Dockerfile

Dockefile: why?

A docker can be created by hand

- pull an image
- start a container
- modify the container
- commit the changes

this is more or less the process for creating a reusable container *an Image*

Dockerfile: why?

By *hand* is good for practicing or testing but is very bad for

- reproducibility
- automation
- dependencies

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reproducibility: lost the history of the commands that create the final image

- automation
- dependencies

Dockerfile: why?

By *hand* is good for practicing or testing but is very bad for

- reproducibility

automation: images are lost because some disaster and eveything was on a local machine

- dependencies

Dockerfile: why?

By *hand* is good for practicing or testing but is very bad for

- reproducibility
- automation

dependencies: images are build from other images and something must be changed in the original image

Dockerfile: what is it?

A simple text files with all the instructions for

- start (PULL) from a (public) Linux distribution
- install software
- configure the installation
- configure the container for running automatically

Dockerfile: what is it?

The most minimal `Dockerfile`

```
FROM ubuntu:18.04
```

Note by convention `Dockerfile` is the name to use for the file containing the instructions.

Dockefile: how to use it

A `Dockerfile` can be used for building a new image

```
$ docker build -t origin .
Sending build context to Docker daemon  2.048kB
Step 1/1 : FROM ubuntu:18.04
 ---> cd6d8154f1e1
 Successfully built cd6d8154f1e1
 Successfully tagged origin:latest
```

A new image is created with the `sha256 cd6d8154f1e1` called `origin` and the version, in this case by default `Docker` assign the tag `latest`

Dockerfile: FROM

Start from a Linux distribution or previous *installations*/images

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


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


FROM <image>[@<digest>] [AS <name>]
```

Dockerfile: LABEL

Metadata are useful in order to describe the image, making it more consumable by others

`LABEL <key>=<value> <key>=<value> <key>=<value> ...`

```
LABEL org.ingm.group=”Your Boss name”
LABEL maintainer=”Bonnal Raoul J.P. <bonnal@ingm.org>”
LABEL project=”Elixir Test”
LABEL description=”Dockerfile example \
with multiple lines.”
LABEL version=”1.2”

LABEL maintainer”=bonnal@ingm.”org
```

User is free to use any kind of `key=val` convention but the *reverse DNS* notation.

Dockerfile: ENV

Environment variables can be set inside the container

`ENV <key> <value> ENV <key>=<value> ...`

```
ENV software=”samtools” description=A\ great\ piece\ of\ softw
    author=someone
```

and

```
ENV software samtools
ENV description A great piece of software
ENV author someone
```

these variable are available during the building process and when the container is running

Dockerfile: WORKDIR

Sets the working directory for the following *instructions*

```
ENV MYSUBDIR mytmp
RUN mkdir /opt/$MYSUBDIR
WORKDIR /opt/$MYSUBDIR
RUN pwd
```

Works for `RUN`, `CMD`, `ENTRYPOINT`, `COPY` and `ADD`

Dockerfile: injecting files

To fully customize the image, external files can be included. To achieve this `Docker` provides two different tools

- `ADD`
- `COPY`

Dockerfile: ADD

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

- Digest URLs, download
- Unpack archives (identity, gzip, bzip2 or xz)
- Does not perform authentication
- At every build it is re excuted

Dockerfile: COPY

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

- Relative path outside of context does not work
- Works only with local files or directory
- Can copy files from source location to a previous build stage “FROM“
- NO URLs
- NO auto unpacking

Dockerfile: SHELL

When commands must be run with a different shell

```
SHELL [”executable”, ”parameters”]
```

Dockerfile: USER

Set the USER to use during when the containers run. It also set the user for RUN, CMD, ENTRYPOINT following the declaration of USER

```
USER <user>[:<group>]
USER <UID>[:<GID>]
```

Dockerfile: RUN

To customise the installation the user must execute commands.

The commands are run inside a default shell `/bin/sh -c`

Use the `SHELL` clause to change the shell for the following `Dockerfile`

When a `RUN` succeed Docker will write a layer.

Dockerfile: RUN

`RUN` have two forms:

```
RUN apt-get update
```

or use a more explicit form where parameters are passed in a sort of `JSON` notation

```
RUN [”apt-get”, ”update”]
```

The JSON form does not create a shell for the command, so variable can not be substituted. To use the shell substitution call the shell first.

Dockerfile: RUN

A RUN command can span multiple lines

```
RUN apt-get install -y wget git python3.6
```

```
RUN apt-get install -y wget \
                       git \
                       python3.6
```

Dockerfile: RUN

A `RUN` command can be made by multiple commands

```
RUN comamnd1 && command2
```

The `RUN` will pass and create a layer only if it succeed. Otherwise, Docker will report the original error.

Dockerfile: RUN

Combining commands and spanning the commands on multiple lines helps in readibility and building complex configurations.

```
RUN apt-get update &&\
    apt-get install -y wget
```

Dockerfile: RUN

Combining commands and spanning the commands on multiple lines helps in readibility and building complex configurations.

