Data Science Internship at Data Glacier

Week 5: Cloud and API Deployment

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1. Project Introduction

Heroku is a cloud platform as a service supporting several programming languages. One of the first cloud platforms, Heroku has been in development since June 2007, when it supported only the Ruby programming language, but now supports Java, Node.js, Scala, Clojure, Python, PHP, and Go.

Model deployment is the process of putting machine learning models into production. This makes the model's predictions available to users, developers or systems, so they can make business decisions based on data, interact with their application

Model: Predicting house prices in certain metropolitan areas based in Malborne, Australia.

2. Dataset Description

I have taken data from Kaggle. I am going to use this data for the model. The full data set contains 18396 rows of data with 21 attributes**.** Notes on Specific Variables are given below.

- **Rooms**: Number of rooms
- **Price**: Price in dollars
- **Suburb**: The residential area on the outskirts of a city or large town.
- **Method**:

    - S - property sold;
    - SP - property sold prior;
    - PI - property passed in;
    - PN - sold prior not disclosed;
    - SN - sold not disclosed;
    - NB - no bid;
    - VB - vendor bid;
    - W - withdrawn prior to auction;

- SA - sold after auction;
- SS - sold after auction price not disclosed.
- N/A - price or highest bid not available.

- **Type**:

    - br - bedroom(s);
    - h - house, cottage, villa, semi, terrace;
    - u - unit, duplex;
    - t - townhouse;
    - dev site - development site;
    - res - other residential.

- **SellerG**: Real Estate Agent
- **Date**: Date sold
- **Distance**: Distance from CBD
- **Regionname**: General Region (West, North West, North, North east …etc.)
- **Propertycount**: Number of properties that exist in the suburb.
- **Bedroom2**: Scraped # of Bedrooms (from different source)
- **Bathroom**: Number of Bathrooms
- **Car**: Number of carspots
- **Landsize**: Land Size
- **BuildingArea**: Building Size
- **CouncilArea**: Governing council for the area
- **Latitude**: Latitude
- **Longitude**: Longitude
- **YearBuilt**: Year the house was built
- **Address**: Address of the property
- **Postcode**: Postcode of the property

3. Model Building

```
import pandas as pd
import numpy as np
from sklearn.model_selection import train_test_split
from sklearn.ensemble import RandomForestRegressor
from sklearn import metrics
from sklearn.model_selection import RandomizedSearchCV

import pickle

import warnings
warnings.filterwarnings('ignore')

data=pd.read_csv('melb_data.csv',index_col=0)

data.isna().sum()
data=data.dropna(axis=0)

y=data["Price"]

data_features=['Rooms','Bedroom2','Bathroom','Car','Landsize','BuildingArea','Lattitude','Longtitude']
X=data[data_features]


X_train, X_test, y_train, y_test = train_test_split(X,y, test_size=0.2, random_state=1)

rf_model = RandomForestRegressor(random_state=1)
rf_model.fit(X_train, y_train)

y_pred = rf_model.predict(X_test)

# Evaluating the Model
#print('Mean Absolute Error:', metrics.mean_absolute_error(y_test, y_pred))
#print('Root Mean Squared Error:', np.sqrt(metrics.mean_squared_error(y_test, y_pred)))

#score= rf_model.score(X_test,y_test) #R2 Score
#print(score)
```

Hyperparameter Tuning

```
# Number of trees in random forest
n_estimators = [int(x) for x in np.linspace(start = 200, stop = 2000, num = 10)]

# Number of features to consider at every split
max_features = ['auto', 'sqrt']

# Maximum number of levels in tree
max_depth = [int(x) for x in np.linspace(10, 110, num = 11)]
max_depth.append(None)

# Minimum number of samples required to split a node
min_samples_split = [2, 5, 10]

# Minimum number of samples required at each leaf node
min_samples_leaf = [1, 2, 4]

# Method of selecting samples for training each tree
bootstrap = [True, False]

# Create the random grid
random_grid = {'n_estimators': n_estimators,
               'max_features': max_features,
               'max_depth': max_depth,
               'min_samples_split': min_samples_split,
               'min_samples_leaf': min_samples_leaf,
               'bootstrap': bootstrap}


ran_model_1 = RandomizedSearchCV(estimator = rf_model, param_distributions = random_grid,
                                 n_iter = 100, cv = 3, verbose=2, random_state=42, n_jobs = -1)
ran_model_1.fit(X_train,y_train)

ran_model_1.best_params_

predictions=ran_model_1.best_estimator_.predict(X_test)

# Evaluating the Algorithm

#print('Mean Absolute Error:', metrics.mean_absolute_error(y_test, predictions))
#print('Root Mean Squared Error:', np.sqrt(metrics.mean_squared_error(y_test, predictions)))

#score= ran_model_1.best_estimator_.score(X_test,y_test) #R2 Score
#print(score)
```

