Winning Space Race with Data Science

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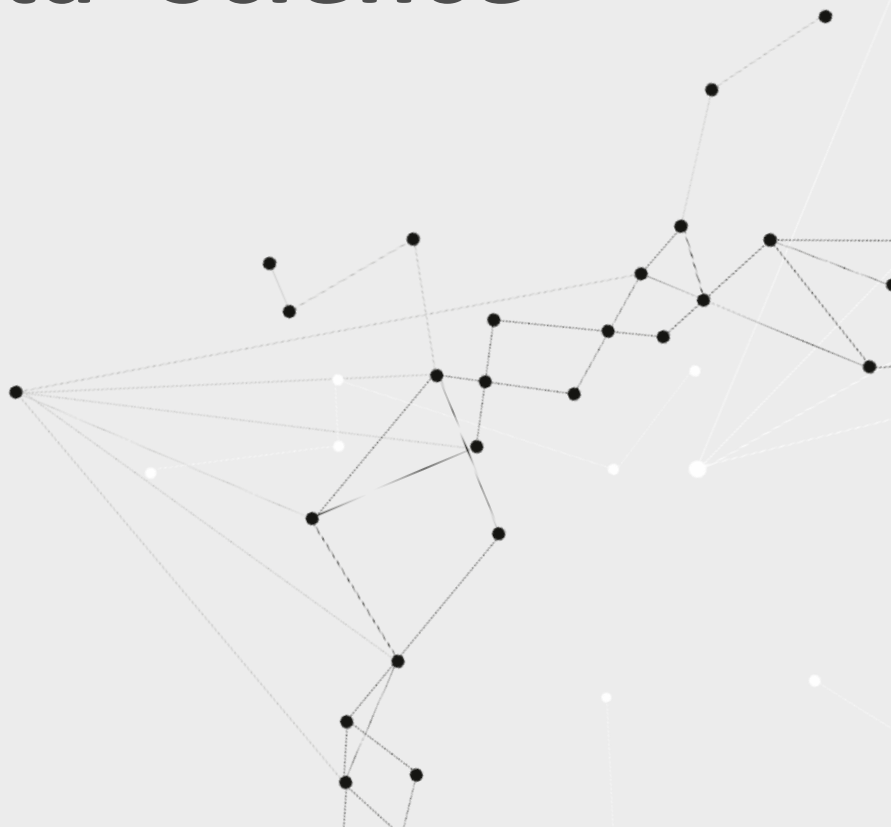

CONTENT

01

Summary

Summary of methodologies and results

01. Summary

Summary of methodologies and results

- This project is designed to predict the success rate of Falcon 9 launch.
- I used the historical data collected from SpaceX API, performed exploratory data analysis and visual analytics to understand the relationship between variables. Then, I performed feature engineering, and made predictive analysis. I used 4 supervised algorithms (K Nearest Neighbors, SVM, Decision Tree, Logistic Regression) to deal with the problem, finally, found that the decision tree is the best way to predict the success rate for Falcon 9 launch.

02

Introduction

Project background and problems we want to find answers

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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.

Background

Problems

-Which parameters have the higher impact in success landings for SpaceX, Falcon 9.
-Which is the best way to predict the success rate for rocket launch.

03

Methodology

Methodology of every stage

03. Methodology

Methodology of every stage

Data processing

- Collect the launch data from SpaceX API
- Clean requested data

Interactive visual analytics

- Build maps with Folium and dashboard with Plotly Dash

Exploratory data analysis

- Finding relationships in the data by means of scatterplots, bar charts

Predictive analysis

- Defining suitable prediction model
- Setting and running the models
- Choosing the most accurate prediction model

03. Methodology

Methodology of every stage

Data processing

- Request and parse the SpaceX launch data using the **GET** request
- Read raw data and send it to a data frame
- Filter the data frame to only include Falcon 9 launches
- Find missing value and replace them with mean

- Remove missing values
- Eliminating irrelevant columns
- Identify successful and unsuccessful launches by **One Hot Encoding**
- Get information for each column and place it into the dictionary, then convert it into a data frame

03. Methodology

Methodology of every stage

Exploratory data analysis

(EDA)

Perform Exploratory Data Analysis and
Feature Engineering using Pandas and Matplotlib

