AD campaign recommender

CAPSTONE – 01

Model Deployment

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Source code – Flask App

app.py

```python
import pickle
mdl_gender = pickle.load(open("final_model_gender.pkl","rb"))
mdl_age_group = pickle.load(open("final_model_age_group.pkl","rb"))
test_data_gender = pickle.load(open("test_data_gender.pkl","rb"))
test_data_age_group = pickle.load(open("test_data_age_group.pkl","rb"))

test_data_gender.columns = ["DeviceID", "Gender", "AgeGroup", "TravellerType", "HighLevelCategory", "Cluster", "EventCount", "MobilePhoneBrand", "DeviceModel", "TrainTestFlag"]

test_data_age_group.columns = ['DeviceID', 'Gender', 'AgeGroup', 'TravellerType', 'HighLevelCategory',
    'Cluster', 'EventCount', 'MobilePhoneBrand', 'DeviceModel',
    'TrainTestFlag']

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


app =Flask(__name__)


@app.route("/")
def homepage():
    device_ids = test_data_gender["DeviceID"].values
    return render_template('index.html', device_ids=device_ids)
```

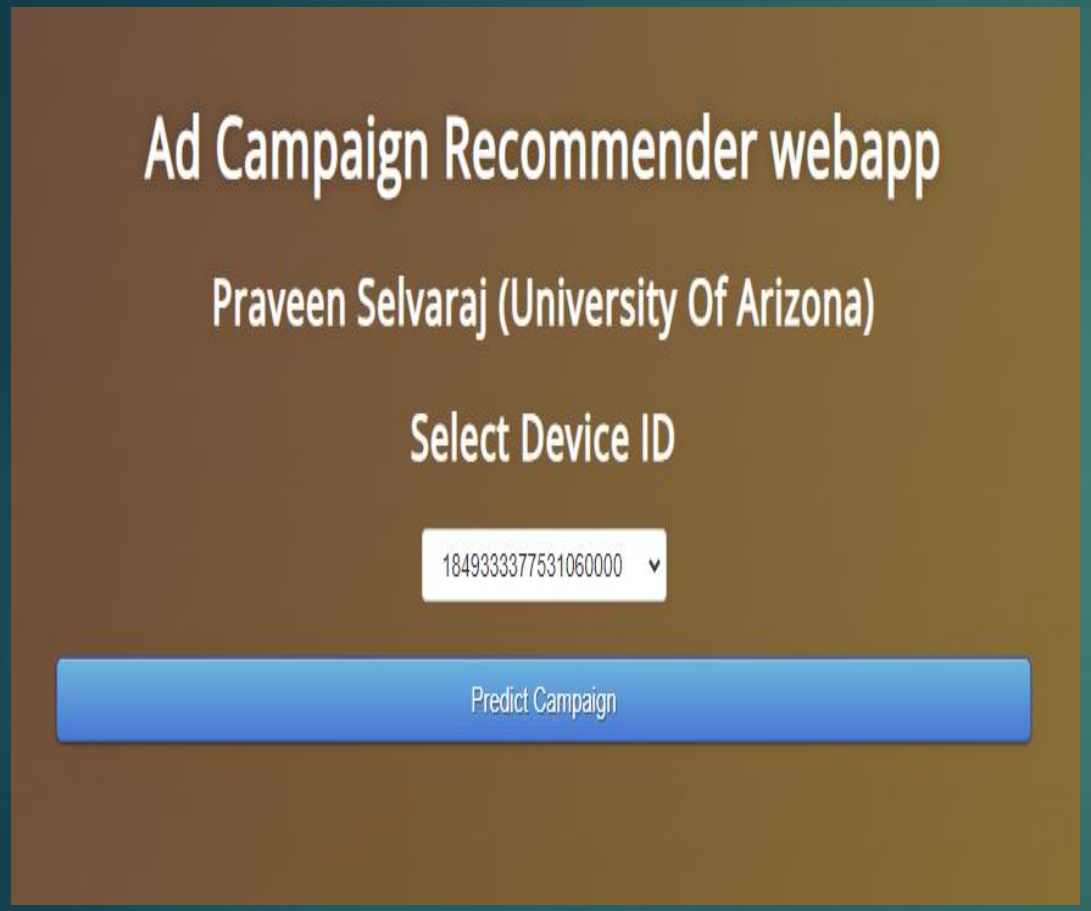
```python
@app.route("/recommend_campaign",methods=['POST'])
def predict():
    def select_campaign(gender,age_group):
        campaign={
            "Female":[("Campaign 1","Specific personalized fashion-related campaigns targeting female customers."),
                      ("Campaign 2","Specific cashback offers on special days [for example, International Women's Day] targeting female customers.")],
            "Male":[
                      ("Campaign 3","Personalized call and data packs targeting male customers.")],

            "0-24":
                      [("Campaign 4","Bundled smartphone offers for the age group 0-24 years.")],
                    "25-32" : [("Campaign 5","Special offers for payment wallet offers - those in the age group of 25-32 years.")],
                    "33-45":[ ("Campaign 6","Special cashback offers for Privilege Membership 33-45 years.")],
                    "46+":[ ("Campaign 6","Special cashback offers for Older Customers [46+] years.")]


                  }
        final=""
        for cmp in campaign[gender]:
            final = final + cmp[0] + " - " + cmp[1] + "\n"
        for cmp in campaign[age_group]:
            final = final + cmp[0] + " - " + cmp[1] + "\n"
        return final


    device_id=[int(x) for x in request.form.values()][0]


    X_gender=test_data_gender[test_data_gender["DeviceID"]==device_id].drop(["DeviceID","Gender","AgeGroup","TrainTestFlag"],axis=1).iloc[0,:]
    X_age_group=test_data_age_group[test_data_age_group["DeviceID"]==device_id].drop(["DeviceID","Gender","AgeGroup","TrainTestFlag"],axis=1).iloc[0,:]
    gender="Female" if mdl_gender.predict(X_gender.values.reshape(1, -1))[0] == 0 else "Male"

    age_group_predicted=mdl_age_group.predict(X_age_group.values.reshape(1, -1))[0]
    age_group = "0-24" if age_group_predicted == 0 else "25-32" if age_group_predicted == 1 else "33-45" if age_group_predicted == 2 else "46+"

    campaign=select_campaign(gender,age_group)
    result_var = [device_id, gender, age_group, campaign]

    return render_template("index.html", prediction_text = result_var)
```

