

Name: Thejas N U	SRN: PES1UG20CS606	Section: J
	Date: 11/2/2022	Week Number:3

Computer Networks

	Password Authentication:
	<p>Steps of execution:</p> <p>1) Update the existing softwares and integrating</p> <p>sudo apt-get update</p> <pre>thejas@ubuntu-vm:~\$ sudo apt-get update [sudo] password for thejas: Hit:1 http://in.archive.ubuntu.com/ubuntu focal InRelease Hit:2 http://in.archive.ubuntu.com/ubuntu focal-updates InRelease Hit:3 http://in.archive.ubuntu.com/ubuntu focal-backports InRelease Hit:4 http://security.ubuntu.com/ubuntu focal-security InRelease Reading package lists... Done thejas@ubuntu-vm:~\$</pre> <p>2) Installing apache utility</p> <p>sudo apt-get install apache2 apache2-utils</p> <pre>thejas@ubuntu-vm:~\$ sudo apt-get install apache2 apache2-utils Reading package lists... Done Building dependency tree Reading state information... Done apache2 is already the newest version (2.4.41-4ubuntu3.9). apache2-utils is already the newest version (2.4.41-4ubuntu3.9). 0 upgraded, 0 newly installed, 0 to remove and 65 not upgraded. thejas@ubuntu-vm:~\$</pre>

- 3) Setting up password

```
sudo htpasswd -c /etc/apache2/.htpasswd bhagya
```

```
thejas@ubuntu-vm:~$ sudo htpasswd -c /etc/apache2/.htpasswd thejas
New password:
Re-type new password:
Adding password for user thejas
thejas@ubuntu-vm:~$
```

- 4) To view if the password is set or not

```
sudo cat /etc/apache2/.htpasswd
```

```
thejas@ubuntu-vm:~$ sudo cat /etc/apache2/.htpasswd
thejas:$apr1$IoofgfWn$C1eoBaIarhi2qsgbXB/fC0
thejas@ubuntu-vm:~$
```

- 5) Setting up the authentication phase

```
sudo vim /etc/apache2/sites-available/000-default.conf
```

```
<VirtualHost *:80>
    # The ServerName directive sets the request scheme, hostname and port that
    # the server uses to identify itself. This is used when creating
    # redirection URLs. In the context of virtual hosts, the ServerName
    # specifies what hostname must appear in the request's Host: header to
    # match this virtual host. For the default virtual host (this file) this
    # value is not decisive as it is used as a last resort host regardless.
    # However, you must set it for any further virtual host explicitly.
    #ServerName www.example.com

    ServerAdmin webmaster@localhost
    DocumentRoot /var/www/html

    # Available loglevels: trace8, ..., trace1, debug, info, notice, warn,
    # error, crit, alert, emerg.
    # It is also possible to configure the loglevel for particular
    # modules, e.g.
    #LogLevel info ssl:warn

    ErrorLog ${APACHE_LOG_DIR}/error.log
    CustomLog ${APACHE_LOG_DIR}/access.log combined

    <Directory "/var/www/html">
        AuthType Basic
        AuthName "RESTRICTED"
        AuthUserFile /etc/apache2/.htpasswd
        Require valid-user
    </Directory>

    # For most configuration files from conf-available/, which are
    # enabled or disabled at a global level, it is possible to
    # include a line for only one particular virtual host. For example the
    # following line enables the CGI configuration for this host only
    # after it has been globally disabled with "a2disconf".
    #Include conf-available/serve-cgi-bin.conf
</VirtualHost>

# vim: syntax=apache ts=4 sw=4 sts=4 sr noet
```

6) Restart the apache server

sudo service apache2 restart

```
thejas@ubuntu-vm:~$ sudo service apache2 restart
[sudo] password for thejas:
thejas@ubuntu-vm:~$
```

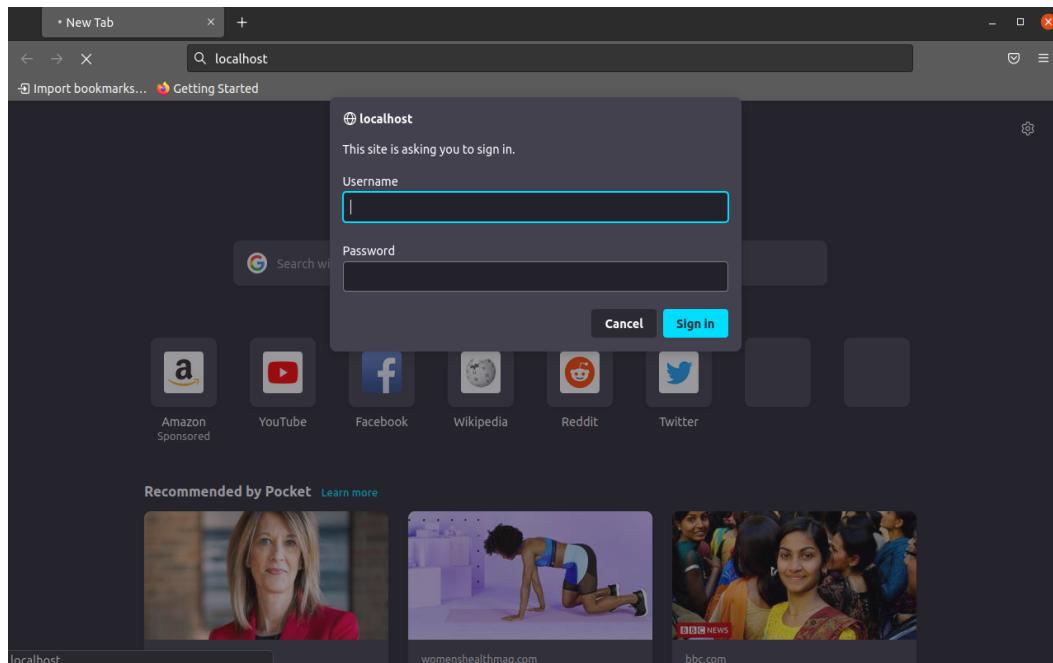
7) Check if apache server is up and running

```
sudo systemctl status apache2
```

```
thejas@ubuntu-vm:~$ sudo systemctl status apache2
● apache2.service - The Apache HTTP Server
   Loaded: loaded (/lib/systemd/system/apache2.service; enabled; vendor prese>
   Active: active (running) since Wed 2022-02-16 18:30:51 IST; 1min 28s ago
     Docs: https://httpd.apache.org/docs/2.4/
   Process: 4398 ExecStart=/usr/sbin/apachectl start (code=exited, status=0/SU>
 Main PID: 4402 (apache2)
   Tasks: 55 (limit: 4593)
  Memory: 4.7M
    CGroup: /system.slice/apache2.service
            └─4402 /usr/sbin/apache2 -k start
                  ├─4403 /usr/sbin/apache2 -k start
                  ├─4404 /usr/sbin/apache2 -k start

Feb 16 18:30:51 ubuntu-vm systemd[1]: Starting The Apache HTTP Server...
Feb 16 18:30:51 ubuntu-vm apachectl[4401]: AH00558: apache2: Could not reliably>
Feb 16 18:30:51 ubuntu-vm systemd[1]: Started The Apache HTTP Server.
lines 1-16/16 (END)
```

8) Access the localhost





9) Wireshark packet capture

The figure shows a screenshot of the Wireshark application interface. The top menu bar includes File, Edit, View, Go, Capture, Analyze, Statistics, Telephony, Wireless, Tools, and Help. Below the menu is a toolbar with various icons for file operations and search. The main window has a green title bar labeled "http".

Packets List:

No.	Time	Source	Destination	Protocol	Length	Info
55	16.644864525	192.168.214.130	142.250.205.227	OCSP	481	Request
57	16.71780505	142.250.205.227	192.168.214.130	OCSP	758	Response
81	17.630899682	127.0.0.1	127.0.0.1	HTTP	501	GET / HTTP/1.1
83	17.639395146	127.0.0.1	127.0.0.1	HTTP	788	HTTP/1.1 401 Unauthorized (text/html)
185	53.400718849	192.168.214.130	117.18.237.29	OCSP	478	Request
189	53.455102760	117.18.237.29	192.168.214.130	OCSP	855	Response
243	55.892247272	192.168.214.130	23.3.70.167	HTTP	359	GET /openh264-linux64-2e1774ab6dc6c43debb0b5b628bdf122
410	56.260690655	23.3.70.167	192.168.214.130	HTTP	1074	HTTP/1.1 200 OK (application/zip)
5641	91.447372685	127.0.0.1	127.0.0.1	HTTP	548	GET / HTTP/1.1
5643	91.454693685	127.0.0.1	127.0.0.1	HTTP	3545	HTTP/1.1 200 OK (text/html)
5779	92.120664420	127.0.0.1	127.0.0.1	HTTP	490	GET /icons/ubuntu-logo.png HTTP/1.1
5781	92.121389052	127.0.0.1	127.0.0.1	HTTP	3691	HTTP/1.1 200 OK (PNG)
5829	92.296986245	127.0.0.1	127.0.0.1	HTTP	480	GET /favicon.ico HTTP/1.1
5831	92.298540189	127.0.0.1	127.0.0.1	HTTP	555	HTTP/1.1 404 Not Found (text/html)

Frame Details:

- Frame 81: 501 bytes on wire (4008 bits), 501 bytes captured (4008 bits) on interface any, id 0
- Linux cooked capture
- Internet Protocol Version 4, Src: 127.0.0.1, Dst: 127.0.0.1
- Transmission Control Protocol, Src Port: 47630, Dst Port: 80, Seq: 1, Ack: 1, Len: 433
- HyperText Transfer Protocol

Hex Editor:

0000	00 00 03 04 00 06 00 00	00 00 00 00 00 00 00 08 00
0010	45 00 01 e5 a5 12 40 00	40 06 95 fe 7f 00 00 01	E@. @.....
0020	7f 00 00 01 ba 0e 00 50	cd 98 7f d6 eb 3b be e1P
0030	80 18 02 00 ff d9 00 00	01 01 08 0a b9 52 e1 43R.C
0040	b9 52 e1 36 47 45 54 20	2f 20 48 54 54 50 2f 31	R 6GET / HTTP/1

Summary: any: <live capture in progress> | Packets: 15629 · Displayed: 14 (0.1%) | Profile: Default