Scatter chart

Visualize the relationships between variables

Bar chart

Find out the relationship between success rate and orbit type

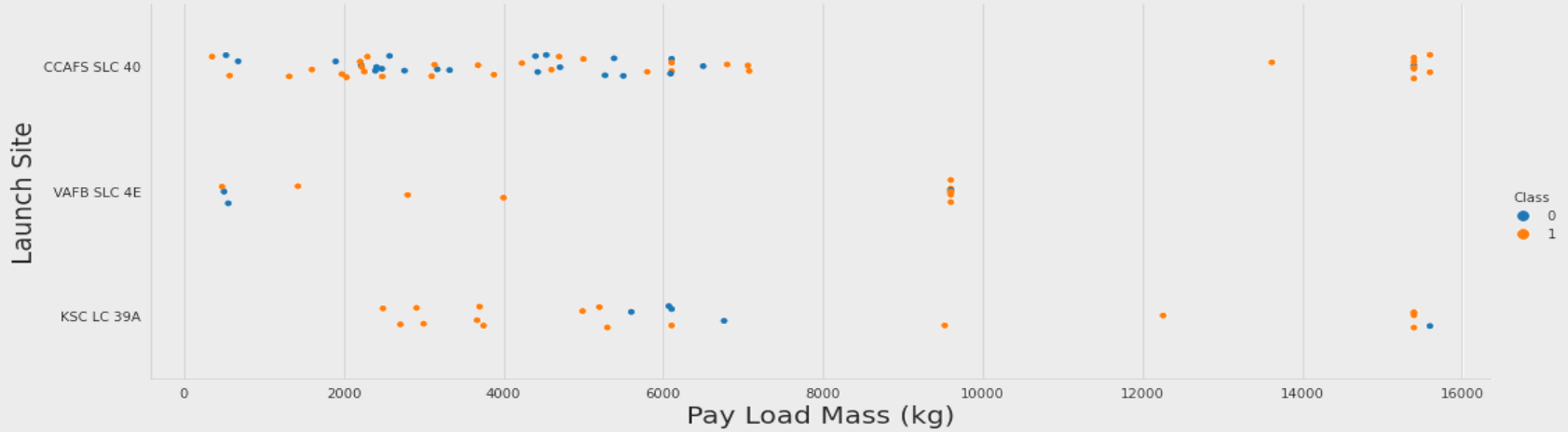
Line chart

Visualize the launch success yearly trend

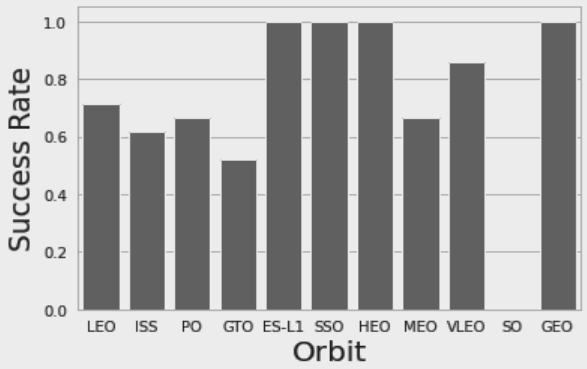
Success Rate: 66.67%

03. Methodology

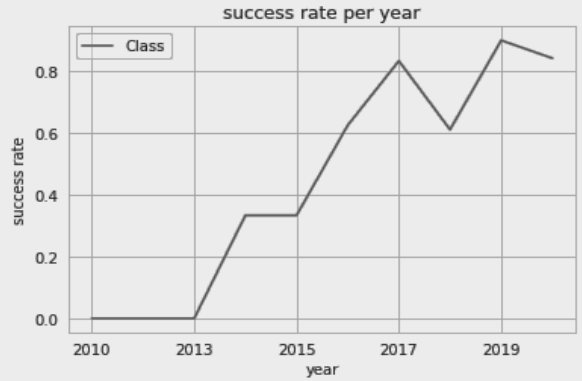
Methodology of every stage



- Different launch sites have different success rates. CCAFS LC-40: 60 %, KSC LC-39A and VAFB SLC 4E: 77%.
- In general, CCAFS SLC 40 with payload lager than 12000kg and KSC LC 39A with payload lower than 5000 have the best performance.



