Lab#11:Apache2 vs Nginx + Full Demos

🎯 Objectives:

Setting up Apache2 and Nginx servers with the addition of a few demos.

Step-by-Step Instructions / Summary

Demo 1: Apache2 Setup.

1. Install Apache2
2. Start Apache2
3. Open Web Browser
4. Replace Default Page

Demo 2: Nginx Setup

1. Install Nginx
2. Start Nginx
3. Open Web Browser
4. Replace Default Page

🧠 1. Introduction: What Is a Web Server?

Definition:
A web server is a program that delivers content (like HTML pages, images, etc.) to users over the web.

🏛️ 2. What Is Apache2?

Feature	Apache2
Release Year	1995 (Apache Software Foundation)
Architecture	**Process-driven**: forks a new process per request
Config Files	/etc/apache2/apache2.conf, .htaccess

PHP Support	Built-in via mod_php
Use Case	Flexible hosting with dynamic modules
Default Port	80

🧩 **Use Apache2 when**:

You want fine-grained control with .htaccess
You need built-in PHP support
You expect moderate traffic

🚀 3. What Is Nginx?

Feature	**Nginx (Engine-X)**
Release Year	2004 (Igor Sysoev)
Architecture	**Event-driven**: handles thousands of connections
Config Files	/etc/nginx/nginx.conf, /etc/nginx/sites-available/
PHP Support	Requires PHP-FPM
Use Case	High-performance static & proxy server
Default Port	80

🧩 **Use Nginx when**:

You expect **high concurrency** traffic
You need **reverse proxy** or load balancing
You prioritize **speed** and **efficiency**

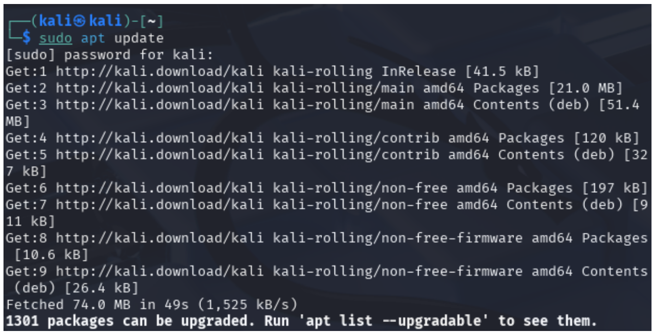
⚔️ 4. Side-by-Side Visual Comparison

Feature	Apache2	Nginx
Architecture	Process-based	Event-based
Performance (Static)	Slower	Faster
.htaccess Support	✅ Yes	❌ No
Reverse Proxy	✅ Basic support	✅ Excellent built-in
PHP Integration	mod_php	PHP-FPM
Configuration	More granular, verbose	Simpler, centralized

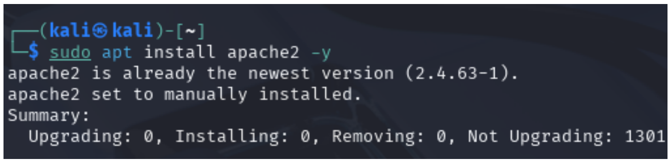
🧪 5. DEMO 1: Apache2

1. 📦Install Apache2

```
sudo apt update
sudo apt install apache2 -y
```



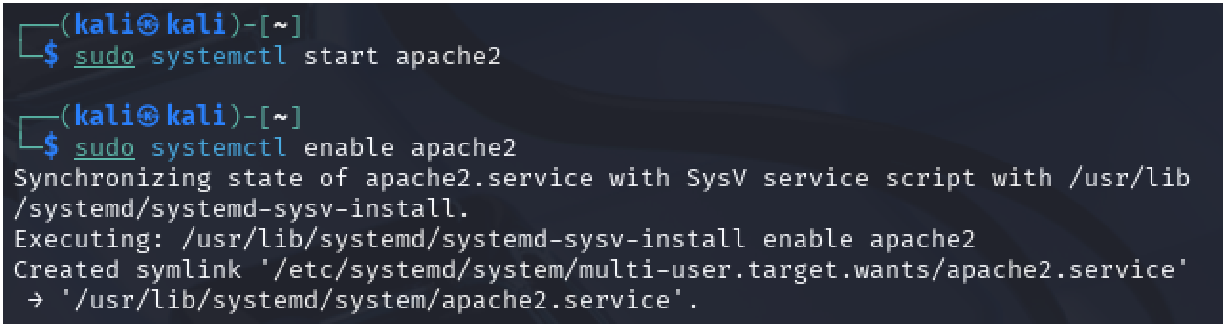
```
┌──(kali㉿kali)-[~]
└─$ sudo apt update
[sudo] password for kali:
Get:1 http://kali.download/kali kali-rolling InRelease [41.5 kB]
Get:2 http://kali.download/kali kali-rolling/main amd64 Packages [21.0 MB]
Get:3 http://kali.download/kali kali-rolling/main amd64 Contents (deb) [51.4
MB]
Get:4 http://kali.download/kali kali-rolling/contrib amd64 Packages [120 kB]
Get:5 http://kali.download/kali kali-rolling/contrib amd64 Contents (deb) [32
7 kB]
Get:6 http://kali.download/kali kali-rolling/non-free amd64 Packages [197 kB]
Get:7 http://kali.download/kali kali-rolling/non-free amd64 Contents (deb) [9
11 kB]
Get:8 http://kali.download/kali kali-rolling/non-free-firmware amd64 Packages
 [10.6 kB]
Get:9 http://kali.download/kali kali-rolling/non-free-firmware amd64 Contents
 (deb) [26.4 kB]
Fetched 74.0 MB in 49s (1,525 kB/s)
1301 packages can be upgraded. Run 'apt list --upgradable' to see them.
```



```
┌──(kali㉿kali)-[~]
└─$ sudo apt install apache2 -y
apache2 is already the newest version (2.4.63-1).
apache2 set to manually installed.
Summary:
  Upgrading: 0, Installing: 0, Removing: 0, Not Upgrading: 1301
```

2. ▶️Start Apache:

