Docker basics

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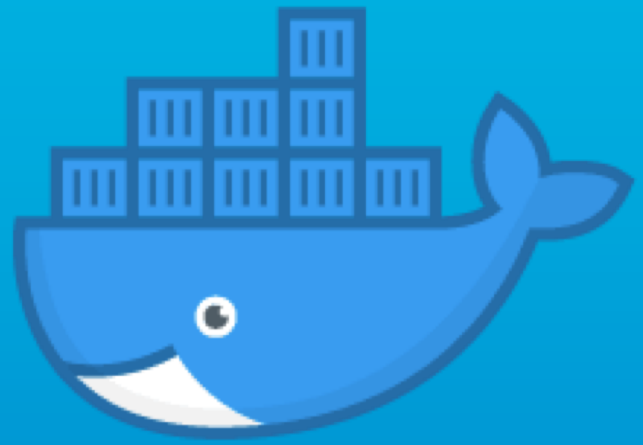

June 21, 2019

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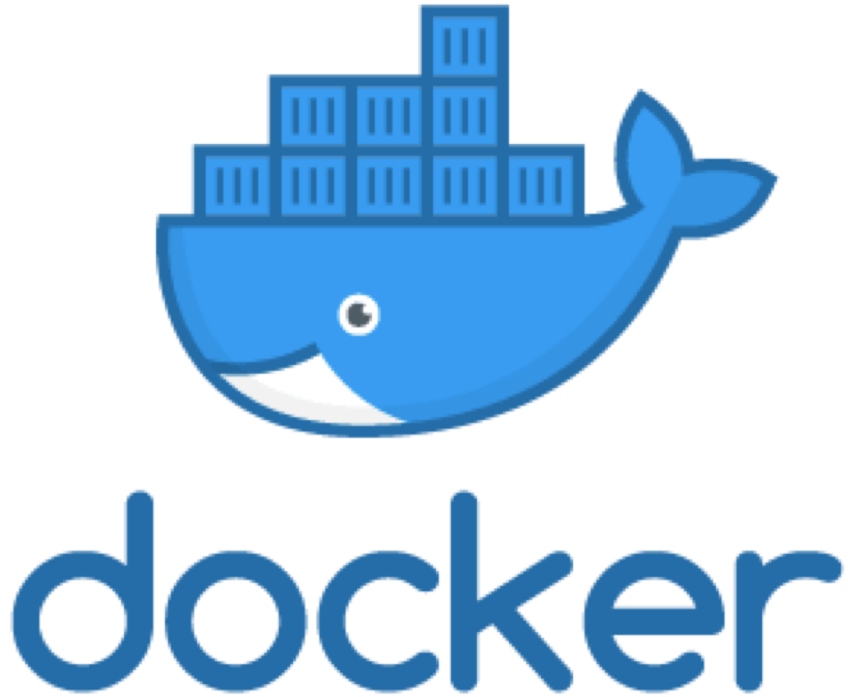


docker why

- Choose an OS
- Install CUDA and CuDNN
- Install python (2.7? 3.5? 3.8?) & libraries
- Install tensorflow
- TF & CUDA versions not compatible
- Expose ports
- Possible conflicts
- Breaking updates
- Different OS/libraries in Dev/Prod
- Ok, but now it doesn't scale
- HEEEEELLLLPP!!!!!!

