Section 7 - Container Images - Docker Hub Registry

3 Docker images - Local Cache

Image layers (1)

- What is an image layer?
- When we use `docker pull`, we can see from the output of the command that the image is not a single big blob of data.

```
# docker pull mysql
Using default tag: latest
latest: Pulling from library/mysql
27833a3ba0a5: Already exists
864c283b3c4b: Already exists
5479aaef3d30: Already exists
9667974ee097: Pull complete
4ebb5e7ad6ac: Downloading [==============>    ] 17.14MB/88.99MB
021bd5074e22: Downloading [======>            ] 33.14MB/69.99MB
cce70737c123: Waiting
544ff12e028f: Waiting
```

Image layers (2)

```
# docker pull mysql
Using default tag: latest
latest: Pulling from library/mysql
27833a3ba0a5: Already exists
864c283b3c4b: Already exists
5479aaef3d30: Already exists
9667974ee097: Pull complete
4ebb5e7ad6ac: Downloading [==============>    ] 17.14MB/88.99MB
021bd5074e22: Downloading [======>            ] 33.14MB/69.99MB
cce70737c123: Waiting
544ff12e028f: Waiting
```

- The image is composed from smaller pieces of data => layers.
- Some of the layer "Already exists" on the local cache => No need to download this part
- The images are designed using the union file system which concept is to make layers for a set of changes

Image layers - Example

- For an over-simplified example you could create a new image based on Ubuntu. This would be your first image's layer.
- Then, add the Python packages. This would be the second layer.
- Finally, you could add a security patch. This would be the third layer.

docker image history (1)

- Use the `docker image history` command to show the history of an image.
- Show layers of changes made on the image.

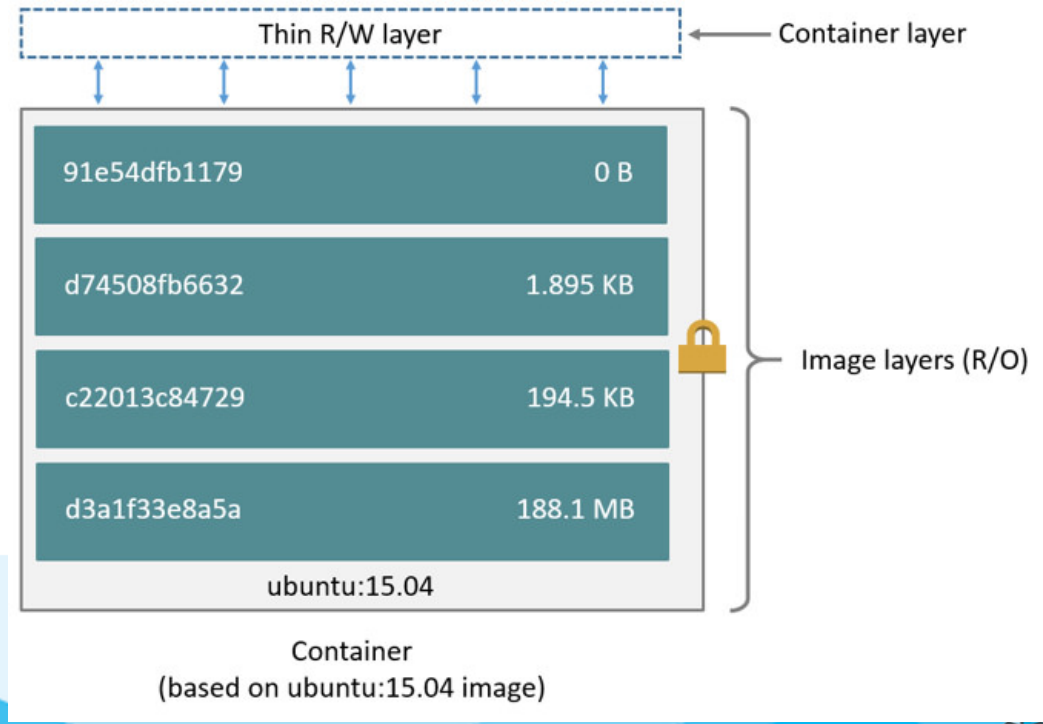
```
# docker image history nginx
IMAGE          CREATED       CREATED BY
27a188018e18   9 days ago    /bin/sh -c #(nop)  CMD ["nginx" "-g" "daem
<missing>      9 days ago    /bin/sh -c #(nop)  STOPSIGNAL SIGTERM
<missing>      9 days ago    /bin/sh -c #(nop)  EXPOSE 80
<missing>      9 days ago    /bin/sh -c ln -sf /dev/stdout /var/log/ngi
<missing>      9 days ago    /bin/sh -c set -x  && apt-get update  && a
<missing>      9 days ago    /bin/sh -c #(nop)  ENV NJS_VERSION=1.15.12
<missing>      9 days ago    /bin/sh -c #(nop)  ENV NGINX_VERSION=1.15.
<missing>      4 weeks ago   /bin/sh -c #(nop)  LABEL maintainer=NGINX
<missing>      4 weeks ago   /bin/sh -c #(nop)  CMD ["bash"]
<missing>      4 weeks ago   /bin/sh -c #(nop) ADD file:4fc310c0cb879c8
```

