

DevOps Homework 2 - Winter 2026

Student: César Núñez

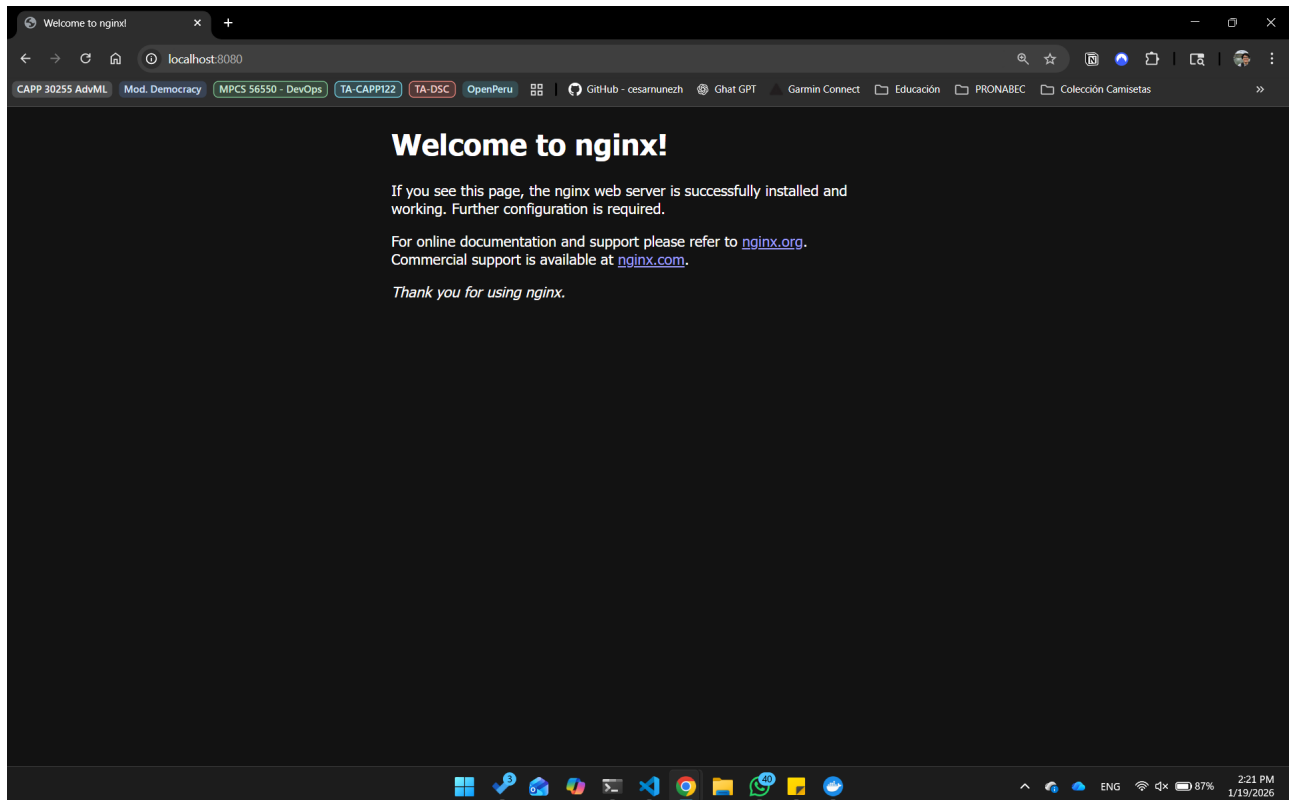
Date: 01/19/2026

Exercise 1: Basic Container Operations

Task 1.1: Working with Pre-built Images

Deliverable:

- Screenshot of the nginx welcome page:



- Terminal commands used:

```
canun:homework2 (main)$ docker run -d -p 8080:80 --name nginx nginx:trixie-perl
e5e54b9b2b91c350045acb2a8ec77e06e7edcc90b28bcbf39072c8e35d19259
canun:homework2 (main)$ docker container stop nginx
nginx
canun:homework2 (main)$ docker container rm nginx
nginx
canun:homework2 (main)$ docker images
```

