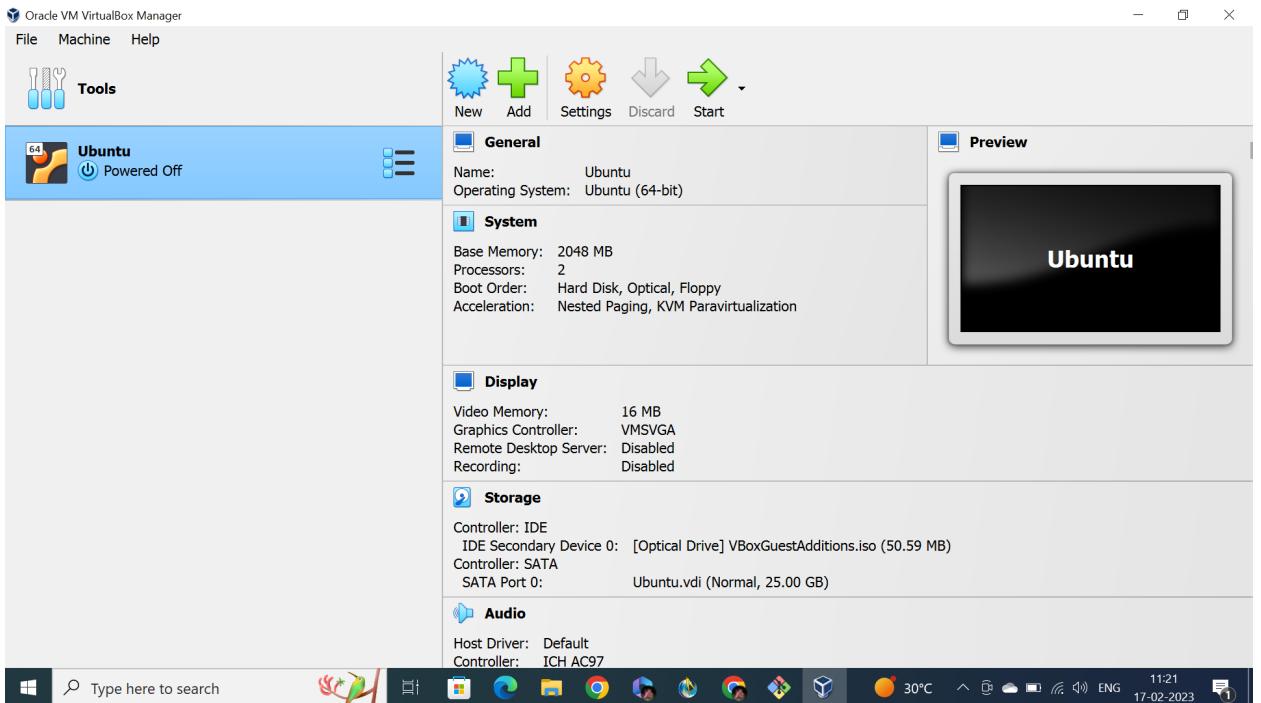
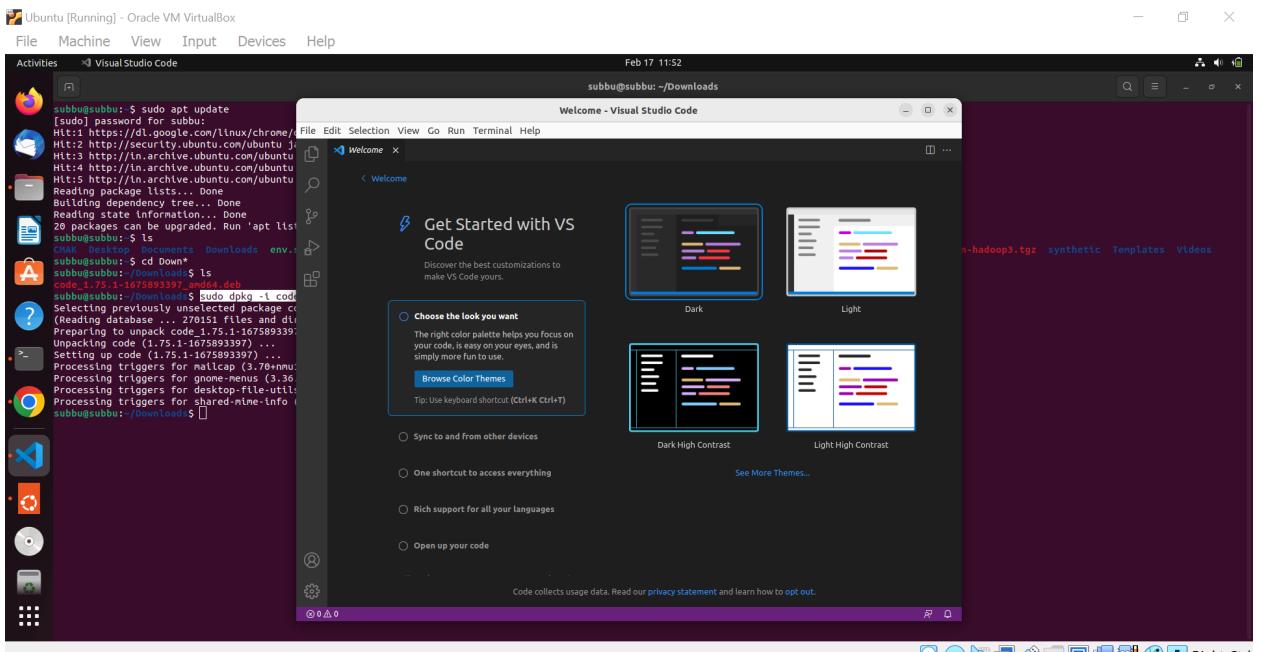


