



**Department of Computer Science and Engineering (Data Science)**

**Subject: Big Data Engineering (DJ19DSL604)**

**AY: 2022-23**

**Experiment 2**

**(Infrastructure Implementation)**

**Name : Sarvagya Singh**

**SAPID : 60009200030**

**BATCH : K1**

**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.

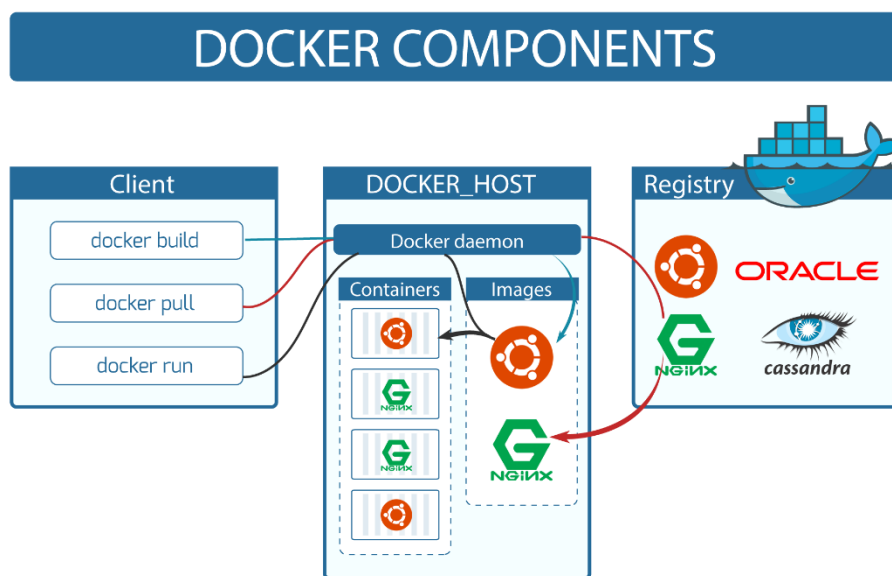
Docker provides tooling and a platform to manage the lifecycle of your containers:

- 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.



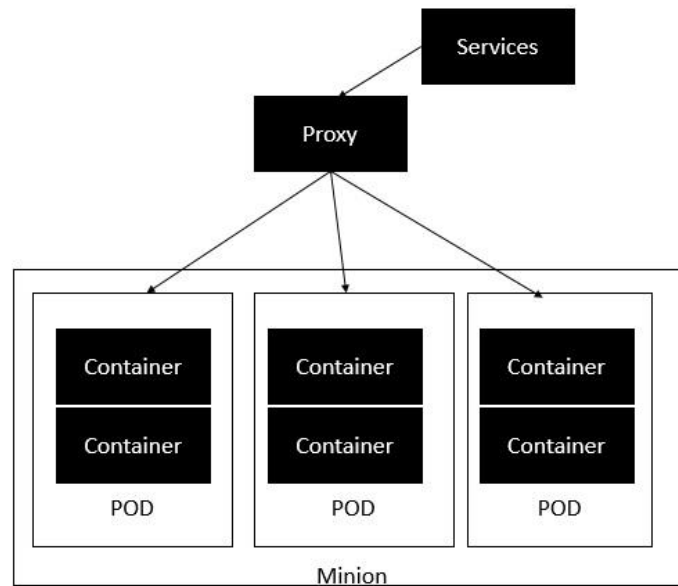
## Kubernetes

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 & minus;

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.



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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 it 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 : Sarvagya Singh