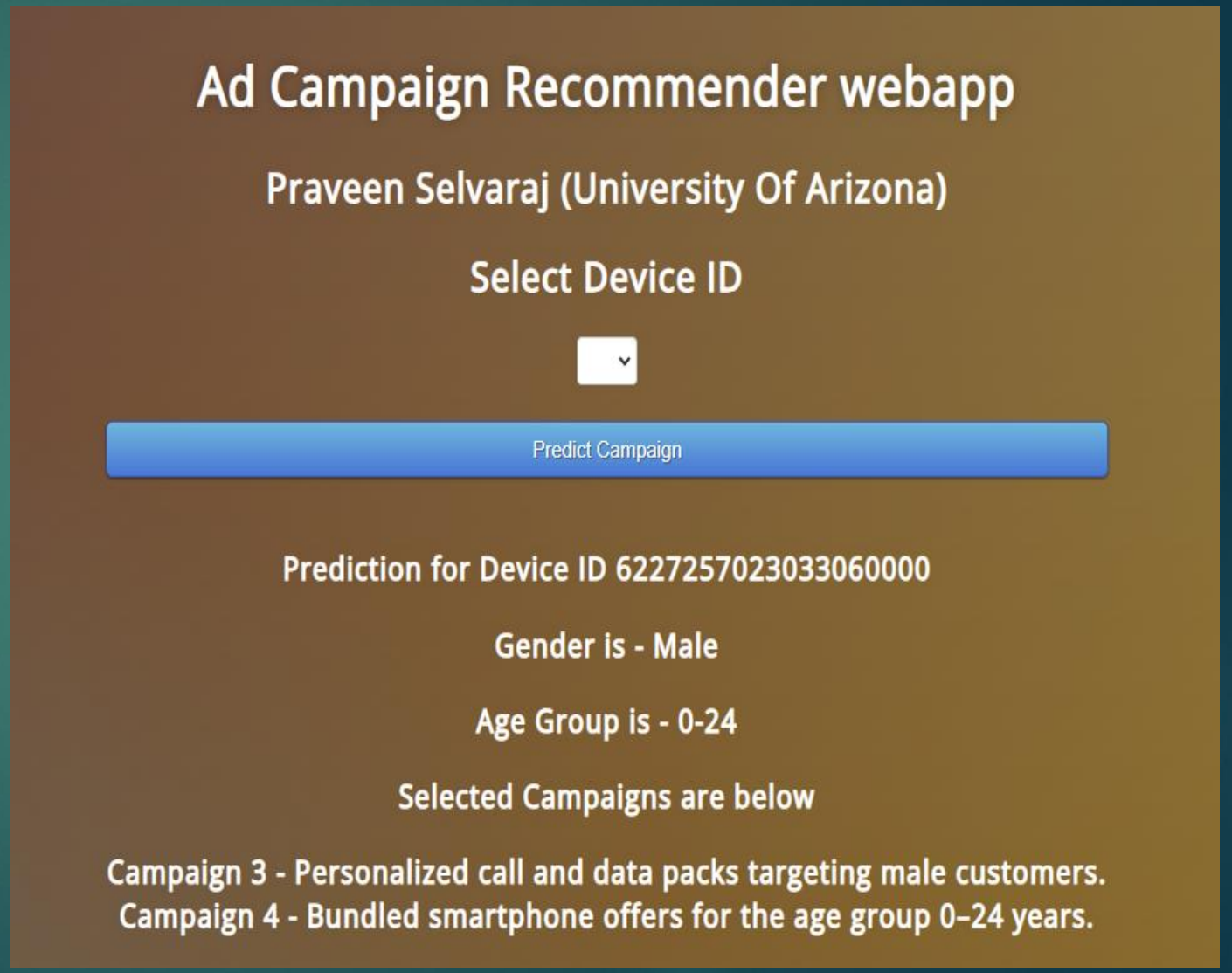
Source code – Flask App

index.html

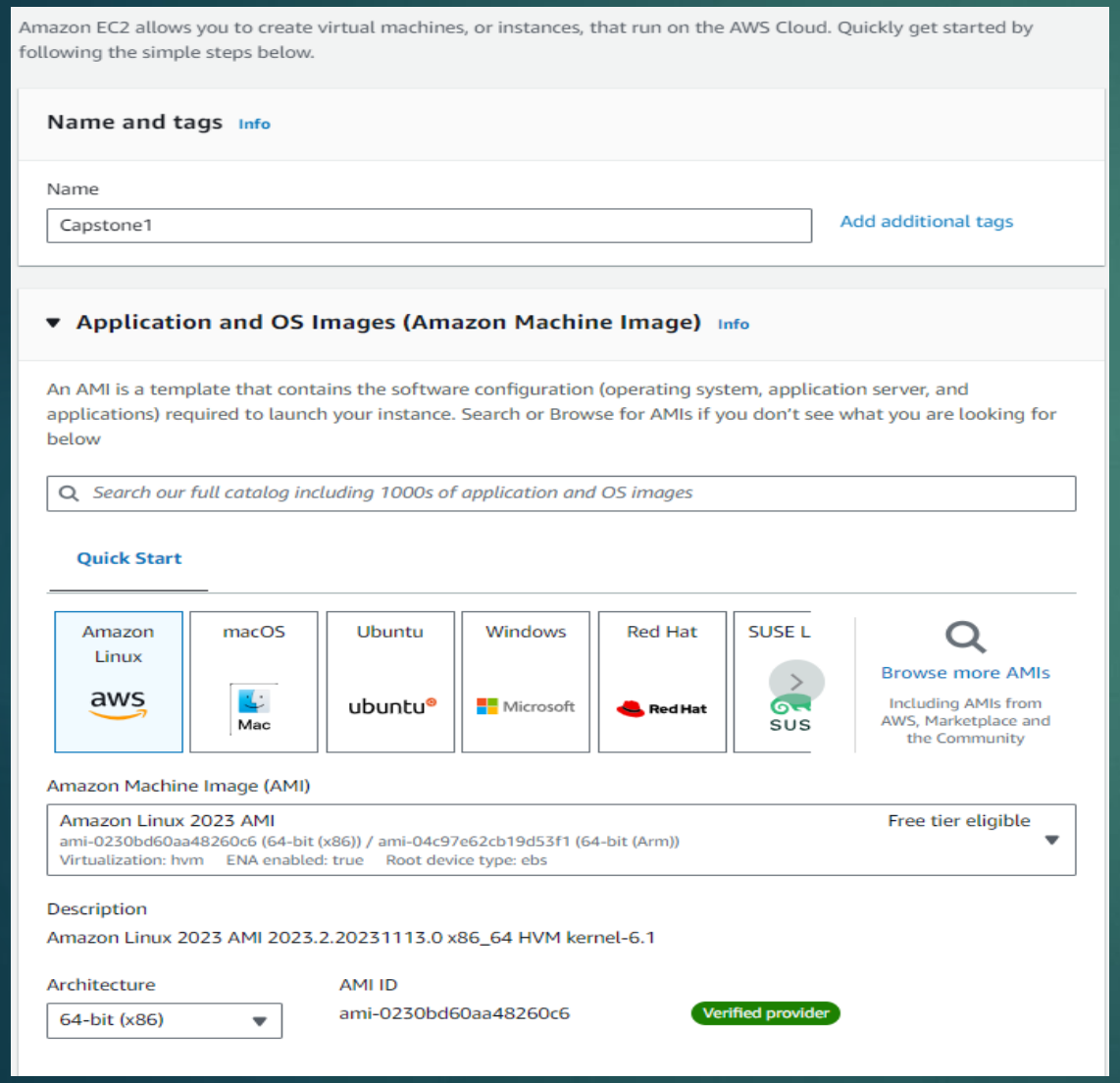
```
<!DOCTYPE html>
<html >
<!--From https://codepen.io/frytyler/pen/EGdtg-->
<head>
  <meta charset="UTF-8">
  <title>ML Classification Regression API</title>
  <link href='https://fonts.googleapis.com/css?family=Pacifico' rel='stylesheet' type='text/css'>
<link href='https://fonts.googleapis.com/css?family=Arimo' rel='stylesheet' type='text/css'>
<link href='https://fonts.googleapis.com/css?family=Hind: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>

<!--------Do not touch the above code---->

<body>
 <div class="login">
    <h1>Ad Campaign Recommender webapp </h1>
    <h2>Praveen Selvaraj (University Of Arizona)</h2>
     <!-- Main Input For Receiving Query to our ML -->

<h2>Select Device ID</h2>    <form action="{{ url_for('predict')}}"method="post">


<select class="custom-select" name="device_id">
            {% for device_id in device_ids %}
            <option value="{{ device_id }}">{{ device_id }}</option>
            {% endfor %}
        </select>
       <br><br> <button type="submit" class="btn btn-primary btn-block btn-large">Predict Campaign</button>
    </form>

   <br>

   {% for each in prediction_text %}
       {% if loop.index0 == 0 %}
         <h3>Prediction for Device ID {{ prediction_text[0] }}</h2>
       {% endif %}
       {% if loop.index0 == 1 %}
         <h3>Gender is - {{ prediction_text[1] }}</h3>
       {% endif %}
       {% if loop.index0 == 2 %}
         <h3>Age Group is - {{ each }}</h3>
       {% endif %}
       {% if loop.index0 == 3 %}
         <h3>Selected Campaigns are below</h3>
         <h3>{{ prediction_text[3] }}</h3>
       {% endif %}
   {% endfor %}


 </div>


</body>
</html>
```

