

Conteneurs: Notions de base (Usage)

Cycle de vie, volumes, réseaux, ressources, bonnes pratiques

Emmanuel BRUNO

Université de Toulon, LIS UMR CNRS 7020

emmanuel.bruno@univ-tln.fr

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1 Objectifs du cours

À l'issue de ce cours, vous devez être capables de :

- Manipuler des conteneurs Docker (run, stop, start, rm)
- Utiliser les volumes pour la persistance
- Connecter des conteneurs via des réseaux
- Exposer des ports vers l'hôte
- Gérer les ressources d'un conteneur (CPU / RAM / PIDs)
- Comprendre et appliquer les bonnes pratiques d'usage

2 Rappel rapide

Un **conteneur** est une instance d'une **image**. L'image est un artefact immuable (voir le cours «Image»). Le conteneur est un **processus isolé** qui tourne sur le noyau de l'hôte.

💡 Astuce

- **Image** = template immuable
- **Conteneur** = exécution d'un processus isolé

3 Les images

- Une image contient tout le nécessaire pour exécuter une application (code, runtime, bibliothèques, dépendances, fichiers de configuration).
- Chaque couche est en lecture seule, sauf la dernière (couche de conteneur).
- Les images sont stockées dans des registres (Docker Hub, GitHub Container Registry, etc.).
- Les images sont identifiées par un nom : `[registre/]nom[:tag]` (ex: `docker.io/library/nginx:1.23`).
 - Si le registre n'est pas spécifié, Docker Hub est utilisé par défaut.
 - Si le tag n'est pas spécifié, `latest` est utilisé par défaut.
 - Une image peut être référencée par son **digest** (SHA256).
 - Une image peut avoir plusieurs tags.
 - Ex:
`nginx:1`, `nginx:1.29`, `nginx:mainline`, `nginx:latest`, `nginx:f3524ef8b874` peuvent référencer la même image.
- Une image est destinée à une plateforme spécifique (architecture CPU, OS).
 - Ex: `linux/amd64`, `linux/arm64/v8`, `windows/amd64`.
 - Il est possible de créer des images multi-plateformes (multi-arch).

4 Cycle de vie d'un conteneur

Exécution simple

- La commande `docker run` crée et démarre un conteneur à partir d'une image.

- Le conteneur s'arrête lorsque le processus principal se termine (`--rm` pour supprimer automatiquement après).
- Le format général est `docker run [OPTIONS] IMAGE [COMMAND] [ARG...]`.
- Si l'image n'est pas présente localement, Docker la télécharge depuis le registre.

```
#| label: lst-run-alpine
#| title: "Premier conteneur Docker"
#| caption: "Exécution d'un conteneur Alpine jetable affichant un message"
#| code-fold: true
#| code-summary: "Afficher la commande Docker"
#| collapse: true
docker run --label ebpro-render=true
--rm alpine:3.18 echo "Hello"
```

```
Unable to find image 'alpine:3.18'
locally
```

```
3.18: Pulling from library/alpine
```

```
44cf07d57ee4: Pulling fs layer
```

```
44cf07d57ee4:
Downloading 48.51kB/3.418MB
```

```
44cf07d57ee4: Verifying Checksum
```

```
44cf07d57ee4: Download complete
```

```
44cf07d57ee4:
Extracting 65.54kB/3.418MB
```

```
44cf07d57ee4:
Extracting 2.032MB/3.418MB
```

```
44cf07d57ee4:
Extracting 3.418MB/3.418MB
```

```
44cf07d57ee4: Pull complete
```

```
Digest: sha256:de0eb0b3f2a47baleb89389
Status: Downloaded newer image for
alpine:3.18
Hello
```

4.1 Conteneur en arrière-plan (--detach, -d)

- La commande `docker run -d` démarre un conteneur en arrière-plan (détaché -- `detach`).

```
#| label: lst-run-nginx
#| title: "Conteneur Nginx en
arrière-plan"
#| caption: "Démarrage d'un conteneur
Nginx en arrière-plan"
docker rm -f my-nginx >/dev/null 2>&1
|| true
docker run --label ebpro-render=true
-d --name my-nginx nginx:1.23
```

```
Unable to find image 'nginx:1.23'
locally
1.23: Pulling from library/nginx
```

```
f03b40093957: Pulling fs layer
```

```
0972072e0e8a: Pulling fs layer
```

```
a85095acb896: Pulling fs layer
```

```
d24b987aa74e: Pulling fs layer
```

```
6c1a86118ade: Pulling fs layer
```

```
9989f7b33228: Pulling fs layer
```

d24b987aa74e: Waiting

```
9989f7b33228: Waiting
```

```
6c1a86118ade: Waiting
```

a85095acb896:

Downloading 624B/624B

```
a85095acb896: Verifying Checksum
```

```
a85095acb896: Download complete
```

0972072e0e8a:

Downloading 262.1kB/25.58MB

f03b40093957:

Downloading 327kB/31.4MB

0972072e0e8a:

Downloading 5.267MB/25.58MB

f03b40093957:

Downloading 5.242MB/31.4MB

0972072e0e8a:

Downloading 12.61MB/25.58MB

f03b40093957:

Downloading 11.14MB/31.4MB

0972072e0e8a:

Downloading 19.16MB/25.58MB

d24b987aa74e:

Downloading 958B/958B

d24b987aa74e: Verifying Checksum

d24b987aa74e: Download complete

f03b40093957:

Downloading 16.38MB/31.4MB

0972072e0e8a:

