Docker
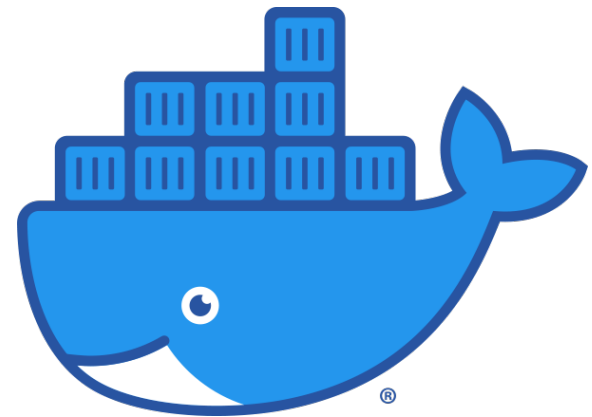
Lecture 2

Daniel Smith

So What Is It?

- Docker is a system for running "pretend" (virtual) computers inside a real computer.

- These virtual computers are called "containers"

- https://docs.docker.com/desktop/mac/install/
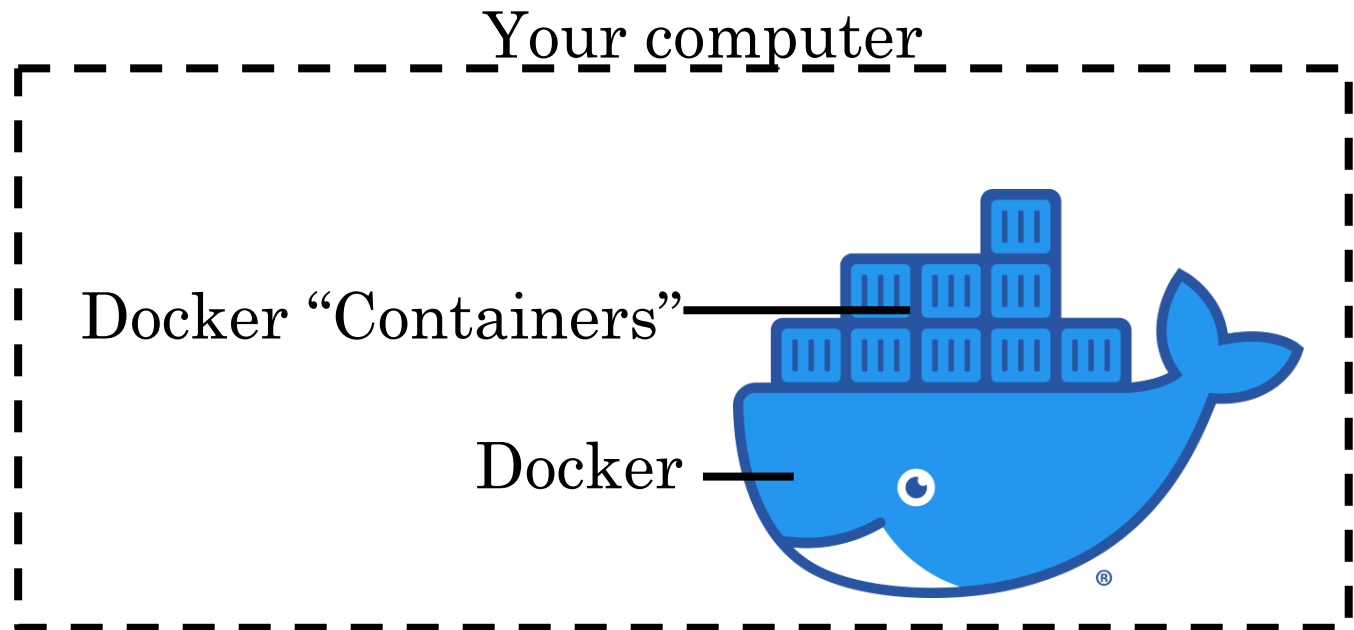
- https://docs.docker.com/desktop/windows/install/

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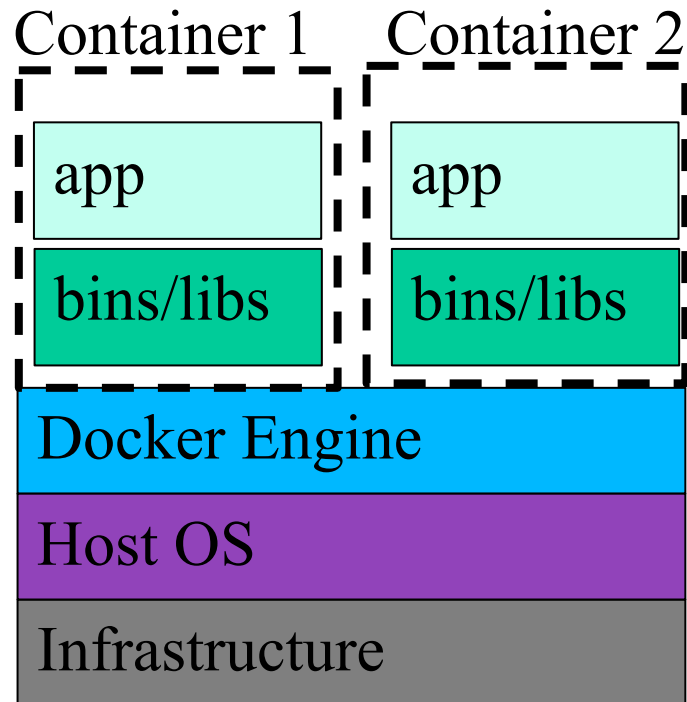Your computer

Docker "Containers"

Docker

Why Docker?

