Department of Computer Science and Engineering (Data Science)

Subject: Big Data Engineering (DJ19DSL604)

AY: 2022-23

Experiment 2

(Infrastructure Implementation)

Name : Rishabh Singhvi

SAPID : 60009210206   **BATCH : D2**

Aim: Hands on experience of Dockers and Kubernetes.

Theory:

Docker Overview

Docker is an open platform for developing, shipping, and running applications. Docker enables you to separate your applications from your infrastructure so you can deliver software quickly. With Docker, you can manage your infrastructure in the same ways you manage your applications. By taking advantage of Docker's methodologies for shipping, testing, and deploying code quickly, you can significantly reduce the delay between writing code and running it in production.

The Docker Platform

Docker provides the ability to package and run an application in a loosely isolated environment called a container. The isolation and security allows you to run many containers simultaneously on a given host. Containers are lightweight and contain everything needed to run the application, so you do not need to rely on what is currently installed on the host. You can easily share containers while you work, and be sure that everyone you share with gets the same container that works in the same way.

Docker provides tooling and a platform to manage the lifecycle of your containers:

 • Develop your application and its supporting components using containers.

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- The container becomes the unit for distributing and testing your application.

- When you're ready, deploy your application into your production environment, as a container or an orchestrated service. This works the same whether your production environment is a local data center, a cloud provider, or a hybrid of the two.
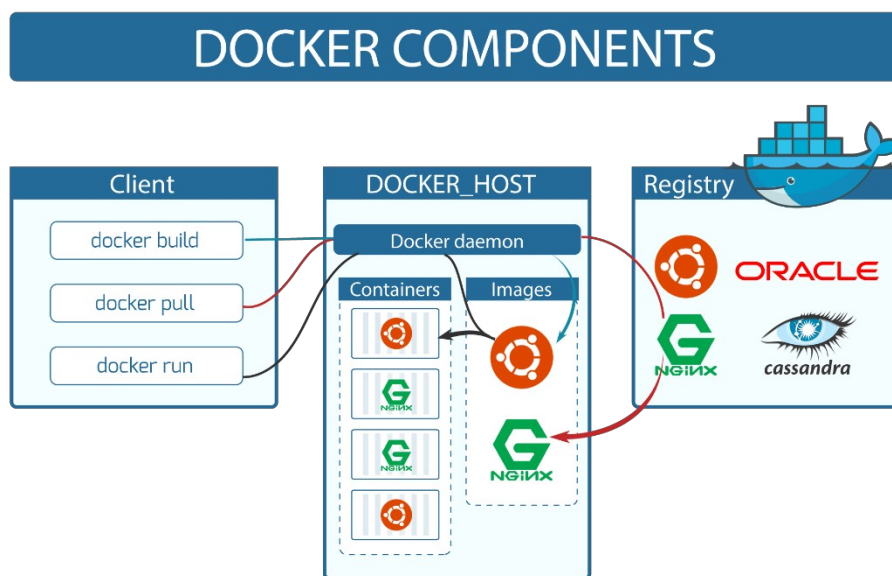

Kubernetes

Kubernetes is an orchestration framework for Docker containers which helps expose containers as services to the outside world. For example, you can have two services − One service would contain nginx and mongoDB, and another service would contain nginx and redis. Each service can have an IP or service point which can be connected by other applications. Kubernetes is then used to manage these services.

The following diagram shows in a simplistic format how Kubernetes works from an architecture point of view.

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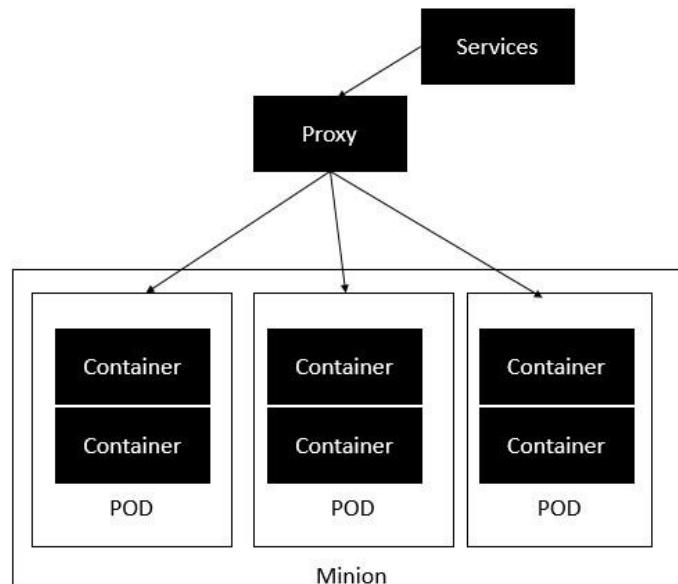
The minion is the node on which all the services run. You can have many minions running at one point in time. Each minion will host one or more POD. Each POD is like hosting a service. Each POD then contains the Docker containers. Each POD can host a different set of Docker containers. The proxy is then used to control the exposing of these services to the outside world.

