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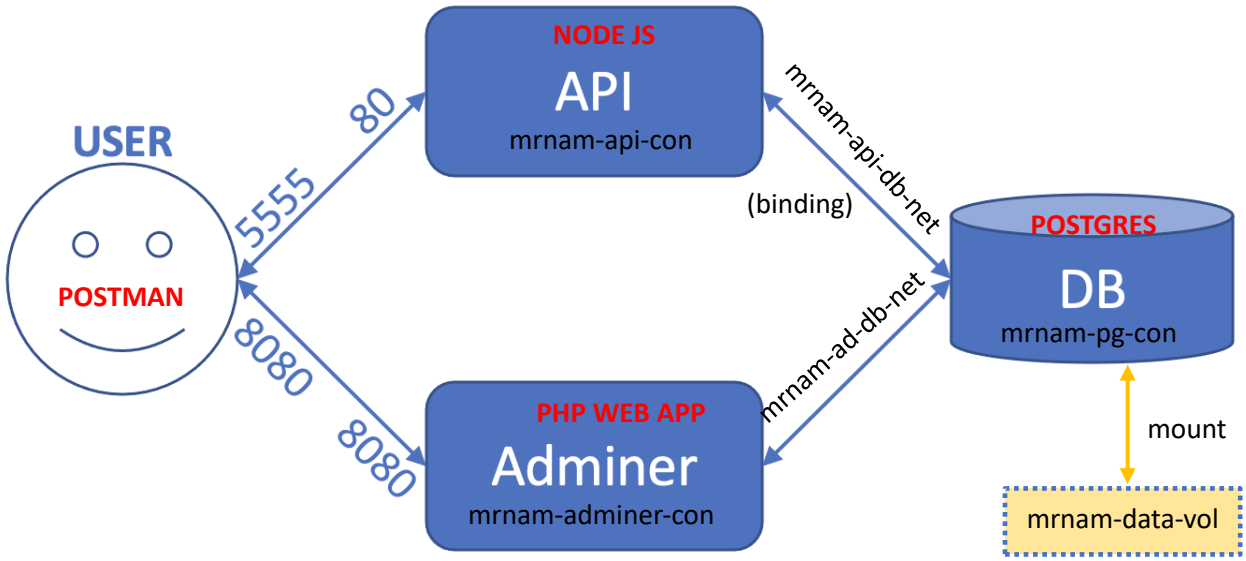
THỰC HÀNH XÂY DỰNG ỨNG DỤNG DỊCH VỤ VỚI DOCKER

Mô hình



(Nếu giả lập trên máy ảo Virtual Box thì chạy Virtual Box dưới quyền Administrator)

Phần 1: Chuẩn bị hệ thống

1. Tiến hành ssh để copy thư mục backend về máy chủ server /home/osboxes

```
C:\Windows\system32>scp -r C:\backend\ osboxes@192.168.1.8:
The authenticity of host '192.168.1.8 (192.168.1.8)' can't be established.
ECDSA key fingerprint is SHA256:sI1xqq0R4zxeieoXVGVnhFtnss7/QeTdGgfk4ffMAKs.
Are you sure you want to continue connecting (yes/no/[fingerprint])?
Warning: Permanently added '192.168.1.8' (ECDSA) to the list of known hosts.
osboxes@192.168.1.8's password:
.dockerignore                                 100%   30    10.0KB/s   00:00
data.js                                       100%  630   314.5KB/s   00:00
Dockerfile                                    100%  133    66.7KB/s   00:00
package-lock.json                             100%   53KB  13.3MB/s   00:00
package.json                                  100%  337   196.7KB/s   00:00
start.js                                      100%  687   480.3KB/s   00:00

C:\Windows\system32>ssh osboxes@192.168.1.8
osboxes@192.168.1.8's password:
Welcome to Ubuntu 23.10 (GNU/Linux 6.5.0-14-generic x86_64)

 * Documentation:  https://help.ubuntu.com
 * Management:     https://landscape.canonical.com
 * Support:        https://ubuntu.com/advantage

  System information as of Sat Jan 27 06:59:38 AM UTC 2024

  System load:  0.0               Processes:             106
  Usage of /:   7.6% of 97.87GB   Users logged in:       1
  Memory usage: 7%                IPv4 address for enp0s3: 192.168.1.8
  Swap usage:   0%


49 updates can be applied immediately.
To see these additional updates run: apt list --upgradable


Last login: Sat Jan 27 06:47:05 2024
osboxes@osboxes:~$ ls /
bin  boot  cdrom  dev  etc  home  lib  lib64  lost+found  media  mnt  opt  proc  root  run  sbin  snap  srv  swap.img  sys  tmp  usr  var
osboxes@osboxes:~$ ls /home/osboxes
backend  flask_app
osboxes@osboxes:~$
```

