
IBM Developer
SKILLS NETWORK
Winning Space Race with Data Science
Gabriel Demetrios Lafis
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Gabriel Demetrios Lafis

Outline

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

Executive Summary

- Summary of methodologies
- Summary of all results

Introduction

- Project background and context
- Problems you want to find answers

Section 1

Methodology

Methodology

Executive Summary

- Data collection methodology:
  - Describe how data was collected
- Perform data wrangling
  - Describe how data was processed
- 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.
- 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

- 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

Place your flowchart of web scraping here

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

EDA with Data Visualization

- Summarize what charts were plotted and why you used those charts
- Add the GitHub URL of your completed EDA with data visualization notebook, as an external reference and peer-review purpose

EDA with SQL

- Using bullet point format, summarize the SQL queries you performed
- Add the GitHub URL of your completed EDA with SQL notebook, as an external reference and peer-review purpose

Build an Interactive Map with Folium

- Summarize what map objects such as markers, circles, lines, etc. you created and added to a folium map
- 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

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

Predictive Analysis (Classification)

- Summarize how you built, evaluated, improved, and found the best performing classification model
- 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

Results

- Exploratory data analysis results
- 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
- Present your query result with a short explanation here

Launch Site Names Begin with 'CCA'

- Find 5 records where launch sites begin with `CCA`
- Present your query result with a short explanation here

Total Payload Mass

- Calculate the total payload carried by boosters from NASA
- 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
- 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
- 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

- 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
- 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
- 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

- 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

- Present your query result with a short explanation here

Section 3

Launch Sites Proximities Analysis

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<Folium Map Screenshot 1>

- Replace <Folium map screenshot 1> title with an appropriate title
- 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

<Folium Map Screenshot 2>

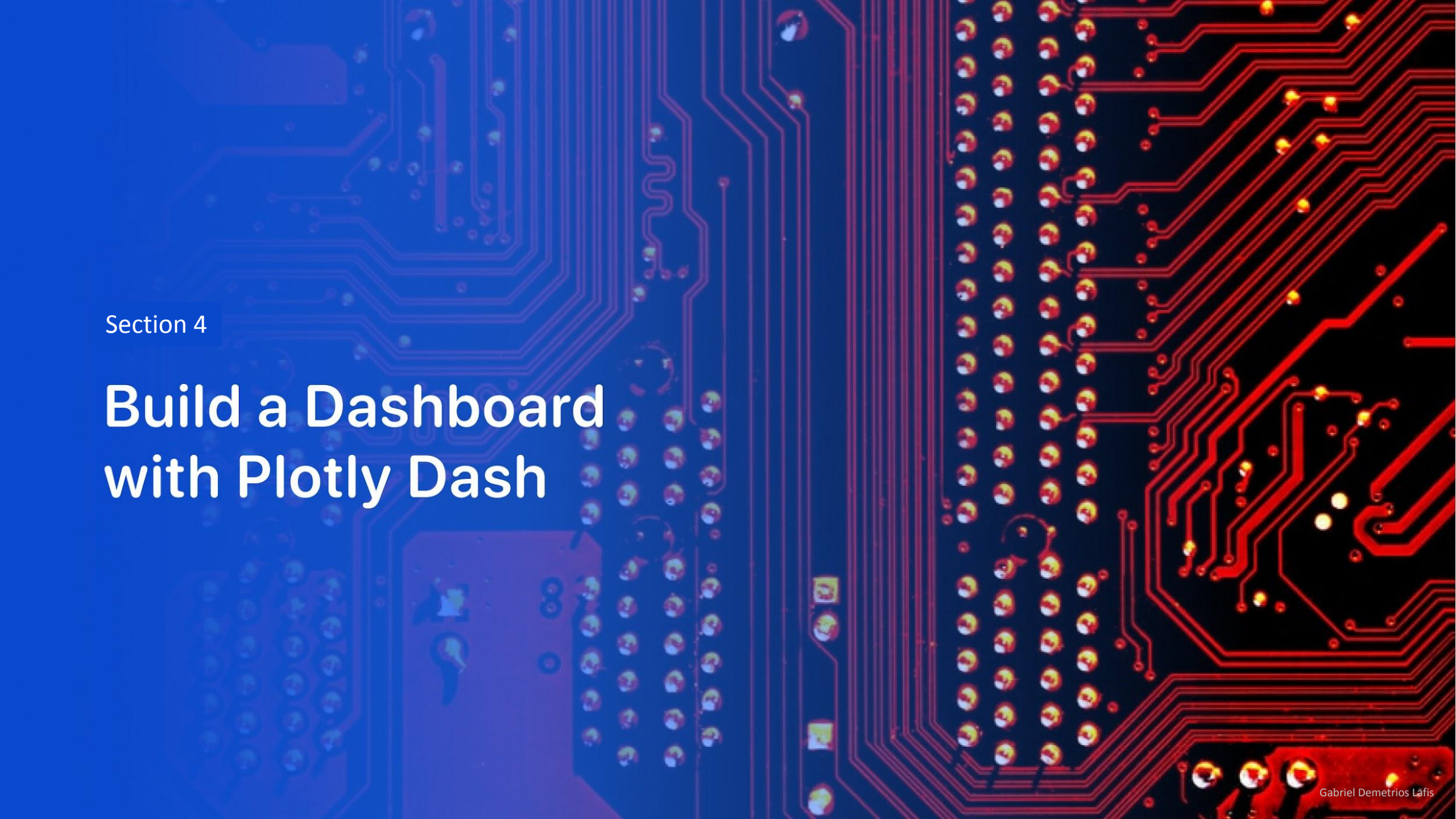
- Replace <Folium map screenshot 2> title with an appropriate title
- Explore the folium map and make a proper screenshot to show the color-labeled launch outcomes on the map
- Explain the important elements and findings on the screenshot

