Labo HTTP Infra

Directives summary

Objectives

- Learn (web infra, apache2 and express.js)
- Implement (dynamic web app HTML, CSS, JS + Ajax Requests)
- Practice (docker)

General instructions

- Instructions are given through videos at each step (if correctly done, ensure a grade of 4.5)
- The rest of the points come from your own research and creativity.
- We can use other technologies if we want (apache ⇔ nginx, express.js ⇔ django, ...)

> Go ahead, we **LOVE** that

Preamble

- Each step have its own folder.
- In each folder you will find a `docker-compose.yml` file: You can simply run the following command from each step folder

```
docker-compose up
```

- The steps 3 and 4 re-use some images from steps 1 and 2: you need to build these images before doing `docker-compose up`.
  This can be done by running `docker-compose build` in `step1/` and `step2/` folders

Required Steps (max grade: 4.5)

Step 1: Static HTTP server with apache httpd

Goals

- Create a github repository
- Create a apache2 docker image with custom content

Remarks

The repository is available here

startbootstrap.com: some bootstrap templates.

The template we used: Freelancer (download)

```
# Build
## Using Docker
docker build -f apache2.Dockerfile -t res-http-apache2-static .
## Using Docker compose
docker-compose build

# Run
## Using Docker
docker run -p "8080:80" res-http-apache2-static
## Using Docker compose (Build + Run)
docker-compose up # add -d option to run as a daemon (i.e in the background)
```

Nb: We will keep using `docker-compose` on the next steps to deploy the services

Step 2: Dynamic HTTP server with express.js

Goals

- Write a dynamic HTTP app (express.js)
- Query the server (postman)

Remarks

We made 3 versions:

- Express
- Flask
- CrowCpp: The build has been leveraged using 2 methods:
  - Using a docker container as a build environement:

    ```
    # The following instructions are run from the cpp/ folder
    # Build the build environment image
    docker build -f build.Dockerfile -t res-crow-build .
    # Mount the sources and build. The binary will then be available in the sources' folder
    docker run --rm -v "$PWD:/build" res-crow-build g++ server.cpp -o server -lpthread
    # Create the final image by copying the binary inside of it
    docker build --no-cache -f crow.Dockerfile -t res-crow .
    ```

    (see `step2/cpp/build.sh` script)

    This method is better when building with local cache (e.g. node) since we won't have to pull then everytime.

  - Using Docker multi-step build:

    1. One image is created with the required package to build
    2. A second image is created from the previous one and the sources. The binary is built inside of this image
    3. This final image will simply copy from the second one the compiled binary.

    This method is standalone and perfectly reproducible, but will take longer since it won't be able to remember cache information between the builds. It is easier to use with docker-compose since we don't have to do extra previous steps before running `docker-compose up`

Step 3: Reverse proxy with apache (static configuration)

Goals

Setup the reverse proxy: see Reverse Proxy Guide

Remarks

- There are 2 configurations (file `vhosts1.conf`):
  - The one required: it can be accessed using `res-http.localhost`. The route `/` provides the static website, and `/api/students` provides the data.
    There are also `/api/express` which is an "alias" for `/api/students`, and `/api/flask` which is another server having the same api but made using Flask framework.
    We can change

    ```
    ProxyPass        "/api/students" "http://students-api:8080/"
    ProxyPassReverse "/api/students" "http://students-api:8080/"
    ```

    to

    ```
    ProxyPass        "/api/students" "http://flask-app:5000/"
    ProxyPassReverse "/api/students" "http://flask-app:5000/"
    ```

