Lab2 Notes/Findings

Step 1: Install Docker Engine

```
kacper@UNKNOWN:~$ sudo dnf -y install docker-ce docker-ce-cli containerd.io \
              docker-buildx-plugin docker-compose-plugin
sudo systemctl enable --now docker
Updating and loading repositories:
 Docker CE Stable - x86_64                                    100% | 141.5 KiB/s |   9.9 KiB |  00m00s
Repositories loaded.
Package                        Arch      Version                      Repository            Size
Installing:
 containerd.io                 x86_64    1.7.27-3.1.fc42              docker-ce-stable    155.4 MiB
 docker-buildx-plugin          x86_64    0.23.0-1.fc42                docker-ce-stable     72.3 MiB
 docker-ce                     x86_64    3:28.1.1-1.fc42              docker-ce-stable     83.3 MiB
 docker-ce-cli                 x86_64    1:28.1.1-1.fc42              docker-ce-stable     33.8 MiB
 docker-compose-plugin         x86_64    2.35.1-1.fc42                docker-ce-stable     70.4 MiB
Installing dependencies:
 libcgroup                     x86_64    3.0-8.fc42                   fedora              157.7 KiB
 slirp4netns                   x86_64    1.3.1-2.fc42                 fedora               89.3 KiB
Installing weak dependencies:
 docker-ce-rootless-extras     x86_64    28.1.1-1.fc42                docker-ce-stable     10.4 MiB

Transaction Summary:
 Installing:       8 packages

Total size of inbound packages is 106 MiB. Need to download 106 MiB.
After this operation, 426 MiB extra will be used (install 426 MiB, remove 0 B).
[1/8] docker-ce-cli-1:28.1.1-1.fc42.x86_64                    100% |   5.5 MiB/s |   8.2 MiB |  00m02s
[2/8] docker-ce-3:28.1.1-1.fc42.x86_64                        100% |   7.1 MiB/s |  19.7 MiB |  00m03s
[3/8] docker-buildx-plugin-0:0.23.0-1.fc42.x86_64            100% |   4.6 MiB/s |  16.1 MiB |  00m04s
[4/8] docker-compose-plugin-0:2.35.1-1.fc42.x86_64          100% |   5.9 MiB/s |  14.5 MiB |  00m02s
[5/8] libcgroup-0:3.0-8.fc42.x86_64                           100% | 307.5 KiB/s |  73.8 KiB |  00m00s
[6/8] slirp4netns-0:1.3.1-2.fc42.x86_64                       100% | 519.6 KiB/s |  47.3 KiB |  00m00s
[7/8] docker-ce-rootless-extras-0:28.1.1-1.fc42.x86_64      100% |   4.6 MiB/s |   3.2 MiB |  00m01s
[8/8] containerd.io-0:1.7.27-3.1.fc42.x86_64                 100% |   7.3 MiB/s |  44.0 MiB |  00m06s
--------------------------------------------------------------------------------------------------
[8/8] Total                                                   100% |  16.1 MiB/s | 105.9 MiB |  00m07s
[1/9] https://download.docker.com/linux/fedora/gpg           ???% [<=>              ] |   0.0   B/s |   0.0   B |  00m00s
[1/9] https://download.docker.com/linux/fedora/gpg          100% |  46.7 KiB/s |   1.6 KiB |  00m00s
--------------------------------------------------------------------------------------------------
[9/9] Total                                                   100% |  16.1 MiB/s | 105.9 MiB |  00m07s
Importing OpenPGP key 0x621E9F35:
 UserID     : "Docker Release (CE rpm) <docker@docker.com>"
 Fingerprint: 060A61C51B558A7F742B77AAC52FEB6B621E9F35
 From       : https://download.docker.com/linux/fedora/gpg
The key was successfully imported.
[ 1/10] Verify package files                                  100% |  29.0   B/s |   8.0   B |  00m00s
[ 2/10] Prepare transaction                                   100% |  29.0   B/s |   8.0   B |  00m00s
[ 3/10] Installing slirp4netns-0:1.3.1-2.fc42.x86_64          100% |   3.7 MiB/s |  90.7 KiB |  00m00s
[ 4/10] Installing libcgroup-0:3.0-8.fc42.x86_64             100% |  31.1 MiB/s | 159.1 KiB |  00m00s
[ 5/10] Installing docker-ce-cli-1:28.1.1-1.fc42.x86_64      100% | 258.1 MiB/s |  33.8 MiB |  00m00s
[ 6/10] Installing containerd.io-0:1.7.27-3.1.fc42.x86_64    100% | 437.7 MiB/s | 155.4 MiB |  00m00s
[ 7/10] Installing docker-ce-3:28.1.1-1.fc42.x86_64         100% | 389.2 MiB/s |  83.3 MiB |  00m00s
[ 8/10] Installing docker-ce-rootless-extras-0:28.1.1-1.fc42.x86_64  100% | 164.5 MiB/s |  10.4 MiB |  00m00s
[ 9/10] Installing docker-compose-plugin-0:2.35.1-1.fc42.x86_64      100% | 479.0 MiB/s |  70.4 MiB |  00m00s
[10/10] Installing docker-buildx-plugin-0:0.23.0-1.fc42.x86_64       100% |  74.6 MiB/s |  72.3 MiB |  00m01s
Complete!
Created symlink '/etc/systemd/system/multi-user.target.wants/docker.service' → '/usr/lib/systemd/system/docker.service'.
```

