Docker Fundamentals

.NET CORE

*Docker provides the ability to package and run an application in a loosely isolated environment called a **container**. You can run many containers simultaneously on a given host. Containers don't need a hypervisor and run directly within the host machine's kernel and can even run within virtual host machines.*

HTTPS://DOCS.DOCKER.COM/ENGINE/DOCKER-OVERVIEW/

What is Containerization?

https://hackernoon.com/what-is-containerization-83ae53a709a6

Containerization involves bundling an application together with all its related configuration files, libraries, and dependencies required for it to run efficiently and bug-free across different computing environments.

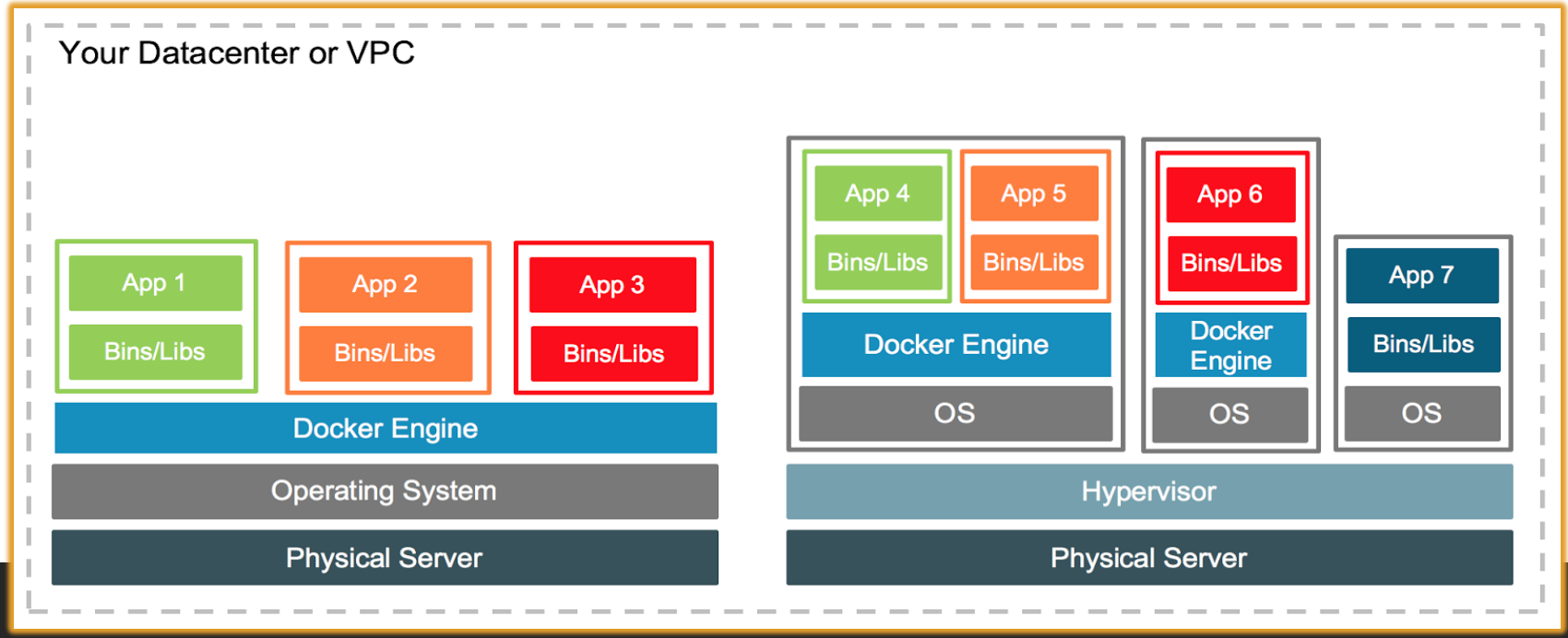
The most popular ***containerization*** ecosystems are ***Docker*** and Kubernetes.

What is Virtualization?

https://en.wikipedia.org/wiki/Virtualization#Hardware_virtualization
https://www.docker.com/blog/containers-and-vms-together/

In computing, virtualization refers to the act of creating a virtual (rather than actual) version of something.
Hardware ***virtualization*** or platform ***virtualization*** refers to the creation of a virtual machine (an application) that simulates a real computer with an operating system.

Software executed on a virtual machine is separated from the underlying hardware resources.



