Containerization & Documentation

SoftUni Team

Technical Trainers

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Table of Contents

Docker

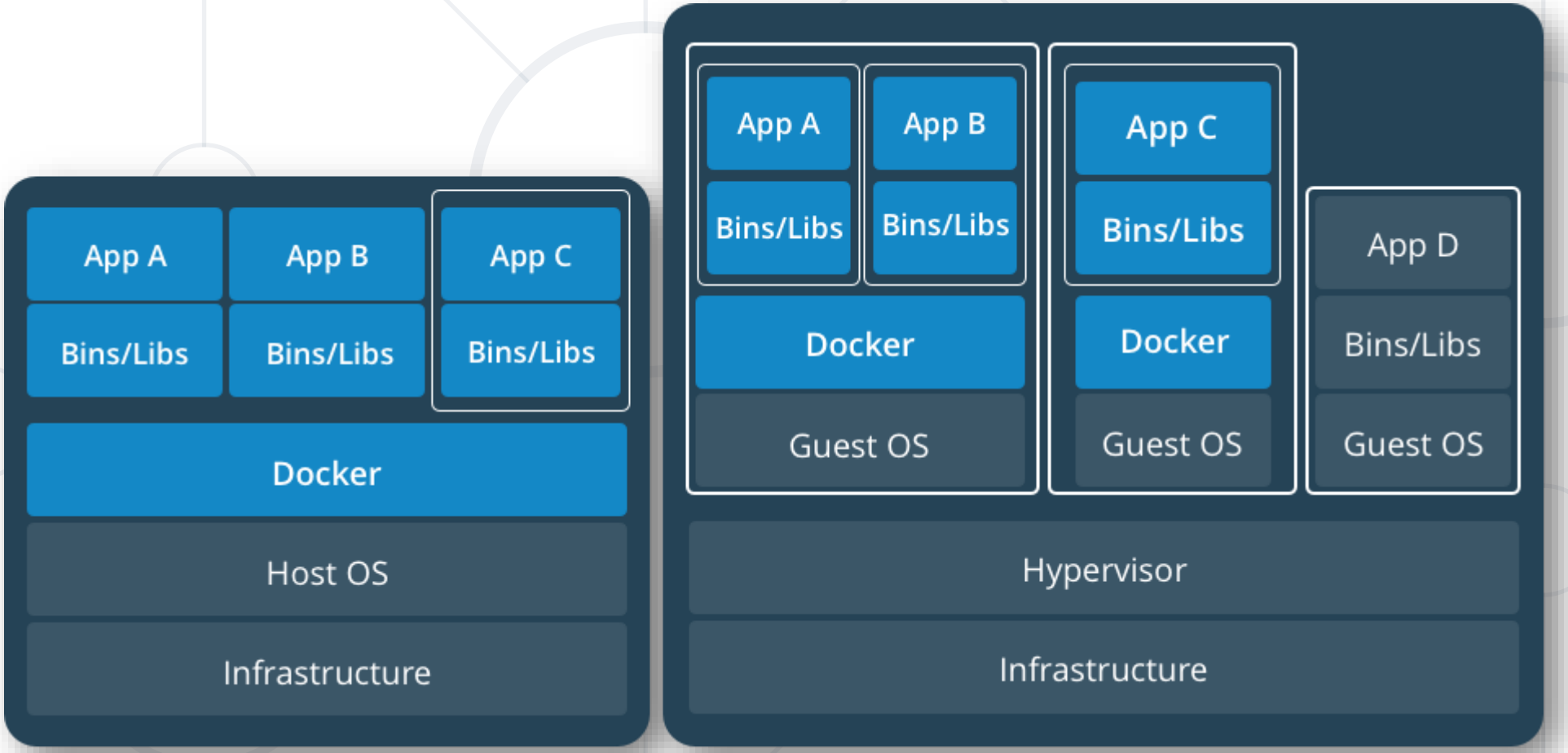
Past. Present. Future Whole New World

Containerization

> OS-level virtualization refers to an operating system paradigm in which the kernel allows the existence of **multiple isolated** user **space instances** known as **containers**, **zones**, **jails**, …

https://en.wikipedia.org/wiki/OS-level_virtualization

VMs and Containers



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

Solutions

- **rkt** by CoreOS
  - Application container engine
  - https://coreos.com/rkt
- **Docker** by Docker Inc
  - Application container engine
  - https://www.docker.com/

