****

Ansible

****

Ansible

- Ansible is a configuration management tool.
- It is an open-source, community-driven product.
- In Ansible, there is a concept of control node and managed nodes.
- The server where the Ansible package is installed is called the control node.
- The control node and managed nodes are connected using the SSH protocol on port 22.
- Ansible is agentless, meaning we only need to install the Ansible package on the control node.
- There's no need to install anything on the managed nodes.

Playbook in Ansible

- Ansible uses a concept called a playbook.
- Playbooks are written on the control node.
- Whatever is written in the playbook is executed on the managed nodes connected to the control node.
- Playbooks are written in YAML (Yet Another Markup Language).
- A playbook contains plays, and plays contain tasks.
- Tasks written in a playbook are executed in a parallel way across all managed nodes.

For example,

- if we have 3 managed nodes and 2 tasks in a playbook:
- The first task will run on all 3 machines in parallel.
- Then the second task will run on all 3 machines in parallel.
- The configuration file for Ansible is located at: /etc/ansible/ansible.cfg

1. **amazon-linux-extras enable ansible2**
2. **yum install -y ansible**
3. **vi /home/ec2-user/keypair2.pem**
4. **chmod 400 /home/ec2-user/keypair2.pem**
5. **vi /etc/ansible/hosts**
6. **ansible -m ping webservers**
7. **vi install_httpd.yml**
8. **ansible-playbook install_httpd.yml**

- **vi /etc/ansible/hosts**

  [webservers]
  host1 ansible_host=1.2.3.4 ansible_user=ec2-user
  ansible_ssh_private_key_file=/home/ec2-user/keypair1.pem
  host2 ansible_host=5.6.7.8 ansible_user=ec2-user
  ansible_ssh_private_key_file=/home/ec2-user/keypair2.pem

- **vi install_httpd.yml**

```
---
- name: Install and start Apache on webservers
  hosts: webservers
  become: yes

  tasks:
    - name: Install httpd
      yum:
        name: httpd
        state: present

    - name: Start and enable httpd
      service:
        name: httpd
        state: started
        enabled: yes

    - name: Create index.html
      copy:
        content: "<h1>Welcome to {{ inventory_hostname }}</h1>"
        dest: /var/www/html/index.html
```

****

Virtualization & Hypervisor

****

Virtualization

- Virtualization is the process of creating multiple virtual machines using a hypervisor

Hypervisor

- A hypervisor is software that allows us to create multiple virtual machines.

Advantages of Virtualization

1. Reduced capital and operating costs.
2. Minimized or eliminated downtime.
3. Increased IT productivity and efficiency.

Disadvantages of Virtualization

1. It takes time.
2. Wastage of resources.
3. Software/applications that run in one environment may not run in another environment.

Types of Virtualization

1) Desktop Virtualization
2) Application Virtualization
3) Server Virtualization
4) Storage Virtualization
5) Network Virtualization
6) OS Virtualization
7) Hardware Virtualization

Types of Hypervisors

Type 1 Hypervisor

- (Also called a bare-metal hypervisor)
- Type 2 Hypervisor

Type 1 Hypervisor

- If hypervisor software is directly installed on hardware, it is called a Type 1 hypervisor.
- For a Type 1 hypervisor, an OS is needed.

Examples

1. VMware ESXi
2. KVM (Kernel-Based VM)
3. Xen

Type 2 Hypervisor

- If hypervisor software is installed on an operating system (OS), it is called a Type 2 hypervisor.
- For a Type 2 hypervisor, an OS is needed.

Example:

- Oracle VirtualBox

****

Docker

****

- Docker is an open platform for developing, shipping, and running applications.
- It is an open-source software platform used to create, deploy, and manage virtualized application containers on a common operating system (OS).
- Docker was developed in 2013.
- Docker is used to run containers.

****

Container

****

Container

- A container is a runnable instance of an image.
- It is a standard unit of software that packages up code and all its dependencies so the application runs quickly and reliably from one computing environment to another.
- Containers are lightweight and contain everything needed to run an application, so we don't need to rely on what is currently installed on the host.
- A container is a fully packaged and portable computing environment. Everything an application needs to run, such as binaries, libraries, configuration files, and dependencies, is encapsulated and isolated within the container.
- We can create, start, stop, move, or delete a container using the Docker API or CLI.
- Containers are isolated from each other.

