

The SpaceX logo is displayed in white, pixelated, uppercase letters on a black rectangular background. The letters are spaced out, and a small, white, curved line resembling a rocket's exhaust trail is positioned to the right of the 'X'.

# First Stage Landing of SpaceX Rockets

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# OUTLINE

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- Executive Summary
- Introduction
- Methodology
- EDA
- Success rates of launch sites
- Model Accuracy
- Conclusion
- Appendix

# EXECUTIVE SUMMARY

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- The objective of this presentation aims to show insights on the launch of Falcon 9 rockets by SpaceX
- Insights from the data were drawn using visualizations
- A machine learning model was built to predict whether a rocket will land successfully or not in the first stage

# INTRODUCTION

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- The data consists of details related to the Booster Version, Orbit, Payload, Launch sites and other features
- There were a total of 90 launches of the Falcon 9 booster
- The rockets were launched from 3 launch sites i.e., CCAFS SLC 40, VAFB SLC 4E, KSC LC 39A
- The rockets were launched into various orbits e.g., Low Earth Orbit (LEO), Very Low Earth Orbit (VLEO), etc.
- The rockets carried payloads ranging from 350KG to 15600 KG

# METHODOLOGY - DATA COLLECTION

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- The data was collected from SpaceX REST API
- We used the URL <https://api.spacexdata.com/v4/launches/past> and performed a get request using the requests library to obtain the launch data
- This gave us a result of a list of JSON objects which were converted to a Pandas Dataframe after which the analysis was performed
- The data visualization with Folium was done using `spacex_launch_geo.csv` which is an augmented dataset

# METHODOLOGY - DATA WRANGLING

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- Following calculations were done:
  - Missing values from dataset
  - Total launches from each site
  - Launches into each orbit
  - Mission outcome per orbit type
  - Mean of Class column (Success rate)
- Mapped Landing outcome from 'Outcome' column as 1 (good outcome) or 0 (bad outcome)
- Some values present in PayloadMass column were NaNs, they were replaced with the mean