Kubernetes has several components in its architecture. The role of each component is explained below &mius;

etcd − This component is a highly available key-value store that is used for storing shared configuration and service discovery. Here the various applications will be able to connect to the services via the discovery service.

Flannel − This is a backend network which is required for the containers.

kube-apiserver − This is an API which can be used to orchestrate the Docker containers.

kube-controller-manager − This is used to control the Kubernetes services.

kube-scheduler − This is used to schedule the containers on hosts.

Kubelet − This is used to control the launching of containers via manifest files.

kube-proxy − This is used to provide network proxy services to the outside world.

Lab Assignment:

1. Installation of Docker and Kubernetes on Ubuntu 20.4.5.
2. Group Activity (3 students): Create two Docker containers. One with an OS image and another with Node.js and React.
3. Develop a website in one Docker Container, share is with your team mates and allow parallel corrections from all team members.
4. Connect both the Dockers through Kubernetes and show how new request is handled.

EXPERIMENT : 2
Name : Rishabh Singhvi   SAPID : 60009210206
Dockers :

2.

```
  Network: bridge host ipvlan macvlan null overlay
   Log: awslogs fluentd gcplogs gelf journald json-file local logentries splunk syslog
 Swarm: inactive
 Runtimes: io.containerd.runc.v2 runc
 Default Runtime: runc
 Init Binary: docker-init
 containerd version: 2456e983eb9e37e47538f59ea18f2043c9a73640
 runc version: v1.1.4-0-g5fd4c4d
 init version: de40ad0
 Security Options:
  apparmor
  seccomp
   Profile: builtin
  cgroupns
 Kernel Version: 5.19.0-38-generic
 Operating System: Ubuntu 22.04.1 LTS
 OSType: linux
 Architecture: x86_64
 CPUs: 12
 Total Memory: 7.459GiB
 Name: csedsstudent-cvl15
 ID: c18d4e0e-c278-4bcf-b69e-7065b82dcdf0
 Docker Root Dir: /var/lib/docker
 Debug Mode: false
 Username: tanayagarwal
 Registry: https://index.docker.io/v1/
 Experimental: false
 Insecure Registries:
  127.0.0.0/8
 Live Restore Enabled: false

cseds-student@csedsstudent-cvl15:~$ docker run hello-world

Hello from Docker!
This message shows that your installation appears to be working correctly.

To generate this message, Docker took the following steps:
 1. The Docker client contacted the Docker daemon.
 2. The Docker daemon pulled the "hello-world" image from the Docker Hub.
    (amd64)
 3. The Docker daemon created a new container from that image which runs the
    executable that produces the output you are currently reading.
 4. The Docker daemon streamed that output to the Docker client, which sent it
    to your terminal.

To try something more ambitious, you can run an Ubuntu container with:
 $ docker run -it ubuntu bash

Share images, automate workflows, and more with a free Docker ID:
 https://hub.docker.com/

For more examples and ideas, visit:
 https://docs.docker.com/get-started/

cseds-student@csedsstudent-cvl15:~$ []
```