Downloading 25.48MB/25.58MB

0972072e0e8a: Verifying Checksum

0972072e0e8a: Download complete

f03b40093957:
Downloading 20.97MB/31.4MB

f03b40093957:
Downloading 29.49MB/31.4MB

f03b40093957: Verifying Checksum

f03b40093957: Download complete

f03b40093957:
Extracting 327.7kB/31.4MB

6c1a86118ade:
Downloading 772B/772B

6c1a86118ade: Verifying Checksum

6c1a86118ade: Download complete

9989f7b33228:
Downloading 1.405kB/1.405kB

9989f7b33228: Download complete

f03b40093957:
Extracting 2.949MB/31.4MB

f03b40093957:
Extracting 6.226MB/31.4MB

f03b40093957:
Extracting 8.192MB/31.4MB

f03b40093957:
Extracting 10.49MB/31.4MB

f03b40093957:
Extracting 12.78MB/31.4MB

f03b40093957:
Extracting 15.07MB/31.4MB

f03b40093957:
Extracting 16.38MB/31.4MB

f03b40093957:
Extracting 18.68MB/31.4MB

f03b40093957:
Extracting 21.95MB/31.4MB

f03b40093957:
Extracting 25.56MB/31.4MB

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Extracting 28.18MB/31.4MB

f03b40093957:
Extracting 28.84MB/31.4MB

f03b40093957:
Extracting 29.82MB/31.4MB

f03b40093957:
Extracting 30.15MB/31.4MB

f03b40093957:
Extracting 30.47MB/31.4MB

f03b40093957:
Extracting 31.13MB/31.4MB

f03b40093957:
Extracting 31.4MB/31.4MB

f03b40093957: Pull complete

0972072e0e8a:
Extracting 262.1kB/25.58MB

0972072e0e8a:

```
Extracting 2.621MB/25.58MB
```

```
0972072e0e8a:
```

```
Extracting 5.767MB/25.58MB
```

```
0972072e0e8a:
```

```
Extracting 9.699MB/25.58MB
```

```
0972072e0e8a:
```

```
Extracting 13.89MB/25.58MB
```

```
0972072e0e8a:
```

```
Extracting 16.52MB/25.58MB
```

```
0972072e0e8a:
```

```
Extracting 19.14MB/25.58MB
```

```
0972072e0e8a:
```

```
Extracting 22.02MB/25.58MB
```

```
0972072e0e8a:
```

```
Extracting 23.33MB/25.58MB
```

```
0972072e0e8a:
```

```
Extracting 23.59MB/25.58MB
```

```
0972072e0e8a:
```

```
Extracting 25.58MB/25.58MB
```

```
0972072e0e8a: Pull complete
```

```
a85095acb896: Extracting 624B/624B
```

```
a85095acb896: Extracting 624B/624B
```

```
a85095acb896: Pull complete
```

```
d24b987aa74e: Extracting 958B/958B
```

```
d24b987aa74e: Extracting 958B/958B
```

```
d24b987aa74e: Pull complete
```

```
6c1a86118ade: Extracting 772B/772B
```

```
6c1a86118ade: Extracting 772B/772B
```

```
6c1a86118ade: Pull complete
```

```
9989f7b33228:
```

```
Extracting 1.405kB/1.405kB
```

```
9989f7b33228:
```

```
Extracting 1.405kB/1.405kB
```

```
9989f7b33228: Pull complete
```

```
Digest: sha256:f5747a42e3adcb3168049d63278d7251d91185bb
```

```
Status: Downloaded newer image for  
nginx:1.23
```

```
0750820a02b658c868a8024ba6e079a4a96cf71ac815e62fdd1e6be
```

4.2 Liste des conteneurs (container ls, ps)

- La commande `docker ps` (docker container ls) liste les conteneurs en cours d'exécution.
- L'option `-a` liste tous les conteneurs (y compris arrêtés).
- Chaque conteneur a un ID unique, un nom, un statut, des ports exposés, etc.

```
#| label: lst-docker-ps  
#| title: "Liste des conteneurs en  
cours d'exécution"  
#| caption: "Affichage des conteneurs  
Docker en cours d'exécution"  
docker ps
```

CONTAINER	ID	IMAGE
COMMAND		CREATED
STATUS	PORTS	NAMES
0750820a02b6		nginx:1.23
"/docker-entrypoint..."	2 seconds	
ago Up Less than a second	80/tcp	
my-nginx		
5158299069d3	ghcr.io/ebpro/jupyter-	

```
base:quarto-full-fix-chromium-ci-  
headless-render "bash -lc 'source /  
h..." 4 minutes ago Up 4 minutes  
quarto-render-37292921914
```

4.3 Arrêter (stop) / démarrer (start) / supprimer (rm)

- Le cycle de vie d'un conteneur inclut les états : démarré, arrêté, supprimé.
- Lorsqu'un conteneur est arrêté, il reste sur le système jusqu'à sa suppression (rm).

```
#| label: lst-stop-nginx  
docker stop my-nginx
```

```
my-nginx
```

```
#| label: lst-docker-ps-all  
docker ps -a
```

CONTAINER	ID	IMAGE
COMMAND		CREATED
STATUS		PORTS
NAMES		
	0750820a02b6	nginx:1.23
"/docker-entrypoint..."		3 seconds ago
Exited (0) Less than a second ago		
	my-nginx	
	5158299069d3	ghcr.io/ebpro/jupyter-
base:quarto-full-fix-chromium-ci-		
headless-render "bash -lc 'source /		
h..." 4 minutes ago Up 4 minutes		
quarto-render-37292921914		

```
#| label: lst-start-nginx  
docker start my-nginx
```

```
my-nginx
```

```
#| label: lst-rm-nginx  
docker stop my-nginx
```

```
my-nginx
```

```
#| label: lst-rm-nginx  
docker rm my-nginx
```

```
my-nginx
```

4.4 Exercice 1

Lancer un conteneur `alpine`, exécuter `uname -a`, puis le supprimer.

```
#| label: lst-run-alpine-uname  
docker rm -f my-alpine >/dev/null  
2>&1 || true  
docker run --label ebpro-render=true  
--name my-alpine alpine:3.18 uname -a  
docker rm my-alpine
```

```
Linux 7ddb5f2275 6.8.0-142-generic  
#142-Ubuntu SMP PREEMPT_DYNAMIC Wed  
Sep 2 14:24:27 UTC 2026 x86_64 Linux  
my-alpine
```

- L'option `--rm` peut être utilisée avec `docker run` pour supprimer automatiquement le conteneur après son arrêt.

5 Logs, exec et monitoring

- Les logs d'un conteneur sont accessibles via `docker logs`.
- L'option `-f` permet de suivre les logs en temps réel.

```
#| label: lst-run-nginx-logs
docker rm -f my-nginx >/dev/null 2>&1
|| true
docker run --label ebpro-render=true
--name my-nginx -d nginx:1.23
```

```
7a21610ee246179d85e45ed1c30745b50ddb579e
```

```
#| label: lst-docker-logs
docker logs my-nginx
# docker logs -f my-nginx
```

```
/docker-entrypoint.sh: /docker-
entrypoint.d/ is not empty, will
attempt to perform configuration
/docker-entrypoint.sh: Looking for
shell scripts in /docker-
entrypoint.d/
/docker-entrypoint.sh: Launching /
docker-entrypoint.d/10-listen-on-
ipv6-by-default.sh
10-listen-on-ipv6-by-default.sh:
info: Getting the checksum of /etc/
nginx/conf.d/default.conf
10-listen-on-ipv6-by-default.sh:
info: Enabled listen on IPv6 in /etc/
nginx/conf.d/default.conf
/docker-entrypoint.sh: Launching /
docker-entrypoint.d/20-envsubst-on-
templates.sh
/docker-entrypoint.sh: Launching /
docker-entrypoint.d/30-tune-worker-
processes.sh
/docker-entrypoint.sh: Configuration
complete; ready for start up
2026/10/05 11:12:44 [notice] 1#1:
using the "epoll" event method
2026/10/05 11:12:44 [notice] 1#1:
nginx/1.23.4
2026/10/05 11:12:44 [notice] 1#1:
built by gcc 10.2.1 20210110 (Debian
```

```
10.2.1-6)
2026/10/05 11:12:44 [notice] 1#1: OS:
Linux 6.8.0-142-generic
2026/10/05 11:12:44 [notice]
1#1: getrlimit(RLIMIT_NOFILE):
1048576:1048576
2026/10/05 11:12:44 [notice] 1#1:
start worker processes
2026/10/05 11:12:44 [notice] 1#1:
start worker process 29
2026/10/05 11:12:44 [notice] 1#1:
start worker process 30
2026/10/05 11:12:44 [notice] 1#1:
start worker process 31
2026/10/05 11:12:44 [notice] 1#1:
start worker process 32
2026/10/05 11:12:44 [notice] 1#1:
start worker process 33
2026/10/05 11:12:44 [notice] 1#1:
start worker process 34
2026/10/05 11:12:44 [notice] 1#1:
start worker process 35
2026/10/05 11:12:44 [notice] 1#1:
start worker process 36
2026/10/05 11:12:44 [notice] 1#1:
start worker process 37
2026/10/05 11:12:44 [notice] 1#1:
start worker process 38
2026/10/05 11:12:44 [notice] 1#1:
start worker process 39
2026/10/05 11:12:44 [notice] 1#1:
start worker process 40
2026/10/05 11:12:44 [notice] 1#1:
start worker process 41
2026/10/05 11:12:44 [notice] 1#1:
start worker process 42
2026/10/05 11:12:44 [notice] 1#1:
start worker process 43
2026/10/05 11:12:44 [notice] 1#1:
start worker process 44
2026/10/05 11:12:44 [notice] 1#1:
start worker process 45
2026/10/05 11:12:44 [notice] 1#1:
```

```

start worker process 46
2026/10/05 11:12:44 [notice] 1#1:
start worker process 47
2026/10/05 11:12:44 [notice] 1#1:
start worker process 48
2026/10/05 11:12:44 [notice] 1#1:
start worker process 49
2026/10/05 11:12:44 [notice] 1#1:
start worker process 50
2026/10/05 11:12:44 [notice] 1#1:
start worker process 51
2026/10/05 11:12:44 [notice] 1#1:
start worker process 52
2026/10/05 11:12:44 [notice] 1#1:
start worker process 53
2026/10/05 11:12:44 [notice] 1#1:
start worker process 54
2026/10/05 11:12:44 [notice] 1#1:
start worker process 55
2026/10/05 11:12:44 [notice] 1#1:
start worker process 56
2026/10/05 11:12:44 [notice] 1#1:
start worker process 57
2026/10/05 11:12:44 [notice] 1#1:
start worker process 58
2026/10/05 11:12:44 [notice] 1#1:
start worker process 59
2026/10/05 11:12:44 [notice] 1#1:
start worker process 60

