WORKING WITH DOCKER

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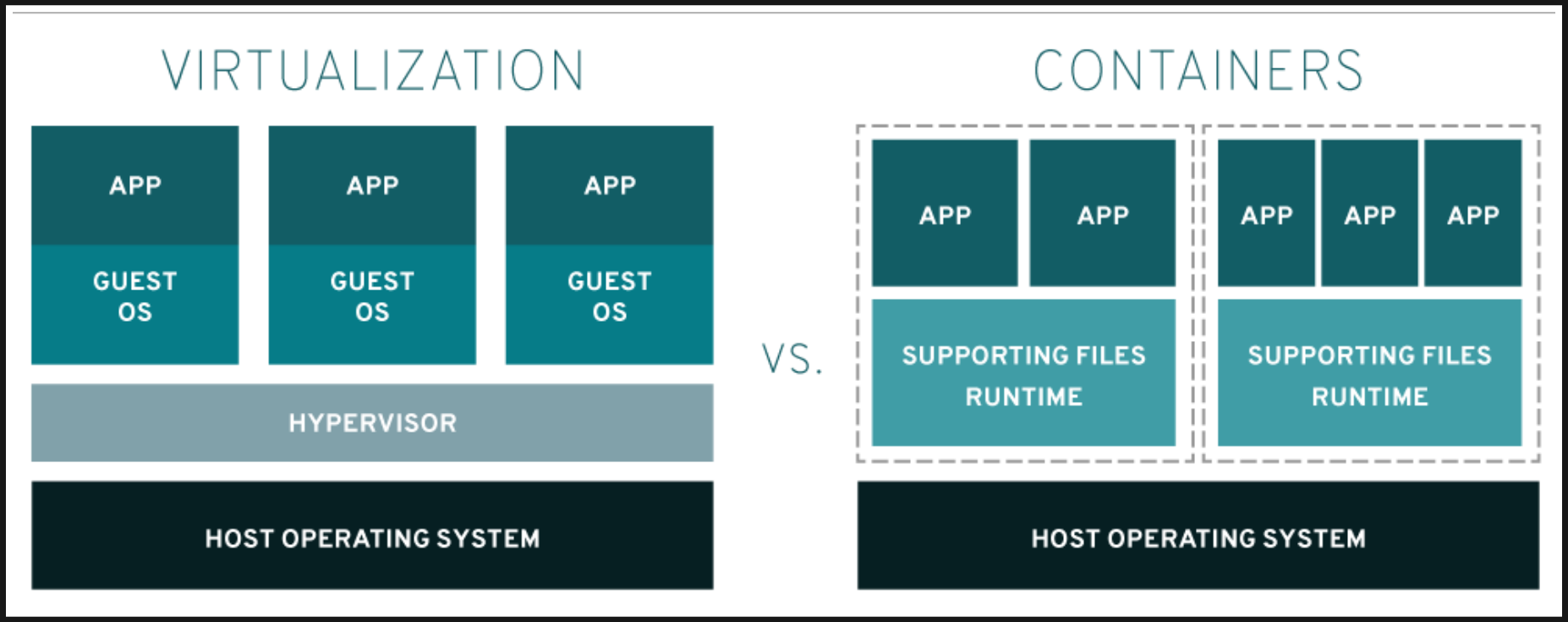
Containers provide a fairly good balance between virtualisation and native execution.



Source: Red Hat

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- Can containers use devices such as GPUs?
  Yes, you just need to expose the device to the container and install the appropriate OS components in the container.

COMMAND-LINE DOCKER

```
# Download an image
docker pull alpine

# Create a container, run a command and stop immediately.
docker run --name=helloalpine1 alpine echo hello

# Create a container and keep it running.
docker run --name=helloalpine2 alpine tail -f /dev/null

# To the running container, open another shell and execute:
docker stop helloalpine2

# Clean up
docker rm helloalpine1 helloalpine2
```

Lifecycle of a container:

create → start → stop → remove.