    And it would still work
  - The second configuration (file `vhosts2.conf`): It provides direct access to the services
    - `static-apache2.localhost`: Another way to access the static apache server
    - `crow-app.localhost`: An access to a server made with CrowCpp
    - `flask-app.localhost`: An access to a server made with Flask (the one available at `res-http.localhost/api/flask`)
    - `express-app.localhost`: An access to a server made with express (the one available at `res-http.localhost/api/student`)
    - `wordpress.localhost`: A wordpress server as a mere example for the reverse proxy
- This step re-uses the images generated on step 1 and 2. They must have been built beforehand.
- We used `*.localhost` domains to avoid dealing with DNS and updating configuration files.
- It is NOT possible to prevent access to containers from host by just using Docker. The containers are using interfaces on the host machine. **BUT** the browsers have a same-origin-policy which prevents cross-origin-resource-sharing, i.e. fetching data from another source than the current page's one.
  But, on Windows and Mac using Docker-Desktop, docker is run in a virtual machine. In this case, the services are not available from the host directly without using port forwarding.
- Docker networks have their own dns resolution, we do not need to use static ip adresses and can use hostnames instead. This allows us to have 2 or more proxypasses for the same host using `aliases` to have multiple domains for each host.
- The apache static configuration will have to be updated manually each time a network change is made (change of ip/hostname, adding/removing service/replicas, ...)

Step 4: AJAX requests with JQuery

Goals

- Use Jquery to make an AJAX request
- Jquery is not part of bootstrap anymore. We had to import it from a CDN.

```
<script src="https://code.jquery.com/jquery-3.6.0.min.js"
integrity="sha256-/xUj+3OJU5yExlq6GSYGSHk7tPXikynS7ogEvDej/m4="
crossorigin="anonymous"></script>
```

Remarks

- This step re-use the images generated on step 1 and 2. They must have been built beforehand.

Step 5: Dynamic reverse proxy configuration

Goals

- Use traefik for dynamic reverse proxy.

Additional steps to get extra points on top of the "base" grade

Load balancing: multiple server nodes (0.5 pt)

Using Traefik, we juste need to have many instance of the same service routed by traefik (i.e. the correct labels must be defined)

```
- "traefik.enable=true"
- "traefik.http.routers.static.rule=Host(`res-http.localhost`)"
- "traefik.http.routers.static.entrypoints=web"
```

We can see that the default behavior is using a round-robin load balancing.

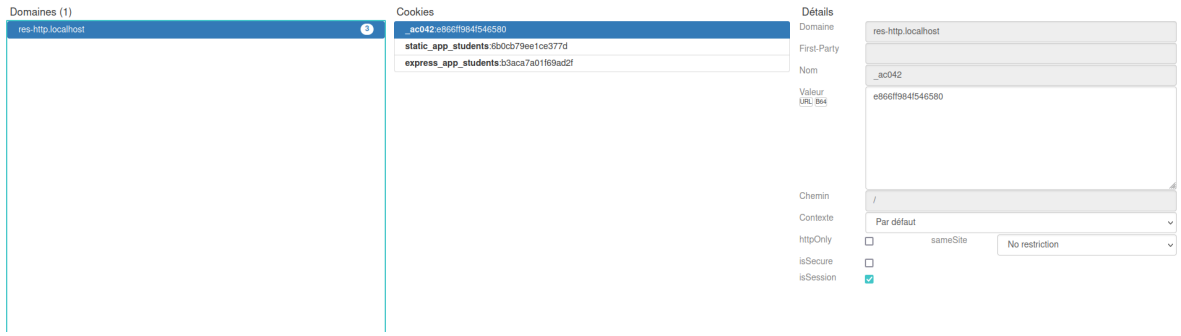
```
static_1  | 172.27.0.4 - - [24/May/2022:18:29:44 +0000] "GET / HTTP/1.1" 304 -
static_3  | 172.27.0.4 - - [24/May/2022:18:29:46 +0000] "GET / HTTP/1.1" 304 -
static_1  | 172.27.0.4 - - [24/May/2022:18:29:48 +0000] "GET / HTTP/1.1" 304 -
static_2  | 172.27.0.4 - - [24/May/2022:18:29:49 +0000] "GET / HTTP/1.1" 304 -
static_3  | 172.27.0.4 - - [24/May/2022:18:29:50 +0000] "GET / HTTP/1.1" 304 -
static_1  | 172.27.0.4 - - [24/May/2022:18:29:52 +0000] "GET / HTTP/1.1" 304 -
static_2  | 172.27.0.4 - - [24/May/2022:18:29:53 +0000] "GET / HTTP/1.1" 304 -
static_3  | 172.27.0.4 - - [24/May/2022:18:29:54 +0000] "GET / HTTP/1.1" 304 -
static_1  | 172.27.0.4 - - [24/May/2022:18:29:56 +0000] "GET / HTTP/1.1" 304 -
static_2  | 172.27.0.4 - - [24/May/2022:18:29:58 +0000] "GET / HTTP/1.1" 304 -
static_3  | 172.27.0.4 - - [24/May/2022:18:30:26 +0000] "GET / HTTP/1.1" 304 -
static_1  | 172.27.0.4 - - [24/May/2022:18:30:27 +0000] "GET / HTTP/1.1" 304 -
static_2  | 172.27.0.4 - - [24/May/2022:18:30:29 +0000] "GET / HTTP/1.1" 304 -
static_3  | 172.27.0.4 - - [24/May/2022:18:30:30 +0000] "GET / HTTP/1.1" 304 -
static_1  | 172.27.0.4 - - [24/May/2022:18:30:32 +0000] "GET / HTTP/1.1" 304 -
static_2  | 172.27.0.4 - - [24/May/2022:18:30:33 +0000] "GET / HTTP/1.1" 304 -
static_3  | 172.27.0.4 - - [24/May/2022:18:30:34 +0000] "GET / HTTP/1.1" 304 -
static_1  | 172.27.0.4 - - [24/May/2022:18:30:36 +0000] "GET / HTTP/1.1" 304 -
static_2  | 172.27.0.4 - - [24/May/2022:18:30:38 +0000] "GET / HTTP/1.1" 304 -
static_3  | 172.27.0.4 - - [24/May/2022:18:30:39 +0000] "GET / HTTP/1.1" 304 -
static_1  | 172.27.0.4 - - [24/May/2022:18:30:41 +0000] "GET / HTTP/1.1" 304 -
static_2  | 172.27.0.4 - - [24/May/2022:18:30:42 +0000] "GET / HTTP/1.1" 304 -
```

