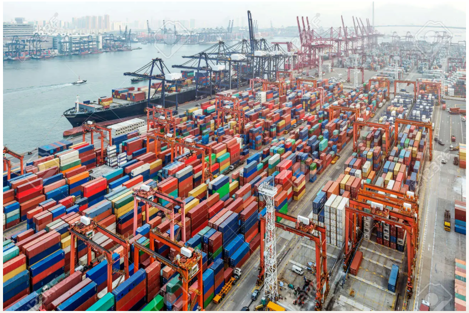
Container technology is not very old

The most famous : docker

Solomon Hykes was inspirated by container port in the world travel



Docker is an open source project, a community and a private company

- Born in 2010

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- Packaged to Ubuntu in 2014 (V14.04)

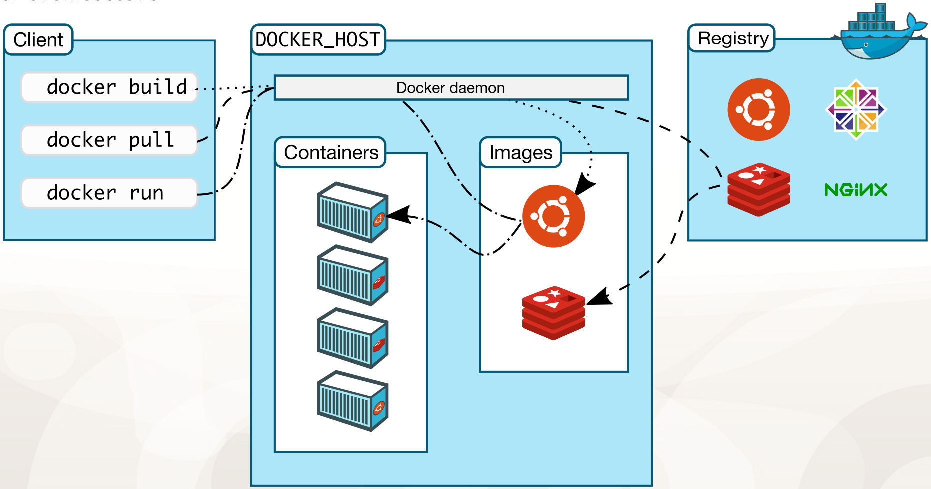
[<+->]Term definitions

- Docker image –> "snapshot" immutable file
    - Set of libraries, functions
    - Static state
    - Online Store or share
    - Automatically build

- Docker container –> instance of an image
    - Result of the image activation
    - Can be modified
    - Can be tunred into an image
    - 1 image –> multiple containers

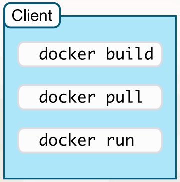
Docker architecture

client-server architecture



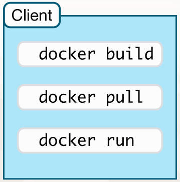
Docker client

1. The user way to interact with Docker



Docker client

1. The user way to interact with Docker
2. Client talk to a daemon (Docker background program)



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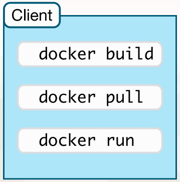

Docker client

1. The user way to interact with Docker
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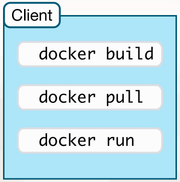
3. API based –> can communicate with several deamons

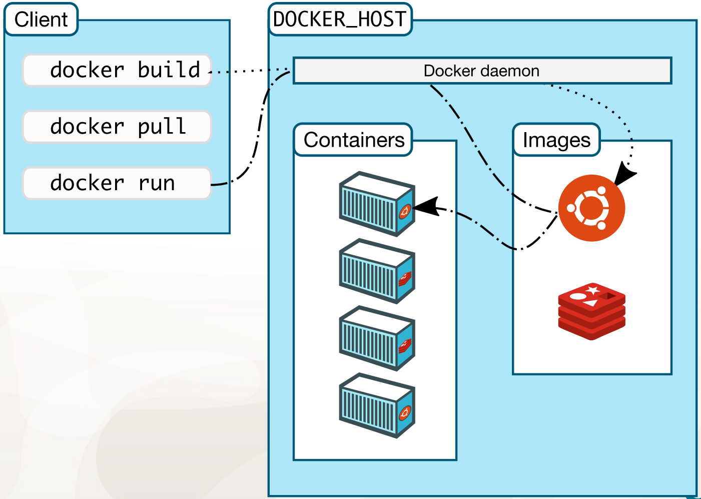
Client

```
$ docker build [path][url]
  docker build https://github.com/docker/rootfs.git#container:docker
$ docker pull [image_name]
  docker pull biocontainers/samtools
$ docker run [image_name]
  docker run biocontainers/samtools
```



