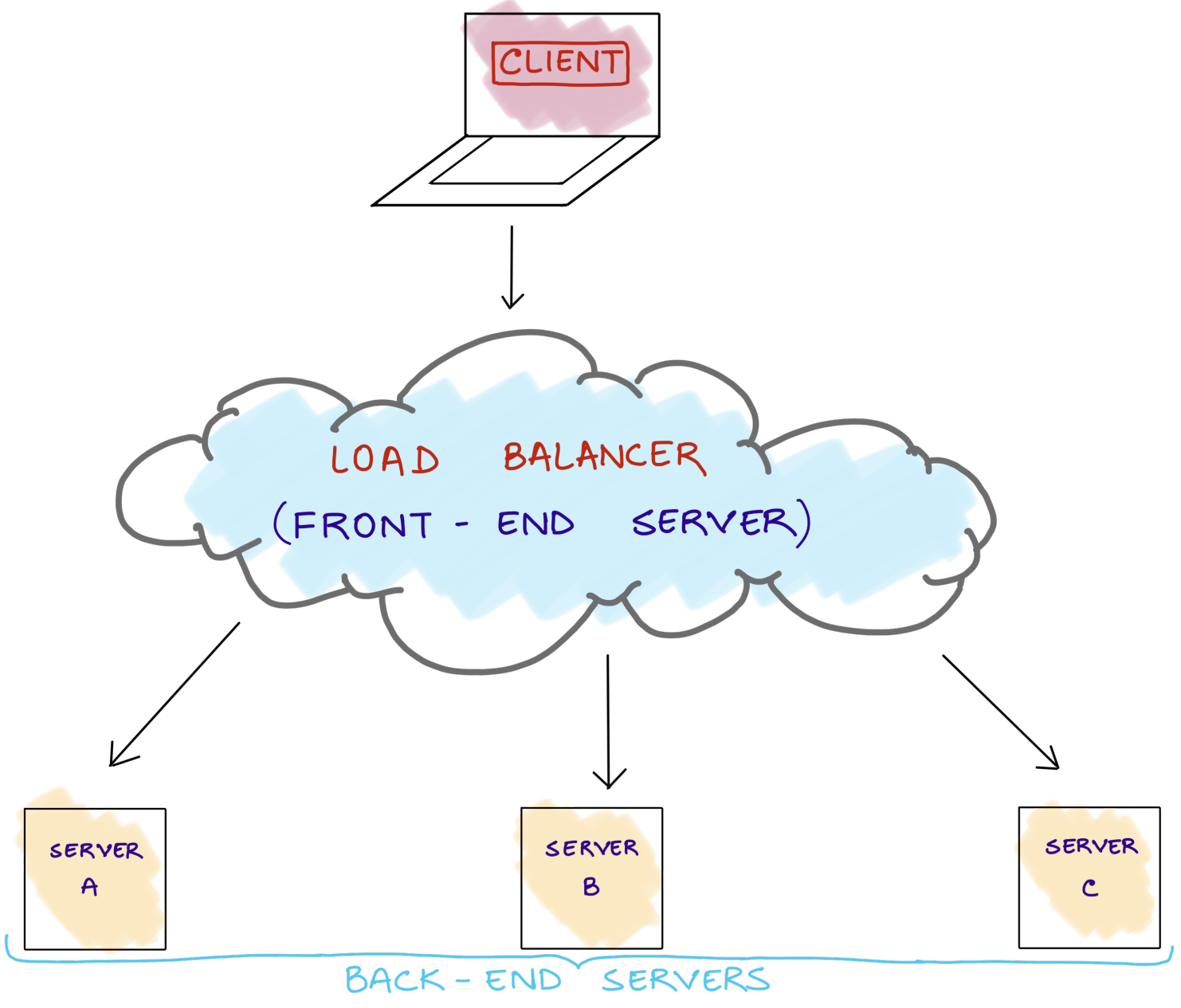
Automating Webservers Using Ansible

(PERFORMED BY VINIT RAJ)

IN THIS PROJECT, WE'LL IMPLEMENT FOLLOWING OBJECTIVES:-

- SETTING UP LOAD BALANCER WHICH WILL WORK AS FRONT-END SERVER.
- USE OF ROUND ROBIN ALGORITHM IN LOAD BALANCING.
- USE OF `HAPROXY` AS FRONT END WEBSERVER.
- USE OF APACHE's HTTPD WEBSERVER AS BACKEND WEBSERVER.
- IMPLEMENT HORIZONTAL SCALING.

DIAGRAMATIC REPRESENTATION OF OUR SETUP :-

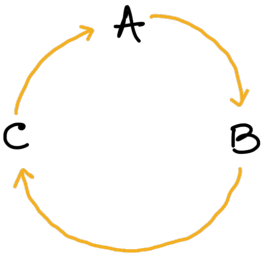


★ HOW DOES ROUND ROBIN ALGORITHM WORK ?

→ In our case, the Round Robin algorithm will send connections to servers in CYCLIC ORDER.

- → 1st CONNECTION : Server A.
- → 2nd CONNECTION : Server B.
- → 3rd CONNECTION : Server C.
- → 4th CONNECTION : Server A.

PATTERN :



★ HERE, OUR FRONT END SERVER ACTS AS 'REVERSE PROXY'.

A reverse proxy is a server that sits in front of web-servers and forwards client requests to the backend web servers.

★ FUNCTIONING OF LOAD BALANCER (FRONT WEB SERVER) :-

① REQUEST FROM CLIENT GOES TO LOAD BALANCER.

↓

② LOAD BALANCER CREATES A NEW REQUEST.

↓

③ THIS NEW REQUEST IS SENT TO THE BACKEND SERVER.

↓

④ BACK END SERVERS SEND THE REQUESTED DATA TO LOAD BALANCER.

↓

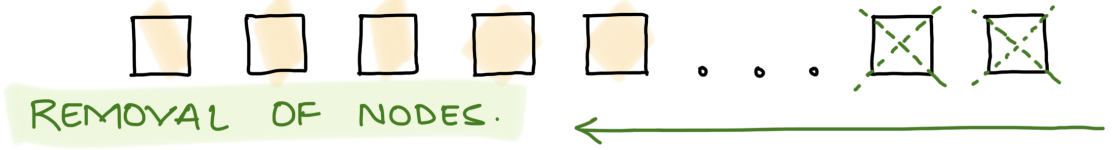
⑤ LOAD BALANCER SENDS THE RECEIVED DATA BACK TO CLIENT.

★ HORIZONTAL SCALING :-

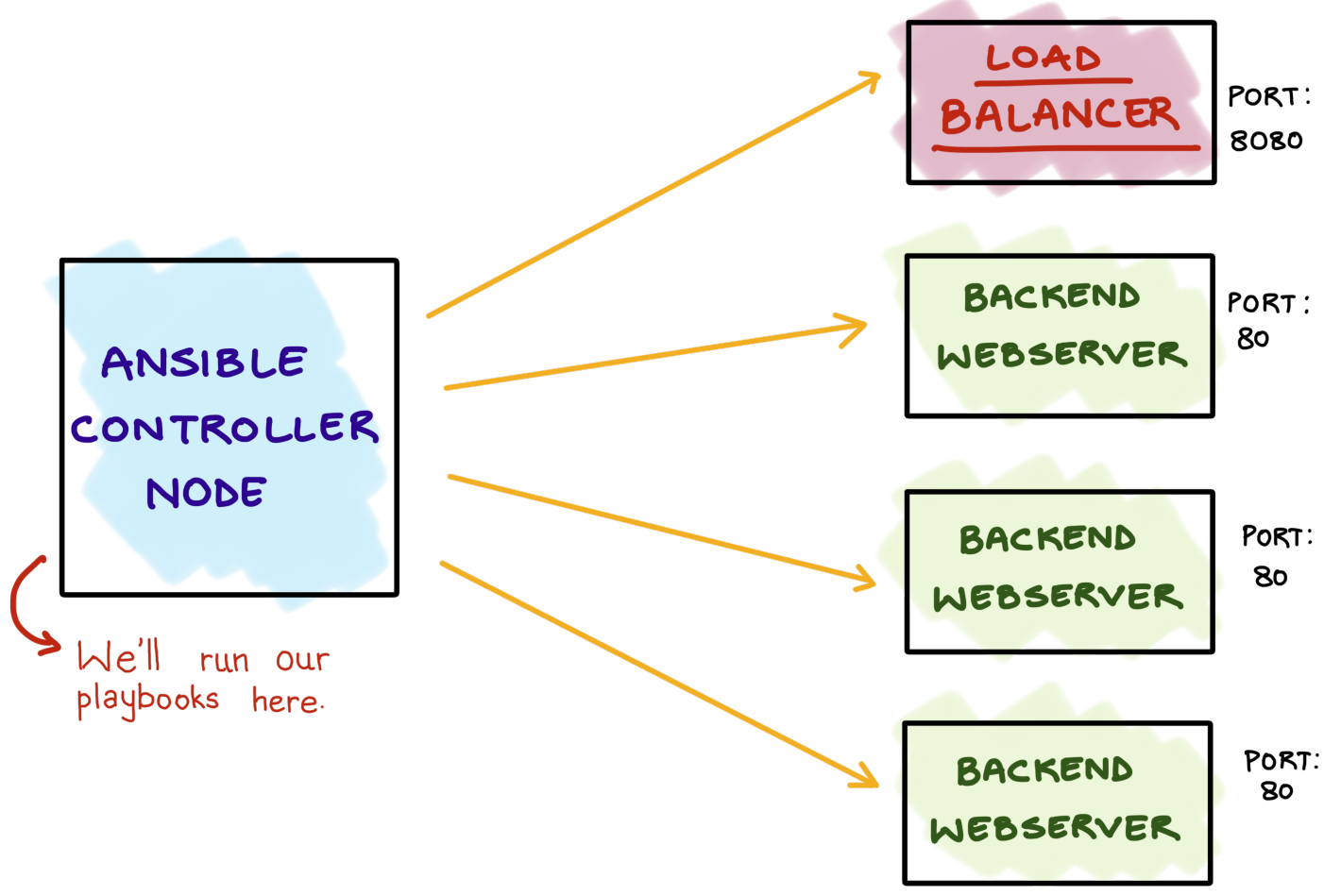
Horizontal scaling refers to adding additional nodes or machines to the infrastructure to cope new demands.