For Context, attempting to install and run docker on a Linux Fedora System for this section.

```
kacper@UNKNOWN:~$ sudo usermod -aG docker $USER
newgrp docker
kacper@UNKNOWN:~$ systemctl status docker
● docker.service - Docker Application Container Engine
     Loaded: loaded (/usr/lib/systemd/system/docker.service; enabled; preset: disabled)
    Drop-In: /usr/lib/systemd/system/service.d
             └─10-timeout-abort.conf, 50-keep-warm.conf
     Active: active (running) since Sun 2025-05-04 11:31:51 IST; 1min 21s ago
 Invocation: 0c0a68e007d44424ca757c251fc18bf13
 TriggeredBy: ● docker.socket
       Docs: https://docs.docker.com
   Main PID: 10590 (dockerd)
      Tasks: 18
     Memory: 74.2M (peak: 78.3M)
        CPU: 252ms
     CGroup: /system.slice/docker.service
             └─10590 /usr/bin/dockerd -H fd:// --containerd=/run/containerd/containerd.sock

May 04 11:31:50 UNKNOWN dockerd[10590]: time="2025-05-04T11:31:50.268717832+01:00" level=info msg="Creating a containerd client" >
May 04 11:31:50 UNKNOWN dockerd[10590]: time="2025-05-04T11:31:50.306479124+01:00" level=info msg="Loading containers: start."
May 04 11:31:50 UNKNOWN dockerd[10590]: time="2025-05-04T11:31:50.322963684+01:00" level=info msg="Firewalld: created docker-forw>
May 04 11:31:50 UNKNOWN dockerd[10590]: time="2025-05-04T11:31:50.963182110+01:00" level=info msg="Loading containers: done."
May 04 11:31:51 UNKNOWN dockerd[10590]: time="2025-05-04T11:31:51.006768130+01:00" level=info msg="Docker daemon" commit=01f442b >
May 04 11:31:51 UNKNOWN dockerd[10590]: time="2025-05-04T11:31:51.006981727+01:00" level=info msg="Initializing buildkit"
May 04 11:31:51 UNKNOWN dockerd[10590]: time="2025-05-04T11:31:51.110824959+01:00" level=info msg="Completed buildkit initializat>
May 04 11:31:51 UNKNOWN dockerd[10590]: time="2025-05-04T11:31:51.119135744+01:00" level=info msg="Daemon has completed initializ>
May 04 11:31:51 UNKNOWN dockerd[10590]: time="2025-05-04T11:31:51.119246967+01:00" level=info msg="API listen on /run/docker.sock"
May 04 11:31:51 UNKNOWN systemd[1]: Started docker.service - Docker Application Container Engine.

[1]+  Stopped                 systemctl status docker
kacper@UNKNOWN:~$ `dnf repolist
>
> ^C
kacper@UNKNOWN:~$ ^C
kacper@UNKNOWN:~$ ls
counter-contract                                Music              vault-manager
cuda-repo-fedora41-12-8-local-12.8.0_570.86.10-1.x86_64.rpm  MyOnlinePortfolio  Videos
Desktop                                         Pictures           waydroid_script
Documents                                       Public             Y452
Downloads                                       rapids-env         Year4ProjectSikrakenTestTool
improved-osk-gnome-ext                          scikit_learn_data  Year4ProjectSikrakenTestTool.zip