4.


```
 Insecure Registries:
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cseds-student@csedsstudent-cvl15:~$ docker search ubuntu
NAME                              DESCRIPTION                                STARS   OFFICIAL   AUTOMATED
ubuntu                            Ubuntu is a Debian-based Linux operating sys…  15825  [OK]
websphere-liberty                 WebSphere Liberty multi-architecture images …  293    [OK]
open-liberty                      Open Liberty multi-architecture images based…  59     [OK]
neurodebian                       NeuroDebian provides neuroscience research s…  99     [OK]
ubuntu-debootstrap                DEPRECATED; use "ubuntu" instead               50     [OK]
ubuntu-upstart                    DEPRECATED, as is Upstart (find other proces…  112    [OK]
ubuntu/nginx                      Nginx, a high-performance reverse proxy & we…  84
ubuntu/cortex                     Cortex provides storage for Prometheus. Long…  3
ubuntu/squid                      Squid is a caching proxy for the Web. Long-t…  54
ubuntu/apache2                    Apache, a secure & extensible open-source HT…  57
ubuntu/mysql                      MySQL open source fast, stable, multi-thread…  45
ubuntu/kafka                      Apache Kafka, a distributed event streaming …  29
ubuntu/bind9                      BIND 9 is a very flexible, full-featured DNS…  51
ubuntu/redis                      Redis, an open source key-value store. Long-…  17
ubuntu/prometheus                 Prometheus is a systems and service monitori…  40
ubuntu/postgres                   PostgreSQL is an open source object-relation…  27
ubuntu/zookeeper                  ZooKeeper maintains configuration informatio…  5
ubuntu/grafana                    Grafana, a feature rich metrics dashboard & …  9
ubuntu/memcached                  Memcached, in-memory keyvalue store for smal…  5
ubuntu/prometheus-alertmanager    Alertmanager handles client alerts from Prom…  8
ubuntu/dotnet-deps                Chiselled Ubuntu for self-contained .NET & A…  7
ubuntu/dotnet-runtime             Chiselled Ubuntu runtime image for .NET apps…  5
ubuntu/cassandra                  Cassandra, an open source NoSQL distributed …  2
ubuntu/dotnet-aspnet              Chiselled Ubuntu runtime image for ASP.NET a…  4
ubuntu/telegraf                   Telegraf collects, processes, aggregates & w…  4
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```

5.

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ubuntu/telegraf               Telegraf collects, processes, aggregates & w…  4
cseds-student@csedsstudent-cvl15:~$ docker pull ubuntu
Using default tag: latest
latest: Pulling from library/ubuntu
Digest: sha256:67211c14fa74f070d27cc59d69a7fa9aeff8e28ea118ef3babc295a0428a6d21
Status: Image is up to date for ubuntu:latest
docker.io/library/ubuntu:latest
cseds-student@csedsstudent-cvl15:~$
```

7.

```
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Using default tag: latest
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Digest: sha256:67211c14fa74f070d27cc59d69a7fa9aeff8e28ea118ef3babc295a0428a6d21
Status: Image is up to date for ubuntu:latest
docker.io/library/ubuntu:latest
cseds-student@csedsstudent-cvl15:~$ docker images
REPOSITORY                     TAG       IMAGE ID       CREATED        SIZE
ankit1iladva/ubuntu-nodejs     latest    ac646221473b   3 weeks ago    204MB
cseds-student/ubuntu-nodejs    latest    3180a7153a47   4 weeks ago    204MB
tanayagarwal/ubuntu-nodejs     latest    3180a7153a47   4 weeks ago    204MB
repository/new_image_name      latest    3a49915911f4   4 weeks ago    204MB
sarvy123/ubuntu-nodejs         latest    a249787f8e4b   5 weeks ago    13.3kB
ubuntu                         latest    08d22c0ceb15   5 weeks ago    77.8MB
ubuntu                         <none>    74f2314a03de   6 weeks ago    77.8MB
gcr.io/k8s-minikube/kicbase    v0.0.37   01c0ce65fff7   2 months ago   1.15GB
hello-world                    latest    feb5d9fea6a5   18 months ago  13.3kB
cseds-student@csedsstudent-cvl15:~$
```

8.