Decoded Text:

```
GET / HTTP/1.1
Host: localhost
User-Agent: Mozilla/5.0 (X11; Ubuntu; Linux x86_64; rv:96.0) Gecko/20100101 Firefox/96.0
Accept: text/html,application/xhtml+xml,application/xml;q=0.9,image/avif,image/webp,*/*;q=0.8
Accept-Language: en-US,en;q=0.5
Accept-Encoding: gzip, deflate
Connection: keep-alive
Upgrade-Insecure-Requests: 1
Sec-Fetch-Dest: document
Sec-Fetch-Mode: navigate
Sec-Fetch-Site: none
Sec-Fetch-User: ?1
Authorization: Basic dGhlaWZ0OndlZWsdGFzazFn

HTTP/1.1 200 OK
Date: Wed, 16 Feb 2022 13:07:38 GMT
Server: Apache/2.4.41 (Ubuntu)
Last-Modified: Wed, 16 Feb 2022 12:54:33 GMT
ETag: "2aa6-5d82226b5488f-gzip"
Accept-Ranges: bytes
Vary: Accept-Encoding
Content-Encoding: gzip
Content-Length: 3138
Keep-Alive: timeout=5, max=100
Connection: Keep-Alive
Content-Type: text/html

.....Z.s.6....U.$...."{'c....$...."!.....c....d5..~.H.%..5...H....o.....n....././
7...=......d.....0..GzKc.q.n6..<.j.N?..Hk....).b....&..JS.....L.....w2.s.b2WrE...+6.4!
R....d....4.....
0.6$Kcjkl&'....p8.....d....Y.-S.. 3.,[.px2.....d4..[+'f.;`....w)...3.nS.#....`BT%..Tif.?Mo...
=....R....L.RK. ./1....v...
```

10) Decrypt the base64 encryption

- We can observe that the authorization field stores the password we had entered to access localhost.
- This password is encrypted using the base64 algorithm before it is transmitted along the network.

```
thejas@ubuntu-vm:~$ echo dGhlaMFnldZWsZdGFzazFh > password.txt
thejas@ubuntu-vm:~$ base64 -d password.txt
thejas:week3task1athejas@ubuntu-vm:~$
```

2 Setting the Cookie

- 1) Install PHP

sudo apt-get install php

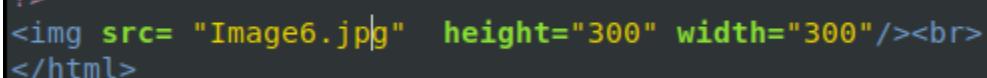
```
thejas@ubuntu-vm:~$ sudo apt-get install php
Reading package lists... Done
Building dependency tree
Reading state information... Done
php is already the newest version (2:7.4+75).
0 upgraded, 0 newly installed, 0 to remove and 65 not upgraded.
thejas@ubuntu-vm:~$
```

- 2) Start the apache server

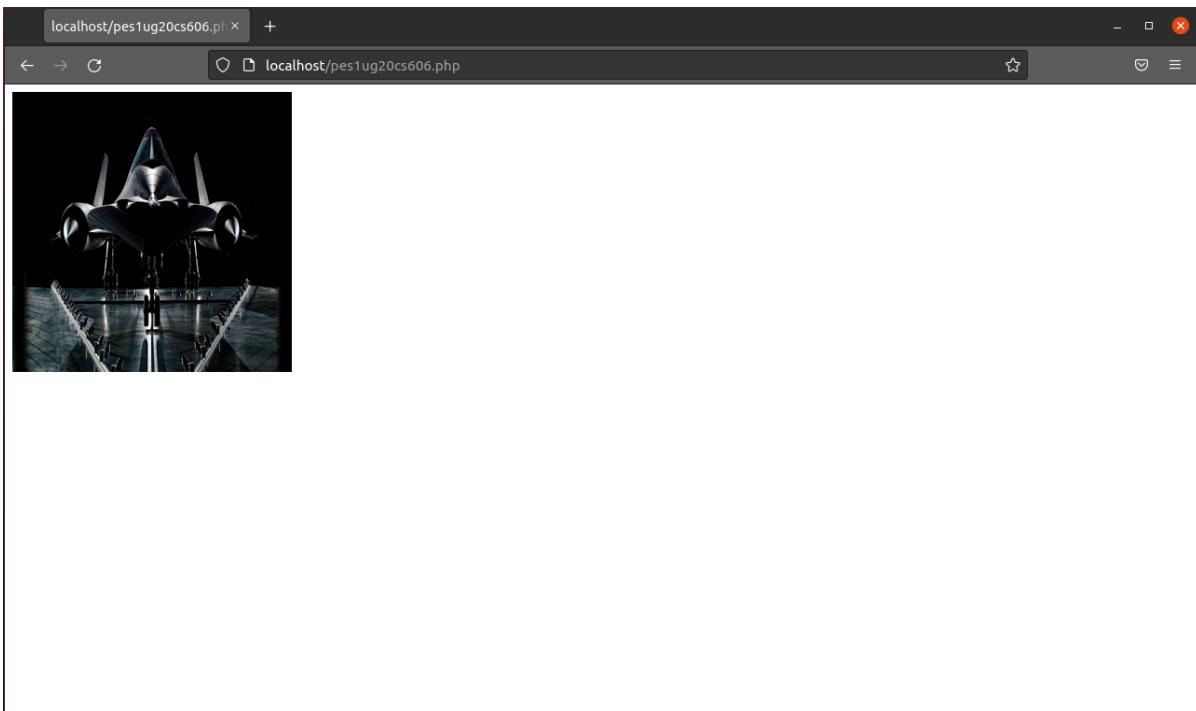
sudo service apache2 start

```
thejas@ubuntu-vm:~$ sudo service apache2 start
thejas@ubuntu-vm:~$
```

- 3) Create a php file in the html home directory

```
<html>
<?php
setcookie("name","thejas",time()+3600,'/');
setcookie("srn","peslug20cs606",time()+3600,'/');
?>

</html>
```

- 4) Access the created file from the browser after clearing the cache and capture the packet using wireshark.



Week Assignment 3

No.	Time	Source	Destination	Protocol	Length	Info
168	6.624864877	192.168.214.130	34.107.221.82	HTTP	355	GET /canonical.html HTTP/1.1
170	6.675147749	34.107.221.82	192.168.214.130	HTTP	358	HTTP/1.1 200 OK (text/html)
192	6.798240384	192.168.214.130	34.107.221.82	HTTP	357	GET /success.txt?ipv4 HTTP/1.1
194	6.887309294	34.107.221.82	192.168.214.130	HTTP	275	HTTP/1.1 200 OK (text/plain)
256	15.494031449	192.168.214.130	142.250.182.131	OCSP	481	Request
262	15.600743509	142.250.182.131	192.168.214.130	OCSP	758	Response
291	21.230200954	127.0.0.1	127.0.0.1	HTTP	518	GET /pes1ug20cs606.php HTTP/1.1
293	21.234628637	127.0.0.1	127.0.0.1	HTTP	788	HTTP/1.1 401 Unauthorized (text/html)
342	72.404172828	127.0.0.1	127.0.0.1	HTTP	565	GET /pes1ug20cs606.php HTTP/1.1
344	72.436985903	127.0.0.1	127.0.0.1	HTTP	578	HTTP/1.1 200 OK (text/html)
372	72.970611990	127.0.0.1	127.0.0.1	HTTP	536	GET /Image6.jpg HTTP/1.1
429	72.976175650	127.0.0.1	127.0.0.1	HTTP	30467	HTTP/1.1 200 OK (JPEG/JFIF image)
431	73.102196713	127.0.0.1	127.0.0.1	HTTP	537	GET /favicon.ico HTTP/1.1
433	73.103034061	127.0.0.1	127.0.0.1	HTTP	555	HTTP/1.1 404 Not Found (text/html)

```

GET /pes1ug20cs606.php HTTP/1.1
Host: localhost
User-Agent: Mozilla/5.0 (X11; Ubuntu; Linux x86_64; rv:96.0) Gecko/20100101 Firefox/96.0
Accept: text/html,application/xhtml+xml,application/xml;q=0.9,image/avif,image/webp,*/*;q=0.8
Accept-Language: en-US,en;q=0.5
Accept-Encoding: gzip, deflate
Connection: keep-alive
Upgrade-Insecure-Requests: 1
Sec-Fetch-Dest: document
Sec-Fetch-Mode: navigate
Sec-Fetch-Site: none
Sec-Fetch-User: ?1
Authorization: Basic dGhlaMfzOnd1ZWsZdGFzazFh

HTTP/1.1 200 OK
Date: Wed, 16 Feb 2022 15:44:34 GMT
Server: Apache/2.4.41 (Ubuntu)
Set-Cookie: name=thejas; expires=Wed, 16-Feb-2022 16:44:34 GMT; Max-Age=3600; path=/
Set-Cookie: srn=pes1ug20cs606; expires=Wed, 16-Feb-2022 16:44:34 GMT; Max-Age=3600; path=/
Vary: Accept-Encoding
Content-Encoding: gzip
Content-Length: 81
Keep-Alive: timeout=5, max=100
Connection: Keep-Alive
Content-Type: text/html; charset=UTF-8

.....(.....MW(.J.UP..ML05..*HWRP.H.L.(.U260PR(.L).....1.....!...<c..G...GET /Image6.jpg HTTP/1.1
Host: localhost
User-Agent: Mozilla/5.0 (X11; Ubuntu; Linux x86_64; rv:96.0) Gecko/20100101 Firefox/96.0
Accept: image/avif,image/webp,*/*
Accept-Language: en-US,en;q=0.5
Accept-Encoding: gzip, deflate
Authorization: Basic dGhlaMfzOnd1ZWsZdGFzazFh
Connection: keep-alive
Referer: http://localhost/pes1ug20cs606.php
Cookie: name=thejas; srn=pes1ug20cs606
Sec-Fetch-Dest: image
Sec-Fetch-Mode: no-cors
Sec-Fetch-Site: same-origin

HTTP/1.1 200 OK
Date: Wed, 16 Feb 2022 15:44:35 GMT
Server: Apache/2.4.41 (Ubuntu)
Last-Modified: Wed, 16 Feb 2022 15:32:59 GMT
ETag: "15f59b-5d8245d4e02d3"
Accept-Ranges: bytes
Content-Length: 1439131
Keep-Alive: timeout=5, max=99
Connection: Keep-Alive
Content-Type: image/jpeg

.....Exif..MM.....;CREATOR: gd-jpeg v1.0 (using IJG JPEG v62), quality = 90
...C.....

