

リスト1 (Dockerのインストール)

```

cq@rp4:~/CQ/Docker $ mkdir -p $HOME/CQ/Docker
cq@rp4:~/CQ/Docker $ cd $HOME/CQ/Docker
cq@rp4:~/CQ/Docker $ curl -fsSL https://get.docker.com -o get-docker.sh
cq@rp4:~/CQ/Docker $ sh get-docker.sh

```

リスト2 (Dockerグループへ追加するコマンド)

```

cq@rp4:~/CQ/Docker $ sudo usermod -aG docker cq

```

リスト3 (Dockerグループの確認)

```

cq@rp4:~ $ id
uid=1000(cq) gid=1000(cq)
groups=1000(cq), 4(adm), 20(dialout), 24(cdrom), 27(sudo), 29(audio), 44(video), 46(plugdev), 60(games), 100(users), 102(input), 105(render), 106(netdev), 115(lpadmin), 991(docker), 993(gpio), 994(i2c), 995(spi)
cq@rp4:~ $

```

リスト4 (Dockerコマンドの実行結果)

```

cq@rp4:~ $ docker ps
CONTAINER ID   IMAGE     COMMAND   CREATED   STATUS    PORTS   NAMES
cq@rp4:~ $

```

リスト5 (このメッセージがでたらメモリ・コントローラが有効になっていない)

```

WARNING: No memory limit support
WARNING: No swap limit support

```

リスト6 (編集前のcmdline.txt)

```

console=serial0,115200 console=tty1 root=PARTUUID=b60f051e-02 rootfstype=ext4 fsck.repair=yes rootwait quiet splash
plymouth.ignore-serial-console cgroup_enable=memory

```

リスト7 (編集後のcmdline.txt)

```

console=serial0,115200 console=tty1 root=PARTUUID=b60f051e-02 rootfstype=ext4 fsck.repair=yes rootwait quiet splash
plymouth.ignore-serial-console cgroup_enable=memory

```

リスト8 (docker imagesコマンドで管理しているイメージの一覧を確認)

```

cq@rp4:~/CQ/Docker $ docker images
REPOSITORY TAG IMAGE ID CREATED SIZE
cq@rp4:~/CQ/Docker $

```

リスト9 [コンテナ起動した様子 (初回)]

```

cq@rp4:~/CQ/Docker $ docker run -it debian
Unable to find image 'debian:latest' locally ★iDockerはイメージを持っていない
latest: Pulling from library/debian ★Docker HUBからイメージを持ってくる
56c9b9253ff9: Pull complete
Digest: sha256:b8084b1a576c5504a031936e1132574f4ce1d6cc7130bbcc25a28f074539ae6b
Status: Downloaded newer image for debian:latest
root@6757a6a62a5f:/#

```

リスト10 (登録されたイメージの確認)

```

cq@rp4:~/CQ/Docker $ docker images
REPOSITORY TAG IMAGE ID CREATED SIZE
debian latest b442aaf37046 2 weeks ago 139MB
cq@rp4:~/CQ/Docker $

```

リスト11 (2回目以降はイメージの取得が行われないのでコンテナは瞬時に起動する)

```

cq@rp4:~/CQ/Docker $ docker run -it debian
root@24d7a225a7b2:/#

```

リスト12 (debianコンテナを起動しただけではpython3コマンドは使えない)

```

root@24d7a225a7b2:/# python3
bash: python3: command not found
root@24d7a225a7b2:/#

```

リスト13 (python3をインストールしてpython3コマンドを実行)

```
root@24d7a225a7b2:/# python3
Python 3.11.2 (main, Aug 26 2024, 07:20:54) [GCC 12.2.0] on linux
Type "help", "copyright", "credits" or "license" for more information.
>>>
```

リスト14 (コンテナ・イメージの登録手順)

```
cq@rp4:~ $ docker ps
CONTAINER ID   IMAGE     COMMAND   CREATED   STATUS    PORTS   NAMES
24d7a225a7b2  debian   "bash"    9 hours ago  Up 9 hours           sad_bassi
cq@rp4:~ $ docker commit 24d7a225a7b2 debian_with_py
sha256:7852d0dbfcaf91507e6e6ebb96b5c958256cbc96b1a6842cc2ac7c265dd56158
cq@rp4:~ $ docker images
REPOSITORY    TAG       IMAGE ID       CREATED        SIZE
debian_with_py  latest   7852d0dbfcaf   About a minute ago  209MB
debian         latest   b442aaf37046   2 weeks ago     139MB
cq@rp4:~ $
```

リスト15 (コンテナを起動してpython3が実行できることを確認)

```
cq@rp4:~ $ docker run -it debian_with_py
root@867364b383b9:/# python
bash: python: command not found
root@867364b383b9:/# python3
Python 3.11.2 (main, Aug 26 2024, 07:20:54) [GCC 12.2.0] on linux
Type "help", "copyright", "credits" or "license" for more information.
>>>
```

リスト16 (-o オプションでファイル名 (debian_with_py.img) を指定してコンテナ・イメージをファイルに保存)

```
cq@rp4:~ $ docker images
REPOSITORY    TAG       IMAGE ID       CREATED        SIZE
debian_with_py  latest   7852d0dbfcaf   2 hours ago    209MB
debian         latest   b442aaf37046   2 weeks ago    139MB
cq@rp4:~ $ docker save -o debian_with_py.img debian_with_py
cq@rp4:~ $ ls -l debian_with_py.img
-rw----- 1 cq cq 215599616 Sep 20 20:51 debian_with_py.img
cq@rp4:~ $
```

リスト17 (docker rmコマンドでコンテナ・イメージ (24d7a225a7b2) を削除)

```
cq@rp4:~ $ docker ps -a
CONTAINER ID   IMAGE     COMMAND   CREATED   STATUS    PORTS   NAMES
867364b383b9  debian_with_py  "bash"    2 hours ago  Exited (0) 2 hours ago           cranky_shirley
24d7a225a7b2  debian       "bash"    11 hours ago  Exited (0) 2 hours ago           sad_bassi
cq@rp4:~ $ docker rm 24d7a225a7b2
24d7a225a7b2
cq@rp4:~ $ docker ps -a
CONTAINER ID   IMAGE     COMMAND   CREATED   STATUS    PORTS   NAMES
24d7a225a7b2  debian       "bash"    11 hours ago  Exited (0) 2 hours ago           sad_bassi
cq@rp4:~ $
```

リスト18 (docker rmiコマンドでコンテナ・イメージ (debian_with_py) を削除)

```
cq@rp4:~ $ docker images
REPOSITORY    TAG       IMAGE ID       CREATED        SIZE
debian_with_py  latest   7852d0dbfcaf   2 hours ago    209MB
debian         latest   b442aaf37046   2 weeks ago    139MB
cq@rp4:~ $ docker rmi debian_with_py
Untagged: debian_with_py:latest
Deleted: sha256:7852d0dbfcaf91507e6e6ebb96b5c958256cbc96b1a6842cc2ac7c265dd56158
Deleted: sha256:5eed8087cf9c1ff03c8200c810c166c05905df7d2afba54656494a0ac62d02ee
cq@rp4:~ $ docker images
REPOSITORY    TAG       IMAGE ID       CREATED        SIZE
debian         latest   b442aaf37046   2 weeks ago    139MB
cq@rp4:~ $
```

リスト19 (コンテナ・イメージの登録)

```
cq@rp4:~ $ docker load -i debian_with_py.img
f75d3e3de006: Loading layer [=====>] 71.99MB/71.99MB
Loaded image: debian_with_py:latest
cq@rp4:~ $ docker images
REPOSITORY    TAG       IMAGE ID       CREATED        SIZE
debian_with_py  latest   7852d0dbfcaf   3 hours ago    209MB
debian         latest   b442aaf37046   2 weeks ago    139MB
cq@rp4:~ $
```

