Week 4: Deployment on Flask

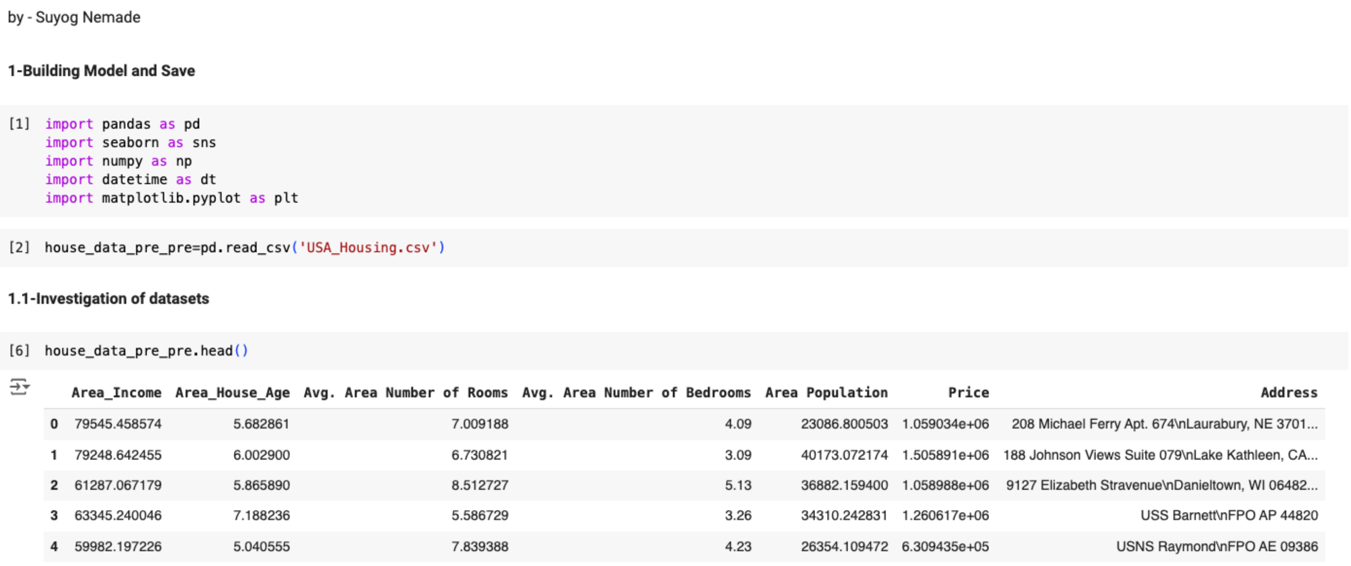
Name: Deployment on Flask
Report date: 28-OCT-2024
Internship Batch: LISUM38
Data intake by: Suyog Nemade
Data intake reviewer : Data Glacier
Data storage location: https://github.com/Suyog005/Data-Glacier
Tabular data details:

Total number of observations	5000
Total number of files	1
Total number of features	7
Base format of the file	csv
Size of the data	709 KB

1- Building Model and Save

1.1-Investigation of Datasets

Here, the dataset containing US home information was imported to predict home prices.



by - Suyog Nemade

1-Building Model and Save

```
[1] import pandas as pd
    import seaborn as sns
    import numpy as np
    import datetime as dt
    import matplotlib.pyplot as plt
```

```
[2] house_data_pre_pre=pd.read_csv('USA_Housing.csv')
```

1.1-Investigation of datasets

```
[6] house_data_pre_pre.head()
```

	Area_Income	Area_House_Age	Avg. Area Number of Rooms	Avg. Area Number of Bedrooms	Area Population	Price	Address
0	79545.458574	5.682861	7.009188	4.09	23086.800503	1.059034e+06	208 Michael Ferry Apt. 674\nLaurabury, NE 3701...
1	79248.642455	6.002900	6.730821	3.09	40173.072174	1.505891e+06	188 Johnson Views Suite 079\nLake Kathleen, CA...
2	61287.067179	5.865890	8.512727	5.13	36882.159400	1.058988e+06	9127 Elizabeth Stravenue\nDanieltown, WI 06482...
3	63345.240046	7.188236	5.586729	3.26	34310.242831	1.260617e+06	USS Barnett\nFPO AP 44820
4	59982.197226	5.040555	7.839388	4.23	26354.109472	6.309435e+05	USNS Raymond\nFPO AE 09386

[7]
```
house_data_pre_pre.rename(columns = {'Avg. Area Income':'Area_Income'}, inplace = True)
house_data_pre_pre.rename(columns = {'Avg. Area House Age':'Area_House_Age'}, inplace = True)
house_data_pre_pre.rename(columns = {'Avg. Area Number of Rooms':'Area_Number_Rooms'}, inplace = True)
house_data_pre_pre.rename(columns = {'Avg. Area Number of Bedrooms':'Area_Number_Bedrooms'}, inplace = True)
house_data_pre_pre.rename(columns = {'Area Population':'Area_Populations'}, inplace = True)
```

```
house_data_pre_pre.head()
```

