Deploy and Run the Flask application within a Docker Container on EC2 instance

Copying the Flask application components to EC2 instance:

```
D:\Prashant\Upgrad\Capstone\FinalSubmission\DockerFiles>set EC2_HOSTNAME=ec2-user@ec2-3-80-102-
136.compute-1.amazonaws.com

D:\Prashant\Upgrad\Capstone\FinalSubmission\DockerFiles>scp -i csd_pair.pem app.py
%EC2_HOSTNAME%:/home/ec2-user/docker_files/
app.py                                                    100% 3412     0.1KB/s   00:29

D:\Prashant\Upgrad\Capstone\FinalSubmission\DockerFiles>scp -i csd_pair.pem df_KStable.csv
%EC2_HOSTNAME%:/home/ec2-user/docker_files/
df_KStable.csv                                            100%  921     2.2KB/s   00:00

D:\Prashant\Upgrad\Capstone\FinalSubmission\DockerFiles>scp -i csd_pair.pem df_scn1_test.csv
%EC2_HOSTNAME%:/home/ec2-user/docker_files/
df_scn1_test.csv                                          100%   13MB  19.5KB/s   11:09

D:\Prashant\Upgrad\Capstone\FinalSubmission\DockerFiles>scp -i csd_pair.pem Dockerfile
%EC2_HOSTNAME%:/home/ec2-user/docker_files/
Dockerfile                                                100%  575     2.0KB/s   00:00

D:\Prashant\Upgrad\Capstone\FinalSubmission\DockerFiles>scp -i csd_pair.pem requirements.txt
%EC2_HOSTNAME%:/home/ec2-user/docker_files
requirements.txt                                          100%   82     0.2KB/s   00:00

D:\Prashant\Upgrad\Capstone\FinalSubmission\DockerFiles>scp -i csd_pair.pem scn1_age_LR.pkl
%EC2_HOSTNAME%:/home/ec2-user/docker_files
scn1_age_LR.pkl                                           100%   17KB   2.6KB/s   00:06

D:\Prashant\Upgrad\Capstone\FinalSubmission\DockerFiles>scp -i csd_pair.pem scn1_gender_LR.pkl
%EC2_HOSTNAME%:/home/ec2-user/docker_files
scn1_gender_LR.pkl                                        100% 6385     1.4KB/s   00:04
```

Commands used for deploying the flask application on the EC2 instance:

```
(base) [ec2-user@ip-172-31-21-149 ~]$ cd docker_files/

(base) [ec2-user@ip-172-31-21-149 docker_files]$ ls -l
total 13092
-rw-rw-r-- 1 ec2-user ec2-user     3412 Oct 27 12:15 app.py
-rw-rw-r-- 1 ec2-user ec2-user      921 Oct 27 12:16 df_KStable.csv
-rw-rw-r-- 1 ec2-user ec2-user 13360014 Oct 27 12:30 df_scn1_test.csv
-rw-rw-r-- 1 ec2-user ec2-user      575 Oct 27 12:31 Dockerfile
-rw-rw-r-- 1 ec2-user ec2-user       82 Oct 27 12:34 requirements.txt
-rw-rw-r-- 1 ec2-user ec2-user    17504 Oct 27 12:36 scn1_age_LR.pkl
-rw-rw-r-- 1 ec2-user ec2-user     6385 Oct 27 12:37 scn1_gender_LR.pkl

(base) [ec2-user@ip-172-31-21-149 docker_files]$ sudo yum install docker
Loaded plugins: extras_suggestions, langpacks, priorities, update-motd
amzn2-core
| 3.7 kB  00:00:00
Package docker-20.10.7-3.amzn2.x86_64 already installed and latest version
Nothing to do
```

```
(base) [ec2-user@ip-172-31-21-149 docker_files]$ sudo service docker start
Redirecting to /bin/systemctl start docker.service

(base) [ec2-user@ip-172-31-21-149 docker_files]$ sudo usermod -a -G docker ec2-user

(base) [ec2-user@ip-172-31-21-149 docker_files]$ sudo chmod 666 /var/run/docker.sock

(base) [ec2-user@ip-172-31-21-149 docker_files]$ docker build -t predict_campaigns:v1 .
Sending build context to Docker daemon   13.4MB
Step 1/12 : FROM python:3.7-slim
 ---> 375e181c2688
Step 2/12 : WORKDIR /app/
 ---> Using cache
 ---> bec6b61db122
Step 3/12 : COPY requirements.txt /app/
 ---> Using cache
 ---> 9e26e0b7154a
Step 4/12 : RUN pip install -r ./requirements.txt
 ---> Using cache
 ---> b9cf17ef7b41
Step 5/12 : COPY app.py /app/
 ---> 18628c50728b
Step 6/12 : COPY df_KStable.csv /app/
 ---> 63dd9bb84c39
Step 7/12 : COPY df_scn1_test.csv /app/
 ---> a9203b8d1a49.
.
Step 12/12 : EXPOSE 5000
 ---> Running in 9f92dfa6ae84
Removing intermediate container 9f92dfa6ae84
 ---> de7e241d00b2
Successfully built de7e241d00b2
Successfully tagged predict_campaigns:v1

(base) [ec2-user@ip-172-31-21-149 docker_files]$ docker images
REPOSITORY          TAG        IMAGE ID       CREATED         SIZE
predict_campaigns   v1         de7e241d00b2   3 minutes ago   451MB
python              3.7-slim   375e181c2688   2 weeks ago     120MB

(base) [ec2-user@ip-172-31-21-149 docker_files]$ docker run -p 5000:5000 --name predict_campaigns
predict_campaigns:v1 &
[1] 4421
(base) [ec2-user@ip-172-31-21-149 docker_files]$  * 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
 * Running on all addresses.
   WARNING: This is a development server. Do not use it in a production deployment.
 * Running on http://172.17.0.2:5000/ (Press CTRL+C to quit)
 * Restarting with stat
 * Debugger is active!
 * Debugger PIN: 751-094-197

(base) [ec2-user@ip-172-31-21-149 docker_files]$ docker ps -a
CONTAINER ID   IMAGE                 COMMAND           CREATED          STATUS          PORTS
NAMES
9d78fe43bda9   predict_campaigns:v1   "python app.py"   19 minutes ago   Up 19 minutes
0.0.0.0:5000->5000/tcp, :::5000->5000/tcp   predict_campaigns
```

