Docker Intro

Docker makes open-source project setup very easy.

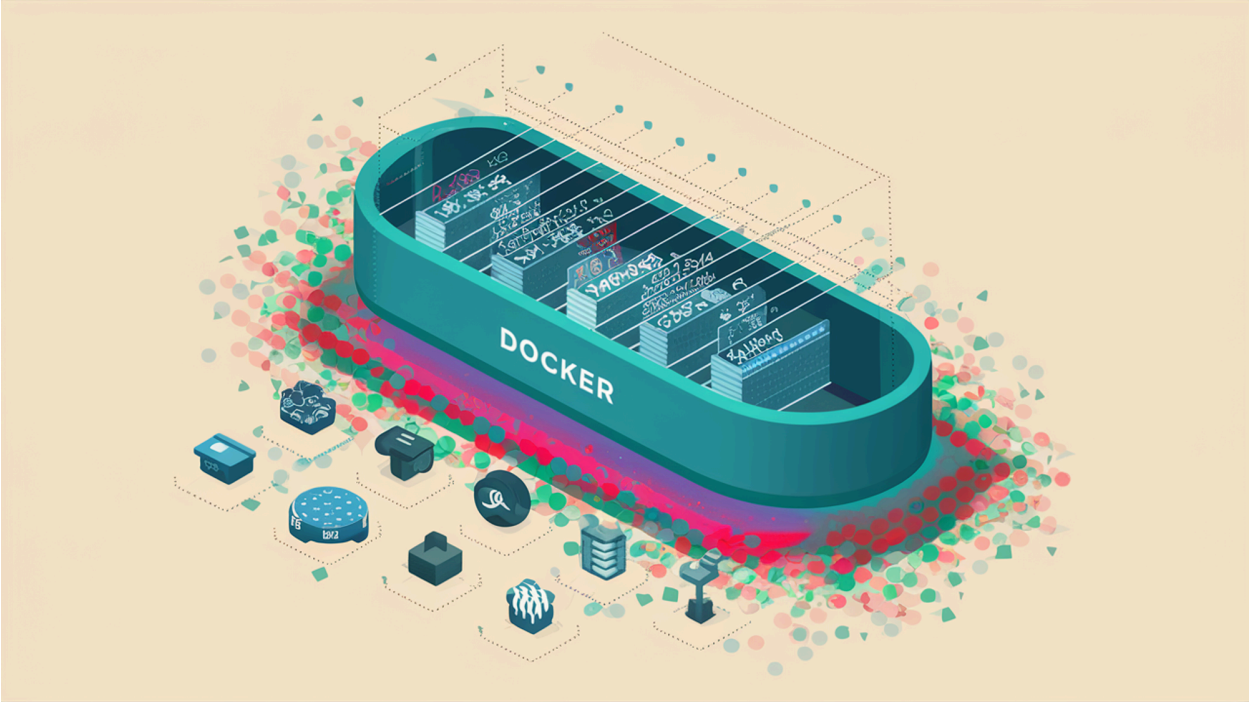
If we have isolated environment we can run many applications and they can’t talk to each other

Docker-file make it very easy to start

Auxillary services: postgres etc

What is Containerization

What is Container



Containers are a way to package and distribute software applications in a way that makes them **easy to deploy** and **run consistently across different environments**. They allow you to package an application, along with all its dependencies and libraries, into a single unit that can be **run on any machine with a container runtime**, such as Docker.
Container are mini machine. Container which has some code/filesystem / network

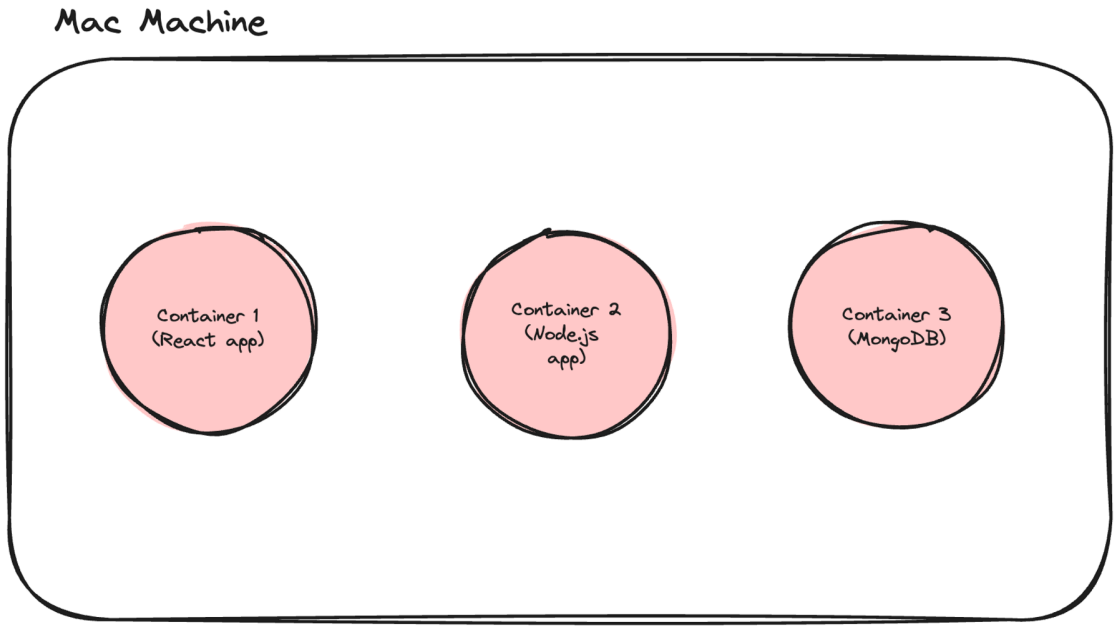
Why Containers

1. Steps to run a project can vary based on the OS

We can give same container to the MAC user or window user and they have to run a single command
That container has everything installed node/mongo/etc

2. Extremely hard to keep track of dependencies as project grows.

Benefits of using container



- Let us describe our configuration in a single file.
- Can run in isolated environment (hard for to take complete CPU or communicate to mongoDB)
- Makes local setup easy OS easy
- Makes installing auxiliary services easy

Example: docker run -d -p 27017:27017 mongo

Docker isn't the only way to create containers.