2. Tiến hành copy thư mục database sang máy chủ ảo
   scp -r C:\database\ osboxes@192.168.1.9:

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```
C:\Windows\system32>scp -r C:\database\ osboxes@192.168.1.9:
osboxes@192.168.1.9's password:
init-db.sql                                                   100%  120    40.1KB/s   00:00

C:\Windows\system32>ssh osboxes@192.168.1.9
osboxes@192.168.1.9's password:
Welcome to Ubuntu 23.10 (GNU/Linux 6.5.0-14-generic x86_64)

 * Documentation:  https://help.ubuntu.com
 * Management:     https://landscape.canonical.com
 * Support:        https://ubuntu.com/advantage

  System information as of Sun Jan 28 03:30:37 AM UTC 2024

  System load:  0.01              Processes:              109
  Usage of /:   7.9% of 97.87GB   Users logged in:        1
  Memory usage: 8%                IPv4 address for enp0s3: 192.168.1.9
  Swap usage:   0%


60 updates can be applied immediately.
11 of these updates are standard security updates.
To see these additional updates run: apt list --upgradable


Last login: Sun Jan 28 03:07:56 2024 from 192.168.1.95
osboxes@osboxes:~$ ls
backend  database  flask_app
```

3. Tiến hành build image với tên mrnam-api-image

```
osboxes@osboxes:~$ ls
backend  flask_app
osboxes@osboxes:~$ cd backend
osboxes@osboxes:~/backend$ ls
data.js  Dockerfile  package.json  package-lock.json  start.js
osboxes@osboxes:~/backend$
```

sudo docker build -t mrnam-api-image .

```
osboxes@osboxes:~/backend$ sudo docker build -t mrnam-api-image .
[+] Building 2.0s (11/11) FINISHED                                                  docker:default
 => [internal] load build definition from Dockerfile                                         0.0s
 => => transferring dockerfile: 172B                                                         0.0s
 => [internal] load .dockerignore                                                            0.1s
 => => transferring context: 70B                                                             0.0s
 => [internal] load metadata for docker.io/library/node:14-alpine                            1.8s
 => [auth] library/node:pull token for registry-1.docker.io                                  0.0s
 => [1/5] FROM docker.io/library/node:14-alpine@sha256:434215b487a329c9e867202ff89e704d3a75e554822e07f3e0c0f9e606  0.0s
 => [internal] load build context                                                            0.0s
 => => transferring context: 189B                                                            0.0s
 => CACHED [2/5] WORKDIR /usr/src/app                                                        0.0s
 => CACHED [3/5] COPY package*.json ./                                                       0.0s
 => CACHED [4/5] RUN ["npm", "ci"]                                                           0.0s
 => CACHED [5/5] COPY . .                                                                    0.0s
 => exporting to image                                                                       0.0s
 => => exporting layers                                                                      0.0s
 => => writing image sha256:02a498f2f573fd481dd302862b21dcb96ba73d84ca011229c5d51e20cd9c3a73  0.0s
 => => naming to docker.io/library/mrnam-api-image                                           0.0s
osboxes@osboxes:~/backend$ sudo docker images
REPOSITORY        TAG       IMAGE ID       CREATED         SIZE
mrnam-api-image   latest    02a498f2f573   4 minutes ago   125MB
```

4. Tạo hai bridge network trong hệ thống docker là: mrnam-api-db-net và mrnam-ad-db-net
   sudo docker network create --driver bridge mrnam-api-db-net
   sudo docker network create --driver bridge mrnam-ad-db-net
   sudo docker network ls

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```
osboxes@osboxes:~$ sudo docker network create --driver bridge mrnam-api-db-net
ce97cf1bf4a9160401309311434680711b2bebb329124dac179fc6bd096cffb0
osboxes@osboxes:~$ sudo docker network create --driver bridge mrnam-ad-db-net
bd20bec3d96cb506e4bd4790901f198bf7b90cbb43320c49b0973724f2e66545
osboxes@osboxes:~$ sudo docker network ls
NETWORK ID     NAME              DRIVER    SCOPE
6c22e863c6ab   bridge            bridge    local
566473afbac0   host              host      local
bd20bec3d96c   mrnam-ad-db-net   bridge    local
ce97cf1bf4a9   mrnam-api-db-net  bridge    local
d2a45d575e86   none              null      local
```

