Week 4 : Deployment on Flask

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Introduction

In this document, we are going to deploy a simple Machine Learning model using the Flask webserver. As a demonstration, our Machine Learning model will help us classify the variety of flowers based on the length and width of sepals and petals. We will build two simple HTML web pages to accept the measurements as input and classify the variety based on the classification model.

Dataset

When building the Machine Learning model, we will make use of the **IRIS** dataset. This Dataset contains **four features**, length and width of sepals and petals of 50 samples of **three species** of Iris:

- Iris setosa,
- Iris virginica and
- Iris versicolor.

Four features were measured from each sample. They are:

- Sepal Length
- Sepal Width
- Petal Length
- Petal Width.

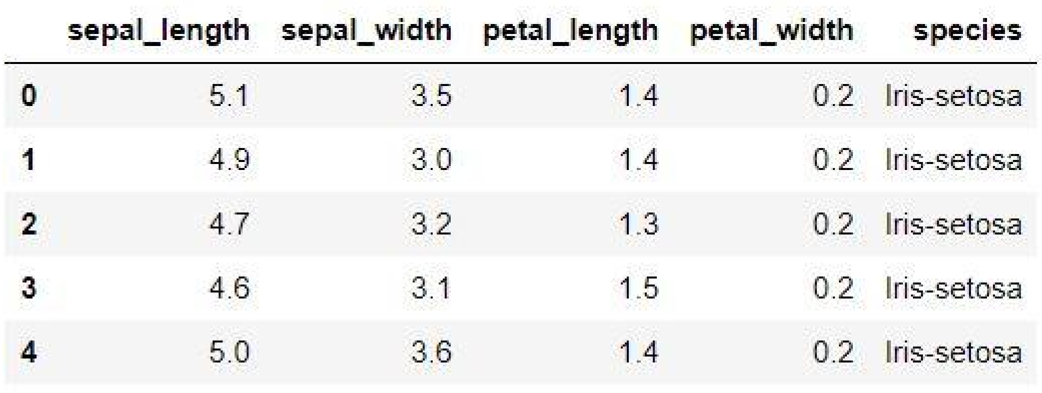
All these four parameters are measured in Centimeters. Based on the combination of these four features, the species among three can be predicted.

Machine Learning Model

Having chosen the dataset, it is time to build our classification model. First, we import the necessary Python libraries to work with for building our model. Here, we use:

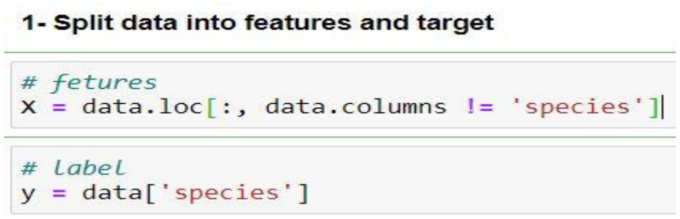
- Pandas
- Numpy
- Sklearn/Sci-kit learn

Next, we read the CSV file of our dataset `IRIS.csv` . As we can see from the following capture, the target variable is in the column ‘**species**’:



	sepal_length	sepal_width	petal_length	petal_width	species
0	5.1	3.5	1.4	0.2	Iris-setosa
1	4.9	3.0	1.4	0.2	Iris-setosa
2	4.7	3.2	1.3	0.2	Iris-setosa
3	4.6	3.1	1.5	0.2	Iris-setosa
4	5.0	3.6	1.4	0.2	Iris-setosa

In order to implement our classification model, we need to separate the independent values (features) from the dependent values (target).

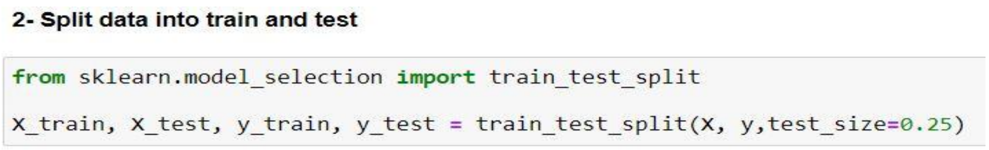


1- Split data into features and target

```
# fetures
X = data.loc[:, data.columns != 'species']
```

```
# label
y = data['species']
```

