AN INTRODUCTION TO OS VIRTUALIZATION (AND DOCKER)

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Summary

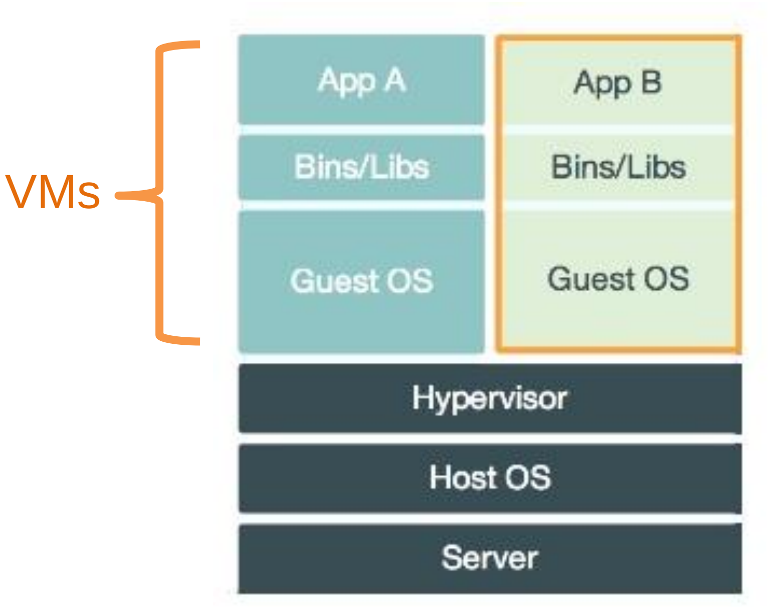
1. Virtualization
   1. Hardware (HW) virtualization
   2. Operating system (OS) virtualization
   3. Performance comparisons (HW vs OS virtualization)
2. Docker platform
   a. Docker image
   b. Docker container
   c. Docker registry
3. Try Docker

Virtualization and Cloud

- Maximize resources
- Shared system
- Cost reduction
- Decouple applications from the hardware

Hardware virtualization

Hypervisor (VMM)* manages multiple Virtual machines (VMs) on a single host.

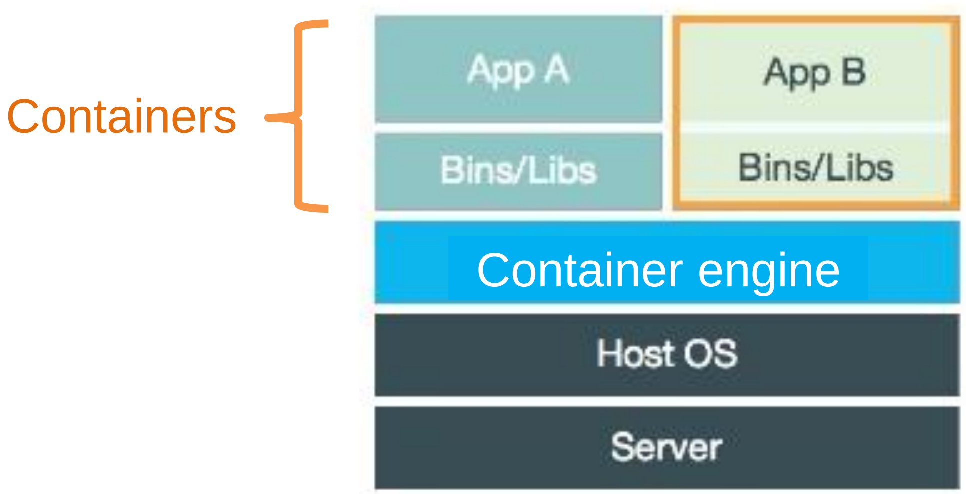


*type1 loaded directly on the Hw (data center), type 2 loaded in an OS running on the HW (desktop)

