

Conteneurs: Notions de base (Usage)

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

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2026-10-14

Table des matières

1 Objectifs du cours	1	8.3 Exercice de persistance	21
2 Rappel rapide	1	9 Gestion des ressources (Avancé)	31
3 Les images	2	9.1 Modifier les limites d'un conteneur	
4 Cycle de vie d'un conteneur	2	existant	33
4.1 Conteneur en arrière-plan (<code>--detach</code> ,		10 Bonnes pratiques d'usage	33
<code>-d</code>)	3	11 Atelier final	34
4.2 Liste des conteneurs (<code>container ls</code> ,		12 Conclusion	34
<code>ps</code>)	5		
4.3 Arrêter (<code>stop</code>) / démarrer (<code>start</code>) /			
supprimer (<code>rm</code>)	6		
4.4 Exercice 1	6		
5 Logs, exec et monitoring	6		
5.1 Exécuter une commande dans un			
conteneur en cours	8		
5.2 Monitoring	8		
6 Réseau	8		
6.1 Réseau par défaut (bridge)	8		
6.2 Réseau custom (bonne pratique) . . .	9		
6.3 Vérifier le réseau (Avancé)	12		
6.4 Communication conteneur →			
conteneur	13		
6.5 Exercice 2 (Max 10 min)	16		
7 Port mapping	16		
7.1 Tester depuis l'hôte	19		
7.2 Accès conteneur -> hôte	19		
8 Volumes : persistance	20		
8.1 Bind mount (risky, dev)	20		
8.2 Volume nommé (better, prod)	20		

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 1.835MB/3.418MB
```

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

```
44cf07d57ee4: Pull complete
```

```
Digest: sha256:de0eb0b3f2a47baleb89389859:
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 257.7kB/25.58MB

f03b40093957:
Downloading 321.6kB/31.4MB

0972072e0e8a:
Downloading 6.072MB/25.58MB

f03b40093957:
Downloading 5.499MB/31.4MB

0972072e0e8a:
Downloading 13.24MB/25.58MB

f03b40093957:
Downloading 10.64MB/31.4MB

d24b987aa74e:
Downloading 958B/958B

d24b987aa74e: Verifying Checksum

d24b987aa74e: Download complete

0972072e0e8a:
Downloading 19.34MB/25.58MB

f03b40093957:
Downloading 15.83MB/31.4MB

0972072e0e8a: Verifying Checksum

0972072e0e8a: Download complete

f03b40093957:
Downloading 21.35MB/31.4MB

f03b40093957:
Downloading 28.77MB/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: Verifying Checksum

9989f7b33228: Download complete

f03b40093957:
Extracting 2.949MB/31.4MB

f03b40093957:
Extracting 6.554MB/31.4MB

f03b40093957:
Extracting 9.175MB/31.4MB

f03b40093957:
Extracting 12.12MB/31.4MB

f03b40093957:
Extracting 14.09MB/31.4MB

f03b40093957:
Extracting 16.06MB/31.4MB

f03b40093957:
Extracting 17.69MB/31.4MB

f03b40093957:
Extracting 20.97MB/31.4MB

f03b40093957:
Extracting 24.58MB/31.4MB

f03b40093957:
Extracting 27.53MB/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 2.359MB/25.58MB

0972072e0e8a:
Extracting 5.505MB/25.58MB

```
0972072e0e8a:
Extracting 9.699MB/25.58MB
```

```
0972072e0e8a:
Extracting 13.37MB/25.58MB
```

```
0972072e0e8a:
Extracting 15.99MB/25.58MB
```

```
0972072e0e8a:
Extracting 18.87MB/25.58MB
```

```
0972072e0e8a:
Extracting 23.07MB/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
```

```
6d256e8efac8cead451c1d0020e5696b3297c4cf800a77684f5e842
```

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
6d256e8efac8		nginx:1.23
"/docker-entrypoint..."	1 second ago	
Up Less than a second	80/tcp	my-nginx
65d0349b944b	ghcr.io/ebpro/jupyter-base:quarto-full-fix-chromium-ci-headless-render	"bash -lc 'source /h..."
7 minutes ago	Up 7 minutes	quarto-render-38578863251

