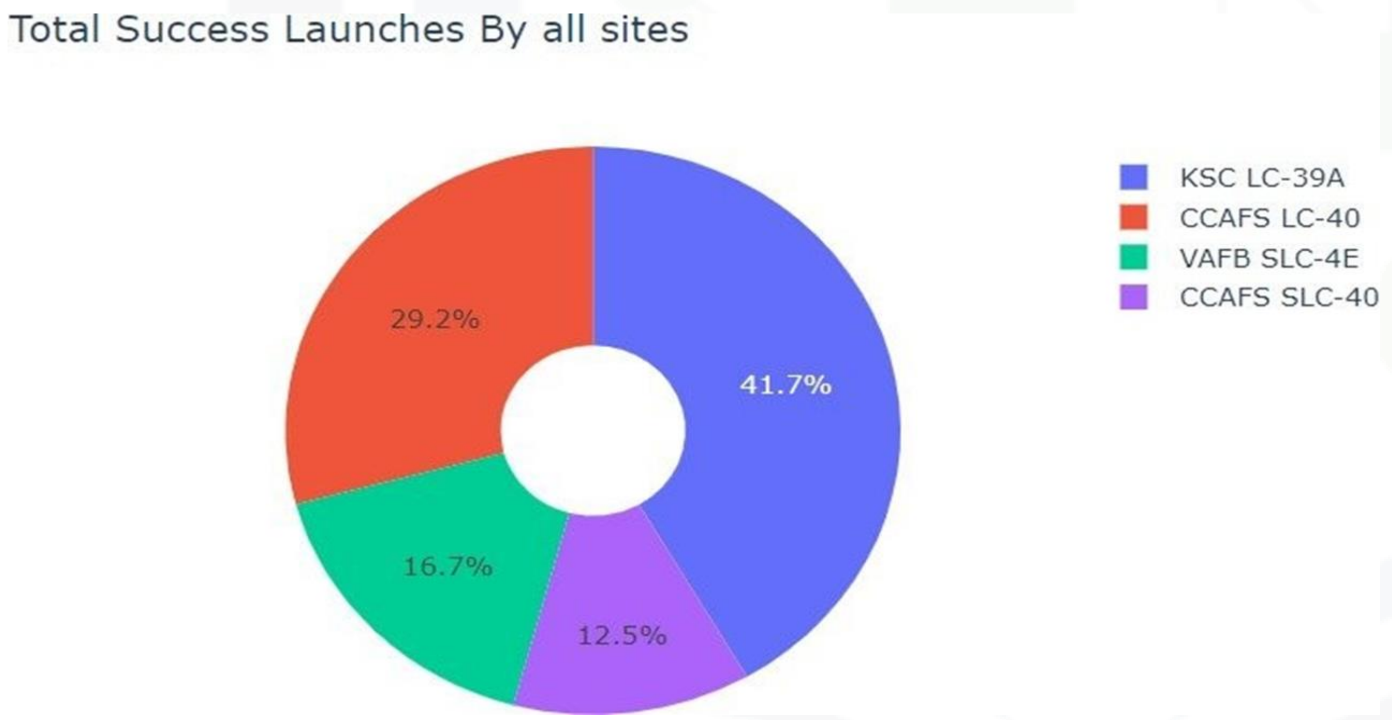
a much more complex query as I had my ***Date*** fields in SQL Server stored as ***NVARCHAR*** the ***MONTH*** function returns name month. The function ***CONVERT*** converts ***NVARCHAR*** to ***Date***.
WHERE clause filters ***Year*** to be 2017

Month	Booster_Version	Launch_Site	Landing_Outcome
January	F9 FT B1029.1	VAFB SLC-4E	Success (drone ship)
February	F9 FT B1031.1	KSC LC-39A	Success (ground pad)
March	F9 FT B1021.2	KSC LC-39A	Success (drone ship)
May	F9 FT B1032.1	KSC LC-39A	Success (ground pad)
June	F9 FT B1035.1	KSC LC-39A	Success (ground pad)
June	F9 FT B1029.2	KSC LC-39A	Success (drone ship)
June	F9 FT B1036.1	VAFB SLC-4E	Success (drone ship)
August	F9 B4 B1039.1	KSC LC-39A	Success (ground pad)
August	F9 FT B1038.1	VAFB SLC-4E	Success (drone ship)
September	F9 B4 B1040.1	KSC LC-39A	Success (ground pad)
October	F9 B4 B1041.1	VAFB SLC-4E	Success (drone ship)
October	F9 FT B1031.2	KSC LC-39A	Success (drone ship)
October	F9 B4 B1042.1	KSC LC-39A	Success (drone ship)
December	F9 FT B1035.2	CCAFS SLC-40	Success (ground pad)

