

**NATIONAL UNIVERSITY OF COMPUTER AND
EMERGING SCIENCES
PROGRAM: SOFTWARE ENGINEERING**



***SOFTWARE CONSTRUCTION AND DEVELOPMENT
LAB***

LAB TASK 09

SUBMITTED BY:

Name: Ahmed Ali

Roll No: 22P-9318

Section: BS(SE)-5B

INSTRUCTOR NAME: Sir Saood Sarwar

A DEPARTMENT OF COMPUTER SCIENCE

This command will update the packages in the system.

```
(base) amei-302@amei302-HP-EliteBook-840-G3:~$ sudo apt update
Hit:1 http://pk.archive.ubuntu.com/ubuntu jammy InRelease
Hit:2 http://pk.archive.ubuntu.com/ubuntu jammy-updates InRelease
Hit:3 http://pk.archive.ubuntu.com/ubuntu jammy-backports InRelease
Hit:4 http://security.ubuntu.com/ubuntu jammy-security InRelease
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
21 packages can be upgraded. Run 'apt list --upgradable' to see
(base) amei-302@amei302-HP-EliteBook-840-G3:~$
```

Command to install Dockers:

```
(base) amei-302@amei302-HP-EliteBook-840-G3:~$ sudo apt install docker.io
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
The following packages were automatically installed and are no longer required:
  libwpe-1.0-1 libwpebackend-fdo-1.0-1
Use 'sudo apt autoremove' to remove them.
Suggested packages:
  aufs-tools btrfs-progs cgroupfs-mount | cgroup-lite debootstrap
```

The Below command will start the docker services:

```
(base) amei-302@amei302-HP-EliteBook-840-G3:~$ sudo systemctl start docker
(base) amei-302@amei302-HP-EliteBook-840-G3:~$ sudo systemctl enable docker
(base) amei-302@amei302-HP-EliteBook-840-G3:~$
```

To check the docker version type `docker --version`:

```
(base) amei-302@amei302-HP-EliteBook-840-G3:~$ docker --version
Docker version 24.0.7, build 24.0.7-0ubuntu2~22.04.1
(base) amei-302@amei302-HP-EliteBook-840-G3:~$
```

Building first Docker image:

First I create an new directory and make a .html file inside it, **you can see in the image below all the code of html file**

```
(base) ame-i-302@ame-i302-HP-EliteBook-840-G3:~$ mkdir workspace
(base) ame-i-302@ame-i302-HP-EliteBook-840-G3:~$ cd workspace
(base) ame-i-302@ame-i302-HP-EliteBook-840-G3:~/workspace$ vim index.html
(base) ame-i-302@ame-i302-HP-EliteBook-840-G3:~/workspace$ cat index.html
<html>
<body>
<h1>HelloWorld
No table of contents entries found.
d..!! I am inside container..!!</h1>
</body>
</html>
(base) ame-i-302@ame-i302-HP-EliteBook-840-G3:~/workspace$
```

add the following code inside the Dockerfile, to be able to build a working image with the web application

```
(base) ame-i-302@ame-i302-HP-EliteBook-840-G3:~/workspace$ vim Dockerfile
(base) ame-i-302@ame-i302-HP-EliteBook-840-G3:~/workspace$ cat Dockerfile
FROM ubuntu:22.04
RUN apt-get update -y
RUN apt-get install -y apache2
RUN chown -R www-data:www-data /var/www/
ENV APACHE_RUN_USER www-data
ENV APACHE_RUN_GROUP www-data
ENV APACHE_LOG_DIR /var/log/apache2
ENV APACHE_LOCK_DIR /var/lock/apache2
ENV APACHE_PID_FILE /var/run/apache2.pid
ADD index.html /var/www/html/
EXPOSE 80
ENTRYPOINT ["/usr/sbin/apache2ctl"]
CMD ["-D","FOREGROUND"]
(base) ame-i-302@ame-i302-HP-EliteBook-840-G3:~/workspace$
(base) ame-i-302@ame-i302-HP-EliteBook-840-G3:~/workspace$
```