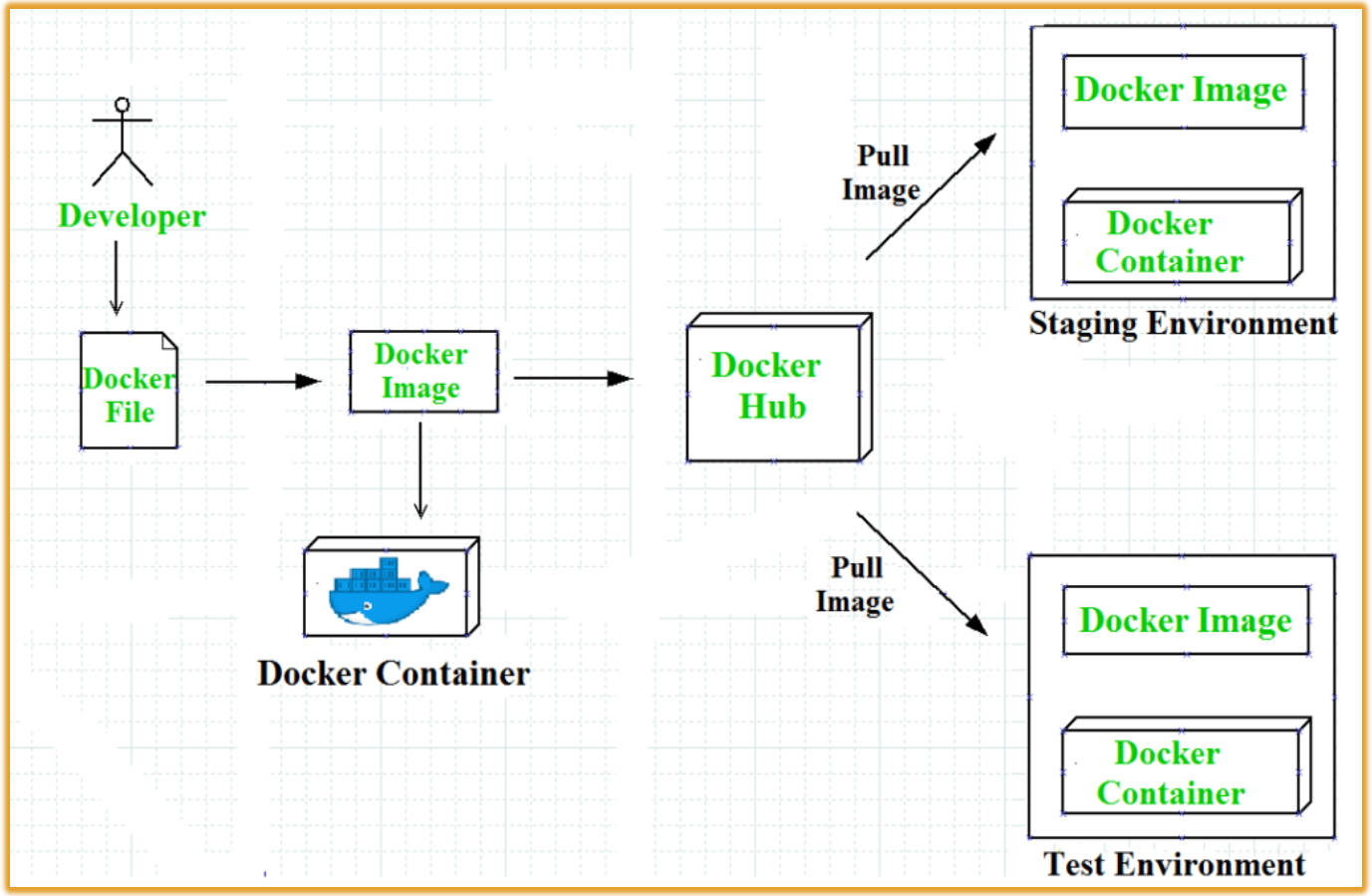
V · T · E	Virtualization software		[hide]
Comparison of platform virtualization software			
Hardware virtualization (hypervisors)	**Native**	Adeos · CP/CMS · Hyper-V · KVM (Red Hat Enterprise Virtualization) · LDoms / Oracle VM Server for SPARC · Logical Partition (LPAR) · LynxSecure · PikeOS · Proxmox VE · SIMMON · VMware ESXi (VMware vSphere · vCloud) · VMware Infrastructure · Xen (Oracle VM Server for x86 · XenServer) · XtratuM · z/VM	
	Hosted	**Specialized**	Basilisk II · bhyve · Bochs · Cooperative Linux · DOSBox · DOSEMU · PCem · PikeOS · SheepShaver · SIMH · Windows on Windows (Virtual DOS machine) · Win4Lin
		Independent	Microsoft Virtual Server · Parallels Workstation · Parallels Desktop for Mac · Parallels Server for Mac · PearPC · QEMU · VirtualBox · Virtual Iron · VMware Fusion · VMware Server · VMware Workstation (Player) · Windows Virtual PC
	Tools	Ganeti · oVirt · System Center Virtual Machine Manager · Virtual Machine Manager	
OS-level virtualization	**OS containers**	FreeBSD jail · iCore Virtual Accounts · Linux-VServer · LXC · OpenVZ · Solaris Containers · Virtuozzo · Workload Partitions	
	Application containers	Docker · lmctfy · rkt	
	Virtual kernel architectures	User-mode Linux · vkernel	
	Related kernel features	BrandZ · cgroups · chroot · namespaces · seccomp	
	Orchestration	Amazon ECS · Kubernetes · OpenShift	
Desktop virtualization	Citrix XenApp · Citrix XenDesktop · Remote Desktop Services · VMware Horizon View · Ulteo Open Virtual Desktop		
Application virtualization	Ceedo · Citrix XenApp · Dalvik · InstallFree · Microsoft App-V · Remote Desktop Services · Symantec Workspace Virtualization · Turbo · VMware ThinApp · ZeroVM		
Network virtualization	Distributed Overlay Virtual Ethernet (DOVE) · Ethernet VPN (EVPN) · NVGRE · Open vSwitch · Virtual security switch · Virtual Extensible LAN (VXLAN)		
See also: List of emulators			

Docker – Purpose

https://docs.docker.com/engine/docker-overview/#what-can-i-use-docker-for

Docker allows developers to work in standardized environments using ***containers*** which provide applications and services. ***Containers*** are great for ***CI/CD*** workflows.