****

Docker Registries

****

Docker Registries

- Docker images are stored in a Docker registry.

There are two types of registries:

- Public registry
- Private registry

Docker Hub is a public registry that anyone can use.

- When we use the docker pull command, the required images are pulled from the registry.
- When we use the docker push command, the required images are pushed to the registry.

Advantages of Docker

1) No pre-allocation of RAM.
2) Lower cost.
3) Lightweight.
4) Takes very little time to create containers.
5) We can reuse images.

Disadvantages of Docker

- Docker is not suitable for applications that require a rich GUI.
- Difficult to manage a large number of containers.
- Docker does not support cross-platform compatibility. If an application is designed to run in a Docker container on Windows, it cannot run on Linux, and vice versa.
- Docker is only suitable when the developer's OS and tester's OS are the same. If the OS is different, a VM is required.

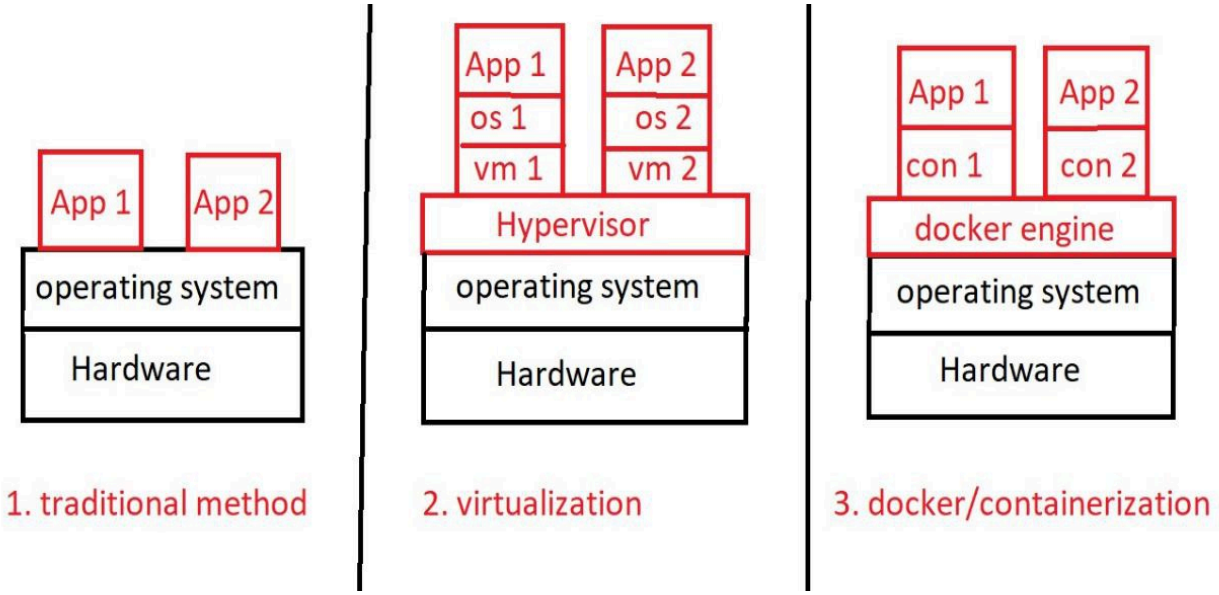
A developer writes code in a Dockerfile.

- A Dockerfile contains all dependencies and software required to run an application.

For example,

- it may specify that:
- The container should have Red Hat OS.
- Git should be installed.
- Certain files and directories should be present.

- When we run this Dockerfile on the Docker engine, it creates an image, and from that image, it creates a container.
- We can upload this image to Docker Hub (registry).



