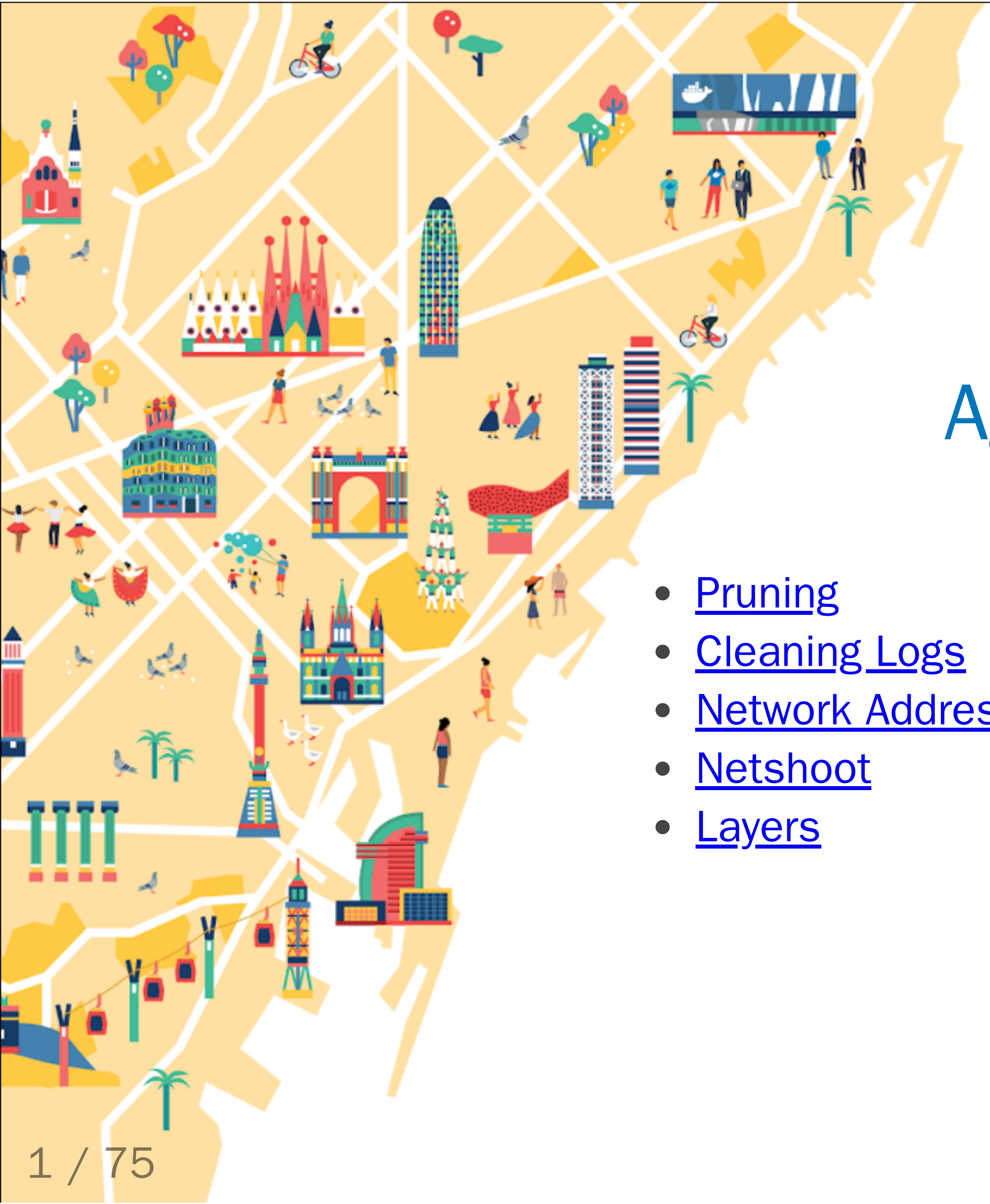


Agenda

- Pruning
- Cleaning Logs
- Network Address Pools
- Netshoot
- Layers
- Merging Layers
- Buildkit
- Local Volume Driver
- Fixing Permissions

dockercon18 EUROPE

Tips and Tricks From A Docker Captain

Brandon Mitchell
Twitter: @sudo_bmitch
GitHub: sudo-bmitch

docker con 18 EUROPE

```
$ whoami
- Solutions Architect @ BoxBoat
- Docker Captain
- Frequenter of StackOverflow
```

Who is a Developer?

Ops 101 - Full Harddrive

Prune

```
$ docker system prune
WARNING! This will remove:
        - all stopped containers
        - all networks not used by at least one container
        - all dangling images
        - all build cache
```

Prune

```
$ docker system prune
WARNING! This will remove:
        - all stopped containers
        - all networks not used by at least one container
        - all dangling images
        - all build cache
```

What this doesn't clean by default:

- Running containers (and their logs)
- Tagged images
- Volumes

Prune - YOLO

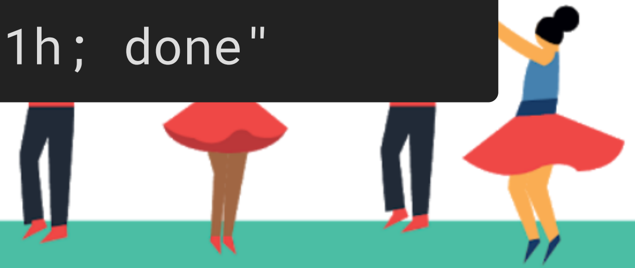
```
$ docker run -d --restart=unless-stopped --name cleanup \
    -v /var/run/docker.sock:/var/run/docker.sock
    docker /bin/sh -c \
    "while true; do docker system prune -f; sleep 1h; done"
```

docker con 18 EUROPE

Prune - YOLO

```
$ docker run -d --restart=unless-stopped --name cleanup \
    -v /var/run/docker.sock:/var/run/docker.sock
    docker /bin/sh -c \
    "while true; do docker system prune -f; sleep 1h; done"
```

```
$ docker service create --mode global --name cleanup \
    --mount type=bind,src=/var/run/docker.sock,\
            dst=/var/run/docker.sock \
    docker /bin/sh -c \
    "while true; do docker system prune -f; sleep 1h; done"
```