History of Docker

https://www.ycombinator.com/blog/solomon-hykes-docker-dotcloud-interview/

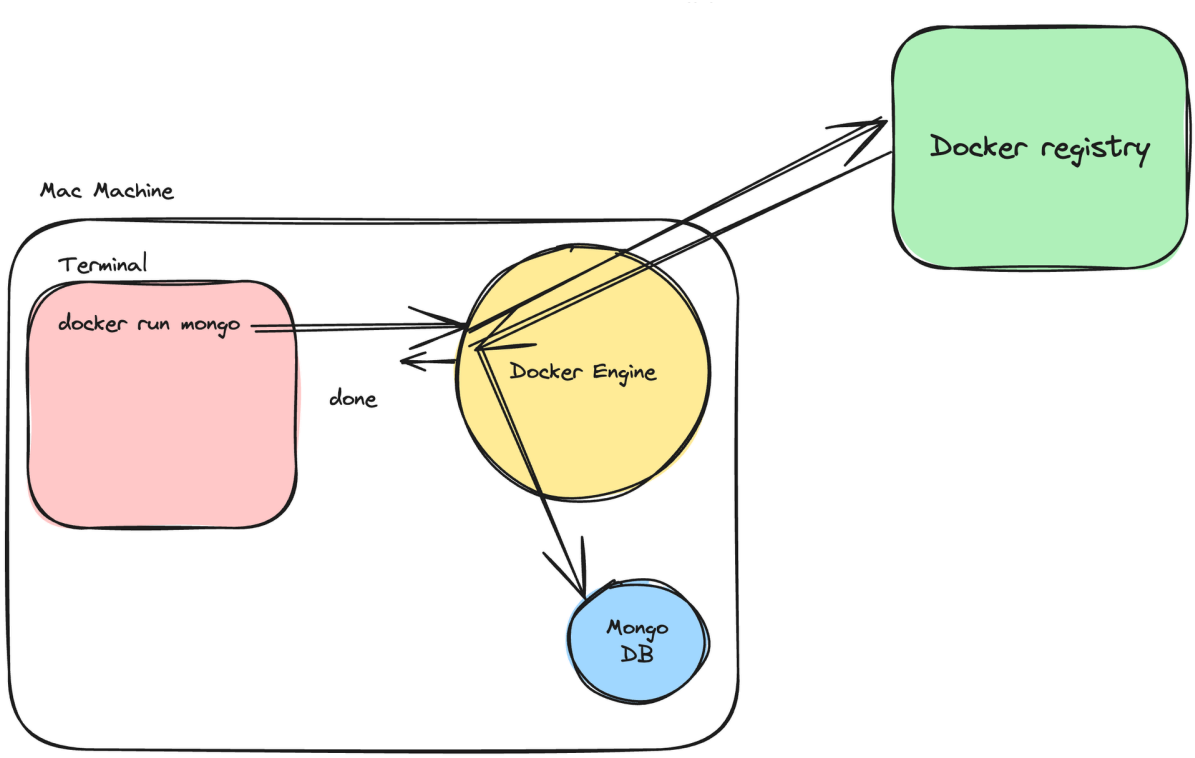
Installing Docker

https://docs.docker.com/engine/install/

Dockerfile

docker.yml

Inside docker



Terminal talks to docker engine (starts container download images etc).

Codebase in github

What is mongo image, it is similar to codebase, if we want to setup mongodb locally it will get the image from somewhere

- Docker engine

- Docker cli
- Docker registry

Docker engine

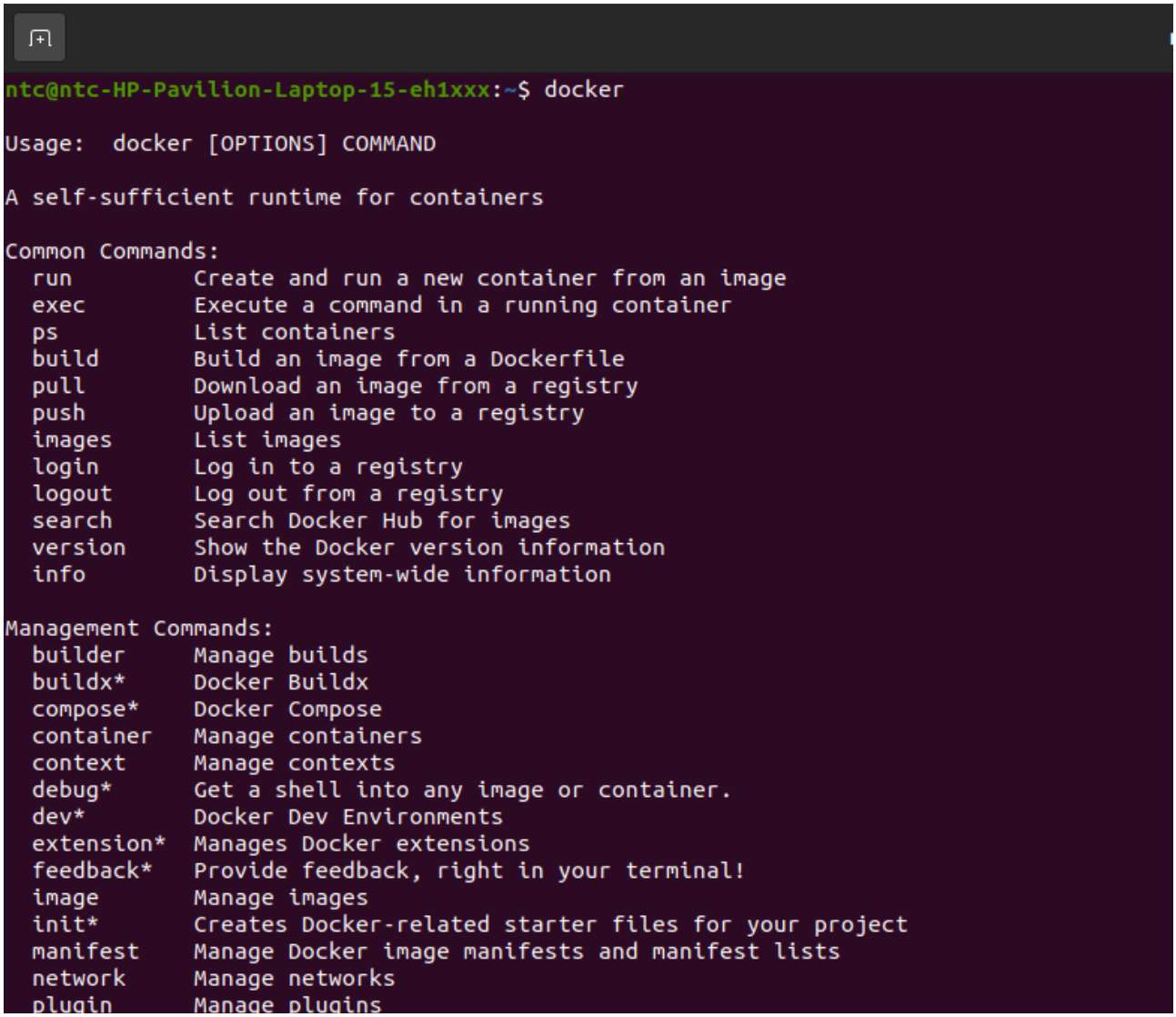
Docker Engine is an open-source containerization technology that allows developers to package applications into container
Containers are standardized executable components combining application source code with the **operating system (OS) libraries** and **dependencies required** to run that code in any environment.