	Area_Income	Area_House_Age	Area_Number_Rooms	Area_Number_Bedrooms	Area_Populations	Price	Address
0	79545.458574	5.682861	7.009188	4.09	23086.800503	1.059034e+06	208 Michael Ferry Apt. 674\nLaurabury, NE 3701...
1	79248.642455	6.002900	6.730821	3.09	40173.072174	1.505891e+06	188 Johnson Views Suite 079\nLake Kathleen, CA...
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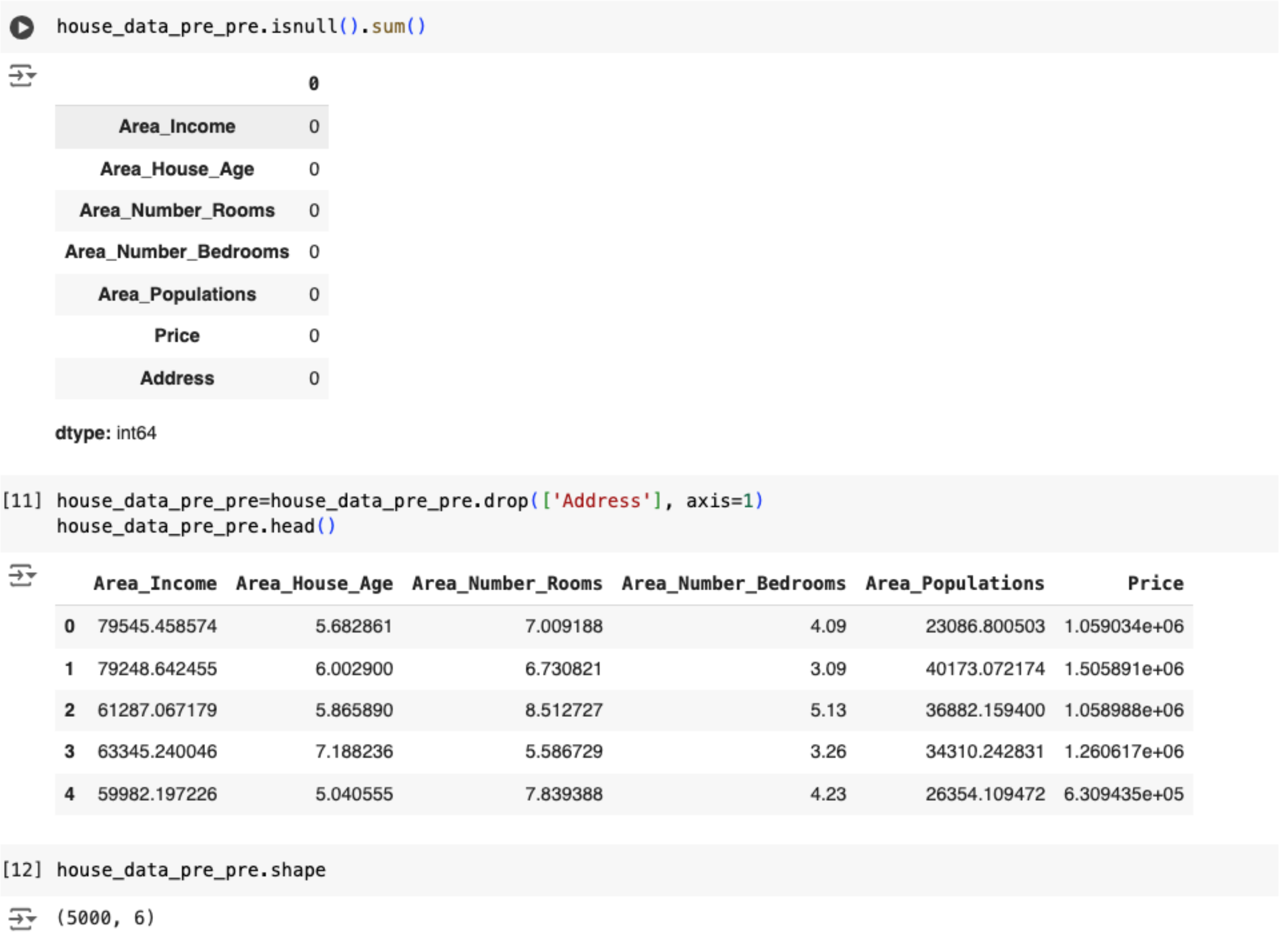
[9]
```
house_data_pre_pre.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 5000 entries, 0 to 4999
Data columns (total 7 columns):
 #   Column                Non-Null Count  Dtype  
---  ------                --------------  -----  
 0   Area_Income           5000 non-null   float64
 1   Area_House_Age        5000 non-null   float64
 2   Area_Number_Rooms     5000 non-null   float64
 3   Area_Number_Bedrooms  5000 non-null   float64
 4   Area_Populations      5000 non-null   float64
 5   Price                 5000 non-null   float64
 6   Address               5000 non-null   object 
dtypes: float64(6), object(1)
memory usage: 273.6+ KB
```



```python
house_data_pre_pre.isnull().sum()
```

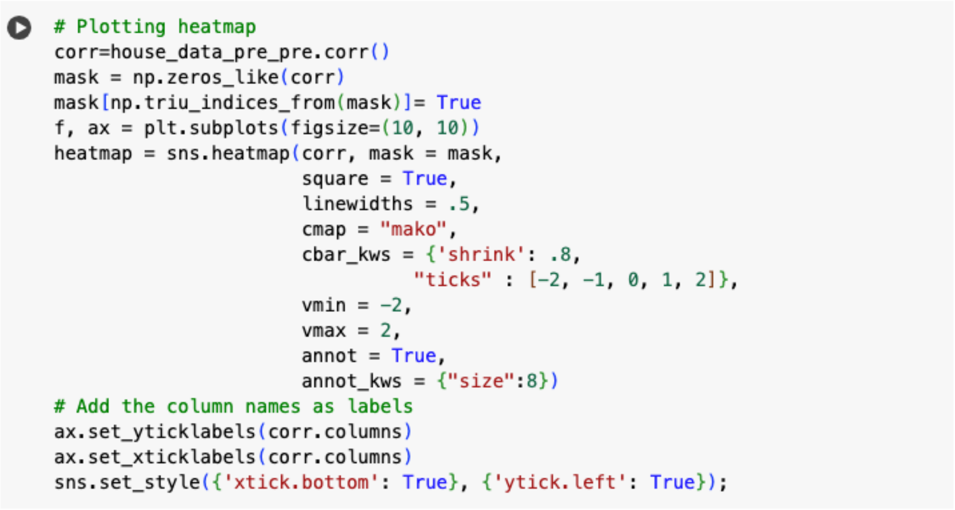
```
                      0
Area_Income           0
Area_House_Age        0
Area_Number_Rooms     0
Area_Number_Bedrooms  0
Area_Populations      0
Price                 0
Address               0

dtype: int64
```

```python
[11] house_data_pre_pre=house_data_pre_pre.drop(['Address'], axis=1)
     house_data_pre_pre.head()
```

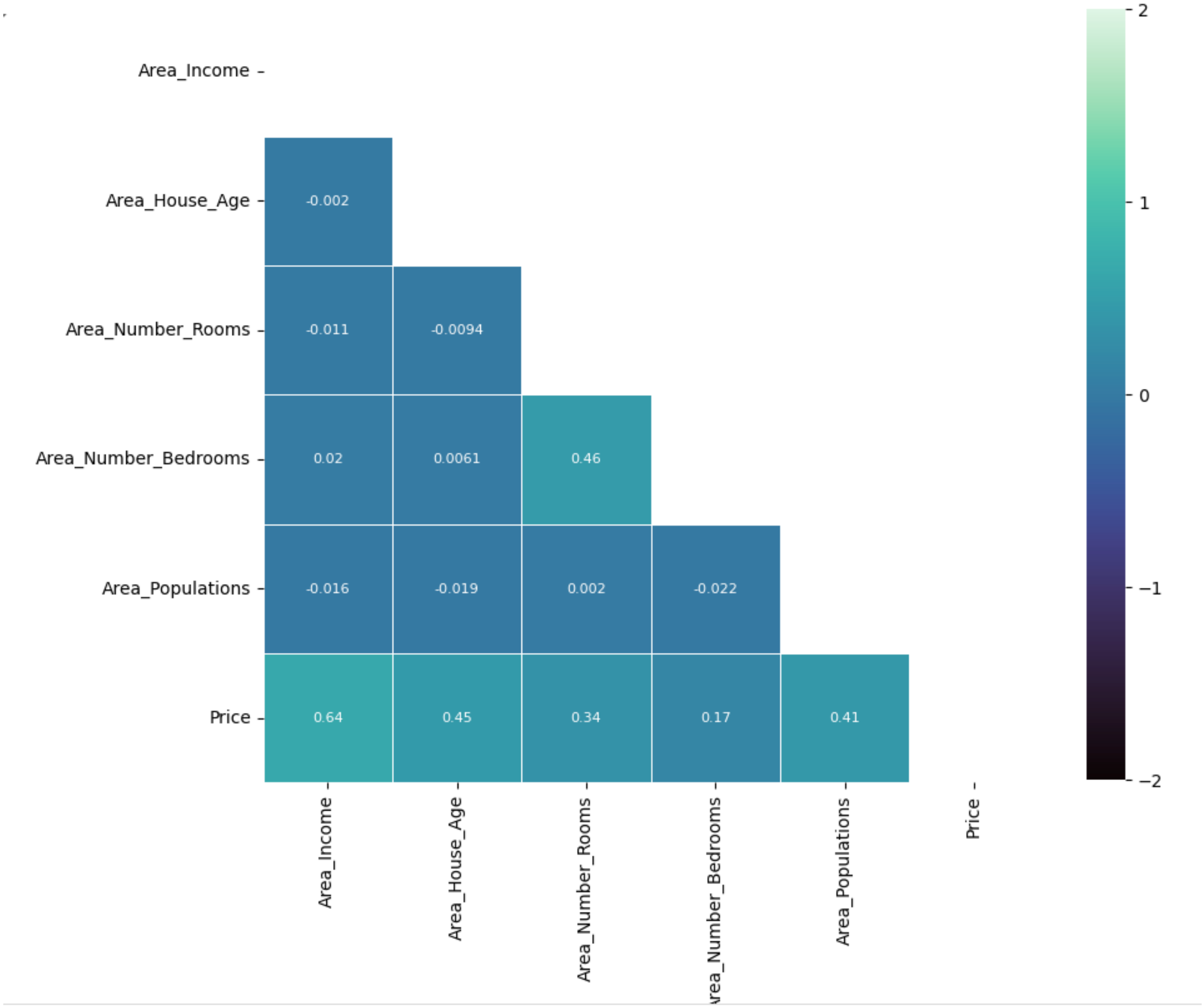
```
   Area_Income   Area_House_Age  Area_Number_Rooms  Area_Number_Bedrooms  Area_Populations  Price
0  79545.458574  5.682861        7.009188           4.09                  23086.800503      1.059034e+06
1  79248.642455  6.002900        6.730821           3.09                  40173.072174      1.505891e+06
2  61287.067179  5.865890        8.512727           5.13                  36882.159400      1.058988e+06
3  63345.240046  7.188236        5.586729           3.26                  34310.242831      1.260617e+06
4  59982.197226  5.040555        7.839388           4.23                  26354.109472      6.309435e+05
```

```python
[12] house_data_pre_pre.shape
```

```
(5000, 6)
```

