

Docker

1. Introduction to containerization and Docker fundamentals, Basic Commands

Terminal

```
Windows PowerShell
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Install the latest PowerShell for new features and improvements! https://aka.ms/PSWindows

PS C:\Users\Ayush Pandey> docker --version
registry          2           26b2eb03618e  20 months ago  25.4MB
mongo             4.0-xenial   fb1435e8841c  2 years ago   430MB
PS C:\Users\Ayush Pandey> docker pull ubuntu
Using default tag: latest
latest: Pulling from library/ubuntu
d9d352c11bbd: Pull complete
Digest: sha256:b59d21599a2b151e23eea5f6602f4af4d7d31c4e236d22bf0b62b86d2e386b8f
Status: Downloaded newer image for ubuntu:latest
docker.io/library/ubuntu:latest
```

```
PS C:\Users\Ayush Pandey> docker run -it ubuntu
root@8f54c0fbbc01:/#
```

```
PS C:\Users\Ayush Pandey> docker ps
CONTAINER ID IMAGE      COMMAND   CREATED    STATUS     PORTS      NAMES
PS C:\Users\Ayush Pandey> docker ps -a
CONTAINER ID IMAGE      COMMAND   CREATED    STATUS     PORTS      NAMES
558c4c034873  ubuntu      "/bin/bash" 14 seconds ago Exited (0) 14 seconds ago  blissful_fermat
8f54c0fbbc01  ubuntu      "/bin/bash" About a minute ago Exited (0) 31 seconds ago  clever_dhawan
a579d12119b9  java-chat-app  "java server" 18 hours ago Exited (130) 18 hours ago  goofy_morse
PS C:\Users\Ayush Pandey>
```

```
PS C:\Users\Ayush Pandey> docker rm 558c4c034873
558c4c034873
PS C:\Users\Ayush Pandey> docker ps -a
CONTAINER ID IMAGE      COMMAND   CREATED    STATUS     PORTS      NAMES
8f54c0fbbc01  ubuntu      "/bin/bash" 3 minutes ago Exited (0) 2 minutes ago  clever_dhawan
a579d12119b9  java-chat-app  "java server" 18 hours ago Exited (130) 18 hours ago  goofy_morse
```

```

PS C:\Users\Ayush Pandey> docker images
REPOSITORY          TAG      IMAGE ID      CREATED        SIZE
java-chat-app       latest   7a0c1d29f6be  18 hours ago  326MB
ubuntu              latest   bf16bdcff9c9  2 weeks ago   78.1MB
nginx               latest   1e5f3c5b981a  8 weeks ago   192MB
localhost:5000/nginx1  latest   1e5f3c5b981a  8 weeks ago   192MB
localhost:5000/nginx2  latest   1e5f3c5b981a  8 weeks ago   192MB
registry            2        26b2eb03618e  20 months ago  25.4MB
mongo               4.0-xenial  fb1435e8841c  2 years ago   430MB

PS C:\Users\Ayush Pandey> docker rmi nginx
Untagged: nginx:latest
Untagged: nginx@sha256:6784fb0834aa7dbbe12e3d7471e69c290df3e6ba810dc38b34ae33d3c1c05f7d
PS C:\Users\Ayush Pandey> docker images
REPOSITORY          TAG      IMAGE ID      CREATED        SIZE
java-chat-app       latest   7a0c1d29f6be  18 hours ago  326MB
ubuntu              latest   bf16bdcff9c9  2 weeks ago   78.1MB
localhost:5000/nginx1  latest   1e5f3c5b981a  8 weeks ago   192MB
localhost:5000/nginx2  latest   1e5f3c5b981a  8 weeks ago   192MB
registry            2        26b2eb03618e  20 months ago  25.4MB
mongo               4.0-xenial  fb1435e8841c  2 years ago   430MB

```

2. Docker installation and basic container operations, Build an image from Dockerfile
- Docker installation and basic container operations, Build an image from Dockerfile

```

ayush@ayush:~$ sudo apt-get update
[sudo] password for ayush:
Get:1 https://dl.google.com/linux/chrome/deb stable InRelease [1,825 B]
Hit:2 http://in.archive.ubuntu.com/ubuntu jammy InRelease
Hit:3 http://security.ubuntu.com/ubuntu jammy-security InRelease
Get:4 https://dl.google.com/linux/chrome/deb stable/main amd64 Packages [1,210 B]
Hit:5 http://in.archive.ubuntu.com/ubuntu jammy-updates InRelease
Hit:6 http://in.archive.ubuntu.com/ubuntu jammy-backports InRelease
Fetched 3,035 B in 1s (2,272 B/s)
Reading package lists... Done