Docker CLI

Command line interface lets us talk to the docker engine and lets you start/stop/list containers

docker run -d -p 27017:27017 mongo

Docker cli is not the only way to talk to a docker engine. You can hit the docker `REST` API to do the same things



Docker Registry

The docker registry is how Docker makes money.

It is similar to github, but it lets you push images rather than sourcecode

Docker's main registry - https://dockerhub.com/

Mongo image on docker registry - https://hub.docker.com/_/mongo

If we want to upload in AWS better idea to is get image from AWS registry

Images Vs Container

Docker image

A Docker image is a lightweight, standalone, executable package that includes everything needed to run a piece of software, including the code, a runtime, libraries, environment variables, and config files.

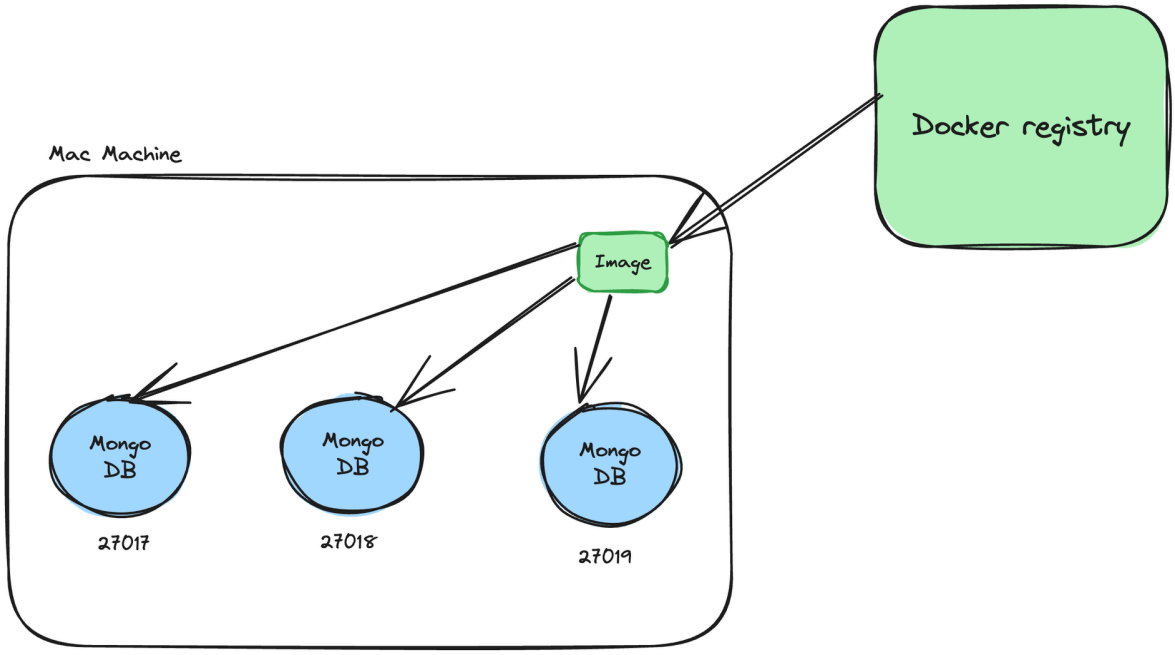
A good mental model for an image is **Your codebase on github**

Has bunch of librarires environmnetal etc need to run it

Docker container

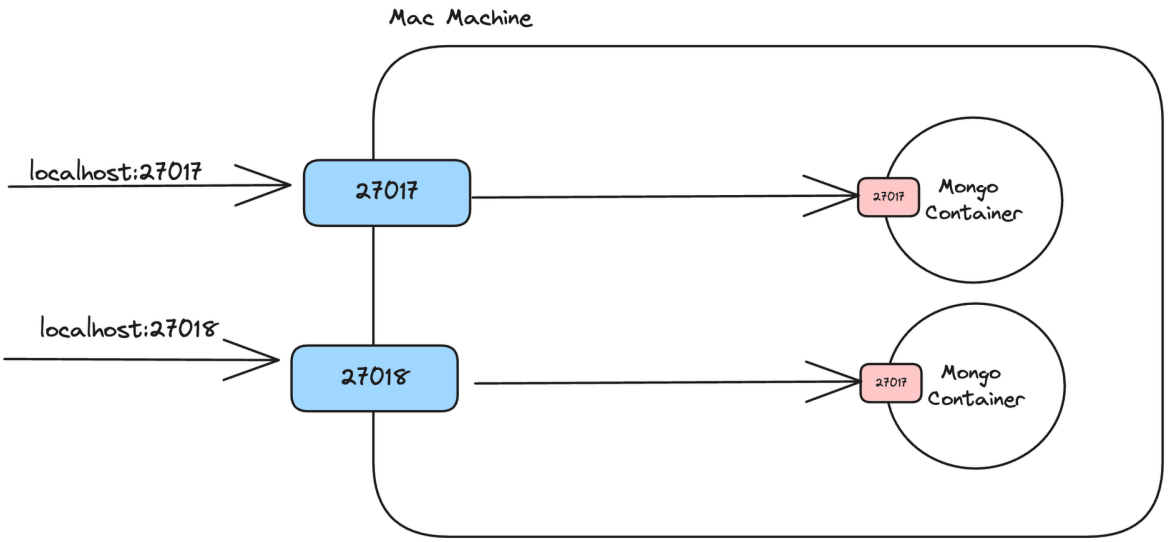
A container is a running instance of an image. It encapsulates the application or service and its dependencies, running in an isolated environment.

