



Docker and Docker Compose

.NET CORE

docker compose is a tool for defining and running multi-container Docker applications. ***docker compose*** uses a YAML file to configure your application's services.

[HTTPS://DOCS.DOCKER.COM/COMPOSE/](https://docs.docker.com/compose/)

docker compose – Overview

<https://docs.docker.com/compose/>

With a single command, **docker compose** allows you to create and start all the services from your configuration. **docker compose** works in all environments: production, staging, development, testing, and CI/CD workflows.

Using **docker compose** is a three-step process:

1. Define your app's environment with a **Dockerfile** so it can be reproduced anywhere.
2. Define the services that make up your app in **docker-compose.yml** so they can be run together in an isolated environment.
3. Run **docker-compose up** and the **Compose** app starts and runs your entire app.

```
version: '2.0'
services:
  web:
    build: .
    ports:
      - "5000:5000"
    volumes:
      - ./code
      - logvolume01:/var/log
    links:
      - redis
  redis:
    image: redis
volumes:
  logvolume01: {}
```

Docker Compose - Features

<https://docs.docker.com/compose/#features>

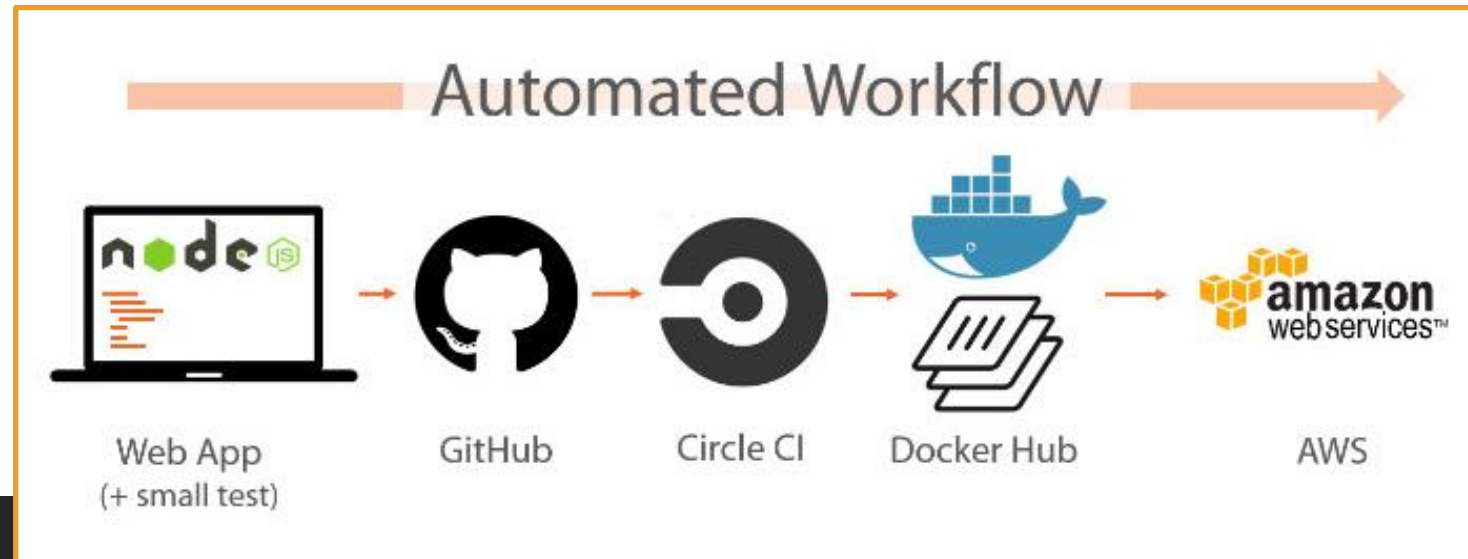
Have many isolated environments on one host	Preserve volume data when containers are created	Recreate containers that have changed	A composition is portable between environments
Because Compose uses unique names for each project, the projects run independently of each other. Use -p to give your project a unique name.	When docker-compose up runs, it copies the volumes from the old container to the new container . This ensures that any data you've created in volumes isn't lost.	Compose re-uses existing containers if they haven't been changed.	You can use variables in the Compose file to customize your composition for different environments or different users.