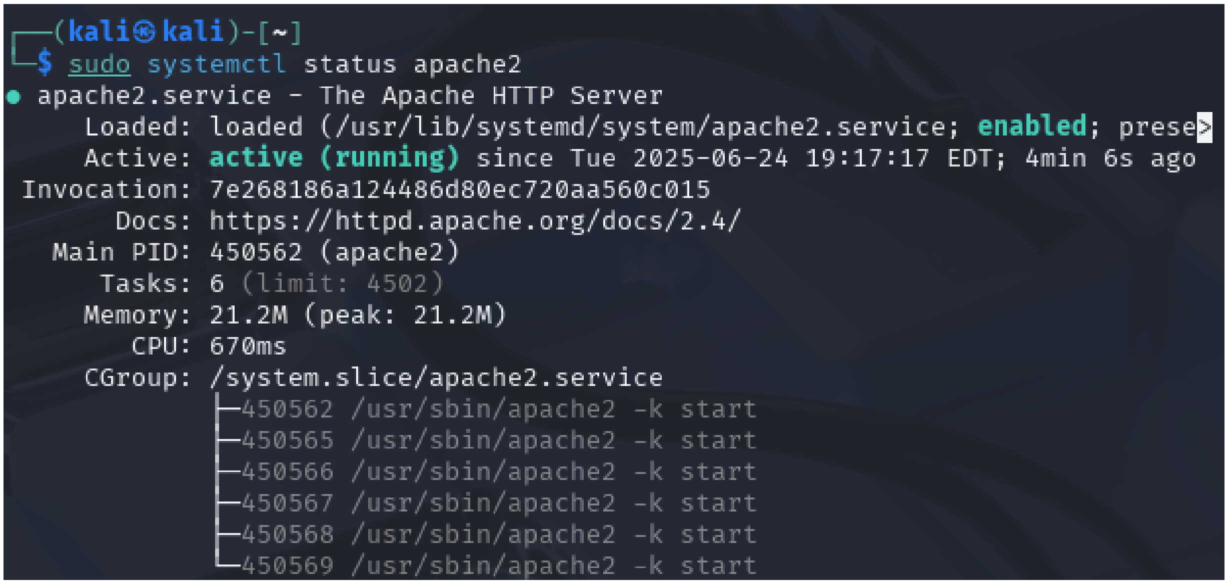
```
sudo systemctl start apache2
sudo systemctl enable apache2
```



```
┌──(kali㉿kali)-[~]
└─$ sudo systemctl start apache2

┌──(kali㉿kali)-[~]
└─$ sudo systemctl enable apache2
Synchronizing state of apache2.service with SysV service script with /usr/lib
/systemd/systemd-sysv-install.
Executing: /usr/lib/systemd/systemd-sysv-install enable apache2
Created symlink '/etc/systemd/system/multi-user.target.wants/apache2.service'
 → '/usr/lib/systemd/system/apache2.service'.
```

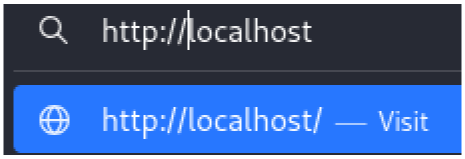
*Optional checking the status of apache2

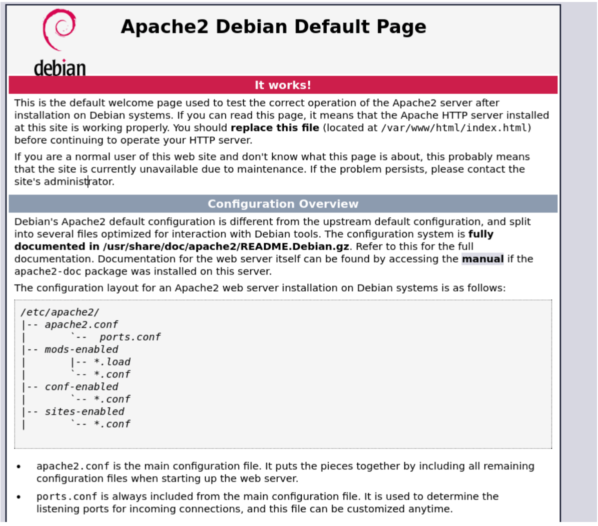
```
sudo systemctl status apache2
```



```
┌──(kali㉿kali)-[~]
└─$ sudo systemctl status apache2
● apache2.service - The Apache HTTP Server
     Loaded: loaded (/usr/lib/systemd/system/apache2.service; enabled; prese>
     Active: active (running) since Tue 2025-06-24 19:17:17 EDT; 4min 6s ago
 Invocation: 7e268186a124486d80ec720aa560c015
       Docs: https://httpd.apache.org/docs/2.4/
   Main PID: 450562 (apache2)
      Tasks: 6 (limit: 4502)
     Memory: 21.2M (peak: 21.2M)
        CPU: 670ms
     CGroup: /system.slice/apache2.service
             ├─450562 /usr/sbin/apache2 -k start
             ├─450565 /usr/sbin/apache2 -k start
             ├─450566 /usr/sbin/apache2 -k start
             ├─450567 /usr/sbin/apache2 -k start
             ├─450568 /usr/sbin/apache2 -k start
             └─450569 /usr/sbin/apache2 -k start
```

3. 🌐Open Web Browser:

Visit: http://localhost or http://<your-ip> Expected output: 🟢 **"Welcome to Nginx!"**	 http://localhost http://localhost/ — Visit After entering the url it'll send this page



Apache2 Debian Default Page

debian

It works!

This is the default welcome page used to test the correct operation of the Apache2 server after installation on Debian systems. If you can read this page, it means that the Apache HTTP server installed at this site is working properly. You should **replace this file** (located at `/var/www/html/index.html`) before continuing to operate your HTTP server.

If you are a normal user of this web site and don't know what this page is about, this probably means that the site is currently unavailable due to maintenance. If the problem persists, please contact the site's administrator.

Configuration Overview

Debian's Apache2 default configuration is different from the upstream default configuration, and split into several files optimized for interaction with Debian tools. The configuration system is **fully documented in /usr/share/doc/apache2/README.Debian.gz**. Refer to this for the full documentation. Documentation for the web server itself can be found by accessing the **manual** if the apache2-doc package was installed on this server.

