LEVEL UP Your Java Container Images

Melissa McKay
Developer Advocate @JFrog

MELISSA MCKAY

Developer Advocate @JFrog

@melissajmckay

linkedin.com/in/melissajmckay

THE AGENDA

- Brief History
- The Container Market
- What is Docker?
- What is a Container?
- Container Gotchas

HOW ARE YOU USING CONTAINERS TODAY???

- LOCALLY
- TEST/QA ENVIRONMENTS
- PRODUCTION
- WE DON’T USE THEM TODAY
- WE ARE CONSIDERING USING THEM

ALL ABOUT . . .

CONTAINERS

SHARING LIMITED RESOURCES

1979 / 1982- chroot

PROGRESS TOWARD VIRTUALIZATION

- 2000 - FreeBSD jail
- 2004 - Solaris Zones / snapshots
- 2006 - Google Process Containers / cgroups
- 2008 - IBM **L**inu**X** **C**ontainers (LXC)
- 2013 - Docker (open source!)
  - Google LMCTFY (open source!)
- 2014 - Docker trades LXC for libcontainer
- … *more stuff happened*
- June 2015 - Open Container Project/Initiative (OCI)
  - Runtime Specification (runtime-spec)
  - Image Specification (image-spec)
- … *even more stuff happened and is* ***still happening!***

2011
Java 7

2014
Java 8

THE CONTAINER MARKET (according to Sysdig)

2017 - 45,000 Containers, 99% Docker

2018 - 90,000 Containers

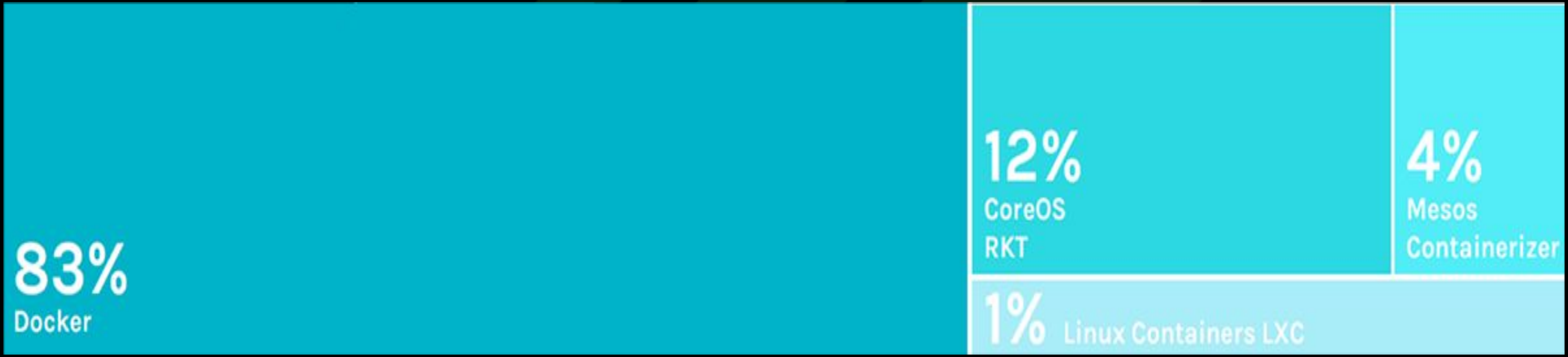
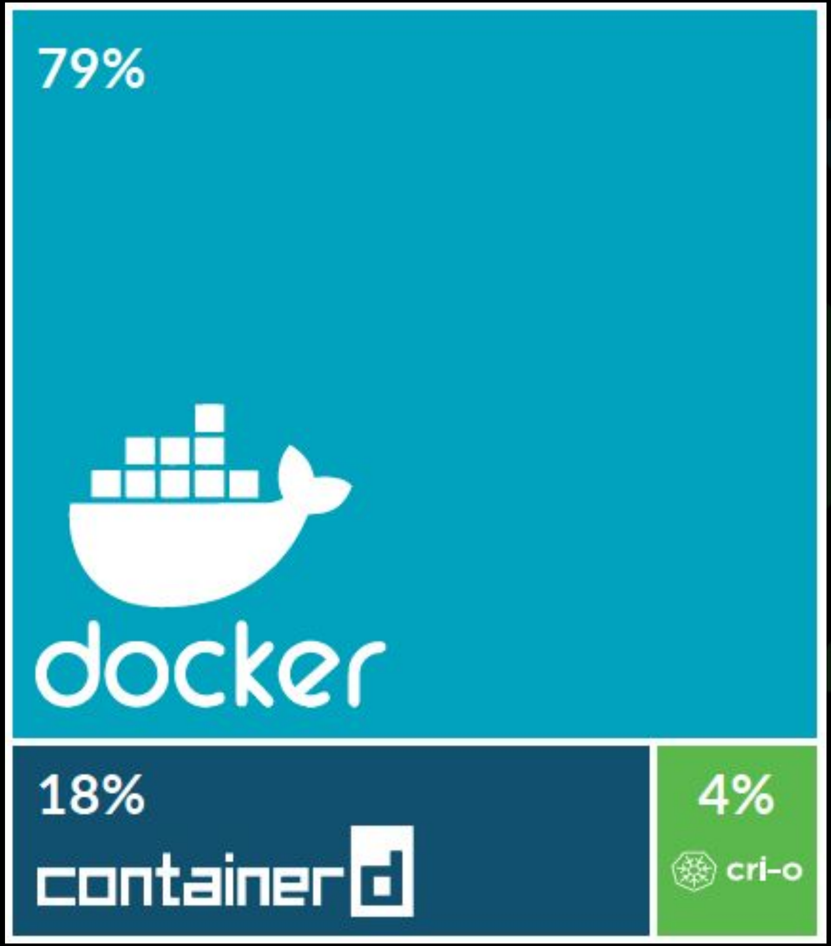