Clean Your Logs

- Docker logs to per container json files by default, without any limits
- Rotating yourself could break that json formatting
- Luckily "without any limits" is just the default... we can change that

Clean Your Logs

```
$ docker container run \
    --log-opt max-size=10m --log-opt max-file=3 \
    ...
```

Clean Your Logs

```
$ docker container run \
    --log-opt max-size=10m --log-opt max-file=3 \
    ...
```

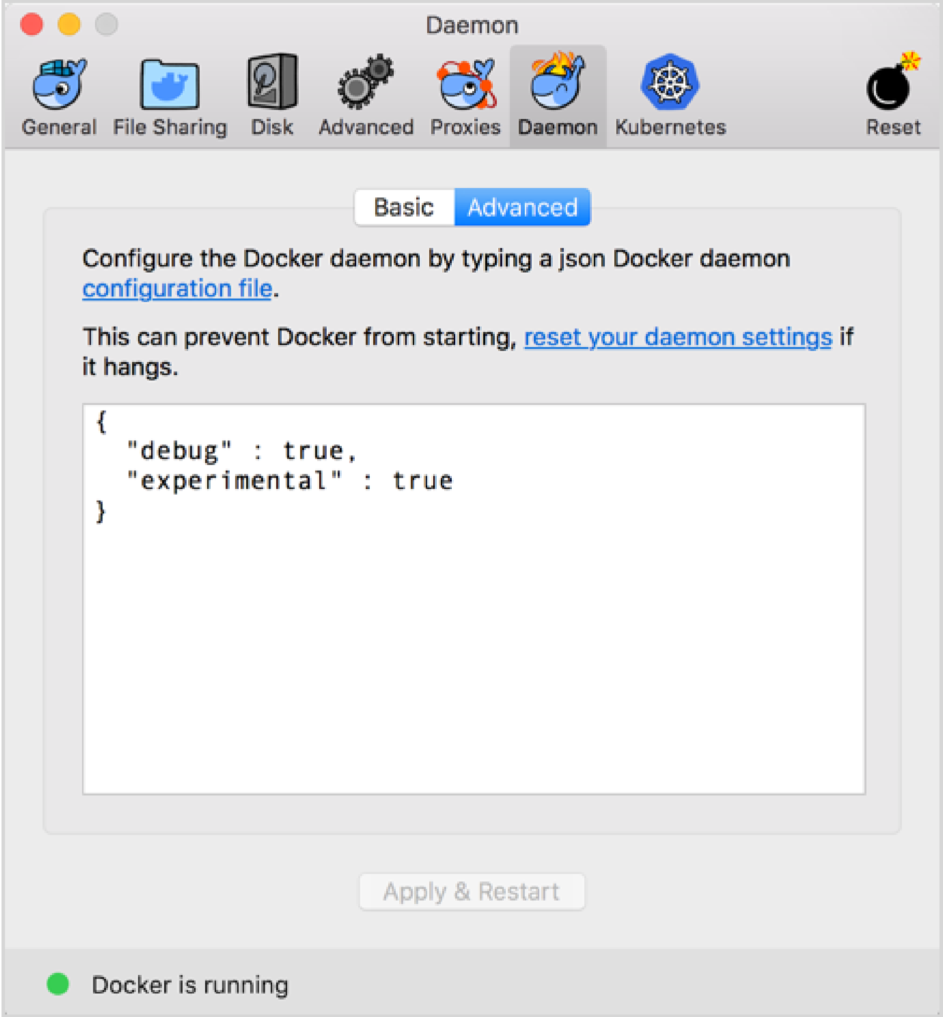
```
$ cat docker-compose.yml
version: '3.7'
services:
  app:
    image: your_app
    logging:
      options:
        max-size: "10m"
        max-file: "3"
```

Clean Your Logs

```
version: '3.7'
x-default-opts: &default-opts
  logging:
    options:
      max-size: "10m"
      max-file: "3"
services:
  app_a:
    <<: *default-opts
    image: your_app_a
  app_b:
    <<: *default-opts
    image: your_app_b
```

Clean Your Logs

```
$ cat /etc/docker/daemon.json
{
  "log-opts": {"max-size": "10m", "max-file": "3"}
}
$ systemctl reload docker
```

