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
- Used SpaceX API
- WIKI WebScrapping
- Python Visual Library
- EDA SQL
- Folium

- Summary of all results
- SpaceY can successfully use the SpaceX model to launch and return Rockets

Introduction

- SpaceY was inquiring about the SpaceX approach to launch and reuse rockets
- The goal of this research is to determine if the SpaceX had a good or bad success rate on their launch attempts and what the parameters of each launch was in terms of success or failure

Section 1

Methodology

Methodology

Executive Summary

Data collection methodology:

- Data was collected using the SpaceX database

Perform data wrangling

- Data was processed using Python analytical tools and Machine Learning

Performed exploratory data analysis (EDA) using visualization and SQL

Performed interactive visual analytics using Folium and Plotly Dash

Performed 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

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 used the SpaceX Api call

Cleaned the data using Panda and Numpy

Created a Dataframe that we could manipulate

https://github.com/kingHannibal66/SpaceY/blob/main/jupyter-labs-spacex-data-collection-api.ipynb

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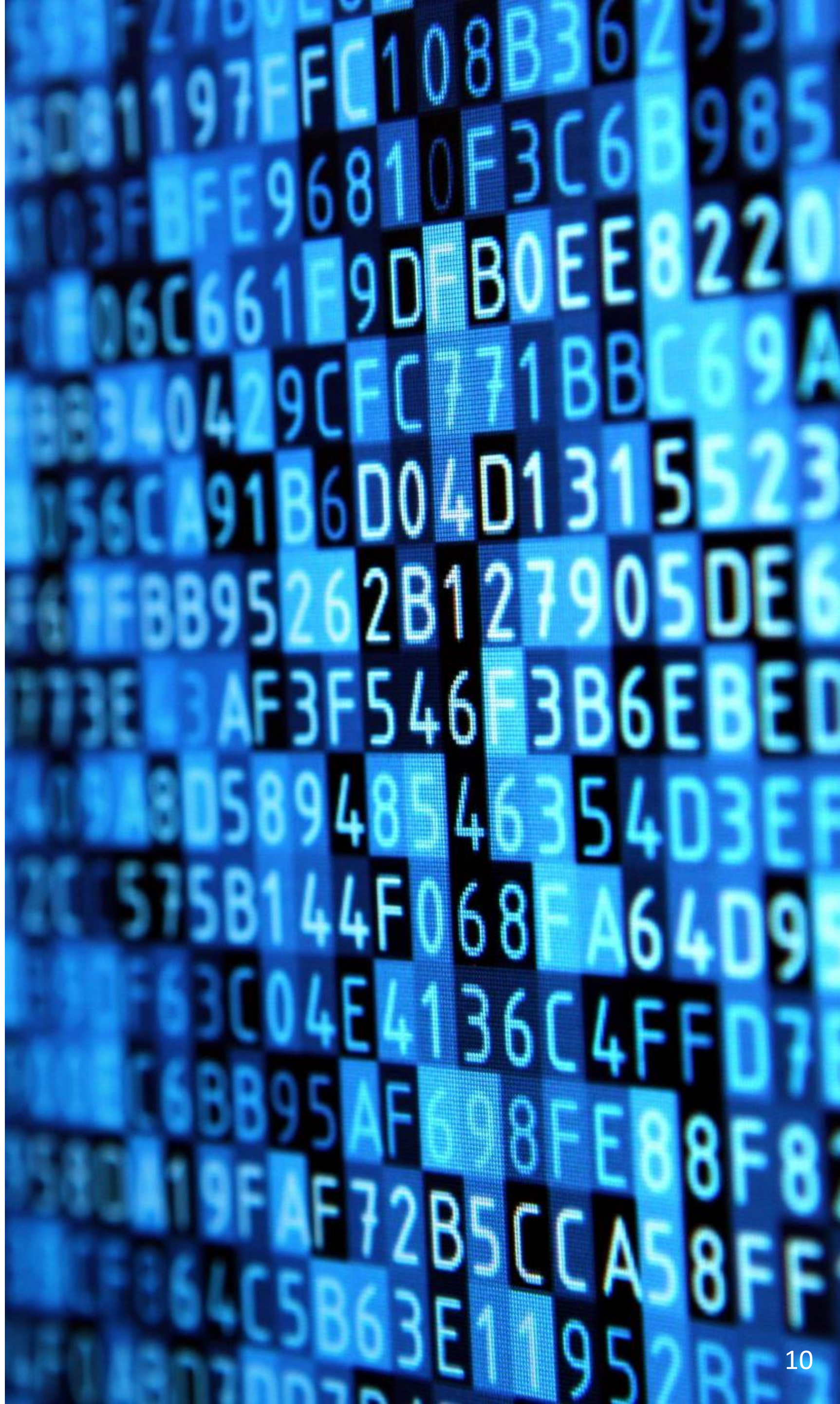
Data Wrangling

- Using the Dataset we
- Calculated the number of launches from each SpaceX site
- Calculated the number of missions and the outcome of those missions
- https://github.com/kingHannibal66/SpaceY/blob/main/labs-jupyter-spacex-Data%20wrangling.ipynb



EDA with Data Visualization

- Used MatPlotLib to chart the differences in Payload mass, Lauchsite, Flightnumber, Orbit of launch, and success or failure of mission
- https://github.com/kingHannibal66/SpaceY/blob/main/jupyter-labs-eda-dataviz.ipynb.jupyterlite.ipynb

EDA with SQL

- Some of the SQL queries performed are
- Create table. to display SpaceX information
- Select sum. to display the Payloadmass
- Select avg. to average the payload mass carried by each mission
- Select count. to display the success or failure of the missions

- https://github.com/kingHannibal66/SpaceY/blob/main/jupyter-labs-eda-sql-coursera_sqllite.ipynb

Build an Interactive Map with Folium

- Used circles show the launch sites and successful/ failed launches
- Lines to show distance from major cities and highways to SpaceX launchsites
- https://github.com/kingHannibal66/SpaceY/blob/main/lab_jupyter_launch_site_location.jupyterlite.ipynb

Build a Dashboard with Plotly Dash

- Created a SpaceX lauch dashboard the filtered all lauches with the success and failue rate of each launch vehicle and site and a payload mass plot

