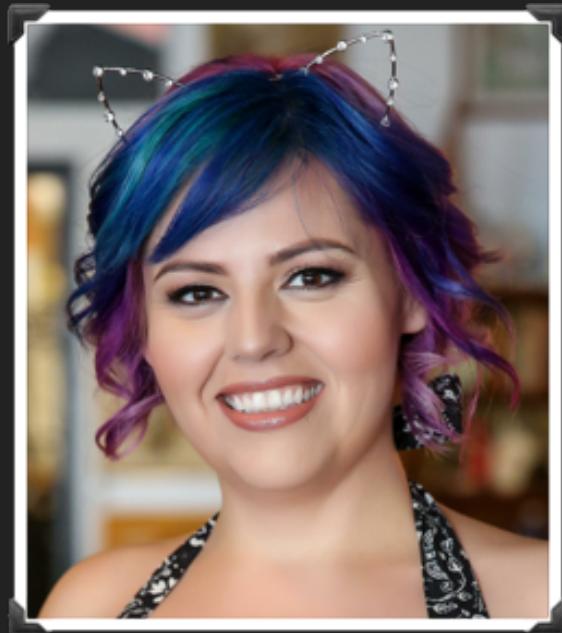


CONTAINERS:

NO, NOT YOUR MAMA'S TUPPERWARE.



ELL MARQUEZ

Technical Trainer
Rackspace Private Cloud Training
ell.marquez@rackspace.com

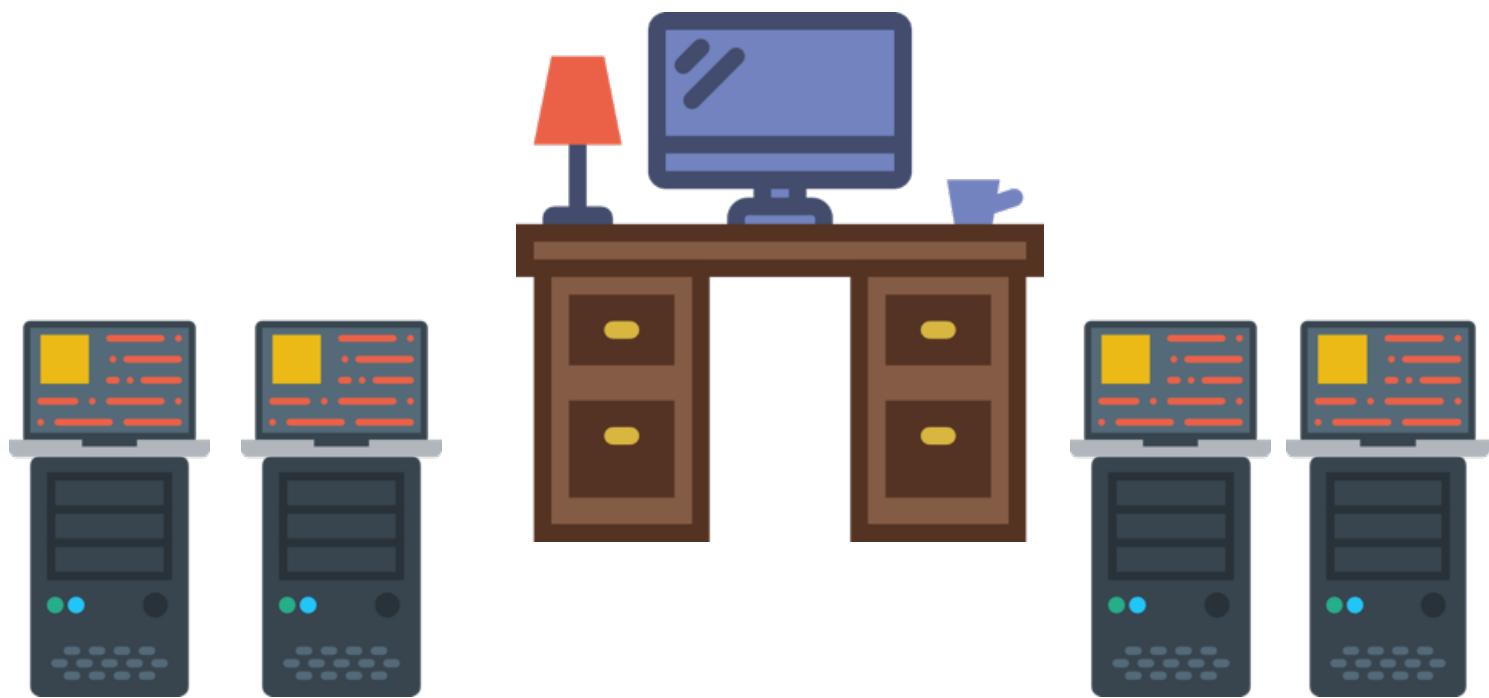
Agenda

Virtualization

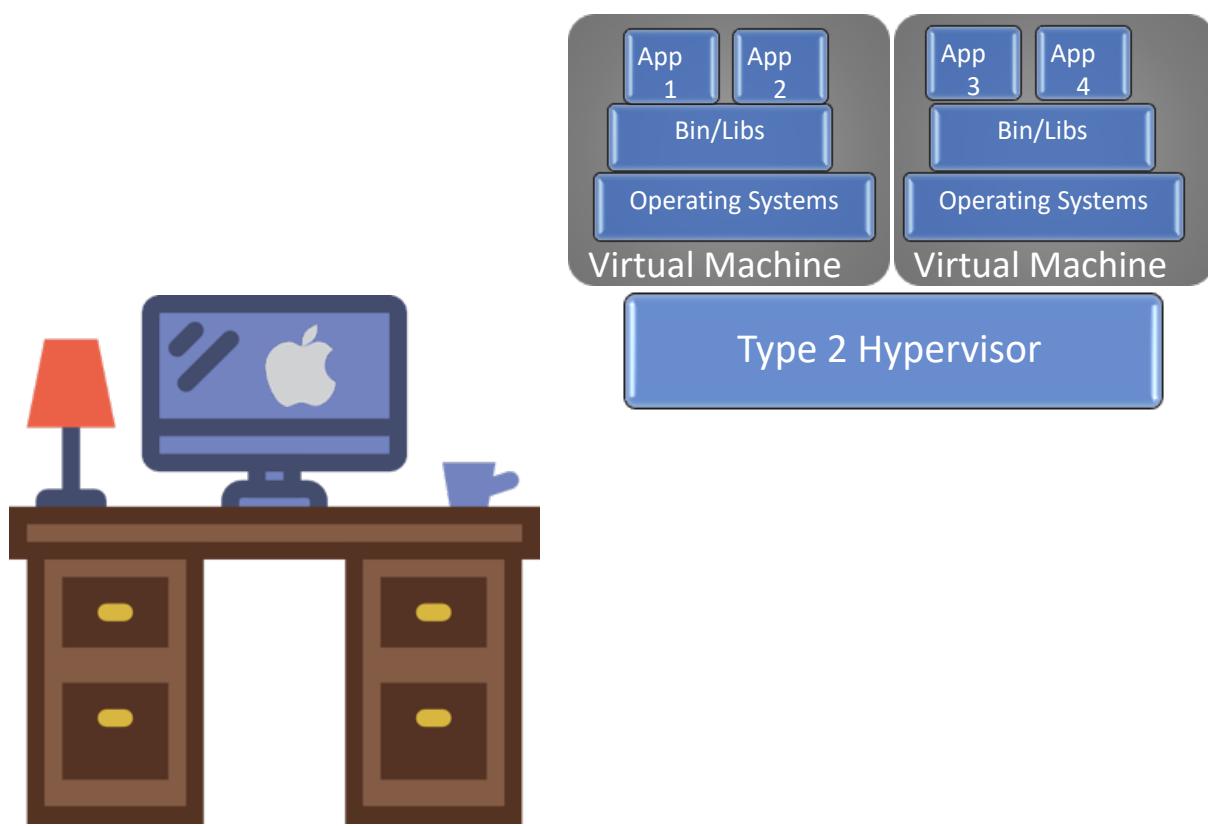
Containerization

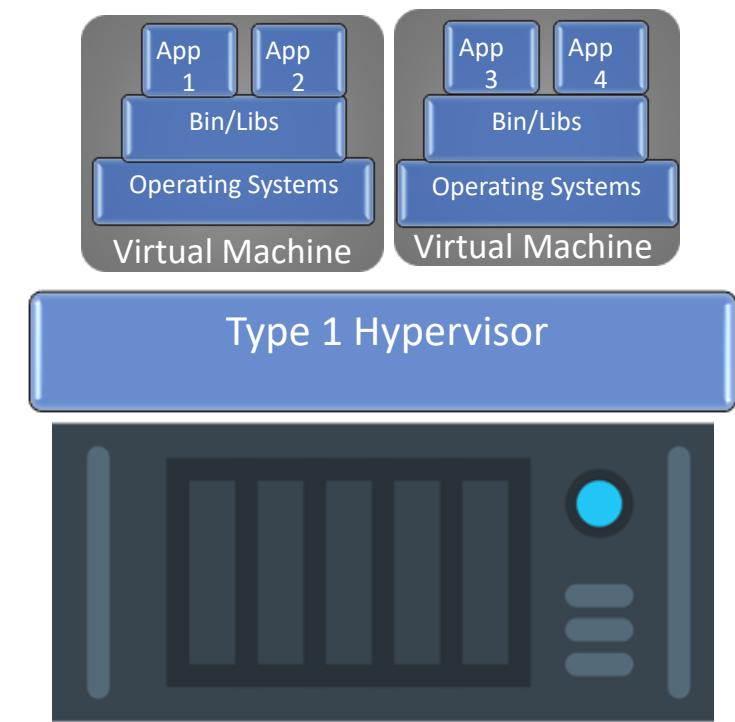
Docker

Kubernetes



What is Virtualization?







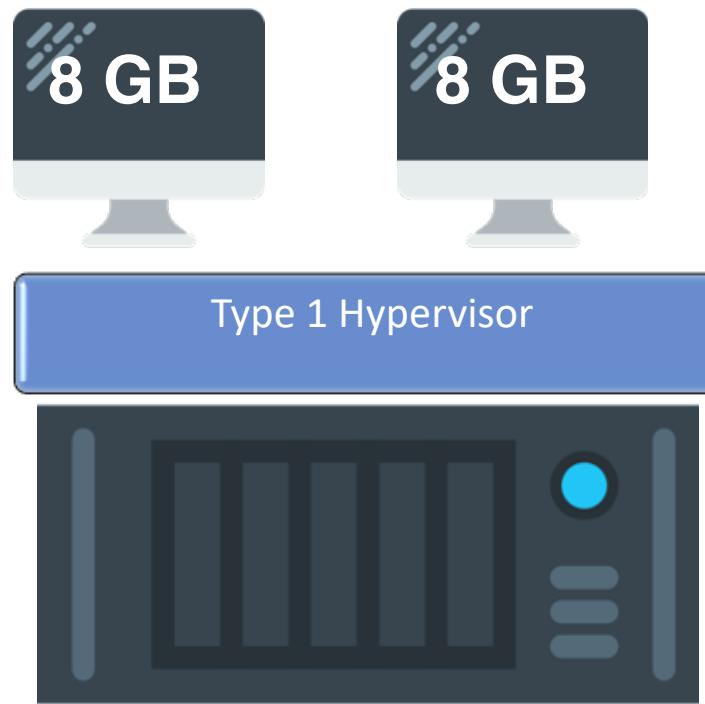
Type 1 Hypervisor





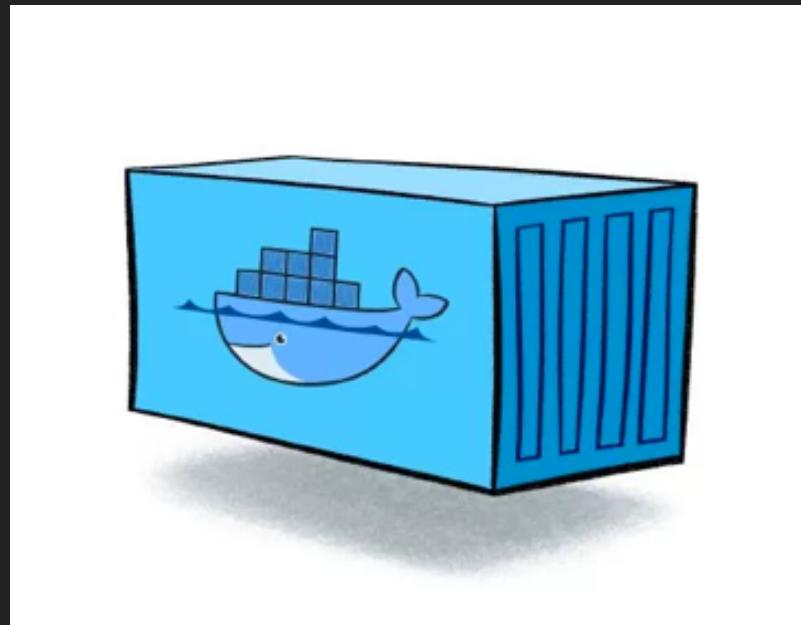
Type 1 Hypervisor







Containerization

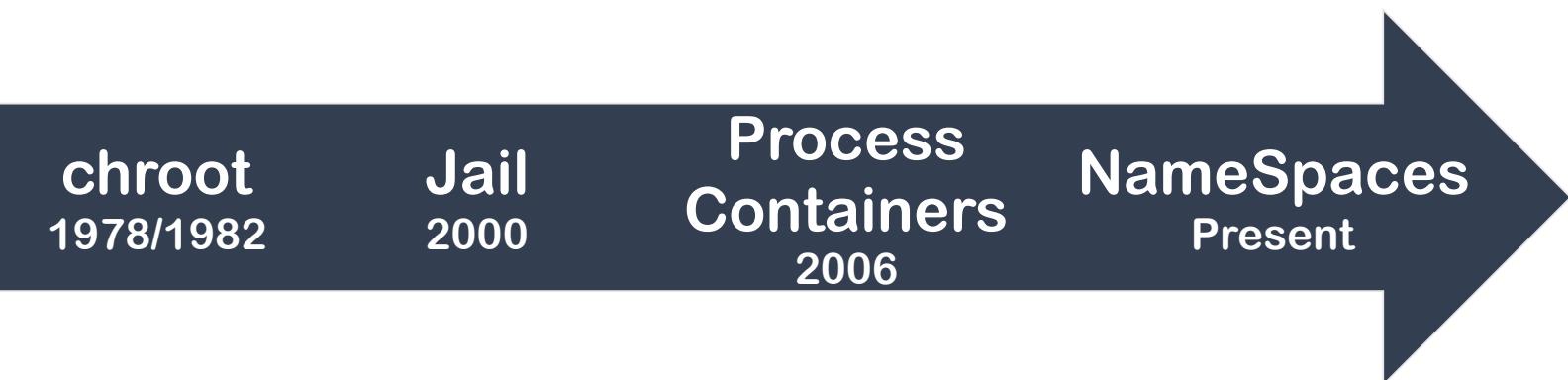


chroot
1978/1982

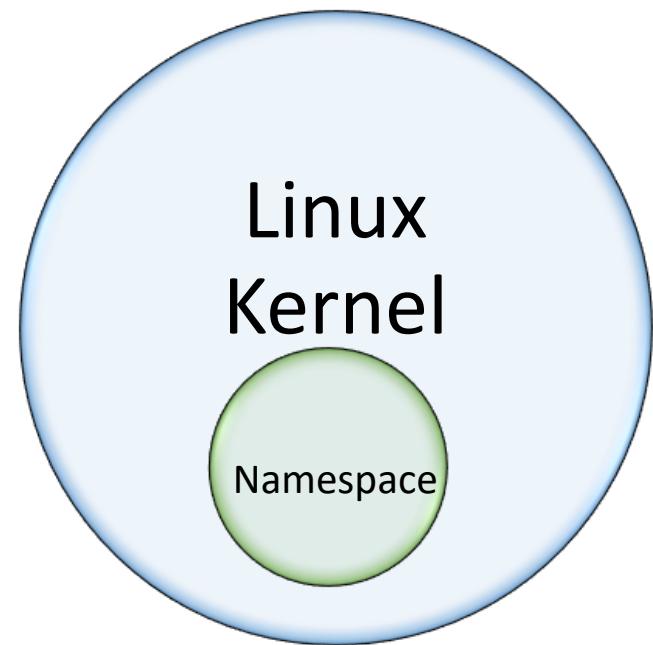
Jail
2000

**Process
Containers**
2006

NameSpaces
Present



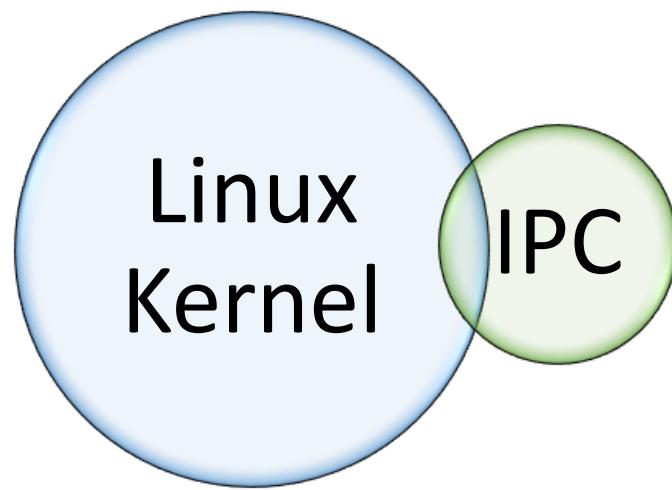
- Similar to a Type 2 Hypervisor
- Restricts the resource process has to on the host