1. Installed virtual box and ubuntu virtual machine.



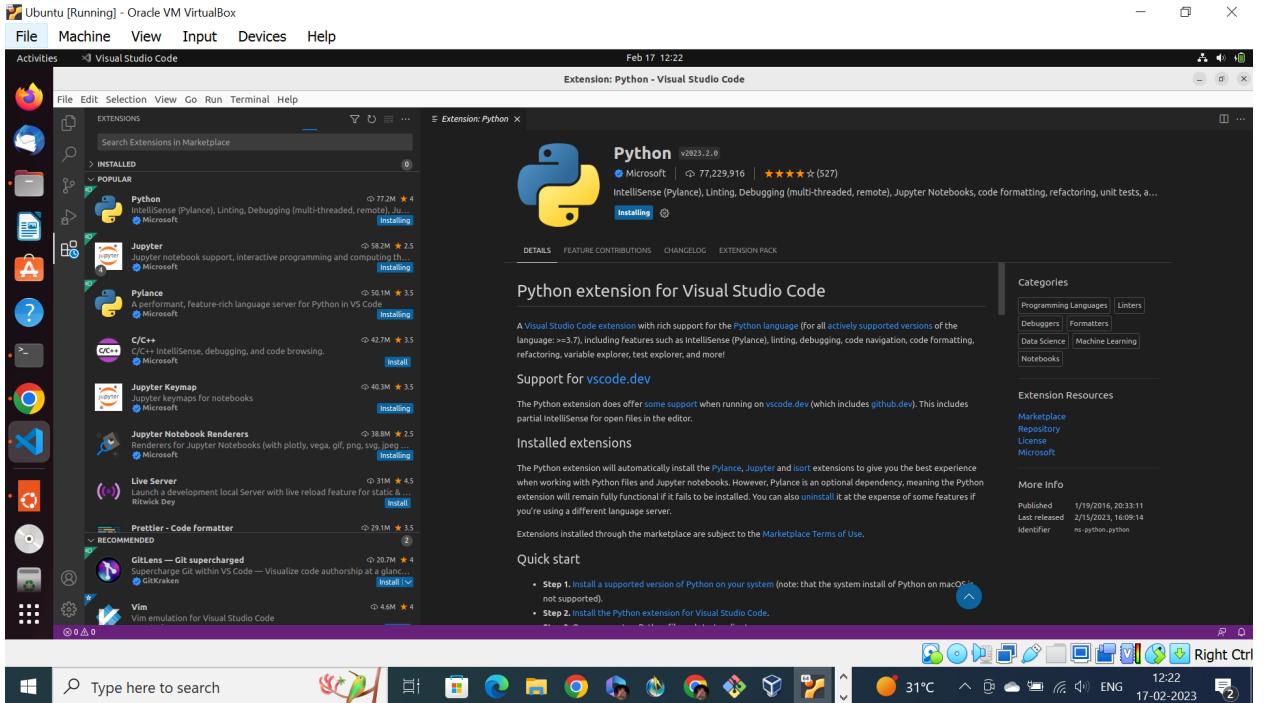
2. Windows desktop environment.

3. Installed visual studio code.



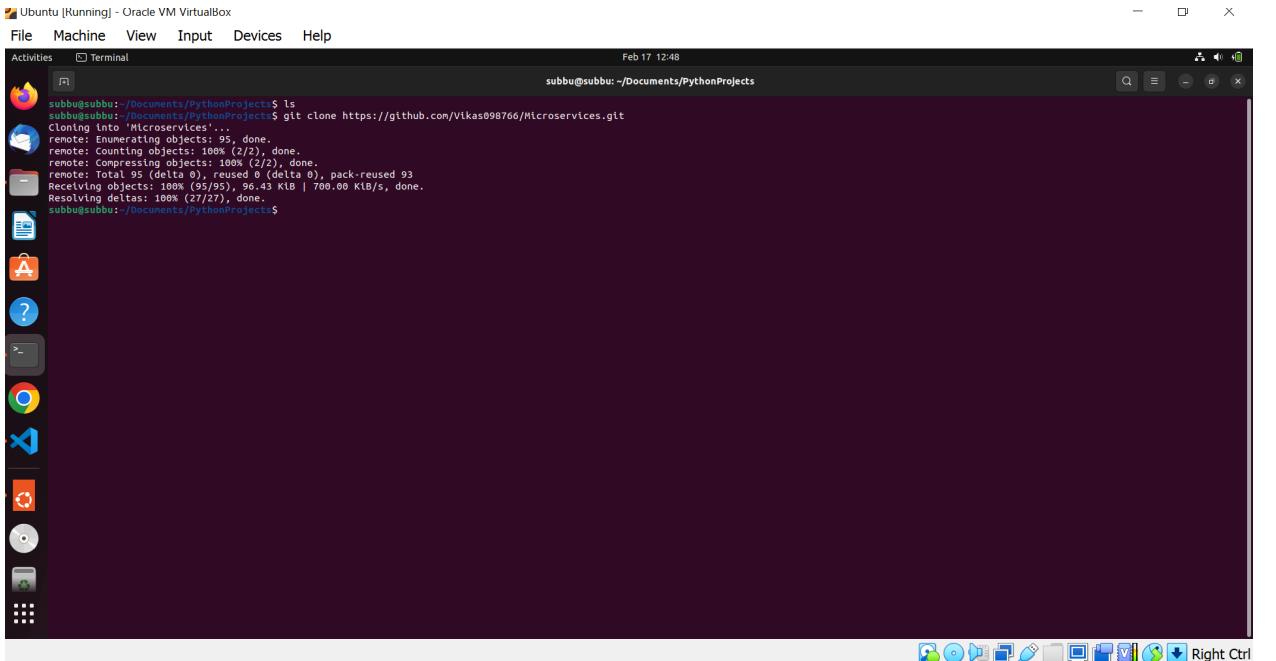
4.