```

```
ayush@ayush:~$ sudo apt-get install ca-certificates curl gnupg lsb-release
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
lsb-release is already the newest version (11.1.0ubuntu4).
lsb-release set to manually installed.
ca-certificates is already the newest version (20240203~22.04.1).
ca-certificates set to manually installed.
gnupg is already the newest version (2.2.27-3ubuntu2.3).
gnupg set to manually installed.
The following NEW packages will be installed:
  curl
0 upgraded, 1 newly installed, 0 to remove and 143 not upgraded.
Need to get 194 kB of archives.
After this operation, 455 kB of additional disk space will be used.
Do you want to continue? [Y/n] y
Get:1 http://in.archive.ubuntu.com/ubuntu jammy-updates/main amd64 curl amd64 7.81.0-1ubuntu1.20 [194 kB]
Fetched 194 kB in 2s (116 kB/s)
Selecting previously unselected package curl.
(Reading database ... 209742 files and directories currently installed.)
Preparing to unpack .../curl_7.81.0-1ubuntu1.20_amd64.deb ...
Unpacking curl (7.81.0-1ubuntu1.20) ...
Setting up curl (7.81.0-1ubuntu1.20) ...
Processing triggers for man-db (2.10.2-1) ...
```

```
ayush@ayush:~$ sudo mkdir -p /etc/apt/keyrings
ayush@ayush:~$ curl -fsSL https://download.docker.com/linux/ubuntu/gpg | sudo gpg --dearmor -o /etc/apt/keyrings/docker.gpg
ayush@ayush:~$ echo "deb [arch=$(dpkg --print-architecture) signed-by=/etc/apt/keyrings/docker.gpg] https://download.docker.com/linux/ubuntu $(lsb_release -cs) stable" | sudo tee /etc/apt/sources.list.d/docker.list > /dev/null
ayush@ayush:~$ sudo apt-get update
Get:1 https://download.docker.com/linux/ubuntu jammy InRelease [48.8 kB]
Hit:2 https://dl.google.com/linux/chrome/deb stable InRelease
Get:3 https://download.docker.com/linux/ubuntu jammy/stable amd64 Packages [51.0 kB]
Hit:4 http://security.ubuntu.com/ubuntu jammy-security InRelease
Hit:5 http://in.archive.ubuntu.com/ubuntu jammy InRelease
Hit:6 http://in.archive.ubuntu.com/ubuntu jammy-updates InRelease
Hit:7 http://in.archive.ubuntu.com/ubuntu jammy-backports InRelease
Fetched 99.9 kB in 1s (78.8 kB/s)
Reading package lists... Done
```

```
ayush@ayush:~$ sudo apt-get install docker-ce docker-ce-cli containerd.io docker-buildx-plugin docker-compose-plugin
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
The following additional packages will be installed:
  docker-ce-rootless-extras libslirp0 pigz slirp4netns
Suggested packages:
  cgroupfs-mount | cgroup-lite docker-model-plugin
The following NEW packages will be installed:
  containerd.io docker-buildx-plugin docker-ce docker-ce-cli
  docker-ce-rootless-extras docker-compose-plugin libslirp0 pigz
  slirp4netns
0 upgraded, 9 newly installed, 0 to remove and 143 not upgraded.
Need to get 121 MB of archives.
After this operation, 444 MB of additional disk space will be used.
Do you want to continue? [Y/n] y
Get:1 https://download.docker.com/linux/ubuntu jammy/stable amd64 containerd.io amd64 1.7.27-1 [30.5 MB]
Get:2 http://in.archive.ubuntu.com/ubuntu jammy/universe amd64 pigz amd64 2.6-1 [63.6 kB]
Get:3 https://download.docker.com/linux/ubuntu jammy/stable amd64 docker-ce-cli amd64 5:28.2.2-1~ubuntu.22.04~jammy [16.2 MB]
Get:4 https://download.docker.com/linux/ubuntu jammy/stable amd64 docker-ce amd64 5:28.2.2-1~ubuntu.22.04~jammy [19.5 MB]
Get:5 https://download.docker.com/linux/ubuntu jammy/stable amd64 docker-buildx-plugin amd64 0.24.0-1~ubuntu.22.04~jammy [34.4 MB]
Get:6 http://in.archive.ubuntu.com/ubuntu jammy/main amd64 libslirp0 amd64 4.6.1-1build1 [61.5 kB]
Get:7 http://in.archive.ubuntu.com/ubuntu jammy/universe amd64 slirp4netns amd64 1.0.1-2 [28.2 kB]
Get:8 https://download.docker.com/linux/ubuntu jammy/stable amd64 docker-ce-rootless-extras amd64 5:28.2.2-1~ubuntu.22.04~jammy [6,480 kB]
Get:9 https://download.docker.com/linux/ubuntu jammy/stable amd64 docker-compose-plugin amd64 2.36.2-1~ubuntu.22.04~jammy [14.0 MB]
Fetched 121 MB in 2s (71.0 MB/s)
Selecting previously unselected package containerd.io.
(Reading database ... 209749 files and directories currently installed.)
Preparing to unpack .../0-containerd.io_1.7.27-1_amd64.deb ...
Unpacking containerd.io (1.7.27-1) ...
Selecting previously unselected package docker-ce-cli.
Preparing to unpack .../1-docker-ce-cli_5%3a28.2.2-1~ubuntu.22.04~jammy_amd64.deb ...
Unpacking docker-ce-cli (5:28.2.2-1~ubuntu.22.04~jammy) ...
```

```
ayush@ayush: $ docker --version
Docker version 28.2.2, build e6534b4
ayush@ayush: $ docker version
Client: Docker Engine - Community
 Version:          28.2.2
 API version:      1.50
 Go version:       go1.24.3
 Git commit:       e6534b4
 Built:            Fri May 30 12:07:28 2025
 OS/Arch:          linux/amd64
 Context:          default
permission denied while trying to connect to the Docker daemon socket at unix:///var/run/docker.sock: Get "http://%2Fvar%2Frun%2Fdocker.sock/v1.50/version": dial unix /var/run/docker.sock: connect: permission denied
ayush@ayush: $
```

```
ayush@ayush:~$ sudo docker pull ubuntu
Using default tag: latest
latest: Pulling from library/ubuntu
d9d352c11bbd: Pull complete
Digest: sha256:b59d21599a2b151e23eea5f6602f4af4d7d31c4e236d22bf0b62b86d2e386b8f
Status: Downloaded newer image for ubuntu:latest
docker.io/library/ubuntu:latest
```

```
ayush@ayush:~$ sudo docker run -it ubuntu
root@a3ecb4a44cd0:/# docker run ubuntu echo "Hello, this message is from inside the container"
bash: docker: command not found
root@a3ecb4a44cd0:/# echo "Hello"
Hello
root@a3ecb4a44cd0:/# exit
exit
```

```
ayush@ayush:~$ sudo docker run ubuntu echo "Hello from inside the container"
Hello from inside the container
```

```
ayush@ayush:~$ sudo docker ps
CONTAINER ID   IMAGE    COMMAND   CREATED   STATUS    PORTS     NAMES
ayush@ayush:~$ sudo docker ps -a
CONTAINER ID   IMAGE    COMMAND   CREATED   STATUS    PORTS     NAMES
af5fcdd5c3ed   ubuntu   "echo 'Hello from in..."   20 seconds ago   Exited (0) 20 seconds ago   flamboyant_ritchie
a3ecb4a44cd0   ubuntu   "/bin/bash"           2 minutes ago   Exited (0) 50 seconds ago   practical_lederberg
```

```
ayush@ayush: $ sudo docker stop af5fcdd5c3ed
af5fcdd5c3ed
ayush@ayush: $ sudo docker ps -a
CONTAINER ID   IMAGE    COMMAND   CREATED   STATUS    PORTS     NAMES
af5fcdd5c3ed   ubuntu   "echo 'Hello from in..."   About a minute ago   Exited (0) About a minute ago   flamboyant_ritchie
a3ecb4a44cd0   ubuntu   "/bin/bash"           3 minutes ago   Exited (0) About a minute ago   practical_lederberg
ayush@ayush: $ sudo docker rm af5fcdd5c3ed
af5fcdd5c3ed
ayush@ayush: $ sudo docker ps -a
CONTAINER ID   IMAGE    COMMAND   CREATED   STATUS    PORTS     NAMES
a3ecb4a44cd0   ubuntu   "/bin/bash"           3 minutes ago   Exited (0) 2 minutes ago   practical_lederberg
```

```
ayush@ayush:~$ sudo docker images
REPOSITORY   TAG      IMAGE ID   CREATED   SIZE
ubuntu       latest   bf16bdcff9c9   2 weeks ago  78.1MB
ayush@ayush:~$ sudo docker rmi bf16bdcff9c9
Error response from daemon: conflict: unable to delete bf16bdcff9c9 (must be forced) - image is being used by stopped container a3ecb4a44cd0
ayush@ayush:~$ sudo docker rm a3ecb4a44cd0
a3ecb4a44cd0
ayush@ayush:~$ sudo docker rmi bf16bdcff9c9
Untagged: ubuntu@sha256:b59d21599a2b151e23eea5f6602f4af4d7d31c4e236d22bf0b62b86d2e386b8f
Deleted: sha256:bf16bdcff9c96b76a6d417bd8f0a3abe0e55c0ed9bdb3549e906834e2592fd5f
Deleted: sha256:a8346d259389bc6221b4f3c61bad4e48087c5b82308e8f53ce703cf8333c7b3
ayush@ayush:~$
```

```

ayush@ayush:~$ cd celebal
ayush@ayush:~/celebal$ ls
file2.txt file3.txt test
ayush@ayush:~/celebal$ mkdir myapp
ayush@ayush:~/celebal$ ls
file2.txt file3.txt myapp test
ayush@ayush:~/celebal$ cd myapp
ayush@ayush:~/celebal/myapp$ vim app.py
ayush@ayush:~/celebal/myapp$ cat app.py
print("Hello from inside a Docker container!!!")
ayush@ayush:~/celebal/myapp$ vim Dockerfile
ayush@ayush:~/celebal/myapp$ cat Dockerfile
FROM python:3.10-slim

```

```
WORKDIR /app
```

```
COPY . /app
```

```
CMD ["python", "app.py"]
```

```

ayush@ayush:~/celebal/myapp$ sudo docker build -t my-python .
[+] Building 9.1s (8/8) FINISHED                                            docker:default
=> [internal] load build definition from Dockerfile                      0.0s
=> => transferring dockerfile: 112B                                         0.0s
=> [internal] load metadata for docker.io/library/python:3.10-slim        3.9s
=> [internal] load .dockerignore                                         0.0s
=> => transferring context: 2B                                         0.0s
=> [1/3] FROM docker.io/library/python:3.10-slim@sha256:034724ef64585eeb0e82385e9aabceabfe5f7cae 4.8s
=> => resolve docker.io/library/python:3.10-slim@sha256:034724ef64585eeb0e82385e9aabceabfe5f7cae 0.0s
=> => sha256:50a956a18493962b03f716b86299535ce63a1d6a1a1770be582b59f8fedb46b7 15.65MB / 15.65MB 0.9s
=> => sha256:034724ef64585eeb0e82385e9aabceabfe5f7cae2c2dcedb1da95114372b6d7 9.13kB / 9.13kB 0.0s
=> => sha256:fd939bec23d8e9a1274d70e24db96bceed53e56612f828098f5505086a64f523 1.75kB / 1.75kB 0.0s
=> => sha256:cce3651534b6639e18fe761c0f1bc3974459853da95ebadadc607194524d77a7 5.37kB / 5.37kB 0.0s
=> => sha256:dad67da3f26bce15939543965e09c4059533b025f707aad72ed3d3f3a09c66f8 28.23MB / 28.23MB 1.4s
=> => sha256:4b03b4f4fa5c508f2b215b45a26f6dd30b310aaa2a4a24b593f630bdf07da1a8 3.51MB / 3.51MB 1.2s
=> => sha256:c14326ed6c858d7eb04960cbc1469da7ff6192285edf9bdb9d3c4cf035105826 250B / 250B 1.4s
=> => extracting sha256:dad67da3f26bce15939543965e09c4059533b025f707aad72ed3d3f3a09c66f8 1.8s
=> => extracting sha256:4b03b4f4fa5c508f2b215b45a26f6dd30b310aaa2a4a24b593f630bdf07da1a8 0.2s
=> => extracting sha256:50a956a18493962b03f716b86299535ce63a1d6a1a1770be582b59f8fedb46b7 1.1s
=> => extracting sha256:c14326ed6c858d7eb04960cbc1469da7ff6192285edf9bdb9d3c4cf035105826 0.0s
=> [internal] load build context                                         0.0s
=> => transferring context: 196B                                         0.0s
=> [2/3] WORKDIR /app                                              0.3s
=> [3/3] COPY . /app                                               0.0s
=> exporting to image                                                 0.0s
=> => exporting layers                                              0.0s
=> => writing image sha256:fa7937f0fe5e5fa9f636a9ae17fdd87d6eac6aaa267581e95aa5d305f17d81df 0.0s
=> => naming to docker.io/library/my-python                           0.0s