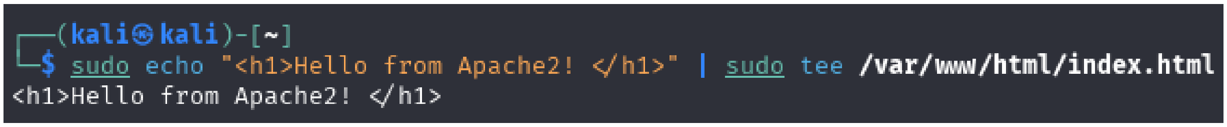
The configuration layout for an Apache2 web server installation on Debian systems is as follows:

```
/etc/apache2/
|-- apache2.conf
|       `--  ports.conf
|-- mods-enabled
|       |-- *.load
|       `-- *.conf
|-- conf-enabled
|       `-- *.conf
|-- sites-enabled
|       `-- *.conf
```

- `apache2.conf` is the main configuration file. It puts the pieces together by including all remaining configuration files when starting up the web server.
- `ports.conf` is always included from the main configuration file. It is used to determine the listening ports for incoming connections, and this file can be customized anytime.

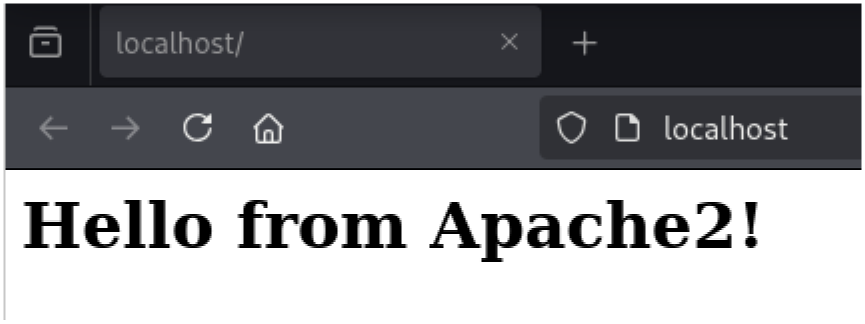
4. Replace Default Page:

```
echo "<h1>Hello from Nginx!</h1>" | sudo tee
/var/www/html/index.nginx-debian.html
```



```
┌──(kali㉿kali)-[~]
└─$ sudo echo "<h1>Hello from Apache2! </h1>" | sudo tee /var/www/html/index.html
<h1>Hello from Apache2! </h1>
```

After revising and refreshing the page:

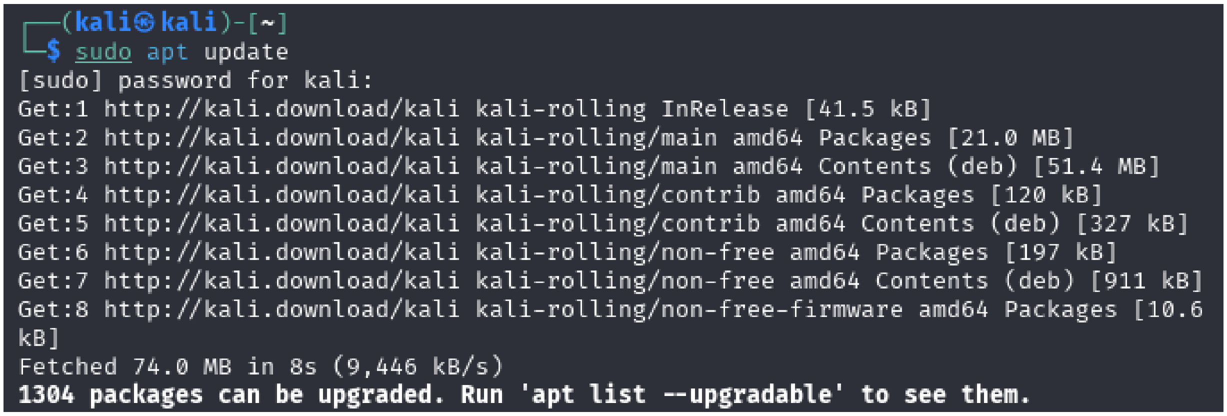


Hello from Apache2!

🧪 6. DEMO 2: Nginx

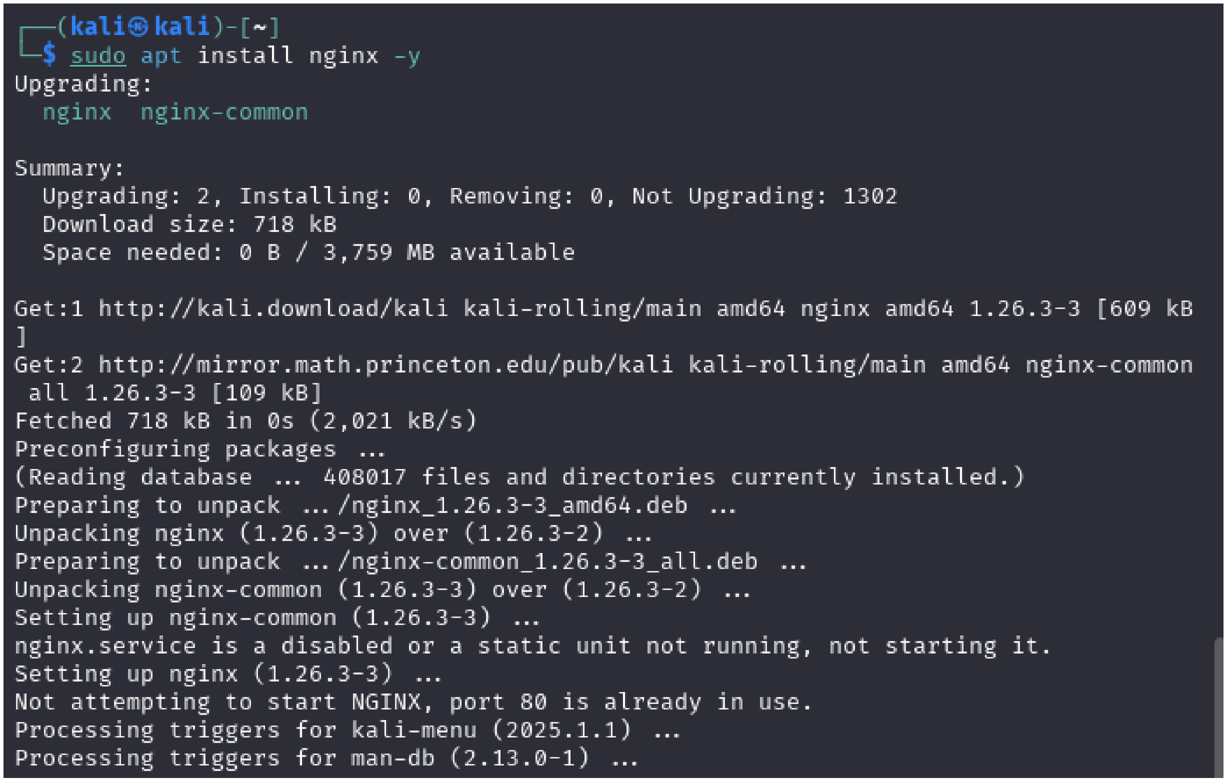
1. Install Nginx

```
sudo apt update
```



```
┌──(kali㉿kali)-[~]
└─$ sudo apt update
[sudo] password for kali:
Get:1 http://kali.download/kali kali-rolling InRelease [41.5 kB]
Get:2 http://kali.download/kali kali-rolling/main amd64 Packages [21.0 MB]
Get:3 http://kali.download/kali kali-rolling/main amd64 Contents (deb) [51.4 MB]
Get:4 http://kali.download/kali kali-rolling/contrib amd64 Packages [120 kB]
Get:5 http://kali.download/kali kali-rolling/contrib amd64 Contents (deb) [327 kB]
Get:6 http://kali.download/kali kali-rolling/non-free amd64 Packages [197 kB]
Get:7 http://kali.download/kali kali-rolling/non-free amd64 Contents (deb) [911 kB]
Get:8 http://kali.download/kali kali-rolling/non-free-firmware amd64 Packages [10.6
kB]
Fetched 74.0 MB in 8s (9,446 kB/s)
1304 packages can be upgraded. Run 'apt list --upgradable' to see them.
```