Fig. 1. 2018 Container Runtimes from: "2018 Docker usage report," 29 May. 2018, sysdig.com/blog/2018-docker-usage-report/. Accessed 10 Jun. 2020.

THE CONTAINER MARKET (according to Sysdig)



2019 - 2 million Containers
(includes both SaaS & on prem users)

Fig. 2. 2019 Container Runtimes from: "Sysdig 2019 Container Usage Report: New Kubernetes and security insights," 29 Oct. 2019, sysdig.com/blog/sysdig-2019-container-usage-report/. Accessed 10 Jun. 2020.

THE CONTAINER MARKET (according to Sysdig)

2020/21 - 2 million Containers
(a subset of customer containers)

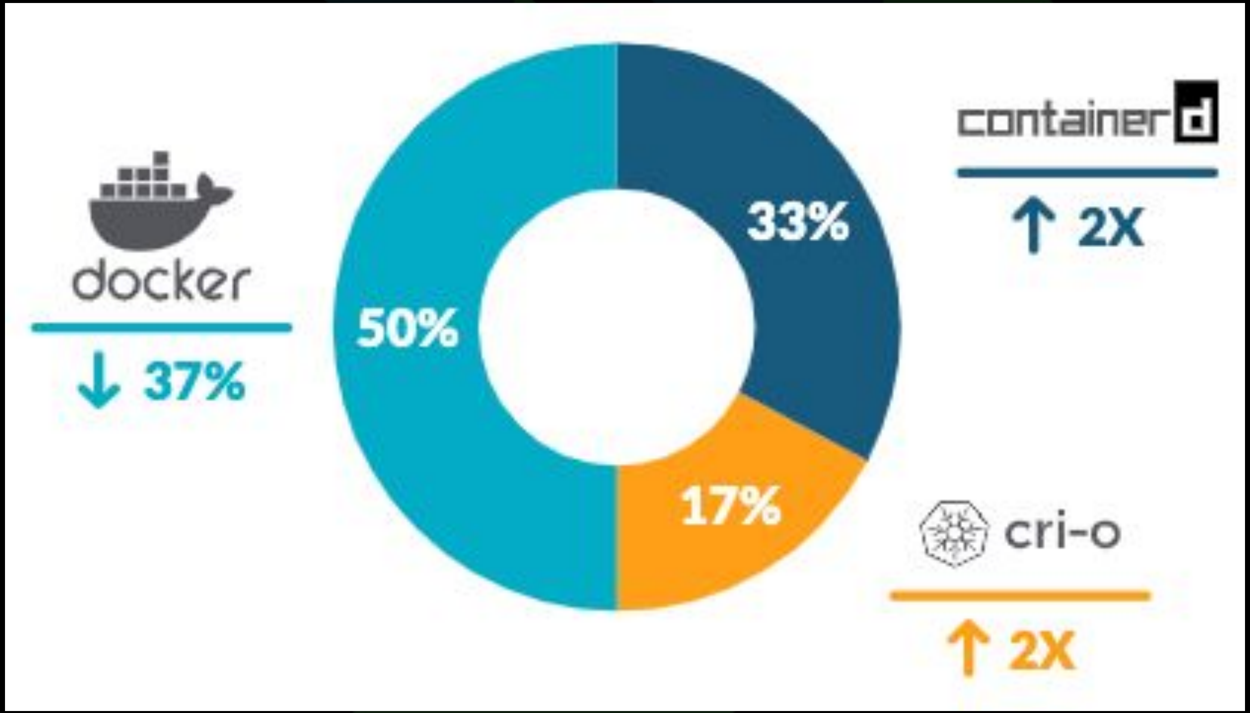


Fig. 3. Container runtimes from: "REPORT.2021 Container Security And Usage Report," Jan 2021, https://dig.sysdig.com/c/pf-2021-container-security-and-usage-report?x=u_WFRi. Accessed 21 Jan. 2021.

