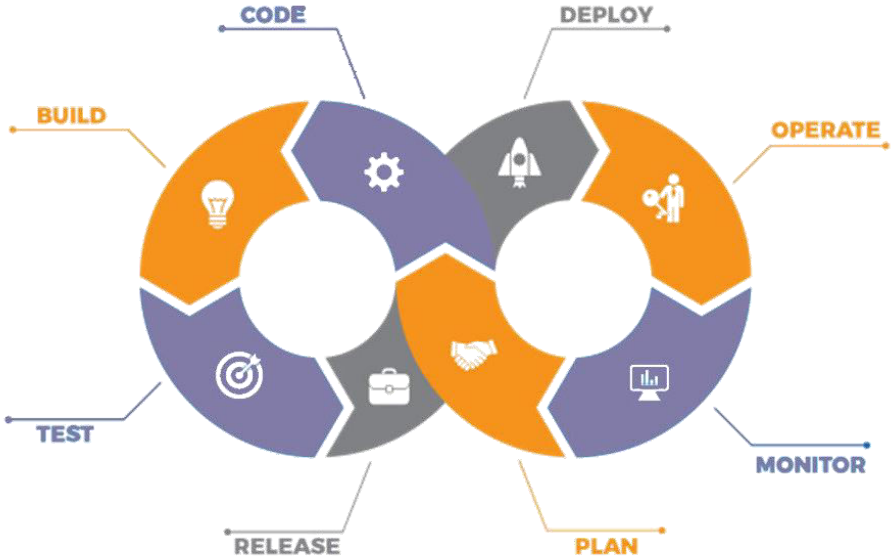
Containerization Using Docker - I



Agenda

01 What is Virtualization?

02 What is Containerization?

03 Containerization Tools

04 Components of Docker

05 Installing Docker

06 Common Docker Commands

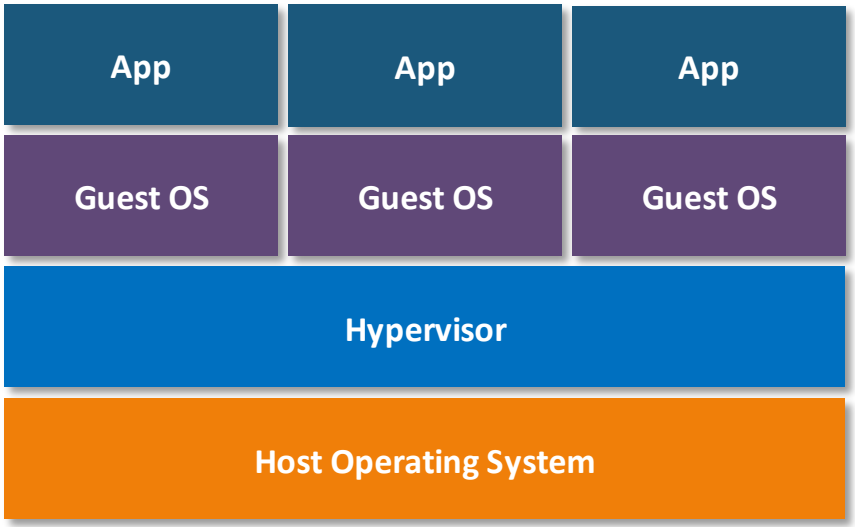
07 Creating a Docker Hub Account

08 Introduction to Dockerfile

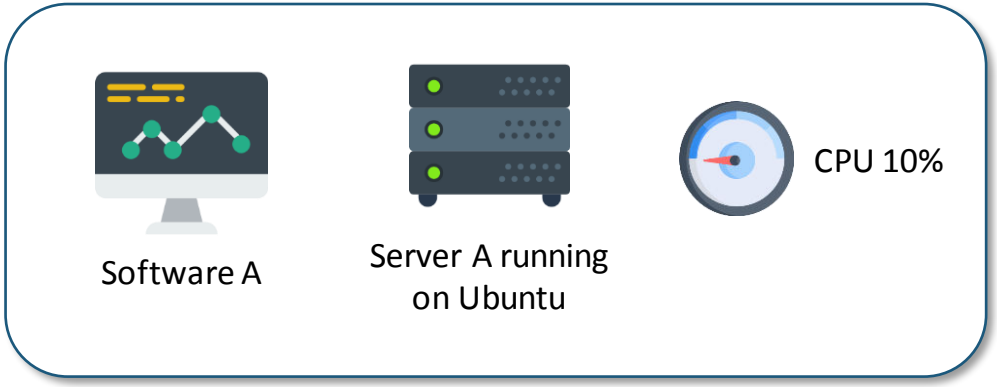
What is Virtualization?

What is Virtualization?

Virtualization is the process of running multiple virtual systems or resources on top of a single physical machine. These resources could be a storage device, network or even an operating system!

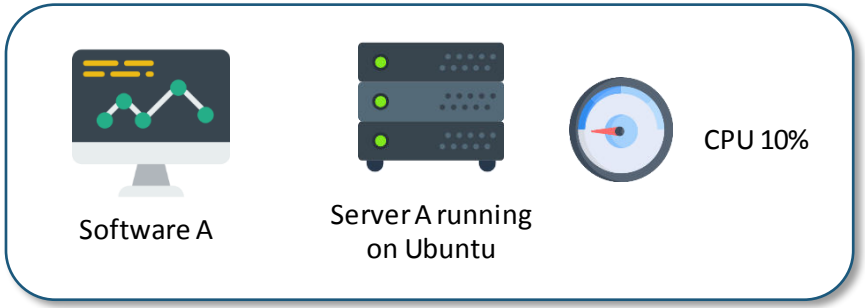


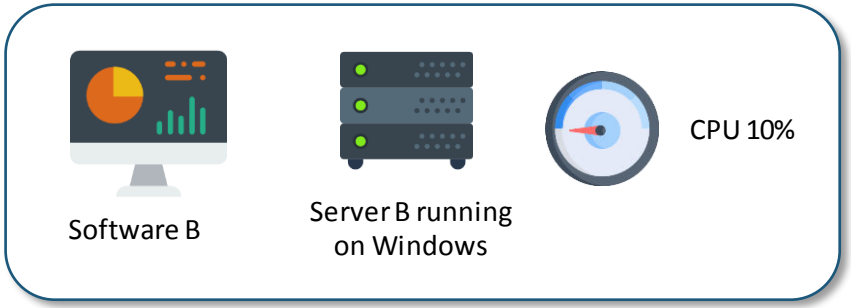
Problems before Virtualization



Imagine Software A running on Server A which has Ubuntu running on it. This software can only run in the Ubuntu environment.

Problems before Virtualization



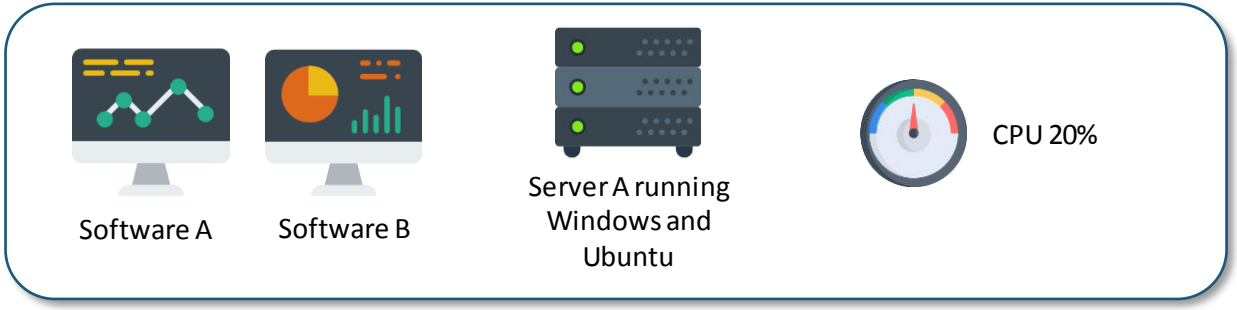


Some time later, we needed Software B which can only run on Windows. Therefore, we had to buy and run a Server B which had windows running on it. The software took only 10% of the CPU resources.

Problems before Virtualization

- Buying servers was expensive.
- Resources were not being utilized at their full potential.
- The process of getting any software up and running was time consuming.
- Disaster recovery was difficult.

After Virtualization



Windows and Ubuntu OS now are running on the same server in parallel using the Virtualization technology. This accounts for better CPU utilization and cost savings!

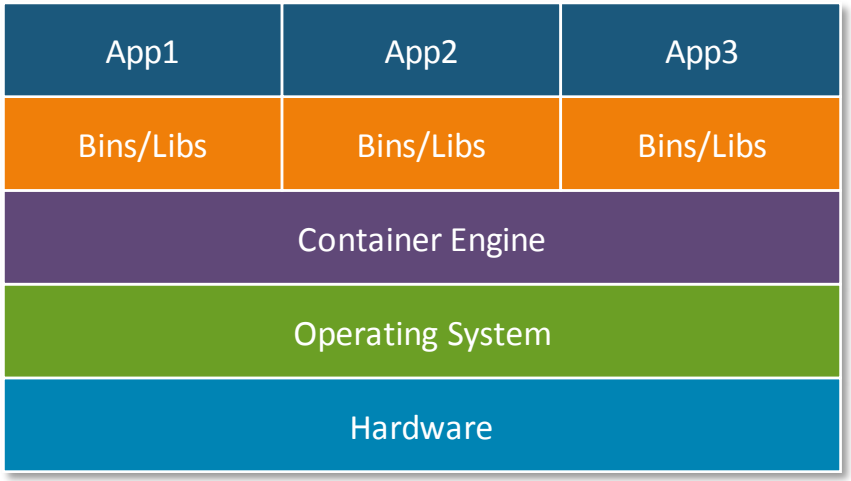
Advantages of Virtualization

- It results in reduced spending.
- Resources are utilized more efficiently.
- Process of getting software up and running is shorter.
- Easier backup and disaster recovery is available.