Build the docker image

```
(base) ame-i-302@ame-i302-HP-EliteBook-840-G3:~/workspace$ sudo docker build -t webserver:latest .
[sudo] password for ame-i-302:
DEPRECATED: The legacy builder is deprecated and will be removed in a future release.
            Install the buildx component to build images with BuildKit:
            https://docs.docker.com/go/buildx/

Sending build context to Docker daemon  3.072kB
Step 1/13 : FROM ubuntu:22.04
22.04: Pulling from library/ubuntu
6414378b6477: Pull complete
Digest: sha256:0e5e4a57c2499249aafc3b40fcd541e9a456aab7296681a3994d631587203f97
Status: Downloaded newer image for ubuntu:22.04
--> 97271d29cb79
Step 2/13 : RUN apt-get update -y
--> Running in 7dc00cc59005
Get:1 http://security.ubuntu.com/ubuntu jammy-security InRelease [129 kB]
Get:2 http://security.ubuntu.com/ubuntu jammy-security/restricted amd64 Packages [3241 kB]
Get:3 http://archive.ubuntu.com/ubuntu jammy InRelease [270 kB]
Get:4 http://security.ubuntu.com/ubuntu jammy-security/universe amd64 Packages [1163 kB]
Get:5 http://archive.ubuntu.com/ubuntu jammy-updates InRelease [128 kB]
Get:6 http://security.ubuntu.com/ubuntu jammy-security/main amd64 Packages [2397 kB]
Get:7 http://archive.ubuntu.com/ubuntu jammy-backports InRelease [127 kB]
Get:8 http://security.ubuntu.com/ubuntu jammy-security/multiverse amd64 Packages [44.7 kB]
```


By entering below command, it will show list of images that has been installed on dockers till current time

```
(base) amei-302@amei302-HP-EliteBook-840-G3:~/workspace$ sudo docker images
REPOSITORY    TAG       IMAGE ID       CREATED        SIZE
webserver     latest    8cd08d3658a7   59 seconds ago 243MB
ubuntu        22.04    97271d29cb79   8 weeks ago    77.9MB
(base) amei-302@amei302-HP-EliteBook-840-G3:~/workspace$
```

Installing Alpine ISO File on dockers:

```
(base) amei-302@amei302-HP-EliteBook-840-G3:~/workspace$ sudo docker pull alpine
Using default tag: latest
latest: Pulling from library/alpine
43c4264eed91: Pull complete
Digest: sha256:beefd8a1da6d2915566fde36db9db0b524eb737fc57cd1367effd16dc0d06d
Status: Downloaded newer image for alpine:latest
docker.io/library/alpine:latest
```

To check if it has been installed or not, do:

```
(base) amei-302@amei302-HP-EliteBook-840-G3:~/workspace$ sudo docker images
REPOSITORY    TAG       IMAGE ID       CREATED        SIZE
webserver     latest    8cd08d3658a7   6 minutes ago 243MB
ubuntu        22.04    97271d29cb79   8 weeks ago    77.9MB
alpine        latest    91ef0af61f39   2 months ago   7.8MB
(base) amei-302@amei302-HP-EliteBook-840-G3:~/workspace$
```

Installing Ubuntu ISO File on dockers and checking is it installed or not:

```
(base) amei-302@amei302-HP-EliteBook-840-G3:~/workspace$ sudo docker pull ubuntu
Using default tag: latest
latest: Pulling from library/ubuntu
ff65ddf9395b: Pull complete
Digest: sha256:99c35190e22d294cdace2783ac55effc69d32896daaa265f0bbedbcde4fbe3e5
Status: Downloaded newer image for ubuntu:latest
docker.io/library/ubuntu:latest
(base) amei-302@amei302-HP-EliteBook-840-G3:~/workspace$ sudo docker images
REPOSITORY    TAG       IMAGE ID       CREATED        SIZE
webserver     latest    8cd08d3658a7   8 minutes ago 243MB
ubuntu        latest    59ab366372d5   4 weeks ago    78.1MB
ubuntu        22.04    97271d29cb79   8 weeks ago    77.9MB
alpine        latest    91ef0af61f39   2 months ago   7.8MB
(base) amei-302@amei302-HP-EliteBook-840-G3:~/workspace$
```

Now, let's start a container from the Alpine image.