lib                                             task-manager
nsfonts                                         Templates
kacper@UNKNOWN:~$ id
uid=1000(kacper) gid=969(docker) groups=969(docker),10(wheel),972(ollama),1000(kacper) context=unconfined_u:unconfined_r:unconfined_t:s0-s0:c0.c1023
kacper@UNKNOWN:~$ docker run --rm hello-world
Unable to find image 'hello-world:latest' locally
latest: Pulling from library/hello-world
e6590344b1a5: Pull complete
Digest: sha256:c41088499908a59aae84b0a49c70e86f4731e588a737f1637e73c8c09d995654
Status: Downloaded newer image for hello-world:latest

Hello from Docker!
This message shows that your installation appears to be working correctly.

To generate this message, Docker took the following steps:
```

```
kacper@UNKNOWN:~$ docker run --rm hello-world
Unable to find image 'hello-world:latest' locally
latest: Pulling from library/hello-world
e6590344b1a5: Pull complete
Digest: sha256:c41088499908a59aae84b0a49c70e86f4731e588a737f1637e73c8c09d995654
Status: Downloaded newer image for hello-world:latest

Hello from Docker!
This message shows that your installation appears to be working correctly.

To generate this message, Docker took the following steps:
 1. The Docker client contacted the Docker daemon.
 2. The Docker daemon pulled the "hello-world" image from the Docker Hub.
    (amd64)
 3. The Docker daemon created a new container from that image which runs the
    executable that produces the output you are currently reading.
 4. The Docker daemon streamed that output to the Docker client, which sent it
    to your terminal.

To try something more ambitious, you can run an Ubuntu container with:
 $ docker run -it ubuntu bash

Share images, automate workflows, and more with a free Docker ID:
 https://hub.docker.com/

For more examples and ideas, visit:
 https://docs.docker.com/get-started/

kacper@UNKNOWN:~$ docker run -d -p 8080:80 --name web nginx:alpine
curl -I http://localhost:8080
Unable to find image 'nginx:alpine' locally
alpine: Pulling from library/nginx
f18232174bc9: Pull complete
61ca4f733c80: Pull complete
b464cfdf2a63: Pull complete
d7e507024086: Pull complete
81bd8ed7ec67: Pull complete
197eb75867ef: Pull complete
34a64644b756: Pull complete
39c2ddfd6010: Pull complete
Digest: sha256:65645c7bb6a0661892a8b03b89d0743208a18dd2f3f17a54ef4b76fb8e2f2a10
Status: Downloaded newer image for nginx:alpine
d630b9e47a0c18b9f228819796b72aebcd340f07d4d122528945b645cc8df2a4
curl: (56) Recv failure: Connection reset by peer
kacper@UNKNOWN:~$
```

```
kacper@UNKNOWN:~$ curl -I http://localhost:8080
HTTP/1.1 200 OK
Server: nginx/1.27.5
Date: Sun, 04 May 2025 11:35:30 GMT
Content-Type: text/html
Content-Length: 615
Last-Modified: Wed, 16 Apr 2025 12:55:34 GMT
Connection: keep-alive
ETag: "67ffa8c6-267"
Accept-Ranges: bytes
```