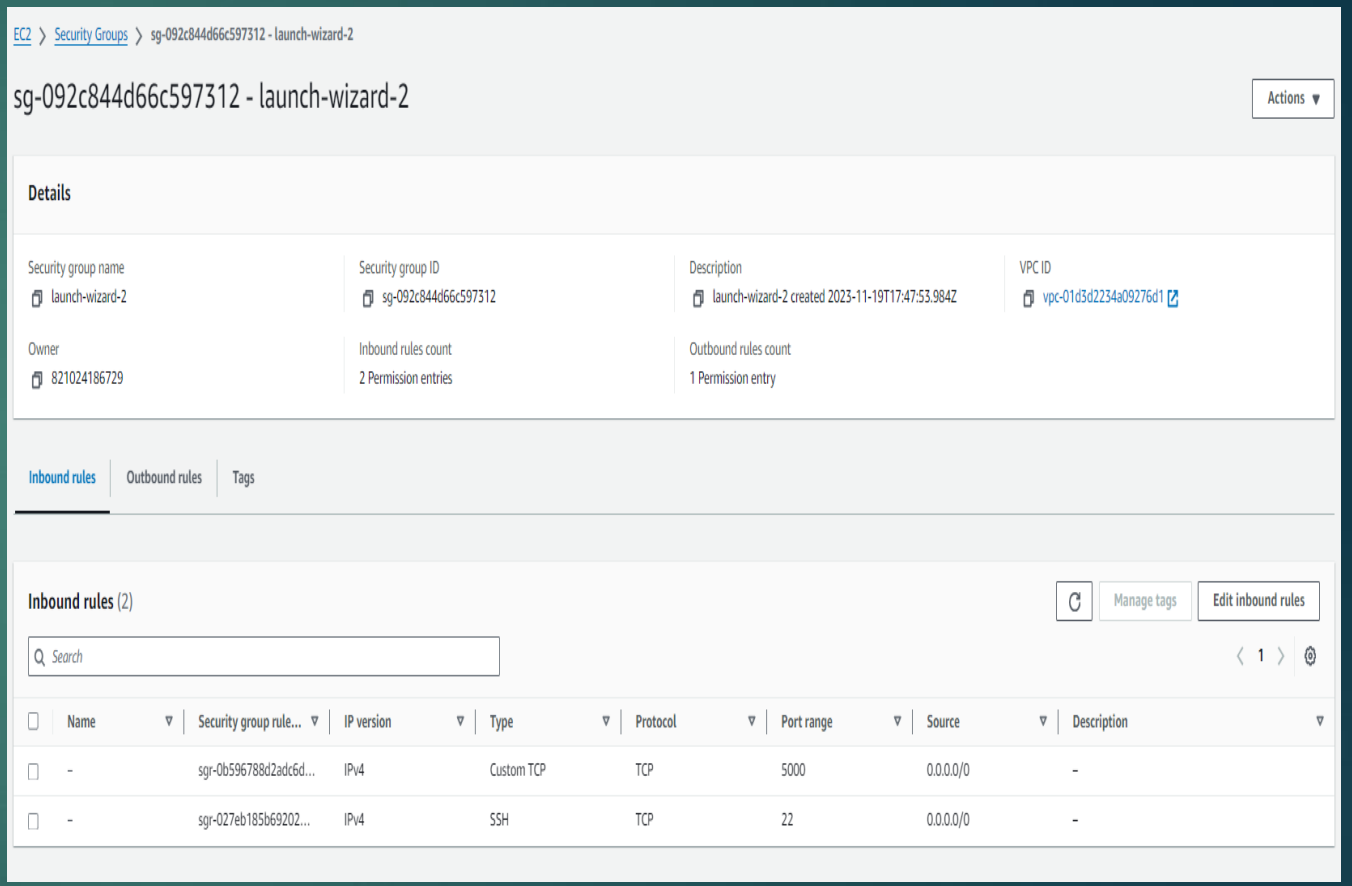
Flask Application - page





EC2 Instance and Security Group





Connect to EC2 Instance and Install Docker

```
   ,     #_
   ~\_  ####_        Amazon Linux 2023
  ~~  \_#####\
  ~~     \###|
  ~~       \#/ ___   https://aws.amazon.com/linux/amazon-linux-2023
   ~~       V~' '->
    ~~~         /
      ~~._.   _/
         _/ _/
       _/m/'
[ec2-user@ip-172-31-47-238 ~]$ sudo yum install docker
Last metadata expiration check: 0:03:54 ago on Sun Nov 19 17:50:38 2023.
Dependencies resolved.
================================================================================================================
 Package                        Architecture        Version                        Repository             Size
================================================================================================================
Installing:
 docker                         x86_64              24.0.5-1.amzn2023.0.2          amazonlinux            42 M
Installing dependencies:
 containerd                     x86_64              1.7.2-1.amzn2023.0.4           amazonlinux            34 M
 iptables-libs                  x86_64              1.8.8-3.amzn2023.0.2           amazonlinux           401 k
 iptables-nft                   x86_64              1.8.8-3.amzn2023.0.2           amazonlinux           183 k
 libcgroup                      x86_64              3.0-1.amzn2023.0.1             amazonlinux            75 k
 libnetfilter_conntrack         x86_64              1.0.8-2.amzn2023.0.2           amazonlinux            58 k
 libnfnetlink                   x86_64              1.0.1-19.amzn2023.0.2          amazonlinux            30 k
 libnftnl                       x86_64              1.2.2-2.amzn2023.0.2           amazonlinux            84 k
 pigz                           x86_64              2.5-1.amzn2023.0.3             amazonlinux            83 k
 runc                           x86_64              1.1.7-1.amzn2023.0.3           amazonlinux           3.0 M

Transaction Summary
================================================================================================================
Install  10 Packages

Total download size: 80 M
Installed size: 306 M
Is this ok [y/N]: y
Downloading Packages:
(1/10): libnetfilter_conntrack-1.0.8-2.amzn2023.0.2.x86_64.rpm          889 kB/s |  58 kB     00:00
(2/10): libcgroup-3.0-1.amzn2023.0.1.x86_64.rpm                         1.0 MB/s |  75 kB     00:00
(3/10): iptables-libs-1.8.8-3.amzn2023.0.2.x86_64.rpm                    10 MB/s | 401 kB     00:00
(4/10): libnfnetlink-1.0.1-19.amzn2023.0.2.x86_64.rpm                   1.6 MB/s |  30 kB     00:00
(5/10): libnftnl-1.2.2-2.amzn2023.0.2.x86_64.rpm                        2.3 MB/s |  84 kB     00:00
(6/10): iptables-nft-1.8.8-3.amzn2023.0.2.x86_64.rpm                    3.7 MB/s | 183 kB     00:00
(9/10): docker-24.0.5-1.amzn2023.0.2.x86_64.rpm                          28 MB/s |  42 MB     00:01
(10/10): containerd-1.7.2-1.amzn2023.0.4.x86_64.rpm                      21 MB/s |  34 MB     00:01
----------------------------------------------------------------------------------------------------------------
Total                                                                    42 MB/s |  80 MB     00:01
Running transaction check
Transaction check succeeded.
Running transaction test
Transaction test succeeded.
Running transaction
  Preparing        :                                                                               1/1
  Installing       : runc-1.1.7-1.amzn2023.0.3.x86_64                                              1/10
  Installing       : containerd-1.7.2-1.amzn2023.0.4.x86_64                                        2/10
  Running scriptlet: containerd-1.7.2-1.amzn2023.0.4.x86_64                                        2/10
  Installing       : pigz-2.5-1.amzn2023.0.3.x86_64                                                3/10
  Installing       : libnftnl-1.2.2-2.amzn2023.0.2.x86_64                                          4/10
  Installing       : libnfnetlink-1.0.1-19.amzn2023.0.2.x86_64                                     5/10
  Installing       : libnetfilter_conntrack-1.0.8-2.amzn2023.0.2.x86_64                            6/10
