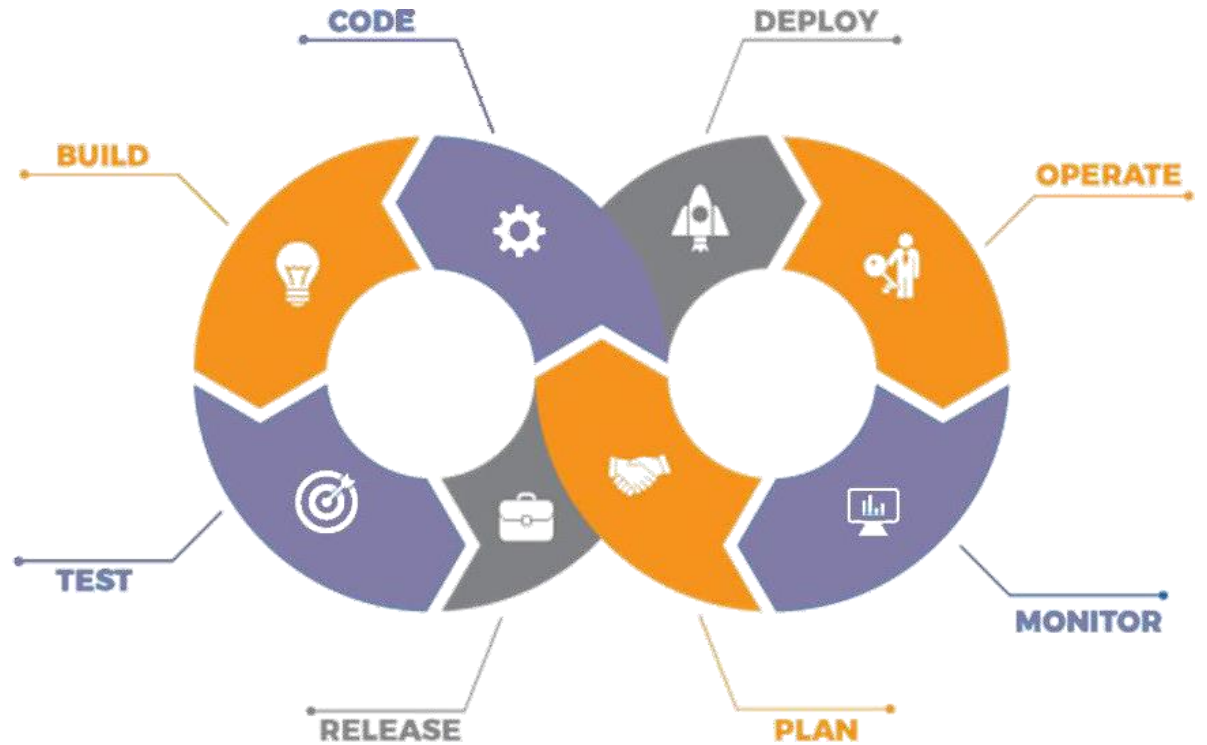


Containerization Using Docker - I



Agenda

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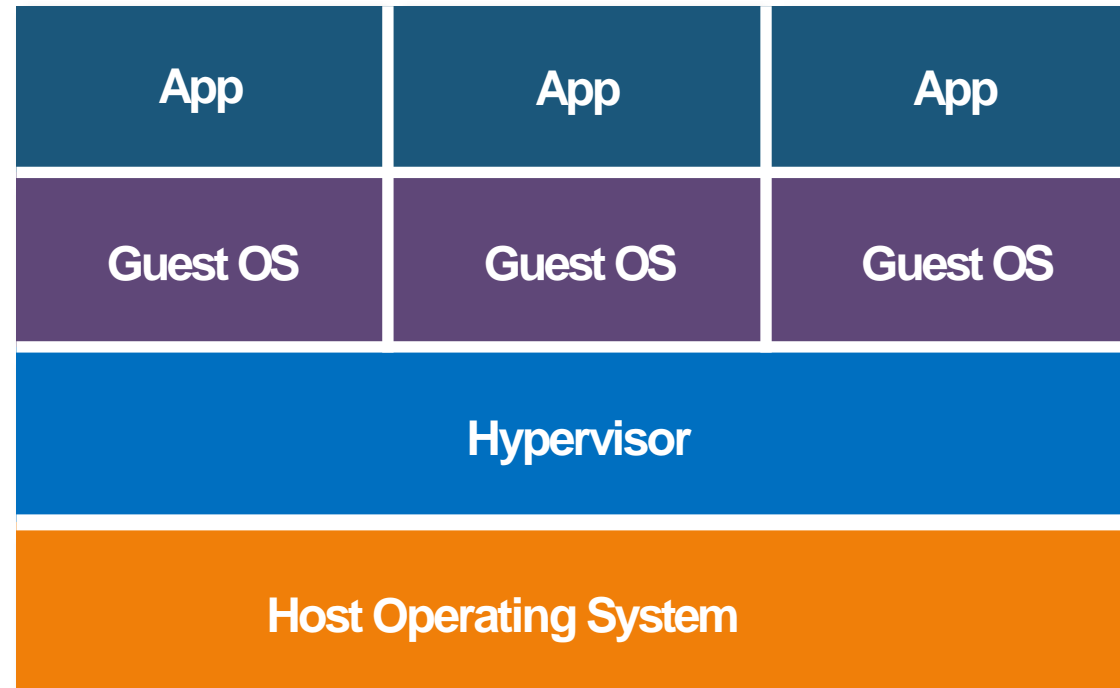
08

Introduction to
Dockerfile

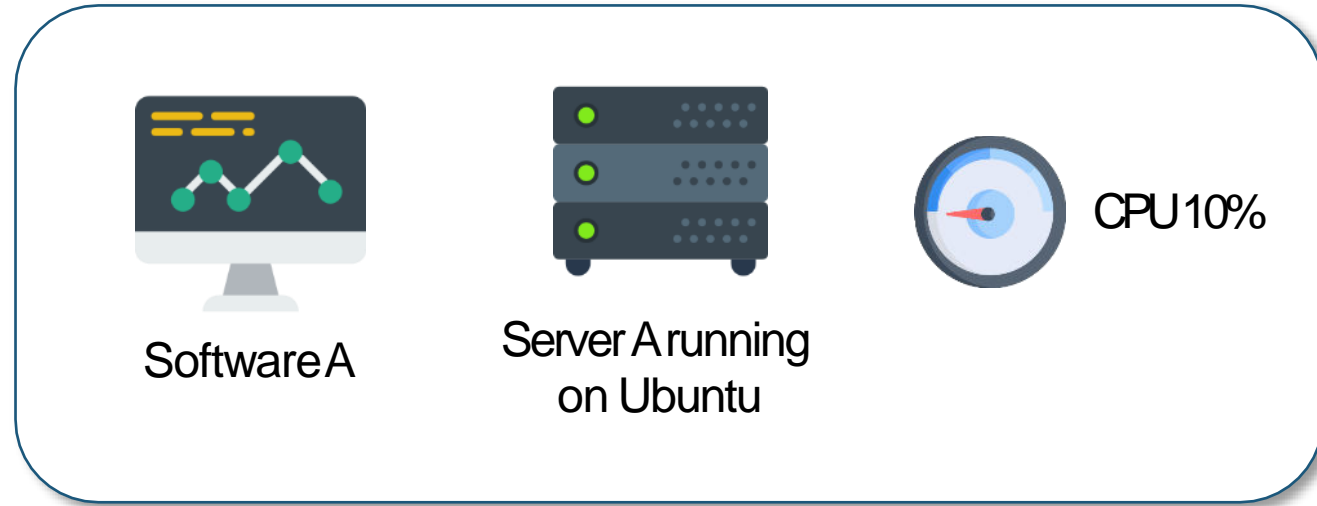
What is Virtualization?