Step 2: Publish Container Ports:

```
kacper@UNKNOWN:~$ docker ps
CONTAINER ID   IMAGE          COMMAND                CREATED         STATUS          PORTS
NAMES
d630b9e47a0c   nginx:alpine   "/docker-entrypoint.…" 53 minutes ago  Up 53 minutes   0.0.0.0:8080->80/tcp, [::]:8080->80/tcp
web
```

Step 3: Override Container Defaults:

```
kacper@UNKNOWN:~$ docker ps
CONTAINER ID   IMAGE          COMMAND                CREATED          STATUS            PORTS                                        NAMES
d630b9e47a0c   nginx:alpine   "/docker-entrypoint.…" About an hour ago Up About an hour  0.0.0.0:8080->80/tcp, [::]:8080->80/tcp    web
kacper@UNKNOWN:~$ docker run -d --name db1 -e POSTGRES_PASSWORD=secret -p 5432:5432 postgres
Unable to find image 'postgres:latest' locally
latest: Pulling from library/postgres
254e724d7786: Pull complete
5ed504ed4ebe: Pull complete
6b1012ab103c: Pull complete
688bd672efd5: Pull complete
18c4f6c1b1e7: Pull complete
5b2c2f1196a6: Pull complete
451329d20b9f: Pull complete
33518fbc18a9: Pull complete
8ac7e820633f: Pull complete
f17c4120c789: Pull complete
8937a896f225: Pull complete
d65a61d71ceb: Pull complete
13b75ce6e0b4: Pull complete
bb9034c7832a: Pull complete
Digest: sha256:304ab813518754228f9f792f79d6da36359b82d8ecf418096c636725f8c930ad
Status: Downloaded newer image for postgres:latest
be6b75a7058ec877b37e6cfe71222fa4f559299b5223526dd5383dab32c7af3a
kacper@UNKNOWN:~$ docker run -d --name db2 -e POSTGRES_PASSWORD=secret \
        -p 5433:5432 --memory="512m" --cpus="0.5" postgres
a5e4ce2f436a00441c39d884cd6a6818c7736b3b9531b87a035d9e902281c52f
```

```
kacper@UNKNOWN:~$ docker ps
CONTAINER ID   IMAGE          COMMAND                CREATED          STATUS            PORTS                                          NAMES
a5e4ce2f436a   postgres       "docker-entrypoint.s…" 59 minutes ago   Up 59 minutes     0.0.0.0:5433->5432/tcp, [::]:5433->5432/tcp    db2
be6b75a7058e   postgres       "docker-entrypoint.s…" About an hour ago Up About an hour  0.0.0.0:5432->5432/tcp, [::]:5432->5432/tcp    db1
d630b9e47a0c   nginx:alpine   "/docker-entrypoint.…" 2 hours ago      Up 2 hours        0.0.0.0:8080->80/tcp, [::]:8080->80/tcp        web
```

db1runs Postgres with default resources on the standard host port 5432
- db2 demonstrates overrides:
  -p 5433:5432` → shifts the host port to 5433
  `--memory="512m" --cpus="0.5"` → limits RAM to 512 MiB and CPU to half a core
  `-e POSTGRES_PASSWORD=secret` → passes an environment variable at runtime

```
CONTAINER ID   NAME   CPU %   MEM USAGE / LIMIT    MEM %   NET I/O        BLOCK I/O     PIDS
be6b75a7058e   db1    0.00%   23.61MiB / 62.44GiB  0.04%   64.9kB / 126B  0B / 78MB     6
a5e4ce2f436a   db2    0.74%   23.55MiB / 512MiB    4.60%   53.1kB / 126B  0B / 77.6MB   6
```