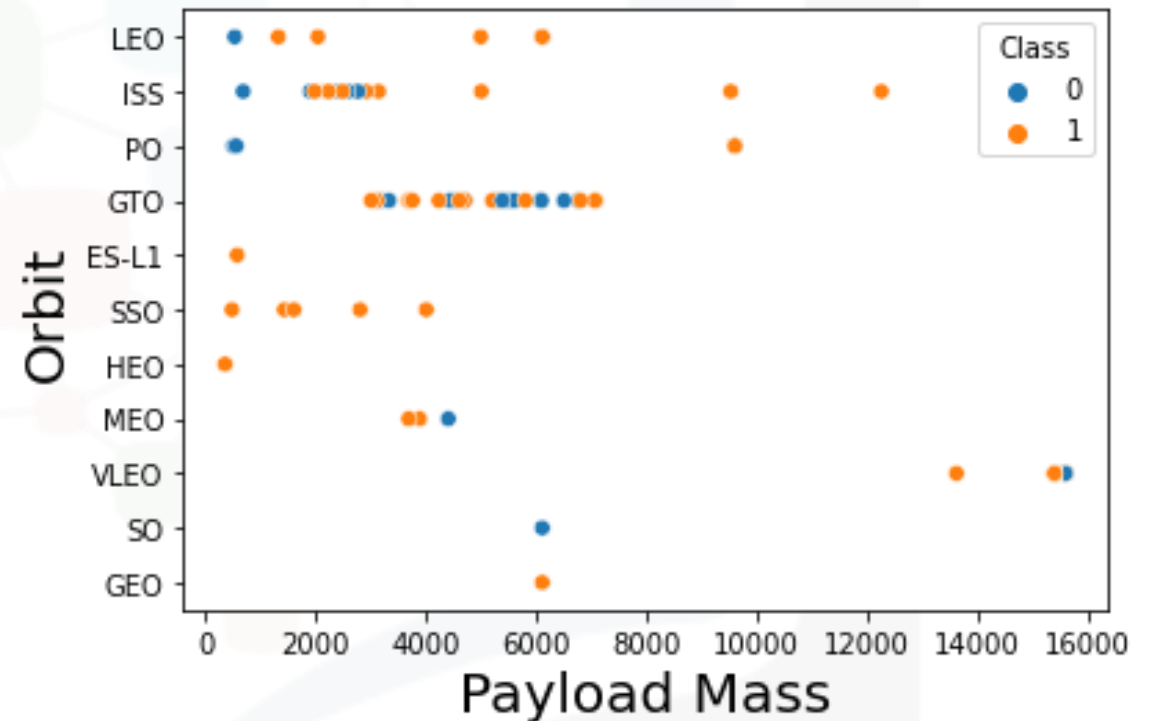
# METHODOLOGY – PREDICTIVE ANALYTICS

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- Standardized all predictor variables using Standard Scaler
- Performed Train-Test split with 80:20 ratio
- Made predictions using Logistic Regression, Decision Tree Classifier, Support Vector Machine, K – Nearest Neighbour
- Created a confusion matrix

# EDA 1

- Launches carrying a payload above 9000 kg had a 87% success rate
- ES-L1, GEO, HEO, SSO orbits had 100% success rate
- With heavy payloads the successful landing or positive landing rate are more for Polar, LEO and ISS.





# EDA 2

- The maximum payload carried was 15600 KG
- They were carried by the following Booster Versions (Fig. A)
- These boosters had successful droneship landings and carried a payload between 4000 to 6000KG (Fig. B)

Fig. A

	Booster_Version	PAYLOAD_MASS_KG_
▶	F9 B5 B1048.4	15600
	F9 B5 B1049.4	15600
	F9 B5 B1051.3	15600
	F9 B5 B1056.4	15600
	F9 B5 B1048.5	15600
	F9 B5 B1051.4	15600
	F9 B5 B1049.5	15600
	F9 B5 B1060.2	15600
	F9 B5 B1058.3	15600
	F9 B5 B1051.6	15600
	F9 B5 B1060.3	15600
	F9 B5 B1049.7	15600