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!

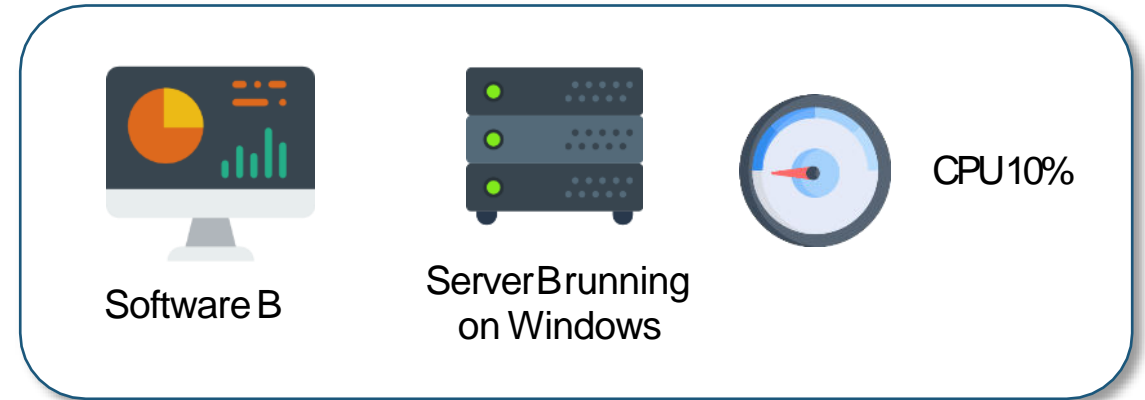
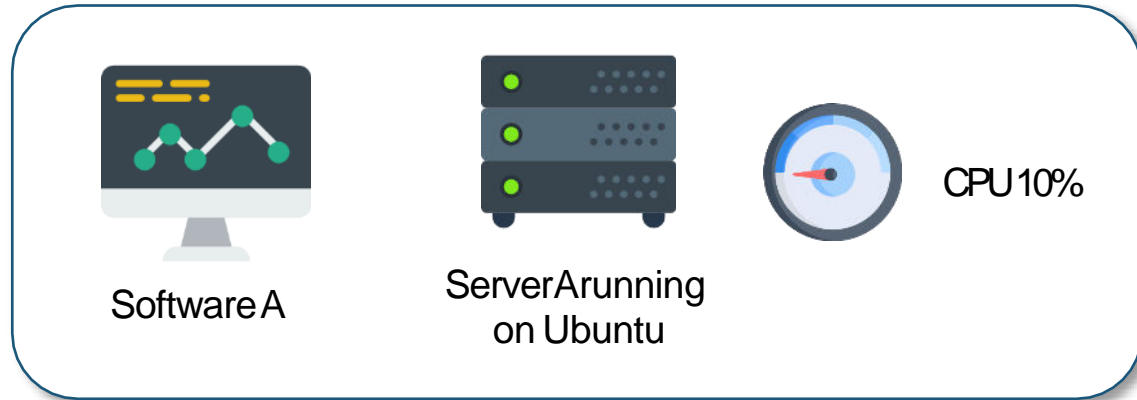


Problems before Virtualization



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



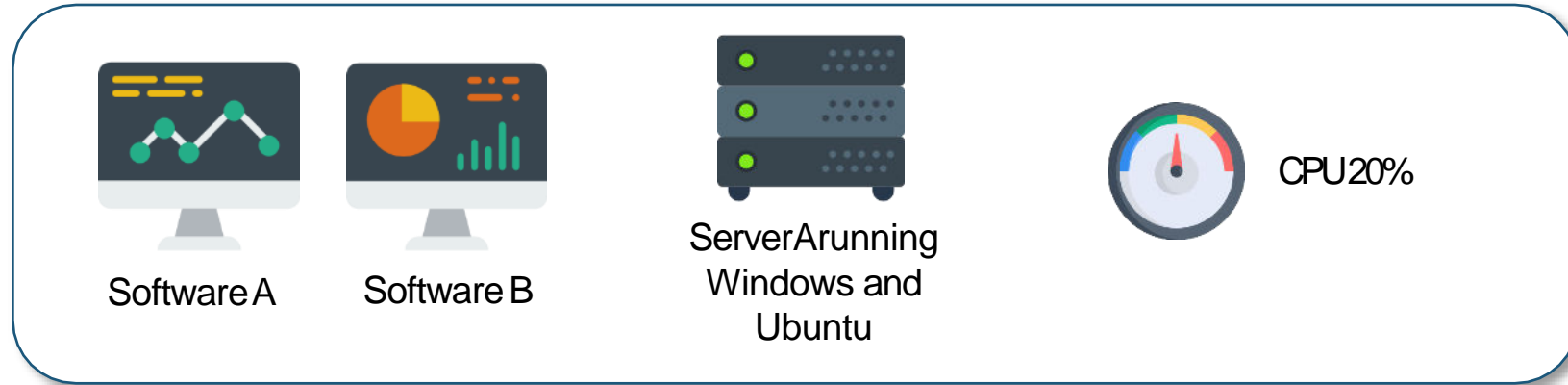
Some time later, we needed Software B which can only run on Windows. Therefore, we had to buy and run a Server B which had windows running on it. The software took only 10% of the CPU resources.

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 OSnow are running on the same server in parallel using the Virtualization technology. This accounts for better CPUutilization and cost savings!

