



Week 5: CLOUD AND API DEPLOYMENT

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Batch Code: LISUM04

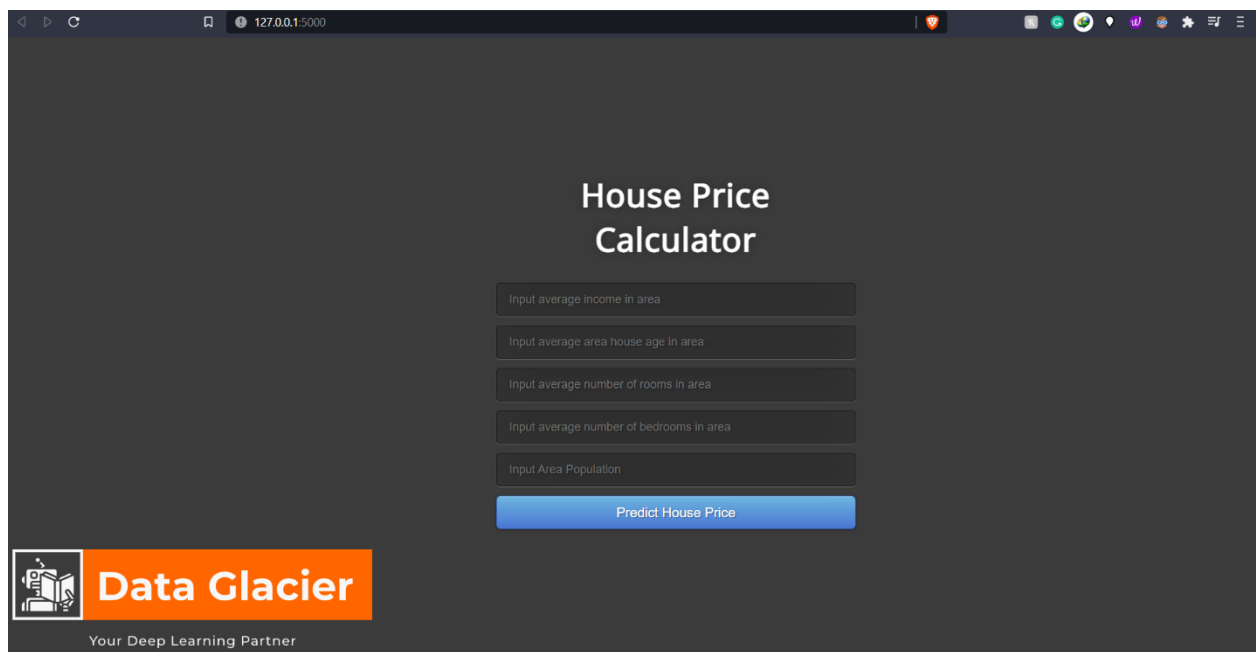
Submission Data: 10/24/2021

Submitted to: Data Glacier

Introduction

The Flask web had been developed to predict the house price based on different variables in the selected area from “USA Housing” [dataset](#) from Kaggle: Average Income, Average House Age, Average Number of Room, Average of Bedroom in Area, and Area Population. In the following sections, I will explain each of the project of the project separately in detail:

Here is the picture of the web app interface:



The screenshot shows a web application interface for a 'House Price Calculator'. The interface is dark-themed with a central form. The form contains five input fields for user data: 'Input average income in area', 'Input average area house age in area', 'Input average number of rooms in area', 'Input average number of bedrooms in area', and 'Input Area Population'. Below these fields is a blue button labeled 'Predict House Price'. In the bottom left corner, there is a logo for 'Data Glacier' with the tagline 'Your Deep Learning Partner'.