What is Containerization?

What is Containerization?

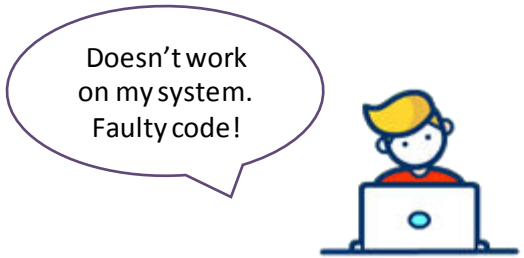
Application **containerization** is an OS-level virtualization method used to deploy and run distributed applications without launching an entire virtual machine (VM) for each app.



Problems before Containerization

Developers when run the code on their system, it would run perfectly. But the same code would not run on the operations team's system.

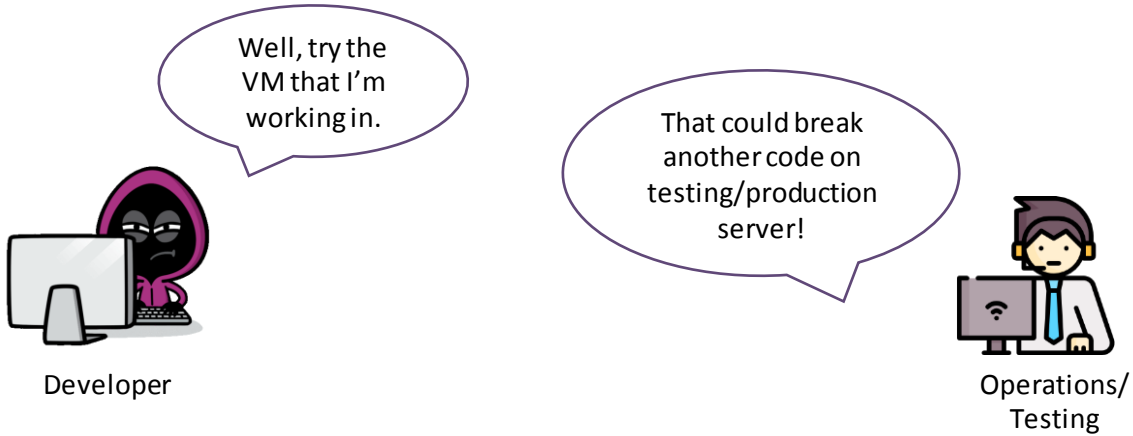
Developer



Operations/ Testing

Problems before Containerization

The problem was with the environment the code was being run in. Well, a simple answer could be, why not give the same VM to the operations/testing team to run the code.



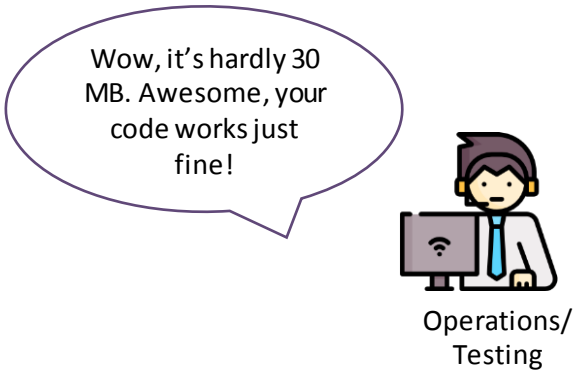
Problems before Containerization

- VMs took too many resources to run.
- VMs were too big in size to be portable.
- VMs were not developer friendly.

How did containers solve the problems?

With containers, all the environment issues were solved. The developer could easily wrap their code in a lightweight container and pass it on to the operations team.

Developer



Operations/ Testing

Advantages of Containers

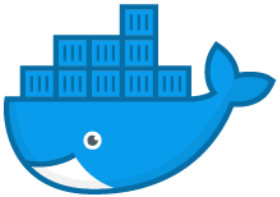
- Containers are not resource hungry.
- They are lightweight and hence portable.
- They are developer friendly and can be configured through the code.

Containerization Tools

Containerization Tools

MESOS

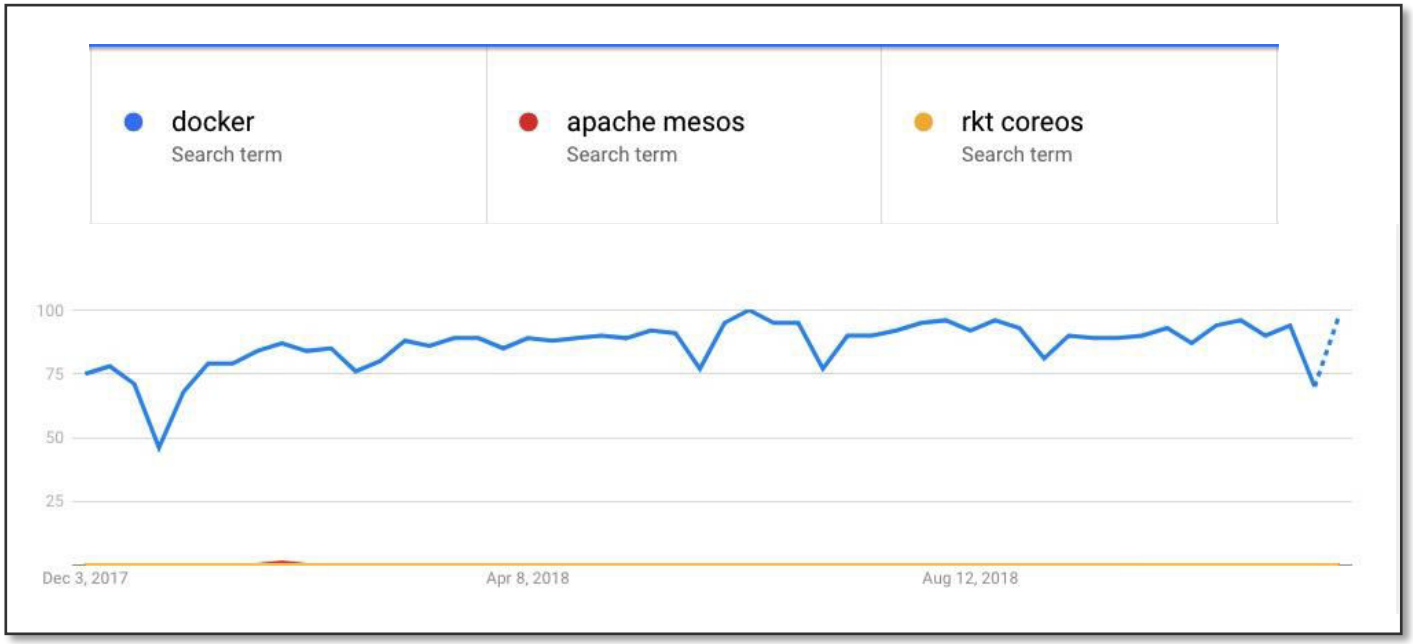
rkt



docker

Containerization Tools

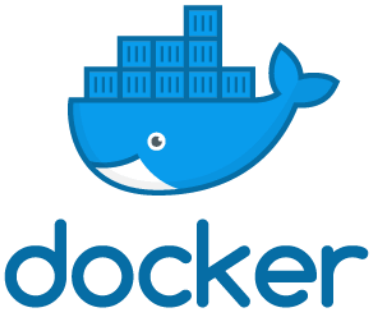
Docker is clearly the most famous among them all!



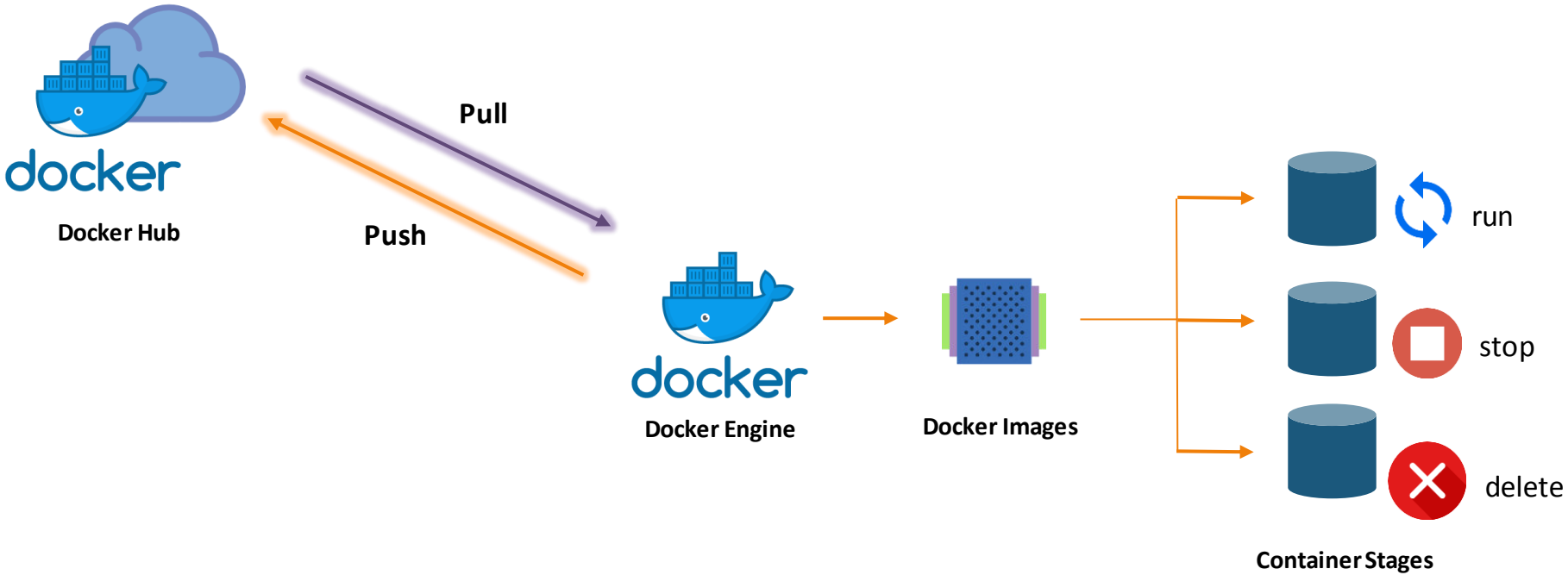
What is Docker?