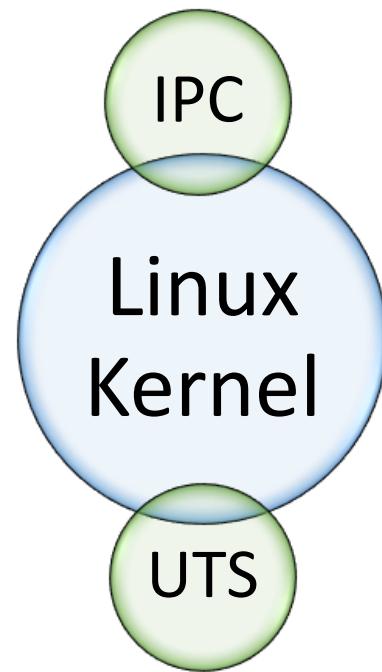
What is a Process?

- Set of instructions for computer to perform.
- Linux is multiprocessing.
- Namespaces allow for separation of processes from the global environment.

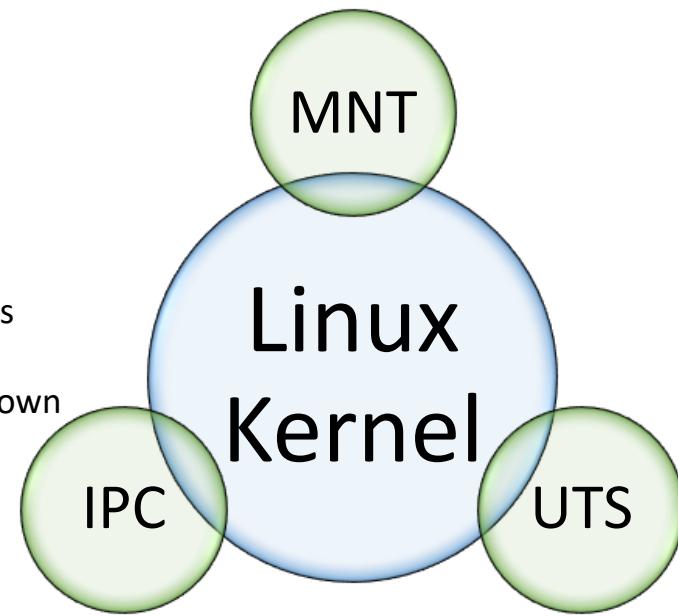
- Multi process data exchange
- Separate message queue for each namespace



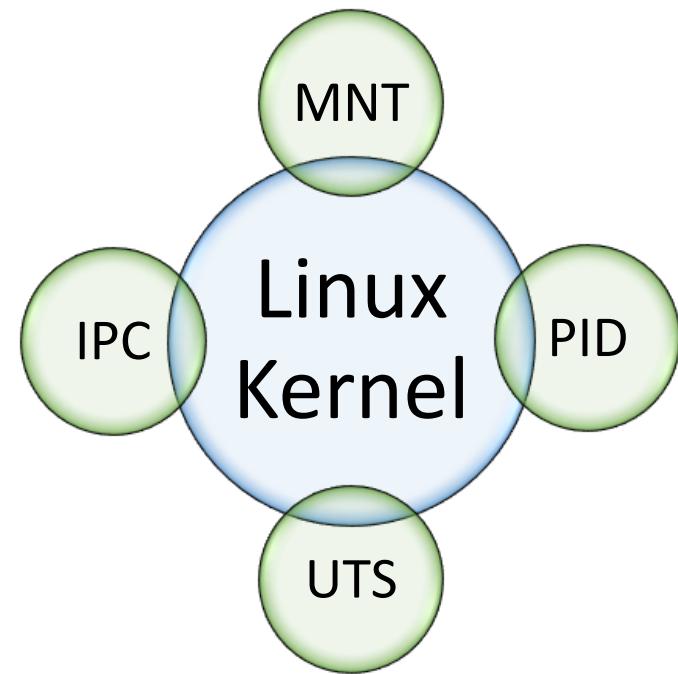
- Allowed for isolation of hostnames
- Hostnames could be unique identifiers.



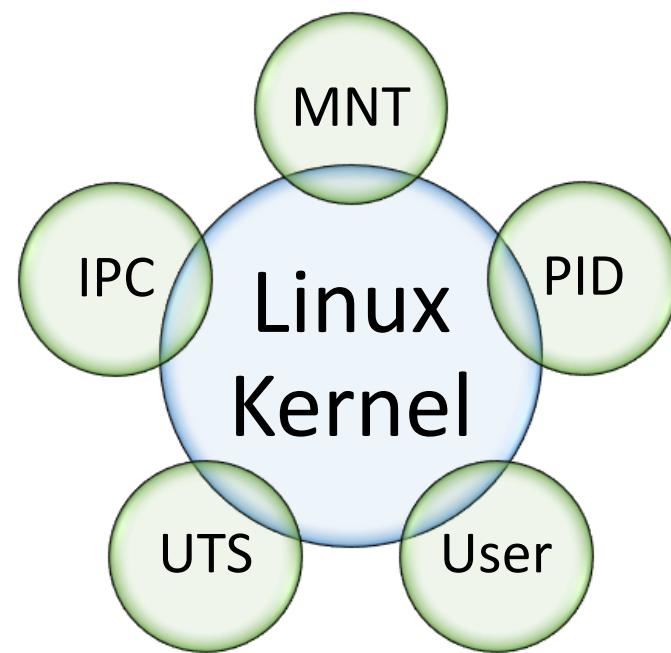
- Controls filesystem mount points
- Each Namespace could have its own root file system



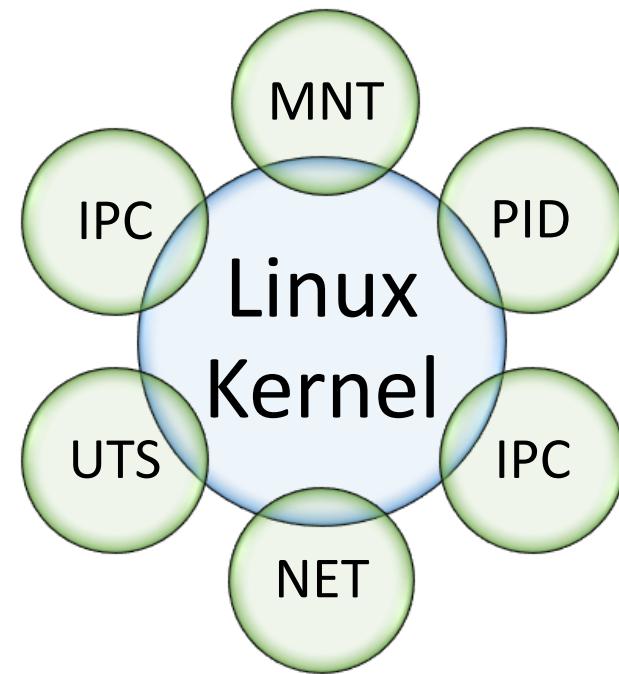
- Isolation of Process ID numbers
- Suspend and move possesses



- Allowed for Root access to container but not to host.



- Each container has a copy of its own network stack.
- Network Devices can belong to exactly 1 Network namespace.



trainer@rackspacetraining:~\$ █

```
trainer@rackspace-training:~$  
trainer@rackspace-training:~$ sudo iptables -L  
Chain INPUT (policy ACCEPT)  
target     prot opt source          destination  
f2b-sshd   tcp  --  anywhere        anywhere       multiport dports ssh  
  
Chain FORWARD (policy ACCEPT)  
target     prot opt source          destination  
  
Chain OUTPUT (policy ACCEPT)  
target     prot opt source          destination  
  
Chain f2b-sshd (1 references)  
target     prot opt source          destination  
RETURN    all  --  anywhere        anywhere
```

```
trainer@rackspace-training:~$ █
```

```
trainer@rackspacetraining:~$  
trainer@rackspacetraining:~$ sudo iptables -L  
Chain INPUT (policy ACCEPT)  
target     prot opt source          destination  
f2b-sshd   tcp  --  anywhere        anywhere          multiport dports ssh  
  
Chain FORWARD (policy ACCEPT)  
target     prot opt source          destination  
  
Chain OUTPUT (policy ACCEPT)  
target     prot opt source          destination  
  
Chain f2b-sshd (1 references)  
target     prot opt source          destination  
RETURN    all  --  anywhere        anywhere  
trainer@rackspacetraining:~$ sudo ip netns add sample && sudo ip netns list  
sample  
trainer@rackspacetraining:~$ █
```

```
trainer@rackspace:~$  
trainer@rackspace:~$ sudo iptables -L  
Chain INPUT (policy ACCEPT)  
target     prot opt source          destination  
f2b-sshd   tcp  --  anywhere        anywhere          multiport dports ssh  
  
Chain FORWARD (policy ACCEPT)  
target     prot opt source          destination  
  
Chain OUTPUT (policy ACCEPT)  
target     prot opt source          destination  
  
Chain f2b-sshd (1 references)  
target     prot opt source          destination  
RETURN    all  --  anywhere        anywhere  
trainer@rackspace:~$ sudo ip netns add sample && sudo ip netns list  
sample  
trainer@rackspace:~$ sudo ip netns exec sample bash  
root@rackspace:~#
```

```
trainer@rackspaceTraining:~$  
trainer@rackspaceTraining:~$ sudo iptables -L  
Chain INPUT (policy ACCEPT)  
target     prot opt source          destination  
f2b-sshd   tcp  --  anywhere        anywhere          multiport dports ssh  
  
Chain FORWARD (policy ACCEPT)  
target     prot opt source          destination  
  
Chain OUTPUT (policy ACCEPT)  
target     prot opt source          destination  
  
Chain f2b-sshd (1 references)  
target     prot opt source          destination  
RETURN    all  --  anywhere        anywhere  
trainer@rackspaceTraining:~$ sudo ip netns add sample && sudo ip netns list  
sample  
trainer@rackspaceTraining:~$ sudo ip netns exec sample bash  
root@rackspaceTraining:~# iptables -L  
Chain INPUT (policy ACCEPT)  
target     prot opt source          destination  
  
Chain FORWARD (policy ACCEPT)  
target     prot opt source          destination  
  
Chain OUTPUT (policy ACCEPT)  
target     prot opt source          destination  
root@rackspaceTraining:~#
```

```
trainer@rackspacetraining:~$  
trainer@rackspacetraining:~$ sudo iptables -L  
Chain INPUT (policy ACCEPT)  
target     prot opt source          destination  
f2b-sshd   tcp  --  anywhere        anywhere          multiport dports ssh  
  
Chain FORWARD (policy ACCEPT)  
target     prot opt source          destination  
  
Chain OUTPUT (policy ACCEPT)  
target     prot opt source          destination  
  
Chain f2b-sshd (1 references)  
target     prot opt source          destination  
RETURN    all  --  anywhere        anywhere  
trainer@rackspacetraining:~$ sudo ip netns add sample && sudo ip netns list  
sample  
trainer@rackspacetraining:~$ sudo ip netns exec sample bash  
root@rackspacetraining:~# iptables -L  
Chain INPUT (policy ACCEPT)  
target     prot opt source          destination  
  
Chain FORWARD (policy ACCEPT)  
target     prot opt source          destination  
  
Chain OUTPUT (policy ACCEPT)  
target     prot opt source          destination  
root@rackspacetraining:~# iptables -A INPUT -p tcp -m tcp --dport 80 -j ACCEPT  
root@rackspacetraining:~# iptables -A INPUT -p tcp -m tcp --dport 443 -j ACCEPT  
root@rackspacetraining:~# █
```

```
Chain f2b-sshd (1 references)
target    prot opt source          destination
RETURN    all  --  anywhere       anywhere
trainer@rackspace-training:~$ sudo ip netns add sample && sudo ip netns list
sample
trainer@rackspace-training:~$ sudo ip netns exec sample bash
root@rackspace-training:~# iptables -L
Chain INPUT (policy ACCEPT)
target    prot opt source          destination
Chain FORWARD (policy ACCEPT)
target    prot opt source          destination
Chain OUTPUT (policy ACCEPT)
target    prot opt source          destination
root@rackspace-training:~# iptables -A INPUT -p tcp -m tcp --dport 80 -j ACCEPT
root@rackspace-training:~# iptables -A INPUT -p tcp -m tcp --dport 443 -j ACCEPT
root@rackspace-training:~# iptables -L
Chain INPUT (policy ACCEPT)
target    prot opt source          destination
ACCEPT    tcp  --  anywhere       anywhere           tcp dpt:http
ACCEPT    tcp  --  anywhere       anywhere           tcp dpt:https
Chain FORWARD (policy ACCEPT)
target    prot opt source          destination
Chain OUTPUT (policy ACCEPT)
target    prot opt source          destination
root@rackspace-training:~# █
```

```
sample
trainer@rackspacetraining:~$ sudo ip netns exec sample bash
root@rackspacetraining:~# iptables -L
Chain INPUT (policy ACCEPT)
target     prot opt source          destination
Chain FORWARD (policy ACCEPT)
target     prot opt source          destination
Chain OUTPUT (policy ACCEPT)
target     prot opt source          destination
root@rackspacetraining:~# iptables -A INPUT -p tcp -m tcp --dport 80 -j ACCEPT
root@rackspacetraining:~# iptables -A INPUT -p tcp -m tcp --dport 443 -j ACCEPT
root@rackspacetraining:~# iptables -L
Chain INPUT (policy ACCEPT)
target     prot opt source          destination
ACCEPT    tcp   --  anywhere        anywhere         tcp dpt:http
ACCEPT    tcp   --  anywhere        anywhere         tcp dpt:https
Chain FORWARD (policy ACCEPT)
target     prot opt source          destination
Chain OUTPUT (policy ACCEPT)
target     prot opt source          destination
root@rackspacetraining:~# exit
exit
trainer@rackspacetraining:~$ iptables -L
iptables v1.6.0: can't initialize iptables table `filter': Permission denied (you must be root)
Perhaps iptables or your kernel needs to be upgraded.
trainer@rackspacetraining:~$
```

```
Chain INPUT (policy ACCEPT)
target     prot opt source               destination
ACCEPT    tcp  --  anywhere             anywhere            tcp dpt:http
ACCEPT    tcp  --  anywhere             anywhere            tcp dpt:https

Chain FORWARD (policy ACCEPT)
target     prot opt source               destination

Chain OUTPUT (policy ACCEPT)
target     prot opt source               destination
root@rackspacetraining:~# exit
exit
trainer@rackspacetraining:~$ iptables -L
iptables v1.6.0: can't initialize iptables table `filter': Permission denied (you must be root)
Perhaps iptables or your kernel needs to be upgraded.
trainer@rackspacetraining:~$ sudo iptables -L
Chain INPUT (policy ACCEPT)
target     prot opt source               destination
f2b-sshd  tcp  --  anywhere             anywhere            multiport dports ssh

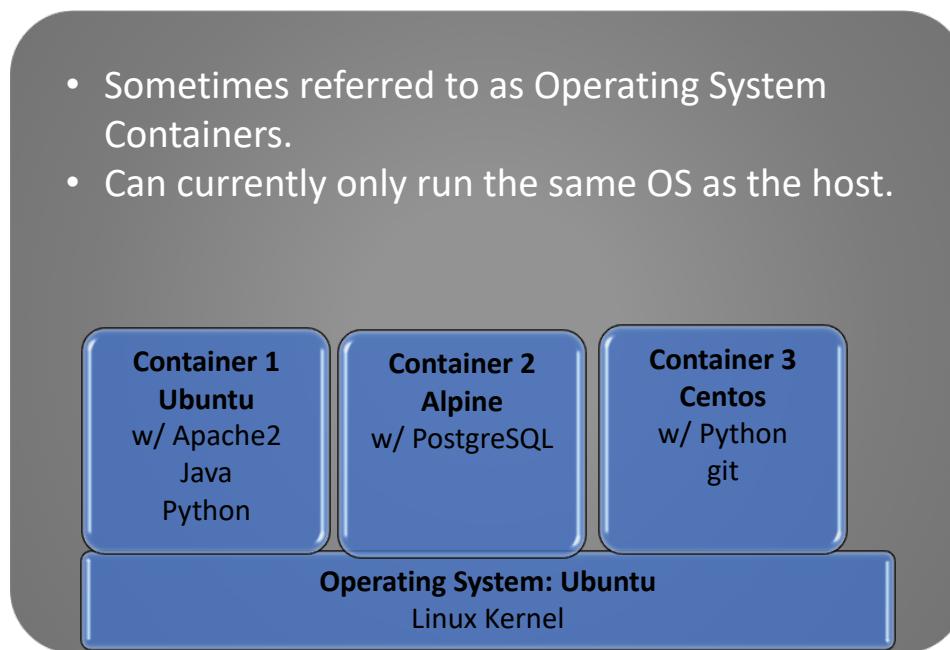
Chain FORWARD (policy ACCEPT)
target     prot opt source               destination

Chain OUTPUT (policy ACCEPT)
target     prot opt source               destination

Chain f2b-sshd (1 references)
target     prot opt source               destination
RETURN   all  --  anywhere             anywhere
trainer@rackspacetraining:~$
```