Advantages of Virtualization

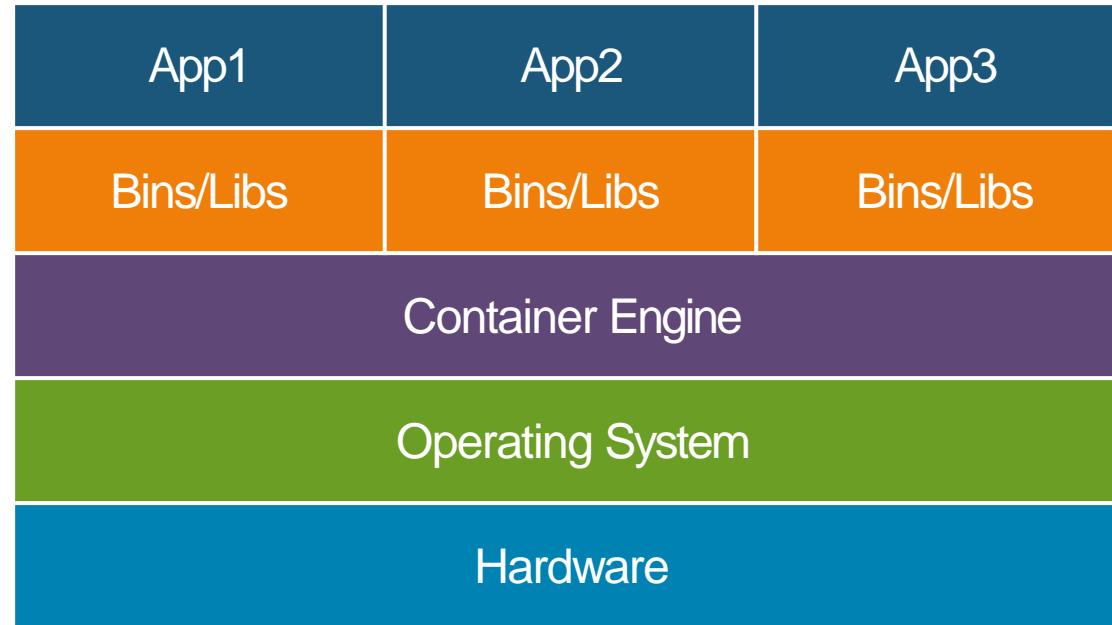


- ✓ It results in reduced spending.
- ✓ Resources are utilized more efficiently.
- ✓ Process of getting software up and running is shorter.
- ✓ Easier backup and disaster recovery is available.

What is Containerization?

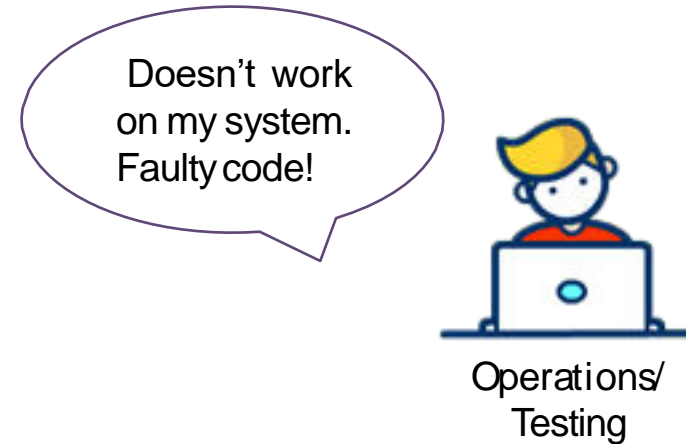
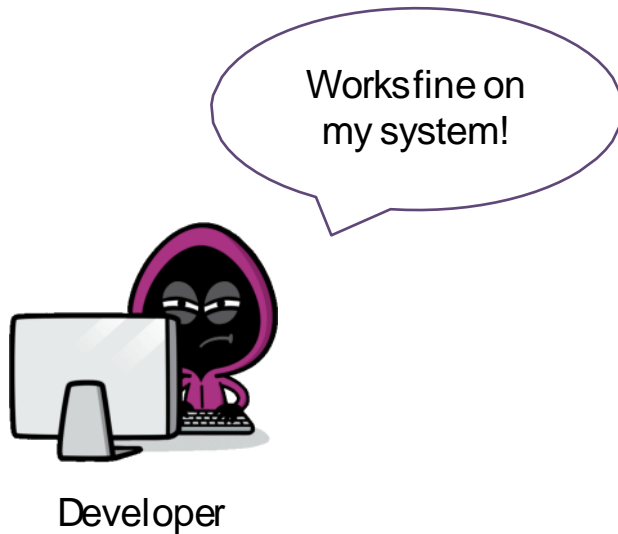
What is Containerization?

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.



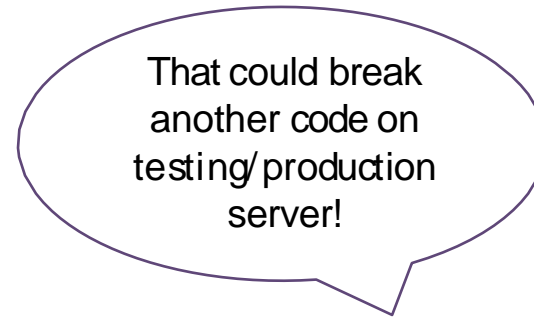
Problems before Containerization

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.



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.



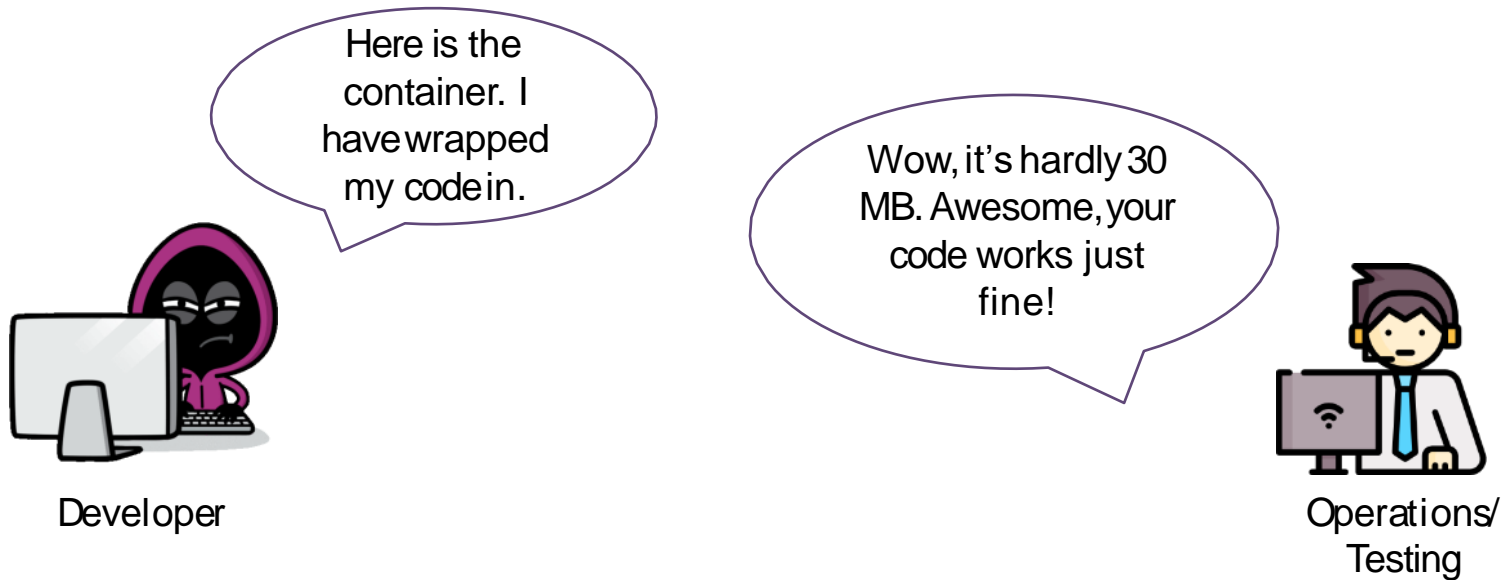
Problems before Containerization



- ❌ 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.