4. Saving the model

```
pickle.dump(ran_model_1,open('model.pkl','wb'))
model=pickle.load(open('model.pkl','rb'))
```

5. Deploying the model using Flask

❖ App.py

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

#Initialize Flask and set the template folder to "template"
app = Flask(__name__, template_folder = 'templates')

#Open our model
model = pickle.load(open('model.pkl','rb'))

#create our "home" route using the "index.html" page
@app.route('/')
def home():
    return render_template('index.html')

#Set a post method to yield predictions on page
@app.route('/', methods = ['POST'])
def predict():

    #obtain all form values and place them in an array, convert into integers
    int_features = [int(x) for x in request.form.values()]
    #Combine them all into a final numpy array
    final_features = [np.array(int_features)]
    #predict the price given the values inputted by user
    prediction = model.predict(final_features)

    #Round the output to 2 decimal places
    output = round(prediction[0], 2)

    #If the output is negative, the values entered are unreasonable to the context of the application
    #If the output is greater than 0, return prediction
    if output < 0:
        return render_template('index.html', prediction_text = "Predicted Price is negative, values entered not reasonable")
    elif output >= 0:
        return render_template('index.html', prediction_text = 'Predicted Price of the house is: ${}'.format(output))

#Run app
if __name__ == "__main__":
    app.run(debug=True)
```

❖ Index.html

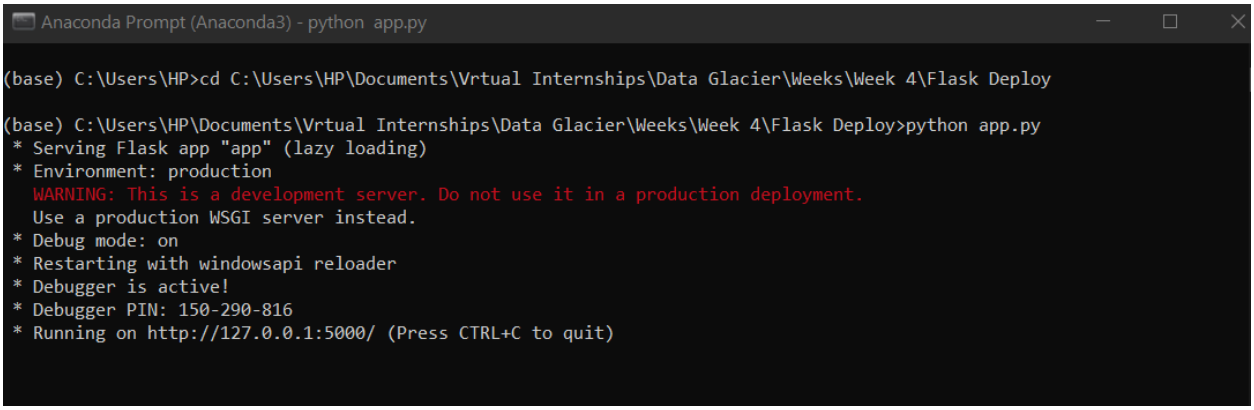
```
<!DOCTYPE html>
<html>
    <head>
        <meta charset="UTF-8">
        <link rel= "stylesheet" href="{{ url_for('static', filename='styles/styling.css') }}" />
    </head>
    <body>
        <!---Initialize structure of Title and house picture--->
        <div class = "title">
            <h1>House Price Predictor</h1>
        </div>