- SCALE OUT :-

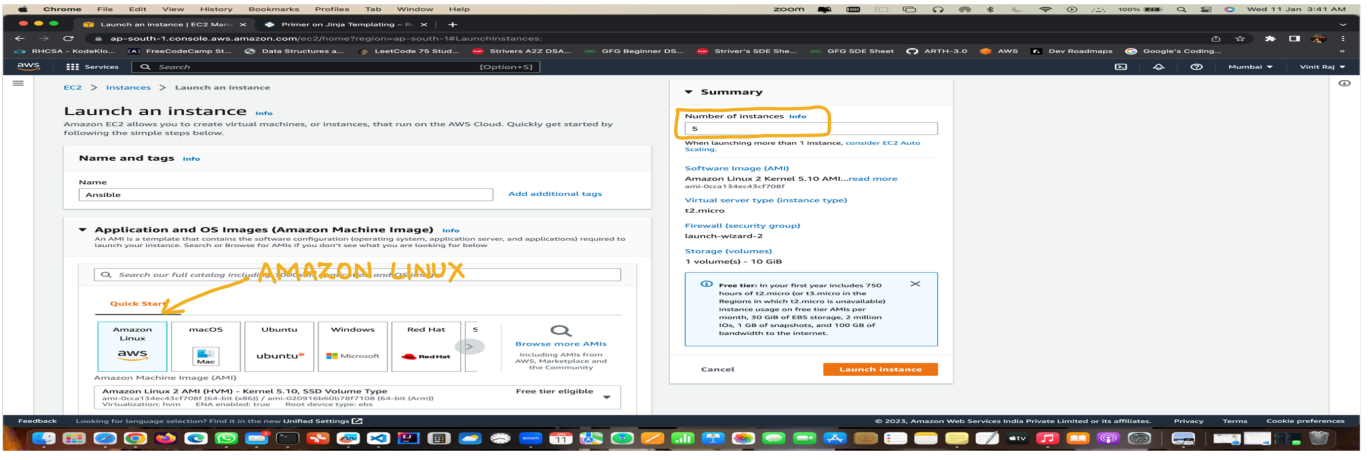
- SCALE IN :-

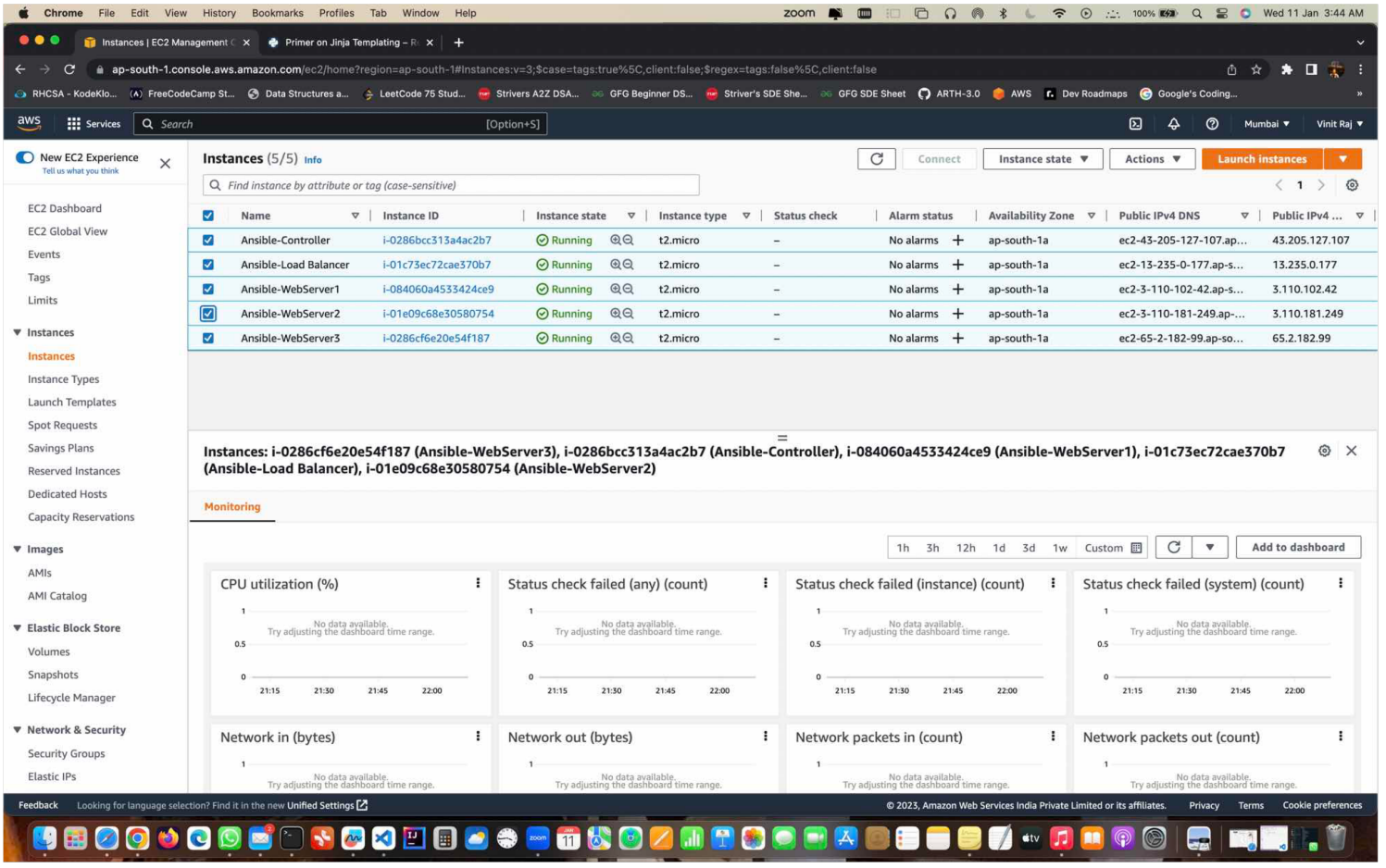


★ SCHEMATICS OF OUR SETUP :-

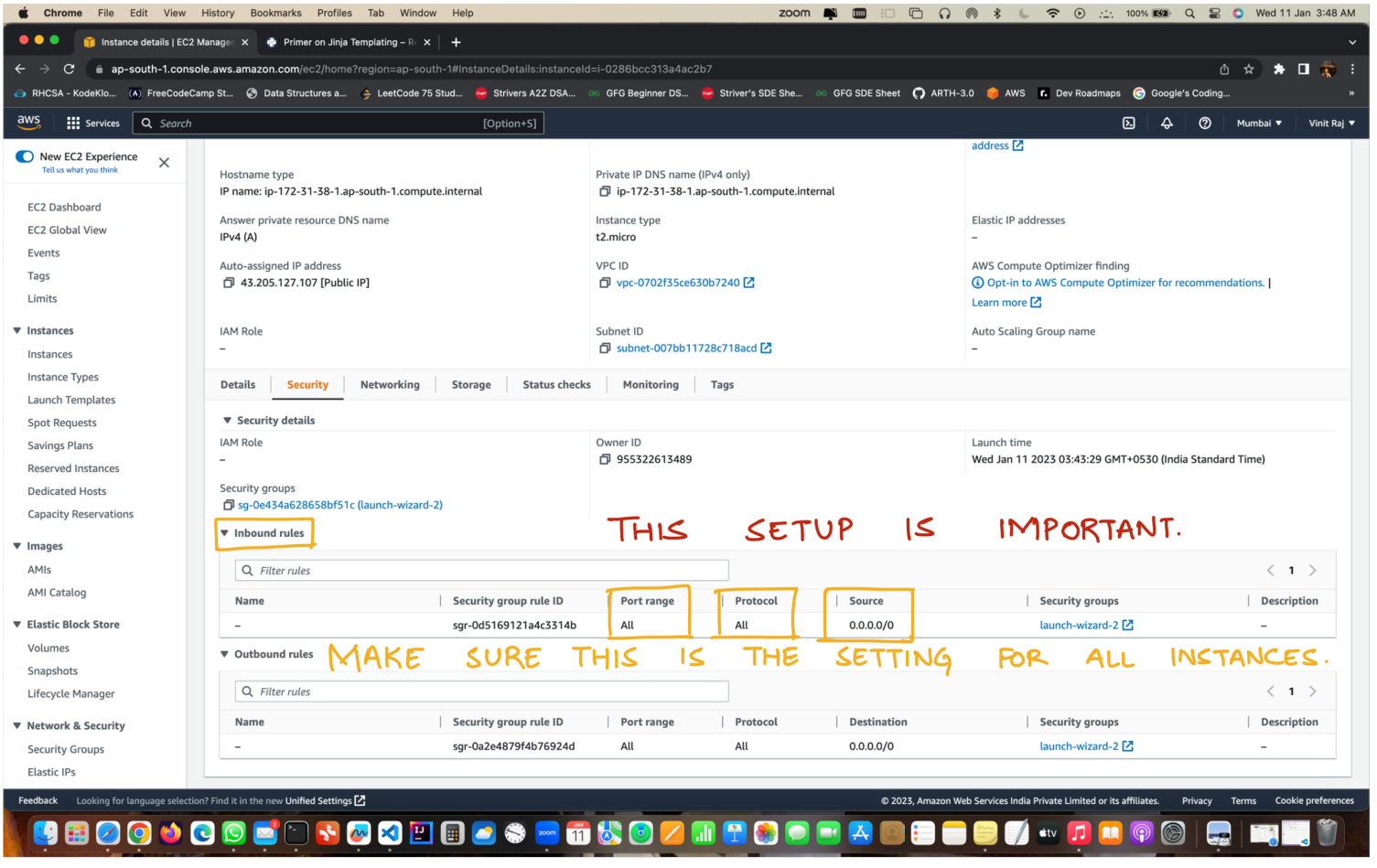


→ HERE, WE'LL LAUNCH 05 INSTANCES OF AMAZON LINUX.