WHAT EXACTLY IS DOCKER?

WHAT DO WE ACTUALLY NEED/WANT?

- An isolated environment where a user/application can operate, sharing the host system’s OS/kernel without interfering with the operation of another isolated environment on the same system (a container)
- A way to define a container (an image format)
- A way to build an image of a container
- A way to manage container images
- A way to distribute/share container images
- A way to create a container environment
- A way to launch/run a container (a container runtime)
- A way to manage the lifecycle of container instances

DOCKER, THE WHOLE PACKAGE

DOCKER ENGINE

DOCKER IMAGE FORMAT

Dockerfile `docker build`

`docker images`

`docker rm`

`docker push`

`docker pull`

DOCKER HUB

`docker run`

`docker stop`

`docker ps`

BREAKING UP THE MONOLITH

OCI IMAGE FORMAT

- Docker V2 Image Spec

OCI CONTAINER RUNTIME

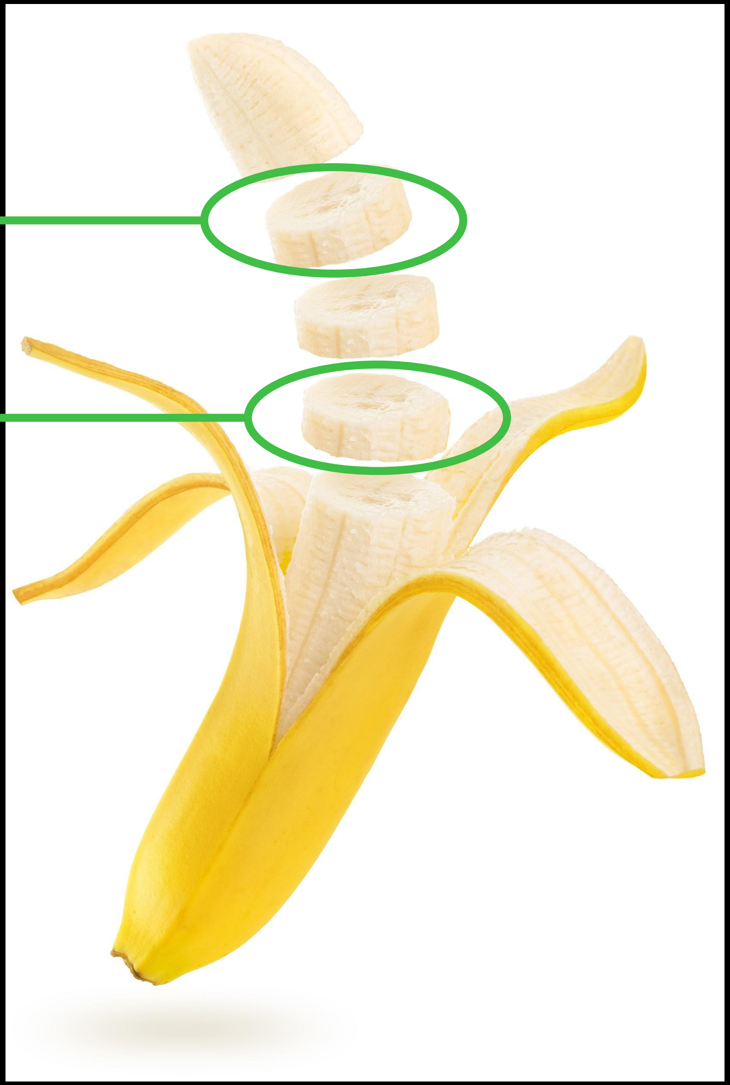
- runC *(which used to be libcontainer… which was written by Docker)*

😢

OTHERS - containerd, ~~rkt~~, cri-o, Kata, etc…

https://lwn.net/Articles/741897/

https://www.ianlewis.org/en/container-runtimes-part-1-introduction-container-r



WHAT IF I DON'T WANNA DOCKAH??