        <!---Containerize main page for styling--->
        <div class = "page">
            <!---Containerize paragraph and form for styling--->
            <div class = "container">
                <div class = "intro">
                    <b>
                        <p class = "Note"><b>Note: Enter values which are reasonable to the context</b></p>
                    </b>
                </div>
                <br>
                <!---Initialize form structure and inputs, set method to "POST"--->
                <form action = "{{url_for('predict')}}" method = "post" class = "info">
                    <input type="text" id="Rooms" name="rooms" placeholder="Total Number of Rooms" required="required"/><span style="color:red"> * </span>
                    <br>
                    <br>
                    <input type="text" id="Bedrooms" name="bedroom" placeholder="Number of Bedrooms" required="required"/><span style="color:red"> * </span>
                    <br>
                    <br>
                    <input type="text" id="Bathrooms" name="bathroom" placeholder="Number of Bathrooms" required="required"/><span style="color:red"> * </span>
                    <br>
                    <br>
                    <input type="text" id="Car" name="car" placeholder="Number of Carspots" required="required"/><span style="color:red"> * </span>
                    <br>
                    <br>
                    <input type="text" id="Land_size" name="Labdsize" placeholder="Land Size" required="required"/><span style="color:red"> * </span>
                    <br>
                    <br>
                    <input type="text" id="Building_Area" name="buildingarea" placeholder="Building Size" required="required"/><span style="color:red"> * </span>
                    <br>
                    <br>
                    <input type="text" id="Lattitude" name="lattitude" placeholder="Lattitude of the Location" required="required"/><span style="color:red"> * </span>
                    <br>
                    <br>
                    <input type="text" id="Longtitude" name="Longtitude" placeholder="Longtitude of the Location" required="required"/><span style="color:red"> * </span>
                    <br>
                    <br>
                    <button type="submit" class="btn">Predict</button>
                </form>
                <br>
                <!---Set placeholder for prediction output--->
                <div class ="pred">
                    <p class = "result"><b>{{ prediction_text }}</b></p>
                </div>
            </div>
        </div>
    </body>
</html>
```

❖ Styling.css

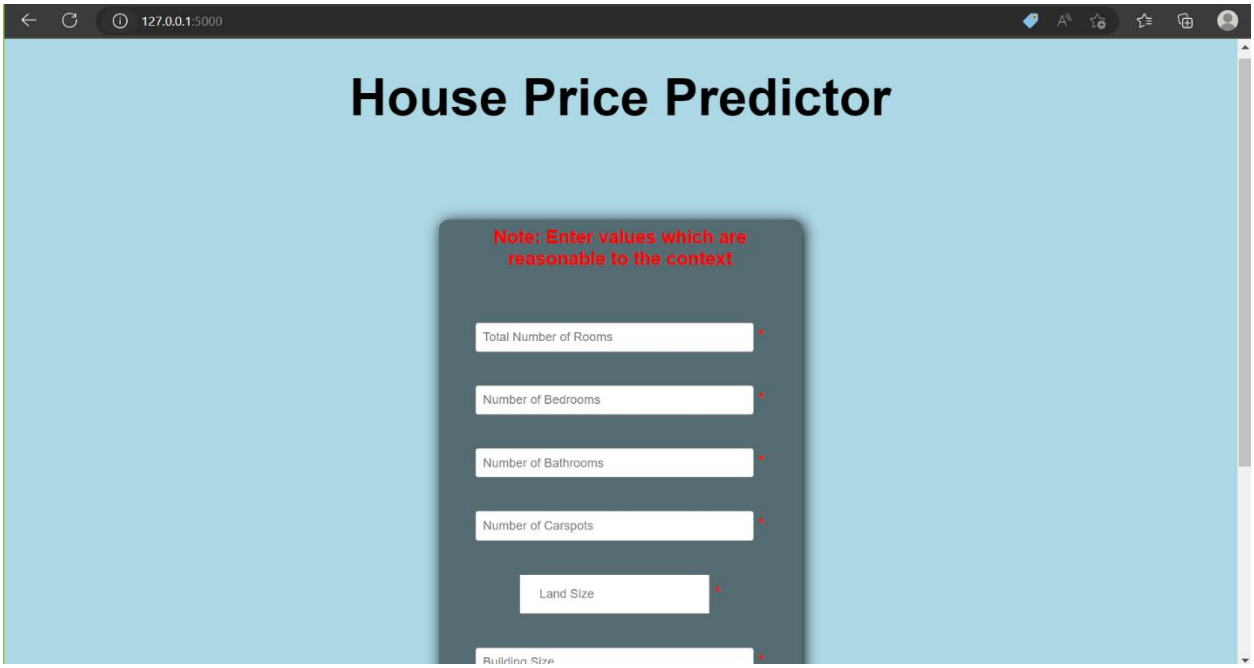
```css
/*This section involves the overall style of main tags*/
* {
    font-family: sans-serif;
}
body {
    background-color: lightblue;
    background-size: cover;
}
form {
    text-align: center;
}
h1 {
    text-align: center;
    font-size: 350%;
}
button {
    font-weight: bold;
    background-color: #4CAF50;
    padding: 8px 16px;
    display: inline-block;
    text-decoration: none;
    border-radius:3px;
    color: black;
    border-color: black;
    font-family: Arial;
    border-style: ridge;
}