5. Installed python extension.



6.

7. Cloning the repository



8.

9. Installing python3-venv on ubuntu machine.



11. Creating virtual environment in VS code.

The screenshot shows a Linux desktop environment with a window titled "Ubuntu [Running] - Oracle VM VirtualBox". The window contains a Visual Studio Code interface. The left sidebar shows a file tree for a project named "MICROSERVICES" containing files like "code_model_training.py", "data.csv", "model.pkl", "functions.py", and "msenv". The main editor area displays a Python script named "functions.py" with the following code:

```
import pandas as pd
from ms import model

def predict(X, model):
    prediction = model.predict(X)[0]
    return prediction

def get_model_response(json_data):
    X = pd.DataFrame.from_dict(json_data)
    prediction = predict(X, model)
    if prediction == 1:
        label = "M"
    else:
        label = "B"
    return label
```

The terminal tab at the bottom shows the command "python3 -m venv msenv" being run in a terminal window.



13. Activating the virtual env in vs code

```
msubbu@subbu:~/Documents/PythonProjects/Microservices$ cd msenv
msubbu@subbu:~/Documents/PythonProjects/Microservices/msenv$ cd bin
msubbu@subbu:~/Documents/PythonProjects/Microservices/msenv/bin$ source ./activate
```

14.

15. Installing requirements

```
msubbu@subbu:~/Documents/PythonProjects/Microservices$ cd msenv
msubbu@subbu:~/Documents/PythonProjects/Microservices/msenv$ cd bin
msubbu@subbu:~/Documents/PythonProjects/Microservices/msenv/bin$ source ./activate
(msenv) msubbu@subbu:~/Documents/PythonProjects/Microservices/msenv/bin$ pip install -r ../../requirements.txt
Collecting click==8.0.3-py3-none-any.whl (97 kB)
  Downloading click-8.0.3-py3-none-any.whl (97.5/97.5 KB) 973.8 kB/s eta 0:00:00
Collecting cycler==0.11.0
  Downloading cycler-0.11.0-py3-none-any.whl (6.4 kB)
Collecting Flask==2.0.2
  Downloading Flask-2.0.2-py3-none-any.whl (95 kB)
Collecting fonttools==4.28.5
  Downloading fonttools-4.28.5-py3-none-any.whl (890 kB)
  95.2/95.2 KB 1.1 MB/s eta 0:00:00
Collecting fonttools==4.28.5-py3-none-any.whl (890 kB)
  Downloading fonttools-4.28.5-py3-none-any.whl (890 kB)
  696.4/696.4 kB 3.6 MB/s eta 0:00:00
```

16.

17. Training the model

Ubuntu [Running] - Oracle VM VirtualBox

File Machine View Input Devices Help

Activities Matplotlib

File Edit Selection View Go Run Terminal Help

Feb 17 19:04

train.py - Microservices - Visual Studio Code

Figure 1

```

code_model_training > train.py > ...
40    pipe = Pipeline([
41        ('imputer', SimpleImputer()),
42        ('scale', MinMaxScaler(feature_range=(0, 1))),
43        ('model', ensemble) # Ensemble Model
44    ])
45
46    # Train the model
47    pipe.fit(X_train, y_train)
48
49    # Test Accuracy
50    print("Accuracy: %s" % str(pipe.score(X_test, y_test)))
51
52    # Plot confusion matrix
53    print(ConfusionMatrixDisplay.from_estimator(pipe, X_test))
54    plt.show()
55
56    # Export model
57    joblib.dump(pipe, gzip.open('model/model_binary.dat.gz', 'wb'))
58
59
source /home/subbu/Documents/PythonProjects/Microservices/msenv/bin/activate
/home/subbu/Documents/PythonProjects/Microservices/msenv/bin/python
● subbu@subbu:~/Documents/PythonProjects/Microservices$ source /home/subbu/Documents/PythonProjects/Microservices/msenv/bin/activate
Microservices$ code_model_training/train.py
Accuracy: 0.9736842105263158
<sklearn.metrics._plot.confusion_matrix.ConfusionMatrixDisplay object at 0x7f104b3dbf40>

```

PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL

Ln 54, Col 11 Spaces: 4 UTF-8 CRLF Python 3.10.6 (msenv:venv) /R

18.

