SMART BRIDGE INTERNS EXTERNSHIP

COURSE NAME : APPLIED DATA SCIENCE

PROJECT NAME: SPACEX FALCON 9 FIRST STAGE LANDING SUCCESS PREDICTOR

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1. INTRODUCTION

1.1 Overview

a) Description

This project is on Spacex Falcon 9 First Stage Landing Success Predictor. Our project tests the factors responsible for successful landing of space shuttle and rule out the areas of improvement, Data is collected and preprocessed. This preprocessed data is tested and trained and applied to a suitable ML model of Data science which is then integrated with a simple web application through flask that displays an user friendly UI to seek detailed observations. By providing the essential details we receive the prediction of success

b) Business Requirements

i. Rocket reusability
ii. Cost effective manufacturing
iii. Modifiable payload capacity
iv. Network connectivity
v. Security
vi. Performance

1.2 Purpose

a. Use of this project :-

i. With the application of suitable ML algorithm we can derive the prediction of successful landing which can ensure the safety of crew members and the success rate of the mission.
ii. With the availability of this prediction we can take proactive approach to repair the areas of improvement.
iii.
iv. Space shuttles take off and landing consumes lots of non renewable resources, using this prediction we can save those resources for next time usage.

b. Following can be achieved using this-:

i. **More detailed reports -:** The feature of reliability, reusability and cost effectiveness has helped for greater advances in space research. Celebrated successes are deployment of satellites, mission to moon and mars.

ii. **Growth in commercial space industry**-: Affordable launch services has called for establishment of more research and satellite deployment centre
iii. **Growth in Job creations**-: more engineers and scientists are attracted to explore more in this field of space
iv. **Benefit to environment -:** Reusability has reduced consumption of raw materials, energy usage and wastage generation
v. **Inspiration to public** -: Achievements of falcon 9 such as interplanetary travel and launching astronauts from US soil has inspired many.

2. LITERATURE SURVEY

2.1 Existing problem

There are two major category problems existing in field of space and research-:

Problem 1:

i. The type of space shuttles being used. Traditional space shuttles are non-reusable because of which it consumes lot more raw materials and becomes expensive to equip them with payloads.(Payloads are the equipments which does observation, capture records and promote communication)
ii. The old technology incorporated in traditional space shuttles doesn't stand out with modern standards
iii. Traditional space shuttles comes with lot of reliability and security concerns

Problem 2:-

i. Having a predictor with incorrect accuracy produce great losses
ii. It costs lives of crew members and wastage of resources

2.2 Proposed solution

Solution 1:-

i. Incorporating spaceX shuttles which are reusable rockets.
ii. The payloads to launch with them are cost effective

