

Introduction to Containerization (Docker, Docker Compose, and Singularity)

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Nov 14, 2022

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STEP 0: SET-UP

Create a Docker ID: <https://hub.docker.com/signup>

Pick one of the following options for proceeding:

Option # 1: Use your own laptop with Docker installed on it

Option # 2: Use an instance of a VM, provisioned with Docker, on a cloud computing platform

Option # 3: Use Docker's online platform for learning about Docker: <https://tinyurl.com/y9sg7eq7>

STEP 1: RUNNING PRE-BUILT DOCKER CONTAINERS (1)

Please go to “Step 1” at the following link: <https://tinyurl.com/5n939rhm>

```
[node1] (local) root@192.168.0.38 ~
$ docker run alpine date
Unable to find image 'alpine:latest' locally
latest: Pulling from library/alpine
050382585609: Pull complete
Digest: sha256:6a92cd1fcdc8d8cdec60f33dda4db2cb1fcdcacf3410a8e05b3741f44a9b5998
Status: Downloaded newer image for alpine:latest
Thu Jul 25 21:14:59 UTC 2019
[node1] (local) root@192.168.0.38 ~
$ docker ps
CONTAINER ID        IMAGE               COMMAND             CREATED             STATUS              PORTS              N
AMES
[node1] (local) root@192.168.0.38 ~
$ docker container ls --all
CONTAINER ID        IMAGE               COMMAND             CREATED             STATUS              PORTS
NAMES
041179d7c93b       alpine             "date"             41 seconds ago     Exited (0) 39 seconds ago
funny_dirac
[node1] (local) root@192.168.0.38 ~
$
```

STEP 1: RUNNING PRE-BUILT DOCKER CONTAINERS (2)

Please go to "Step 1" at the following link: <https://tinyurl.com/5n939rhm>

```
[node1] (local) root@192.168.0.38 ~
$ docker run --interactive --tty alpine /bin/sh
/ #
/ # ls
bin    dev    etc    home  lib    media  mnt    opt    proc  root  run    sbin  srv    sys    tmp    usr    var
/ # exit
[node1] (local) root@192.168.0.38 ~
$ docker container ls --all
CONTAINER ID        IMAGE               COMMAND             CREATED             STATUS              PORTS
NAMES
b12478fb3f94        alpine             "/bin/sh"          15 seconds ago     Exited (0) 7 seconds ago
determined_lalande
041179d7c93b        alpine             "date"             9 minutes ago      Exited (0) 9 minutes ago
funny_dirac
[node1] (local) root@192.168.0.38 ~
$ docker start -a -i b12478fb3f94
/ # ls
bin    dev    etc    home  lib    media  mnt    opt    proc  root  run    sbin  srv    sys    tmp    usr    var
/ # exit
[node1] (local) root@192.168.0.38 ~
$
```

STEP 1: RUNNING PRE-BUILT DOCKER CONTAINERS (3)

Please go to "Step 1" at the following link: <https://tinyurl.com/5n939rhm>

```
$ docker run --interactive --tty --rm ubuntu /bin/bash
Unable to find image 'ubuntu:latest' locally
latest: Pulling from library/ubuntu
7413c47ba209: Pull complete
0fe7e7cbb2e8: Pull complete
1d425c982345: Pull complete
344da5c95cec: Pull complete
Digest: sha256:c303f19cfe9ee92badbbbd7567bc1ca47789f79303ddcef56f77687d4744cd7a
Status: Downloaded newer image for ubuntu:latest
root@cd2f17c662c2:/# exit
exit
[node1] (local) root@192.168.0.38 ~
$ docker container ls --all
CONTAINER ID        IMAGE               COMMAND             CREATED             STATUS              PORTS
NAMES
b12478fb3f94       alpine             "/bin/sh"          15 minutes ago     Exited (0) 14 minutes ago
determined_lalande
041179d7c93b       alpine             "date"             25 minutes ago     Exited (0) 25 minutes ago
funny_dirac
[node1] (local) root@192.168.0.38 ~
$ □
```

STEP 1: RUNNING PRE-BUILT DOCKER CONTAINERS (4)

Please go to “Step 1” at the following link: <https://tinyurl.com/5n939rhm>

```
RRC02C92WZMD6NIP01:democontainer vrv207$ docker run --interactive --tty --rm ubuntu bash
Unable to find image 'ubuntu:latest' locally
latest: Pulling from library/ubuntu
e96e057aae67: Pull complete
Digest: sha256:4b1d0c4a2d2aaf63b37111f34eb9fa89fa1bf53dd6e4ca954d47caebca4005c2
Status: Downloaded newer image for ubuntu:latest
root@f82f11b92a0d:/# ls
bin    dev    home  lib32  libx32  mnt    proc  run    srv    tmp    var
boot  etc    lib    lib64  media   opt    root  sbin   sys    usr
root@f82f11b92a0d:/# date
Fri Nov 11 18:45:48 UTC 2022
root@f82f11b92a0d:/# exit
exit
```

```
RRC02C92WZMD6NIP01:democontainer vrv207$ docker start -a -i f82f11b92a0d
Error: No such container: f82f11b92a0d
```

STEP 2: PACKAGE AND RUN AN APPLICATION USING DOCKER (1)

Please go to "Step 2" at the following link: <https://tinyurl.com/5n939rhm>

```
[node1] (local) root@192.168.0.38 ~
$ vi Dockerfile
[node1] (local) root@192.168.0.38 ~
$ cat Dockerfile
FROM alpine
CMD ["echo", "hello world!"]
[node1] (local) root@192.168.0.38 ~
$ docker build -t appl .
Sending build context to Docker daemon 1.748MB
Step 1/2 : FROM alpine
---> b7b28af77ffe
Step 2/2 : CMD ["echo", "hello world!"]
---> Using cache
---> 020925a69856
Successfully built 020925a69856
Successfully tagged appl:latest
[node1] (local) root@192.168.0.38 ~
$ □
```