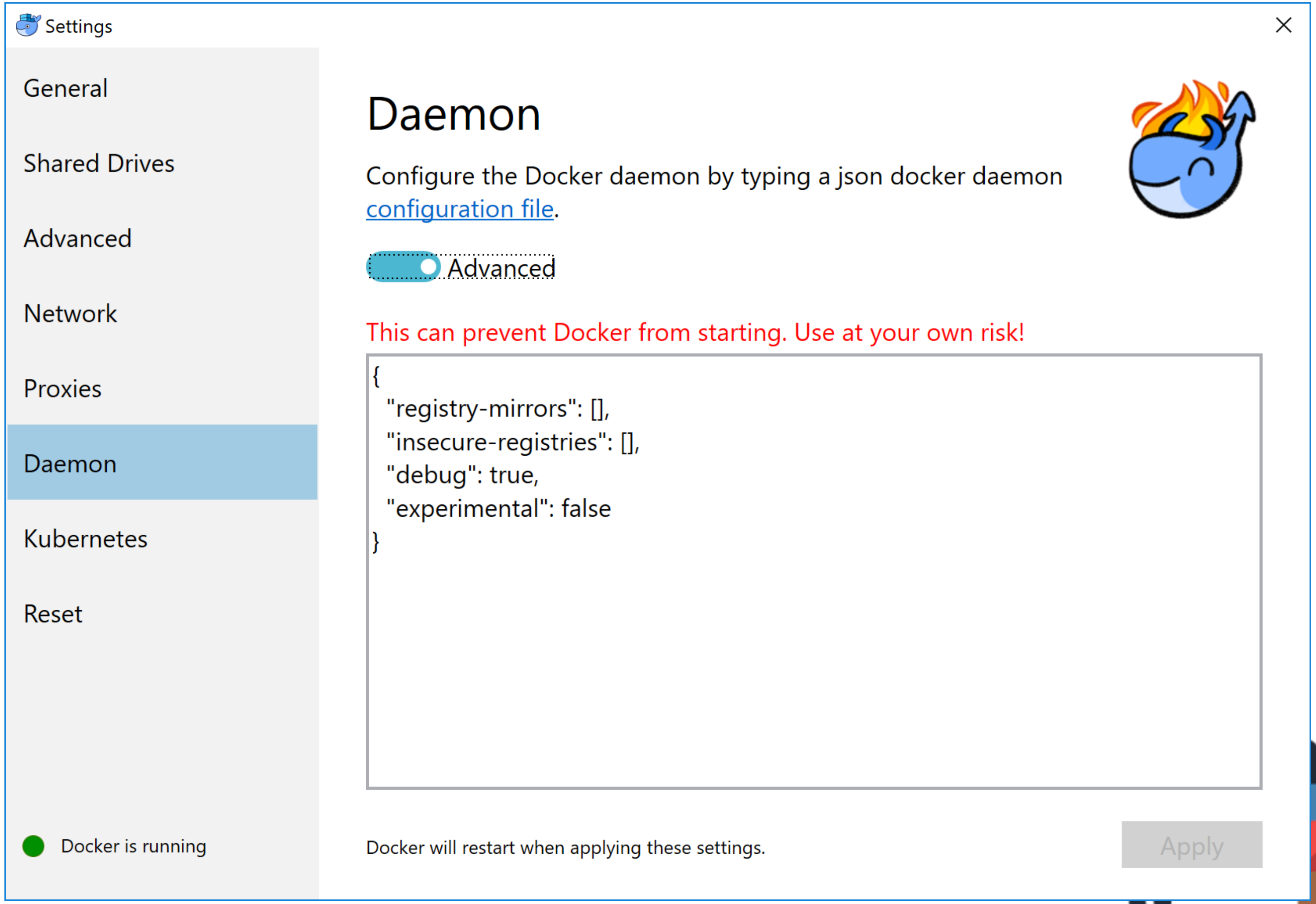


Configure the Docker daemon by typing a json Docker daemon configuration file.

This can prevent Docker from starting, reset your daemon settings if it hangs.

```
{
  "debug" : true,
  "experimental" : true
}
```

Docker is running



Daemon

Configure the Docker daemon by typing a json docker daemon configuration file.

Advanced

This can prevent Docker from starting. Use at your own risk!

```
{
  "registry-mirrors": [],
  "insecure-registries": [],
  "debug": true,
  "experimental": false
}
```

● Docker is running

Docker will restart when applying these settings.

Networking

Subnet Collisions

- Docker networks sometimes conflict with other networks

Subnet Collisions

- Docker networks sometimes conflict with other networks
- Originally we had the BIP setting

```
$ cat /etc/docker/daemon.json
{
  "bip": "10.15.0.0/24"
}
```

Subnet Collisions

- Default address poll added in 18.06

```
$ cat /etc/docker/daemon.json
{
  "bip": "10.15.0.0/24",
  "default-address-pools": [
    {"base": "10.20.0.0/16", "size": 24},
    {"base": "10.40.0.0/16", "size": 24}
  ]
}
```

Subnet Collisions

```
$ docker swarm init --help
...
  --default-addr-pool ipNetSlice
  --default-addr-pool-mask-length uint32
```

Subnet Collisions

```
$ docker swarm init --help
...
  --default-addr-pool ipNetSlice
  --default-addr-pool-mask-length uint32
```

```
$ docker swarm init \
  --default-addr-pool 10.20.0.0/16 \
  --default-addr-pool 10.40.0.0/16 \
  --default-addr-pool-mask-length 24
```

Network Debugging

- Networks in docker come in a few flavors: bridge, overlay, host, none
- You can also configure the network namespace to be another container

Network Debugging

- Networks in docker come in a few flavors: bridge, overlay, host, none
- You can also configure the network namespace to be another container

```
$ docker run --name web-app -p 9080:80 -d nginx

$ docker run -it --rm --net container:web-app \
    nicolaka/netshoot ss -lnt
State      Recv-Q Send-Q Local  Address:Port     Peer Address:Port
LISTEN     0      128           *:80             *:*
```

Network Debugging

```
$ docker run -it --rm --net container:web-app \
    nicolaka/netshoot tcpdump -n port 80
tcpdump: verbose output suppressed, use -v or -vv for full
protocol decode
listening on eth0, link-type EN10MB (Ethernet), capture size
262144 bytes
```

