Containers & CI

Module #03

Storage

Environment Variables

CMD vs ENTRYPOINT

Limits

Lab

Storage

Persistent Storage for containers

Storage

- Data doesn't persist when a container is removed, and it can be difficult to get the data out of the container if another process needs it
- A container's writable layer is tightly coupled to the host machine where the container is running
- Writing into a container's writable layer requires a storage driver to manage the filesystem

Mounting data in containers

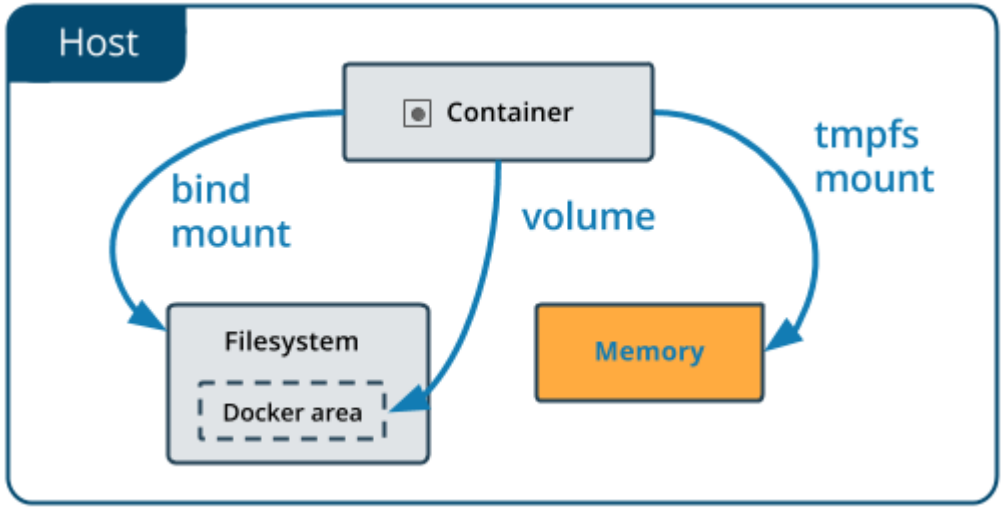
Storage

- tmpfs mounts
  - Stores data in host system memory ONLY (Linux-only)
  - Data is not created on container writable layer
- bind mounts
  - File or directory on the host machine is mounted into a container
  - Referenced by its absolute path on the host machine
- Volumes
  - Preferred mechanism for persisting data generated by and used by Docker containers
  - Stored in a part of the host filesystem which is managed by Docker

When to use tempfs

Storage

- Cases when you do not want the data to persist either on the host machine or within the container
- Security reasons or to protect the performance of the container when your application needs to write a large volume
- Don’t allow sharing between containers



How to use tempfs

Storage

```
docker run -d -it \
--mount type=tmpfs,destination=/tmp  \
nginx:latest
```

- Using **`--mount`** flag with several options split by comma (**`,`**)
  - **`type=tmpfs`**, mandatory and static
  - **`destination=folder`**, where tmpfs is mounted inside contains
  - **`tmpfs-size=# of bytes`**, size of tmpfs in bytes. Unlimited by default

How to use tempfs

Storage

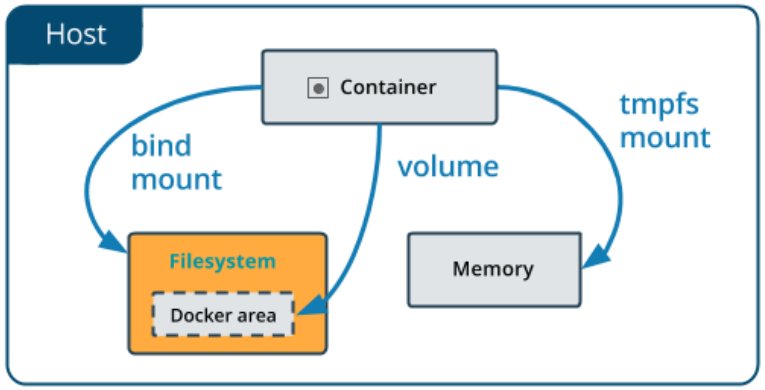
```
docker run -d -it \
--tmpfs /tmp  \
nginx:latest
```

- Using **`--tmpfs`** flag
  - Only allows to define destination on the container
  - Exists for legacy purpose
  - **`--mount`** is the preferable way to mount tmpfs

Bind mounts

Storage

- Very performant, but they rely on the host machine's filesystem
- Hard to share configuration between hosts
- Data already on container is not propagated to the host
- Non-empty directory on the container, the directory's existing contents are obscured by the bind mount
- Allow sharing between containers



When to use bind mounts

Storage

- Sharing configuration files from the host machine to containers (ex. DNS resolution)
- Sharing source code or build artifacts between a development environment on the Docker host and a container (ex. Debugger)
- When the file or directory structure of the Docker host is guaranteed to be consistent with the bind mounts the containers require.