Docker Compose – Use Cases

<https://docs.docker.com/compose/#common-use-cases>

Compose is used Extensively with *Continuous Deployment/Continuous Integration (CI/CD)*.

Compose is used in a development environment. The **Compose** File is used to automate testing configurations and dependencies so that workflows are automated and end-to-end testing is faster and easier.



Dockerfile

<https://docs.docker.com/engine/reference/builder/>
https://docs.docker.com/develop/develop-images/dockerfile_best-practices/

The **Dockerfile** is a file which is used by the **docker build** command to create a container **image**.

A **Dockerfile** is a text document that contains all the commands a user would call on the command line to assemble a Docker **image**.

docker build executes several command-line instructions in succession.

```
$ docker build -t svendowideit/ambassador .
```

```
Sending build context to Docker daemon 15.36 kB
```

```
Step 1/4 : FROM alpine:3.2
```

```
--> 31f630c65071
```

```
Step 2/4 : MAINTAINER SvenDowideit@home.org.au
```

```
--> Using cache
```

```
--> 2a1c91448f5f
```

```
Step 3/4 : RUN apk update && apk add socat && rm -r /var/cache/
```

```
--> Using cache
```

```
--> 21ed6e7fbb73
```

```
Step 4/4 : CMD env | grep _TCP= | (sed 's/.*_PORT_\([0-9]*\) _TCP=tcp:\V\V\(.*\):\(.*\)/socat -t 100000000 TCP4-LISTEN:\1,fork,reuseaddr TCP4:\2:\3 \&/' && echo wait) | sh
```

```
--> Using cache
```

```
--> 7ea8aef582cc
```

```
Successfully built 7ea8aef582cc
```


Dockerfile Format

<https://docs.docker.com/engine/reference/builder/#format>
<https://docs.docker.com/engine/reference/builder/#official-releases>

The **Dockerfile** follows a format very similar to a bash script. Instructions are run sequentially. By convention, keywords are uppercase.

A **Dockerfile** must begin with a **FROM** instruction. **FROM** specifies the *Parent Image* from which you are building. **FROM** may only be preceded by one or more **ARG** instructions which declare arguments that are used in **FROM** lines in the **Dockerfile**.

Lines that begin with **#** are comments. **#** anywhere else in a line is treated as an argument.

Pre-made *images* for building **Dockerfiles** are available in the docker/**dockerfile** repo on Docker Hub (<https://hub.docker.com/>).

```
# Comment  
INSTRUCTION arguments
```

```
FROM alpine:3.2  
#this is a comment  
MAINTAINER SvenDowideit@home.org.au  
RUN apk update && apk add socat && rm -r /var/cache/  
CMD env | grep _TCP= | (sed 's/.*_PORT_\([0-  
9]*\) _TCP=tcp:\V\V\(.*\):\(.*\)/socat -t 100000000 TCP4-  
LISTEN:\1,fork,reuseaddr TCP4:\2:\3 \&/' && echo wait) | sh
```

ENV(ironment) variables

<https://docs.docker.com/engine/reference/builder/#environment-replacement>

The **ENV** instruction sets an environment variable `<key>` to `<value>`. The value will be in the environment for all subsequent instructions.

Environment variables set using **ENV** will persist when a container is run from the resulting image. **docker inspect** allows you to view them. You can change them with **docker run --env <key>=<value>**.

The **ENV** instruction has two forms.

- **ENV <key> <value>** sets a single variable to a value.
- **ENV <key>=<value> ...**, allows for multiple variables to be set at one time. Quotes and backslashes can be used to include (escape) spaces within values.

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

```
ENV myName John Doe  
ENV myDog Rex The Dog  
ENV myCat fluffy
```

yields the same results as

```
ENV myName="John Doe" myDog=Rex\ The\ Dog \  
myCat=fluffy
```


.dockerignore file

<https://docs.docker.com/engine/reference/builder/#dockerignore-file>

Exclude files and directories from **docker build** by adding a **.dockerignore** file to the **context** root directory.