/*Margin, layout and design of paragraphs and structures*/
.para {
    text-align:center;
}
.result {
    font-weight: bold;
    background-color: #4CAF50;
    padding: 8px 16px;
    display: inline-block;
    text-decoration: none;
    border-radius:3px;
    color: black;
    border-color: black;
    font-family: Arial;
    border-style: ridge;
}
.Note {
    text-align: center;
    color: red;
    margin: 7px;
    padding: 7px 0px;
}
.pred {
    text-align:center;
}
.intro {
    font-size: 20px;
}

/*Layout and structure of form body in page*/
div.container {
    background-color: rgba(0,0,0,0.5);
    font-size: 18px;
    margin: 1%;
    border-radius: 10px;
    border: 1px soid rgba)255,255,255,0.3);
    box-shadow: 2px 2px 15px

}
div.page {
    width: 400px;
    margin: 100px auto 0px auto;
}
form.info {
    margin: 15px;
}

/*This section involves the design of the inputs in the form*/
input#Rooms {
    width: 300px;
    border: 1px solid #ddd;
    border-radius: 3px;
    outline: 0;
    padding: 7px;
    background-color: #fff;
    box-shadow: insert 1px 1px 5px rgba(0,0,0,0.3);
}
input#Bedrooms {
    width: 300px;
    border: 1px solid #ddd;
```

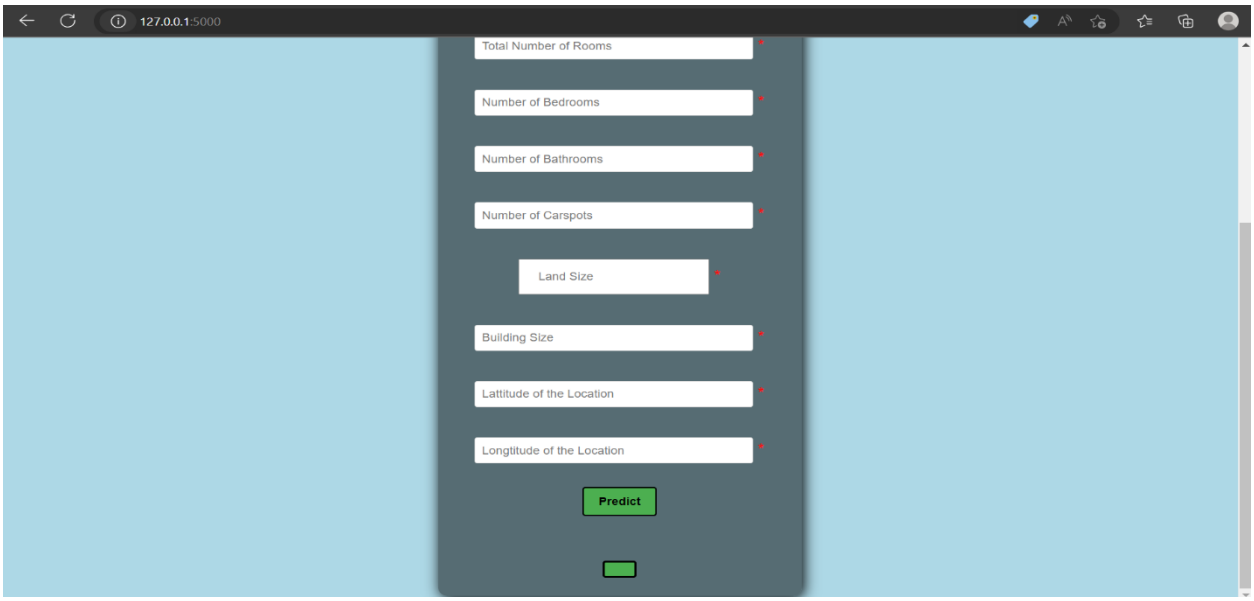
```
    border-radius: 3px;
    outline: 0;
    padding: 7px;
    background-color: #fff;
    box-shadow: insert 1px 1px 5px rgba(0,0,0,0.3);
}
input#Bathrooms {
    width: 300px;
    border: 1px solid #ddd;
    border-radius: 3px;
    outline: 0;
    padding: 7px;
    background-color: #fff;
    box-shadow: insert 1px 1px 5px rgba(0,0,0,0.3);
}
input#Car {