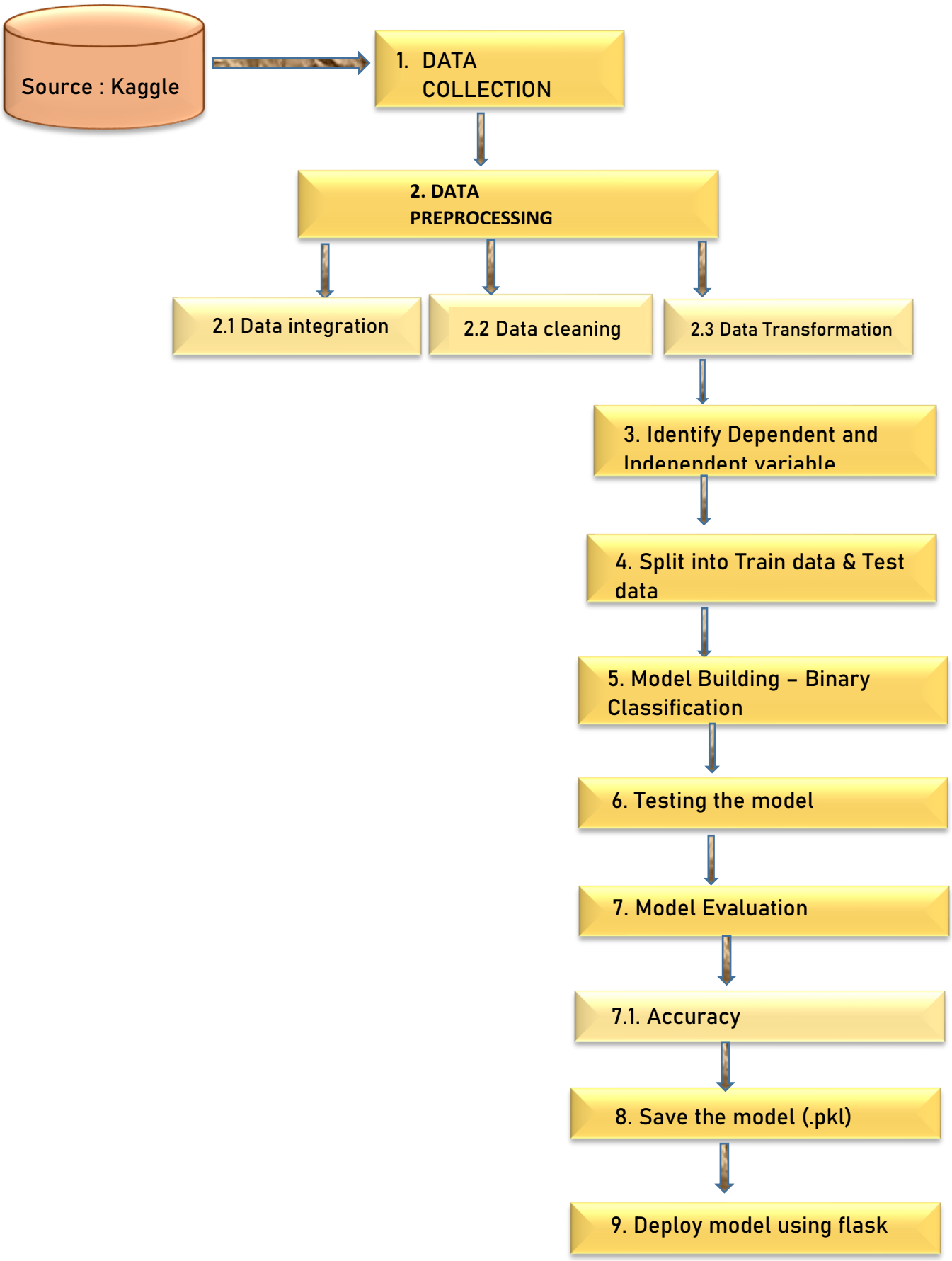
iii. Spacex shuttles are deployed with modern technology
iv. Offer high degree of safety and security

Solution 2-:

i. Space shuttles predictor when deployed with very suitable ML algorithm offers the most precise prediction
ii. This proper prediction saves lives, increase operational efficiency and conserve resources

3. THEORITICAL ANALYSIS

3.1 Block diagram


Source : Kaggle
1. DATA COLLECTION
2. DATA PREPROCESSING
2.1 Data integration
2.2 Data cleaning
2.3 Data Transformation
3. Identify Dependent and Independent variable
4. Split into Train data & Test data
5. Model Building – Binary Classification
6. Testing the model
7. Model Evaluation
7.1. Accuracy
8. Save the model (.pkl)
9. Deploy model using flask

3.2 Hardware & Software designing of the project

a. Hardware requirements –

i. Rocket engines
ii. Propellant tanks
iii. Avionic and Guidance systems
iv. Fairing to shield the payload equipments
v. Landing legs for stability
vi. Recovery systems