Changes made in a container are preserved when it's stopped, but are lost when it's removed.

1. `docker run -it --name=helloalpine alpine`
2. Make a change, such as `touch hello.txt`, then exit.
3. `docker start -i helloalpine`
    - The file is still present.
4. `docker rm helloalpine`
    - All files are gone, but the image is still on storage and can be used to create new containers.

Filesystem mounts allow sharing persistent storage with the container.

```
justme@home:~$ mkdir testdir
justme@home:~$ docker run --rm -it \
    --mount type=bind,src="$PWD"/testdir,dst=/data \
    alpine
```

The path `./testdir` on the host is now bound-mounted to `/data` in the container. Changes to one location are reflected in the other.

What happens with file ownership?

This is better demonstrated on a Linux host, such as an IKIM node.

```
justme@home:~$ ssh \
    -J justme@login.ikim.uk-essen.de \
    justme@g1-2

justme@g1-2:~$ mkdir testdir
justme@g1-2:~$ docker run --rm -it \
    --mount type=bind,src="$PWD"/testdir,dst=/data \
    alpine
/ # echo hello > /data/hello.txt

justme@g1-2:~$ ls -l testdir/hello.txt
-rw-r--r-- 1 root root 6 Jun  5 08:44 testdir/hello.txt
```

The file is owned by root, even if you're neither root nor have passwordless sudo. Why?

```
justme@g1-2:~$ groups
justme docker

justme@g1-2:~$ ls -l /var/run/docker.sock
srw-rw---- 1 root docker 0 Mar 31 13:14 /var/run/docker.sock
```

- You belong to the `docker` group, which can write to the Docker socket.
- By writing to the Docker socket, you send commands to Docker Engine, which runs as root.
- As a result, you are effectively root. You can do scary things such as bind-mounting a path where you couldn't normally write.

DOCKERFILES

Docker images can be created by building on top of existing images.

Create a file called `Dockerfile` in the current directory.

```
FROM ubuntu
ARG USERNAME=justme
ARG USER_UID=1000
ARG USER_GID=$USER_UID
RUN groupadd --gid $USER_GID $USERNAME \
    && useradd --uid $USER_UID --gid $USER_GID -m $USERNAME
USER $USERNAME
```

Build and run the image.

```
justme@g1-2:~$ docker build -t ubuntu-nonroot .
justme@g1-2:~$ docker run --rm -it ubuntu-nonroot
```

PORTABILITY

- The root user in the container is root outside of the container too. The same goes for all other UIDs and GIDs.
- If you want to be "you" in a container, build an image and create an account with the same UID+GIDs.

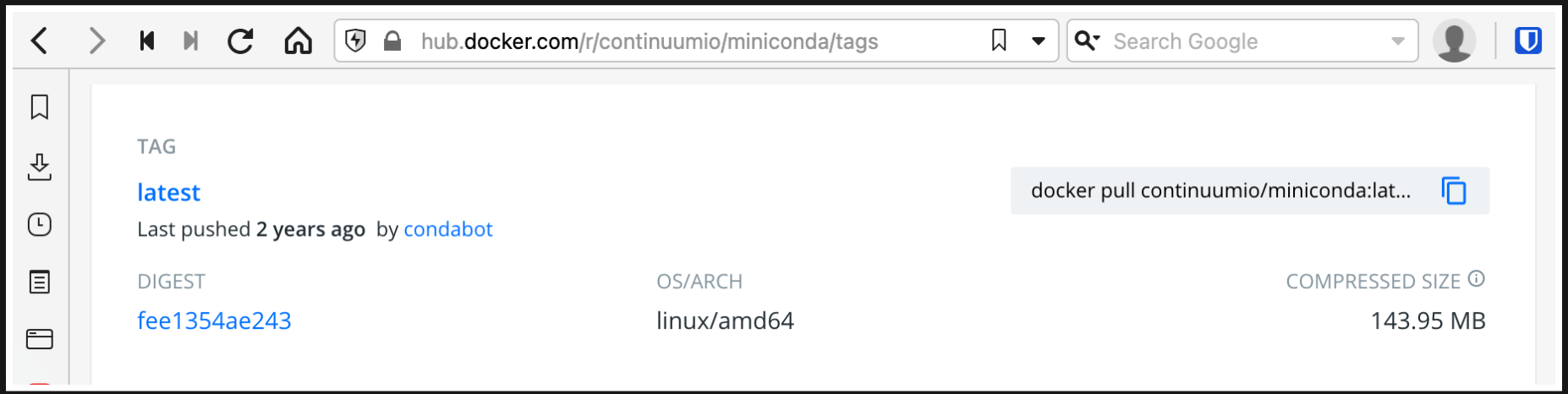
How to find the relevant information?