Type here to search 28°C 19:04 17-02-2023 Right Ctrl

19. Running the app

Ubuntu [Running] - Oracle VM VirtualBox

File Machine View Input Devices Help

Activities Visual Studio Code

File Edit Selection View Go Run Terminal Help

Feb 17 19:13

app.py - Microservices - Visual Studio Code

File Edit Selection View Go Run Terminal Help

EXPLORER app.py info

```

result = {}
result['name'] = model_name
result['version'] = version
return result

```

PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL

```

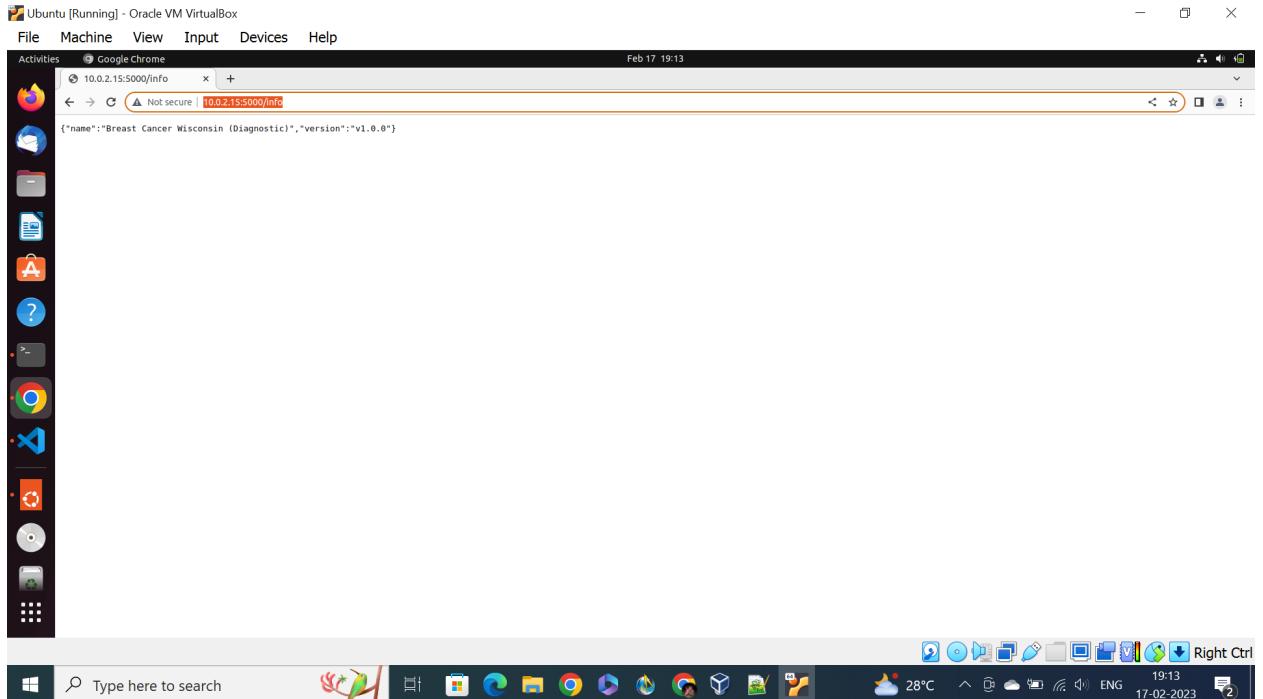
source /home/subbu/Documents/PythonProjects/Microservices/msenv/bin/activate
● subbu@subbu:~/Documents/PythonProjects/Microservices$ source /home/subbu/Documents/PythonProjects/Microservices/msenv/bin/activate
Microservices$ code_model_training/app.py
* Serving Flask app "ms" (lazy loading)
* Environment: production
WARNING: This is a development server. Do not use it in a production deployment.
For the WSGI server use 'gunicorn' or 'uWSGI' instead.
* Debug mode: off
* Running on all addresses.
WARNING: This is a development server. Do not use it in a production deployment.
* Running on 0.0.0.0:5000 (Press CTRL+C to quit)
10.0.2.15 - - [17/Feb/2023 19:12:34] "GET / HTTP/1.1" 404 -
10.0.2.15 - - [17/Feb/2023 19:12:35] "GET /favicon.ico HTTP/1.1" 404 -
10.0.2.15 - - [17/Feb/2023 19:12:42] "GET /info HTTP/1.1" 200 -

```

Ln 25, Col 16 Spaces: 4 UTF-8 CRLF Python 3.10.6 (msenv:venv) /R

20.