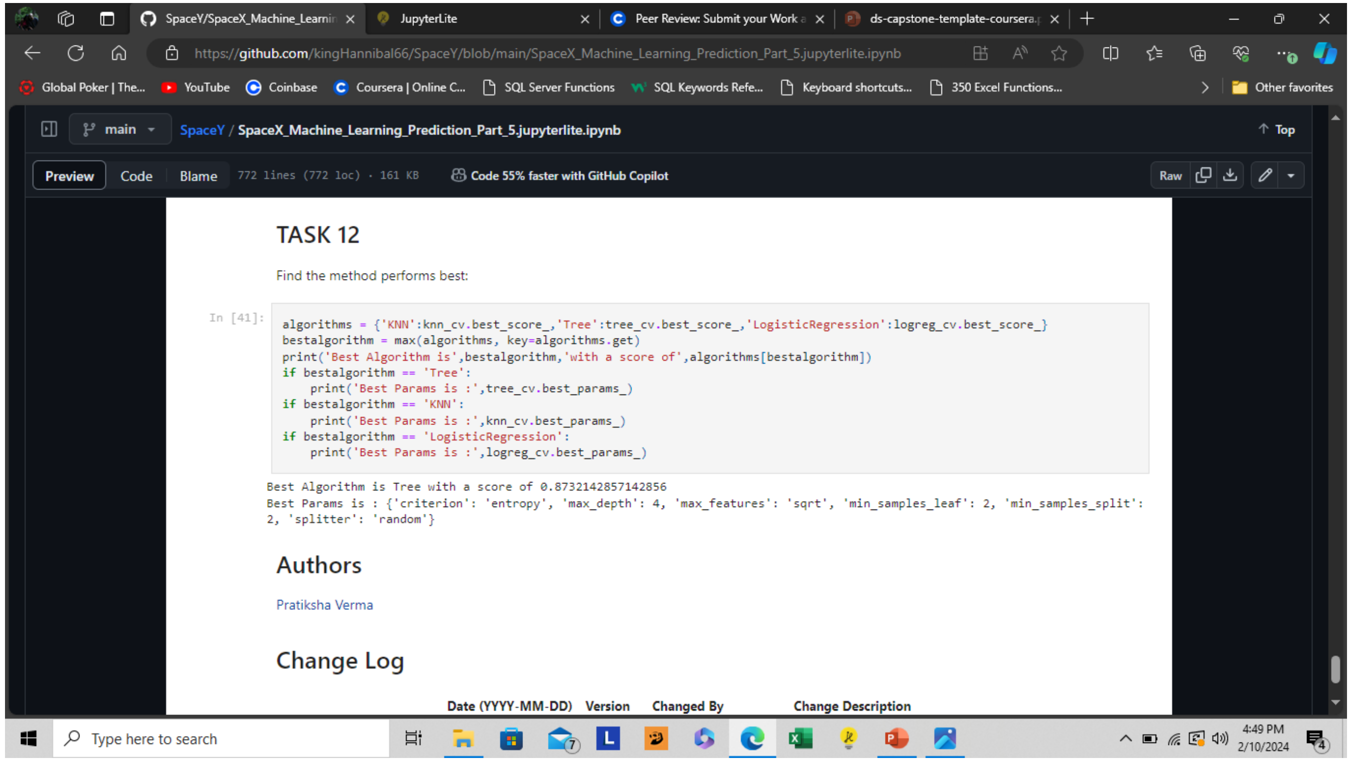
- https://github.com/kingHannibal66/SpaceY/blob/main/spacex_dash_app.py

Predictive Analysis (Classification)

- Used Machine learning(ML) prediction to create , train, and test 3 different ML algorithms to find the best fit for the data.
- The algorithms used where KNN, Decision Tree Classifier, and Logistic regression.
- https://github.com/kingHannibal66/SpaceY/blob/main/SpaceX_Machine_Learning_Prediction_Part_5.jupyterlite.ipynb

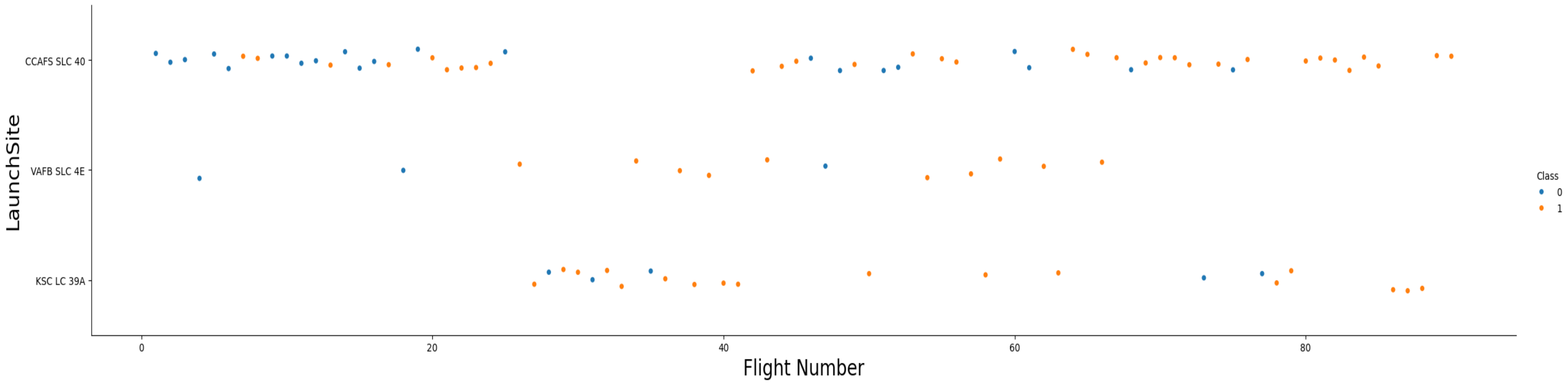
Results

- Decision Tree Classifier had the best outcome at 87%



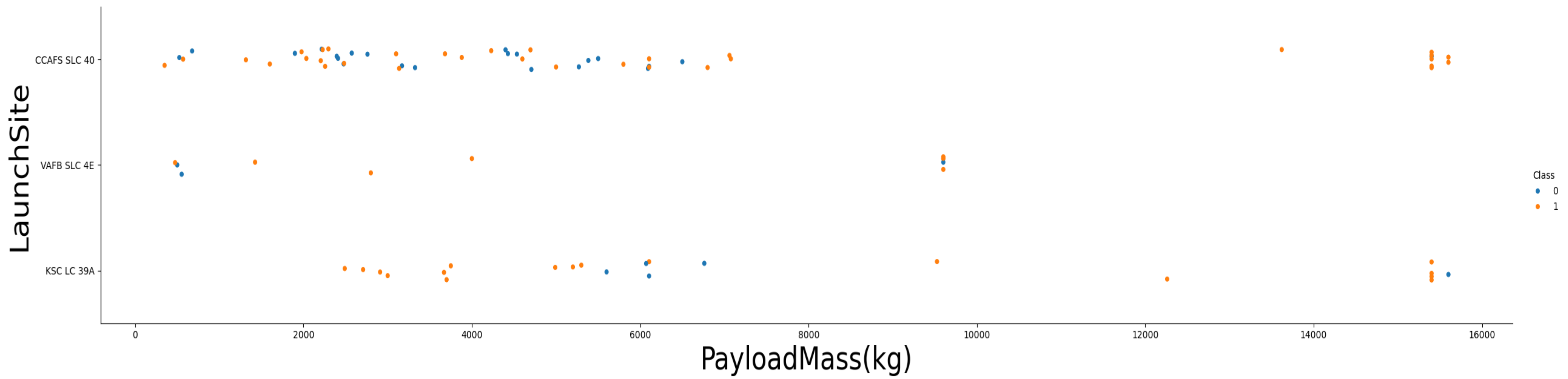
Section 2

Insights drawn from EDA



Flight Number vs. Launch Site

- 0 = Failure(blue)
- 1= Success(Orange)