```

```
ayush@ayush:~/celebal/myapp$ sudo docker run my-python
```

```
Hello from inside a Docker container!!!
```

```
ayush@ayush:~/celebal/myapp$ █
```

3. Docker Registry, DockerHub, Create a Multi-Stage Build

```
ayush@ayush:~/celebal$ git clone https://github.com/andrewagain/calculator.git
Cloning into 'calculator'...
remote: Enumerating objects: 485, done.
remote: Total 485 (delta 0), reused 0 (delta 0), pack-reused 485 (from 1)
Receiving objects: 100% (485/485), 4.77 MiB | 2.64 MiB/s, done.
Resolving deltas: 100% (256/256), done.
ayush@ayush:~/celebal$ ls
calculator file2.txt file3.txt myapp test
ayush@ayush:~/celebal$ cd calculator
ayush@ayush:~/celebal/calculator$ ls
LICENSE           package.json      public      src
'Logotype primary.png' package-lock.json README.md  yarn.lock
```

```
ayush@ayush:~/celebal$ cd calculator
ayush@ayush:~/celebal/calculator$ vim Dockerfile
ayush@ayush:~/celebal/calculator$ cat Dockerfile
FROM node:14-alpine AS builder

WORKDIR /app

COPY package.json

RUN npm install

COPY . .

EXPOSE 3000

RUN npm build
```

```

ayush@ayush:~/celebal/calculator$ sudo docker build . -f BuildDockerfile -t calculator:build
[+] Building 80.0s (11/11) FINISHED
=> [internal] load build definition from BuildDockerfile
=> => transferring dockerfile: 186B
=> [internal] load metadata for docker.io/library/node:14-alpine
=> [internal] load .dockerignore
=> => transferring context: 2B
=> [1/6] FROM docker.io/library/node:14-alpine@sha256:434215b487a329c9e867202ff89e704
=> => resolve docker.io/library/node:14-alpine@sha256:434215b487a329c9e867202ff89e704
=> => sha256:434215b487a329c9e867202ff89e704d3a75e554822e07f3e0c0f9e6 1.43kB / 1.43kB 0.0s
=> => sha256:4e84c956cd276af9ed14a8b2939a734364c2b0042485e90e1b97175e 1.16kB / 1.16kB 0.0s
=> => sha256:0dac3dc27b1ad570e6c3a7f7cd29e88e7130ff0cad31b2ec5a0f222f 6.44kB / 6.44kB 0.0s
=> => sha256:f56be85fc22e46face30e2c3de3f7fe7c15f8fd7c4e5add29d7f64b8 3.37MB / 3.37MB 0.6s
=> => sha256:8f665685b215c7daf9164545f1bbdd74d800af77d0d267db31fe03 37.17MB / 37.17MB 1.6s
=> => sha256:e5fca6c395a62ec277102af9e5283f6edb43b3e4f20f798e3ce7e425 2.37MB / 2.37MB 1.0s
=> => extracting sha256:f56be85fc22e46face30e2c3de3f7fe7c15f8fd7c4e5add29d7f64b87abda 0.1s
=> => sha256:561cb69653d56a9725be56e02128e4e96fb434a8b4b4decf2bdeb479a225 448B / 448B 1.4s
=> => extracting sha256:8f665685b215c7daf9164545f1bbdd74d800af77d0d267db31fe0345c08f 2.4s
=> => extracting sha256:e5fca6c395a62ec277102af9e5283f6edb43b3e4f20f798e3ce7e425be226 0.1s
=> => extracting sha256:561cb69653d56a9725be56e02128e4e96fb434a8b4b4decf2bdeb479a225f 0.0s
=> [internal] load build context
=> => transferring context: 5.93MB
=> [2/6] WORKDIR /app
=> [3/6] COPY package.json .
=> [4/6] RUN npm install
=> [5/6] COPY .
=> [6/6] RUN npm build
=> exporting to image
=> => exporting layers
=> => writing image sha256:aaf684db284629d67d95815933e92547af70f550293f29c5521b1eff36 0.0s
=> => naming to docker.io/library/calculator:build 0.0s

```

```

ayush@ayush:~/celebal/calculator$ sudo docker run -p 3000:3000 -it -d calculator:build
3fe6451b1fa875c4233355380f2a9388712f2e0303def9da823cee4e692776d7

```

```

ayush@ayush:~/celebal/calculator$ sudo docker ps
CONTAINER ID        IMAGE               COMMAND             CREATED            STATUS              PORTS                         NAMES
3fe6451b1fa8        calculator:build   "docker-entrypoint.s..."   14 seconds ago   Up 13 seconds   0.0.0.0:3000->3000/tcp, [::]:3000->3000/tcp   festive_kapitsa
ayush@ayush:~/celebal/calculator$ ls
BuildDockerfile  'Logotype primary.png'  package-lock.json  README.md  yarn.lock
LICENSE          package.json           public           src

```

```

ayush@ayush:~/celebal/calculator$ vim Dockerfile
ayush@ayush:~/celebal/calculator$ cat Dockerfile
FROM node:14-alpine AS builder

WORKDIR /app

COPY package.json
RUN npm install .

COPY . .
ENV NODE_ENV production

RUN yarn build
FROM nginx:1.21.0-alpine AS production
ENV NODE_ENV production

COPY --from=builder /app/build /usr/share/nginx/html
RUN ls -latr /usr/share/nginx/html

COPY nginx.conf /etc/nginx/conf.d/default.conf

EXPOSE 80

CMD ["nginx", "-g", "daemon off;"]

```

```

ayush@ayush:~/celebal/calculator$ sudo docker build --no-cache . -t calculator:latest
[+] Building 75.9s (16/16) FINISHED
      docker:default
--> [internal] load build definition from Dockerfile          0.0s
--> => transferring dockerfile: 420B                         0.0s
--> [internal] load metadata for docker.io/library/nginx:1.21.0-a 1.0s
--> [internal] load metadata for docker.io/library/node:14-alpine 0.9s
--> [internal] load .dockerignore                            0.0s
--> => transferring context: 2B                           0.0s
--> [builder 1/6] FROM docker.io/library/node:14-alpine@sha256:43 0.0s
--> [internal] load build context                          0.0s
--> => transferring context: 3.62kB                      0.0s
--> [production 1/4] FROM docker.io/library/nginx:1.21.0-alpine@s 3.0s
--> => resolve docker.io/library/nginx:1.21.0-alpine@sha256:cc8c4 0.0s
--> => sha256:0ae30075c5da17b026dbafbf1e108cccd9 7.02MB / 7.02MB 1.1s
--> => sha256:9da81141e74e38839836e81c2691d3c7ac54bf3 603B / 603B 2.3s
--> => sha256:cc8c413c74aba9fef9dae7f3da736725136 1.65kB / 1.65kB 0.0s
--> => sha256:2e76f4d4e21bae1d012267cff67e032bb00 1.57kB / 1.57kB 0.0s
--> => sha256:a6eb2a334a9fcf41788e0cff252f749df07 8.25kB / 8.25kB 0.0s
--> => sha256:540db60ca9383eac9e418f78490994d0af4 2.81MB / 2.81MB 0.6s
--> => extracting sha256:540db60ca9383eac9e418f78490994d0af424aab 0.1s
--> => sha256:b2e41dd2ded0b631f5cbbaa3461bb2f94b9398f 894B / 894B 1.1s
--> => sha256:7f40e809fb2dd163789a69d9ef40505ba223650 664B / 664B 2.9s
--> => extracting sha256:0ae30075c5da17b026dbafbf1e108cccd9fb0d3 0.5s
--> => sha256:758848c4841163e472bc4fd0a8fc9c1e128 1.39kB / 1.39kB 1.6s
--> => extracting sha256:9da81141e74e38839836e81c2691d3c7ac54bf34 0.0s
--> => extracting sha256:b2e41dd2ded0b631f5cbbaa3461bb2f94b9398fc 0.0s
--> => extracting sha256:7f40e809fb2dd163789a69d9ef40505ba223650b 0.0s
--> => extracting sha256:758848c4841163e472bc4fd0a8fc9c1e1282c4ce 0.0s
--> CACHED [builder 2/6] WORKDIR /app                         0.0s
--> [builder 3/6] COPY package.json .                         0.0s
--> [builder 4/6] RUN npm install .                         64.5s
--> [builder 5/6] COPY . .                                0.1s
--> [builder 6/6] RUN yarn build                         9.1s