Before the docker CLI sends the **context** to the **docker daemon**, it looks for a file named **.dockerignore**. Files mentioned in the **.dockerignore** are excluded.

The **.dockerignore** file is a newline-separated list of filenames relative to the root directory of the **context**. The root of the **context** is also the working directory.

```
# comment  
*/temp*  
*/*/temp*  
temp?
```

Comment. ignored

Exclude files/directories whose names start with temp in any immediate subdirectory of the root.

Exclude files/directories starting with temp in any subdirectory two levels below the root.

Exclude files and directories in the root directory whose names are a one-character extension of temp. (For example, **/tempa**)

Dockerfile commands – FROM

<https://docs.docker.com/engine/reference/builder/#from>

FROM initializes a new build stage and sets the *Base Image* for subsequent instructions. A *Dockerfile* must start with **FROM**.

ARG is the only instruction that may precede **FROM** in the *Dockerfile*.

FROM can appear multiple times within a single *Dockerfile* to create multiple images or use one build stage as a dependency for another.

Give a name to a new build stage by adding **AS** to the **FROM** instruction. The name can be used in subsequent **FROM** and **COPY --from=<name|index>** instructions to refer to the image built in the previous stage.

FROM can use variables that are declared by any **ARGs** occurring before the first **FROM**.

An **ARG** declared before a **FROM** is outside of a build stage, so it can't be used in any instruction after a **FROM**. The **FROM** itself can use it.

```
FROM [--platform=<platform>] <image> [AS <name>]
```

```
ARG CODE_VERSION=latest
FROM base:${CODE_VERSION}
CMD /code/run-app

FROM extras:${CODE_VERSION}
CMD /code/run-extras
```

```
ARG VERSION=latest
FROM busybox:$VERSION
ARG VERSION
RUN echo $VERSION > image_version
```

Dockerfile commands – WORKDIR

<https://docs.docker.com/engine/reference/builder/#workdir>

WORKDIR sets the working directory for any **RUN**, **CMD**, **ENTRYPOINT**, **COPY** and **ADD** instructions that follow it in the Dockerfile. If a **WORKDIR** doesn't exist, it will be automatically assigned.

WORKDIR can be used multiple times in a Dockerfile. If a relative path is provided, it will be relative to the path of the previous **WORKDIR**.

WORKDIR can resolve environment variables previously set using **ENV**. You can only use environment variables explicitly set in the Dockerfile.

```
WORKDIR /path/to/workdir
```

The output of **pwd** (path to working directory) in this Dockerfile will be **/a/b/c**

```
WORKDIR /a
WORKDIR b
WORKDIR c
RUN pwd
```

```
ENV DIRPATH /path
WORKDIR $DIRPATH/$DIRNAME
RUN pwd
```

The output of **pwd** in this Dockerfile will be **/path/\$DIRNAME**

Dockerfile commands – RUN

<https://docs.docker.com/engine/reference/builder/#run>

RUN has 2 forms:

- **RUN <command>** (shell form, the command is run in a shell)
- **RUN ["executable", "param1", "param2"]** (exec form)

RUN will execute commands in a new layer on top of the current image and then commit the results. The resulting committed image will be used for the next *Dockerfile* step.

Layering **RUN** instructions and generating commits conforms to the core concepts of Docker where containers can be created from any point in an image's history.

exec form syntax makes it possible to **RUN** commands using a *base image* that does not contain the specified shell executable.

```
RUN /bin/bash -c 'source $HOME/.bashrc; echo $HOME'
```

```
RUN ["/bin/bash", "-c", "echo hello"]
```

Exec form syntax

Dockerfile commands – COPY

<https://docs.docker.com/engine/reference/builder/#copy>

The **COPY** instruction copies new files or directories from **<src>** and adds them to the filesystem of the **container** at the path **<dest>**.

Multiple **<src>** resources may be specified. Paths are interpreted relative to the **context**. Each **<src>** may contain wildcards.