Advantages of Containers



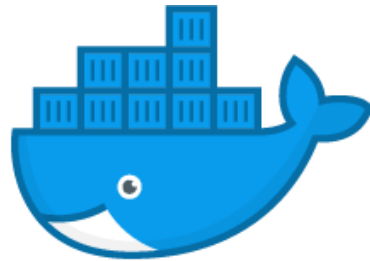
- ✓ Containers are not resource hungry.
- ✓ They are lightweight and hence portable.
- ✓ They are developer friendly and can be configured through the code.

Containerization Tools

Containerization Tools



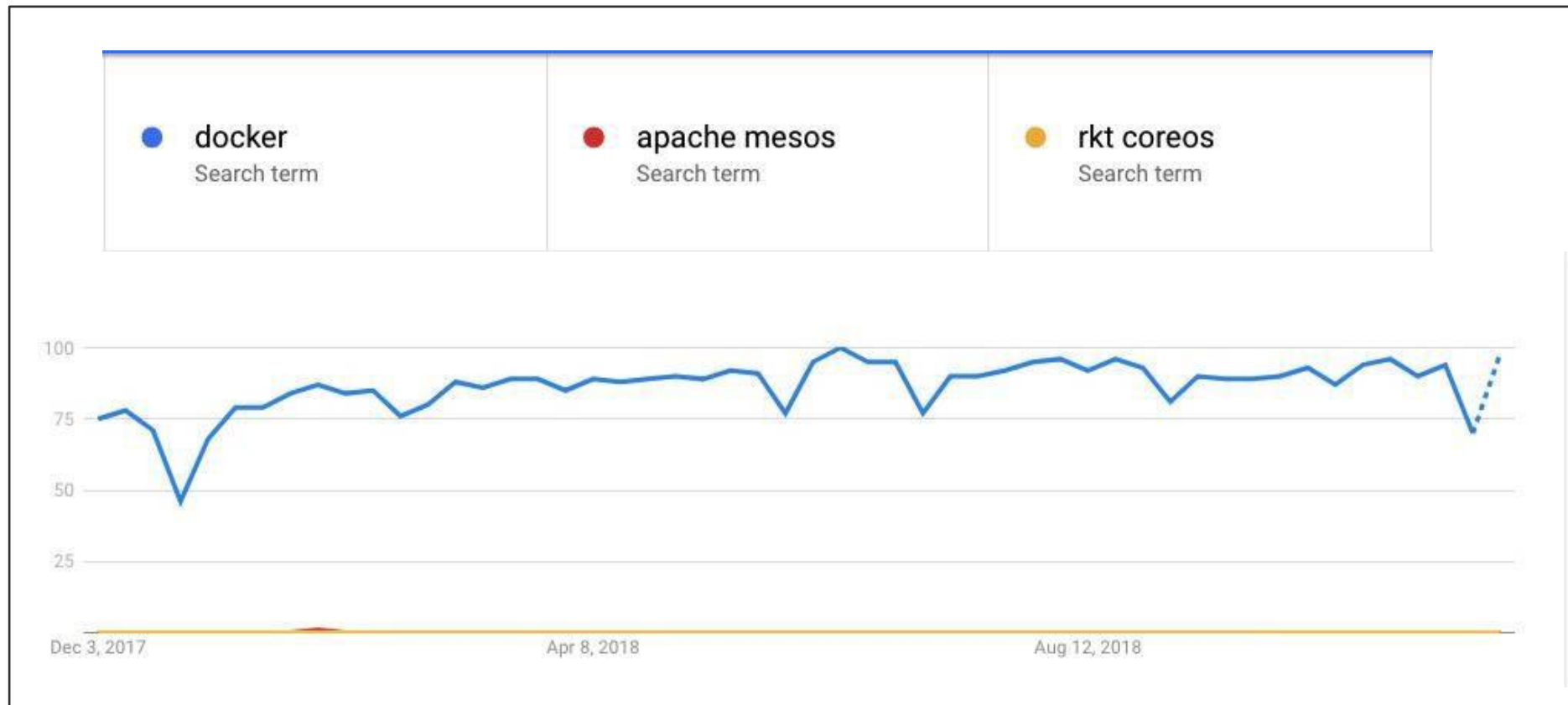
MESOS



docker

Containerization Tools

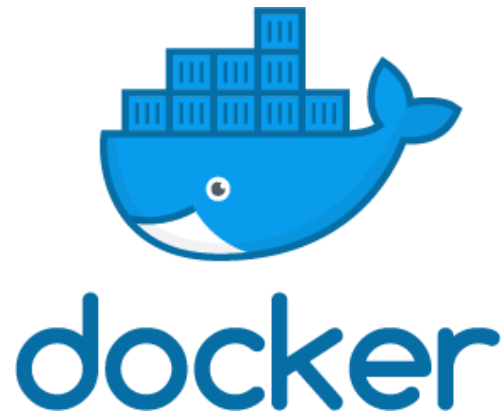
Docker is clearly the most famous among them all!



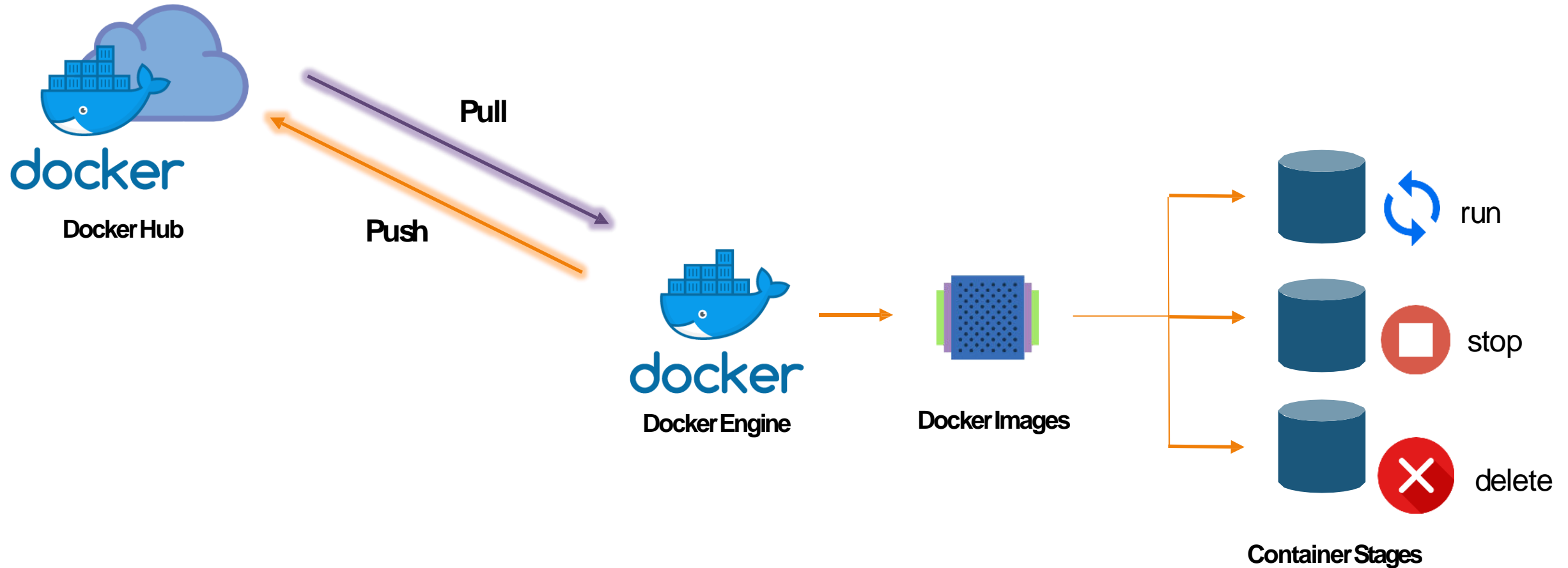
What is Docker?