    width: 300px;
    border: 1px solid #ddd;
    border-radius: 3px;
    outline: 0;
    padding: 7px;
    background-color: #fff;
    box-shadow: insert 1px 1px 5px rgba(0,0,0,0.3);
}
input#Land_Size {
    width: 300px;
    border: 1px solid #ddd;
    border-radius: 3px;
    outline: 0;
    padding: 7px;
    background-color: #fff;
    box-shadow: insert 1px 1px 5px rgba(0,0,0,0.3);
}
input#Building_Area {
    width: 300px;
    border: 1px solid #ddd;
    border-radius: 3px;
    outline: 0;
    padding: 7px;
    background-color: #fff;
    box-shadow: insert 1px 1px 5px rgba(0,0,0,0.3);
}
input#Lattitude {
    width: 300px;
    border: 1px solid #ddd;
    border-radius: 3px;
    outline: 0;
    padding: 7px;
    background-color: #fff;
    box-shadow: insert 1px 1px 5px rgba(0,0,0,0.3);
}
input#Longtitude {
    width: 300px;
    border: 1px solid #ddd;
    border-radius: 3px;
    outline: 0;
    padding: 7px;
    background-color: #fff;
    box-shadow: insert 1px 1px 5px rgba(0,0,0,0.3);
}
/*Design of links/buttons*/
a.link {
    font-weight: bold;
    background-color: orange;
    padding: 8px 16px;
    display: inline-block;
    text-decoration: none;
    border-radius:3px;
    color: black;
    border-color: black;
    border-style: ridge;
}

/*Responsible for shadow backgrounds*/
#menu-outer {
    height: 70px;
    background-color: rgba(0,0,0,0.5);
    font-size: 18px;
    margin: 1%;
    border-radius: 10px;
    border: 1px soid rgba)255,255,255,0.3);
}
.table {
    display: table;
    margin: 0 auto;
    margin-left: 33.85%;
}

