

Week 5: Model Deployment on Flask

Internship Batch LISUM37

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Data Information

Tabular data details: Medical_insurance

Total number of observations	2772
Total number of files	1
Total number of features	7
Base format of the file	.csv
Size of the data	0.112 MB

Introduction

The aim of the project was to deploy a Linear Regression model that would predict the charges insurance client would pay given certain variables.

Building the Model

```
In [1]: # import necessary libraries
import pandas as pd
import pickle
from sklearn.model_selection import train_test_split
from sklearn.linear_model import LinearRegression
```

```
In [2]: # import data
data = pd.read_csv('Medical_insurance.csv')
```

```
In [3]: data.head()
```

```
Out[3]:
```

	age	sex	bmi	children	smoker	region	charges
0	19	female	27.900	0	yes	southwest	16884.92400
1	18	male	33.770	1	no	southeast	1725.55230
2	28	male	33.000	3	no	southeast	4449.46200
3	33	male	22.705	0	no	northwest	21984.47061
4	32	male	28.880	0	no	northwest	3866.85520

```
In [4]: data.describe()
```

```
Out[4]:
```

	age	bmi	children	charges
count	2772.000000	2772.000000	2772.000000	2772.000000
mean	39.109668	30.701349	1.101732	13261.369959
std	14.081459	6.129449	1.214806	12151.768945
min	18.000000	15.960000	0.000000	1121.873900
25%	26.000000	26.220000	0.000000	4687.797000
50%	39.000000	30.447500	1.000000	9333.014350
75%	51.000000	34.770000	2.000000	16577.779500
max	64.000000	53.130000	5.000000	63770.428010

```
In [6]: # Data Preprocessing
from sklearn.preprocessing import LabelEncoder

In [7]: encode = LabelEncoder()

In [8]: data['sex'] = encode.fit_transform(data['sex'])
data['smoker'] = encode.fit_transform(data['smoker'])
data['region'] = encode.fit_transform(data['region'])

In [9]: data
```

```
Out[9]:
```

	age	sex	bmi	children	smoker	region	charges
0	19	0	27.900	0	1	3	16884.92400
1	18	1	33.770	1	0	2	1725.55230
2	28	1	33.000	3	0	2	4449.46200
3	33	1	22.705	0	0	1	21984.47061
4	32	1	28.880	0	0	1	3866.85520
...
2767	47	0	45.320	1	0	2	8569.86180
2768	21	0	34.600	0	0	3	2020.17700
2769	19	1	26.030	1	1	1	16450.89470
2770	23	1	18.715	0	0	1	21595.38229
2771	54	1	31.600	0	0	3	9850.43200

2772 rows x 7 columns

Create the x and y data necessary for the regression model

```
In [15]: x = data.drop('charges', axis=1)
y = data['charges']
```

```
In [16]: x
```

```
Out[16]:
```

	age	sex	bmi	children	smoker	region
0	19	0	27.900	0	1	3
1	18	1	33.770	1	0	2
2	28	1	33.000	3	0	2
3	33	1	22.705	0	0	1
4	32	1	28.880	0	0	1
...
2767	47	0	45.320	1	0	2
2768	21	0	34.600	0	0	3
2769	19	1	26.030	1	1	1
2770	23	1	18.715	0	0	1
2771	54	1	31.600	0	0	3

2772 rows x 6 columns

```
In [17]: y
```

```
Out[17]:
```

0	16884.92400
1	1725.55230
2	4449.46200
3	21984.47061
4	3866.85520
...	...
2767	8569.86180
2768	2020.17700
2769	16450.89470
2770	21595.38229
2771	9850.43200

