Section 9 - Persistent Data and Volumes

2 Persistent Data: Volumes

Volume in Dockerfile

- A VOLUME can be also defined in a Dockerfile.

```
FROM debian
...
VOLUME /path/to/data-dir
...
```

- The *Dockerfile* of official images is good reference to see how *volumes* are used.

Example - mysql (1a)

- https://hub.docker.com/_/mysql
- https://github.com/docker-library/mysql/blob/26380f33a0fcd07dda35e37516eb24eaf962845c/5.7/

```
FROM debian:stretch-slim
...
VOLUME /var/lib/mysql
...
```

Example - mysql (1b)

- `/var/lib/mysql` => The MySQL "data directory". The MySQL "data directory" (a.k.a., "datadir") is the area where the Retain database would be stored
- `VOLUME /var/lib/mysql` => When we start a new container, a new *volume* with the content of the `/var/lib/mysql` directory will be created.
- Any file created in the `/var/lib/mysql` directory will be preserved even after the container is deleted.
- The contents of the `volume` can be delete only "manually" by executing the related `docker volume delete` command.

Example - mysql (2)

- We can also see information about the *volume* by inspecting the mysql docker image:

```
# docker image pull mysql:5.7
# docker image inspect mysql:5.7
...
"Volumes": {
            "/var/lib/mysql": {}
        },
...
```

Example - mysql (3a)

- Create and inspect a mysql container:

```
# docker container run -d -e MYSQL_ALLOW_EMPTY_PASSWORD=true --name mysql r
# docker container inspect mysql
"Mounts": [
            {
                "Type": "volume",
                "Name": "b256cc6cc11f6392d44db73f1b24e2925e7063dcc479701a5
                "Source": "/var/lib/docker/volumes/b256cc6cc11f6392d44db73
                "Destination": "/var/lib/mysql",
                "Driver": "local",
                 ...
            }
        ],
        "Config": {
...
"Volumes": {
                "/var/lib/mysql": {}
            },
...
```

Example - mysql (3b)

- From the output of the inspect command we can see the location of the volume:
  - in the host file system and => Source: `/var/lib/docker/volumes/b25.../`
  - in the container file system => Destination: `/var/lib/mysql`

Example - mysql (4)

- Use the `docker volume ls` command to list the volumes available on a Docker host:

```
# docker volume ls
DRIVER              VOLUME NAME
local               b256cc6cc11f6392d44db73f1b24e2925e7063dcc479701a5e6ef2
```

> Note:
> The volume created from the mysql container is listed

Example - mysql (5)

- Use `docker volume insect` command to see detailed information about a volume

```
# docker volume inspect b256cc6cc11f6392d44db73f1b24e2925e7063dcc479701
...
    "CreatedAt": "2019-05-01T20:37:23+03:00",
    "Driver": "local",
    "Labels": null,
    "Mountpoint": "/var/lib/docker/volumes/b256cc6cc11f6392d44db73f1b24
    "Name": "b256cc6cc11f6392d44db73f1b24e2925e7063dcc479701a5e6ef2a6a1
    "Options": null,
    "Scope": "local"
...
```

> Note: From the output of the `docker volume inspect` command we **cannot** see which container is using this volume.

Example - mysql (6)

- On a linux host we could actually navigate to the volume location (/var/lib/docker/volumes/b25.../_data") and access the files that have been created from the container.
- On a Windows/MAC host running Docker toolbox we cannot do this because the file system of linux VM running the Docker daemon is not accessible (Note: This actually is NOT completely true).

Example - mysql (7)

- Delete the mysql container and verify that the volume is preserved:

```
# docker container stop mysql
# docker container rm mysql
# docker volume ls
DRIVER              VOLUME NAME
local               b256cc6cc11f6392d44db73f1b24e2925e7063dcc479701a5e6
```

> *Note:*
> It is not very user friendly handling volumes with such long names (IDs)
> The solution to this problem are the **Named Volumes**

Named Volumes

- Named Volume => Friendly way to assign volume to container
- Use the `--volume` or `-v` option to defined a named volume.

```
-v <volume_name>:<container_path>
```

Example mysql - Named Volume

```
# docker container run -v mysql-db:/var/lib/mysql -d -e MYSQL_ALLOW_EMPTY_
...

# docker volume ls
DRIVER              VOLUME NAME
local               b256cc6cc11f6392d44db73f1b24e2925e7063dcc479701a5e6ef2
local               mysql-db
```

> Note:
> We can see that the new volume has a friendly name **mysql-db**.

Example mysql - Named Volume (2a)

- Inspect the mysql container:

```
# docker container inspect mysql
...
"Mounts": [
        {
            "Type": "volume",
            "Name": "mysql-db",
            "Source": "/var/lib/docker/volumes/mysql-db/_data",
            "Destination": "/var/lib/mysql",
            "Driver": "local",
            "Mode": "z",
            "RW": true,
            "Propagation": ""
        }
...
```

Example mysql - Named Volume (2b)

- Inspect the named volume *mysql-db*:

```
# docker volume inspect mysql-db
[
{
    "CreatedAt": "2019-05-01T21:27:12+03:00",
    "Driver": "local",
    "Labels": null,
    "Mountpoint": "/var/lib/docker/volumes/mysql-db/_data",
    "Name": "mysql-db",
    "Options": null,
    "Scope": "local"
}
]
```

> Note:
> The name volume is created at a specific predictable location `/var/lib/docker/volumes/mysql-db/_data`.

Example mysql - Named Volume (3a)

- Use an existing volume with a new container.
- In this example we will delete the mysql container and create a new mysql2 container specifying the existing named volume "mysql-db".

```
docker container rm -f mysql # <== The "-f" option \
    is used to force the removal of a running container

docker container run -v mysql-db:/var/lib/mysql -d -e MYSQL_ALLOW_EMPTY_PAS
```

Example mysql - Named Volume (3b)

- Inspect the mysql2 container:

```
# docker container inspect mysql2
...
 "Mounts": [
            {
                "Type": "volume",
                "Name": "mysql-db",
                "Source": "/var/lib/docker/volumes/mysql-db/_data",
                "Destination": "/var/lib/mysql",
                "Driver": "local",
                "Mode": "z",
                "RW": true,
                "Propagation": ""
            }
...
```

> *Note:* All data created from mysql container are preserved and available from mysql2 container.

docker volume create (1)

- "Empty" named volumes can be also created with `docker volume create` command ahead of time.
- We can then configure a container to use it.

```
# docker volume create --help

Usage:  docker volume create [OPTIONS] [VOLUME]

Create a volume

Options:
  -d, --driver string   Specify volume driver name (default "local")
      --label list      Set metadata for a volume
  -o, --opt map         Set driver specific options (default map[])
```

docker volume create (2)

- The main reason we may want to create a volume is because this is the only way to specify a different volume driver.
- In this case we can use the `--driver` option to specify a volume driver other that the default one ("local").
- An example of a very common third party volume driver is REX-Ray.

> REX-Ray driver can be used to access storage such as an Amazon EBS storage.