- 4 types of orbit has the best success rate : ES-L1/SSO/HEO/GEO



- The success rate since 2013 kept increasing till 2020

03. Methodology

Methodology of every stage

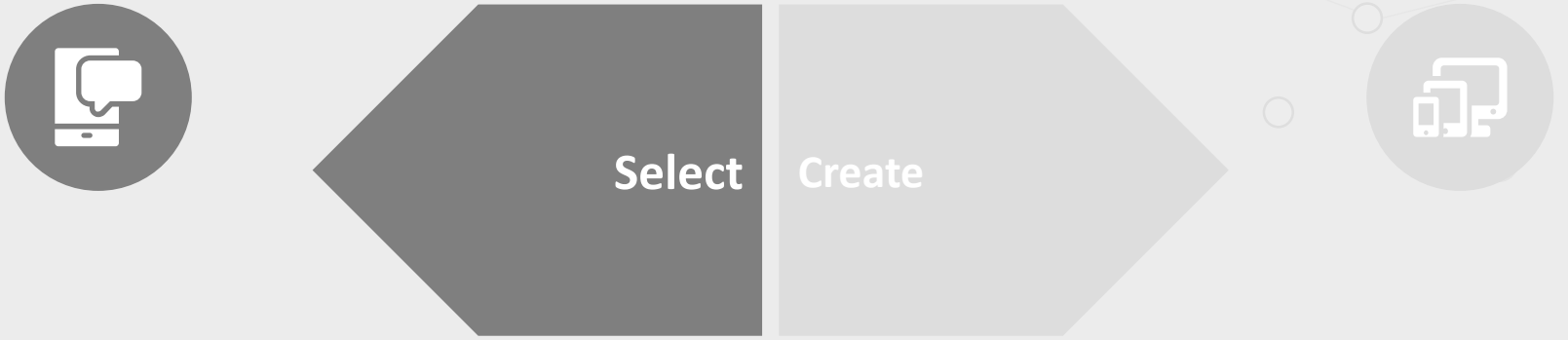
Interactive visual analytics

- Failure/Success labels were placed on each of the launching sites.
- KSC LC 39A in FLORIDA Shows very good results.
- The rest of sites does deliver good result, but the majority of launches have been failures.

success

failure

Features Engineering



- Select the features that will be used in success prediction in the future module： 'FlightNumber', 'PayloadMass', 'Orbit', 'LaunchSite', 'Flights', 'GridFins', 'Reused', 'Legs', 'LandingPad', 'Block', 'ReusedCount', 'Serial'

- Create dummy variables to categorical columns. Use the function get dummies and features data frame to apply OneHotEncoder to the column: Orbits, LaunchSite, LandingPad, and Serial

03. Methodology

Methodology of every stage

Predictive analysis

- create a machine learning pipeline to predict if the first stage will land given the data from the preceding labs.

Determine training labels

Create a column for the class

Standardize the data

Split into training data and test data

Find the method which has the best accuracy

03. Methodology

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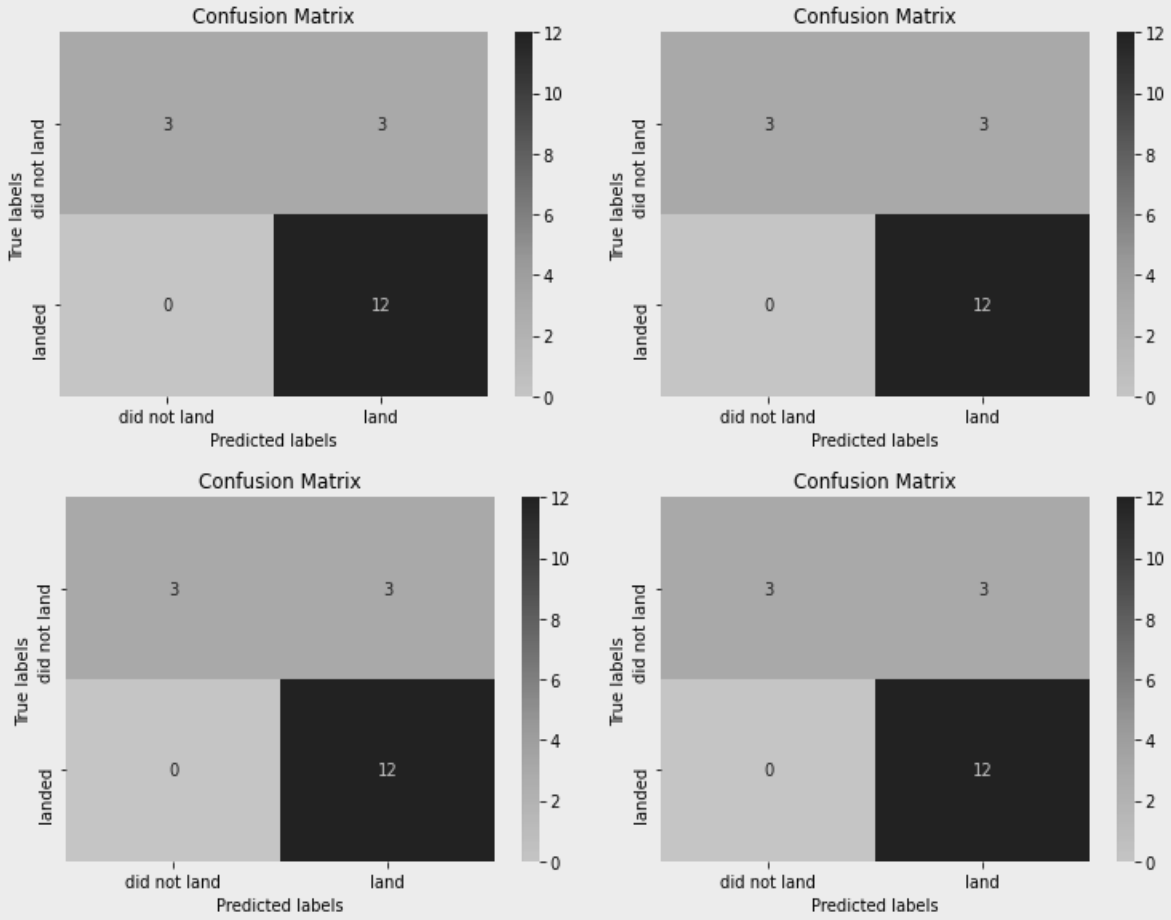