Type the following command and press Enter to start a new container from Alpine image.

```
(base) amei-302@amei302-HP-EliteBook-840-G3:~/workspace$ sudo docker run -itd -p 8080:80 webserver:latest 47ef1153b2420a334bec746e38f35aa52f6c776da5e93d3dc9543bd38689468c
(base) amei-302@amei302-HP-EliteBook-840-G3:~/workspace$
```

Let us open up Firefox and type localhost:8080:



let's try to start Alpine image:

```
(base) amei-302@amei302-HP-EliteBook-840-G3:~/workspace$ sudo docker run -itd alpine f3636c52db0d343681eeb2b39f1144a20661739e255f3eb065c4d3f7ddaac7db
(base) amei-302@amei302-HP-EliteBook-840-G3:~/workspace$
```

let's try to start Ubuntu image:

```
(base) amei-302@amei302-HP-EliteBook-840-G3:~/workspace$ sudo docker run -itd ubuntu 1f47550c9e4da8019445ab917e2fda31ad5d2ab71626d6d16acff70d3fbcce74
(base) amei-302@amei302-HP-EliteBook-840-G3:~/workspace$
```

Now we can check the container ids using the following command.

```
(base) amei-302@amei302-HP-EliteBook-840-G3:~/workspace$ sudo docker ps
```

CONTAINER ID	IMAGE	COMMAND	CREATED	STATUS	PORTS	NAMES
1f47550c9e4d	ubuntu	"/bin/bash"	2 minutes ago	Up About a minute		confident_haslett
f3636c52db0d	alpine	"/bin/sh"	2 minutes ago	Up 2 minutes		sad_haibt
47ef1153b242	webserver:latest	"/usr/sbin/apache2ct..."	7 minutes ago	Up 7 minutes	0.0.0.0:8080->80/tcp, :::8080->80/tcp	jolly_haibt

```
(base) amei-302@amei302-HP-EliteBook-840-G3:~/workspace$
```

We can also get an interactive shell using the container id using the docker exec command:

```
(base) ame1-302@amei302-HP-EliteBook-840-G3:~/workspace$ sudo docker exec -it f3636c52db0d sh  
/ #
```

We can specify the container id and the command we want to use, in this case we are specifying sh which will give us a shell on the alpine container.

Running Practical Tasks in Containers:

(a) Container 1 - Alpine: Start a container with the alpine image, then:

- Install curl inside the container.
- Use curl to fetch and display the HTML content of <https://example.com>.
- Take a screenshot showing the successful installation of curl and the output of the curl command.

By Entering: `sudo docker run -it alpine COMMAND` we get access to alpine container.

Then I add the command of `apk add curl COMMAND` through which curl is now installed in alpine container

```
(base) ame1-302@amei302-HP-EliteBook-840-G3:~/workspace$ sudo docker run -it alpine  
/ # apk add curl  
fetch https://dl-cdn.alpinelinux.org/alpine/v3.20/main/x86_64/APKINDEX.tar.gz  
fetch https://dl-cdn.alpinelinux.org/alpine/v3.20/community/x86_64/APKINDEX.tar.gz  
(1/10) Installing ca-certificates (20240705-r0)  
(2/10) Installing brotli-libs (1.1.0-r2)  
(3/10) Installing c-ares (1.33.1-r0)  
(4/10) Installing libunistring (1.2-r0)  
(5/10) Installing libidn2 (2.3.7-r0)  
(6/10) Installing nghttp2-libs (1.62.1-r0)  
(7/10) Installing libpsl (0.21.5-r1)  
(8/10) Installing zstd-libs (1.5.6-r0)  
(9/10) Installing libcurl (8.11.0-r1)  
(10/10) Installing curl (8.11.0-r1)  
Executing busybox-1.36.1-r29.trigger  
Executing ca-certificates-20240705-r0.trigger  
OK: 13 MiB in 24 packages  
/ #
```