SAPID : 60009200030

## Dockers :

```
Activities Terminal Apr 12 11:35 cseeds-student@cseedsstudent-cv115: ~  
cseeds-student@cseedsstudent-cv115: $ sudo apt install docker-ce  
[sudo] password for cseeds-student:  
Reading package lists... Done  
Building dependency tree... Done  
Reading state information... Done  
The following packages were automatically installed and are no longer required:  
  genders libflashrom1 libftdi1-2 libgenders0  
Use 'sudo apt autoremove' to remove them.  
Suggested packages:  
  aufs-tools cgroupfs-mount | cgroup-lite  
The following packages will be upgraded:  
  docker-ce  
1 upgraded, 0 newly installed, 0 to remove and 128 not upgraded.  
Need to get 22.0 MB of archives.  
After this operation, 85.0 kB of additional disk space will be used.  
Get:1 https://download.docker.com/linux/ubuntu focal/stable amd64 docker-ce amd64 5:23.0.3-1-ubuntu.20.04-focal [22.0 MB]  
Fetched 22.0 MB in 19s (1,138 kB/s)  
(Reading database ... 254575 files and directories currently installed.)  
Preparing to unpack .../docker-ce_5:23.0.3-1-ubuntu.20.04-focal_amd64.deb ...  
Unpacking docker-ce (5:23.0.3-1-ubuntu.20.04-focal) over (5:23.0.1-1-ubuntu.20.04-focal) ...  
Setting up docker-ce (5:23.0.3-1-ubuntu.20.04-focal) ...  
cseeds-student@cseedsstudent-cv115: $ sudo systemctl status docker  
● docker.service - Docker Application Container Engine  
   Loaded: loaded (/lib/systemd/system/docker.service; enabled; vendor preset: enabled)  
   Active: active (running) since Wed 2023-04-12 11:34:38 IST; 4s ago  
   TriggeredBy: ● docker.socket  
     Docs: https://docs.docker.com  
    Main PID: 5362 (dockerd)  
      Tasks: 17  
     Memory: 26.2M  
        CPU: 495ms  
    CGroup: /system.slice/docker.service  
            └─5362 /usr/bin/dockerd -H fd:// --containerd=/run/containerd/containerd.sock  
  
Apr 12 11:34:37 cseedsstudent-cv115 dockerd[5362]: time="2023-04-12T11:34:37.765538698+05:30" level=info msg="[core] [channel #4] Channel connectivity change to READY" module=grpc  
Apr 12 11:34:37 cseedsstudent-cv115 dockerd[5362]: time="2023-04-12T11:34:37.826535507+05:30" level=info msg="[graphdriver] using prior storage driver: overlay2"  
Apr 12 11:34:37 cseedsstudent-cv115 dockerd[5362]: time="2023-04-12T11:34:37.839569727+05:30" level=info msg="Loading containers: start."  
Apr 12 11:34:38 cseedsstudent-cv115 dockerd[5362]: time="2023-04-12T11:34:38.394846283+05:30" level=info msg="Default bridge (docker0) is assigned with an IP address 172.17.0.0/16. Daemon option --bip c  
Apr 12 11:34:38 cseedsstudent-cv115 dockerd[5362]: time="2023-04-12T11:34:38.489927756+05:30" level=info msg="Loading containers: done."  
Apr 12 11:34:38 cseedsstudent-cv115 dockerd[5362]: time="2023-04-12T11:34:38.507190378+05:30" level=info msg="Docker daemon" commit=59118bf graphdriver=overlay2 version=23.0.3  
Apr 12 11:34:38 cseedsstudent-cv115 dockerd[5362]: time="2023-04-12T11:34:38.507437222+05:30" level=info msg="Daemon has completed initialization"  
Apr 12 11:34:38 cseedsstudent-cv115 dockerd[5362]: time="2023-04-12T11:34:38.533062540+05:30" level=info msg="[core] [Server #7] Server created" module=grpc  
Apr 12 11:34:38 cseedsstudent-cv115 systemd[1]: Started Docker Application Container Engine.  
Apr 12 11:34:38 cseedsstudent-cv115 dockerd[5362]: time="2023-04-12T11:34:38.538997636+05:30" level=info msg="API listen on /run/docker.sock"  
lines 1-22/22 (END)
```