Operating system (OS) virtualization

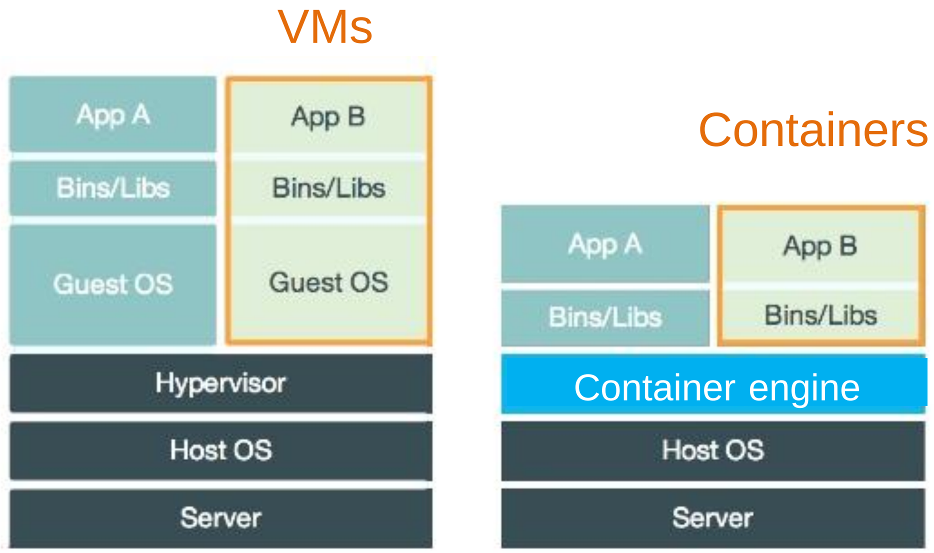
The **kernel*** of an operating system allows the existence of multiple isolated user-space instance, instead of just one.

Such instances are called **containers.**



(*) A *kernel* is the part of the operating system that mediates access to system resources. It's responsible for enabling multiple applications to effectively share the hardware by controlling access to CPU, memory, disk I/O, and networking

Hardware VS OS virtualization



- Lightweigth virtualization
- Less resource consumptions (CPU, Memory)
- Faster start-up

Performance comparisons

Time to scale:
- 1 container : 8 secs
- 1 VM : 3 mins

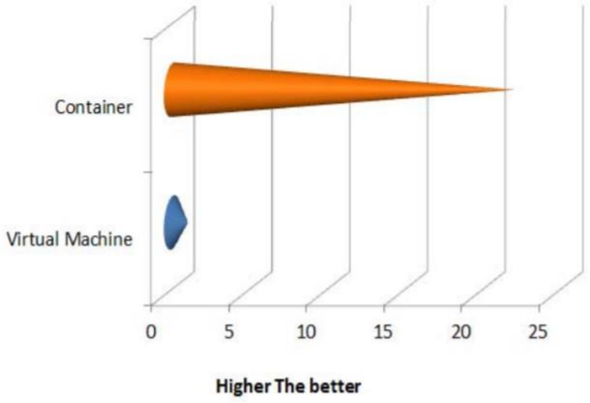


Fig. 8. Scalability between VM's and Containers

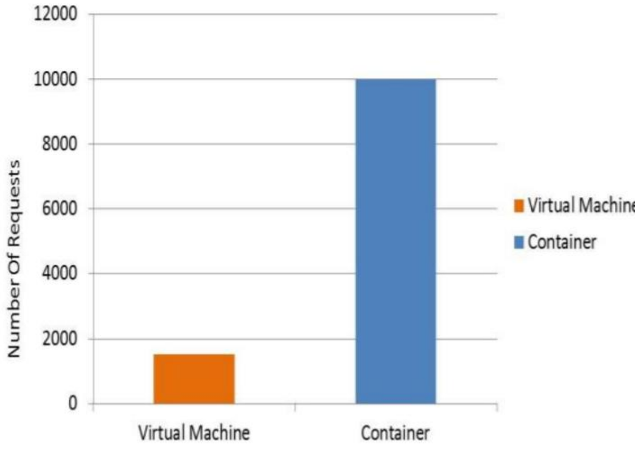


Fig. 6. Processed requests in 600 seconds

A. M. Joy, "Performance comparison between Linux containers and virtual machines," *2015 International Conference on Advances in Computer Engineering and Applications*,