What is Docker?

Docker is a computer program that performs operating-system-level virtualization, also known as "containerization". It was first released in 2013 and is developed by Docker, Inc. Docker is used to run software packages called "containers".

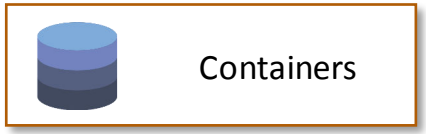


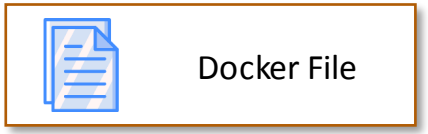
Docker Container Life Cycle



Components of Docker Ecosystem

Components of Docker Ecosystem

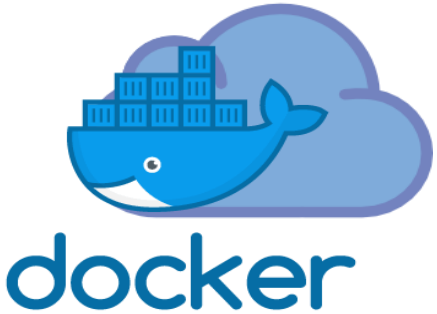




Components of Docker Ecosystem

- Docker Hub
- Docker Engine
- Docker Images
- Containers
- Docker Volumes
- Docker File

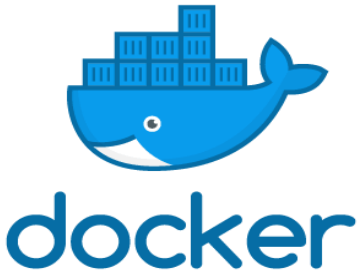
- Docker Hub is a central public docker registry.
- It can store custom docker images.
- The service is free, but your images would be public.
- It requires username/password.



Components of Docker Ecosystem

- Docker Hub
- Docker Engine
- Docker Images
- Containers
- Docker Volumes
- Docker File

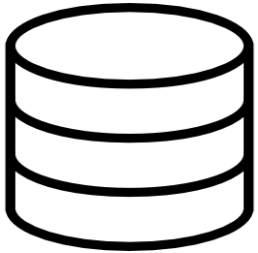
- Docker Engine is the heart of the docker ecosystem.
- It is responsible for managing your container runtimes.
- It works on top of operating system level.
- It utilizes the kernel of the underlying OS.



Components of Docker Ecosystem

- Docker Hub
- Docker Engine
- Docker Images
- Containers
- Docker Volumes
- Docker File

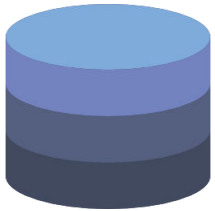
- Docker Image is like the template of a container.
- It is created in layers.
- Any new changes in the image results in creating a new layer.
- One can launch multiple containers from a single docker image.



Components of Docker Ecosystem

- Docker Hub
- Docker Engine
- Docker Images
- Containers
- Docker Volumes
- Docker File

- A Docker Container is a lightweight software environment.
- It works on top of the underlying OS kernel.
- It is small in size and therefore is highly portable.
- It is created using the docker image.



Components of Docker Ecosystem

- Docker Hub
- Docker Engine
- Docker Images
- Containers
- Docker Volumes
- Docker File

- Docker Containers cannot persist data.
- To persist data in containers, we can use Docker Volume.
- A Docker Volume can connect to multiple containers simultaneously.
- If not created explicitly, a volume is automatically created when we create a container.

Components of Docker Ecosystem

- Docker Hub
- Docker Engine
- Docker Images
- Containers
- Docker Volumes
- Dockerfile

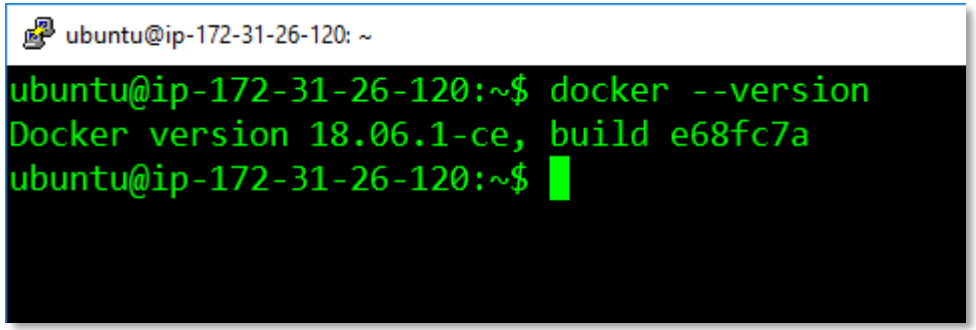
- Dockerfile is a YAML file, which is used to create custom containers
- It can include commands that have to be run on the command line
- This Dockerfile can be used to build custom container images

Installing Docker

Common Docker Commands

Common Docker Commands

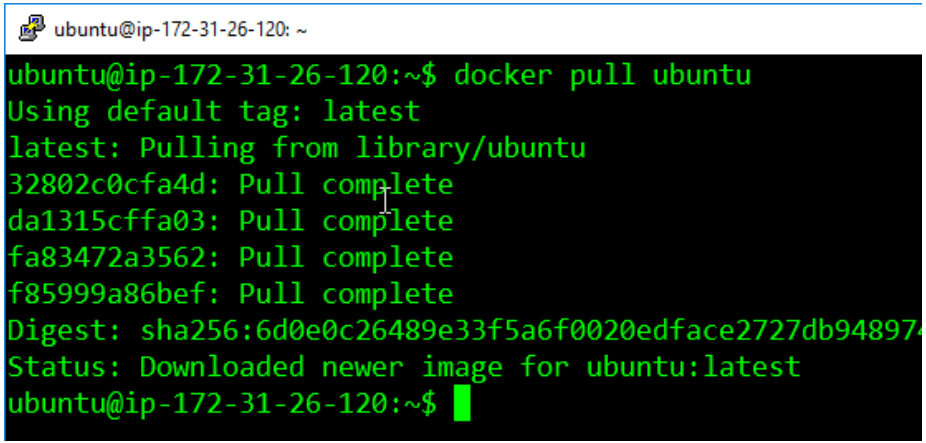
```
docker --version
```



This command helps you know the installed version of the docker software on your system.

Common Docker Commands

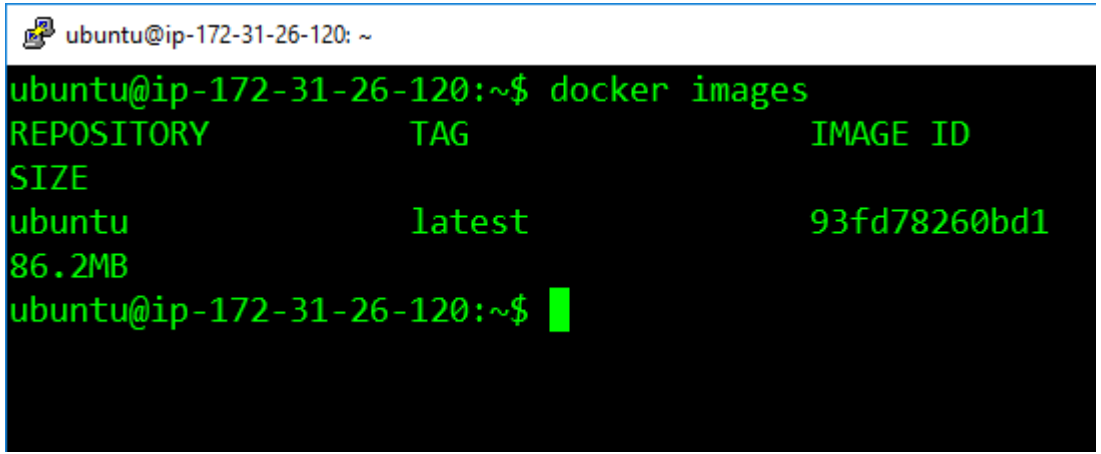
```
docker pull <image-name>
```



This command helps you pull images from the central docker repository.