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REPOSITORY                          TAG        IMAGE ID       CREATED        SIZE
ankit1iladva/ubuntu-nodejs          latest     ac646221473b   3 weeks ago    204MB
cseds-student/ubuntu-nodejs         latest     3180a7153a47   4 weeks ago    204MB
tanayagarwal/ubuntu-nodejs          latest     3180a7153a47   4 weeks ago    204MB
repository/new_image_name           latest     3a49915911f4   4 weeks ago    204MB
sarvy123/ubuntu-nodejs              latest     a249787f8e4b   5 weeks ago    13.3kB
ubuntu                              latest     08d22c0ceb15   5 weeks ago    77.8MB
ubuntu                              <none>     74f2314a03de   6 weeks ago    77.8MB
gcr.io/k8s-minikube/kicbase         v0.0.37    01c0ce65fff7   2 months ago   1.15GB
hello-world                         latest     feb5d9fea6a5   18 months ago  13.3kB
cseds-student@csedsstudent-cvl15:~$ docker run -it ubuntu
root@048acff057ab:/# apt update
Get:1 http://archive.ubuntu.com/ubuntu jammy InRelease [270 kB]
Get:2 http://security.ubuntu.com/ubuntu jammy-security InRelease [110 kB]
Get:3 http://archive.ubuntu.com/ubuntu jammy-updates InRelease [119 kB]
Get:4 http://archive.ubuntu.com/ubuntu jammy-backports InRelease [108 kB]
Get:5 http://security.ubuntu.com/ubuntu jammy-security/restricted amd64 Packages [914 kB]
Get:6 http://archive.ubuntu.com/ubuntu jammy/multiverse amd64 Packages [266 kB]
Get:7 http://archive.ubuntu.com/ubuntu jammy/main amd64 Packages [1792 kB]
Get:8 http://security.ubuntu.com/ubuntu jammy-security/multiverse amd64 Packages [23.2 kB]
Get:9 http://security.ubuntu.com/ubuntu jammy-security/universe amd64 Packages [909 kB]
Get:10 http://archive.ubuntu.com/ubuntu jammy/universe amd64 Packages [17.5 MB]
Get:11 http://security.ubuntu.com/ubuntu jammy-security/main amd64 Packages [917 kB]
Get:12 http://archive.ubuntu.com/ubuntu jammy/restricted amd64 Packages [164 kB]
Get:13 http://archive.ubuntu.com/ubuntu jammy-updates/main amd64 Packages [1256 kB]
Get:14 http://archive.ubuntu.com/ubuntu jammy-updates/universe amd64 Packages [1149 kB]
Get:15 http://archive.ubuntu.com/ubuntu jammy-updates/restricted amd64 Packages [967 kB]
Get:16 http://archive.ubuntu.com/ubuntu jammy-updates/multiverse amd64 Packages [28.6 kB]
Get:17 http://archive.ubuntu.com/ubuntu jammy-backports/main amd64 Packages [49.0 kB]
Get:18 http://archive.ubuntu.com/ubuntu jammy-backports/universe amd64 Packages [23.3 kB]
Fetched 26.5 MB in 26s (1036 kB/s)
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
2 packages can be upgraded. Run 'apt list --upgradable' to see them.
root@048acff057ab:/# apt install nodejs
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
The following additional packages will be installed:
  ca-certificates javascript-common libbrotli1 libc-ares2 libicu70 libjs-highlight.js libnghttp2-14 libnode72 libuv1 nodejs-doc openssl
Suggested packages:
  apache2 | lighttpd | httpd npm
The following NEW packages will be installed:
  ca-certificates javascript-common libbrotli1 libc-ares2 libicu70 libjs-highlight.js libnghttp2-14 libnode72 libuv1 nodejs nodejs-doc openssl
0 upgraded, 12 newly installed, 0 to remove and 2 not upgraded.
Need to get 26.1 MB of archives.
After this operation, 93.0 MB of additional disk space will be used.
Do you want to continue? [Y/n] Y
Get:1 http://archive.ubuntu.com/ubuntu jammy-updates/main amd64 openssl amd64 3.0.2-0ubuntu1.8 [1184 kB]
Get:2 http://archive.ubuntu.com/ubuntu jammy-updates/main amd64 ca-certificates all 20211016ubuntu0.22.04.1 [144 kB]
Get:3 http://archive.ubuntu.com/ubuntu jammy/main amd64 libicu70 amd64 70.1-2 [10.6 MB]
Get:4 http://archive.ubuntu.com/ubuntu jammy/main amd64 libnghttp2-14 amd64 1.43.0-1build3 [76.3 kB]
Get:5 http://archive.ubuntu.com/ubuntu jammy/main amd64 libuv1 amd64 1.43.0-1 [93.1 kB]
Get:6 http://archive.ubuntu.com/ubuntu jammy/main amd64 javascript-common all 11+nmu1 [5936 B]
Get:7 http://archive.ubuntu.com/ubuntu jammy/main amd64 libbrotli1 amd64 1.0.9-2build6 [315 kB]
```

9.