Type here to search 28°C 19:13 17-02-2023 Right Ctrl



21.  Type here to search

22. Installing curl

Ubuntu [Running] - Oracle VM VirtualBox

File Machine View Input Devices Help

Activities Terminal Feb 17 19:16

```
subbu@subbu: ~
```

subbu@subbu: ~ cd Documents/

subbu@subbu: ~/Documents \$ cd PythonProjects/

subbu@subbu: ~/Documents/PythonProjects \$ cd Microservices/

subbu@subbu: ~/Documents/PythonProjects/Microservices \$ code .

subbu@subbu: ~/Documents/PythonProjects/Microservices \$ curl -d '[{"radius_mean": 17.99, "texture_mean": 10.38, "perimeter_mean": 122.8, "area_mean": 1001.0, "smoothness_mean": 0.1184, "compactness_mean": 0.2776, "concavity_mean": 0.3801, "concave_points_mean": 0.1471, "symmetry_mean": 0.2419, "fractal_dimension_mean": 0.07871, "radius_se": 1.095, "texture_se": 0.9053, "perimeter_se": 8.589, "area_se": 15.34, "smoothness_se": 0.006399, "compactness_se": 0.04904, "concavity_se": 0.05373, "concave_points_se": 0.0187, "symmetry_se": 0.03083, "fractal_dimension_se": 0.006193, "radius_worst": 25.38, "texture_worst": 20.5, "perimeter_worst": 196.0, "area_worst": 2019.0, "smoothness_worst": 0.1622, "compactness_worst": 0.0650, "concavity_worst": 0.7119, "concave_points_worst": 0.2654, "symmetry_worst": 0.4601, "fractal_dimension_worst": 1.1589}]' -H 'Content-Type: application/json' '

-X POST http://0.0.0.0:8080/predict

Command 'curl' not found, but can be installed with:

sudo snap install curl --version 7.87.0, or

sudo apt install curl --version 7.81.0~ubuntu1.7

See 'snap info curl' for additional versions.

subbu@subbu: ~/Documents/PythonProjects/Microservices \$ sudo apt install curl

[sudo] password for subbu:

Reading package lists... Done

Building dependency tree... Done

Reading status information... Done

The following packages were automatically installed and are no longer required:

chromium-codecs-ffmpeg-extra gstreamer1.0-vaapi_1965.0-va-driver intel-media-va-driver libbaacs0 libbaom3 libbass9 liblavcdec58 liblavformat58 liblavutil56 libbdbluse libbluray2 libbs2b0 libchromaprint1 libcodecs2-1.0 liblbad1d5 libflashrom liblfilter libfdtd1-2 libgbm0 libgsr3mmer-plugins-bad1_0.0 liblbigdpmn12 liblivilv3 libmfxl1bmynsofa1 libopenmp10 libpostproc55 librabbitmq4 librubberband2 librsb-0.6.0 libssh3e libssnapy19 libtbsrtn-0.0 libtsrtn-0.0 libvrt1.4-grnnts libvsh-gcrypt-4 libwsamples libwscales libudrread0 libvba-drm2 libvba-wayland2 libvba-x11-2 libvba7 libvdpd1 libvdpstab1.0 libx265-194 libxvhdcore4 libzbimg2 libzbvbi0 mesa-va-drivers mesa-vdpau-drivers pocketsphinx-en-us va-driver-all vdpau-driver-all

Use 'sudo apt autoremove' to remove them.

The following NEW packages will be installed:

curl

0 upgraded, 1 newly installed, 0 to remove and 22 not upgraded.

Need to get 193 kB of archives.

All selected packages will be installed. After this operation, 100 MB of additional disk space will be used.

Get:1 http://in.archive.ubuntu.com/ubuntu jammy-updates/main amd64 curl amd64 7.81.0~ubuntu1.7 [193 kB]

Fetched 193 kB in 2s (100 kB/s)

Selecting previously unselected package curl.

(Reading database ... 271593 files and directories currently installed.)

Preparing to unpack .../curl_7.81.0~ubuntu1.7_amd64.deb ...

Unpacking curl (7.81.0~ubuntu1.7) ...

Setting up curl (7.81.0~ubuntu1.7) ...

Processing triggers for man-db (2.10.2-1) ...

```
subbu@subbu: ~/Documents/PythonProjects/Microservices $
```

24 Predict using curl command

The screenshot shows an Ubuntu desktop environment with a dark theme. At the top is a horizontal menu bar with options: File, Machine, View, Input, Devices, Help. Below the menu is a docked terminal window titled "Terminal". The terminal window displays a command-line session:

```
subbu@subbu:~/Documents/PythonProjects/Microservices$ curl -d '[{"radius_mean": 17.99, "texture_mean": 10.38, "perimeter_mean": 122.8, "area_mean": 1001.0, "smoothness_mean": 0.1184, "compactness_mean": 0.2776, "concavity_mean": 0.3001, "concave points_mean": 0.1471, "symmetry_mean": 0.2419, "fractal_dimension_mean": 0.07871, "radius_se": 1.095, "texture_se": 0.9053, "perimeter_se": 0.589, "area_se": 15.0776, "smoothness_se": 0.04909, "compactness_se": 0.04994, "concavity_se": 0.05373, "concave points_se": 0.01987, "symmetry_se": 0.03093, "fractal_dimension_se": 0.00193, "radius_worst": 25.38, "texture_worst": 1.33, "perimeter_worst": 191.6, "area_worst": 2019.0, "smoothness_worst": 0.022, "compactness_worst": 0.0656, "concavity_worst": 0.7119, "concave points_worst": 0.2654, "symmetry_worst": 0.406, "fractal_dimension_worst": 0.1189}]' -H "Content-Type: application/json" -X POST http://0.0.0.0:5000/predict
{"label": "M", "prediction": 1, "status": 200}
subbu@subbu:~/Documents/PythonProjects/Microservices$
```

The terminal window is part of the Unity interface, which includes a dock on the left containing icons for various applications like a browser, file manager, and terminal, and a dock at the bottom with icons for system functions like search, calendar, and network status.