```

3
Conditional Get

No.	Time	Source	Destination	Protocol	Length	Info
38	7.209309366	192.168.214.130	128.119.245.12	HTTP	443	GET /wireshark-labs/HTTP-wireshark-file2.html HTTP/1.1
42	7.496857465	128.119.245.12	192.168.214.130	HTTP	786	HTTP/1.1 200 OK (text/html)
101	7.879767106	192.168.214.130	128.119.245.12	HTTP	400	GET /favicon.ico HTTP/1.1
133	8.158035929	128.119.245.12	192.168.214.130	HTTP	541	HTTP/1.1 404 Not Found (text/html)
148	9.888972631	192.168.214.130	128.119.245.12	HTTP	555	GET /wireshark-labs/HTTP-wireshark-file2.html HTTP/1.1
152	10.172436154	128.119.245.12	192.168.214.130	HTTP	295	HTTP/1.1 304 Not Modified

```

GET /wireshark-labs/HTTP-wireshark-file2.html HTTP/1.1
Host: gaia.cs.umass.edu
User-Agent: Mozilla/5.0 (X11; Ubuntu; Linux x86_64; rv:96.0) Gecko/20100101 Firefox/96.0
Accept: text/html,application/xhtml+xml,application/xml;q=0.9,image/avif,image/webp,*/*;q=0.8
Accept-Language: en-US,en;q=0.5
Accept-Encoding: gzip, deflate
Connection: keep-alive
Upgrade-Insecure-Requests: 1

HTTP/1.1 200 OK
Date: Wed, 16 Feb 2022 16:34:03 GMT
Server: Apache/2.4.6 (CentOS) OpenSSL/1.0.2k-fips PHP/7.4.27 mod_perl/2.0.11 Perl/v5.16.3
Last-Modified: Wed, 16 Feb 2022 06:59:01 GMT
ETag: "173-5d81d2f401d21"
Accept-Ranges: bytes
Content-Length: 371
Keep-Alive: timeout=5, max=100
Connection: Keep-Alive
Content-Type: text/html; charset=UTF-8

<html>
Congratulations again! Now you've downloaded the file lab2-2.html. <br>
This file's last modification date will not change. <p>
Thus if you download this multiple times on your browser, a complete copy <br>
will only be sent once by the server due to the inclusion of the IN-MODIFIED-SINCE<br>
field in your browser's HTTP GET request to the server.

</html>
GET /wireshark-labs/HTTP-wireshark-file2.html HTTP/1.1
Host: gaia.cs.umass.edu
User-Agent: Mozilla/5.0 (X11; Ubuntu; Linux x86_64; rv:96.0) Gecko/20100101 Firefox/96.0
Accept: text/html,application/xhtml+xml,application/xml;q=0.9,image/avif,image/webp,*/*;q=0.8
Accept-Language: en-US,en;q=0.5
Accept-Encoding: gzip, deflate
Connection: keep-alive
Upgrade-Insecure-Requests: 1
If-Modified-Since: Wed, 16 Feb 2022 06:59:01 GMT
If-None-Match: "173-5d81d2f401d21"
Cache-Control: max-age=0

HTTP/1.1 304 Not Modified
Date: Wed, 16 Feb 2022 16:34:05 GMT
Server: Apache/2.4.6 (CentOS) OpenSSL/1.0.2k-fips PHP/7.4.27 mod_perl/2.0.11 Perl/v5.16.3
Connection: Keep-Alive
Keep-Alive: timeout=5, max=99
ETag: "173-5d81d2f401d21"

```

Week Assignment 3

Second request to the server

```

GET /wireshark-labs/HTTP-wireshark-file2.html HTTP/1.1
Host: gaia.cs.umass.edu
User-Agent: Mozilla/5.0 (X11; Ubuntu; Linux x86_64; rv:96.0) Gecko/20100101 Firefox/96.0
Accept: text/html,application/xhtml+xml,application/xml;q=0.9,image/avif,image/webp,*/*;q=0.8
Accept-Language: en-US,en;q=0.5
Accept-Encoding: gzip, deflate
Connection: keep-alive
Upgrade-Insecure-Requests: 1

HTTP/1.1 200 OK
Date: Wed, 16 Feb 2022 16:34:03 GMT
Server: Apache/2.4.6 (CentOS) OpenSSL/1.0.2k-fips PHP/7.4.27 mod_perl/2.0.11 Perl/v5.16.3
Last-Modified: Wed, 16 Feb 2022 06:59:01 GMT
ETag: "173-5d81d2f401d21"
Accept-Ranges: bytes
Content-Length: 371
Keep-Alive: timeout=5, max=100
Connection: Keep-Alive
Content-Type: text/html; charset=UTF-8

<html>
Congratulations again! Now you've downloaded the file lab2-2.html. <br>
This file's last modification date will not change. <p>
Thus if you download this multiple times on your browser, a complete copy <br>
will only be sent once by the server due to the inclusion of the IN-MODIFIED-SINCE<br>
field in your browser's HTTP GET request to the server.

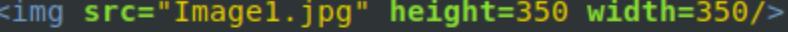
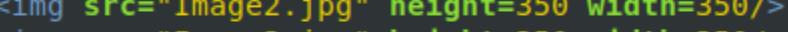
</html>
GET /wireshark-labs/HTTP-wireshark-file2.html HTTP/1.1
Host: gaia.cs.umass.edu
User-Agent: Mozilla/5.0 (X11; Ubuntu; Linux x86_64; rv:96.0) Gecko/20100101 Firefox/96.0
Accept: text/html,application/xhtml+xml,application/xml;q=0.9,image/avif,image/webp,*/*;q=0.8
Accept-Language: en-US,en;q=0.5
Accept-Encoding: gzip, deflate
Connection: keep-alive
Upgrade-Insecure-Requests: 1
If-Modified-Since: Wed, 16 Feb 2022 06:59:01 GMT
If-None-Match: "173-5d81d2f401d21"
Cache-Control: max-age=0

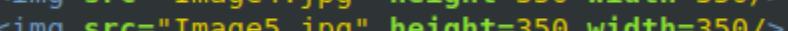
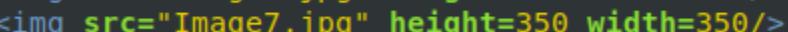
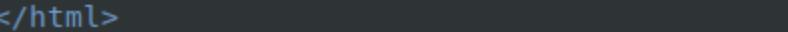
HTTP/1.1 304 Not Modified
Date: Wed, 16 Feb 2022 16:34:05 GMT
Server: Apache/2.4.6 (CentOS) OpenSSL/1.0.2k-fips PHP/7.4.27 mod_perl/2.0.11 Perl/v5.16.3
Connection: Keep-Alive
Keep-Alive: timeout=5, max=99
ETag: "173-5d81d2f401d21"

```

Conditional Get on localhost

```

<html>






</html>

```

Week Assignment 3

No.	Time	Source	Destination	Protocol	Length	Info
56	4.578832661	192.168.214.130	35.232.111.17	HTTP	143	GET / HTTP/1.1
58	4.849391837	35.232.111.17	192.168.214.130	HTTP	204	HTTP/1.1 204 No Content
86	6.639580281	127.0.0.1	127.0.0.1	HTTP	519	GET /pesiug20cs606.html HTTP/1.1
88	6.640034652	127.0.0.1	127.0.0.1	HTTP	788	HTTP/1.1 401 Unauthorized (text/html)
96	23.270090325	127.0.0.1	127.0.0.1	HTTP	566	GET /pesiug20cs606.html HTTP/1.1
98	23.271654005	127.0.0.1	127.0.0.1	HTTP	501	HTTP/1.1 200 OK (text/html)
107	23.597343692	127.0.0.1	127.0.0.1	HTTP	497	GET /Image1.jpg HTTP/1.1
264	23.611291001	127.0.0.1	127.0.0.1	HTTP	29688	HTTP/1.1 200 OK (JPEG JFIF image)
278	23.618023274	127.0.0.1	127.0.0.1	HTTP	497	GET /Image2.jpg HTTP/1.1
283	23.620404423	127.0.0.1	127.0.0.1	HTTP	497	GET /Image3.jpg HTTP/1.1
288	23.633880177	127.0.0.1	127.0.0.1	HTTP	497	GET /Image4.jpg HTTP/1.1
293	23.636554500	127.0.0.1	127.0.0.1	HTTP	497	GET /Image5.jpg HTTP/1.1
339	23.669093480	127.0.0.1	127.0.0.1	HTTP	25160	HTTP/1.1 200 OK (JPEG JFIF image)
387	23.671451030	127.0.0.1	127.0.0.1	HTTP	25411	HTTP/1.1 200 OK (JPEG JFIF image)
439	23.696694526	127.0.0.1	127.0.0.1	HTTP	865	HTTP/1.1 200 OK (JPEG JFIF image)
490	23.914416097	127.0.0.1	127.0.0.1	HTTP	498	GET /favicon.ico HTTP/1.1
492	23.914930104	127.0.0.1	127.0.0.1	HTTP	555	HTTP/1.1 404 Not Found (text/html)
494	27.031941331	127.0.0.1	127.0.0.1	HTTP	683	GET /pesiug20cs606.html HTTP/1.1
496	27.033480693	127.0.0.1	127.0.0.1	HTTP	500	HTTP/1.1 200 OK (text/html)
498	27.124926950	127.0.0.1	127.0.0.1	HTTP	612	GET /Image1.jpg HTTP/1.1
499	27.125697586	127.0.0.1	127.0.0.1	HTTP	251	HTTP/1.1 304 Not Modified
501	27.130353321	127.0.0.1	127.0.0.1	HTTP	611	GET /Image2.jpg HTTP/1.1
503	27.130523827	127.0.0.1	127.0.0.1	HTTP	612	GET /Image3.jpg HTTP/1.1
505	27.130709105	127.0.0.1	127.0.0.1	HTTP	612	GET /Image4.jpg HTTP/1.1
506	27.131209513	127.0.0.1	127.0.0.1	HTTP	250	HTTP/1.1 304 Not Modified
508	27.131962846	127.0.0.1	127.0.0.1	HTTP	251	HTTP/1.1 304 Not Modified
510	27.132669491	127.0.0.1	127.0.0.1	HTTP	251	HTTP/1.1 304 Not Modified
512	27.133180585	127.0.0.1	127.0.0.1	HTTP	612	GET /Image5.jpg HTTP/1.1
514	27.133923093	127.0.0.1	127.0.0.1	HTTP	251	HTTP/1.1 304 Not Modified
534	34.170841883	127.0.0.1	127.0.0.1	HTTP	683	GET /pesiug20cs606.html HTTP/1.1
536	34.172508917	127.0.0.1	127.0.0.1	HTTP	501	HTTP/1.1 200 OK (text/html)
538	34.270562893	127.0.0.1	127.0.0.1	HTTP	612	GET /Image1.jpg HTTP/1.1
540	34.271365713	127.0.0.1	127.0.0.1	HTTP	251	HTTP/1.1 304 Not Modified
542	34.277880759	127.0.0.1	127.0.0.1	HTTP	611	GET /Image2.jpg HTTP/1.1
544	34.278592455	127.0.0.1	127.0.0.1	HTTP	250	HTTP/1.1 304 Not Modified
546	34.284415165	127.0.0.1	127.0.0.1	HTTP	612	GET /Image3.jpg HTTP/1.1
548	34.285142595	127.0.0.1	127.0.0.1	HTTP	251	HTTP/1.1 304 Not Modified
550	34.287143546	127.0.0.1	127.0.0.1	HTTP	612	GET /Image4.jpg HTTP/1.1
551	34.287820782	127.0.0.1	127.0.0.1	HTTP	251	HTTP/1.1 304 Not Modified
553	34.292426057	127.0.0.1	127.0.0.1	HTTP	612	GET /Image5.jpg HTTP/1.1
554	34.293245244	127.0.0.1	127.0.0.1	HTTP	251	HTTP/1.1 304 Not Modified

```

GET /pesiug20cs606.html HTTP/1.1
Host: localhost
User-Agent: Mozilla/5.0 (X11; Ubuntu; Linux x86_64; rv:96.0) Gecko/20100101 Firefox/96.0
Accept: text/html,application/xhtml+xml,application/xml;q=0.9,image/avif,image/webp,*/*;q=0.8
Accept-Language: en-US,en;q=0.5
Accept-Encoding: gzip, deflate
Connection: keep-alive
Upgrade-Insecure-Requests: 1
Sec-Fetch-Dest: document
Sec-Fetch-Mode: navigate
Sec-Fetch-Site: none
Sec-Fetch-User: ?1
Authorization: Basic dGhlaGFzOndlZWszdGFzazFh

HTTP/1.1 200 OK
Date: Wed, 16 Feb 2022 17:24:46 GMT
Server: Apache/2.4.41 (Ubuntu)
Last-Modified: Wed, 16 Feb 2022 17:06:00 GMT
ETag: "100-5d825a9fb0b30-gzip"
Accept-Ranges: bytes
Vary: Accept-Encoding
Content-Encoding: gzip
Content-Length: 97
Keep-Alive: timeout=5, max=100
Connection: Keep-Alive
Content-Type: text/html

.....Qt.w...pU.(.....R...
.E..J.....zY..J
....%...
...%..->b#R.....C<
.B.....GET /Image1.jpg HTTP/1.1
Host: localhost
User-Agent: Mozilla/5.0 (X11; Ubuntu; Linux x86_64; rv:96.0) Gecko/20100101 Firefox/96.0
Accept: image/avif,image/webp,*/*
Accept-Language: en-US,en;q=0.5
Accept-Encoding: gzip, deflate
Authorization: Basic dGhlaGFzOndlZWszdGFzazFh
Connection: keep-alive
Referer: http://localhost/pesiug20cs606.html
Sec-Fetch-Dest: image
Sec-Fetch-Mode: no-cors
Sec-Fetch-Site: same-origin

HTTP/1.1 200 OK
Date: Wed, 16 Feb 2022 17:24:46 GMT
Server: Apache/2.4.41 (Ubuntu)
Last-Modified: Wed, 16 Feb 2022 15:32:59 GMT