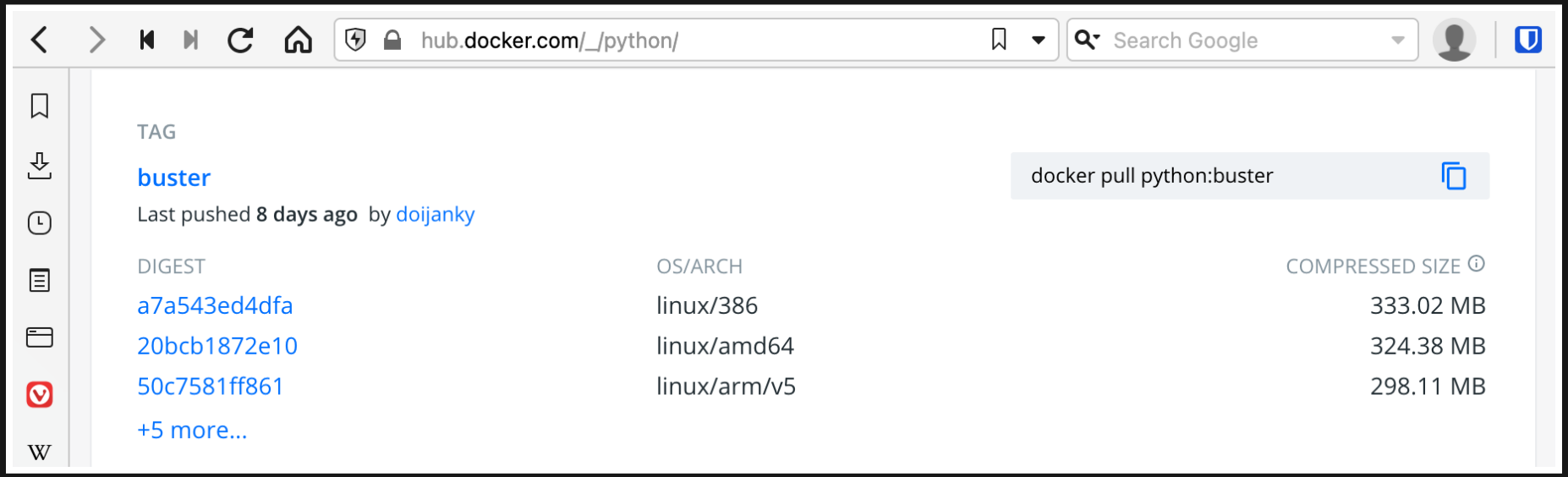
```
justme@g1-2:~$ id
uid=1014(justme) gid=1014(justme) groups=1014(justme),998(dock
```

These considerations apply when Docker can use the native kernel.

In other cases, such as with a macOS host, the VM layer handles users and privileges.

Pay attention to the CPU architecture of a Docker image.





THANKS!

Further reading:

- Docker Compose:
  multi-container applications.
- Devcontainers in Visual Studio Code:
  portable (with the usual caveats), self-documenting development environments.
- Container orchestration with Kubernetes:
  deploy containerised services in a cluster.