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".

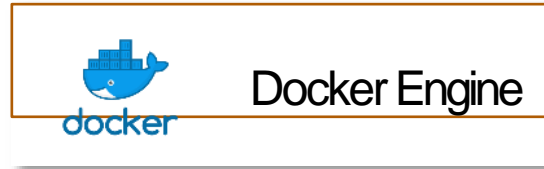
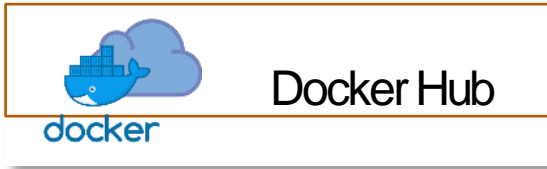


Docker Container Life Cycle



Components of Docker Ecosystem

Components of Docker Ecosystem



Components of Docker Ecosystem



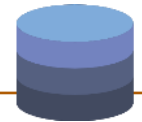
Docker Hub



Docker Engine



Docker Images



Containers

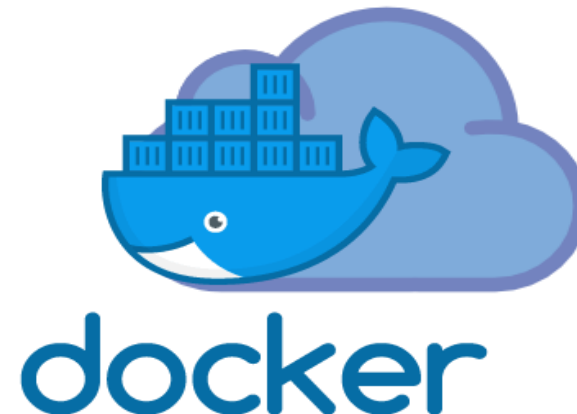


Docker Volumes



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



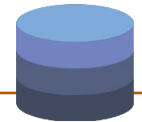
Docker Hub



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



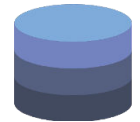
Docker Hub



Docker Engine



Docker Images



Containers



Docker Volumes



Docker File



Docker Image is like the template of a container.



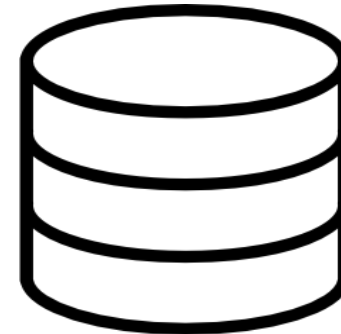
It is created in layers.



Any new changes in the image result in creating a new layer.



One can launch multiple containers from a single Docker image.



Components of Docker Ecosystem



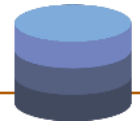
Docker Hub



Docker Engine



Docker Images



Containers



Docker Volumes



Docker File



A Docker Container is a lightweight software environment.



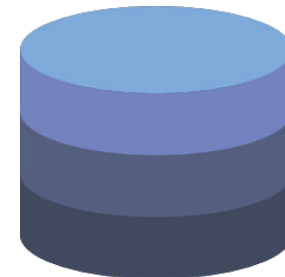
It works on top of the underlying OS kernel.



It is small in size and therefore is highly portable.



It is created using the docker image.



Components of Docker Ecosystem



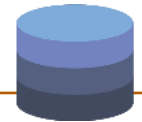
Docker Hub



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



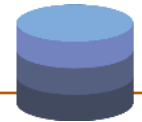
Docker Hub



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

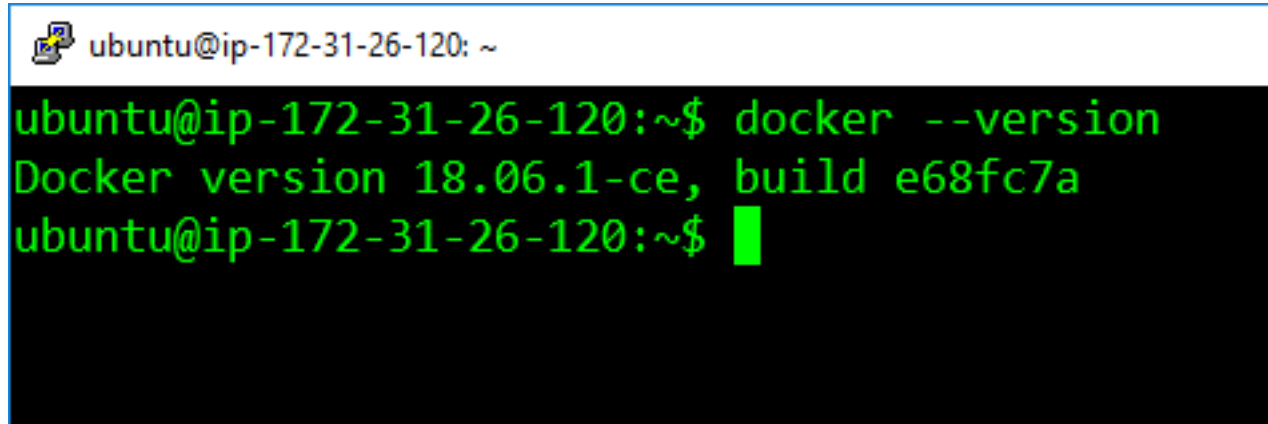
```
sudo apt-get update
```

```
sudo apt-get install docker.io
```

Common Docker Commands

Common Docker Commands

```
docker --version
```

A terminal window with a white title bar and a black background. The title bar shows a small icon and the text 'ubuntu@ip-172-31-26-120: ~'. The terminal content shows a green prompt 'ubuntu@ip-172-31-26-120:~\$' followed by the command 'docker --version' in green. The output 'Docker version 18.06.1-ce, build e68fc7a' is displayed in green on the next line. A second green prompt 'ubuntu@ip-172-31-26-120:~\$' is on the third line, followed by a green cursor block.

```
ubuntu@ip-172-31-26-120: ~  
ubuntu@ip-172-31-26-120:~$ docker --version  
Docker version 18.06.1-ce, build e68fc7a  
ubuntu@ip-172-31-26-120:~$ █
```