Load balancing: round-robin vs sticky sessions (0.5 pt)

To use sticky sessions, we need 2 labels:

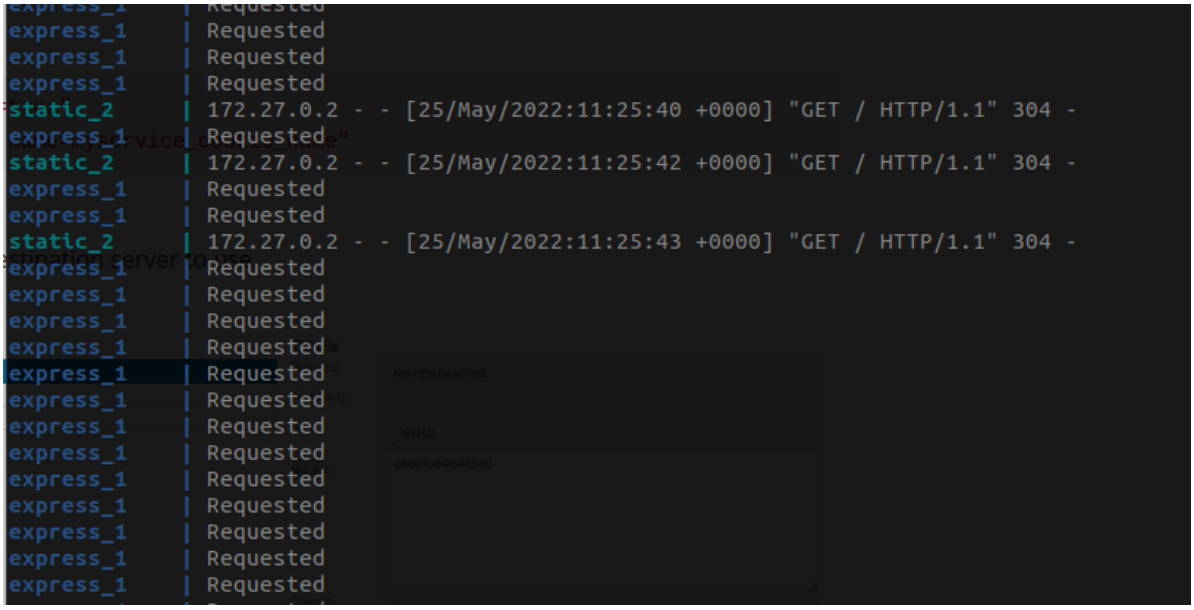
```
- "traefik.http.services.myservername.loadbalancer.sticky.cookie=true"
-
"traefik.http.services.myservername.loadBalancer.sticky.cookie.name=myservice_cookie_name"
```