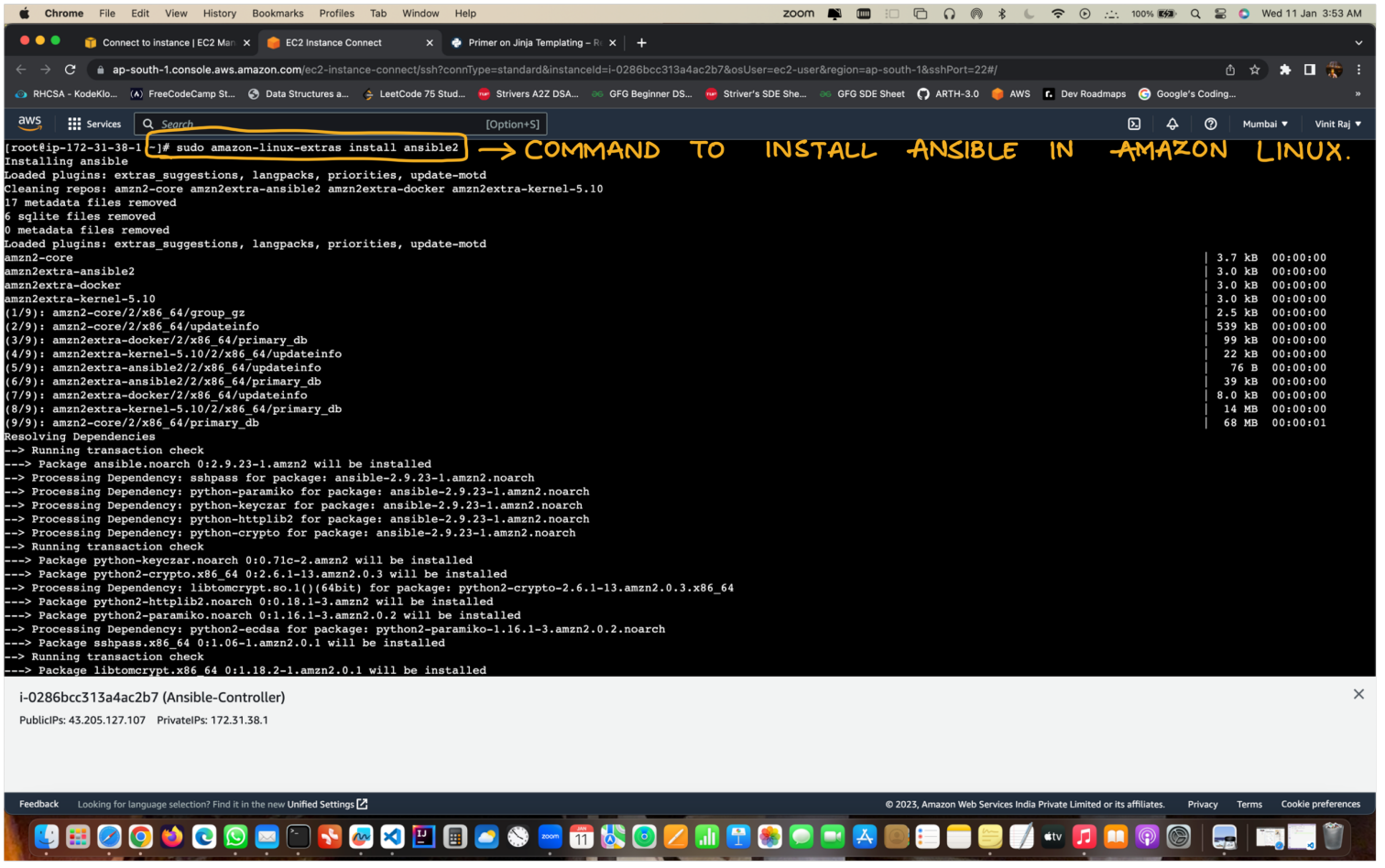




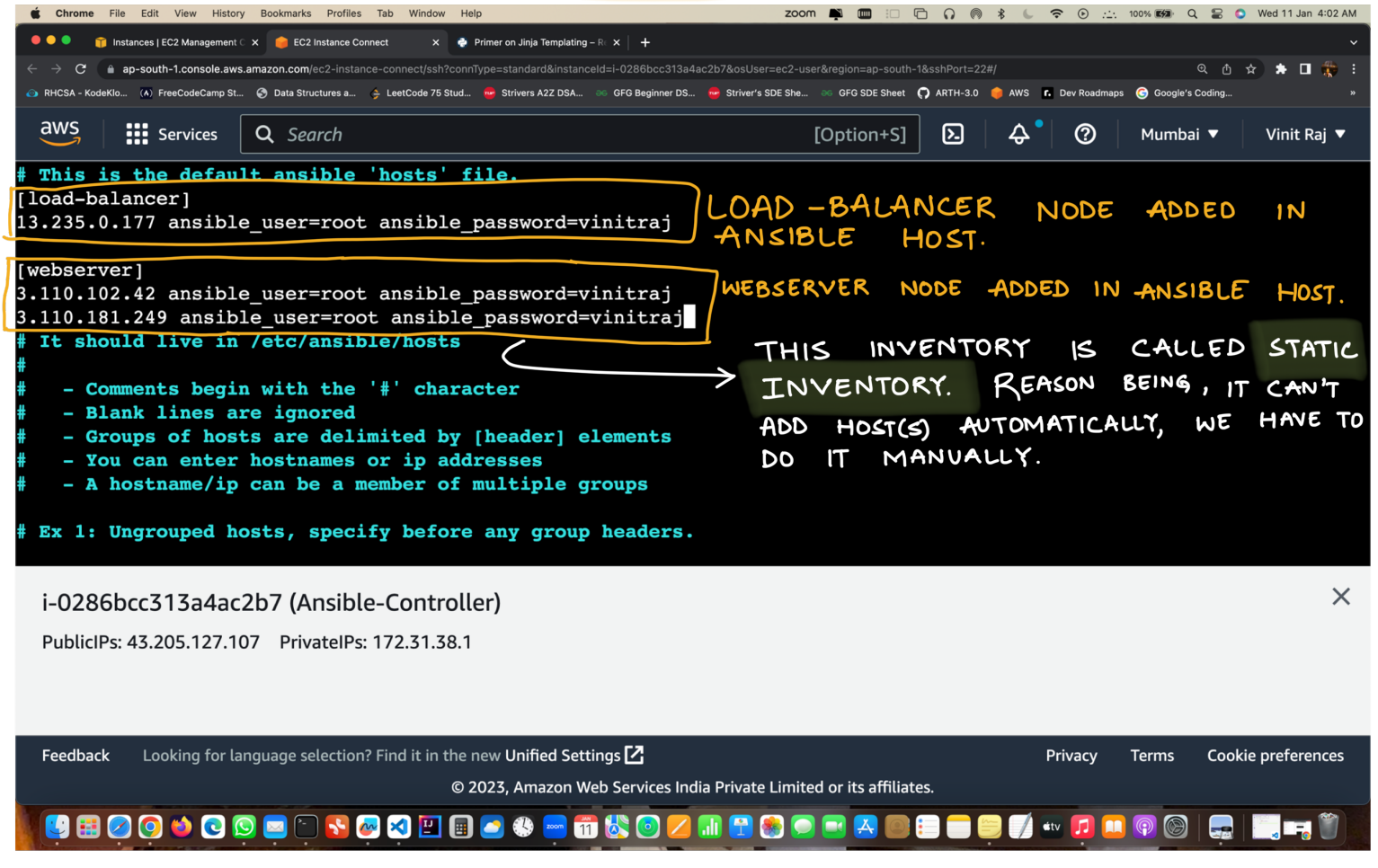
→ MAKE SURE THAT CONNECTIONS ARE ALLOWED FROM ALL IP ADDRESSES AND FROM ALL PORT NUMBERS.

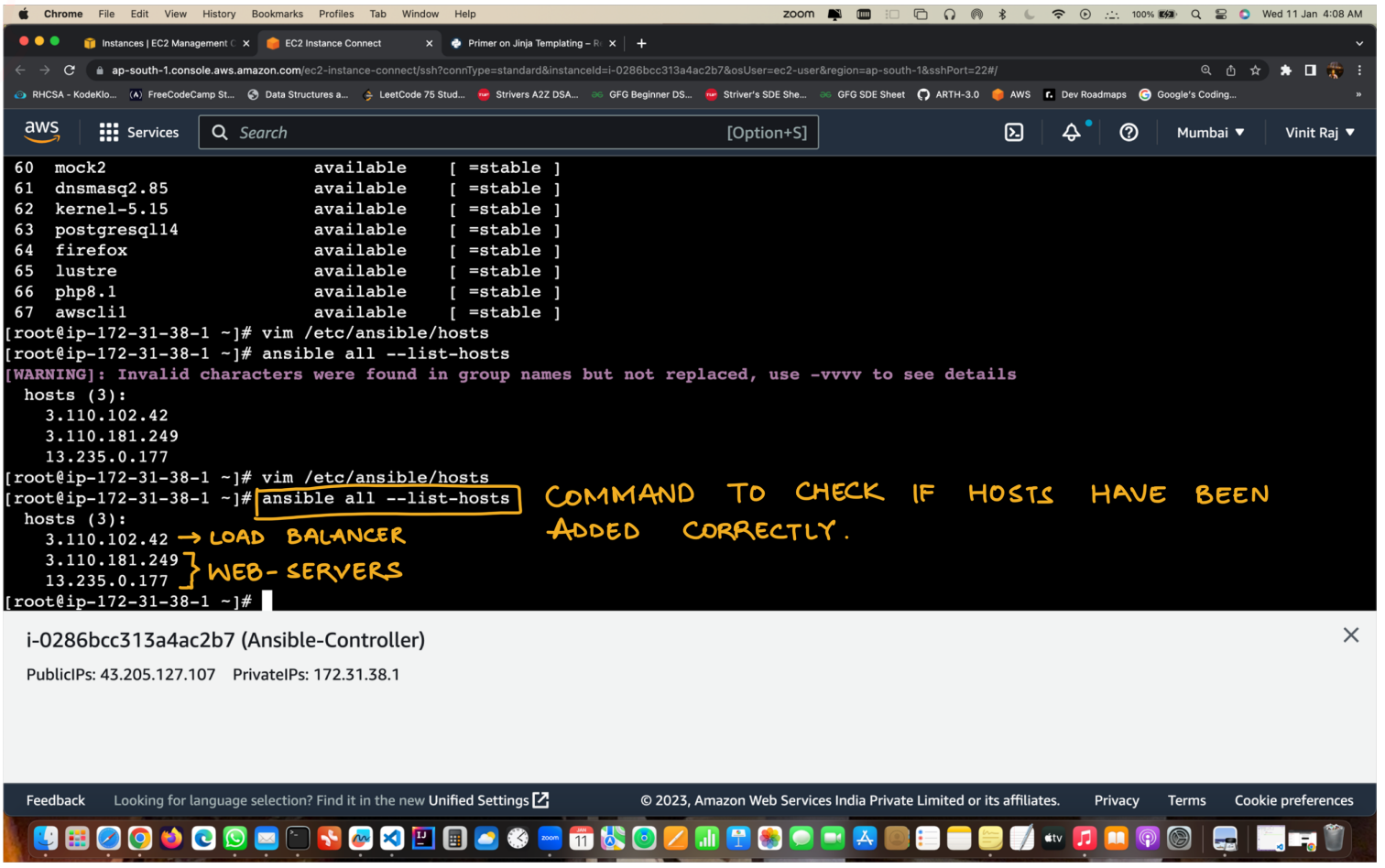


→ NOW, INSTALL ANSIBLE IN ANSIBLE CONTROLLER NODE.