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

Common Docker Commands


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

```
ubuntu@ip-172-31-26-120: ~  
ubuntu@ip-172-31-26-120:~$ docker pull ubuntu  
Using default tag: latest  
latest: Pulling from library/ubuntu  
32802c0cfa4d: Pull complete  
da1315cffa03: Pull complete  
fa83472a3562: Pull complete  
f85999a86bef: Pull complete  
Digest: sha256:6d0e0c26489e33f5a6f0020edface2727db948974  
Status: Downloaded newer image for ubuntu:latest  
ubuntu@ip-172-31-26-120:~$
```

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

Common Docker Commands

docker images

 ubuntu@ip-172-31-26-120: ~

```
ubuntu@ip-172-31-26-120:~$ docker images
```


| REPOSITORY | TAG | IMAGE ID |
|------------|--------|--------------|
| ubuntu | latest | 93fd78260bd1 |
| 86.2MB | | |

```
ubuntu@ip-172-31-26-120:~$ █
```

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

Common Docker Commands

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

 ubuntu@ip-172-31-26-120: ~

```
ubuntu@ip-172-31-26-120:~$ docker run -it -d ubuntu
233e926091f338a18d3ba915ad34a6b1bc868642d7f3eb120f91-
ubuntu@ip-172-31-26-120:~$ █
```

This command helps in running containers from their image name.

Common Docker Commands

`docker ps`

```
ubuntu@ip-172-31-26-120: ~  
ubuntu@ip-172-31-26-120:~$ docker ps  
CONTAINER ID        IMAGE               COMMAND  
STATUS              PORTS              NAMES  
233e926091f3        ubuntu             "/bin/bash"  
Up About a minute   angry_jennings  
ubuntu@ip-172-31-26-120:~$
```

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

Common Docker Commands

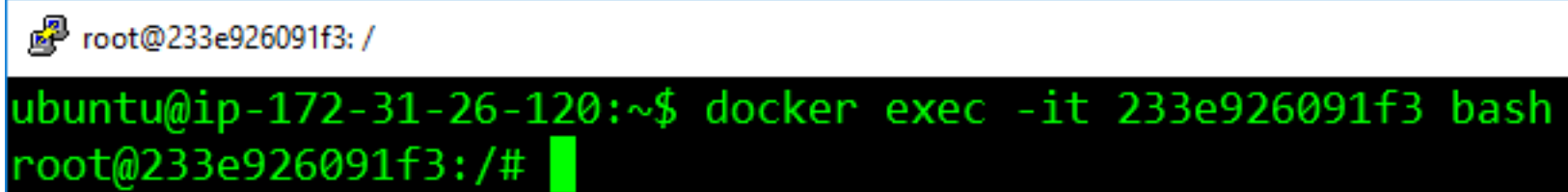
```
docker ps -a
```

```
ubuntu@ip-172-31-26-120: ~  
ubuntu@ip-172-31-26-120:~$ docker ps -a  
CONTAINER ID        IMAGE               COMMAND  
STATUS              PORTS              NAMES  
f0a5fa001b0e        ubuntu             "/bin/bash"  
Exited (0) 5 seconds ago                relaxed_clark  
233e926091f3        ubuntu             "/bin/bash"  
Up 4 minutes                angry_jenning  
ubuntu@ip-172-31-26-120:~$
```

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>
```



```
root@233e926091f3: /  
ubuntu@ip-172-31-26-120:~$ docker exec -it 233e926091f3 bash  
root@233e926091f3:/#
```

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

Common Docker Commands

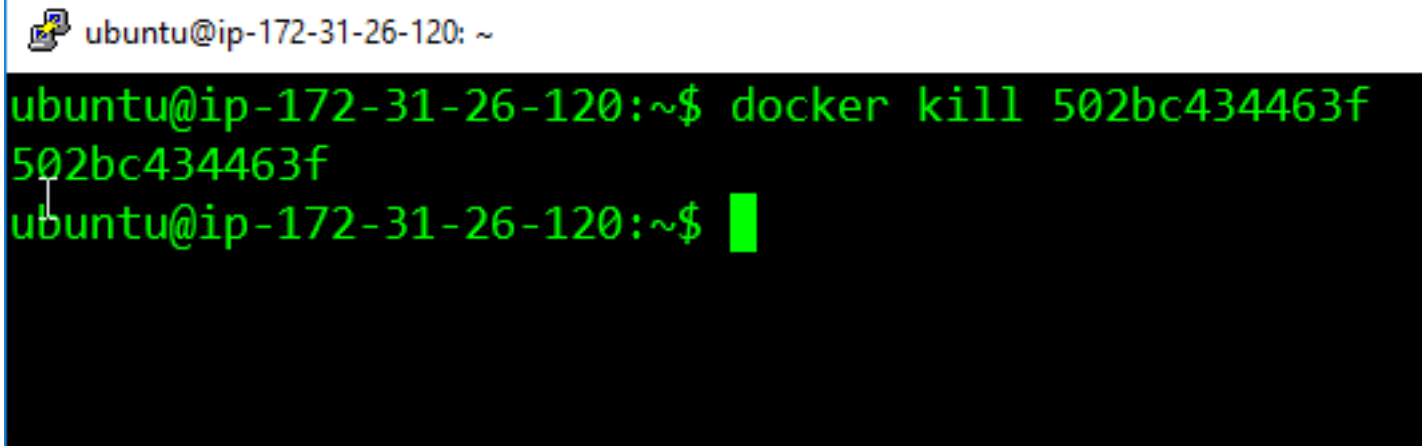
```
docker stop <container-id>
```

```
ubuntu@ip-172-31-26-120: ~  
ubuntu@ip-172-31-26-120:~$ docker stop 233e926091f3  
233e926091f3  
ubuntu@ip-172-31-26-120:~$ █
```

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

Common Docker Commands

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

A terminal window with a black background and green text. The prompt is 'ubuntu@ip-172-31-26-120: ~'. The command 'docker kill 502bc434463f' is entered and executed. The output shows the container ID '502bc434463f' on a new line, followed by the prompt 'ubuntu@ip-172-31-26-120:~\$' and a green cursor.

```
ubuntu@ip-172-31-26-120: ~  
ubuntu@ip-172-31-26-120:~$ docker kill 502bc434463f  
502bc434463f  
ubuntu@ip-172-31-26-120:~$
```

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>
```



A terminal window screenshot showing the execution of the `docker rm` command. The prompt is `ubuntu@ip-172-31-26-120: ~`. The command `docker rm 502bc434463f` is entered and executed, resulting in the prompt `ubuntu@ip-172-31-26-120:~$` being displayed again.

```
ubuntu@ip-172-31-26-120: ~  
ubuntu@ip-172-31-26-120:~$ docker rm 502bc434463f  
502bc434463f  
ubuntu@ip-172-31-26-120:~$
```