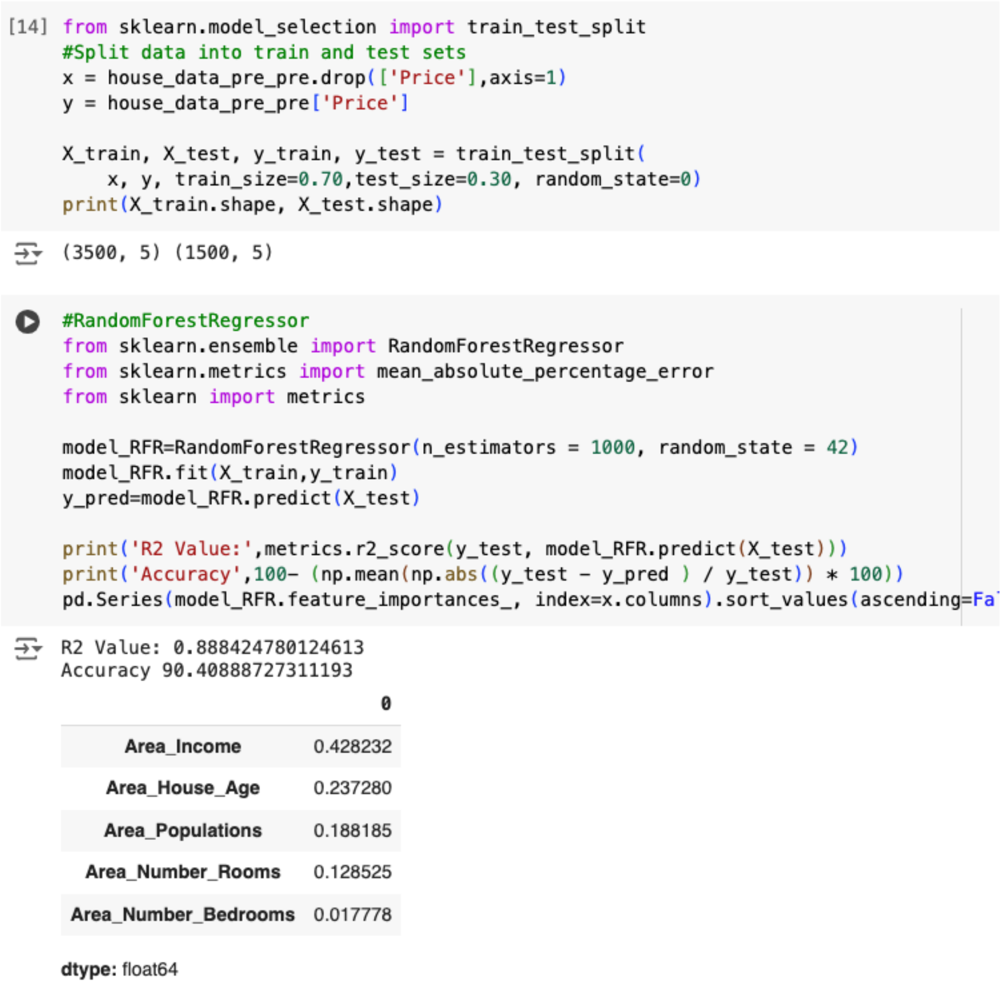


```python
# Plotting heatmap
corr=house_data_pre_pre.corr()
mask = np.zeros_like(corr)
mask[np.triu_indices_from(mask)]= True
f, ax = plt.subplots(figsize=(10, 10))
heatmap = sns.heatmap(corr, mask = mask,
                      square = True,
                      linewidths = .5,
                      cmap = "mako",
                      cbar_kws = {'shrink': .8,
                                  "ticks" : [-2, -1, 0, 1, 2]},
                      vmin = -2,
                      vmax = 2,
                      annot = True,
                      annot_kws = {"size":8})
# Add the column names as labels
ax.set_yticklabels(corr.columns)
ax.set_xticklabels(corr.columns)
sns.set_style({'xtick.bottom': True}, {'ytick.left': True});
```



1.2- Build Model

After data preprocessing, machine learning model was implemented to predict house prices. Model was created with Random Forest Regressor and Linear Regression using scikit-learn. The best performance was achieved with the Linear Regression method.



```
[14] from sklearn.model_selection import train_test_split
     #Split data into train and test sets
     x = house_data_pre_pre.drop(['Price'],axis=1)
     y = house_data_pre_pre['Price']

     X_train, X_test, y_train, y_test = train_test_split(
         x, y, train_size=0.70,test_size=0.30, random_state=0)
     print(X_train.shape, X_test.shape)
```

```
(3500, 5) (1500, 5)
```