1. Developers write code locally in a ***development environment*** and share their work using Docker ***containers***.
2. They use Docker to push their applications into a test environment to execute automated and manual tests.
3. Bugs can be fixed in the ***development environment*** and redeployed to the ***test environment*** for re-testing and validation.
4. When testing is complete, push the updated image to the ***production environment***.



Docker – Benefits

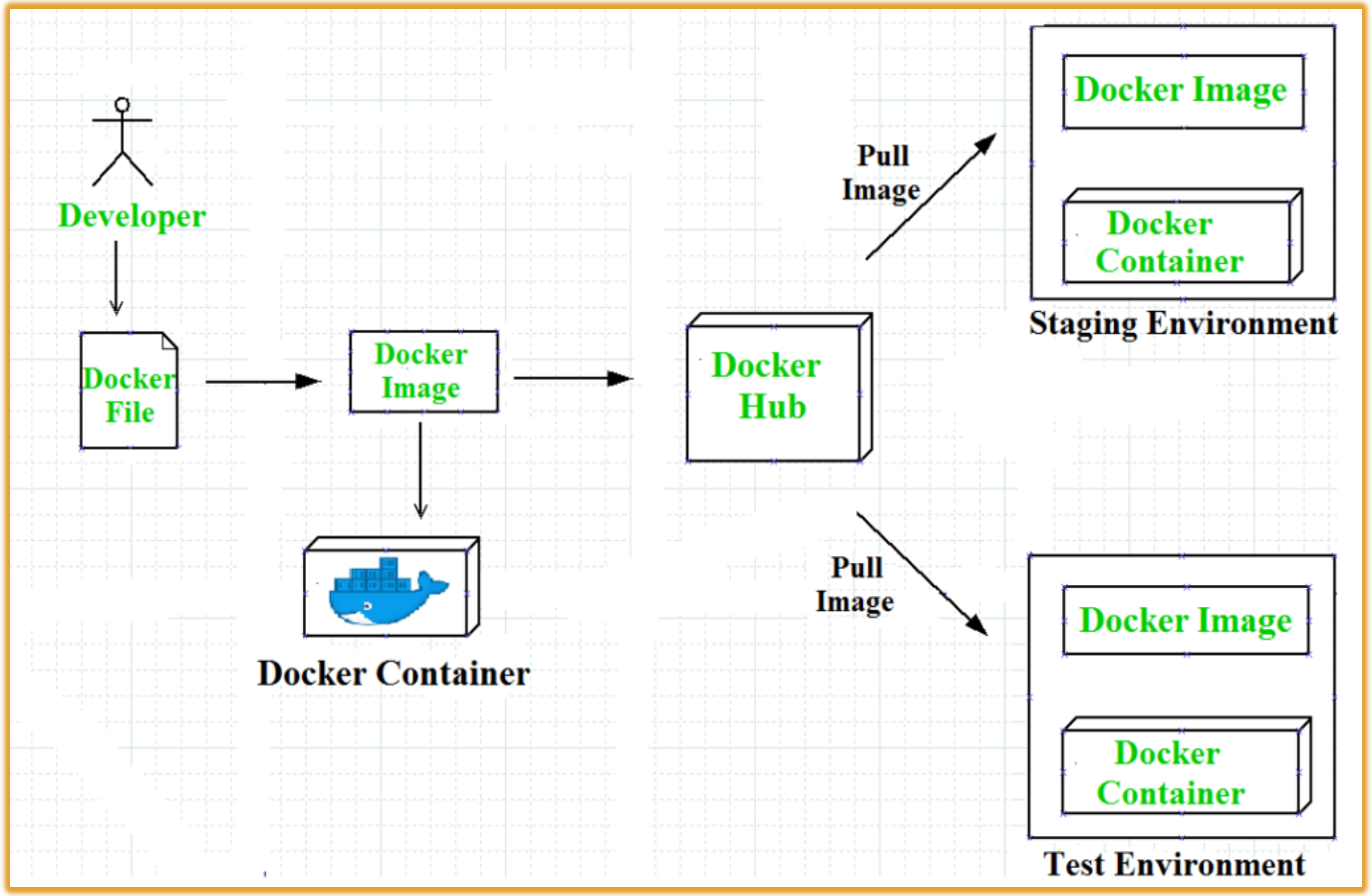
https://docs.docker.com/engine/docker-overview/#what-can-i-use-docker-for

Responsive deployment and scaling

- *Docker Containers* are portable and can run on a developer's local laptop, on physical and virtual machines, in a data center, or on cloud providers.
- You can scale up or tear down applications (and services) as business needs dictate.

Running more workloads on the same hardware

- Docker is lightweight and fast.
- Docker is NOT itself a Virtual Machine.
  - a *virtual machine* (VM) runs a full-blown "guest" operating system with *virtual* access to host resources through a hypervisor. VMs incur a lot of overhead.