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

Common Docker Commands

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

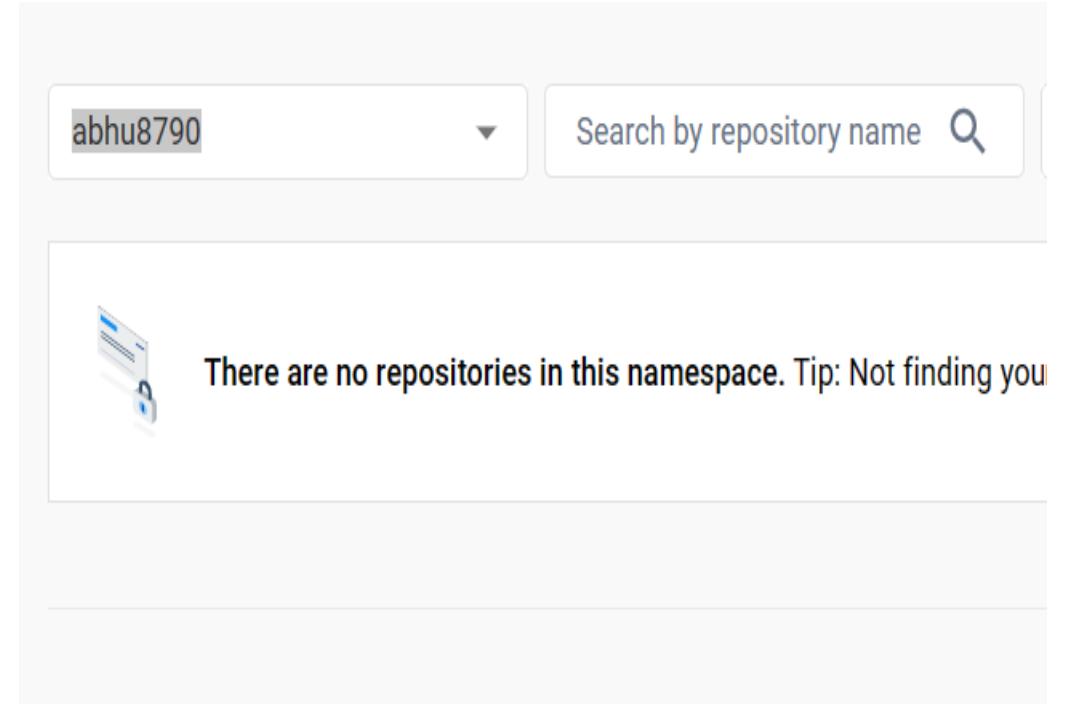
```
ubuntu@ip-172-31-26-120: ~  
ubuntu@ip-172-31-26-120:~$ docker rmi 93fd78260bd1  
Untagged: ubuntu:latest  
Untagged: ubuntu@sha256:6d0e0c26489e33f5a6f0020edface27  
71f23c49  
Deleted: sha256:93fd78260bd1495afb484371928661f63e64be3  
Deleted: sha256:1c8cd755b52d6656df927bc8716ee0905853fad  
Deleted: sha256:9203aabb0b583c3cf927d2caf6ba5b11124b0a2  
Deleted: sha256:32f84095aed5a2e947b12a3813f019fc69f159c  
Deleted: sha256:bc7f4b25d0ae3524466891c41cefc7c6833c533  
ubuntu@ip-172-31-26-120:~$
```

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

Creating a Docker Hub Account

Creating a Docker Hub Account

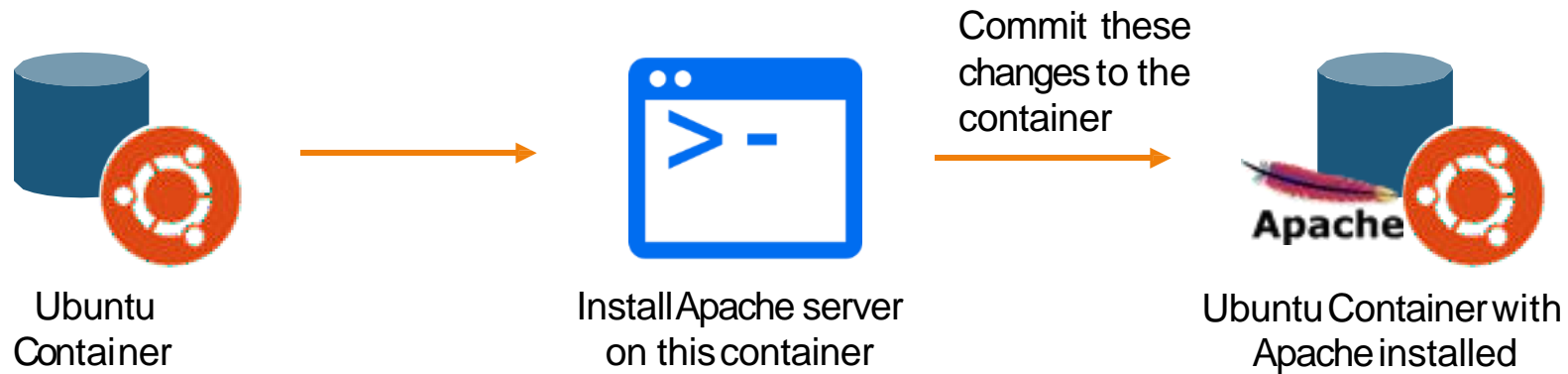
1. Navigate to <https://hub.docker.com>
2. Sign up on the website
3. Agree to the terms and conditions
4. Click on Sign up
5. Check your email, and verify your email by clicking on the link
6. Finally, login using the credentials you provided on the sign up page



Committing Changes to a
Container

Committing Changes to a Docker Container

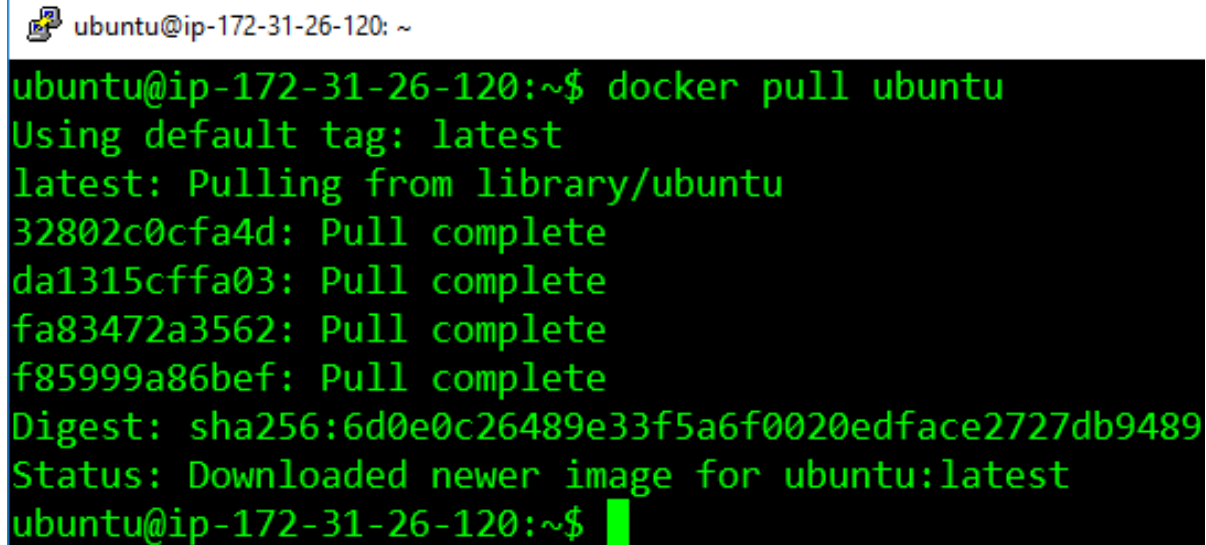
Let's try to accomplish the following example with a container and see how we can commit this container into an image.