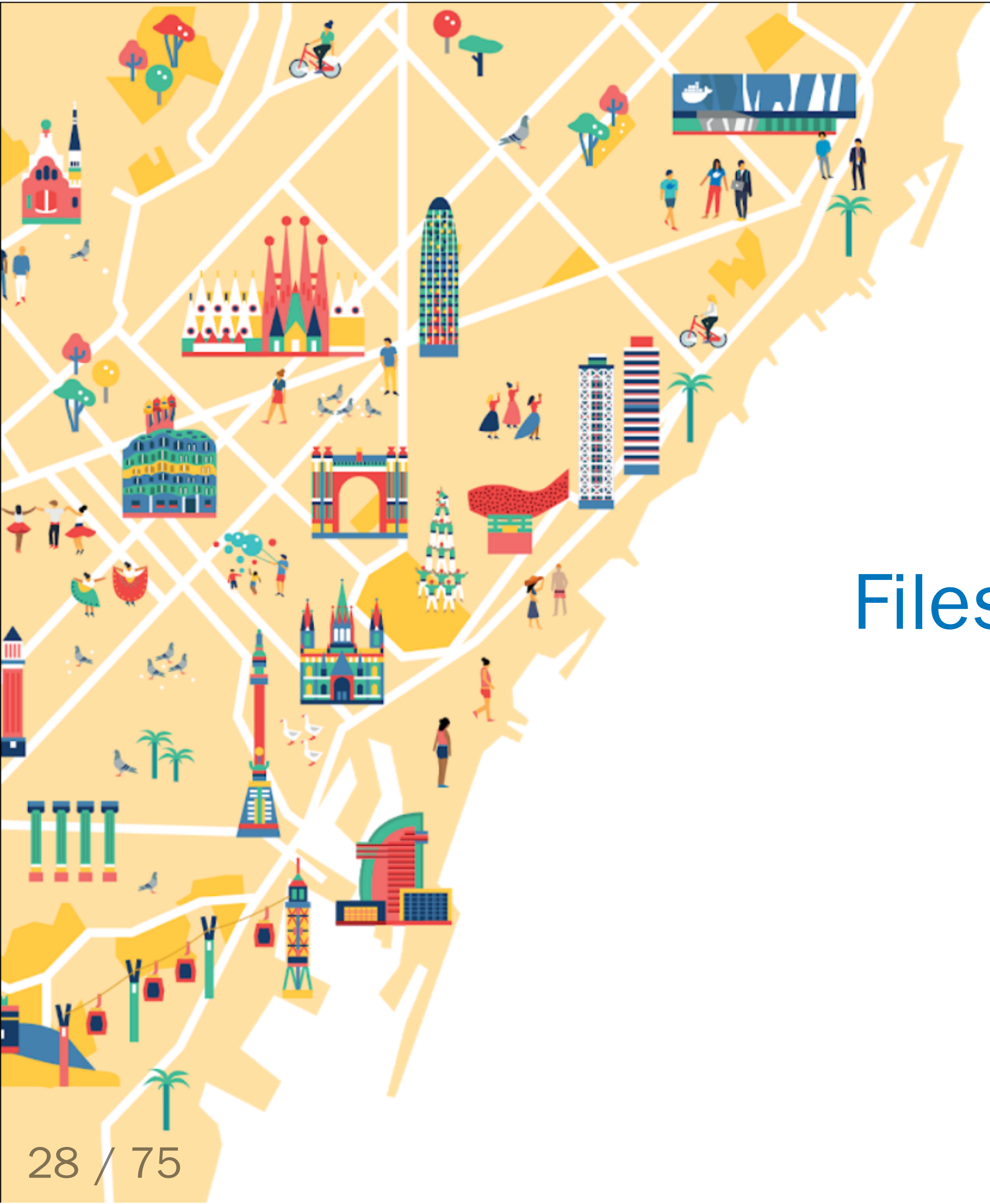
Network Debugging

```
$ docker run -it --rm --net container:web-app \
    nicolaka/netshoot tcpdump -n port 80
tcpdump: verbose output suppressed, use -v or -vv for full
protocol decode
listening on eth0, link-type EN10MB (Ethernet), capture size
262144 bytes
```

```
$ curl localhost:9080
<!DOCTYPE html>
<html>
<head>
<title>Welcome to nginx!</title>
...
```

Network Debugging

```
$ docker run -it --rm --net container:web-app \
    nicolaka/netshoot tcpdump -n port 80
14:08:58.878822 IP 172.17.0.1.55194 > 172.17.0.2.80: Flags [S],...
14:08:58.878848 IP 172.17.0.2.80 > 172.17.0.1.55194: Flags [S.],..
14:08:58.878872 IP 172.17.0.1.55194 > 172.17.0.2.80: Flags [.],...
14:08:58.879089 IP 172.17.0.1.55194 > 172.17.0.2.80: Flags [P.],..
14:08:58.879110 IP 172.17.0.2.80 > 172.17.0.1.55194: Flags [.],...
14:08:58.879208 IP 172.17.0.2.80 > 172.17.0.1.55194: Flags [P.],..
14:08:58.879238 IP 172.17.0.1.55194 > 172.17.0.2.80: Flags [.],...
14:08:58.879267 IP 172.17.0.2.80 > 172.17.0.1.55194: Flags [P.],..
14:08:58.879285 IP 172.17.0.1.55194 > 172.17.0.2.80: Flags [.],...
14:08:58.879695 IP 172.17.0.1.55194 > 172.17.0.2.80: Flags [F.],..
14:08:58.879739 IP 172.17.0.2.80 > 172.17.0.1.55194: Flags [F.],..
14:08:58.879776 IP 172.17.0.1.55194 > 172.17.0.2.80: Flags [.],...
```