```
Setting up libuv1:amd64 (1.43.0-1) ...
Setting up libjs-highlight.js (9.18.5+dfsg1-1) ...
Setting up openssl (3.0.2-0ubuntu1.8) ...
Setting up libicu70:amd64 (70.1-2) ...
Setting up libnode72:amd64 (12.22.9-dfsg-1ubuntu3) ...
Setting up ca-certificates (20211016ubuntu0.22.04.1) ...
debconf: unable to initialize frontend: Dialog
debconf: (No usable dialog-like program is installed, so the dialog based frontend cannot be used. at /usr/share/perl5/Debconf/FrontEnd/Dialog.pm line 78.)
debconf: falling back to frontend: Readline
debconf: unable to initialize frontend: Readline
debconf: (Can't locate Term/ReadLine.pm in @INC (you may need to install the Term::ReadLine module) (@INC contains: /etc/perl /usr/local/lib/x86_64-linux-gnu/5.34.0 /usr/local/share/perl/5.34.0 /usr
/lib/x86_64-linux-gnu/perl5/5.34 /usr/share/perl5 /usr/lib/x86_64-linux-gnu/perl-base /usr/lib/x86_64-linux-gnu/perl/5.34 /usr/share/perl/5.34 /usr/local/lib/site_perl) at /usr/share/perl5/Debconf/FrontE
nd/Readline.pm line 7.)
debconf: falling back to frontend: Teletype
Updating certificates in /etc/ssl/certs...
124 added, 0 removed; done.
Setting up nodejs-doc (12.22.9-dfsg-1ubuntu3) ...
Setting up nodejs (12.22.9-dfsg-1ubuntu3) ...
update-alternatives: using /usr/bin/nodejs to provide /usr/bin/js (js) in auto mode
update-alternatives: warning: skip creation of /usr/share/man/man1/js.1.gz because associated file /usr/share/man/man1/nodejs.1.gz (of link group js) doesn't exist
Processing triggers for libc-bin (2.35-0ubuntu3.1) ...
Processing triggers for ca-certificates (20211016ubuntu0.22.04.1) ...
Updating certificates in /etc/ssl/certs...
0 added, 0 removed; done.
Running hooks in /etc/ca-certificates/update.d...
done.
root@048acff057ab:/# node -v
v12.22.9
root@048acff057ab:/# docker ps
bash: docker: command not found
root@048acff057ab:/# ^C
root@048acff057ab:/# ^C
root@048acff057ab:/# exit
exit
cseds-student@csedsstudent-cvl15:~$ docker ps
CONTAINER ID   IMAGE     COMMAND   CREATED   STATUS    PORTS     NAMES
cseds-student@csedsstudent-cvl15:~$ docker ps -a
CONTAINER ID   IMAGE                             COMMAND                  CREATED        STATUS                      PORTS     NAMES
048acff057ab   ubuntu                            "/bin/bash"              3 minutes ago  Exited (130) 12 seconds ago           determined_wright
a9621e1b96c5   hello-world                       "/hello"                 4 minutes ago  Exited (0) 4 minutes ago              tender_khorana
1254cb7ea30d   ubuntu                            "/bin/bash"              3 weeks ago    Exited (137) 3 weeks ago              funny_galois
5c038f5f1bcc   hello-world                       "/hello"                 3 weeks ago    Exited (0) 3 weeks ago                heuristic_germain
e7ec6cd53de2   74f2314a03de                      "/bin/bash"              4 weeks ago    Exited (137) 4 weeks ago              kind_moore
23e8d659e43e   gcr.io/k8s-minikube/kicbase:v0.0.37  "/usr/local/bin/entr…"  4 weeks ago    Exited (137) 4 weeks ago              minikube
2e4c91c1e6be   74f2314a03de                      "/bin/bash"              4 weeks ago    Exited (137) 4 weeks ago              quirky_dewdney
c5df0ad24182   hello-world                       "/hello"                 4 weeks ago    Exited (0) 4 weeks ago                great_boyd
8fe07a19ecb4   hello-world                       "/hello"                 5 weeks ago    Exited (0) 5 weeks ago                kind_jones
70bf8b792ef1   hello-world                       "/hello"                 5 weeks ago    Exited (0) 5 weeks ago                practical_fermi
cseds-student@csedsstudent-cvl15:~$ docker ps -l
CONTAINER ID   IMAGE     COMMAND       CREATED        STATUS                      PORTS     NAMES
048acff057ab   ubuntu    "/bin/bash"   3 minutes ago  Exited (130) 20 seconds ago           determined_wright
cseds-student@csedsstudent-cvl15:~$ docker start 1c08a7a0d0e4
Error response from daemon: No such container: 1c08a7a0d0e4
Error: failed to start containers: 1c08a7a0d0e4
cseds-student@csedsstudent-cvl15:~$
```

10.