```

REPOSITORY	TAG	IMAGE ID	CREATED	SIZE
calculator	latest	c20a69b969cc	8 minutes ago	23.2MB
calculator	build	aaf684db2846	50 minutes ago	434MB
my-python	latest	fa7937f0fe5e	2 hours ago	127MB

```

ayush@ayush:~/celebal/calculator$ sudo docker run -p 8080:80 calculator:latest
/docker-entrypoint.sh: /docker-entrypoint.d/ is not empty, will attempt to perform configuration
/docker-entrypoint.sh: Looking for shell scripts in /docker-entrypoint.d/
/docker-entrypoint.sh: Launching /docker-entrypoint.d/10-listen-on-ipv6-by-default.sh
10-listen-on-ipv6-by-default.sh: info: Getting the checksum of /etc/nginx/conf.d/default.conf
10-listen-on-ipv6-by-default.sh: info: /etc/nginx/conf.d/default.conf differs from the packaged version
/docker-entrypoint.sh: Launching /docker-entrypoint.d/20-envsubst-on-templates.sh
/docker-entrypoint.sh: Launching /docker-entrypoint.d/30-tune-worker-processes.sh
/docker-entrypoint.sh: Configuration complete; ready for start up
2025/06/12 12:37:18 [notice] 1#1: using the "epoll" event method
2025/06/12 12:37:18 [notice] 1#1: nginx/1.21.0
2025/06/12 12:37:18 [notice] 1#1: built by gcc 10.2.1 20201203 (Alpine 10.2.1_pre1)
2025/06/12 12:37:18 [notice] 1#1: OS: Linux 6.8.0-59-generic
2025/06/12 12:37:18 [notice] 1#1: getrlimit(RLIMIT_NOFILE): 1048576:1048576
2025/06/12 12:37:18 [notice] 1#1: start worker processes
2025/06/12 12:37:18 [notice] 1#1: start worker process 31
2025/06/12 12:37:18 [notice] 1#1: start worker process 32
2025/06/12 12:37:18 [notice] 1#1: start worker process 33
2025/06/12 12:37:18 [notice] 1#1: start worker process 34
172.17.0.1 - - [12/Jun/2025:12:37:52 +0000] "GET / HTTP/1.1" 200 2336 "-" "Mozilla/5.0 (X11; Ubuntu; Linux x86_64; rv:139.0) Gecko/20100101 Firefox/139.0"
172.17.0.1 - - [12/Jun/2025:12:37:52 +0000] "GET /calculator/static/css/2.2d5861c9.chunk.css HTTP/1.1" 200 2336 "http://localhost:8080/" "Mozilla/5.0 (X11; Ubuntu; Linux x86_64; rv:139.0) Gecko/20100101 Firefox/139.0"
172.17.0.1 - - [12/Jun/2025:12:37:52 +0000] "GET /calculator/static/js/2.205ef69f.chunk.js HTTP/1.1" 200 2336 "http://localhost:8080/" "Mozilla/5.0 (X11; Ubuntu; Linux x86_64; rv:139.0) Gecko/20100101 Firefox/139.0"
172.17.0.1 - - [12/Jun/2025:12:37:52 +0000] "GET /calculator/static/css/main.6fdcdd19.chunk.css HTTP/1.1" 200 2336 "http://localhost:8080/" "Mozilla/5.0 (X11; Ubuntu; Linux x86_64; rv:139.0) Gecko/20100101 Firefox/139.0"
172.17.0.1 - - [12/Jun/2025:12:37:52 +0000] "GET /calculator/static/js/main.35aa7dad.chunk.js HTTP/1.1" 200 2336 "http://localhost:8080/" "Mozilla/5.0 (X11; Ubuntu; Linux x86_64; rv:139.0) Gecko/20100101 Firefox/139.0"
172.17.0.1 - - [12/Jun/2025:12:37:52 +0000] "GET /calculator/favicon.ico HTTP/1.1" 200 2336 "http://localhost:8080/" "Mozilla/5.0 (X11; Ubuntu; Linux x86_64; rv:139.0) Gecko/20100101 Firefox/139.0"
2025/06/12 12:39:07 [notice] 1#1: signal 28 (SIGWINCH) received
2025/06/12 12:39:07 [notice] 1#1: signal 28 (SIGWINCH) received

```

4. Create a docker image from multiple methods likes Dockerfile, running containers.

a. Method 1 - Create Image Using a Dockerfile

```
ayush@ayush:~/celebal$ mkdir pythonapp
ayush@ayush:~/celebal$ cd pythonapp
ayush@ayush:~/celebal/pythonapp$ vim app.py
ayush@ayush:~/celebal/pythonapp$ cat app.py
print("This is the content written for the Docker image,
      which is build using the Dockerfile!!!")
ayush@ayush:~/celebal/pythonapp$ vim Dockerfile
ayush@ayush:~/celebal/pythonapp$ cat Dockerfile
FROM python:3.10-slim

WORKDIR /app

COPY app.py

CMD ["python", "app.py"]

ayush@ayush:~/celebal/pythonapp$ sudo docker build -t my-python-app .
[+] Building 2.4s (8/8) FINISHED
          docker:default
=> [internal] load build definition from Dockerfile          0.0s
=> => transferring dockerfile: 114B                      0.0s
=> [internal] load metadata for docker.io/library/python:3. 2.3s
=> [internal] load .dockerignore                         0.0s
=> => transferring context: 2B                         0.0s
=> [1/3] FROM docker.io/library/python:3.10-slim@sha256:034 0.0s
=> [internal] load build context                       0.0s
=> => transferring context: 140B                      0.0s
=> CACHED [2/3] WORKDIR /app                         0.0s
=> [3/3] COPY app.py .                                0.0s
=> exporting to image                                 0.0s
=> => exporting layers                               0.0s
=> => writing image sha256:b0a141205cd987cc66f6a16bc09551cc 0.0s
=> => naming to docker.io/library/my-python-app       0.0s
```

```

ayush@ayush:~/celebal/pythonapp$ sudo docker build -t my-python-app .
[+] Building 1.1s (8/8) FINISHED
      docker:default
--> [internal] load build definition from Dockerfile          0.0s
--> => transferring dockerfile: 114B                         0.0s
--> [internal] load metadata for docker.io/library/python:3. 1.0s
--> [internal] load .dockerignore                            0.0s
--> => transferring context: 2B                           0.0s
--> [1/3] FROM docker.io/library/python:3.10-slim@sha256:034 0.0s
--> [internal] load build context                          0.0s
--> => transferring context: 131B                         0.0s
--> CACHED [2/3] WORKDIR /app                            0.0s
--> [3/3] COPY app.py .                                0.0s
--> exporting to image                                 0.0s
--> => exporting layers                               0.0s
--> => writing image sha256:2ec6e8342664e93ac5e51b8e0ebb4c18 0.0s
--> => naming to docker.io/library/my-python-app        0.0s
ayush@ayush:~/celebal/pythonapp$ sudo docker run my-python-app
This is the content written for the Docker image, which is build using the Dockerfile!!!
ayush@ayush:~/celebal/pythonapp$ 

```

b. Method 2 - Create Image from a Running Container

```

ayush@ayush:~/celebal/pythonapp$ cd ..
ayush@ayush:~/celebal$ mkdir pythoncontainer
ayush@ayush:~/celebal$ cd pythoncontainer

```

```

ayush@ayush:~/celebal/pythoncontainer$ sudo docker run -it python:3.10-slim /bin/bash
Unable to find image 'python:3.10-slim' locally
3.10-slim: Pulling from library/python
dad67da3f26b: Already exists
4b03b4f4fa5c: Already exists
50a956a18493: Already exists
c14326ed6c85: Already exists
Digest: sha256:034724ef64585eeb0e82385e9aabcbabfe5f7cae2c2dcedb1da95114372b6d7
Status: Downloaded newer image for python:3.10-slim
root@4fcf5b473763:/# echo 'print("Hello, this is the content of the image made using the Running container!!")' > app.py
root@4fcf5b473763:/# python app.py
Hello, this is the content of the image made using the Running container!!!
root@4fcf5b473763:/# exit
exit