Fig. B

	Booster_Version
▶	F9 FT B1022
	F9 FT B1026
	F9 FT B1021.2
	F9 FT B1031.2

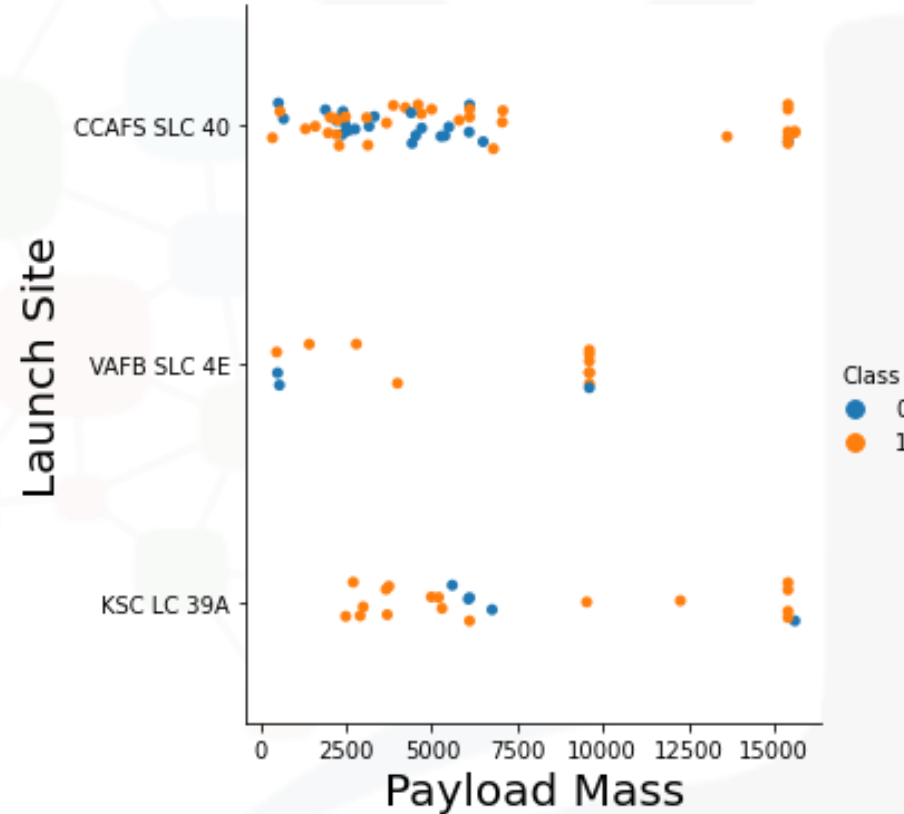
# EDA 3

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- Successful landings:
- ASDS – 87.23% (Drone ship)
- RTLS – 93.33% (Ground pad)
- Ocean – 71.42%
- Ocean landings are less likely to be successful
- RTLS has the best chance, however, overall ASDS has had more successful landings

# SUCCESS RATES OF LAUNCH SITES - 1

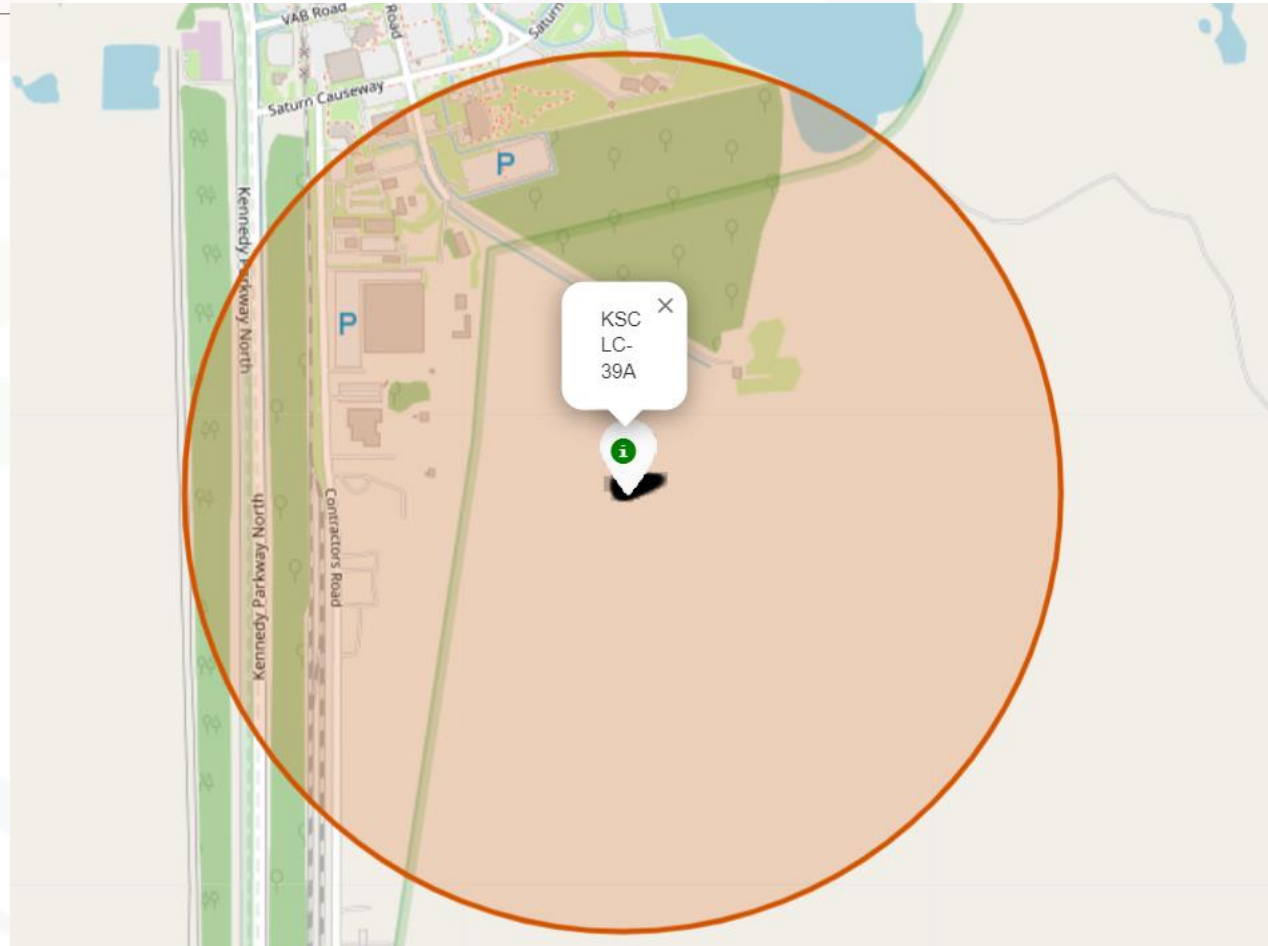
- CCAFS SLC 40 had the highest number of rocket launches
- All rockets from CCAFS SLC 40 successfully launched carrying a payload mass above 12500KG
- VAFB SLC 4E had no rockets launched with a payload mass above 10000KG