Common Docker Commands

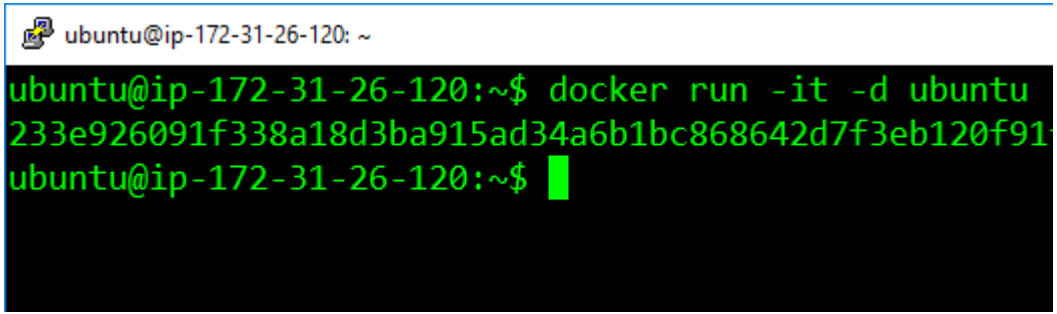
docker images



This command helps you in listing all the docker images downloaded on your system.

Common Docker Commands

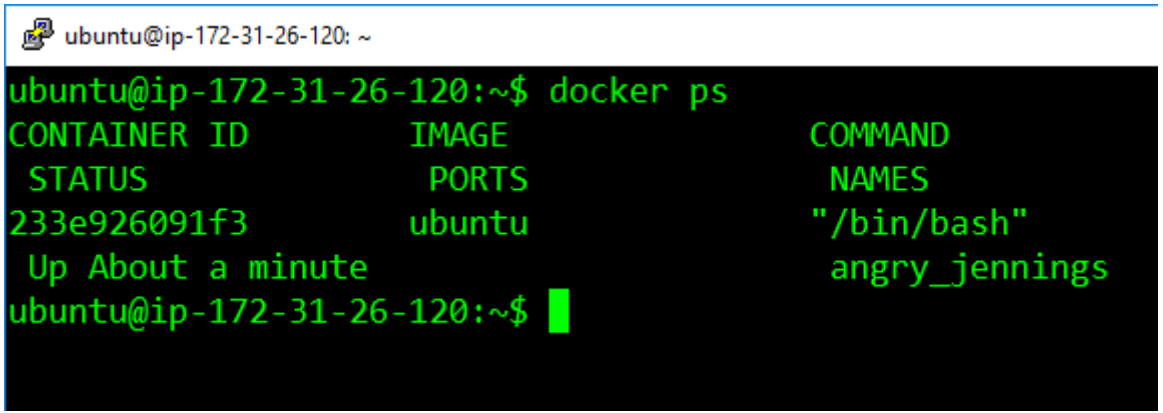
```
docker run <image-name>
```



This command helps in running containers from their image name.

Common Docker Commands

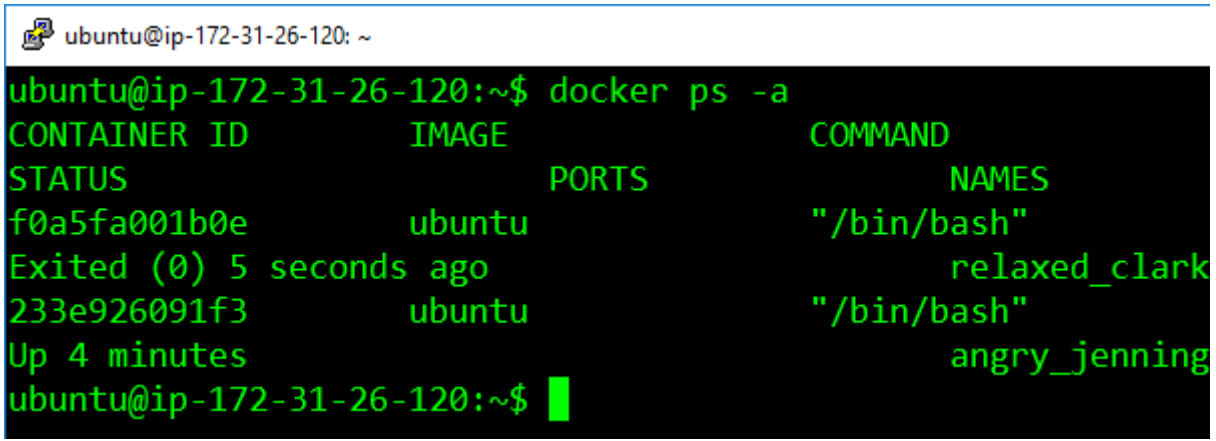
docker ps



This command helps in listing all the containers which are **running** in the system.

Common Docker Commands

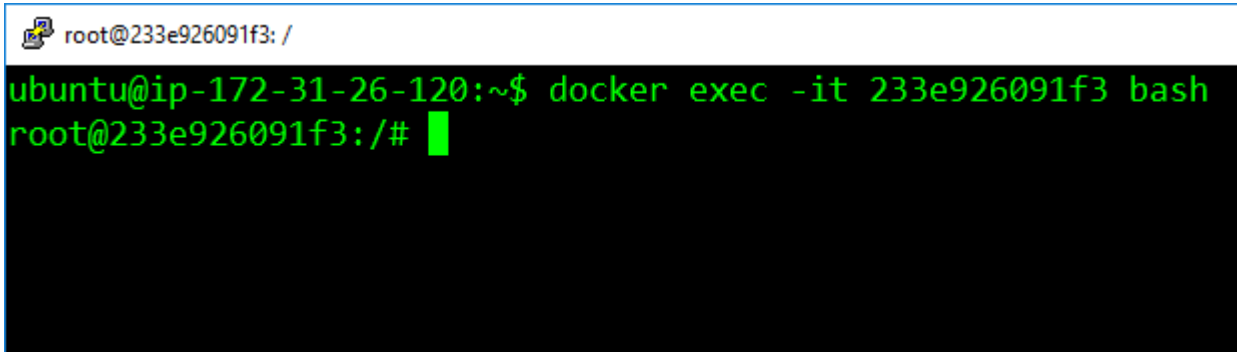
docker ps -a



If there are any stopped containers, they can be seen by adding the **-a** flag in this command.

Common Docker Commands

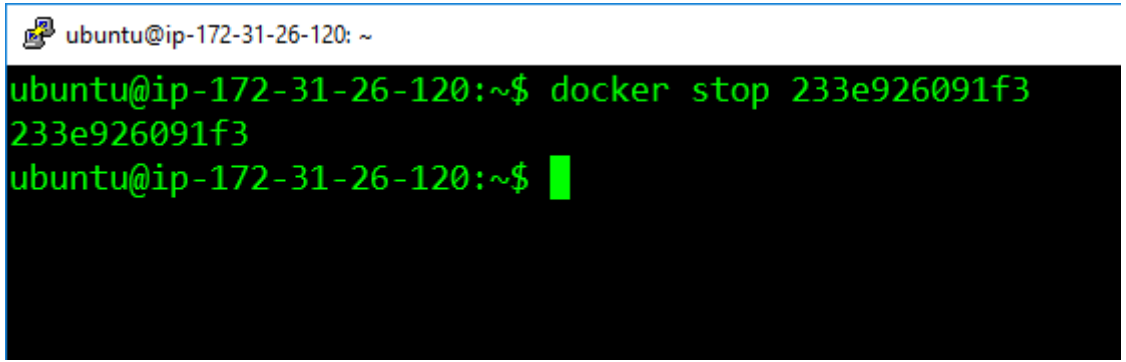
```
docker exec <container-id>
```



For logging into/accessing the container, one can use the **exec** command.

Common Docker Commands

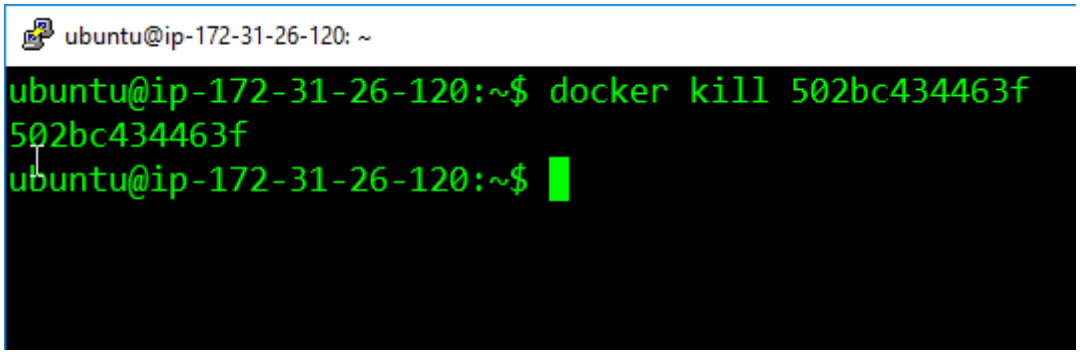
```
docker stop <container-id>
```



For stopping a running container, we use the **stop** command.

Common Docker Commands

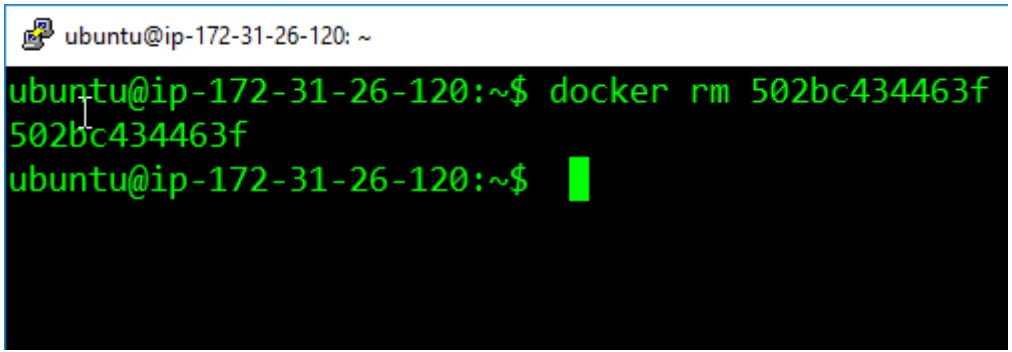
```
docker kill <container-id>
```



This command kills the container by stopping its execution immediately.
The difference between **docker kill** and **docker stop**: 'docker stop' gives the container time to shutdown gracefully; whereas, in situations when it is taking too much time for getting the container to stop, one can opt to kill it.