5. Tạo volume mang tên mrnam-data-vol
   sudo docker volume create mrnam-data-vol
   sudo docker volume ls

```
osboxes@osboxes:~$ sudo docker volume create mrnam-data-vol
mrnam-data-vol
osboxes@osboxes:~$ sudo docker volume ls
DRIVER    VOLUME NAME
local     mrnam-data-vol
```

Phần 2: Chuẩn bị Database Postgres

1. Khởi tạo container (detached mode) mang tên mrnam-pg-con và gắn (mount) vào mrnam-data-vol
   sudo docker run --name mrnam-pg-con -p 5432:5432 -e POSTGRES_USER=admin -e POSTGRES_PASSWORD=admin -e POSTGRES_DB=dbshop -v mrnam-data-vol:/var/lib/postgresql/data -d postgres

```
osboxes@osboxes:~$ sudo docker run --name mrnam-pg-con -p 5432:5432 -e POSTGRES_USER=admin -e POSTGRES_PASSWORD
=admin -e POSTGRES_DB=dbbooks -v mrnam-data-vol:/var/lib/postgresql/data -d postgres
30d22bf8291fed3deb3591b209398b7fd511994f71f8222e102c6acb8fc66661
osboxes@osboxes:~$ sudo docker volume ls
DRIVER    VOLUME NAME
local     mrnam-data-vol
osboxes@osboxes:~$ sudo docker container ls
CONTAINER ID   IMAGE      COMMAND                  CREATED              STATUS              PORTS
                     NAMES30d22bf8291f   postgres   "docker-entrypoint.s…"   About a minute ago   Up About
a minute   0.0.0.0:5432->5432/tcp, :::5432->5432/tcp   mrnam-pg-con
```

2. Kiểm tra xem container đã chạy và kiểm tra truy cập thành công vào postgres database với tài khoản admin

   sudo docker exec -it mrnam-pg-con psql -U admin -d dbshop

```
osboxes@osboxes:~$ sudo docker exec -it mrnam-pg-con psql -U admin -d dbshop
psql (16.1 (Debian 16.1-1.pgdg120+1))
Type "help" for help.

dbshop=# \q
osboxes@osboxes:~$
```

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3. Copy file init-db.sql trong thư mục database vào thư mục docker-entrypoint-initdb.d trong container mrnam-pg-con

   sudo docker cp /home/osboxes/database/init-db.sql mrnam-pg-con:/docker-entrypoint-initdb.d/init-db.sql

```
osboxes@osboxes:~$ sudo docker cp /home/osboxes/database/init-db.sql mrnam-pg-con:/docker-entrypoint-initdb.d/init-db.sql
Successfully copied 2.05kB to mrnam-pg-con:/docker-entrypoint-initdb.d/init-db.sql
```

4. Sử dụng tài khoản root của container để khởi chạy script init-db.sql để tạo bảng books và nạp dữ liệu cho bảng tblbook trong CSDL dbshop

   sudo docker exec -u root mrnam-pg-con psql dbshop admin -f docker-entrypoint-initdb.d/init-db.sql

   (Cú pháp: docker exec -u <container_user> containername psql <dbname> <postgres_user> -f /container/path/file.sql)

```
osboxes@osboxes:~$ sudo docker exec -u root mrnam-pg-con psql dbshop admin -f docker-entrypoint-initdb.d/init-db.sql
CREATE TABLE
INSERT 0 5
```