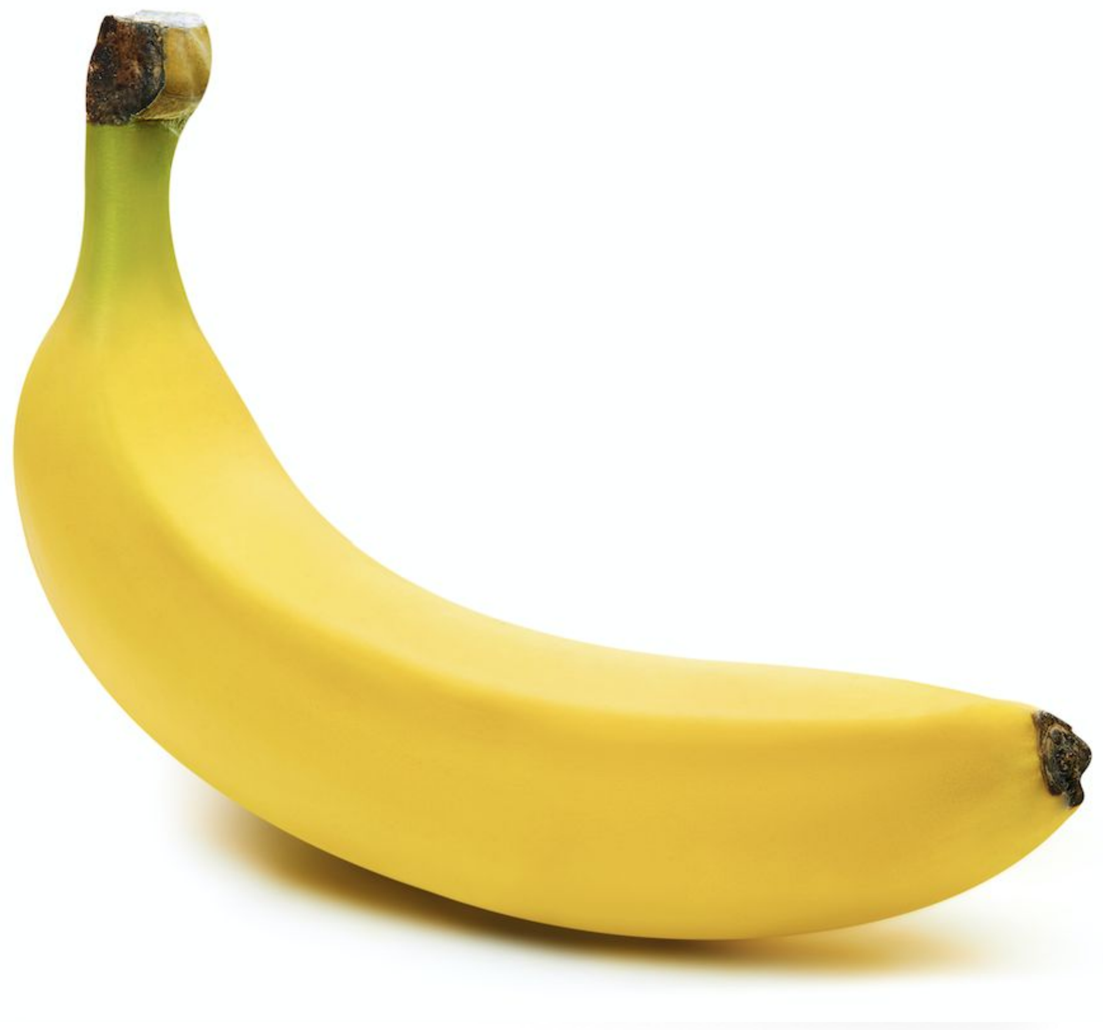
podman

buildah

& Skopeo

https://developers.redhat.com/blog/2019/02/21/podman-and-buildah-for-docker-users/
https://www.redhat.com/en/blog/say-hello-buildah-podman-and-skopeo
https://developers.redhat.com/blog/2020/02/12/podman-for-macos-sort-of/

WHAT EXACTLY IS A CONTAINER?