Name: charges, Length: 2772, dtype: float64

Save model and pickle it

```
In [15]: x_train, x_test, y_train, y_test = train_test_split(x, y, test_size=0.3, random_state=101)
```

```
In [16]: print(x_train.shape, x_test.shape)
print(y_train.shape, y_test.shape)

(1940, 6) (832, 6)
(1940,) (832,)
```

```
In [17]: regression = LinearRegression()
regression.fit(x_train, y_train)
```

```
Out[17]: LinearRegression()
```

```
In [18]: pickle.dump(regression, open('model.pickle', 'wb'))
```

Create the Index HTML file

```
<!DOCTYPE html>

<head>
    <meta charset="UTF-8">
    <title>ML API</title>
    <link href='https://fonts.googleapis.com/css?family=Pacifico' rel="stylesheet" type="text/css">
    <link href='https://fonts.googleapis.com/css?family=Arimio' rel="stylesheet" type="text/css">
    <link href='https://fonts.googleapis.com/css?family=Mind:300' rel="stylesheet" type="text/css">
    <link href='https://fonts.googleapis.com/css?family=Open+Sans+Condensed:300' rel="stylesheet" type="text/css">
    <link rel="stylesheet" href="{{ url_for('static', filename='css/style.css')}}">
</head>

<body>
    <div class='login'>
        <h1>Predict Insurance Charges</h1>
        <!-- Main input for receiving query to our ML-->
        <form action="/predict" method="post">
            <input type='text' name='age' placeholder='income' required='required' />
            <input type='text' name='sex' placeholder='sex' required='required' />
            <input type='text' name='bmi' placeholder='bmi' required='required' />
            <input type='text' name='children' placeholder='children' required='required' />
            <input type='text' name='smoker' placeholder='smoker' required='required' />
            <input type='text' name='region' placeholder='region' required='required' />

            <button type="submit" class="btn btn-primary btn-block btn-large">Predict</button>
        </form>
        <br>
        <br>
        {{ prediction_text }}
    </div>
</body>
```