```

CONTAINER ID	IMAGE	COMMAND	CREATED	STATUS	PORTS	NAMES
4fcf5b473763	python:3.10-slim	"/bin/bash"	About a minute ago	Exited (0) 9 seconds ago		nostalgic_shannon
1f611651c9f4	my-python-app	"python app.py"	12 minutes ago	Exited (0) 12 minutes ago		zealous_matsumoto
df0ea471483b	b0a141205cd9	"python app.py"	12 minutes ago	Exited (1) 12 minutes ago		unruffled_williams
db7e824ac40a	b0a141205cd9	"python app.py"	13 minutes ago	Exited (1) 13 minutes ago		reverent_antonelli
64d54971db46	calculator:latest	"/docker-entrypoint..."	7 hours ago	Exited (0) 7 hours ago		romantic_turing
3fe6451b1fa8	calculator:build	"docker-entrypoint.s..."	8 hours ago	Exited (0) 6 hours ago		festive_kapitsa
1d8fab1a35ef	my-python	"python app.py"	10 hours ago	Exited (0) 10 hours ago		modest_wu

```

ayush@ayush:~/celebal/pythoncontainer$ sudo docker commit 4fcf5b473763 manual-python-app
sha256:cd33ae543318e44007994778ad6e1a6d9b06a9773e29165e3361bd027b45258f
ayush@ayush:~/celebal/pythoncontainer$ sudo docker run manual-python-app python app.py
Hello, this is the content of the image made using the Running container!!!
ayush@ayush:~/celebal/pythoncontainer$ 

```

5. Push and pull image to Docker hub and ACR

A. Docker Hub

```
Windows PowerShell
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Install the latest PowerShell for new features and improvements! https://aka.ms/PSWindows

PS C:\Users\Ayush Pandey> docker login
Authenticating with existing credentials... [Username: ayush2442]

[ Info → To login with a different account, run 'docker logout' followed by 'docker login'

Login Succeeded
PS C:\Users\Ayush Pandey> docker tag java-chat-app ayush2442/myapp:v1
PS C:\Users\Ayush Pandey> docker push ayush2442/myapp:v1
The push refers to repository [docker.io/ayush2442/myapp]
429e5dd17d1e: Pushed
210466109874: Pushed
4ee1c63dd2f1: Pushed
34f7184834b2: Mounted from library/openjdk
5836ece05bfd: Mounted from library/openjdk
72e830a4dff5: Mounted from library/openjdk
v1: digest: sha256:2137f29a5b3f44b9d657139d985f179faaef8bc282d3eed798ec912549358043 size: 1574
PS C:\Users\Ayush Pandey> docker pull ayush2442/myapp:v1
v1: Pulling from ayush2442/myapp
Digest: sha256:2137f29a5b3f44b9d657139d985f179faaef8bc282d3eed798ec912549358043
Status: Image is up to date for ayush2442/myapp:v1
docker.io/ayush2442/myapp:v1
PS C:\Users\Ayush Pandey> |
```

B. Azure Container Registry (ACR)

```
PS /home/ayush> az acr create --resource-group vmcli --name myazregistry2442 --sku Basic
{
  "adminUserEnabled": false,
  "anonymousPullEnabled": false,
  "creationDate": "2025-06-12T20:34:11.822054+00:00",
  "dataEndpointEnabled": false,
  "dataEndpointHostNames": [],
  "encryption": {
    "keyVaultProperties": null,
    "status": "disabled"
  },
  "id": "/subscriptions/4af928af-144b-44ea-a5ad-9fe8d622bd21/resourceGroups/vmcli/providers/Microsoft.ContainerRegistry/registries/myazregistry2442",
  "identity": null,
  "location": "eastus",
  "loginServer": "myazregistry2442.azurecr.io",
  "metadataSearch": "Disabled",
  "name": "myazregistry2442",
  "networkRuleBypassOptions": "AzureServices",
  "networkRuleSet": null,
  "policies": {
    "azureAdAuthenticationAsArmPolicy": {
      "status": "enabled"
    },
    "exportPolicy": {
      "status": "enabled"
    },
    "quarantinePolicy": {
      "status": "disabled"
    },
    "retentionPolicy": {
      "days": 7,
      "lastUpdatedTime": "2025-06-12T20:34:18.663645+00:00",
      "status": "disabled"
    }
  }
}
```

```

PS /home/ayush> az acr login --name myazregistry2442 --expose-token
The output will be changed in next breaking change release(2.73.0) scheduled for May 2025. Exit code will be 1 if command fails for docker login.
You can perform manual login using the provided access token below, for example: 'docker login loginServer -u 00000000-0000-0000-0000-000000000000 -p accessToken'
{
  "accessToken": "eyJhbGciOiJSUzI1NiIsInR5cCI6IkpXVCisImtpZCI6IkFNTDU6UNWjpCRDQ10kRSRDIGRkdESTo3Q1NGOkdVUE1V1RNQTpVVtJ0jRKN1Y6Mjcb0TpQSkrVIn8.eyJqdGkiOiIxM2MyNy1kMD4LTQ2NjctYTAzN1h0Zm0WkVtzg2YjciLCJzdWl0IiYMKjETzEWMD4QGN1Y2hklmluIiwbmJmjoxnzQ5NzU50TQyLCJleHai0jE3NDk3NzE2NDIsIm1hdC16MTc10Tk0MiwiAxNzIjoiQxplcmUg29udGpbmlyIFJ1Z21zdHJ51iwiYXViijoibXhenJ121Zdh05Mj0WMiShenVYzNMyM1v1YiwidmVyc1vbh167jfaWCIsIn1pZCT61j1kVzgztTEwQ0Yj0427h1m2AwVjBkVjcyODm7zcIwi1Z3jhnb0fch1LwS16Tm17n12h1c1hfb7C16Tm12NzjdMjkwLWNmNGTtNGF4751hNj81lkxYmE2NTBnNGFizS1sIn1bmFud161j1bYmK1L7jHyzEtNDFhzS052j44LTR1MGExZjExNzA2YIsInB1m1pc3Nb25zIjp7ImFjdG1vb01sicmVhZC1sIndyaKR1i1w1ZGVs2XR11iw1bw8WWRhdGeVmVhZC1sIm1ld6FKYXRhL3dyRL1iwiZGzsXK1zC9yZNF1iwiZGvsZXR1zC9yZXWb331L2fdg1vb1JdfSwicm9sXWb10ltfQ.Ys19i08PT_1t-58Iam-eBKIEjeVK-JVrfsIAZKRoF60cpICa4zyM2L5GbICScc7Mnydu81_PDNpf1slQ_L1fhpm-m7dMq-Q-Zd-Stk8yCrUmvwZBDNH13d4dy18Haj1luKxTjMoTTSOFNkU_jpA5JGpCyZrsVzfj1GvIw2uukt85B_tr8RSDq5Dtb1wmz1o67rw2_w01tN1pETjt-S1Vdx3157qbVogiq8z1ofJNqbHTapM8-pYg/ZJXV6v3kw9K-nVzSzCZY6y6TDYJcmXfbwf1766a6dt11e81Vb11jhxFaCJ_XeZelWEVv_SuhfbZ-gA",
  "loginServer": "myazregistry2442.azurecr.io"
}
PS /home/ayush>

```

```

Windows PowerShell
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Install the latest PowerShell for new features and improvements! https://aka.ms/PSWindows

PS C:\Users\Ayush Pandey> docker login
Authenticating with existing credentials... [Username: ayush2442]

```

[Info → To login with a different account, run 'docker logout' followed by 'docker login'

```

Login Succeeded
PS C:\Users\Ayush Pandey> docker tag java-chat-app ayush2442/myapp:v1
PS C:\Users\Ayush Pandey> docker push ayush2442/myapp:v1
The push refers to repository [docker.io/ayush2442/myapp]
429e5dd17d1e: Pushed
210466109874: Pushed
4ee1c63dd2f1: Pushed
34f7184834b2: Mounted from library/openjdk
5836ece05bfd: Mounted from library/openjdk
72e830a4dff5: Mounted from library/openjdk
v1: digest: sha256:2137f29a5b3f44b9d657139d985f179faaeef8bc282d3eed798ec912549358043 size: 1574
PS C:\Users\Ayush Pandey> docker pull ayush2442/myapp:v1
v1: Pulling from ayush2442/myapp
Digest: sha256:2137f29a5b3f44b9d657139d985f179faaeef8bc282d3eed798ec912549358043
Status: Image is up to date for ayush2442/myapp:v1
docker.io/ayush2442/myapp:v1