Machine Containers

- Sometimes referred to as Operating System Containers.
- Can currently only run the same OS as the host.



trainer@rackspace:~\$ █

```
trainer@rackspace:~$ sudo lxc list
+-----+-----+-----+-----+
| NAME | STATE | IPV4 | IPV6 | TYPE | SNAPSHOTS |
+-----+-----+-----+-----+
trainer@rackspace:~$ █
```

```
trainer@rackspace-training:~$ sudo lxc list
+-----+-----+-----+-----+
| NAME | STATE | IPV4 | IPV6 | TYPE | SNAPSHOTS |
+-----+-----+-----+-----+
trainer@rackspace-training:~$ sudo lxc launch ubuntu:16.04 ubuntu-container
Creating ubuntu-container
Starting ubuntu-container
trainer@rackspace-training:~$ █
```

```
trainer@rackspace-training:~$ sudo lxc list
+-----+-----+-----+-----+
| NAME | STATE | IPV4 | IPV6 | TYPE | SNAPSHOTS |
+-----+-----+-----+-----+
trainer@rackspace-training:~$ sudo lxc launch ubuntu:16.04 ubuntu-container
Creating ubuntu-container
Starting ubuntu-container
trainer@rackspace-training:~$ sudo lxc list
+-----+-----+-----+-----+-----+-----+
|      NAME      | STATE | IPV4 |          IPV6          | TYPE | SNAPSHOTS |
+-----+-----+-----+-----+-----+-----+
| ubuntu-container | RUNNING |      | fdf2:82e5:d36b:f591:216:3eff:fe3e:a154 (eth0) | PERSISTENT | 0      |
+-----+-----+-----+-----+-----+-----+
trainer@rackspace-training:~$ █
```

```
trainer@rackspace-training:~$ sudo lxc list
+-----+-----+-----+-----+
| NAME | STATE | IPV4 | IPV6 | TYPE | SNAPSHOTS |
+-----+-----+-----+-----+
trainer@rackspace-training:~$ sudo lxc launch ubuntu:16.04 ubuntu-container
Creating ubuntu-container
Starting ubuntu-container
trainer@rackspace-training:~$ sudo lxc list
+-----+-----+-----+-----+-----+-----+
|      NAME      | STATE | IPV4 |          IPV6          | TYPE | SNAPSHOTS |
+-----+-----+-----+-----+-----+-----+
| ubuntu-container | RUNNING |      | fdf2:82e5:d36b:f591:216:3eff:feec:b066 (eth0) | PERSISTENT | 0      |
+-----+-----+-----+-----+-----+-----+
trainer@rackspace-training:~$ cat /etc/issue
Ubuntu 16.04.3 LTS \n \l

trainer@rackspace-training:~$
```

```
trainer@rackspace-training:~$ sudo lxc list
+-----+-----+-----+-----+
| NAME | STATE | IPV4 | IPV6 | TYPE | SNAPSHOTS |
+-----+-----+-----+-----+
trainer@rackspace-training:~$ sudo lxc launch ubuntu:16.04 ubuntu-container
Creating ubuntu-container
Starting ubuntu-container
trainer@rackspace-training:~$ sudo lxc list
+-----+-----+-----+-----+-----+-----+
|      NAME      | STATE | IPV4 |          IPV6          | TYPE | SNAPSHOTS |
+-----+-----+-----+-----+-----+-----+
| ubuntu-container | RUNNING |      | fdf2:82e5:d36b:f591:216:3eff:feec:b066 (eth0) | PERSISTENT | 0      |
+-----+-----+-----+-----+-----+-----+
trainer@rackspace-training:~$ cat /etc/issue
Ubuntu 16.04.3 LTS \n \l

trainer@rackspace-training:~$ sudo lxc launch images:alpine/3.5 alpine-container
Creating alpine-container
Starting alpine-container
trainer@rackspace-training:~$ 
```

```
Creating ubuntu-container
```

```
Starting ubuntu-container
```

```
trainer@rackspace-training:~$ sudo lxc list
```

| NAME | STATE | IPV4 | IPV6 | TYPE | SNAPSHOTS |
|------------------|---------|------|---|------------|-----------|
| ubuntu-container | RUNNING | | fdf2:82e5:d36b:f591:216:3eff:feec:b066 (eth0) | PERSISTENT | 0 |

```
trainer@rackspace-training:~$ cat /etc/issue
```

```
Ubuntu 16.04.3 LTS \n \l
```

```
trainer@rackspace-training:~$ sudo lxc launch images:alpine/3.5 alpine-container
```

```
Creating alpine-container
```

```
Starting alpine-container
```

```
trainer@rackspace-training:~$ sudo lxc list
```

| NAME | STATE | IPV4 | IPV6 | TYPE | SNAPS |
|------------------|---------|------|---|------------|-------|
| alpine-container | RUNNING | | fdf2:82e5:d36b:f591:216:3eff:feb6:3bf2 (eth0) | PERSISTENT | 0 |
| ubuntu-container | RUNNING | | fdf2:82e5:d36b:f591:216:3eff:feec:b066 (eth0) | PERSISTENT | 0 |

```
trainer@rackspace-training:~$ █
```

```
Starting ubuntu-container
```

```
trainer@rackspace-training:~$ sudo lxc list
```

| | NAME | STATE | IPV4 | IPV6 | TYPE | SNAPSHOTS |
|--|------------------|---------|------|---|------------|-----------|
| | ubuntu-container | RUNNING | | fdf2:82e5:d36b:f591:216:3eff:feec:b066 (eth0) | PERSISTENT | 0 |

```
trainer@rackspace-training:~$ cat /etc/issue
```

```
Ubuntu 16.04.3 LTS \n \l
```

```
trainer@rackspace-training:~$ sudo lxc launch images:alpine/3.5 alpine-container
```

```
Creating alpine-container
```

```
Starting alpine-container
```

```
trainer@rackspace-training:~$ sudo lxc list
```

| | NAME | STATE | IPV4 | IPV6 | TYPE | SNAPS |
|--|------------------|---------|------|---|------------|-------|
| | HOTS | | | | | |
| | alpine-container | RUNNING | | fdf2:82e5:d36b:f591:216:3eff:feb6:3bf2 (eth0) | PERSISTENT | 0 |
| | ubuntu-container | RUNNING | | fdf2:82e5:d36b:f591:216:3eff:feec:b066 (eth0) | PERSISTENT | 0 |

```
trainer@rackspace-training:~$ sudo lxc exec alpine-container -- ash
```

```
~ #
```

| NAME | STATE | IPV4 | IPV6 | TYPE | SNAPSHOTS |
|------------------|---------|------|---|------------|-----------|
| ubuntu-container | RUNNING | | fdf2:82e5:d36b:f591:216:3eff:feec:b066 (eth0) | PERSISTENT | 0 |

```
trainer@rackspace-training:~$ cat /etc/issue
Ubuntu 16.04.3 LTS \n \l
```

```
trainer@rackspace-training:~$ sudo lxc launch images:alpine/3.5 alpine-container
```

```
Creating alpine-container
Starting alpine-container
```

```
trainer@rackspace-training:~$ sudo lxc list
```

| NAME | STATE | IPV4 | IPV6 | TYPE | SNAPS |
|------------------|---------|------|---|------------|-------|
| HOTS | | | | | |
| alpine-container | RUNNING | | fdf2:82e5:d36b:f591:216:3eff:feb6:3bf2 (eth0) | PERSISTENT | 0 |
| ubuntu-container | RUNNING | | fdf2:82e5:d36b:f591:216:3eff:feec:b066 (eth0) | PERSISTENT | 0 |

```
trainer@rackspace-training:~$ sudo lxc exec alpine-container -- ash
```

```
~ # whoami
root
~ #
```

```
| ubuntu-container | RUNNING |      | fdf2:82e5:d36b:f591:216:3eff:feec:b066 (eth0) | PERSISTENT | 0      |
+-----+-----+-----+-----+-----+-----+
trainer@rackspace-training:~$ cat /etc/issue
Ubuntu 16.04.3 LTS \n \l

trainer@rackspace-training:~$ sudo lxc launch images:alpine/3.5 alpine-container
Creating alpine-container
Starting alpine-container
trainer@rackspace-training:~$ sudo lxc list
+-----+-----+-----+-----+-----+-----+
|       NAME      | STATE   | IPV4           |          IPV6           |      TYPE      | SNAPS
HOTS  |
+-----+-----+-----+-----+-----+-----+
| alpine-container | RUNNING | 10.49.185.39 (eth0) | fdf2:82e5:d36b:f591:216:3eff:feb6:3bf2 (eth0) | PERSISTENT | 0
|
+-----+-----+-----+-----+-----+-----+
| ubuntu-container | RUNNING |          | fdf2:82e5:d36b:f591:216:3eff:feec:b066 (eth0) | PERSISTENT | 0
|
+-----+-----+-----+-----+-----+-----+
|       |
trainer@rackspace-training:~$ sudo lxc exec alpine-container -- ash
~ # whoami
root
~ # cat /etc/issue
Welcome to Alpine Linux 3.5
Kernel \r on an \m (\l)

~ #
```

Application Containers

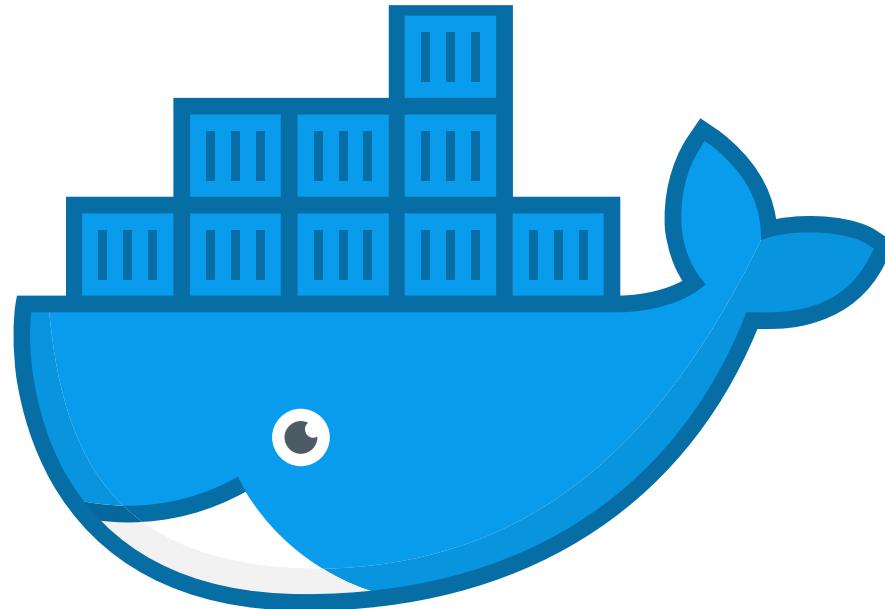
- Process container
- Allows for provisioning of stand alone environment for application or single process.