How to use bind mounts

Storage

```
docker run -d -it \
--mount type=bind,source=/tmp/data,target=/share\
nginx:latest
```

- Using **`--mount`** flag with several options split by comma (**`,`**)
  - **`type=bind`**, mandatory and static
  - **`source=folder`**, host folder to share
  - **`target=folder`**, container folder to contain data
  - **`readonly`**, making the mount read-only

How to use bind mounts

Storage

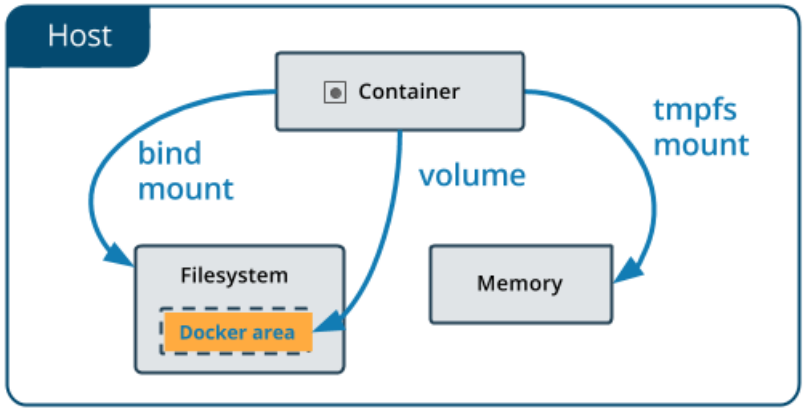
```
docker run -d -it \
-v /tmp/data:/share  \
nginx:latest
```

- Using `-v` flag
  - Source and destination folder split by colon (`:`)
  - Access mode as additional block: `:rw` or `:ro`
  - Default access mode is `:rw`

Volumes

Storage

- Volumes are the preferred way to persist data
- Docker object that make part of daemon configuration
- Data is controlled by Docker even can be stored on a common folder on host filesystem



Docker volumes: Advantages

Storage

- Volumes are easier to back up or migrate than bind mounts.
- You can manage volumes using Docker CLI commands or the Docker API.
- Volumes work on both Linux and Windows containers.
- Volumes can be more safely shared among multiple containers.
- Volume drivers let you store volumes on remote hosts or cloud providers, to encrypt the contents of volumes, or to add other functionality.
- New volumes can have their content pre-populated by a container.

When to use volumes

Storage

- Sharing data among multiple running containers
- When the Docker host is not guaranteed to have a given directory or file structure
- When you want to store your container's data on a remote host or a cloud provider, rather than locally
- When you need to back up, restore, or migrate data from one Docker host to another, volumes are a better choice

How to manage Volumes

Storage

- Create a new volume

```
docker volume create my-vol
```

- List all available volumes

```
docker volume ls
```

- Get volume details

```
docker volume inspect my-vol
```

- Delete a volume

```
docker volume rm my-vol
```

How to use volumes

Storage

```
docker run -d -it \
--mount source=my-vol,target=/share\
nginx:latest
```

- Using **`--mount`** flag with several options split by comma (**`,`**)
  - **`source=volume`**, volume name to use
  - **`target=folder`**, container folder to contain data
  - **`readonly`**, making the mount read-only

How to use volumes

Storage

```
docker run -d -it \
-v my-vol:/share  \
nginx:latest
```

- Using `-v` flag
  - Volume name and destination folder split by colon (`:`)
  - Access mode as additional block: `:rw` or `:ro`
  - Default access mode is `:rw`

Demo: Storage

Environment Variables

How to run containers dynamically?

Env Vars

- Container runs on an isolated context
- Environment variables exists on container's scope
- Preferrable way to "send" values to the container allowing different executions
- These variables can be set on docker run command

Can be used and set on build time?

Env Vars

- ENV is an available command on Dockerfile
- Using ENV allows to set static values on the image
- ARG is an available command on Dockerfile that allows to dynamically send values during build time
- ARG and ENV can be used together to environment variables on the image

Demo: Env Vars

CMD vs ENTRYPOINT

Shell vs. Exec Form

CMD vs. ENTRYPOINT

- Shell form
  - Runs the commands as a bash command
  - EX. CMD echo “Hello World” → /bin/sh –c ‘echo “Hello World”
- Exec form
  - Runs the commands directly without bash context
  - Env vars cannot be used on this approach since only have values inside the shell
  - EX. CMD [“/bin/echo”, “Hello”, “World”]
- Exec form is preferrable since the process will be executed directly and will be easily controlled regarding container lifecycle

What to choose?

CMD vs. ENTRYPOINT

- CMD
  - Runs a process using arguments set on Dockerfile
  - This command can be overwritten during docker run command
- ENTRYPOINT
  - Runs a process using arguments set on Dockerfile
  - This command cannot be overwritten during docker run command
  - The arguments sent on docker run are sent the process defined on ENTRYPOINT as arguments
- CMD and ENTRYPOINT can work together using CMD values as default arguments for ENTRYPOINT process

Demo: cmd vs entrypoint

Limits

How to restrict resources?

Limits

- Containers shares host resources
- By default, any container can consume all host resources
- Those resources are shared by all containers
- Not having explicit control may cause resources exhaustion causing impact on containers and the host
- When running a container, you may enforce limits on how much CPU and memory can be used by the container
- Reaching the limit will not break the container, only don't allow it to get more resources

How to restrict resources?

Limits

Option	Description
`--cpus=<value>`	Specify how much of the available CPU resources a container can use. For instance, if the host machine has two CPUs and you set `--cpus="1.5"`, the container is guaranteed at most one and a half of the CPUs. This is the equivalent of setting `--cpu-period="100000"` and `--cpu-quota="150000"`.

Option	Description
`-m` or `--memory=`	The maximum amount of memory the container can use. If you set this option, the minimum allowed value is `6m` (6 megabytes). That is, you must set the value to at least 6 megabytes.

Demo: Limits

Lab

Lab 3: Persistency in containers

Github

[containers-ci-training/lab03.md at main · theonorg/containers-ci-training (github.com)]