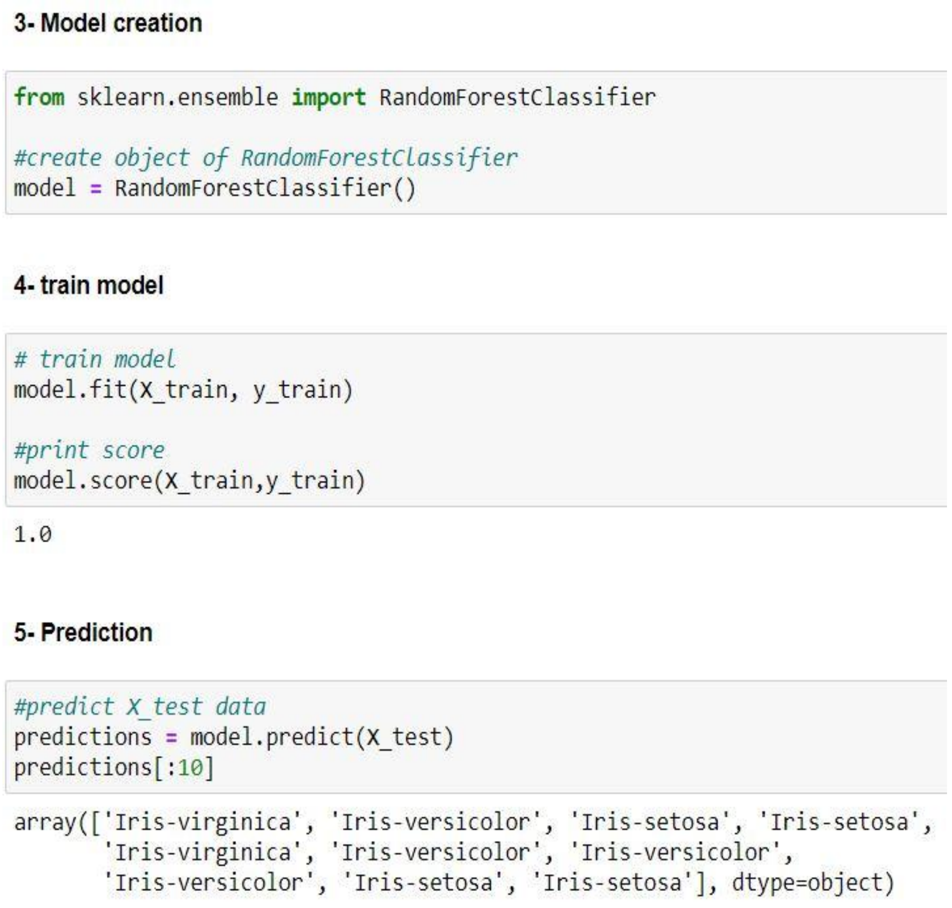
then, we split the data into train and test to train our model:



2- Split data into train and test

```
from sklearn.model_selection import train_test_split

X_train, X_test, y_train, y_test = train_test_split(X, y,test_size=0.25)
```

Next, we initialize the `RandomForestClassifier()` model by calling and creating a python object and assigning it to a variable called `model`. Finally, we fit the features with the target values. This can be done by making use of the `fit()` function. The following capture shows how we use `model` to make prediction:



3- Model creation

```
from sklearn.ensemble import RandomForestClassifier

#create object of RandomForestClassifier
model = RandomForestClassifier()
```

4- train model

```
# train model
model.fit(X_train, y_train)

#print score
model.score(X_train,y_train)
```

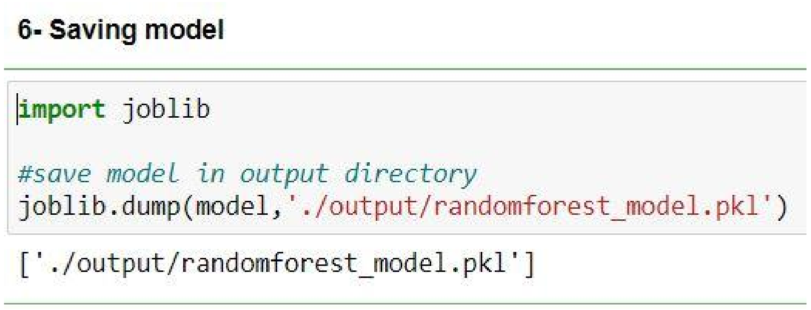
```
1.0
```

5- Prediction

```
#predict X_test data
predictions = model.predict(X_test)
predictions[:10]
```

```
array(['Iris-virginica', 'Iris-versicolor', 'Iris-setosa', 'Iris-setosa',
       'Iris-virginica', 'Iris-versicolor', 'Iris-versicolor',
       'Iris-versicolor', 'Iris-setosa', 'Iris-setosa'], dtype=object)
```