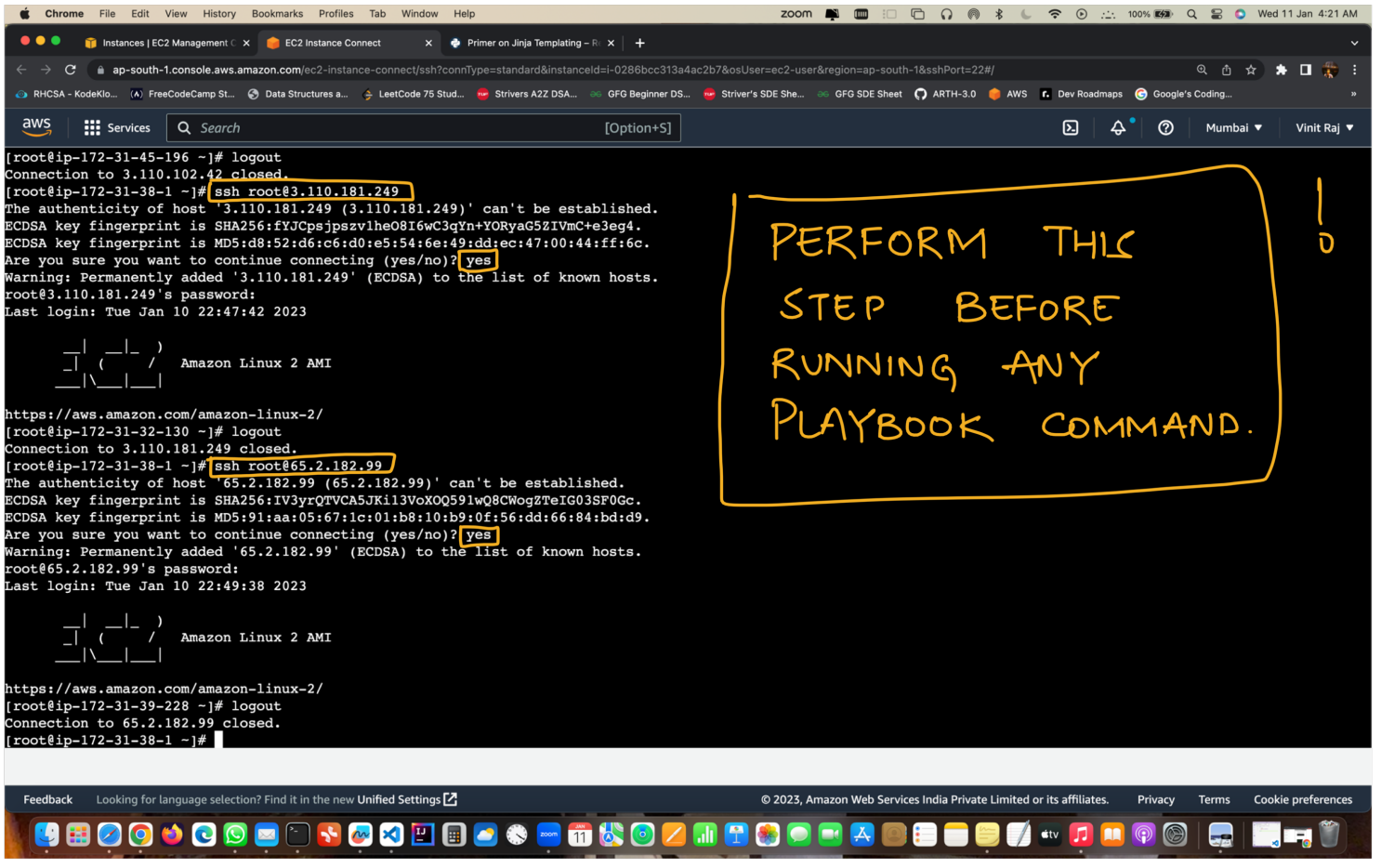
→ NOW, ADD THE NODES IN ANSIBLE INVENTORY (# vim /etc/ansible/hosts)



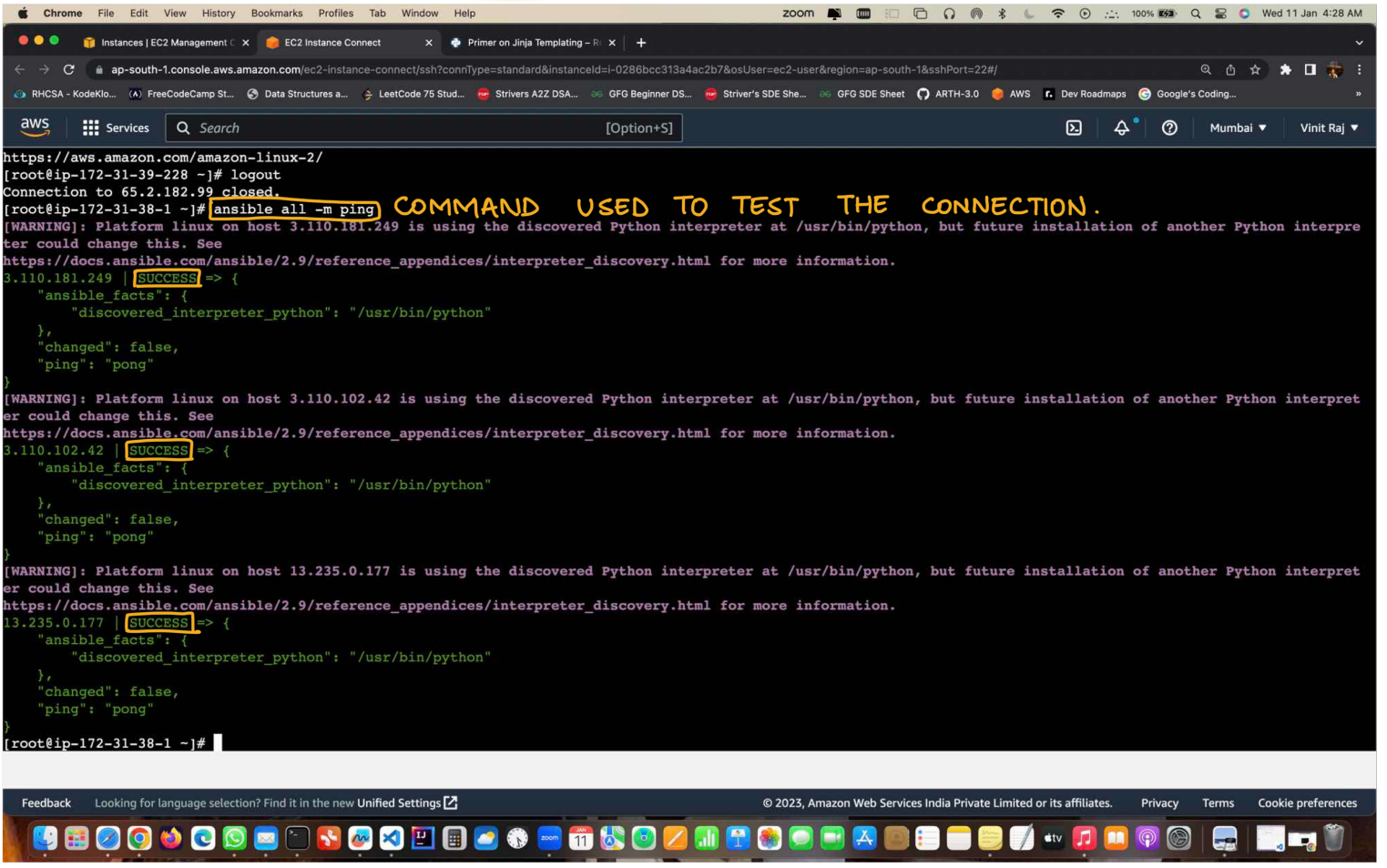


→ NOW, TEST THE SSH CONNECTION WITH ALL THE NODES:-

(# ssh root@[IP Add.])



→ NOW, CHECK THE CONNECTION BETWEEN MANAGER AND CONTROLLER NODES :-



→ INSIDE CONTROLLER NODE, WE'LL CREATE A DIRECTORY NAMED 'code' :- (# mkdir code) → (# cd code)

→ NOW, WE WILL CREATE PLAYBOOK FILE FOR LOAD-BALANCER WITH FOLLOWING CONTENT : (# vim lb.yml)

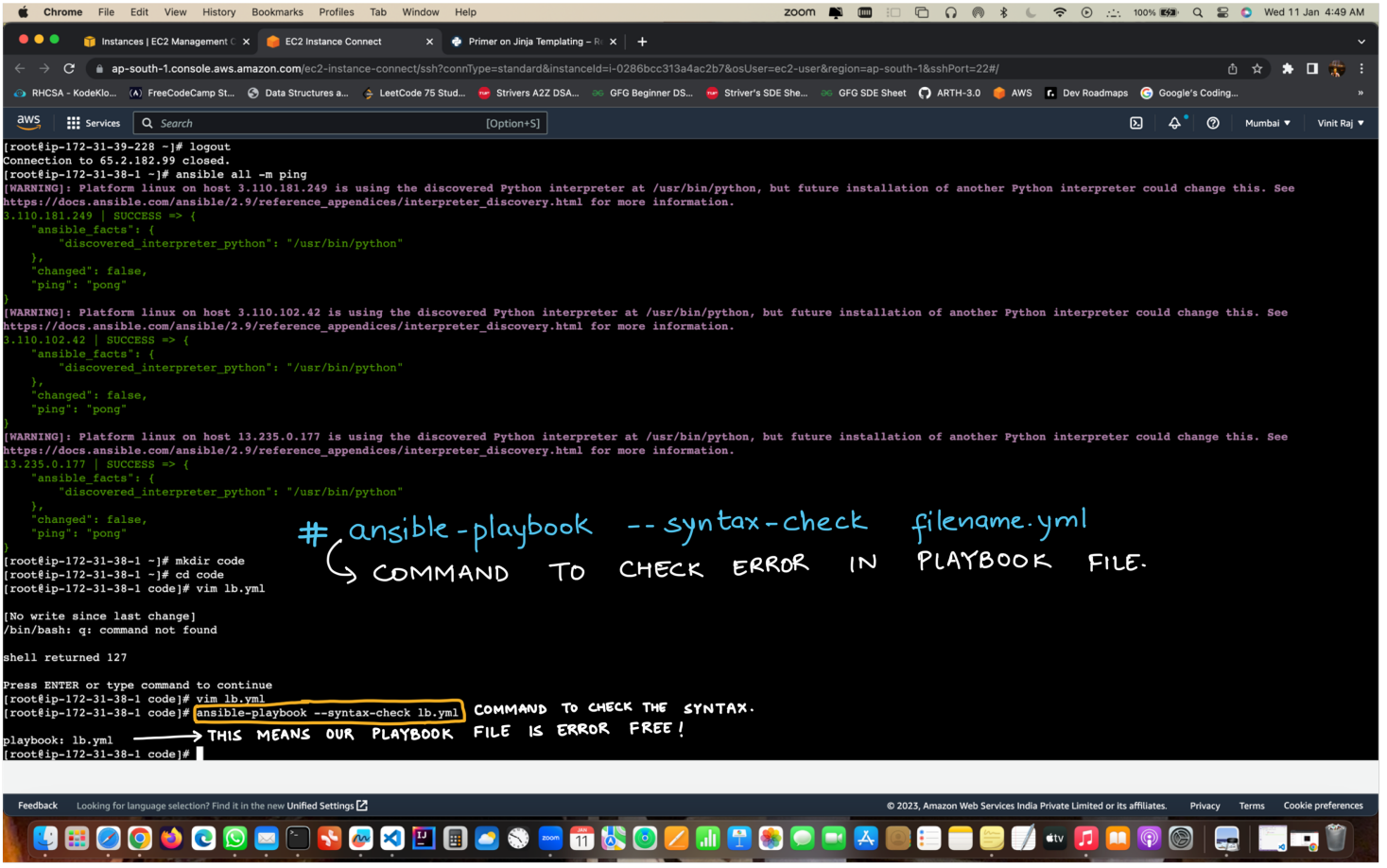
```
- hosts: loadbalancer
  tasks:
    - name: "Installing HAProxy Load Balancer"
      package:
        name: "haproxy"
        state: present

    - name: "Registering webservers by adding them in configuration file"
      template:
        src: "local.conf.j2"
        dest: "/etc/haproxy/haproxy.cfg"

    - name: "Starting the Load Balancer"
      service:
        name: "haproxy"
        state: restarted
        enabled: true
```

OUR HOST IS LOAD BALANCER.