  Installing       : iptables-libs-1.8.8-3.amzn2023.0.2.x86_64                                     7/10
  Installing       : iptables-nft-1.8.8-3.amzn2023.0.2.x86_64                                      8/10
  Running scriptlet: iptables-nft-1.8.8-3.amzn2023.0.2.x86_64                                      8/10
  Installing       : libcgroup-3.0-1.amzn2023.0.1.x86_64                                           9/10
  Running scriptlet: docker-24.0.5-1.amzn2023.0.2.x86_64                                          10/10
  Installing       : docker-24.0.5-1.amzn2023.0.2.x86_64                                          10/10
  Running scriptlet: docker-24.0.5-1.amzn2023.0.2.x86_64                                          10/10
Created symlink /etc/systemd/system/sockets.target.wants/docker.socket → /usr/lib/systemd/system/docker.socket.

  Verifying        : runc-1.1.7-1.amzn2023.0.3.x86_64                                              1/10
  Verifying        : libnetfilter_conntrack-1.0.8-2.amzn2023.0.2.x86_64                            2/10
  Verifying        : libcgroup-3.0-1.amzn2023.0.1.x86_64                                           3/10
  Verifying        : docker-24.0.5-1.amzn2023.0.2.x86_64                                           4/10
  Verifying        : iptables-libs-1.8.8-3.amzn2023.0.2.x86_64                                     5/10
  Verifying        : libnfnetlink-1.0.1-19.amzn2023.0.2.x86_64                                     6/10
  Verifying        : libnftnl-1.2.2-2.amzn2023.0.2.x86_64                                          7/10
  Verifying        : iptables-nft-1.8.8-3.amzn2023.0.2.x86_64                                      8/10
  Verifying        : containerd-1.7.2-1.amzn2023.0.4.x86_64                                        9/10
  Verifying        : pigz-2.5-1.amzn2023.0.3.x86_64                                               10/10

Installed:
  containerd-1.7.2-1.amzn2023.0.4.x86_64              docker-24.0.5-1.amzn2023.0.2.x86_64        iptables-libs-1.8.8-3.amzn2023.0.2.x86_64     iptables-nft-1.8.8-3.amzn2023.0.2.x86_64     libcgroup-3.0-1.amzn2023.0.1.x86_64
  libnetfilter_conntrack-1.0.8-2.amzn2023.0.2.x86_64  libnfnetlink-1.0.1-19.amzn2023.0.2.x86_64  libnftnl-1.2.2-2.amzn2023.0.2.x86_64          pigz-2.5-1.amzn2023.0.3.x86_64               runc-1.1.7-1.amzn2023.0.3.x86_64

Complete!
[ec2-user@ip-172-31-47-238 ~]$
```

Start Docker Service

```
[ec2-user@ip-172-31-36-110 MyFlask]$ sudo systemctl status docker
o docker.service - Docker Application Container Engine
     Loaded: loaded (/usr/lib/systemd/system/docker.service; disabled; preset: disabled)
     Active: inactive (dead)
TriggeredBy: o docker.socket
       Docs: https://docs.docker.com

Nov 19 18:38:51 ip-172-31-36-110.ec2.internal systemd[1]: /usr/lib/systemd/system/docker.service:20: Failed to parse resource value, ignoring: inifity
[ec2-user@ip-172-31-36-110 MyFlask]$ sudo systemctl start docker
[ec2-user@ip-172-31-36-110 MyFlask]$ sudo systemctl enable docker
Created symlink /etc/systemd/system/multi-user.target.wants/docker.service → /usr/lib/systemd/system/docker.service.
```

CP files from S3 bucket to EC2 Instance

```
[ec2-user@ip-172-31-36-110 MyFlask]$ aws s3 cp s3://uoamsdsc5bucket1/MyFlask/ ./ --recursive
download: s3://uoamsdsc5bucket1/MyFlask/test_data_age_group.pkl to ./test_data_age_group.pkl
download: s3://uoamsdsc5bucket1/MyFlask/requirements.txt to ./requirements.txt
download: s3://uoamsdsc5bucket1/MyFlask/final_model_gender.pkl to ./final_model_gender.pkl
download: s3://uoamsdsc5bucket1/MyFlask/index.html to ./index.html
download: s3://uoamsdsc5bucket1/MyFlask/style.css to ./style.css
download: s3://uoamsdsc5bucket1/MyFlask/app.py to ./app.py
download: s3://uoamsdsc5bucket1/MyFlask/final_model_age_group.pkl to ./final_model_age_group.pkl
download: s3://uoamsdsc5bucket1/MyFlask/Dockerfile to ./Dockerfile
download: s3://uoamsdsc5bucket1/MyFlask/test_data_gender.pkl to ./test_data_gender.pkl
[ec2-user@ip-172-31-36-110 MyFlask]$ ls
Dockerfile  app.py  final_model_age_group.pkl  final_model_gender.pkl  index.html  requirements.txt  style.css  test_data_age_group.pkl  test_data_gender.pkl
```