リスト20 (登録したコンテナ・イメージでコンテナを起動)

```

cq@rp4:~ $ docker run -it debian_with_py
root@313e3bd2ad:/# python3
Python 3.11.2 (main, Aug 26 2024, 07:20:54) [GCC 12.2.0] on linux
Type "help", "copyright", "credits" or "license" for more information.
>>>

```

リスト21 [コンテナ起動前の名前空間の様子 (sudo lsns)]

```

-----
      NS TYPE   NPROCS   PID USER           COMMAND
4026531834 time      209      1 root           /sbin/init splash
4026531835 cgroup    209      1 root           /sbin/init splash
4026531836 pid      209      1 root           /sbin/init splash
4026531837 user     209      1 root           /sbin/init splash
4026531838 uts      206      1 root           /sbin/init splash
4026531839 ipc      209      1 root           /sbin/init splash
4026531840 net      207      1 root           /sbin/init splash
4026531841 mnt      201      1 root           /sbin/init splash
4026532404 mnt        1     298 root           |---/lib/systemd/systemd-udev
4026532405 uts        1     298 root           |---/lib/systemd/systemd-udev
4026532479 mnt        1     486 systemd-timesync |---/lib/systemd/systemd-timesync
4026532490 uts        1     486 systemd-timesync |---/lib/systemd/systemd-timesync
4026532491 net        1     549 root           |---/usr/libexec/accounts-daemon
4026532567 mnt        1     549 root           |---/usr/libexec/accounts-daemon
4026532568 mnt        1     552 root           |---/usr/libexec/bluetooth/bluetoothd
4026532569 net        1     899 rtkit          |---/usr/libexec/rtkit-daemon
4026532646 mnt        1     570 root           |---/lib/systemd/systemd-logind
4026532647 uts        1     570 root           |---/lib/systemd/systemd-logind
4026532648 mnt        1     673 root           |---/usr/sbin/NetworkManager --no-daemon
4026532727 mnt        1     696 root           |---/usr/sbin/ModemManager
4026531862 mnt        1      39 root           kdevtmpfs
-----

```

リスト22 (debianコンテナを起動)

```

cq@rp4:~/CQ/Docker $ docker run -it debian
root@d917ace390f1:/#

```

リスト23 (コンテナ起動後の名前空間の様子)

```

-----
      NS TYPE   NPROCS   PID USER           COMMAND
4026531834 time      213      1 root           /sbin/init splash
4026531835 cgroup    212      1 root           /sbin/init splash
4026531836 pid      212      1 root           /sbin/init splash
4026531837 user     213      1 root           /sbin/init splash
4026531838 uts      209      1 root           /sbin/init splash
4026531839 ipc      212      1 root           /sbin/init splash
4026531840 net      210      1 root           /sbin/init splash
4026531841 mnt      204      1 root           /sbin/init splash
4026532404 mnt        1     298 root           |---/lib/systemd/systemd-udev
4026532405 uts        1     298 root           |---/lib/systemd/systemd-udev
4026532479 mnt        1     486 systemd-timesync |---/lib/systemd/systemd-timesync
4026532490 uts        1     486 systemd-timesync |---/lib/systemd/systemd-timesync
4026532491 net        1     549 root           |---/usr/libexec/accounts-daemon
4026532567 mnt        1     549 root           |---/usr/libexec/accounts-daemon
4026532568 mnt        1     552 root           |---/usr/libexec/bluetooth/bluetoothd
4026532569 net        1     899 rtkit          |---/usr/libexec/rtkit-daemon
4026532646 mnt        1     570 root           |---/lib/systemd/systemd-logind
4026532647 uts        1     570 root           |---/lib/systemd/systemd-logind
4026532648 mnt        1     673 root           |---/usr/sbin/NetworkManager --no-daemon
4026532727 mnt        1     696 root           |---/usr/sbin/ModemManager
4026531862 mnt        1      39 root           kdevtmpfs
4026532652 mnt        1    2595 root           bash
4026532653 uts        1    2595 root           bash
4026532654 ipc        1    2595 root           bash
4026532655 pid        1    2595 root           bash
4026532656 net        1    2595 root           bash
4026532756 cgroup    1    2595 root           bash
-----

```

リスト24 (ホストでプロセスの様子を確認)

```

-----
UID      PID    PPID  C STIME TTY          TIME CMD
cq       2533   2463  0 09:08 pts/1      00:00:00 docker run -it debian
root     2573     1  0 09:08 ?          00:00:00 /usr/bin/containerd-shim-runc-v2 -namespace moby -id
d917ace390f17b3c4f03e8db378621816f6fa765d0fc85752e3a6bbf29be9acb -address /run/c
root     2595   2573  0 09:08 pts/0      00:00:00 bash
-----

```

リスト25 (自身のPIDを確認)

```

root@d917ace390f1:/# echo $$
1
root@d917ace390f1:/#

```

リスト26 (psコマンドでのプロセス一覧)

```
root@d917ace390f1:~# ps -aef
UID      PID     PPID  C  STIME TTY          TIME CMD
root         1         0  0  00:08 pts/0        00:00:00 bash
root        194         1  50 01:04 pts/0        00:00:00 ps -aef
root@d917ace390f1:~#
```

リスト27 (ホスト側でのマウント状態)

```
cq@rp4:~/CQ/Docker $ mount
sysfs on /sys type sysfs (rw,nosuid,nodev,noexec,relatime)
proc on /proc type proc (rw,relatime)
```

~~ 中略 ~~

```
overlay on /var/lib/docker/overlay2/319a6285e3b024d6d69a402a74a2c7a1d0d06015619e56c6aa214b8ee4c7ca51/merged type overlay
(rw,relatime,lowerdir=/var/lib/docker/overlay2/l/LWIBC66RUUBGBSURP5NTR3YDN4:/var/lib/docker/overlay2/l/AKC4EILHVS3TNTIWAQT
R724RI,upperdir=/var/lib/docker/overlay2/319a6285e3b024d6d69a402a74a2c7a1d0d06015619e56c6aa214b8ee4c7ca51/diff,workdir=/var
/lib/docker/overlay2/319a6285e3b024d6d69a402a74a2c7a1d0d06015619e56c6aa214b8ee4c7ca51/work)
nsfs on /run/docker/netns/2a886cfeffcb type nsfs (rw)
cq@rp4:~/CQ/Docker $
```

リスト28 (コンテナ側でのマウント状態)

```
root@d917ace390f1:~# mount
overlay on / type overlay
(rw,relatime,lowerdir=/var/lib/docker/overlay2/l/LWIBC66RUUBGBSURP5NTR3YDN4:/var/lib/docker/overlay2/l/AKC4EILHVS3TNTIWAQT
R724RI,upperdir=/var/lib/docker/overlay2/319a6285e3b024d6d69a402a74a2c7a1d0d06015619e56c6aa214b8ee4c7ca51/diff,workdir=/var
/lib/docker/overlay2/319a6285e3b024d6d69a402a74a2c7a1d0d06015619e56c6aa214b8ee4c7ca51/work)
proc on /proc type proc (rw,nosuid,nodev,noexec,relatime)
```

~~ 中略 ~~

```
tmpfs on /sys/firmware type tmpfs (ro,relatime)
root@d917ace390f1:~#
```

リスト29 (コンテナ環境に入ったことが分かるようにする)

```
root@d917ace390f1:~# while :; do date; sleep 10; done &
[1] 202
root@d917ace390f1:~# Sat Sep 21 01:12:55 UTC 2024
```