```

```
GET /pesiug20cs606.html HTTP/1.1
Host: localhost
User-Agent: Mozilla/5.0 (X11; Ubuntu; Linux x86_64; rv:96.0) Gecko/20100101 Firefox/96.0
Accept: text/html,application/xhtml+xml,application/xml;q=0.9,image/avif,image/webp,*/*;q=0.8
Accept-Language: en-US,en;q=0.5
Accept-Encoding: gzip, deflate
Authorization: Basic dGhlaGFzOnd1ZWszdGFzazFh
Connection: keep-alive
Upgrade-Insecure-Requests: 1
Sec-Fetch-Dest: document
Sec-Fetch-Mode: navigate
Sec-Fetch-Site: none
Sec-Fetch-User: ?1
If-Modified-Since: Wed, 16 Feb 2022 17:06:00 GMT
If-None-Match: "100-5d825a9fb0b30-gzip"
Cache-Control: max-age=0

HTTP/1.1 200 OK
Date: Wed, 16 Feb 2022 17:24:57 GMT
Server: Apache/2.4.41 (Ubuntu)
Last-Modified: Wed, 16 Feb 2022 17:06:00 GMT
ETag: "100-5d825a9fb0b30-gzip"
Accept-Ranges: bytes
Vary: Accept-Encoding
Content-Encoding: gzip
Content-Length: 97
Keep-Alive: timeout=5, max=100
Connection: Keep-Alive
Content-Type: text/html

.....Qt.w...pu.(.....R...
.E..J.....zY..J
....%.....
..%>..>.b#R.....C<
.B.....GET /Image1.jpg HTTP/1.1
Host: localhost
User-Agent: Mozilla/5.0 (X11; Ubuntu; Linux x86_64; rv:96.0) Gecko/20100101 Firefox/96.0
Accept: image/avif,image/webp,*/*
Accept-Language: en-US,en;q=0.5
Accept-Encoding: gzip, deflate
Authorization: Basic dGhlaGFzOnd1ZWszdGFzazFh
Connection: keep-alive
Referer: http://localhost/pesiug20cs606.html
Sec-Fetch-Dest: image
Sec-Fetch-Mode: no-cors
Sec-Fetch-Site: same-origin
If-Modified-Since: Wed, 16 Feb 2022 15:32:59 GMT
If-None-Match: "1bf290-5d8245d4dc453"
```

Persistent and Non-persistent HTTP Connections

Server Side:

Step 1: Checking Web Server

```
thejas@ubuntu-vm:~$ sudo systemctl status apache2
● apache2.service - The Apache HTTP Server
  Loaded: loaded (/lib/systemd/system/apache2.service; enabled; vendor prese>
  Active: active (running) since Thu 2022-02-17 18:46:40 IST; 13min ago
    Docs: https://httpd.apache.org/docs/2.4/
  Process: 828 ExecStart=/usr/sbin/apachectl start (code=exited, status=0/SUC>
 Main PID: 918 (apache2)
   Tasks: 6 (limit: 2250)
  Memory: 15.9M
    CGroup: /system.slice/apache2.service
            └─918 /usr/sbin/apache2 -k start
              ├─936 /usr/sbin/apache2 -k start
              ├─939 /usr/sbin/apache2 -k start
              ├─941 /usr/sbin/apache2 -k start
              ├─942 /usr/sbin/apache2 -k start
              └─944 /usr/sbin/apache2 -k start

Feb 17 18:46:38 ubuntu-vm systemd[1]: Starting The Apache HTTP Server...
Feb 17 18:46:39 ubuntu-vm apachectl[859]: AH00558: apache2: Could not reliably >
Feb 17 18:46:40 ubuntu-vm systemd[1]: Started The Apache HTTP Server.
lines 1-19/19 (END)
```

Step 2: Setting up the Server IP address

```
thejas@ubuntu-vm:~$ sudo ip addr add 172.16.10.1/24 dev ens33
thejas@ubuntu-vm:~$
```

```
thejas@ubuntu-vm:~$ ip addr
1: lo: <LOOPBACK,UP,LOWER_UP> mtu 65536 qdisc noqueue state UNKNOWN group default qlen 1000
    link/loopback 00:00:00:00:00:00 brd 00:00:00:00:00:00
    inet 127.0.0.1/8 scope host lo
        valid_lft forever preferred_lft forever
    inet6 ::1/128 scope host
        valid_lft forever preferred_lft forever
2: ens33: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc fq_codel state UP group default qlen 1000
    link/ether 00:0c:29:f4:db:c9 brd ff:ff:ff:ff:ff:ff
    altname enp2s1
    inet 192.168.214.133/24 brd 192.168.214.255 scope global dynamic noprefixroute ens33
        valid_lft 1699sec preferred_lft 1699sec
    inet 172.16.10.1/24 scope global ens33
        valid_lft forever preferred_lft forever
    inet6 fe80::bf0:be1d:2c7b:39c8/64 scope link noprefixroute
        valid_lft forever preferred_lft forever
thejas@ubuntu-vm:~$
```

Step 3: The apache2.conf file present in the etc/apache2 directory is modified as:

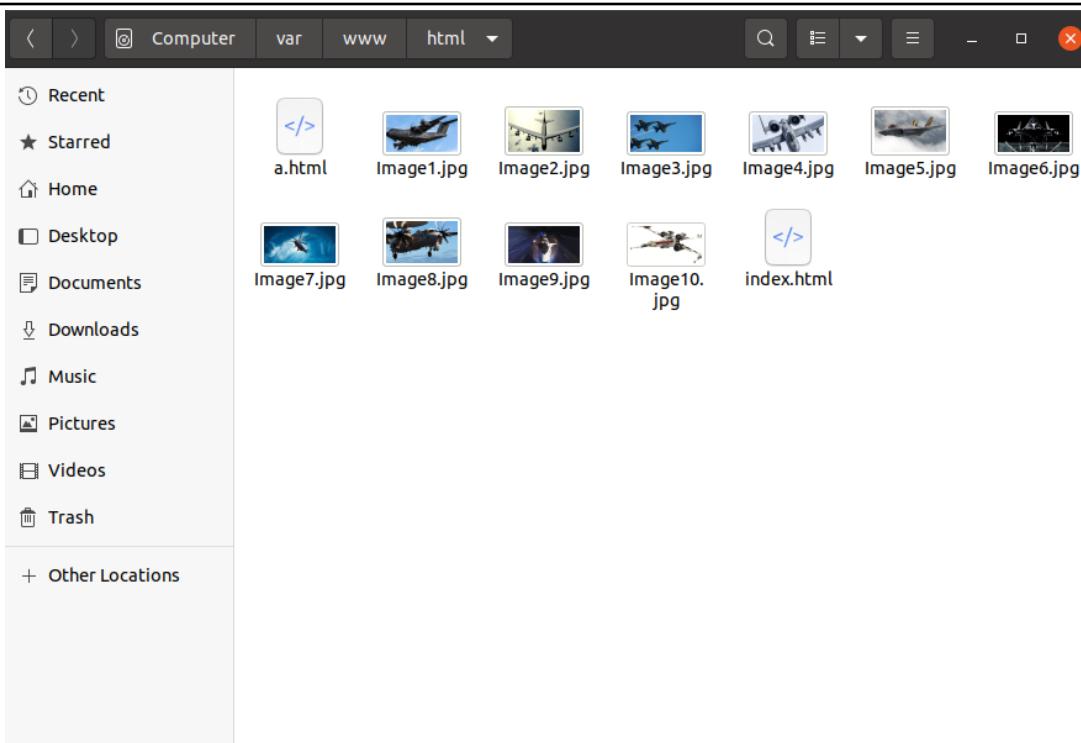
- a) The keep-alive option was set (i.e. value was made ON)
- b) The MaximumKeepAliveRequests were set to 2

```
# KeepAlive: Whether or not to allow persistent connections (more than
# one request per connection). Set to "Off" to deactivate.
#
KeepAlive On

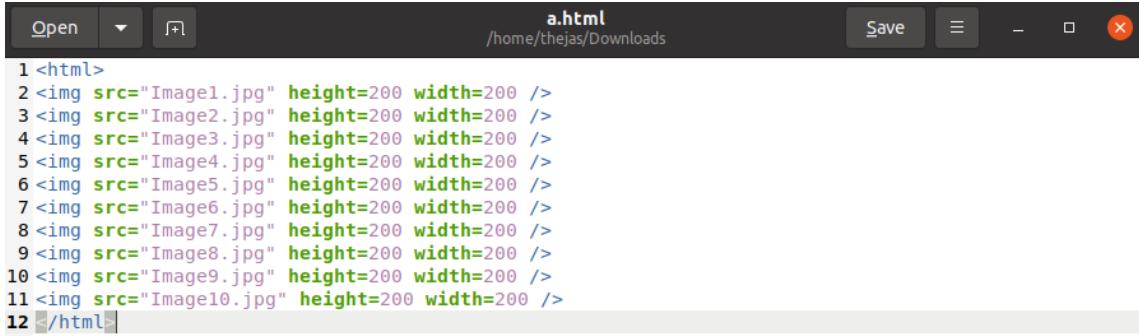
#
# MaxKeepAliveRequests: The maximum number of requests to allow
# during a persistent connection. Set to 0 to allow an unlimited amount.
# We recommend you leave this number high, for maximum performance.
#
MaxKeepAliveRequests 2

#
# KeepAliveTimeout: Number of seconds to wait for the next request from the
# same client on the same connection.
#
KeepAliveTimeout 5
```

Step 4: Store images in the server path. A html page consisting of 10 images having size > 2MB were placed and accessed by the client. This html page is stored in the location - /var/www/html/a.html.



Step 5: Preparation of webpage



```
1 <html>
2 
3 
4 
5 
6 
7 
8 
9 
10 
11 
12 </html>
```

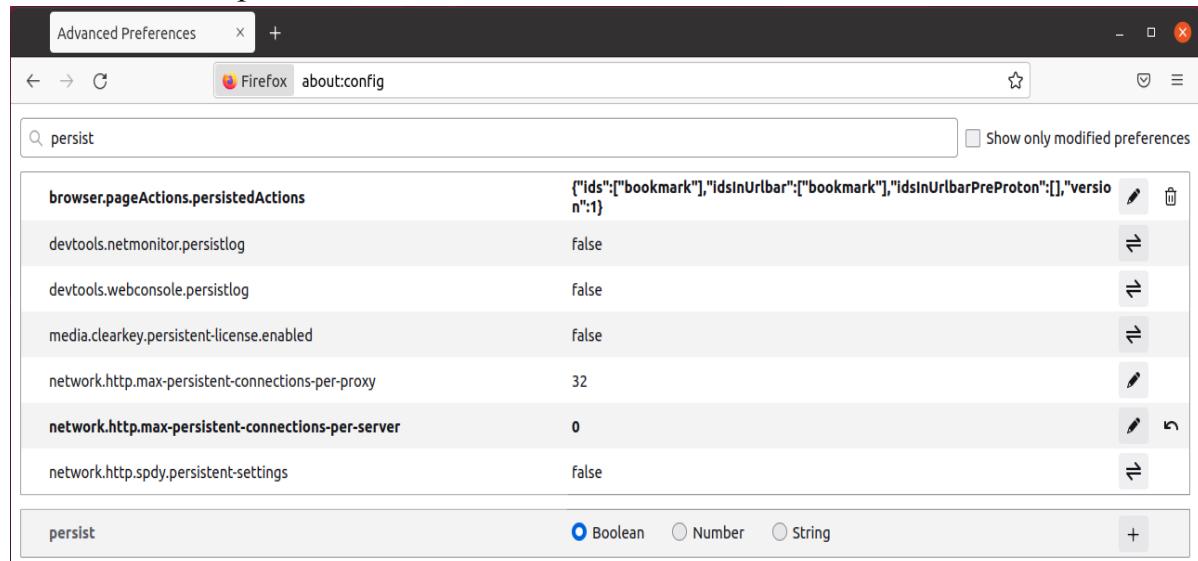
Client side:

Step 1: Setting up the Client IP address

```
thejas@ubuntu-vm:~$ sudo ip addr add 172.16.10.2/24 dev ens33
[sudo] password for thejas:
thejas@ubuntu-vm:~$ sudo ip addr
1: lo: <LOOPBACK,UP,LOWER_UP> mtu 65536 qdisc noqueue state UNKNOWN group default qlen 1000
    link/loopback 00:00:00:00:00:00 brd 00:00:00:00:00:00
    inet 127.0.0.1/8 scope host lo
        valid_lft forever preferred_lft forever
    inet6 ::1/128 scope host
        valid_lft forever preferred_lft forever
2: ens33: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc fq_codel state UP group default qlen 1000
    link/ether 00:0c:29:73:9e:9a brd ff:ff:ff:ff:ff:ff
    altname enp2s1
    inet 192.168.214.132/24 brd 192.168.214.255 scope global dynamic noprefixroute ens33
        valid_lft 1401sec preferred_lft 1401sec
    inet 172.16.10.2/24 scope global ens33
        valid_lft forever preferred_lft forever
    inet6 fe80::7312:5c26:a3c2:19d6/64 scope link noprefixroute
        valid_lft forever preferred_lft forever
thejas@ubuntu-vm:~$
```

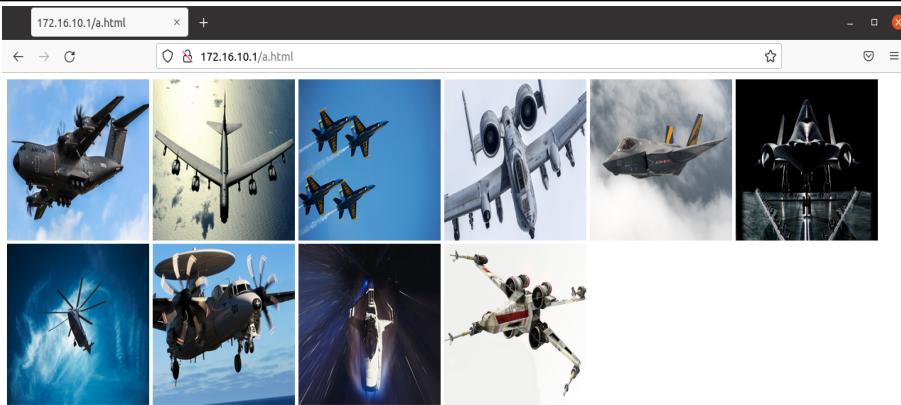
PART 1: NON-PERSISTENT CONNECTION

Step 1: This is done by setting the value of max-persistent-connection-per-server to 0 in the client computer



Step 2: Access web page on client-side browser

Week Assignment 3



Step 3: Wireshark packet capture

No.	Time	Source	Destination	Protocol	Length	Info
10	8.282750549	172.16.10.2	172.16.10.1	HTTP	404	GET /a.html HTTP/1.1
12	8.388635288	172.16.10.1	172.16.10.2	HTTP	569	HTTP/1.1 200 OK (text/html)
27	8.68385861	172.16.10.2	172.16.10.1	HTTP	354	GET /Image1.jpg HTTP/1.1
160	8.734024566	172.16.10.1	172.16.10.2	HTTP	27720	HTTP/1.1 200 OK (JPEG JFIF image)
187	8.789106698	172.16.10.2	172.16.10.1	HTTP	354	GET /Image2.jpg HTTP/1.1
226	8.803149343	172.16.10.1	172.16.10.2	HTTP	11063	HTTP/1.1 200 OK (JPEG JFIF image)
229	8.819381638	172.16.10.2	172.16.10.1	HTTP	354	GET /Image3.jpg HTTP/1.1
274	8.833886567	172.16.10.1	172.16.10.2	HTTP	32018	HTTP/1.1 200 OK (JPEG JFIF image)
278	8.865493109	172.16.10.2	172.16.10.1	HTTP	354	GET /Image4.jpg HTTP/1.1
322	8.884959464	172.16.10.1	172.16.10.2	HTTP	52208	HTTP/1.1 200 OK (JPEG JFIF image)
324	8.917097706	172.16.10.2	172.16.10.1	HTTP	354	GET /Image5.jpg HTTP/1.1
363	8.930065786	172.16.10.1	172.16.10.2	HTTP	45834	HTTP/1.1 200 OK (JPEG JFIF image)
365	8.958162205	172.16.10.2	172.16.10.1	HTTP	354	GET /Image6.jpg HTTP/1.1
406	8.982964930	172.16.10.1	172.16.10.2	HTTP	7419	HTTP/1.1 200 OK (JPEG JFIF image)
408	8.992697995	172.16.10.2	172.16.10.1	HTTP	354	GET /Image7.jpg HTTP/1.1
439	9.007989224	172.16.10.1	172.16.10.2	HTTP	24342	HTTP/1.1 200 OK (JPEG JFIF image)
441	9.063160007	172.16.10.2	172.16.10.1	HTTP	354	GET /Image8.jpg HTTP/1.1
476	9.089826970	172.16.10.1	172.16.10.2	HTTP	7454	HTTP/1.1 200 OK (JPEG JFIF image)
480	9.188254472	172.16.10.2	172.16.10.1	HTTP	354	GET /Image9.jpg HTTP/1.1
534	9.247012034	172.16.10.1	172.16.10.2	HTTP	39657	HTTP/1.1 200 OK (JPEG JFIF image)
536	9.288469582	172.16.10.2	172.16.10.1	HTTP	355	GET /Image10.jpg HTTP/1.1
621	9.354577011	172.16.10.1	172.16.10.2	HTTP	20444	HTTP/1.1 200 OK (JPEG JFIF image)
623	9.587979861	172.16.10.2	172.16.10.1	HTTP	355	GET /favicon.ico HTTP/1.1
624	9.589419543	172.16.10.1	172.16.10.2	HTTP	557	HTTP/1.1 404 Not Found (text/html)