2.

```
Activities Terminal Apr 12 11:36 cseeds-student@cseedsstudent-cv115: ~  
cseeds-student@cseedsstudent-cv115: ~  
--tls-cert string Path to TLS certificate file (default "/home/cseeds-student/.docker/cert.pem")  
--tls-key string Path to TLS key file (default "/home/cseeds-student/.docker/key.pem")  
--tls-verify Use TLS and verify the remote  
-v, --version Print version information and quit  
  
Run 'docker COMMAND --help' for more information on a command.  
  
For more help on how to use Docker, head to https://docs.docker.com/go/guides/  
cseeds-student@cseedsstudent-cv115: $ docker info  
Client:  
Context: default  
Debug Mode: false  
Plugins:  
buildx: Docker Buildx (Docker Inc.)  
  Version: v0.10.3  
  Path: /usr/lib/docker/cli-plugins/docker-buildx  
compose: Docker Compose (Docker Inc.)  
  Version: v2.15.1  
  Path: /usr/lib/docker/cli-plugins/docker-compose  
dev: Docker Dev Environments (Docker Inc.)  
  Version: v0.1.0  
  Path: /usr/lib/docker/cli-plugins/docker-dev  
extension: Manages Docker extensions (Docker Inc.)  
  Version: v0.2.18  
  Path: /usr/lib/docker/cli-plugins/docker-extension  
sbom: View the packaged-based software Bill of Materials (SBOM) for an image (Anchore Inc.)  
  Version: 0.6.0  
  Path: /usr/lib/docker/cli-plugins/docker-sbom  
scan: Docker Scan (Docker Inc.)  
  Version: v0.25.0  
  Path: /usr/lib/docker/cli-plugins/docker-scan  
scout: Command line tool for Docker Scout (Docker Inc.)  
  Version: v0.6.0  
  Path: /usr/lib/docker/cli-plugins/docker-scout  
  
Server:  
Containers: 8  
  Running: 0  
  Paused: 0  
  Stopped: 8  
Images: 0  
Server Version: 23.0.3  
Storage Driver: overlay2  
  Backing Filesystem: extfs  
  Supports d_type: true  
  Using metacopy: false  
  Native Overlay Diff: true  
  userxattr: false  
Logging Driver: json-file  
Cgroup Driver: systemd  
Cgroup Version: 2  
Plugins:  
  Volume: local  
  Network: bridge host ipvlan macvlan null overlay  
  Log: awslogs fluentd gcplogs gelf journald json-file local logentries splunk syslog  
Swarm: inactive
```

3.

```
Activities Terminal Apr 12 11:37 cseeds-student@cseedsstudent-cv115: ~  
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  
cgroups  
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: cseedsstudent-cv115  
ID: c18d4e0e-c278-4bcf-b09e-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  
  
cseeds-student@cseedsstudent-cv115: $ 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/  
  
cseeds-student@cseedsstudent-cv115: $
```

4.

```
Activities Terminal Apr 12 11:37 cseeds-student@cseedsstudent-cv115: ~  
Insecure Registries:  
127.0.0.0/8  
Live Restore Enabled: false  
  
cseeds-student@cseedsstudent-cv115: $ 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.  
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https://hub.docker.com/  
  
For more examples and ideas, visit:  
https://docs.docker.com/get-started/  
  
cseeds-student@cseedsstudent-cv115: $ docker search ubuntu  


| NAME                           | DESCRIPTION                                      | STARS | OFFICIAL | AUTOMATED |
|--------------------------------|--------------------------------------------------|-------|----------|-----------|
| ubuntu                         | Ubuntu is a Debian-based Linux operating sys...  | 15825 | [OK]     |           |
| webosphere-liberty             | Webosphere 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                 | 56    | [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-relatio...   | 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 sna...   | 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     |          |           |

  
cseeds-student@cseedsstudent-cv115: $
```

5.



```
Activities Terminal Apr 12 11:38 cseeds-student@cseedsstudent-cv115: ~  
  
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.  
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https://hub.docker.com/  
  
For more examples and ideas, visit:  
https://docs.docker.com/get-started/  
  
cseeds-student@cseedsstudent-cv115: $ docker search ubuntu  
NAME DESCRIPTION STARS OFFICIAL AUTOMATED  
ubuntu Ubuntu is a Debian-based Linux operating sys... 15825 [OK]  
webosphere-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/blink9 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  
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ubuntu/zookeeper ZooKeeper maintains configuration informatio... 5  
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ubuntu/memcached Memcached, in-memory keyvalue store for sna... 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  
cseeds-student@cseedsstudent-cv115: $ docker pull ubuntu  
Using default tag: latest  
latest: Pulling from library/ubuntu  
Digest: sha256:67211c14fa74f070d27cc59d99a7fa9aeff8e28ea118ef3babc295a0428a6d21  
Status: Image is up to date for ubuntu:latest  
docker.io/library/ubuntu:latest  
cseeds-student@cseedsstudent-cv115: $
```