```

```

PS C:\Users\Ayush Pandey> docker login myazregistry2442.azurecr.io
Username: 00000000-0000-0000-000000000000
Password:

Login Succeeded
PS C:\Users\Ayush Pandey> docker tag java-chat-app myazregistry2442.azurecr.io/myapp:v1
PS C:\Users\Ayush Pandey> docker push myazregistry2442.azurecr.io/myapp:v1
The push refers to repository [myazregistry2442.azurecr.io/myapp]
429e5dd17d1e: Pushed
210466109874: Pushed
4ee1c63dd2f1: Pushed
34f7184834b2: Pushed
5836ece05bfd: Pushed
72e830a4dff5: Pushed
v1: digest: sha256:2137f29a5b3f44b9d657139d985f179faaeef8bc282d3eed798ec912549358043 size: 1574

```

```

PS C:\Users\Ayush Pandey> docker pull myazregistry2442.azurecr.io/myapp:v1
v1: Pulling from myapp
Digest: sha256:2137f29a5b3f44b9d657139d985f179faaeef8bc282d3eed798ec912549358043
Status: Image is up to date for myazregistry2442.azurecr.io/myapp:v1
myazregistry2442.azurecr.io/myapp:v1
PS C:\Users\Ayush Pandey>

```

6. Create a Custom Docker Bridge Network

```
PS C:\Users\Ayush Pandey> docker network ls
NETWORK ID      NAME      DRIVER      SCOPE
d4a648896d35    bridge    bridge      local
d0adcc196d12    host      host       local
8e97d0b361f8    none      null       local
PS C:\Users\Ayush Pandey> docker run -dit --name alpine1 alpine ash
Unable to find image 'alpine:latest' locally
latest: Pulling from library/alpine
fe07684b16b8: Already exists
Digest: sha256:8a1f59ffb675680d47db6337b49d22281a139e9d709335b492be023728e11715
Status: Downloaded newer image for alpine:latest
2626e82aa160e10ab867018b8350aa2f06b01a25256cbf512beb9d4cd54d1afa
PS C:\Users\Ayush Pandey> docker run -dit --name alpine2 alpine ash
a5dcdd81b1cd6a079cf05c3bd33b01ce2b0548fb3575b8d9767414e84400153
PS C:\Users\Ayush Pandey> docker ps
CONTAINER ID      IMAGE      COMMAND      CREATED      STATUS      PORTS      NAMES
a5dcdd81b1cd    alpine     "ash"        6 seconds ago  Up 6 seconds          alpine2
2626e82aa160    alpine     "ash"        17 seconds ago Up 16 seconds          alpine1
```

```
PS C:\Users\Ayush Pandey> docker network inspect bridge
[
  {
    "Name": "bridge",
    "Id": "d4a648896d359ce38586c272382b9f45ccdf2086ccf0ee7c15c67157331db2b",
    "Created": "2025-06-13T06:19:24.9738316Z",
    "Scope": "local",
    "Driver": "bridge",
    "EnableIPv4": true,
    "EnableIPv6": false,
    "IPAM": {
      "Driver": "default",
      "Options": null,
      "Config": [
        {
          "Subnet": "172.17.0.0/16",
          "Gateway": "172.17.0.1"
        }
      ]
    },
    "Internal": false,
    "Attachable": false,
    "Ingress": false,
    "ConfigFrom": {
      "Network": ""
    },
    "ConfigOnly": false,
    "Containers": {
      "2626e82aa160e10ab867018b8350aa2f06b01a25256cbf512beb9d4cd54d1afa": {
        "Name": "alpine1",
        "EndpointID": "37153cb4bd58a7717593bc0994b88f182fc3b3bf2c89e775b9aa5afe96247dc",
        "MacAddress": "e6:0f:75:23:71:84",
        "IPv4Address": "172.17.0.2/16",
        "IPv6Address": ""
      },
      "a5dcdd81b1cd6a079cf05c3bd33b01ce2b0548fb3575b8d9767414e84400153": {
        "Name": "alpine2",
        "EndpointID": "dd14124f44d79aaac38391cb656a071770dd96f0f9ce73e26b9f1b26bbffddfac",
        "MacAddress": "8a:ec:09:c5:25:48",
        "IPv4Address": "172.17.0.3/16",
        "IPv6Address": ""
      }
    }
  }
]
```

```

PS C:\Users\Ayush Pandey> docker network ls
NETWORK ID      NAME      DRIVER      SCOPE
d4a648896d35    bridge    bridge    local
d0adcc196d12    host      host      local
8e97d0b361f8    none      null      local
PS C:\Users\Ayush Pandey> ping 172.17.0.3

Pinging 172.17.0.3 with 32 bytes of data:
Reply from 172.16.2.2: TTL expired in transit.

Ping statistics for 172.17.0.3:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
PS C:\Users\Ayush Pandey> docker ps
CONTAINER ID      IMAGE      COMMAND      CREATED      STATUS      PORTS      NAMES
a5cd81b1cd      alpine      "ash"       3 minutes ago  Up 3 minutes   alpine2
2626e82aa160      alpine      "ash"       3 minutes ago  Up 3 minutes   alpine1
PS C:\Users\Ayush Pandey> docker attach alpine1
/ # ip address show
1: lo: <LOOPBACK,UP,LOWER_UP> mtu 65536 qdisc noqueue state UNKNOWN qlen 1000
    link/loopback 00:00:00:00:00:00 brd 00:00:00:00:00:00
        inet 127.0.0.1/8 scope host lo
            valid_lft forever preferred_lft forever
        inet6 ::1/128 scope host
            valid_lft forever preferred_lft forever
2: eth0@if5: <BROADCAST,MULTICAST,UP,LOWER_UP,M-DOWN> mtu 1500 qdisc noqueue state UP
    link/ether e6:0f:75:23:71:84 brd ff:ff:ff:ff:ff:ff
        inet 172.17.0.2/16 brd 172.17.255.255 scope global eth0
            valid_lft forever preferred_lft forever

```

```

/ # ping google.com
PING google.com (142.250.192.174): 56 data bytes
64 bytes from 142.250.192.174: seq=0 ttl=63 time=10.412 ms
64 bytes from 142.250.192.174: seq=1 ttl=63 time=10.690 ms
64 bytes from 142.250.192.174: seq=2 ttl=63 time=10.929 ms
64 bytes from 142.250.192.174: seq=3 ttl=63 time=13.482 ms
64 bytes from 142.250.192.174: seq=4 ttl=63 time=13.777 ms
64 bytes from 142.250.192.174: seq=5 ttl=63 time=10.558 ms
64 bytes from 142.250.192.174: seq=6 ttl=63 time=10.380 ms
64 bytes from 142.250.192.174: seq=7 ttl=63 time=10.681 ms
64 bytes from 142.250.192.174: seq=8 ttl=63 time=10.400 ms
64 bytes from 142.250.192.174: seq=9 ttl=63 time=17.089 ms
64 bytes from 142.250.192.174: seq=10 ttl=63 time=12.406 ms
^C
--- google.com ping statistics ---
11 packets transmitted, 11 packets received, 0% packet loss
round-trip min/avg/max = 10.380/11.891/17.089 ms
/ # ping -c 5 172.17.0.3
PING 172.17.0.3 (172.17.0.3): 56 data bytes
64 bytes from 172.17.0.3: seq=0 ttl=64 time=0.095 ms
64 bytes from 172.17.0.3: seq=1 ttl=64 time=0.044 ms
64 bytes from 172.17.0.3: seq=2 ttl=64 time=0.080 ms
64 bytes from 172.17.0.3: seq=3 ttl=64 time=0.051 ms
64 bytes from 172.17.0.3: seq=4 ttl=64 time=0.054 ms

--- 172.17.0.3 ping statistics ---
5 packets transmitted, 5 packets received, 0% packet loss
round-trip min/avg/max = 0.044/0.064/0.095 ms
/ # exit
PS C:\Users\Ayush Pandey> docker ps
CONTAINER ID      IMAGE      COMMAND      CREATED      STATUS      PORTS      NAMES
a5cd81b1cd      alpine      "ash"       5 minutes ago  Up 5 minutes   alpine2
PS C:\Users\Ayush Pandey> |