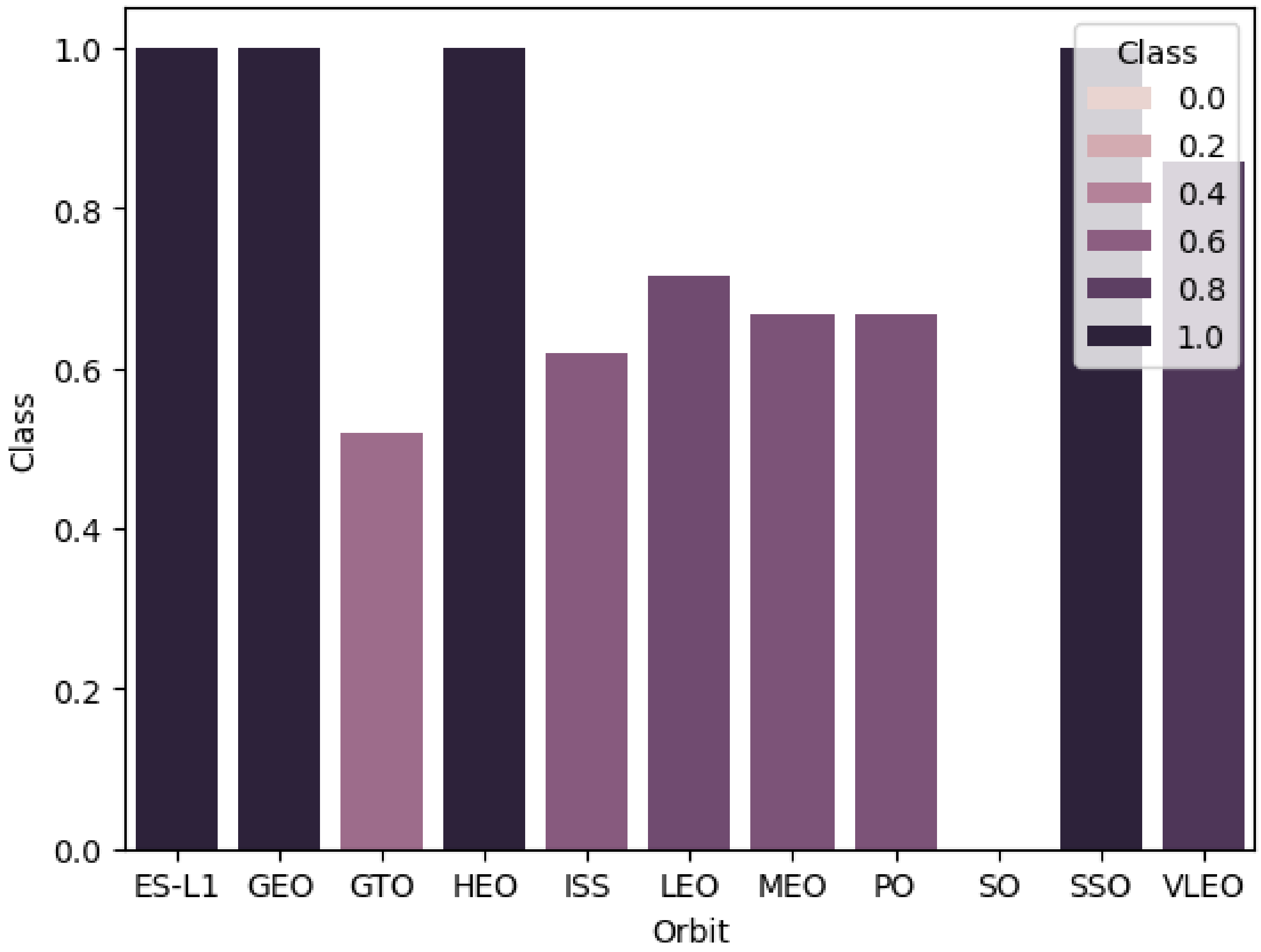


Payload vs. Launch Site

- No launches for a payload greater than 10,000kg

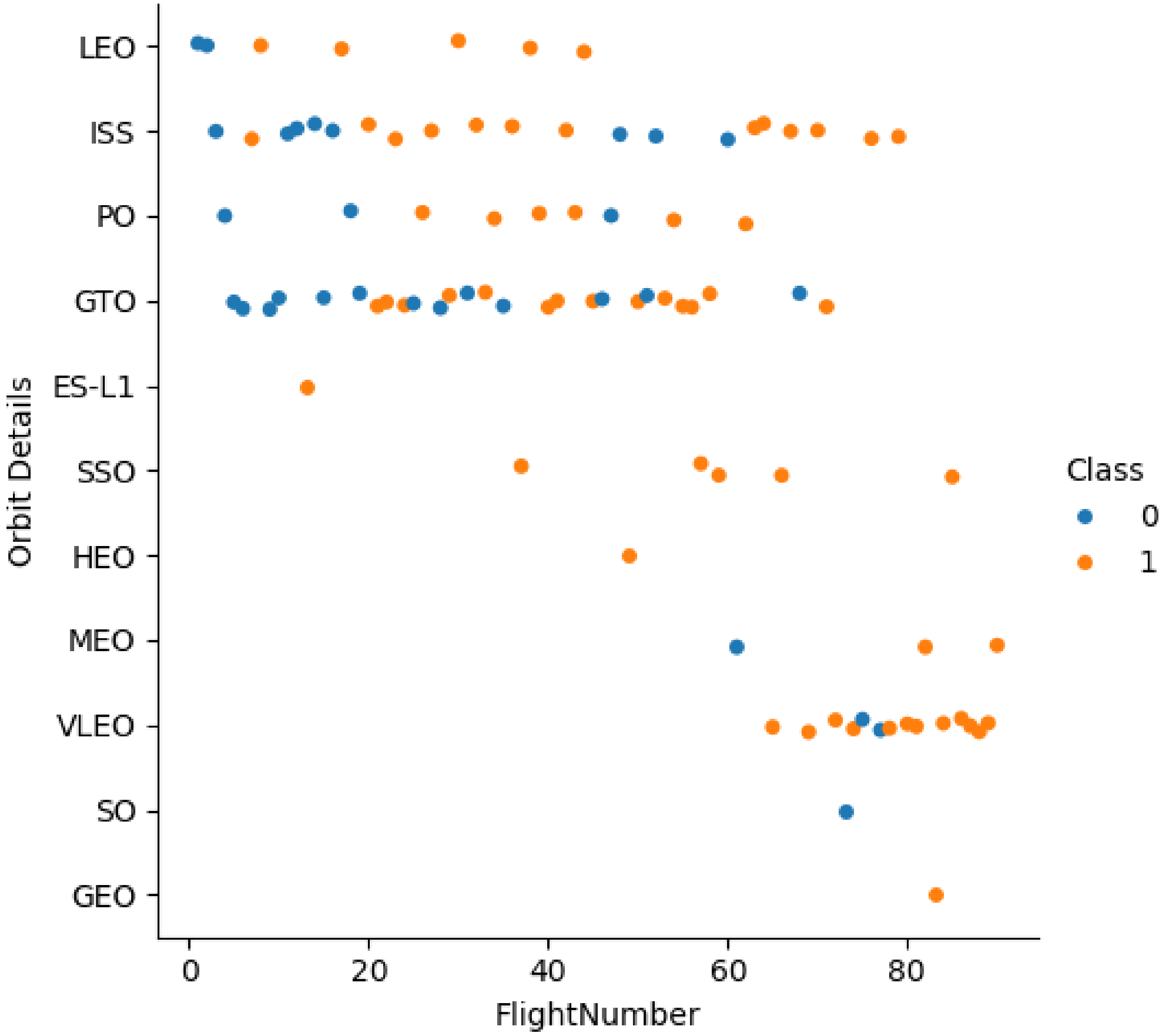
Success Rate vs. Orbit Type

- A graph showing which orbits have the highest success rate



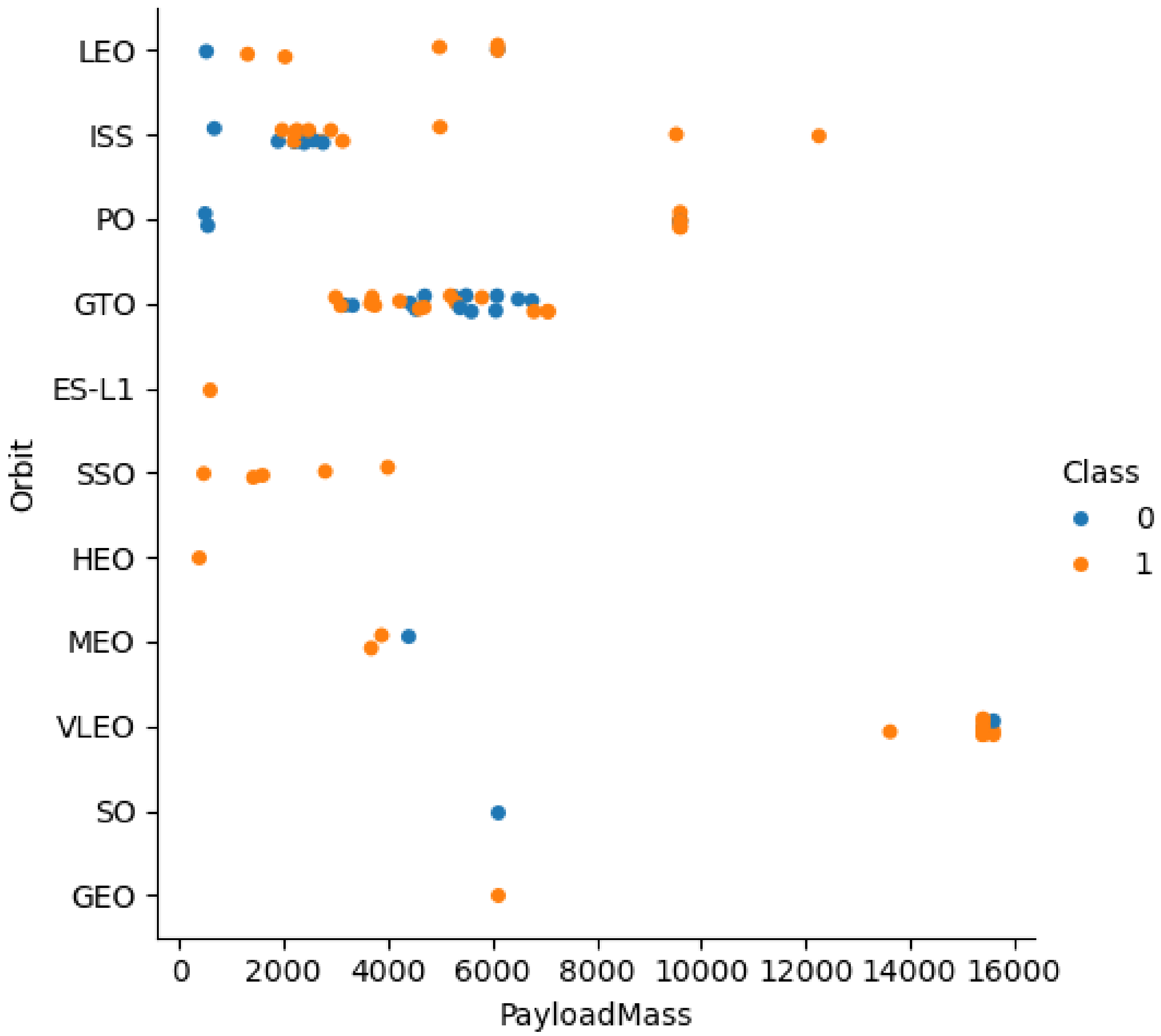
Flight Number vs. Orbit Type

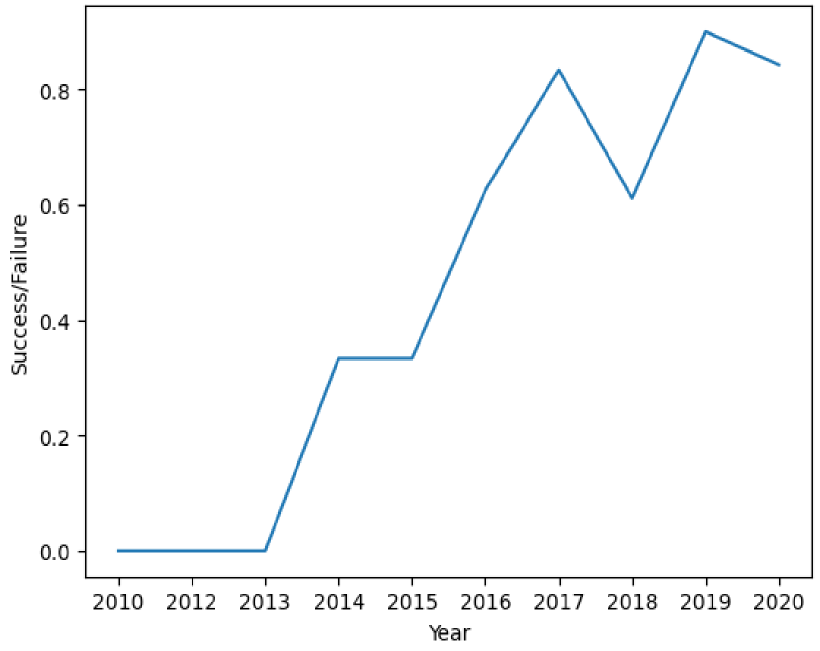
- You should see that in the LEO orbit the Success appears related to the number of flights; on the other hand, there seems to be no relationship between flight number when in GTO orbit.



Payload vs. Orbit Type

- How payload mass and orbit correleate





Launch Success Yearly Trend

- SpaceX has been more successful with launches every year

All Launch Site Names

- SELECT DISTINCT(Launch_Site) From SPACEXTBL
- Selected distinct launch sites
- Results:

CCAFS LC-40

VAFB SLC-4E

KSC LC-39A

CCAFS SLC-40

main SpaceY / jupyter-labs-eda-sql-coursera_sqllite.ipynb Top

Preview Code Blame 985 lines (985 loc) · 26.6 KB Code 55% faster with GitHub Copilot Raw

Out[65]:

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

Launch Site Names Begin with 'CCA'

- SELECT * FROM SPACEXTBL
- WHERE (Launch_Site) LIKE ‘CCA%’ LIMIT 5;
- 5 CCA Launch sites

Total Payload Mass

select sum(PAYLOAD_MASS__KG_) as payloadmass from SPACEXTBL

where Customer='NASA (CRS)';

Total payload mass was 45596kg

Average Payload Mass by F9 v1.1

- select avg(PAYLOAD_MASS__KG_) as payloadmass from SPACEXTBL
- where Booster_Version = 'F9 v1.1’;
- Avg Payload mass = 2928.4

First Successful Ground Landing Date

- sql select min(DATE) from SPACEXTBL
- where Landing_Outcome= 'Success(ground pad)’;
- NA

Successful Drone Ship Landing with Payload between 4000 and 6000

- sql select Booster_Version from SPACEXTBL
- where Landing_Outcome ='Success(drone ship)' and PAYLOAD_MASS__KG_>4000 and PAYLOAD_MASS__KG_<6000;
- NA