Container 1
Java

Container2
Apache2

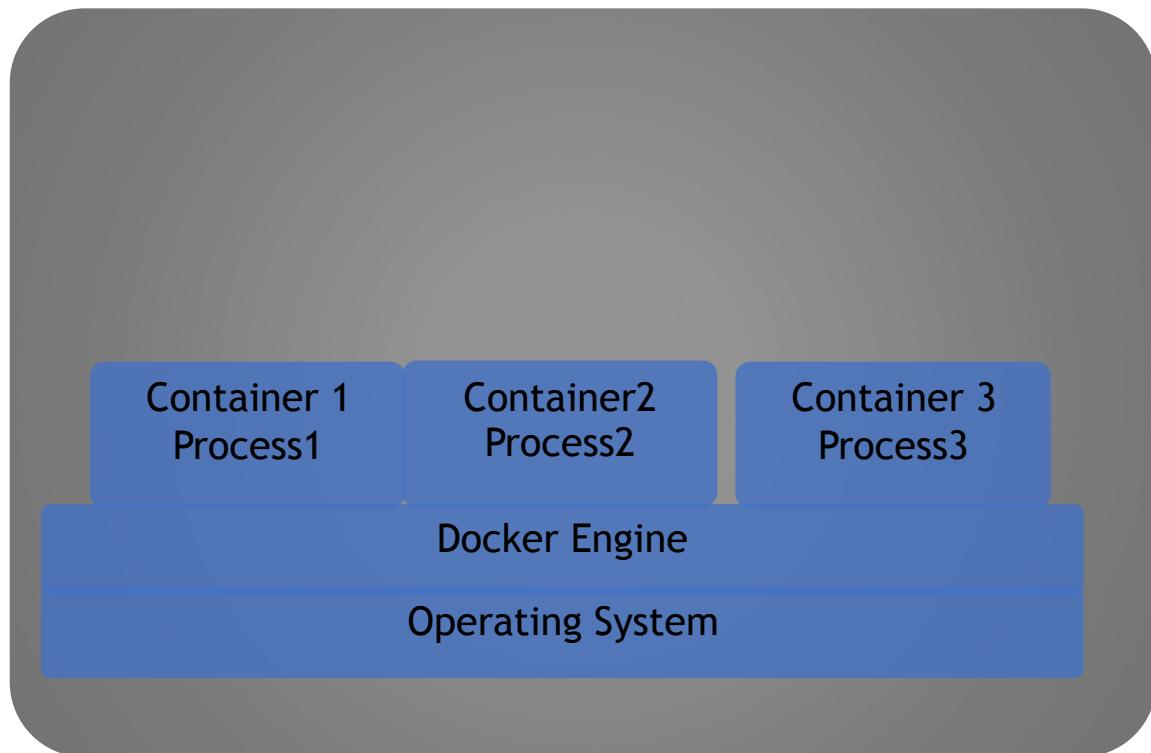
Container 3
MySQL

Operating System

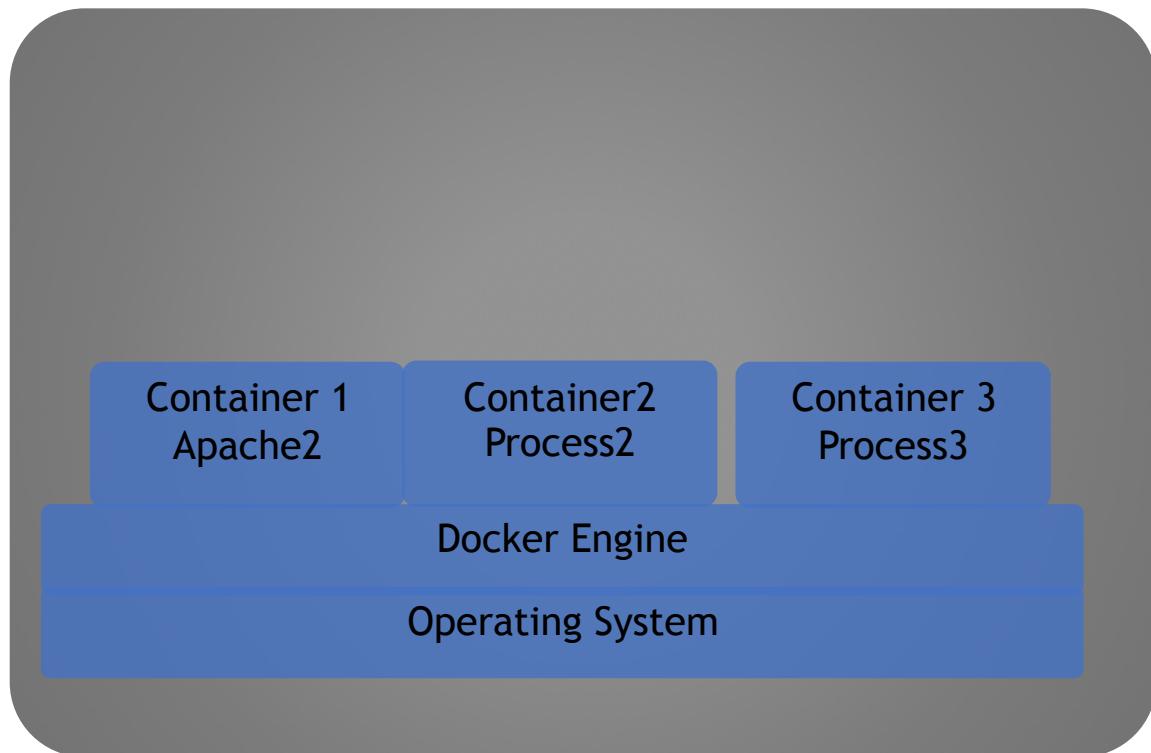


docker

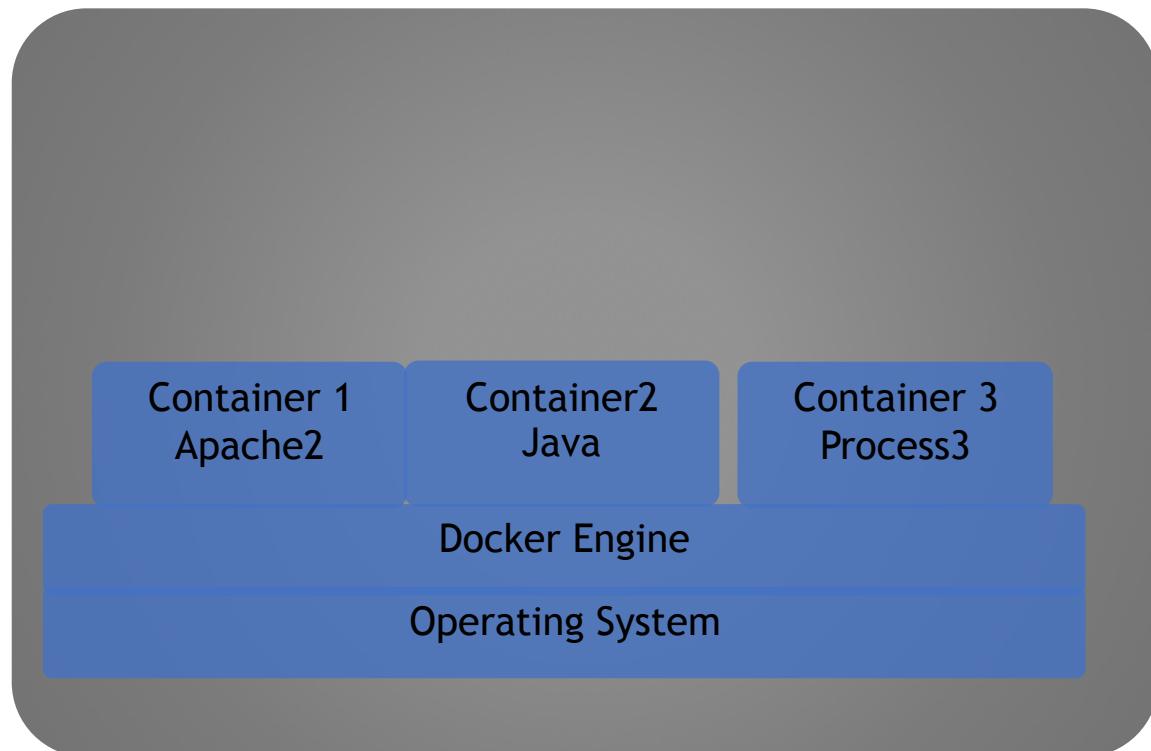
Application Containers



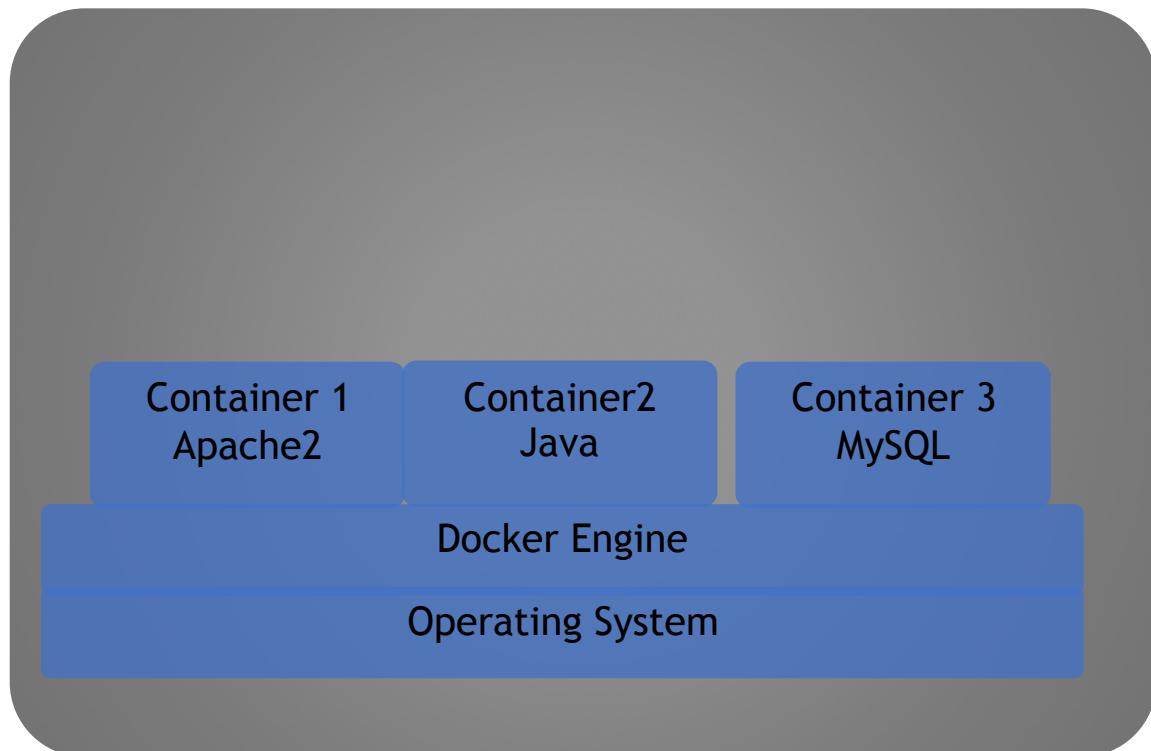
Application Containers



Application Containers



Application Containers



Machine Container

Httpd
MySQL
PHP

Nginx
PostgreSQL

Git
Python

Container 1
Ubuntu

Container 2
Centos

Container 3
Alpine

Operating System :Ubuntu
Linux Kernel

Application Container

Container
1
PHP

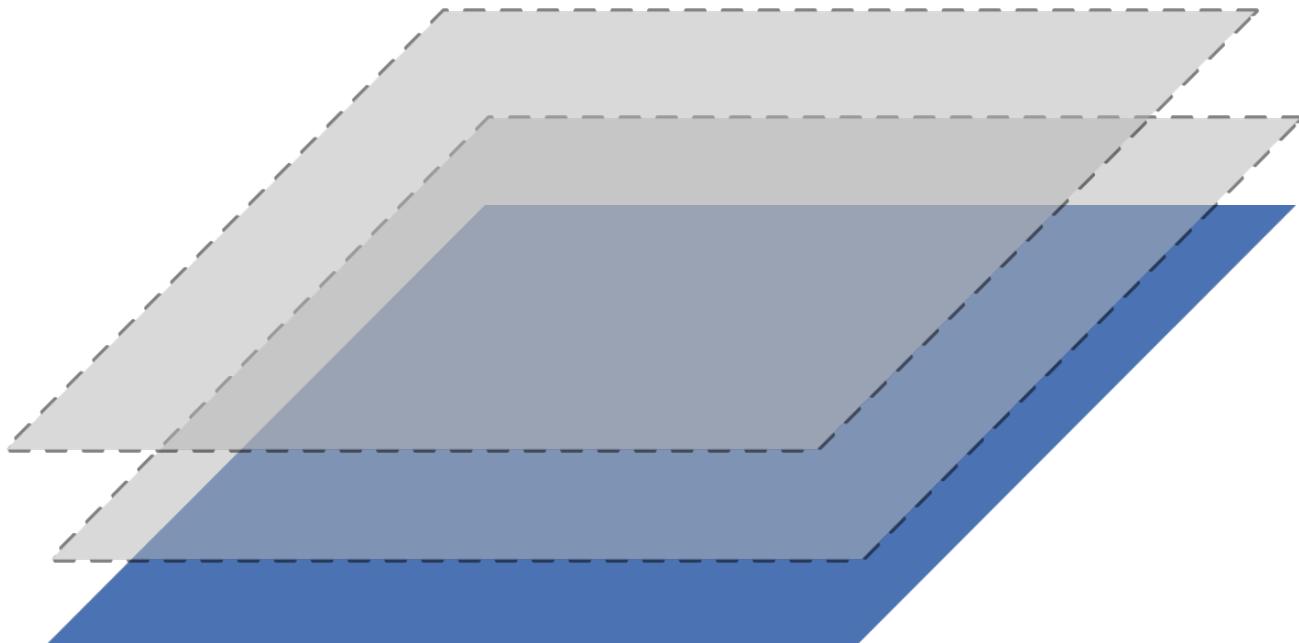
Container2
Apache2

Container
3
MySQL

Docker Engine

Operating System

Docker Image

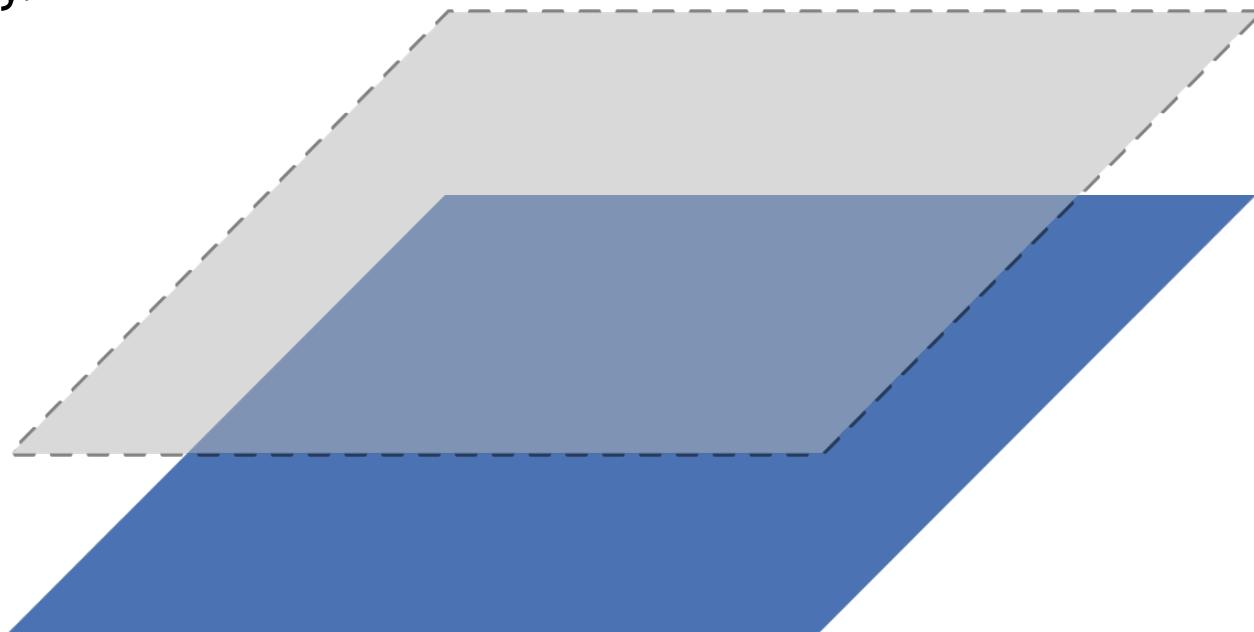


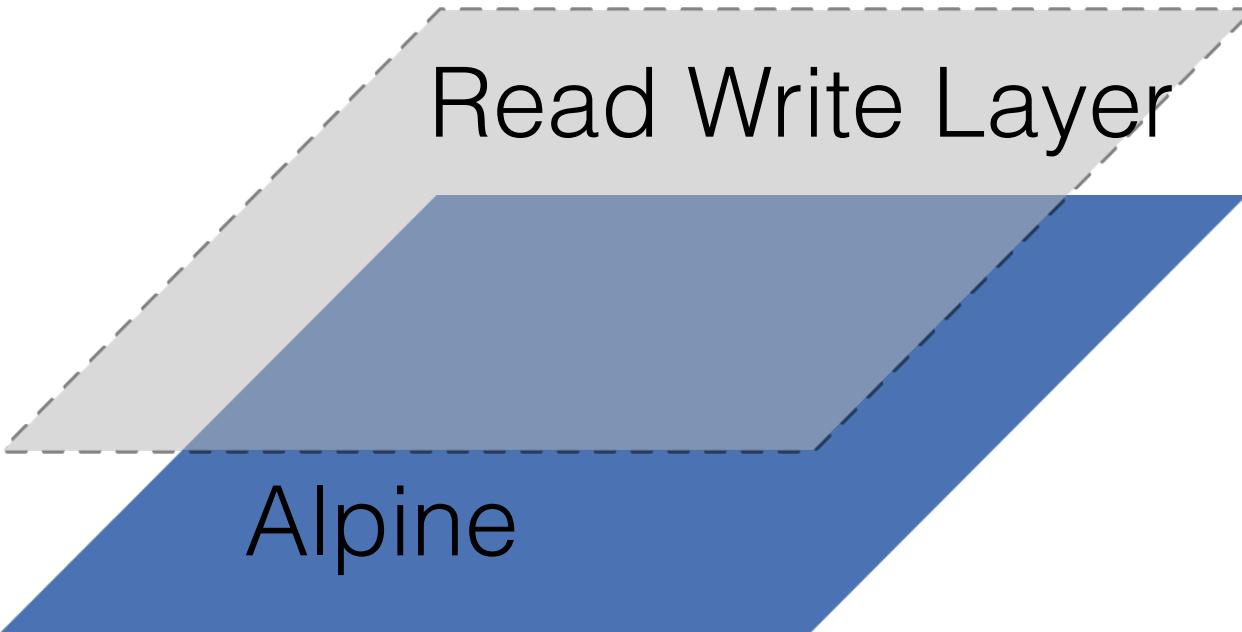
Base Image



Read Write Layer

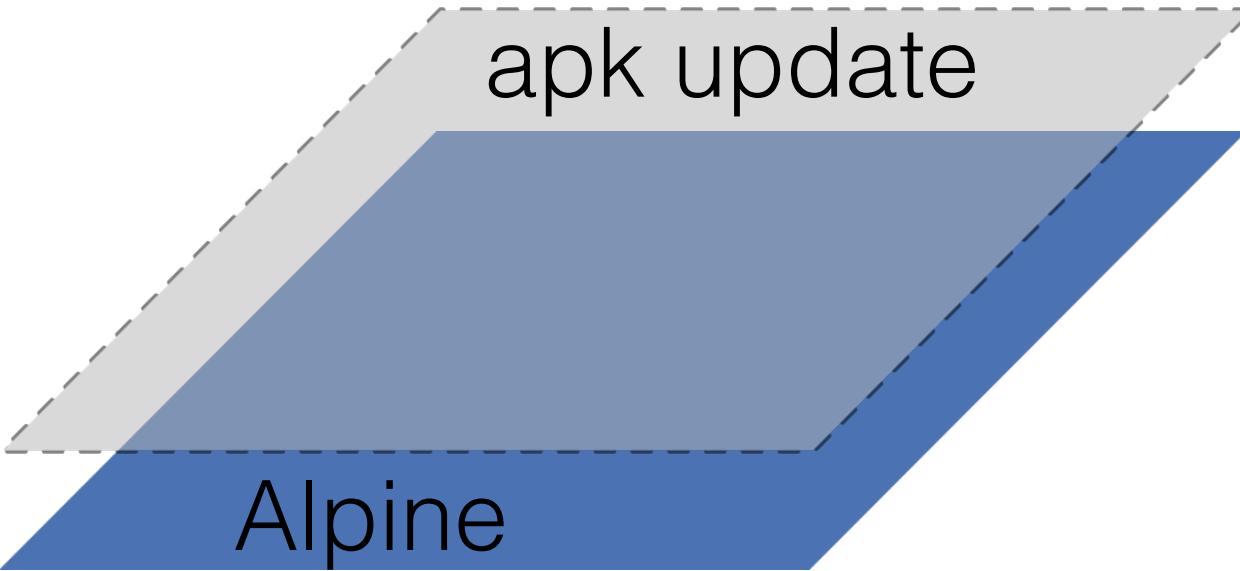
- Makes use of Copy on Write strategy.





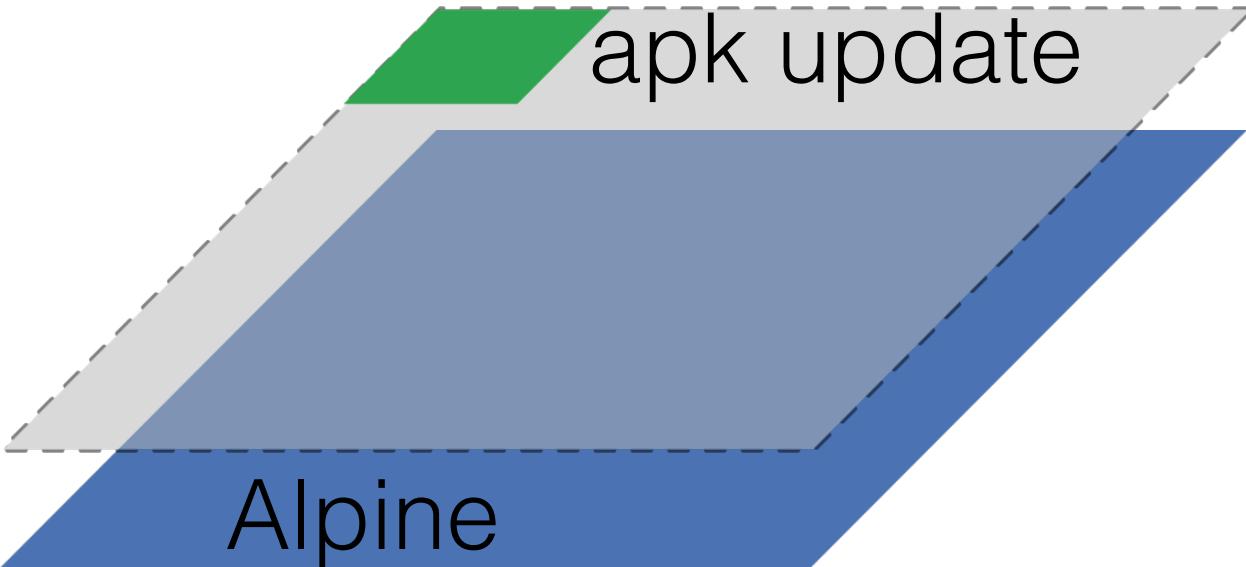
Read Write Layer

Alpine



apk update

Alpine



apk update

Alpine

The Docker Store

Find Trusted and Enterprise Ready Containers, Plugins, and Docker Editions

  Search for great content (e.g. mysql) Docker EE Docker CE Containers Plugins

GET DOCKER

Get started with Docker

Docker is the world's leading software container platform available for



Docker File

```
From alpine:latest  
Run apk update  
Run apk add htop
```

```
trainer@rackspace:~$ sudo docker build .
Sending build context to Docker daemon 22.02 kB
Step 1/3 : FROM alpine:latest
latest: Pulling from library/alpine
ff3a5c916c92: Pull complete
Digest: sha256:7df6db5aa61ae9480f52f0b3a06a140ab98d427f86d8d5de0bedab9b8df6b1c0
Status: Downloaded newer image for alpine:latest
--> 3fd9065eaf02
Step 2/3 : RUN apk update
--> Running in 1eca023ad8b5
fetch http://dl-cdn.alpinelinux.org/alpine/v3.7/main/x86_64/APKINDEX.tar.gz
fetch http://dl-cdn.alpinelinux.org/alpine/v3.7/community/x86_64/APKINDEX.tar.gz
v3.7.0-63-g2bfbc724f [http://dl-cdn.alpinelinux.org/alpine/v3.7/main]
v3.7.0-66-g3a4ccadc0d [http://dl-cdn.alpinelinux.org/alpine/v3.7/community]
OK: 9045 distinct packages available
--> 66dbbe8efa76
Removing intermediate container 1eca023ad8b5
Step 3/3 : RUN apk add htop
--> Running in 68e8164e970e
(1/4) Installing ncurses-terminfo-base (6.0_p20171125-r0)
(2/4) Installing ncurses-terminfo (6.0_p20171125-r0)
(3/4) Installing ncurses-libs (6.0_p20171125-r0)
(4/4) Installing htop (2.0.2-r0)
Executing busybox-1.27.2-r7.trigger
OK: 12 MiB in 15 packages
--> d91489a54832
Removing intermediate container 68e8164e970e
Successfully built d91489a54832