リスト30 (Dockerコンテナでプロセスを確認した結果)

```
root@d917ace390f1:~# ps -aef
UID      PID     PPID  C  STIME TTY          TIME CMD
root         1         0  0  00:08 pts/0        00:00:00 bash
root        202         1  0  01:12 pts/0        00:00:00 bash
root        204        202  0  01:12 pts/0        00:00:00 sleep 10
root        205         1  99 01:12 pts/0        00:00:00 ps -aef
root@d917ace390f1:~#
```

リスト31 (Dockerコンテナと同じ名前空間でbashを起動してプロセス一覧を取得)

```
cq@rp4:~/CQ/Docker $ sudo nsenter -t 2595 -a
root@d917ace390f1:~# ps -aef
UID      PID     PPID  C  STIME TTY          TIME CMD
root         1         0  0  00:08 pts/0        00:00:00 bash
root        202         1  0  01:12 pts/0        00:00:00 bash
root        229        202  0  01:14 pts/0        00:00:00 sleep 10
root        230         0  0  01:14 ?          00:00:00 -bash
root        233        230  0  01:14 ?          00:00:00 ps -aef
root@d917ace390f1:~#
```

リスト32 (PID名前空間だけホスト側と同じ空間を参照するようにしてbashを起動)

```
cq@rp4:~/CQ/Docker $ sudo nsenter -t 2595 -a --pid=/proc/1/ns/pid
root@d917ace390f1:~#
```

リスト33 (プロセス一覧の確認)

```
root@d917ace390f1:~# ps -aef
Error, do this: mount -t proc proc /proc
root@d917ace390f1:~#
```

リスト34 (メッセージになるようにprocをマウント)

```
root@d917ace390f1:~# mount -t proc proc /proc
root@d917ace390f1:~# ps -aef
UID      PID     PPID  C  STIME TTY          TIME CMD
```

```

                                S3_list.txt
root          1          0 0 Sep20 ?      00:00:03 /sbin/init splash
root          2          0 0 Sep20 ?      00:00:00 [kthreadd]
root          3          2 0 Sep20 ?      00:00:00 [pool_workqueue_release]
root          4          2 0 Sep20 ?      00:00:00 [kworker/R-rcu_g]
~~  中略  ~~
root          3593       2481 0 01:22 ?      00:00:00 sudo nsenter -t 2595 -a --pid=/proc/1/ns/pid
root          3594       3593 0 01:22 ?      00:00:00 sudo nsenter -t 2595 -a --pid=/proc/1/ns/pid
root          3595       3594 0 01:22 ?      00:00:00 nsenter -t 2595 -a --pid=/proc/1/ns/pid
root          3596       3595 0 01:22 ?      00:00:00 -bash
root          3600       3324 0 01:22 pts/0      00:00:00 sleep 10
root          3601       3596 99 01:22 ?      00:00:00 ps -aef
root@d917ace390f1:/#
root@d917ace390f1:/#
root@d917ace390f1:/# echo $$
3596
root@d917ace390f1:/#

```

リスト35 (ホストとディレクトリ共有を有効としてコンテナを起動)

```

cq@rp4:~ $ cd CQ/Docker
cq@rp4:~/CQ/Docker $ mkdir host_dir
cq@rp4:~/CQ/Docker $ docker run -v ./host_dir:/sharedVol -it debian
root@9636de2115ea:/#

```

リスト36 (コンテナ側で共有されたディレクトリの状態を確認)

```

root@9636de2115ea:/# ls -l /
total 52
lrwxrwxrwx 1 root root 7 Sep 4 09:00 bin -> usr/bin
drwxr-xr-x 2 root root 4096 Aug 14 16:10 boot
drwxr-xr-x 5 root root 340 Sep 21 01:57 dev
drwxr-xr-x 1 root root 4096 Sep 21 01:57 etc
drwxr-xr-x 2 root root 4096 Aug 14 16:10 home
lrwxrwxrwx 1 root root 7 Sep 4 09:00 lib -> usr/lib
drwxr-xr-x 2 root root 4096 Sep 4 09:00 media
drwxr-xr-x 2 root root 4096 Sep 4 09:00 mnt
drwxr-xr-x 2 root root 4096 Sep 4 09:00 opt
dr-xr-xr-x 270 root root 0 Sep 21 01:57 proc
drwx----- 2 root root 4096 Sep 4 09:00 root
drwxr-xr-x 3 root root 4096 Sep 4 09:00 run
lrwxrwxrwx 1 root root 8 Sep 4 09:00 sbin -> usr/sbin
drwxr-xr-x 2 1000 1000 4096 Sep 21 01:57 sharedVol
drwxr-xr-x 2 root root 4096 Sep 4 09:00 srv
dr-xr-xr-x 12 root root 0 Sep 21 01:57 sys
drwxrwxrwt 2 root root 4096 Sep 4 09:00 tmp
drwxr-xr-x 11 root root 4096 Sep 4 09:00 usr
drwxr-xr-x 11 root root 4096 Sep 4 09:00 var
root@9636de2115ea:/# ls -l /sharedVol
total 0
root@9636de2115ea:/#

```

リスト37 (ホスト側からのファイル書き込み)

```

cq@rp4:~/CQ/Docker $ echo "Hello" > host_dir/fromHOST
cq@rp4:~/CQ/Docker $ cat host_dir/fromHOST
Hello
cq@rp4:~/CQ/Docker $

```

リスト38 (コンテナでファイルを確認)

```

root@9636de2115ea:/# ls -l /sharedVol/fromHOST
-rw-r--r-- 1 1000 1000 6 Sep 21 04:36 /sharedVol/fromHOST
root@9636de2115ea:/# cat /sharedVol/fromHOST
Hello
root@9636de2115ea:/#

```

リスト39 (コンテナ側からのファイル書き込み)

```

root@9636de2115ea:/# echo "Hi" > /sharedVol/fromCONT
root@9636de2115ea:/# cat /sharedVol/fromCONT
Hi
root@9636de2115ea:/#

```

リスト40 (ホスト側でファイルを確認)

```

cq@rp4:~/CQ/Docker $ ls -l host_dir/
total 8
-rw-r--r-- 1 root root 3 Sep 21 13:37 fromCONT
-rw-r--r-- 1 cq cq 6 Sep 21 13:36 fromHOST
cq@rp4:~/CQ/Docker $ cat host_dir/fromCONT
Hi
cq@rp4:~/CQ/Docker $

```

リスト41 (コンテナで見える/ファイル・システム)

```
overlay on / type overlay
(rw,relatime,lowerdir=/var/lib/docker/overlay2/l/JV2POUEBAWILYQWKB24YE4S2AP:/var/lib/docker/overlay2/l/AKC4EILHVS3TNTIWAQTR724RI,upperdir=/var/lib/docker/overlay2/fa571cb584bfd01d959446f2979b5afa99876ea513598c029f64f306de62740c/diff,workdir=/var/lib/docker/overlay2/fa571cb584bfd01d959446f2979b5afa99876ea513598c029f64f306de62740c/work)
```

リスト42 (ホストでのマウント状態)

```
overlay on /var/lib/docker/overlay2/fa571cb584bfd01d959446f2979b5afa99876ea513598c029f64f306de62740c/merged type overlay
(rw,relatime,lowerdir=/var/lib/docker/overlay2/l/JV2POUEBAWILYQWKB24YE4S2AP:/var/lib/docker/overlay2/l/AKC4EILHVS3TNTIWAQTR724RI,upperdir=/var/lib/docker/overlay2/fa571cb584bfd01d959446f2979b5afa99876ea513598c029f64f306de62740c/diff,workdir=/var/lib/docker/overlay2/fa571cb584bfd01d959446f2979b5afa99876ea513598c029f64f306de62740c/work)
```