Total Number of Successful and Failure Mission Outcomes

sql select count (MISSION_OUTCOME) as missionoutcomes from SPACEXTBL

group by Mission_Outcome ='Success' or Mission_Outcome = 'Failure’

Successful missions = 98

Failed missions =3

Boosters Carried Maximum Payload

- sql select BOOSTER_VERSION as boosterversion from SPACEXTBL
- where PAYLOAD_MASS__KG_=(select max(PAYLOAD_MASS__KG_) from SPACEXTBL);
- boosterversion
- F9 B5 B1048.4
- F9 B5 B1049.4
- F9 B5 B1051.3
- F9 B5 B1056.4
- F9 B5 B1048.5
- F9 B5 B1051.4
- F9 B5 B1049.5
- F9 B5 B1060.2
- F9 B5 B1058.3
- F9 B5 B1051.6
- F9 B5 B1060.3
- F9 B5 B1049.7

2015 Launch Records

- sql select 'Booster_Version','Launch_Site' from SPACEXTABLE
- where 'Landing_Outcome' = 'Failure(drone ship)'
- and substr(Date,1,4) = '2015’;
- NA

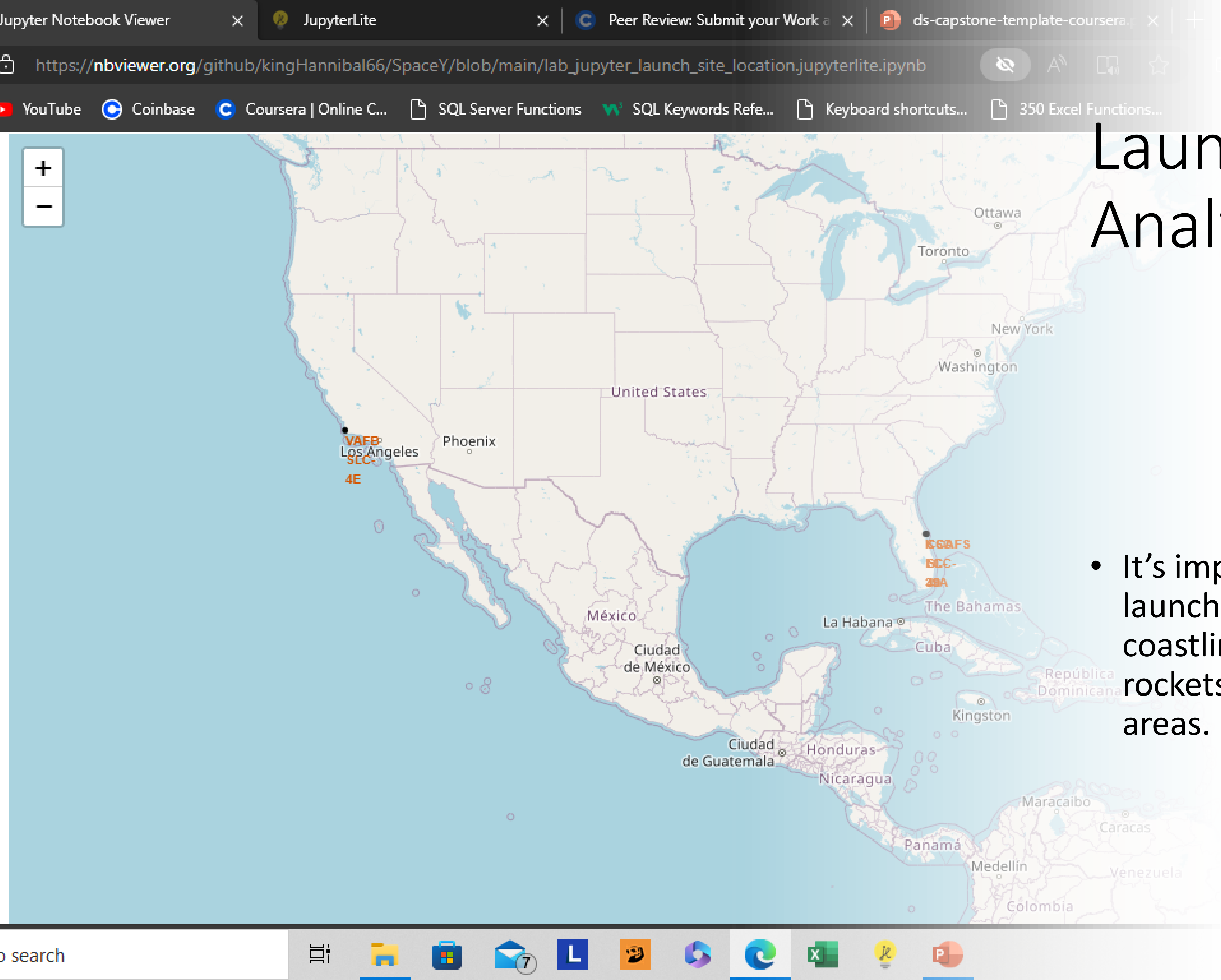
Rank Landing Outcomes Between 2010-06-04 and 2017-03-20

- sql select 'LANDING_OUTCOME', count(*) as 'count' from SPACEXTBL
- where substr(Date,1,4)||substr(Date,6,2)|| substr(date,9,2)
- between '20100604' and '20170320'
- group by 'Landing_Outcome' order by 'count' Desc;