NAME OF THE LOAD BALANCING SERVICE WE'LL USE.

HERE, INSTEAD OF COPY, WE'LL USE TEMPLATE (TO GET THE FUNCTIONALITIES OF JINJA TEMPLATING)

.j2 IS THE EXTENSION FOR JINJA TEMPLATE FILE (WE'RE USING JINJA TEMPLATING FILE TO GET FUNCTIONALITIES WHICH AREN'T AVAILABLE IN COPY).



→ NOW, WE'LL CREATE TEMPLATE CONFIGURATION FILE FOR HAPROXY WHICH WILL REGISTER WEBSERVERS IN HAPROXY :- (# vim local.conf.j2)

```
frontend loadbalancer          THIS MEANS LOADALANCER NODE WILL BE USED AS FRONT END SERVER.
        bind *:8080            THIS BINDS LOADBALANCER NODE WITH PORT NO. : 8080
        timeout client 10s
        defualt_backend webserver   THIS SETS WEBSERVER NODES AS DEFAULT BACKEND SERVER(S).

backend webserver
        balance roundrobin     THIS LETS ROUND ROBIN ALGORITHM DO THE BALANCING.
        timeout connect 10s
        timeout server 10s
{% for ip in groups['webserver'] %}     SYNTAX OF FOR LOOP IN JINJA TEMPLATE.
        server app{{ loop.index }} {{ ip }}:80
{% endfor %}
~
~
```

GROUPS['WEBSERVER'] IS A MAGIC VARIABLE OF ANSIBLE : WHICH GIVES EVERY SINGLE IP ADDRESS PRESENT IN THE INVENTORY ADDED IN IT'S GROUP.

LOOP.INDEX RETURNS 01 : IF LOOP IS RUNNING FOR FIRST TIME;
RETURNS 02 : IF LOOP IS RUNNING FOR THE SECOND TIME.
:
RETURNS 'n' : IF LOOP IS RUNNING FOR THE nth TIME.

BINDS IP ADDRESS OF WEBSERVERS WITH PORT NO. 80.

→ NOW, WE'LL CREATE PLAYBOOK FILE FOR OUR WEBSERVERS WITH FOLLOWING CONTENT :- (# vim webserver.yml)

```
- hosts: webserver
  tasks:
    - name: "Installing Web Server (HTTPD)"
      package:
        name: "httpd"
        state: present

    - name: "Installing PHP package"
      package:
        name: "php"
        state: present

    - name: "Deploying (copying) Web Page"
      copy:
        src: "index.php"
        dest: "/var/www/html"
    - name: "Starting Web Server Now"
      service:
        name: "httpd"
        state: started
        enabled: true
```

HERE, WE'LL USE COPY MODULE BECAUSE WE NEED TO COPY THE CONTENT AS-IT-IS.

DEFAULT LOCATION TO HOST / DEPLOY WEBPAGE FOR HTTPD WEBSERVER.

→ NOW, WE'LL CREATE INDEX.PHP WEBPAGE FOR HTTPD WEBSERVER:-

(# vim index.php)

```
<pre>
    <?php
    print_r($_SERVER);
    ?>
</pre>
```

THIS COMMAND PRINTS THE DETAILS OF SERVER THE CLIENT IS CONNECTED TO.
WE ARE USING THIS TO VERIFY THAT THE LOAD BALANCER IS USING ROUND ROBIN ALGORITHM TO BALANCE CONNECTION REQUESTS.

→ NOW, IT'S TIME TO DEPLOY OUR SERVERS AND WEBPAGE:-

FIRST, I'LL DEPLOY BACKEND SERVER(S) :- (# ansible-playbook webserver.yml)

```
[root@ip-172-31-38-1 code]# date
Wed Jan 11 00:06:37 UTC 2023
[root@ip-172-31-38-1 code]# vim webserver.yml
[root@ip-172-31-38-1 code]# vim index.php

[No write since last change]
/bin/bash: q: command not found

shell returned 127

Press ENTER or type command to continue
[root@ip-172-31-38-1 code]# vim index.php
[root@ip-172-31-38-1 code]# ansible-playbook webserver.yml

PLAY [webserver] ***************************************************************************************************************************************************************

TASK [Gathering Facts] *********************************************************************************************************************************************************
[WARNING]: Platform linux on host 3.110.102.42 is using the discovered Python interpreter at /usr/bin/python, but future installation of another Python interpreter could change this. See
https://docs.ansible.com/ansible/2.9/reference_appendices/interpreter_discovery.html for more information.
ok: [3.110.102.42]
[WARNING]: Platform linux on host 3.110.181.249 is using the discovered Python interpreter at /usr/bin/python, but future installation of another Python interpreter could change this. See
https://docs.ansible.com/ansible/2.9/reference_appendices/interpreter_discovery.html for more information.
ok: [3.110.181.249]

TASK [Installing Web Server (HTTPD)] *******************************************************************************************************************************************
changed: [3.110.181.249]
changed: [3.110.102.42]

TASK [Installing PHP package] **************************************************************************************************************************************************
changed: [3.110.181.249]
changed: [3.110.102.42]

TASK [Deploying (copying) Web Page] ********************************************************************************************************************************************
changed: [3.110.102.42]
changed: [3.110.181.249]

TASK [Starting Web Server Now] *************************************************************************************************************************************************
changed: [3.110.181.249]
changed: [3.110.102.42]

PLAY RECAP *********************************************************************************************************************************************************************
3.110.102.42               : ok=5    changed=4    unreachable=0    failed=0    skipped=0    rescued=0    ignored=0
3.110.181.249              : ok=5    changed=4    unreachable=0    failed=0    skipped=0    rescued=0    ignored=0

[root@ip-172-31-38-1 code]#
```

→ NOW, WE'LL DEPLOY FRONTEND WEBSERVER WHICH ALSO ACTS AS LOAD BALANCER :- (# ansible-playbook lb.yml)

```
[root@ip-172-31-38-1 code]# vim lb.yml
[root@ip-172-31-38-1 code]# ansible-playbook lb.yml

PLAY [loadbalancer] ************************************************************************************************************************************************************

TASK [Gathering Facts] *********************************************************************************************************************************************************
[WARNING]: Platform linux on host 13.235.0.177 is using the discovered Python interpreter at /usr/bin/python, but future installation of another Python interpreter could change this. See
https://docs.ansible.com/ansible/2.9/reference_appendices/interpreter_discovery.html for more information.
ok: [13.235.0.177]

TASK [Installing HAProxy Load Balancer] ****************************************************************************************************************************************
ok: [13.235.0.177]

TASK [Registering webservers by adding them in configuration file] *************************************************************************************************************
fatal: [13.235.0.177]: FAILED! => {"changed": false, "msg": "Could not find or access 'local.cfg.j2'\nSearched in:\n\t/root/code/templates/local.cfg.j2\n\t/root/code/local.cfg.j2\n\t/root/code/temp
lates/local.cfg.j2\n\t/root/code/local.cfg.j2 on the Ansible Controller.\nIf you are using a module and expect the file to exist on the remote, see the remote_src option"}

PLAY RECAP *********************************************************************************************************************************************************************
13.235.0.177               : ok=2    changed=0    unreachable=0    failed=1    skipped=0    rescued=0    ignored=0

[root@ip-172-31-38-1 code]# ls
index.php  lb.yml  local.conf.j2  webserver.yml
[root@ip-172-31-38-1 code]# vim lb.yml
[root@ip-172-31-38-1 code]# ansible-playbook lb.yml

PLAY [loadbalancer] ************************************************************************************************************************************************************

TASK [Gathering Facts] *********************************************************************************************************************************************************
[WARNING]: Platform linux on host 13.235.0.177 is using the discovered Python interpreter at /usr/bin/python, but future installation of another Python interpreter could change this. See
https://docs.ansible.com/ansible/2.9/reference_appendices/interpreter_discovery.html for more information.
ok: [13.235.0.177]

TASK [Installing HAProxy Load Balancer] ****************************************************************************************************************************************
ok: [13.235.0.177]

TASK [Registering webservers by adding them in configuration file] *************************************************************************************************************
changed: [13.235.0.177]

TASK [Starting the Load Balancer] **********************************************************************************************************************************************
changed: [13.235.0.177]

PLAY RECAP *********************************************************************************************************************************************************************
13.235.0.177               : ok=4    changed=2    unreachable=0    failed=0    skipped=0    rescued=0    ignored=0

[root@ip-172-31-38-1 code]#
```