A good mental model for container is **node index.js**



docker images : to see the images on the docker

docker ps : to see the containers



running

Port Mapping

docker run -d -p 27018:27017 mongo

First port if of our machine second if of the container

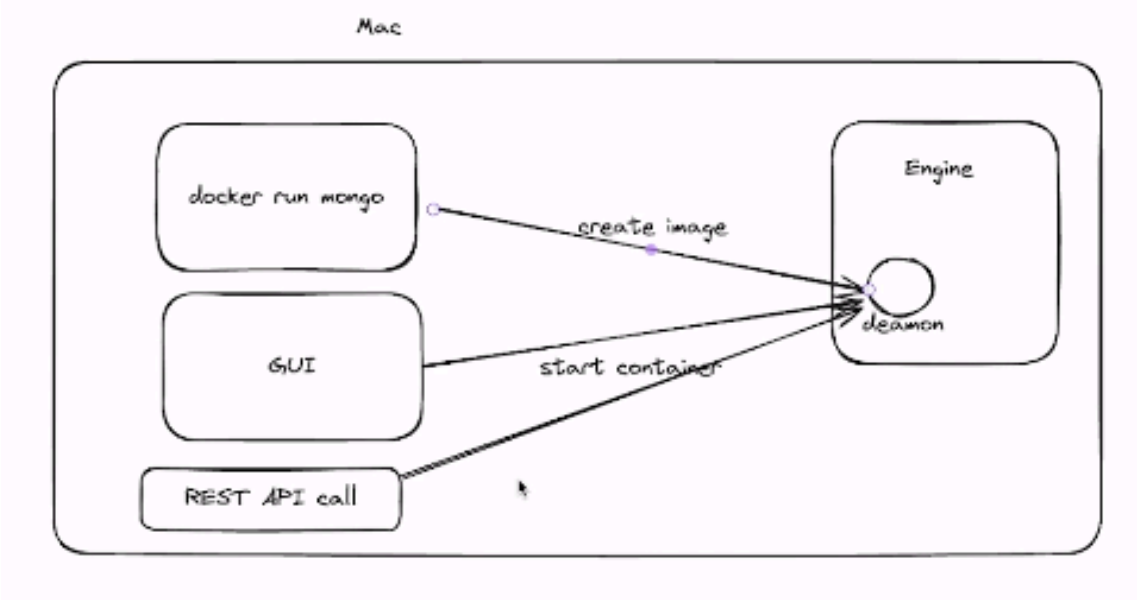
Containers are very isolated, whatever container we are starting. It means even if the mongodb is listening on 27017 port then it is listening on its own set of port its is different from mac 27017 port

Recap:

Docker is something which let us run container .

Docker has a demon , create image / start container . There are various way to contact to deamon.

docker kill



Socket_url then convert it to http url

We either

1. Create an image and push to docker hub
2. Or we start container locally using other people images/our images
3. Deploy to AWS machine using docker/kubernetes

Common docker commands

- **docker images** : Shows you all the images that you have on your machine
- **docker ps :** Shows you all the containers you are running on your machine
- **docker run**

Lets you start a container

-p ⇒ let's you create a port mapping

-d. ⇒ Let's you run it in detatched mode (terminal becomes free)

- **docker build**

Lets you build an image. We will see this after we understand how to create your own Dockerfile

- **docker push**

Lets you push your image to a registry

- **docker kill** container_id
- **docker exec**
- **docker pull mongo**

Dockerfile

These dockerfile is created once , they are not changed very often , if we want to create opensource project where we want others to contribute use it. If we create a database of our own its good idea to publish to docker registry.

What is Dockerfile

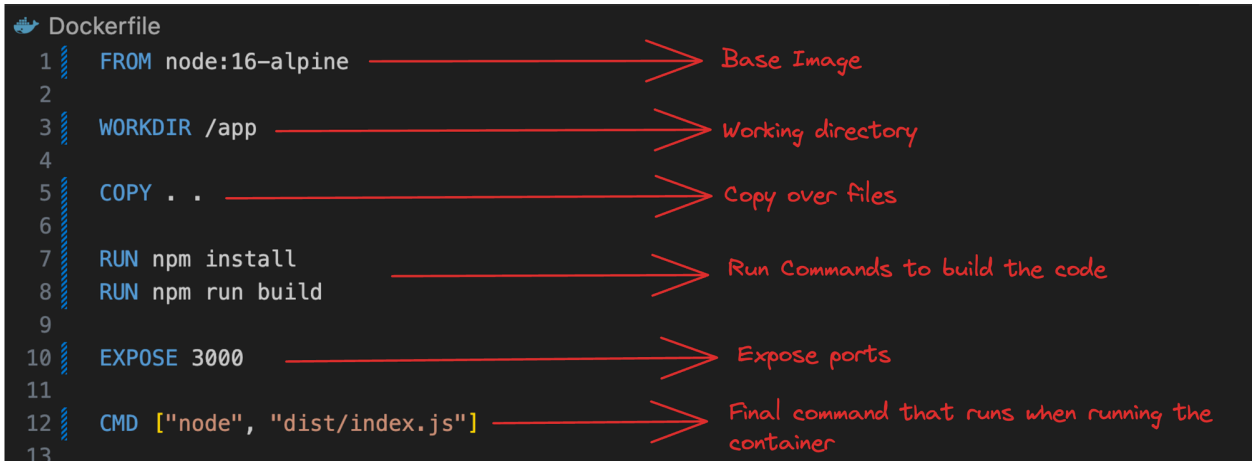
If you want to create an image from your own code, that you can push to dockerhub, you need to create a Dockerfile for your application.
A Dockerfile is a text document that contains all the commands a user could call on the command line to create an image.