ul#horizontal-list {
    min-width: 696px;
    list-style: none;
}
```

❖ Run the Flask Application

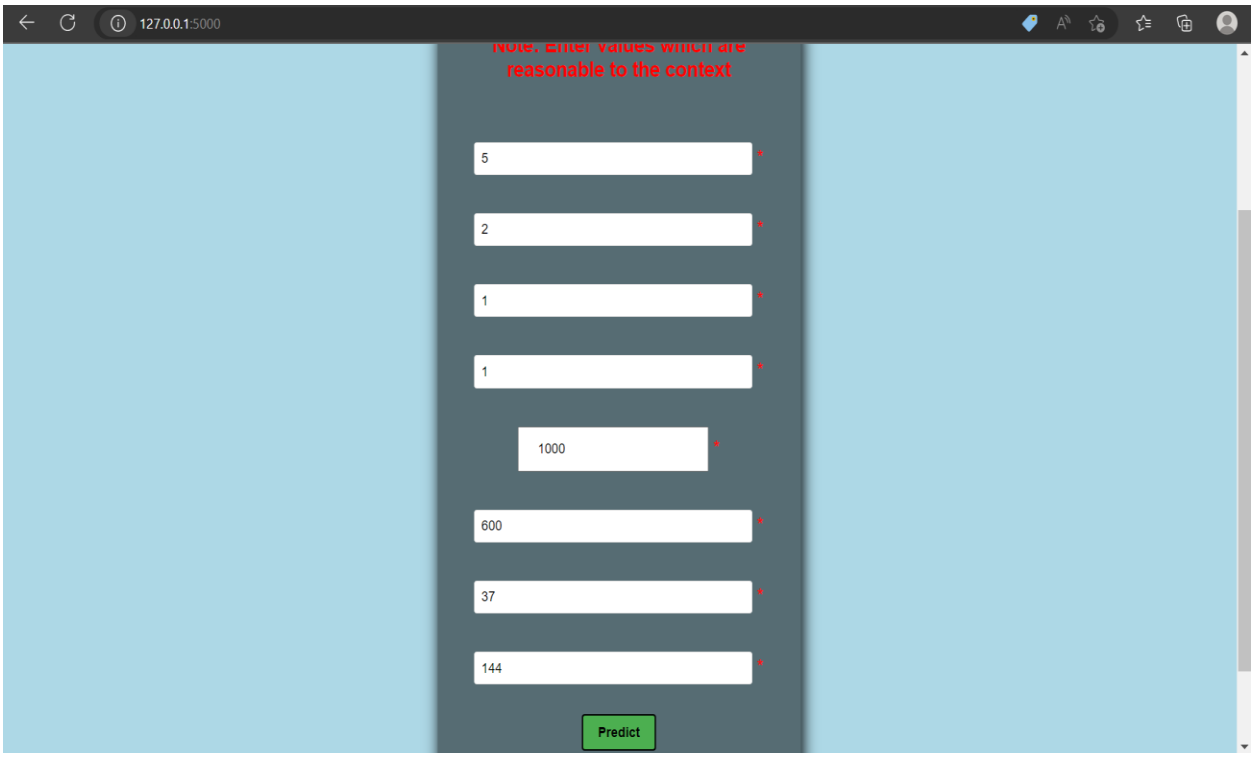


❖ Open the link in the browser

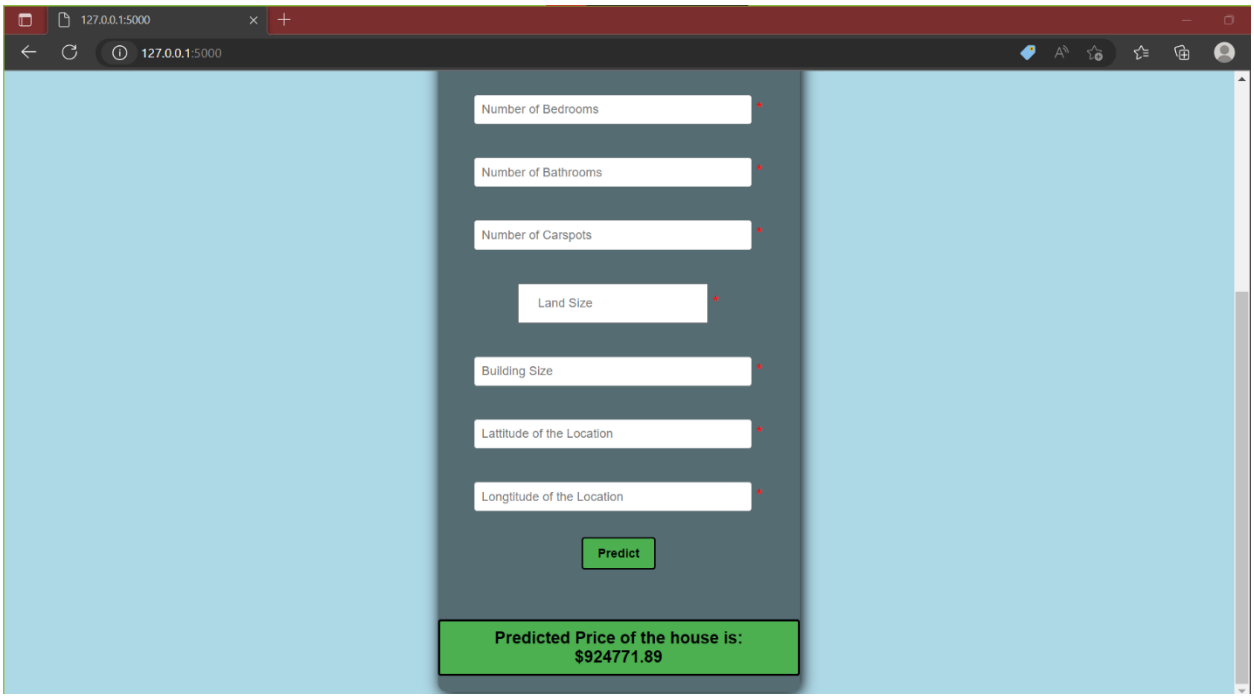