Filesystems and Volumes

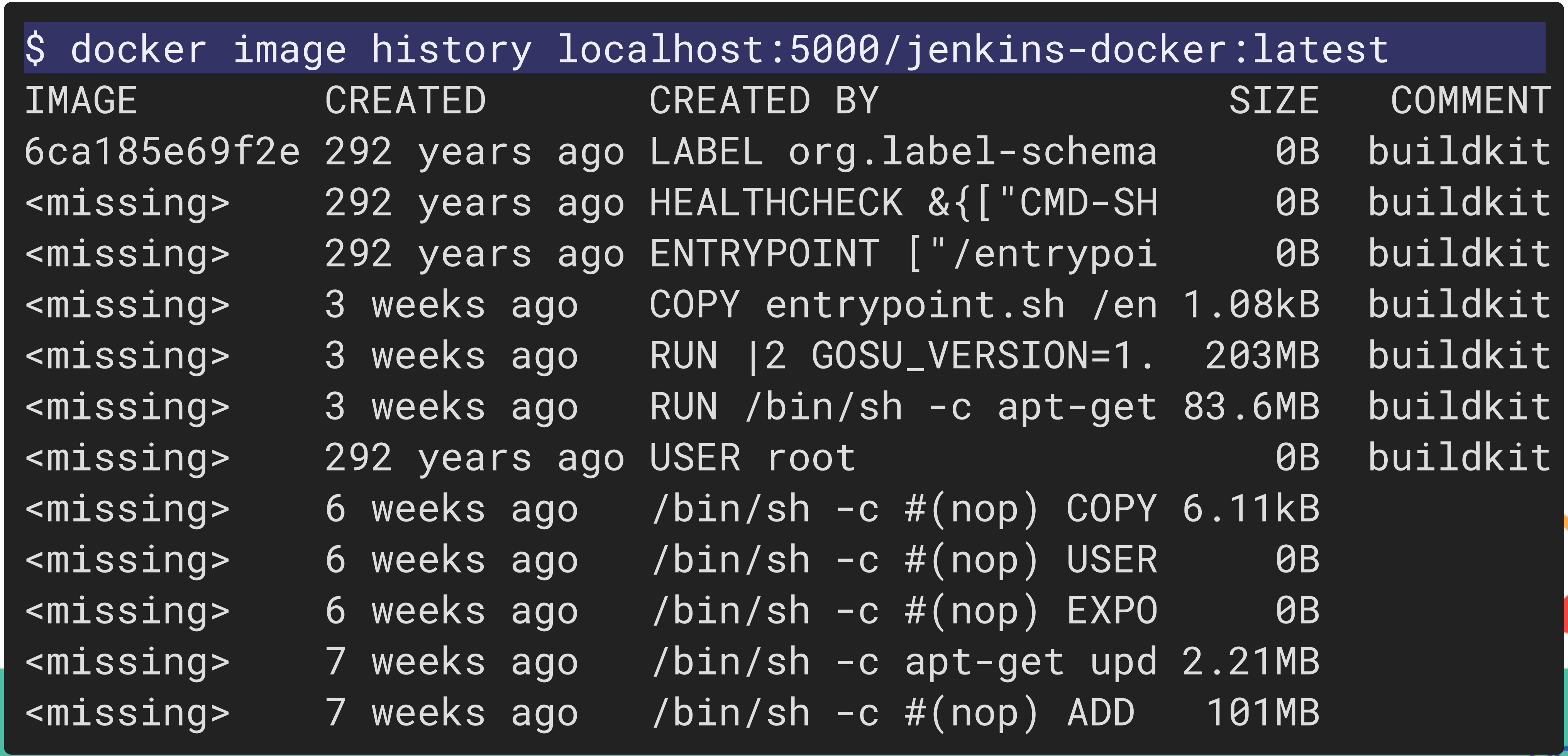
Understanding Layers

```
$ docker image inspect localhost:5000/jenkins-docker:latest \
    --format '{{json .RootFS.Layers}}' | jq .
[
  "sha256:b28ef0b6fef80faa25436bec0a1375214d9a23a91e9b75975bb...",
  ...
  "sha256:08794ff8753b0fbca869a7ece2dff463cdb7cffd5d7ce792ec0...",
  "sha256:37986c5c5dff18257b9a12a19801828a80aea036992b34d35a3...",
  "sha256:34bb0412a3f6c0f3684e05fcd0a301dc999510511c3206d8cd3...",
  "sha256:696245ae585527c34e2cbc0d01d333aa104693e12e0b79cf193...",
  "sha256:91b63ceb91a75edb481c1ef8b005f9a55aa39d57ac6cc6ef490...",
  "sha256:afddea070d31e748730901215d11b546f4f212114e38e685465...",
  "sha256:0c05256b3bb44190557669126bf69897c7faf7628ff1ed2e2d4...",
  "sha256:0c05256b3bb44190557669126bf69897c7faf7628ff1ed2e2d4..."
]
```

Understanding Layers

```
$ docker image inspect jenkins/jenkins:lts \
    --format '{{json .RootFS.Layers}}' | jq .
[
  "sha256:b28ef0b6fef80faa25436bec0a1375214d9a23a91e9b75975bb...",
  ...
  "sha256:08794ff8753b0fbca869a7ece2dff463cdb7cffd5d7ce792ec0...",
  "sha256:37986c5c5dff18257b9a12a19801828a80aea036992b34d35a3...",
  "sha256:34bb0412a3f6c0f3684e05fcd0a301dc999510511c3206d8cd3..."
]
```