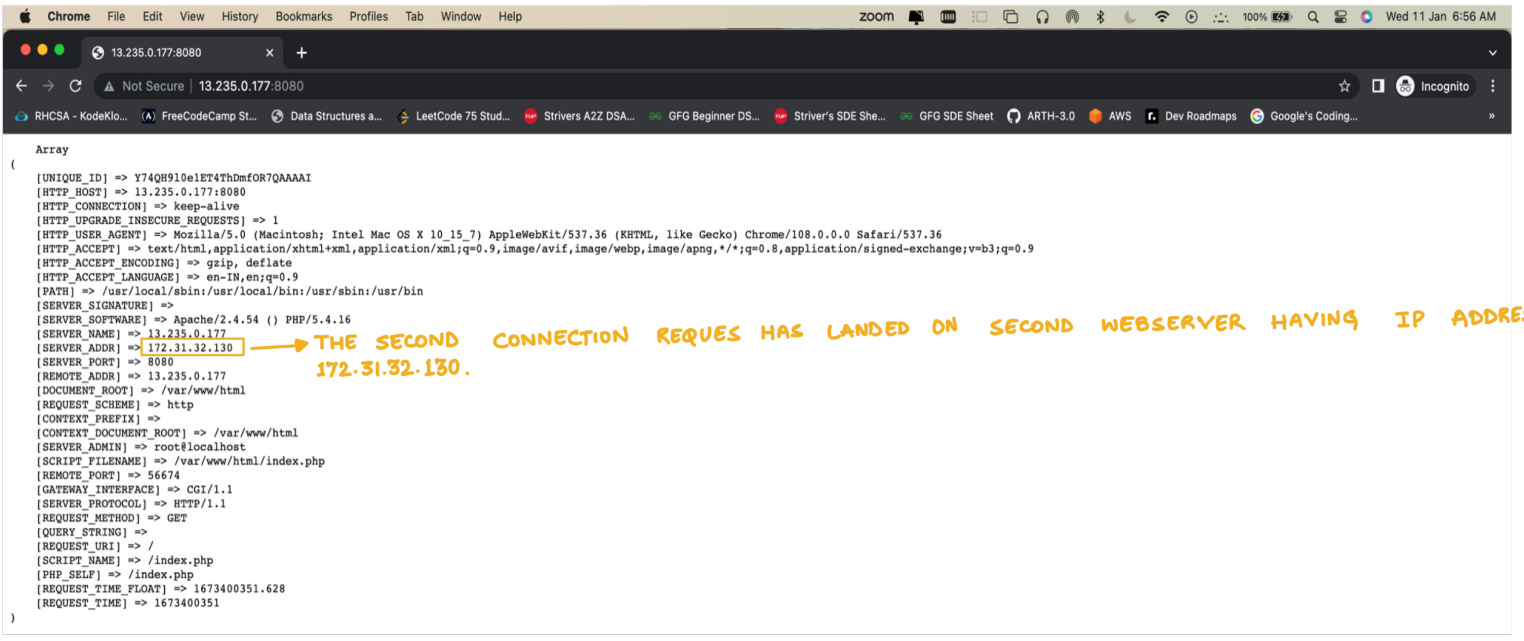
→ NOW, TIME TO CHECK IF OUR LOAD BALANCER IS WORKING PROPERLY OR NOT :- (http://13.235.0.177:8080)

IP ADDRESS OF LOAD-BALANCER

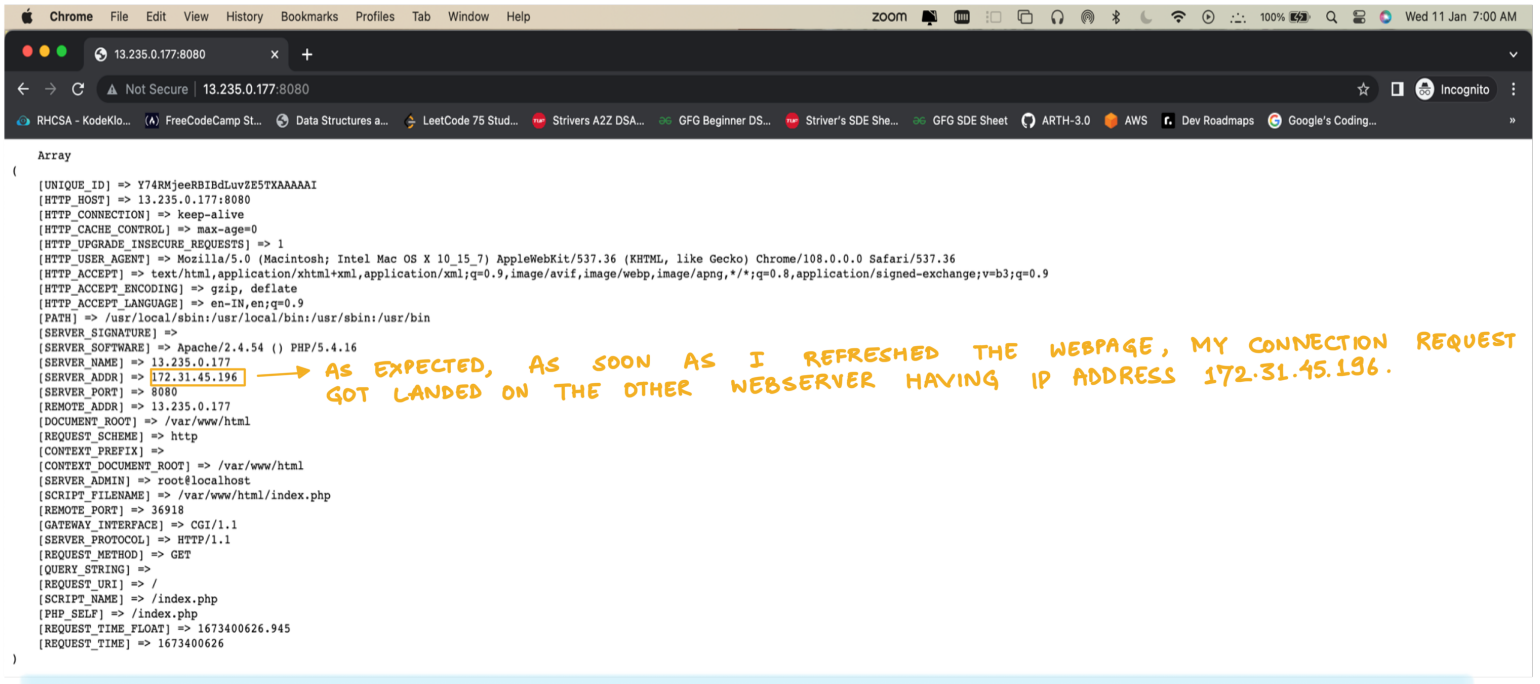
```
Array
(
    [UNIQUE_ID] => Y74OgqYQy2emi95uDtdQ3AAAAAQ
    [HTTP_HOST] => 13.235.0.177:8080
    [HTTP_CONNECTION] => keep-alive
    [HTTP_UPGRADE_INSECURE_REQUESTS] => 1
    [HTTP_USER_AGENT] => Mozilla/5.0 (Macintosh; Intel Mac OS X 10_15_7) AppleWebKit/537.36 (KHTML, like Gecko) Chrome/108.0.0.0 Safari/537.36
    [HTTP_ACCEPT] => text/html,application/xhtml+xml,application/xml;q=0.9,image/avif,image/webp,image/apng,*/*;q=0.8,application/signed-exchange;v=b3;q=0.9
    [HTTP_PURPOSE] => prefetch
    [HTTP_ACCEPT_ENCODING] => gzip, deflate
    [HTTP_ACCEPT_LANGUAGE] => en-IN,en;q=0.9,hi-IN;q=0.8,hi;q=0.7,en-GB;q=0.6,en-US;q=0.5
    [PATH] => /usr/local/sbin:/usr/local/bin:/usr/sbin:/usr/bin
    [SERVER_SIGNATURE] =>
    [SERVER_SOFTWARE] => Apache/2.4.54 () PHP/5.4.16
    [SERVER_NAME] => 13.235.0.177
    [SERVER_ADDR] => 172.31.45.196
    [SERVER_PORT] => 8080
    [REMOTE_ADDR] => 13.235.0.177
    [DOCUMENT_ROOT] => /var/www/html
    [REQUEST_SCHEME] => http
    [CONTEXT_PREFIX] =>
    [CONTEXT_DOCUMENT_ROOT] => /var/www/html
    [SERVER_ADMIN] => root@localhost
    [SCRIPT_FILENAME] => /var/www/html/index.php
    [REMOTE_PORT] => 52436
    [GATEWAY_INTERFACE] => CGI/1.1
    [SERVER_PROTOCOL] => HTTP/1.1
    [REQUEST_METHOD] => GET
    [QUERY_STRING] =>
    [REQUEST_URI] => /
    [SCRIPT_NAME] => /index.php
    [PHP_SELF] => /index.php
    [REQUEST_TIME_FLOAT] => 1673399938.296
    [REQUEST_TIME] => 1673399938
)
```

→ FIRST CONNECTION REQUEST LANDED TO SERVER HAVING IP ADD. : 172.31.45.196

- NOW, WE'LL GO THE SAME URL FROM ANOTHER BROWSER. (PREFERABLY FROM INCOGNITO MODE).



- NOW IF I REFRESH THIS PAGE, THE NEXT CONNECTION SHOULD BE SENT TO THE OTHER SERVER.



THIS IS ENOUGH TO PROVE THAT OUR LOAD BALANCER IS WORKING EXACTLY THE WAY IT SHOULD!

★ NOW, TO PERFORM HORIZONTAL SCALING, ALL WE NEED TO DO IS:

WE JUST NEED TO ADD THE DETAILS OF OUR NEW NODE AND THEN RE-RUN THE ANSIBLE-PLAYBOOK COMMAND.

↓

WE HAVE WRITTEN OUR CODE IN SUCH A WAY THAT THE SERVER WILL GET ADDED IN THE LIST JUST BY RE-RUNNING 'ONE SINGLE COMMAND'.

(# vim /etc/ansible/hosts)

```
# This is the default ansible 'hosts' file.
[loadbalancer]
13.235.0.177 ansible_user=root ansible_password=vinitraj

[webserver]
3.110.102.42 ansible_user=root ansible_password=vinitraj
3.110.181.249 ansible_user=root ansible_password=vinitraj
65.2.182.99 ansible_user=root ansible_password=vinitraj
# It should live in /etc/ansible/hosts
#
#   - Comments begin with the '#' character
#   - Blank lines are ignored
#   - Groups of hosts are delimited by [header] elements
#   - You can enter hostnames or ip addresses
#   - A hostname/ip can be a member of multiple groups

# Ex 1: Ungrouped hosts, specify before any group headers.

## green.example.com
## blue.example.com
## 192.168.100.1
## 192.168.100.10
```

→ WE HAVE ADDED OUR NEW HOST IN WEBSERVER GROUP.

↓

NOW JINJA TEMPLATE FILE WILL AUTOMATICALLY ADD THIS NODE IN BACKEND WEBSERVERS LIST.

↓

HORIZONTAL SCALING IS DONE!