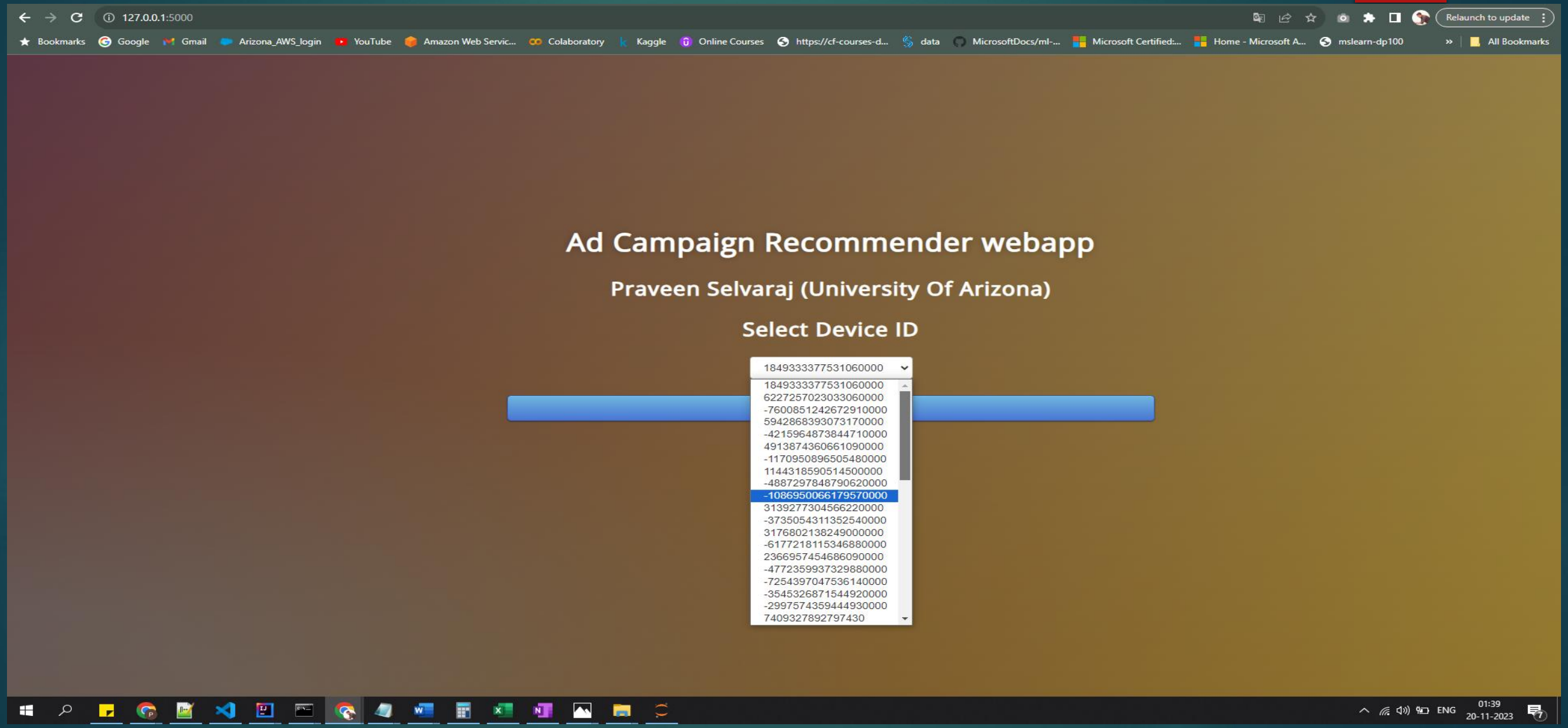
Create Docker Image

```
[ec2-user@ip-172-31-36-110 MyFlask]$ sudo docker build -t praveencapstone:latest .
[+] Building 7.4s (7/15)                                                                   docker:default
[+] Building 22.8s (7/15)                                                                  docker:default
[+] Building 26.2s (7/15)                                                                  docker:default
[+] Building 26.5s (7/15)                                                                  docker:default
[+] Building 27.6s (7/15)                                                                  docker:default
[+] Building 28.5s (7/15)                                                                  docker:default
[+] Building 28.6s (7/15)                                                                  docker:default
[+] Building 28.9s (7/15)                                                                  docker:default
[+] Building 29.7s (7/15)                                                                  docker:default
[+] Building 30.9s (7/15)                                                                  docker:default
[+] Building 31.3s (7/15)                                                                  docker:default
[+] Building 31.5s (7/15)                                                                  docker:default
[+] Building 80.8s (16/16) FINISHED                                                        docker:default
 => [internal] load build definition from Dockerfile                                                 0.0s
 => => transferring dockerfile: 532B                                                                 0.0s
 => [internal] load .dockerignore                                                                    0.0s
 => => transferring context: 2B                                                                      0.0s
 => [internal] load metadata for docker.io/library/python:3.7-slim                                   0.2s
 => [ 1/11] FROM docker.io/library/python:3.7-slim@sha256:b53f496ca43e5af6994f8e316cf03af31050bf7944e0e4a308ad86c001cf028b   4.1s
 => => resolve docker.io/library/python:3.7-slim@sha256:b53f496ca43e5af6994f8e316cf03af31050bf7944e0e4a308ad86c001cf028b     0.0s
 => => sha256:a255ffcb469f2ec40f2958a76beb0c2bbebfe92ce9af67a9b48d84b4cb695ac8 7.54kB / 7.54kB       0.0s
 => => sha256:a803e7c4b030119420574a882a52b6431e160fceb7620f61b525d49bc2d58886 29.12MB / 29.12MB     0.5s
 => => sha256:bf3336e84c8e00632cdea35b18fec9a5691711bdc8ac885e3ef54a3d5ff500ba 3.50MB / 3.50MB       0.4s
 => => sha256:8973eb85275f19b8d72c6047560629116ad902397e5c1885b2508788197de28b 11.38MB / 11.38MB     0.5s
 => => sha256:b53f496ca43e5af6994f8e316cf03af31050bf7944e0e4a308ad86c001cf028b 1.86kB / 1.86kB       0.0s
 => => sha256:ffd28e36ef37b3a4a24f6a771a48d7c5499ea42d6309ac911a3f699e122060be 1.37kB / 1.37kB       0.0s
 => => extracting sha256:a803e7c4b030119420574a882a52b6431e160fceb7620f61b525d49bc2d58886            1.9s
 => => sha256:f9afc3cc0135aad884dad502f28a5b3d8cd32565116131da818ebf2ea6d46095 244B / 244B           0.6s
 => => sha256:39312d8b4ab77de264678427265a2668073675bb8666caf723da18c9e4b7e3fc 3.13MB / 3.13MB       0.9s
 => => extracting sha256:bf3336e84c8e00632cdea35b18fec9a5691711bdc8ac885e3ef54a3d5ff500ba            0.2s
 => => extracting sha256:8973eb85275f19b8d72c6047560629116ad902397e5c1885b2508788197de28b            0.7s
 => => extracting sha256:f9afc3cc0135aad884dad502f28a5b3d8cd32565116131da818ebf2ea6d46095            0.0s
 => => extracting sha256:39312d8b4ab77de264678427265a2668073675bb8666caf723da18c9e4b7e3fc            0.3s
 => [internal] load build context                                                                    0.0s
 => => transferring context: 2.90kB                                                                  0.0s
 => [ 2/11] WORKDIR /app/                                                                            0.4s
 => [ 3/11] COPY requirements.txt /app/                                                              0.0s
 => [ 4/11] RUN pip install -r ./requirements.txt                                                   51.0s
 => [ 5/11] COPY app.py /app/                                                                        0.2s
 => [ 6/11] COPY final_model_gender.pkl /app/                                                        0.0s
 => [ 7/11] COPY final_model_age_group.pkl /app/                                                     0.0s
 => [ 8/11] COPY test_data_gender.pkl /app/                                                          0.1s
 => [ 9/11] COPY test_data_age_group.pkl /app/                                                       0.0s
 => [10/11] COPY templates/index.html /app/templates/index.html                                      0.0s
 => [11/11] COPY static/css/style.css /app/static/css/style.css                                      0.0s
 => exporting to image                                                                              20.2s
 => => exporting layers                                                                             20.2s
 => => writing image sha256:67f1b1f89f73557bb2cbda094116a0465d734abe7d46966a73849b7b46321e82         0.0s
 => => naming to docker.io/library/praveencapstone:latest                                            0.0s
```