NOW to fetch and display the HTML content of <https://example.com>

```
(base) ame-i-302@ame-i-302-HP-EliteBook-840-G3:~/workspace$ ~$ docker run -it alpine
/ # curl https://example.com
<!doctype html>
<html>
<head>
  <title>Example Domain</title>

  <meta charset="utf-8" />
  <meta http-equiv="Content-type" content="text/html; charset=utf-8" />
  <meta name="viewport" content="width=device-width, initial-scale=1" />
  <style type="text/css">
    body {
      background-color: #f0f0f2;
      margin: 0;
      padding: 0;
      font-family: -apple-system, system-ui, BlinkMacSystemFont, "Segoe UI", "Open Sans", "Helvetica Neue", Helvetica, Arial, sans-serif;
    }
    div {
      width: 600px;
      margin: 5em auto;
      padding: 2em;
      background-color: #fdfdff;
      border-radius: 0.5em;
      box-shadow: 2px 3px 7px 2px rgba(0,0,0,0.02);
    }
    a:link, a:visited {
      color: #38488f;
      text-decoration: none;
    }
    @media (max-width: 700px) {
      div {
        margin: 0 auto;
        width: auto;
      }
    }
  </style>
</head>

<body>
<div>
  <h1>Example Domain</h1>
  <p>This domain is for use in illustrative examples in documents. You may use this
  domain in literature without prior coordination or asking for permission.</p>
  <p><a href="https://www.iana.org/domains/example">More information...</a></p>
</div>
</body>
</html>
/ # █
```

(b) Container 2 - Ubuntu: Start a container with the ubuntu image, then:

- Install Python inside the container.
 - Write and execute a simple Python script that calculates the factorial of a number provided as input.
 - Show the installation of Python, the code for the Python script, and the output after running it with an example input.
-

Command to Start a container with the ubuntu image

```
(base) ame1-302@ame1302-HP-EliteBook-840-G3:~/workspace$ sudo docker run -it ubuntu  
root@49a7d1090620:/#
```

To install python in ubuntu container we need first to update the container and then install python in it when you enter the command **apt update && apt install python3** after a while you will be asked do you want to continue, you need to press y and hit enter key here. You can see in the image where the text is selected.

```
root@49a7d1090620:/# apt update && apt install python3  
Get:1 http://security.ubuntu.com/ubuntu noble-security InRelease [126 kB]  
Get:2 http://archive.ubuntu.com/ubuntu noble InRelease [256 kB]  
Get:3 http://security.ubuntu.com/ubuntu noble-security/universe amd64 Packages [720 kB]  
Get:4 http://archive.ubuntu.com/ubuntu noble-updates InRelease [126 kB]  
Get:5 http://archive.ubuntu.com/ubuntu noble-backports InRelease [126 kB]  
Get:6 http://archive.ubuntu.com/ubuntu noble/restricted amd64 Packages [117 kB]  
Get:7 http://security.ubuntu.com/ubuntu noble-security/main amd64 Packages [574 kB]  
Get:8 http://archive.ubuntu.com/ubuntu noble/multiverse amd64 Packages [331 kB]  
Get:9 http://security.ubuntu.com/ubuntu noble-security/multiverse amd64 Packages [15.3 kB]  
Get:10 http://security.ubuntu.com/ubuntu noble-security/restricted amd64 Packages [542 kB]  
Get:11 http://archive.ubuntu.com/ubuntu noble/main amd64 Packages [1808 kB]  
Get:12 http://archive.ubuntu.com/ubuntu noble/universe amd64 Packages [19.3 MB]  
Get:13 http://archive.ubuntu.com/ubuntu noble-updates/main amd64 Packages [793 kB]  
Get:14 http://archive.ubuntu.com/ubuntu noble-updates/restricted amd64 Packages [542 kB]  
Get:15 http://archive.ubuntu.com/ubuntu noble-updates/universe amd64 Packages [930 kB]  
Get:16 http://archive.ubuntu.com/ubuntu noble-updates/multiverse amd64 Packages [18.4 kB]  
Get:17 http://archive.ubuntu.com/ubuntu noble-backports/universe amd64 Packages [11.8 kB]  
Fetched 26.4 MB in 11s (2483 kB/s)  
Reading package lists... Done  
Building dependency tree... Done  
Reading state information... Done  
3 packages can be upgraded. Run 'apt list --upgradable' to see them.  
Reading package lists... Done  
Building dependency tree... Done  
Reading state information... Done  
The following additional packages will be installed:  
  ca-certificates libexpat1 libpython3-stdlib libpython3.12-minimal libpython3.12-stdlib libreadline8t  
  python3.12 python3.12-minimal readline-common tzdata  
Suggested packages:  
  python3-doc python3-tk python3-venv python3.12-venv python3.12-doc binutils binfmt-support readline-  
The following NEW packages will be installed:  
  ca-certificates libexpat1 libpython3-stdlib libpython3.12-minimal libpython3.12-stdlib libreadline8t  
  python3-minimal python3.12 python3.12-minimal readline-common tzdata  
0 upgraded, 16 newly installed, 0 to remove and 3 not upgraded.  
Need to get 8430 kB of archives.  
After this operation, 30.2 MB of additional disk space will be used.  
Do you want to continue? [Y/n] y  
Get:1 http://archive.ubuntu.com/ubuntu noble-updates/main amd64 libpython3.12-minimal amd64 3.12.3-1ub  
Get:2 http://archive.ubuntu.com/ubuntu noble-updates/main amd64 libexpat1 amd64 2.6.1-2ubuntu0.1 [87.1  
Get:3 http://archive.ubuntu.com/ubuntu noble-updates/main amd64 python3.12-minimal amd64 3.12.3-1ubunt  
Get:4 http://archive.ubuntu.com/ubuntu noble-updates/main amd64 python3-minimal amd64 3.12.3-0ubuntu2  
Get:5 http://archive.ubuntu.com/ubuntu noble/main amd64 media-types all 10.1.0 [27.5 kB]
```