Common Docker Commands

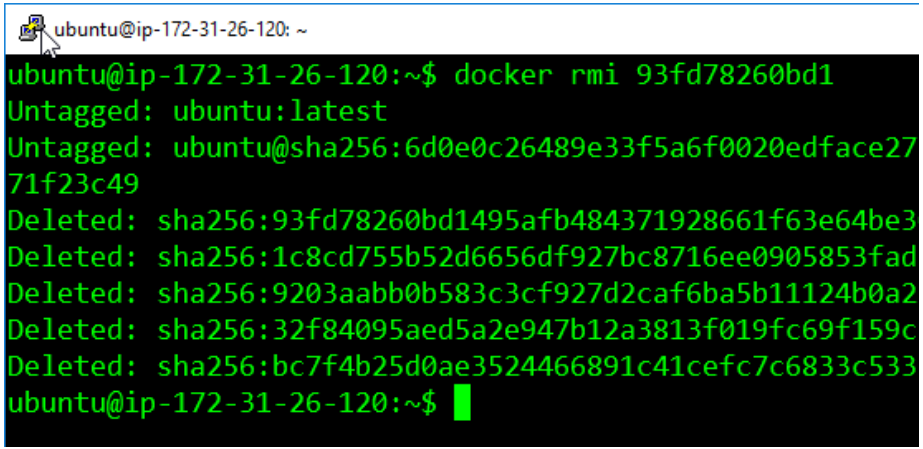
```
docker rm <container-id>
```



To remove a stopped container from the system, we use the **rm** command.

Common Docker Commands

```
docker rmi <image-id>
```

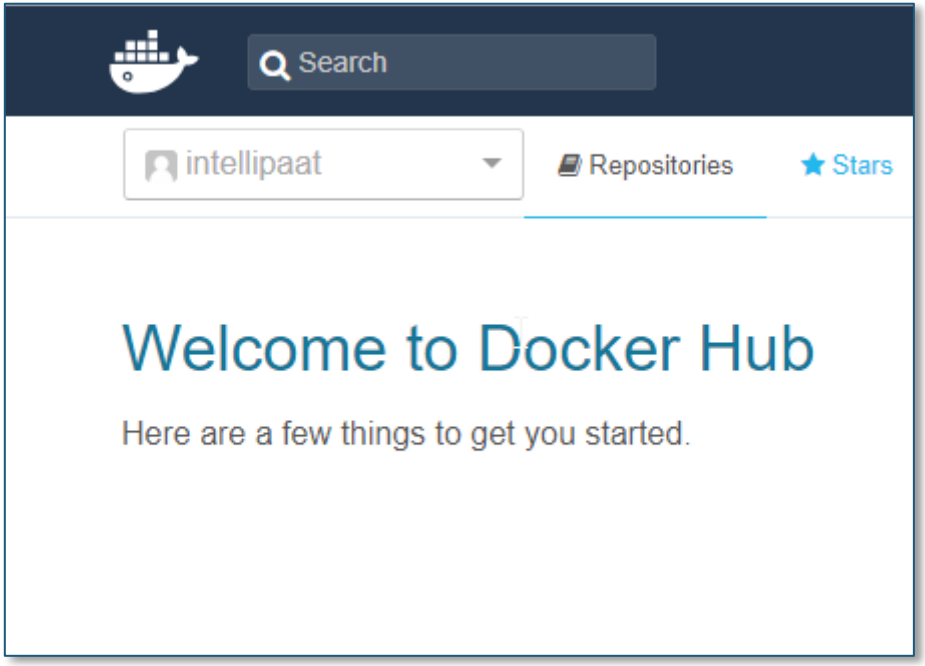


To remove an image from the system, we use the **rmi** command.

Creating a Docker Hub Account

Creating a Docker Hub Account

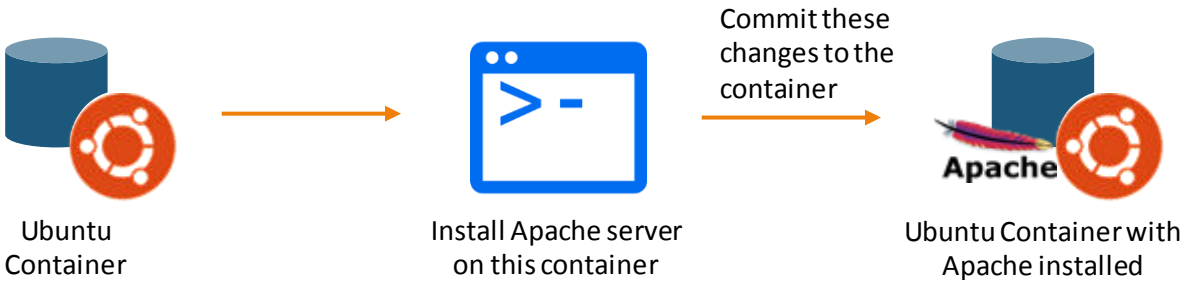
1. Navigate to https://hub.docker.com
2. Sign up on the website
3. Agree to the terms and conditions
4. Click on Sign up
5. Check your email, and verify your email by clicking on the link
6. Finally, login using the credentials you provided on the sign up page



Committing Changes to a Container

Committing Changes to a Docker Container

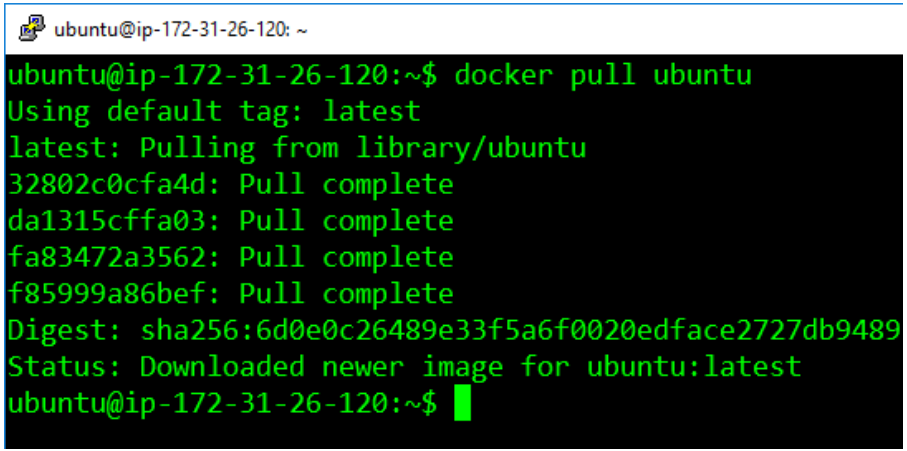
Let's try to accomplish the following example with a container and see how we can commit this container into an image.



Committing Changes to a Docker Container

1. Pull the Docker Container using the command:

```
docker pull ubuntu
```

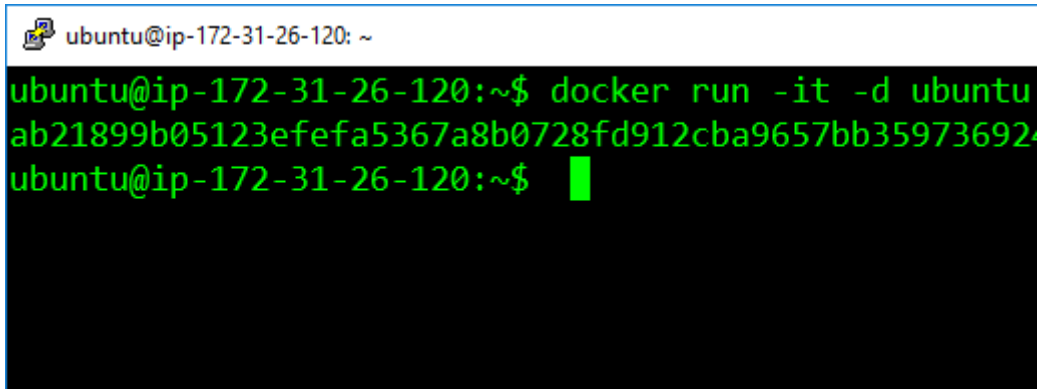


In our case, the image name is “ubuntu”.