Now, our random forest model classifies the species based on the above-pre-processed input. The last thing we need to add is to save the model before using it in the deployment process. To do so, we are using the joblib model to serialize python objects. `joblib.dump()` will allow us to save the object on disk.



6- Saving model

```
import joblib

#save model in output directory
joblib.dump(model,'./output/randomforest_model.pkl')
```

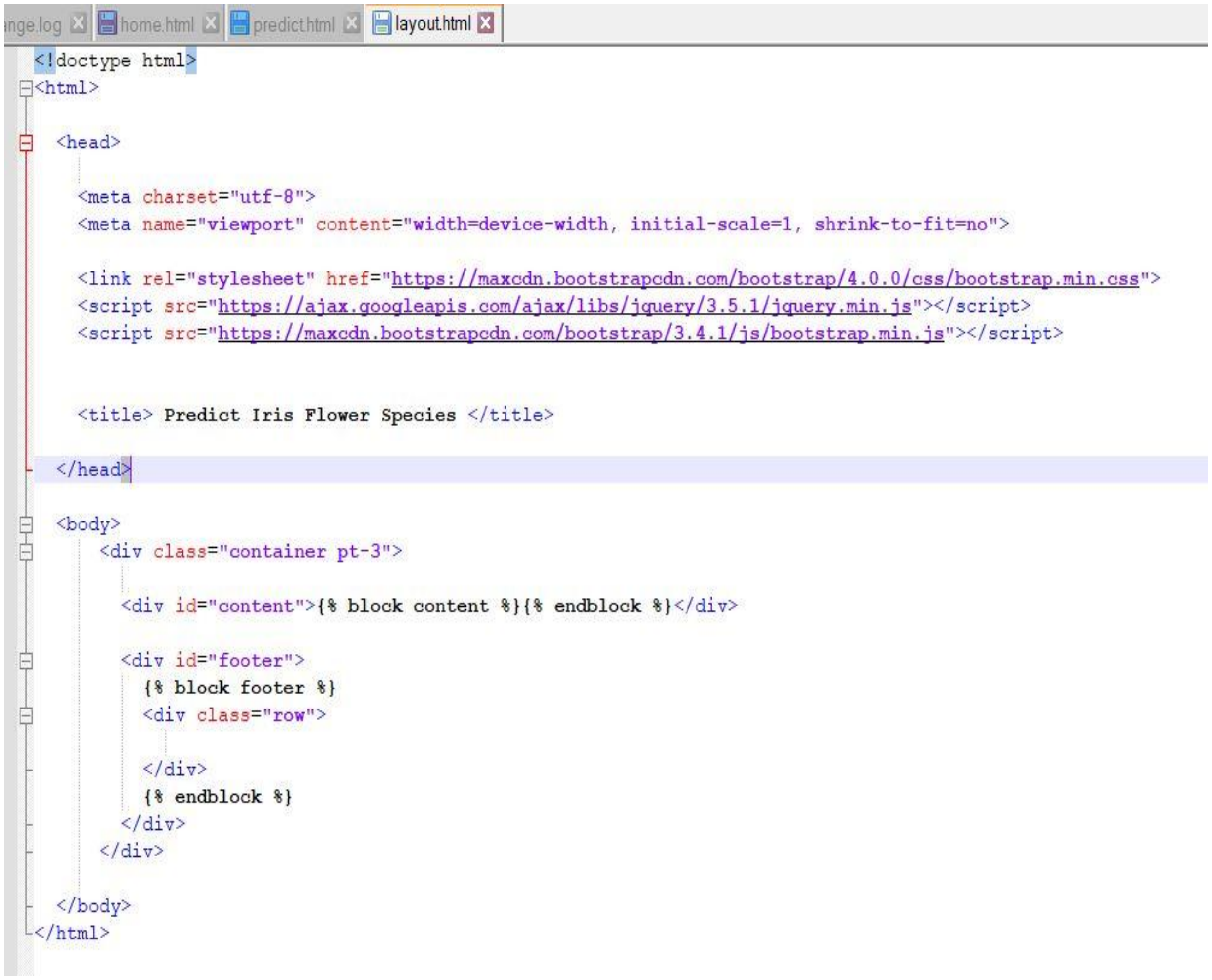
```
['./output/randomforest_model.pkl']
```