VMs vs Containers

- VMs virtualize the hardware
- Complete isolation
- Complete OS installation. Requires more resources
- Runs almost any OS

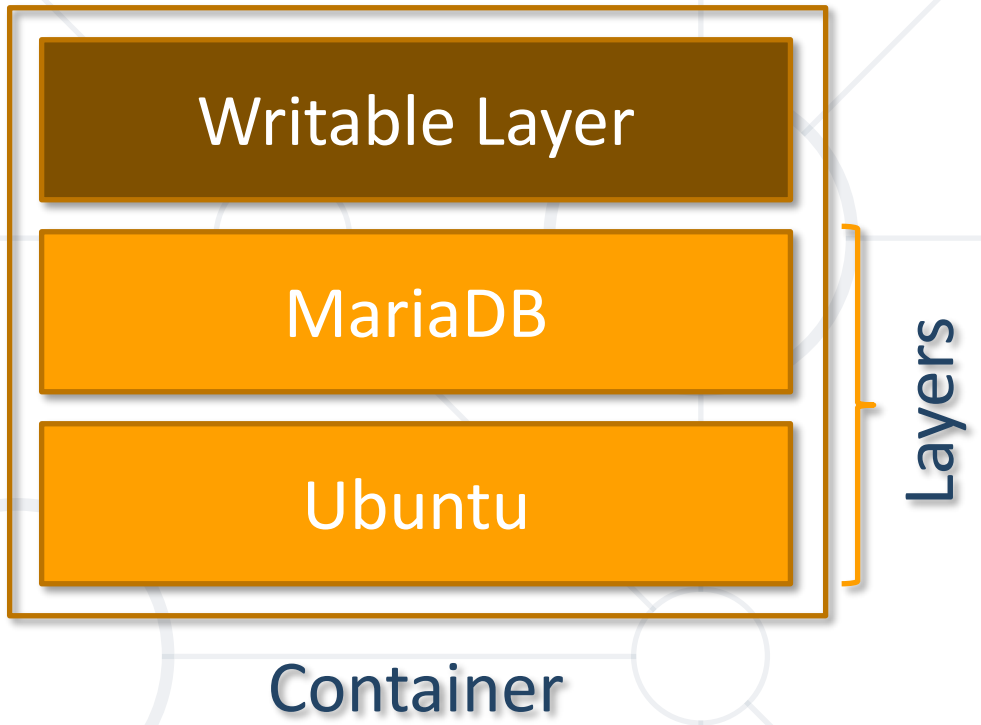
- Containers virtualize the OS
- Lightweight isolation
- Shared kernel. Requires fewer resources
- Runs on the same OS

Containers Concepts (Docker View)

- **Container image** shows the state of a container, including registry or file system changes
- **Container OS image** is the first layer of potentially many image layers that make up a container
- **Container repository** stores container images and their dependencies