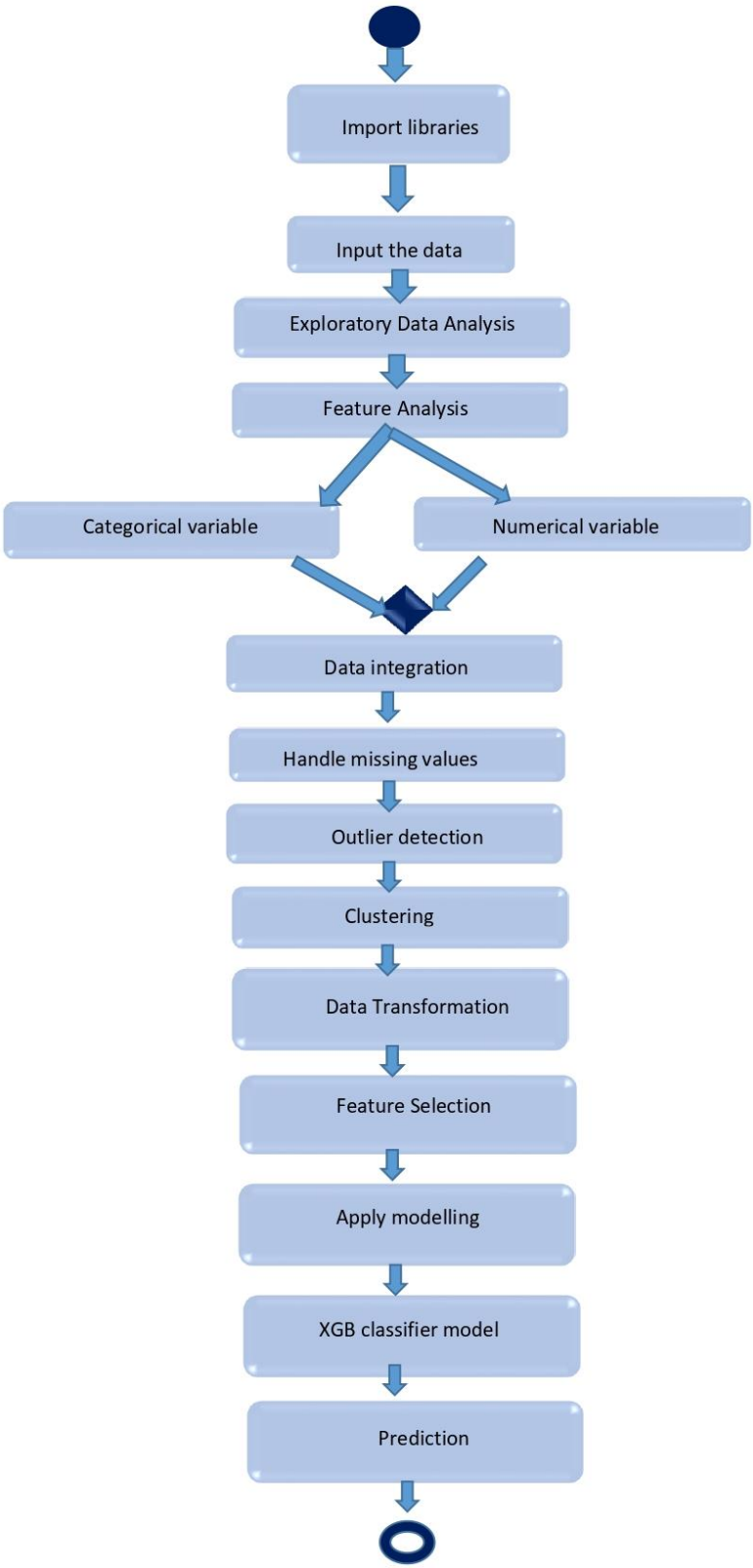
b. Software requirements

i. Programming language – python
ii. Components for data collection
iii. Components for data preprocessing
iv. Machine Learning algo
v. Integration with mission control systems
vi. Graphical User Interface
vii. Software for testing and validation

4. EXPERIMENTAL INVESTIGATIONS

The text data need to be organized before proceeding with the project. We will be using “spacex.csv “ dataset file to obtain the text data of training data. After the collection of data, the data need to be preprocessed i.e data should be cleaned and transformed. The result should be data free from missing values ,outliers, the attributes should be scaled properly. We will create a function that uses the pre-trained model for predicting custom outputs. Then we have to test and train the model. After the model is build, we will be integrating it to a web application build in flask