- Docker containers provide a consistent, contained environment on your local machine
- All students get the same environment and you can't mess up your computer by mistake.
- Docker containers are lightweight, portable, and boot quickly.
- Real world uses of Docker include cloud applications, software testing, and hardware-agnostic software development.
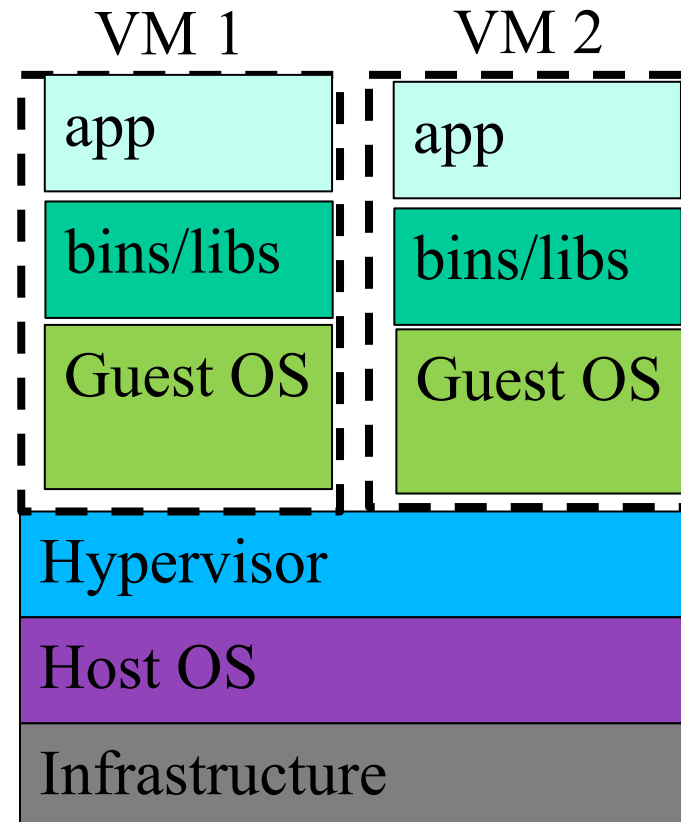
Docker vs Traditional Virtual Machine

- Docker containers are typically **stateless** (container storage is erased when the container stops)!
- Docker uses OS-level virtualization, so containers share the host operating system without the need for a hypervisor. This means containers are typically smaller and faster than VMs.
- The Docker platform can run many containers simultaneously and facilitates communication between them
- Online Docker registries allow straightforward deployment of Docker images
- Docker is free for educational use