The Docker Platform

https://www.docker.com/resources/what-container

Docker provides a platform to manage the entire lifecycle of your ***containers***:

1. You develop an application and its supporting components using ***containers***.
2. The ***container*** becomes the unit for distributing and testing your application.
3. Deploy your application into your production environment as a ***container***. This works the same whether your production environment is a local data center, a cloud provider, or a hybrid of the two.

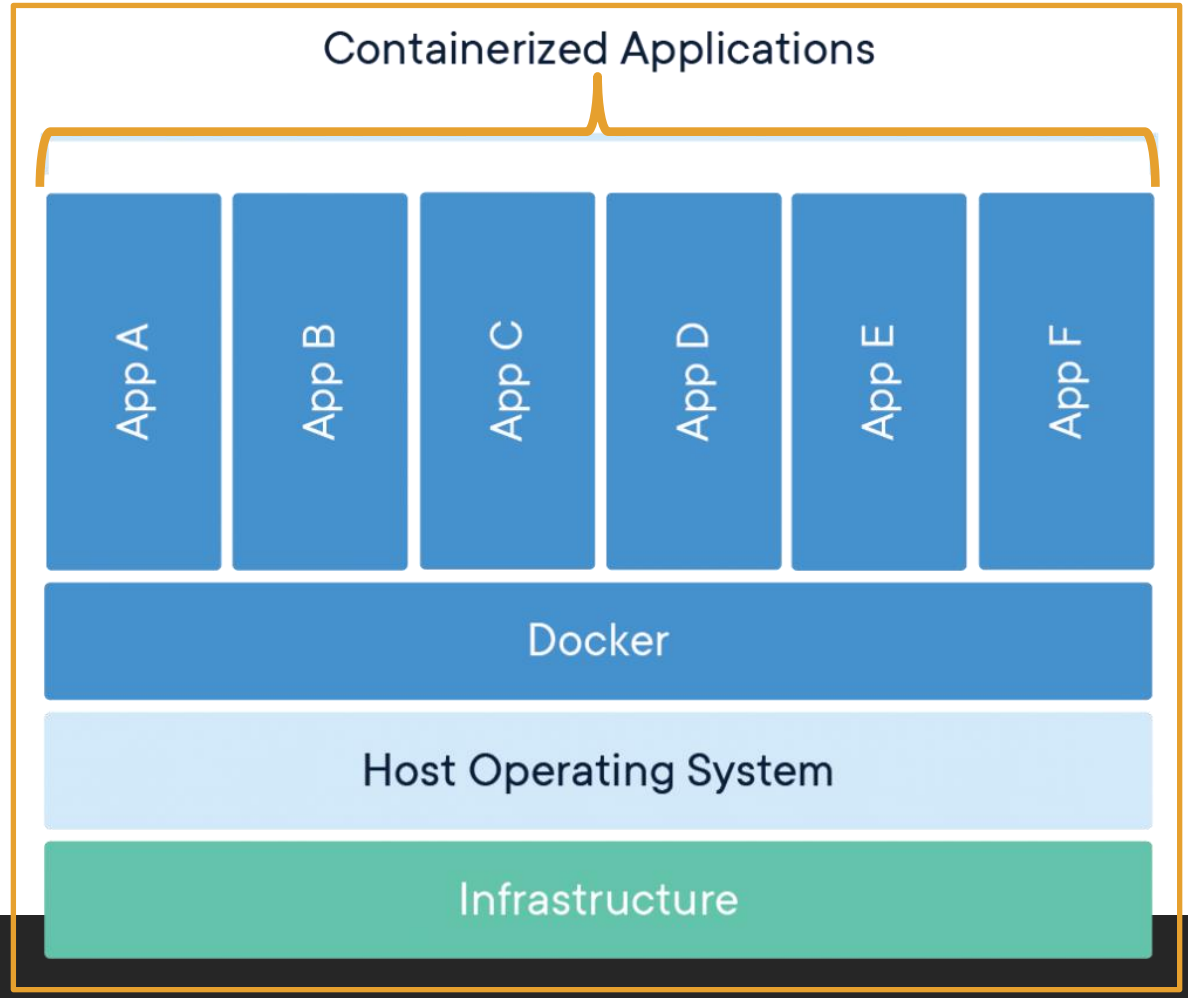
Docker Container

https://www.docker.com/resources/what-container
https://docs.docker.com/get-started/

A ***Docker Image*** is a standalone executable package of software that includes everything needed to run an application: code, runtime, system tools, system libraries, and settings.

Docker Images become ***Docker Containers*** at runtime when run on the ***Docker Engine***. ***Containers*** run identically, regardless of the infrastructure (Linux or PC).

A ***Docker Container*** isolates software from its environment. Each container interacts with its own private filesystem.