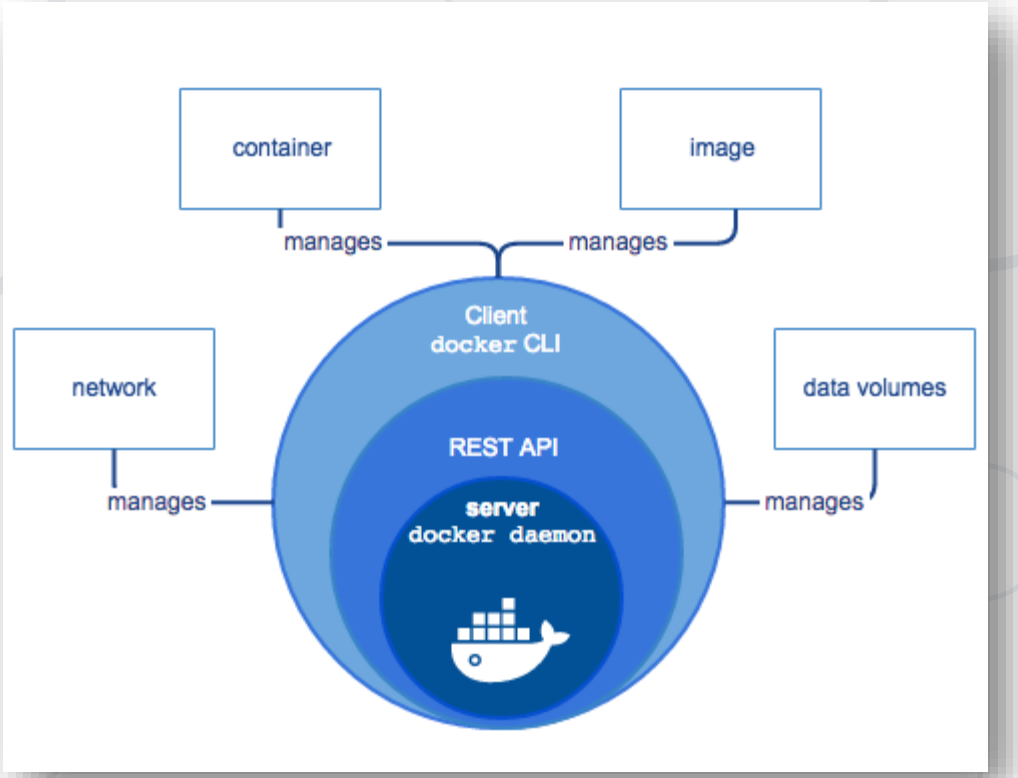
Definitions

- Container
  - Containers are processes with much more isolation
- Image
  - Images provide a way for simpler software distribution



Docker Engine

- Docker Mission – **Build**, **Ship**, **Deploy**
- Client-server application
- Components
  - dockerd daemon
  - REST API
  - docker CLI