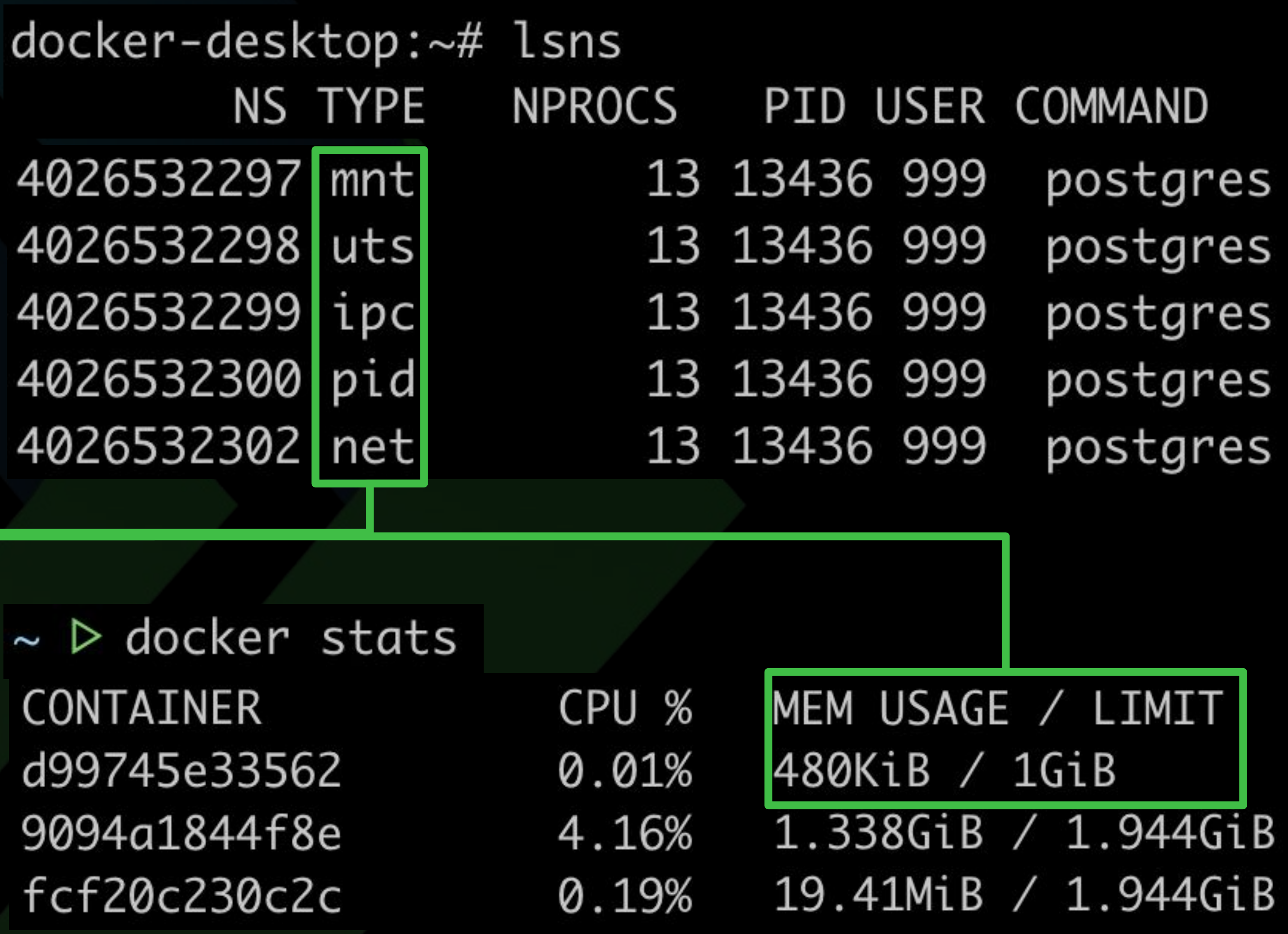


CONTAINER COMPONENTS

TARBALL OF A FILESYSTEM

LINUX FEATURES

- namespaces
- cgroups
- Union File systems



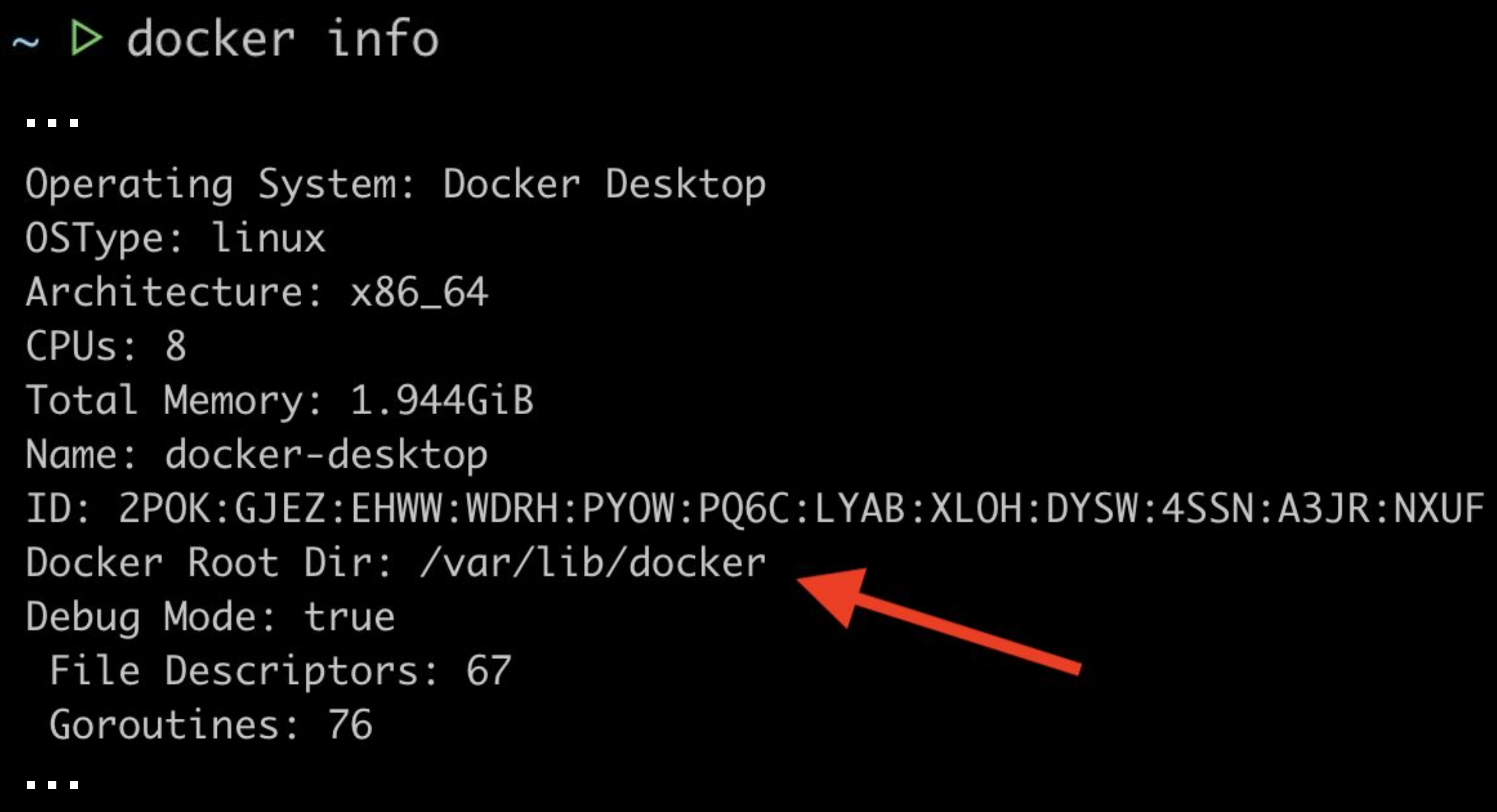
```
docker-desktop:~# lsns
        NS TYPE   NPROCS   PID USER COMMAND
4026532297 mnt        13 13436 999  postgres
4026532298 uts        13 13436 999  postgres
4026532299 ipc        13 13436 999  postgres
4026532300 pid        13 13436 999  postgres
4026532302 net        13 13436 999  postgres
```

```
~ ▷ docker stats
CONTAINER         CPU %    MEM USAGE / LIMIT
d99745e33562      0.01%    480KiB / 1GiB