Deploy Model With Flask Web Framework

Having built our Machine Learning model, now let’s build a simple form using HTML to accept the inputs from the user. We start by creating a Flask application with an `app.py` file. We create an instance of Flask, load the saved model and pass input data to model and predict.

We will use templates to render HTML which will display in the browser. The views are called by the `render_template()` function. The template files will be stored in the templates directory inside the flask package.

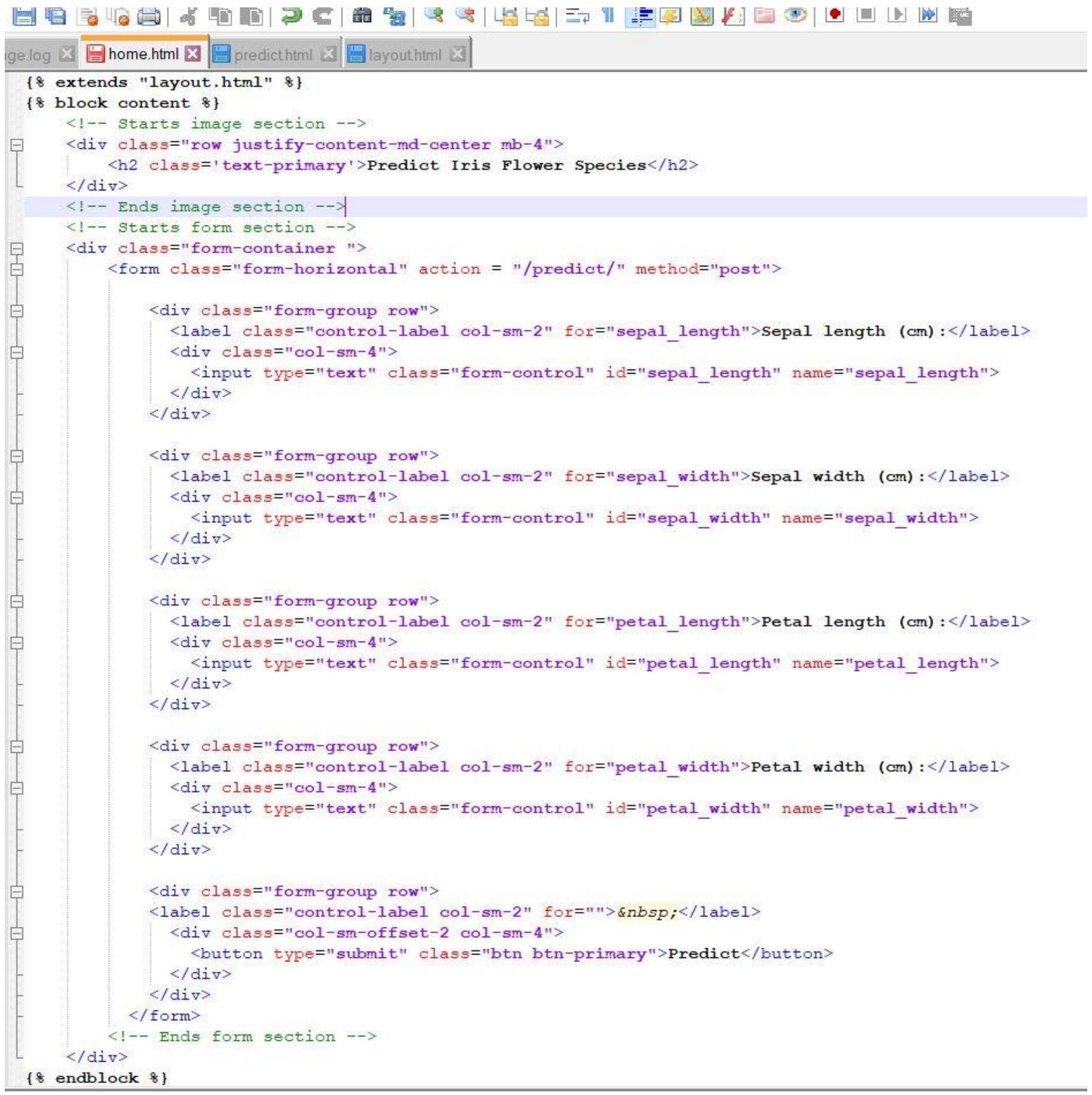
➔ **Create the base layout** : Each page in the application will have the same basic layout around a different body. `layout.html`



```
<!doctype html>
<html>

  <head>

    <meta charset="utf-8">
    <meta name="viewport" content="width=device-width, initial-scale=1, shrink-to-fit=no">

    <link rel="stylesheet" href="https://maxcdn.bootstrapcdn.com/bootstrap/4.0.0/css/bootstrap.min.css">
    <script src="https://ajax.googleapis.com/ajax/libs/jquery/3.5.1/jquery.min.js"></script>
    <script src="https://maxcdn.bootstrapcdn.com/bootstrap/3.4.1/js/bootstrap.min.js"></script>


    <title> Predict Iris Flower Species </title>

  </head>

  <body>
      <div class="container pt-3">

        <div id="content">{% block content %}{% endblock %}</div>

        <div id="footer">
          {% block footer %}
          <div class="row">

          </div>
          {% endblock %}
        </div>
      </div>

  </body>
</html>
```