House Price Calculator

Input average income in area


Input average area house age in area

Input average number of rooms in area

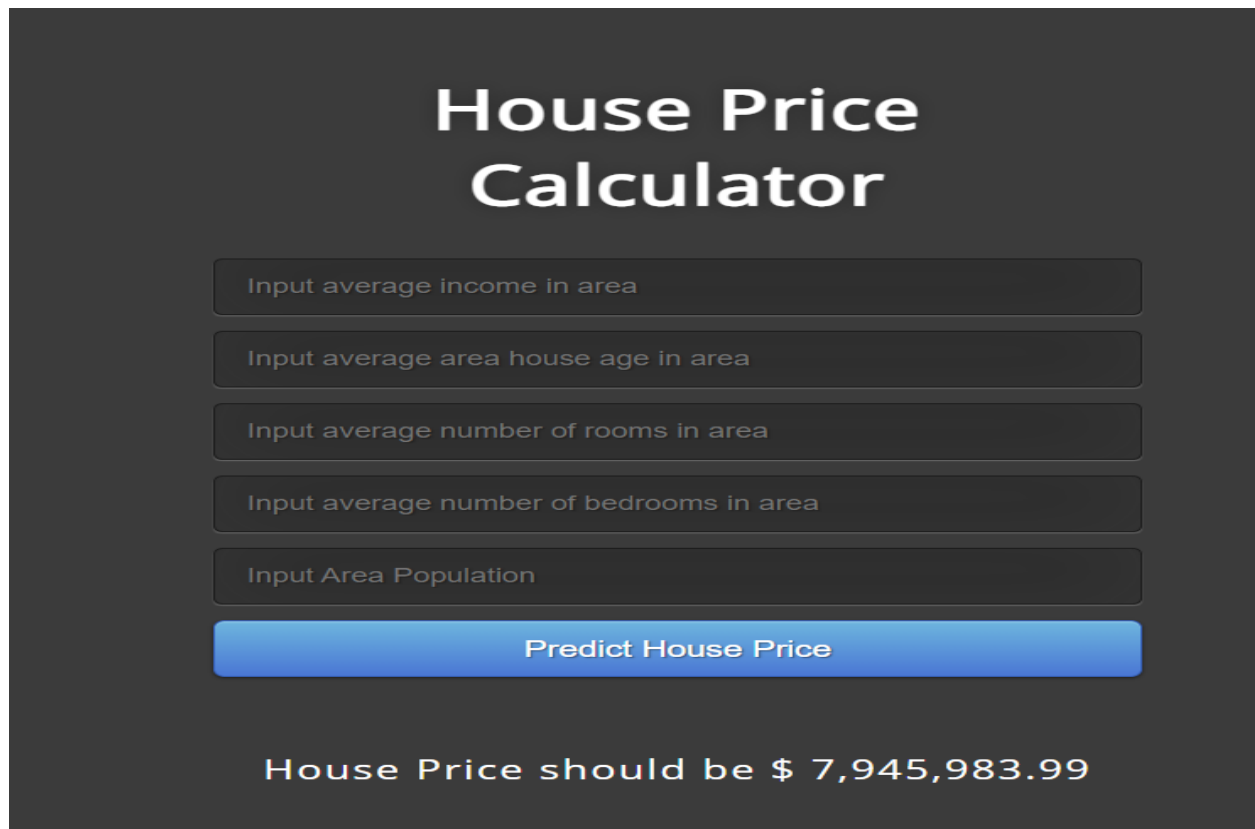
Input average number of bedrooms in area

Input Area Population

Predict House Price

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After a user put values and press the “Predict House Price” button, the answers will come immediately:



The image shows a dark-themed user interface for a 'House Price Calculator'. At the top, the title 'House Price Calculator' is displayed in a large, white, sans-serif font. Below the title, there are five input fields, each with a light gray placeholder text: 'Input average income in area', 'Input average area house age in area', 'Input average number of rooms in area', 'Input average number of bedrooms in area', and 'Input Area Population'. These fields are stacked vertically. Below the input fields is a prominent blue button with the text 'Predict House Price' in white. At the bottom of the interface, the calculated result is shown: 'House Price should be \$ 7,945,983.99'.

House Price Calculator

Input average income in area

Input average area house age in area

Input average number of rooms in area

Input average number of bedrooms in area

Input Area Population

Predict House Price

House Price should be \$ 7,945,983.99

Dataset

The dataset that I used it is “USA housing” Dataset. The below picture illustrates all features of this dataset Since house price is a continues variable, this is a regression problem. The data contains the following columns:

- ‘Avg. Area Income’: Avg. Income of residents of the city house is located in.
- ‘Avg. Area House Age’: Avg Age of Houses in same city
- ‘Avg. Area Number of Rooms’: Avg Number of Rooms for Houses in same city
- ‘Avg. Area Number of Bedrooms’: Avg Number of Bedrooms for Houses in same city
- ‘Area Population’: Area population
- ‘Price’: Price that the house sold at
- ‘Address’: Address for the house

MODEL

I have deployed a model to predict house price based on 5 variables:

- ‘Avg. Area Income’
- ‘Avg. Area House Age’
- ‘Avg. Area Number of Rooms’
- ‘Avg. Area Number of Bedrooms’
- ‘Area Population’

Linear Regression is the method in this project to predict the target and train the model with whole dataset. The code has been included in my Git Folder. Here is the model valuation based on MAE, MSE, RMSE, R2square and Cross Validation

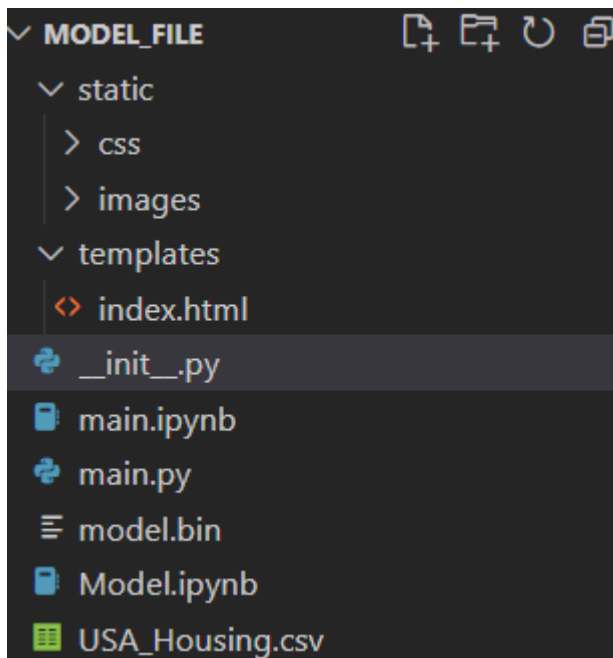
```
# Have * before evaluate func or will getting error
results_df = pd.DataFrame(data=[["Linear Regression", *evaluate(y_test, test_pred) , cross_val(LinearRegression())]],
                           columns=['Model', 'MAE', 'MSE', 'RMSE', 'R2 Square', "Cross Validation"])
results_df
```

	Model	MAE	MSE	RMSE	R2 Square	Cross Validation
0	Linear Regression	81135.57	10068422551.40	100341.53	0.91	0.92

The code is written in Jupyter Notebook, and my model is stored as “model.bin” for deploying in Flask

FLAKS DEPLOYMENT

After install Flask, we will need some other important material for the deployment such as .html for web design, style with .css, image, model.bin to store my model, the main code .py to launch it. The following image is the summary of all necessary file need for the Flask deployment:



Model. Bin: is the model for our deployment. We could store as .pkl as well

Style.css This file will help create a beautiful view for our app. Here is the snapshot of this file:

```

static > css > # style.css > body
1  @import url(https://fonts.googleapis.com/css?family=Open+Sans);
2  .btn { display: inline-block; *display: inline; *zoom: 1; padding: 4px 10px 4px; margin-bottom: 0; font-size: 13px; line-height: 18px; co
3  .btn:hover, .btn.active, .btn.active, .btn.disabled, .btn[disabled] { background-color: #e6e6e6; }
4  .btn-large { padding: 9px 14px; font-size: 15px; line-height: normal; -webkit-border-radius: 5px; -moz-border-radius: 5px; border-radius:
5  .btn:hover { color: #333333; text-decoration: none; background-color: #e6e6e6; background-position: 0 -15px; -webkit-transition: back
6  .btn-primary, .btn-primary:hover { text-shadow: 0 -1px 0 rgba(0, 0, 0, 0.25); color: #ffffff; }
7  .btn-primary.active { color: rgba(255, 255, 255, 0.75); }
8  .btn-primary { background-color: #4a77d4; background-image: -moz-linear-gradient(top, #6eb6de, #4a77d4); background-image: -ms-lin
9  .btn-primary:hover, .btn-primary.active, .btn-primary.active, .btn-primary.disabled, .btn-primary[disabled] { filter: none; background-co
10 .btn-block { width: 100%; display: block; }
11
12 * { -webkit-box-sizing: border-box; -moz-box-sizing: border-box; -ms-box-sizing: border-box; -o-box-sizing: border-box; box-sizing: border-box; }
13
14 html { width: 100%; height: 100%; overflow: hidden; }
15
16 body {
17     width: 100%;
18     height: 100%;
19     font-family: 'Open Sans', sans-serif;
20     color: #fff;
21     font-size: 18px;
22     text-align: center;
23     letter-spacing: 1.2px;
24     background: #3B3B3B !important;
25     filter: progid:DXImageTransform.Microsoft.gradient( startColorstr='#3E1D6D', endColorstr='#092756', GradientType=1 );
26
27 }
28 .login {
29     position: absolute;
30     top: 40%;
31     left: 50%;
32     margin: -150px 0 0 -150px;
33     width: 400px;
34     height: 400px;
35 }
36
37 .login h1 { color: #fff; text-shadow: 0 0 10px rgba(0,0,0,0.3); letter-spacing: 1px; text-align: center; }
38