リスト43 [Dockerコンテナの詳細のコンテナ・ストレージ構成 (抜粋)]

```
"GraphDriver": {
  "Data": {
    "LowerDir":
"/var/lib/docker/overlay2/fa571cb584bfd01d959446f2979b5afa99876ea513598c029f64f306de62740c-init/diff:/var/lib/docker/overlay2/7fd133bc749c415828022c02b4bc3f43ff0c10a9783cb7495d2a6d29145e2526/diff",
    "MergedDir":
"/var/lib/docker/overlay2/fa571cb584bfd01d959446f2979b5afa99876ea513598c029f64f306de62740c/merged",
    "UpperDir":
"/var/lib/docker/overlay2/fa571cb584bfd01d959446f2979b5afa99876ea513598c029f64f306de62740c/diff",
    "WorkDir": "/var/lib/docker/overlay2/fa571cb584bfd01d959446f2979b5afa99876ea513598c029f64f306de62740c/work"
  },
  "Name": "overlay2"
},
```

リスト44 (共有ディレクトリをマウントするためのディレクトリと使用するコンテナのベース・データ)

```
cq@rp4:~/CQ/Docker $ sudo ls -l /var/lib/docker/overlay2/l/JV2POUEBAWILYQWKB24YE4S2AP
lrwxrwxrwx 1 root root 77 Sep 21 10:57 /var/lib/docker/overlay2/l/JV2POUEBAWILYQWKB24YE4S2AP ->
../fa571cb584bfd01d959446f2979b5afa99876ea513598c029f64f306de62740c-init/diff
cq@rp4:~/CQ/Docker $ sudo ls -l /var/lib/docker/overlay2/l/AKC4EILHVS3TNTIWAQTR724RI
lrwxrwxrwx 1 root root 72 Sep 20 09:29 /var/lib/docker/overlay2/l/AKC4EILHVS3TNTIWAQTR724RI ->
../7fd133bc749c415828022c02b4bc3f43ff0c10a9783cb7495d2a6d29145e2526/diff
cq@rp4:~/CQ/Docker $ sudo ls -l
/var/lib/docker/overlay2/fa571cb584bfd01d959446f2979b5afa99876ea513598c029f64f306de62740c/diff
total 4
drwxr-xr-x 2 root root 4096 Sep 21 10:57 sharedVol
cq@rp4:~/CQ/Docker $
cq@rp4:~/CQ/Docker $ sudo ls -l /var/lib/docker/overlay2/l/JV2POUEBAWILYQWKB24YE4S2AP/
total 8
drwxr-xr-x 4 root root 4096 Sep 21 10:57 dev
drwxr-xr-x 2 root root 4096 Sep 21 10:57 etc
cq@rp4:~/CQ/Docker $ sudo ls -l /var/lib/docker/overlay2/l/AKC4EILHVS3TNTIWAQTR724RI/
total 60
lrwxrwxrwx 1 root root 7 Sep 4 18:00 bin -> usr/bin
drwxr-xr-x 2 root root 4096 Aug 15 01:10 boot
drwxr-xr-x 2 root root 4096 Sep 4 18:00 dev
drwxr-xr-x 29 root root 4096 Sep 4 18:00 etc
drwxr-xr-x 2 root root 4096 Aug 15 01:10 home
lrwxrwxrwx 1 root root 7 Sep 4 18:00 lib -> usr/lib
drwxr-xr-x 2 root root 4096 Sep 4 18:00 media
drwxr-xr-x 2 root root 4096 Sep 4 18:00 mnt
drwxr-xr-x 2 root root 4096 Sep 4 18:00 opt
drwxr-xr-x 2 root root 4096 Aug 15 01:10 proc
drwx----- 2 root root 4096 Sep 4 18:00 root
drwxr-xr-x 3 root root 4096 Sep 4 18:00 run
lrwxrwxrwx 1 root root 8 Sep 4 18:00 sbin -> usr/sbin
drwxr-xr-x 2 root root 4096 Sep 4 18:00 srv
drwxr-xr-x 2 root root 4096 Aug 15 01:10 sys
drwxrwxrwt 2 root root 4096 Sep 4 18:00 tmp
drwxr-xr-x 11 root root 4096 Sep 4 18:00 usr
drwxr-xr-x 11 root root 4096 Sep 4 18:00 var
cq@rp4:~/CQ/Docker $
```

リスト45 (コンテナ・イメージのIDを確認)

```
cq@rp4:~/CQ/Docker $ docker images
REPOSITORY TAG IMAGE ID CREATED SIZE
debian latest b442aaf37046 2 weeks ago 139MB
cq@rp4:~/CQ/Docker $
```

リスト46 [コンテナ・イメージの詳細 (抜粋)]

```
"GraphDriver": {
  "Data": {
    "MergedDir":
```

```

"/var/lib/docker/overlay2/7fd133bc749c415828022c02b4bc3f43ff0c10a9783cb7495d2a6d29145e2526/merged",
  "UpperDir":
"/var/lib/docker/overlay2/7fd133bc749c415828022c02b4bc3f43ff0c10a9783cb7495d2a6d29145e2526/diff",
  "WorkDir": "/var/lib/docker/overlay2/7fd133bc749c415828022c02b4bc3f43ff0c10a9783cb7495d2a6d29145e2526/work"
},
  "Name": "overlay2"
},

```

リスト47 (python3ファイルの検索結果)

```

cq@rp4:~/CQ/Docker $ sudo find /var/lib/docker/overlay2/ -name python3
/var/lib/docker/overlay2/fa571cb584bfd01d959446f2979b5afa99876ea513598c029f64f306de62740c/diff/usr/share/doc/python3
/var/lib/docker/overlay2/fa571cb584bfd01d959446f2979b5afa99876ea513598c029f64f306de62740c/diff/usr/share/lintian/overrides/python3
/var/lib/docker/overlay2/fa571cb584bfd01d959446f2979b5afa99876ea513598c029f64f306de62740c/diff/usr/share/python3
/var/lib/docker/overlay2/fa571cb584bfd01d959446f2979b5afa99876ea513598c029f64f306de62740c/diff/usr/lib/python3
/var/lib/docker/overlay2/fa571cb584bfd01d959446f2979b5afa99876ea513598c029f64f306de62740c/diff/usr/bin/python3
/var/lib/docker/overlay2/fa571cb584bfd01d959446f2979b5afa99876ea513598c029f64f306de62740c/diff/etc/python3
/var/lib/docker/overlay2/fa571cb584bfd01d959446f2979b5afa99876ea513598c029f64f306de62740c/merged/usr/share/doc/python3
/var/lib/docker/overlay2/fa571cb584bfd01d959446f2979b5afa99876ea513598c029f64f306de62740c/merged/usr/share/lintian/overrides/python3
/var/lib/docker/overlay2/fa571cb584bfd01d959446f2979b5afa99876ea513598c029f64f306de62740c/merged/usr/share/python3
/var/lib/docker/overlay2/fa571cb584bfd01d959446f2979b5afa99876ea513598c029f64f306de62740c/merged/usr/lib/python3
/var/lib/docker/overlay2/fa571cb584bfd01d959446f2979b5afa99876ea513598c029f64f306de62740c/merged/usr/bin/python3
/var/lib/docker/overlay2/fa571cb584bfd01d959446f2979b5afa99876ea513598c029f64f306de62740c/merged/etc/python3
cq@rp4:~/CQ/Docker $

```

リスト48 (ホスト側のマウント状態)