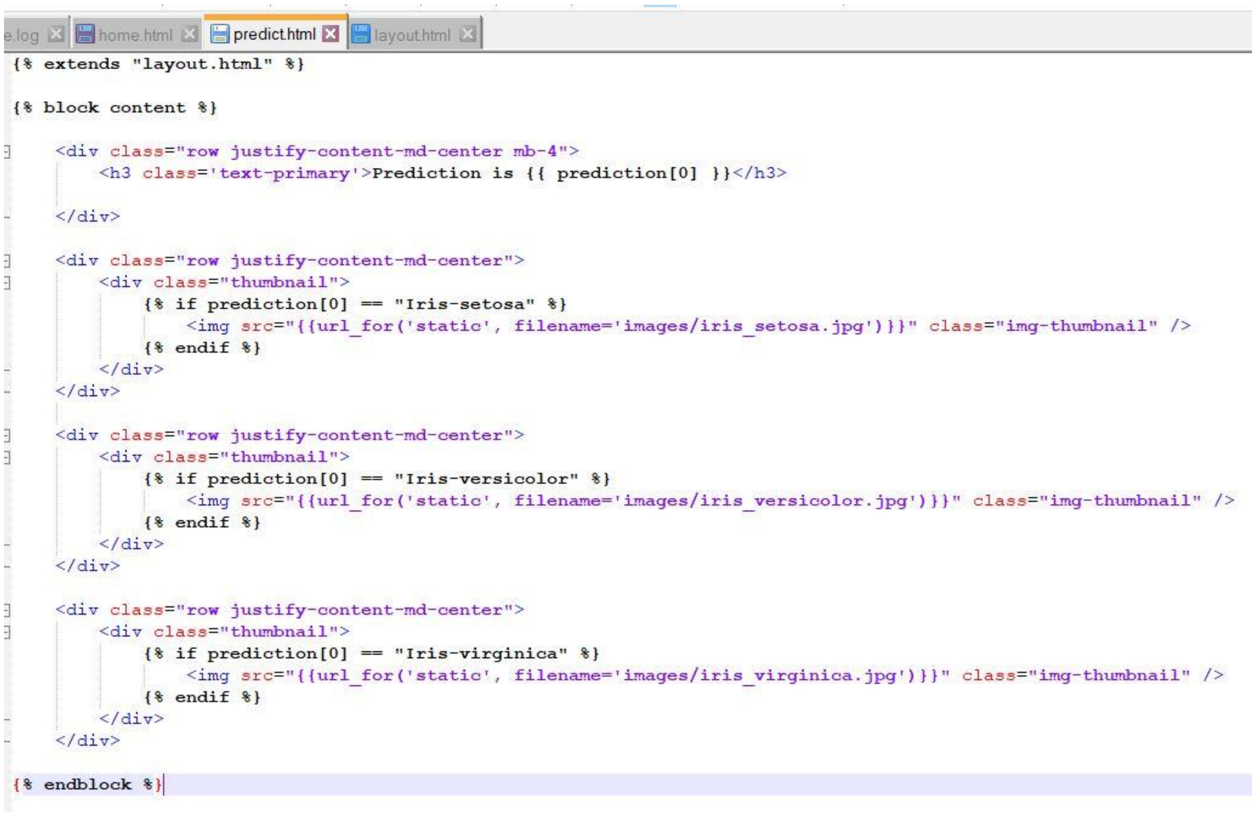
➔ **Add a static file for images** : Create a static folder and inside that images folder. After that keep images of iris flowers, which we are going to display on ‘predict’ page.