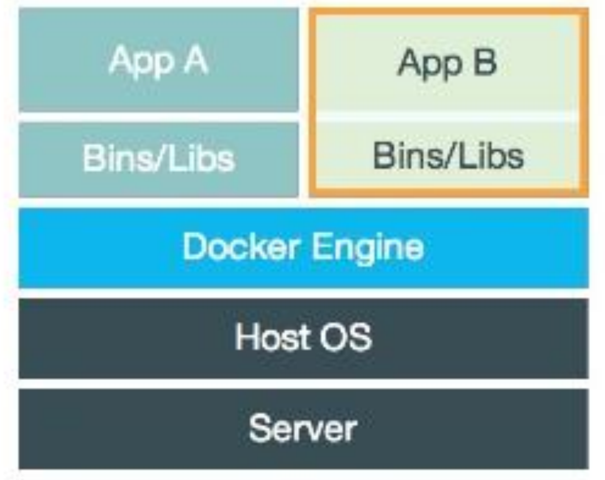
A CONTAINER ENGINE

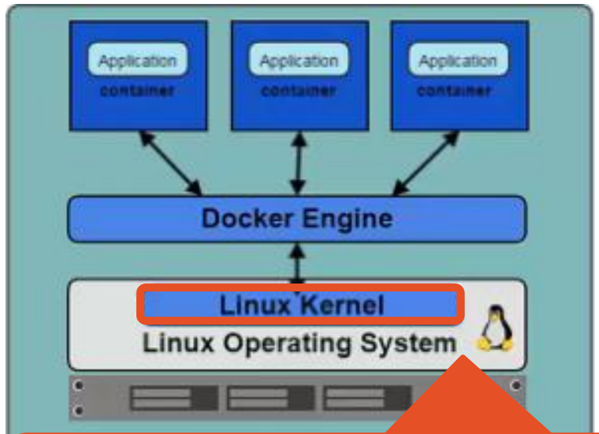
Docker

Docker is a platform for developing, shipping, and running applications using **container-based** technology

Docker engine

The Docker engine (aka. Docker daemon) is the program that enables containers to be built, shipped and run.





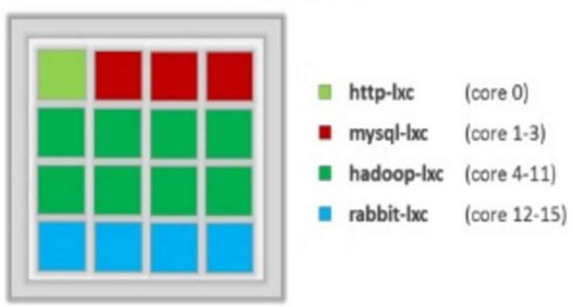
Uses the linux kernel features (cgroups, namespaces,...) to run isolated containerrs

Linux kernel features (some...)

cgroups

Control Groups provides resource *limiting* and *metering (e.g. memory, CPU, network, I/O).*

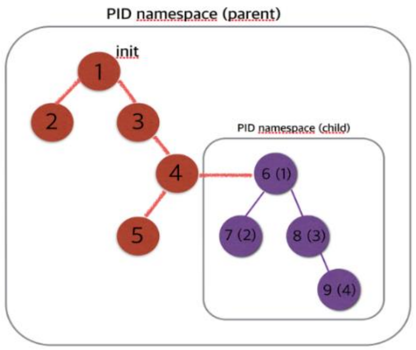
“Limit How much you can use”