<Folium Map Screenshot 3>

- Replace <Folium map screenshot 3> title with an appropriate title
- 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

Section 4

Build a Dashboard with Plotly Dash



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<Dashboard Screenshot 1>

- Replace <Dashboard screenshot 1> title with an appropriate title
- Show the screenshot of launch success count for all sites, in a piechart
- Explain the important elements and findings on the screenshot

<Dashboard Screenshot 2>

- Replace <Dashboard screenshot 2> title with an appropriate title
- Show the screenshot of the piechart for the launch site with highest launch success ratio
- Explain the important elements and findings on the screenshot

<Dashboard Screenshot 3>

- Replace <Dashboard screenshot 3> title with an appropriate title
- 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.

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

Conclusions

- Point 1
- Point 2
- Point 3
- Point 4
- …

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!

Outline

- Executive Summary
- Introduction to SpaceX & Falcon Family
- Falcon 9 Evolution (v1.0 to Block 5)
- Launch Statistics & Success Rate
- Reusability: Landings & Reflights
- Falcon Heavy Overview
- Notable Missions & Payloads
- Conclusion
- Appendix
- References

Executive Summary

- SpaceX's Falcon 9 has become a dominant force in the global launch market.
- Boasting a high success rate (over 99% overall, ~99.8% for Block 5).
- Revolutionary first-stage reusability significantly reduces launch costs.
- Boosters have landed successfully over 430 times, with some flying over 25 missions.
- Falcon 9 Block 5 is the current workhorse, optimized for rapid reuse.
- Key missions include Starlink deployment, ISS resupply, and diverse satellite launches.

Introduction to SpaceX & Falcon Family

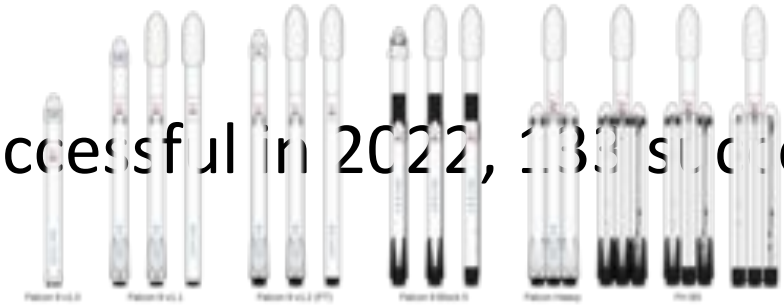
- SpaceX, founded in 2002, aims to revolutionize space technology.
- The Falcon launch vehicle family is central to this vision.
- Includes retired versions: Falcon 9 v1.0, v1.1, v1.2 "Full Thrust".
- Current active version: Falcon 9 Block 5.
- Falcon Heavy: Heavy-lift derivative using three Falcon 9 cores.

Falcon 9 Evolution

- v1.0 (2010-2013): 5 launches, initial flights.
- v1.1 (2013-2016): 15 launches, increased performance.
- v1.2 "Full Thrust" (2015-2018): 36 launches, significant upgrades, first landing attempts.
- Block 5 (May 2018-Present reusability (10+ flights with performance, and meeting
- Each iteration brought incr capabilities.