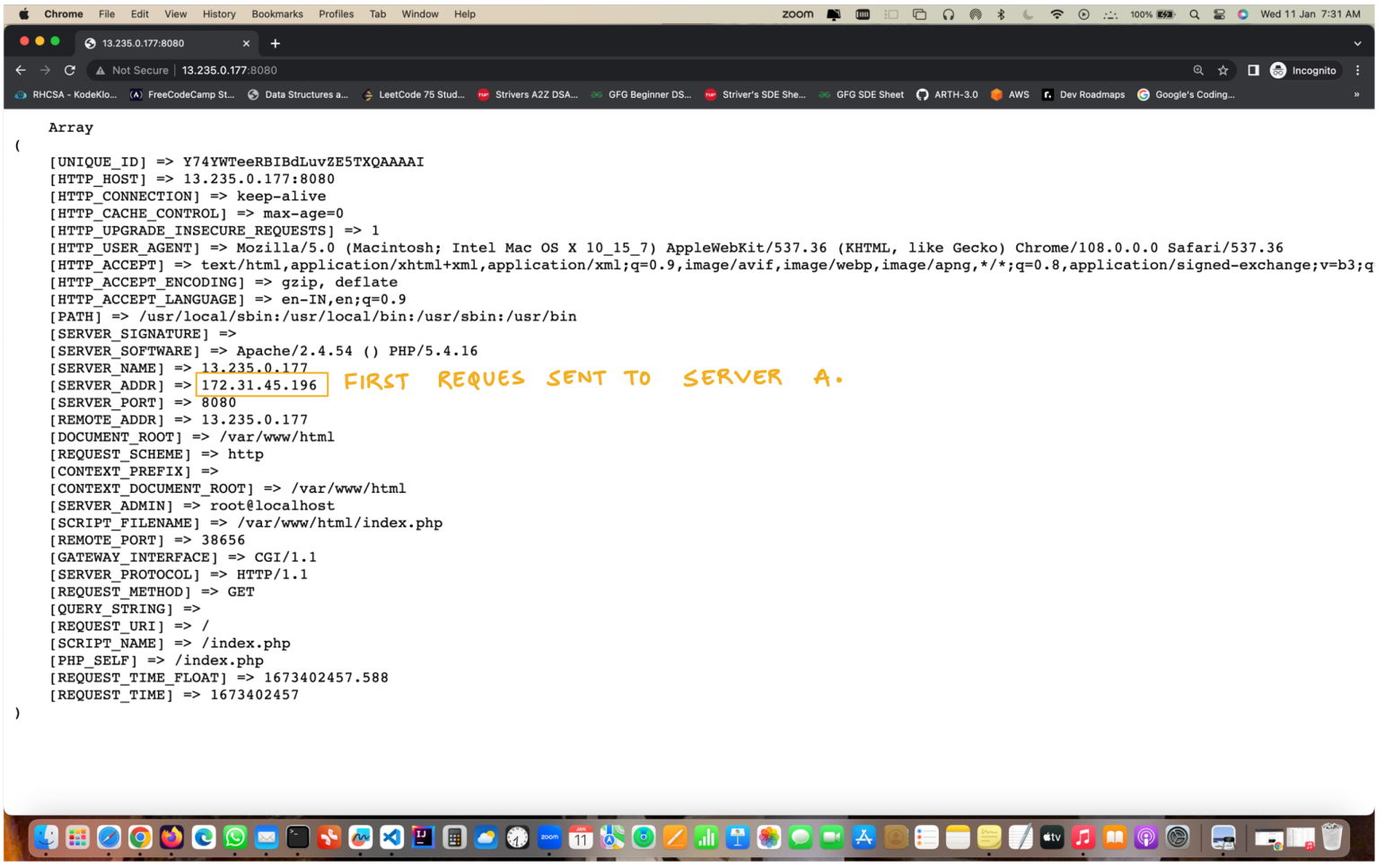
→ TIME TO RE-RUN THE PLAYBOOK COMMANDS :-

(# ansible-playbook webserver.yml)

(# ansible-playbook lb.yml)

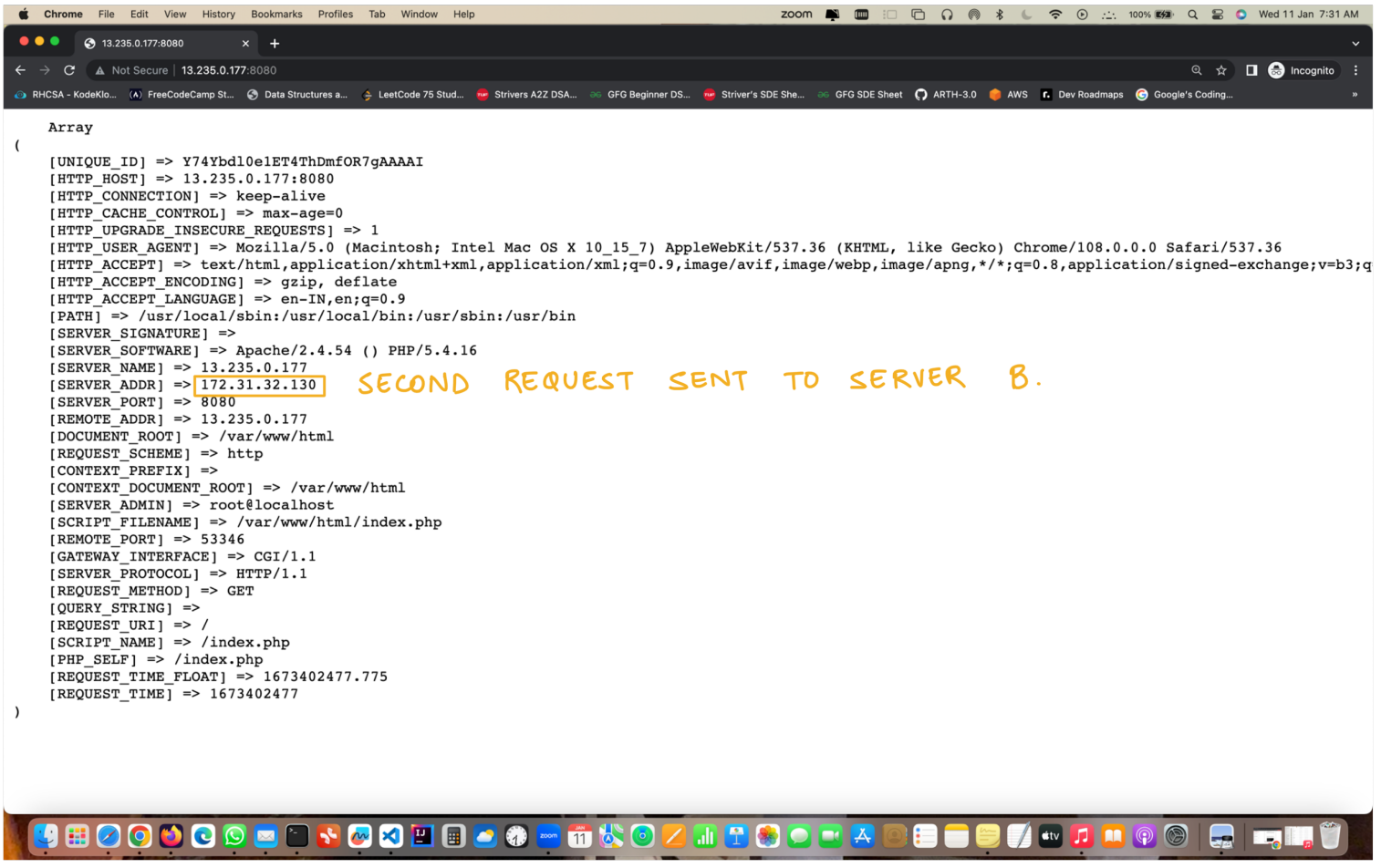
```
ok: [3.110.181.249]
changed: [65.2.182.99]

TASK [Installing PHP package] ***********************************************************************************************************************************************************
^[[Aok: [3.110.102.42]
ok: [3.110.181.249]
changed: [65.2.182.99]

TASK [Deploying (copying) Web Page] ******************************************************************************************************************************************************
ok: [3.110.181.249]
ok: [3.110.102.42]
changed: [65.2.182.99]

TASK [Starting Web Server Now] ***********************************************************************************************************************************************************
ok: [3.110.181.249]
ok: [3.110.102.42]
changed: [65.2.182.99]

PLAY RECAP *******************************************************************************************************************************************************************************
3.110.102.42               : ok=5    changed=0    unreachable=0    failed=0    skipped=0    rescued=0    ignored=0
3.110.181.249              : ok=5    changed=0    unreachable=0    failed=0    skipped=0    rescued=0    ignored=0
65.2.182.99                : ok=5    changed=4    unreachable=0    failed=0    skipped=0    rescued=0    ignored=0

[root@ip-172-31-38-1 code]# ansible-playbook lb.yml

PLAY [loadbalancer] **********************************************************************************************************************************************************************

TASK [Gathering Facts] *******************************************************************************************************************************************************************
[WARNING]: Platform linux on host 13.235.0.177 is using the discovered Python interpreter at /usr/bin/python, but future installation of another Python interpreter could change this. See
https://docs.ansible.com/ansible/2.9/reference_appendices/interpreter_discovery.html for more information.
ok: [13.235.0.177]

TASK [Installing HAProxy Load Balancer] **************************************************************************************************************************************************
ok: [13.235.0.177]

TASK [Registering webservers by adding them in configuration file] ***********************************************************************************************************************
changed: [13.235.0.177]

TASK [Starting the Load Balancer] ********************************************************************************************************************************************************
changed: [13.235.0.177]

PLAY RECAP *******************************************************************************************************************************************************************************
13.235.0.177               : ok=4    changed=2    unreachable=0    failed=0    skipped=0    rescued=0    ignored=0

[root@ip-172-31-38-1 code]#
```