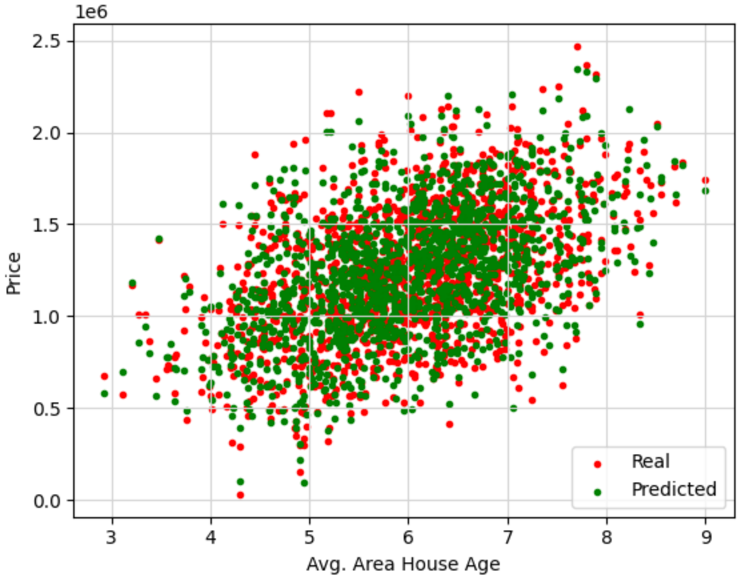
```
#RandomForestRegressor
from sklearn.ensemble import RandomForestRegressor
from sklearn.metrics import mean_absolute_percentage_error
from sklearn import metrics

model_RFR=RandomForestRegressor(n_estimators = 1000, random_state = 42)
model_RFR.fit(X_train,y_train)
y_pred=model_RFR.predict(X_test)

print('R2 Value:',metrics.r2_score(y_test, model_RFR.predict(X_test)))
print('Accuracy',100- (np.mean(np.abs((y_test - y_pred ) / y_test)) * 100))
pd.Series(model_RFR.feature_importances_, index=x.columns).sort_values(ascending=Fa
```

```
R2 Value: 0.888424780124613
Accuracy 90.40888727311193
```

	0
Area_Income	0.428232
Area_House_Age	0.237280
Area_Populations	0.188185
Area_Number_Rooms	0.128525
Area_Number_Bedrooms	0.017778

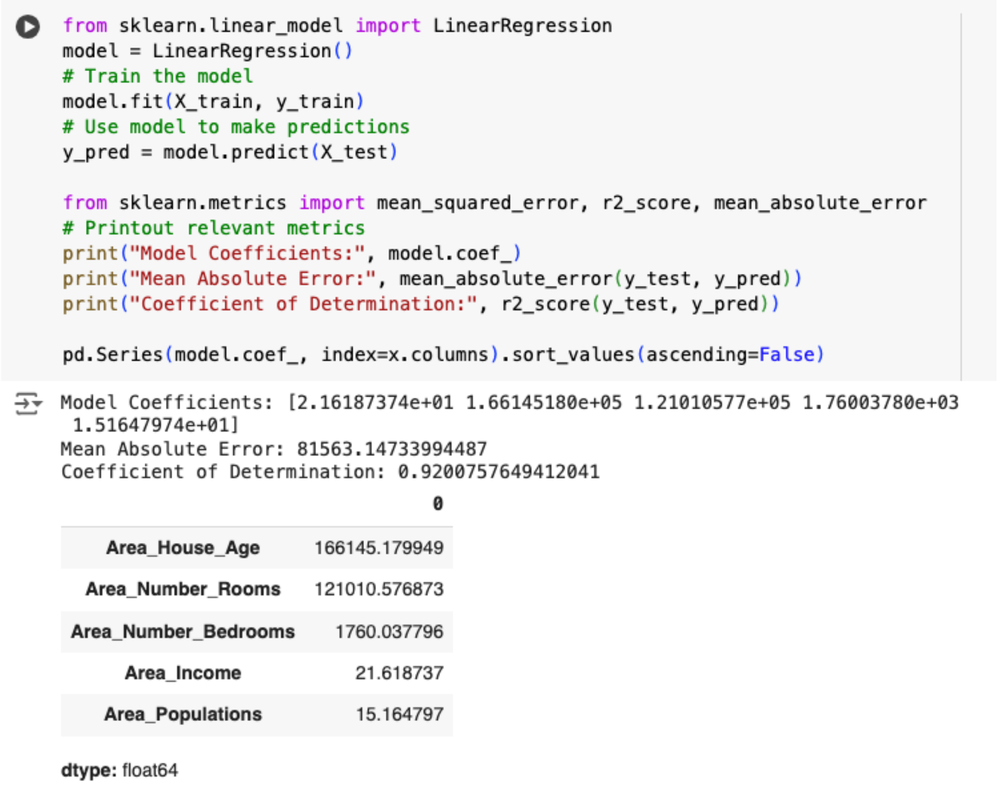
dtype: float64

```
# Import library for visualization
import matplotlib.pyplot as plt

# Define x axis
x_axis = X_test.Area_House_Age

# Build scatterplot
plt.scatter(x_axis, y_test, color = 'red', marker = '.', label = 'Real')
plt.scatter(x_axis, y_pred, color = 'green',marker = '.',label = 'Predicted')
plt.xlabel('Avg. Area House Age')
plt.ylabel('Price')
plt.grid(color ='#D3D3D3')
plt.legend(loc ='lower right')
plt.show()
```



```
# Import library for metrics
from sklearn.metrics import mean_squared_error, r2_score, mean_absolute_error

# Mean absolute error (MAE)
mae = mean_absolute_error(y_test, y_pred)
# Mean squared error (MSE)
mse = mean_squared_error(y_test, y_pred)
# R-squared scores
r2 = r2_score(y_test.values,y_pred)
# Print metrics
print('Mean Absolute Error:', round(mae, 2))
print('Mean Squared Error:', round(mse, 2))
print('R-squared scores:', round(r2, 2))
```

```
Mean Absolute Error: 95982.06
Mean Squared Error: 14431051360.91
R-squared scores: 0.89
```

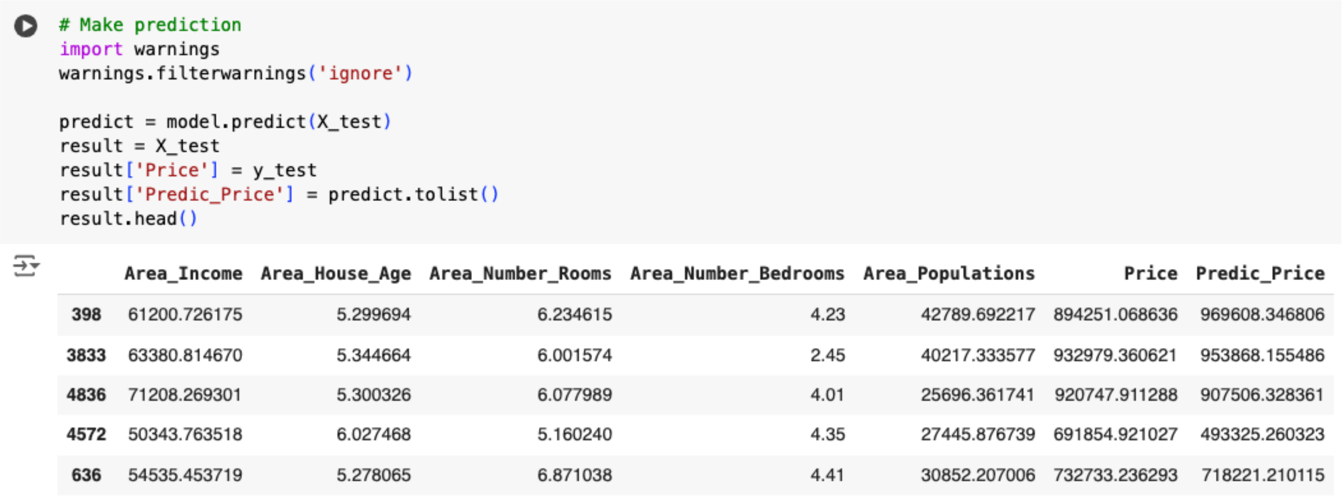


```python
from sklearn.linear_model import LinearRegression
model = LinearRegression()
# Train the model
model.fit(X_train, y_train)
# Use model to make predictions
y_pred = model.predict(X_test)

from sklearn.metrics import mean_squared_error, r2_score, mean_absolute_error
# Printout relevant metrics
print("Model Coefficients:", model.coef_)
print("Mean Absolute Error:", mean_absolute_error(y_test, y_pred))
print("Coefficient of Determination:", r2_score(y_test, y_pred))

pd.Series(model.coef_, index=x.columns).sort_values(ascending=False)
```

```
Model Coefficients: [2.16187374e+01 1.66145180e+05 1.21010577e+05 1.76003780e+03
 1.51647974e+01]
Mean Absolute Error: 81563.14733994487
Coefficient of Determination: 0.9200757649412041
```