6.

```
Activities Terminal Apr 12 11:38 cseeds-student@cseedsstudent-cv115: ~  
  
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/  
  
cseeds-student@cseedsstudent-cv115: $ docker search ubuntu  
NAME DESCRIPTION STARS OFFICIAL AUTOMATED  
ubuntu Ubuntu is a Debian-based Linux operating sys... 15825 [OK]  
webosphere-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/blink9 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-relatio... 27  
ubuntu/zookeeper ZooKeeper maintains configuration informatio... 5  
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ubuntu/memcached Memcached, in-memory keyvalue store for sna... 5  
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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  
cseeds-student@cseedsstudent-cv115: $ docker pull ubuntu  
Using default tag: latest  
latest: Pulling from library/ubuntu  
Digest: sha256:67211c14fa74f070d27cc59d99a7fa9aeff8e28ea118ef3babc295a0428a6d21  
Status: Image is up to date for ubuntu:latest  
docker.io/library/ubuntu:latest  
cseeds-student@cseedsstudent-cv115: $ docker images  
REPOSITORY TAG IMAGE ID CREATED SIZE  
ankit11ladva/ubuntu-nodejs latest ac046221473b 3 weeks ago 204MB  
cseeds-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 08d220c0eb15 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  
cseeds-student@cseedsstudent-cv115: $
```

