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

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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

```bash
[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: sha256:6a92cd1fcdce8d8cdec60f33dda4db2cb1fcdcaf3410a8e05b3741f44a9b5998
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      NAMES
041179d7c93b     alpine            "date"               41 seconds ago      Exited (0) 39 seconds ago  
```

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

Please go to “Step 1” at the following link: [https://tinyurl.com/5n939rhm](https://tinyurl.com/5n939rhm)

```
[nodel] (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
[nodel] (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
[nodel] (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
[nodel] (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

```bash
$ 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
344da5c95ec: Pull complete
Digest: sha256:c303f19cfe9ee92badbbbd7567bc1ca47789f79303ddcef56f77687d4744cd7a
Status: Downloaded newer image for ubuntu:latest
```

```bash
root@cd2f17c662c2:/# exit
exit
[nodel] (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
[nodel] (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

```bash
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 ~
$ 
```
Please go to “Step 3” at the following link: https://tinyurl.com/5n939rhm
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STEP 3: ADDING VOLUME (4)

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

```
[noed1] (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/Hello.java
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 ~
$ 
```