After this Please Select your time zone first and hit enter key, then select your area accordingly and hit enter key.


```

Please select the geographic area in which you live. Subsequent configuration questions will narrow this down by presenting a list of cities, representing the
zones in which they are located.

1. Africa 2. America 3. Antarctica 4. Arctic 5. Asia 6. Atlantic 7. Australia 8. Europe 9. Indian 10. Pacific 11. Etc
Geographic area: 5

Please select the city or region corresponding to your time zone.

1. Aden 11. Baku 21. Damascus 31. Hong_Kong 41. Kashgar 51. Makassar 61. Pyongyang 71. Srednekolymsk 81. Urumqi
2. Almaty 12. Bangkok 22. Dhaka 32. Hovd 42. Kathmandu 52. Manila 62. Qatar 72. Taipei 82. Ust-Nera
3. Amman 13. Barnaul 23. Dili 33. Irkutsk 43. Khandyga 53. Muscat 63. Qostanay 73. Tashkent 83. Vientiane
4. Anadyr 14. Beirut 24. Dubai 34. Istanbul 44. Kolkata 54. Nicosia 64. Qyzylorda 74. Tbilisi 84. Vladivostok
5. Aqtau 15. Bishkek 25. Dushanbe 35. Jakarta 45. Krasnoyarsk 55. Novokuznetsk 65. Riyadh 75. Tehran 85. Yakutsk
6. Aqtobe 16. Brunei 26. Famagusta 36. Jayapura 46. Kuala_Lumpur 56. Novosibirsk 66. Sakhalin 76. Tel_Aviv 86. Yangon
7. Ashgabat 17. Chita 27. Gaza 37. Jerusalem 47. Kuching 57. Omsk 67. Samarkand 77. Thimphu 87. Yekaterinburg
8. Atyrau 18. Choibalsan 28. Harbin 38. Kabul 48. Kuwait 58. Oral 68. Seoul 78. Tokyo 88. Yerevan
9. Baghdad 19. Chongqing 29. Hebron 39. Kamchatka 49. Macau 59. Phnom_Penh 69. Shanghai 79. Tomsk
10. Bahrain 20. Colombo 30. Ho_Chi_Minh 40. Karachi 50. Magadan 60. Pontianak 70. Singapore 80. Ulaanbaatar

Time zone: 40

Current default time zone: 'Asia/Karachi'
Local time is now: Sat Nov 9 18:02:53 PKT 2024.
Universal Time is now: Sat Nov 9 13:02:53 UTC 2024.
Run 'dpkg-reconfigure tzdata' if you wish to change it.