7.

```
Activities Terminal Apr 12 11:41 root@048acff057ab: /

REPOSITORY TAG IMAGE ID CREATED SIZE
ankitiladva/ubuntu-nodejs latest ac646221473b 3 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 01c0ce5ffff7 2 months ago 1.15GB
hello-world latest feb5d9fea6a5 18 months ago 13.3kB

cseds-student@csedsstudent-cv115:~$ docker run -it ubuntu
root@048acff057ab:/# apt update
Get:1 http://archive.ubuntu.com/ubuntu janny InRelease [270 kB]
Get:2 http://security.ubuntu.com/ubuntu janny-security InRelease [110 kB]
Get:3 http://archive.ubuntu.com/ubuntu janny-updates InRelease [119 kB]
Get:4 http://archive.ubuntu.com/ubuntu janny-backports InRelease [108 kB]
Get:5 http://security.ubuntu.com/ubuntu janny-security/restricted amd64 Packages [914 kB]
Get:6 http://archive.ubuntu.com/ubuntu janny/multiverse amd64 Packages [266 kB]
Get:7 http://archive.ubuntu.com/ubuntu janny/main amd64 Packages [1792 kB]
Get:8 http://security.ubuntu.com/ubuntu janny-security/multiverse amd64 Packages [23.2 kB]
Get:9 http://security.ubuntu.com/ubuntu janny-security/universe amd64 Packages [909 kB]
Get:10 http://archive.ubuntu.com/ubuntu janny/universe amd64 Packages [17.5 MB]
Get:11 http://security.ubuntu.com/ubuntu janny-security/main amd64 Packages [917 kB]
Get:12 http://archive.ubuntu.com/ubuntu janny/restricted amd64 Packages [164 kB]
Get:13 http://archive.ubuntu.com/ubuntu janny-updates/main amd64 Packages [1256 kB]
Get:14 http://archive.ubuntu.com/ubuntu janny-updates/universe amd64 Packages [1149 kB]
Get:15 http://archive.ubuntu.com/ubuntu janny-updates/restricted amd64 Packages [967 kB]
Get:16 http://archive.ubuntu.com/ubuntu janny-updates/multiverse amd64 Packages [28.6 kB]
Get:17 http://archive.ubuntu.com/ubuntu janny-backports/main amd64 Packages [40.0 kB]
Get:18 http://archive.ubuntu.com/ubuntu janny-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 libcares2 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 libcares2 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 janny-updates/main amd64 openssl amd64 3.0.2-0ubuntu1.8 [1184 kB]
Get:2 http://archive.ubuntu.com/ubuntu janny-updates/main amd64 ca-certificates all 20211010ubuntu0.22.04.1 [144 kB]
Get:3 http://archive.ubuntu.com/ubuntu janny/main amd64 libicu70 amd64 70.1-2 [10.6 MB]
Get:4 http://archive.ubuntu.com/ubuntu janny/main amd64 libnghttp2-14 amd64 1.43.0-1build3 [76.3 kB]
Get:5 http://archive.ubuntu.com/ubuntu janny/main amd64 libuv1 amd64 1.43.0-1 [93.1 kB]
Get:6 http://archive.ubuntu.com/ubuntu janny/main amd64 javascript-common all 11+nmu1 [5936 B]
Get:7 http://archive.ubuntu.com/ubuntu janny/main amd64 libbrotli1 amd64 1.0.9-2build1 [315 kB]
Get:8 http://archive.ubuntu.com/ubuntu janny/main amd64 libcares2 amd64 1.18.4-1 [52.8 kB]
Get:9 http://archive.ubuntu.com/ubuntu janny/main amd64 libnode72 amd64 12.22.9-1 [10.6 MB]
Get:10 http://archive.ubuntu.com/ubuntu janny/main amd64 nodejs amd64 12.22.9-1 [10.6 MB]
Get:11 http://archive.ubuntu.com/ubuntu janny/main amd64 nodejs-doc all 12.22.9-1 [10.6 MB]
Get:12 http://archive.ubuntu.com/ubuntu janny/main amd64 openssl amd64 3.0.2-0ubuntu1.8 [1184 kB]
Fetched 76.1 MB in 10s (7611 kB/s)
debconf: unable to initialize frontend: Dialog
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/perl/5.34.0 /usr/local/share/perl/5.34.0 /usr/lib/x86_64-linux-gnu/perl/5.34 /usr/share/perl/5.34 /usr/local/lib/site_perl) at /usr/share/perl5/Debconf/FrontEnd/Dialog.pm line 78.)
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 (20211010ubuntu0.22.04.1) ...
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:/# exit
exit
cseds-student@csedsstudent-cv115:~$ docker ps
CONTAINER ID   IMAGE     COMMAND   CREATED   STATUS    PORTS   NAMES
cseds-student@csedsstudent-cv115:~$ docker ps -a
CONTAINER ID   IMAGE     COMMAND   CREATED   STATUS    PORTS   NAMES
048acff057ab   ubuntu   "/bin/bash"   3 minutes ago   Exited (130) 12 seconds ago   tender_wright
a9021eb39c5    hello-world   "/hello"   4 minutes ago   Exited (0) 4 minutes ago   tender_khorana
1254cb7ea39d    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
23e6d59e43e    gcr.io/k8s-minikube/kicbase:v0.0.37   "/usr/local/bin/entr..."   4 weeks ago   Exited (137) 4 weeks ago   minikube
2e4c91e0b6     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
8feb7a19ecb4    hello-world   "/hello"   5 weeks ago   Exited (0) 5 weeks ago   kind_jones
70bf0b792ef1    hello-world   "/hello"   5 weeks ago   Exited (0) 5 weeks ago   practical_ferni
cseds-student@csedsstudent-cv115:~$ docker ps -l
CONTAINER ID   IMAGE     COMMAND   CREATED   STATUS    PORTS   NAMES
048acff057ab   ubuntu   "/bin/bash"   3 minutes ago   Exited (130) 20 seconds ago   tender_wright
cseds-student@csedsstudent-cv115:~$ docker start 1c08a7a0dd0e4
Error response from daemon: No such container: 1c08a7a0dd0e4
Error: failed to start containers: 1c08a7a0dd0e4
cseds-student@csedsstudent-cv115:~$
```