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		
	6d256e8efac8	nginx:1.23
"/docker-entrypoint...."		2 seconds ago
Exited (0) Less than a second ago		my-nginx
65d0349b944b	ghcr.io/ebpro/jupyter-base:quarto-full-fix-chromium-ci-headless-render	"bash -lc 'source / h..." 7 minutes ago Up 7 minutes
quarto-render-38578863251		

```
#| 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 68ef6d144657 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
```

```
ff7f3d01980ee0a9fb9b94f45941a3f1636b92e52e637179b044219
```

```
#| 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
2026/10/14 14:29:40 [notice] 1#1:
using the "epoll" event method
2026/10/14 14:29:40 [notice] 1#1:
nginx/1.23.4
2026/10/14 14:29:40 [notice] 1#1:
built by gcc 10.2.1 20210110 (Debian
10.2.1-6)
2026/10/14 14:29:40 [notice] 1#1: OS:
Linux 6.8.0-142-generic
2026/10/14 14:29:40 [notice]
1#1: getrlimit(RLIMIT_NOFILE):
1048576:1048576
2026/10/14 14:29:40 [notice] 1#1:
start worker processes
2026/10/14 14:29:40 [notice] 1#1:
```

```
start worker process 29
2026/10/14 14:29:40 [notice] 1#1:
start worker process 30
2026/10/14 14:29:40 [notice] 1#1:
start worker process 31
2026/10/14 14:29:40 [notice] 1#1:
start worker process 32
2026/10/14 14:29:40 [notice] 1#1:
start worker process 33
2026/10/14 14:29:40 [notice] 1#1:
start worker process 34
2026/10/14 14:29:40 [notice] 1#1:
start worker process 35
2026/10/14 14:29:40 [notice] 1#1:
start worker process 36
2026/10/14 14:29:40 [notice] 1#1:
start worker process 37
2026/10/14 14:29:40 [notice] 1#1:
start worker process 38
2026/10/14 14:29:40 [notice] 1#1:
start worker process 39
2026/10/14 14:29:40 [notice] 1#1:
start worker process 40
2026/10/14 14:29:40 [notice] 1#1:
start worker process 41
2026/10/14 14:29:40 [notice] 1#1:
start worker process 42
2026/10/14 14:29:40 [notice] 1#1:
start worker process 43
2026/10/14 14:29:40 [notice] 1#1:
start worker process 44
2026/10/14 14:29:40 [notice] 1#1:
start worker process 45
2026/10/14 14:29:40 [notice] 1#1:
start worker process 46
2026/10/14 14:29:40 [notice] 1#1:
start worker process 47
2026/10/14 14:29:40 [notice] 1#1:
start worker process 48
2026/10/14 14:29:40 [notice] 1#1:
start worker process 49
2026/10/14 14:29:40 [notice] 1#1:
start worker process 50
```

```

2026/10/14 14:29:40 [notice] 1#1:
start worker process 51
2026/10/14 14:29:40 [notice] 1#1:
start worker process 52
2026/10/14 14:29:40 [notice] 1#1:
start worker process 53
2026/10/14 14:29:40 [notice] 1#1:
start worker process 54
2026/10/14 14:29:40 [notice] 1#1:
start worker process 55
2026/10/14 14:29:40 [notice] 1#1:
start worker process 56
2026/10/14 14:29:40 [notice] 1#1:
start worker process 57
2026/10/14 14:29:40 [notice] 1#1:
start worker process 58
2026/10/14 14:29:40 [notice] 1#1:
start worker process 59
2026/10/14 14:29:40 [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
65d0349b944b		quarto-
render-38578863251		0.14%
797.3MiB / 62.66GiB		1.24%
1.99MB / 70.8kB	709MB / 366MB	57

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 3.85MB/3.85MB
```

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

```
e2de96513ba9: Pull complete
Digest: sha256:294b683cb724975bec92580e1e
Status: Downloaded newer image for
alpine:latest
45152a7e8919163ae817f75faf1e53e457fe3d2e2
4ed596851089a95d770d4f01d289b1031ff0083db
```

- 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 ebro-render=true
--detach --name db \
--network app-net \
redis:7.0.9
```