trainer@rackspace:~$ █
```

```
trainer@rackspace:~$ sudo docker build .
Sending build context to Docker daemon 22.02 kB
Step 1/3 : FROM alpine:latest
latest: Pulling from library/alpine
ff3a5c916c92: Pull complete
Digest: sha256:7df6db5aa61ae9480f52f0b3a06a140ab98d427f86d8d5de0bedab9b8df6b1c0
Status: Downloaded newer image for alpine:latest
    --> 3fd9065eaf02
Step 2/3 : RUN apk update
    --> Running in 1eca023ad8b5
fetch http://dl-cdn.alpinelinux.org/alpine/v3.7/main/x86_64/APKINDEX.tar.gz
fetch http://dl-cdn.alpinelinux.org/alpine/v3.7/community/x86_64/APKINDEX.tar.gz
v3.7.0-63-g2bfbc724f [http://dl-cdn.alpinelinux.org/alpine/v3.7/main]
v3.7.0-66-g3a4ccadc0d [http://dl-cdn.alpinelinux.org/alpine/v3.7/community]
OK: 9045 distinct packages available
    --> 66dbbe8efa76
Removing intermediate container 1eca023ad8b5
Step 3/3 : RUN apk add htop
    --> Running in 68e8164e970e
(1/4) Installing ncurses-terminfo-base (6.0_p20171125-r0)
(2/4) Installing ncurses-terminfo (6.0_p20171125-r0)
(3/4) Installing ncurses-libs (6.0_p20171125-r0)
(4/4) Installing htop (2.0.2-r0)
Executing busybox-1.27.2-r7.trigger
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    --> d91489a54832
Removing intermediate container 68e8164e970e
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trainer@rackspace:~$
```

```
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Sending build context to Docker daemon 22.02 kB
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latest: Pulling from library/alpine
ff3a5c916c92: Pull complete
Digest: sha256:7df6db5aa61ae9480f52f0b3a06a140ab98d427f86d8d5de0bedab9b8df6b1c0
Status: Downloaded newer image for alpine:latest
--> 3fd9065eaf02
Step 2/3 : RUN apk update
--> Running in 1eca023ad8b5
fetch http://dl-cdn.alpinelinux.org/alpine/v3.7/main/x86_64/APKINDEX.tar.gz
fetch http://dl-cdn.alpinelinux.org/alpine/v3.7/community/x86_64/APKINDEX.tar.gz
v3.7.0-63-g2bfbc724f [http://dl-cdn.alpinelinux.org/alpine/v3.7/main]
v3.7.0-66-g3a4ccadc0d [http://dl-cdn.alpinelinux.org/alpine/v3.7/community]
OK: 9045 distinct packages available
--> 66dbbe8efa76
Removing intermediate container 1eca023ad8b5
Step 3/3 : RUN apk add htop
--> Running in 68e8164e970e
(1/4) Installing ncurses-terminfo-base (6.0_p20171125-r0)
(2/4) Installing ncurses-terminfo (6.0_p20171125-r0)
(3/4) Installing ncurses-libs (6.0_p20171125-r0)
(4/4) Installing htop (2.0.2-r0)
Executing busybox-1.27.2-r7.trigger
OK: 12 MiB in 15 packages
--> d91489a54832
Removing intermediate container 68e8164e970e
Successfully built d91489a54832
trainer@rackspace:~$
```