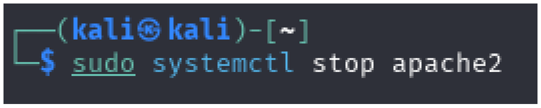
sudo install nginx -y



```
┌──(kali㉿kali)-[~]
└─$ sudo apt install nginx -y
Upgrading:
  nginx  nginx-common

Summary:
  Upgrading: 2, Installing: 0, Removing: 0, Not Upgrading: 1302
  Download size: 718 kB
  Space needed: 0 B / 3,759 MB available

Get:1 http://kali.download/kali kali-rolling/main amd64 nginx amd64 1.26.3-3 [609 kB
]
Get:2 http://mirror.math.princeton.edu/pub/kali kali-rolling/main amd64 nginx-common
 all 1.26.3-3 [109 kB]
Fetched 718 kB in 0s (2,021 kB/s)
Preconfiguring packages ...
(Reading database ... 408017 files and directories currently installed.)
Preparing to unpack .../nginx_1.26.3-3_amd64.deb ...
Unpacking nginx (1.26.3-3) over (1.26.3-2) ...
Preparing to unpack .../nginx-common_1.26.3-3_all.deb ...
Unpacking nginx-common (1.26.3-3) over (1.26.3-2) ...
Setting up nginx-common (1.26.3-3) ...
nginx.service is a disabled or a static unit not running, not starting it.
Setting up nginx (1.26.3-3) ...
Not attempting to start NGINX, port 80 is already in use.
Processing triggers for kali-menu (2025.1.1) ...
Processing triggers for man-db (2.13.0-1) ...
```

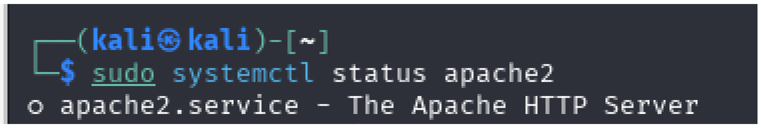
2. Start Nginx

sudo systemctl stop apache2

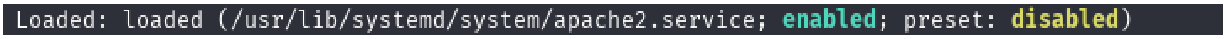


```
┌──(kali㉿kali)-[~]
└─$ sudo systemctl stop apache2
```

sudo systemctl status apache2



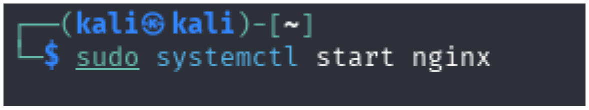
```
┌──(kali㉿kali)-[~]
└─$ sudo systemctl status apache2
○ apache2.service - The Apache HTTP Server
```



```
Loaded: loaded (/usr/lib/systemd/system/apache2.service; enabled; preset: disabled)
```

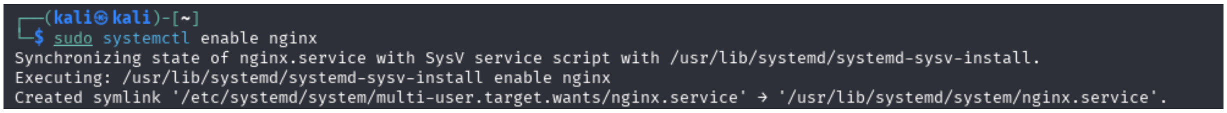
Now, the following would work:

sudo systemctl start nginx



```
┌──(kali㉿kali)-[~]
└─$ sudo systemctl start nginx
```