9094a1844f8e      4.16%    1.338GiB / 1.944GiB
fcf20c230c2c      0.19%    19.41MiB / 1.944GiB
```

Mix these together to create and run a container! Voila!

https://docs.docker.com/get-started/overview/

FILESYSTEM DETAILS

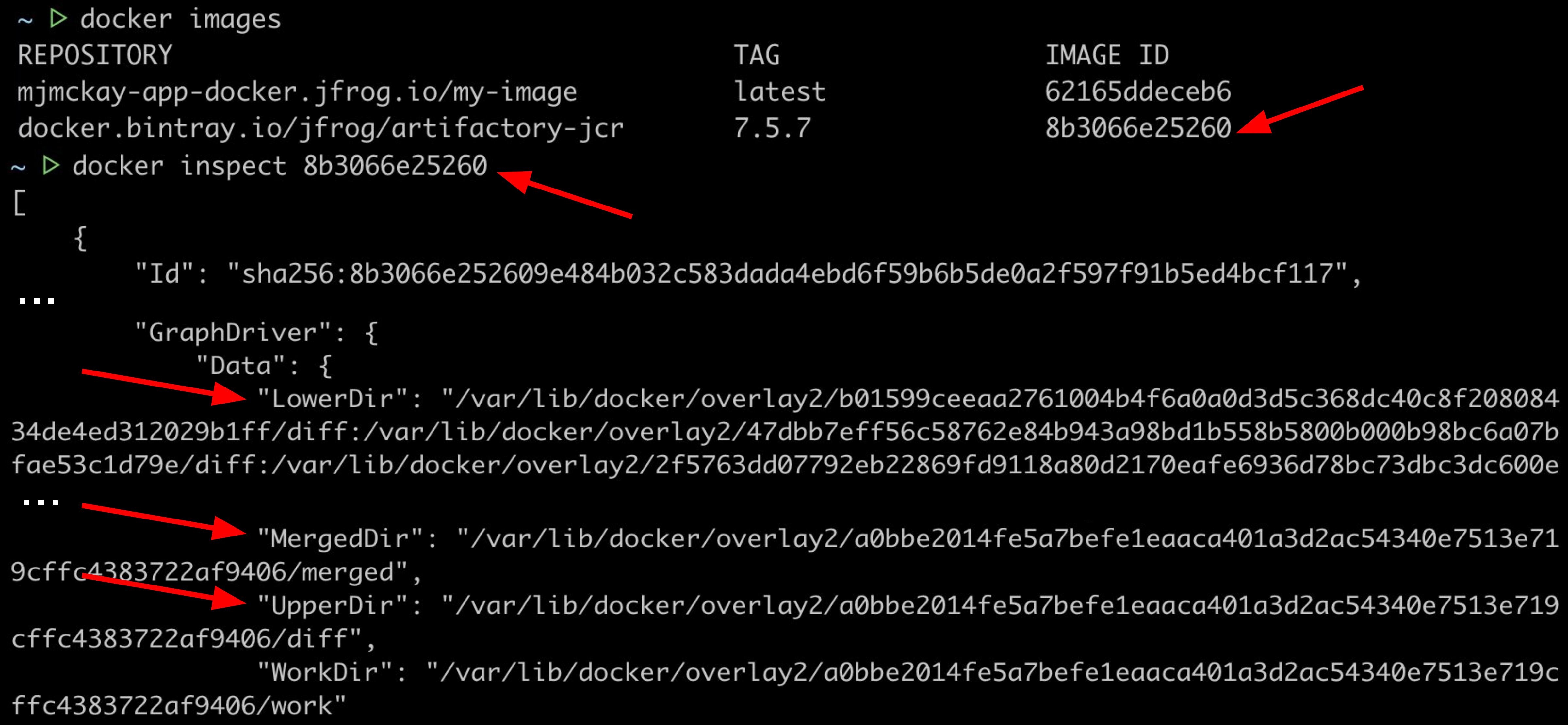


```
~ ▷ docker info
...
Operating System: Docker Desktop
OSType: linux
Architecture: x86_64
CPUs: 8
Total Memory: 1.944GiB
Name: docker-desktop
ID: 2POK:GJEZ:EHWW:WDRH:PYOW:PQ6C:LYAB:XLOH:DYSW:4SSN:A3JR:NXUF
Docker Root Dir: /var/lib/docker
Debug Mode: true
 File Descriptors: 67
 Goroutines: 76
...
```