```
812fcd6816334565a082876382ee402b36c7a7472
5367c15a5eb2de2fff119139899be4780267092a8
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: Verifying Checksum
```

```
241c2d338588: Download complete
```

```
89515d93a23e:
Downloading 16.38kB/1.463MB
```

```
3f9582a2cbe7:
Downloading 327kB/31.41MB
```

```
89515d93a23e: Verifying Checksum
```

```
89515d93a23e: Download complete
```

```
3f9582a2cbe7:
Downloading 6.225MB/31.41MB
```

```
3f9582a2cbe7:
Downloading 13.11MB/31.41MB
```

```
65e8ba9473fe:
Downloading 97.66kB/9.579MB
```

```
3f9582a2cbe7:
Downloading 19.99MB/31.41MB
```

```
585124038cab:
Downloading 133B/133B
```

```
585124038cab: Download complete
```

```
65e8ba9473fe:
Downloading 5.013MB/9.579MB
```

```
3f9582a2cbe7:
Downloading 26.21MB/31.41MB
```

```
65e8ba9473fe: Verifying Checksum
```

```
65e8ba9473fe: Download complete
```

```
3f9582a2cbe7: Verifying Checksum
```

```
3f9582a2cbe7: Download complete
```

```
3f9582a2cbe7:
```

```
Extracting 327.7kB/31.41MB

b483de716a47:
Downloading 574B/574B

b483de716a47: Verifying Checksum
b483de716a47: Download complete

3f9582a2cbe7:
Extracting 2.949MB/31.41MB

3f9582a2cbe7:
Extracting 6.226MB/31.41MB

3f9582a2cbe7:
Extracting 8.847MB/31.41MB

3f9582a2cbe7:
Extracting 12.78MB/31.41MB

3f9582a2cbe7:
Extracting 15.4MB/31.41MB

3f9582a2cbe7:
Extracting 17.37MB/31.41MB

3f9582a2cbe7:
Extracting 20.64MB/31.41MB

3f9582a2cbe7:
Extracting 23.92MB/31.41MB

3f9582a2cbe7:
Extracting 26.21MB/31.41MB

3f9582a2cbe7:
Extracting 28.51MB/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  5.997MB/9.579MB

65e8ba9473fe:
Extracting  8.749MB/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:e50c7e23f79ae81351beacb20e
Status: Downloaded newer image for
redis:7.0.9
ba97ef90941809afd55cb06fc127dbaca5c97a48a

```

6.3 Vérifier le réseau (Avancé)

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

```

[
  {
    "Name": "app-net",
    "Id": "812fcd6816334565a082876382ee4",
    "Created":
"2026-10-14T14:30:11.616283861Z",
    "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": {
        "5367c15a5eb2de2ffff119139899be4780267092a86c3e3": {
          "Name": "web",
          "EndpointID": "092c57de04f7c3e50ca284d7df1e0",
          "IPAddress": "172.18.0.2/16",
          "IPv6Address": ""
        },
        "ba97ef90941809afd55cb06fc127dbaca5c97a48ad164f": {
          "Name": "db",
          "EndpointID": "121568b924bb5500bda639fb281c7",
          "IPAddress": "172.18.0.3/16",
          "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

df0b84b7230e: Waiting

8d68097e7e08: Waiting

659101a913e8: Pulling fs layer

473ceed980f8: Pulling fs layer

4c26da78c210: Waiting

b0calde0cc3e: Pulling fs layer

45477c99a790: Pulling fs layer

659101a913e8: Waiting

b0calde0cc3e: Waiting

d4c655b444ee: Pulling fs layer

473ceed980f8: Waiting

45477c99a790: Waiting

d4c655b444ee: Waiting

213ec9aee27d:
Downloading 32.17kB/2.806MB

55bfd993f83a:
Downloading 16.38kB/608.7kB

ea634e3b33ec:
Downloading 49.15kB/4.396MB

55bfd993f83a: Verifying Checksum

55bfd993f83a: Download complete

213ec9aee27d: Verifying Checksum

213ec9aee27d: Download complete

213ec9aee27d:
Extracting 32.77kB/2.806MB

ea634e3b33ec:
Downloading 4.396MB/4.396MB

ea634e3b33ec: Verifying Checksum

ea634e3b33ec: Download complete

213ec9aee27d:
Extracting 1.573MB/2.806MB

213ec9aee27d:

Extracting 2.806MB/2.806MB

df0b84b7230e:
Downloading 1.265kB/1.265kB

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: Download complete

213ec9aee27d: Pull complete

4c26da78c210: Verifying Checksum

4c26da78c210: Download complete

ea634e3b33ec:
Extracting 65.54kB/4.396MB

ea634e3b33ec:
Extracting 2.097MB/4.396MB

ea634e3b33ec:
Extracting 4.396MB/4.396MB

ea634e3b33ec: Pull complete

55bfd993f83a:
Extracting 32.77kB/608.7kB

659101a913e8:
Downloading 16.38kB/162.4kB

659101a913e8: Verifying Checksum

659101a913e8: Download complete

473ceed980f8:
Downloading 3.5kB/52.34kB

473ceed980f8:
Downloading 52.34kB/52.34kB

473ceed980f8: Download complete

b0calde0cc3e:
Downloading 161B/161B

b0calde0cc3e: Verifying Checksum

b0calde0cc3e: Download complete

55bfd993f83a:
Extracting 608.7kB/608.7kB

55bfd993f83a:
Extracting 608.7kB/608.7kB

55bfd993f83a: Pull complete

df0b84b7230e:
Extracting 1.265kB/1.265kB

df0b84b7230e:
Extracting 1.265kB/1.265kB

df0b84b7230e: Pull complete

8d68097e7e08:
Extracting 32.77kB/123.2kB

8d68097e7e08:
Extracting 123.2kB/123.2kB

8d68097e7e08:
Extracting 123.2kB/123.2kB

```

45477c99a790:
Downloading      159B/159B

45477c99a790: Verifying Checksum

45477c99a790: Download complete

d4c655b444ee:
Downloading      291B/291B

d4c655b444ee: Verifying Checksum

d4c655b444ee: Download complete

8d68097e7e08: Pull complete

4c26da78c210:
Extracting  32.77kB/347.4kB

4c26da78c210:
Extracting  347.4kB/347.4kB

4c26da78c210:
Extracting  347.4kB/347.4kB

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  ---:---:  ---:---:  ---:---:    0
100  615 100  615    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>

    0 21523    0 ---:--:-- ---:--:--
--:--:-- 21964
```

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.
- 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
```

```
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
4744f2344932: Waiting
63ef37274310: Waiting
400f8ac367e0: Pulling fs layer
```

39a24e95a1e9: Waiting

400f8ac367e0: Waiting

f176d5d8a1c1:
Downloading 627B/627B

f176d5d8a1c1: Verifying Checksum

f176d5d8a1c1: Download complete

5435b2dcdf5c:
Downloading 308.8kB/29.78MB

6a7080264fc9:
Downloading 334.4kB/33.11MB

6a7080264fc9:
Downloading 5.701MB/33.11MB

5435b2dcdf5c:
Downloading 5.745MB/29.78MB

5435b2dcdf5c:
Downloading 11.21MB/29.78MB

6a7080264fc9:
Downloading 13.08MB/33.11MB

6a7080264fc9:
Downloading 19.15MB/33.11MB

5435b2dcdf5c:
Downloading 16.72MB/29.78MB

5435b2dcdf5c:
Downloading 21.94MB/29.78MB

6a7080264fc9:
Downloading 26.3MB/33.11MB

6a7080264fc9: Verifying Checksum

6a7080264fc9: Download complete

5435b2dcdf5c:
Downloading 27.77MB/29.78MB

5435b2dcdf5c: Verifying Checksum

5435b2dcdf5c: Download complete

5435b2dcdf5c:
Extracting 327.7kB/29.78MB

5435b2dcdf5c:
Extracting 2.949MB/29.78MB

4744f2344932:
Downloading 402B/402B

4744f2344932: Download complete

5435b2dcdf5c:
Extracting 5.571MB/29.78MB

39a24e95a1e9: Download complete

5435b2dcdf5c:
Extracting 8.192MB/29.78MB

5435b2dcdf5c:
Extracting 10.16MB/29.78MB

400f8ac367e0:
Downloading 1.397kB/1.397kB

400f8ac367e0: Verifying Checksum

400f8ac367e0: Download complete

5435b2dcdf5c:
Extracting 11.8MB/29.78MB

5435b2dcdf5c:
Extracting 15.4MB/29.78MB

5435b2dcdf5c:
Extracting 18.68MB/29.78MB

5435b2dcdf5c:
Extracting 22.28MB/29.78MB

63ef37274310:
Downloading 955B/955B

63ef37274310: Verifying Checksum

63ef37274310: Download complete

5435b2dcdf5c:
Extracting 25.56MB/29.78MB

5435b2dcdf5c:
Extracting 26.21MB/29.78MB

5435b2dcdf5c:
Extracting 28.18MB/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 3.244MB/33.11MB

6a7080264fc9:
Extracting 6.488MB/33.11MB

6a7080264fc9:
Extracting 9.732MB/33.11MB

6a7080264fc9:
Extracting 13.34MB/33.11MB

6a7080264fc9:
Extracting 14.78MB/33.11MB

6a7080264fc9:
Extracting 18.38MB/33.11MB

6a7080264fc9:
Extracting 21.99MB/33.11MB

6a7080264fc9:
Extracting 25.59MB/33.11MB

6a7080264fc9:
Extracting 28.84MB/33.11MB

6a7080264fc9:
Extracting 30.64MB/33.11MB

6a7080264fc9:
Extracting 32.8MB/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: sha256:146adea4768b83c607d0bdfa418
Status: Downloaded newer image for
nginx:1.28
522c9b49905d3d6958571eea94d45417e8dc4fd9d
9bda9ff376b9e4d984b62e3f936beb84d1f5d6430