COPY has two forms:

- **COPY [--chown=<user>:<group>] <src>... <dest>**
- **COPY [--chown=<user>:<group>] ["<src>",... "<dest>"]**
(used for whitespace)

The optional **--chown** flag specifies a given userName, groupName, or UID/GID combination to request specific ownership of the copied content.

```
COPY hom* /mydir/
```

adds all files starting with "hom".

```
COPY test.txt relativeDir/
```

adds "test.txt" to **<WORKDIR>/relativeDir/**

```
COPY --chown=55:mygroup files* /somedir/
```

If the user or group are invalid, the build fails on **COPY**.

Dockerfile commands – EXPOSE

<https://docs.docker.com/engine/reference/builder/#expose>

EXPOSE informs Docker that the container listens on the specified ports. By default, the port listens on TCP.

EXPOSE does not actually publish the port. It functions as documentation between those who build the image and those who run the container.

To publish the port when running the container, use the **-p** flag on **docker run** to publish and map one or more ports, or the **-P** flag to publish all exposed ports and map them to high-order ports.

You can override **Dockerfile EXPOSE** settings at runtime with the **-p** flag.

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

```
EXPOSE 80/udp
```

```
docker run -p 80:80/tcp -p 80:80/udp ...
```

To override EXPOSE settings

Dockerfile commands – CMD

<https://docs.docker.com/engine/reference/builder/#cmd>

CMD provides defaults for an executing container. These defaults can include an executable.

The **CMD** instruction has three forms:

- **CMD ["executable","param1","param2"]** (exec form. Preferred)
- **CMD ["param1","param2"]** (default params to ENTRYPOINT)
- **CMD command param1 param2** (shell form)

There can only be one **CMD** instruction in a *Dockerfile*.

CMD does not execute anything at build time but specifies the intended command for the image.

```
FROM ubuntu
CMD ["/usr/bin/wc","--help"]
```

This **exec** form is the preferred format of **CMD**. Params must be expressed as strings in the array.

```
FROM ubuntu
CMD echo "This is a test." | wc -
```

Shell form. The <command> will execute in /bin/sh -c

Dockerfile commands – ENTRYPOINT

<https://docs.docker.com/engine/reference/builder/#entrypoint>

ENTRYPOINT allows configuration of a container to run as an executable.

It has two forms:

- **ENTRYPOINT** ["executable", "param1", "param2"] (**exec** form. Preferred)
- **ENTRYPOINT** command param1 param2 (shell form*)

When **CMD** omits the executable, you must specify an **ENTRYPOINT** instruction as well.

If **CMD** is used to provide default arguments for the **ENTRYPOINT** instruction, both the **CMD** and **ENTRYPOINT** instructions should use the JSON array format.

```
FROM ubuntu
ENTRYPOINT ["top", "-b"]
CMD ["-c"]
```

```
docker run -i -t --rm -p 80:80 nginx
```

This command starts nginx with its default content, listening on port 80:

*Click the link above for more specifics on the shell form of **ENTRYPOINT** instruction.

Dockerfile commands – ENTRYPOINT(cont.)

<https://docs.docker.com/engine/reference/builder/#exec-form-entrypoint-example>

Command line arguments to **docker run <image>** will be appended after all elements in an **exec** form **ENTRYPOINT**, and will override all elements specified using **CMD**. This allows **docker run <image> -d** to pass the **-d** argument to the entry point. You can override the **ENTRYPOINT** instruction using the **docker run --entrypoint** flag.

Use the **exec** form of **ENTRYPOINT** to set default commands/arguments and then use **CMD** to set additional defaults that are more likely to be changed on execution.

```
FROM ubuntu
ENTRYPOINT ["top", "-b"]
CMD ["-c"]
```

Configure the above, then run the container to see that 'top' is the only process.

```
$ docker run -it --rm --name test top -H

top - 08:25:00 up 7:27, 0 users, load average: 0.00, 0.01, 0.05
Threads: 1 total, 1 running, 0 sleeping, 0 stopped, 0 zombie
%Cpu(s): 0.1 us, 0.1 sy, 0.0 ni, 99.7 id, 0.0 wa, 0.0 hi, 0.0 si, 0.0 st
KiB Mem: 2056668 total, 1616832 used, 439836 free, 99352 buffers
KiB Swap: 1441840 total, 0 used, 1441840 free. 1324440 cached Mem

  PID USER      PR  NI   VIRT   RES   SHR S  %CPU  %MEM    TIME+  COMMAND
    1 root        20   0  19744   2336  2080 R   0.0   0.1   0:00.04 top
```

*Click the link above for more specifics on the shell form of **ENTRYPOINT** instruction.