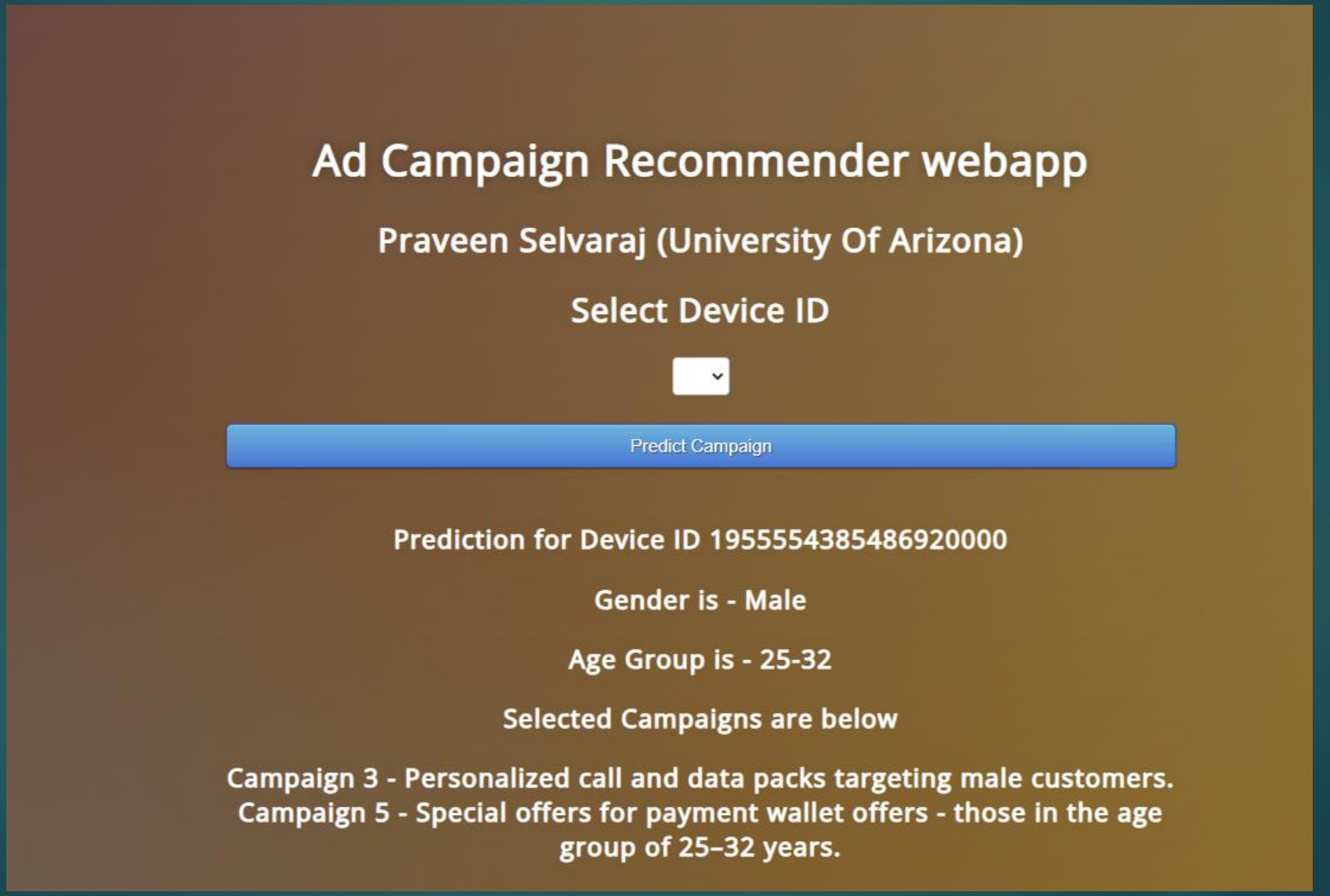
Start Docker Container

```
[ec2-user@ip-172-31-36-110 MyFlask]$ sudo docker image ls
REPOSITORY        TAG       IMAGE ID       CREATED         SIZE
praveencapstone   latest    67f1b1f89f73   3 minutes ago   1.26GB
[ec2-user@ip-172-31-36-110 MyFlask]$ sudo docker run -p 5000:5000 praveencapstone
 * Serving Flask app 'app'
 * Debug mode: on
/usr/local/lib/python3.7/site-packages/sklearn/base.py:338: UserWarning: Trying to unpickle estimator LogisticRegression from version 1.2.2 when using version 1.0.2. This might lead to breaking code or invalid results. Use at your own ris
k. For more info please refer to:
https://scikit-learn.org/stable/modules/model_persistence.html#security-maintainability-limitations
  UserWarning,
WARNING: This is a development server. Do not use it in a production deployment. Use a production WSGI server instead.
 * Running on all addresses (0.0.0.0)
 * Running on http://127.0.0.1:5000
 * Running on http://172.17.0.2:5000
Press CTRL+C to quit
 * Restarting with stat
/usr/local/lib/python3.7/site-packages/sklearn/base.py:338: UserWarning: Trying to unpickle estimator LogisticRegression from version 1.2.2 when using version 1.0.2. This might lead to breaking code or invalid results. Use at your own ris
k. For more info please refer to:
https://scikit-learn.org/stable/modules/model_persistence.html#security-maintainability-limitations
  UserWarning,
 * Debugger is active!
 * Debugger PIN: 114-584-019
```