	0
Area_House_Age	166145.179949
Area_Number_Rooms	121010.576873
Area_Number_Bedrooms	1760.037796
Area_Income	21.618737
Area_Populations	15.164797

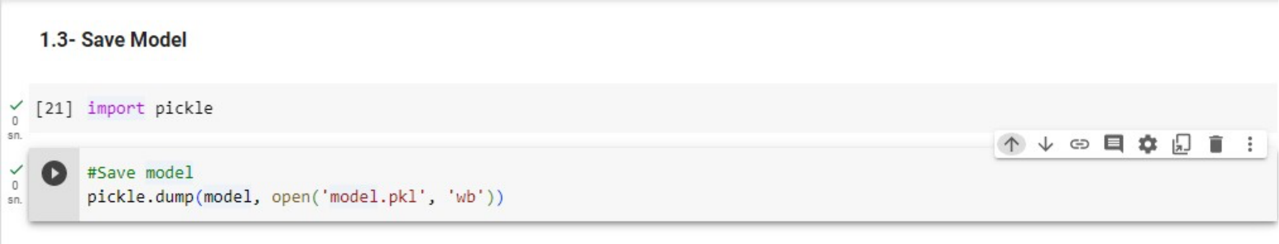
dtype: float64



```python
# Make prediction
import warnings
warnings.filterwarnings('ignore')

predict = model.predict(X_test)
result = X_test
result['Price'] = y_test
result['Predic_Price'] = predict.tolist()
result.head()
```

	Area_Income	Area_House_Age	Area_Number_Rooms	Area_Number_Bedrooms	Area_Populations	Price	Predic_Price
398	61200.726175	5.299694	6.234615	4.23	42789.692217	894251.068636	969608.346806
3833	63380.814670	5.344664	6.001574	2.45	40217.333577	932979.360621	953868.155486
4836	71208.269301	5.300326	6.077989	4.01	25696.361741	920747.911288	907506.328361
4572	50343.763518	6.027468	5.160240	4.35	27445.876739	691854.921027	493325.260323
636	54535.453719	5.278065	6.871038	4.41	30852.207006	732733.236293	718221.210115