****

Installation of Docker

****

Installation of Docker

To install Docker

- yum install -y docker

To check the Docker version

- docker --version
- (OR)
- docker -v

To check the status of Docker

- systemctl status docker

To start Docker

- systemctl start docker

Go to *Docker Hub* → *Explore* → (You can see multiple Docker images here)

To list all images:

- docker images
- (OR)
- docker image ls

To pull an image from Docker Hub:

- docker pull <image-name>

Example:

- docker pull ubuntu
- docker pull centos

To pull a specific version of an image:

- docker pull ubuntu:22.04

To list running containers:

- docker ps
- (OR)
- docker container ls

To list all containers (including stopped ones):

- docker ps -a
- (OR)

- docker container ls -a

To create a container from an image:
- docker run <image-name>
- (The container will be in a stopped state.)

Example:
- docker run ubuntu

To create/run a container from a specific image version:
- docker run <image-name>:<tag>
- (The container will be in a stopped state.)

Example:
- docker run ubuntu:20.04

We can create multiple containers using the same image.

To delete an image:
- docker rmi -f <image-name>

Example:
- docker rmi -f ubuntu

(If we delete an image, it does not affect existing containers.)

To delete a stopped container:
- docker container rm <container-id>

To delete a running or stopped container:
- docker rm -f <container-id>

To delete multiple containers:
- docker rm -f <container-id-1> <container-id-2>

To delete all stopped containers and images:
- docker system prune -a -f

To create and enter a container:
- docker run -it <image-name> bash

Example:
- docker run -it ubuntu bash

To exit from the container:
- exit
- (OR)
- Ctrl + d
- (The container will be in a stopped state.)

To detach from the container (keep it running):

- Ctrl + p + q
- (The container will remain in a running state.)

To start a container:

- docker start <container-id>
- (OR)
- docker container start <container-id>

To stop a container:

- docker stop <container-id>
- (OR)
- docker container stop <container-id>

To stop multiple containers:

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

To enter a running container:

- (Container must be in a running state.)
- docker exec -it <container-id> bash
- (OR)
- docker attach <container-id>

To search for an image

- docker search httpd
- docker search ubuntu

To rename an existing container

- docker rename old-container-name new-container-name

To create a container with a custom name

- docker run --name containername imagename
- docker run --name lekharaj5 ubuntu
- docker run -it --name sumit ubuntu

To see information about containers

- docker info

To see CPU and memory utilization by a container

- docker stats container-id

To view container logs

- docker logs -f container-id

Docker port expose/mapping/binding

- docker run -itp 80:80 ubuntu
- apt-get update -y
- apt-get install apache2 -y
- service apache2 status
- service apache2 start
- cat > /var/www/html/index.html

- If we have already created a container and forgot to set up port mapping, we can't modify the port mapping for the existing container.
- But we can delete that container and create a new one using the same image and set up the correct port mapping by using the below command,
- docker run -itp 80:80 imagename

Docker volume

- To sync a directory on a local machine with a directory in a container, we use Docker volume:
- docker run -itv machine_dir:container_dir ubuntu

Port mapping & docker volume

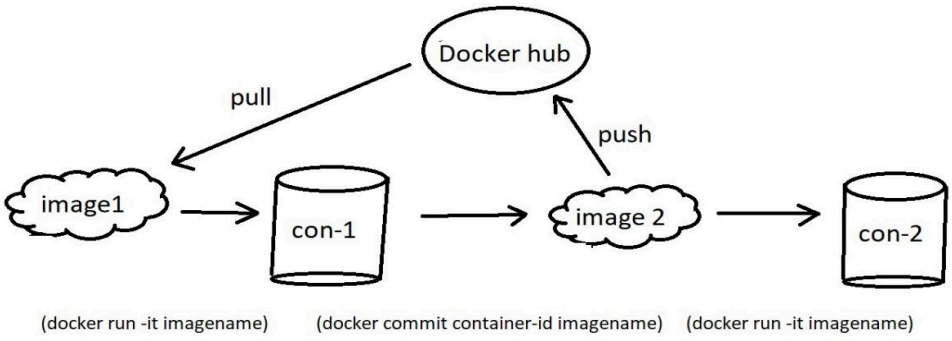
- docker run -itp 80:80 -v machine_dir:container dir imagename

To create a container from an image

- docker run -it imagename

To create an image from a container

- docker commit container-name imagename



To push an image to docker hub

- docker login

- docker push imagename

To check network connectivity

- ping 8.8.8.8
- ping google.com
- ping localhost

- ping 8.8.8.8 -c 5
- ping google.com -c 5
- ping -c 5 google.com
- ping localhost -c 5