docker image history (2)

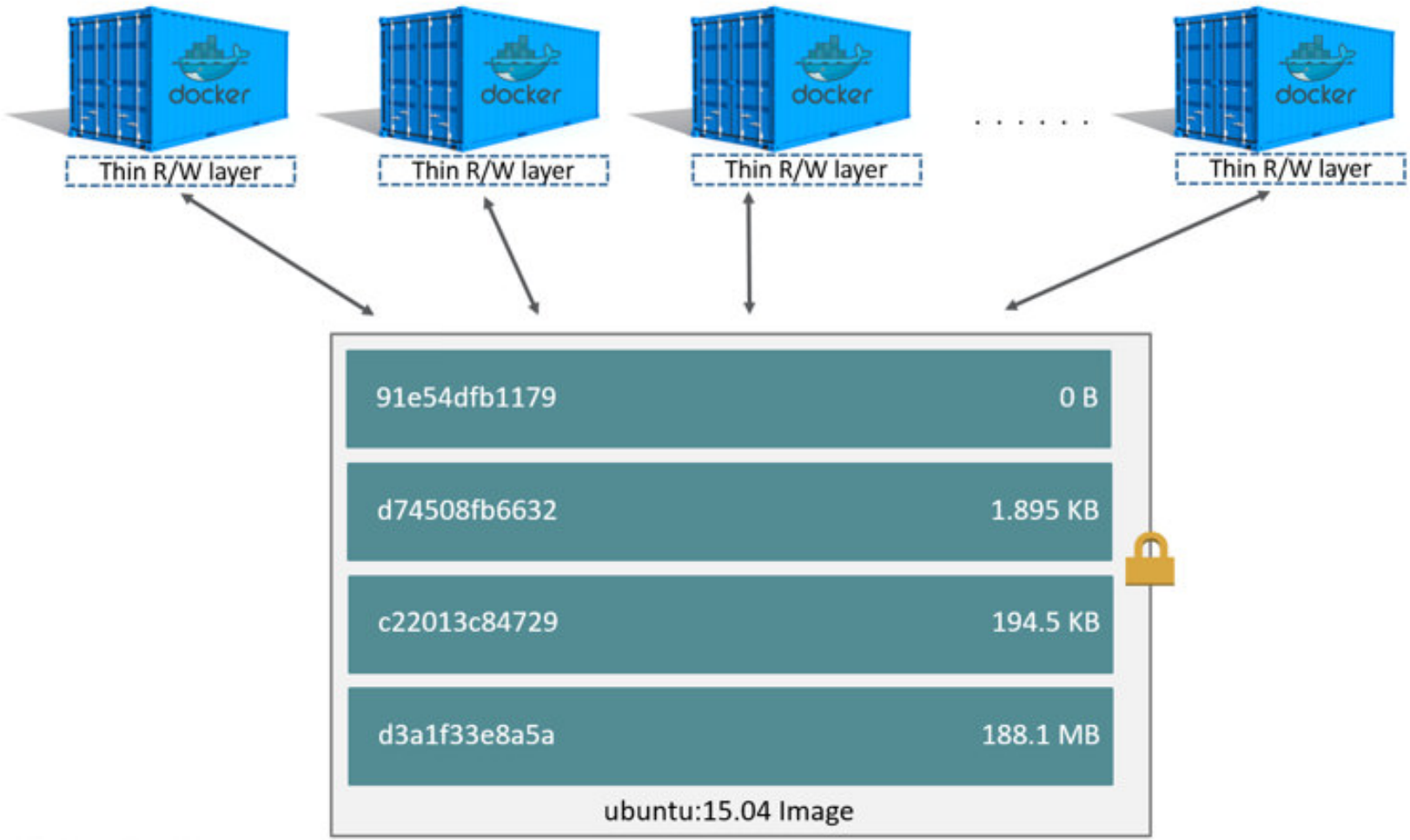
- Every set of changes on the image file system is another layer.
- Some layers may not change in terms of the file size => metadata (e.g EXPOSE 80)
- Every layer has a unique SHA number that identify the changes made.
- Different images can have common layers => which means that for example:
  - Two custom images may have the same common base image such as "ubuntu".
  - These two images will have a common set of layers, all related to the common base image.