5. Kiểm tra xem dữ liệu đã được tạo thành công

   sudo docker exec -it mrnam-pg-con psql -U admin -d dbshop

```
osboxes@osboxes:~$ sudo docker exec -it mrnam-pg-con psql -U admin -d dbshop
psql (16.1 (Debian 16.1-1.pgdg120+1))
Type "help" for help.

dbshop=# select * from tblbook;
 id |       title       | author
----+-------------------+---------
  1 | DevOps            | MR. NAM
  2 | Big Data          | MR. NAM
  3 | Cloud Deployement | MR. NAM
  4 | Data Analysis     | MR. NAM
  5 | Block Chain       | MR. NAM
(5 rows)

dbshop=# \q
```

6. Thiết lập mạng cho container mrnam-pg-con vào network mrnam-api-db-net. Sau đó, kiểm tra xem network đã config thành công

   sudo docker network connect mrnam-api-db-net mrnam-pg-con
   sudo docker network inspect mrnam-api-db-net

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```
osboxes@osboxes:~$ sudo docker network connect mrnam-api-db-net mrnam-pg-con
osboxes@osboxes:~$ sudo docker network inspect mrnam-api-db-net
[
    {
        "Name": "mrnam-api-db-net",
        "Id": "ce97cf1bf4a9160401309311434680711b2bebb329124dac179fc6bd096cffb0",
        "Created": "2024-02-16T04:07:56.369224985Z",
        "Scope": "local",
        "Driver": "bridge",
        "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": {
            "26e185d12ea62e092bfff6315d47669a402dcae67f7378bf4285b53336c4b13d": {
                "Name": "mrnam-pg-con",
                "EndpointID": "8e251c82da8265796994837394058d25e121d648195c0bcc93cfb77e5ac5a23",
                "MacAddress": "02:42:ac:12:00:02",
                "IPv4Address": "172.18.0.2/16",
                "IPv6Address": ""
            }
        },
        "Options": {},
        "Labels": {}
    }
]
```

Phần 3: Container mrnam-api-con

1. Khởi chạy container mrnam-api-con dưới ứng dụng nền (detached) với cấu hình biến môi trường (dùng -e)

   sudo docker run --name mrnam-api-con -p 5555:80 -e PGUSER='admin' -e PGPASSWORD='admin' -e PGDATABASE='dbshop' -e PGHOST='mrnam-pg-con' -e PGPORT=5432 -d mrnam-api-image

```
osboxes@osboxes:~$ sudo docker run --name mrnam-api-con -e PGUSER='admin' -e PGPASSWORD='admin' -e
PGDATABASE='dbshop' -e PGHOST='mrnam-api-db-net' -e PGPORT=5432 -d mrnam-api-image
[sudo] password for osboxes:
4084730de977c765300858ac78e958bd0f30f6ec84a01e1085caad194c8296e3
```

2. Kiểm tra danh sách container đang chạy
   sudo docker container ls -a

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```
osboxes@osboxes:~$ sudo docker container ls
CONTAINER ID   IMAGE             COMMAND                  CREATED         STATUS         PORTS                                       NAMES
4084730de977   mrnam-api-image   "docker-entrypoint.s…"   8 minutes ago   Up 8 minutes   80/tcp                                      mrnam-api-con
26e185d12ea6   postgres          "docker-entrypoint.s…"   2 hours ago     Up 2 hours     0.0.0.0:5432->5432/tcp, :::5432->5432/tcp   mrnam-pg-con
```

3. Thiết lập mạng cho container mrnam-api-con vào network mrnam-api-db-net

   sudo docker network connect mrnam-api-db-net mrnam-api-con

```
osboxes@osboxes:~$ sudo docker network connect mrnam-api-db-net mrnam-api-con
```

4. Kiểm tra xem network đã config thành công

   sudo docker network inspect mrnam-api-db-net

```
"Containers": {
    "7e7215d3a521ce657bc3db196408f4e442fddc4ec93d801b6295d1de2ab4fff4": {
        "Name": "mrnam-api-con",
        "EndpointID": "2cd1ecf3b8d81753f5428f15f13b8fe5044be06aa5df9987f8ff5eaca2d507af",
        "MacAddress": "02:42:ac:12:00:02",
        "IPv4Address": "172.18.0.2/16",
        "IPv6Address": ""
    },
    "c5df89ad88694d94e99d5cdb46766ed4283d95d6e04068b8adbfe7e2c8b1ba17": {
        "Name": "mrnam-pg-con",
        "EndpointID": "96c41ac38f1391b168c561d2e3f6baca7944a9e658279b6dd315a6ce65904fd9",
        "MacAddress": "02:42:ac:12:00:03",
        "IPv4Address": "172.18.0.3/16",
        "IPv6Address": ""
    }
},
```