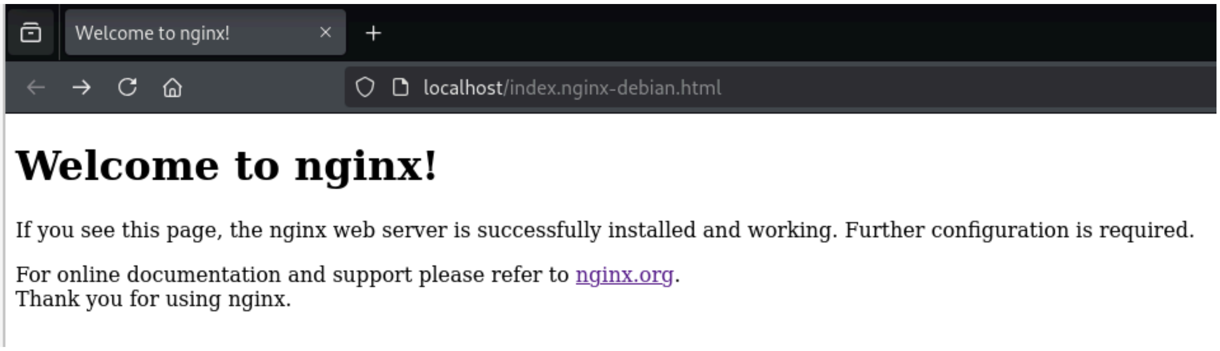
sudo systemctl enable nginx



```
┌──(kali㉿kali)-[~]
└─$ sudo systemctl enable nginx
Synchronizing state of nginx.service with SysV service script with /usr/lib/systemd/systemd-sysv-install.
Executing: /usr/lib/systemd/systemd-sysv-install enable nginx
Created symlink '/etc/systemd/system/multi-user.target.wants/nginx.service' → '/usr/lib/systemd/system/nginx.service'.
```

3. Open Web Browser

http://localhost/index.nginx-debian.html



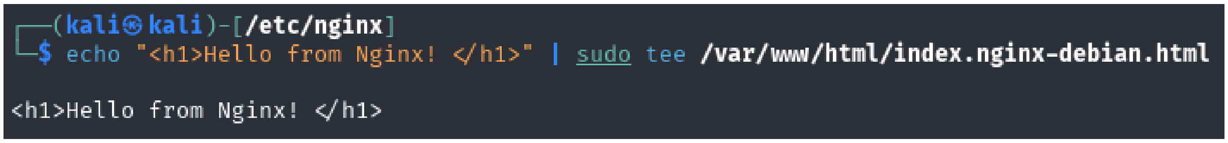
Welcome to nginx!

If you see this page, the nginx web server is successfully installed and working. Further configuration is required.

For online documentation and support please refer to nginx.org.
Thank you for using nginx.

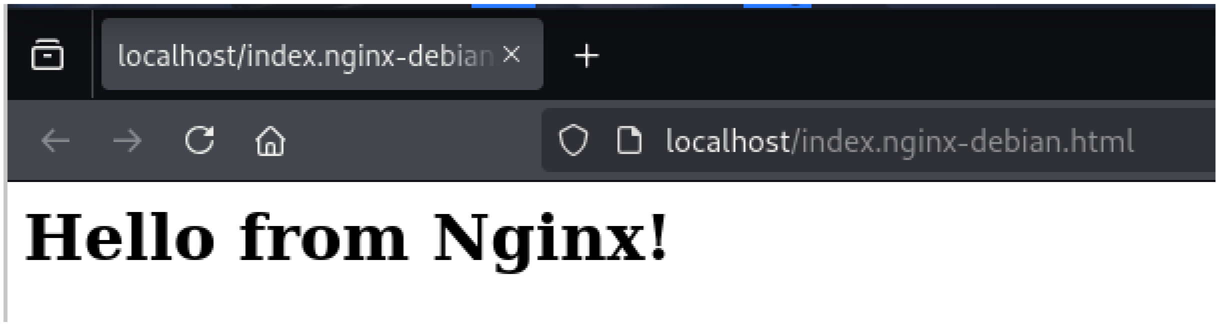
4. Replace Default Page

```
echo "<h1>Hello from Nginx!</h1>" | sudo tee
/var/www/html/index.nginx-debian.html
```



```
┌──(kali㉿kali)-[/etc/nginx]
└─$ echo "<h1>Hello from Nginx! </h1>" | sudo tee /var/www/html/index.nginx-debian.html

<h1>Hello from Nginx! </h1>
```

http://localhost/index.nginx-debian.html

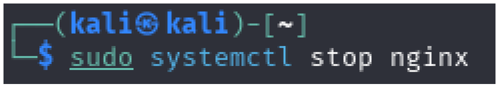

localhost/index.nginx-debian
localhost/index.nginx-debian.html

Hello from Nginx!

5. 🔄 **Switching Between Apache2 and Nginx (Same Port)**

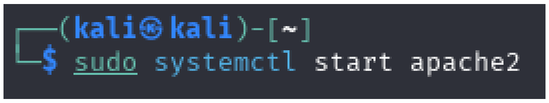
   a. **Run Apache2**

sudo systemctl stop nginx



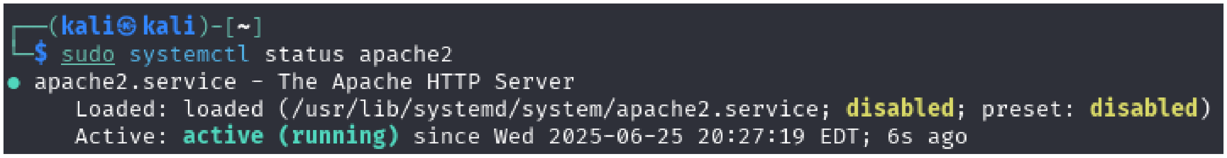
```
┌──(kali㉿kali)-[~]
└─$ sudo systemctl stop nginx
```

sudo systemctl start apache2



```
┌──(kali㉿kali)-[~]
└─$ sudo systemctl start apache2
```

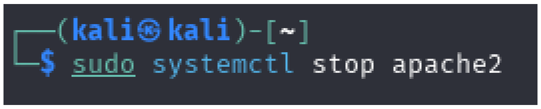
sudo systemctl status apache2 (Optional)



```
┌──(kali㉿kali)-[~]
└─$ sudo systemctl status apache2
● apache2.service - The Apache HTTP Server
     Loaded: loaded (/usr/lib/systemd/system/apache2.service; disabled; preset: disabled)
     Active: active (running) since Wed 2025-06-25 20:27:19 EDT; 6s ago
```