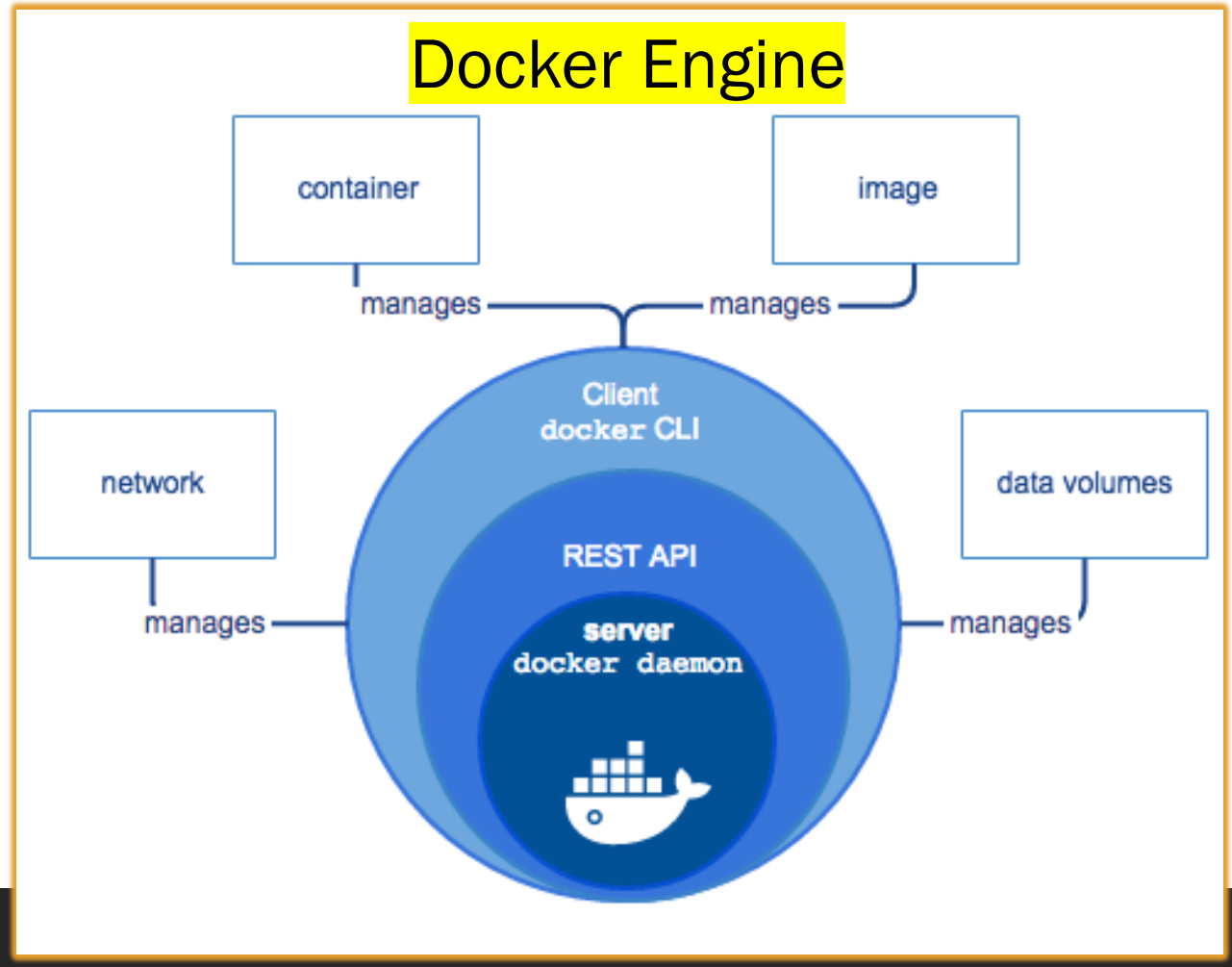


Docker Engine

https://docs.docker.com/engine/docker-overview/#docker-engine

Docker Engine is a client-server application with three major components:

1. A server which is a type of long-running program called a ***daemon*** process (the ***dockerd*** command).
2. A ***REST API*** which specifies interfaces that programs can use to talk to the daemon and instruct it what to do.
3. A command line interface (***CLI***) client (the **docker** command).