➔ **Create home page template** : `home.html`



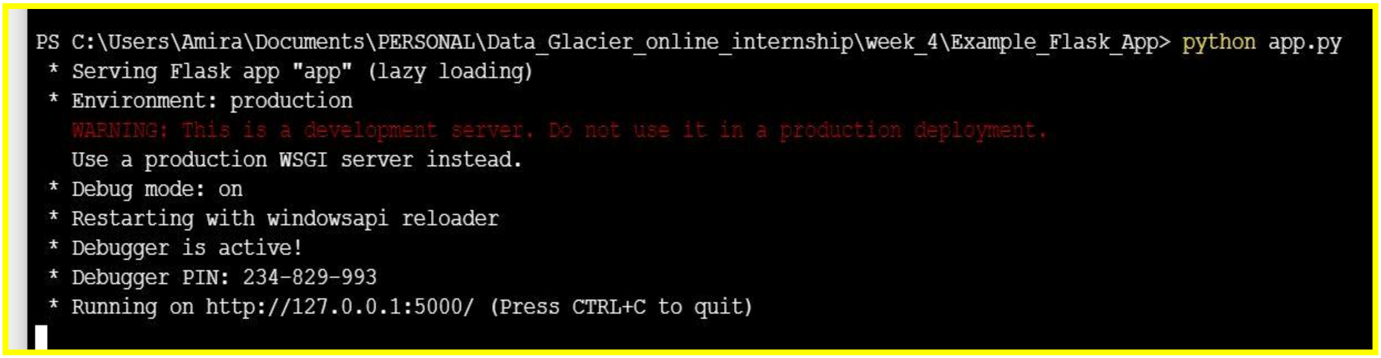
```
{% extends "layout.html" %}
{% block content %}
    <!-- Starts image section -->
    <div class="row justify-content-md-center mb-4">
        <h2 class='text-primary'>Predict Iris Flower Species</h2>
    </div>
    <!-- Ends image section -->
    <!-- Starts form section -->
    <div class="form-container ">
        <form class="form-horizontal" action = "/predict/" method="post">

            <div class="form-group row">
              <label class="control-label col-sm-2" for="sepal_length">Sepal length (cm):</label>
              <div class="col-sm-4">
                <input type="text" class="form-control" id="sepal_length" name="sepal_length">
              </div>
            </div>

            <div class="form-group row">
              <label class="control-label col-sm-2" for="sepal_width">Sepal width (cm):</label>
              <div class="col-sm-4">
                <input type="text" class="form-control" id="sepal_width" name="sepal_width">
              </div>
            </div>

            <div class="form-group row">
              <label class="control-label col-sm-2" for="petal_length">Petal length (cm):</label>
              <div class="col-sm-4">
                <input type="text" class="form-control" id="petal_length" name="petal_length">
              </div>
            </div>

            <div class="form-group row">
              <label class="control-label col-sm-2" for="petal_width">Petal width (cm):</label>
              <div class="col-sm-4">
                <input type="text" class="form-control" id="petal_width" name="petal_width">
              </div>
            </div>

            <div class="form-group row">
            <label class="control-label col-sm-2" for="">&nbsp;</label>
              <div class="col-sm-offset-2 col-sm-4">
                <button type="submit" class="btn btn-primary">Predict</button>
              </div>
            </div>
          </form>
        <!-- Ends form section -->
    </div>
{% endblock %}
```