Phần 4: Test thử dịch vụ backend sử dụng curl tại máy ảo server

1. Tiến hành thực hiện request với phương thức HTTP GET:
   (tham khảo: https://linuxize.com/post/curl-rest-api/)

   sudo curl http://localhost:5555/api/books

```
osboxes@osboxes:~$ sudo curl http://localhost:5555/api/books
[{"id":1,"title":"DevOps","author":"MR. NAM"},{"id":2,"title":"Big Data","author":"MR. NAM"},{"id":3,"title":"Cloud Deployement","author":"MR. NAM"},{"id":4,"title":"Da
ta Analysis","author":"MR. NAM"},{"id":5,"title":"Block Chain","author":"MR. NAM"}]osboxes@osboxes:~$
```

   (Ctrl Z) hoặc (Ctrl C) để thoát

2. Hướng dẫn thao tác lõi container để check log của container:
   container: sudo docker exec -it mrnam-api-con sh

```
osboxes@osboxes:~$ sudo docker exec -it  mrnam-api-con sh
/usr/src/app #
```

   Kiểm tra xem port 80 đang chạy node: netstat -tulpn | grep :80

```
/usr/src/app # netstat -tulpn | grep :80
tcp        0      0 :::80                   :::*                    LISTEN      18/node
```

(Gõ exit để thoát)

3. Xem log của container: sudo docker container logs mrnam-api-con

```
osboxes@osboxes:~$ sudo docker container logs mrnam-api-con

> practic@1.0.0 start /usr/src/app
> node start.js

Server started listening on port 80
Getting all books
Getting all books
```

4. Tiến hành thêm dữ liệu mới với phương thức HTTP POST
   curl -X POST -H "Content-Type: application/json" -d '{"title": "Docker Lesson","author":"MR. Huynh Nam", "body": "Post body."}' http://localhost:5555/api/books

```
osboxes@osboxes:~$ curl -X POST -H "Content-Type: application/json" -d '{"title": "Docker Lesson","author":"MR. Huynh Nam", "body": "Post body."}' http://localhost:5555
/api/books
{"id":10}osboxes@osboxes:~$
```

5. Kiểm tra lại dữ liệu mới với HTTP GET

```
osboxes@osboxes:~$ sudo curl http://localhost:5555/api/books
[{"id":1,"title":"DevOps","author":"MR. NAM"},{"id":2,"title":"Big Data","author":"MR. NAM"},{"id":3,"title":"Cloud Deployeme
nt","author":"MR. NAM"},{"id":4,"title":"Data Analysis","author":"MR. NAM"},{"id":5,"title":"Block Chain","author":"MR. NAM"}
osboxes@osboxes:~$
```