Step 4: Persisting Container Data:

```
kacper@UNKNOWN:~$ docker volume create pgdata
pgdata
kacper@UNKNOWN:~$ docker run -d --name pg \
        -e POSTGRES_PASSWORD=persist \
        -v pgdata:/var/lib/postgresql/data \
        -p 5432:5432 postgres
f81e5651f1b09f10df3dd687d36d9defd8c50e032555c432b58cbaf108c75756
kacper@UNKNOWN:~$ docker ps
CONTAINER ID   IMAGE       COMMAND            CREATED         STATUS         PORTS                                                    NA
MES
f81e5651f1b0   postgres    "docker-entrypoint.s…"  9 seconds ago  Up 9 seconds  0.0.0.0:5432->5432/tcp, [::]:5432->5432/tcp   pg
kacper@UNKNOWN:~$ docker volume ls
DRIVER      VOLUME NAME
local       pgdata
```

```
kacper@UNKNOWN:~$ docker exec -it pg psql -U postgres -c "CREATE TABLE test(id int);"
CREATE TABLE
kacper@UNKNOWN:~$ docker exec -it pg psql -U postgres -c "\dt"
        List of relations
 Schema | Name | Type  |  Owner
--------+------+-------+----------
 public | test | table | postgres
(1 row)
```

Now delete container pg (but the volume will be kept)

```
kacper@UNKNOWN:~$ docker rm -f pg          # stops and deletes the container
docker ps -a           # pg is gone
pg
CONTAINER ID   IMAGE           COMMAND              CREATED        STATUS                 PORTS      NAMES
e51c5f6d5c93   nginx:alpine    "/docker-entrypoint.…"  24 hours ago   Created                           web2
d630b9e47a0c   nginx:alpine    "/docker-entrypoint.…"  25 hours ago   Exited (0) 22 hours ago           web
kacper@UNKNOWN:~$ docker rm -f pg
```

Start a new postgres pointing to the same volume and the test table will persist in the new postgre (showing that data can persist outside of previous containers)

```
kacper@UNKNOWN:~$ docker run -d --name pg2 \
        -e POSTGRES_PASSWORD=persist \
        -v pgdata:/var/lib/postgresql/data \
        -p 5432:5432 postgres
506fada59389eca3fa8b774f0932352b67548ac721a3af898f5c26724f65631b
kacper@UNKNOWN:~$ docker exec -it pg2 psql -U postgres -c "\dt"
        List of relations
 Schema | Name | Type  |  Owner
--------+------+-------+----------
 public | test | table | postgres
(1 row)
```

Step 5: Sharing Host Files with a Container:

Make a test directory and a mock html file, which will be hosted by docker.

```
kacper@UNKNOWN:~$ mkdir -p ~/docker-labs/site
kacper@UNKNOWN:~$ cat > ~/docker-labs/site/index.html <<'HTML'
<!doctype html>
<h1 style="font-family:sans-serif;color:#3085d6">
  Hello World
</h1>
<p>This page is served by Nginx running in Docker.</p>
HTML
kacper@UNKNOWN:~$ cd ~/docker-labs/
kacper@UNKNOWN:~/docker-labs$ docker rm -f web
web
kacper@UNKNOWN:~/docker-labs$ docker run -d -p 8080:80 \
          -v "$PWD/site":/usr/share/nginx/html:Z \
          --name web nginx:alpine
curl -I http://localhost:8080
2a851dae96d3911b3240eea4002560c50fddd941c8e3ca43901bd39862238c23
curl: (56) Recv failure: Connection reset by peer
kacper@UNKNOWN:~/docker-labs$ docker ps
CONTAINER ID   IMAGE          COMMAND                CREATED          STATUS          PORTS                                          NAMES
2a851dae96d3   nginx:alpine   "/docker-entrypoint.…"   15 seconds ago   Up 14 seconds   0.0.0.0:8080->80/tcp, [::]:8080->80/tcp        web
003472328c26   nginx:alpine   "/docker-entrypoint.…"   10 minutes ago   Up 10 minutes   0.0.0.0:8081->80/tcp, [::]:8081->80/tcp        mysite
506fada59389   postgres       "docker-entrypoint.s…"   43 minutes ago   Up 43 minutes   0.0.0.0:5432->5432/tcp, [::]:5432->5432/tcp    pg2
kacper@UNKNOWN:~/docker-labs$ sleep 3
curl -I http://localhost:8080
HTTP/1.1 200 OK
Server: nginx/1.27.5
Date: Mon, 05 May 2025 12:54:15 GMT
Content-Type: text/html
Content-Length: 141
Last-Modified: Mon, 05 May 2025 12:51:27 GMT
Connection: keep-alive
ETag: "6818b44f-8d"
Accept-Ranges: bytes
```