- Install Docker
- Write a Dockerfile
- docker build
- docker run
-

docker why

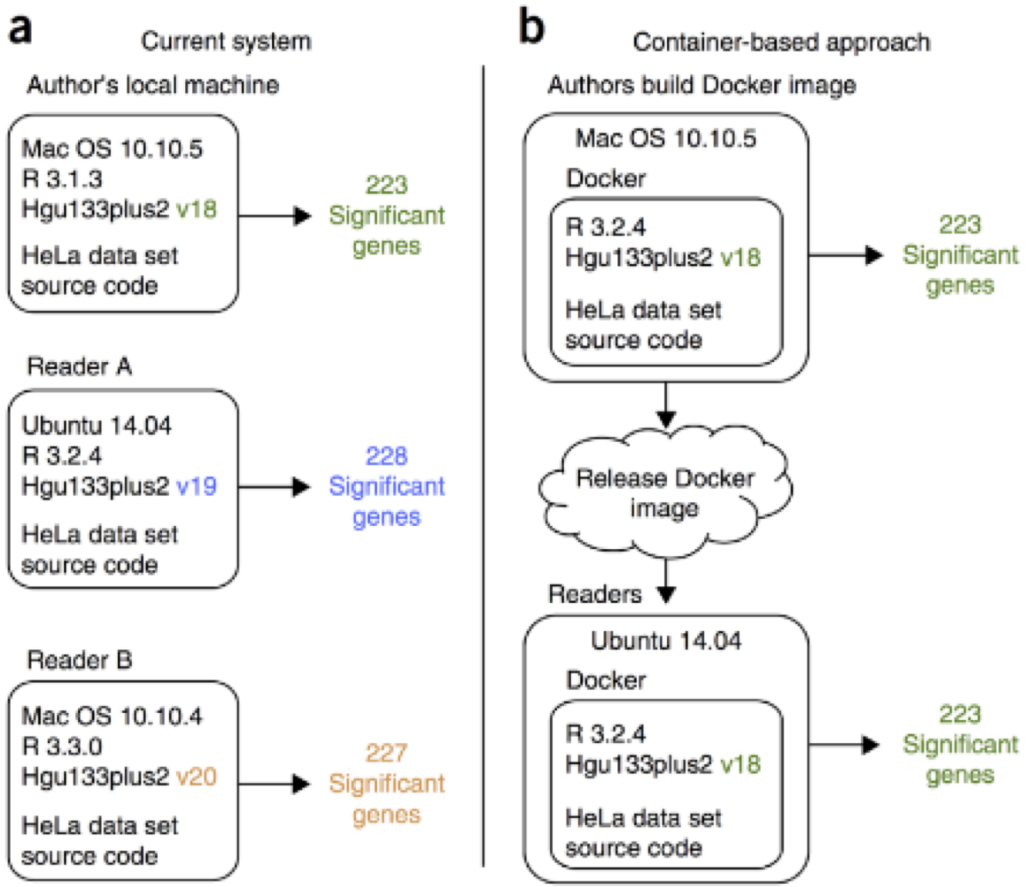
A true story

nature biotechnology

Reproducibility of computational workflows is automated using continuous analysis

Brett K Beaulieu-Jones[1] & Casey S Greene[2]

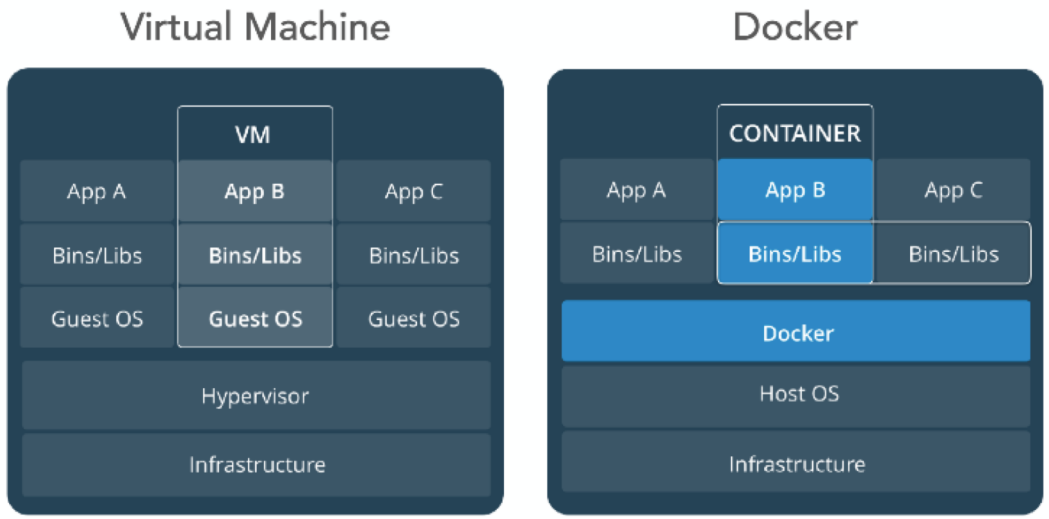
Beaulieu-Jones & Greene (2017) doi:10.1038/nbt.3780



docker what

virtual machines solve the **dependency** issue…

…but they're very resource-intensive (**scalability**). We need a lighter framework



docker what

Docker containers are:

- Cheaper
- Less computational overhead
- Trendy
- Made to crash and be restarted
- Scaling and coordinating is easy
- **Develop code in your preferred environment, run anywhere**

docker what

Docker containers are **not** virtual machines:

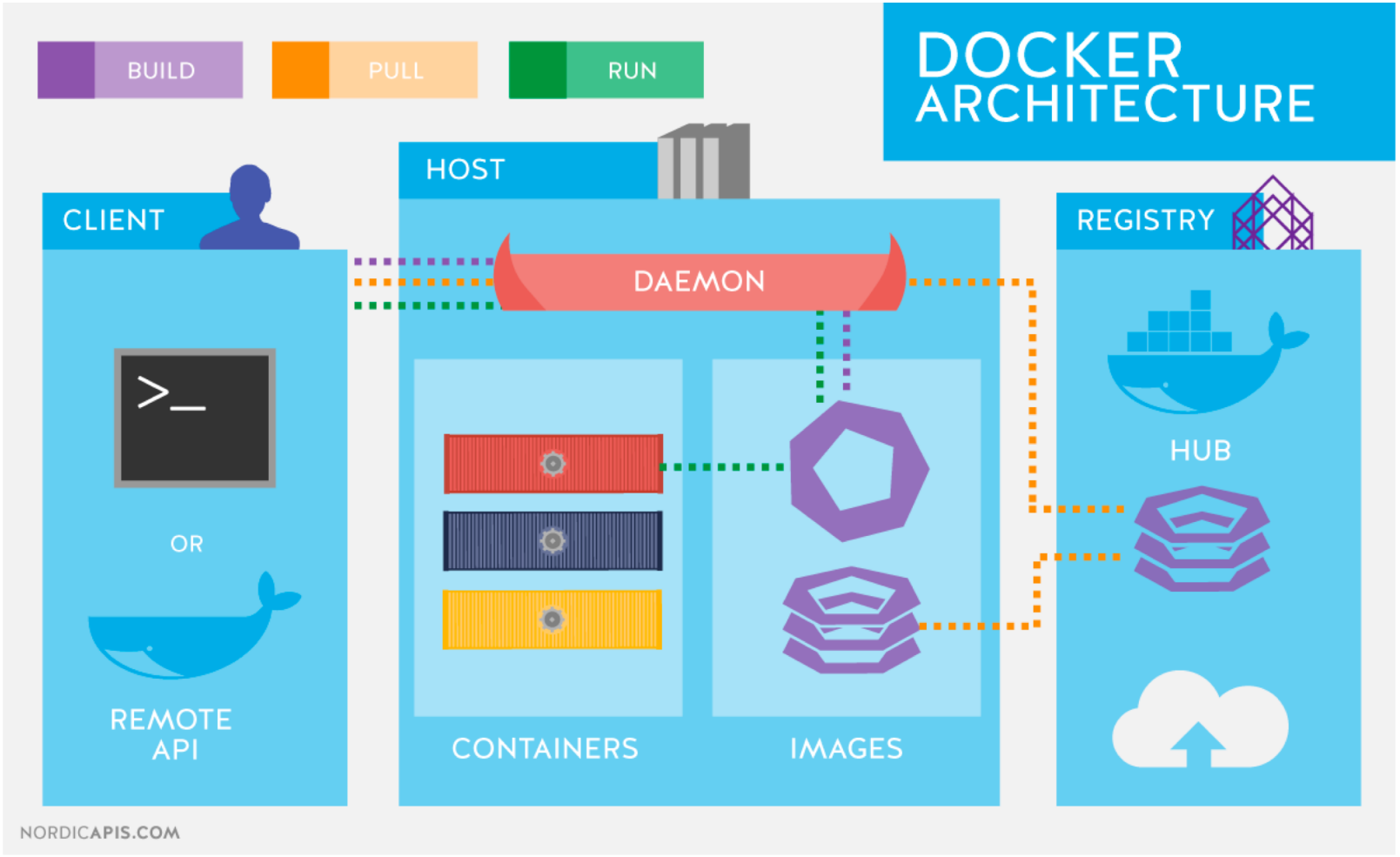
- “VMs are like houses, each is a single unit w/ standalone plumbing and wiring. Containers are like apartments; each one is a unit (process) in a host (building), sharing the plumbing and wiring w/ one another as well as the rest of the building” (Mike Coleman - Technology Evangelist, Docker)