- Landing Outcome = 31

Section 3

Launch Sites Proximities Analysis

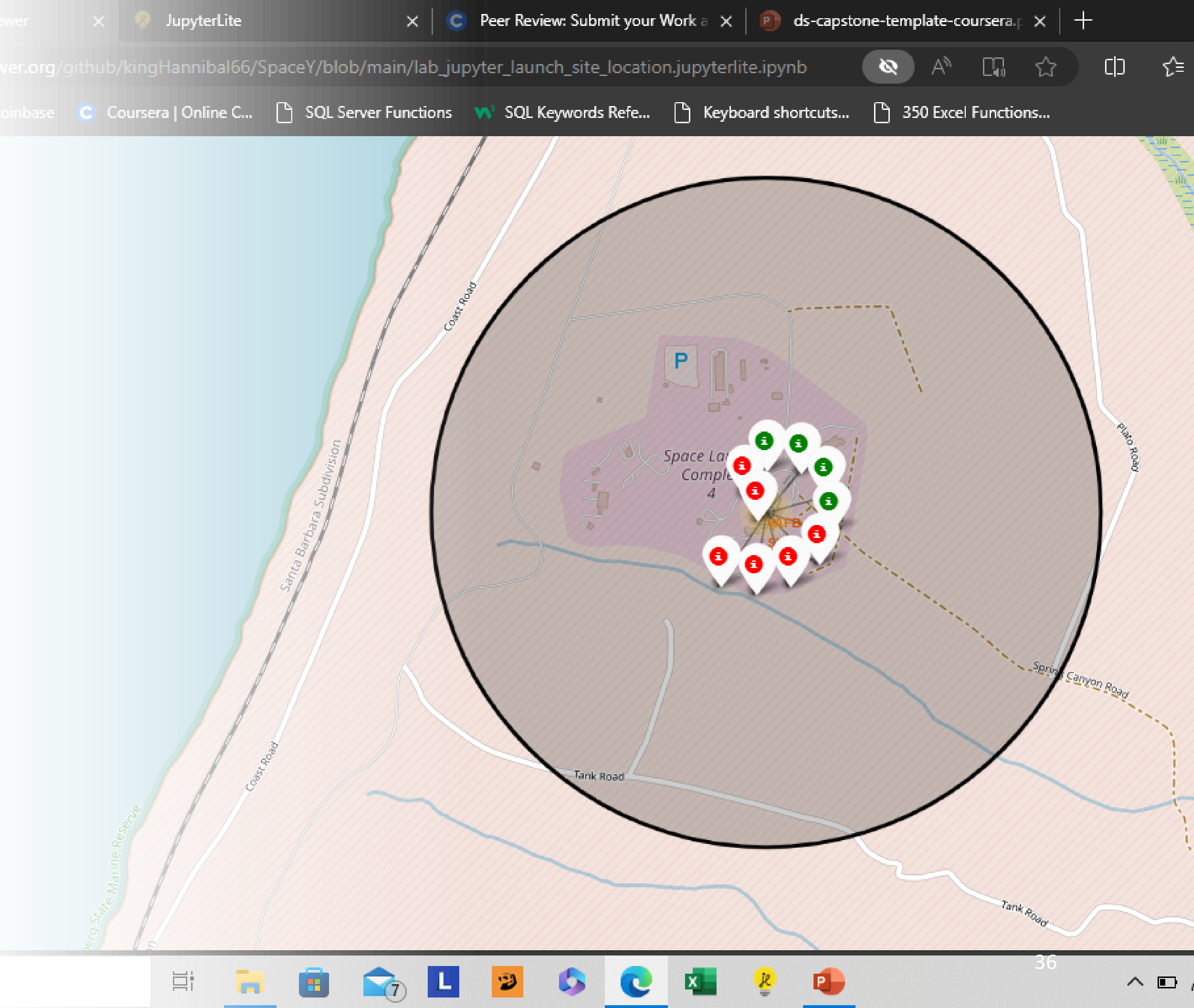


Launch Site Analysis

- It's important to note that all the launch sites are near the coastline. Most likely to have rockets launch over unpopulated areas.

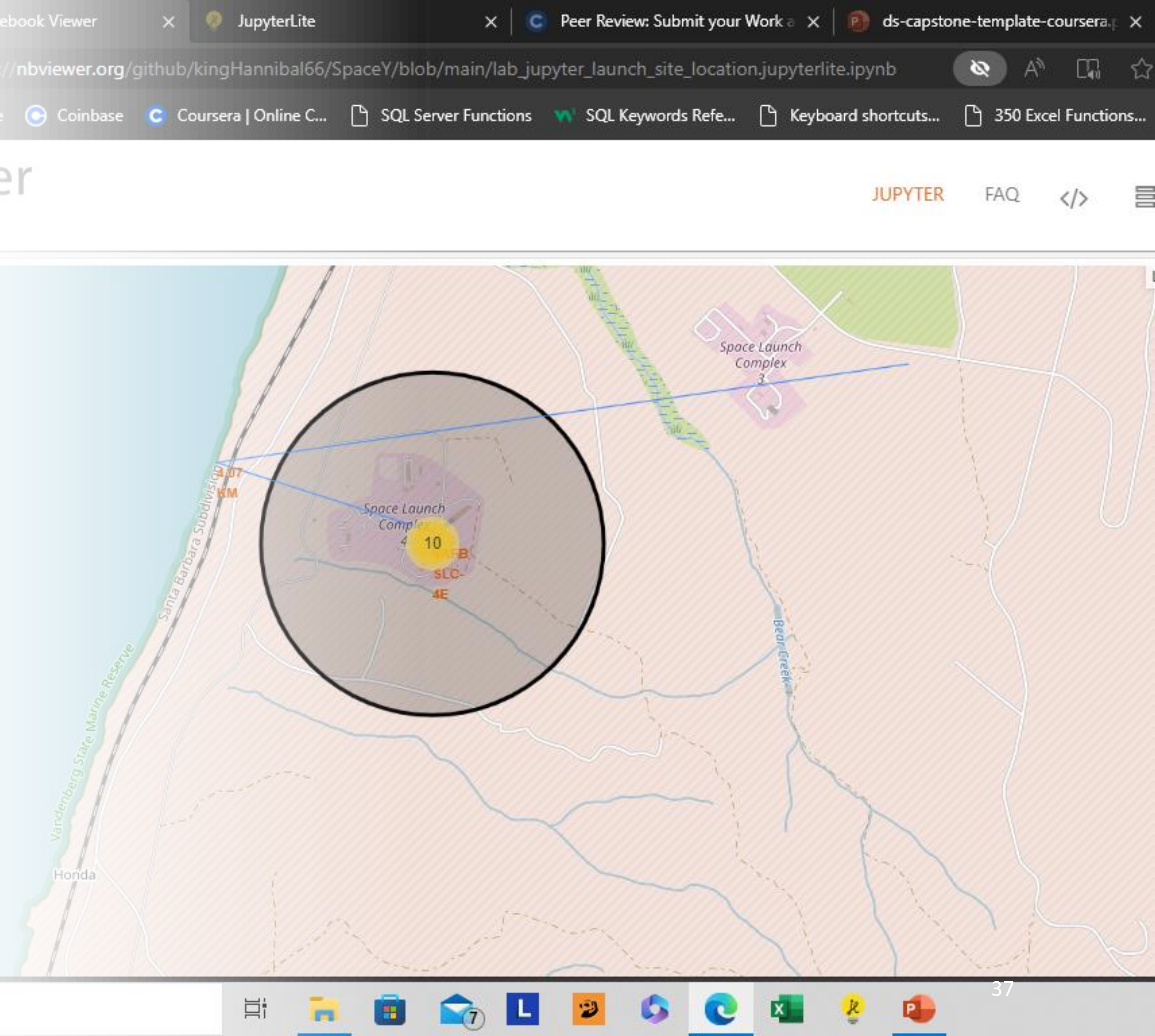
Launch Site Success/Failure

- Green = Launch success
- Red = Launch failure



Launch Site Area

- Launch sites are always in proximity of railways and highways presumably for supply and logistic reasons