TARGET	OPTIONS	SOURCE
/		/dev/mmcblk0p2
ext4	rw, noatime	
├─/sys		sysfs
sysfs	rw, nosuid, nodev, noexec, relatime	
├─├─/sys/kernel/security		securityfs
securityfs	rw, nosuid, nodev, noexec, relatime	
├─├─/sys/fs/cgroup		cgroup2
cgroup2	rw, nosuid, nodev, noexec, relatime, nsdelegate, memory_recursiveprot	
├─├─/sys/fs/pstore		pstore
pstore	rw, nosuid, nodev, noexec, relatime	
├─├─/sys/fs/bpf		bpf
bpf	rw, nosuid, nodev, noexec, relatime, mode=700	
├─├─/sys/kernel/debug		debugfs
debugfs	rw, nosuid, nodev, noexec, relatime	
├─├─/sys/kernel/tracing		tracefs
tracefs	rw, nosuid, nodev, noexec, relatime	
├─├─/sys/kernel/config		configfs
configfs	rw, nosuid, nodev, noexec, relatime	
├─├─/sys/fs/fuse/connections		fusectl
fusectl	rw, nosuid, nodev, noexec, relatime	
├─/proc		proc
proc	rw, relatime	
├─├─/proc/sys/fs/binfmt_misc		systemd-1
autofs	rw, relatime, fd=29, pgrp=1, timeout=0, minproto=5, maxproto=5, direct, pipe_ino=1966	
├─├─/proc/sys/fs/binfmt_misc		binfmt_misc
binfmt_misc	rw, nosuid, nodev, noexec, relatime	
├─/dev		udev
devtmpfs	rw, nosuid, relatime, size=1668224k, nr_inodes=417056, mode=755	
├─├─/dev/pts		devpts
devpts	rw, nosuid, noexec, relatime, gid=5, mode=620, ptmxmode=000	
├─├─/dev/shm		tmpfs
tmpfs	rw, nosuid, nodev	
├─├─/dev/mqueue		mqueue
mqueue	rw, nosuid, nodev, noexec, relatime	
├─/run		tmpfs
tmpfs	rw, nosuid, nodev, noexec, relatime, size=388300k, mode=755	
├─├─/run/lock		tmpfs
tmpfs	rw, nosuid, nodev, noexec, relatime, size=5120k	
├─├─/run/credentials/systemd-sysctl.service		ramfs
ramfs	ro, nosuid, nodev, noexec, relatime, mode=700	
├─├─/run/credentials/systemd-sysusers.service		ramfs
ramfs	ro, nosuid, nodev, noexec, relatime, mode=700	
├─├─/run/credentials/systemd-tmpfiles-setup-dev.service		ramfs
ramfs	ro, nosuid, nodev, noexec, relatime, mode=700	
├─├─/run/rpc_pipefs		sunrpc
rpc_pipefs	rw, relatime	
├─├─/run/credentials/systemd-tmpfiles-setup.service		ramfs
ramfs	ro, nosuid, nodev, noexec, relatime, mode=700	
├─├─/run/user/1000		tmpfs
tmpfs	rw, nosuid, nodev, relatime, size=388296k, nr_inodes=97074, mode=700, uid=1000, gid=1000	
├─├─├─/run/user/1000/gvfs		gvfsd-fuse
fuse.gvfsd-fuse	rw, nosuid, nodev, relatime, user_id=1000, group_id=1000	
├─├─├─/run/user/1000/doc		portal
fuse.portal	rw, nosuid, nodev, relatime, user_id=1000, group_id=1000	
├─├─├─/run/docker/netns/f4c0080f9dc0		

```

nsfs[net:[4026532656]] nsfs          rw          /dev/mmcblk0p1
└─/boot/firmware
vfat          rw,relatime,mask=0022,dmask=0022,codepage=437,ioccharset=ascii,shortname=mixed,errors=remount-ro
└─/var/lib/docker/overlay2/fa571cb584bfd01d959446f2979b5afa99876ea513598c029f64f306de62740c/merged overlay
overlay
rw,relatime,lowerdir=/var/lib/docker/overlay2/l/JV2POUEBAWILYQWKB24YE4S2AP:/var/lib/docker/overlay2/l/AKC4EILHVA3TNTIWAQTR
724RI,upperdir=/var/lib/docker/overlay2/fa571cb584bfd01d959446f2979b5afa99876ea513598c029f64f306de62740c/diff,workdir=/var/
lib/docker/overlay2/fa571cb584bfd01d959446f2979b5afa99876ea513598c029f64f306de62740c/work

```

リスト49 (コンテナ側のマウント状態)

```

/dev/mmcblk0p2 on /sharedVol type ext4 (rw, noatime)
/dev/mmcblk0p2 on /etc/resolv.conf type ext4 (rw, noatime)
/dev/mmcblk0p2 on /etc/hostname type ext4 (rw, noatime)
/dev/mmcblk0p2 on /etc/hosts type ext4 (rw, noatime)
devpts on /dev/console type devpts (rw, nosuid, noexec, relatime, gid=5, mode=620, ptmxmode=666)
proc on /proc/bus type proc (ro, nosuid, nodev, noexec, relatime)
proc on /proc/fs type proc (ro, nosuid, nodev, noexec, relatime)
proc on /proc/irq type proc (ro, nosuid, nodev, noexec, relatime)
proc on /proc/sys type proc (ro, nosuid, nodev, noexec, relatime)
proc on /proc/sysrq-trigger type proc (ro, nosuid, nodev, noexec, relatime)
tmpfs on /proc/asound type tmpfs (ro, relatime)
tmpfs on /proc/keys type tmpfs (rw, nosuid, size=65536k, mode=755)
tmpfs on /proc/latency_stats type tmpfs (rw, nosuid, size=65536k, mode=755)
tmpfs on /proc/timer_list type tmpfs (rw, nosuid, size=65536k, mode=755)
tmpfs on /sys/firmware type tmpfs (ro, relatime)
root@9636de2115ea:/#
root@9636de2115ea:/# findmnt
TARGET                SOURCE                FSTYPE  OPTIONS
/                      overlay              overlay
rw,relatime,lowerdir=/var/lib/docker/overlay2/l/JV2POUEBAWILYQWKB24YE4S2AP:/var/lib/docker/overlay2/l/AKC4EIL
- /proc                proc                 proc     rw, nosuid, nodev, noexec, relatime
  | - /proc/bus         proc[/bus]          proc     ro, nosuid, nodev, noexec, relatime
  | - /proc/fs          proc[/fs]           proc     ro, nosuid, nodev, noexec, relatime
  | - /proc/irq         proc[/irq]          proc     ro, nosuid, nodev, noexec, relatime
  | - /proc/sys         proc[/sys]          proc     ro, nosuid, nodev, noexec, relatime
  | - /proc/sysrq-trigger proc[/sysrq-trigger] proc     ro, nosuid, nodev, noexec, relatime
  | - /proc/asound      tmpfs               tmpfs    ro, relatime
  | - /proc/keys        tmpfs[/null]        tmpfs    rw, nosuid, size=65536k, mode=755
  | - /proc/latency_stats tmpfs[/null]        tmpfs    rw, nosuid, size=65536k, mode=755
  | - /proc/timer_list  tmpfs[/null]        tmpfs    rw, nosuid, size=65536k, mode=755
- /dev                 tmpfs               tmpfs    rw, nosuid, size=65536k, mode=755
  | - /dev/console     devpts[/0]          devpts
rw, nosuid, noexec, relatime, gid=5, mode=620, ptmxmode=666
  | - /dev/pts         devpts              devpts
rw, nosuid, noexec, relatime, gid=5, mode=620, ptmxmode=666
  | - /dev/mqueue      mqueue              mqueue   rw, nosuid, nodev, noexec, relatime
  | - /dev/shm         shm                 tmpfs    rw, nosuid, nodev, noexec, relatime, size=65536k
- /sys                 sysfs               sysfs    ro, nosuid, nodev, noexec, relatime
  | - /sys/firmware    tmpfs               tmpfs    ro, relatime
  | - /sys/fs/cgroup   cgroup              cgroup2
ro, nosuid, nodev, noexec, relatime, nsdelegate, memory_recursiveprot
- /sharedVol          /dev/mmcblk0p2[/home/cq/CQ/Docker/host_dir] ext4     rw, noatime
- /etc/resolv.conf
/dev/mmcblk0p2[/var/lib/docker/containers/9636de2115eaddf371a119c15555c5957155866002f928ef3d93d74cb6dd77f3/resolv.conf]
  ext4     rw, noatime
- /etc/hostname
/dev/mmcblk0p2[/var/lib/docker/containers/9636de2115eaddf371a119c15555c5957155866002f928ef3d93d74cb6dd77f3/hostname]
  ext4     rw, noatime
- /etc/hosts
/dev/mmcblk0p2[/var/lib/docker/containers/9636de2115eaddf371a119c15555c5957155866002f928ef3d93d74cb6dd77f3/hosts]
  ext4     rw, noatime
root@9636de2115ea:/#