Committing Changes to a Docker Container

2. Run the container using the command:

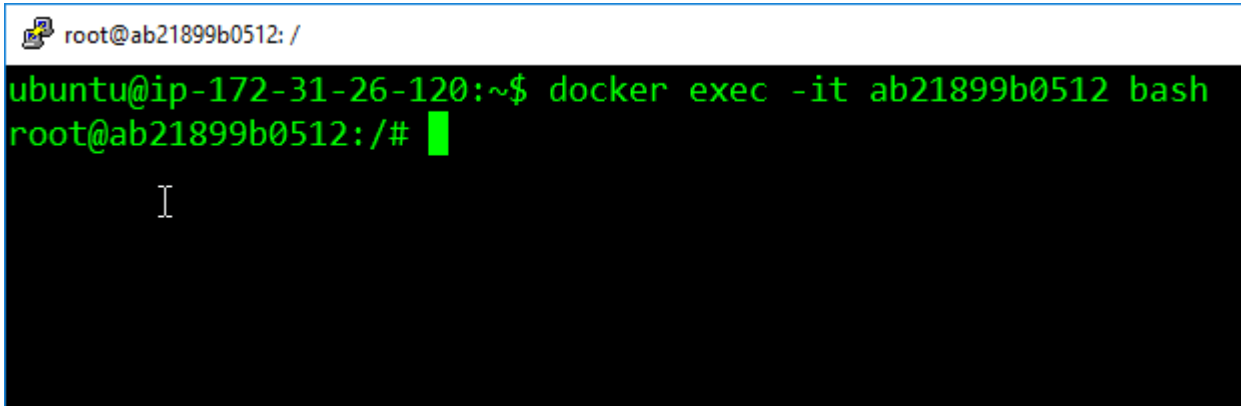
```
docker run -it -d ubuntu
```



Committing Changes to a Docker Container

3. Access the container using the command:

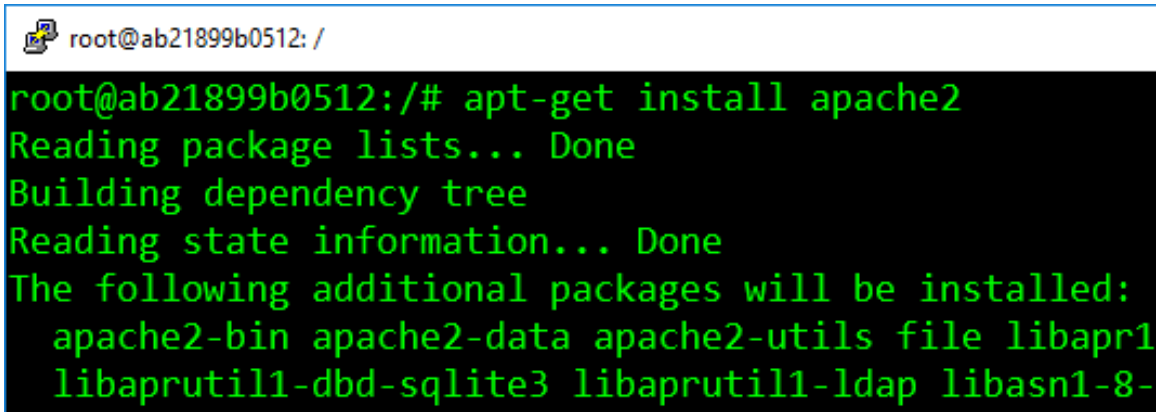
```
docker exec -it <container-id> bash
```



Committing Changes to a Docker Container

4. Install Apache2 on this container using the following commands:

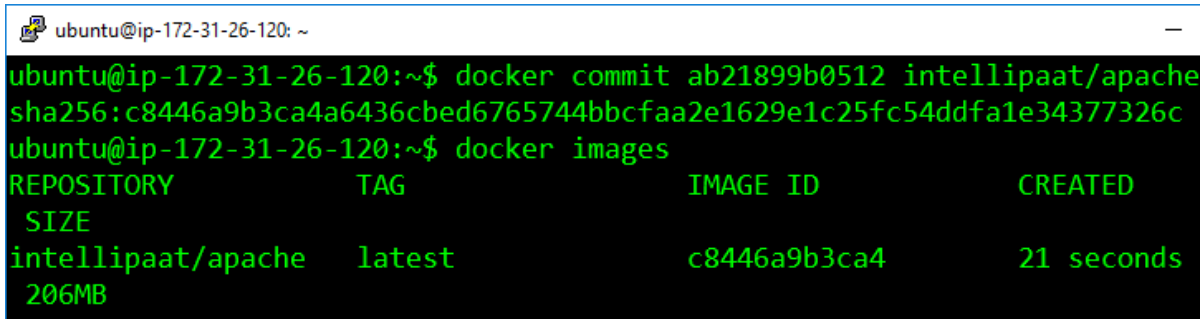
```
apt-get update
apt-get install apache2
```



Committing Changes to a Docker Container

5. Exit the container and save it using this command. The saved container will be converted into an image with the name specified.

```
docker commit <container-id> <username>/<container-name>
```



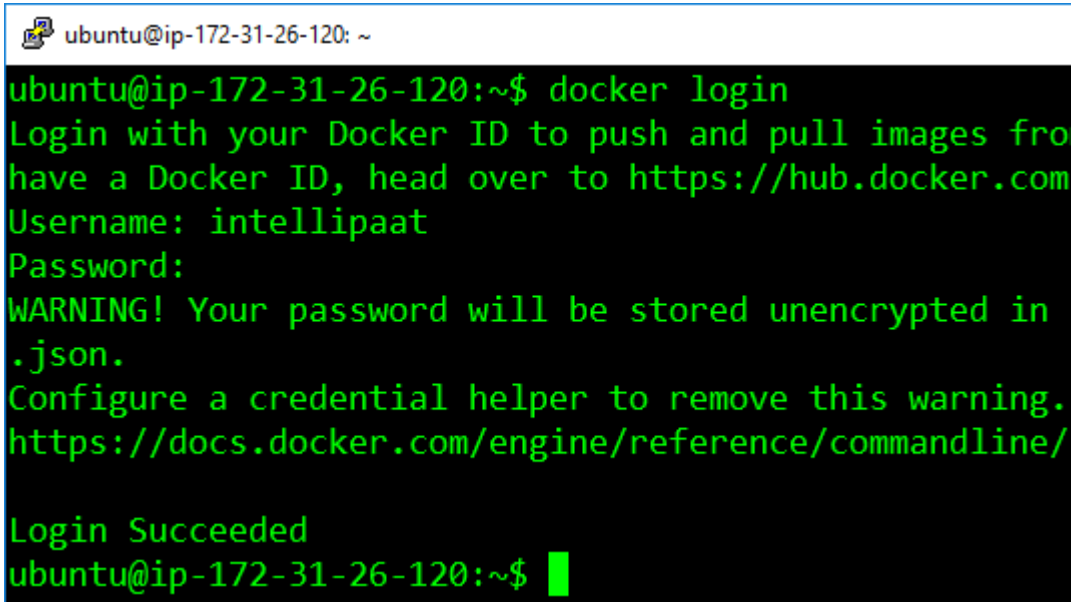
The **username** has to match with the username you created on DockerHub.
The **container-name** can be anything.