25.

26. Installing Docker

27.

28. Creating Dockerfile

```

FROM python:3.10.6
WORKDIR /python-docker
ENV VIRTUAL_ENV=/python-docker/flaskenv
RUN python -m venv $VIRTUAL_ENV
COPY requirements.txt $VIRTUAL_ENV/bin:$PATH
RUN pip3 install -r requirements.txt
COPY . .
CMD ["python3","-m","flask","run","--host=0.0.0.0","--port=5000"]

```

The terminal output shows the Flask application running on port 5000, with several requests being handled by the server.

29.

30. Building Image

```

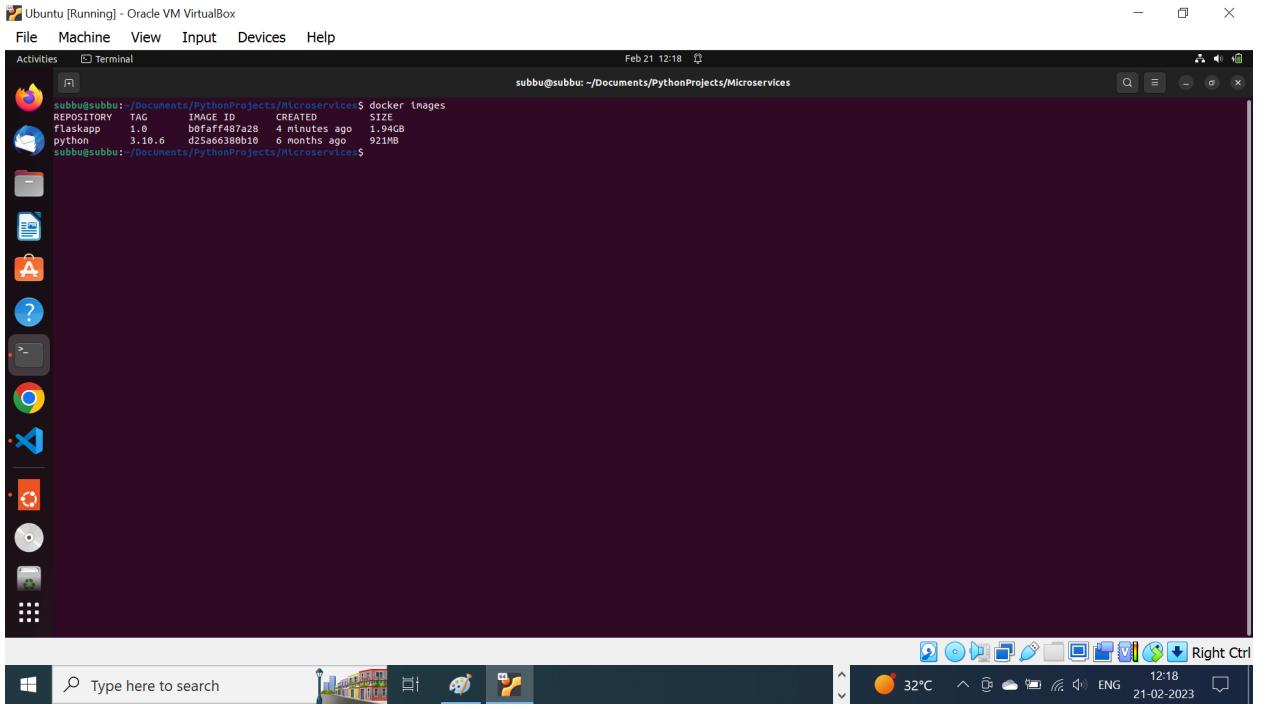
subbu@subbu:~/Documents/PythonProjects/Microservices$ docker build -t flaskapp:1.0 .

```

The terminal output shows the Docker build process, which includes pulling Python 3.10.6, creating a temporary container, copying the Dockerfile and requirements.txt file, setting up the environment, and finally building the image. The image is successfully built and tagged as flaskapp:1.0.

31.

