

Lab#10: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

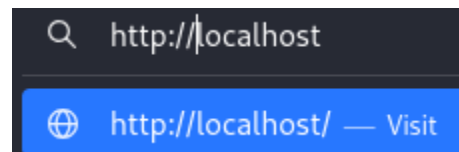
```
(kali㉿kali)-[~]
$ sudo systemctl status apache2
● apache2.service - The Apache HTTP Server
   Loaded: loaded (/usr/lib/systemd/system/apache2.service; enabled; prese
   Active: active (running) since Tue 2025-06-24 19:17:17 EDT; 4min 6s ago
   Invocation: 7e268186a124486d80ec720aa560c015
     Docs: 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!"



After entering the url it'll send this page

 **Apache2 Debian Default Page**

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
```

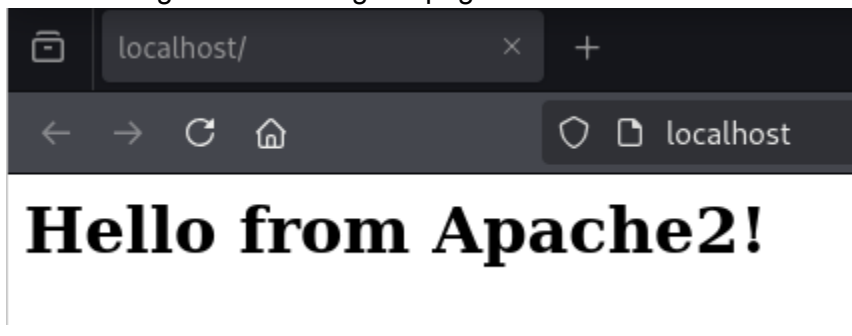
- `apache2.conf` is the main configuration file. It puts the pieces together by including all remaining configuration files when starting up the web server.
- `ports.conf` is always included from the main configuration file. It is used to determine the listening ports for incoming connections, and this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



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  
o 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

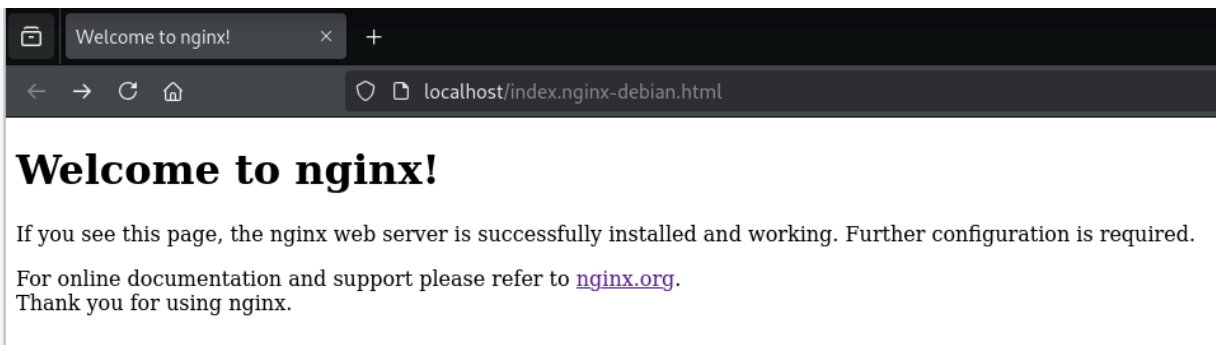
```
(kali㉿kali)-[~]  
$ sudo systemctl start nginx
```

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

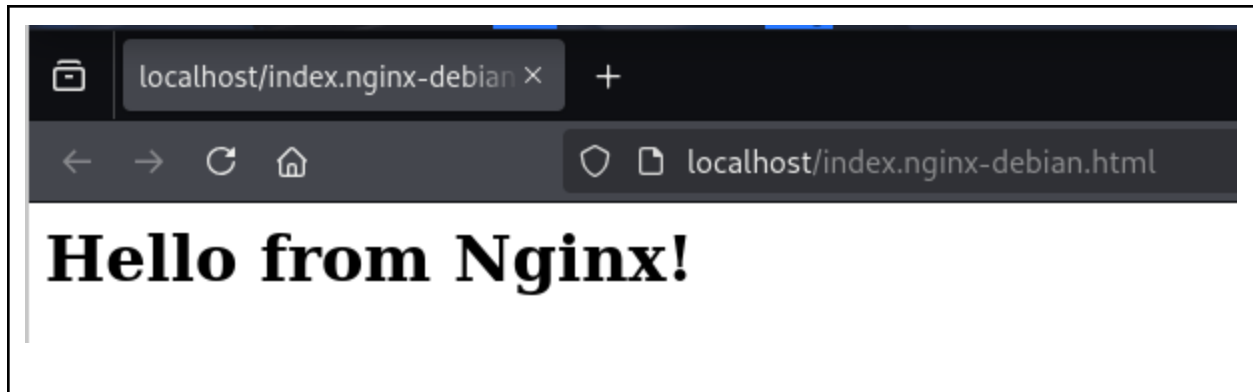


4. Replace Default Page

```
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



5.  Switching Between Apache2 and Nginx (Same Port)
- 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
```

- 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

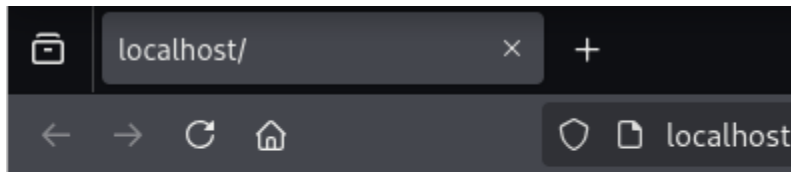
```
(kali㉿kali)-[~]  
$ sudo apt install apache2 -y  
apache2 is already the newest version (2.4.63-1).  
apache2 set to manually installed.  
Summary:  
  Upgrading: 0, Installing: 0, Removing: 0, Not Upgrading: 1301
```

```
(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:

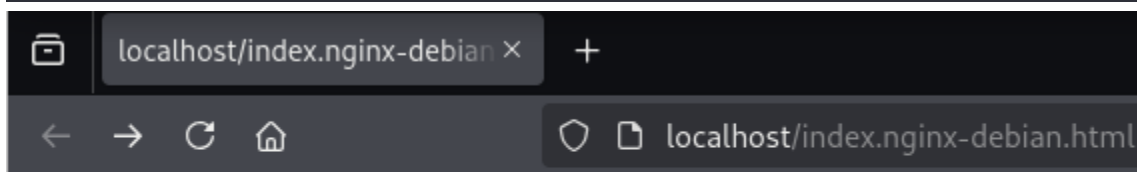
```
(kali㉿kali)-[~]  
$ echo "<h1>Alex from Apache2! </h1"> | sudo tee /var/www/html/index.html  
  
<h1>Alex from Apache2! </h1
```



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>
```



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 liblua5.1-2 liblua5.1-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 | max | 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.