Namespaces

Provides processes with their own view of the system (namespaces example: *pid, net, user…)*

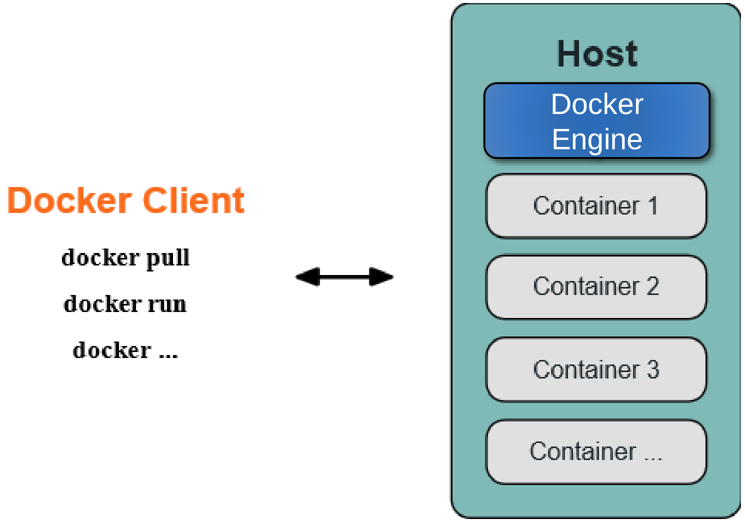
“*Limits what you can see (and therefore use)”*



Docker architecture

Client-server architecture:

- Server: **Docker Engine** (daemon)
- Client: `docker` command line interface.



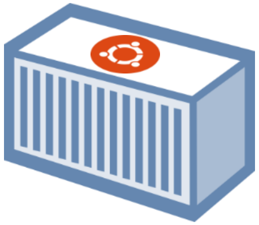
Docker platform

Key components of the Docker platform:

Docker image

e.g. ubuntu:16.04

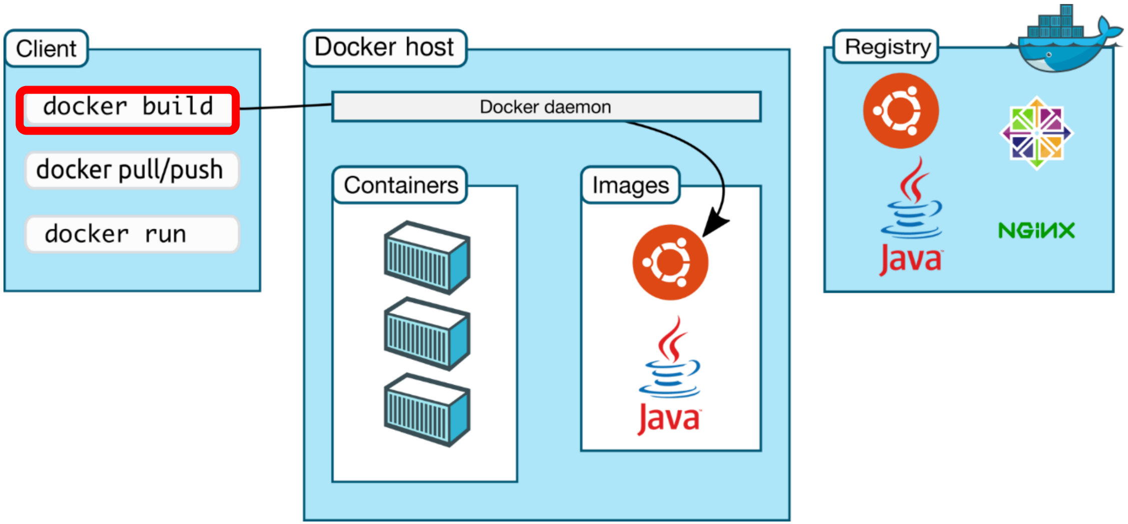
Docker container



Docker registry

Docker: **build** an image

An *Image* is a read-only template composed by a filesystem and parameters to use at runtime.



```
docker build [OPTIONS] PATH | URL | -
```