Pushing the Container on DockerHub

Pushing the Container on DockerHub

1. The first step is to login. It can be done using the following command:

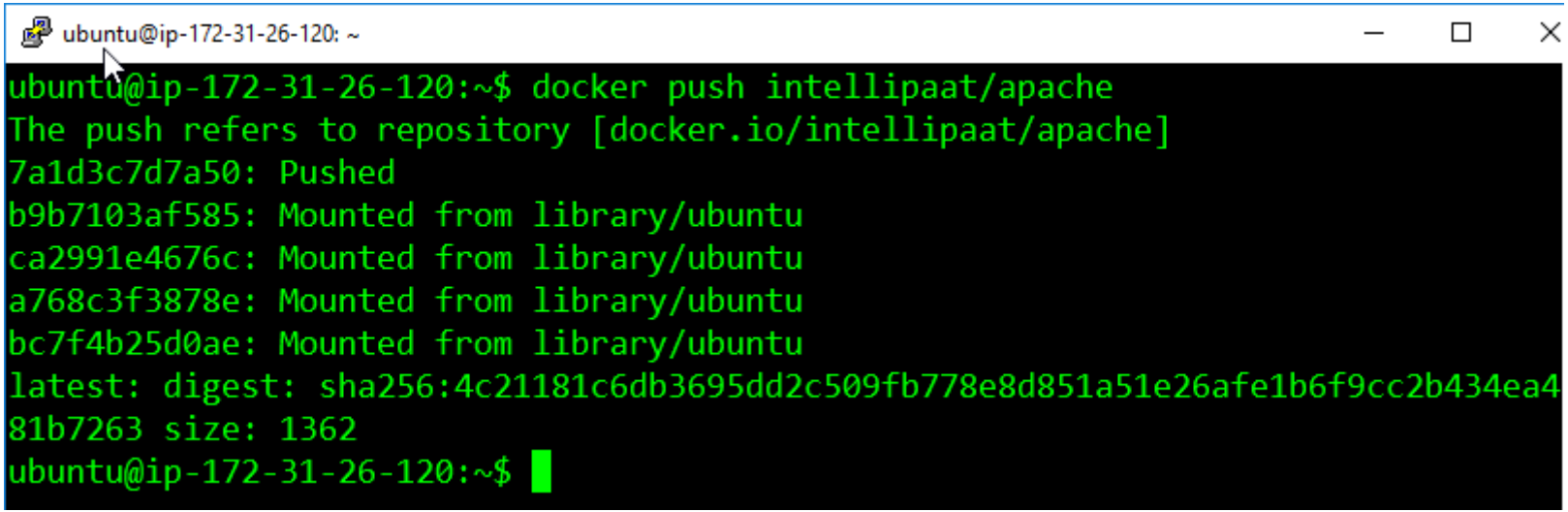
```
docker login
```



Pushing the Container on DockerHub

2. For pushing your container on DockerHub, use the following command:

```
docker push <username>/<container-id>
```

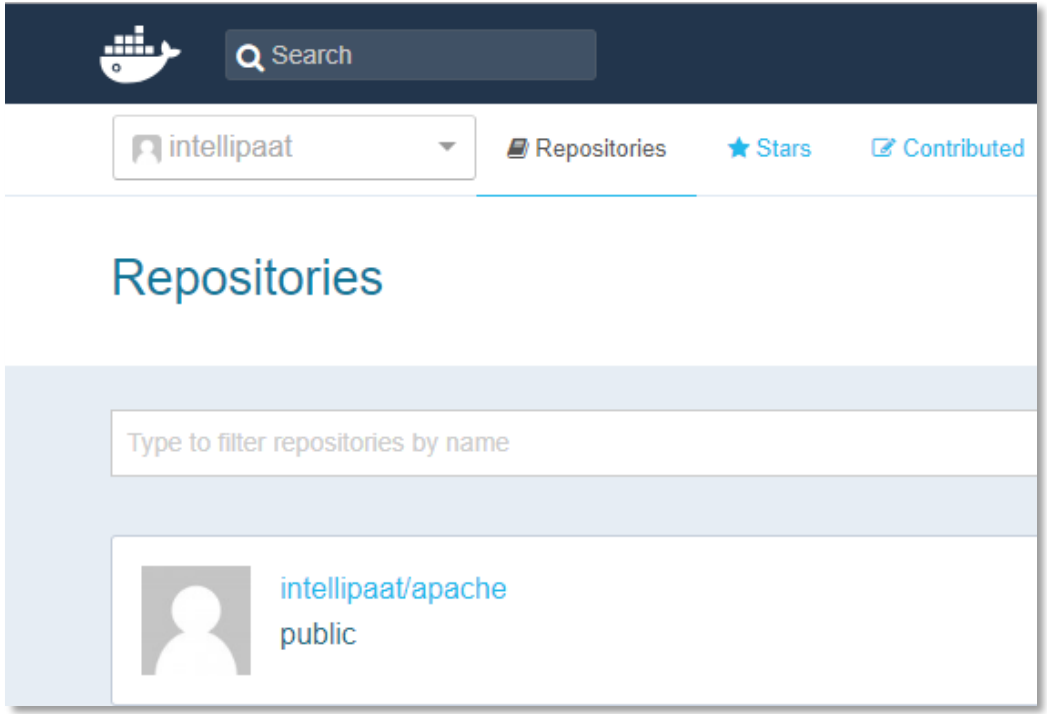


Pushing the Container on DockerHub

3. You can verify the push on DockerHub.

Now anyone, who wants to download this container, can simply pass the following command:

docker pull intellipaat/apache



Private Registry for Docker

Private Registry for Docker

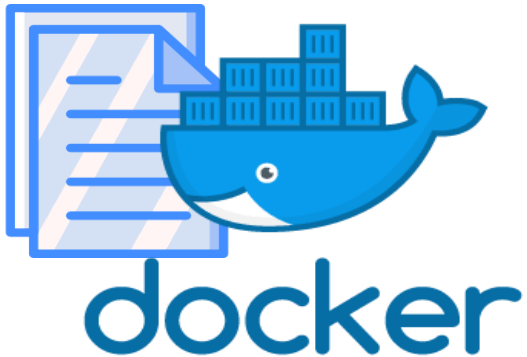
- DockerHub is a publicly available Docker Registry
- You may want to create a Private Registry for your company or personal use
- The registry is available on DockerHub, as a container named ‘registry’

Hands-on: Creating a Private Registry in Docker

Introduction to Dockerfile

Introduction to Dockerfile

A **Dockerfile** is a text document that contains all the commands a user could call on the command line to assemble an image. Using the **docker** build, users can create an automated build that executes several command-line instructions in succession.



Various Commands in Dockerfile

- **FROM**
- ADD
- RUN
- CMD
- ENTRYPOINT
- ENV

The **FROM** keyword is used to define the base image, on which we will be building.

Example

```
FROM ubuntu
```

Dockerfile

Various Commands in Dockerfile

- FROM
- **ADD**
- RUN
- CMD
- ENTRYPOINT
- ENV

The **ADD** keyword is used to add files to the container being built. The syntax used is:

ADD <source> <destination in container>

Example

```
FROM ubuntu
ADD .  /var/www/html
```

Dockerfile

Various Commands in Dockerfile

- FROM
- ADD
- **RUN**
- CMD
- ENTRYPOINT
- ENV

The **RUN** keyword is used to add layers to the base image, by installing components. Each RUN statement adds a new layer to the docker image.

Example

```
FROM ubuntu
RUN apt-get update
RUN apt-get -y install apache2
ADD .  /var/www/html
```

Dockerfile

Various Commands in Dockerfile

- FROM
- ADD
- RUN
- **CMD**
- ENTRYPOINT
- ENV

The **CMD** keyword is used to run commands on the start of the container. These commands run only when there is no argument specified while running the container.

Example

```
FROM ubuntu
RUN apt-get update
RUN apt-get -y install apache2
ADD .  /var/www/html
CMD apachectl –D FOREGROUND
```

Dockerfile

Various Commands in Dockerfile

- FROM
- ADD
- RUN
- CMD
- **ENTRYPOINT**
- ENV

The **ENTRYPOINT** keyword is used strictly to run commands the moment the container initializes. The difference between CMD and ENTRYPOINT: ENTRYPOINT will run irrespective of the fact whether the argument is specified or not.

Example

```
FROM ubuntu
RUN apt-get update
RUN apt-get -y install apache2
ADD .  /var/www/html
ENTRYPOINT apachectl –D FOREGROUND
```

Dockerfile

Various Commands in Dockerfile

- FROM
- ADD
- RUN
- CMD
- ENTRYPOINT
- **ENV**

The **ENV** keyword is used to define environment variables in the container runtime.

Example

```
FROM ubuntu
RUN apt-get update
RUN apt-get -y install apache2
ADD .  /var/www/html
ENTRYPOINT apachectl –D FOREGROUND
ENV name Devops Intellipaat
```

Dockerfile

Running the Sample Dockerfile

Running the Sample Dockerfile

Let's see how we can run this sample Dockerfile now.

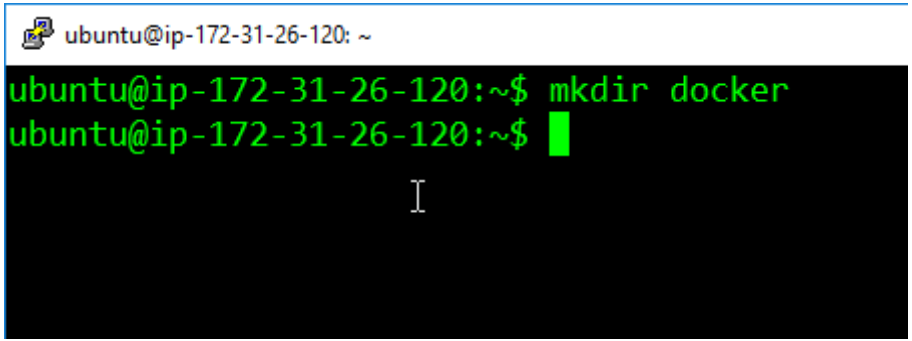
Example

```
FROM ubuntu
RUN apt-get update
RUN apt-get -y install apache2
ADD .  /var/www/html
ENTRYPOINT apachectl -D FOREGROUND
ENV name Devops Intellipaat
```