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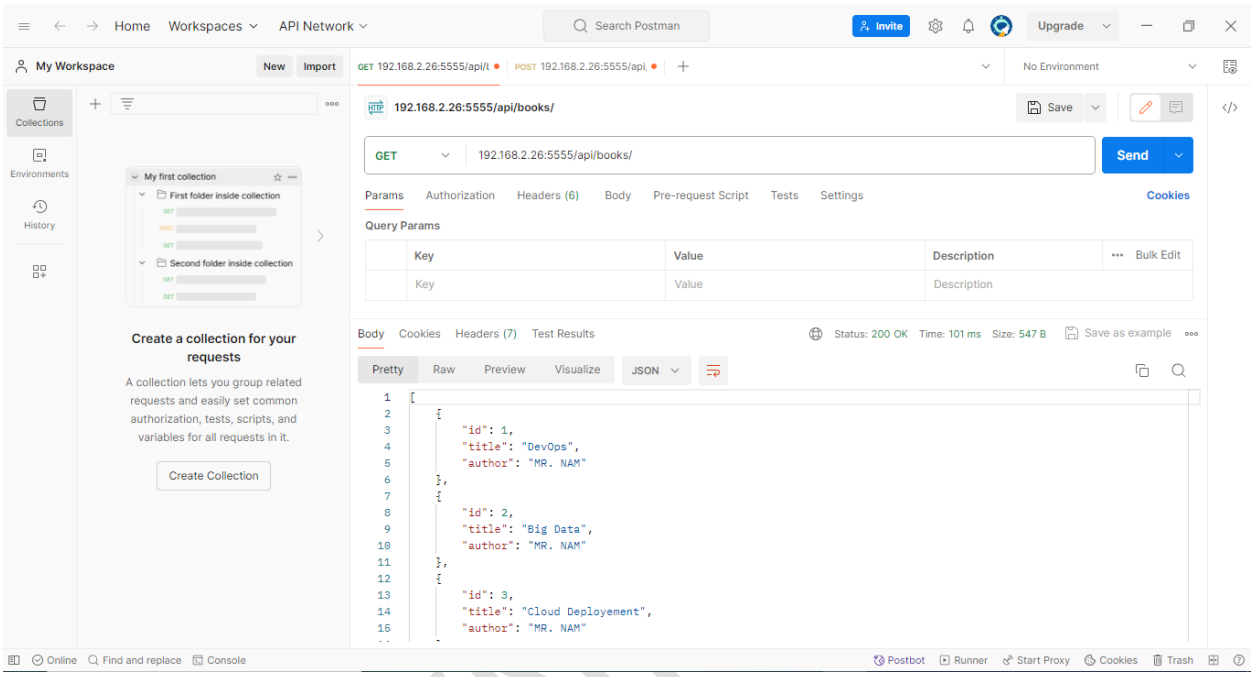
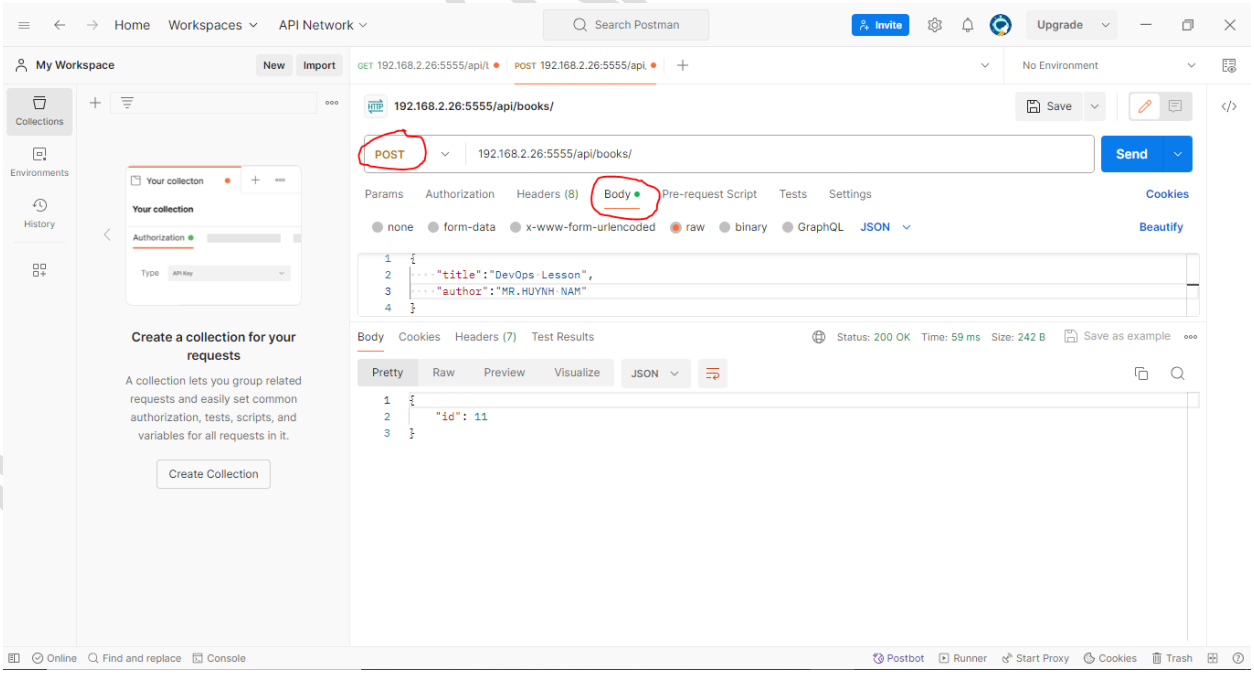
Phần 6: Sử dụng POST MAN để kiểm tra dịch vụ (máy thật)