```

5.1 Exécuter une commande dans un conteneur en cours

- La commande `docker exec` permet d'exécuter des commandes dans un conteneur en cours d'exécution.
- Lance un nouveau processus dans le conteneur
 - `docker exec container <cmd>` → non interactif
 - `docker exec -it container sh` → interactif (ou un autre shell ou programme interactif)

```

#| label: lst-run-nginx-exec
docker exec my-nginx ls /usr/share/nginx/html

```

```

50x.html
index.html

```

```

#| label: lst-run-nginx-exec-interactive
docker stop my-nginx
docker rm my-nginx

```

```

my-nginx
my-nginx

```

5.2 Monitoring

- La commande `docker stats` affiche l'utilisation des ressources (CPU, mémoire, réseau, disques) des conteneurs en cours d'exécution.
- L'option `--no-stream` affiche une seule fois les statistiques.

```

#| label: lst-docker-stats
docker stats --no-stream

```

CONTAINER	ID	NAME
CPU %	MEM USAGE / LIMIT	MEM %
NET I/O	BLOCK I/O	PIDS
5158299069d3		quarto-render-37292921914
0.11%		
457.7MiB / 62.66GiB	0.71%	2MB /
76.7kB	36.7MB / 171MB	54

6 Réseau

- Chaque conteneur a une interface réseau virtuelle et une adresse IP.
- Par défaut, les conteneurs sont connectés à un réseau bridge par défaut.

- Il est possible de créer des réseaux custom pour isoler les conteneurs.
- Les conteneurs sur le même réseau custom peuvent communiquer entre eux par **nom** (DNS interne).

6.1 Réseau par défaut (bridge)

- Par défaut, Docker crée un réseau bridge nommé bridge.

```
#| label: lst-docker-network-ls
docker rm -f c1 >/dev/null 2>&1 ||
true
docker run --label ebpro-render=true
-d --name c1 alpine sleep 3600
docker rm -f c2 >/dev/null 2>&1 ||
true
docker run --label ebpro-render=true
-d --name c2 alpine sleep 3600
```

```
Unable to find image 'alpine:latest'
locally
latest: Pulling from library/alpine
```

```
e2de96513ba9: Pulling fs layer
```

```
e2de96513ba9:
Downloading 48.55kB/3.85MB
```

```
e2de96513ba9: Verifying Checksum
```

```
e2de96513ba9: Download complete
```

```
e2de96513ba9:
Extracting 65.54kB/3.85MB
```

```
e2de96513ba9:
Extracting 1.376MB/3.85MB
```

```
e2de96513ba9:
Extracting 3.736MB/3.85MB
```

```
e2de96513ba9:
Extracting 3.85MB/3.85MB
```

```
e2de96513ba9:
Extracting 3.85MB/3.85MB
```

```
e2de96513ba9: Pull complete
Digest: sha256:294b683cb724975bec92580e1e685676bd4b50bd
Status: Downloaded newer image for
alpine:latest
0ea207e8f1f9705ac8cc12b38ff521295713fc96d56f4e199b6e5e8
1cd346b45f36824eb12d8f964be566d7642050a33e033f705d63239
```

- Les conteneurs ont une adresse IP dans le réseau bridge par défaut.
 - La commande `docker inspect` permet de voir les détails d'un conteneur et permet de définir un format personnalisé (ici l'adresse IP).

```
#| label: lst-docker-inspect-ip
docker inspect -f '{{.Name}} -
{{range .NetworkSettings.Networks}}
{{.IPAddress}}{{end}}' c1 c2
```

```
/c1 - 172.17.0.3
/c2 - 172.17.0.4
```

✗ Sur le réseau bridge par défaut :

- les conteneurs **n'ont pas de DNS interne**
- ils ne peuvent pas se résoudre par nom

```
#| label: lst-docker-ping-fail
docker exec c1 ping -c 1 c2
```

```
ping: bad address 'c2'
```

```
: 1
```

6.2 Réseau custom (bonne pratique)

- Créer un réseau custom avec `docker network create`.
- Lancer des conteneurs (un serveur web, une base de données) sur ce réseau avec `--network`.

```
#| label: lst-docker-network-create
docker network create app-net

docker rm -f web >/dev/null 2>&1 ||
true
docker run --label ebpro-render=true
--detach --name web \
--network app-net \
nginx:1.23

docker rm -f db >/dev/null 2>&1 ||
true
docker run --label ebpro-render=true
--detach --name db \
--network app-net \
redis:7.0.9
```

```
eef50493f005c2c3fef9b2878da93e6f6ed696e
e9d5d3289e223b153dad3f70b8c3c47af6040f1b7
Unable to find image 'redis:7.0.9'
locally
7.0.9: Pulling from library/redis
```

3f9582a2cbe7: Pulling fs layer

241c2d338588: Pulling fs layer

89515d93a23e: Pulling fs layer

65e8ba9473fe: Pulling fs layer

585124038cab: Pulling fs layer

b483de716a47: Pulling fs layer

65e8ba9473fe: Waiting

585124038cab: Waiting

b483de716a47: Waiting

241c2d338588:
Downloading 1.732kB/1.732kB

241c2d338588: Download complete

89515d93a23e:
Downloading 16.38kB/1.463MB

3f9582a2cbe7:
Downloading 324.8kB/31.41MB

89515d93a23e: Verifying Checksum

89515d93a23e: Download complete

3f9582a2cbe7:
Downloading 7.11MB/31.41MB

3f9582a2cbe7:
Downloading 14.22MB/31.41MB

65e8ba9473fe:
Downloading 96.73kB/9.579MB

3f9582a2cbe7:
Downloading 21.66MB/31.41MB

585124038cab:
Downloading 133B/133B

585124038cab: Verifying Checksum

65e8ba9473fe:
Downloading 5.057MB/9.579MB

3f9582a2cbe7:
Downloading 27.5MB/31.41MB

65e8ba9473fe: Verifying Checksum

65e8ba9473fe: Download complete

3f9582a2cbe7: Verifying Checksum

3f9582a2cbe7: Download complete

3f9582a2cbe7:
Extracting 327.7kB/31.41MB

3f9582a2cbe7:
Extracting 2.949MB/31.41MB

b483de716a47:
Downloading 574B/574B

b483de716a47: Verifying Checksum

b483de716a47: Download complete

3f9582a2cbe7:
Extracting 6.226MB/31.41MB

3f9582a2cbe7:
Extracting 8.192MB/31.41MB

3f9582a2cbe7:
Extracting 10.49MB/31.41MB

3f9582a2cbe7:
Extracting 13.11MB/31.41MB

3f9582a2cbe7:
Extracting 15.4MB/31.41MB

3f9582a2cbe7:
Extracting 17.37MB/31.41MB

3f9582a2cbe7:

Extracting 20.97MB/31.41MB

3f9582a2cbe7:
Extracting 24.58MB/31.41MB

3f9582a2cbe7:
Extracting 27.53MB/31.41MB

3f9582a2cbe7:
Extracting 28.84MB/31.41MB

3f9582a2cbe7:
Extracting 29.82MB/31.41MB

3f9582a2cbe7:
Extracting 30.15MB/31.41MB

3f9582a2cbe7:
Extracting 30.47MB/31.41MB

3f9582a2cbe7:
Extracting 31.13MB/31.41MB

3f9582a2cbe7:
Extracting 31.41MB/31.41MB

3f9582a2cbe7: Pull complete

241c2d338588:
Extracting 1.732kB/1.732kB

241c2d338588:
Extracting 1.732kB/1.732kB

241c2d338588: Pull complete

89515d93a23e:
Extracting 32.77kB/1.463MB

89515d93a23e:
Extracting 1.463MB/1.463MB

89515d93a23e:

```

Extracting 1.463MB/1.463MB

89515d93a23e: Pull complete

65e8ba9473fe:
Extracting 98.3kB/9.579MB

65e8ba9473fe:
Extracting 1.769MB/9.579MB

65e8ba9473fe:
Extracting 3.834MB/9.579MB

65e8ba9473fe:
Extracting 6.193MB/9.579MB

65e8ba9473fe:
Extracting 8.847MB/9.579MB

65e8ba9473fe:
Extracting 9.579MB/9.579MB

65e8ba9473fe: Pull complete

585124038cab: Extracting 133B/133B

585124038cab: Extracting 133B/133B

585124038cab: Pull complete

b483de716a47: Extracting 574B/574B

b483de716a47: Extracting 574B/574B

b483de716a47: Pull complete
Digest: sha256:e50c7e23f79ae81351beacb20e0 {
Status: Downloaded newer image for
redis:7.0.9
d21b635204010f5880e8dd377b5fbfc3dc2b08c62

```

6.3 Vérifier le réseau (Avancé)

```

#| label: lst-docker-network-inspect
docker network inspect app-net

```

```

[
  {
    "Name": "app-net",
    "Id": "efeef50493f005c2c3fef9b2878da93e6f6ed696eeb",
    "Created":
      "2026-10-05T11:13:15.098905385Z",
    "Scope": "local",
    "Driver": "bridge",
    "EnableIPv4": true,
    "EnableIPv6": false,
    "IPAM": {
      "Driver": "default",
      "Options": {},
      "Config": [
        {
          "Subnet":
            "172.18.0.0/16",
          "Gateway": "172.18.0.1"
        }
      ]
    },
    "Internal": false,
    "Attachable": false,
    "Ingress": false,
    "ConfigFrom": {
      "Network": ""
    },
    "ConfigOnly": false,
    "Containers": {
      "d21b635204010f5880e8dd377b5fbfc3dc2b08c62d1f3c": {
        "Name": "db",
        "EndpointID": "e2fc5447056aa204e7a33e51158b0",
        "MacAddress":
          "be:66:3a:9c:b7:ba",
        "IPv4Address":
          "172.18.0.3/16",
        "IPv6Address": ""
      }
    }
  }
]

```

```

    },
    "e9d5d3289e223b153dad3f70b8c3c47a
{
    "Name": "web",
    "EndpointID": "e4100bb01db2ef1a
    "MacAddress":
"5e:91:3e:37:51:a1",
    "IPv4Address":
"172.18.0.2/16",
    "IPv6Address": ""
}
},
"Options": {},
"Labels": {}
}
]

```

6.4 Communication conteneur → conteneur

```

#| label: lst-docker-ping-success
docker run --label ebpro-render=true
--rm --network app-net curlimages/
curl:7.88.1 http://web

```

```

Unable to find image 'curlimages/
curl:7.88.1' locally
7.88.1: Pulling from curlimages/curl

```

```
213ec9aee27d: Pulling fs layer
```

```
ea634e3b33ec: Pulling fs layer
```

```
55bfd993f83a: Pulling fs layer
```

```
df0b84b7230e: Pulling fs layer
```

```
8d68097e7e08: Pulling fs layer
```

```
4c26da78c210: Pulling fs layer
```

```
659101a913e8: Pulling fs layer
```

```
473ceed980f8: Pulling fs layer
```

```
b0calde0cc3e: Pulling fs layer
```

```
45477c99a790: Pulling fs layer
```

```
d4c655b444ee: Pulling fs layer
```

```
659101a913e8: Waiting
```

```
df0b84b7230e: Waiting
```

```
473ceed980f8: Waiting
```

```
8d68097e7e08: Waiting
```

```
b0calde0cc3e: Waiting
```

```
4c26da78c210: Waiting
```

```
45477c99a790: Waiting
```

```
d4c655b444ee: Waiting
```

```
55bfd993f83a:
Downloading 16.38kB/608.7kB
```

```
213ec9aee27d:
Downloading 32.17kB/2.806MB
```

```
ea634e3b33ec:
Downloading 49.15kB/4.396MB
```

```
55bfd993f83a:
Downloading 608.7kB/608.7kB
```

```
55bfd993f83a: Verifying Checksum
```

```
55bfd993f83a: Download complete
```

```
213ec9aee27d: Verifying Checksum
```

```
6f88be2c4",
```

213ec9aee27d: Download complete

213ec9aee27d:

Extracting 32.77kB/2.806MB

ea634e3b33ec: Verifying Checksum

ea634e3b33ec: Download complete

213ec9aee27d:

Extracting 1.442MB/2.806MB

213ec9aee27d:

Extracting 2.806MB/2.806MB

213ec9aee27d: Pull complete

ea634e3b33ec:

Extracting 65.54kB/4.396MB

df0b84b7230e:

Downloading 1.265kB/1.265kB

df0b84b7230e: Verifying Checksum

df0b84b7230e: Download complete

8d68097e7e08:

Downloading 16.38kB/123.2kB

4c26da78c210:

Downloading 16.38kB/347.4kB

8d68097e7e08:

Downloading 123.2kB/123.2kB

8d68097e7e08: Download complete

4c26da78c210:

Downloading 347.4kB/347.4kB

4c26da78c210: Download complete

ea634e3b33ec:

Extracting 2.097MB/4.396MB

ea634e3b33ec:

Extracting 4.396MB/4.396MB

ea634e3b33ec: Pull complete

55bfd993f83a:

Extracting 32.77kB/608.7kB

55bfd993f83a:

Extracting 608.7kB/608.7kB

55bfd993f83a:

Extracting 608.7kB/608.7kB

659101a913e8:

Downloading 16.38kB/162.4kB

659101a913e8:

Downloading 162.4kB/162.4kB

659101a913e8: Verifying Checksum

659101a913e8: Download complete

55bfd993f83a: Pull complete

df0b84b7230e:

Extracting 1.265kB/1.265kB

df0b84b7230e:

Extracting 1.265kB/1.265kB

473ceed980f8:

Downloading 16.38kB/52.34kB

473ceed980f8: Download complete

b0calde0cc3e:

Downloading 161B/161B

b0calde0cc3e: Verifying Checksum

b0calde0cc3e: Download complete

df0b84b7230e: Pull complete

8d68097e7e08:
Extracting 32.77kB/123.2kB

8d68097e7e08:
Extracting 123.2kB/123.2kB

8d68097e7e08: Pull complete

4c26da78c210:
Extracting 32.77kB/347.4kB

45477c99a790:
Downloading 159B/159B

45477c99a790: Download complete

4c26da78c210:
Extracting 347.4kB/347.4kB

4c26da78c210:
Extracting 347.4kB/347.4kB

d4c655b444ee:
Downloading 291B/291B

d4c655b444ee: Verifying Checksum

4c26da78c210: Pull complete

659101a913e8:
Extracting 32.77kB/162.4kB

659101a913e8:
Extracting 162.4kB/162.4kB

659101a913e8:

Extracting 162.4kB/162.4kB

659101a913e8: Pull complete

473ceed980f8:
Extracting 32.77kB/52.34kB

473ceed980f8:
Extracting 52.34kB/52.34kB

473ceed980f8: Pull complete

b0calde0cc3e: Extracting 161B/161B

b0calde0cc3e: Extracting 161B/161B

b0calde0cc3e: Pull complete

45477c99a790: Extracting 159B/159B

45477c99a790: Extracting 159B/159B

45477c99a790: Pull complete

d4c655b444ee: Extracting 291B/291B

d4c655b444ee: Extracting 291B/291B

d4c655b444ee: Pull complete

Digest: sha256:48318407b8d98e8c7d5bd4741c88e8e1a5442de6

Status: Downloaded newer image for
curlimages/curl:7.88.1

	% Total	% Received	% Xferd	Average	
Speed	Time	Time	Time	Current	Dload
Upload	Total	Spent	Left	Speed	

0	0	0	0	0	0
0	--:--:--	--:--:--	--:--:--		0<!

DOCTYPE html>

<html>

<head>

<title>Welcome to nginx!</title>

```

<style>
html { color-scheme: light dark; }
body { width: 35em; margin: 0 auto;
font-family: Tahoma, Verdana, Arial,
sans-serif; }
</style>
</head>
<body>
<h1>Welcome to nginx!</h1>
<p>If you see this page, the nginx web
server is successfully installed and
working. Further configuration is
required.</p>

<p>For online documentation and
support please refer to
<a href="http://nginx.
org/">nginx.org</a>.<br/>
Commercial support is available at
<a href="http://nginx.
com/">nginx.com</a>.</p>

<p><em>Thank you for using nginx.</
em></p>
</body>
</html>

100   615   100   615    0    0   158k
0  ---:--  ---:--  ---:--  200k

```

- Ils peuvent donc utiliser les mêmes ports en interne sans conflit.
 - Ex: plusieurs conteneurs postgres peuvent écouter sur **leur** port 5432.
- Pour exposer un service d'un conteneur vers l'hôte, utiliser `--publish hôte:conteneur`.
- Cela mappe un port de l'hôte vers un port du conteneur.
 - Ex: `--publish 8080:80` mappe le port 8080 de l'hôte vers le port 80 du conteneur.
 - Attention aux conflits de ports sur l'hôte.
 - Attention si docker tourne dans une VM (WSL, Docker Desktop): le port est exposé sur la VM, pas directement sur l'hôte.
 - Le port mapping est une règle de NAT entre l'hôte et le réseau bridge Docker.

```

#| label: lst-docker-port-mapping
docker rm -f web-port-1 >/dev/null
2>&1 || true
docker run --label ebpro-render=true
--detach --name web-port-1 --publish
8080:80 nginx:1.28

docker rm -f web-port-2 >/dev/null
2>&1 || true
docker run --label ebpro-render=true
--detach --name web-port-2 --publish
8081:80 nginx:1.23

```

6.5 Exercice 2 (Max 10 min)

Créer un réseau `mynet`, lancer deux conteneurs `alpine` nommés `a1` et `a2` sur ce réseau, puis vérifier qu'ils se ping par nom **en exécutant une commande dans un conteneur** en mode **non-interactif**.

7 Port mapping

- Chaque conteneur a son propre espace réseau isolé.

```

Unable to find image 'nginx:1.28'
locally
1.28: Pulling from library/nginx

5435b2dcdf5c: Pulling fs layer
6a7080264fc9: Pulling fs layer
f176d5d8a1c1: Pulling fs layer
63ef37274310: Pulling fs layer

```

4744f2344932: Pulling fs layer
39a24e95a1e9: Pulling fs layer
400f8ac367e0: Pulling fs layer
63ef37274310: Waiting
4744f2344932: Waiting
39a24e95a1e9: Waiting
400f8ac367e0: Waiting
f176d5d8a1c1:
Downloading 627B/627B
f176d5d8a1c1: Download complete
6a7080264fc9:
Downloading 341.2kB/33.11MB
5435b2dcdf5c:
Downloading 309.9kB/29.78MB
6a7080264fc9:
Downloading 5.455MB/33.11MB
5435b2dcdf5c:
Downloading 5.897MB/29.78MB
6a7080264fc9:
Downloading 12.59MB/33.11MB
5435b2dcdf5c:
Downloading 10.83MB/29.78MB
6a7080264fc9:
Downloading 19.42MB/33.11MB
5435b2dcdf5c:
Downloading 15.74MB/29.78MB

6a7080264fc9:
Downloading 26.22MB/33.11MB
5435b2dcdf5c:
Downloading 20.65MB/29.78MB
6a7080264fc9:
Downloading 32.68MB/33.11MB
6a7080264fc9: Verifying Checksum
6a7080264fc9: Download complete
5435b2dcdf5c:
Downloading 25.24MB/29.78MB
5435b2dcdf5c: Verifying Checksum
5435b2dcdf5c: Download complete
63ef37274310:
Downloading 955B/955B
63ef37274310: Verifying Checksum
63ef37274310: Download complete
5435b2dcdf5c:
Extracting 327.7kB/29.78MB
4744f2344932:
Downloading 402B/402B
4744f2344932: Verifying Checksum
4744f2344932: Download complete
5435b2dcdf5c:
Extracting 2.949MB/29.78MB
39a24e95a1e9:
Downloading 1.208kB/1.208kB

39a24e95a1e9: Verifying Checksum

39a24e95a1e9: Download complete

5435b2dcdf5c:

Extracting 5.898MB/29.78MB

400f8ac367e0:

Downloading 1.397kB/1.397kB

400f8ac367e0: Verifying Checksum

400f8ac367e0: Download complete

5435b2dcdf5c:

Extracting 8.192MB/29.78MB

5435b2dcdf5c:

Extracting 10.16MB/29.78MB

5435b2dcdf5c:

Extracting 11.8MB/29.78MB

5435b2dcdf5c:

Extracting 14.42MB/29.78MB

5435b2dcdf5c:

Extracting 17.69MB/29.78MB

5435b2dcdf5c:

Extracting 20.97MB/29.78MB

5435b2dcdf5c:

Extracting 24.25MB/29.78MB

5435b2dcdf5c:

Extracting 26.21MB/29.78MB

5435b2dcdf5c:

Extracting 28.51MB/29.78MB

5435b2dcdf5c:

Extracting 28.84MB/29.78MB

5435b2dcdf5c:

Extracting 29.16MB/29.78MB

5435b2dcdf5c:

Extracting 29.78MB/29.78MB

5435b2dcdf5c: Pull complete

6a7080264fc9:

Extracting 360.4kB/33.11MB

6a7080264fc9:

Extracting 2.884MB/33.11MB

6a7080264fc9:

Extracting 5.767MB/33.11MB

6a7080264fc9:

Extracting 9.011MB/33.11MB

6a7080264fc9:

Extracting 12.26MB/33.11MB

6a7080264fc9:

Extracting 14.42MB/33.11MB

6a7080264fc9:

Extracting 17.66MB/33.11MB

6a7080264fc9:

Extracting 20.91MB/33.11MB

6a7080264fc9:

Extracting 24.15MB/33.11MB

6a7080264fc9:

Extracting 27.39MB/33.11MB

6a7080264fc9:

Extracting 30.28MB/33.11MB

```

6a7080264fc9:
Extracting 30.64MB/33.11MB

6a7080264fc9:
Extracting 33.11MB/33.11MB

6a7080264fc9: Pull complete

f176d5d8a1c1: Extracting 627B/627B

f176d5d8a1c1: Extracting 627B/627B

f176d5d8a1c1: Pull complete

63ef37274310: Extracting 955B/955B

63ef37274310: Extracting 955B/955B

63ef37274310: Pull complete

4744f2344932: Extracting 402B/402B

4744f2344932: Extracting 402B/402B

4744f2344932: Pull complete

39a24e95a1e9:
Extracting 1.208kB/1.208kB

39a24e95a1e9:
Extracting 1.208kB/1.208kB

39a24e95a1e9: Pull complete

400f8ac367e0:
Extracting 1.397kB/1.397kB

400f8ac367e0:
Extracting 1.397kB/1.397kB

400f8ac367e0: Pull complete
Digest: sha256:146adea4768b83c607d0bdfa41
Status: Downloaded newer image for

```

```

nginx:1.28
13fc5249619d2a2d08e78f04238c2e38b2c63ac1da9b96d9e8de45b
30999328c26156a1eb16929533a9eb3327bcfd11a26935574bddff5

```

7.1 Tester depuis l'hôte

- Il est possible de tester l'accès au service exposé depuis l'hôte avec `curl` ou un navigateur.
- Avec l'adresse `http://localhost:8080` si Docker est natif.
- Avec l'adresse IP de la VM si Docker tourne dans une VM (ex: WSL, Docker Desktop).
- A moins que Docker soit configuré pour exposer les ports vers l'hôte directement.

```
curl --max-time 30 -I http://localhost:8080
```

```
curl --max-time 30 -I http://localhost:8081
```

```

#| label: lst-docker-port-mapping-curl
curl --max-time 30 -I http://dind:8080

```

```
curl --max-time 30 -I http://dind:8081
```

```

HTTP/1.1 200 OK
Server: nginx/1.28.3
Date: Mon, 05 Oct 2026 11:13:42 GMT
Content-Type: text/html
Content-Length: 615
Last-Modified: Tue, 24 Mar 2026 18:33:23 GMT
Connection: keep-alive
ETag: "69c2d8f3-267"
Accept-Ranges: bytes

HTTP/1.1 200 OK

```

```
Server: nginx/1.23.4
Date: Mon, 05 Oct 2026 11:13:43 GMT
Content-Type: text/html
Content-Length: 615
Last-Modified: Tue, 28 Mar 2023
15:01:54 GMT
Connection: keep-alive
ETag: "64230162-267"
Accept-Ranges: bytes
```

7.2 Accès conteneur -> hôte

- Il est possible d'accéder à un service exposé sur l'hôte depuis un conteneur.
- Utiliser `host.docker.internal` comme nom d'hôte.
- ATTENTION : `host.docker.internal` fonctionne nativement sur Docker Desktop (Windows/Mac) et Docker sous Linux (depuis Docker 20.10) mais n'est standardisé que sur Docker Desktop.

```
docker run --label ebpro-render=true
--rm \
    curlimages/curl:7.88.1 http://
host.docker.internal:8080
```

8 Volumes : persistance

- Les données dans un conteneur sont éphémères : elles disparaissent à l'arrêt/suppression du conteneur.
- Pour persister les données, utiliser des volumes.
- Un volume est un espace de stockage géré par Docker, indépendant du cycle de vie des conteneurs.
- Les volumes peuvent être montés dans un conteneur avec `--volume volume:chemin_dans_conteneur`.
- Il existe deux types de volumes :
 - **Bind mount** : mappe un répertoire de l'hôte vers un répertoire du conteneur.

- **Volume nommé** : volume géré par Docker, stocké dans l'espace de stockage Docker.

💡 Astuce

- bind mount = couplage fort hôte ↔ conteneur
- volume nommé = abstraction portable

8.1 Bind mount (risky, dev)

- montage avec `--volume /chemin/host:/chemin/conteneur`

```
#| output: true
#| echo: true

#| label: lst-bind-mount-nginx
echo "hello" > ${TP_DIR}/www/
index.html
```

```
docker run --label ebpro-render=true
--rm -v ${TP_DIR}/www:/usr/share/
nginx/html \
    -p :80 nginx:1.23
```

- Utile en développement pour monter du code source.
- Permet d'éditer les fichiers sur l'hôte et de les voir dans le conteneur.
- Dangers :
 - les permissions peuvent poser problème selon l'OS hôte
 - les performances peuvent être dégradées (ex: Docker Desktop sur Windows/Mac)
 - le conteneur ne peut pas être déplacé facilement (dépendance à l'hôte)

8.2 Volume nommé (better, prod)

- montage avec `--volume`
`nom_volume:chemin/conteneur`

```
#| label: lst-named-volume-postgres
IMAGE="postgres:15.2"
VOLUME="pgdata"
PW="secret"

docker volume create "$VOLUME"

# Initialisation de la base et
création d'une table
docker rm -f db >/dev/null 2>&1 ||
true
docker run --label ebpro-render=true
-d --name db \
-v "$VOLUME":/var/lib/postgresql/
data \
-e POSTGRES_PASSWORD="$PW" \
"$IMAGE"

# Attendre que la base soit prête
timeout 60 sh -c 'until docker exec
db pg_isready -U postgres >/dev/null
2>&1; do echo -n '.'; sleep 1; done'
|| (echo "Postgres not ready after
60s" >&2; exit 1)

# Créer une table et insérer des
données depuis le conteneur de la base
docker exec db psql -U postgres -c
"CREATE TABLE test (id SERIAL PRIMARY
KEY, name VARCHAR(50));"
docker exec db psql -U postgres -
c "INSERT INTO test (name) VALUES
('Alice'), ('Bob');"

# Arrêter et supprimer le conteneur
mais conserver le volume
docker stop db && docker rm db
```

```
pgdata
a6aede6cc50d8b61df813c641799c141660e5dfa0800b8ad6704b39
.
psql: error: connection to
server on socket "/var/run/
postgresql/.s.PGSQL.5432" failed: No
such file or directory
Is the server running locally and
accepting connections on that socket?
ERROR: relation "test" does not exist
LINE 1: INSERT INTO test (name) VALUES
('Alice'), ('Bob');
^
db
db
```

```
#| label: lst-verify-named-volume
# Redémarrer un nouveau conteneur
avec le même volume
docker rm -f db2 >/dev/null 2>&1 ||
true
docker run --label ebpro-render=true
-d --name db2 \
-v "$VOLUME":/var/lib/postgresql/
data \
-e POSTGRES_PASSWORD="$PW" \
"$IMAGE"

# Attendre que la base soit prête
timeout 60 sh -c 'until docker exec
db2 pg_isready -U postgres >/dev/null
2>&1; do echo -n '.'; sleep 1; done'
|| (echo "Postgres not ready after
60s" >&2; exit 1)

# Vérifier que les données persistent
docker exec db2 psql -U postgres -c
"SELECT * FROM test;"

# Nettoyage
docker stop db2 && docker rm db2
docker volume rm "$VOLUME"
```

```
58d30fb3b35b291f8b1d38c34534d4fb228b2b269
ERROR: relation "test" does not exist
LINE 1: SELECT * FROM test;
          ^

db2
db2
pgdata
```