```

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: Wed, 14 Oct 2026 14:30:40 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: Wed, 14 Oct 2026 14:30:40 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 (de-

puis 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
3e354767fa41b62e131f34c081cbc0e0f9e933466
..
CREATE TABLE
INSERT 0 2
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"

```

```

9fdefd94f210317685845c18b79f33d89f0e79f62fc1f4d19471d95
id | name
----+-----
 1 | Alice
 2 | Bob
(2 rows)

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=${MYSQL_ROOT_P
\
--env
MYSQL_DATABASE=${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
0d74d296605b: Waiting
297d04cfe470: Waiting
a63160a5eda1: Waiting
7534d1db9f8d: Waiting
49ec2dab01d9: Pulling fs layer
4c8a3e0d4e4b: Waiting
ab24264a27e9: Pulling fs layer
96d30d9fbee8: Pulling fs layer
49ec2dab01d9: Waiting
ab24264a27e9: Waiting
96d30d9fbee8: Waiting
6ef6c7b50a93:
Downloading      884B/884B
6ef6c7b50a93: Verifying Checksum

```

```

6ef6c7b50a93: Download complete
e3e5dlac74c1:
Downloading   15.74kB/783.6kB
edf85873f64e:
Downloading   474.5kB/47.31MB
e3e5dlac74c1:
Downloading   783.6kB/783.6kB
e3e5dlac74c1: Verifying Checksum
e3e5dlac74c1: Download complete
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edf85873f64e:
Downloading    15.2MB/47.31MB
0d74d296605b:
Downloading    64.87kB/6.173MB
edf85873f64e:
Downloading    22.33MB/47.31MB
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0d74d296605b: Verifying Checksum
0d74d296605b: Download complete
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edf85873f64e:
Downloading    35.16MB/47.31MB
297d04cfe470:
Downloading    2.607kB/2.607kB

```

297d04cfe470: Download complete

edf85873f64e:

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edf85873f64e: Verifying Checksum

edf85873f64e: Download complete

4c8a3e0d4e4b:

Downloading 335B/335B

4c8a3e0d4e4b: Verifying Checksum

4c8a3e0d4e4b: Download complete

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Extracting 983kB/47.31MB

a63160a5eda1:

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edf85873f64e:

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a63160a5eda1: Verifying Checksum

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96d30d9fbee8: Verifying Checksum

96d30d9fbee8: Download complete

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ab24264a27e9: Verifying Checksum

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49ec2dab01d9: Verifying Checksum

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96d30d9fbee8: Extracting 120B/120B

96d30d9fbee8: Extracting 120B/120B

96d30d9fbee8: Pull complete
Digest: sha256:7dcddc01f13bab2f15cde676d4
Status: Downloaded newer image for
mysql:8.0
2b42858c9c9111c0c2ac34ce09e5e8482a23314c7
.....
mysql-db
mysql-db
b972691ba93ffb83fa580e46dea383ca65cdb997d
...
2026-10-14 14:32:12+00:00 [Note]
[Entrypoint]: Entrypoint script for
MySQL Server 8.0.46-1.el9 started.
2026-10-14 14:32:12+00:00 [Note]
[Entrypoint]: Switching to dedicated
user 'mysql'
2026-10-14 14:32:12+00:00 [Note]
[Entrypoint]: Entrypoint script for
MySQL Server 8.0.46-1.el9 started.
2026-10-14T14:32:13.453993Z 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.
2026-10-14T14:32:13.459914Z 0
[System] [MY-010116] [Server] /usr/
sbin/mysqld (mysqld 8.0.46) starting
as process 1