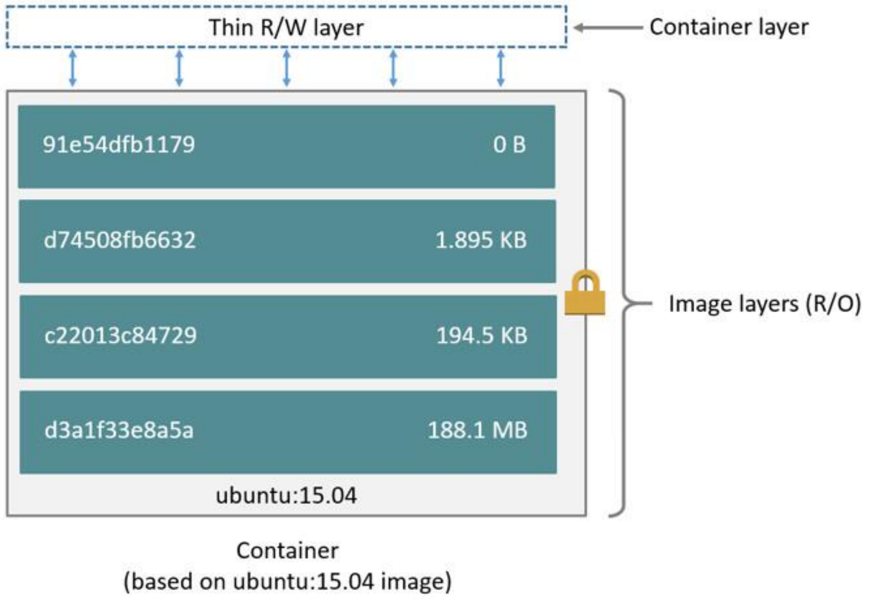
Docker image

References a list of read-only layers that represent filesystem differences. Layers are stacked on top of each other to form a base for a container's root filesystem