```

Now we need to install vim or nano, both are text editor used to edit or add text to a file, while remaining inside the terminal.

Here I am installing Vim

```

root@49a7d1090620:/# apt install vim
Reading package lists... 80%

```

Making a python file and entering code in it.

```

root@49a7d1090620:/# vim factorial.py
root@49a7d1090620:/# cat factorial.py
def factorial(n):
    if n < 0:
        return "Factorial is not defined for negative numbers."
    elif n == 0 or n == 1:
        return 1
    else:
        result = 1
        for i in range(2, n + 1):
            result *= i
        return result

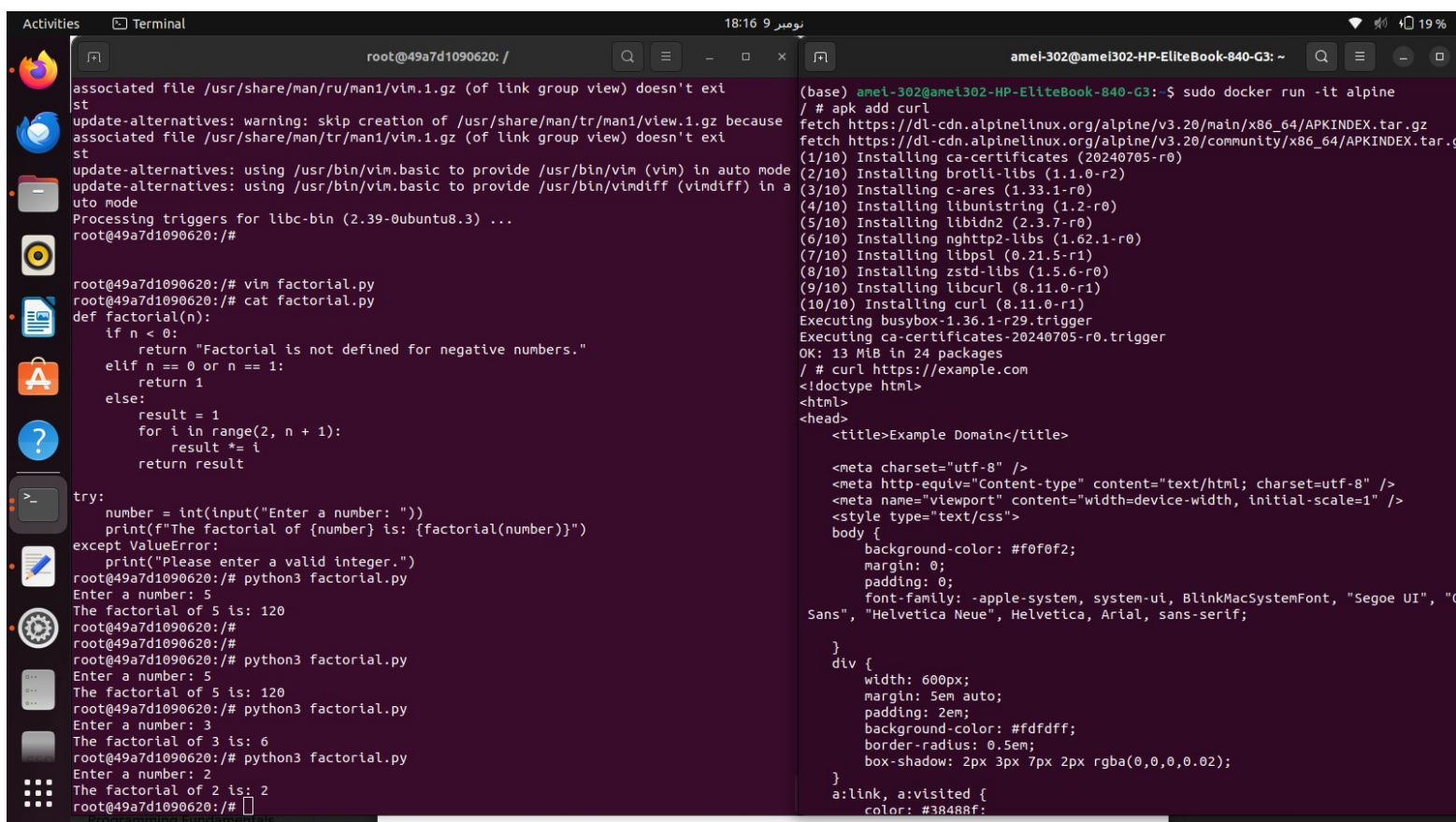
try:
    number = int(input("Enter a number: "))
    print(f"The factorial of {number} is: {factorial(number)}")
except ValueError:
    print("Please enter a valid integer.")
root@49a7d1090620:/#