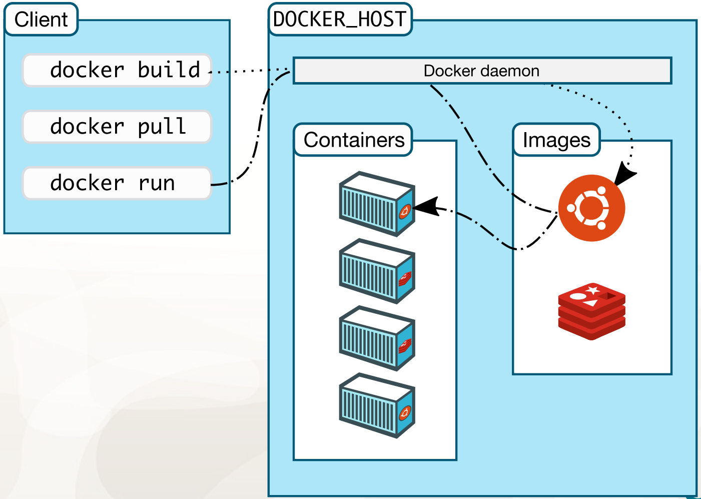
Docker daemon

1. listen API requests



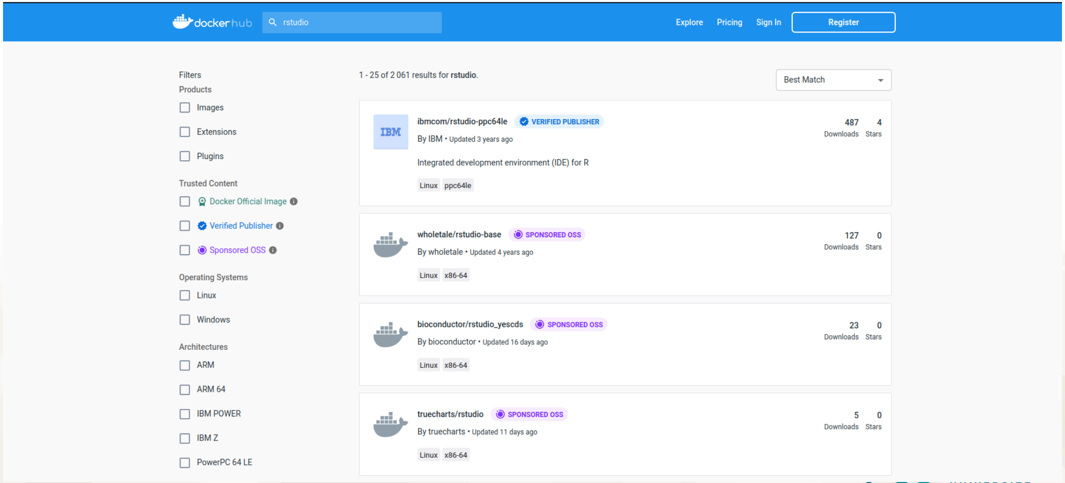
Docker daemon

1. listen API requests
2. manage Dockers images, containers...