Docker vs Traditional Virtual Machine

Docker

Virtual Machine

VM 1   VM 2

Container 1   Container 2

app	app
bins/libs	bins/libs

app	app
bins/libs	bins/libs
Guest OS	Guest OS

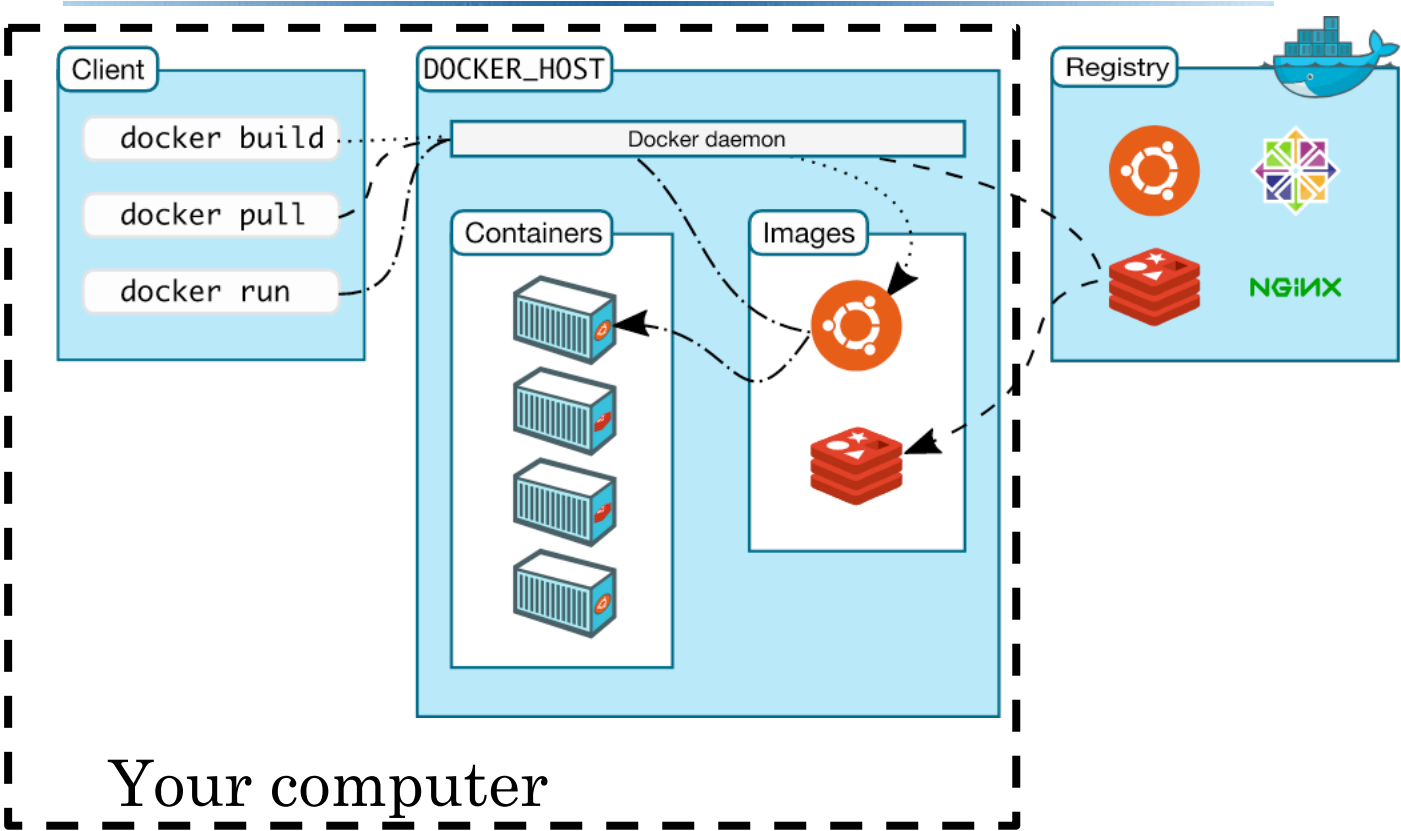| Docker Engine	Hypervisor
Host OS	Host OS
Infrastructure	Infrastructure

Docker Architecture

Docker Architecture

- **Client:** The way you interact with Docker. For us, this will be on the command line.
- **Daemon:** A background service that listens for API requests and manages Docker objects.
- **Docker Desktop:** An easy-to-install application that includes a client (both CLI and GUI), a daemon, and other stuff.
- **Docker registry:** A place where Docker images are stored. We will use Docker Hub, a public registry that is configured in Docker by default.
- **Docker Objects:**
  - *An **image** is a read-only template for a container.*
  - *A **container** is a runnable instance of an image that can be started/stopped/paused etc.*

Running Docker

- Launch docker with mounted directory:

```
docker run \
--mount type=bind,source=HOST_PATH,target=CONTAINER_PATH \
-it IMAGE:TAG
```

`--mount` takes a local `HOST_PATH` from your real computer and makes it appear in the container at `CONTAINER_PATH`. Note that both paths must be **absolute**.

`-it` Runs the container as an interactive terminal

`IMAGE` is the Docker image to run, and `TAG` is the specific version of that image

- Leave Docker and stop the container with `exit`

Running Docker: example

```
mkdir cits4407

docker run \

--mount
type=bind,source="$(pwd)"/cits4407,target=/home/stud/perm \

-it cits4407:v0
```

- We are mounting the local directory `"$(pwd)"/cits4407`
- `pwd` gets the absolute path of the current directory
- This directory is mounted to `/home/stud/perm`
- After this command succeeds, we will be in a new shell running inside our container

WARNING

- Remember, Docker containers are stateless. This means that **when a container stops, everything inside it will be deleted forever**.

- To avoid losing your work, **make sure you save it in your mounted directory**

```
docker run \

--mount
type=bind,source="$(pwd)"/cits4407,target=/home/stud/perm \

-it cits4407:v0

cd ~/perm # everything in perm is permanent!

echo "This file is permanent" > safe.txt

exit

ls cits4407
```

Cheat Sheet

- Make sure the daemon is running
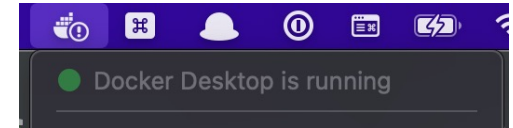
- Run docker with mounted directory using `--mount`

- Use absolute paths with `--mount`

- Launch containers from the command line, not Docker Desktop

- Further reading:
  - *https://docs.docker.com/get-started/*
  - *https://docs.docker.com/engine/reference/run/*
  - *https://docs.docker.com/storage/bind-mounts/*

Demo

- See lab 1 for OS-specific steps
- Install Docker desktop client: https://docs.docker.com/desktop/
- Launch and close a Docker container
- Launch Docker container with a mounted directory