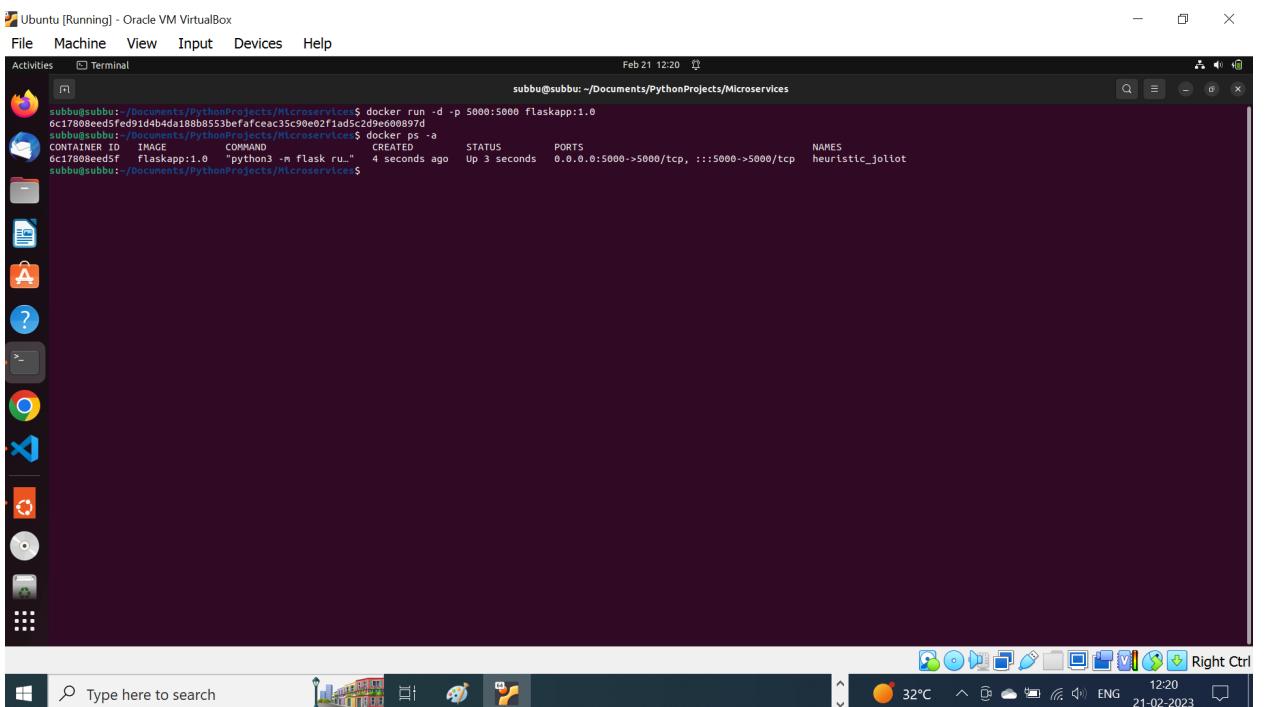
32. Listing images



```
subbu@subbu:~/Documents/PythonProjects/Microservices$ docker images
REPOSITORY    TAG      IMAGE ID      CREATED     SIZE
Flaskapp      1.0      b0faaff487a28   4 minutes ago  1.94GB
python         3.10.6   d25aa66380b10   6 months ago  921MB
subbu@subbu:~/Documents/PythonProjects/Microservices$
```

33.

34. Running the container



```
subbu@subbu:~/Documents/PythonProjects/Microservices$ docker run -d -p 5000:5000 flaskapp:1.0
6c17808eed5fed1d4bda18bb8553befafcead35c90e02f1ad5c2de0e00897d
subbu@subbu:~/Documents/PythonProjects/Microservices$ docker ps -a
CONTAINER ID        IMAGE               COMMAND             CREATED            STATUS              PORTS               NAMES
6c17808eed5f        flaskapp:1.0      "python3 -m flask ru..."   4 seconds ago     Up 3 seconds          0.0.0.0:5000->5000/tcp, ::1:5000->5000/tcp   heuristic_joliot
subbu@subbu:~/Documents/PythonProjects/Microservices$
```

35.

36. Running the curl to get the prediction

Ubuntu [Running] - Oracle VM VirtualBox

File Machine View Input Devices Help

Activities Terminal Feb 21 12:24

```
subbu@subbu: ~/Documents/PythonProjects/Microservices/test$ docker run -d -p 5000:5000 flaskapp:1.0
subbu@subbu: ~/Documents/PythonProjects/Microservices/test$ docker ps -a
CONTAINER ID IMAGE COMMAND CREATED STATUS PORTS NAMES
6c1788eed5f fed914db4ad188b8553befefcc3c59e0e2f1ad5c2d9e60897d
subbu@subbu: ~/Documents/PythonProjects/Microservices/test$ cd tests
subbu@subbu: ~/Documents/PythonProjects/Microservices/test$ ls
example_calls.txt
subbu@subbu: ~/Documents/PythonProjects/Microservices/test$ cat example_calls.txt
# POST method predict
curl -d '[{"radius_mean": 17.99, "texture_mean": 10.38, "perimeter_mean": 122.8, "area_mean": 1001.0, "smoothness_mean": 0.1184, "compactness_mean": 0.2776, "concavity_mean": 0.3001, "concave points_mean": 0.1471, "symmetry_mean": 0.2419, "fractal_dimension_mean": 0.07871, "radius_se": 1.095, "texture_se": 0.9053, "perimeter_se": 0.8589, "area_se": 153.4, "smoothness_se": 0.05373, "concave points_se": 0.01587, "symmetry_se": 0.03003, "fractal_dimension_se": 0.006193, "radius_worst": 25.38, "texture_worst": 17.33, "perimeter_worst": 184.6, "area_worst": 2019.0, "smoothness_worst": 0.1622, "compactness_worst": 0.6056, "concavity_worst": 0.7119, "concave points_worst": 0.2654, "symmetry_worst": 0.4661, "fractal_dimension_worst": 0.1189}]' \
-X POST http://0.0.0.0:5000/predict
# GET method info
curl -X GET http://localhost:5000/info
# GET method health
curl -X GET http://localhost:5000/healthsubbu@subbu: ~/Documents/curl -d '[{"radius_mean": 17.99, "texture_mean": 10.38, "perimeter_mean": 122.8, "area_mean": 1001.0, "smoothness_mean": 0.1184, "compactness_mean": 0.2776, "concavity_mean": 0.3001, "concave points_mean": 0.1471, "symmetry_mean": 0.2419, "fractal_dimension_mean": 0.07871, "radius_se": 1.095, "texture_se": 0.9053, "perimeter_se": 0.8589, "area_se": 153.4, "smoothness_se": 0.05373, "concave points_se": 0.01587, "symmetry_se": 0.03003, "fractal_dimension_se": 0.006193, "radius_worst": 25.38, "texture_worst": 17.33, "perimeter_worst": 184.6, "area_worst": 2019.0, "smoothness_worst": 0.1622, "compactness_worst": 0.6056, "concavity_worst": 0.7119, "concave points_worst": 0.2654, "symmetry_worst": 0.4661, "fractal_dimension_worst": 0.1189}]' \
-X POST http://0.0.0.0:5000/predict
{"label": "M", "prediction": 1, "status": 200}
subbu@subbu: ~/Documents/PythonProjects/Microservices/test$
```