- the `cookie=true` enable the sticky session cookie
- the `cookie.name=...` used to know the cookie used to remember the destination server to use.
  By default, a name is provided using a hash

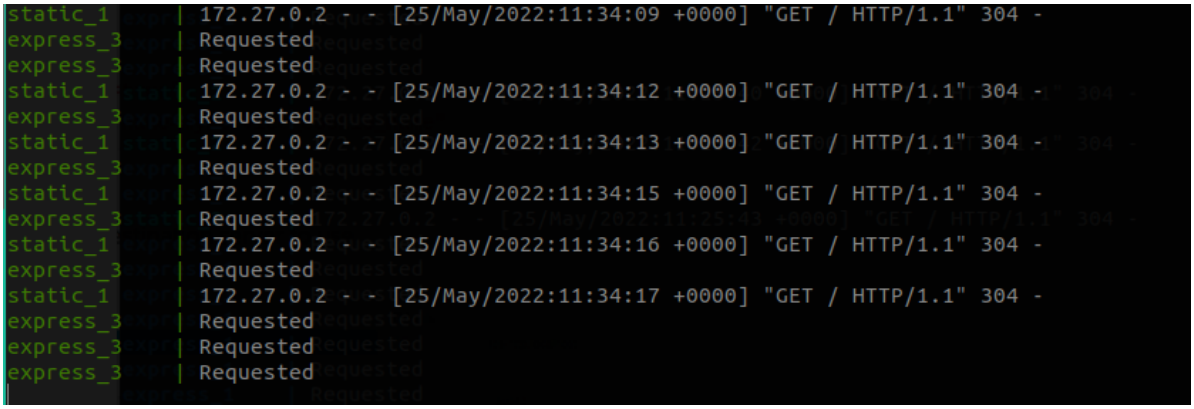


(This view of the cookie is provided by "Cookie Quick Manager" Firefox extension)

As we can see, each reload of the page will request the `static_2` server, eventhough there are 2 other server `statcic_1` and `static_3`. Also, this server will always query the same express server `express_1`

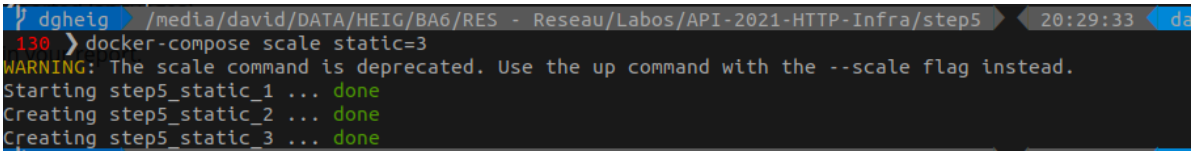


But when accessed from another context (using another browser or private navigation), we may use other servers



Dynamic cluster management (0.5 pt)

```
1 docker-compose scale static=3
```



This command will take the service `static` (according to the docker-compose file) and create/delete instances to match the requested number of instance (here: 3).

We can scale many services at once

```
1 docker-compose scale static=3 express=4
```

Management UI (0.5 pt)

We will use Portainer-ce.

```
  portainer:
    image: portainer/portainer-ce:latest
    container_name: portainer
    restart: unless-stopped
    security_opt:
      - no-new-privileges:true
    volumes:
      - /etc/localtime:/etc/localtime:ro
      - /var/run/docker.sock:/var/run/docker.sock:ro
      - portainer-data:/data
    ports:
      - 9000:9000
```

Nb: We do not need special routing from traefik.

- The UI is available at `localhost:9000`.
- We need to configure a local docker by using the socket (available inside the container through a mount)