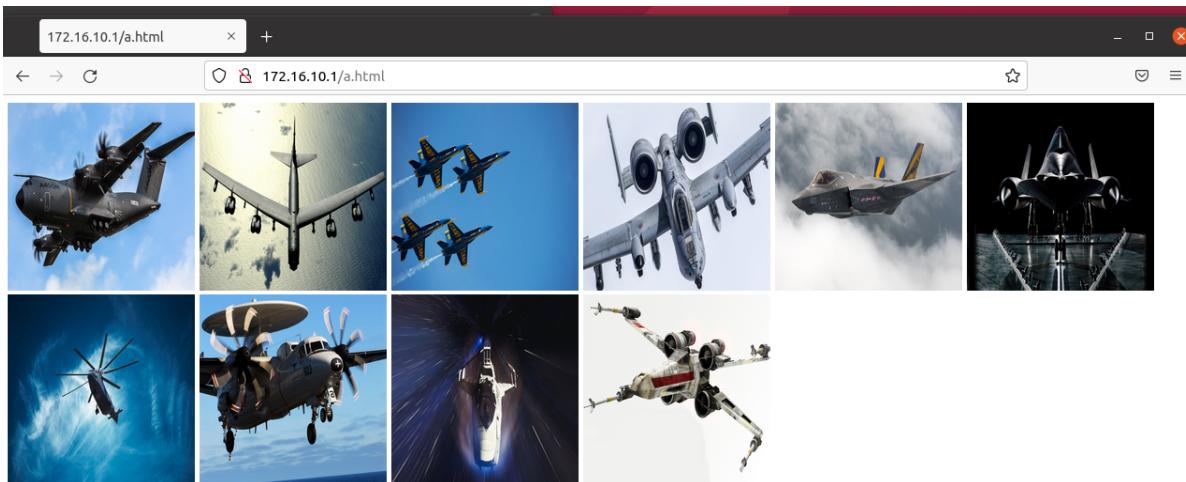
Here it is $9.354577011 - 8.282750549 = 1.071826462$

PART 2: PERSISTENT CONNECTIONS

Step 1: This is done by setting the value of max-persistent-connection-per-server to 2 in the client computer

Advanced Preferences	
about:config	
<input type="text" value="persis"/>	<input type="checkbox"/> Show only modified preferences
browser.pageActions.persistedActions	{ "ids": ["bookmark"], "idsInUrlbar": ["bookmark"], "idsInUrlbarPreProton": [], "version": 1 }
devtools.netmonitor.persistlog	false
devtools.webconsole.persistlog	false
media.clearkey.persistent-license.enabled	false
network.http.max-persistent-connections-per-proxy	32
network.http.max-persistent-connections-per-server	2
network.http.spdy.persistent-settings	false
persis	<input checked="" type="radio"/> Boolean <input type="radio"/> Number <input type="radio"/> String

Step 2: Access web page on client-side browser



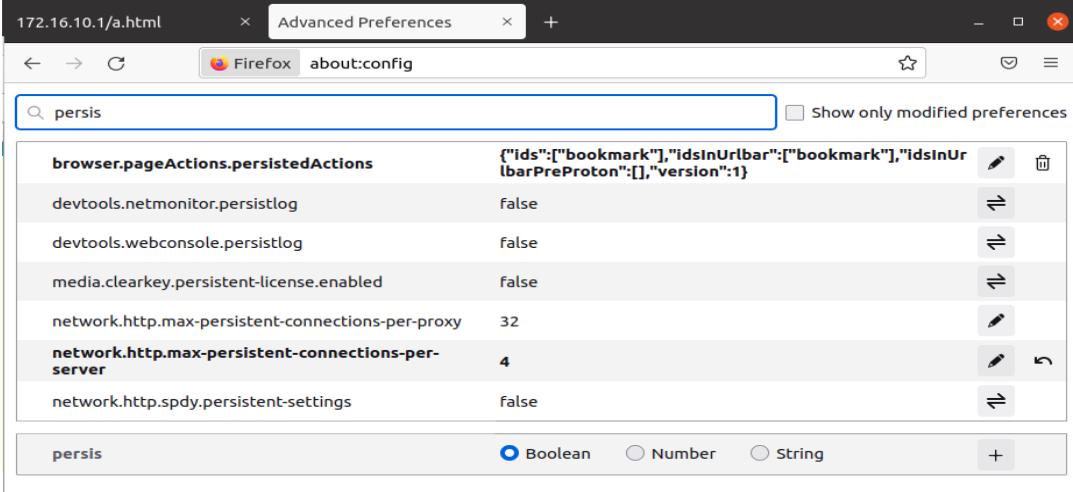
Step 3: Wireshark packet capture

No.	Time	Source	Destination	Protocol	Length	Info
203	27.925472611	34.107.221.82	192.168.214.132	HTTP	357	HTTP/1.1 200 OK (text/html)
236	28.005522938	192.168.214.132	34.107.221.82	HTTP	357	GET /success.txt?ipv4 HTTP/1.1
238	28.059056212	34.107.221.82	192.168.214.132	HTTP	276	HTTP/1.1 200 OK (text/plain)
245	34.112844977	172.16.10.2	172.16.10.1	HTTP	404	GET /a.html HTTP/1.1
247	34.134027875	172.16.10.1	172.16.10.2	HTTP	509	HTTP/1.1 200 OK (text/html)
277	34.426166654	172.16.10.2	172.16.10.1	HTTP	354	GET /Image1.jpg HTTP/1.1
282	34.429440945	172.16.10.2	172.16.10.1	HTTP	354	GET /Image2.jpg HTTP/1.1
496	34.492751060	172.16.10.1	172.16.10.2	HTTP	33584	HTTP/1.1 200 OK (JPEG JFIF image)
535	34.511561362	172.16.10.1	172.16.10.2	HTTP	29888	HTTP/1.1 200 OK (JPEG JFIF image)
537	34.568062493	172.16.10.2	172.16.10.1	HTTP	354	GET /Image3.jpg HTTP/1.1
604	34.609917082	172.16.10.2	172.16.10.1	HTTP	354	GET /Image4.jpg HTTP/1.1
645	34.618072959	172.16.10.1	172.16.10.2	HTTP	23240	HTTP/1.1 200 OK (JPEG JFIF image)
664	34.630130021	172.16.10.1	172.16.10.2	HTTP	14642	HTTP/1.1 200 OK (JPEG JFIF image)
666	34.637919760	172.16.10.2	172.16.10.1	HTTP	354	GET /Image5.jpg HTTP/1.1
723	34.671601681	172.16.10.2	172.16.10.1	HTTP	354	GET /Image6.jpg HTTP/1.1
765	34.680862917	172.16.10.1	172.16.10.2	HTTP	5971	HTTP/1.1 200 OK (JPEG JFIF image)
771	34.694818229	172.16.10.1	172.16.10.2	HTTP	9634	HTTP/1.1 200 OK (JPEG JFIF image)
773	34.70255997	172.16.10.2	172.16.10.1	HTTP	354	GET /Image7.jpg HTTP/1.1
822	34.713712898	172.16.10.1	172.16.10.2	HTTP	19998	HTTP/1.1 200 OK (JPEG JFIF image)
824	34.737558655	172.16.10.2	172.16.10.1	HTTP	354	GET /Image8.jpg HTTP/1.1
862	34.745200196	172.16.10.1	172.16.10.2	HTTP	47998	HTTP/1.1 200 OK (JPEG JFIF image)
864	34.756436910	172.16.10.2	172.16.10.1	HTTP	354	GET /Image9.jpg HTTP/1.1
910	34.800221688	172.16.10.2	172.16.10.1	HTTP	355	GET /Image10.jpg HTTP/1.1
996	34.821584995	172.16.10.1	172.16.10.2	HTTP	39657	HTTP/1.1 200 OK (JPEG JFIF image)
1024	34.870841767	172.16.10.1	172.16.10.2	HTTP	30580	HTTP/1.1 200 OK (JPEG JFIF image)
1027	34.956385998	172.16.10.2	172.16.10.1	HTTP	355	GET /Favicon.ico HTTP/1.1
1028	34.957169093	172.16.10.1	172.16.10.2	HTTP	557	HTTP/1.1 404 Not Found (text/html)

Here it is $34.870841767 - 34.112844977 = 0.75799679$

Week Assignment 3

Step 4: For 4 persistent connections, Set the value of max-persistent-connection-per-server to 4 in the client computer



The screenshot shows the Firefox configuration page (`about:config`). A search bar at the top contains the text "persis". In the list of preferences, the entry `network.http.max-persistent-connections-per-server` is highlighted and has its value set to `4`. Other visible settings include `browser.pageActions.persistedActions`, `devtools.netmonitor.persistlog`, `devtools.webconsole.persistlog`, `media.clearkey.persistent-license.enabled`, `network.http.max-persistent-connections-per-proxy` (set to `32`), and `network.http.spdy.persistent-settings` (set to `false`).

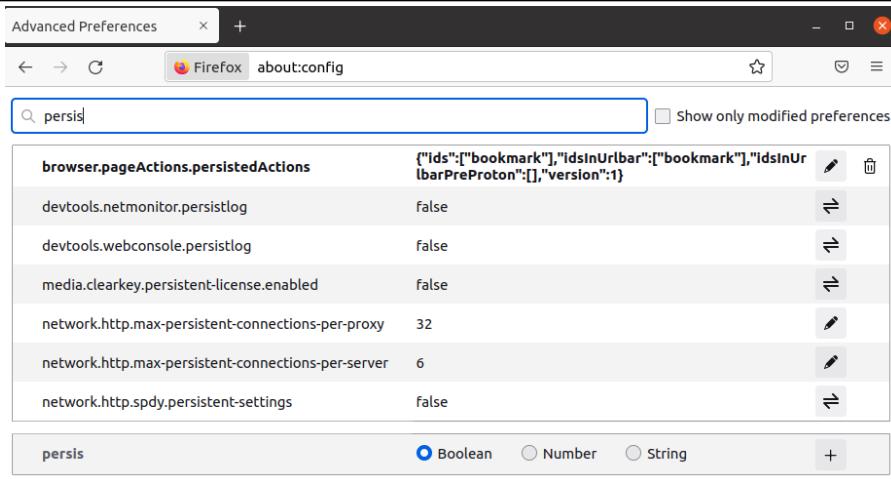
Step 5: Repeat the steps 1-3.