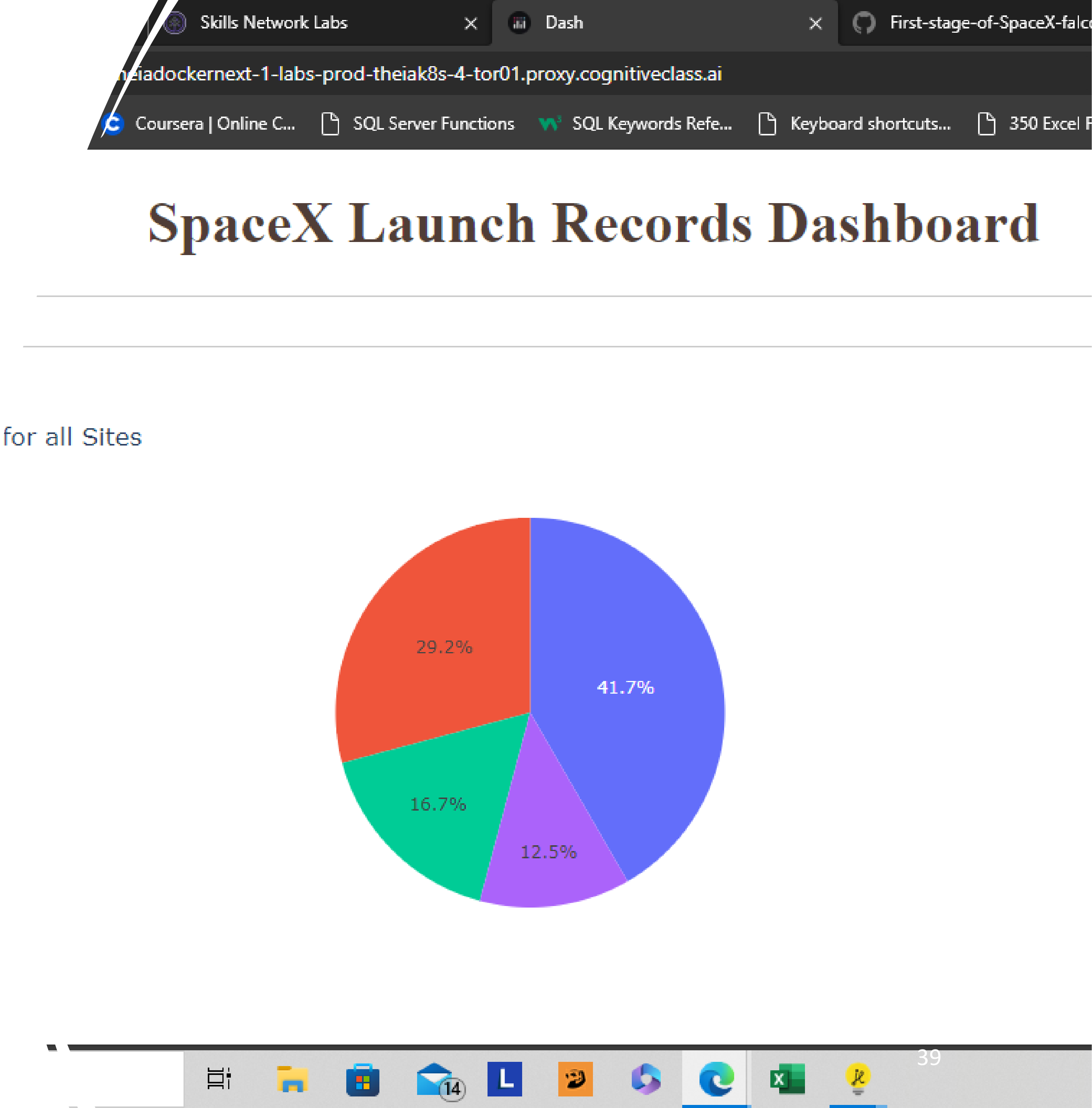


Section 4

Build a Dashboard with Plotly Dash

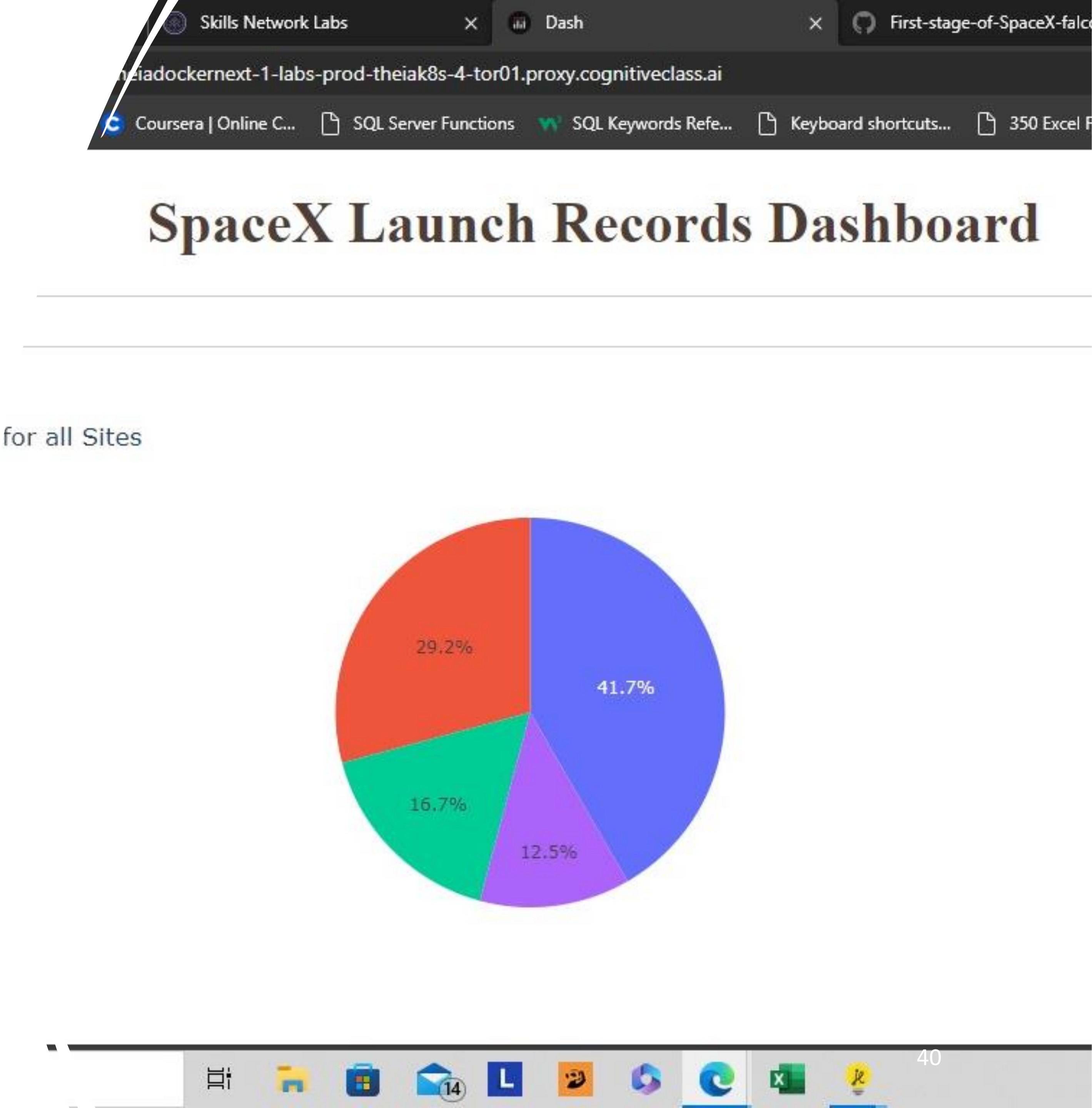
Launch Success Dashboard

- Launch success for all sites



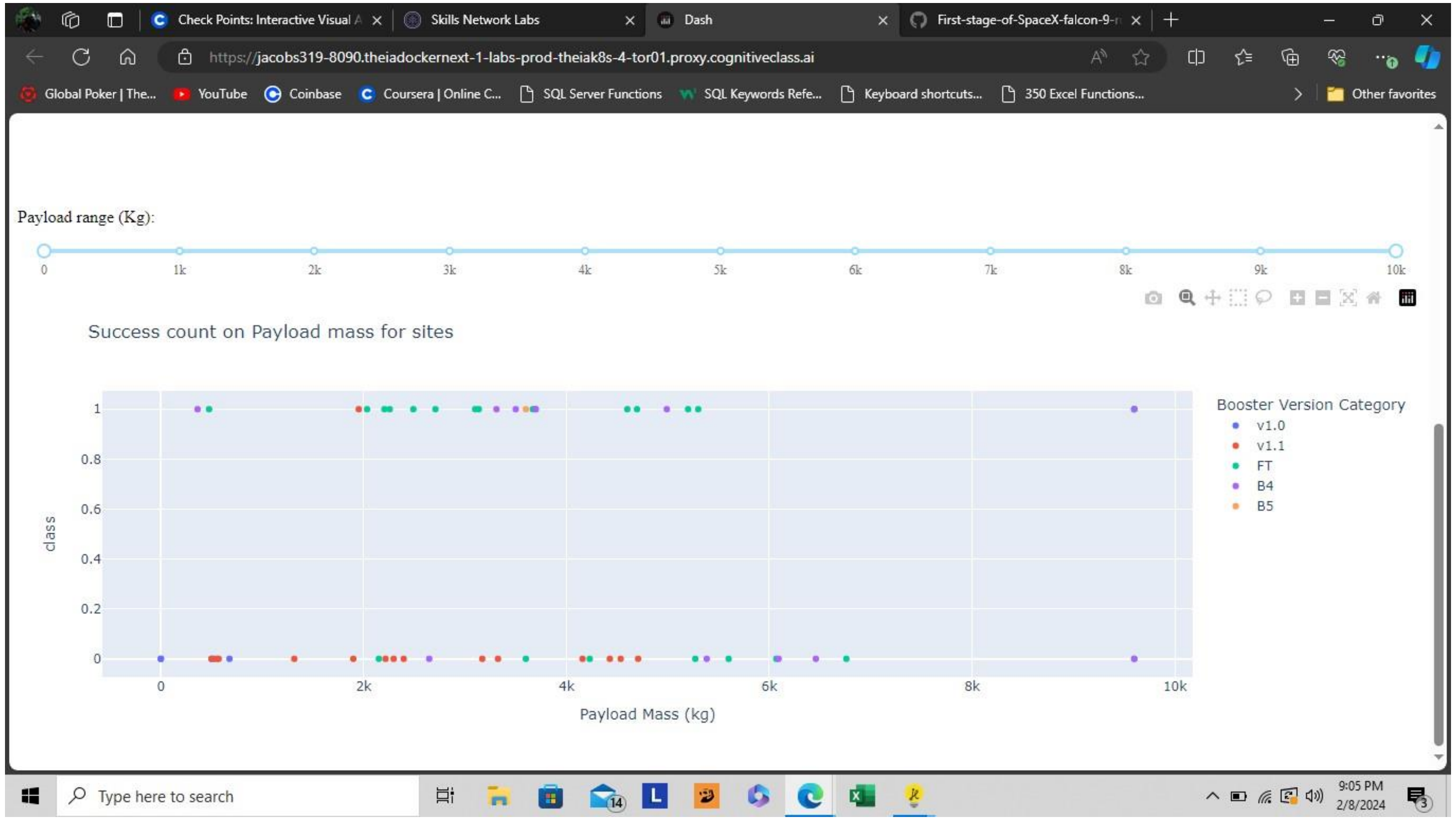
Launch Success Ratio

- Launch site with the highest ratio is KSC LC-40



Payload Launch vs Outcome

- Anything over 8000k booster version B4 is best suited
- For 8000k and under booster version FT is best suited