```

```

.login h1 { color: #fff; text-shadow: 0 0 10px rgba(0,0,0,0.3); letter-spacing: 1px; text-align: center; }

input {
    width: 100%;
    margin-bottom: 10px;
    background: rgba(0,0,0,0.3);
    border: none;
    outline: none;
    padding: 10px;
    font-size: 13px;
    color: #fff;
    text-shadow: 1px 1px 1px rgba(0,0,0,0.3);
    border: 1px solid rgba(0,0,0,0.3);
    border-radius: 4px;
    box-shadow: inset 0 -5px 45px rgba(100,100,100,0.2), 0 1px 1px rgba(255,255,255,0.2);
    -webkit-transition: box-shadow .5s ease;
    -moz-transition: box-shadow .5s ease;
    -o-transition: box-shadow .5s ease;
    -ms-transition: box-shadow .5s ease;
    transition: box-shadow .5s ease;
}
input:focus { box-shadow: inset 0 -5px 45px rgba(100,100,100,0.4), 0 1px 1px rgba(255,255,255,0.2); }

```

Index.html: This is the main view page that contains all static elements so the client can see in UI:

```

templates > < index.html > ...
1  <!DOCTYPE html>
2  <html>
3  <head>
4      <meta charset="UTF-8">
5      <title>House Price Calculator</title>
6      <link href="https://fonts.googleapis.com/css?family=Pacifico" rel="stylesheet" type="text/css">
7      <link href="https://fonts.googleapis.com/css?family=Arimo" rel="stylesheet" type="text/css">
8      <link href="https://fonts.googleapis.com/css?family=Hind:300" rel="stylesheet" type="text/css">
9      <link href="https://fonts.googleapis.com/css?family=Open+Sans+Condensed:300" rel="stylesheet" type="text/css">
10     <link rel="stylesheet" href="{{ url_for('static', filename='css/style.css') }}">
11
12 </head>
13
14 <body>
15     <div class="login">
16         <h1>House Price Calculator</h1>
17
18         <!-- Main Input For Receiving Query to our ML -->
19         <form action="{{ url_for('predict') }}" method="post">
20             <input type="text" name="Avg. Area Income" placeholder="Input average income in area" required="required" />
21             <input type="text" name="Avg. Area House Age" placeholder="Input average area house age in area" required="required" />
22             <input type="text" name="Avg. Area Number of Rooms" placeholder="Input average number of rooms in area" required="required" />
23             <input type="text" name="Avg. Area Number of Bedroom" placeholder="Input average number of bedrooms in area" required="required" />
24             <input type="text" name="Area Population" placeholder="Input Area Population" required="required" />
25
26             <button type="submit" class="btn btn-primary btn-block btn-large">Predict House Price </button>
27         </form>
28
29         <br>
30         <br>
31         {{ prediction_text }}
32     </div>
33
34     
35
36 </body>
37 </html>