NOTE: On OSX, containers will actually be running in a tiny Linux VM (use screen)

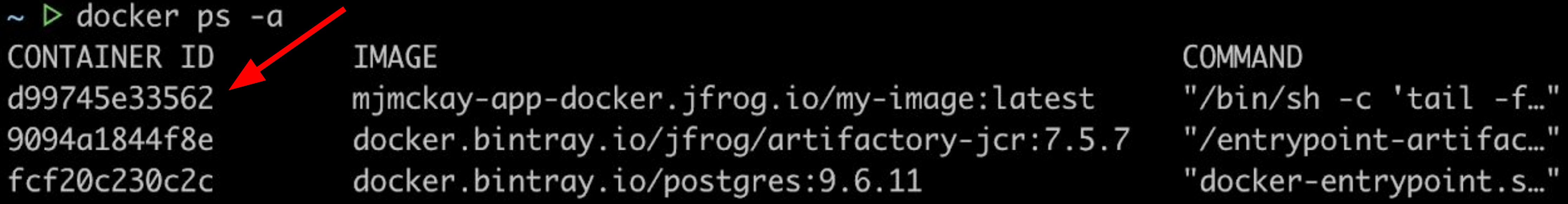
```
screen ~/Library/Containers/com.docker.docker/Data/vms/0/tty
```