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Sending build context to Docker daemon 22.02 kB
Step 1/3 : FROM alpine:latest
latest: Pulling from library/alpine
ff3a5c916c92: Pull complete
Digest: sha256:7df6db5aa61ae9480f52f0b3a06a140ab98d427f86d8d5de0bedab9b8df6b1c0
Status: Downloaded newer image for alpine:latest
--> 3fd9065eaf02
Step 2/3 : RUN apk update
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fetch http://dl-cdn.alpinelinux.org/alpine/v3.7/community/x86_64/APKINDEX.tar.gz
v3.7.0-63-g2bfbc724f [http://dl-cdn.alpinelinux.org/alpine/v3.7/main]
v3.7.0-66-g3a4ccadc0d [http://dl-cdn.alpinelinux.org/alpine/v3.7/community]
OK: 9045 distinct packages available
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Removing intermediate container 1eca023ad8b5
Step 3/3 : RUN apk add htop
--> Running in 68e8164e970e
(1/4) Installing ncurses-terminfo-base (6.0_p20171125-r0)
(2/4) Installing ncurses-terminfo (6.0_p20171125-r0)
(3/4) Installing ncurses-libs (6.0_p20171125-r0)
(4/4) Installing htop (2.0.2-r0)
Executing busybox-1.27.2-r7.trigger
OK: 12 MiB in 15 packages
--> d91489a54832
Removing intermediate container 68e8164e970e
Successfully built d91489a54832
trainer@rackspace:~$ █
```

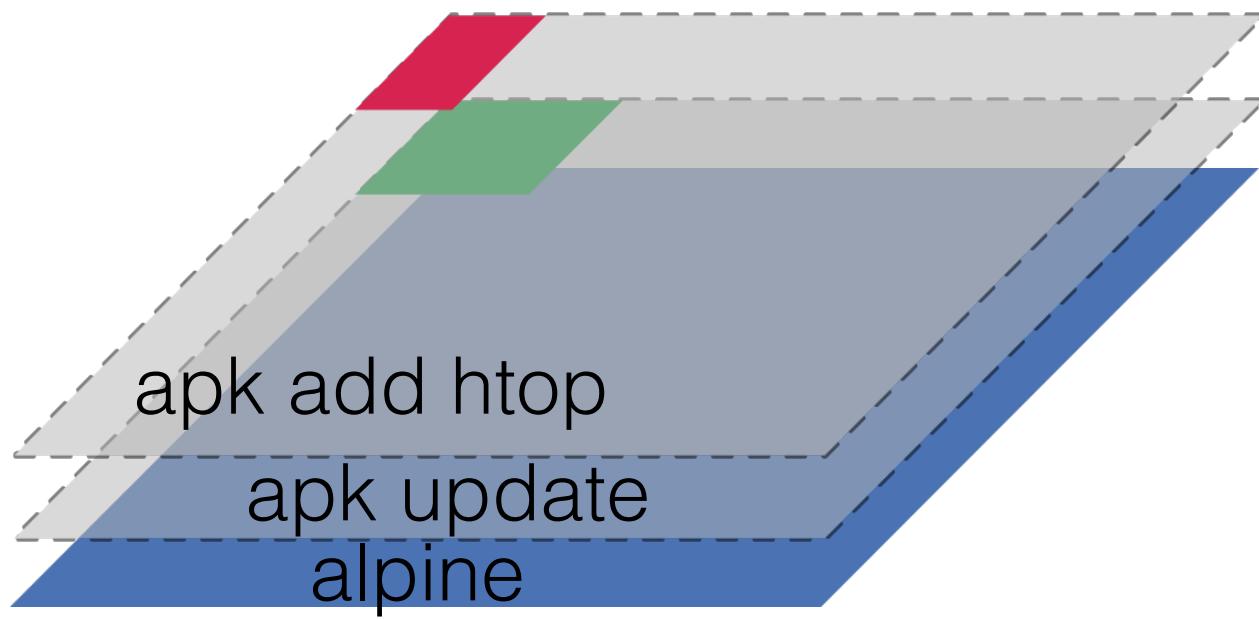
```
trainer@rackspace:~$ sudo docker build .
Sending build context to Docker daemon 22.02 kB
Step 1/3 : FROM alpine:latest
latest: Pulling from library/alpine
ff3a5c916c92: Pull complete
Digest: sha256:7df6db5aa61ae9480f52f0b3a06a140ab98d427f86d8d5de0bedab9b8df6b1c0
Status: Downloaded newer image for alpine:latest
    --> 3fd9065eaf02
Step 2/3 : RUN apk update
    --> Running in 1eca023ad8b5
fetch http://dl-cdn.alpinelinux.org/alpine/v3.7/main/x86_64/APKINDEX.tar.gz
fetch http://dl-cdn.alpinelinux.org/alpine/v3.7/community/x86_64/APKINDEX.tar.gz
v3.7.0-63-g2bfbc724f [http://dl-cdn.alpinelinux.org/alpine/v3.7/main]
v3.7.0-66-g3a4ccadc0d [http://dl-cdn.alpinelinux.org/alpine/v3.7/community]
OK: 9045 distinct packages available
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(3/4) Installing ncurses-libs (6.0_p20171125-r0)
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OK: 12 MiB in 15 packages
    --> d91489a54832
Removing intermediate container 68e8164e970e
Successfully built d91489a54832
trainer@rackspace:~$
```

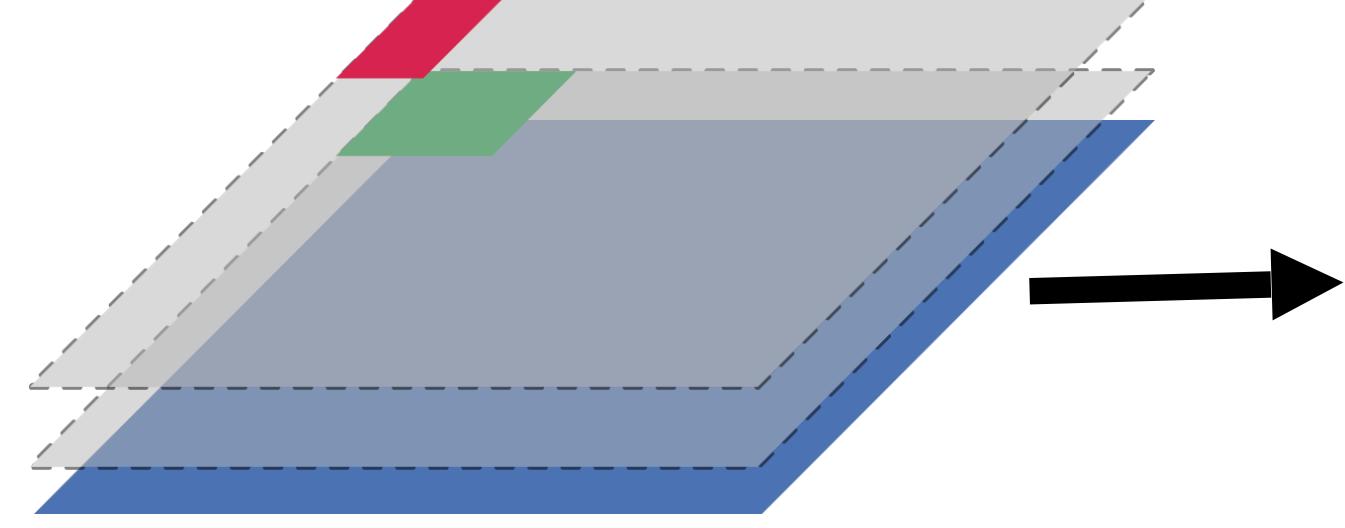
```
trainer@rackspace:~$ sudo docker build .
Sending build context to Docker daemon 22.02 kB
Step 1/3 : FROM alpine:latest
latest: Pulling from library/alpine
ff3a5c916c92: Pull complete
Digest: sha256:7df6db5aa61ae9480f52f0b3a06a140ab98d427f86d8d5de0bedab9b8df6b1c0
Status: Downloaded newer image for alpine:latest
--> 3fd9065eaf02
Step 2/3 : RUN apk update
--> Running in 1eca023ad8b5
fetch http://dl-cdn.alpinelinux.org/alpine/v3.7/main/x86_64/APKINDEX.tar.gz
fetch http://dl-cdn.alpinelinux.org/alpine/v3.7/community/x86_64/APKINDEX.tar.gz
v3.7.0-63-g2bfbc724f [http://dl-cdn.alpinelinux.org/alpine/v3.7/main]
v3.7.0-66-g3a4ccadc0d [http://dl-cdn.alpinelinux.org/alpine/v3.7/community]
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trainer@rackspace:~$ █
```

```
trainer@rackspace:~$ sudo docker build .
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Step 1/3 : FROM alpine:latest
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Status: Downloaded newer image for alpine:latest
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fetch http://dl-cdn.alpinelinux.org/alpine/v3.7/main/x86_64/APKINDEX.tar.gz
fetch http://dl-cdn.alpinelinux.org/alpine/v3.7/community/x86_64/APKINDEX.tar.gz
v3.7.0-63-g2bfbc724f [http://dl-cdn.alpinelinux.org/alpine/v3.7/main]
v3.7.0-66-g3a4ccadc0d [http://dl-cdn.alpinelinux.org/alpine/v3.7/community]
OK: 9045 distinct packages available
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Executing busybox-1.27.2-r7.trigger
OK: 12 MiB in 15 packages
    --> d91489a54832
Removing intermediate container 68e8164e970e
Successfully built d91489a54832
trainer@rackspace:~$
```

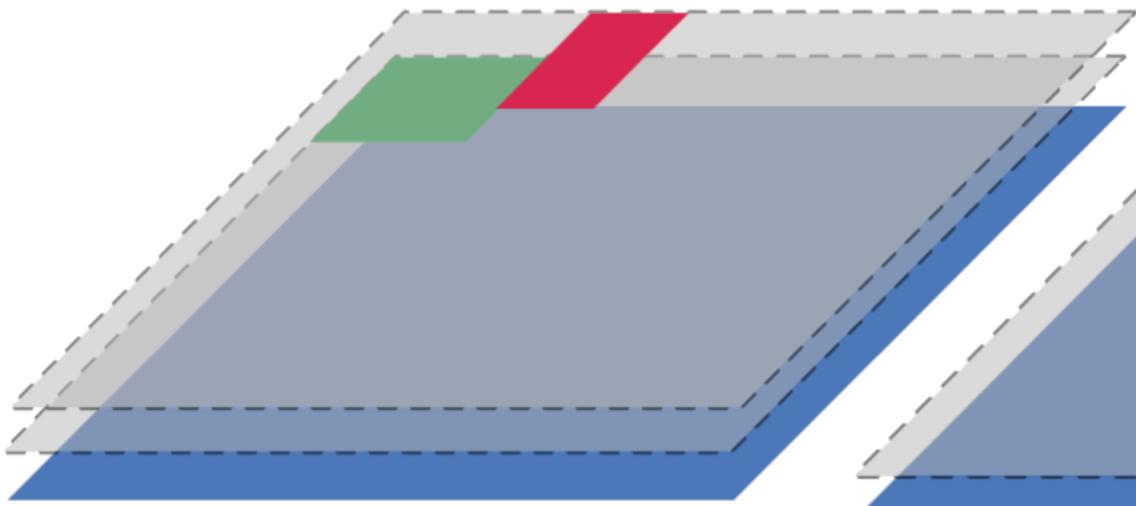
```
trainer@rackspace:~$ sudo docker build .
Sending build context to Docker daemon 22.02 kB
Step 1/3 : FROM alpine:latest
latest: Pulling from library/alpine
ff3a5c916c92: Pull complete
Digest: sha256:7df6db5aa61ae9480f52f0b3a06a140ab98d427f86d8d5de0bedab9b8df6b1c0
Status: Downloaded newer image for alpine:latest
    --> 3fd9065eaf02
Step 2/3 : RUN apk update
    --> Running in 1eca023ad8b5
fetch http://dl-cdn.alpinelinux.org/alpine/v3.7/main/x86_64/APKINDEX.tar.gz
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v3.7.0-63-g2bfbc724f [http://dl-cdn.alpinelinux.org/alpine/v3.7/main]
v3.7.0-66-g3a4ccadc0d [http://dl-cdn.alpinelinux.org/alpine/v3.7/community]
OK: 9045 distinct packages available
    --> 66dbbe8efa76
Removing intermediate container 1eca023ad8b5
Step 3/3 : RUN apk add htop
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(2/4) Installing ncurses-terminfo (6.0_p20171125-r0)
(3/4) Installing ncurses-libs (6.0_p20171125-r0)
(4/4) Installing htop (2.0.2-r0)
Executing busybox-1.27.2-r7.trigger
OK: 12 MiB in 15 packages
    --> d91489a54832
Removing intermediate container 68e8164e970e
Successfully built d91489a54832
trainer@rackspace:~$
```

```
latest: Pulling from library/alpine
ff3a5c916c92: Pull complete
Digest: sha256:7df6db5aa61ae9480f52f0b3a06a140ab98d427f86d8d5de0bedab9b8df6b1c0
Status: Downloaded newer image for alpine:latest
--> 3fd9065eaf02
Step 2/3 : RUN apk update
--> Running in 1eca023ad8b5
fetch http://dl-cdn.alpinelinux.org/alpine/v3.7/main/x86_64/APKINDEX.tar.gz
fetch http://dl-cdn.alpinelinux.org/alpine/v3.7/community/x86_64/APKINDEX.tar.gz
v3.7.0-63-g2bfbc724f [http://dl-cdn.alpinelinux.org/alpine/v3.7/main]
v3.7.0-66-g3a4ccadc0d [http://dl-cdn.alpinelinux.org/alpine/v3.7/community]
OK: 9045 distinct packages available
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Removing intermediate container 1eca023ad8b5
Step 3/3 : RUN apk add htop
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(2/4) Installing ncurses-terminfo (6.0_p20171125-r0)
(3/4) Installing ncurses-libs (6.0_p20171125-r0)
(4/4) Installing htop (2.0.2-r0)
Executing busybox-1.27.2-r7.trigger
OK: 12 MiB in 15 packages
--> d91489a54832
Removing intermediate container 68e8164e970e
Successfully built d91489a54832
trainer@rackspace-training:~$ sudo docker images
REPOSITORY          TAG           IMAGE ID        CREATED         SIZE
<none>              <none>        d91489a54832   18 minutes ago  8.09 MB
alpine               latest        3fd9065eaf02    4 weeks ago    4.15 MB
trainer@rackspace-training:~$ █
```

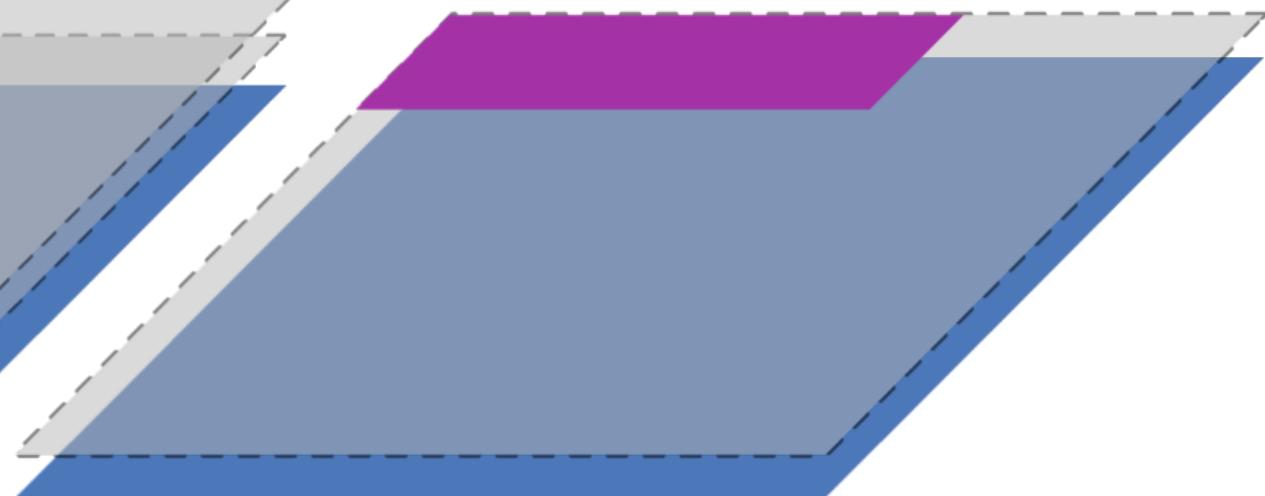




**Run apk update
Run apk add htop**



**Run apk update && apk add htop &&
apk add bash**



```
trainer@rackspacetraining:~$ sudo docker images
REPOSITORY      TAG          IMAGE ID      CREATED       SIZE
alpine          bash         24565039698a  4 days ago   9.66 MB
<none>          <none>       d91489a54832  4 days ago   8.09 MB
alpine          latest        3fd9065eaf02  4 weeks ago  4.15 MB
trainer@rackspacetraining:~$
```

```
trainer@rackspace:~$ sudo docker images
REPOSITORY      TAG          IMAGE ID      CREATED       SIZE
alpine          bash         24565039698a  4 days ago   9.66 MB
<none>          <none>       d91489a54832  4 days ago   8.09 MB
alpine          latest        3fd9065eaf02  4 weeks ago  4.15 MB
trainer@rackspace:~$ sudo docker run □
```

```
trainer@rackspace:~$ sudo docker images
REPOSITORY      TAG          IMAGE ID      CREATED       SIZE
alpine          bash         24565039698a  4 days ago   9.66 MB
<none>          <none>       d91489a54832  4 days ago   8.09 MB
alpine          latest        3fd9065eaf02  4 weeks ago  4.15 MB
trainer@rackspace:~$ sudo docker run docker/whalesay
```

```
trainer@rackspace:~$ sudo docker images
REPOSITORY      TAG          IMAGE ID      CREATED       SIZE
alpine          bash         24565039698a  4 days ago   9.66 MB
<none>          <none>       d91489a54832  4 days ago   8.09 MB
alpine          latest        3fd9065eaf02  4 weeks ago  4.15 MB
trainer@rackspace:~$ sudo docker run docker/whalesay cowsay "Hello World!"
```

```
trainer@rackspace:~$ sudo docker images
REPOSITORY          TAG        IMAGE ID      CREATED       SIZE
alpine              bash        24565039698a    4 days ago   9.66 MB
<none>              <none>     d91489a54832    4 days ago   8.09 MB
alpine              latest      3fd9065eaf02    4 weeks ago  4.15 MB
trainer@rackspace:~$ sudo docker run docker/whalesay cowsay "Hello World!"
Unable to find image 'docker/whalesay:latest' locally
latest: Pulling from docker/whalesay
e190868d63f8: Pull complete
909cd34c6fd7: Pull complete
0b9bfabab7c1: Pull complete
a3ed95caeb02: Pull complete
00bf65475aba: Pull complete
c57b6bcc83e3: Pull complete
8978f6879e2f: Pull complete
8eed3712d2cf: Pull complete
Digest: sha256:178598e51a26abbc958b8a2e48825c90bc22e641de3d31e18aaf55f3258ba93b
Status: Downloaded newer image for docker/whalesay:latest
```