```

Main.py: This is important file for this project

```

# In[1]:
from flask import Flask, request, jsonify, render_template
import pickle
import numpy as np
import sklearn
Run Cell | Run Above | Debug Cell

# In[2]:
#change the save path location for model.bin depends on your computer
save_path = r"C:\Users\nguye\Desktop\Data Science Stuff\Projects\Python\Flask\model_file\model.bin"
# # Deployment of Flask
Run Cell | Run Above | Debug Cell

# In[3]:
app = Flask(__name__)
with open(save_path, 'rb') as f:
    model = pickle.load(f)
Run Cell | Run Above | Debug Cell

# In[4]:
@app.route("/")
def home():
    return render_template("index.html")
Run Cell | Run Above | Debug Cell

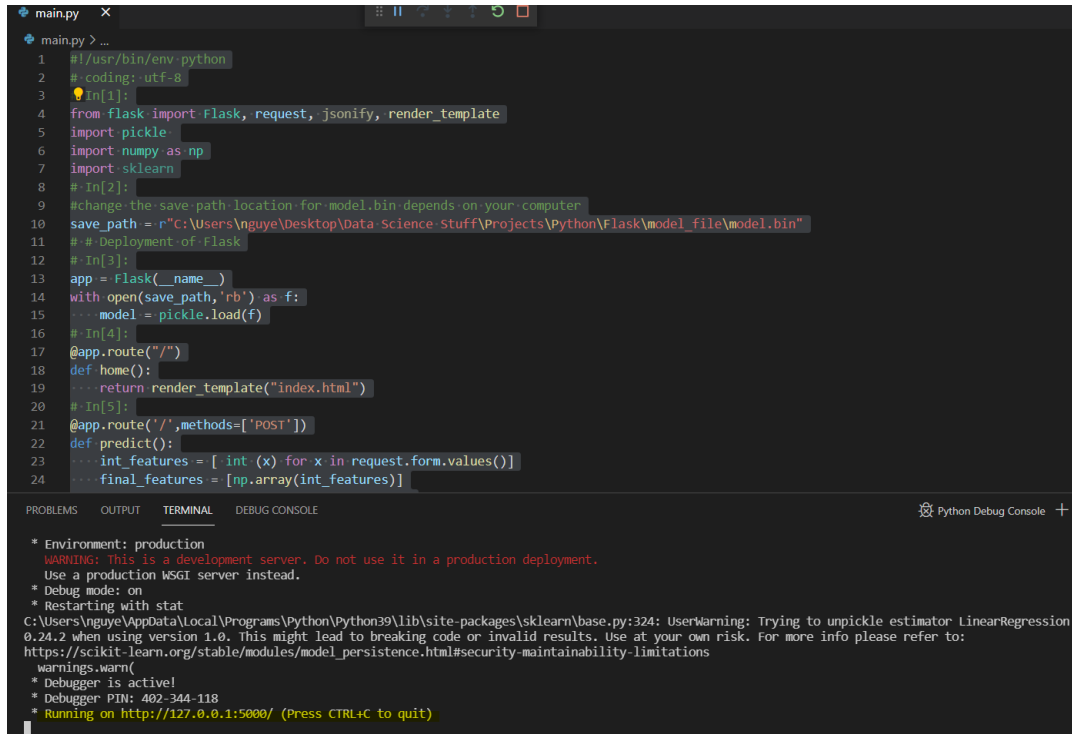
# In[5]:
@app.route('/', methods=['POST'])
def predict():
    int_features = [int(x) for x in request.form.values()]
    final_features = [np.array(int_features)]
    prediction = model.predict(final_features)
    output = round(prediction[0], 2)
    return render_template('index.html', prediction_text='House Price should be $ {:.,}'.format(output))
Run Cell | Run Above | Debug Cell

# In[ ]:
if __name__ == '__main__':
    app.run(port=5000, debug=True)

```

Test Running App

For running application, we will run the main.py, which is the python code, and find the address of our location like : “127.0.0.1:5000/”, or we can customize our address as well.



```
main.py > ...
1 #!/usr/bin/env python
2 # coding: utf-8
3 In[1]:
4 from flask import Flask, request, jsonify, render_template
5 import pickle
6 import numpy as np
7 import sklearn
8 # In[2]:
9 #change the save path location for model.bin depends on your computer
10 save_path = r"C:\Users\nguye\Desktop\Data Science Stuff\Projects\Python\Flask\model_file\model.bin"
11 # - Deployment of Flask
12 # In[3]:
13 app = Flask(__name__)
14 with open(save_path, 'rb') as f:
15     model = pickle.load(f)
16 # In[4]:
17 @app.route("/")
18 def home():
19     return render_template("index.html")
20 # In[5]:
21 @app.route('/', methods=['POST'])
22 def predict():
23     int_features = [int(x) for x in request.form.values()]
24     final_features = [np.array(int_features)]
```