Docker registries

1. Store Docker images



Filters

Products

- Images
- Extensions
- Plugins

Trusted Content

- Docker Official Image
- Verified Publisher
- Sponsored OSS

Operating Systems

- Linux
- Windows

Architectures

- ARM
- ARM 64
- IBM POWER
- IBM Z
- PowerPC 64 LE

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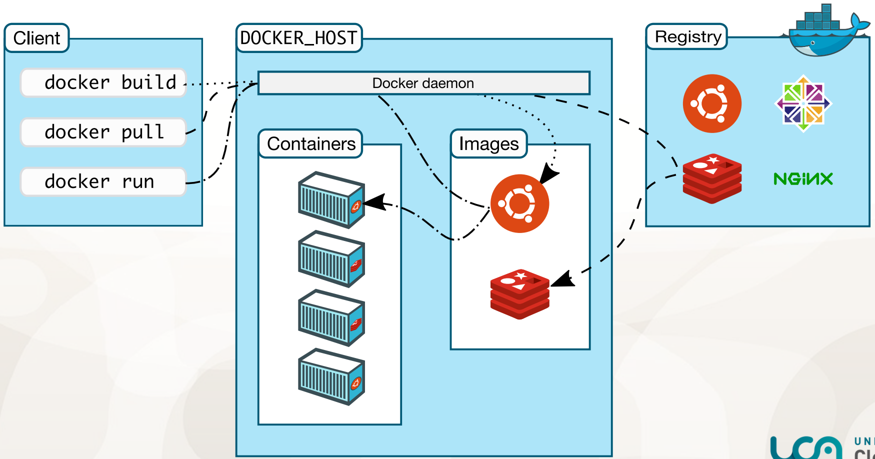
Docker registries

1. Store Docker images
2. Docker hub is a publix registry



Docker registries

1. Store Docker images
2. Docker hub is a publix registry
3. You can run your own registry

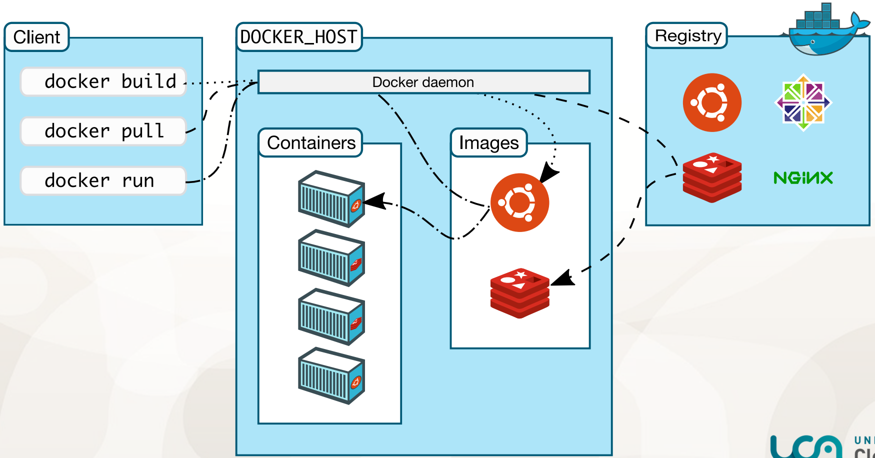


Image layers

Focus on image building

- Layers building

```
$ docker pull debian
Using default tag: latest
latest: Pulling from library/debian
fdd5d7827f33: Pull complete
a3ed95caeb02: Pull complete
Digest: sha256:e7d38b3517548a1c71e41bffe9c8ae6d6d29546ce46bf62159837aad072c90aa
Status: Downloaded newer image for debian:latest
```

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- Several layers to one image

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Focus on image building

- Layers building
- Several layers to one image
- Some layers shared by images when pulling
- Lightheight the download and use of image on you computer

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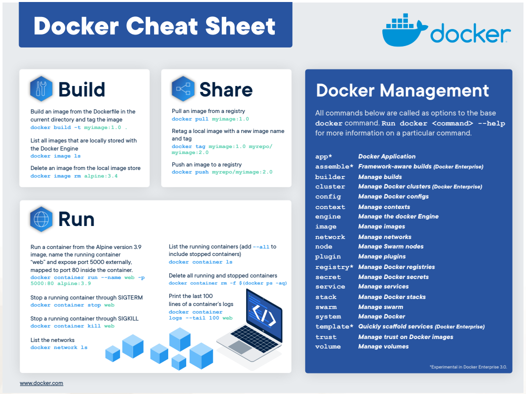


Docker Cheat Sheet

docker

Build

Build an image from the Dockerfile in the current directory and tag the image

```
docker build -t myimage:1.0 .
```

List all images that are locally stored with the Docker Engine

```
docker image ls
```

Delete an image from the local image store

```
docker image rm alpine:3.4
```

Share

Pull an image from a registry

```
docker pull myimage:1.0
```

Retag a local image with a new image name and tag

```
docker tag myimage:1.0 myrepo/
myimage:2.0
```

Push an image to a registry

```
docker push myrepo/myimage:2.0
```

Run

Run a container from the Alpine version 3.9 image, name the running container "web" and expose port 5000 externally, mapped to port 80 inside the container.

```
docker container run --name web -p
5000:80 alpine:3.9
```

Stop a running container through SIGTERM

```
docker container stop web
```

Stop a running container through SIGKILL

```
docker container kill web
```

List the networks

```
docker network ls
```

List the running containers (add `--all` to include stopped containers)

```
docker container ls
```