→ TIME TO VISIT OUR WEBSITE (LOADBALANCER IP :8080) :-



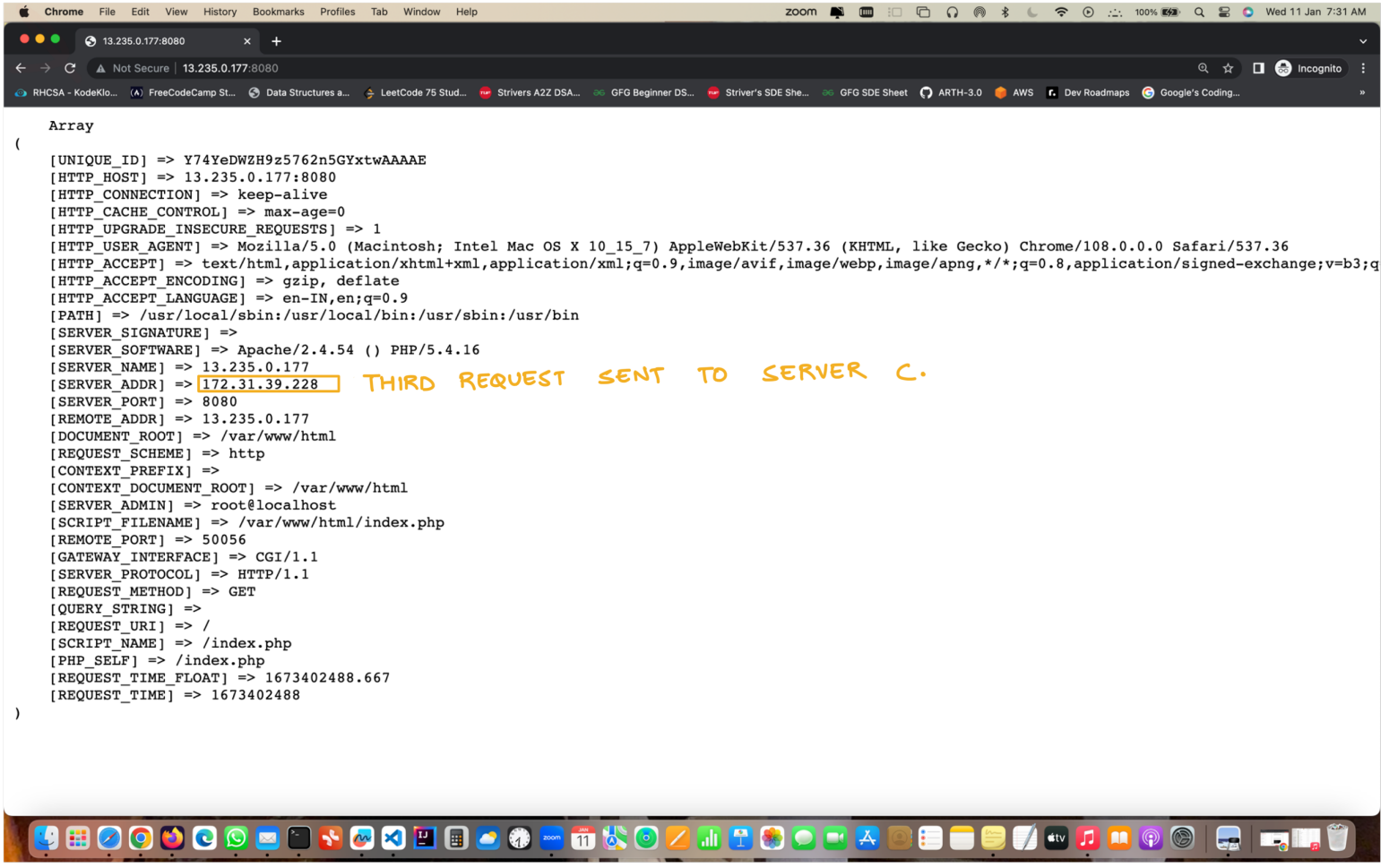
```
Array
(
    [UNIQUE_ID] => Y74YWTeeRBIBdLuvZE5TXQAAAAI
    [HTTP_HOST] => 13.235.0.177:8080
    [HTTP_CONNECTION] => keep-alive
    [HTTP_CACHE_CONTROL] => max-age=0
    [HTTP_UPGRADE_INSECURE_REQUESTS] => 1
    [HTTP_USER_AGENT] => Mozilla/5.0 (Macintosh; Intel Mac OS X 10_15_7) AppleWebKit/537.36 (KHTML, like Gecko) Chrome/108.0.0.0 Safari/537.36
    [HTTP_ACCEPT] => text/html,application/xhtml+xml,application/xml;q=0.9,image/avif,image/webp,image/apng,*/*;q=0.8,application/signed-exchange;v=b3;q
    [HTTP_ACCEPT_ENCODING] => gzip, deflate
    [HTTP_ACCEPT_LANGUAGE] => en-IN,en;q=0.9
    [PATH] => /usr/local/sbin:/usr/local/bin:/usr/sbin:/usr/bin
    [SERVER_SIGNATURE] =>
    [SERVER_SOFTWARE] => Apache/2.4.54 () PHP/5.4.16
    [SERVER_NAME] => 13.235.0.177
    [SERVER_ADDR] => 172.31.45.196
    [SERVER_PORT] => 8080
    [REMOTE_ADDR] => 13.235.0.177
    [DOCUMENT_ROOT] => /var/www/html
    [REQUEST_SCHEME] => http
    [CONTEXT_PREFIX] =>
    [CONTEXT_DOCUMENT_ROOT] => /var/www/html
    [SERVER_ADMIN] => root@localhost
    [SCRIPT_FILENAME] => /var/www/html/index.php
    [REMOTE_PORT] => 38656
    [GATEWAY_INTERFACE] => CGI/1.1
    [SERVER_PROTOCOL] => HTTP/1.1
    [REQUEST_METHOD] => GET
    [QUERY_STRING] =>
    [REQUEST_URI] => /
    [SCRIPT_NAME] => /index.php
    [PHP_SELF] => /index.php
    [REQUEST_TIME_FLOAT] => 1673402457.588
    [REQUEST_TIME] => 1673402457
)
```

FIRST REQUES SENT TO SERVER A.

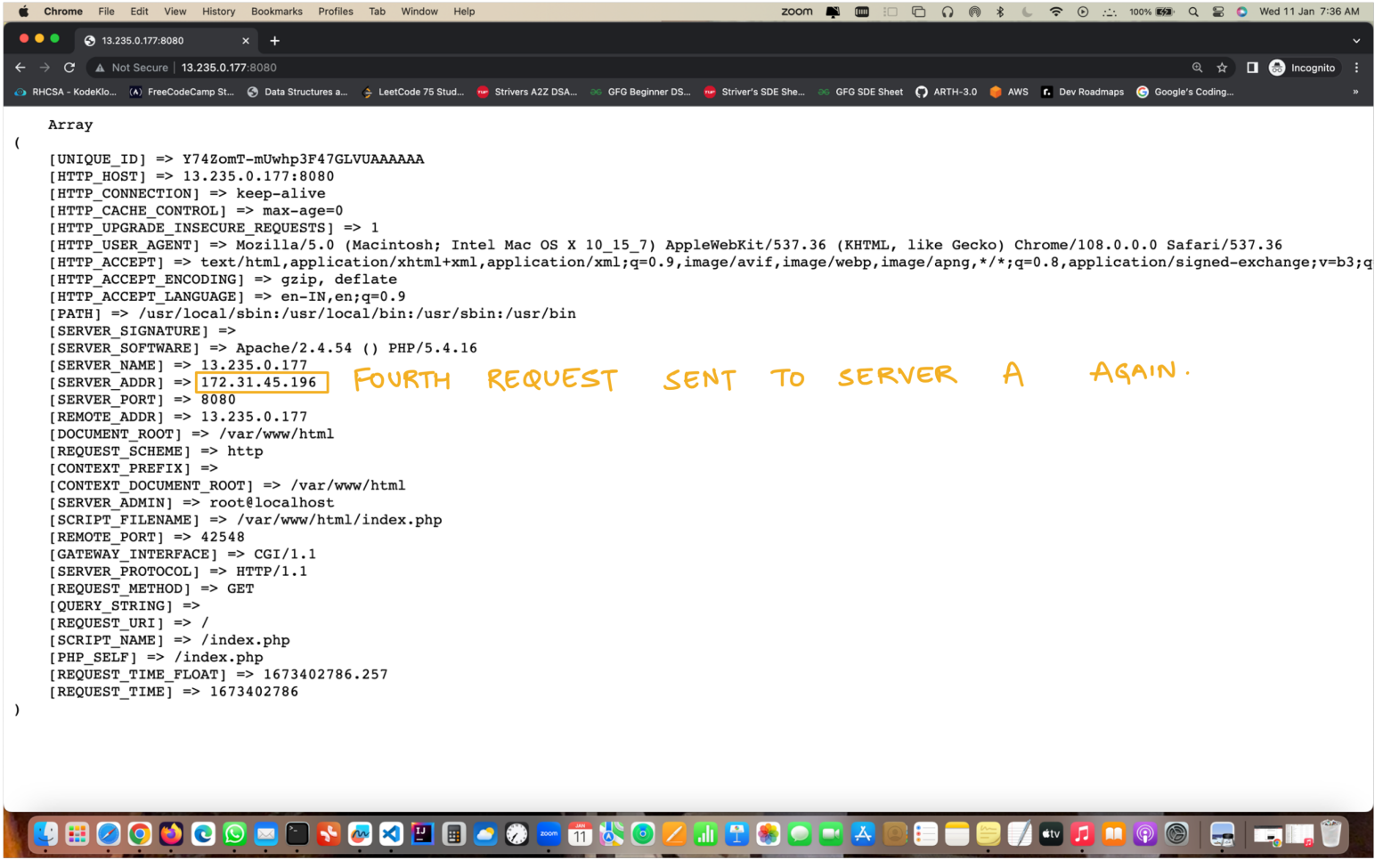


```
Array
(
    [UNIQUE_ID] => Y74Ybdl0e1ET4ThDmfOR7gAAAAI
    [HTTP_HOST] => 13.235.0.177:8080
    [HTTP_CONNECTION] => keep-alive
    [HTTP_CACHE_CONTROL] => max-age=0
    [HTTP_UPGRADE_INSECURE_REQUESTS] => 1
    [HTTP_USER_AGENT] => Mozilla/5.0 (Macintosh; Intel Mac OS X 10_15_7) AppleWebKit/537.36 (KHTML, like Gecko) Chrome/108.0.0.0 Safari/537.36
    [HTTP_ACCEPT] => text/html,application/xhtml+xml,application/xml;q=0.9,image/avif,image/webp,image/apng,*/*;q=0.8,application/signed-exchange;v=b3;q
    [HTTP_ACCEPT_ENCODING] => gzip, deflate
    [HTTP_ACCEPT_LANGUAGE] => en-IN,en;q=0.9
    [PATH] => /usr/local/sbin:/usr/local/bin:/usr/sbin:/usr/bin
    [SERVER_SIGNATURE] =>
    [SERVER_SOFTWARE] => Apache/2.4.54 () PHP/5.4.16
    [SERVER_NAME] => 13.235.0.177
    [SERVER_ADDR] => 172.31.32.130
    [SERVER_PORT] => 8080
    [REMOTE_ADDR] => 13.235.0.177
    [DOCUMENT_ROOT] => /var/www/html
    [REQUEST_SCHEME] => http
    [CONTEXT_PREFIX] =>
    [CONTEXT_DOCUMENT_ROOT] => /var/www/html
    [SERVER_ADMIN] => root@localhost
    [SCRIPT_FILENAME] => /var/www/html/index.php
    [REMOTE_PORT] => 53346
    [GATEWAY_INTERFACE] => CGI/1.1
    [SERVER_PROTOCOL] => HTTP/1.1
    [REQUEST_METHOD] => GET
    [QUERY_STRING] =>
    [REQUEST_URI] => /
    [SCRIPT_NAME] => /index.php
    [PHP_SELF] => /index.php
    [REQUEST_TIME_FLOAT] => 1673402477.775
    [REQUEST_TIME] => 1673402477
)
```

SECOND REQUEST SENT TO SERVER B.



THIRD REQUEST SENT TO SERVER C.



FOURTH REQUEST SENT TO SERVER A AGAIN.

THIS PROVES OUR WEBSERVERS ARE WORKING EXACTLY THE WAY THEY SHOULD !

ROUND ROBIN ALGORITHM IS BALANCING THE CONNECTION REQUESTS CORRECTLY.

ADDING A BACKEND WEBSERVER AT THE END AND GETTING IT TO WORK PROPERLY : SUCCESSFULLY IMPLEMENTED HORIZONTAL SCALING.

— VINIT RAJ