```

```
PS C:\Users\Ayush Pandey> docker network create --driver bridge custom-bridge
39ffcfcaedcd4963d358258dcfd791aa90ecd58d7bb6b0a6628a2552f91a385
PS C:\Users\Ayush Pandey> docker network ls
NETWORK ID      NAME      DRIVER      SCOPE
d4a648896d35    bridge    bridge      local
39ffcfcaedc    custom-bridge    bridge      local
d0adcc196d12    host      host      local
8e97d0b361f8    none      null      local
PS C:\Users\Ayush Pandey> docker network inspect custom-bridge
[
  {
    "Name": "custom-bridge",
    "Id": "39ffcfcaedcd4963d358258dcfd791aa90ecd58d7bb6b0a6628a2552f91a385",
    "Created": "2025-06-13T06:33:40.838929553Z",
    "Scope": "local",
    "Driver": "bridge",
    "EnableIPv4": true,
    "EnableIPv6": false,
    "IPAM": {
      "Driver": "default",
      "Options": {},
      "Config": [
        {
          "Subnet": "172.18.0.0/16",
          "Gateway": "172.18.0.1"
        }
      ]
    },
    "Internal": false,
    "Attachable": false,
    "Ingress": false,
    "ConfigFrom": {
      "Network": ""
    },
    "ConfigOnly": false,
    "Containers": {},
    "Options": {
      "com.docker.network.enable_ipv4": "true",
      "com.docker.network.enable_ipv6": "false"
    },
    "Labels": {}
  }
]
```

```

PS C:\Users\Ayush Pandey> docker ps
CONTAINER ID   IMAGE      COMMAND   CREATED          STATUS    PORTS      NAMES
a5dcdd81b1cd   alpine     "ash"     10 minutes ago   Up 10 minutes   alpine2
PS C:\Users\Ayush Pandey> docker run -dit --name container1 --network custom-bridge alpine
17fbfd5180ab2125d48bad960e634733ee2970006f62d48d467f5fbad82cf2cf
PS C:\Users\Ayush Pandey> docker run -dit --name container2 --network custom-bridge alpine
7dfb44eb6be8f98611060f6f7a2beeb309503bb924bdfce9e8e34d39b8634de2
PS C:\Users\Ayush Pandey> docker exec -it container1 sh
/ # ping container2
PING container2 (172.18.0.3): 56 data bytes
64 bytes from 172.18.0.3: seq=0 ttl=64 time=0.060 ms
64 bytes from 172.18.0.3: seq=1 ttl=64 time=0.081 ms
64 bytes from 172.18.0.3: seq=2 ttl=64 time=0.052 ms
64 bytes from 172.18.0.3: seq=3 ttl=64 time=0.053 ms
64 bytes from 172.18.0.3: seq=4 ttl=64 time=0.050 ms
64 bytes from 172.18.0.3: seq=5 ttl=64 time=0.068 ms
^C
--- container2 ping statistics ---
6 packets transmitted, 6 packets received, 0% packet loss
round-trip min/avg/max = 0.050/0.060/0.081 ms
/ # exit
PS C:\Users\Ayush Pandey> docker rm -f container1 container2
container1
container2
PS C:\Users\Ayush Pandey> docker network rm custom-bridge
custom-bridge
PS C:\Users\Ayush Pandey> docker ps
CONTAINER ID   IMAGE      COMMAND   CREATED          STATUS    PORTS      NAMES
a5dcdd81b1cd   alpine     "ash"     12 minutes ago   Up 12 minutes   alpine2
PS C:\Users\Ayush Pandey> docker network ls
NETWORK ID     NAME      DRIVER    SCOPE
d4a648896d35   bridge    bridge    local
d0adcc196d12   host      host      local
8e97d0b361f8   none     null     local
PS C:\Users\Ayush Pandey>

```

7. Create a Docker volume and mount it to a container.

```

Windows PowerShell
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Install the latest PowerShell for new features and improvements! https://aka.ms/PSWindows

PS C:\Users\Ayush Pandey> docker volume ls
DRIVER      VOLUME NAME
PS C:\Users\Ayush Pandey> docker volume create volume1
volume1
PS C:\Users\Ayush Pandey> docker ps
CONTAINER ID   IMAGE      COMMAND   CREATED          STATUS    PORTS      NAMES
PS C:\Users\Ayush Pandey> docker ps -a
CONTAINER ID   IMAGE      COMMAND   CREATED          STATUS    PORTS      NAMES
a5dcdd81b1cd   alpine     "ash"     10 hours ago    Exited (255) About a minute ago   alpine2
2626e82aa160   alpine     "ash"     10 hours ago    Exited (0) 10 hours ago   alpine1
8f54c0fbcbc01  ubuntu     "/bin/bash"  34 hours ago   Exited (0) 34 hours ago   clever_dhawan
a579d12119b9   java-chat-app "java server"  2 days ago    Exited (130) 2 days ago   goofy_morse
PS C:\Users\Ayush Pandey> docker run -d --name container_vol -v volume1:/app/data busybox sleep 3600
Unable to find image 'busybox:latest' locally
latest: Pulling from library/busybox
90b9666d4aed: Pull complete
Digest: sha256:f85340bf132ae937d2c2a763b8335c9bab35d6e8293f70f606b9c6178d84f42b
Status: Downloaded newer image for busybox:latest
94081ef5c5318e5d4fd32a41805a8a51d30091b9e1216f472146c7ca947a177a
PS C:\Users\Ayush Pandey> docker volume inspect volume1
[
  {
    "CreatedAt": "2025-06-13T16:44:37Z",
    "Driver": "local",
    "Labels": null,
    "Mountpoint": "/var/lib/docker/volumes/volume1/_data",
    "Name": "volume1",
    "Options": null,
    "Scope": "local"
  }
]

```

```
PS C:\Users\Ayush Pandey> docker exec -it container_vol sh
/ # ls /app/data
/ # echo "this is the content for volume" > /app/data/test/txt
sh: can't create /app/data/test/txt: nonexistent directory
/ # echo "this is the content for volume" > /app/data/test.txt
/ # exit
PS C:\Users\Ayush Pandey> docker stop container_vol
container_vol
PS C:\Users\Ayush Pandey> docker rm container_vol
container_vol
PS C:\Users\Ayush Pandey> docker run -it --rm -v volume1:/app/data busybox sh
/ # ls
app bin dev etc home lib lib64 proc root sys tmp usr var
/ # cd /app/data
/app/data # ls
test.txt
/app/data # cat test.txt
this is the content for volume
/app/data # |
```

8. Docker Compose for multi-container applications, Docker security best practices

A. Docker Compose for multi-container applications

```
ayush@ayush:~$ ls
celebal Downloads Music Public test.class
Desktop eclipse-workspace myapp snap test.java
Documents folder Pictures Templates Videos
ayush@ayush:~$ cd celebal
ayush@ayush:~/celebal$ mkdir multi_container
ayush@ayush:~/celebal$ cd multi_container
ayush@ayush:~/celebal/multi_container$ mkdir backend frontend
ayush@ayush:~/celebal/multi_container$ vim docker-compose.yml
ayush@ayush:~/celebal/multi_container$ cd backend
ayush@ayush:~/celebal/multi_container/backend$ vim app.py
ayush@ayush:~/celebal/multi_container/backend$ cat app.py
from flask import Flask
app = Flask(__name__)

@app.route("/")
def hello():
    return "Hello, this is the Backend application of Flask Application!!!"
ayush@ayush:~/celebal/multi_container/backend$ vim Dockerfile
```

```
ayush@ayush:~/celebal/multi_container/backend$ cat Dockerfile
FROM python:3.10-slim

WORKDIR /app

COPY app.py .

RUN pip install flask

CMD ["python", "app.py"]
ayush@ayush:~/celebal/multi_container/backend$ cd ..
ayush@ayush:~/celebal/multi_container$ cd frontend

ayush@ayush:~/celebal/multi_container/frontend$ vim default.conf
ayush@ayush:~/celebal/multi_container/frontend$ cat default.conf
server {
    listen 80;
    location / {
        proxy_pass http://backend:5000;
    }
}
ayush@ayush:~/celebal/multi_container/frontend$ cd ..
ayush@ayush:~/celebal/multi_container$ vim docker-compose.yml
ayush@ayush:~/celebal/multi_container$ cat docker-compose.yml
version: '3.8'

services:
  backend:
    build: ./backend
    container_name: flask_backend
    expose:
      - "5000"

  frontend:
    image: nginx:alpine
    container_name: nginx_frontend
    volume:
      - ./frontend/default.conf:/etc/nginx/conf.d/default.conf
    ports:
      - "8000:80"
    depends_on:
      - backend
```

```

ayush@ayush:~/celebal/multi_container$ sudo docker-compose up --build
Creating network "multi_container_default" with the default driver
Building backend
[+] Building 4.2s (9/9) FINISHED                                            docker:default
=> [internal] load build definition from Dockerfile                      0.0s
=> => transferring dockerfile: 137B                                         0.0s
=> [internal] load metadata for docker.io/library/python:3.10-            0.0s
=> [internal] load .dockerignore                                         0.0s
=> => transferring context: 2B                                           0.0s
=> [1/4] FROM docker.io/library/python:3.10-slim                         0.0s
=> [internal] load build context                                         0.0s
=> => transferring context: 187B                                         0.0s
=> CACHED [2/4] WORKDIR /app                                              0.0s
=> [3/4] COPY app.py .                                                 0.0s
=> [4/4] RUN pip install flask                                         3.9s
=> exporting to image                                                 0.2s
=> => exporting layers                                                 0.2s
=> => writing image sha256:dd60db05e87aa6c34edc83455f005f11dd4 0.0s
=> => naming to docker.io/library/multi_container_backend           0.0s
Pulling frontend (nginx:alpine)...
alpine: Pulling from library/nginx
f18232174bc9: Pull complete
61ca4f733c80: Pull complete
b464cfdf2a63: Pull complete
d7e507024086: Pull complete
81bd8ed7ec67: Pull complete
197eb75867ef: Pull complete
34a64644b756: Pull complete
39c2ddfd6010: Pull complete
Digest: sha256:65645c7bb6a0661892a8b03b89d0743208a18dd2f3f17a54ef4b76fb8e2f2a10
Status: Downloaded newer image for nginx:alpine
Creating flask_backend ... done
Creating nginx_frontend ... done