To run a CentOS container

- docker run -it centos:centos7 bash

To run a CentOS container and execute a command

- docker run -it centos:centos7
- Ping 8.8.8.8

- docker run -it centos:centos7 ping 8.8.8.8

- docker run -itd centos:centos7 ping 8.8.8.8

****

Docker Compose

****

Docker Compose

- Docker Compose is a tool for defining and running multiple containers.
- It uses a YAML file where all the configuration steps are defined.
- YAML stands for YAML Ain't Markup Language (a recursive acronym originally standing for Yet Another Markup Language").
- Docker Compose treats each container as a service.
- With Docker Compose, we can create and manage multiple containers easily.
- Docker Compose configuration is written in YAML format.
- YAML files use a key-value format:
- key: value

The Docker Compose file should be named either:

- docker-compose.yml or docker-compose.yaml
- There are multiple versions of the Docker Compose file format.
- We need to specify the version you are using at the beginning of the file.

A commonly used version is 3.

- yum install -y docker
- systemctl start docker
- To install Docker Compose
- curl -L --fail https://github.com/docker/compose/releases/download/1.29.2/run.sh -o /usr/local/bin/docker-compose
- chmod +x /usr/local/bin/docker-compose

Ubuntu and CentOS containers using Docker Compose

vim docker-compose.yaml

```
version: '3'
services:
  one:
    image: 'ubuntu'
    command: tail -f /dev/null

  two:
    image: 'centos:centos7'
    command: tail -f /dev/null
```

To run a Docker Compose file

- docker-compose up -d
- docker ps
- docker exec -it container_name_or_id bash

To run a particular service

- docker-compose up servicename
- docker-compose up -d one
- docker-compose up -d two

Creating an Ubuntu web server, binding port 80 of the host to port 80 of the Ubuntu container, and syncing /dir1 on the host with /dir2 in the container using Docker Compose.

```
mkdir /dir1
cd /dir1
touch file1
cd /root
```

vim docker-compose.yaml

```
version: '3.8'
services:
  ubuntu-apache:
    image: ubuntu:22.04
    container_name: ubuntu_apache_server
    ports:
      - "80:80"
    volumes:
      - /dir1:/dir2
    command: >
      bash -c "apt-get update &&
               apt-get install -y apache2 &&
               echo 'ServerName localhost' >> /etc/apache2/apache2.conf &&
               echo 'hello all' > /var/www/html/index.html &&
               apachectl -D FOREGROUND"
```

****

Dockerfile

****

- A Dockerfile is a simple text file with a set of instructions.
- The name of the file should be "Dockerfile" (with a capital D).
- vim Dockerfile
- Component names should be in capital letters.
- Components of a Dockerfile:

1. FROM
- Specifies the base image to be downloaded from Docker Hub.

2. MAINTAINER
- Defines the author or owner of the Dockerfile.

3. EXPOSE
- Specifies the ports that need to be opened.

4. WORKDIR
- Sets the directory to log in to within the container.

5. ENV
- Sets environment variables inside the container.

6. ARG
- Passes an argument to the container.

7. COPY
- Copies data from the local machine to the container.

8. ADD
- Similar to COPY but also extracts files into the container from the local machine.
- It can also download data from the internet.

9. RUN
- Executes commands while creating the image.

10. CMD
- Executes commands while creating the container.
- Multiple CMD instructions can be used.

11. ENTRYPOINT
- Similar to CMD but has a higher priority than CMD.
- A Dockerfile can have only one ENTRYPOINT.
- The first command executed in the container is from ENTRYPOINT, followed by the commands mentioned in CMD.

cd /root

vim Dockerfile

```
FROM ubuntu
MAINTAINER Lekharaj
WORKDIR /tmp
RUN echo "Hello all" > /file1
```

To create an image from a Dockerfile

- docker build -t custom-imagename path-of-Dockerfile
- docker build -t image1 /root