```
RUN apt-get update &&\
    apt-get install -y wget \
                       git \
                       python3.6
```

Dockerfile: ENTRYPOINT

Defines a container that runs as an executable

Forms:

exec: preferred

```
ENTRYPOINT [”executable”, ”param1”, ”param2”]
```

shell:

```
ENTRYPOINT command param1 param2
```

Dockerfile: CMD

Defines the default behaviour for the container.

Forms:

exec: preferred

```
CMD [”executable”,”param1”,”param2”]
```

default parameters to ENTRYPOINT:

```
CMD [”param1”,”param2”]
```

shell:

```
CMD command param1 param2
```

Dockerfile: VOLUME

It is possible to embed the volume definition at build time.

Any change, at build time, after the definition will be discarded.

```
VOLUME [”/path”,”...”]
```

```
VOLUME /path_a /path_b
```

Volumes are:

- created automatically at run time
- can be shared between containers with `--volumes-from`
- are anonymous at runtime
- can be inspected looking at `/var/lib/docker/volumes`

Dockerfile: VOLUME

Example of creating a VOLUME

```
FROM ubuntu:18.04
RUN mkdir /opt/elixir-volume
RUN echo ”This is a file with a foo text” > /opt/elixir-volume
VOLUME [”/opt/elixir-volume”]
```

Dockerfile: context

Context defines what is visibleOA at the build time by Docker. Data inside the `context` are copied in a temporary place where the building process is working. The building process can see only data in that temporary place.

This process of `building the context` can take a lot of time if files are big and many.

Avoid:

- huge files
- temporary or working file
- backup

in the context.

A lean `context` means quick build.

Dockerfile: validation

A `Dockerfile` is a text file and Docker keep tracks of changes in the file.

Most of the *instructions* generate a layer.

Changes to the text are invalidaing all the following *instructions* and they will be re-executed.

Dockerfile: example

```
FROM ubuntu:18.04

LABEL org.ingm.group=”Your Boss name”
LABEL maintainer=”Bonnal Raoul J.P. <bonnal@ingm.org>”
LABEL project=”Elixir Test”
LABEL description=”Dockerfile example”
LABEL version=”1.2”

RUN apt-get update &&\
    apt-get install -y wget \
                       git \
                       python3.6
```

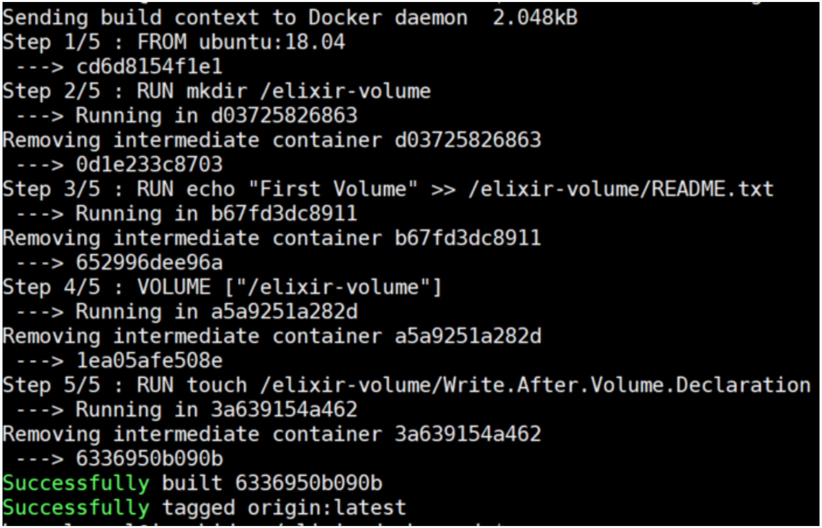
Dockerfile: bulding

```
$ docker build -t origin .

$ docker build -t origin Dockerfile .

$ docker build -t origin -f /absolute/path/Dockerfile .
```

Dockerfile: building



```
Sending build context to Docker daemon  2.048kB
Step 1/5 : FROM ubuntu:18.04
 ---> cd6d8154f1e1
Step 2/5 : RUN mkdir /elixir-volume
 ---> Running in d03725826863
Removing intermediate container d03725826863
 ---> 0d1e233c8703
Step 3/5 : RUN echo "First Volume" >> /elixir-volume/README.txt
 ---> Running in b67fd3dc8911
Removing intermediate container b67fd3dc8911
 ---> 652996dee96a
Step 4/5 : VOLUME ["/elixir-volume"]
 ---> Running in a5a9251a282d
Removing intermediate container a5a9251a282d
 ---> 1ea05afe508e
Step 5/5 : RUN touch /elixir-volume/Write.After.Volume.Declaration
 ---> Running in 3a639154a462
Removing intermediate container 3a639154a462
 ---> 6336950b090b
Successfully built 6336950b090b
Successfully tagged origin:latest
```

Figure 1: DokerBuilding