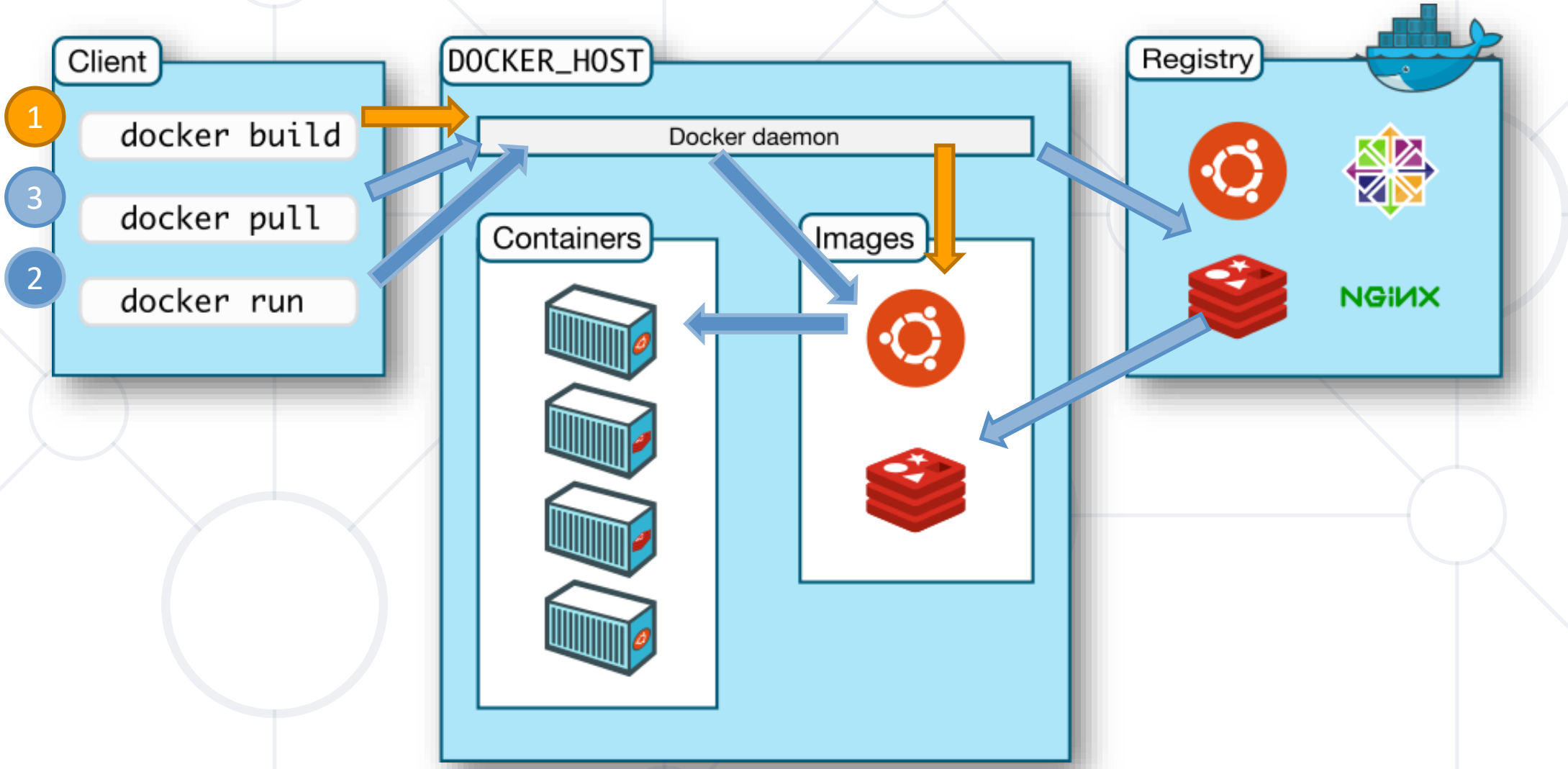


https://docs.docker.com/engine/docker-overview

Registries

- Provided by Docker
  - Cloud
    - Docker Hub (https://hub.docker.com/explore/)
    - Docker Store (https://store.docker.com/)
  - On-premise
- Provided by 3rd parties
  - Quay.io, Artifactory, Google Container Registry

Workflow



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

Docker Installation What We Need to Know?

- **Two Editions** (Community and Enterprise)
- **Native Options**
  - Docker for Linux
  - Docker for MAC
  - Docker for Windows

Deployment via package system (three channels – **stable**, **nightly**, and **test**), script, or archive

Specific requirements: OS version, Hypervisor, etc.

- **Docker Toolbox** (deprecated) - All-in-one solution
  - For Mac and Windows

Working with Docker - Pull / Image Pull

- Purpose
  - Pull an image or a repository from a registry
- Old syntax

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

- New syntax

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

- Example

```
docker image pull ubuntu:latest
```

Run / Container Run

- Purpose
  - Run a command in a new container
- Old syntax

```
docker run [OPTIONS] IMAGE [COMMAND] [ARG]
```

- New syntax

```
docker container run [OPTIONS] IMAGE [COMMAND] [ARG]
```

- Example

```
docker container run -it ubuntu
```

Images / Image Ls

- Purpose
  - List locally available images
- Old syntax

```
docker images [OPTIONS] [REPOSITORY[:TAG]]
```

- New syntax

```
docker image ls [OPTIONS] [REPOSITORY[:TAG]]
```

- Example

```
docker image ls fedora
```

Ps / Container Ls

- Purpose
  - List containers
- Old syntax

```
docker ps [OPTIONS]
```

- New syntax

```
docker container ls [OPTIONS]
```

- Example

```
docker container ls -a -q
```

Rm / Container Rm

- Purpose
  - Remove one or more containers
- Old syntax

```
docker rm [OPTIONS] CONTAINER [CONTAINER]
```