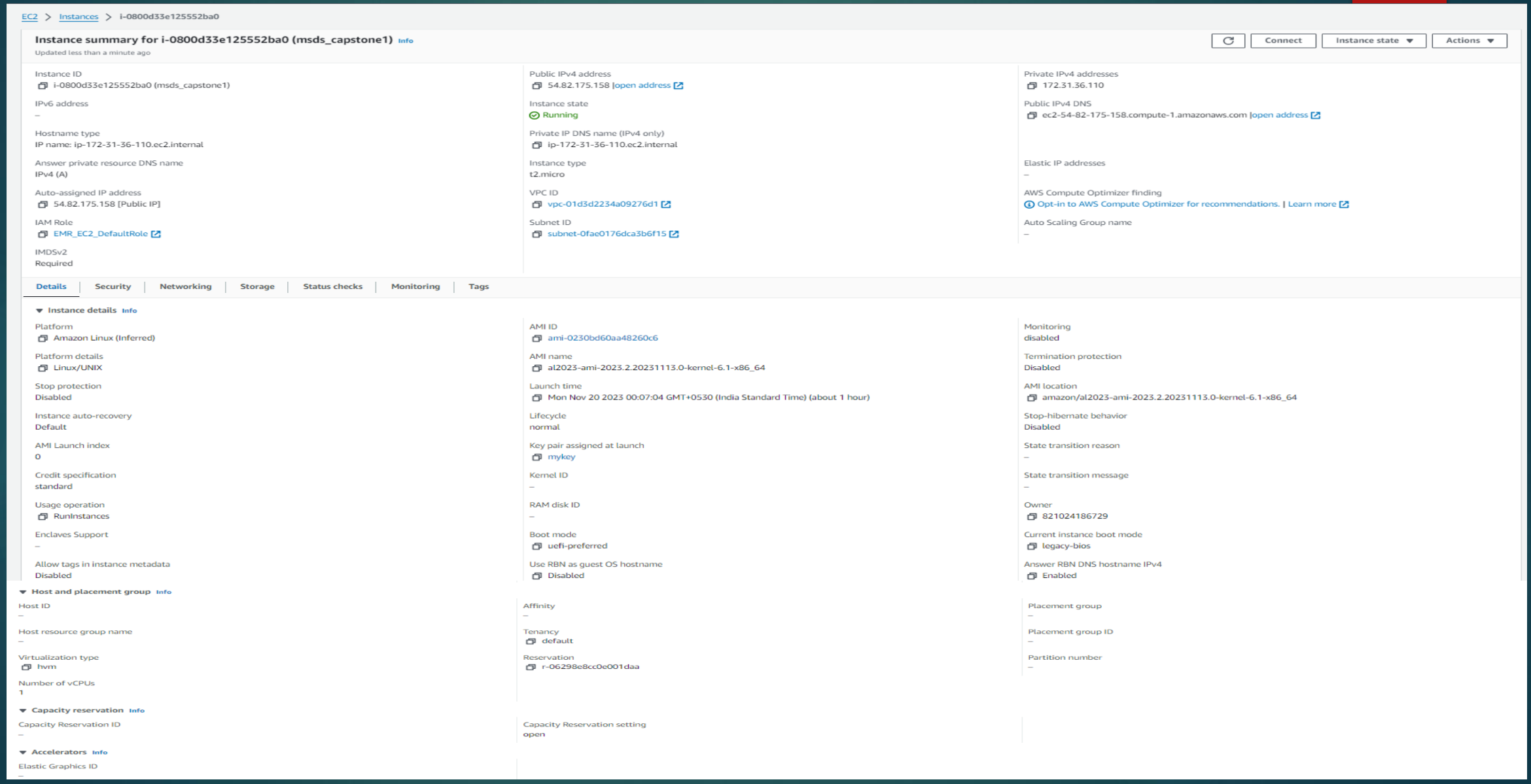
Access the Web Application from the browser



Access the Web Application from the browser



AWS EC2 Instance Stats



EC2 > Instances > i-0800d33e125552ba0

Instance summary for i-0800d33e125552ba0 (msds_capstone1) Info

Updated less than a minute ago

Connect | Instance state | Actions

Instance ID i-0800d33e125552ba0 (msds_capstone1)	Public IPv4 address 54.82.175.158 |open address	Private IPv4 addresses 172.31.36.110
IPv6 address –	Instance state Running	Public IPv4 DNS ec2-54-82-175-158.compute-1.amazonaws.com |open address
Hostname type IP name: ip-172-31-36-110.ec2.internal	Private IP DNS name (IPv4 only) ip-172-31-36-110.ec2.internal	
Answer private resource DNS name IPv4 (A)	Instance type t2.micro	Elastic IP addresses –
Auto-assigned IP address 54.82.175.158 [Public IP]	VPC ID vpc-01d3d2234a09276d1	AWS Compute Optimizer finding Opt-in to AWS Compute Optimizer for recommendations. | Learn more
IAM Role EMR_EC2_DefaultRole	Subnet ID subnet-0fae0176dca3b6f15	Auto Scaling Group name –
IMDSv2 Required		

Details | Security | Networking | Storage | Status checks | Monitoring | Tags

Instance details Info

Platform Amazon Linux (Inferred)	AMI ID ami-0230bd60aa48260c6	Monitoring disabled
Platform details Linux/UNIX	AMI name al2023-ami-2023.2.20231113.0-kernel-6.1-x86_64	Termination protection Disabled
Stop protection Disabled	Launch time Mon Nov 20 2023 00:07:04 GMT+0530 (India Standard Time) (about 1 hour)	AMI location amazon/al2023-ami-2023.2.20231113.0-kernel-6.1-x86_64
Instance auto-recovery Default	Lifecycle normal	Stop-hibernate behavior Disabled
AMI Launch index 0	Key pair assigned at launch mykey	State transition reason –
Credit specification standard	Kernel ID –	State transition message –
Usage operation RunInstances	RAM disk ID –	Owner 821024186729
Enclaves Support –	Boot mode uefi-preferred	Current instance boot mode legacy-bios
Allow tags in instance metadata Disabled	Use RBN as guest OS hostname Disabled	Answer RBN DNS hostname IPv4 Enabled

Host and placement group Info

Host ID –	Affinity –	Placement group –
Host resource group name –	Tenancy default	Placement group ID –
Virtualization type hvm	Reservation r-06298e8cc0e001daa	Partition number –
Number of vCPUs 1		