PROBLEMS OUTPUT TERMINAL DEBUG CONSOLE Python Debug Console

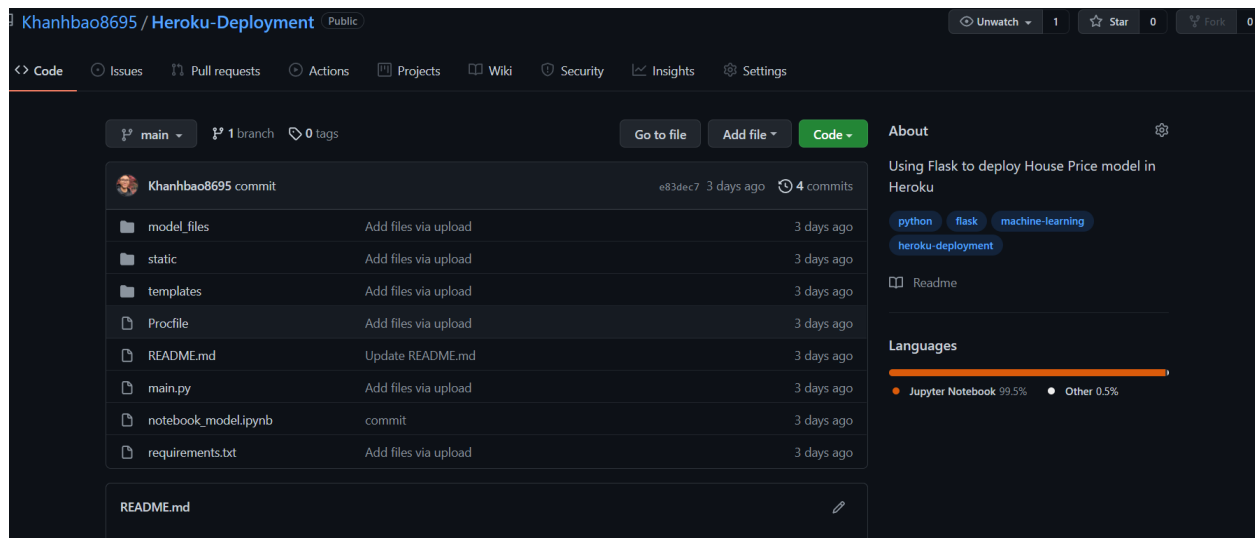
```
* Environment: production
WARNING: This is a development server. Do not use it in a production deployment.
Use a production WSGI server instead.
* Debug mode: on
* Restarting with stat
C:\Users\nguye\AppData\Local\Programs\Python\Python39\lib\site-packages\sklearn\base.py:324: UserWarning: Trying to unpickle estimator LinearRegression f
0.24.2 when using version 1.0. This might lead to breaking code or invalid results. Use at your own risk. For more info please refer to:
https://scikit-learn.org/stable/modules/model_persistence.html#security-maintainability-limitations
warnings.warn(
* Debugger is active!
* Debugger PIN: 402-344-118
* Running on http://127.0.0.1:5000/ (Press CTRL+C to quit)
```

HEROKU DEPLOYMENT

Before Deployment

Create **Procfile** file, which is really important for Heroku can execute the model app. My app name is **main.py**, which will have this command line: web: gunicorn **main**:app. The app name have to match with this command line or it will cause errors. In addition, for the **requirement.txt**, we can run pip freeze command to create this file, but in my case, I choose pipreqs to create the requirement.txt.

Create new GitHub repository, and your repository will have these files:



Main.py: for app running

Notebook.ipynb: contain the model building process

Requirement.txt: can be generated by pip freeze or pipreqs command line

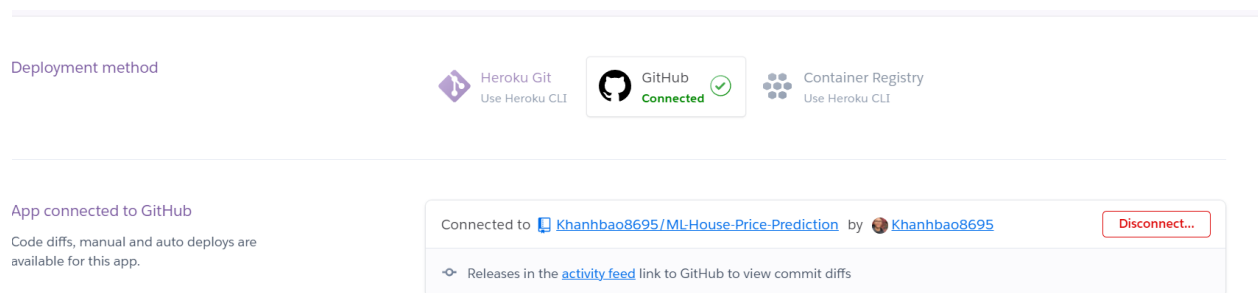
Procfile: we must create it with the command line mentioned above