1.3- Save Model

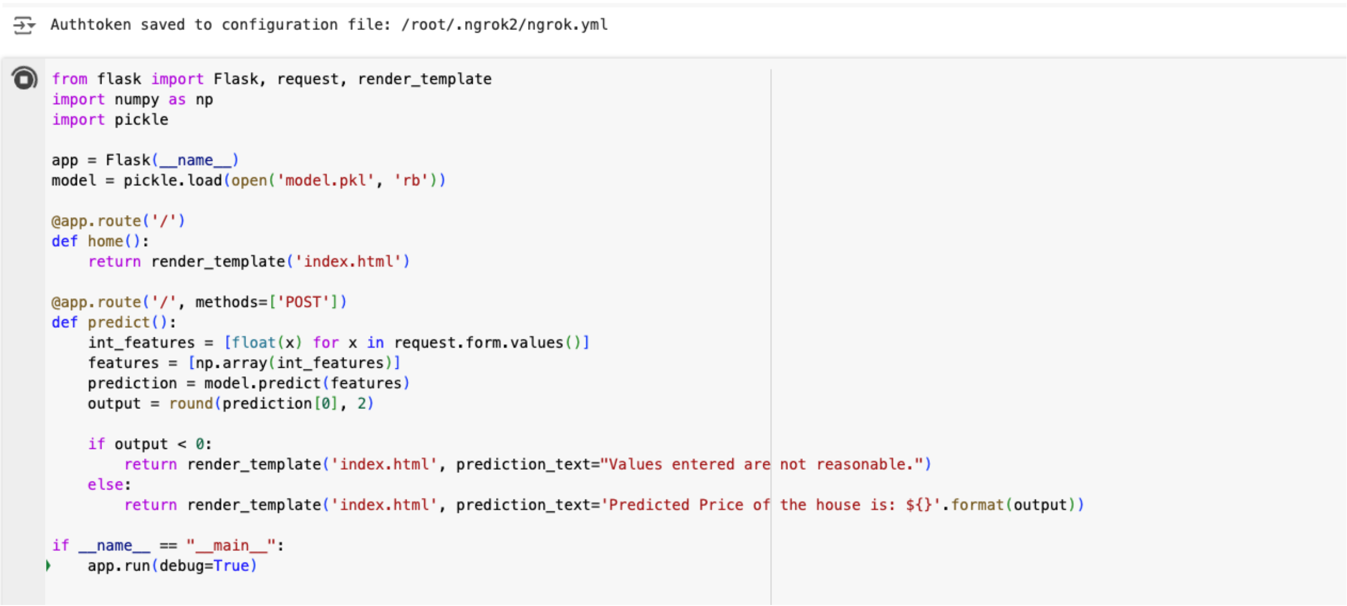


1.3- Save Model

```python
[21] import pickle
```

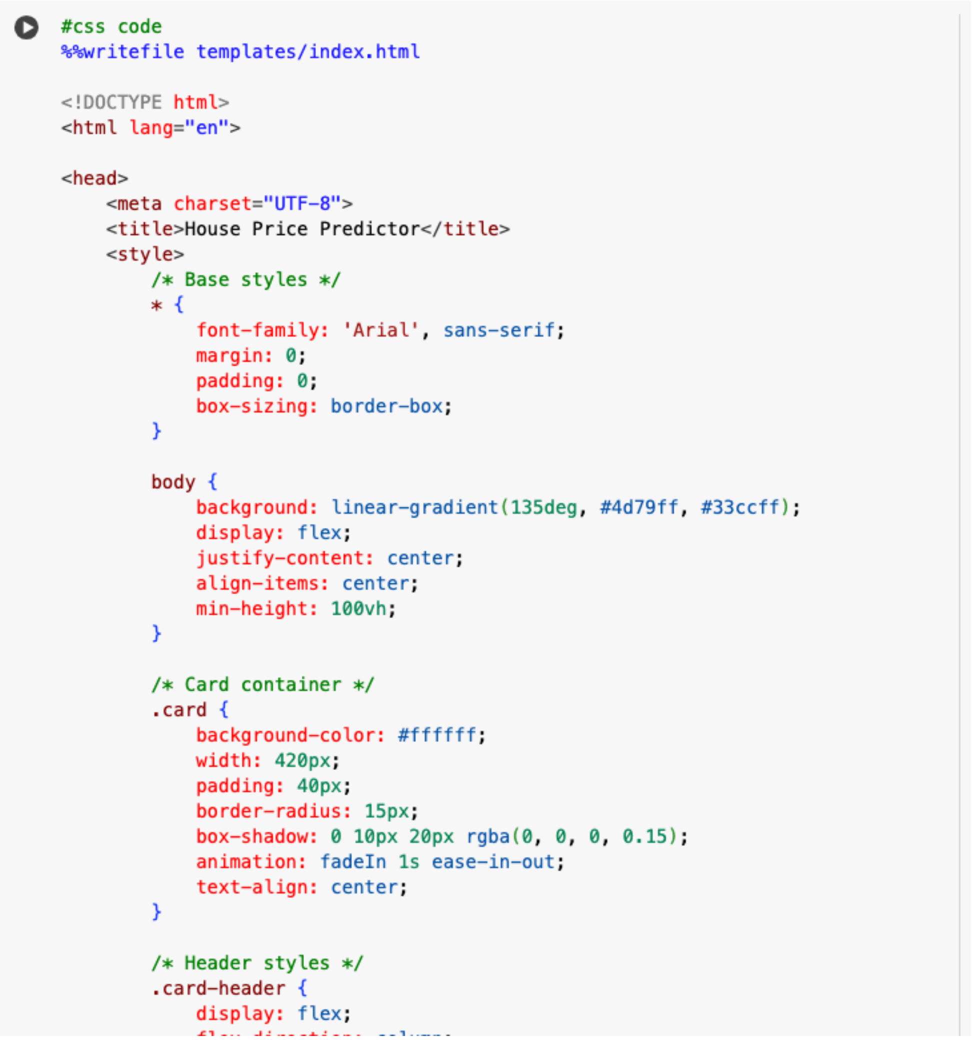
```python
#Save model
pickle.dump(model, open('model.pkl', 'wb'))
```

2- Deploying The Model on Flask (Web App)

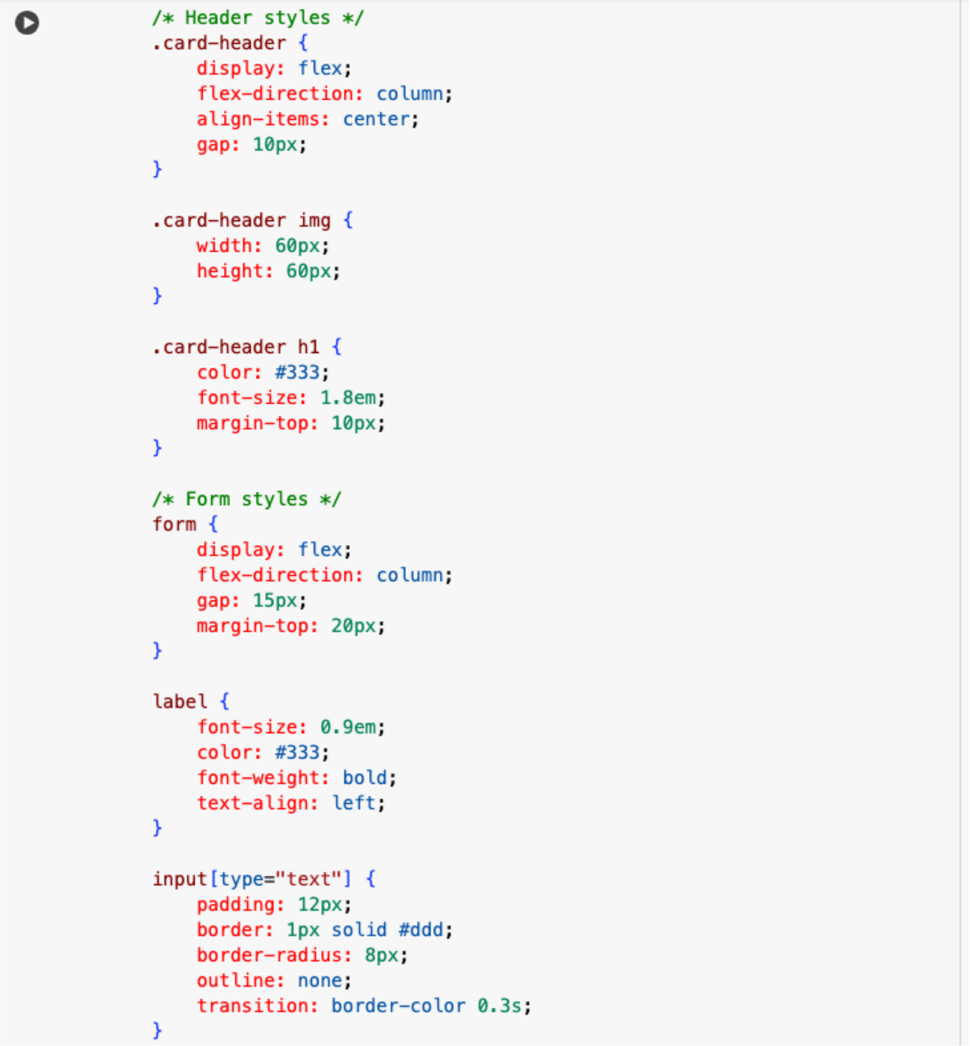


```
Authtoken saved to configuration file: /root/.ngrok2/ngrok.yml
```