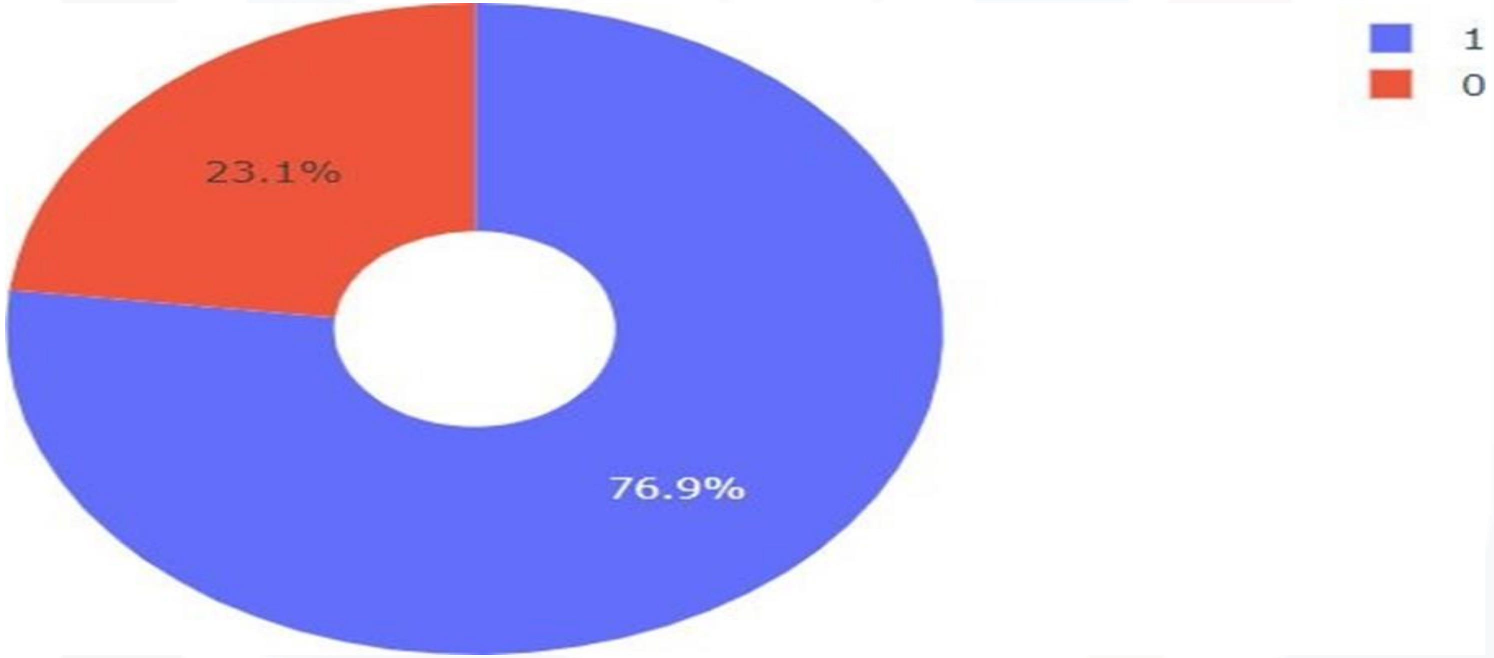
LAUNCH SITES WITH GLOBAL MARKER

COLOR LABEL MARKER

DASHBOARD – Pie chart showing the success percentage achieved by each launch site



DASHBOARD – Pie chart for the launch site with highest launch success ratio



KSC LC-39A achieved a 76.9% success rate while getting a 23.1% failure rate

Conclusion

- The Tree Classifier Algorithm is the best for Machine Learning for this dataset
- Low weighted payloads perform better than the heavier payloads
- The success rates for SpaceX launches is directly proportional time in years they will eventually perfect the launches
- We can see that KSC LC-39A had the most successful launches from all the sites
- Orbit GEO,HEO,SSO,ES-L1 has the best Success Rate