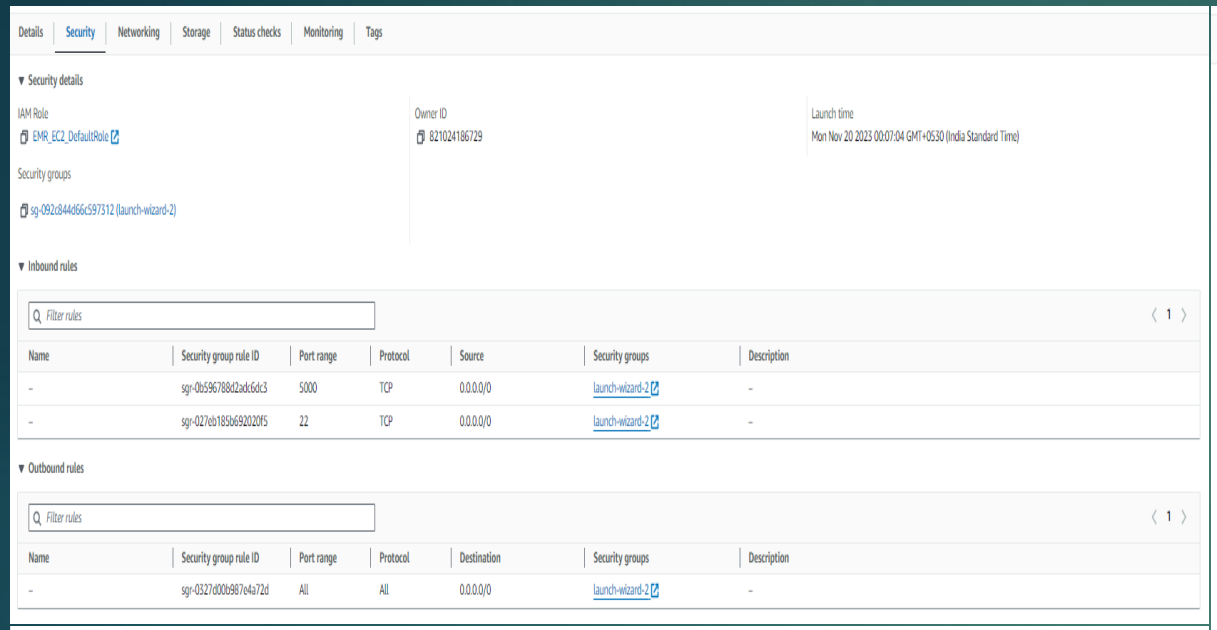
Capacity reservation Info

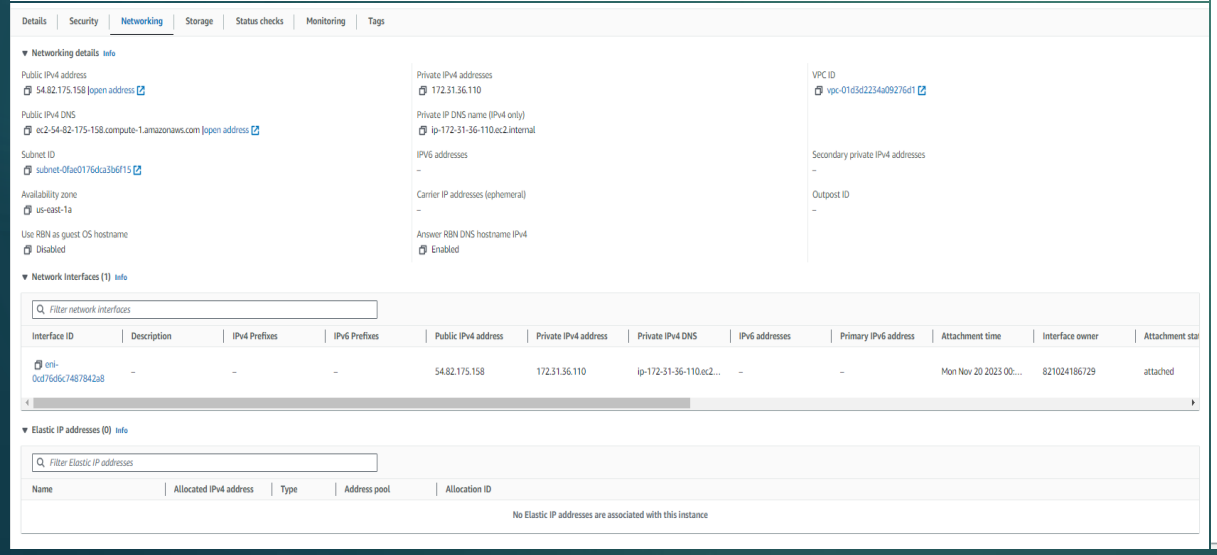
Capacity Reservation ID –	Capacity Reservation setting open

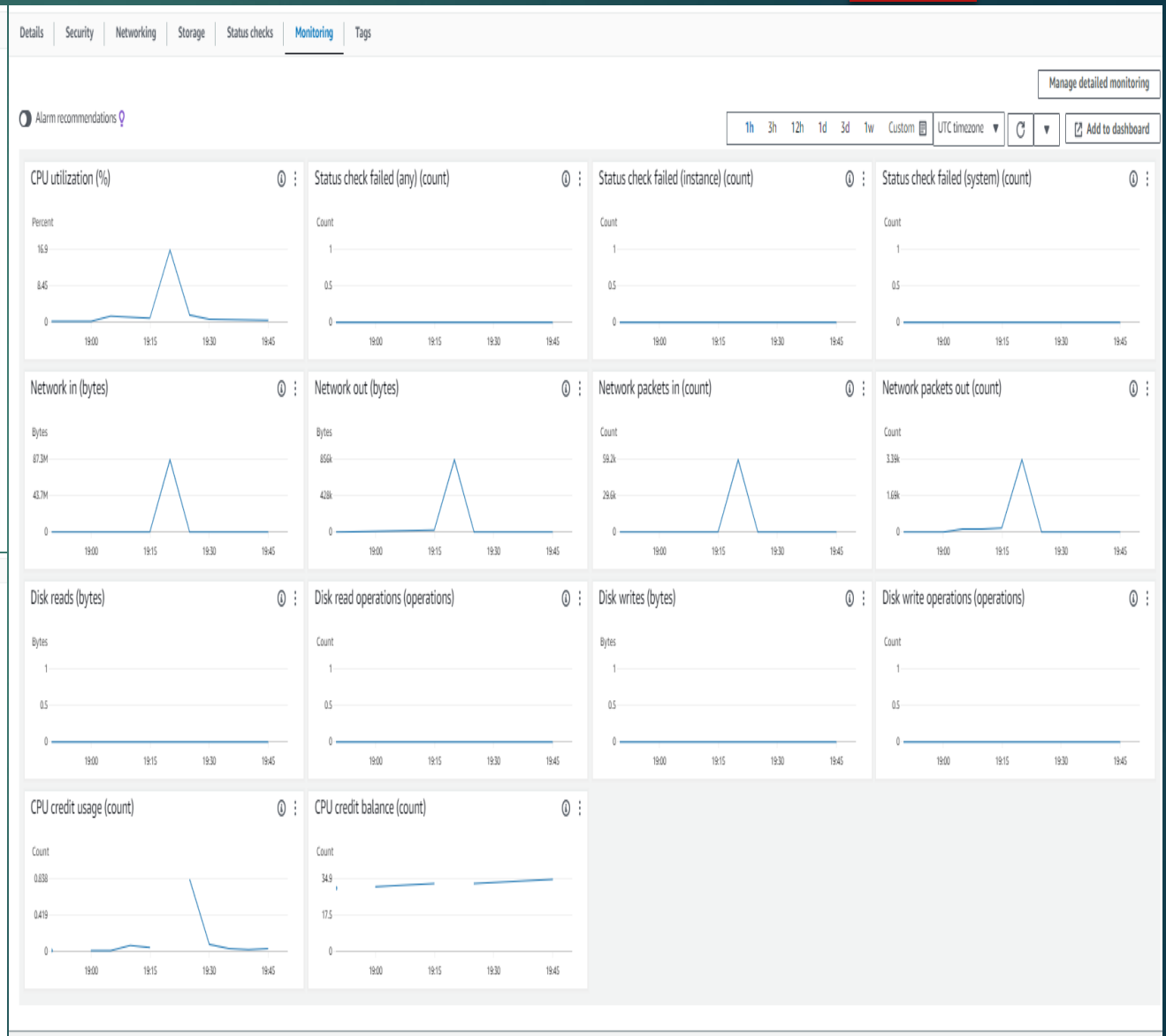
Accelerators Info

Elastic Graphics ID
–

AWS EC2 Instance Stats







Thank You ☺!