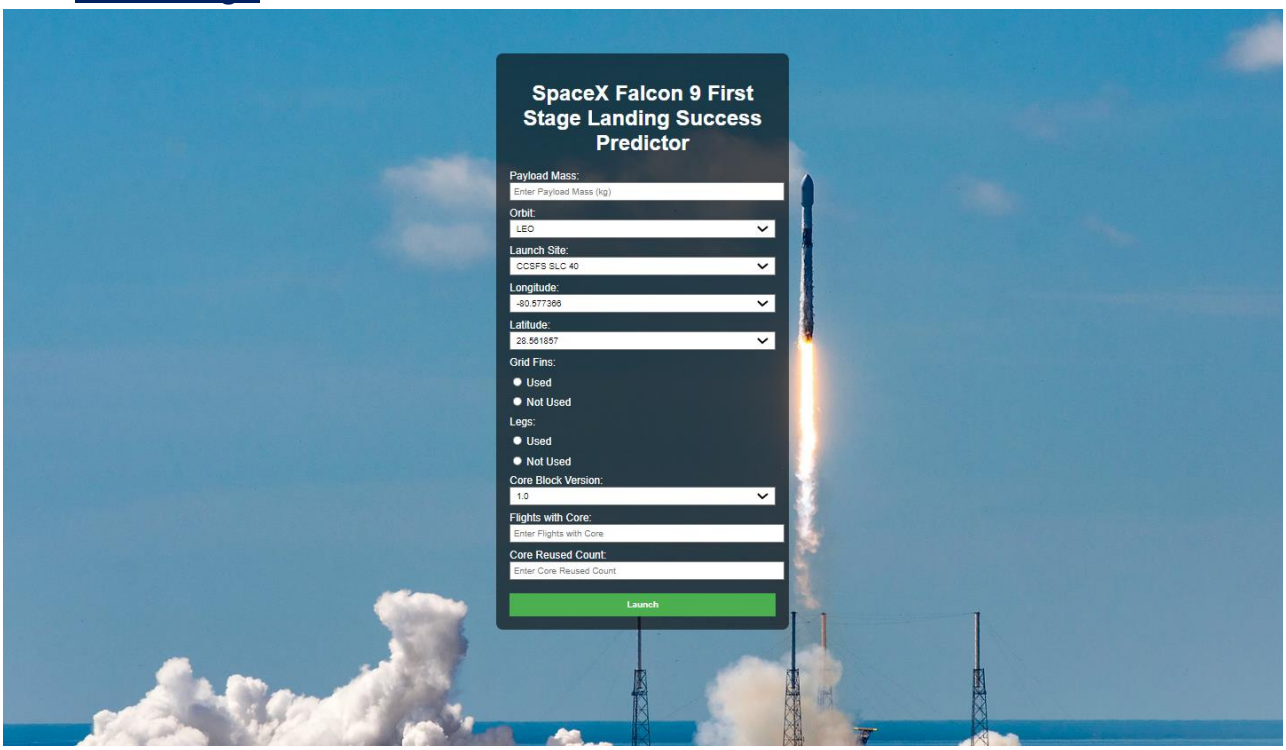
5. FLOWCHART


Import libraries
Input the data
Exploratory Data Analysis
Feature Analysis
Categorical variable
Numerical variable
Data integration
Handle missing values
Outlier detection
Clustering
Data Transformation
Feature Selection
Apply modelling
XGB classifier model
Prediction