IMAGE	ID	DISK USAGE	CONTENT SIZE	EXTRA
cesarnunezh/myapp:latest	5d56f6c8f011	391MB	97MB	U
docker/getting-started:latest	d79336f4812b	73.9MB	21.4MB	U
nginx:trixie-perl	b60f25eb5acd	310MB	79.3MB	

```
canun:homework2 (main)$
```

```
# Run an nginx container in detached mode, mapping port 8080 on your host
to port 80 in the container
docker run -d -p 8080:80 --name nginx nginx:trixie-perl
```

```
# Stop and remove the container
```

```
docker container stop nginx
docker container rm nginx

# List all images on your system
docker images
```

Task 1.2: Container Interaction

Deliverable:

- Terminal session transcript

```
canun:homework2 (main)$ docker run -it --name ubuntu_ex1 ubuntu:latest
root@8907e845fa92:/# vim
bash: vim: command not found
root@8907e845fa92:/# echo 'Cesar Nunez - cnunezh' >> simple.txt
root@8907e845fa92:/# ls
bin boot dev etc home lib lib64 media mnt opt proc root run
sbin simple.txt srv sys tmp usr var
root@8907e845fa92:/# exit
exit
canun:homework2 (main)$ docker restart ubuntu_ex1
ubuntu_ex1

canun:homework2 (main)$ docker start ubuntu_ex1
ubuntu_ex1

canun:homework2 (main)$ docker start -i ubuntu_ex1
root@8907e845fa92:/# ls
bin boot dev etc home lib lib64 media mnt opt proc root run
sbin simple.txt srv sys tmp usr var
```

- Explanation: With the command `docker run` we are creating the container from the image `ubuntu:latest` in a interactive way. Then when creating the file, we are modifying the running container, which then we restart it and the files created still exist in the container. This is because we are not creating from a new image, but from the previous container.

Exercise 2: Building Custom Images

Task 2.1: Simple Web Application

Deliverable:

- Source code: available at my GitHub [repo](#)
- Dockerfile: available [here](#) but also here:

```
# Use official Python image as base
FROM python:3.12

# Set working directory to /app
WORKDIR /app

# Copy requirements file and run pip install
COPY requirements.txt .
RUN pip install -r requirements.txt

# Copy application code
COPY . .

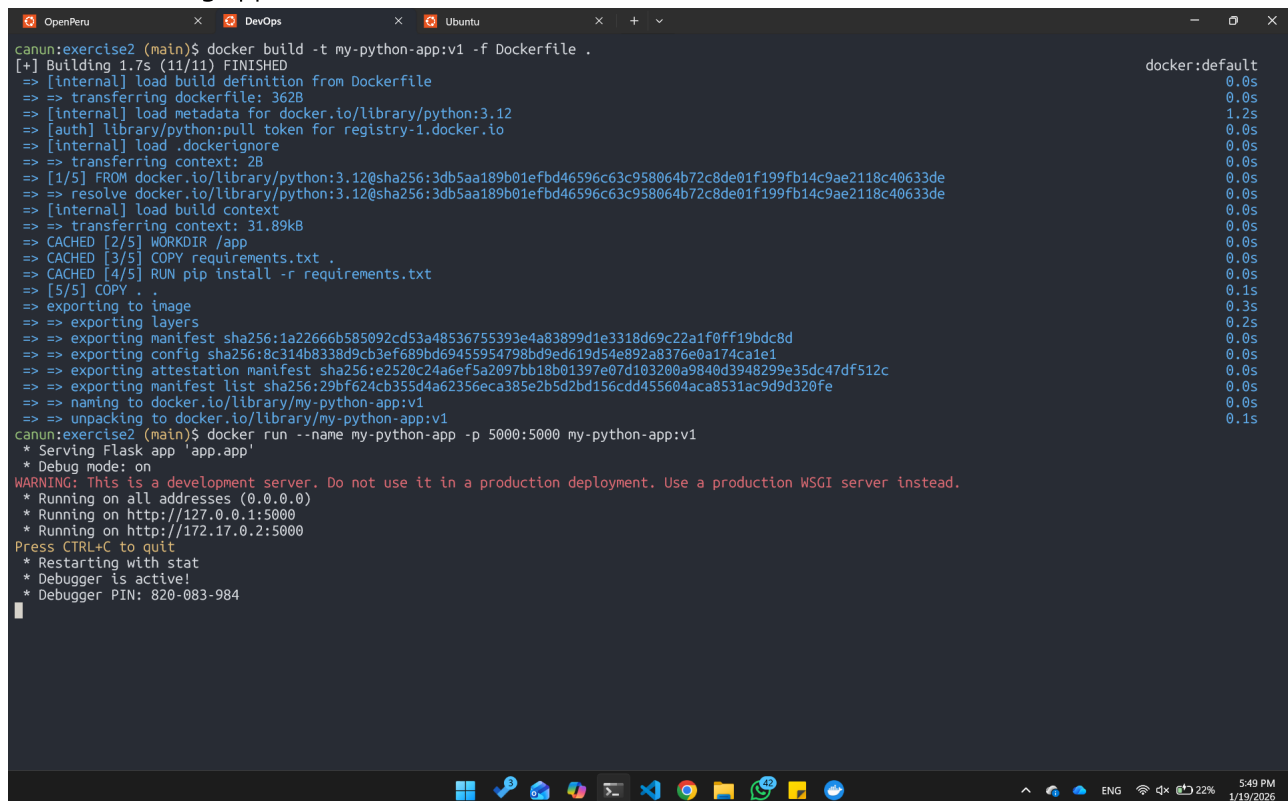
#Expose port 5000
EXPOSE 5000

#Set the startup command
CMD ["python", "-m", "app"]
```