To create a container from an image

- docker run -it imagename bash
- docker run -it image1 bash

cd /root
vim Dockerfile

```
FROM ubuntu
WORKDIR /tmp
RUN echo "Hello all" > /home/file20
RUN mkdir /dir1
COPY file60 /dir1
ADD file5.tar /tmp
```

To create an image from a Dockerfile

- docker build -t custom-imagename path-of-Dockerfile
- docker build -t image1 /root

create a container from an image

- docker run -it imagename
- docker run -it image1

- FROM ubuntu
- RUN apt-get update -y
- RUN apt-get install tree -y
- RUN apt-get install git -y
- RUN apt-get install apache2 -y

To check whether a particular package is installed on an Ubuntu machine

- apt list --installed pkgname

To optimize a Dockerfile:

- FROM ubuntu
- RUN apt-get update -y && apt-get install tree git apache2 -y

Types of formats to write a Dockerfile
1) Shell format
2) Exec format

1) Shell format

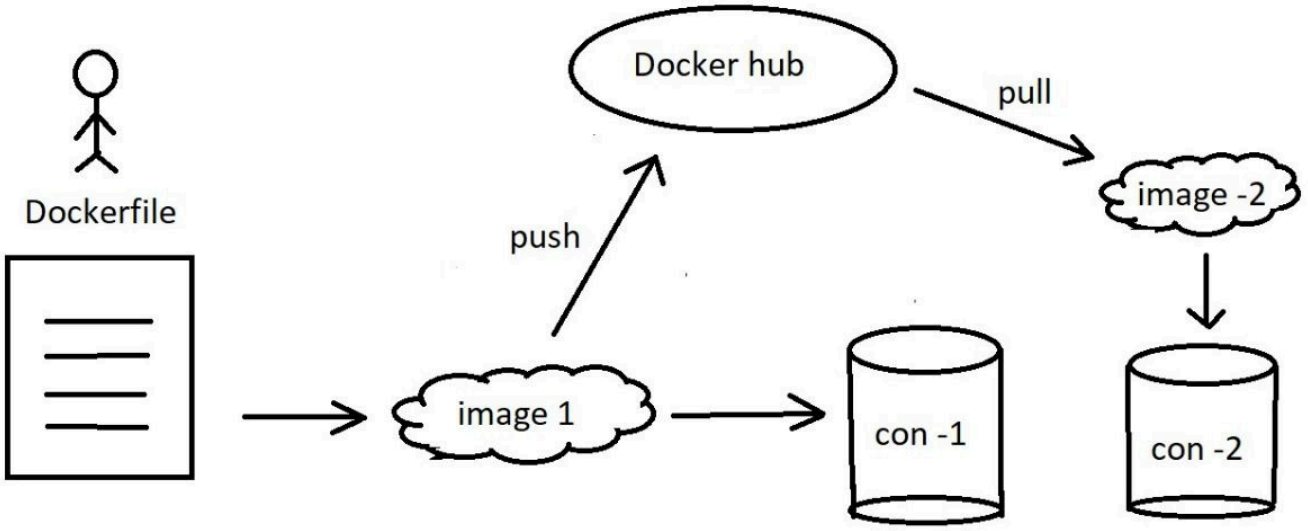
```
FROM ubuntu
RUN mkdir /dir1
RUN touch /file1
```

2) Exec format

```
FROM ubuntu
RUN [ "mkdir", "/dir1" ]
RUN [ "touch", "/file1" ]
```

How to push a custom image to Docker Hub

- Create a Dockerfile
- Build the image
- docker build -t dockerhub-username/imagename path-of-Dockerfile
- Log in to Docker Hub
- docker login
- Push the image
- docker push account-name/imagename



Docker EXP

- Having knowledge of Docker to create isolated environments for development and testing.
- Understanding how to manage Docker images and versions using Docker Hub.
- Knowledge of creating and running Docker containers to ensure consistent application performance.
- Understanding how to write Dockerfiles to build and configure application images.
- Understanding Docker Compose to manage multi-container applications.

Roles & responsibilities in Docker

- Used Docker to create isolated environments for development and testing
- Managed Docker images and their versions using Docker Hub
- Created and managed Docker containers to ensure applications run the same in any environment.
- Created Dockerfiles to build and configure application images