Understanding Layers



```
$ docker image history localhost:5000/jenkins-docker:latest
IMAGE        CREATED       CREATED BY                 SIZE   COMMENT
6ca185e69f2e 292 years ago LABEL org.label-schema      0B   buildkit
<missing>    292 years ago HEALTHCHECK &{["CMD-SH      0B   buildkit
<missing>    292 years ago ENTRYPOINT ["/entrypoi      0B   buildkit
<missing>    3 weeks ago   COPY entrypoint.sh /en 1.08kB   buildkit
<missing>    3 weeks ago   RUN |2 GOSU_VERSION=1.  203MB   buildkit
<missing>    3 weeks ago   RUN /bin/sh -c apt-get 83.6MB   buildkit
<missing>    292 years ago USER root                   0B   buildkit
<missing>    6 weeks ago   /bin/sh -c #(nop) COPY 6.11kB
<missing>    6 weeks ago   /bin/sh -c #(nop) USER      0B
<missing>    6 weeks ago   /bin/sh -c #(nop) EXPO      0B
<missing>    7 weeks ago   /bin/sh -c apt-get upd 2.21MB
<missing>    7 weeks ago   /bin/sh -c #(nop) ADD   101MB
```

Understanding Layers

```
$ DOCKER_BUILDKIT=0 docker build --no-cache --rm=false .
Sending build context to Docker daemon  146.4kB
...
Step 5/17 : RUN apt-get update  && DEBIAN_FRONTEND=noninteracti...
  ---> Running in 1fc215ebb603
...
 ---> d6dff86e8b89
Step 9/17 : RUN curl -fsSL https://download.docker.com/linux/de...
  ---> Running in a7a3a942a617
...
 ---> a241c22525d8
...
Successfully built b01e4c46a2bf
```

Understanding Layers

```
$ docker container diff 1fc215ebb603
C /etc
A /etc/python3.5
A /etc/python3.5/sitecustomize.py
...
C /usr/bin
A /usr/bin/pygettext3
A /usr/bin/helpztags
A /usr/bin/python3
A /usr/bin/rvim
A /usr/bin/view
A /usr/bin/python3.5
...
```

Understanding Layers

- If you create a temporary file in a step, delete it in that same step
- Look for unexpected changes that trigger a copy-on-write, e.g. timestamps
- Do your dirty work in early stages of a multi-stage build
- Merge your `COPY` and `RUN` commands together

Merge COPY and RUN

```
RUN apt-get update
RUN apt-get install -y curl
RUN rm -rf /var/lib/apt/lists/*
```

Merge COPY and RUN

```
RUN apt-get update
RUN apt-get install -y curl
RUN rm -rf /var/lib/apt/lists/*
```

```
RUN apt-get update \
 && apt-get install -y curl \
 && rm -rf /var/lib/apt/lists/*
```

Merge COPY and RUN

```
COPY module_a /code/module_a/
COPY module_b /code/module_b/
```

Merge COPY and RUN

```
COPY module_a /code/module_a/
COPY module_b /code/module_b/
```

```
COPY code /code
```

Merge COPY and RUN

```
COPY code /code
RUN  extract-code.sh \
 &&  compile-binaries.sh \
 &&  cleanup-code.sh
```

Merge COPY and RUN with Just a RUN

```
RUN  apt-get update \
  && apt-get install -y curl build-essential \
  && curl http://company-repo/latest/code.tgz >code.tgz \
  && extract-code.sh \
  && compile-binaries.sh \
  && cleanup-code.sh \
  && apt-get remove -y curl build-essential \
  && rm -rf /var/lib/apt/lists/*
```

Merge COPY and RUN with Multi-Stage

```
FROM openjdk:jdk as build
RUN  apt-get update \
 &&  apt-get install -y maven
COPY code /code
RUN  mvn build

FROM openjdk:jre as final
COPY --from build /code/app.jar /app.jar
ENTRYPOINT ["java", "-jar", "/app.jar"]
```

"Hold my beer."

--BuildKit

Merge COPY and RUN with BuildKit

```
# syntax = tonistiigi/dockerfile:runmount20180607
FROM openjdk:jdk as build
RUN  apt-get update \
 &&  apt-get install -y maven
RUN  --mount=type=bind,target=/code,source=code \
     --mount=type=cache,target=/root/.m2 \
     mvn build

FROM openjdk:jre as final
COPY --from build /output/app.jar /app.jar
ENTRYPOINT ["java", "-jar", "/app.jar"]
```

Merge COPY and RUN with BuildKit

```
$ export DOCKER_BUILDKIT=1
$ docker build -t your_image .
```

Merge COPY and RUN with BuildKit

```
$ export DOCKER_BUILDKIT=1
$ docker build -t your_image .
```

```
$ cat /etc/docker/daemon.json
{ "features": {"buildkit": true} }
```

BuildKit is Awesome

```
# syntax = docker/dockerfile:experimental
FROM python:3
RUN pip install awscli
RUN --mount=type=secret,id=aws,target=/root/.aws/credentials \
    aws s3 cp s3://... ...
```

```
$ docker build --secret id=aws,src=$HOME/.aws/credentials \
  -t s3-app .
```

BuildKit is Awesome

```
# syntax = docker/dockerfile:experimental
FROM alpine
RUN apk add --no-cache openssh-client git
RUN mkdir -p -m 0700 ~/.ssh \
 && ssh-keyscan gitlab.com >> ~/.ssh/known_hosts
RUN --mount=type=ssh git clone git@gitlab.com:private/repo
```

```
$ eval $(ssh-agent)
$ ssh-add ~/.ssh/id_rsa
(Input your passphrase here)
$ docker build --ssh default=$SSH_AUTH_SOCK \
  -t private-app .
```

BuildKit is Awesome

```
FROM openjdk:jdk as build
COPY src /src
RUN  mvn build
CMD  java -jar /app-a.jar

FROM build as test
RUN  mvn test

FROM build as dev
CMD  /bin/bash

FROM openjdk:jre as release
COPY --from=build /app.jar /
CMD  java -jar /app.jar
```