- New syntax

```
docker container rm [OPTIONS] CONTAINER [CONTAINER]
```

- Example

```
docker container rm weezy_snake
```

Rmi / Image Rm

- Purpose
  - Remove one or more images
- Old syntax

```
docker rmi [OPTIONS] IMAGE [IMAGE]
```

- New syntax

```
docker image rm [OPTIONS] IMAGE [IMAGE]
```

- Example

```
docker image rm ubuntu fedora
```

Start / Container Start

- Purpose
  - Start one or more stopped containers
- Old syntax

```
docker start [OPTIONS] CONTAINER [CONTAINER]
```

- New syntax

```
docker container start [OPTIONS] CONTAINER [CONTAINER]
```

- Example

```
docker container start -a -i 0cbf27183
```

Restart / Container Restart

- Purpose
  - Restart a one or more containers
- Old syntax

```
docker restart [OPTIONS] CONTAINER [CONTAINER]
```

- New syntax

```
docker container restart [OPTIONS] CONTAINER [CONTAINER]
```

- Example

```
docker container restart 0cbf27183
```

Stop / Container Stop

- Purpose
  - Stop one or more running containers
- Old syntax

```
docker stop [OPTIONS] CONTAINER [CONTAINER]
```

- New syntax

```
docker container stop [OPTIONS] CONTAINER [CONTAINER]
```

- Example

```
docker container stop 0cbf27183
```

Unpause / Container Unpause

- Purpose
  - Unpause all processes within one or more containers
- Old syntax

```
docker unpause CONTAINER [CONTAINER]
```

- New syntax

```
docker container unpause CONTAINER [CONTAINER]
```

- Example

```
docker container unpause 0cbf27183
```

Attach / Container Attach

- Purpose
  - Attach to a running container
- Old syntax

```
docker attach [OPTIONS] CONTAINER
```

- New syntax

```
docker container attach [OPTIONS] CONTAINER
```

- Example

```
docker container attach 0cbf27183
```

Push / Image Push

- Purpose
  - Push an image or repository to a registry
- Old syntax

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

- New syntax

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

- Example

```
docker image push repo-name/test:latest
```

Login

- Purpose
  - Log into a Docker registry
- Old syntax

```
docker login [OPTIONS] [SERVER]
```

- New syntax

```
# same
```

- Example

```
docker login
```

Logout

- Purpose
  - Log out from a Docker registry
- Old syntax

```
docker logout [SERVER]
```

- New syntax

```
# same
```

- Example

```
docker logout
```

General Structure (Dockerfile)

- Script, composed of commands and arguments
- Always begins with FROM instruction

Comment

Command (Instruction)

```
# Set the base image
FROM nginx

# Set the maintainer
MAINTAINER John Smith

# Copy files
COPY index.html /usr/share/nginx/html/
```

FROM

- Purpose
  - Defines the base image to use to start the build process
- Syntax

```
FROM <image>[:<tag>] [AS <name>]
```

- Example

```
# it is a good practice to state a version (tag)
FROM ubuntu:18.04
# for the latest version the tag could be skipped
FROM ubuntu
```

MAINTAINER

- Purpose
  - Sets the author field of the image. It is deprecated
- Syntax

```
MAINTAINER <name>
```

- Example

```
# deprecated
MAINTAINER John Smith
# newer variant is this:
LABEL maintainer="John Smith"
```

RUN

- Purpose
  - Used during build process to add software (forms another layer)
- Syntax

```
RUN <command>
```

- Example

```
# single command
RUN apt-get -y update
# more than one command
RUN apt-get -y update && apt-get -y upgrade
```

COPY

- Purpose
  - Copy files between the host and the container
- Syntax

```
COPY [--chown=<user>:<group>] <src>... <dest>
```

- Example

```
# Copy single file
COPY readme.txt /root
# Copy multiple files
COPY *.html /var/www/html/my-web-app
```