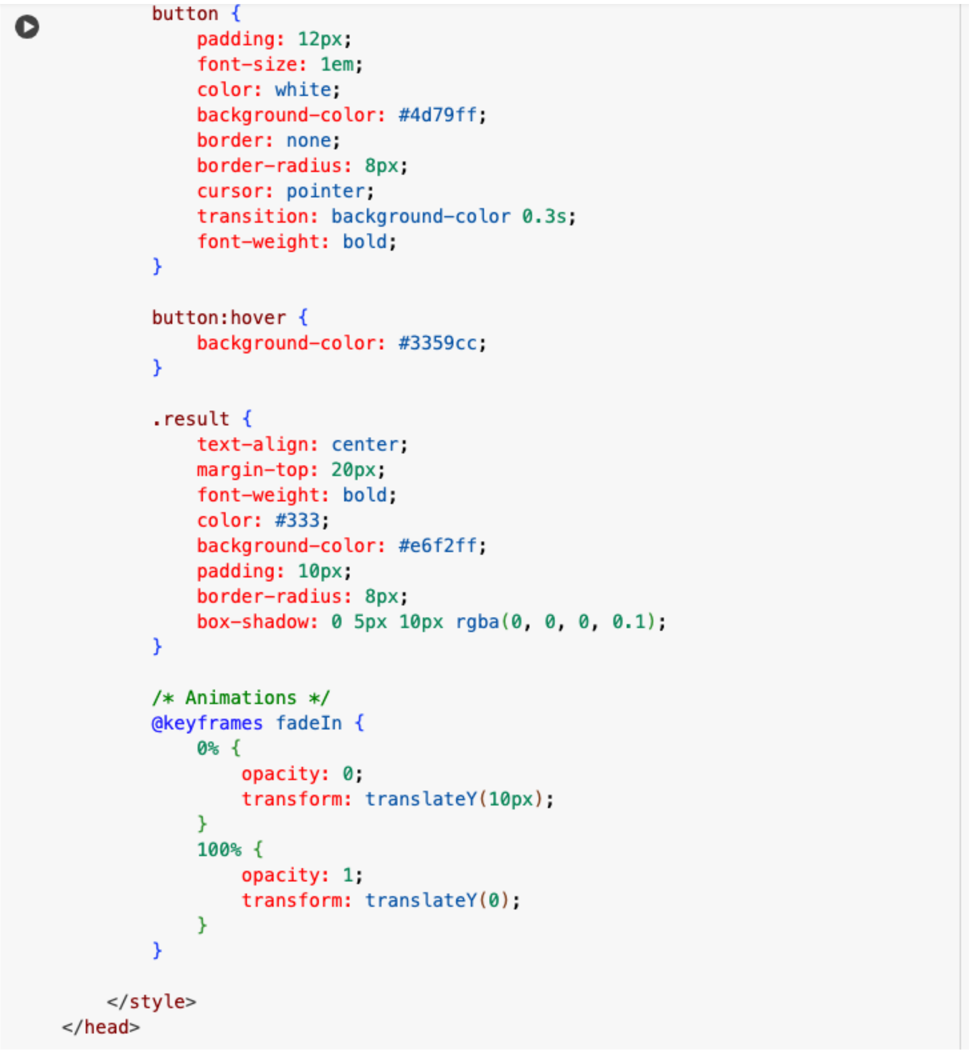
```python
from flask import Flask, request, render_template
import numpy as np
import pickle

app = Flask(__name__)
model = pickle.load(open('model.pkl', 'rb'))

@app.route('/')
def home():
    return render_template('index.html')

@app.route('/', methods=['POST'])
def predict():
    int_features = [float(x) for x in request.form.values()]
    features = [np.array(int_features)]
    prediction = model.predict(features)
    output = round(prediction[0], 2)

    if output < 0:
        return render_template('index.html', prediction_text="Values entered are not reasonable.")
    else:
        return render_template('index.html', prediction_text='Predicted Price of the house is: ${}'.format(output))

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



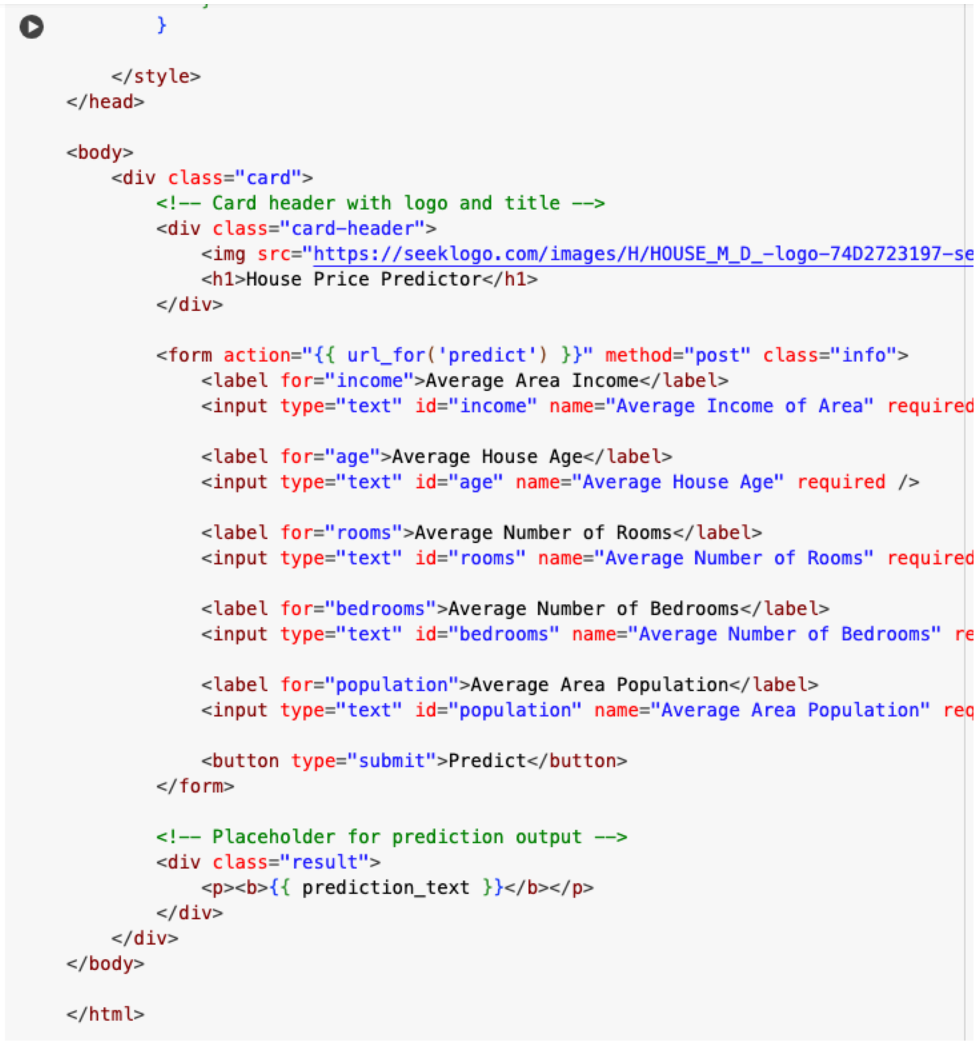
```
#css code
%%writefile templates/index.html

<!DOCTYPE html>
<html lang="en">

<head>
    <meta charset="UTF-8">
    <title>House Price Predictor</title>
    <style>
        /* Base styles */
        * {
            font-family: 'Arial', sans-serif;
            margin: 0;
            padding: 0;
            box-sizing: border-box;
        }

        body {
            background: linear-gradient(135deg, #4d79ff, #33ccff);
            display: flex;
            justify-content: center;
            align-items: center;
            min-height: 100vh;
        }

        /* Card container */
        .card {
            background-color: #ffffff;
            width: 420px;
            padding: 40px;
            border-radius: 15px;
            box-shadow: 0 10px 20px rgba(0, 0, 0, 0.15);
            animation: fadeIn 1s ease-in-out;
            text-align: center;
        }