Dockerfile commands – LABEL

<https://docs.docker.com/engine/reference/builder/#label>

LABEL adds metadata to an image as a key-value pair.

- Include spaces by using quotes (or backslashes) as in command-line parsing.
- You can specify multiple labels on a single line.
- Labels included in parent images (images in the **FROM** line) are inherited.
- If a **LABEL** already exists with a different value, it's overwritten
- To view an image's labels, use **docker image inspect** command.

```
LABEL "com.example.vendor"="ACME Incorporated"  
LABEL com.example.label-with-value="foo"  
LABEL version="1.0"  
LABEL description="This text illustrates \  
that label-values can span multiple lines."
```

```
LABEL multi.label1="value1" multi.label2="value2" other="value3"
```

↓

```
docker image inspect --format=' ' myimage
```

```
{  
  "com.example.vendor": "ACME Incorporated",  
  "com.example.label-with-value": "foo",  
  "version": "1.0",  
  "description": "This text illustrates that label-values can span multiple lines.",  
  "multi.label1": "value1",  
  "multi.label2": "value2",  
  "other": "value3"  
}
```

Dockerfile commands – ADD

<https://docs.docker.com/engine/reference/builder/#add>

ADD copies new files, directories or remote file URLs from **<src>** and adds them to the filesystem of the image at the path **<dest>**.

- Multiple **<src>** resources may be specified.
- File or directory paths are interpreted as relative to the source of the build context.
- Each **<src>** may contain wildcards. Matching is done using Go's [filepath.Match](#) rules.

There are many more options and configurations for **ADD** in the docs linked above.

use a relative path to add “test.txt” to <WORKDIR>/relativeDir/

```
ADD test.txt relativeDir/
```

use an absolute path to add “test.txt” to /absoluteDir/

```
ADD test.txt /absoluteDir/
```

Escaping special chars. Adds “test.txt” to <WORKDIR>/relativeDir/

```
ADD arr[[]0].txt /mydir/
```

Dockerfile commands – VOLUME

<https://docs.docker.com/engine/reference/builder/#volume>

VOLUME creates a mount point with the specified name and marks it as holding externally mounted volumes from native host or other containers.

The value can be a JSON array, (**VOLUME** `["/var/log/"]`), a plain string (**VOLUME** `/var/log`), or have multiple arguments (**VOLUME** `/var/log /var/db`).

docker run initializes the newly created volume with any data that exists at the specified location within the base image.

```
FROM ubuntu
RUN mkdir /myvol
RUN echo "hello world" > /myvol/greeting
VOLUME /myvol
```

The Dockerfile example above results in an image that causes **docker run** to create a new mount point at `/myvol` and copy the greeting file into the newly created volume.

Dockerfile commands – USER

<https://docs.docker.com/engine/reference/builder/#user>

USER sets the user's name or UID and the user group or GID to use when running the image for any **RUN**, **CMD** and **ENTRYPOINT** instructions that follow it in the Dockerfile.

The user will have only the specified group membership. Any other configured group memberships will be ignored.

On Windows, the user must be created first if it's not a built-in account. This is done with **net user** called as part of a Dockerfile.

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

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

```
FROM microsoft/windowsservercore
# Create Windows user in the container
RUN net user /add patrick
# Set it for subsequent commands
USER patrick
```

Resource

<https://medium.com/@saurabh.singh0829/how-to-build-application-inside-and-outside-docker-dockerfile-structure-and-commands-f542b58cd830>

How to build an application inside and outside of Docker.

Dockerfile structure and commands.