How to write a Dockerfile

A dockerfile has 2 parts
Base image
Bunch of commands that you run on the base image (to install dependencies like Node.js)

Let’s write our own Dockerfile

Let’s try to containerise this backend app - https://github.com/100xdevs-cohort-2/week-15-live-1




```
FROM node:20

WORKDIR /app

COPY . .

RUN npm install
RUN npx prisma generate
RUN npm run build

EXPOSE 3000

CMD ["node", "dist/index.js"]
```

Every dockerfile need to have a baseimage at the top, we can even select UBUNTU and then choose the nodejs

Base image is from where we will start, the version we are using is 16-alphine.

Alpine means we get trimmed image.

Common commands

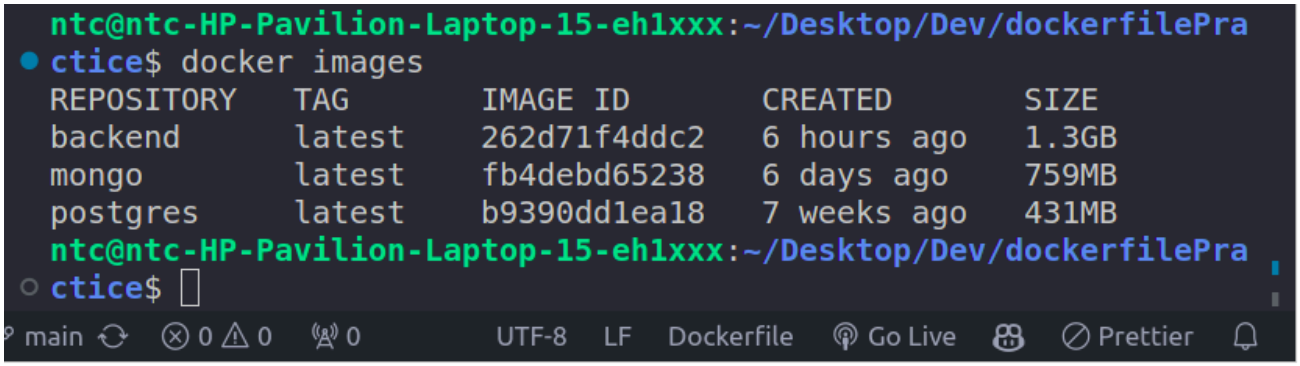
- **WORKDIR :** Sets the working directory for any **RUN, CMD, ENTRYPOINT, COPY** instructions that follow it. (put everything in the app)
- **RUN :** Executes any commands in a new layer on top of the current image and commit the results
- **CMD:** Provides defaults for executing a container. There can only be one CMD instruction in a dockerfile.
- **EXPOSE:** Informs Docker that the container listens on the specified network ports at runtime.
- **ENV :** Sets the environment variable
- **COPY :** Allow files from the Docker host to be added to the Docker image

Copy everything from this folder over the working directory of the images. Copy source code of projects including node_modules

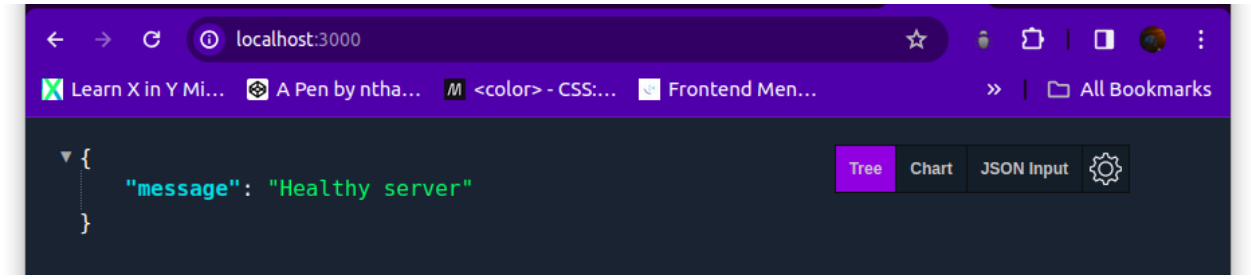
```
FROM node:20

WORKDIR /app

COPY . .
# we are currently copying even node_module so add node_module to
.dockerignore

RUN npm install
RUN npm run build
RUN npx prisma generate
# they don't start the application
EXPOSE 3000
# Runs when we are creating a image
# Runs on thing which bootstrap our application

CMD ["node","dist/index.js"]
# why didn't we use RUN node index.js
# All the code run when we starting the image/container
# actually start our application
```

docker build -t backendApp . (this is basically the name of image of docker and . represent from where we want to build image from)

We created our own image and now if we want we can push to docker hub



docker run -p 3000:3000 backend



Backend running in a machine inside a container we also did put a port

Passing in env variables

docker run -p 3000:3000 -e DATABASE_URL="postgres://avnadmin:AVNS_EeDiMIdW-dNT4Ox9l1n@pg-35339ab4-harkirat-d1b9.a.aivencloud.com:25579/defaultdb?sslmode=require" image_name

The -e argument let's you send in environment variables to your node.js app

Docker is really good at caching

Hence second time it will be very fast

Docker use for database locally don't use for production

How will final container will have the environment variable we cant push env in github.