Create the Flask app

```
# Using flask app to make an api
# import necessary libraries
from flask import Flask, jsonify, request, render_template
import pickle
import pandas as pd
from sklearn.preprocessing import LabelEncoder

# create a Flask app
app = Flask(__name__)

|

@app.route('/') # , methods=['GET', 'POST'])
def home():
    return render_template('index.html')

@app.route('/predict', methods=['POST'])
def price_predict():
    model = pickle.load(open('model.pickle', 'rb'))
    age = request.form.get('age')
    sex = request.form.get('sex')
    bmi = request.form.get('bmi')
    children = request.form.get('children')
    smoker = request.form.get('smoker')
    region = request.form.get('region')
    encoder = LabelEncoder()

    test_df = pd.DataFrame({'age': [age], 'sex': [sex], 'bmi': [bmi], 'children': [children], 'smoker': [smoker],
                             'region': [region]})
    test_df['sex'] = encoder.fit_transform(test_df['sex'])
    test_df['smoker'] = encoder.fit_transform(test_df['smoker'])
    test_df['region'] = encoder.fit_transform(test_df['region'])
    pred_price = model.predict(test_df)
    output = round(pred_price[0], 2)
    return render_template('index.html', prediction_text='Charges should be ${}'.format(output))

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

Upload app to Github repository

The screenshot shows the GitHub web interface for a repository named 'cloud_app' owned by 'maichmarc'. The repository is public and has 0 stars, 0 forks, and 1 watcher. The main branch is 'main'. The repository contains several files and folders, including 'static/css', 'templates', 'LICENSE', 'Medical_insurance.csv', 'Model Deployment repor...', 'Procfle', 'README.md', 'Regression Insurance.ipynb', 'flask_app.py', 'model.pickle', and 'requirements.txt'. The 'README.md' file is selected, showing the repository name 'cloud_app' in a large font. The right sidebar contains sections for 'About', 'Releases', 'Packages', 'Deployments', and 'Languages'. The 'Deployments' section shows a deployment named 'demo-heroku-app' from yesterday, with a link to '+ 6 deployments'.

github.com/maichmarc/cloud_app/tree/main

maichmarc / cloud_app

<> Code Issues Pull requests Actions Projects Wiki Security Insights

cloud_app Public Pin Unwatch 1 Fork 0 Star 0

main Go to file + <> Code About

maichmarc Update index.html 91b0a8a · yesterday

static/css	Add files via upload	yesterday
templates	Update index.html	yesterday
LICENSE	Initial commit	yesterday
Medical_insurance.csv	Add files via upload	yesterday
Model Deployment repor...	Add files via upload	yesterday
Procfle	Add files via upload	yesterday
README.md	Initial commit	yesterday
Regression Insurance.ipynb	Add files via upload	yesterday
flask_app.py	Add files via upload	yesterday
model.pickle	Add files via upload	yesterday
requirements.txt	requirements.txt	yesterday

README MIT license

cloud_app

About

No description, website, or topics provided.

- Readme
- MIT license
- Activity
- 0 stars
- 1 watching
- 0 forks

Releases

No releases published
[Create a new release](#)

Packages

No packages published
[Publish your first package](#)

Deployments 7

demo-heroku-app yesterday
[+ 6 deployments](#)

Languages

Connect Heroku to Github

The screenshot shows the Heroku dashboard for an application named 'demo-heroku-app'. The browser address bar indicates the URL is `dashboard.heroku.com/apps/demo-heroku-app/deploy/github`. The page header includes the Heroku logo and a search bar. Below the header, the application name 'demo-heroku-app' is displayed along with the user 'maichmarc/cloud_app'. A navigation bar contains links for Overview, Resources, Deploy, Metrics, Activity, Access, and Settings. The main content area is divided into two sections. The first section, 'Add this app to a pipeline', provides instructions on how to create a new pipeline or add the app to an existing one. It includes a diagram showing how pipelines connect multiple apps and promote code between them. Below this is a dropdown menu labeled 'Choose a pipeline'. The second section, 'Deployment method', shows three options: Heroku Git (Use Heroku CLI), GitHub (Connected), and Container Registry (Use Heroku CLI). The GitHub option is highlighted with a green checkmark. At the bottom, a section titled 'App connected to GitHub' shows the connection details: 'Connected to maichmarc/cloud_app by maichmarc'. A 'Disconnect...' button is visible next to the connection details.

demo-heroku-app · GitHub | H x +

← → ↻ 📄 dashboard.heroku.com/apps/demo-heroku-app/deploy/github ☆ 🔴 ▶ 📁 | ⬇️ 👤 ⋮

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HEROKU Jump to Favorites, Apps, Pipelines, Spaces... ⋮ 👤

👤 > demo-heroku-app ☆ Open app More ⌵

🔗 maichmarc/cloud_app

Overview Resources **Deploy** Metrics Activity Access Settings

Add this app to a pipeline

Create a new pipeline or choose an existing one and add this app to a stage in it.

Add this app to a stage in a pipeline to enable additional features

Pipelines let you connect multiple apps together and **promote code** between them. [Learn more.](#)

Pipelines connected to GitHub can enable **review apps**, and create apps for new pull requests. [Learn more.](#)

Choose a pipeline ⌵

Deployment method

Heroku Git Use Heroku CLI

GitHub **Connected** ✓

Container Registry Use Heroku CLI

App connected to GitHub

Code diffs, manual and auto deploys are available for this app.


Connected to [maichmarc/cloud_app](#) by [maichmarc](#) Disconnect...

Build the model on Heroku



demo-heroku-app · Build | Heroku



dashboard.heroku.com/apps/demo-heroku-app/activity/builds/1e6...

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 HEROKU

Jump to Favorites, Apps, Pipelines, Spaces...



 demo-heroku-app

☆ Open app More ▾

maichmarc/cloud_app

Overview

Resources

Deploy

Metrics

Activity

Access

Settings

Activity Feed > Build Log ID 1e666ff3-a79d-4733-9f01-8cb25878c7ae

