Distributing Docker Images

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Private Docker registries

- Unlike Docker official images there is no quality guarantee
- Name starts with the url of the private registry

```
dockerhub.myprivateregistry.com/classify_spam
```

```
docker pull dockerhub.myprivateregistry.com/classify_spam:v1
```

```
Using tag: v1
latest: Pulling from dockerhub.myprivateregistry.com
ed02c6ade914: Pull complete
Digest: sha256:b6b83d3c331794420340093eb706b6f152d9c1fa51b262d9bf34594887c2c7ac
Status: Downloaded newer image for dockerhub.myprivateregistry.com/classify_spam:v1
dockerhub.myprivateregistry.com/classify_spam:v1
```

Pushing to a registry

```
docker image push <image name>
```

Pushing to a specific registry --> name of the image needs to start with the registry url

```
docker tag classify_spam:v1 dockerhub.myprivateregistry.com/classify_spam:v1
```

```
docker image push dockerhub.myprivateregistry.com/classify_spam:v1
```

Authenticating against a registry

- Docker official images --> No authentication needed
- Private Docker repository --> Owner can choose

```
docker login dockerhub.myprivateregistry.com
```

```
user@pc ~ % docker login dockerhub.myprivateregistry.com
Username: student
Password:
Login succeeded
```

Docker images as files

Sending a Docker image to one or a few people? Send it as a file!

Save an image

```
docker save -o image.tar classify_spam:v1
```

Load an image

```
docker load -i image.tar
```

Summary of new commands

Usage	Command
Pull image from private registry	docker pull <private-registry-url>/<image-name>
Name an image	docker tag <old-name> <new-name>
Push an image	docker image push <image-name>
Login to private registry	docker login <private-registry-url>
Save image to file	docker save -o <file-name> <image-name>
Load image from file	docker load -i <file-name>

Let's practice!

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Creating your own Docker images

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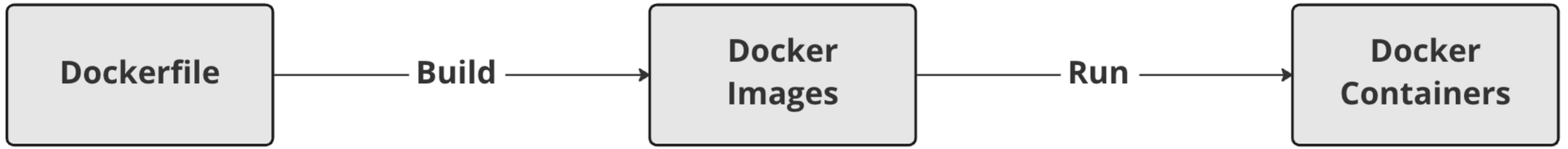
Creating images with Dockerfiles



Text file with instructions to create an image

Blueprint to create a container

Running Image

Starting a Dockerfile

A Dockerfile always start from another image, specified using the FROM instruction.

```
FROM postgres
FROM ubuntu
FROM hello-world
FROM my-custom-data-pipeline
```

```
FROM postgres:15.0
FROM ubuntu:22.04
FROM hello-world:latest
FROM my-custom-data-pipeline:v1
```

Building a Dockerfile

Building a Dockerfile creates an image.

```
docker build /location/to/Dockerfile
docker build .
```

```
[+] Building 0.1s (5/5) FINISHED
 => [internal] load build definition from Dockerfile
 => => transferring dockerfile: 54B
...
 => CACHED [1/1] FROM docker.io/library/ubuntu
 => exporting to image
 => => exporting layers
 => => writing image sha256:a67f41b1d127160a7647b6709b3789b1e954710d96df39ccaa21..
```

Naming our image

In practice we almost always give our images a name using the -t flag:

```
docker build -t first_image .
```

```
...
=> => writing image sha256:a67f41b1d127160a7647b6709b3789b1e954710d96df39ccaa21..
=> => naming to docker.io/library/first_image
```

```
docker build -t first_image:v0 .
```

```
=> => writing image sha256:a67f41b1d127160a7647b6709b3789b1e954710d96df39ccaa21..
=> => naming to docker.io/library/first_image:v0
```

Customizing images

```
RUN <valid-shell-command>
```

```
FROM ubuntu
RUN apt-get update
RUN apt-get install -y python3
```

Use the -y flag to avoid any prompts:

```
...
After this operation, 22.8 MB of additional disk space will be used.
Do you want to continue? [Y/n]
```

Building a non-trivial Dockerfile

When building an image Docker actually runs commands after RUN

Docker running `RUN apt-get update` takes the same amount of time as us running it!

```
root@host:/# apt-get update
Get:1 http://ports.ubuntu.com/ubuntu-ports jammy InRelease [270 kB]
...
Get:17 http://ports.ubuntu.com/ubuntu-ports jammy-security/restricted arm64 Pack..
Fetched 23.0 MB in 2s (12.3 MB/s)
Reading package lists... Done
```

Summary

Usage	Dockerfile Instruction
Start a Dockerfile from an image	FROM <image-name>
Add a shell command to image	RUN <valid-shell-command>
Make sure no user input is needed for the shell-command.	RUN apt-get install **-y** python3

Usage	Shell Command
Build image from Dockerfile	docker build /location/to/Dockerfile
Build image in current working directory	docker build **.**
Choose a name when building an image	docker build -t first_image .