STEP 3: ADDING VOLUME (1)

Please go to "Step 3" at the following link: <https://tinyurl.com/5n939rhm>

```
[node1] (local) root@192.168.0.43 ~
$ vi Dockerfile
[node1] (local) root@192.168.0.43 ~
$ cat Dockerfile
FROM ubuntu
RUN mkdir -p ubuntu1 && cd ubuntu1 && echo "hello hello bye bye" >> file
VOLUME /ubuntu1
CMD /bin/sh
[node1] (local) root@192.168.0.43 ~
$ □
```


STEP 3: ADDING VOLUME (2)

Please go to "Step 3" at the following link: <https://tinyurl.com/5n939rhm>

```
[node1] (local) root@192.168.0.43 ~
$ docker build .
Sending build context to Docker daemon 1.748MB
Step 1/4 : FROM ubuntu
latest: Pulling from library/ubuntu
7413c47ba209: Pull complete
0fe7e7cbb2e8: Pull complete
1d425c982345: Pull complete
344da5c95cec: Pull complete
Digest: sha256:c303f19cfe9ee92badbbbd7567bc1ca47789f79303ddcef56f77687d4744cd7a
Status: Downloaded newer image for ubuntu:latest
---> 3556258649b2
Step 2/4 : RUN mkdir -p ubuntu1 && cd ubuntu1 && echo "hello hello bye bye" >> file
---> Running in 11cec2531d99
Removing intermediate container 11cec2531d99
---> 57a0103c4f45
Step 3/4 : VOLUME /ubuntu1
---> Running in 087ca99ff0b6
Removing intermediate container 087ca99ff0b6
---> bela8b07b358
Step 4/4 : CMD /bin/sh
---> Running in f92efal46fa4
Removing intermediate container f92efal46fa4
---> 239c5b4b5ed6
Successfully built 239c5b4b5ed6
[node1] (local) root@192.168.0.43 ~
$ █
```

STEP 3: ADDING VOLUME (3)

Please go to "Step 3" at the following link: <https://tinyurl.com/5n939rhm>

```
[node1] (local) root@192.168.0.43 ~
$ docker build .
Sending build context to Docker daemon 1.748MB
Step 1/4 : FROM ubuntu
latest: Pulling from library/ubuntu
7413c47ba209: Pull complete
0fe7e7cbb2e8: Pull complete
[node1] (local) root@192.168.0.43 ~
$ docker run --rm -it 239c5b4b5ed6
# ls
bin boot dev etc home lib lib64 media mnt opt proc root run sbin srv sys tmp ubuntu1 usr var
# exit
[node1] (local) root@192.168.0.43 ~
$ mkdir src
[node1] (local) root@192.168.0.43 ~
$ cd src
[node1] (local) root@192.168.0.43 ~/src
$ vi Hello.java
[node1] (local) root@192.168.0.43 ~/src
$ cat Hello.java
public class Hello { public static void main(String... ignored) { System.out.println("Hello, World!"); } }
[node1] (local) root@192.168.0.43 ~/src
$ vi Dockerfile
[node1] (local) root@192.168.0.43 ~/src
$ cat Dockerfile
FROM openjdk:8u131-jdk-alpine
WORKDIR /src
ENTRYPOINT javac Hello.java && java Hello
[node1] (local) root@192.168.0.43 ~/src
$ □
```

STEP 3: ADDING VOLUME (4)

Please go to "Step 3" at the following link: <https://tinyurl.com/5n939rhm>

```
[node1] (local) root@192.168.0.43 ~/src
$ docker build -t my-openjdk .
Sending build context to Docker daemon 3.072kB
Step 1/3 : FROM openjdk:8u131-jdk-alpine
8u131-jdk-alpine: Pulling from library/openjdk
1160f4abea84: Pull complete
b1b3e089ad5b: Pull complete
4220f7d94f04: Pull complete
Digest: sha256:01655aeb8f29002d40e75d25144d0b61b6e455f9d6469b4016eb56c5f43dbb99
Status: Downloaded newer image for openjdk:8u131-jdk-alpine
---> a99736768b96
Step 2/3 : WORKDIR /src
---> Running in 1c3eacc0ed61
Removing intermediate container 1c3eacc0ed61
---> fe69b6d65e3f
Step 3/3 : ENTRYPOINT javac Hello.java && java Hello
---> Running in e758c39eeb44
Removing intermediate container e758c39eeb44
---> 13a1987288fa
Successfully built 13a1987288fa
Successfully tagged my-openjdk:latest
```

STEP 3: ADDING VOLUME (5)

Please go to “Step 3” at the following link: <https://tinyurl.com/5n939rhm>

```
[node1] (local) root@192.168.0.43 ~/src
$ cd ..
[node1] (local) root@192.168.0.43 ~
$ docker run --rm -it -v $(pwd)/src:/src my-openjdk
Hello, World!
[node1] (local) root@192.168.0.43 ~
$ vi src/Hello.java
[node1] (local) root@192.168.0.43 ~
$ cat src/H
Hello.class Hello.java
[node1] (local) root@192.168.0.43 ~
$ cat src/Hello.java
public class Hello { public static void main(String... ignored) { System.out.println("Hello, World from GHC18!"); } }
[node1] (local) root@192.168.0.43 ~
$ docker run --rm -it -v $(pwd)/src:/src my-openjdk
Hello, World from GHC18!
[node1] (local) root@192.168.0.43 ~
$ □
```