Delete all running and stopped containers

```
docker container rm -f $(docker ps -aq)
```

Print the last 100 lines of a container's logs

```
docker container
logs --tail 100 web
```

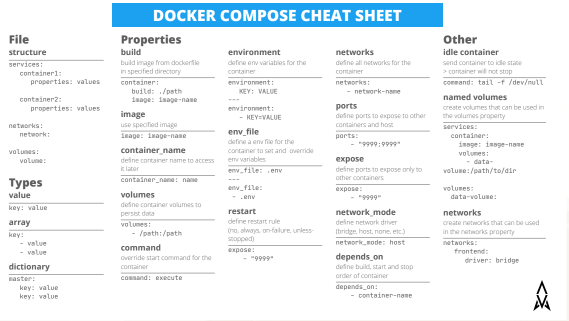
Docker Management

All commands below are called as options to the base `docker` command. Run `docker <command> --help` for more information on a particular command.

`app*`	*Docker Application*
`assemble*`	*Framework-aware builds (Docker Enterprise)*
`builder`	*Manage builds*
`cluster`	*Manage Docker clusters (Docker Enterprise)*
`config`	*Manage Docker configs*
`context`	*Manage contexts*
`engine`	*Manage the docker Engine*
`image`	*Manage images*
`network`	*Manage networks*
`node`	*Manage Swarm nodes*
`plugin`	*Manage plugins*
`registry*`	*Manage Docker registries*
`secret`	*Manage Docker secrets*
`service`	*Manage services*
`stack`	*Manage Docker stacks*
`swarm`	*Manage swarm*
`system`	*Manage Docker*
`template*`	*Quickly scaffold services (Docker Enterprise)*
`trust`	*Manage trust on Docker images*
`volume`	*Manage volumes*

*Experimental in Docker Enterprise 3.0.

www.docker.com



DOCKER COMPOSE CHEAT SHEET

File

structure

```
services:
   container1:
      properties: values

   container2:
      properties: values

networks:
   network:

volumes:
   volume:
```

Types

value

```
key: value
```

array

```
key:
   - value
   - value
```

dictionary

```
master:
   key: value
   key: value
```

Properties

build

build image from dockerfile in specified directory

```
container:
   build: ./path
   image: image-name
```

image

use specified image

```
image: image-name
```

container_name

define container name to access it later

```
container_name: name
```

volumes

define container volumes to persist data

```
volumes:
   - /path:/path
```

command

override start command for the container

```
command: execute
```

environment

define env variables for the container

```
environment:
   KEY: VALUE
---
environment:
   - KEY=VALUE
```

env_file

define a env file for the container to set and override env variables

```
env_file: .env
---
env_file:
 - .env
```

restart

define restart rule (no, always, on-failure, unless-stopped)

```
expose:
    - "9999"
```

networks

define all networks for the container

```
networks:
   - network-name
```

ports

define ports to expose to other containers and host

```
ports:
    - "9999:9999"
```

expose

define ports to expose only to other containers

```
expose:
    - "9999"
```

network_mode

define network driver (bridge, host, none, etc.)

```
network_mode: host
```

depends_on

define build, start and stop order of container

```
depends_on:
    - container-name
```

Other

idle container

send container to idle state
> container will not stop

```
command: tail -f /dev/null
```

named volumes

create volumes that can be used in the volumes property

```
services:
  container:
    image: image-name
    volumes:
      - data-
volume:/path/to/dir

volumes:
  data-volume:
```

networks

create networks that can be used in the networks property

```
networks:
   frontend:
      driver: bridge
```

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Singularity history

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- More adopted in Academic institutions
- Fork project in 2020 with now AppTainer (linux foundation) and SingularityCE
- HPC compatible, no root whrite, integrate ressource managers (slurm)
- Could use Docker images

Singularity commands

classical commands

```
$ singularity search [image_name]
$ singularity pull [image_name]
$ singularity run [image_name]
```

Singularity and Docker

Singularity can use Docker images

```
$ singularity pull docker://debian:latest
INFO:    Converting OCI blobs to SIF format
INFO:    Starting build...
Getting image source signatures
Copying blob f606d8928ed3 done
Copying config 0311b76201 done
Writing manifest to image destination
Storing signatures
2022/10/06 10:50:41  info unpack layer: sha256:f606d8928ed378229f2460b94b504cca239fb9
INFO:    Creating SIF file...
```