No.	Time	Source	Destination	Protocol	Length	Info
6	0.003738344	172.16.10.2	172.16.10.1	HTTP	404	GET /a.html HTTP/1.1
8	0.069300796	172.16.10.1	172.16.10.2	HTTP	509	HTTP/1.1 200 OK (text/html)
99	0.569587633	172.16.10.2	172.16.10.1	HTTP	354	GET /Image1.jpg HTTP/1.1
128	0.582845766	172.16.10.2	172.16.10.1	HTTP	354	GET /Image2.jpg HTTP/1.1
240	0.609824813	172.16.10.2	172.16.10.1	HTTP	354	GET /Image4.jpg HTTP/1.1
248	0.610906684	172.16.10.2	172.16.10.1	HTTP	354	GET /Image3.jpg HTTP/1.1
474	0.660196726	172.16.10.1	172.16.10.2	HTTP	5272	HTTP/1.1 200 OK (JPEG JFIF image)
515	0.677731142	172.16.10.1	172.16.10.2	HTTP	3104	HTTP/1.1 200 OK (JPEG JFIF image)
655	0.715259614	172.16.10.1	172.16.10.2	HTTP	17449	HTTP/1.1 200 OK (JPEG JFIF image)
710	0.798336001	172.16.10.1	172.16.10.2	HTTP	29123	HTTP/1.1 200 OK (JPEG JFIF image)
716	0.854222055	172.16.10.2	172.16.10.1	HTTP	354	GET /Image5.jpg HTTP/1.1
824	1.010399011	172.16.10.1	172.16.10.2	HTTP	8186	HTTP/1.1 200 OK (JPEG JFIF image)
825	1.022361131	172.16.10.2	172.16.10.1	HTTP	354	GET /Image6.jpg HTTP/1.1
914	1.121538862	172.16.10.1	172.16.10.2	HTTP	3075	HTTP/1.1 200 OK (JPEG JFIF image)
917	1.289459999	172.16.10.2	172.16.10.1	HTTP	354	GET /Image7.jpg HTTP/1.1
980	1.298793713	172.16.10.1	172.16.10.2	HTTP	14206	HTTP/1.1 200 OK (JPEG JFIF image)
983	1.451730219	172.16.10.2	172.16.10.1	HTTP	354	GET /Image8.jpg HTTP/1.1
1105	1.547076645	172.16.10.1	172.16.10.2	HTTP	21934	HTTP/1.1 200 OK (JPEG JFIF image)
1108	1.747347911	172.16.10.2	172.16.10.1	HTTP	354	GET /Image9.jpg HTTP/1.1
1279	1.992388775	172.16.10.1	172.16.10.2	HTTP	3457	HTTP/1.1 200 OK (JPEG JFIF image)
1281	2.088151100	172.16.10.2	172.16.10.1	HTTP	355	GET /Image10.jpg HTTP/1.1
1499	2.374104191	172.16.10.1	172.16.10.2	HTTP	10308	HTTP/1.1 200 OK (JPEG JFIF image)
1502	3.480827819	172.16.10.2	172.16.10.1	HTTP	355	GET /favicon.ico HTTP/1.1
1504	3.483136242	172.16.10.1	172.16.10.2	HTTP	557	HTTP/1.1 404 Not Found (text/html)

Here it is $2.374104191 - 0.003738344 = 2.370365847$

Step 6: For 6 persistent connections, set the value of max-persistent-connection-per-server to 6 in the client computer.

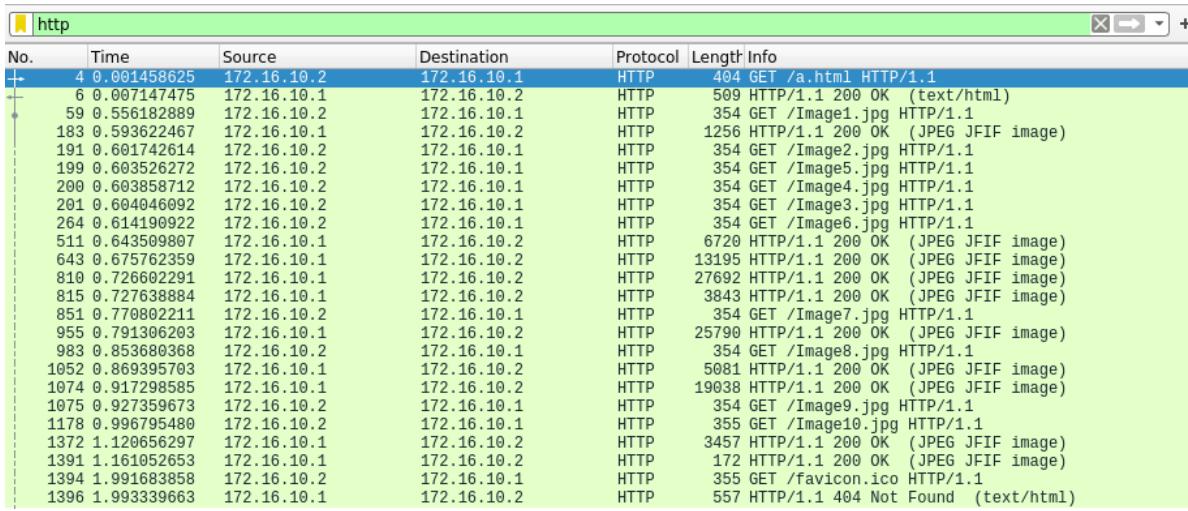
Week Assignment 3



The screenshot shows the Firefox Advanced Preferences window with the search bar containing "persis". The results list several preferences related to persistent connections:

- browser.pageActions.persistedActions**: {"Ids":["bookmark"], "IdsInUrlbar":["bookmark"], "IdsInUr..."}, Type: Object
- devtools.netmonitor.persistlog**: false, Type: Boolean
- devtools.webconsole.persistlog**: false, Type: Boolean
- media.clearkey.persistent-license.enabled**: false, Type: Boolean
- network.http.max-persistent-connections-per-proxy**: 32, Type: Number
- network.http.max-persistent-connections-per-server**: 6, Type: Number
- network.http.spdy.persistent-settings**: false, Type: Boolean

Step 7: Repeat the steps 1-3.

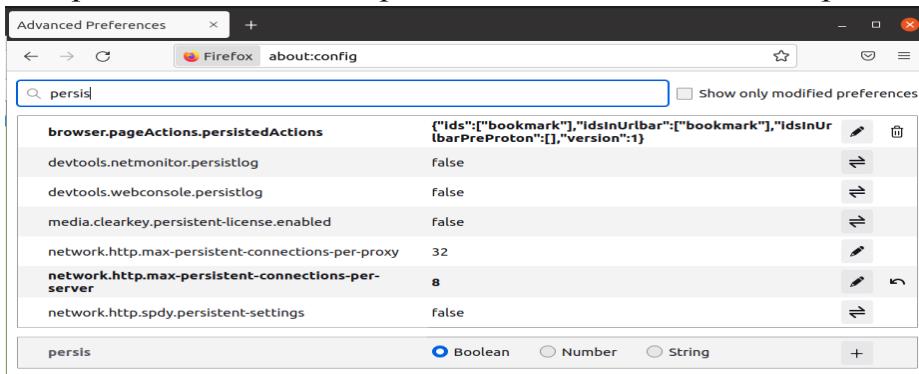


The screenshot shows a NetworkMiner tool interface with a green header bar labeled "http". Below is a table of network traffic logs:

No.	Time	Source	Destination	Protocol	Length	Info
4	0.001458625	172.16.10.2	172.16.10.1	HTTP	404	GET /a.html HTTP/1.1
6	0.007147475	172.16.10.1	172.16.10.2	HTTP	509	HTTP/1.1 200 OK (text/html)
59	0.556182889	172.16.10.2	172.16.10.1	HTTP	354	GET /Image1.jpg HTTP/1.1
183	0.593622467	172.16.10.1	172.16.10.2	HTTP	1256	HTTP/1.1 200 OK (JPEG JFIF image)
191	0.601742614	172.16.10.2	172.16.10.1	HTTP	354	GET /Image2.jpg HTTP/1.1
199	0.603526272	172.16.10.2	172.16.10.1	HTTP	354	GET /Image5.jpg HTTP/1.1
200	0.603858712	172.16.10.2	172.16.10.1	HTTP	354	GET /Image4.jpg HTTP/1.1
201	0.604046092	172.16.10.2	172.16.10.1	HTTP	354	GET /Image3.jpg HTTP/1.1
264	0.614190922	172.16.10.2	172.16.10.1	HTTP	354	GET /Image6.jpg HTTP/1.1
511	0.643509807	172.16.10.1	172.16.10.2	HTTP	6720	HTTP/1.1 200 OK (JPEG JFIF image)
643	0.675762359	172.16.10.1	172.16.10.2	HTTP	13195	HTTP/1.1 200 OK (JPEG JFIF image)
819	0.726602291	172.16.10.1	172.16.10.2	HTTP	27692	HTTP/1.1 200 OK (JPEG JFIF image)
815	0.727638884	172.16.10.1	172.16.10.2	HTTP	3843	HTTP/1.1 200 OK (JPEG JFIF image)
851	0.770802211	172.16.10.2	172.16.10.1	HTTP	354	GET /Image7.jpg HTTP/1.1
955	0.791306203	172.16.10.1	172.16.10.2	HTTP	25790	HTTP/1.1 200 OK (JPEG JFIF image)
983	0.853680368	172.16.10.2	172.16.10.1	HTTP	354	GET /Image8.jpg HTTP/1.1
1052	0.869395703	172.16.10.1	172.16.10.2	HTTP	5081	HTTP/1.1 200 OK (JPEG JFIF image)
1074	0.917298585	172.16.10.1	172.16.10.2	HTTP	19038	HTTP/1.1 200 OK (JPEG JFIF image)
1075	0.927359673	172.16.10.2	172.16.10.1	HTTP	354	GET /Image9.jpg HTTP/1.1
1178	0.996795480	172.16.10.2	172.16.10.1	HTTP	355	GET /Image10.jpg HTTP/1.1
1372	1.120656297	172.16.10.1	172.16.10.2	HTTP	3457	HTTP/1.1 200 OK (JPEG JFIF image)
1391	1.161052653	172.16.10.1	172.16.10.2	HTTP	172	HTTP/1.1 200 OK (JPEG JFIF image)
1394	1.991683858	172.16.10.2	172.16.10.1	HTTP	355	GET /favicon.ico HTTP/1.1
1396	1.993339663	172.16.10.1	172.16.10.2	HTTP	557	HTTP/1.1 404 Not Found (text/html)

Here it is $1.161052653 - 0.001458625 = 1.159594028$

Step 8: For 8 persistent connections, set the value of max-persistent-connection-per-server to 8 in the client computer.