ADD

- Purpose
  - Copy files to the image
- Syntax

```
ADD [--chown=<user>:<group>] <src>... <dest>
```

- Example

```
# Add single file from URL
ADD https://softuni.bg/favicon.ico /www/favicon.ico
# Add tar file content
ADD web-app.tar /var/www/html/my-web-app
```

EXPOSE

- Purpose
  - Informs Docker that the container listens on the specified ports
- Syntax

```
EXPOSE <port> [<port>/<protocol>...]
```

- Example

```
# single port
EXPOSE 80
# multiple ports
EXPOSE 80 8080
```

ENTRYPOINT

- Purpose
  - Allows configuration of container that will run as an executable
- Syntax

```
# exec form, this is the preferred form
ENTRYPOINT ["executable", "param1", "param2"]

# shell form
ENTRYPOINT command param1 param2
```

CMD

- Purpose
  - Main purpose is to provide defaults for an executing container
- Syntax

```
# exec form, this is the preferred form
CMD ["executable","param1","param2"]

# as default parameters to ENTRYPOINT
CMD ["param1","param2"]

# shell form
CMD command param1 param2
```

CMD vs ENTRYPOINT

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- Both **define** what **command** gets **executed** when **running** a container
- **Dockerfile** should specify at **least one** of them
- **ENTRYPOINT** should be defined when using the **container** as an **executable**
- **CMD** should be used as a way of defining **default arguments** for an **ENTRYPOINT** command or for **executing** an **ad-hoc** command in a container
- **CMD** will be overridden when **running** the container with **alternative** arguments

CMD vs ENTRYPOINT

- Both have **exec** and shell **form**
- When used **together always** use their **exec** form

CMD \ ENTRYPOINT	N/A	exec_entry p1_entry	["exec_entry", "p1_entry"]
N/A	Error	/bin/sh -c exec_entry p1_entry	exec_entry p1_entry
["exec_cmd", "p1_cmd"]	exec_cmd p1_cmd	/bin/sh -c exec_entry p1_entry	**exec_entry p1_entry exec_cmd p1_cmd**
["p1_cmd", "p2_cmd"]	p1_cmd p2_cmd	/bin/sh -c exec_entry p1_entry	**exec_entry p1_entry p1_cmd p2_cmd**
exec_cmd p1_cmd	/bin/sh -c exec_cmd p1_cmd	/bin/sh -c exec_entry p1_entry	exec_entry p1_entry /bin/sh -c exec_cmd p1_cmd

https://docs.docker.com/engine/reference/builder/#understand-how-cmd-and-entrypoint-interact

Build / Image Build

- Purpose
  - Build an image from a Dockerfile
- Old syntax

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

- New syntax

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

- Example

```
docker image build -t new-image .
```

Recommendations

- Don't create large images
- Don't use only the "latest" tag
- Don't run more than one process in a single container
- Don't rely on IP addresses
- Put information about the author

https://developers.redhat.com/blog/2016/02/24/10-things-to-avoid-in-docker-containers/

http://www.projectatomic.io/docs/docker-image-author-guidance/

Swagger 3

Swagger

- With the Swagger we can **simplifies** API development for users, teams, and enterprises
- Why we need documentations:
  - front-end and back-end components often **separate** a web application
  - usually, we expose APIs as a back-end component for the front-end component
- Reference documentation should **simultaneously describe** every change in the API