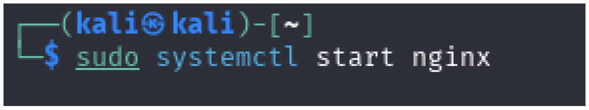
   b. **Run Nginx**

sudo systemctl stop apache2



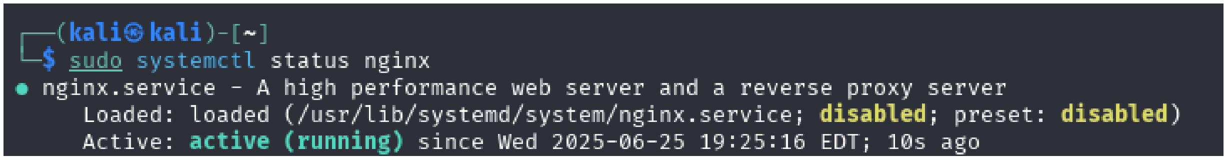
```
┌──(kali㉿kali)-[~]
└─$ sudo systemctl stop apache2
```

sudo systemctl start nginx



```
┌──(kali㉿kali)-[~]
└─$ sudo systemctl start nginx
```

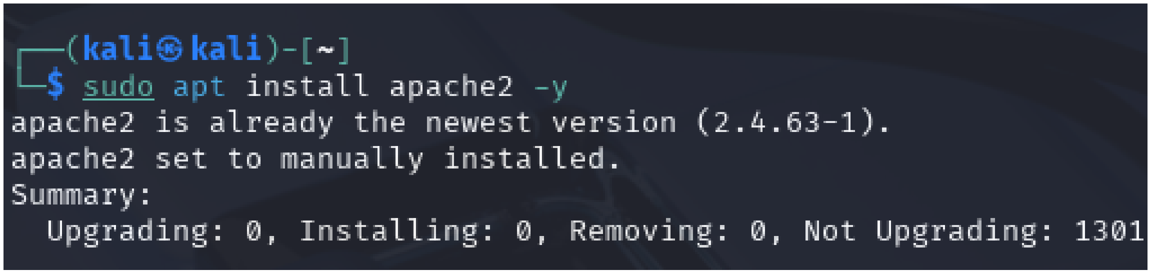
sudo systemctl status nginx (Optional)



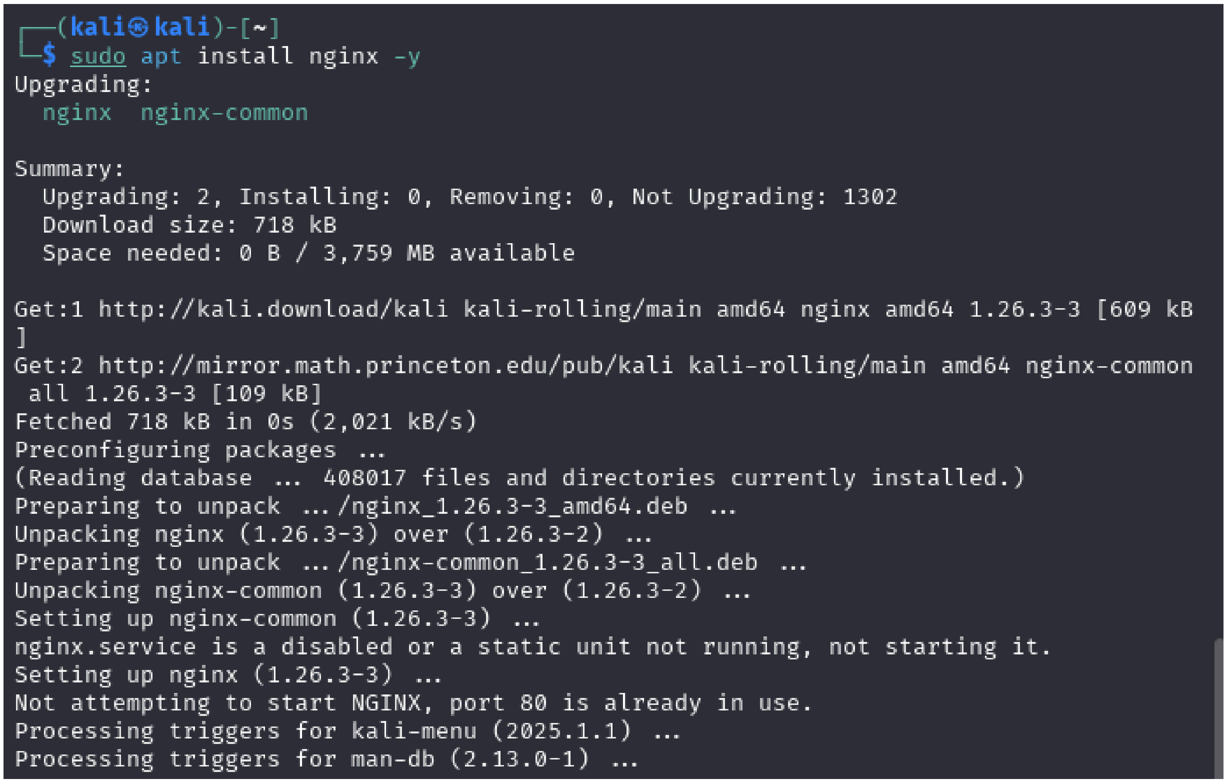
```
┌──(kali㉿kali)-[~]
└─$ sudo systemctl status nginx
● nginx.service - A high performance web server and a reverse proxy server
     Loaded: loaded (/usr/lib/systemd/system/nginx.service; disabled; preset: disabled)
     Active: active (running) since Wed 2025-06-25 19:25:16 EDT; 10s ago
```

🧑‍🏫 Classroom Activity Ideas

Installs both Apache and Nginx



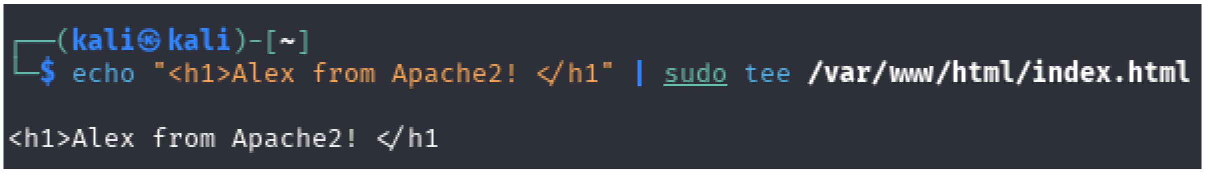
```
┌──(kali㉿kali)-[~]
└─$ sudo apt install apache2 -y
apache2 is already the newest version (2.4.63-1).
apache2 set to manually installed.
Summary:
  Upgrading: 0, Installing: 0, Removing: 0, Not Upgrading: 1301
```