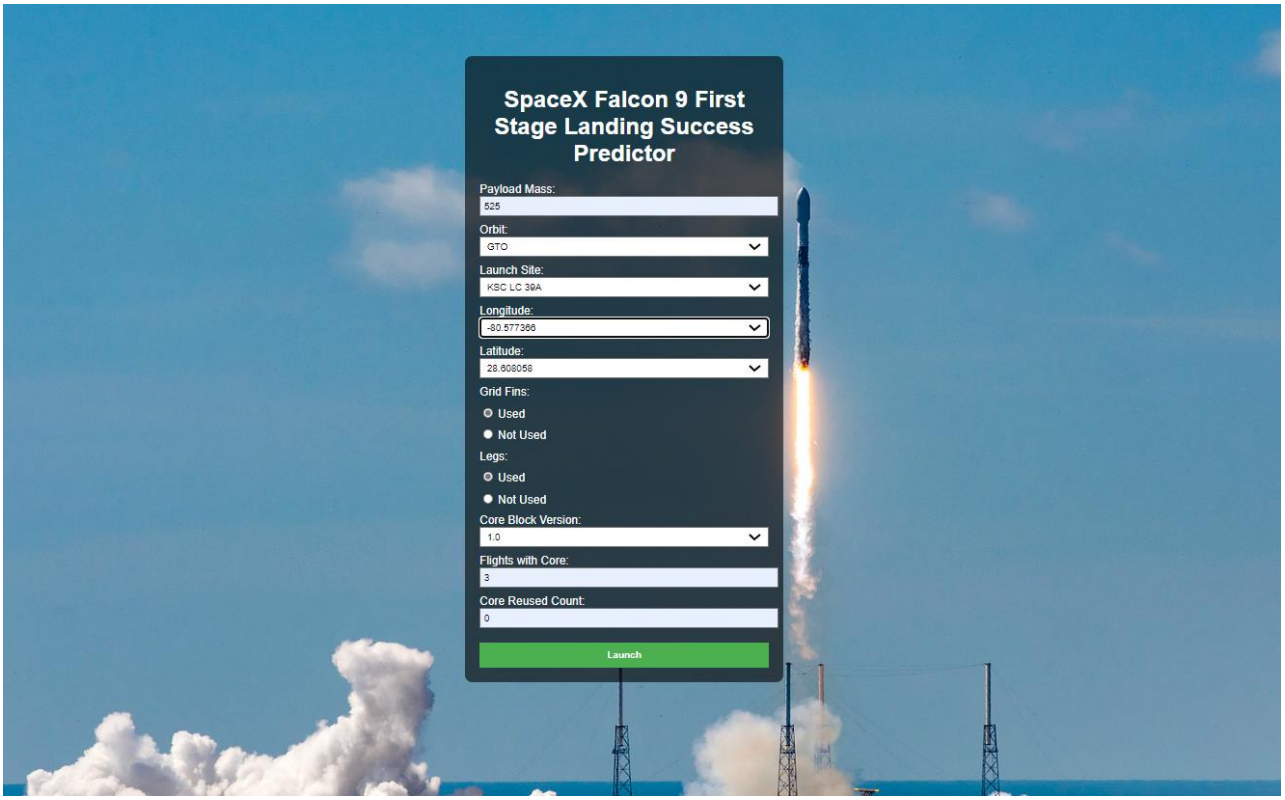
6. RESULT

➔ Home Page

➔ Form Page



➔ Form Filling



➔ Final Page

7. ADVANTAGES AND DISADVANTAGES

a. Advantages

i. Ensuring safety of crew members on a mission
ii. Resources conservation
iii. A low prediction, calls the need for improvement
iv. More accurate planning of space mission
v. Easier to estimate the recovery options

b. Disadvantages

i. The prediction depends on several factors hence there is possibility of uncertainity due to the interdependencies between them
ii. Rigorous training with good amount of data is crucial to obtain the very accurate predictions
iii. Strongly depended on the type of ML model deployed
iv. Chances of false positives and false negatives results

8. AREAS WHERE THIS SOLUTION CAN BE ACHIEVED

i. **Sensor integration** – Sensors responsible for various factor are integrated to give accurate landing prediction
ii. **Control department in Space centre** – uses landing predictors to provided the needed help
iii. **Fault detection** – Landing predictions offered shall help in identifying fraud and discovering the recovery options
iv. **Risk management sector** – Landing predictors cautions on rik about to occur, thru which risk can be proactively managed