# SUCCESS RATES OF LAUNCH SITES - 2

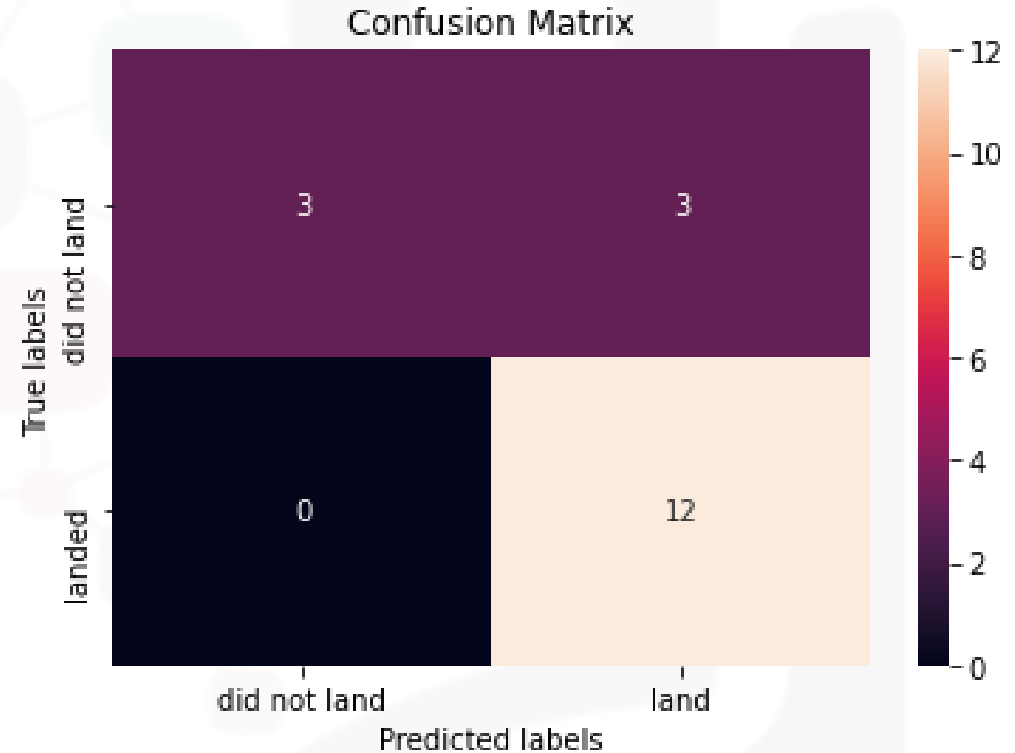
- Success rates of launch sites:
- KSC LC-39A → 77%
- CCAFS SLC - 40 → 43%
- VAFB SLC - 4E → 40%
- CCAFS LC-40 → 27%