Section 5

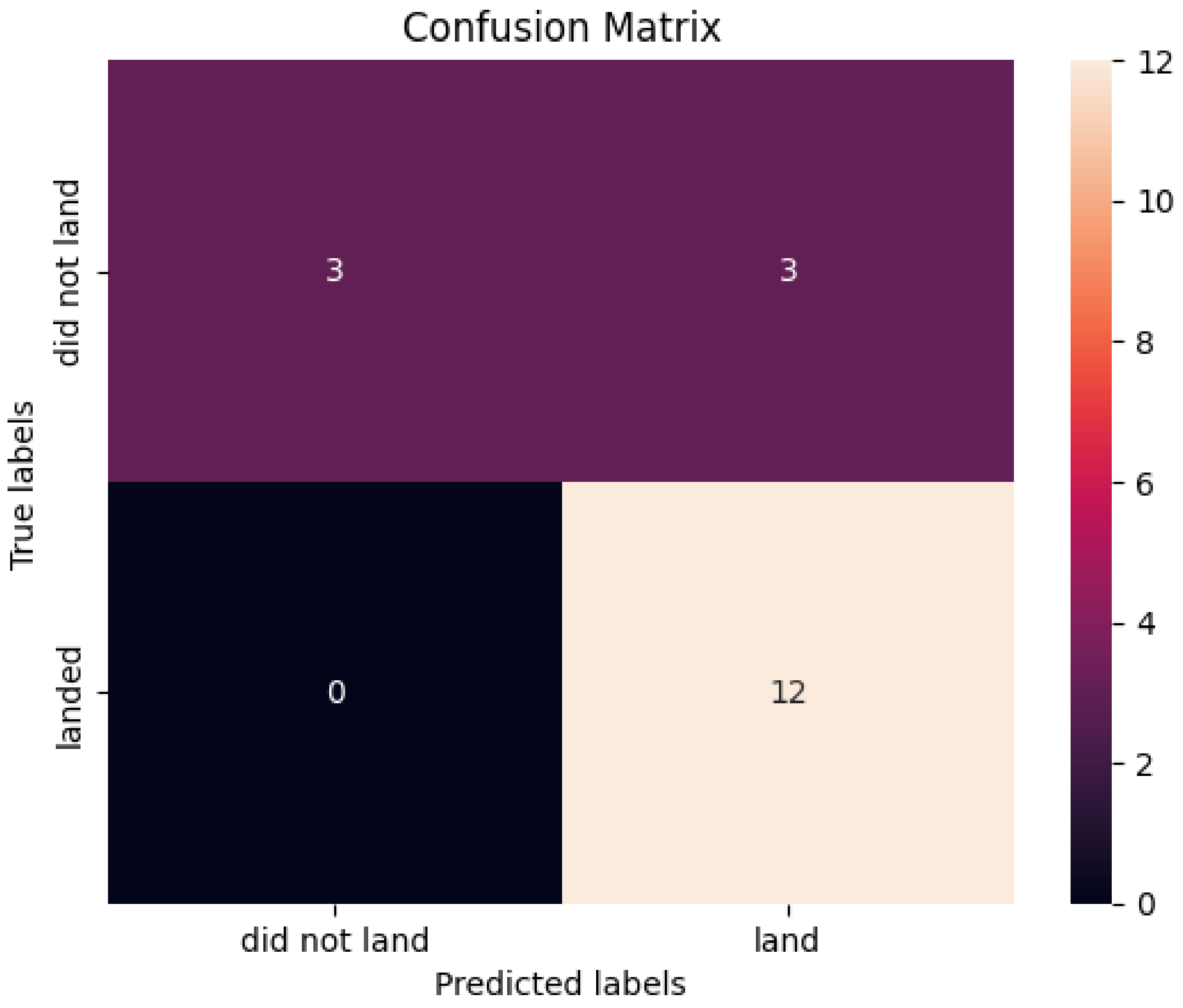
Predictive Analysis (Classification)

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

- The Decision Tree had the best accuracy at 87%



Conclusions

SpaceX has a very high success rate

Depending on payload and orbit our rate goes up even higher

By duplicating the Data SpaceY should be able to successfully launch our vehicles

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!