Anytime you change the env update the DB (migrate)

We may think to write it in Dockerfile. We don't even want it in docker

Hence when we start the docker then we will **pass the env**

More commands

List all contents of a container folder

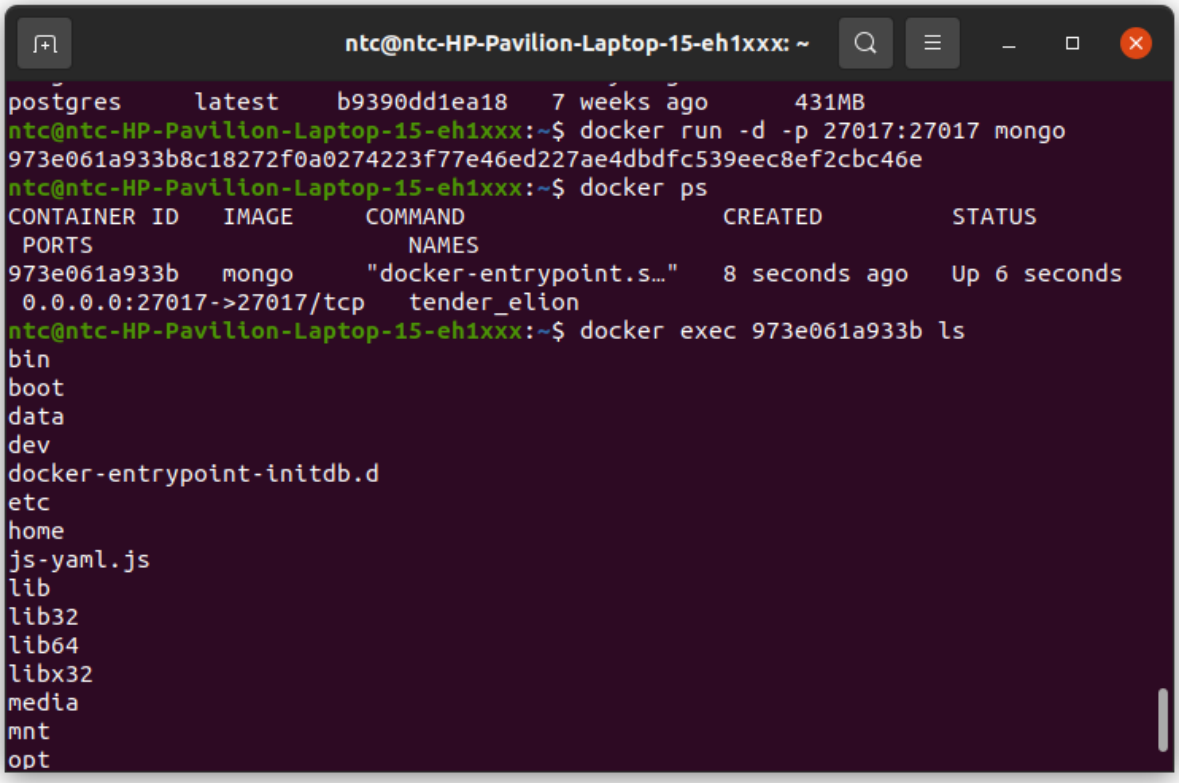
docker exec <container_name_or_id> ls /path/to/directory

Running an interactive shell

docker exec -it <container_name_or_id> /bin/bash

Interactively means that it doesn't exit once we run the command used when we want to run a series of commands.

/bin/bash means that we

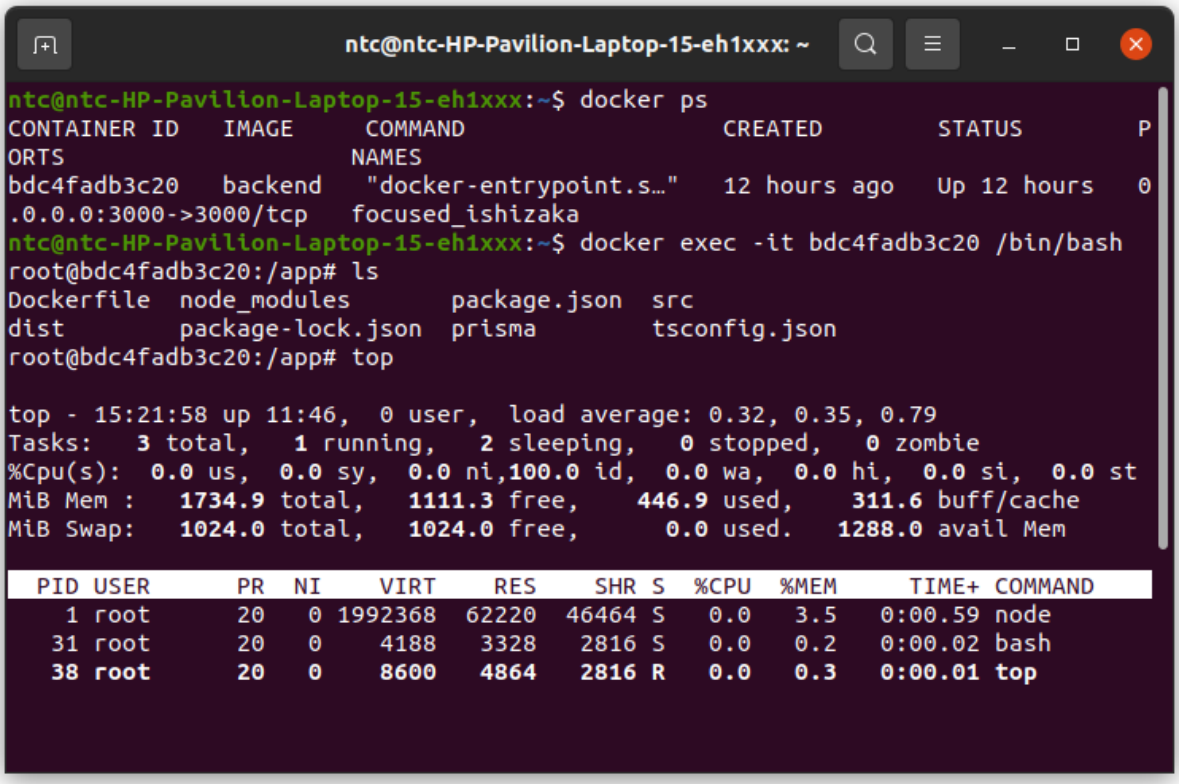


docker rmi <image_name>

Will delete the image and free up the space

- **-force** will forcefully do something

Execute a command inside the container to get the shell access.