```

Running the Program and Entering Input

```
root@49a7d1090620:/# python3 factorial.py
Enter a number: 5
The factorial of 5 is: 120
root@49a7d1090620:/#
root@49a7d1090620:/#
root@49a7d1090620:/# python3 factorial.py
Enter a number: 5
The factorial of 5 is: 120
root@49a7d1090620:/# python3 factorial.py
Enter a number: 3
The factorial of 3 is: 6
root@49a7d1090620:/# python3 factorial.py
Enter a number: 2
The factorial of 2 is: 2
root@49a7d1090620:/#
```

(c) Make sure both containers are running simultaneously



```
root@49a7d1090620:/# python3 factorial.py
Enter a number: 5
The factorial of 5 is: 120
root@49a7d1090620:/#
root@49a7d1090620:/#
root@49a7d1090620:/# python3 factorial.py
Enter a number: 5
The factorial of 5 is: 120
root@49a7d1090620:/# python3 factorial.py
Enter a number: 3
The factorial of 3 is: 6
root@49a7d1090620:/# python3 factorial.py
Enter a number: 2
The factorial of 2 is: 2
root@49a7d1090620:/#
```

```
(base) amei-302@amei302-HP-EliteBook-840-G3:~$ sudo docker run -it alpine
/ # apk add curl
fetch https://dl-cdn.alpinelinux.org/alpine/v3.20/main/x86_64/APKINDEX.tar.gz
fetch https://dl-cdn.alpinelinux.org/alpine/v3.20/community/x86_64/APKINDEX.tar.gz
(1/10) Installing ca-certificates (20240705-r0)
(2/10) Installing brotli-libs (1.1.0-r2)
(3/10) Installing c-ares (1.33.1-r0)
(4/10) Installing libunistring (1.2-r0)
(5/10) Installing libidn2 (2.3.7-r0)
(6/10) Installing nghttp2-libs (1.62.1-r0)
(7/10) Installing libpsl (0.21.5-r1)
(8/10) Installing zstd-libs (1.5.6-r0)
(9/10) Installing libcurl (8.11.0-r1)
(10/10) Installing curl (8.11.0-r1)
Executing busybox-1.36.1-r29.trigger
Executing ca-certificates-20240705-r0.trigger
OK: 13 MiB in 24 packages
/ # curl https://example.com
<!doctype html>
<html>
<head>
<title>Example Domain</title>
<meta charset="utf-8" />
<meta http-equiv="Content-type" content="text/html; charset=utf-8" />
<meta name="viewport" content="width=device-width, initial-scale=1" />
<style type="text/css">
body {
background-color: #f0f0f2;
margin: 0;
padding: 0;
font-family: -apple-system, system-ui, BlinkMacSystemFont, "Segoe UI", "C
Sans", "Helvetica Neue", Helvetica, Arial, sans-serif;
}
div {
width: 600px;
margin: 5em auto;
padding: 2em;
background-color: #fdfdff;
border-radius: 0.5em;
box-shadow: 2px 3px 7px rgba(0,0,0,0.02);
}
a:link, a:visited {
color: #38488f;
```