8.

```
Activities Terminal Apr 12 11:42 cseds-student@csedsstudent-cv115:~$

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 (20211010ubuntu0.22.04.1) ...
debconf: unable to initialize frontend: Dialog
debconf: (The 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/perl/5.34.0 /usr/local/share/perl/5.34.0 /usr/lib/x86_64-linux-gnu/perl/5.34 /usr/share/perl/5.34 /usr/local/lib/site_perl) at /usr/share/perl5/Debconf/FrontEnd/Dialog.pm line 78.)
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 (20211010ubuntu0.22.04.1) ...
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:/# exit
exit
cseds-student@csedsstudent-cv115:~$ docker ps
CONTAINER ID   IMAGE     COMMAND   CREATED   STATUS    PORTS   NAMES
cseds-student@csedsstudent-cv115:~$ docker ps -a
CONTAINER ID   IMAGE     COMMAND   CREATED   STATUS    PORTS   NAMES
048acff057ab   ubuntu   "/bin/bash"   3 minutes ago   Exited (130) 12 seconds ago   tender_wright
a9021eb39c5    hello-world   "/hello"   4 minutes ago   Exited (0) 4 minutes ago   tender_khorana
1254cb7ea39d    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
23e6d59e43e    gcr.io/k8s-minikube/kicbase:v0.0.37   "/usr/local/bin/entr..."   4 weeks ago   Exited (137) 4 weeks ago   minikube
2e4c91e0b6     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
8feb7a19ecb4    hello-world   "/hello"   5 weeks ago   Exited (0) 5 weeks ago   kind_jones
70bf0b792ef1    hello-world   "/hello"   5 weeks ago   Exited (0) 5 weeks ago   practical_ferni
cseds-student@csedsstudent-cv115:~$ docker ps -l
CONTAINER ID   IMAGE     COMMAND   CREATED   STATUS    PORTS   NAMES
048acff057ab   ubuntu   "/bin/bash"   3 minutes ago   Exited (130) 20 seconds ago   tender_wright
cseds-student@csedsstudent-cv115:~$ docker start 1c08a7a0dd0e4
Error response from daemon: No such container: 1c08a7a0dd0e4
Error: failed to start containers: 1c08a7a0dd0e4
cseds-student@csedsstudent-cv115:~$
```

9.



```
Activities Terminal Apr 12 11:44 cseeds-student@cseedsstudent-cv115: ~  
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/perl/5.34.0 /usr/local/share/perl/5.34.0 /usr  
/lib/x86_64-linux-gnu/perl/5.34 /usr/share/perl/5.34 /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  
cseeds-student@cseedsstudent-cv115:~$ docker ps  
CONTAINER ID   IMAGE     COMMAND   CREATED   STATUS    PORTS   NAMES  
cseeds-student@cseedsstudent-cv115:~$ 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  
a902e1b195c5   hello-world   "/hello"   4 minutes ago   Exited (0) 4 minutes ago   tender_khorana  
1254cb7ea39d   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  
23e0d65943e   ger.1o/k8s-minkube/kicbase:v0.0.37   "/usr/local/bin/entr..."   4 weeks ago   Exited (137) 4 weeks ago   minkube  
2e4c91c1e0be   74f2314a03de   "/bin/bash"   4 weeks ago   Exited (137) 4 weeks ago   quirky_dawdney  
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  
70bf0b792ef1   hello-world   "/hello"   5 weeks ago   Exited (0) 5 weeks ago   practical_ferni  
cseeds-student@cseedsstudent-cv115:~$ 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  
cseeds-student@cseedsstudent-cv115:~$ docker start 1c08a7a0d0e4  
Error response from daemon: No such container: 1c08a7a0d0e4  
Error: failed to start containers: 1c08a7a0d0e4  
cseeds-student@cseedsstudent-cv115:~$ docker stop quizzical_mcnullty  
Error response from daemon: No such container: quizzical_mcnullty  
cseeds-student@cseedsstudent-cv115:~$ docker rm youthful_curie  
Error response from daemon: No such container: youthful_curie  
cseeds-student@cseedsstudent-cv115:~$ docker commit -m "added Node.js" -a "sanny" d9b100f2f636 sanny/ubuntu-nodejs-c  
cseeds-student@cseedsstudent-cv115:~$ docker commit -m "added Node.js" -a "sanny" 048acff057ab sanny/ubuntu  
sha256:7ec136ee0c92179447fd6ddada0a6a484b14f9a45aa19cded4e7110551dd6d3  
cseeds-student@cseedsstudent-cv115:~$
```

10.