Predictive analysis

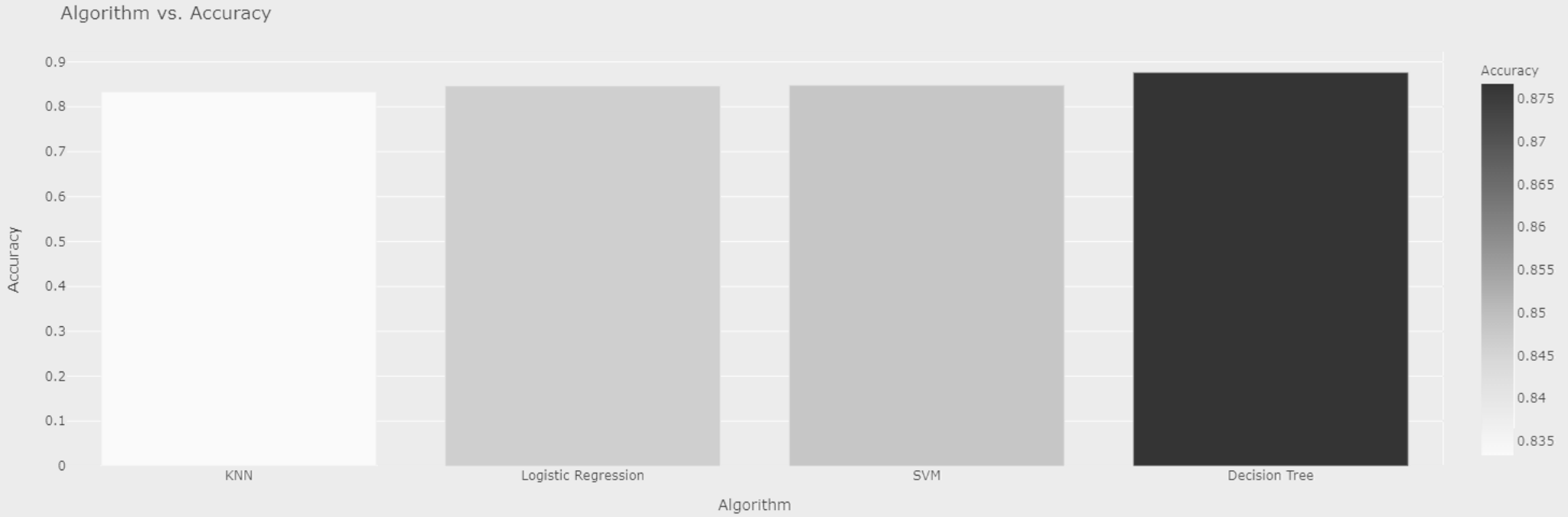
Confusion matrix for all models is the same

- Overall Accuracy=ACC= 0.8333
- precision=PPV=0.5
- Sensitivity=Recall=TPR=0.5
- specificity=TNR=1

The models are good enough
for predicting success rate

03. Methodology

Methodology of every stage



- Decision tree classifier has the highest classification accuracy

04

Conclusion

Conclusion of the project

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Conclusion of the project

- Orbits ES-L1/SSO/HEO/GEO has the best success rate
- KSC LC 39A with Payloads lower than 5000 kg has best success rates
- Decision Three Classifier has the best accuracy(0.88)

05

Appendix

Relevant assets

05. Appendix

Conclusion of the project

Notebooks about this project:

- GitHub Link

Project source:

- IBM Data Science

Thanks