37.

38. Checking container logs

Ubuntu [Running] - Oracle VM VirtualBox

File Machine View Input Devices Help

Activities Terminal Feb 21 12:25

```
subbu@subbu: ~/Documents/PythonProjects/Microservices/test$ docker run -d -p 5000:5000 flaskapp:1.0
subbu@subbu: ~/Documents/PythonProjects/Microservices/test$ docker ps -a
CONTAINER ID IMAGE COMMAND CREATED STATUS PORTS NAMES
6c1788eed5f flaskapp:1.0 "python3 -m flask ru..." 4 seconds ago Up 3 seconds 0.0.0.0:5000->5000/tcp, :::5000->5000/tcp heuristic_jolliot
subbu@subbu: ~/Documents/PythonProjects/Microservices/test$ cd tests
subbu@subbu: ~/Documents/PythonProjects/Microservices/test$ ls
example_calls.txt
subbu@subbu: ~/Documents/PythonProjects/Microservices/test$ cat example_calls.txt
# POST method predict
curl -d '[{"radius_mean": 17.99, "texture_mean": 10.38, "perimeter_mean": 122.8, "area_mean": 1001.0, "smoothness_mean": 0.1184, "compactness_mean": 0.2776, "concavity_mean": 0.3001, "concave points_mean": 0.1471, "symmetry_mean": 0.2419, "fractal_dimension_mean": 0.07871, "radius_se": 1.095, "texture_se": 0.9053, "perimeter_se": 0.8589, "area_se": 153.4, "smoothness_se": 0.05373, "concave points_se": 0.01587, "symmetry_se": 0.03003, "fractal_dimension_se": 0.006193, "radius_worst": 25.38, "texture_worst": 17.33, "perimeter_worst": 184.6, "area_worst": 2019.0, "smoothness_worst": 0.1622, "compactness_worst": 0.6056, "concavity_worst": 0.7119, "concave points_worst": 0.2654, "symmetry_worst": 0.4661, "fractal_dimension_worst": 0.1189}]' \
-X POST http://0.0.0.0:5000/predict
# GET method info
curl -X GET http://localhost:5000/info
# GET method health
curl -X GET http://localhost:5000/healthsubbu@subbu: ~/Documents/curl -d '[{"radius_mean": 17.99, "texture_mean": 10.38, "perimeter_mean": 122.8, "area_mean": 1001.0, "smoothness_mean": 0.1184, "compactness_mean": 0.2776, "concavity_mean": 0.3001, "concave points_mean": 0.1471, "symmetry_mean": 0.2419, "fractal_dimension_mean": 0.07871, "radius_se": 1.095, "texture_se": 0.9053, "perimeter_se": 0.8589, "area_se": 153.4, "smoothness_se": 0.05373, "concave points_se": 0.01587, "symmetry_se": 0.03003, "fractal_dimension_se": 0.006193, "radius_worst": 25.38, "texture_worst": 17.33, "perimeter_worst": 184.6, "area_worst": 2019.0, "smoothness_worst": 0.1622, "compactness_worst": 0.6056, "concavity_worst": 0.7119, "concave points_worst": 0.2654, "symmetry_worst": 0.4661, "fractal_dimension_worst": 0.1189}]' \
-X POST http://0.0.0.0:5000/predict
{"label": "M", "prediction": 1, "status": 200}
subbu@subbu: ~/Documents/PythonProjects/Microservices/test$ docker logs 6c1788eed5f
* Environment: production
WARNING: This is a development server. Do not use it in a production deployment.
* Use a production WSGI server instead.
* Debug mode: off
* Running on http://172.17.0.1:5000/ (Press CTRL+C to quit).
17.17.0.1 - - [21/Feb/2023 06:52:17] "POST /predict HTTP/1.1" 200 -
subbu@subbu: ~/Documents/PythonProjects/Microservices/test$
```

39.