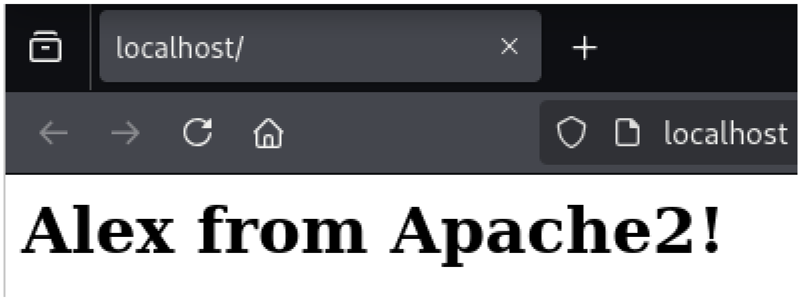
```
┌──(kali㉿kali)-[~]
└─$ sudo apt install nginx -y
Upgrading:
  nginx  nginx-common

Summary:
  Upgrading: 2, Installing: 0, Removing: 0, Not Upgrading: 1302
  Download size: 718 kB
  Space needed: 0 B / 3,759 MB available

Get:1 http://kali.download/kali kali-rolling/main amd64 nginx amd64 1.26.3-3 [609 kB
]
Get:2 http://mirror.math.princeton.edu/pub/kali kali-rolling/main amd64 nginx-common
 all 1.26.3-3 [109 kB]
Fetched 718 kB in 0s (2,021 kB/s)
Preconfiguring packages ...
(Reading database ... 408017 files and directories currently installed.)
Preparing to unpack .../nginx_1.26.3-3_amd64.deb ...
Unpacking nginx (1.26.3-3) over (1.26.3-2) ...
Preparing to unpack .../nginx-common_1.26.3-3_all.deb ...
Unpacking nginx-common (1.26.3-3) over (1.26.3-2) ...
Setting up nginx-common (1.26.3-3) ...
nginx.service is a disabled or a static unit not running, not starting it.
Setting up nginx (1.26.3-3) ...
Not attempting to start NGINX, port 80 is already in use.
Processing triggers for kali-menu (2025.1.1) ...
Processing triggers for man-db (2.13.0-1) ...
```

Replaces default pages with their name

Screenshots for Apache2:

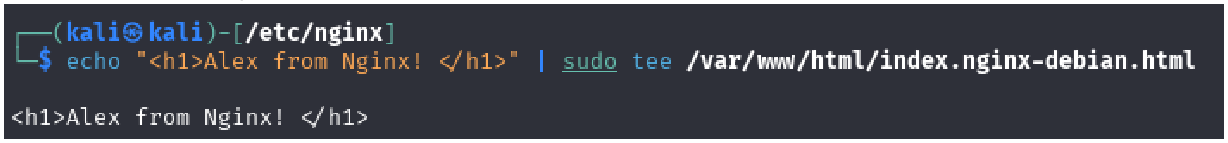


```
┌──(kali㉿kali)-[~]
└─$ echo "<h1>Alex from Apache2! </h1" | sudo tee /var/www/html/index.html

<h1>Alex from Apache2! </h1
```

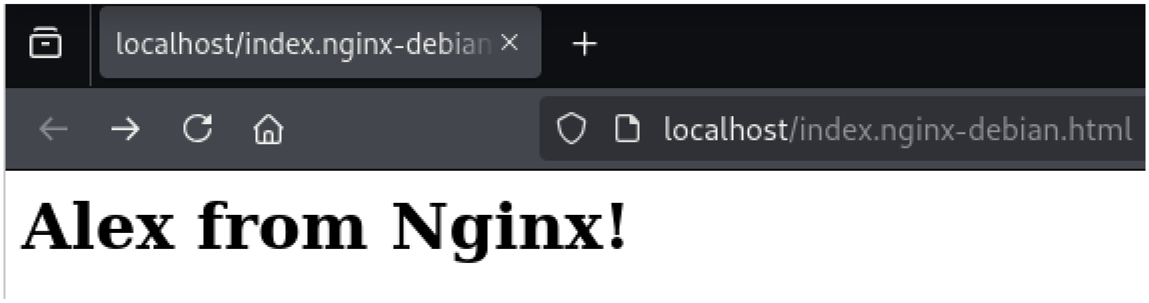


Alex from Apache2!

Screenshots for Nginx:



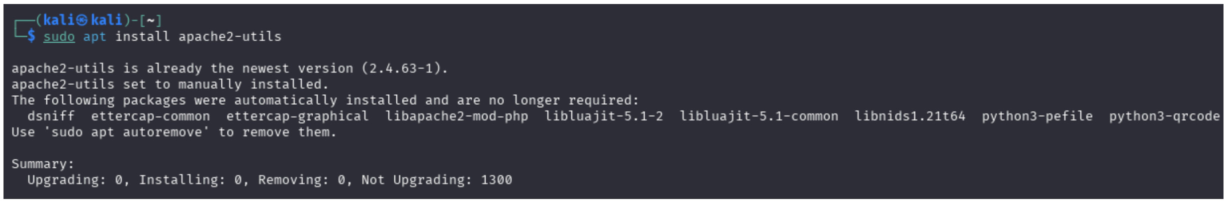
```
┌──(kali㉿kali)-[/etc/nginx]
└─$ echo "<h1>Alex from Nginx! </h1>" | sudo tee /var/www/html/index.nginx-debian.html

<h1>Alex from Nginx! </h1>
```


localhost/index.nginx-debian
localhost/index.nginx-debian.html

Alex from Nginx!