```
<none>          <none>          d91489a54832        4 days ago      8.09 MB
alpine          latest           3fd9065eaf02        4 weeks ago     4.15 MB
trainer@rackspace:~$ sudo docker run docker/whalesay cowsay "Hello World!"
Unable to find image 'docker/whalesay:latest' locally
latest: Pulling from docker/whalesay
e190868d63f8: Pull complete
909cd34c6fd7: Pull complete
0b9bfabab7c1: Pull complete
a3ed95caeb02: Pull complete
00bf65475aba: Pull complete
c57b6bcc83e3: Pull complete
8978f6879e2f: Pull complete
8eed3712d2cf: Pull complete
Digest: sha256:178598e51a26abbc958b8a2e48825c90bc22e641de3d31e18aaf55f3258ba93b
Status: Downloaded newer image for docker/whalesay:latest
```

```
-----  
< Hello World! >
```



```
trainer@rackspace:~$ █
```

Why do I need Kubernetes?



Below has not been organized

What is Kubernetes?



Application



Application



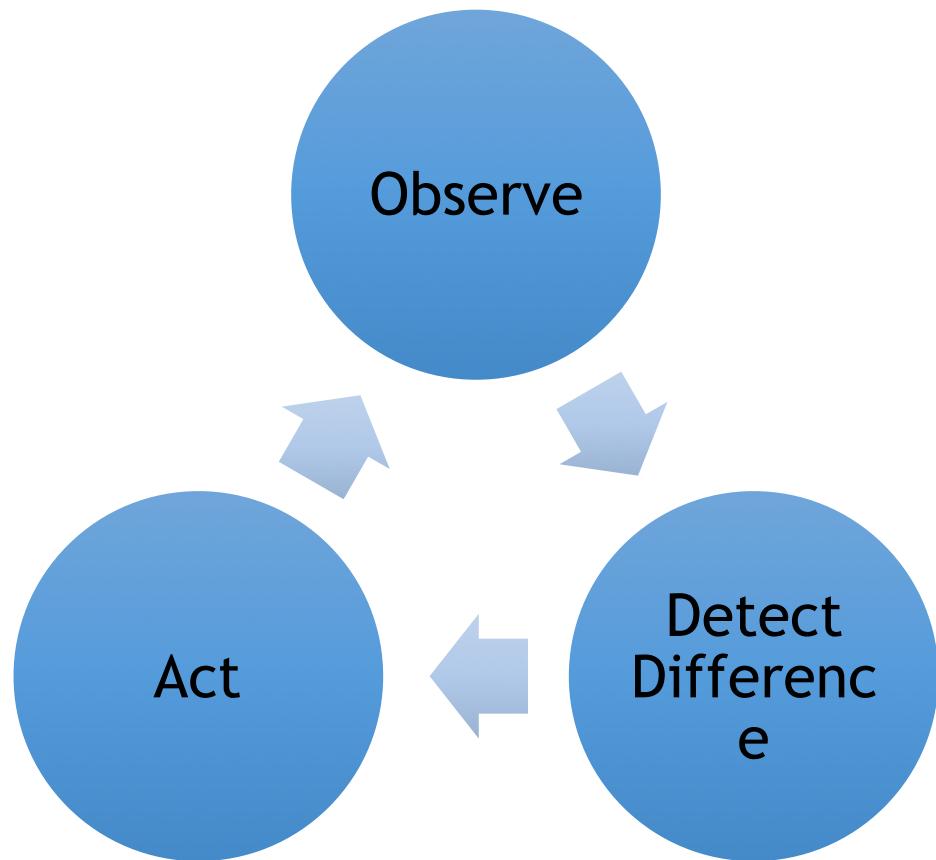
Application



Application

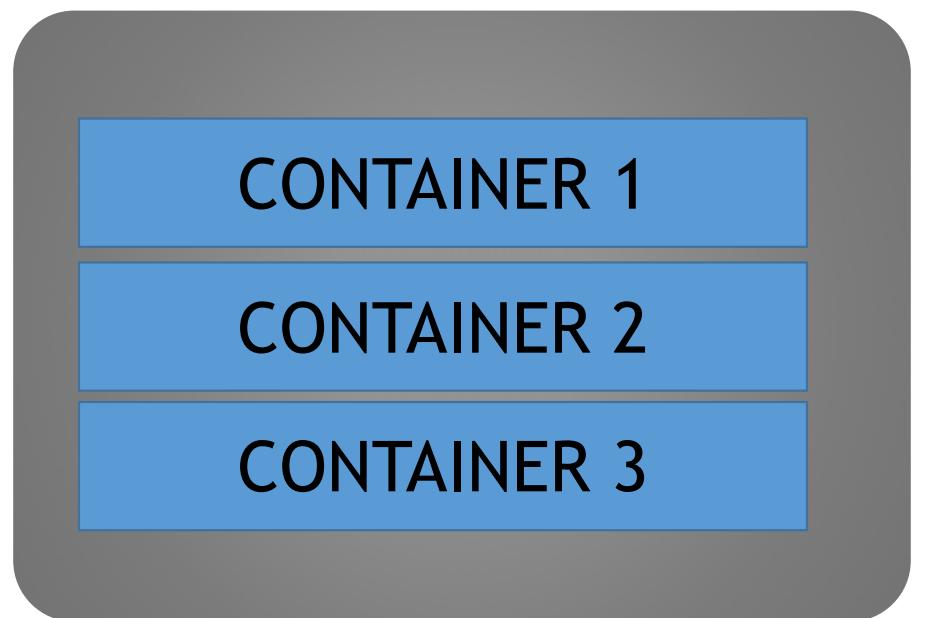


Desired State vs Observed State



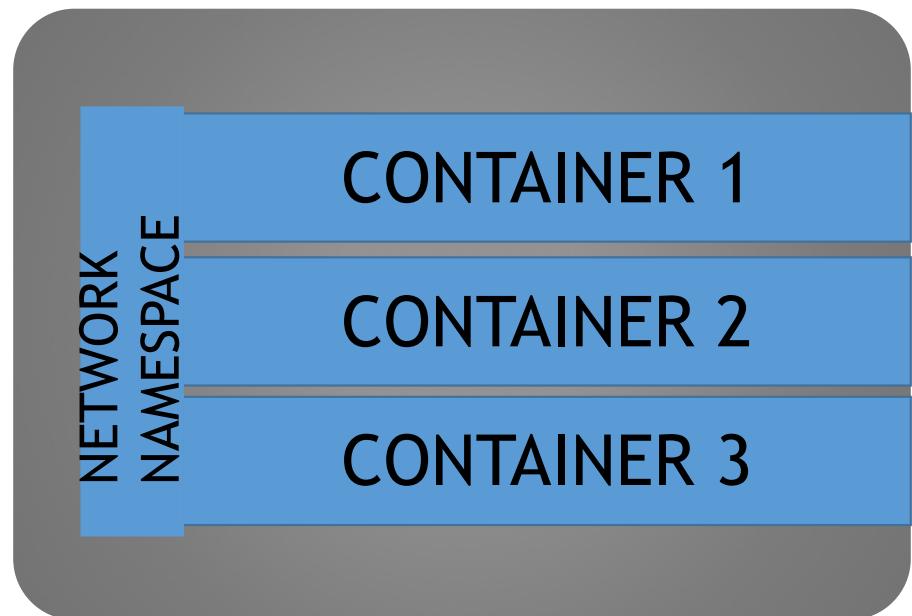
Pods

- Base unit of deployment
- Groups or Single container running under a single service.



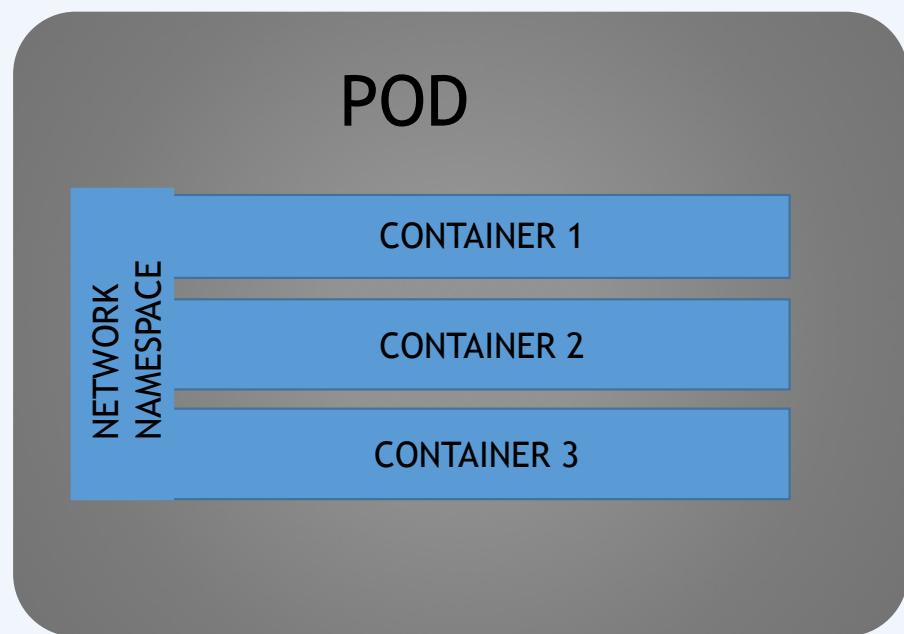
Pods

- Shared IP
- Local host communication
- Shared Namespaces
- Base unit of replication



- Physical or virtual machine
- Previously minion node
- Work in a cluster
- Little user interaction

Worker Node



- Collection of process running on a single node.
- Only one master but you can have followers.
- Master takes commands from administrator and schedules tasks.

Master Node

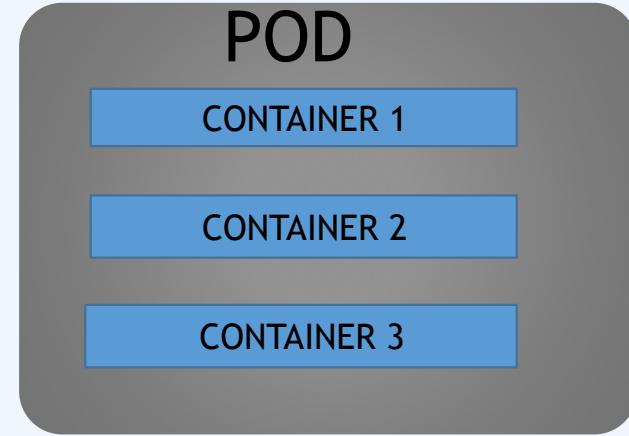


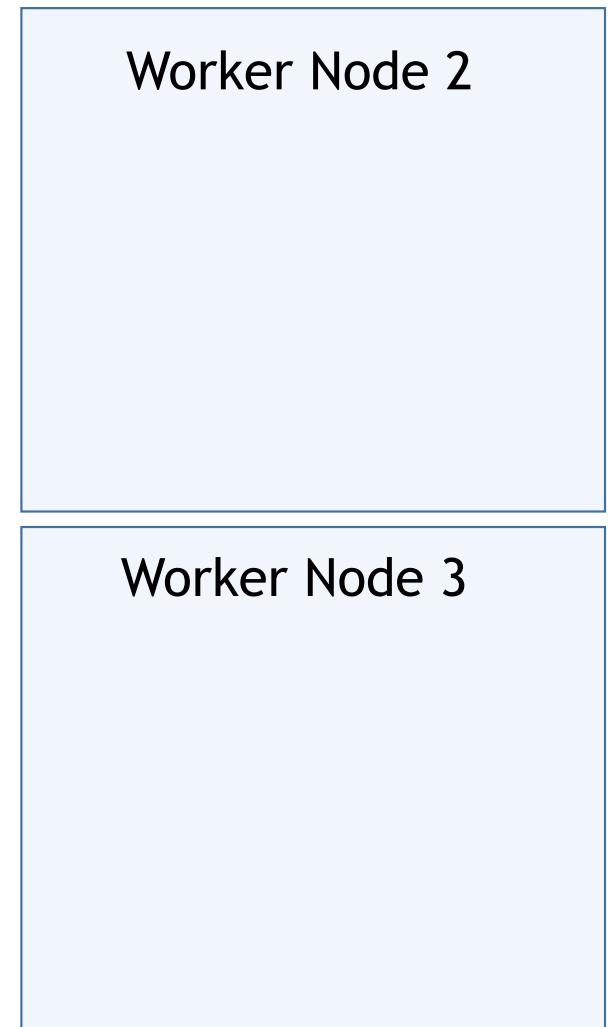
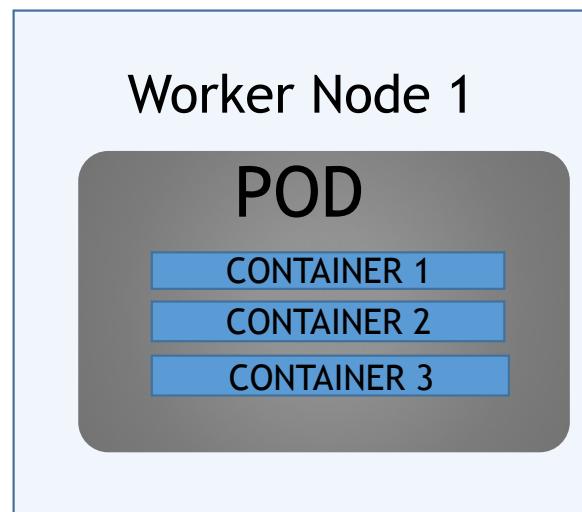
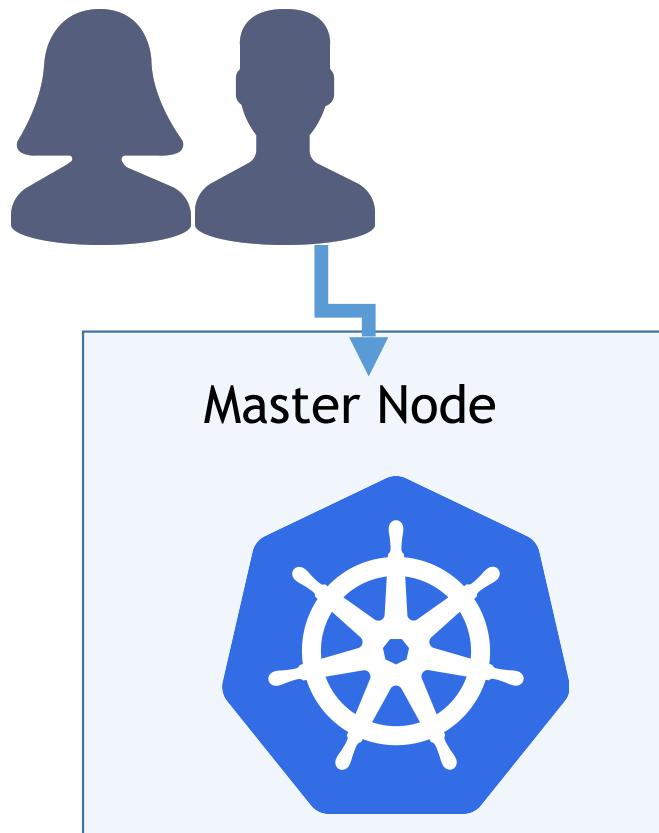
Let's pull it all together.

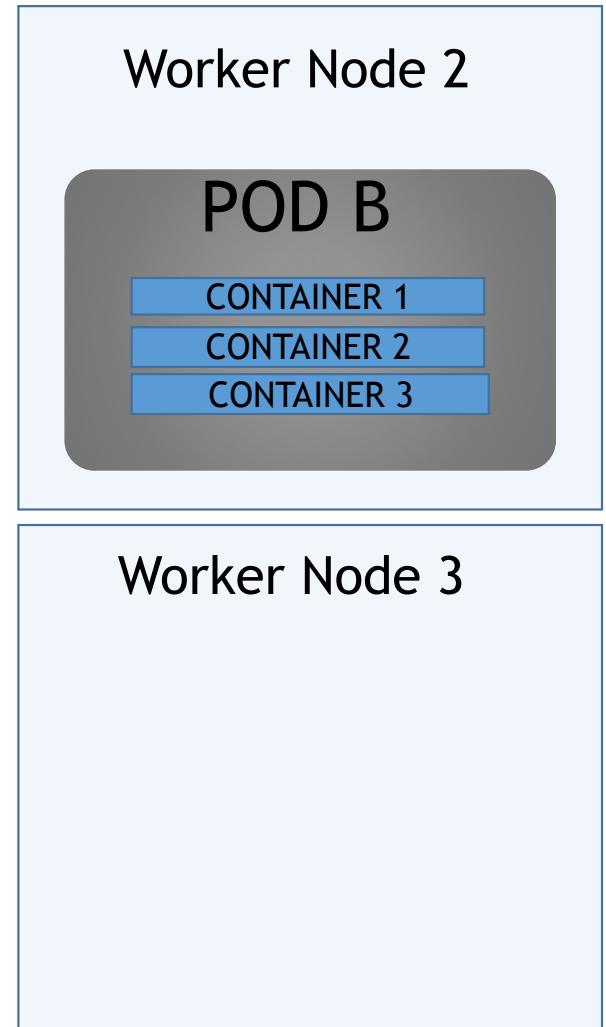
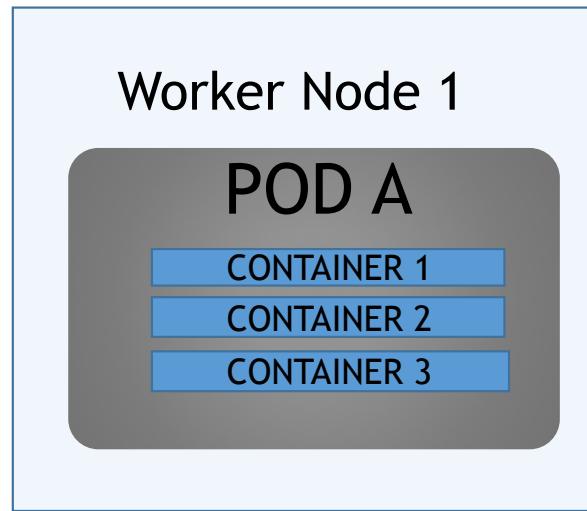
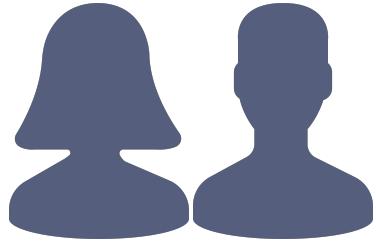
Master Node

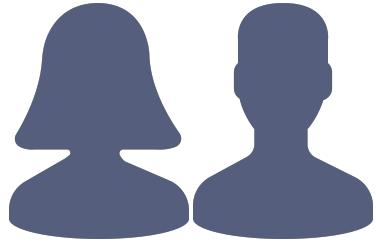


Worker Node









Master Node



Worker Node 1

POD A

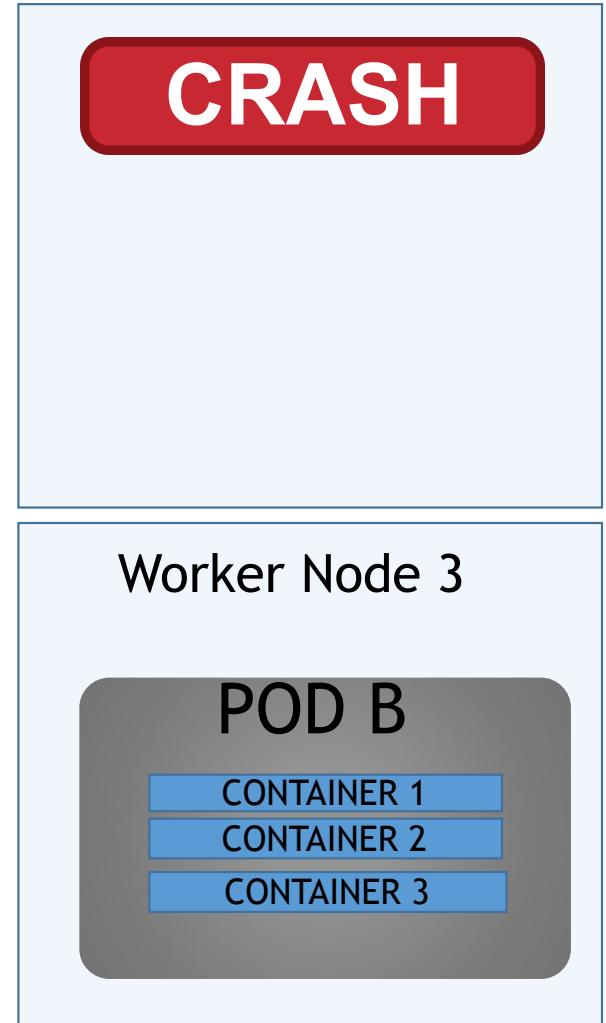
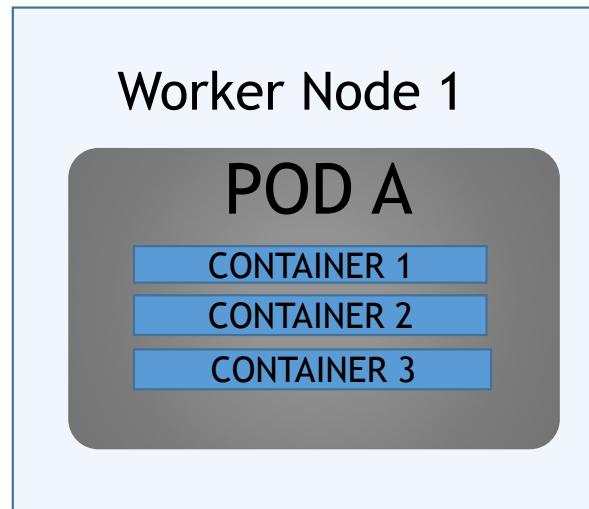
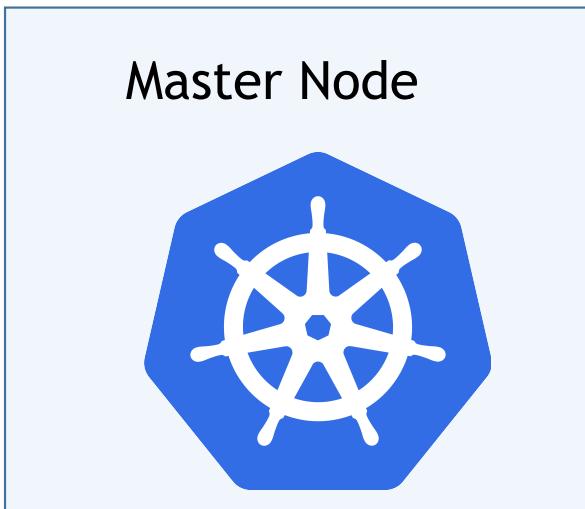
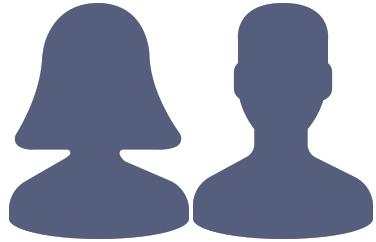
CONTAINER 1
CONTAINER 2
CONTAINER 3

CRASH

POD B

CONTAINER 1
CONTAINER 2
CONTAINER 3

Worker Node 3