8.3 Exercice de persistance

- lancer MySQL sans volume → perdre les données
- relancer avec volume → conserver les données

Hint: l'image officielle MySQL stocke les données dans `/var/lib/mysql`. Voir la page Docker Hub : https://hub.docker.com/_/mysql

Exercice 3 (10 min)

Démarrer MySQL au premier plan, observer l'initialisation (création de la base), arrêter avec Ctrl-C, puis relancer le même volume et constater qu'il n'y a plus d'initialisation.

Consignes :

- Lisez la page Docker Hub de MySQL pour comprendre
 - les variables d'environnement essentielles (notamment `MYSQL_ROOT_PASSWORD`, `MYSQL_DATABASE`) : https://hub.docker.com/_/mysql
 - le chemin de stockage des données dans le conteneur (`/var/lib/mysql`)
- Créez un volume nommé `mysql-data` pour stocker les données persistantes.
- Démarrez MySQL en mode **attaché** (sans `--detach`)

```
#| label: lst-mysql-persistence

# create a named volume for MySQL data
(one-time)
docker volume create mysql-data

export MYSQL_ROOT_PASSWORD=secretpw
export MYSQL_DATABASE=demo

# Run MySQL in the foreground so you
see initialization logs
docker rm -f mysql-db >/dev/null 2>&1
|| true
docker run --label ebpro-render=true
--name mysql-db --detach\
--env MYSQL_ROOT_PASSWORD=${MYSQL_ROOT_PASSWORD}
\
--env
MYSQL_DATABASE=${MYSQL_DATABASE} \
--volume mysql-data:/var/lib/mysql
\
mysql:8.0

# Wait for MySQL to be ready
timeout 60 sh -c 'until docker
exec mysql-db mysqladmin ping -h
"localhost" --silent >/dev/null 2>&1;
do echo -n "."; sleep 1; done' ||
(echo "MySQL not ready after 60s" >&2;
exit 1)

# Stop and remove the container to
simulate a restart
docker stop mysql-db && docker rm
mysql-db

# Start a new container with the same
volume to see data persistence.
docker rm -f mysql-db >/dev/null 2>&1
|| true
docker run --label ebpro-render=true
--name mysql-db --detach\
--env MYSQL_ROOT_PASSWORD=${MYSQL_ROOT_PASSWORD}
```

```

\
--env
MYSQL_DATABASE=${MYSQL_DATABASE} \
--volume mysql-data:/var/lib/mysql
\
mysql:8.0

# Wait for MySQL to be ready again
timeout 60 sh -c 'until docker
exec mysql-db mysqladmin ping -h
"localhost" --silent >/dev/null 2>&1;
do echo -n "."; sleep 1; done' ||
(echo "MySQL not ready after 60s" >&2;
exit 1)

# Check the logs to confirm no re-
initialization
docker logs mysql-db|head -n 20

```

```

mysql-data
Unable to find image 'mysql:8.0'
locally
8.0: Pulling from library/mysql

```

```

edf85873f64e: Pulling fs layer

6ef6c7b50a93: Pulling fs layer

e3e5dlac74c1: Pulling fs layer

0d74d296605b: Pulling fs layer

297d04cfe470: Pulling fs layer

4c8a3e0d4e4b: Pulling fs layer

a63160a5eda1: Pulling fs layer

7534d1db9f8d: Pulling fs layer

49ec2dab01d9: Pulling fs layer

```

```

ab24264a27e9: Pulling fs layer

96d30d9fbee8: Pulling fs layer

297d04cfe470: Waiting

7534d1db9f8d: Waiting

4c8a3e0d4e4b: Waiting

a63160a5eda1: Waiting

96d30d9fbee8: Waiting

ab24264a27e9: Waiting

0d74d296605b: Waiting

49ec2dab01d9: Waiting

6ef6c7b50a93:
Downloading      884B/884B

6ef6c7b50a93: Verifying Checksum

6ef6c7b50a93: Download complete

e3e5dlac74c1:
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edf85873f64e:
Downloading  474.5kB/47.31MB

e3e5dlac74c1:
Downloading  783.6kB/783.6kB

e3e5dlac74c1: Verifying Checksum

e3e5dlac74c1: Download complete

edf85873f64e:
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```

edf85873f64e:
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edf85873f64e:
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0d74d296605b:
Downloading 77.15kB/6.173MB

297d04cfe470: Verifying Checksum

297d04cfe470: Download complete

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0d74d296605b: Verifying Checksum

0d74d296605b: Download complete

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4c8a3e0d4e4b: Download complete

edf85873f64e: Verifying Checksum

edf85873f64e: Download complete

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7534d1db9f8d: Verifying Checksum

7534d1db9f8d: Download complete

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a63160a5eda1: Verifying Checksum

a63160a5eda1: Download complete

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96d30d9fbee8: Verifying Checksum

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ab24264a27e9: Verifying Checksum

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ab24264a27e9: Pull complete

96d30d9fbee8: Extracting 120B/120B

96d30d9fbee8: Extracting 120B/120B

96d30d9fbee8: Pull complete
Digest: sha256:7dcddc01f13bab2f15cde676d4
Status: Downloaded newer image for
mysql:8.0
2ac8eee5b9cebb761ec8b6d5ba5891171898e1957
.....

```

```

mysql-db
mysql-db
6602a44e7a18af469d2b3df59b1f44e8cf4475a4d8629718f1e6618
...
2026-10-05T11:15:16.446076Z      0
[Warning] [MY-011068] [Server]
The syntax '--skip-host-cache' is
deprecated and will be removed in a
future release. Please use SET GLOBAL
host_cache_size=0 instead.
2026-10-05 11:15:15+00:00 [Note]
[Entrypoint]: Entrypoint script for
MySQL Server 8.0.46-1.el9 started.
2026-10-05T11:15:16.448500Z      0
[System] [MY-010116] [Server] /usr/
sbin/mysqld (mysqld 8.0.46) starting
as process 1
2026-10-05 11:15:15+00:00 [Note]
[Entrypoint]: Switching to dedicated
user 'mysql'
2026-10-05 11:15:15+00:00 [Note]
[Entrypoint]: Entrypoint script for
MySQL Server 8.0.46-1.el9 started.
2026-10-05T11:15:16.456216Z      1
[System] [MY-013576] [InnoDB] InnoDB
initialization has started.
'/var/lib/mysql/mysql.sock' -> '/
var/run/mysqld/mysqld.sock'
2026-10-05T11:15:18.020718Z      1
[System] [MY-013577] [InnoDB] InnoDB
initialization has ended.
2026-10-05T11:15:18.264055Z      0
[System] [MY-010229] [Server]
Starting XA crash recovery...
2026-10-05T11:15:18.280971Z      0
[System] [MY-010232] [Server] XA
crash recovery finished.
2026-10-05T11:15:18.439852Z      0
[Warning] [MY-010068] [Server] CA
certificate ca.pem is self signed.
2026-10-05T11:15:18.439924Z      0
[System] [MY-013602] [Server] Channel
mysql_main configured to support

```

```

TLS. Encrypted connections are now
supported for this channel.
2026-10-05T11:15:18.453646Z      0
[Warning] [MY-011810] [Server]
Insecure configuration for --pid-
file: Location '/var/run/mysqld' in
the path is accessible to all OS
users. Consider choosing a different
directory.
2026-10-05T11:15:18.494650Z      0
[System] [MY-011323] [Server] X
Plugin ready for connections. Bind-
address: '::' port: 33060, socket: /
var/run/mysqld/mysqld.sock
2026-10-05T11:15:18.494757Z      0
[System] [MY-010931] [Server] /usr/
sbin/mysqld: ready for connections.
Version: '8.0.46' socket: '/var/
run/mysqld/mysqld.sock' port: 3306
MySQL Community Server - GPL.