9. CONCLUSION

The project has achieved the perfect accuracy for prediction of success of landing the spacex. The data collection and preprocessing has been done properly so a to avoid noisy data. The platform used is jupyter notebook, spyder and flask. Among the various ML algorithms like KNN, Tree, XGB classifier we found XGB classifier works best. The model is saved as .pkl file. We integrated the .py file and .html file to present a user friendly UI for accurate prediction with inputted values of the responsible factors

10. Future Scope

a. **Lunar and planetary landings** – Landing predictors can be made more advanced to predict lunar and planetary landings which face many challenges like atmos. Condition, gravity environment, surface characterstics

b. **Integration with Robotic Systems** - Predictors can assist in identifying suitable landing sites, and aiding in the planning and execution of robotic operations on the surface.

c. **Commercial Space Applications** - Future predictors can be tailored to meet the specific needs of commercial spaceflight, including launch vehicle recovery, crewed missions, satellite deployments, and space tourism operations.

d. **Enhanced Landing accuracy** – With more R&D we foresee more accurate Ml algo to improve prediction

11. BIBILOGRAPHY

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3. https://www.kaggle.com/code/sagarvarandekar/spacex-falcon9-landing-prediction
4. https://www.bing.com/ck/a?!&&p=632444f92b53ac7eJmltdHM9MTY4NzkxMDQwMCZpZ3VpZD0yMmVmNmZjNi01ZjE0LTYxNDMtMTcwOC03ZDhiNWViOTYwYzQmaW5zaWQ9NTI2Ng&ptn=3&hsh=3&fclid=22ef6fc6-5f14-6143-1708-7d8b5eb960c4&psq=SPACEX+FALCON+9+LANDING+SUCCESS+PREDICTION&u=a1aHR0cHM6Ly9naXRodWIuY29tL3N1Z2F0YWdoL1NwYWNlWC1GYWxjb24tOS1GaXJzdC1TdGFnZS1MYW5kaW5nLVByZWRpY3Rpb24&ntb=1
5. https://www.bing.com/ck/a?!&&p=c2beb6e7e04dd02dJmltdHM9MTY4NzkxMDQwMCZpZ3VpZD0yMmVmNmZjNi01ZjE0LTYxNDMtMTcwOC03ZDhiNWViOTYwYzQmaW5zaWQ9NTIxMQ&ptn=3&hsh=3&fclid=22ef6fc6-5f14-6143-1708-7d8b5eb960c4&psq=SPACEX+FALCON+9+LANDING+SUCCESS+PREDICTION&u=a1aHR0cHM6Ly9hcnN0ZWNobmljYS5jb20vc2NpZW5jZS8yMDIyLzAyL3NwYWNleHMtZmFsY29uLTktcm9ja2V0LWhhcy1zZXQtYS1yZWNvcmQtZm9yLW1vc3QtY29uc2VjdXRpdmUtc3VjY2Vzc2VzLw&ntb=1

APPENDIX

A. SOURCE CODE (spxf9app.py) - file

```
import numpy as np
from flask import Flask, request, render_template
import pickle

# creating flask app
flask_app = Flask(__name__)
model = pickle.load(open("C:/Users/Pramo/SpaceX Falcon9 First Stage
Landing Success Predictor-ADS-153/Flask/xgbmodel.pkl", "rb"))

@flask_app.route("/")
def Home():
    return render_template("homespxf9.html")

@flask_app.route("/predict")
def predict():
    return render_template('predictspxf9.html')

@flask_app.route("/pred", methods=["POST"])
def pred():
    float_features = [float(x) for x in request.form.values()]
    features = [np.array(float_features)]
    prediction = model.predict(features)
    output = prediction[0]
    if output == 1:
        launch="Successful"
    else:
        launch="Unsuccessful"

    return render_template("finalspxf9.html", prediction_text = "Launch
{}".format(launch))

if __name__ == "__main__":
    flask_app.run(debug=True)
```