➔ **Create a page for prediction** : When we submit a form from the home page, it will go to /predict/ url. `predict.html`


e.log | home.html | predict.html | layout.html

```
{% extends "layout.html" %}

{% block content %}

    <div class="row justify-content-md-center mb-4">
        <h3 class='text-primary'>Prediction is {{ prediction[0] }}</h3>

    </div>

    <div class="row justify-content-md-center">
        <div class="thumbnail">
            {% if prediction[0] == "Iris-setosa" %}
                <img src="{{url_for('static', filename='images/iris_setosa.jpg')}}" class="img-thumbnail" />
            {% endif %}
        </div>
    </div>

    <div class="row justify-content-md-center">
        <div class="thumbnail">
            {% if prediction[0] == "Iris-versicolor" %}
                <img src="{{url_for('static', filename='images/iris_versicolor.jpg')}}" class="img-thumbnail" />
            {% endif %}
        </div>
    </div>

    <div class="row justify-content-md-center">
        <div class="thumbnail">
            {% if prediction[0] == "Iris-virginica" %}
                <img src="{{url_for('static', filename='images/iris_virginica.jpg')}}" class="img-thumbnail" />
            {% endif %}
        </div>
    </div>

{% endblock %}
```

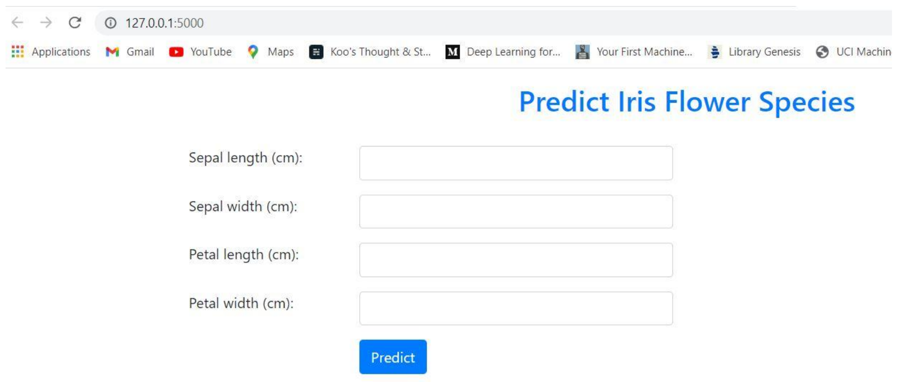
➔ **Run the server**: `python app.py`



```
PS C:\Users\Amira\Documents\PERSONAL\Data_Glacier_online_internship\week_4\Example_Flask_App> python app.py
 * Serving Flask app "app" (lazy loading)
 * 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 windowsapi reloader
 * Debugger is active!
 * Debugger PIN: 234-829-993
 * Running on http://127.0.0.1:5000/ (Press CTRL+C to quit)
```

Run the Flask Application

➔ **Check url:** http://127.0.0.1:5000/



Predict Iris Flower Species

Sepal length (cm):

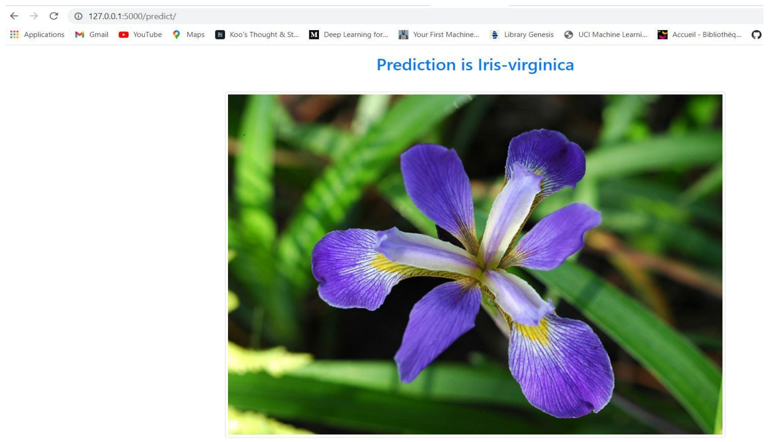
Sepal width (cm):

Petal length (cm):

Petal width (cm):

Predict

➔ **Check url:** http://127.0.0.1:5000/predict/



Prediction is Iris-virginica