```

9 Gestion des ressources (Avancé)

- Docker permet de limiter les ressources utilisées par un conteneur.
- Cela inclut la mémoire, le CPU, et le nombre de PIDs.

Limiter CPU / mémoire / PIDs

```

#| label: lst-limit-cpu-mem

docker rm -f cpu-test >/dev/null 2>&1
|| true
docker run --label ebpro-render=true
--detach --name cpu-test \
--memory="512m" \
--cpus="0.5" \
python:3.11-slim \
python -c "while True: pass"

```

```

Unable to find image 'python:3.11-
slim' locally
3.11-slim: Pulling from library/
python

```

```
6b37362b3da7: Pulling fs layer
```

```
f64163c1b799: Pulling fs layer
```

```
295f1967d045: Pulling fs layer
```

```
48355dfcbf9e: Pulling fs layer
```

```
48355dfcbf9e: Waiting
```

```
f64163c1b799:
Downloading 48.55kB/4.269MB
```

```
295f1967d045:
Downloading 146.9kB/14.46MB
```

```
6b37362b3da7:
Downloading 310.7kB/29.83MB
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f64163c1b799:
Downloading 2.703MB/4.269MB
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295f1967d045:
Downloading 3.981MB/14.46MB
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6b37362b3da7:
Downloading 3.424MB/29.83MB
```

```
f64163c1b799: Verifying Checksum
```

```
f64163c1b799: Download complete
```

```
295f1967d045:
Downloading 8.847MB/14.46MB
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6b37362b3da7:
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295f1967d045:
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6b37362b3da7:
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295f1967d045: Verifying Checksum

295f1967d045: Download complete

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6b37362b3da7: Verifying Checksum

6b37362b3da7: Download complete

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Extracting 29.16MB/29.83MB

6b37362b3da7:
Extracting 29.82MB/29.83MB

6b37362b3da7:
Extracting 29.83MB/29.83MB

6b37362b3da7: Pull complete

f64163c1b799:
Extracting 65.54kB/4.269MB

f64163c1b799:
Extracting 393.2kB/4.269MB

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f64163c1b799:
Extracting 4.063MB/4.269MB

f64163c1b799:

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Extracting 4.269MB/4.269MB
```

```
f64163c1b799: Pull complete
```

```
295f1967d045:  
Extracting 163.8kB/14.46MB
```

```
295f1967d045:  
Extracting 819.2kB/14.46MB
```

```
295f1967d045:  
Extracting 2.949MB/14.46MB
```

```
295f1967d045:  
Extracting 3.604MB/14.46MB
```

```
295f1967d045:  
Extracting 7.373MB/14.46MB
```

```
295f1967d045:  
Extracting 9.011MB/14.46MB
```

```
295f1967d045:  
Extracting 10.32MB/14.46MB
```

```
295f1967d045:  
Extracting 10.98MB/14.46MB
```

```
295f1967d045:  
Extracting 12.12MB/14.46MB
```

```
295f1967d045:  
Extracting 12.78MB/14.46MB
```

```
295f1967d045:  
Extracting 13.43MB/14.46MB
```

```
295f1967d045:  
Extracting 14.42MB/14.46MB
```

```
295f1967d045:  
Extracting 14.46MB/14.46MB
```

```
295f1967d045: Pull complete
```

```
48355dfcbf9e: Extracting 250B/250B
```

```
48355dfcbf9e: Extracting 250B/250B
```

```
48355dfcbf9e: Pull complete  
Digest: sha256:6f31d6e9ba2b0a787a3f81c37b004155b87b9efa  
Status: Downloaded newer image for  
python:3.11-slim  
cadc801b77ddd8095de06b20ab27391b0477f2ed9f198227ad9f0c
```

```
#| label: lst-monitor-cpu-mem
```

```
docker stats --no-stream cpu-test
```

CONTAINER ID	NAME	CPU %	MEM
USAGE / LIMIT	MEM %	NET	I/O
BLOCK I/O	PIDS		
cadc801b77dd	cpu-test	50.72%	
3.922MiB / 512MiB	0.77%	516B /	
84B 0B / 0B	1		

Pensez à arrêter et supprimer le conteneur après le test :

```
#| label: lst-cleanup-cpu-test
```

```
docker stop cpu-test  
docker rm cpu-test
```

```
cpu-test  
cpu-test
```

9.1 Modifier les limites d'un conteneur existant

- Il est possible de modifier les limites d'un conteneur en cours d'exécution avec `docker update`.

```
docker update --memory="1g" --
cpus="1" cpu-test
```

10 Bonnes pratiques d'usage

• Nettoyage régulier

```
docker container prune
docker image prune
docker volume prune
docker network prune
docker system prune --all

# NETTOYAGE COMPLET (ATTENTION :
SUPPRIME TOUT)
# Y COMPRIS LES DONNÉES DANS DES
VOLUMES !
docker system prune --all --volumes
--force # RISQUE
```

• Éviter **latest** en production

- Utiliser des tags de version stables.

• Ne pas stocker de secrets dans l'environnement

- Préférer `--secret` (ou mécanismes externes).

• Logs sur stdout/stderr

- Les conteneurs doivent produire des logs vers la sortie standard.

11 Atelier final

- Déployer une application simple composée de deux conteneurs :
 - une application Java accédant à une base de données via JDBC
 - une base de données PostgreSQL
- Contraintes :
 - chaque composant doit être dans son propre conteneur
 - les deux conteneurs doivent communiquer via un réseau Docker personnalisé

- les données de la base doivent être persistées dans un volume Docker
- l'application Java doit se connecter à la base par le nom du conteneur, pas par localhost
- Objectif :
 - vérifier la communication entre conteneurs, l'usage des réseaux et la persistance des données.

12 Conclusion

! A Retenir

- Un conteneur est une instance d'une image, exécutant un processus isolé.
- Le cycle de vie d'un conteneur inclut les états : démarré, arrêté, supprimé.
- Les conteneurs peuvent être connectés via des réseaux custom pour la communication.
- Les volumes permettent de persister les données indépendamment du cycle de vie des conteneurs.
- Il est possible de limiter les ressources (CPU, mémoire) utilisées par un conteneur.
- Appliquer les bonnes pratiques d'usage pour une gestion efficace des conteneurs.
- Gérer les conteneurs manuellement n'est pas viable en production : il faut automatiser
 - Outils d'Orchestration : docker compose, Kubernetes, ...