The screenshot shows the Firefox Advanced Preferences window with the search bar containing "persis". The results list several preferences related to persistent connections, including one specifically set to 8:

- network.http.max-persistent-connections-per-server**: 8, Type: Number

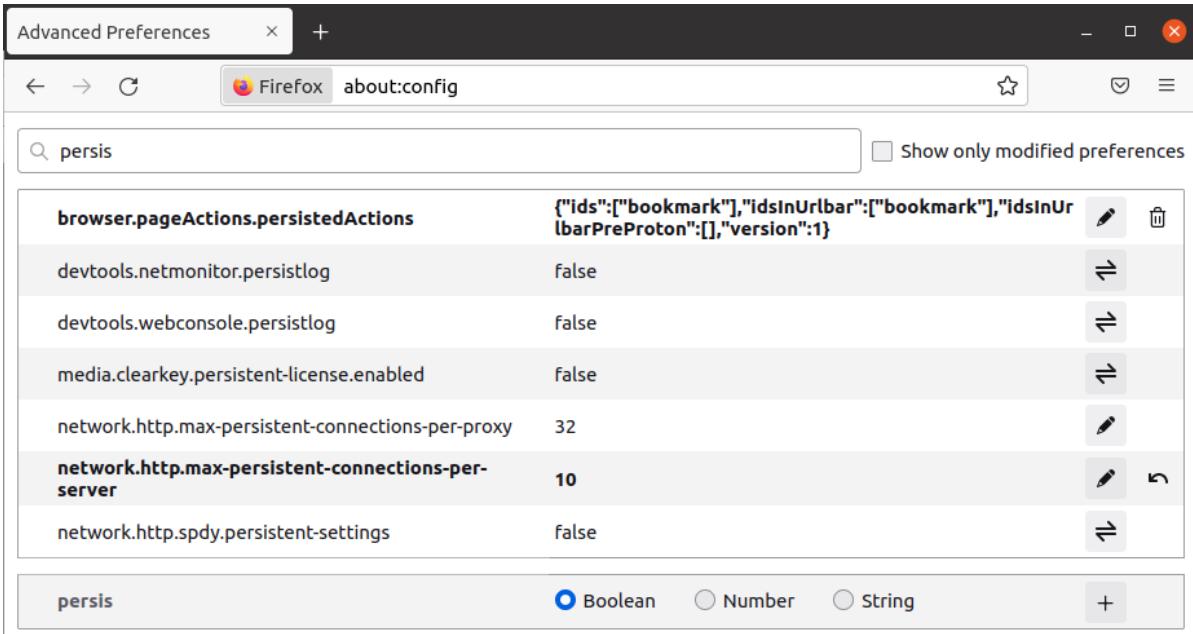
Week Assignment 3

Step 9: Repeat the steps 1-3.

No.	Time	Source	Destination	Protocol	Length	Info
39	1.755166771	192.168.214.132	142.250.67.67	OCSP	481	Request
41	1.842577319	142.250.67.67	192.168.214.132	OCSP	758	Response
124	11.168315632	172.16.10.2	172.16.10.1	HTTP	404	GET /a.html HTTP/1.1
126	11.170434298	172.16.10.1	172.16.10.2	HTTP	509	HTTP/1.1 200 OK (text/html)
211	11.706775736	172.16.10.2	172.16.10.1	HTTP	354	GET /Image1.jpg HTTP/1.1
301	11.722894113	172.16.10.2	172.16.10.1	HTTP	354	GET /Image2.jpg HTTP/1.1
333	11.728951559	172.16.10.2	172.16.10.1	HTTP	354	GET /Image3.jpg HTTP/1.1
393	11.735926794	172.16.10.2	172.16.10.1	HTTP	354	GET /Image4.jpg HTTP/1.1
396	11.736373345	172.16.10.1	172.16.10.2	HTTP	5272	HTTP/1.1 200 OK (JPEG JFIF image)
504	11.749667591	172.16.10.1	172.16.10.2	HTTP	17795	HTTP/1.1 200 OK (JPEG JFIF image)
571	11.764609651	172.16.10.1	172.16.10.2	HTTP	46544	HTTP/1.1 200 OK (JPEG JFIF image)
620	11.768276035	172.16.10.1	172.16.10.2	HTTP	17449	HTTP/1.1 200 OK (JPEG JFIF image)
622	11.769461501	172.16.10.2	172.16.10.1	HTTP	354	GET /Image5.jpg HTTP/1.1
650	11.772519310	172.16.10.2	172.16.10.1	HTTP	354	GET /Image8.jpg HTTP/1.1
651	11.772610556	172.16.10.2	172.16.10.1	HTTP	354	GET /Image7.jpg HTTP/1.1
685	11.774757383	172.16.10.2	172.16.10.1	HTTP	354	GET /Image6.jpg HTTP/1.1
831	11.797517294	172.16.10.1	172.16.10.2	HTTP	28895	HTTP/1.1 200 OK (JPEG JFIF image)
985	11.809419261	172.16.10.1	172.16.10.2	HTTP	23835	HTTP/1.1 200 OK (JPEG JFIF image)
1007	11.817215713	172.16.10.1	172.16.10.2	HTTP	14207	HTTP/1.1 200 OK (JPEG JFIF image)
1073	11.828317317	172.16.10.1	172.16.10.2	HTTP	6668	HTTP/1.1 200 OK (JPEG JFIF image)
1075	11.830008133	172.16.10.2	172.16.10.1	HTTP	354	GET /Image9.jpg HTTP/1.1
1152	11.842694857	172.16.10.1	172.16.10.2	HTTP	7801	HTTP/1.1 200 OK (JPEG JFIF image)
1154	11.852386421	172.16.10.2	172.16.10.1	HTTP	355	GET /Image10.jpg HTTP/1.1
1263	11.944502221	172.16.10.1	172.16.10.2	HTTP	46508	HTTP/1.1 200 OK (JPEG JFIF image)
1273	12.702313963	172.16.10.2	172.16.10.1	HTTP	355	GET /favicon.ico HTTP/1.1
1275	12.703701407	172.16.10.1	172.16.10.2	HTTP	557	HTTP/1.1 404 Not Found (text/html)

Here it is $11.944502221 - 11.168315632 = 0.776186589$

Step 10: For 10 persistent connections, set the value of max-persistent-connections-per-server to 10 in the client computer.



The screenshot shows the Firefox 'about:config' page with the search bar containing 'persis'. The 'network.http.max-persistent-connections-per-server' preference is highlighted and set to 10. Other preferences listed include browser.pageActions.persistedActions, devtools.netmonitor.persistlog, devtools.webconsole.persistlog, media.clearkey.persistent-license.enabled, network.http.max-persistent-connections-per-proxy (set to 32), and network.http.spdy.persistent-settings (set to false). The bottom of the page shows the 'persis' preference again with its type set to Boolean.

Week Assignment 3

Step 11: Repeat the steps 1-3.

No.	Time	Source	Destination	Protocol	Length	Info
33	0.327172578	192.168.214.132	142.250.67.67	OCSP	481	Request
38	0.418460091	142.250.67.67	192.168.214.132	OCSP	758	Response
79	11.089242299	172.16.10.2	172.16.10.1	HTTP	404	GET /a.html HTTP/1.1
81	11.100442584	172.16.10.1	172.16.10.2	HTTP	509	HTTP/1.1 200 OK (text/html)
138	11.501667953	172.16.10.2	172.16.10.1	HTTP	354	GET /Image1.jpg HTTP/1.1
260	11.538145007	172.16.10.1	172.16.10.2	HTTP	12960	HTTP/1.1 200 OK (JPEG JFIF image)
288	11.551626780	172.16.10.2	172.16.10.1	HTTP	354	GET /Image2.jpg HTTP/1.1
289	11.552040363	172.16.10.2	172.16.10.1	HTTP	354	GET /Image8.jpg HTTP/1.1
291	11.552488461	172.16.10.2	172.16.10.1	HTTP	354	GET /Image7.jpg HTTP/1.1
292	11.552741011	172.16.10.2	172.16.10.1	HTTP	354	GET /Image6.jpg HTTP/1.1
300	11.553542031	172.16.10.2	172.16.10.1	HTTP	354	GET /Image5.jpg HTTP/1.1
440	11.569131174	172.16.10.2	172.16.10.1	HTTP	354	GET /Image4.jpg HTTP/1.1
441	11.569389033	172.16.10.2	172.16.10.1	HTTP	354	GET /Image3.jpg HTTP/1.1
639	11.583146669	172.16.10.2	172.16.10.1	HTTP	355	GET /Image10.jpg HTTP/1.1
688	11.584581160	172.16.10.2	172.16.10.1	HTTP	354	GET /Image9.jpg HTTP/1.1
1057	11.607072405	172.16.10.1	172.16.10.2	HTTP	2343	HTTP/1.1 200 OK (JPEG JFIF image)
1170	11.612399985	172.16.10.1	172.16.10.2	HTTP	40004	HTTP/1.1 200 OK (JPEG JFIF image)
1520	11.640228927	172.16.10.1	172.16.10.2	HTTP	13247	HTTP/1.1 200 OK (JPEG JFIF image)
1600	11.650861660	172.16.10.1	172.16.10.2	HTTP	16875	HTTP/1.1 200 OK (JPEG JFIF image)
1681	11.655717764	172.16.10.1	172.16.10.2	HTTP	37721	HTTP/1.1 200 OK (JPEG JFIF image)
1957	11.686700313	172.16.10.1	172.16.10.2	HTTP	1611	HTTP/1.1 200 OK (JPEG JFIF image)
1977	11.705214599	172.16.10.1	172.16.10.2	HTTP	3824	HTTP/1.1 200 OK (JPEG JFIF image)
2480	12.110751646	172.16.10.1	172.16.10.2	HTTP	2010	HTTP/1.1 200 OK (JPEG JFIF image)
2494	12.124570089	172.16.10.1	172.16.10.2	HTTP	8861	HTTP/1.1 200 OK (JPEG JFIF image)
2496	13.638676029	172.16.10.2	172.16.10.1	HTTP	355	GET /favicon.ico HTTP/1.1
2498	13.640146422	172.16.10.1	172.16.10.2	HTTP	557	HTTP/1.1 404 Not Found (text/html)

Here it is $12.124570089-11.089242299=1.03532779$

Observation:

Number of persistent connections	Time Delay
0	1.071826462
2	0.75799679
4	2.370365847
6	1.159594028
8	0.776186589
10	1.03532779