'/var/lib/mysql/mysql.sock' -> '/
var/run/mysqld/mysqld.sock'
2026-10-14T14:32:13.467129Z 1
[System] [MY-013576] [InnoDB] InnoDB
initialization has started.
2026-10-14T14:32:15.193453Z 1
[System] [MY-013577] [InnoDB] InnoDB
initialization has ended.
2026-10-14T14:32:15.640816Z 0
[Warning] [MY-010068] [Server] CA
certificate ca.pem is self signed.
2026-10-14T14:32:15.640936Z 0
[System] [MY-013602] [Server] Channel
mysql_main configured to support
TLS. Encrypted connections are now
supported for this channel.
2026-10-14T14:32:15.661156Z 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.
2026-10-14T14:32:15.699397Z 0
[System] [MY-011323] [Server] X
Plugin ready for connections. Bind-
address: '::' port: 33060, socket: /
var/run/mysqld/mysqlx.sock
2026-10-14T14:32:15.699497Z 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
```

```
ecc510cle359: Pulling fs layer
```

```
0f752a1982d6: Pulling fs layer
```

```
759a7f30c318: Pulling fs layer
```

```
496c1a902b3a: Pulling fs layer
```

```
496c1a902b3a: Waiting
```

```
0f752a1982d6:
Downloading 15.79kB/1.294MB
```

```
759a7f30c318:
Downloading 146.9kB/14.46MB
```

```
ecc510cle359:
```

```
Downloading 310.7kB/29.84MB
```

```
0f752a1982d6: Verifying Checksum
```

```
0f752a1982d6: Download complete
```

```
759a7f30c318:
Downloading 5.308MB/14.46MB
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ecc510cle359:
Downloading 4.358MB/29.84MB
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759a7f30c318:
Downloading 11.06MB/14.46MB
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```
ecc510cle359:
Downloading 9.961MB/29.84MB
```

```
759a7f30c318: Verifying Checksum
```

```
759a7f30c318: Download complete
```

```
ecc510cle359:
Downloading 17.12MB/29.84MB
```

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496c1a902b3a:
Downloading 250B/250B
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```
496c1a902b3a: Verifying Checksum
```

```
496c1a902b3a: Download complete
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ecc510cle359:
Downloading 24.28MB/29.84MB
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```
ecc510cle359: Verifying Checksum
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ecc510cle359: Download complete
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ecc510cle359:
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ecc510cle359: Pull complete

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0f752a1982d6: Pull complete

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759a7f30c318:
Extracting 12.78MB/14.46MB
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759a7f30c318:
Extracting 14.25MB/14.46MB
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759a7f30c318:
Extracting 14.46MB/14.46MB
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```
759a7f30c318: Pull complete
```

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496c1a902b3a: Extracting 250B/250B
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```
496c1a902b3a: Extracting 250B/250B
```

```
496c1a902b3a: Pull complete
Digest: sha256:e88e9763f943ec1834f992a4b5
Status: Downloaded newer image for
python:3.11-slim
c82bedb275098e99f5a8e30b93f03ff22bb74d9a8
```

```
#| 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		
c82bedb27509	cpu-test	50.76%	
3.938MiB / 512MiB	0.77%	266B /	
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, ...