\* spacex\_launch\_geo.csv is an augmented dataset that was used for this section



# MODEL ACCURACY

- A Logistic Regression, Support Vector Machine, Decision Tree Classifier and KNN model was trained on 72 data points and tested on 18
- 83.33% accuracy was achieved on all models
- The confusion matrix gave decent result, there were a few false positives in the test dataset



# CONCLUSION

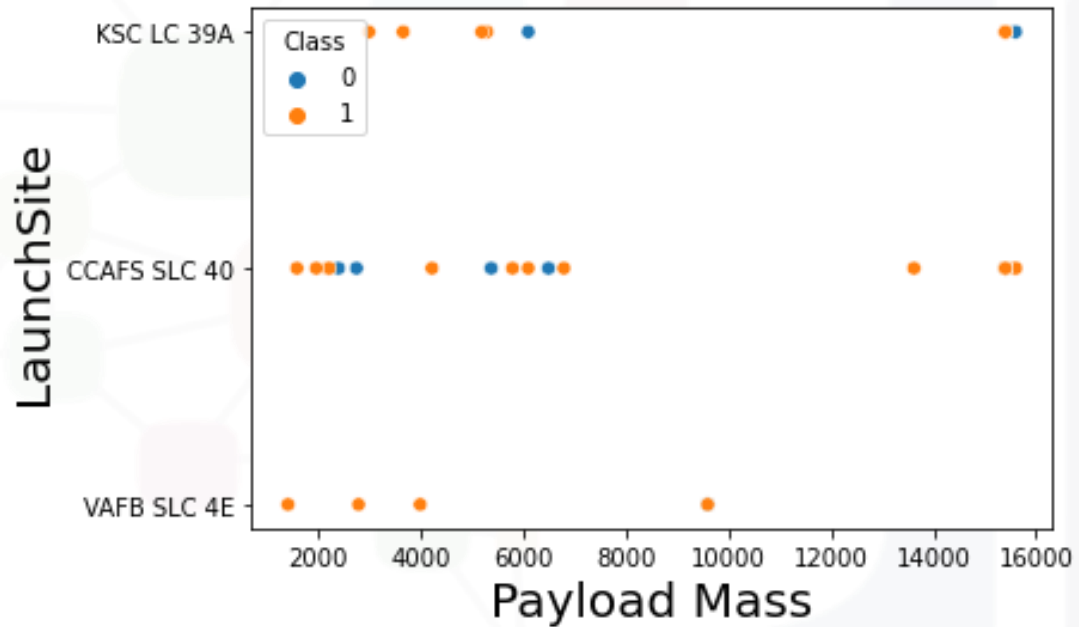
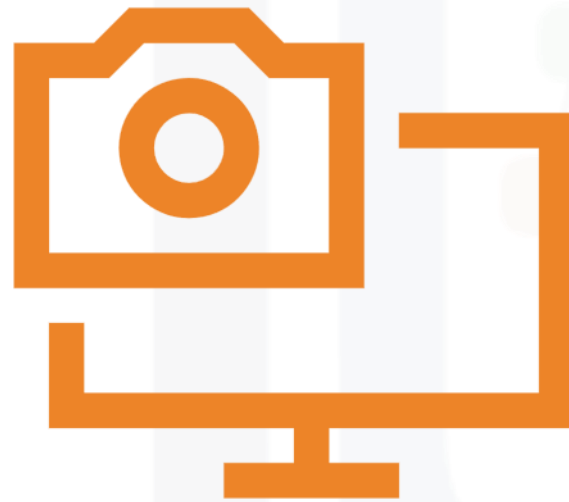
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First stage is likely to be more successful if:

- Rocket is launched at either ES-L1, GEO, HEO, SSO orbits
- Landing is done on RTLS (Ground Pad)
- Rocket is launched from KSC LC-39A
- Rocket is launched from CCAFS SLC – 40 and carries a payload weighing above 12500 KG

# APPENDIX



The reused rockets launched from VAFB SLC 4E all landed successfully