Committing Changes to a Docker Container

1. Pull the Docker Container using the command:

```
docker pull ubuntu
```



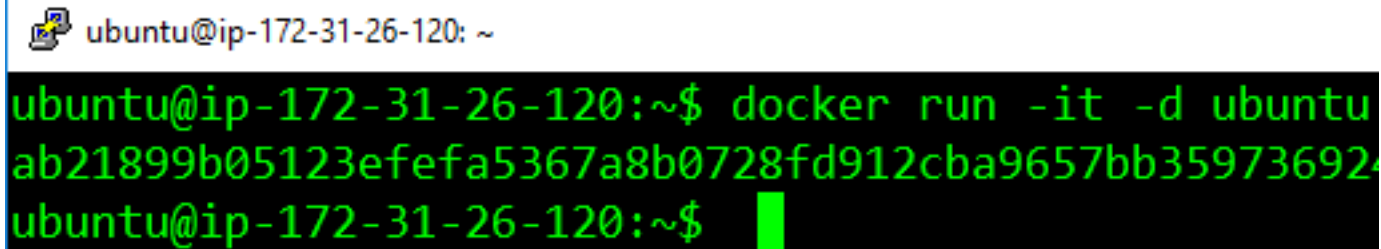
```
ubuntu@ip-172-31-26-120: ~  
ubuntu@ip-172-31-26-120:~$ docker pull ubuntu  
Using default tag: latest  
latest: Pulling from library/ubuntu  
32802c0cfa4d: Pull complete  
da1315cffa03: Pull complete  
fa83472a3562: Pull complete  
f85999a86bef: Pull complete  
Digest: sha256:6d0e0c26489e33f5a6f0020edface2727db9489  
Status: Downloaded newer image for ubuntu:latest  
ubuntu@ip-172-31-26-120:~$
```

In our case, the imagename is “ubuntu”.

Committing Changes to a Docker Container

2. Run the container using the command:

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



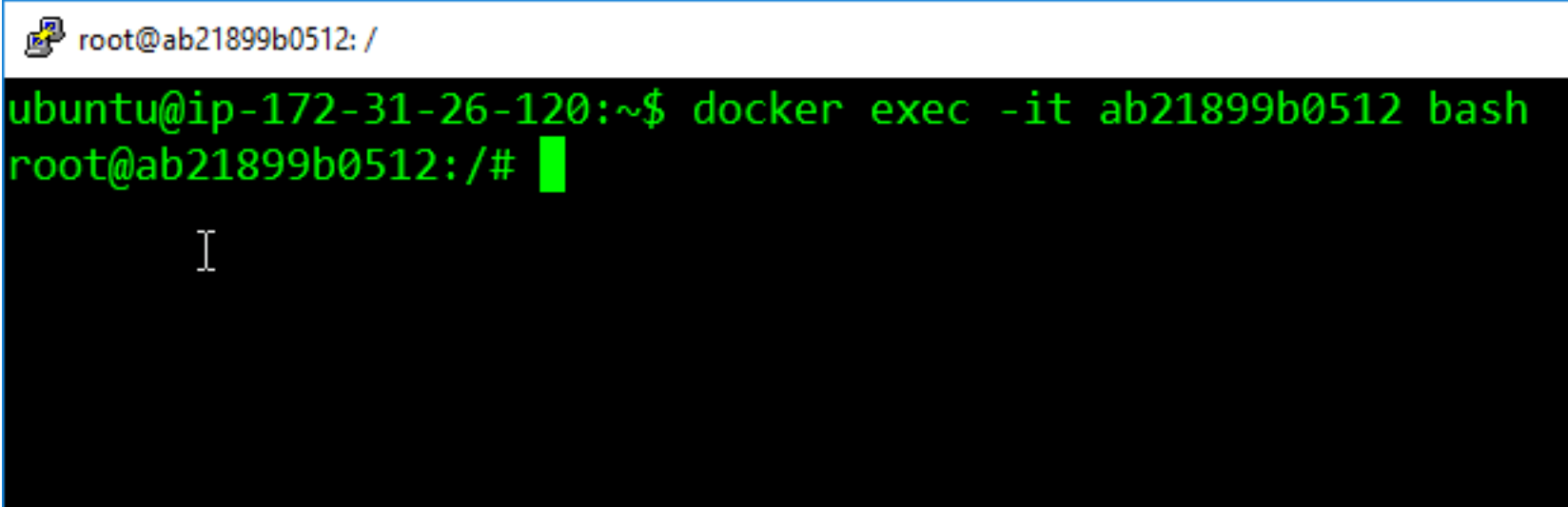
A terminal window with a title bar showing a laptop icon and the text 'ubuntu@ip-172-31-26-120: ~'. The terminal content shows a green prompt 'ubuntu@ip-172-31-26-120:~\$' followed by the command 'docker run -it -d ubuntu'. The next line shows the container ID 'ab21899b05123efefa5367a8b0728fd912cba9657bb359736924' in green. The final line shows the prompt 'ubuntu@ip-172-31-26-120:~\$' with a green cursor block.

```
ubuntu@ip-172-31-26-120: ~  
ubuntu@ip-172-31-26-120:~$ docker run -it -d ubuntu  
ab21899b05123efefa5367a8b0728fd912cba9657bb359736924  
ubuntu@ip-172-31-26-120:~$
```

Committing Changes to a Docker Container

3. Access the container using the command:

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




```
root@ab21899b0512: /  
ubuntu@ip-172-31-26-120:~$ docker exec -it ab21899b0512 bash  
root@ab21899b0512:/#
```

A terminal window with a black background and green text. The top bar shows the container's root shell prompt. The main area shows a user running the `docker exec` command to enter the container, followed by the container's root shell prompt.

Committing Changes to a Docker Container

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

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

 root@ab21899b0512: /

```
root@ab21899b0512:/# apt-get install apache2  
Reading package lists... Done  
Building dependency tree  
Reading state information... Done  
The following additional packages will be installed:  
  apache2-bin apache2-data apache2-utils file libapr1  
  libaprutil1-dbd-sqlite3 libaprutil1-ldap libasn1-8-
```

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>
```

```
ubuntu@ip-172-31-26-120: ~  
ubuntu@ip-172-31-26-120:~$ docker commit ab21899b0512 intellipaat/apache  
sha256:c8446a9b3ca4a6436cbcd6765744bbcf2e1629e1c25fc54ddfa1e34377326c  
ubuntu@ip-172-31-26-120:~$ docker images  
REPOSITORY          TAG                 IMAGE ID            CREATED  
SIZE  
intellipaat/apache  latest             c8446a9b3ca4       21 seconds  
206MB
```

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