Templates and statics folders to contain layout, designs of our models

Model_files: contain the model.bin

Heroku Setup, Create Account and Connect to Github

After created account on Heroku, we need to connect GitHub to Heroku when choosing deployment method



After connection, Heroku will execute building this app for us. Check the Heroku logs for more detail ensure that our app has been built successfully by Heroku

After we successfully built, we will have open app button

Personal > demo-ushouse

GitHub Khanhbao8695/ML-House-Price-Prediction

Overview Resources Deploy Metrics Activity Access Settings

Application Logs ALL PROCESSES

```
2021-10-24T20:16:30.985094+00:00 app[web.1]: https://scikit-learn.org/stable/modules/model_persistence.html#security-maintainability-limitations
2021-10-24T20:16:30.985095+00:00 app[web.1]: warnings.warn(
2021-10-24T20:16:30.994193+00:00 heroku[router]: at=info method=GET path="/" host=demo-ushouse.herokuapp.com request_id=b3e1fd9a-777c-42ce-b156-98f94f4d8ba1 fwd="96.245.161.111"
dyno=web.1 connect=0ms service=1948ms status=200 bytes=1765 protocol=https
2021-10-24T20:16:30.994429+00:00 app[web.1]: 10.1.14.96 - - [24/Oct/2021:20:16:30 +0000] "GET / HTTP/1.1" 200 1610 "https://dashboard.heroku.com/" "Mozilla/5.0 (Windows NT 10.0;
Win64; x64) AppleWebKit/537.36 (KHTML, like Gecko) Chrome/95.0.4638.54 Safari/537.36"
2021-10-24T20:16:31.275578+00:00 heroku[router]: at=info method=GET path="/static/css/style.css" host=demo-ushouse.herokuapp.com request_id=c558e1c0-3550-4cdc-8230-b9147efc8668
fwd="96.245.161.111" dyno=web.1 connect=0ms service=4ms status=200 bytes=4697 protocol=https
2021-10-24T20:16:31.275771+00:00 app[web.1]: 10.1.14.96 - - [24/Oct/2021:20:16:31 +0000] "GET /static/css/style.css HTTP/1.1" 200 0 "https://demo-ushouse.herokuapp.com/"
"Mozilla/5.0 (Windows NT 10.0; Win64; x64) AppleWebKit/537.36 (KHTML, like Gecko) Chrome/95.0.4638.54 Safari/537.36"
2021-10-24T20:16:31.302948+00:00 app[web.1]: 10.1.14.96 - - [24/Oct/2021:20:16:31 +0000] "GET /static/images/Original.svg HTTP/1.1" 200 0 "https://demo-ushouse.herokuapp.com/"
"Mozilla/5.0 (Windows NT 10.0; Win64; x64) AppleWebKit/537.36 (KHTML, like Gecko) Chrome/95.0.4638.54 Safari/537.36"
2021-10-24T20:16:31.303110+00:00 heroku[router]: at=info method=GET path="/static/images/Original.svg" host=demo-ushouse.herokuapp.com request_id=e7fe0d7b-0dbf-4779-a50a-
f62dbe2bc2d0 fwd="96.245.161.111" dyno=web.1 connect=0ms service=2ms status=200 bytes=22080 protocol=https
2021-10-24T20:16:31.587192+00:00 heroku[router]: at=info method=GET path="/favicon.ico" host=demo-ushouse.herokuapp.com request_id=026f2bef-2245-433c-8863-fd3882a13ab7
fwd="96.245.161.111" dyno=web.1 connect=0ms service=1ms status=200 bytes=303 protocol=https
```

☒ Autoscroll with output Save

Here is the result

demo-ushouse.herokuapp.com

House Price Calculator

Input average income in area


Input average area house age in area

Input average number of rooms in area

Input average number of bedrooms in area

Input Area Population

Predict House Price

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Input some example numbers:

demo-ushouse.herokuapp.com

Youtube To Mp3 Co... Env Firms Bao's website Data Science Stuff VietstockFinance ... PostgreSQL LAG() F... Odin Projects Docker Other bookmarks

House Price Calculator

Input average income in area


Input average area house age in area

Input average number of rooms in area

Input average number of bedrooms in area

Input Area Population

Predict House Price

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House Price should be \$ 7,945,983.99