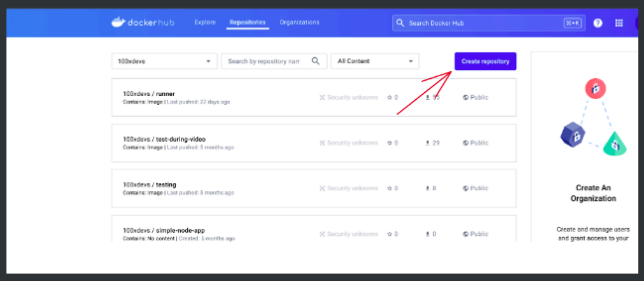


Pushing to Dockerhub

Step 14 - Pushing to dockerhub

Once you've created your image, you can push it to `dockerhub` to share it with the world.

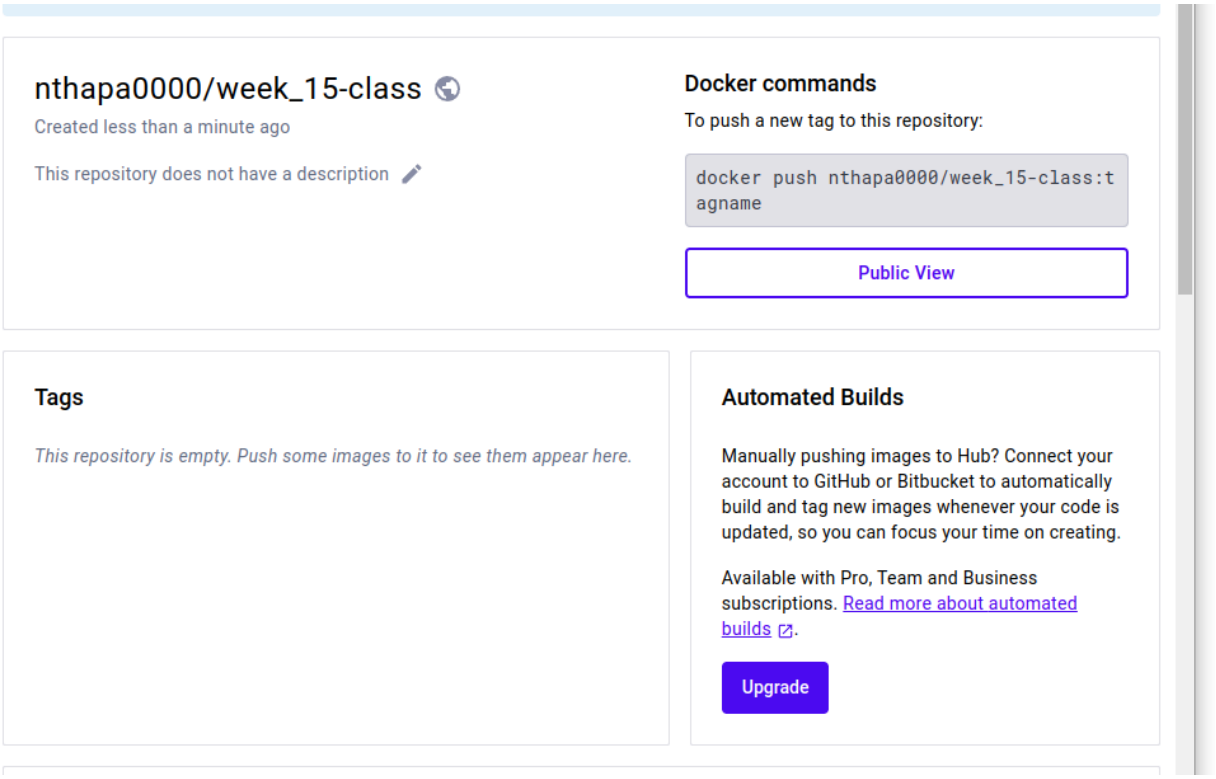
1. Signup to `dockerhub`
2. Create a new repository



3. Login to docker cli
    1. docker login
    2. you might have to create an access token - https://docs.docker.com/security/for-developers/access-tokens/
4. Push to the repository

```
docker push your_username/your_reponame:tagname
```

Sign up in dockerhub



`docker push nthapa0000/week_15-class:tagname`

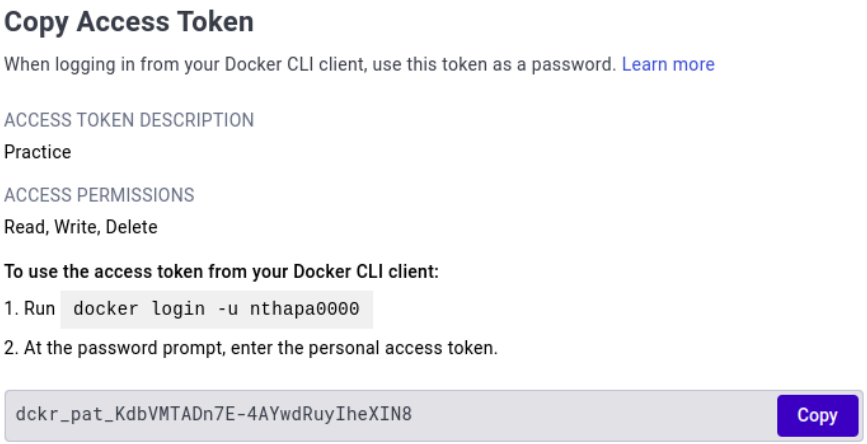
This is done so that we can't pollute the namespace of the docker and create mongo etc

Go to the terminal

docker build -t nthapa0000 .