SpringDoc

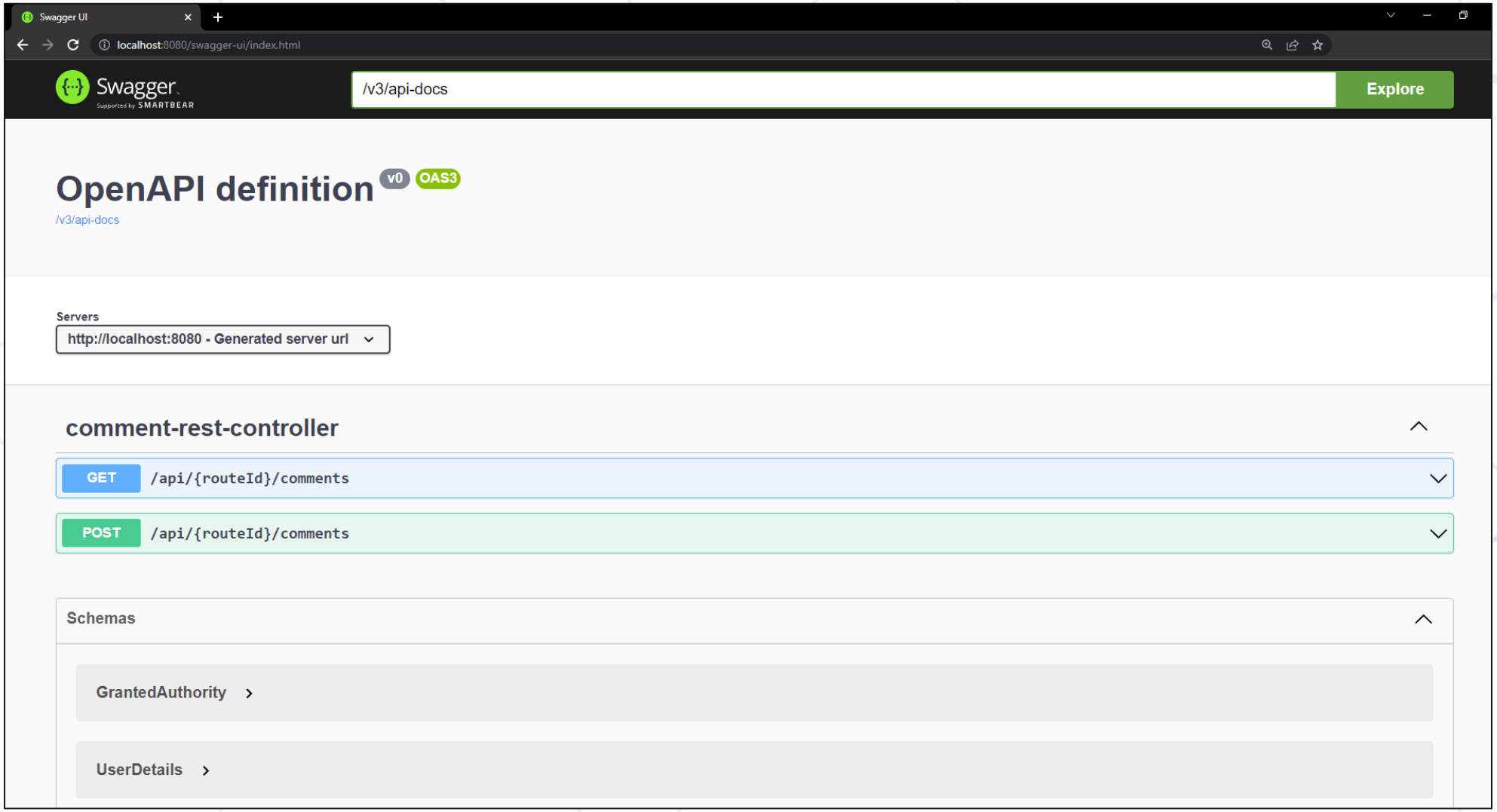
- Spring Boot, using the **SpringDoc** implementation of the **Swagger 3 specification**
- It's enough to add a single **springdoc-openapi-ui** dependency:

```
<dependency>
    <groupId>org.springdoc</groupId>
    <artifactId>springdoc-openapi-ui</artifactId>
    <version>1.6.8</version>
</dependency>
```

```
dependencies {
        implementation 'org.springdoc:springdoc-openapi-ui'
}
```

- Go to http://localhost:8080/swagger-ui/index.html to test it

Using Swagger UI example



Swagger UI

- **Swagger UI** allows anyone to **visualize** and **interact** with the API's resources without having any of the implementation logic in place
- It's **automatically generated** from your OpenAPI (formerly known as Swagger) Specification, with the visual documentation making it easy for back-end implementation and client-side consumption