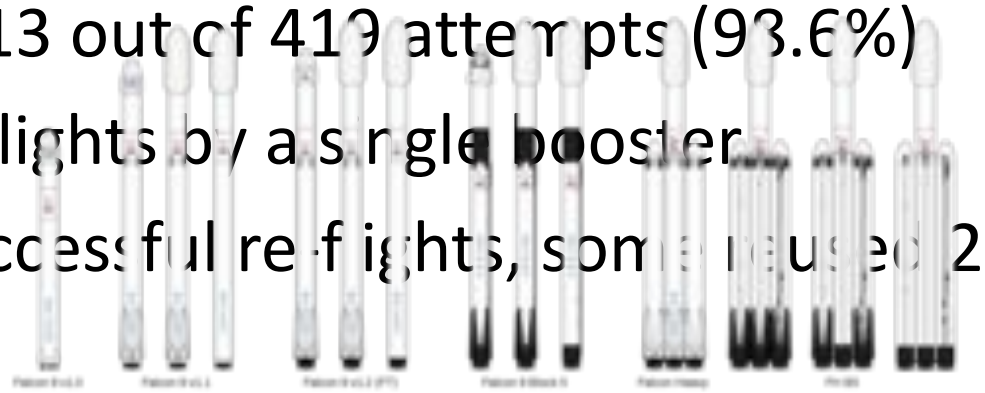
Launch Statistics (as of April 2025)

- Total Falcon 9 Family La[illegible]es: 478
- Full Mission Successes: [illegible]Success Rate: 99.37%)
- Failures: 3 (CRS-7, AMO[illegible]re-flight, Starlink G9-3)
- Partial Failure: 1 (CRS-1 [illegible]ndary payload)
- Falcon 9 Block 5: 410 successful flights in 411 attempts (99.76% success rate).
- Record Launches: 60 successful in 2022, [illegible]essful in 2024.



Reusability: Landings & Reflights

- Falcon 9: First orbital-class rocket with propulsive vertical landing (Dec 2015).
- Boosters land on drone ships (ASDS) or landing zones (LZ).
- Successful Booster Landings: 438 out of 451 attempts (97.1% overall).
- Block 5 Landing Success: 413 out of 419 attempts (93.6%)
- Booster Reuse Record: 27 flights by a single booster.
- Fairing Reuse: Over 300 successful re-flights, some reused 20+ times.



Falcon Heavy Overview

- Heavy-lift launch vehicle derived from Falcon 9.
- Combines a strengthened Falcon 9 center core with two Falcon 9 first stages as side boosters.
- Side boosters typically land back at LZ-1/LZ-2 or on drone ships; center core lands on a drone ship further downrange.
- Capable of lifting significantly heavier payloads to LEO, GTO, and beyond.

Notable Missions & Payloads

- Starlink Constellation: Majority of launches since 2020.
- ISS Resupply: Dragon cargo and crew missions.
- Commercial Satellites: Communications (GTO), Earth observation (LEO/Polar).
- National Security Space Launch (NSSL): Missions for the U.S. Space Force.
- Interplanetary & Deep Space: DSCOVR (L1), TESS (Lunar Flyby), Tesla Roadster (Heliocentric), DART/Hera (Asteroid), Euclid (L2), Psyche (Asteroid), Europa Clipper (Jupiter Moon).

Conclusion

- Falcon 9 has reshaped the launch industry through performance, reliability, and cost-effectiveness driven by reusability.
- Block 5 continues to be the workhorse, enabling frequent launches for Starlink and diverse customer missions.
- Falcon Heavy provides essential heavy-lift capability.
- SpaceX's focus on reusability continues to push the boundaries of spaceflight economics.

Appendix

Additional charts and data related to Falcon 9 and Falcon Heavy launches.

References

- Wikipedia contributors. (2025, May 2). List of Falcon 9 and Falcon Heavy launches. In Wikipedia, The Free Encyclopedia. Retrieved May 2, 2025, from https://en.wikipedia.org/wiki/List_of_Falcon_9_and_Falcon_Heavy_launches
- SpaceX. (n.d.). Falcon 9. Retrieved May 2, 2025, from https://www.spacex.com/vehicles/falcon-9/
- (Additional sources as needed)

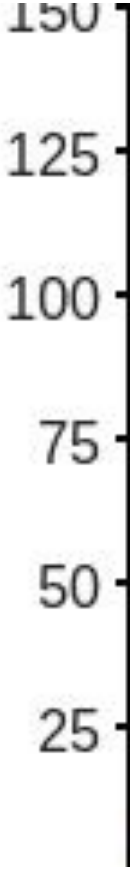
Appendix: Rocket Configurations Over Time

Evolution of Falcon 9 versions and Falcon Heavy launches by year. Source: Wikipedia

Appendix: Launch Sites Usage

Number of launches per site (Cape Canaveral SLC-40, Kennedy LC-39A, Vandenberg SLC-4E) by year. Source: Wikipedia

Appendix: Launch Outcomes Breakdown



Breakdown of launch outcomes (Success, Failure, Planned) by year. Source: Wikipedia

Appendix: Booster Landing Attempts

Number of successful booster landings versus attempts by year. Source: Wikipedia