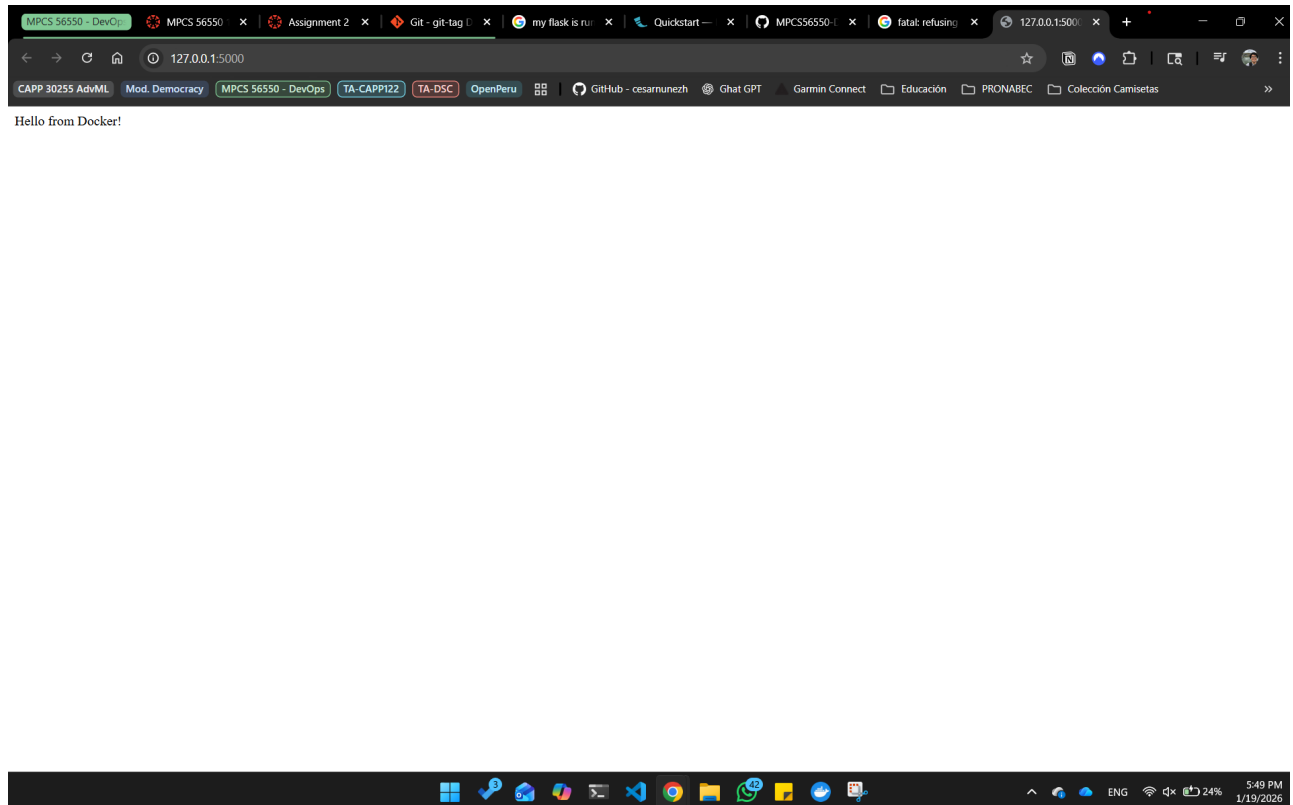
- Docker build and run commands

```
docker build -t my-python-app:v1 -f Dockerfile .
docker run --name my-python-app -p 5000:5000 my-python-app:v1
```