```
[root@master ~]#
```

```
[root@master ~]# kubectl
```

```
[root@master ~]# kubectl get nodes
```

| NAME | STATUS | AGE |
|---------|--------|-----|
| worker1 | Ready | 2d |
| worker2 | Ready | 2d |
| worker3 | Ready | 2d |

```
[root@master ~]# █
```

```
[root@master ~]# kubectl get nodes
```

| NAME | STATUS | AGE |
|---------|--------|-----|
| worker1 | Ready | 2d |
| worker2 | Ready | 2d |
| worker3 | Ready | 2d |

```
[root@master ~]# kubectl get pods
```

No resources found.

```
[root@master ~]# █
```

```
[root@master ~]# kubectl get nodes
```

| NAME | STATUS | AGE |
|---------|--------|-----|
| worker1 | Ready | 2d |
| worker2 | Ready | 2d |
| worker3 | Ready | 2d |

```
[root@master ~]# kubectl get pods
```

No resources found.

```
[root@master ~]# kubectl get ns
```

| NAME | STATUS | AGE |
|-------------|--------|-----|
| default | Active | 3d |
| kube-system | Active | 3d |
| practice | Active | 37m |

```
[root@master ~]# 
```

```
[root@master ~]# kubectl get nodes
NAME      STATUS    AGE
worker1   Ready     2d
worker2   Ready     2d
worker3   Ready     2d
[root@master ~]# kubectl get pods
No resources found.
[root@master ~]# kubectl get ns
NAME      STATUS    AGE
default   Active    3d
kube-system   Active    3d
practice   Active    37m
[root@master ~]# kubectl get pods --all-namespaces
NAMESPACE  NAME      READY    STATUS    RESTARTS   AGE
practice   busybox   1/1      Running   0          23m
[root@master ~]# █
```

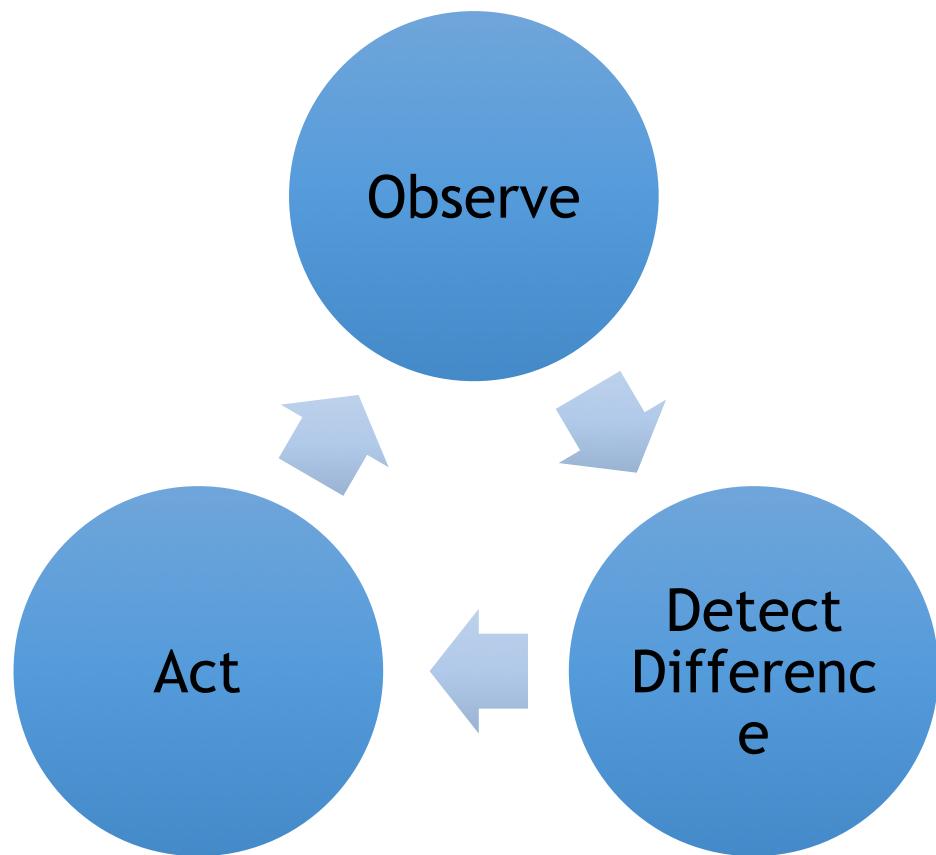
```
[root@master ~]# kubectl get nodes
NAME      STATUS    AGE
worker1   Ready     2d
worker2   Ready     2d
worker3   Ready     2d
[root@master ~]# kubectl get pods
No resources found.
[root@master ~]# kubectl get ns
NAME      STATUS    AGE
default   Active    3d
kube-system   Active    3d
practice   Active    37m
[root@master ~]# kubectl get pods --all-namespaces
NAMESPACE  NAME      READY    STATUS    RESTARTS   AGE
practice   busybox   1/1      Running   0          23m
[root@master ~]# kubectl run webapp --image=nginx --port=80
deployment "webapp" created
[root@master ~]#
```

```
[root@master ~]# kubectl get nodes
NAME      STATUS    AGE
worker1   Ready     2d
worker2   Ready     2d
worker3   Ready     2d
[root@master ~]# kubectl get pods
No resources found.
[root@master ~]# kubectl get ns
NAME      STATUS    AGE
default   Active    3d
kube-system   Active    3d
practice   Active    37m
[root@master ~]# kubectl get pods --all-namespaces
NAMESPACE  NAME      READY    STATUS    RESTARTS   AGE
practice   busybox   1/1      Running   0          23m
[root@master ~]# kubectl run webapp --image=nginx --port=80
deployment "webapp" created
[root@master ~]# kubectl get pods --all-namespaces
NAMESPACE  NAME      READY    STATUS    RESTARTS   AGE
default    webapp-856210044-sgk6q  1/1      Running   0          1m
practice   busybox   1/1      Running   0          27m
[root@master ~]# █
```

```
[root@master ~]# kubectl get nodes
NAME      STATUS    AGE
worker1   Ready     2d
worker2   Ready     2d
worker3   Ready     2d
[root@master ~]# kubectl get pods
No resources found.
[root@master ~]# kubectl get ns
NAME      STATUS    AGE
default   Active    3d
kube-system   Active    3d
practice   Active    37m
[root@master ~]# kubectl get pods --all-namespaces
NAMESPACE  NAME      READY    STATUS    RESTARTS   AGE
practice   busybox   1/1      Running   0          23m
[root@master ~]# kubectl run webapp --image=nginx --port=80
deployment "webapp" created
[root@master ~]# kubectl get pods --all-namespaces
NAMESPACE  NAME      READY    STATUS    RESTARTS   AGE
default   webapp-856210044-sgk6q  1/1      Running   0          1m
practice   busybox   1/1      Running   0          27m
[root@master ~]# kubectl delete pod webapp-856210044-sgk6q
pod "webapp-856210044-sgk6q" deleted
[root@master ~]# █
```

```
[root@master ~]# kubectl get nodes
NAME      STATUS    AGE
worker1   Ready     2d
worker2   Ready     2d
worker3   Ready     2d
[root@master ~]# kubectl get pods
No resources found.
[root@master ~]# kubectl get ns
NAME      STATUS    AGE
default   Active    3d
kube-system   Active    3d
practice   Active    37m
[root@master ~]# kubectl get pods --all-namespaces
NAMESPACE  NAME      READY    STATUS    RESTARTS   AGE
practice   busybox   1/1     Running   0          23m
[root@master ~]# kubectl run webapp --image=nginx --port=80
deployment "webapp" created
[root@master ~]# kubectl get pods --all-namespaces
NAMESPACE  NAME      READY    STATUS    RESTARTS   AGE
default    webapp-856210044-sgk6q  1/1     Running   0          1m
practice   busybox   1/1     Running   0          27m
[root@master ~]# kubectl delete pod webapp-856210044-sgk6q
pod "webapp-856210044-sgk6q" deleted
[root@master ~]# kubectl get pods
NAME      READY    STATUS    RESTARTS   AGE
webapp-856210044-jhqcd  1/1     Running   0          3m
[root@master ~]# █
```

Desired State vs Observed State



Summery

Questions?



@ell_o_punk