1. Tiến hành kiểm tra thử dịch vụ HTTP GET



2. Tiến hành kiểm tra thử dịch vụ HTTP POST



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Phần 7: Quản trị CSDL với Adminer

Sinh viên tự tải image Adminer về và khởi chạy container với tên mrnam-adminer-con, cấu hình theo mô hình trên

1. Thêm mrnam-pg-con vào đường mạng mrnam-ad-db-net
   sudo docker network connect mrnam-ad-db-net mrnam-pg-con

```
osboxes@osboxes:~$ sudo docker network connect mrnam-ad-db-net mrnam-pg-con
```

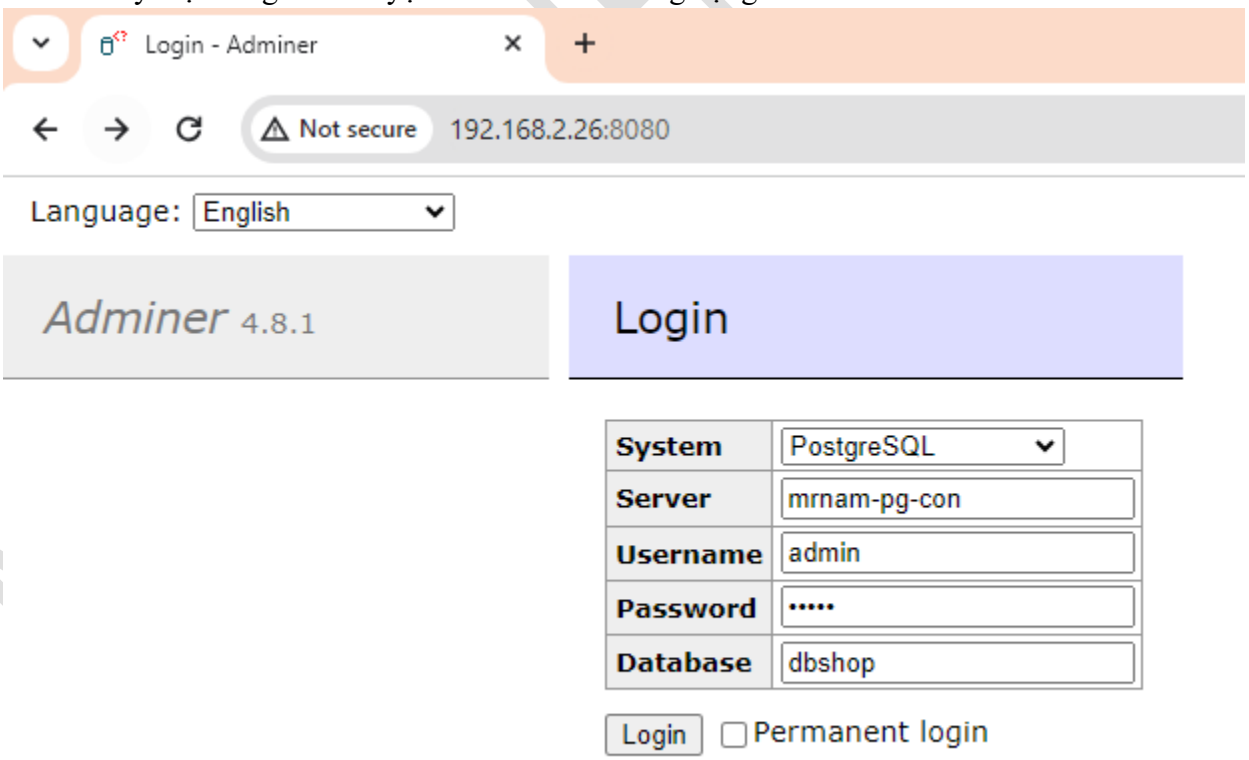
2. Khởi chạy container mrnam-adminer-con với cấu hình
   sudo docker run --name mrnam-adminer-con -p 8080:8080 -e PGUSER='admin' -e PGPASSWORD='admin' -e PGDATABASE='dbshop' -e PGHOST='mrnam-pg-con' -e PGPORT=5432 -d adminer

```
osboxes@osboxes:~$ sudo docker run --name mrnam-adminer-con -p 8080:8080 -e PGUSER='admin' -e PGPASSWORD='admin' -e PGDATABASE='dbshop' -e PGHOST='mrnam-pg-con' -e PGPORT=5432 -d adminer
ac42b79b27d4151da06830346424ae55f5f86976e581908c998bb0f679686db4
```