Add {your code}

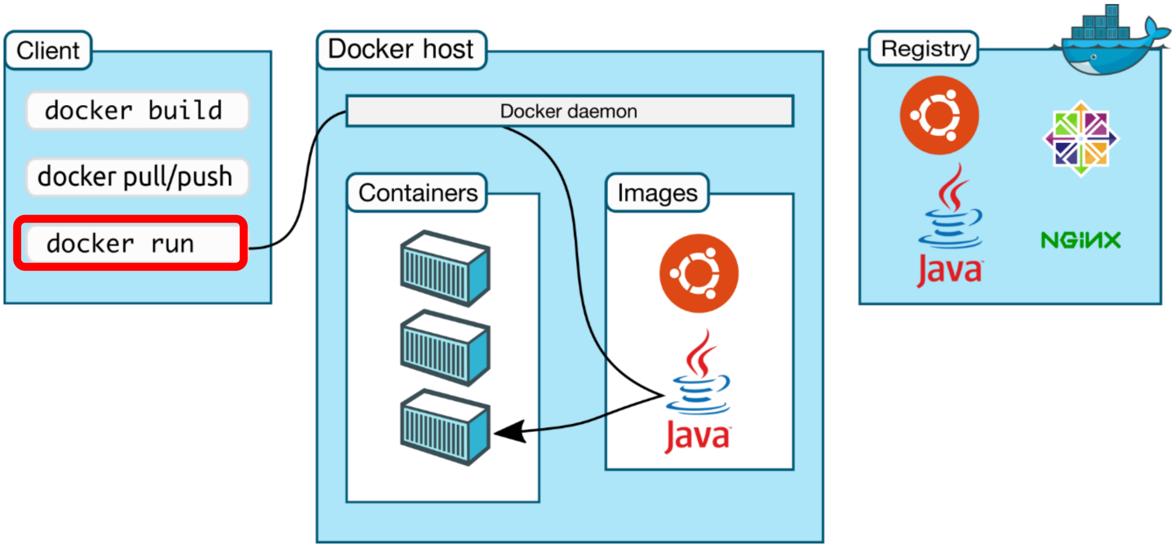
Add Python

Add pip



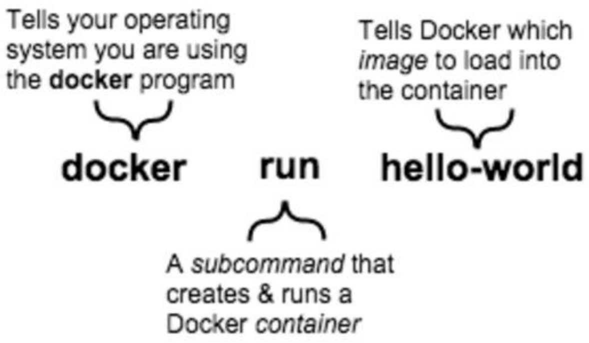
Docker: **run** a container

A *container* is a running instance of an image. From a single image multiple containers can be run.



```
$ docker run [OPTIONS] IMAGE[:TAG|@DIGEST] [COMMAND] [ARG...]
```

Hello-world with Docker

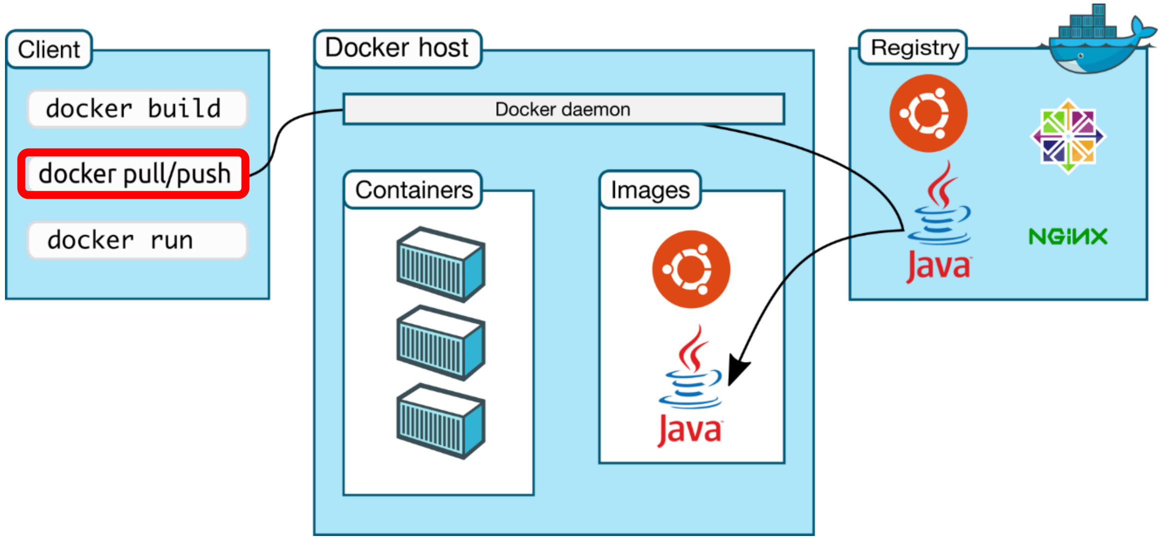

Tells your operating system you are using the **docker** program
Tells Docker which *image* to load into the container
docker
run
hello-world
A *subcommand* that creates & runs a Docker *container*

Other examples:

```
docker run alpine ping www.di.unipi.it
docker run -it ubuntu bash
```