```

リスト50 (Dockerコンテナの詳細のマウント部分の抜粋)

```

"Mounts": [
  {
    "Type": "bind",
    "Source": "/home/cq/CQ/Docker/host_dir",
    "Destination": "/sharedVol",
    "Mode": "",
    "RW": true,
    "Propagation": "rprivate"
  }
],

```

リスト51 (debianコンテナ起動してpython3インストール)

```

cq@rp4:~/CQ/Docker $ docker run -it debian
root@cdb73e885f27:/# apt update
root@cdb73e885f27:/# apt install python3
root@cdb73e885f27:/#

```


リスト52 (コンテナ・イメージを登録する手順)

```

cq@rp4:~/CQ/Docker_RES/exam_img $ docker ps
CONTAINER ID   IMAGE     COMMAND   CREATED        STATUS        PORTS   NAMES
cdb73e885f27   debian   "bash"    11 minutes ago Up 11 minutes        boring_hypatia
cq@rp4:~/CQ/Docker_RES/exam_img $ docker commit cdb73e885f27 debian_with_py
sha256:11d089eba07f83cba6fc5aaf5bf6563fdc9c8d6d43f4b4cadbe985058bf82346
cq@rp4:~/CQ/Docker_RES/exam_img $

```

リスト53 (コンテナ・イメージのIDを確認)

```

cq@rp4:~/CQ/Docker_RES/exam_img $ docker images
REPOSITORY    TAG       IMAGE ID       CREATED        SIZE
debian_with_py latest    11d089eba07f   12 minutes ago 209MB
debian        latest    b442aaf37046   2 weeks ago    139MB
cq@rp4:~/CQ/Docker_RES/exam_img $

```

リスト54 [debianコンテナ・イメージの詳細 (データ部分抜粋)]

```

    "GraphDriver": {
      "Data": {
        "MergedDir":
"/var/lib/docker/overlay2/7fd133bc749c415828022c02b4bc3f43ff0c10a9783cb7495d2a6d29145e2526/merged",
        "UpperDir":
"/var/lib/docker/overlay2/7fd133bc749c415828022c02b4bc3f43ff0c10a9783cb7495d2a6d29145e2526/diff",
        "WorkDir": "/var/lib/docker/overlay2/7fd133bc749c415828022c02b4bc3f43ff0c10a9783cb7495d2a6d29145e2526/work"
      }
    },
    "Name": "overlay2"
  },

```

リスト55 (システム上のファイルを確認)

```

root@rp4:~# ls -l /var/lib/docker/overlay2/7fd133bc749c415828022c02b4bc3f43ff0c10a9783cb7495d2a6d29145e2526
total 8
-rw----- 1 root root 0 Sep 21 20:56 committed
drwxr-xr-x 17 root root 4096 Sep 20 09:29 diff
-rw-r--r-- 1 root root 26 Sep 20 09:29 link
root@rp4:~#

```

リスト56 (Docker HUBから取得したdebinaコンテナ・イメージの保存先)

```

root@rp4:~# ls -l /var/lib/docker/overlay2/7fd133bc749c415828022c02b4bc3f43ff0c10a9783cb7495d2a6d29145e2526/diff/
total 60
lrwxrwxrwx 1 root root 7 Sep 4 18:00 bin -> usr/bin
drwxr-xr-x 2 root root 4096 Aug 15 01:10 boot
drwxr-xr-x 2 root root 4096 Sep 4 18:00 dev
drwxr-xr-x 29 root root 4096 Sep 4 18:00 etc
drwxr-xr-x 2 root root 4096 Aug 15 01:10 home
lrwxrwxrwx 1 root root 7 Sep 4 18:00 lib -> usr/lib
drwxr-xr-x 2 root root 4096 Sep 4 18:00 media
drwxr-xr-x 2 root root 4096 Sep 4 18:00 mnt
drwxr-xr-x 2 root root 4096 Sep 4 18:00 opt
drwxr-xr-x 2 root root 4096 Aug 15 01:10 proc
drwx----- 2 root root 4096 Sep 4 18:00 root
drwxr-xr-x 3 root root 4096 Sep 4 18:00 run
lrwxrwxrwx 1 root root 8 Sep 4 18:00 sbin -> usr/sbin
drwxr-xr-x 2 root root 4096 Sep 4 18:00 srv
drwxr-xr-x 2 root root 4096 Aug 15 01:10 sys
drwxrwxrwt 2 root root 4096 Sep 4 18:00 tmp
drwxr-xr-x 11 root root 4096 Sep 4 18:00 usr
drwxr-xr-x 11 root root 4096 Sep 4 18:00 var
root@rp4:~#

```

リスト57 (debian_with_pyコンテナ・イメージの詳細 (データ部分抜粋))

```

    "GraphDriver": {
      "Data": {
        "LowerDir":
"/var/lib/docker/overlay2/7fd133bc749c415828022c02b4bc3f43ff0c10a9783cb7495d2a6d29145e2526/diff",
        "MergedDir":
"/var/lib/docker/overlay2/54957b7b474a44b65693b62584d079961dc76b867e42d2ca1c7c924bb6a36326/merged",
        "UpperDir":
"/var/lib/docker/overlay2/54957b7b474a44b65693b62584d079961dc76b867e42d2ca1c7c924bb6a36326/diff",
        "WorkDir": "/var/lib/docker/overlay2/54957b7b474a44b65693b62584d079961dc76b867e42d2ca1c7c924bb6a36326/work"
      }
    },
    "Name": "overlay2"
  },

```

リスト58 (システム上のファイルを確認)

```

root@rp4:~# ls -l /var/lib/docker/overlay2/54957b7b474a44b65693b62584d079961dc76b867e42d2ca1c7c924bb6a36326
total 16
-rw----- 1 root root    0 Sep 21 21:18 committed
drwxr-xr-x 7 root root 4096 Sep 21 20:56 diff
-rw-r--r-- 1 root root   26 Sep 21 20:56 link
-rw-r--r-- 1 root root   28 Sep 21 20:56 lower
drwx----- 2 root root 4096 Sep 21 20:56 work
root@rp4:~#