```
-----> Building on the Heroku-22 stack
-----> Using buildpack: heroku/python
-----> Python app detected
-----> No Python version was specified. Using the same version as the last build: python-3.12.7
      To use a different version, see: https://devcenter.heroku.com/articles/python-runtimes
-----> No change in requirements detected, installing from cache
-----> Using cached install of python-3.12.7
-----> Installing pip 24.0, setuptools 70.3.0 and wheel 0.44.0
-----> Installing SQLite3
-----> Installing requirements with pip
-----> Discovering process types
      Procfile declares types -> web
-----> Compressing...
      Done: 150.9M
-----> Launching...
      Released v10
      https://demo-heroku-app-74768593b872.herokuapp.com/ deployed to Heroku
This app is using the Heroku-22 stack, however a newer stack is available.
To upgrade to Heroku-24, see:
https://devcenter.heroku.com/articles/upgrading-to-the-latest-stack
```

Build finished

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Support

Deploy the app on Heroku

The screenshot shows the Heroku dashboard for a project named 'demo-heroku-app'. The browser address bar indicates the URL is 'dashboard.heroku.com/apps/demo-heroku-app/deploy/github'. The page features a search bar at the top with the text 'Jump to Favorites, Apps, Pipelines, Spaces...'. Below this, there's a section for 'Choose a branch to deploy' with a dropdown menu set to 'main'. A checkbox for 'Wait for CI to pass before deploy' is present, with a note that it only applies if a Continuous Integration service is configured. An 'Enable Automatic Deploys' button is also visible. The 'Manual deploy' section on the left explains that it deploys the current state of a branch. The main deployment area shows a 'Deploy a GitHub branch' section with a 'Deploy Branch' button. Below this, a progress list shows four steps: 'Receive code from GitHub', 'Build main 91b0a8a7', 'Release phase', and 'Deploy to Heroku', all of which are marked with green checkmarks. A message at the bottom states 'Your app was successfully deployed.' with a 'View' button.