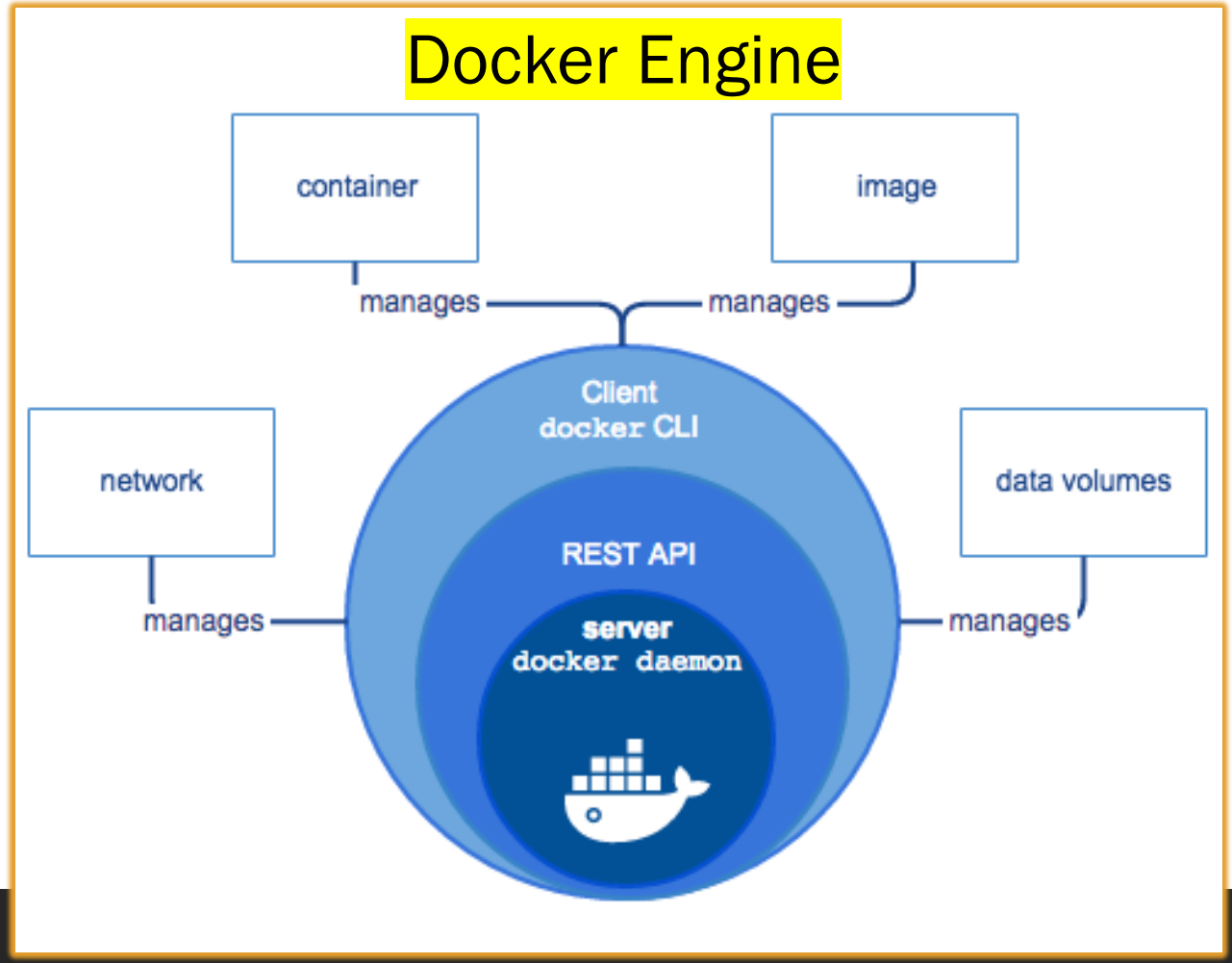


Docker Engine

https://docs.docker.com/engine/docker-overview/#docker-engine

The ***CLI*** uses the ***Docker REST API*** to control or interact with the ***Docker daemon*** through scripting or direct ***CLI*** commands. Many other Docker applications use the underlying ***API*** and ***CLI***.

The ***daemon*** creates and manages Docker objects, such as ***images***, ***containers***, networks, and volumes.