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Managing files in your image

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COPYing files into an image

The COPY instruction copies files from our local machine into the image we're building:

```
COPY <src-path-on-host> <dest-path-on-image>
COPY /projects/pipeline_v3/pipeline.py /app/pipeline.py
```

```
docker build -t pipeline:v3 .
...
[4/4] COPY ./projects/pipeline_v3/pipeline.py /app/pipeline.py
```

If the destination path does not have a filename, the original filename is used:

```
COPY /projects/pipeline_v3/pipeline.py /app/
```

COPYing folders

Not specifying a filename in the src-path will copy all the file contents.

```
COPY <src-folder> <dest-folder>
COPY /projects/pipeline_v3/ /app/
```

`COPY /projects/pipeline_v3/ /app/` will copy everything under `pipeline_v3/`:

```
/projects/
    pipeline_v3/
        pipeline.py
        requirements.txt
        tests/
            test_pipeline.py
```

Copy files from a parent directory

```
/init.py
/projects/
    Dockerfile
    pipeline_v3/
        pipeline.py
```

If our current working directory is in the `projects/` folder.

We can't copy `init.py` into an image.

```
docker build -t pipeline:v3 .
 => ERROR [4/4] COPY ../init.py /     0.0s
failed to compute cache key: "../init.py" not found: not found
```

Downloading files

Instead of copying files from a local directory, files are often downloaded in the image build:

- Download a file

```
RUN curl <file-url> -o <destination>
```

- Unzip the file

```
RUN unzip <dest-folder>/<filename>.zip
```

- Remove the original zip file

```
RUN rm <copy_directory>/<filename>.zip
```

Downloading files efficiently

- Each instruction that downloads files adds to the total size of the image.
- Even if the files are later deleted.
- The solution is to download, unpack and remove files in a single instruction.

```
RUN curl <file_download_url> -o <destination_directory>/<filename>.zip \
&& unzip <destination_directory>/<filename>.zip -d <unzipped-directory> \
&& rm <destination_directory>/<filename>.zip
```

Summary

Usage	Dockerfile Instruction
Copy files from host to the image	COPY <src-path-on-host> <dest-path-on-image>
Copy a folder from host to the image	COPY <src-folder> <dest-folder>
We can't copy from a parent directory where we build a Dockerfile	~~COPY ../<file-in-parent-directory> /~~

Keep images small by downloading, unzipping, and cleaning up in a single RUN instruction:

```
RUN curl <file_download_url> -o <destination_directory> \
&& unzip <destination_directory>/<filename>.zip -d <unzipped-directory> \
&& rm <destination_directory>/<filename>.zip
```

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Choosing a start command for your Docker image

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What is a start command?

The hello-world image prints text and then stops.

```
docker run hello-world
```

```
Hello from Docker!

To generate this message, Docker took the following steps:
 1. The Docker client contacted the Docker daemon.
 2. The Docker daemon created a new container from the hello-world image which runs
    executable that produces the output you are currently reading.
 3. The Docker daemon streamed that output to the Docker client, which sent it
    to your terminal.
```

What is a start command?

An image with python could start python on startup.

```
docker run python3-sandbox
```

```
Python 3.10.6 (main, Nov  2 2022, 18:53:38) [GCC 11.3.0] on linux
Type "help", "copyright", "credits" or "license" for more information.
>>>
...
```

```
....
>>> exit()
repl@host:/#
```

Running a shell command at startup

```
CMD <shell-command>
```

The CMD instruction:

- Runs when the image is started.
- Does not increase the size of the image .
- Does not add any time to the build.
- If multiple exist, only the last will have an effect.

Typical usage

Starting an application to run a workflow or that accepts outside connections.

```
CMD python3 my_pipeline.py
```

```
CMD postgres
```

Starting a script that, in turn, starts multiple applications

```
CMD start.sh
```

```
CMD python3 start_pipeline.py
```

When will it stop?

- hello-world image -> After printing text
- A database image -> When the database exits

A more general image needs a more general start command.

- An Ubuntu image -> When the shell is closed

Overriding the default start command

Starting an image

```
docker run <image>
```

Starting an image with a custom start command

```
docker run <image> <shell-command>
```

Starting an image interactively with a custom start command

```
docker run -it <image> <shell-command>
```

```
docker run -it ubuntu bash
```

Summary

Usage	Dockerfile Instruction
Add a shell command run when a container is started from the image.	CMD <shell-command>

Usage	Shell Command
Override the CMD set in the image	docker run <image> <shell-command>
Override the CMD set in the image and run interactively	docker run -it <image> <shell-command>

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