BuildKit is Awesome

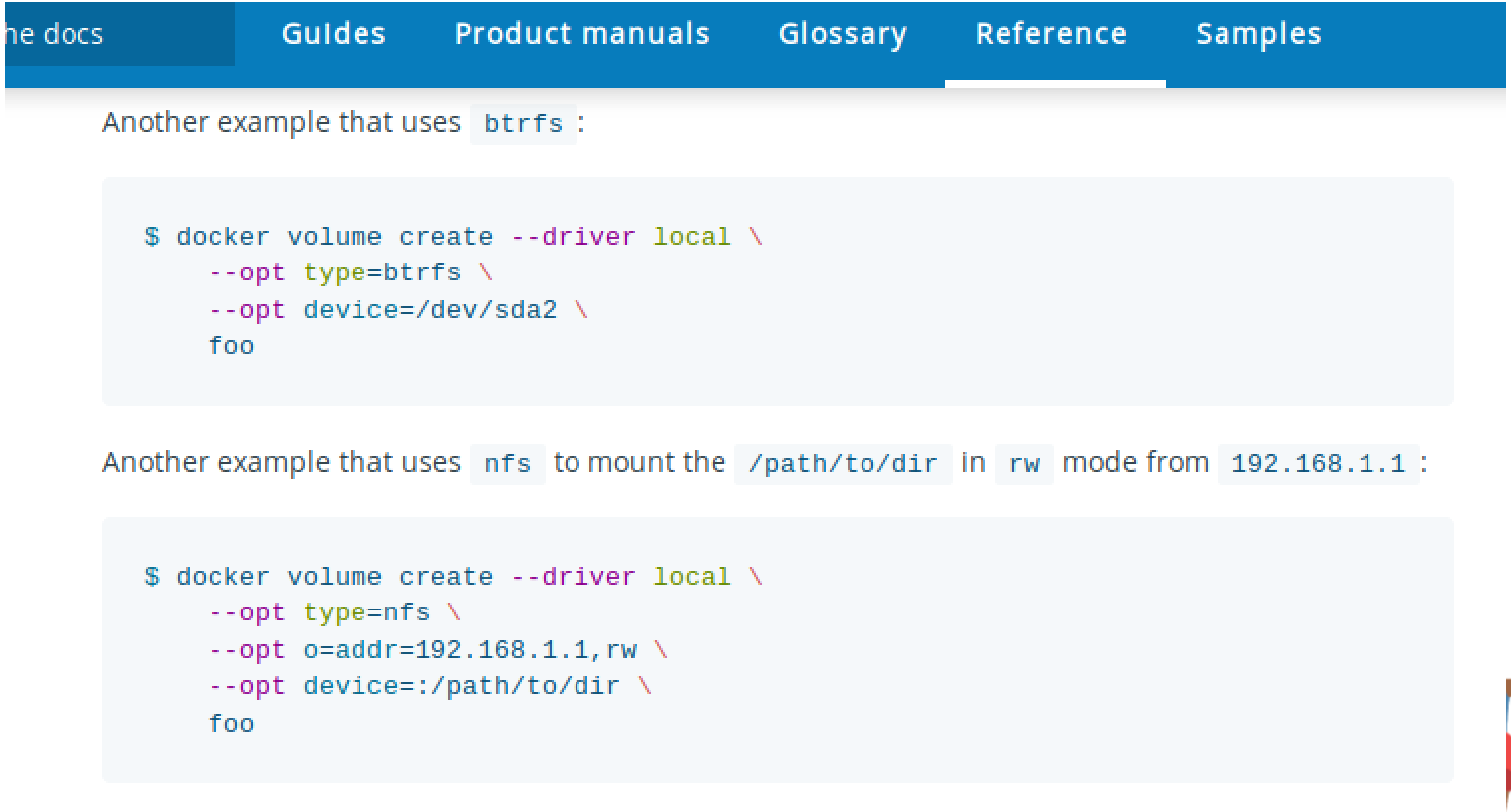
```
FROM openjdk:jdk as build
COPY src /src
RUN  mvn build
CMD  java -jar /app-a.jar

FROM build as test
RUN  mvn test

FROM build as dev
CMD  /bin/bash

FROM openjdk:jre as release
COPY --from=build /app.jar /
CMD  java -jar /app.jar
```

BuildKit is Awesome

- Dockerfile parser can be updated without updating docker engine
- Build context ignores files you do not ADD or COPY
- The build context is cached, similar to rsync
- Uses remote registries efficiently for layer caching
- Only runs the build steps needed for target stage

Volumes

Local Volume Driver



Another example that uses `btrfs` :

```
$ docker volume create --driver local \
    --opt type=btrfs \
    --opt device=/dev/sda2 \
    foo
```

Another example that uses `nfs` to mount the `/path/to/dir` in `rw` mode from `192.168.1.1` :

```
$ docker volume create --driver local \
    --opt type=nfs \
    --opt o=addr=192.168.1.1,rw \
    --opt device=:/path/to/dir \
    foo
```

NFS Mounts

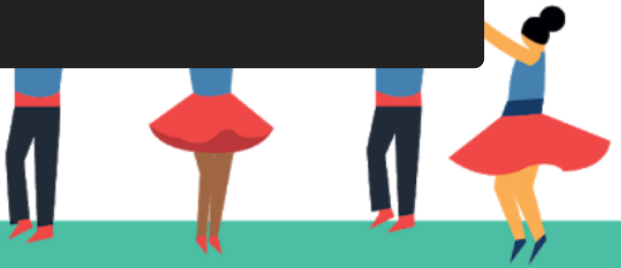
```
$ docker volume create \
    --driver local \
    --opt type=nfs \
    --opt o=nfsvers=4,addr=nfs.example.com,rw \
    --opt device=:/path/to/dir \
    foo
```