3. Thêm container mrnam-adminer-con và mạng mrnam-ad-db-net
   sudo docker network connect mrnam-ad-db-net mrnam-adminer-con

```
osboxes@osboxes:~$ sudo docker network connect mrnam-ad-db-net mrnam-adminer-con
```

4. Trở về máy thật dùng trình duyệt để kiểm tra thử ứng dụng adminer



5. Đăng nhập với tài khoản admin và mật khẩu admin

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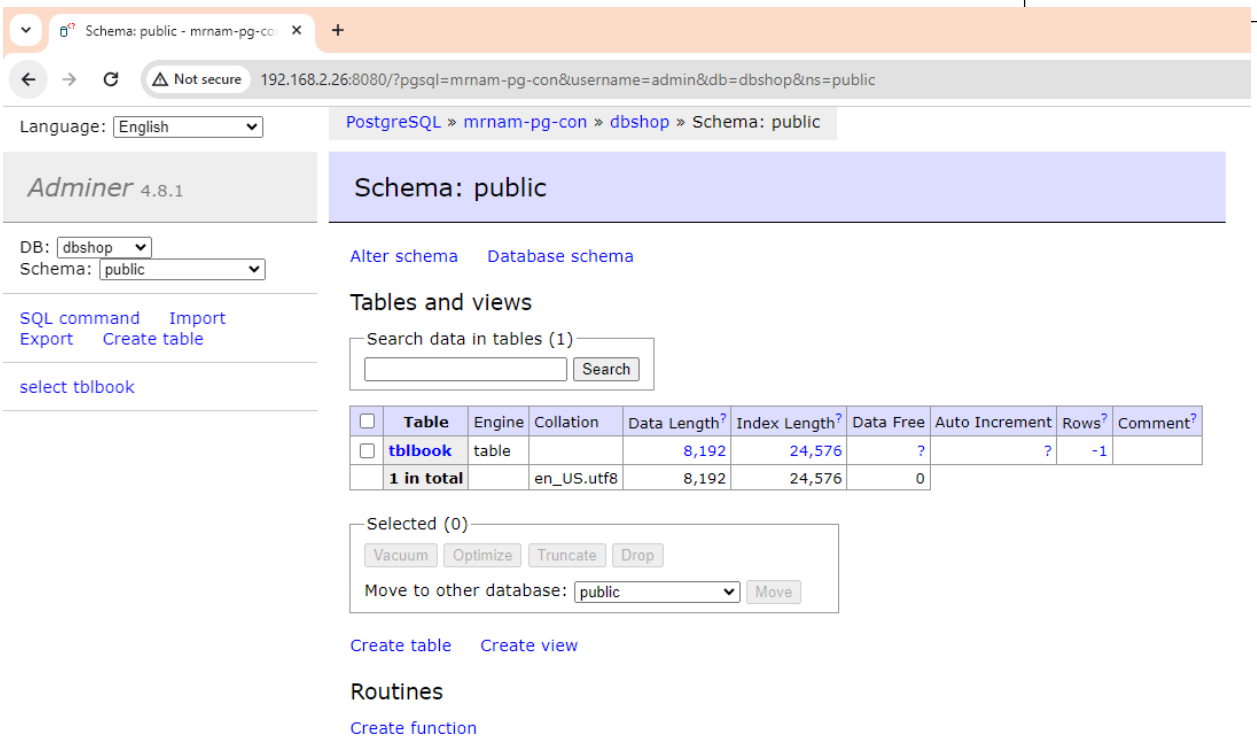

Phần 8: RESET DOCKER (để chuyển qua học Docker Compose)

sudo docker stop mrnam-api-con

sudo docker stop mrnam-adminer-con

sudo docker stop mrnam-pg-con

sudo docker container ls -a

sudo docker system prune

```
osboxes@osboxes:~$ sudo docker system prune
WARNING! This will remove:
  - all stopped containers
  - all networks not used by at least one container
  - all dangling images
  - all dangling build cache

Are you sure you want to continue? [y/N] y
```

sudo docker network prune

sudo docker volume prune