FILESYSTEM DETAILS

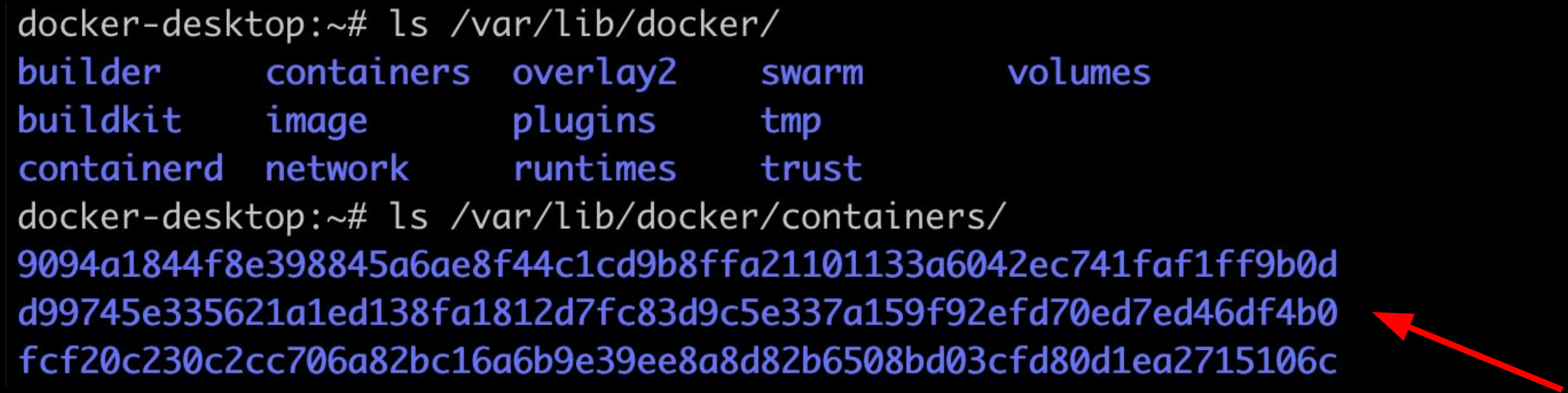


```
 ~ ▷ docker images
 REPOSITORY                                    TAG                 IMAGE ID
 mjmckay-app-docker.jfrog.io/my-image          latest              62165ddeceb6
 docker.bintray.io/jfrog/artifactory-jcr       7.5.7               8b3066e25260
~ ▷ docker inspect 8b3066e25260
[
    {
        "Id": "sha256:8b3066e252609e484b032c583dada4ebd6f59b6b5de0a2f597f91b5ed4bcf117",
 ...
        "GraphDriver": {
            "Data": {
                "LowerDir": "/var/lib/docker/overlay2/b01599ceeaa2761004b4f6a0a0d3d5c368dc40c8f208084
34de4ed312029b1ff/diff:/var/lib/docker/overlay2/47dbb7eff56c58762e84b943a98bd1b558b5800b000b98bc6a07b
fae53c1d79e/diff:/var/lib/docker/overlay2/2f5763dd07792eb22869fd9118a80d2170eafe6936d78bc73dbc3dc600e
 ...
                "MergedDir": "/var/lib/docker/overlay2/a0bbe2014fe5a7befe1eaaca401a3d2ac54340e7513e71
9cffc4383722af9406/merged",
                "UpperDir": "/var/lib/docker/overlay2/a0bbe2014fe5a7befe1eaaca401a3d2ac54340e7513e719
cffc4383722af9406/diff",
                "WorkDir": "/var/lib/docker/overlay2/a0bbe2014fe5a7befe1eaaca401a3d2ac54340e7513e719c
ffc4383722af9406/work"
```

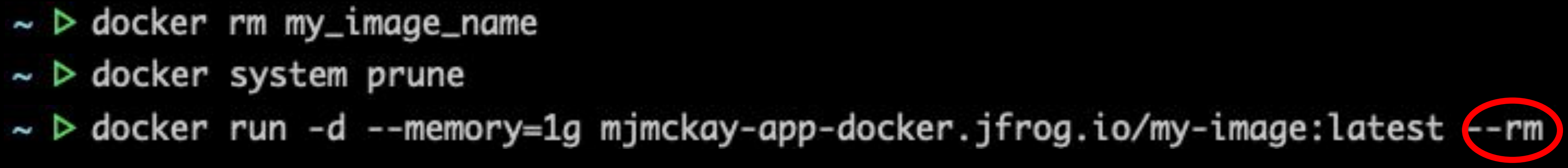
FILESYSTEM DETAILS



```
~ ▷ docker ps -a
CONTAINER ID        IMAGE                                          COMMAND
d99745e33562        mjmckay-app-docker.jfrog.io/my-image:latest    "/bin/sh -c 'tail -f…"
9094a1844f8e        docker.bintray.io/jfrog/artifactory-jcr:7.5.7  "/entrypoint-artifac…"
fcf20c230c2c        docker.bintray.io/postgres:9.6.11              "docker-entrypoint.s…"
```



```
docker-desktop:~# ls /var/lib/docker/
builder     containers  overlay2    swarm       volumes
buildkit    image       plugins     tmp
containerd  network     runtimes    trust
docker-desktop:~# ls /var/lib/docker/containers/
9094a1844f8e398845a6ae8f44c1cd9b8ffa21101133a6042ec741faf1ff9b0d
d99745e335621a1ed138fa1812d7fc83d9c5e337a159f92efd70ed7ed46df4b0
fcf20c230c2cc706a82bc16a6b9e39ee8a8d82b6508bd03cfd80d1ea2715106c
```



```
~ ▷ docker rm my_image_name
~ ▷ docker system prune
~ ▷ docker run -d --memory=1g mjmckay-app-docker.jfrog.io/my-image:latest --rm
```

CONTAINER GOTCHAS

CONTAINER GOTCHAS
- RUNNING AS ROOT

CONTAINER GOTCHAS
- NO CONSTRAINTS

CONTAINER GOTCHAS
- NEVER UPDATING

CONTAINER GOTCHAS
- JAVA/JVM GOTCHAS

CONTAINER GOTCHAS
- IMAGE BLOAT

MANAGING YOUR IMAGES
- REMOTE BY DEFAULT

START FREE:

http://jfrog.co/FreeDevOpsTools_STLJUG

foojay.io

foojay — a place for friends of OpenJDK

https://dzone.com/refcardz/getting-started-with-container-registries