        /* Header styles */
        .card-header {
            display: flex;
            flex-direction: column;
```



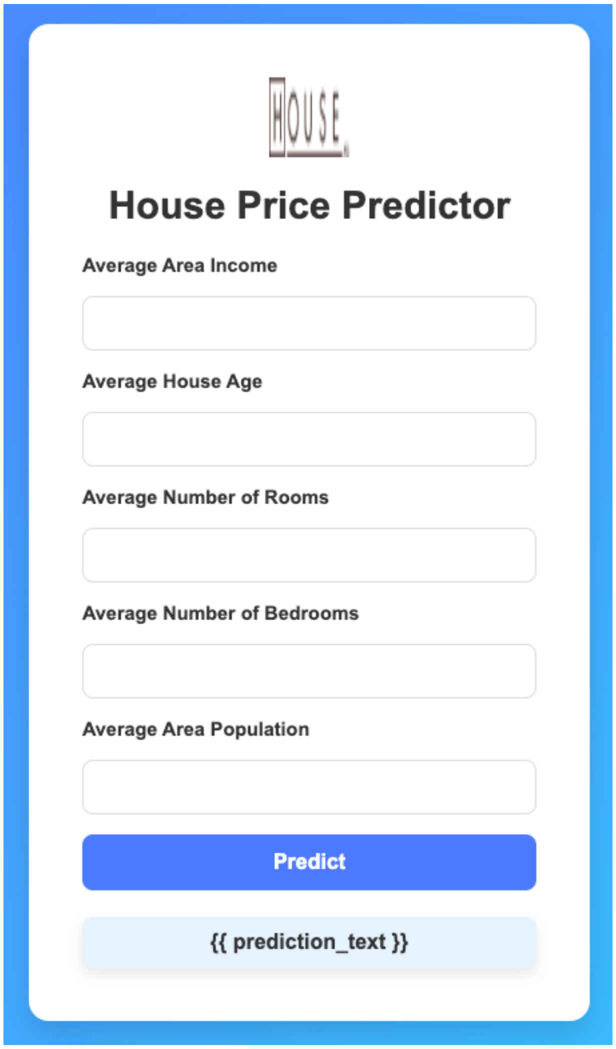
```
        /* Header styles */
        .card-header {
            display: flex;
            flex-direction: column;
            align-items: center;
            gap: 10px;
        }

        .card-header img {
            width: 60px;
            height: 60px;
        }

        .card-header h1 {
            color: #333;
            font-size: 1.8em;
            margin-top: 10px;
        }

        /* Form styles */
        form {
            display: flex;
            flex-direction: column;
            gap: 15px;
            margin-top: 20px;
        }

        label {
            font-size: 0.9em;
            color: #333;
            font-weight: bold;
            text-align: left;
        }

        input[type="text"] {
            padding: 12px;
            border: 1px solid #ddd;
            border-radius: 8px;
            outline: none;
            transition: border-color 0.3s;
        }
```



```
            button {
                padding: 12px;
                font-size: 1em;
                color: white;
                background-color: #4d79ff;
                border: none;
                border-radius: 8px;
                cursor: pointer;
                transition: background-color 0.3s;
                font-weight: bold;
            }

            button:hover {
                background-color: #3359cc;
            }

            .result {
                text-align: center;
                margin-top: 20px;
                font-weight: bold;
                color: #333;
                background-color: #e6f2ff;
                padding: 10px;
                border-radius: 8px;
                box-shadow: 0 5px 10px rgba(0, 0, 0, 0.1);
            }

            /* Animations */
            @keyframes fadeIn {
                0% {
                    opacity: 0;
                    transform: translateY(10px);
                }
                100% {
                    opacity: 1;
                    transform: translateY(0);
                }
            }

        </style>
    </head>
```



```
        }

    </style>
</head>

<body>
    <div class="card">
        <!-- Card header with logo and title -->
        <div class="card-header">
            <img src="https://seeklogo.com/images/H/HOUSE_M_D_-logo-74D2723197-se
            <h1>House Price Predictor</h1>
        </div>

        <form action="{{ url_for('predict') }}" method="post" class="info">
            <label for="income">Average Area Income</label>
            <input type="text" id="income" name="Average Income of Area" required

            <label for="age">Average House Age</label>
            <input type="text" id="age" name="Average House Age" required />

            <label for="rooms">Average Number of Rooms</label>
            <input type="text" id="rooms" name="Average Number of Rooms" required

            <label for="bedrooms">Average Number of Bedrooms</label>
            <input type="text" id="bedrooms" name="Average Number of Bedrooms" re

            <label for="population">Average Area Population</label>
            <input type="text" id="population" name="Average Area Population" req

            <button type="submit">Predict</button>
        </form>

        <!-- Placeholder for prediction output -->
        <div class="result">
            <p><b>{{ prediction_text }}</b></p>
        </div>
    </div>
</body>

</html>
```



House Price Predictor

Average Area Income

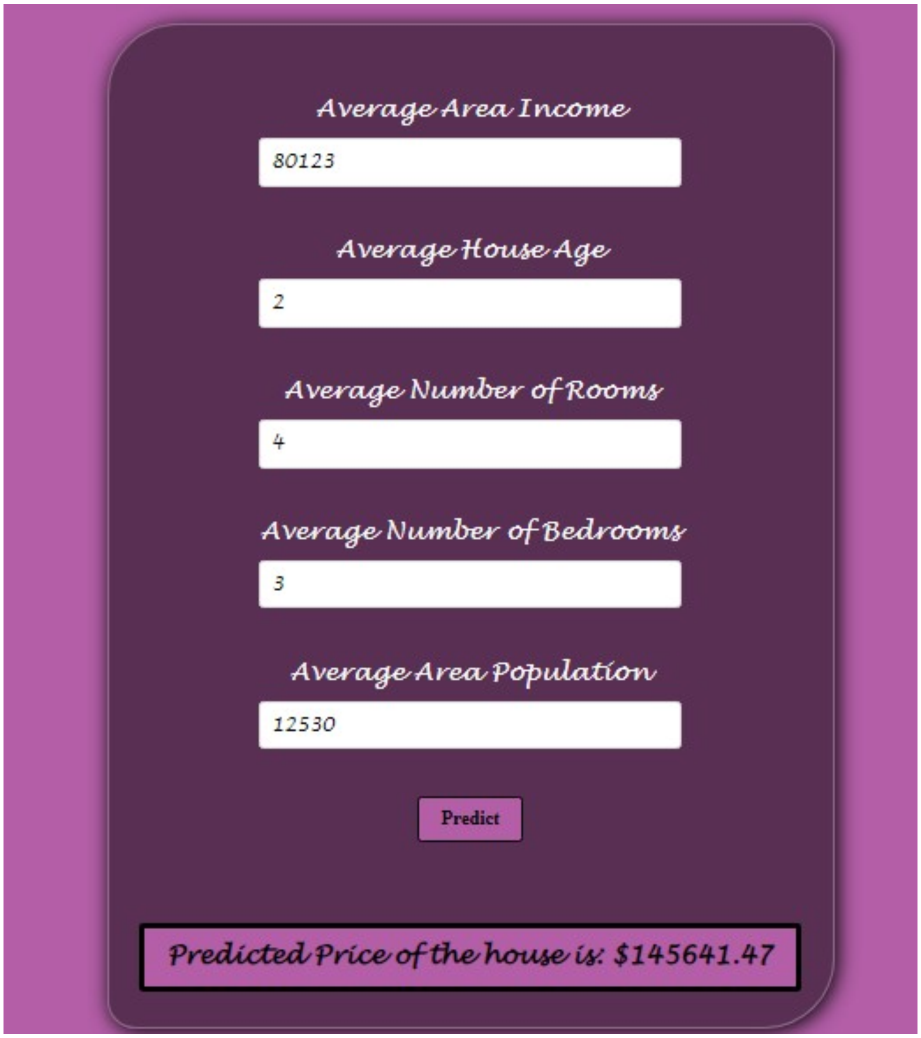
Average House Age

Average Number of Rooms

Average Number of Bedrooms

Average Area Population

{{ prediction_text }}



Average Area Income

80123

Average House Age

2

Average Number of Rooms

4

Average Number of Bedrooms

3

Average Area Population

12530

Predicted Price of the house is: $145641.47