```

リスト59 (python3データが保持されているレイヤの内容)

```

root@rp4:~# ls -l /var/lib/docker/overlay2/54957b7b474a44b65693b62584d079961dc76b867e42d2ca1c7c924bb6a36326/diff/
total 20
drwxr-xr-x 7 root root 4096 Sep 21 20:48 etc
drwx----- 2 root root 4096 Sep 21 20:55 root
drwxrwxrwt 2 root root 4096 Sep 21 20:48 tmp
drwxr-xr-x 7 root root 4096 Sep  4 18:00 usr
drwxr-xr-x 5 root root 4096 Sep  4 18:00 var
root@rp4:~#

root@rp4:~# find /var/lib/docker/overlay2 -name python3
/var/lib/docker/overlay2/54957b7b474a44b65693b62584d079961dc76b867e42d2ca1c7c924bb6a36326/diff/usr/share/doc/python3
/var/lib/docker/overlay2/54957b7b474a44b65693b62584d079961dc76b867e42d2ca1c7c924bb6a36326/diff/usr/share/lintian/overrides/python3
/var/lib/docker/overlay2/54957b7b474a44b65693b62584d079961dc76b867e42d2ca1c7c924bb6a36326/diff/usr/share/python3
/var/lib/docker/overlay2/54957b7b474a44b65693b62584d079961dc76b867e42d2ca1c7c924bb6a36326/diff/usr/lib/python3
/var/lib/docker/overlay2/54957b7b474a44b65693b62584d079961dc76b867e42d2ca1c7c924bb6a36326/diff/usr/bin/python3
/var/lib/docker/overlay2/54957b7b474a44b65693b62584d079961dc76b867e42d2ca1c7c924bb6a36326/diff/etc/python3
root@rp4:~#

```

リスト60 (ポートフォワードを有効にしてコンテナを起動)

```

cq@rp4:~/CQ/Docker $ docker run -p 8888:8000 -it debian
root@5253caec32ed:/#

```

リスト61 (ホストの8888ポートへのアクセスがコンテナの8000ポートへのアクセスとなる)

```

cq@rp4:~/CQ/Docker $ docker ps
CONTAINER ID   IMAGE     COMMAND   CREATED   STATUS    PORTS                               NAMES
5253caec32ed  debian   "bash"    5 hours ago  Up 5 hours  0.0.0.0:8888->8000/tcp, [::]:8888->8000/tcp  boring_heisenberg
cq@rp4:~/CQ/Docker $

```

リスト62 (コンテナ起動前のホスト・ネットワーク)

```

1: lo: <LOOPBACK,UP,LOWER_UP> mtu 65536 qdisc noqueue state UNKNOWN group default qlen 1000
    link/loopback 00:00:00:00:00:00 brd 00:00:00:00:00:00
    inet 127.0.0.1/8 scope host lo
        valid_lft forever preferred_lft forever
    inet6 ::1/128 scope host noprefixroute
        valid_lft forever preferred_lft forever
2: eth0: <NO-CARRIER,BROADCAST,MULTICAST,UP> mtu 1500 qdisc mq state DOWN group default qlen 1000
    link/ether dc:a6:32:70:a7:7a brd ff:ff:ff:ff:ff:ff
3: wlan0: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc pfifo_fast state UP group default qlen 1000
    link/ether dc:a6:32:70:a7:7c brd ff:ff:ff:ff:ff:ff
    inet 192.168.3.14/24 brd 192.168.3.255 scope global dynamic noprefixroute wlan0
        valid_lft 61481sec preferred_lft 61481sec
    inet6 2400:2410:aa00:da00:d7d6:dc5:56b2:3ee2/64 scope global dynamic noprefixroute
        valid_lft 2591889sec preferred_lft 604689sec
    inet6 fe80::e447:84aa:44d7:4dd7/64 scope link noprefixroute
        valid_lft forever preferred_lft forever
4: docker0: <NO-CARRIER,BROADCAST,MULTICAST,UP> mtu 1500 qdisc noqueue state DOWN group default
    link/ether 02:42:82:ea:48:07 brd ff:ff:ff:ff:ff:ff
    inet 172.17.0.1/16 brd 172.17.255.255 scope global docker0
        valid_lft forever preferred_lft forever
    inet6 fe80::42:82ff:feea:4807/64 scope link
        valid_lft forever preferred_lft forever

```

リスト63 (コンテナ起動後のホスト・ネットワーク)

```

1: lo: <LOOPBACK,UP,LOWER_UP> mtu 65536 qdisc noqueue state UNKNOWN group default qlen 1000
    link/loopback 00:00:00:00:00:00 brd 00:00:00:00:00:00
    inet 127.0.0.1/8 scope host lo
        valid_lft forever preferred_lft forever
    inet6 ::1/128 scope host noprefixroute
        valid_lft forever preferred_lft forever
2: eth0: <NO-CARRIER,BROADCAST,MULTICAST,UP> mtu 1500 qdisc mq state DOWN group default qlen 1000
    link/ether dc:a6:32:70:a7:7a brd ff:ff:ff:ff:ff:ff
3: wlan0: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc pfifo_fast state UP group default qlen 1000
    link/ether dc:a6:32:70:a7:7c brd ff:ff:ff:ff:ff:ff

```

S3_list.txt

```
inet 192.168.3.14/24 brd 192.168.3.255 scope global dynamic noprefixroute wlan0
  valid_lft 58592sec preferred_lft 58592sec
inet6 2400:2410:aa00:da00:d7d6:dcc5:56b2:3ee2/64 scope global dynamic noprefixroute
  valid_lft 2591680sec preferred_lft 604480sec
inet6 fe80::e447:84aa:44d7:4dd7/64 scope link noprefixroute
  valid_lft forever preferred_lft forever
4: docker0: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc noqueue state UP group default
  link/ether 02:42:82:ea:48:07 brd ff:ff:ff:ff:ff:ff
  inet 172.17.0.1/16 brd 172.17.255.255 scope global docker0
    valid_lft forever preferred_lft forever
  inet6 fe80::42:82ff:feea:4807/64 scope link
    valid_lft forever preferred_lft forever
16: veth20b5f08@if15: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc noqueue master docker0 state UP group default
  link/ether 4e:d4:b5:ed:cc:45 brd ff:ff:ff:ff:ff:ff link-netnsid 0
  inet6 fe80::4cd4:b5ff:feed:cc45/64 scope link
    valid_lft forever preferred_lft forever
```

リスト64 (コンテナ側のネットワーク構成)

```
root@5253caec32ed:/# ip addr
1: lo: <LOOPBACK,UP,LOWER_UP> mtu 65536 qdisc noqueue state UNKNOWN group default qlen 1000
  link/loopback 00:00:00:00:00:00 brd 00:00:00:00:00:00
  inet 127.0.0.1/8 scope host lo
    valid_lft forever preferred_lft forever
  inet6 ::1/128 scope host
    valid_lft forever preferred_lft forever
15: eth0@if16: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc noqueue state UP group default
  link/ether 02:42:ac:11:00:02 brd ff:ff:ff:ff:ff:ff link-netnsid 0
  inet 172.17.0.2/16 brd 172.17.255.255 scope global eth0
    valid_lft forever preferred_lft forever
root@5253caec32ed:/#
```

リスト65 (Webサーバの起動の様子)

```
root@5253caec32ed:/# python3 -m http.server 8000
Serving HTTP on 0.0.0.0 port 8000 (http://0.0.0.0:8000/) ...
```