Final output for predicting the campaigns for the 50 customers:

```
(base) [ec2-user@ip-172-31-21-149 docker_files]$ curl http://172.17.0.2:5000/predict_campaigns/2
172.17.0.1 - - [27/Oct/2021 12:55:02] "GET /predict_campaigns/2 HTTP/1.1" 200 -
[
  {
    "0_device_id": "5376172438165250000",
    "1_gender_pred": "< Not in Top 3 / Bottom 3 Band >",
    "2_age_group_pred": "[24-32]",
    "Campaign 1": "---",
    "Campaign 2": "---",
    "Campaign 3": "---",
    "Campaign 4": "---",
    "Campaign 5": "YES",
    "Campaign 6": "---"
  },
  {
    "0_device_id": "7012022028164130000",
    "1_gender_pred": "Male",
    "2_age_group_pred": "[24-32]",
    "Campaign 1": "---",
    "Campaign 2": "---",
    "Campaign 3": "YES",
    "Campaign 4": "---",
    "Campaign 5": "YES",
    "Campaign 6": "---"
  }
]
```

API invoked from Jupyter Notebook (notebook is enclosed in final submission zip) -

In [9]:
```
# We will invoke the 'predict_campaigns' API from Docker Container deployed on EC2 instance
# and display the Testing dataset device_id to Campaigns mapping for 50 random samples

host_url = 'http://ec2-3-80-102-136.compute-1.amazonaws.com:5000/predict_campaigns/'
num_samples = 50
url = host_url + str(num_samples)
response = requests.get(url)
dict = response.json()
df = json_normalize(dict)
df.head(num_samples)
```

Out[9]:

	0_device_id	1_gender_pred	2_age_group_pred	Campaign 1	Campaign 2	Campaign 3	Campaign 4	Campaign 5	Campaign 6
0	-7068808712009100000	Female	[32+]	YES	YES	---	---	---	YES
1	-5340790818533100000	< Not in Top 3 / Bottom 3 Band >	[24-32]	---	---	---	---	YES	---
2	3317151242338720000	Female	[24-32]	YES	YES	---	---	YES	---
3	-4303578141242190000	< Not in Top 3 / Bottom 3 Band >	[24-32]	---	---	---	---	YES	---
4	-2377836019195850000	Female	[32+]	YES	YES	---	---	---	YES
5	8568777958817080000	Male	[24-32]	---	---	YES	---	YES	---
6	-4515062558312920000	Male	[32+]	---	---	YES	---	---	YES
7	3556576015004900000	< Not in Top 3 / Bottom 3 Band >	[32+]	---	---	---	---	---	YES
8	5421479341408680000	Female	[24-32]	YES	YES	---	---	YES	---
9	-3169869399995030000	Male	[32+]	---	---	YES	---	---	YES
10	-3198479403348860000	< Not in Top 3 / Bottom 3 Band >	[24-32]	---	---	---	---	YES	---
11	5704604718326170000	< Not in Top 3 / Bottom 3 Band >	[24-32]	---	---	---	---	YES	---
12	6700503628883080000	< Not in Top 3 / Bottom 3 Band >	[32+]	---	---	---	---	---	YES
13	8379679692492050000	Male	[24-32]	---	---	YES	---	YES	---
14	-5082733512360830000	Male	[32+]	---	---	YES	---	---	YES
15	-1025301595256040000	Male	[24-32]	---	---	YES	---	YES	---
16	-2711401763176860000	< Not in Top 3 / Bottom 3 Band >	[32+]	---	---	---	---	---	YES

17	-5730120856981790000	< Not in Top 3 / Bottom 3 Band >	[24-32]	---	---	---	---	YES	---
18	-4182285642902430000	Male	[24-32]	---	---	YES	---	YES	---
19	-3082210958226160000	< Not in Top 3 / Bottom 3 Band >	[24-32]	---	---	---	---	YES	---
20	641003734934977000	Male	[32+]	---	---	YES	---	---	YES
21	1656684048950680000	Male	[32+]	---	---	YES	---	---	YES
22	6069239249965650000	Male	[24-32]	---	---	YES	---	YES	---
23	-5620534217987450000	Male	[24-32]	---	---	YES	---	YES	---
24	-4934378117089880000	Male	[24-32]	---	---	YES	---	YES	---
25	-5098621608323780000	Female	[24-32]	YES	YES	---	---	YES	---
26	-22780715507327900	< Not in Top 3 / Bottom 3 Band >	[24-32]	---	---	---	---	YES	---
27	7833015942211220000	< Not in Top 3 / Bottom 3 Band >	[32+]	---	---	---	---	---	YES
28	2691679512700970000	< Not in Top 3 / Bottom 3 Band >	[24-32]	---	---	---	---	YES	---
29	4484627320190180000	Female	[0-24]	YES	YES	---	YES	---	---
30	2384636672126040000	Male	[24-32]	---	---	YES	---	YES	---
31	-9182270938122260000	Female	[24-32]	YES	YES	---	---	YES	---
32	-5572990067167140000	< Not in Top 3 / Bottom 3 Band >	[32+]	---	---	---	---	---	YES
33	-2420900293850340000	Male	[24-32]	---	---	YES	---	YES	---
34	-5729394417354260000	Male	[24-32]	---	---	YES	---	YES	---
35	5174704076818030000	Male	[32+]	---	---	YES	---	---	YES
36	-341673506902548000	Male	[24-32]	---	---	YES	---	YES	---
37	7234339569357680000	< Not in Top 3 / Bottom 3 Band >	[24-32]	---	---	---	---	YES	---
38	4152972437347800000	Male	[24-32]	---	---	YES	---	YES	---
39	-300569421553737000	Female	[24-32]	YES	YES	---	---	YES	---
40	7922328762495280000	Male	[24-32]	---	---	YES	---	YES	---
41	-7119720796300120000	Male	[24-32]	---	---	YES	---	YES	---
42	-5309152691609430000	< Not in Top 3 / Bottom 3 Band >	[24-32]	---	---	---	---	YES	---
43	1692849541388280000	Male	[24-32]	---	---	YES	---	YES	---
44	6754429247512170000	< Not in Top 3 / Bottom 3 Band >	[32+]	---	---	---	---	---	YES
45	2488356127177220000	Male	[32+]	---	---	YES	---	---	YES
46	-2035432016734580000	Female	[24-32]	YES	YES	---	---	YES	---
47	7256622423963570000	Male	[24-32]	---	---	YES	---	YES	---
48	-5737711494192430000	< Not in Top 3 / Bottom 3 Band >	[24-32]	---	---	---	---	YES	---
49	2241738042985810000	Male	[24-32]	---	---	YES	---	YES	---