```

```

Attaching to flask_backend, nginx_frontend
nginx_frontend | /docker-entrypoint.sh: /docker-entrypoint.d/ is not empty, will attempt to perform configuration
nginx_frontend | /docker-entrypoint.sh: Looking for shell scripts in /docker-entrypoint.d/
nginx_frontend | /docker-entrypoint.sh: Launching /docker-entrypoint.d/10-listen-on-ipv6-by-default.sh
nginx_frontend | 10-listen-on-ipv6-by-default.sh: info: Getting the checksum of /etc/nginx/conf.d/default.conf
nginx_frontend | 10-listen-on-ipv6-by-default.sh: info: /etc/nginx/conf.d/default.conf differs from the packaged version
nginx_frontend | /docker-entrypoint.sh: Sourcing /docker-entrypoint.d/15-local-resolvers.envsh
nginx_frontend | /docker-entrypoint.sh: Launching /docker-entrypoint.d/20-envsubst-on-templates.sh
nginx_frontend | /docker-entrypoint.sh: Launching /docker-entrypoint.d/30-tune-worker-processes.sh
nginx_frontend | /docker-entrypoint.sh: Configuration complete; ready for start up
flask_backend exited with code 0
nginx_frontend | 2025/06/15 07:24:57 [emerg] 1#1: host not found in upstream "backend" in /etc/nginx/conf.d/default.conf:4
nginx_frontend | nginx: [emerg] host not found in upstream "backend" in /etc/nginx/conf.d/default.conf:4
nginx_frontend exited with code 1

```

```

ayush@ayush:~/celebal/multi_container$ sudo docker-compose down
Removing nginx_frontend ... done
Removing flask_backend ... done
Removing network multi_container_default

```

B. Docker security best practices

```

ayush@ayush:~/celebal/multi_container$ cd backend
ayush@ayush:~/celebal/multi_container/backend$ vim Dockerfile
ayush@ayush:~/celebal/multi_container/backend$ cat Dockerfile
FROM python:3.10-slim

WORKDIR /app

COPY app.py .

RUN adduser -D myuser

USER myuser

CMD ["python", "app.py"]
ayush@ayush:~/celebal/multi_container/backend$ cd ..

```

```

ayush@ayush:~/celebal/multi_container$ sudo docker run --cap-drop=ALL --cap-add=NET_BIND_SERVICE dd60db05e87a
ayush@ayush:~/celebal/multi_container$ sudo docker ps
CONTAINER ID   IMAGE      COMMAND   CREATED     STATUS      PORTS      NAMES
ayush@ayush:~/celebal/multi_container$ sudo docker run --read-only dd60db05e87a
ayush@ayush:~/celebal/multi_container$ sudo docker ps
CONTAINER ID   IMAGE      COMMAND   CREATED     STATUS      PORTS      NAMES
ayush@ayush:~/celebal/multi_container$ sudo docker run --memory=512m --cpus=1 dd60db05e87a

```

```

ayush@ayush:~/celebal/multi_container$ sudo apt-get upgrade docker-ce
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
docker-ce is already the newest version (5:28.2.2-1~ubuntu.22.04~jammy).
Calculating upgrade... Done
The following packages will be upgraded:
  alsu-ucm-conf apt apt-utils base-files distro-info-data dmidecode dmsetup dns-root-data ethtool
  fonts-noto-color-emoji gir1.2-mutter-10 gir1.2-nm-1.0 gir1.2-packagekitglib-1.0 gjs
  gnome-control-center gnome-control-center-data gnome-control-center-faces gnome-shell
  gnome-shell-common gnome-shell-extension-ubuntu-dock google-chrome-stable grub-efi-amd64-bin
  grub-efi-amd64-signed gstreamer1.0-packagekit initramfs-tools initramfs-tools-bin
  initramfs-tools-core language-pack-en language-pack-en-base language-pack-gnome-en
  language-pack-gnome-en-base libapt-pkg6.0 libcryptsetup12 libdevmapper1.02.1 libegl-mesa0
  libfprint-2-2 libgbm1 libgjs0g libgl1-mesa-dri libglapi-mesa libglx-mesa0 libldap-2.5-0
  libldap-common libmbim-glib4 libmbim-proxy libmm-glib0 libmutter-10-0 libnautilus-extension1a
  libnm0 libpackagekit-glib2-18 libpam-modules libpam-modules-bin libpam-runtime libpam-sss
  libpam0g libpcap0.8 libseccomp2 libsnmp-base libsnmp40 libxatracker2 linux-base mesa-va-drivers
  mesa-vdpau-drivers mesa-vulkan-drivers modemmanager mutter-common nautilus nautilus-data
  network-manager network-manager-config-connectivity-ubuntu openvpn packagekit packagekit-tools
  pci.ids python-apt-common python3-apt python3-distupgrade python3-paramiko
  python3-update-manager shim-signed snapd ubuntu-advantage-tools ubuntu-desktop
  ubuntu-desktop-minimal ubuntu-minimal ubuntu-pro-client ubuntu-pro-client-l10n
  ubuntu-release-upgrader-core ubuntu-release-upgrader-gtk ubuntu-standard update-manager
  update-manager-core xdg-desktop-portal xserver-common xserver-xephyr xserver-xorg-core
  xserver-xorg-legacy xwayland
98 upgraded, 0 newly installed, 0 to remove and 0 not upgraded.
Need to get 214 MB of archives.
After this operation, 6,265 kB of additional disk space will be used.
Do you want to continue? [Y/n] y
Get:1 https://dl.google.com/linux/chrome/deb stable/main amd64 google-chrome-stable amd64 137.0.7151.103-1 [117 MB]
Get:2 http://in.archive.ubuntu.com/ubuntu jammy-updates/main amd64 base-files amd64 12ubuntu4.7 [61.9 kB]
Get:3 http://in.archive.ubuntu.com/ubuntu jammy-updates/main amd64 libapt-pkg6.0 amd64 2.4.14 [912 kB]

```

```
Processing triggers for plymouth-theme-ubuntu-text (0.9.5+git20211018-1ubuntu3) ...
update-initramfs: deferring update (trigger activated)
Processing triggers for dbus (1.12.20-2ubuntu4.1) ...
Processing triggers for udev (249.11-0ubuntu3.16) ...
Setting up libmutter-10-0:amd64 (42.9-0ubuntu9) ...
Setting up nautilus (1:42.6-0ubuntu2) ...
Setting up gnome-control-center (1:41.7-0ubuntu0.22.04.9) ...
Setting up gir1.2-mutter-10:amd64 (42.9-0ubuntu9) ...
Setting up gnome-shell (42.9-0ubuntu2.3) ...
Setting up update-manager (1:22.04.22) ...
Setting up gnome-shell-extension-ubuntu-dock (72~ubuntu5.22.04.3) ...
Setting up ubuntu-desktop-minimal (1.481.4) ...
Setting up ubuntu-desktop (1.481.4) ...
Processing triggers for initramfs-tools (0.140ubuntu13.5) ...
update-initramfs: Generating /boot/initrd.img-6.8.0-60-generic
Processing triggers for libc-bin (2.35-0ubuntu3.10) ...
ayush@ayush:~/celebal/multi_container$ █
```