リスト66 (他のターミナルからコンテナのWebサーバへアクセスした結果)

```
cq@rp4:~/CQ/Docker $ curl http://172.17.0.2:8000
<!DOCTYPE HTML>
<html lang="en">
<head>
<meta charset="utf-8">
<title>Directory listing for /</title>
</head>
<body>
<h1>Directory listing for /</h1>
<hr>
<ul>
<li><a href=".dockerenv">.dockerenv</a></li>
<li><a href="bin/">bin@</a></li>
<li><a href="boot/">boot/</a></li>
<li><a href="dev/">dev/</a></li>
<li><a href="etc/">etc/</a></li>
<li><a href="home/">home/</a></li>
<li><a href="lib/">lib@</a></li>
<li><a href="media/">media/</a></li>
<li><a href="mnt/">mnt/</a></li>
<li><a href="opt/">opt/</a></li>
<li><a href="proc/">proc/</a></li>
<li><a href="root/">root/</a></li>
<li><a href="run/">run/</a></li>
<li><a href="sbin/">sbin@</a></li>
<li><a href="srv/">srv/</a></li>
<li><a href="sys/">sys/</a></li>
<li><a href="tmp/">tmp/</a></li>
<li><a href="usr/">usr/</a></li>
<li><a href="var/">var/</a></li>
</ul>
<hr>
</body>
</html>
cq@rp4:~/CQ/Docker $
```

リスト67 (コンテナ起動前のnftable)

```
# Warning: table ip nat is managed by iptables-nft, do not touch!
table ip nat {
  chain DOCKER {
    iifname "docker0" counter packets 0 bytes 0 return
```

S3_list.txt

```

}
chain POSTROUTING {
    type nat hook postrouting priority srcnat; policy accept;
    oifname != "docker0" ip saddr 172.17.0.0/16 counter packets 8 bytes 480 masquerade
}
chain PREROUTING {
    type nat hook prerouting priority dstnat; policy accept;
    fib daddr type local counter packets 4 bytes 256 jump DOCKER
}
chain OUTPUT {
    type nat hook output priority -100; policy accept;
    ip daddr != 127.0.0.0/8 fib daddr type local counter packets 0 bytes 0 jump DOCKER
}
}
# Warning: table ip filter is managed by iptables-nft, do not touch!
table ip filter {
    chain DOCKER {
    }
    chain DOCKER-ISOLATION-STAGE-1 {
        iifname "docker0" oifname != "docker0" counter packets 9474 bytes 521629 jump DOCKER-ISOLATION-STAGE-2
        counter packets 30755 bytes 31492600 return
    }
    chain DOCKER-ISOLATION-STAGE-2 {
        oifname "docker0" counter packets 0 bytes 0 drop
        counter packets 9474 bytes 521629 return
    }
    chain FORWARD {
        type filter hook forward priority filter; policy drop;
        counter packets 30755 bytes 31492600 jump DOCKER-USER
        counter packets 30755 bytes 31492600 jump DOCKER-ISOLATION-STAGE-1
        oifname "docker0" ct state related,established counter packets 21281 bytes 30970971 accept
        oifname "docker0" counter packets 0 bytes 0 jump DOCKER
        iifname "docker0" oifname != "docker0" counter packets 9474 bytes 521629 accept
        iifname "docker0" oifname "docker0" counter packets 0 bytes 0 accept
    }
    chain DOCKER-USER {
        counter packets 30755 bytes 31492600 return
    }
}

```

リスト68 (コンテナ起動後のnftable)

```

# Warning: table ip nat is managed by iptables-nft, do not touch!
table ip nat {
    chain DOCKER {
        iifname "docker0" counter packets 0 bytes 0 return
        iifname != "docker0" tcp dport 8888 counter packets 0 bytes 0 dnat to 172.17.0.2:8000
    }
    chain POSTROUTING {
        type nat hook postrouting priority srcnat; policy accept;
        oifname != "docker0" ip saddr 172.17.0.0/16 counter packets 8 bytes 480 masquerade
        ip saddr 172.17.0.2 ip daddr 172.17.0.2 tcp dport 8000 counter packets 0 bytes 0 masquerade
    }
    chain PREROUTING {
        type nat hook prerouting priority dstnat; policy accept;
        fib daddr type local counter packets 4 bytes 256 jump DOCKER
    }
    chain OUTPUT {
        type nat hook output priority -100; policy accept;
        ip daddr != 127.0.0.0/8 fib daddr type local counter packets 0 bytes 0 jump DOCKER
    }
}
# Warning: table ip filter is managed by iptables-nft, do not touch!
table ip filter {
    chain DOCKER {
        iifname != "docker0" oifname "docker0" ip daddr 172.17.0.2 tcp dport 8000 counter packets 0 bytes 0 accept
    }
    chain DOCKER-ISOLATION-STAGE-1 {
        iifname "docker0" oifname != "docker0" counter packets 9474 bytes 521629 jump DOCKER-ISOLATION-STAGE-2
        counter packets 30755 bytes 31492600 return
    }
    chain DOCKER-ISOLATION-STAGE-2 {
        oifname "docker0" counter packets 0 bytes 0 drop
        counter packets 9474 bytes 521629 return
    }
}

```

S3_list.txt

```

chain FORWARD {
    type filter hook forward priority filter; policy drop;
    counter packets 30755 bytes 31492600 jump DOCKER-USER
    counter packets 30755 bytes 31492600 jump DOCKER-ISOLATION-STAGE-1
    oifname "docker0" ct state related,established counter packets 21281 bytes 30970971 accept
    oifname "docker0" counter packets 0 bytes 0 jump DOCKER
    iifname "docker0" oifname != "docker0" counter packets 9474 bytes 521629 accept
    iifname "docker0" oifname "docker0" counter packets 0 bytes 0 accept
}

chain DOCKER-USER {
    counter packets 30755 bytes 31492600 return
}
}

```

リスト69 (コンテナの詳細設定を確認)

```

cq@rp4:~/CQ/Docker $ docker ps
CONTAINER ID   IMAGE     COMMAND   CREATED   STATUS    PORTS                               NAMES
5253caec32ed  debian   "bash"    3 hours ago  Up 3 hours  0.0.0.0:8888->8000/tcp, [::]:8888->8000/tcp  boring_heisenberg
cq@rp4:~/CQ/Docker $ docker inspect 5253caec32ed

```

リスト70 (コンテナ詳細のネットワーク関連部分)

```

"NetworkSettings": {
  "Bridge": "",
  "SandboxID": "9fee9bde97e9e7e8150824dfbe03fe586289dd1a81c18451dce441fc87cea74e",
  "SandboxKey": "/var/run/docker/netns/9fee9bde97e9",
  "Ports": {
    "8000/tcp": [
      {
        "HostIp": "0.0.0.0",
        "HostPort": "8888"
      },
      {
        "HostIp": ":::",
        "HostPort": "8888"
      }
    ]
  },
  "HairpinMode": false,
  "LinkLocalIPv6Address": "",
  "LinkLocalIPv6PrefixLen": 0,
  "SecondaryIPAddresses": null,
  "SecondaryIPv6Addresses": null,
  "EndpointID": "992d1ad69bd6f938893468d2b00d2bbb14f00144e23fa2271fd26512714008bc",
  "Gateway": "172.17.0.1",
  "GlobalIPv6Address": "",
  "GlobalIPv6PrefixLen": 0,
  "IPAddress": "172.17.0.2",
  "IPPrefixLen": 16,
  "IPv6Gateway": "",
  "MacAddress": "02:42:ac:11:00:02",
  "Networks": {
    "bridge": {
      "IPAMConfig": null,
      "Links": null,
      "Aliases": null,
      "MacAddress": "02:42:ac:11:00:02",
      "DriverOpts": null,
      "NetworkID": "4073f74cfbdfd4970d6df7ddd27cdc28cb5a154b66390927a69fb302277bae8f",
      "EndpointID": "992d1ad69bd6f938893468d2b00d2bbb14f00144e23fa2271fd26512714008bc",
      "Gateway": "172.17.0.1",
      "IPAddress": "172.17.0.2",
      "IPPrefixLen": 16,
      "IPv6Gateway": "",
      "GlobalIPv6Address": "",
      "GlobalIPv6PrefixLen": 0,
      "DNSNames": null
    }
  }
}

```