Hello World

This page is served by Nginx running in Docker.
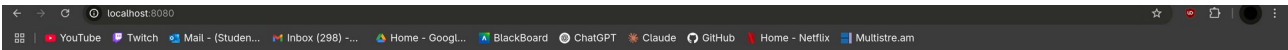
Step 6: Running a multi-container application with Docker Compose:

```
kacper@UNKNOWN:~/docker-labs$ mkdir -p ~/docker-labs/compose-demo
kacper@UNKNOWN:~/docker-labs$ ls
compose-demo  site
kacper@UNKNOWN:~/docker-labs$ cd compose-demo/
kacper@UNKNOWN:~/docker-labs/compose-demo$ cat > compose.yaml <<'YAML'
services:
  redis:
    image: redis:alpine
    ports: [ "6379:6379" ]

  web:
    image: docker/welcome-to-docker
    ports: [ "8090:80" ]
    depends_on: [ redis ]
    environment:
      REDIS_HOST: redis
YAML
kacper@UNKNOWN:~/docker-labs/compose-demo$ ls
compose.yaml
kacper@UNKNOWN:~/docker-labs/compose-demo$ docker compose up -d
[+] Running 18/18
 ✓ web Pulled                                                           6.1s
   ✓ 96526aa774ef Pull complete                                         2.7s
   ✓ 740091335c74 Pull complete                                         3.0s
   ✓ da9c2e764c5b Pull complete                                         3.1s
   ✓ ade17ad21ef4 Pull complete                                         3.1s
   ✓ 4e6f462c8a69 Pull complete                                         3.3s
   ✓ 1324d9977cd2 Pull complete                                         3.7s
   ✓ 1b9b96da2c74 Pull complete                                         3.7s
   ✓ 5d329b1e101a Pull complete                                         3.0s
 ✓ redis Pulled                                                         4.7s
   ✓ f18232174bc9 Already exists                                        0.0s
   ✓ 6bbf9a9fb8d1 Pull complete                                         0.7s
   ✓ b9ad71003506 Pull complete                                         0.8s
   ✓ 5cf94cf2539d Pull complete                                         0.9s
   ✓ 234c75618d30 Pull complete                                         2.4s
   ✓ 1eb3fe6b681a Pull complete                                         2.4s
   ✓ 4f4fb700ef54 Pull complete                                         2.5s
   ✓ 234f7e17f3b5 Pull complete                                         2.5s
[+] Running 3/3
 ✓ Network composedemo_default    Created                               0.2s
 ✓ Container composedemo-redis-1  Started                               0.4s
 ✓ Container composedemo-web-1    Started                               0.5s
kacper@UNKNOWN:~/docker-labs/compose-demo$ docker compose ps
NAME                  IMAGE                       COMMAND                SERVICE   CREATED          STATUS          PORTS
composedemo-redis-1   redis:alpine                "docker-entrypoint.s…" redis     12 seconds ago   Up 11 seconds   0.0.0.0:6379->6379/tcp, [::]:6379->6379/tcp
composedemo-web-1     docker/welcome-to-docker    "/docker-entrypoint.…" web       11 seconds ago   Up 10 seconds   0.0.0.0:8090->80/tcp, [::]:8090->80/tcp
kacper@UNKNOWN:~/docker-labs/compose-demo$
```