docker vocabulary

image	package defining a working environment (binary file)
container	a running instance of an image (process)
Dockerfile	text file containing commands to build an image
Docker Hub	A website/repository for sharing Docker images
Docker client	sends CLI commands to Docker daemon through Docker REST API (process)
Docker daemon	executes calls from Docker client

Docker native client/server architecture makes it easy to design web services

docker architecture



docker how

- Define an image by writing a Dockerfile
- FROM: initialize a new build stage & set base image. A valid Dockerfile **must** start with FROM.
- LABEL: add metadata to an image (key/value pair). A typical key is maintainer
- COPY: copy files/folders from <src> and add to container filesystem at path <dest>
- RUN: execute commands in a new layer on top of the current image and commit results
- WORKDIR: set working directory for any command which follows
- CMD: defaults for the container execution

```
FROM tensorflow/tensorflow:1.13.1-py3-jupyter

LABEL maintainer="youremail@here.com"

COPY Container-Root /

RUN pip3 install --user --upgrade -r /requirements.txt

WORKDIR /

CMD ./startup.sh
```

docker how

To build the image, from the Dockerfile directory run

`docker build [BUILD_OPTS] -t IMAGE:[TAG]` (tip: **always** name & tag your images)

Docker downloads the base image from the Web (if it didn't do it before) and starts building. After building, to run the container, in any directory run

`docker run [OPTIONS] IMAGE[:TAG|@DIGEST] [COMMAND] [ARG...]`
(can be complicated…but see later!)

Each container is an instance of an image: you can run multiple (containers) instances based on the same image, as long as each has a unique name.

Containers are stateless and immutable: once a container completes execution, all its content is lost, and any other container started from the same image doesn't inherit any state from the first one (**reproducibility**).

Mapping local folders

All content from a Docker container is lost, once it terminates execution. In order to export content from it, we **map** a folder on the host filesystem, to a folder in the Docker container filesystem. Example:

```
docker run -v /home/andrea/docker_test:/test -it ubuntu /bin/bash
```

maps the folder `docker_test` on the host system to the folder `/test` in the Docker container, starts a container based on the `ubuntu` image in interactive mode and drops you in the `bash` shell.

depend --on-docker

Depend On Docker is a framework developed at BHGE Digital which helps building, shipping & running applications with Docker.

`docker --deep-learning`

- Let's build a simple image and make some practice with Depend on Docker
- We will create an image to run a pre-trained ResNet-50 model in Keras, inside a Jupyter notebook

```
git clone https://github.com/AndreaPi/docker-training-2019-public.git
```

Manage images/containers

docker images -aq	List all images
docker ps -a	**List all containers:** you need to remove containers before you can remove images
docker rm <container-ID>	remove container
docker rm $(docker ps -aq)	remove all containers
docker rmi <image-ID>	remove image
docker rmi $(docker images -aq)	Remove all images
docker run --rm --it --name cntr myimage	run container with name **cntr**, from image *myimage*, in interactive (*it*) mode and remove (*rm*) container after you exit: **great** to avoid having many hanging containers

`docker resources`

- the official Docker cheatsheet
- Another cheatsheet
- Yet another one
- Some Docker notes
- https://docs.docker.com/engine/reference/builder/
- https://docs.docker.com/develop/develop-images/dockerfile_best-practices