demo-heroku-app · GitHub | H x +

← → ↺ dashboard.heroku.com/apps/demo-heroku-app/deploy/github ☆ 🔴 ▶ 📁 | ⬇ 👤 ⋮

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HEROKU Jump to Favorites, Apps, Pipelines, Spaces... ⋮ 👤

before you push. [Learn more.](#)

Choose a branch to deploy

🔗 main ⇅

☐ Wait for CI to pass before deploy
Only enable this option if you have a Continuous Integration service configured on your repo.

Enable Automatic Deploys

Manual deploy
Deploy the current state of a branch to this app.

Deploy a GitHub branch
This will deploy the current state of the branch you specify below. [Learn more.](#)

Choose a branch to deploy

🔗 main ⇅ **Deploy Branch**

Receive code from GitHub ✓

Build main 91b0a8a7 ✓

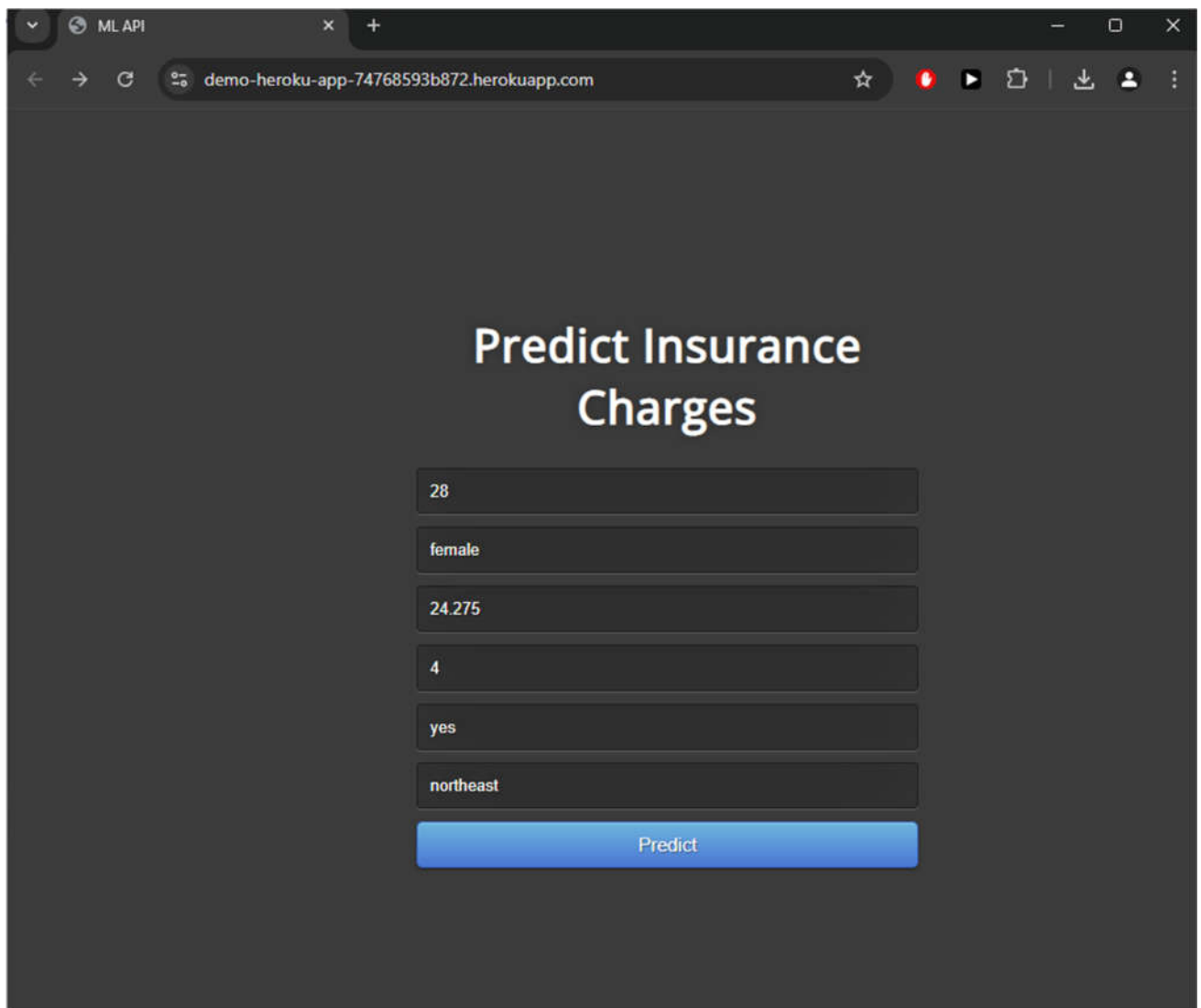
Release phase ✓

Deploy to Heroku ✓

Your app was successfully deployed.

View

Using the url provided by Heroku open the app on browser



The screenshot shows a web browser window with the address bar displaying 'demo-heroku-app-74768593b872.herokuapp.com'. The page has a dark gray background and features the title 'Predict Insurance Charges' in a large, white, sans-serif font. Below the title, there are six input fields stacked vertically, each containing a value: '28', 'female', '24.275', '4', 'yes', and 'northeast'. At the bottom of these fields is a blue button with the text 'Predict' in white. The browser's address bar and tabs are visible at the top, showing 'ML API' as the active tab.

Input Variable	Value
Age	28
Sex	female
Bmi	24.275
NumChildren	4
Smoker	yes
Region	northeast

Input variables

ML API

demo-heroku-app-74768593b872.herokuapp.com/predict

Predict Insurance Charges

age

sex

bmi

children

smoker

region

Predict

Charges should be \$5664.3

Predicted value