❖ Testing the App

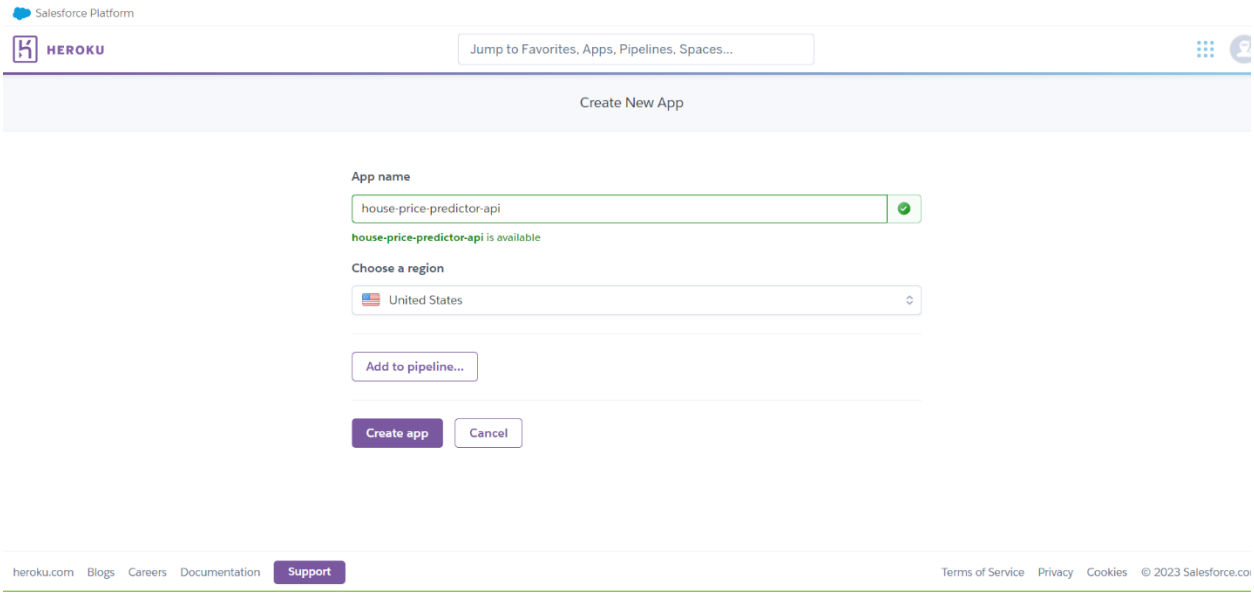


❖ Getting the results

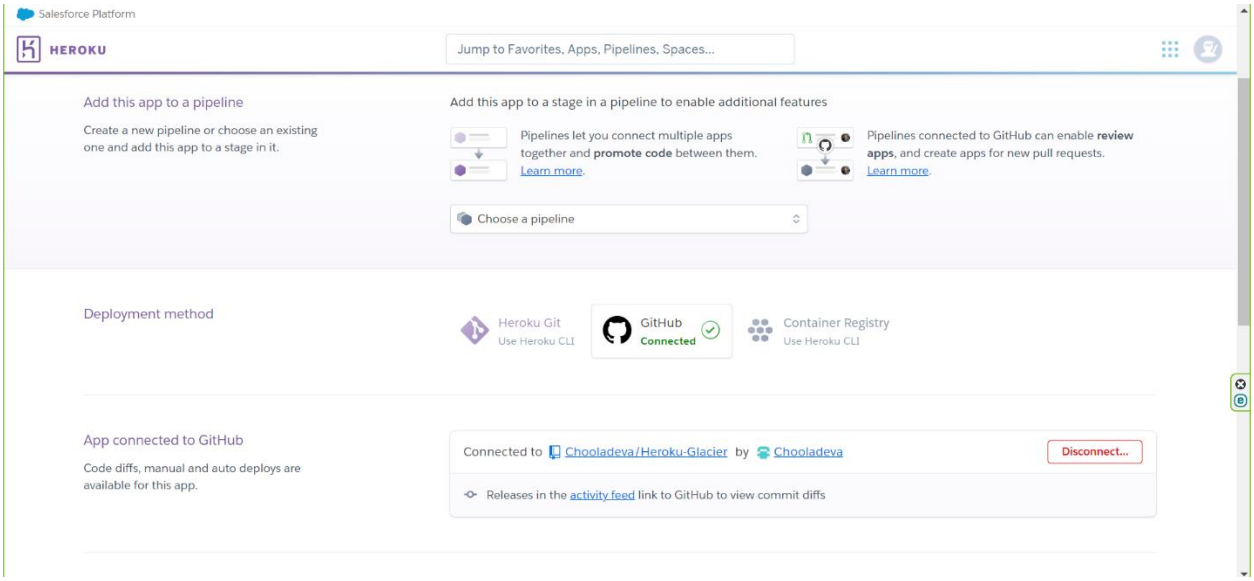


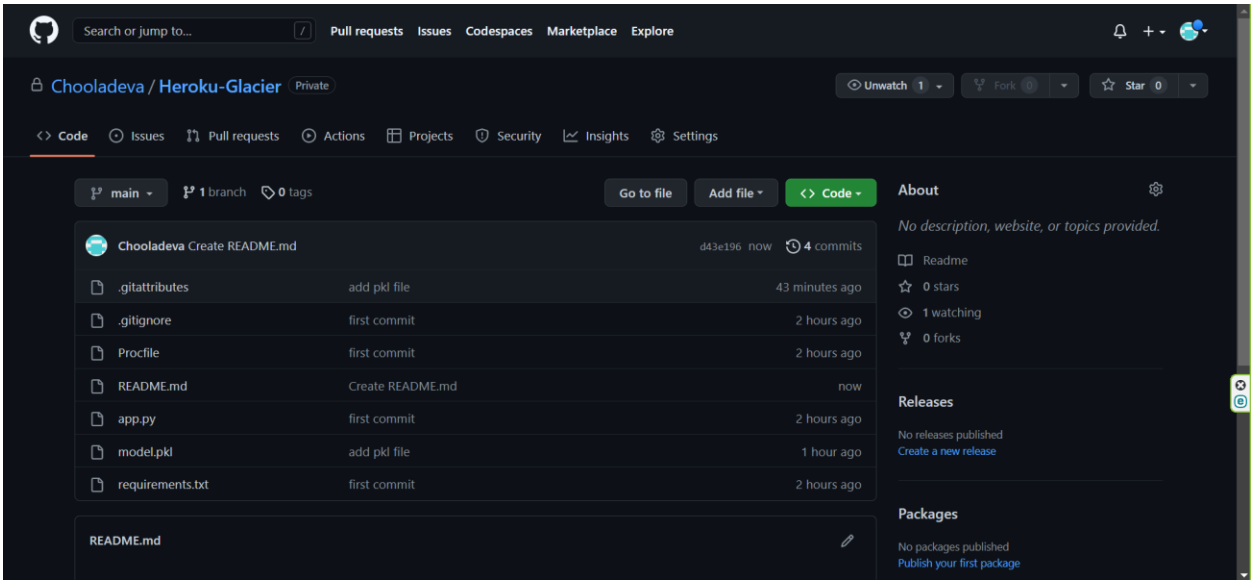
6. Model deployment using Heroku

- **After sign up on heroku then click on Create new app**
- **Entering the App name and the region**



- **Connecting to GitHub repository**





- **Deploying the main branch**