Summary

- Containerization is a hot topic, but it isn't something new
- Docker is de-facto a standard
- Images can be published to private or public registries
- Using Swagger 3 for easy documenting our application

Resources

Docker Documentation

https://docs.docker.com/

Docker Hub Documentation

https://docs.docker.com/docker-hub/

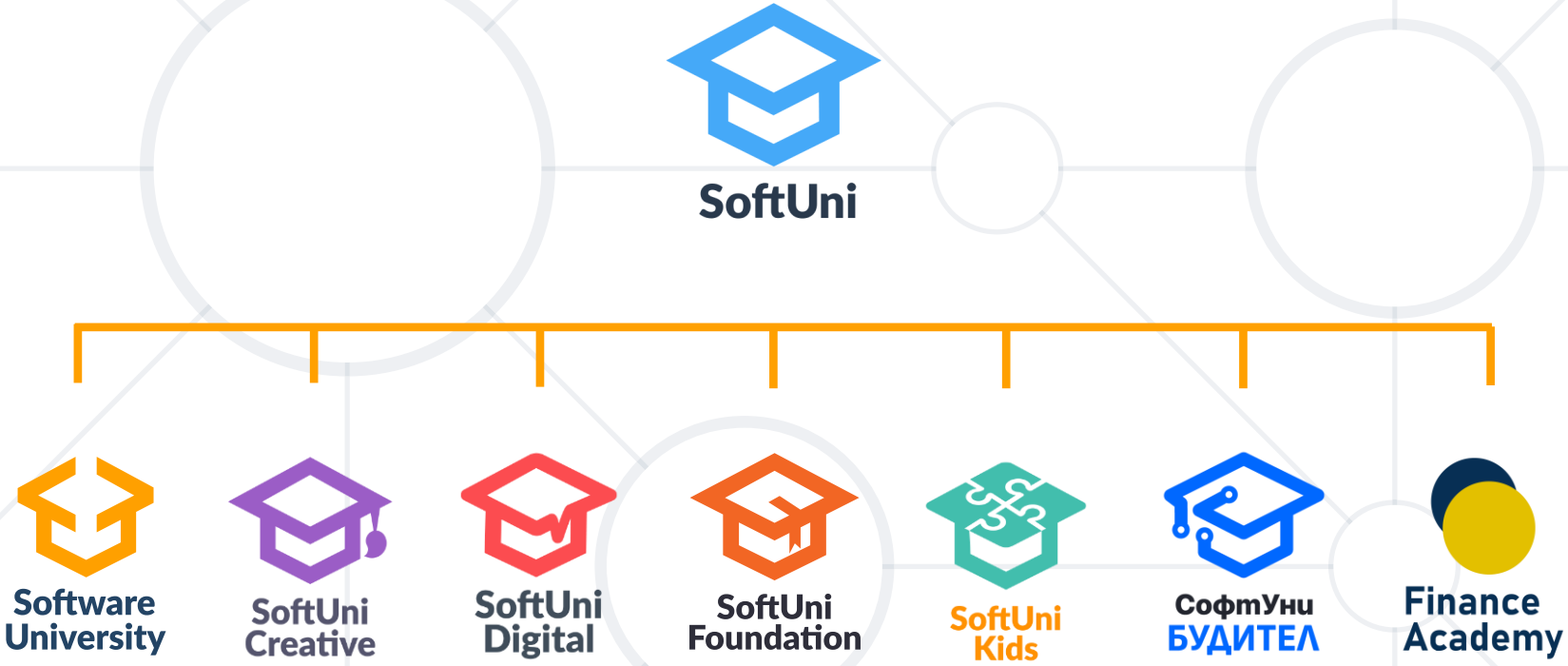
Docker Registry Documentation

https://docs.docker.com/registry/

Swagger Documentation

https://swagger.io/

Questions?



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