Now push to dockerhub

Before pushing sign in to docker hub



dckr_pat_KdbVMTADn7E-4AYwdRuyIheXIN8

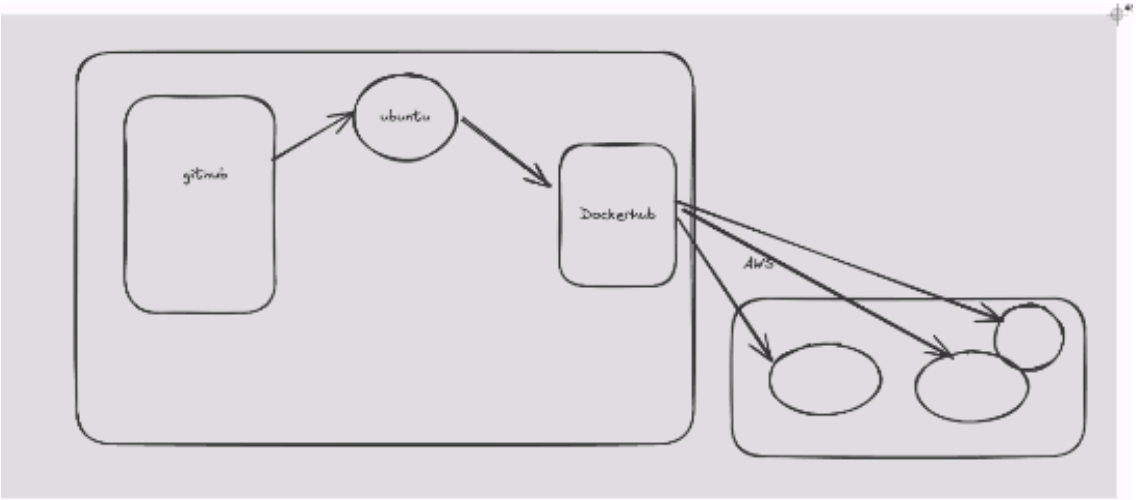
docker push <repository_name>:tagname

Tagname can be like V1

V2 etc anything we want

```
2.2$ docker images
REPOSITORY                TAG       IMAGE ID       CREATED
    SIZE
nthapa0000                latest    786f6f27d328   9 minutes ag
o   1.16GB
nthapa0000/week_15-class  latest    786f6f27d328   9 minutes ag
o   1.16GB
ntc@ntc-HP-Pavilion-Laptop-15-eh1xxx:~/Desktop/Dev/week-15-live-
2.2$ docker push nthapa0000/week_15-class
Using default tag: latest
The push refers to repository [docker.io/nthapa0000/week_15-clas
s]
ef3fea1538ed: Pushing  11.78kB
259edfcd2f10: Pushed
ebc796be3914: Pushing  31.45MB/58.18MB
f7a3b9af30c7: Pushed
bd66bfe67719: Pushed
405973eec1c7: Pushing  3.584kB
1748e4c4bd22: Pushing    278kB/7.521MB
636e6fa01167: Waiting
3e81cc85b636: Waiting
893507f6057f: Waiting
2353f7120e0e: Waiting
51a9318e6edf: Waiting
c5bb35826823: Waiting
```

CI/CD every commit we are pushing to docker hub with the commit id



docker-compose

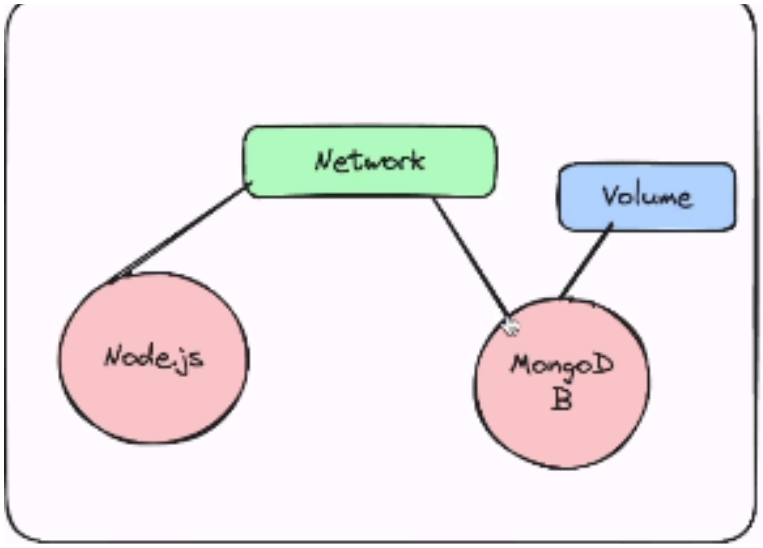
.yml describe data in form of key value pair

Docker Compose is a tool designed to help you define and **run multi-container Docker applications**. With Compose, you use a YAML file to configure your application's services, networks, and volumes. Then, with a single command, you can create and start all the services from your configuration.

Talk to each other using name.

We have define volume

What problem does it solves??



Will talk on port 3000:3000

Till now we have used this approach to run multi container applications.
In future we may have small golang microprocess and multiple container talking to each other and we may need multiper network

What if we can describe all this in a single file

Before docker-compose

- Create an network

docker network create my_custom_network

- Create a volume

docker volume create volume_database

- Start mongo container

docker run -d -v volume_database:/data/db --name mongo --network my_custom_network mongo

- Start backend container

docker run -d -p 3000:3000 --name backend --network my_custom_network backend

Container can talk to each other without any port , port are generally for the host machine

After docker-compose

1. Install docker-compose https://docs.docker.com/compose/install/
2. Create a yaml file describing all your container and volumes (by default all containers in a docker-compoese run on the same network)

```yaml
version: '3.8'
services:
 mongodb:
   image: mongo
   container_name: mongodb
   ports:
     - "27017:27017"
   volumes:
     - mongodb_data:/data/db

 backend22:
   image: backend
   container_name: backend_app
   depends_on:
     - mongodb
   ports:
     - "3000:3000"
   environment:
     MONGO_URL: "mongodb://mongodb:27017"

volumes:
 mongodb_data:
```

This much command is

```
mongodb:
  image: mongo
  container_name: mongodb
  ports:
    - "27017:27017"
  volumes:
    - mongodb_data:/data/db
```

Same as :

docker run –name mongodb -p 27017:27017 -v mongodb_data:/data/db mongo

Docker compose understand this commands and runs multiple docker run commands

```
backend22:
  image: backend
  container_name: backend_app
  depends_on:
    - mongodb
  ports:
    - "3000:3000"
  environment:
    MONGO_URL: "mongodb://mongodb:27017"
```

Ports are array

Whenever we have multiple container in docker-compose it starts them in same network , volume we have to define in same level as services

docker-compose up