Docker: **pull/push** to a registry

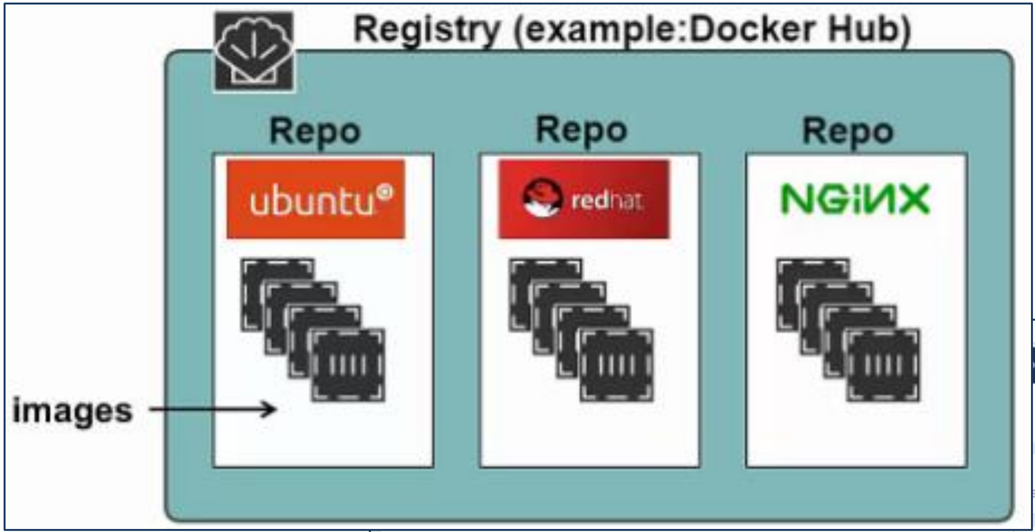
The registry is where we store our images. It can be a local registry or the public registry (Docker Hub: https://hub.docker.com/)

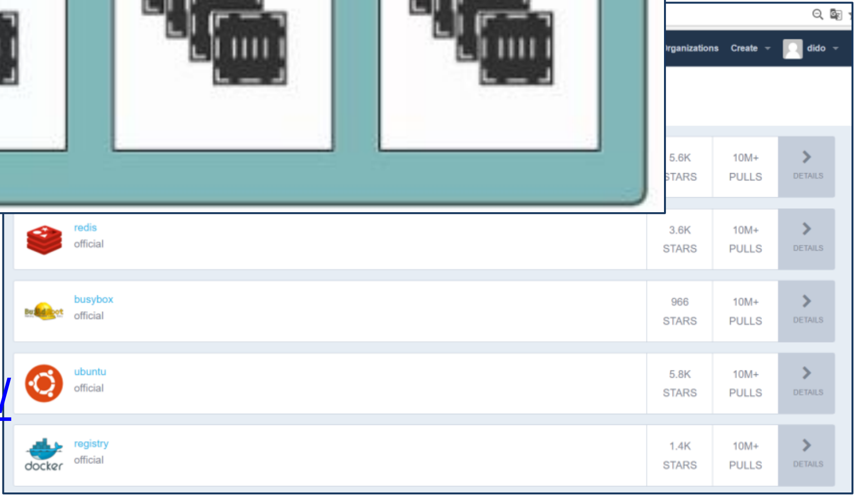


```
docker pull [OPTIONS] NAME[:TAG|@DIGEST]
```

```
docker push [OPTIONS] NAME[:TAG]
```

Docker registry





	5.6K STARS	10M+ PULLS	DETAILS
redis official	3.6K STARS	10M+ PULLS	DETAILS
busybox official	966 STARS	10M+ PULLS	DETAILS
ubuntu official	5.8K STARS	10M+ PULLS	DETAILS
registry official	1.4K STARS	10M+ PULLS	DETAILS

https://hub.docker.com/

TRY DOCKER

http://labs.play-with-docker.com/

THE END

Q&A

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