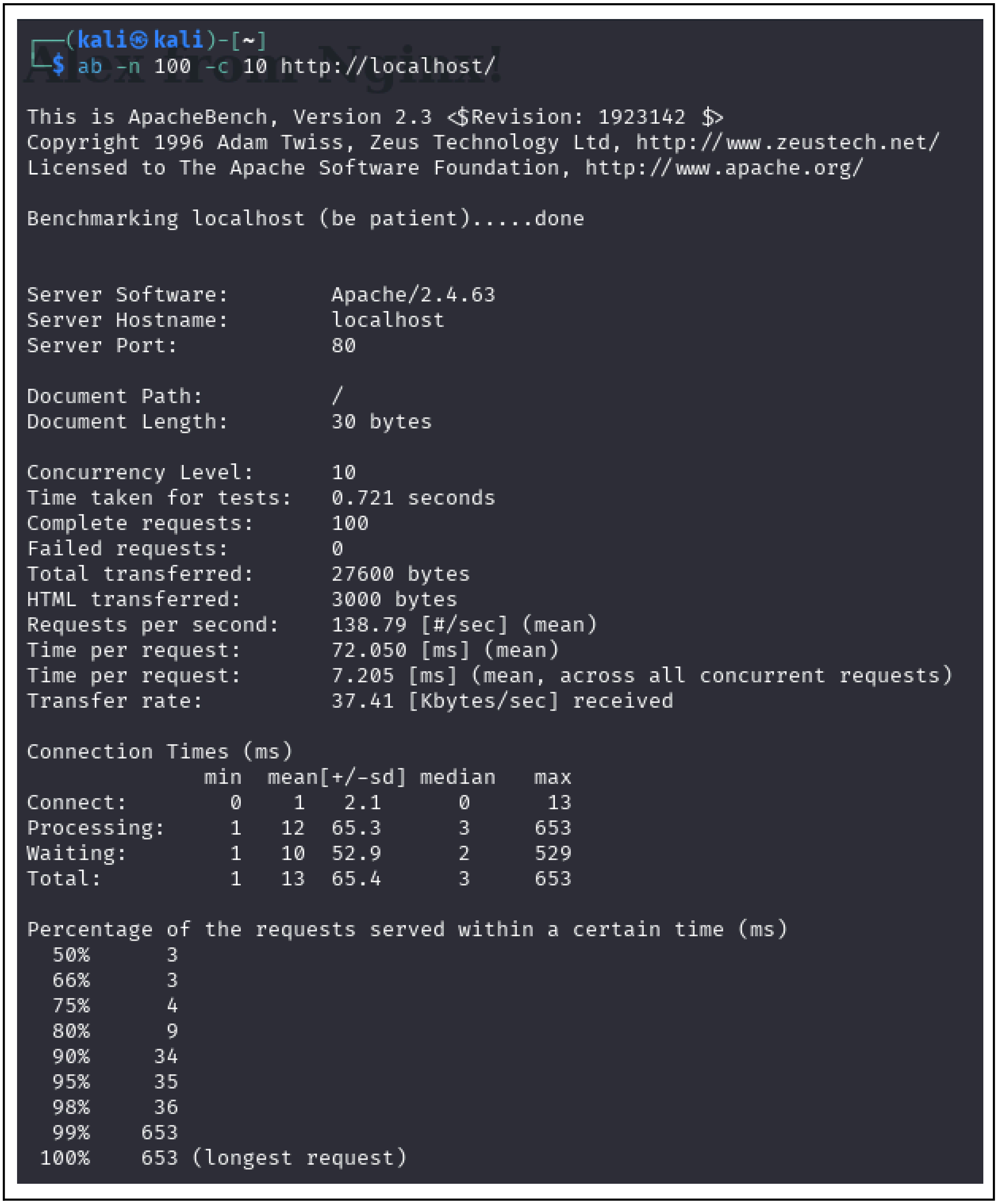
Takes screenshots as proof

Compares performance using ab (Apache Benchmark):
sudo apt install apache2-utils



```
┌──(kali㉿kali)-[~]
└─$ sudo apt install apache2-utils

apache2-utils is already the newest version (2.4.63-1).
apache2-utils set to manually installed.
The following packages were automatically installed and are no longer required:
  dsniff  ettercap-common  ettercap-graphical  libapache2-mod-php  libluajit-5.1-2  libluajit-5.1-common  libnids1.21t64  python3-pefile  python3-qrcode
Use 'sudo apt autoremove' to remove them.

Summary:
  Upgrading: 0, Installing: 0, Removing: 0, Not Upgrading: 1300
```

ab -n 100 -c 10 http://localhost/
These commands run 100 requests with a concurrency of 10
to see how each server handles load.



```
┌──(kali㉿kali)-[~]
└─$ ab -n 100 -c 10 http://localhost/

This is ApacheBench, Version 2.3 <$Revision: 1923142 $>
Copyright 1996 Adam Twiss, Zeus Technology Ltd, http://www.zeustech.net/
Licensed to The Apache Software Foundation, http://www.apache.org/

Benchmarking localhost (be patient).....done


Server Software:        Apache/2.4.63
Server Hostname:        localhost
Server Port:            80

Document Path:          /
Document Length:        30 bytes

Concurrency Level:      10
Time taken for tests:   0.721 seconds
Complete requests:      100
Failed requests:        0
Total transferred:      27600 bytes
HTML transferred:       3000 bytes
Requests per second:    138.79 [#/sec] (mean)
Time per request:       72.050 [ms] (mean)
Time per request:       7.205 [ms] (mean, across all concurrent requests)
Transfer rate:          37.41 [Kbytes/sec] received

Connection Times (ms)
              min  mean[+/-sd] median   max
Connect:        0    1   2.1      0      13
Processing:     1   12  65.3      3     653
Waiting:        1   10  52.9      2     529
Total:          1   13  65.4      3     653

Percentage of the requests served within a certain time (ms)
  50%      3
  66%      3
  75%      4
  80%      9
  90%     34
  95%     35
  98%     36
  99%    653
 100%    653 (longest request)
```

🧰 Tools & Skills Used

Tools:

- Apache2, Nginx
- tee, systemctl, Apache Benchmark (ab)
- Text Editors (nano)

Skills

- Installing Software
- Web Server Management
- Testing and Verifying Servers
- Configuration Management
- Server Troubleshooting

🧰 Real-Life Application

Apache2 is used by WordPress, older CMSs, shared hosting

Nginx powers Netflix, Dropbox, Instagram (as reverse proxy)

🧠 Reflection & Takeaways

This lab helped me setup both apache2 and nginx servers. I initially had a problem with the index.html when switching the nginx server. It only showed the apache2 server configuration, but I figured it out and used this localhost: http://localhost/index.nginx-debian.html. Afterwards it allowed me to go to the server I needed.