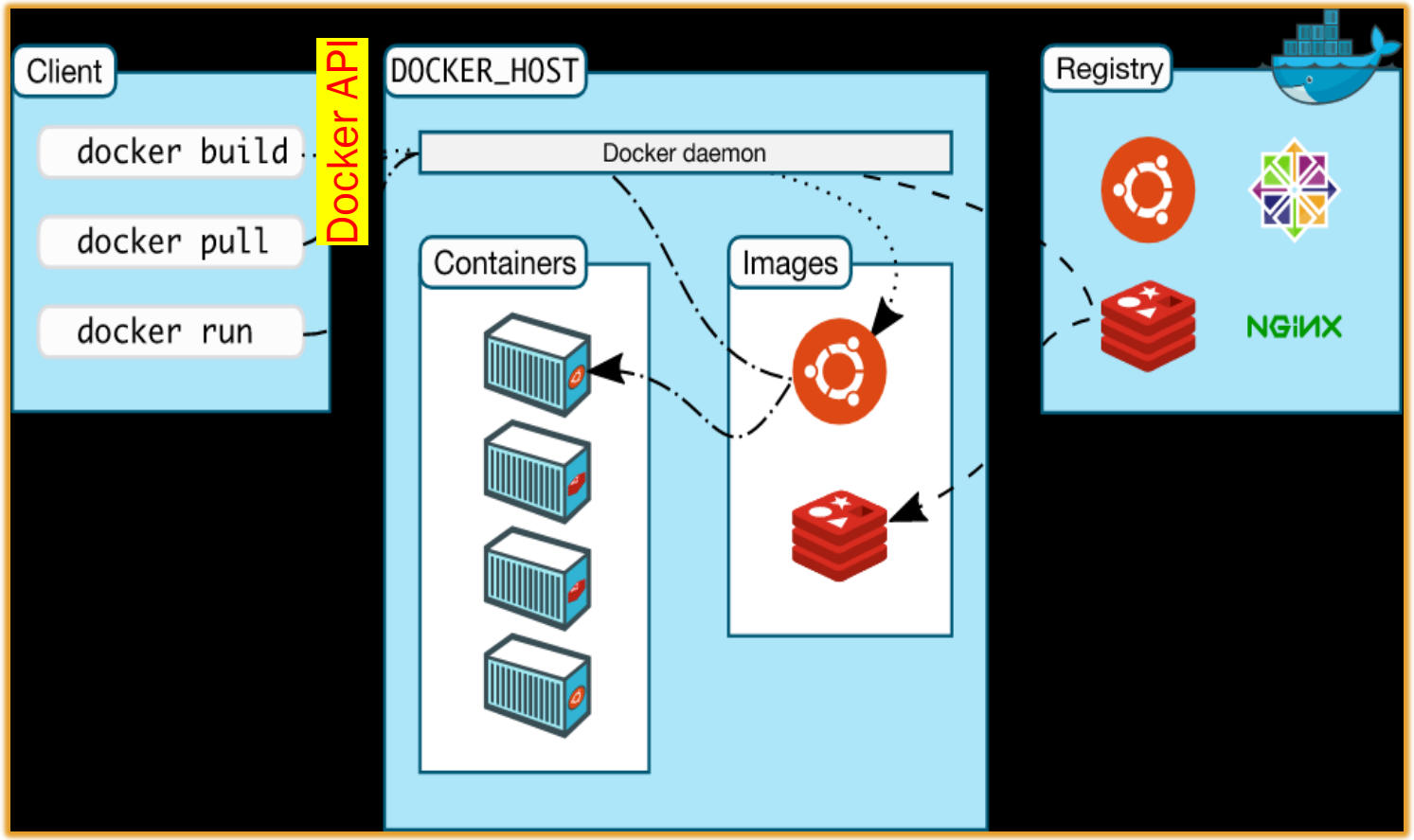
Docker Architecture

https://docs.docker.com/engine/docker-overview/#docker-architecture

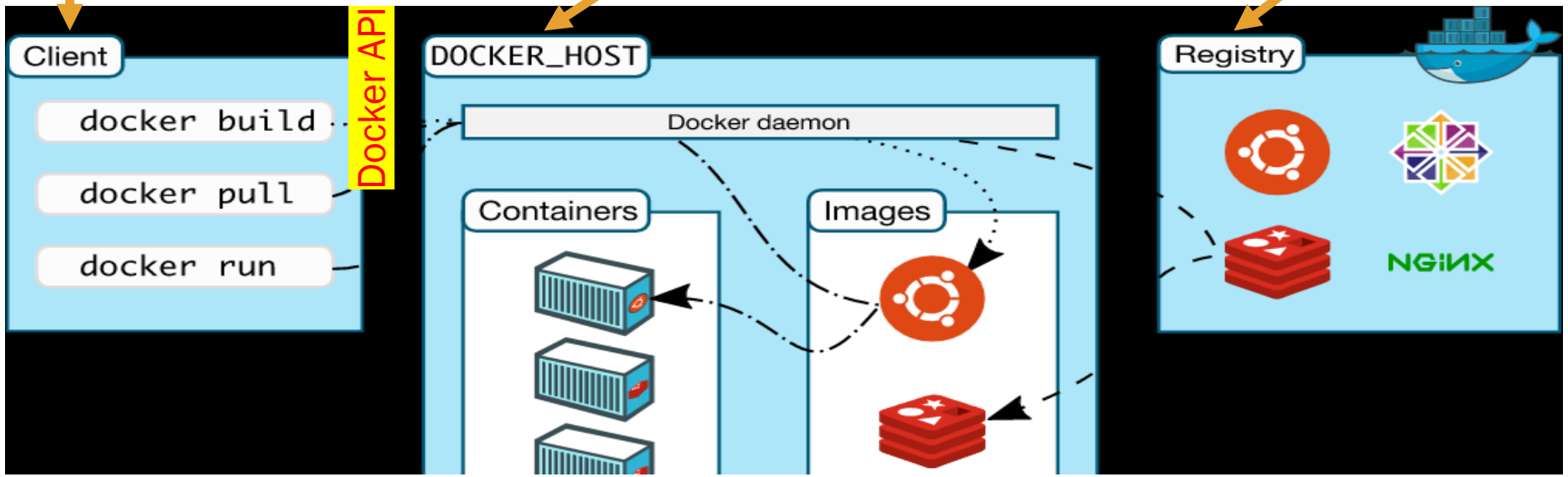
Docker uses a ***client-server architecture***. The ***Docker client*** talks to the ***Docker daemon (server)***, which does the heavy lifting of building, running, and distributing ***Docker containers***.

The ***Docker client*** and ***daemon*** can run on the same system, or you can connect a Docker client to a remote Docker daemon.

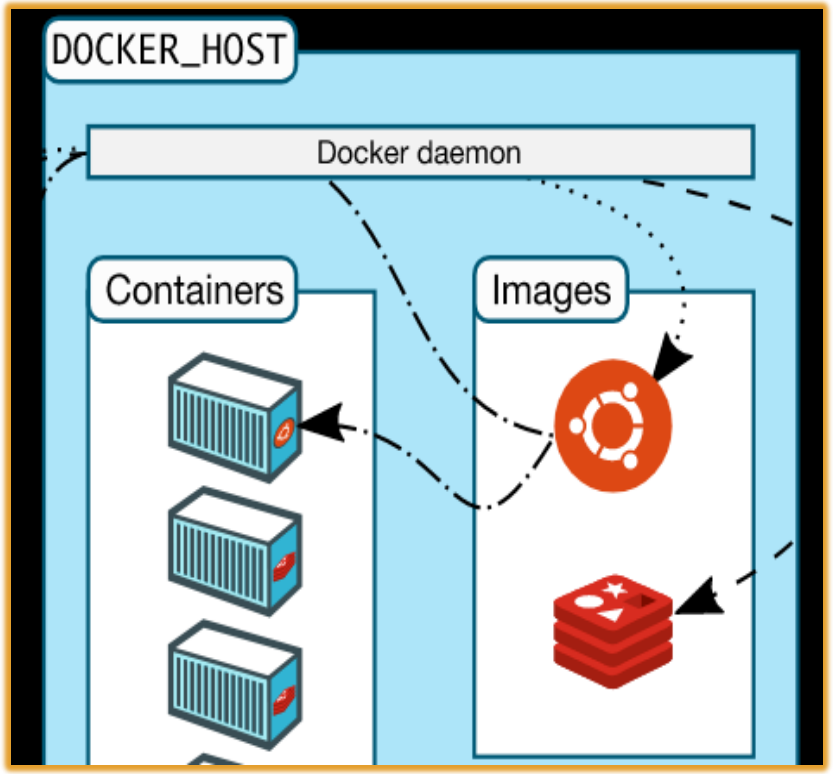
The ***Docker client*** and ***daemon*** communicate using a REST API.