Dockerfile

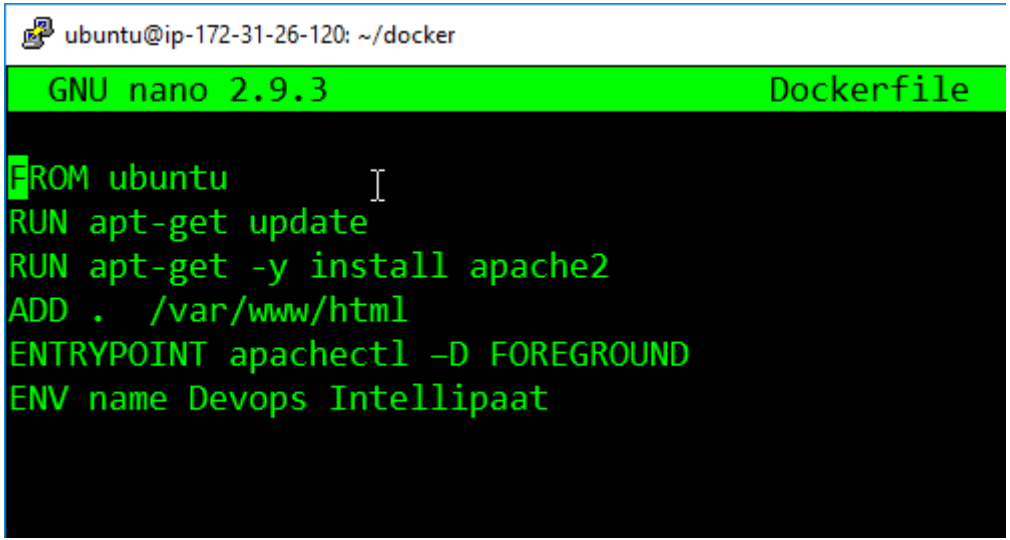
Running the Sample Dockerfile

1. First, create a folder docker in the home directory.



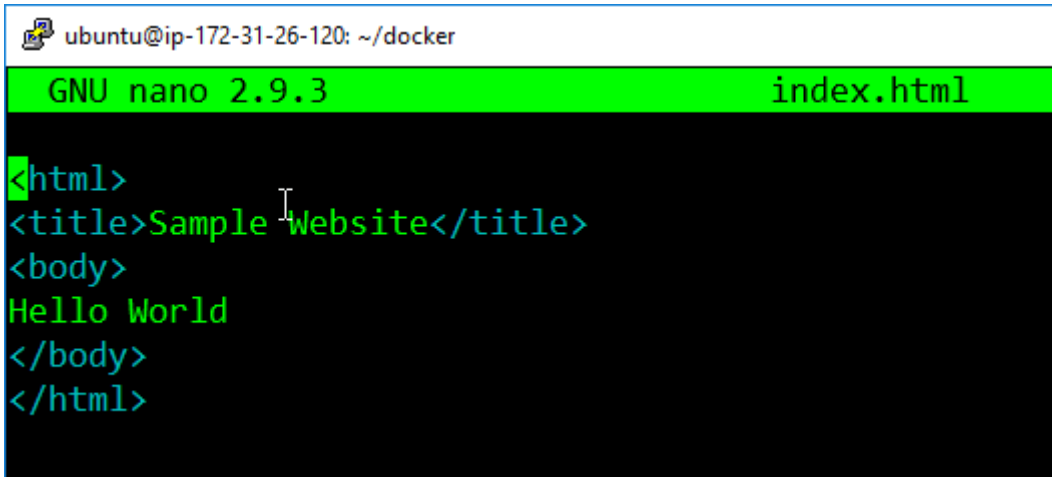
Running the Sample Dockerfile

2. Enter into this directory and create a file called ‘Dockerfile’, with the same contents as the sample Dockerfile.



Running the Sample Dockerfile

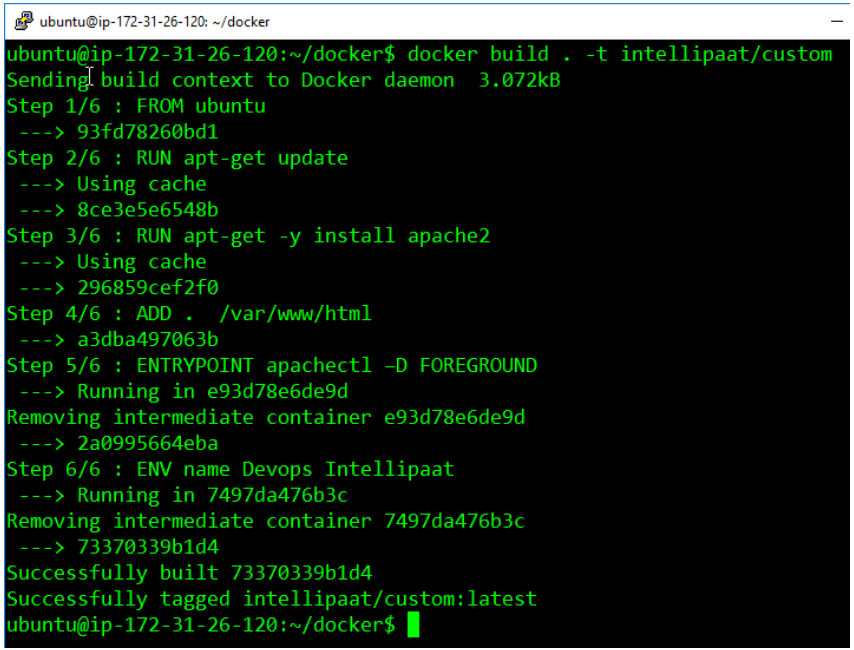
3. Create one more file called ‘index.html’ with the following contents.



Running the Sample Dockerfile

4. Now, pass the following command:

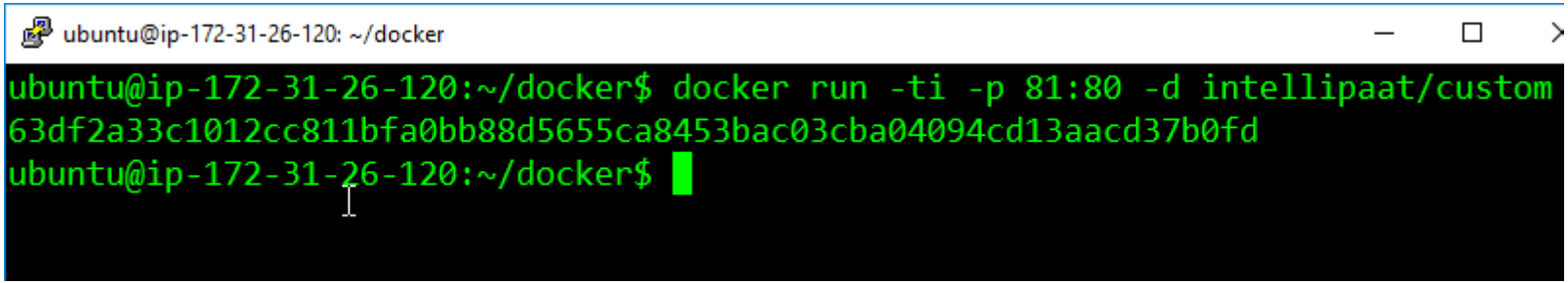
docker build <directory-of-dockerfile> -t <name of container>



Running the Sample Dockerfile

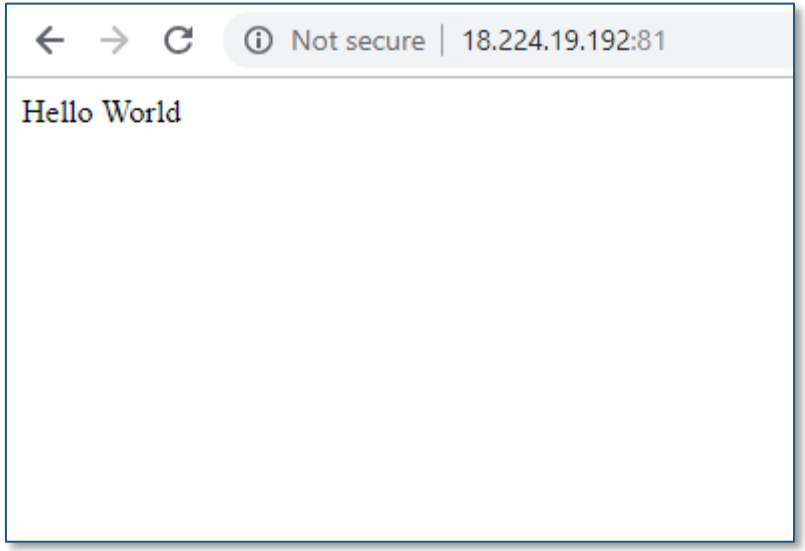
5. Finally, run this built image, using the following command:

docker run –it –p 81:80 –d intellipaat/custom



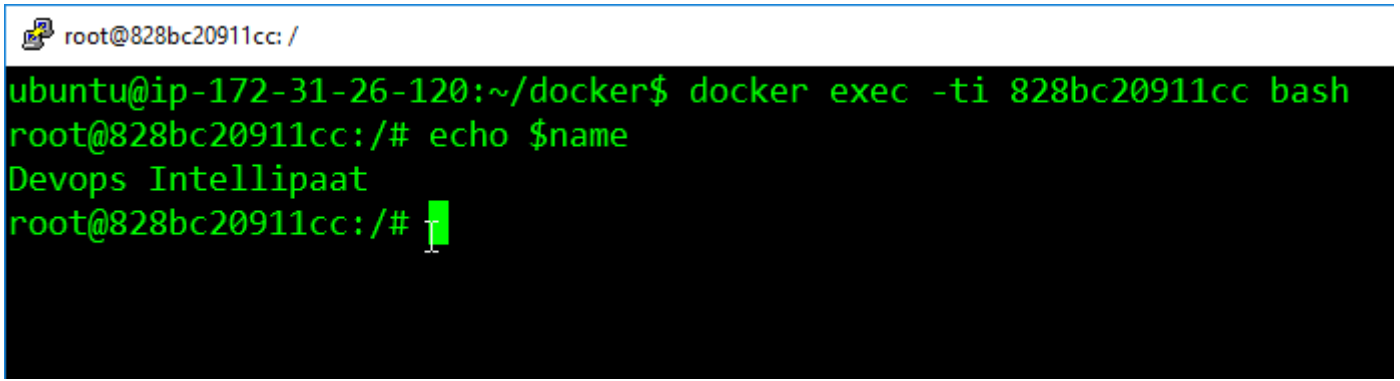
Running the Sample Dockerfile

6. Now, navigate to the server IP address on port 81.



Running the Sample Dockerfile

7. Finally, login into the container and check the variable $name. It will have the same value as given in the Dockerfile.



Quiz

Quiz

1. **Docker Containers include the kernel of OS as well.**

A. True

B. False

Quiz

1. **Docker Containers include the kernel of OS as well.**

A. True

B. False

Quiz

2. How to save an Image of Docker on the disk?

A. Docker save

B. Docker commit

C. Docker push

D. None of these

Quiz

2. How to save an Image of Docker on the disk?

A. Docker save

B. Docker commit

C. Docker push

D. None of these

Quiz

3. _____ is a service from Docker which provides registry capabilities for public and private Docker Images.

A. Docker Cloud

B. Docker Community

C. Docker Hub

D. None of these

Quiz

3. _____ is a service from Docker which provides registry capabilities for public and private Docker Images.

A. Docker Cloud

B. Docker Community

C. Docker Hub

D. None of these

Quiz

4. Virtual Machines include the kernel of the OS.

A. True

B. False

Quiz

4. Virtual Machines include the kernel of the OS.

A. True

B. False

Quiz

5. Containers, running on the same machine, share the underlying kernel of the host OS.

A. True

B. False

Quiz

5. Containers, running on the same machine, share the underlying kernel of the host OS.

A. True

B. False