Image layers - Recap

- Images are made of RO layers created at build time.
- Each layer is related to a set of file system changes.
- When you run a Docker image to create a running container, Docker will create a new RW layer on top of the image.



Container RW layer (1)



Container RW layer (2)

- The major difference between a container and an image is the top writable layer.
- All writes to the container that add new or modify existing data are stored in this writable layer.
- When the container is deleted, the writable layer is also deleted. The underlying image remains unchanged.
- Because each container has its own writable container layer, and all changes are stored in this container layer, multiple containers can share access to the same underlying image and yet have their own data state. The diagram below shows multiple containers sharing the same Ubuntu 15.04 image.
- Ref Container and layers

Storage drivers

- Docker uses storage drivers to manage the contents of the *image layers* and the *writable container layer*.
- Each storage driver handles the implementation differently, but all drivers use stackable image layers and the copy-on-write (CoW) strategy.
- Docker supports different types of storage drivers such as: overlay2, aufs, devicemapper, btrfs etc..
- Recommended storage driver for Ubuntu, CentOS and RHEL is overlay2
- Recommended storage drivers

docker image inspect (1)

- Use the `docker image inspect` command to display detailed information of an image.
- This is the metadata of the image (Remember an image is made up of two parts, the "binaries & dependencies" and the "metadata").
- Information included: ImageId, RepoTags, ExposePorts, Environment variables, CMD , Architecture, GraphDriver, etc...

docker image inspect (2)

```
# docker image inspect nginx
[
    {
        "Id": "sha256:27a188018e1847b312022b02146bb7ac3da54e96fab838b7db9f
        "RepoTags": [
            "nginx:1.15",
            "nginx:1.15.12",
            "nginx:latest"
        ],
        ...
        "GraphDriver": {  ...   "Name": "overlay2" },
        ...
        "RootFS": {
            "Type": "layers",
            "Layers": [
                "sha256:5dacd731af1b0386ead06c8b1feff9f65d9e0bdfec032d2cd0
                "sha256:912ed487215b213aaad80bedb31484cab0b060de73d49bd1cf
                "sha256:fc4c9f8e7dacd81078d56e811c55ce1920688a91748bfbb2b9
...
```

docker image inspect (3)

> Notes
>
> - The "GraphDriver" actually refer to the storage driver
> - The `docker history` command shows the build history of an image (list of changes #10) which is not the strict list of layers such as the one reported from the `docker image inspect` command (list of changes #3)