- Proof of running application



```
canun:exercise2 (main)$ docker build -t my-python-app:v1 -f Dockerfile .
[+] Building 1.7s (11/11) FINISHED
=> [internal] load build definition from Dockerfile
=> => transferring dockerfile: 362B
=> [internal] load metadata for docker.io/library/python:3.12
=> [auth] library/python:pull token for registry-1.docker.io
=> [internal] load .dockerignore
=> => transferring context: 2B
=> [1/5] FROM docker.io/library/python:3.12@sha256:3db5aa189b01efbd46596c63c958064b72c8de01f199fb14c9ae2118c40633de
=> => resolve docker.io/library/python:3.12@sha256:3db5aa189b01efbd46596c63c958064b72c8de01f199fb14c9ae2118c40633de
=> [internal] load build context
=> => transferring context: 31.89kB
=> CACHED [2/5] WORKDIR /app
=> CACHED [3/5] COPY requirements.txt .
=> CACHED [4/5] RUN pip install -r requirements.txt
=> [5/5] COPY . .
=> exporting to image
=> => exporting layers
=> => exporting manifest sha256:1a22666b585092cd53a48536755393e4a83899d1e3318d69c22a1f0ff19bdc8d
=> => exporting config sha256:8c314b8338d9cb3ef689bd69455954798bd9ed619d54e892a8376e0a174ca1e1
=> => exporting attestation manifest sha256:e2520c24a6ef5a2097bb18b01397e07d103200a9840d3948299e35dc47df512c
=> => exporting manifest list sha256:29bf624cb355d4a62356eca385e2b5d2bd156cdd455604aca8531ac9d9d320fe
=> => naming to docker.io/library/my-python-app:v1
=> => unpacking to docker.io/library/my-python-app:v1
canun:exercise2 (main)$ docker run --name my-python-app -p 5000:5000 my-python-app:v1
* Serving Flask app 'app.app'
* Debug mode: on
WARNING: This is a development server. Do not use it in a production deployment. Use a production WSGI server instead.
* Running on all addresses (0.0.0.0)
* Running on http://127.0.0.1:5000
* Running on http://172.17.0.2:5000
Press CTRL+C to quit
* Restarting with stat
* Debugger is active!
* Debugger PIN: 820-083-984
```



Task 2.2: Multi-stage Build

Deliverable:

- Dockerfile: available [here](#) but also here:

```
# Stage 1 - Build Stage:
# Use python:3.11
FROM python:3.11 AS stage1

# Set working directory to /app
WORKDIR /app

# Install build dependencies
RUN apt-get update && apt-get install -y --no-install-recommends \
    build-essential gcc \
    && rm -rf /var/lib/apt/lists/*

# Copy requirements file and run pip install
COPY requirements.txt .
RUN pip install --prefix=/install -r requirements.txt

# Stage 2 - Runtime Stage:
# Use python:3.11-alpine (minimal Alpine-based Python image)
FROM python:3.11-alpine AS stage2

# Set working directory to /app
WORKDIR /app

# Copy the installed packages from the build stage
```

```
COPY --from=stage1 /install /usr/local

# Copy application code
COPY . .

#Expose port 5000
EXPOSE 5000

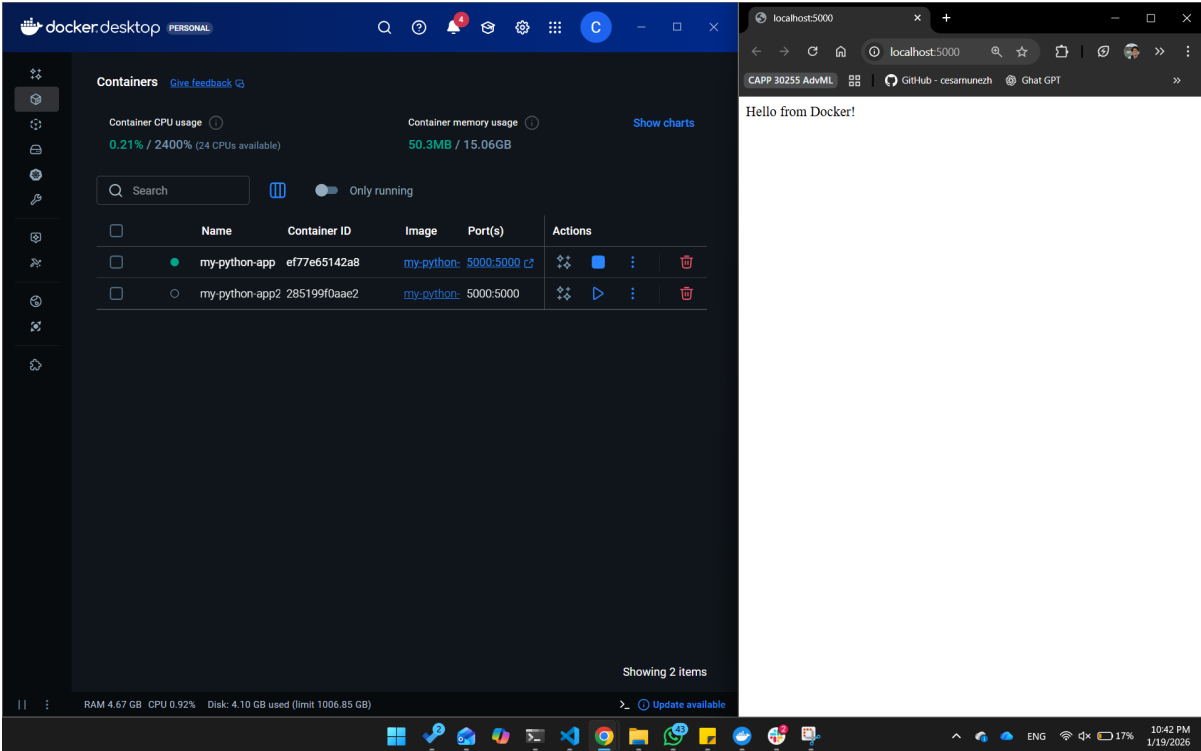
#Set the startup command
CMD ["python", "-m", "app"]
```

- Screenshots showing image size comparison:

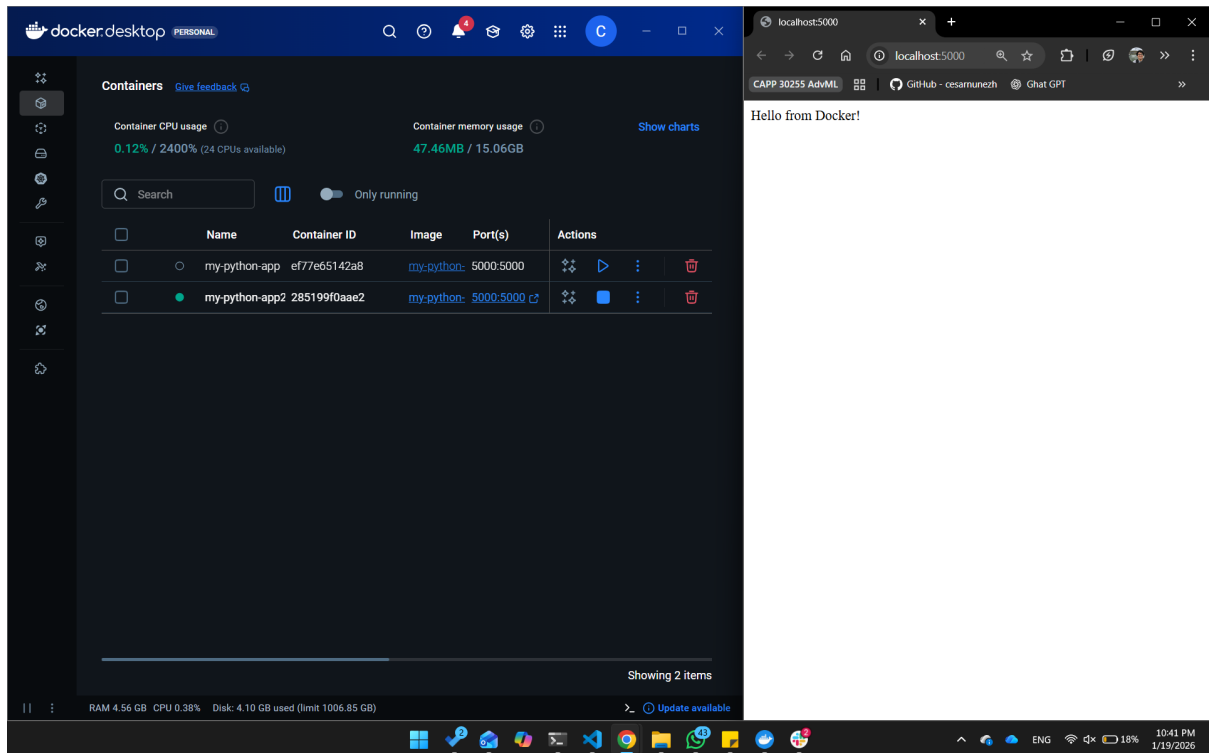
```
canun:exercise2 (main)$ docker images
```

IMAGE	ID	DISK USAGE	CONTENT SIZE	EXTRA
cesarnunezh/my-python-app:v1	2da33095e97d	1.62GB	416MB	
cesarnunezh/my-python-app:v1-optimized	70e0eb847bff	91.1MB	22MB	
cesarnunezh/myapp:latest	5d56f6c8f011	391MB	97MB	
ubuntu:latest	cd1dba651b30	119MB	31.7MB	

- Written analysis explaining the size difference and benefits: The main reason of the size difference is that a multi-stage Dockerfile separates the build-time from the runtime. In that sense, we are using for runtime a subset of the build image that contains what is strictly necessary for the application. The smaller image also impacts the speed of deployment.
- Verification that both images work identically
 - Single Stage:



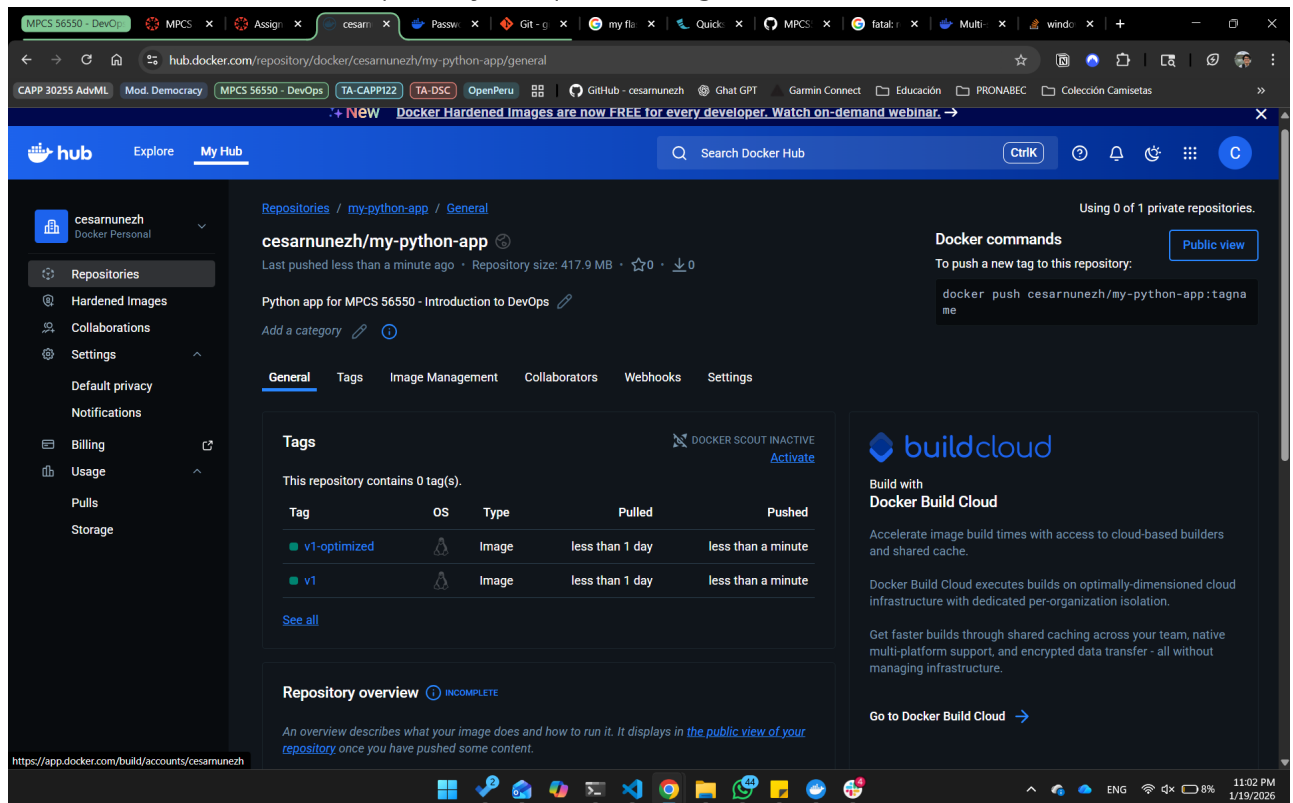
- Multi Stage:



Task 2.3: Docker Hub Registry

Deliverable:

- Screenshots of Docker Hub repository with pushed images



Exercise 3: Docker Compose Multi-Container Application

Task 3.1: Web App with Database

Deliverable:

- Complete application code: available [here](#)
- Docker-compose.yaml

```
services:
  backend:
    build:
      context: backend
      target: runtime
    restart: always
    env_file: .env
    ports:
      - "5000:5000"
    volumes:
      - todo-logs:/backend/logs
    depends_on:
      db:
        condition: service_healthy
    healthcheck:
      test: ["CMD", "python", "-c", "import urllib.request;
urllib.request.urlopen('http://localhost:5000/').read()"]
      interval: 30s
      timeout: 10s
      retries: 5
      start_period: 20s
    networks:
      - backend_net
      - frontend_net

  db:
    image: mysql:8.0
    env_file: .env
    healthcheck:
      test: ["CMD", "mysqladmin", "ping", "-h", "localhost"]
      interval: 10s
      timeout: 5s
      retries: 10
      start_period: 20s
    volumes:
      - todo-db:/var/lib/mysql
      - ./db/init.sql:/docker-entrypoint-initdb.d/init.sql:ro
    expose:
      - 3306
      - 33060
    networks:
      - backend_net

proxy:
```

```
    build: proxy
    restart: always
    env_file: .env
    ports:
      - "8080:80"
    depends_on:
      backend:
        condition: service_healthy
    healthcheck:
      test: ["CMD", "wget", "-q0-", "http://localhost/"]
      interval: 30s
      timeout: 5s
      retries: 5
      start_period: 10s
    networks:
      - frontend_net

volumes:
  todo-db:
    driver: local
  todo-logs:
    driver: local

networks:
  backend_net:
    internal: true
  frontend_net: {}
```