```
debconf: (No usable dialog-like program is installed, so the dialog based frontend cannot be used. at /usr/share/perl5/Debconf/FrontEnd/Dialog.pm line 78.)
debconf: falling back to frontend: Readline
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debconf: (Can't locate Term/ReadLine.pm in @INC (you may need to install the Term::ReadLine module) (@INC contains: /etc/perl /usr/local/lib/x86_64-linux-gnu/perl/5.34.0 /usr/local/share/perl/5.34.0 /usr
/lib/x86_64-linux-gnu/perl5/5.34 /usr/share/perl5 /usr/lib/x86_64-linux-gnu/perl-base /usr/lib/x86_64-linux-gnu/perl/5.34 /usr/share/perl/5.34 /usr/local/lib/site_perl) at /usr/share/perl5/Debconf/FrontE
nd/Readline.pm line 7.)
debconf: falling back to frontend: Teletype
Updating certificates in /etc/ssl/certs...
124 added, 0 removed; done.
Setting up nodejs-doc (12.22.9-dfsg-1ubuntu3) ...
Setting up nodejs (12.22.9-dfsg-1ubuntu3) ...
update-alternatives: using /usr/bin/nodejs to provide /usr/bin/js (js) in auto mode
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CONTAINER ID   IMAGE                              COMMAND                  CREATED        STATUS                     PORTS     NAMES
048acff057ab   ubuntu                             "/bin/bash"              3 minutes ago  Exited (130) 12 seconds ago          determined_wright
a9621e1b96c5   hello-world                        "/hello"                 4 minutes ago  Exited (0) 4 minutes ago             tender_khorana
1254cb7ea30d   ubuntu                             "/bin/bash"              3 weeks ago    Exited (137) 3 weeks ago             funny_galois
5c038f5f1bcc   hello-world                        "/hello"                 3 weeks ago    Exited (0) 3 weeks ago               heuristic_germain
e7ec6cd53de2   74f2314a03de                       "/bin/bash"              4 weeks ago    Exited (137) 4 weeks ago             kind_moore
23e8d659e43e   gcr.io/k8s-minikube/kicbase:v0.0.37 "/usr/local/bin/entr…"  4 weeks ago    Exited (137) 4 weeks ago             minikube
2e4c91c1e0be   74f2314a03de                       "/bin/bash"              4 weeks ago    Exited (137) 4 weeks ago             quirky_dewdney
c5df0ad24182   hello-world                        "/hello"                 4 weeks ago    Exited (0) 4 weeks ago               great_boyd
8fe07a19ecb4   hello-world                        "/hello"                 5 weeks ago    Exited (0) 5 weeks ago               kind_jones
70bf8b792ef1   hello-world                        "/hello"                 5 weeks ago    Exited (0) 5 weeks ago               practical_fermi
cseds-student@csedsstudent-cvl15:~$ docker ps -l
CONTAINER ID   IMAGE     COMMAND       CREATED        STATUS                      PORTS     NAMES
048acff057ab   ubuntu    "/bin/bash"   3 minutes ago  Exited (130) 20 seconds ago           determined_wright
cseds-student@csedsstudent-cvl15:~$ docker start 1c08a7a0d0e4
Error response from daemon: No such container: 1c08a7a0d0e4
Error: failed to start containers: 1c08a7a0d0e4
cseds-student@csedsstudent-cvl15:~$ docker stop quizzical_mcnulty
Error response from daemon: No such container: quizzical_mcnulty
cseds-student@csedsstudent-cvl15:~$ docker rm youthful_curie
Error response from daemon: No such container: youthful_curie
cseds-student@csedsstudent-cvl15:~$ docker commit -m "added Node.js" -a "sammy" d9b100f2f636 sammy/ubuntu-nodejs^C
cseds-student@csedsstudent-cvl15:~$ docker commit -m "added Node.js" -a "sammy" 048acff057ab sammy/ubuntu
sha256:7ec136ee0c9217944f7d6d0ad6a86a6484b14f9a45aa19cded4e7111a551d6d3
cseds-student@csedsstudent-cvl15:~$
```