NFS Mounts

```
$ docker container run -it --rm \
  --mount \
      type=volume,\
      dst=/container/path,\
      volume-driver=local,\
      volume-opt=type=nfs,\
    \"volume-opt=o=nfsvers=4,addr=nfs.example.com\",\
      volume-opt=device=:/host/path \
  foo
```

NFS Mounts

```
$ docker service create \
  --mount \
      type=volume,\
      dst=/container/path,\
      src=foo-nfs-data,\
      volume-driver=local,\
      volume-opt=type=nfs,\
    \"volume-opt=o=nfsvers=4,addr=nfs.example.com\",\
      volume-opt=device=:/host/path \
  foo
```



NFS Mounts

```
version: '3.7'
volumes:
  nfs-data:
    driver: local
    driver_opts:
      type: nfs
      o: nfsvers=4,addr=nfs.example.com,rw
      device: ":/path/to/dir"
services:
  app:
    volumes:
      - nfs-data:/data
...
```

Other Filesystem Mounts

```
version: '3.7'
volumes:
  ext-data:
    driver: local
    driver_opts:
      type: ext4
      o: ro
      device: "/dev/sdb1"
services:
  app:
    volumes:
      - ext-data:/data
...
```

Other Filesystem Mounts

```
version: '3.7'
volumes:
  proc:
    driver: local
    driver_opts:
      type: proc
      device: proc
services:
  app:
    volumes:
      - proc:/ext-proc
...
```

Overlay Filesystem as a Volume

```
version: '3.7'
volumes:
  overlay-data:
    driver: local
    driver_opts:
      type: overlay
      device: overlay
      o: lowerdir=${PWD}/data2:${PWD}/data1,\
         upperdir=${PWD}/upper,workdir=${PWD}/workdir
services:
  app:
    volumes:
      - overlay-data:/data
...
```

Named Bind Mount

```yaml
version: '3.7'
volumes:
  bind-test:
    driver: local
    driver_opts:
      type: none
      o: bind
      device: /home/user/test
services:
  app:
    volumes:
      - "bind-test:/test"
...
```

That's nice, but I just use:
$(pwd)/code:/code

That's nice, but I just use:

~~$(pwd)/code:/code~~

"$(pwd)/code:/code"

Fixing UID/GID

```
FROM openjdk:jdk as build
RUN  useradd -m app
COPY code /code
RUN  --mount=target=/home/app/.m2,type=cache \
     mvn build
CMD ["java", "-jar", "/output/app.jar"]
USER app
```

Fixing UID/GID

```
version: '3.7'
volumes:
  m2:
services:
  app:
    build:
      context: .
      target: build
    image: registry:5000/app/app:dev
    command: "/bin/sh -c 'mvn build && java -jar /output/app.jar'"
    volumes:
    - ./code:/code
    - m2:/home/app/.m2
```

Fixing UID/GID

```
Error accessing /code: permission denied
```

Fixing UID/GID

```
Error accessing /code: permission denied
```

- `app` inside the container doesn't match `$USER` on the host

Fixing UID/GID

Possible solutions:

- Run everything as root
- Change permissions to 777
- Adjust each developers uid/gid to match image
- Adjust image uid/gid to match developers
- Change the container uid/gid from `run` or `compose`

Fixing UID/GID

Possible solutions:

- Run everything as root
- Change permissions to 777
- Adjust each developers uid/gid to match image
- Adjust image uid/gid to match developers
- Change the container uid/gid from `run` or `compose`
- "... or we could use a shell script" - Some Ops Guy

Disclaimer

The following slide may not be suitable for all audiences

Fixing UID/GID

```
# update the uid
if [ -n "$opt_u" ]; then
  OLD_UID=$(getent passwd "${opt_u}" | cut -f3 -d:)
  NEW_UID=$(ls -nd "$1" | awk '{print $3}')
  if [ "$OLD_UID" != "$NEW_UID" ]; then
    echo "Changing UID of $opt_u from $OLD_UID to $NEW_UID"
    usermod -u "$NEW_UID" -o "$opt_u"
    if [ -n "$opt_r" ]; then
      find / -xdev -user "$OLD_UID" -exec chown -h "$opt_u" {} \;
    fi
  fi
fi
```

Fixing UID/GID

```
FROM openjdk:jdk as build
COPY --from=sudobmitch/base:scratch / /
RUN  useradd -m app
COPY code /code
RUN  --mount=target=/home/app/.m2,type=cache \
     mvn build
COPY entrypoint.sh /usr/bin/
ENTRYPOINT ["/usr/bin/entrypointd.sh"]
CMD ["java", "-jar", "/output/app.jar"]
USER app
```

Fixing UID/GID

```
#!/bin/sh
if [ "$(id -u)" = "0" ]; then
  fix-perms -r -u app -g app /code
  exec gosu app "$@"
else
  exec "$@"
fi
```

Fixing UID/GID

```
version: '3.7'
volumes:
  m2:
services:
  app:
    build:
      context: .
      target: build
    image: registry:5000/app/app:dev
    command: "/bin/sh -c 'mvn build && java -jar /output/app.jar'"
    user: "0.0"
    volumes:
    - ./code:/code
    - m2:/home/app/.m2
```

Fixing UID/GID

- Developers run the container as root
- Mount their code as `/code` from the host
- `/code` has uid from the host
- Entrypoint inside the container updates `app` user to match uid of `/code`
- Entrypoint switches from root to app and runs container command with `exec`
- Pid 1 is the app with a uid matching the host
- Reads and writes to `/code` happen as the developers uid

Thank You

github.com/sudo-bmitch/presentations

github.com/sudo-bmitch/docker-base

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