Docker Client	Docker daemon	Docker registries
The ***Docker client (docker)*** is the primary way that most Docker users interact with Docker. With ***docker run***, the client sends these commands to ***dockerd***, which carries them out. The docker command uses the ***Docker API***.	The ***Docker daemon (dockerd)*** listens for ***Docker API*** requests and manages ***Docker objects*** such as ***images***, ***containers***, ***networks***, and ***volumes***.	A **Docker registry** stores **Docker images**. **Docker Hub** is a public registry. With the **docker pull** or **docker run** commands, images are pulled from the configured registry. When you use the **docker push** command, the **image** is pushed to the configured registry.



A *container* is a runnable instance of an ***image***. You can create, start, stop, move, or delete a ***container*** using the ***Docker API*** or ***CLI***. You can connect a ***container*** to one or more networks, attach storage to it, or even create a new ***image*** based on its current state.
A ***container*** is defined by its ***image*** as well as any configuration options you provide to it when you create or start it.



An *image* is a read-only template with instructions for creating a ***Docker container***. An ***image*** can be based on another ***image***, with some additional customization.

An ***image*** could be based on the ubuntu ***image***, but install the Apache web server and your application as well as the configuration details needed to make your application run. Images can be published in a registry.

To build an ***image***, create a ***Dockerfile*** defining the steps to create an ***image*** and run it.
When you change a ***Dockerfile*** and rebuild the ***image***, only those layers which have changed are rebuilt

List of Basic Docker commands

Command	Purpose
docker start [containername]	Start a container.
docker images	List images installed
docker container command	Manage containers
docker stop [containername]	Stop a running container
docker image ls	list the images downloaded to your machine.
docker ps --a	Lists all containers
docker run [containername]	
docker build –t myimage –f dockerfile .	Build an image called myimage from a Dockerfile
docker stop [containername]	Stop a running container
docker rm [containername]	Delete a container
docker push [imagename]	Push an image to your repo in the Docker Registry
docker create myimage	Create an unstarted container from an image
docker ps	Show running containers
docker attach [containername]	Connect to a running container

Docker – Setup and Test Container

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

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1. Download Docker Desktop.
2. Go to Docker.com and create an account
3. Run ***docker –version*** in the Command Line.
4. Run ***docker run Hello-World*** to test that docker is running correctly.
5. Run ***docker image ls*** to list the downloaded hello-world image on your machine.
6. Run ***docker ps –all*** to see the container created from the ***Hello-World image***.
7. Do the Docker tutorial here.
8. Then complete the Getting Started Walk-through for Developers tutorial.

Assignment 2

The assignment for after finishing the tutorials is to redo this tutorial.
The difference is that:

- you will run it on your local machine and
- make the necessary changes to get it to work.

You don't have the .html and .png files that are ***COPY***'d into the container in the Dockerfile. There are certainly others. It is your task to find out what must be changed and change them.
The first person who finishes and presents to the class tomorrow morning will get 5 points added to their quiz on Monday.

You must be the first to contact me with a working site and explanation of exactly what had to be changed. #makealist

Docker in action

The following command runs an ubuntu container, attaches interactively to your local command-line session, and runs the /bin/bash script.

$ docker run -i -t ubuntu /bin/bash

The following happens (assuming default registry configuration):

1. If you do not have the ***ubuntu*** image locally, Docker pulls it from your configured registry, as though you had run ***docker pull ubuntu*** manually.
2. Docker creates a new container, as though you had run a ***docker container create*** command manually.
3. Docker allocates a read-write filesystem to the container, as its final layer.
   - This allows a running container to create or modify files and directories in its local filesystem.
4. Docker creates a network interface to connect the container to the default network,
   - because you did not specify any networking options.
   - This includes assigning an IP address to the container.
   - By default, containers can connect to external networks using the host machine's network connection.
5. Docker starts the container and executes ***/bin/bash***.
   - Because the container is running interactively and attached to your terminal (due to the ***-i*** and ***-t*** flags), you can provide input using your keyboard while the output is logged to your terminal.
6. When you type ***exit*** to terminate the ***/bin/bash*** command, the container stops but is not removed.
   - You can start it again or remove it.

Next Steps

Now you can move on to creating your own Dockerfiles, Images, and Containers!