

Computer Networks Laboratory

UE20CS255

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Section: D

Week 4

Understanding Persistent and Non-persistent HTTP Connections

Objective:

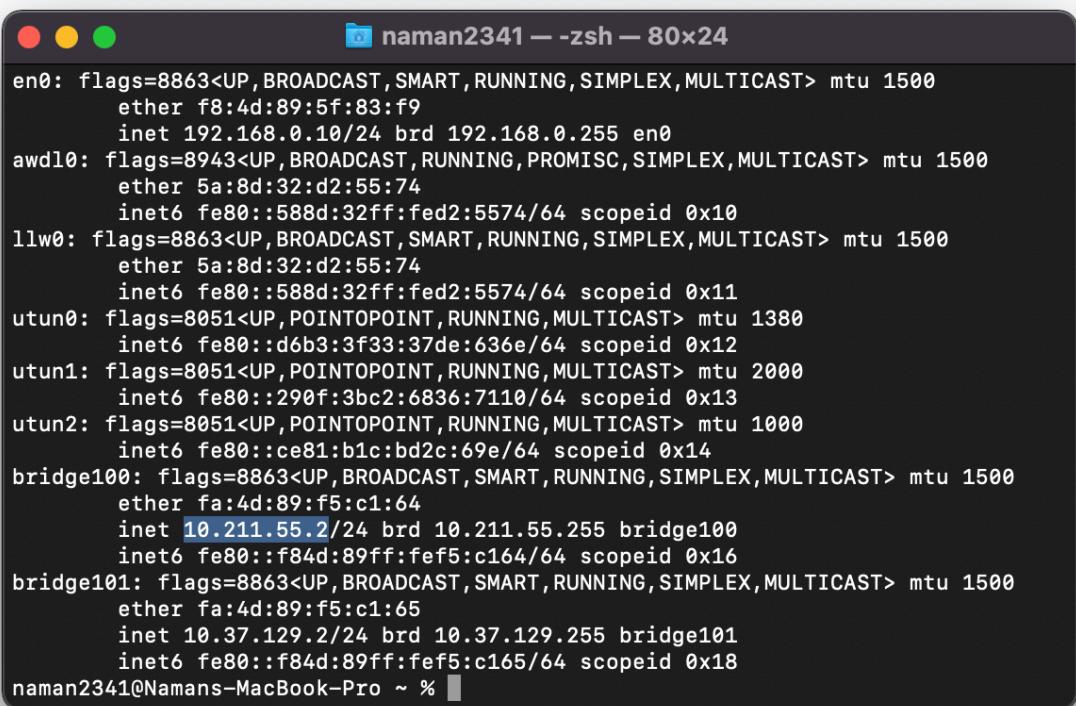
To understand persistent and non-persistent HTTP connections and corresponding performance impact. Create a web page with N (e.g. 10) embedded images. Each image should be of minimum 2MB size. Configure your browser (Firefox ESR) with following settings (each setting requires repeat of experiment)

- Non persistent connection
- 2 persistent connections
- 4 persistent connections
- 6 persistent connections
- 8 persistent connections
- 10 persistent connections.

Observation:

Note down the time taken to display the entire page in each of the settings. Ensure that (cache is cleared before starting the web request). Explain the response time differences. What is the optimal number of persistent connections for best performance? Explain your answer

Configuration

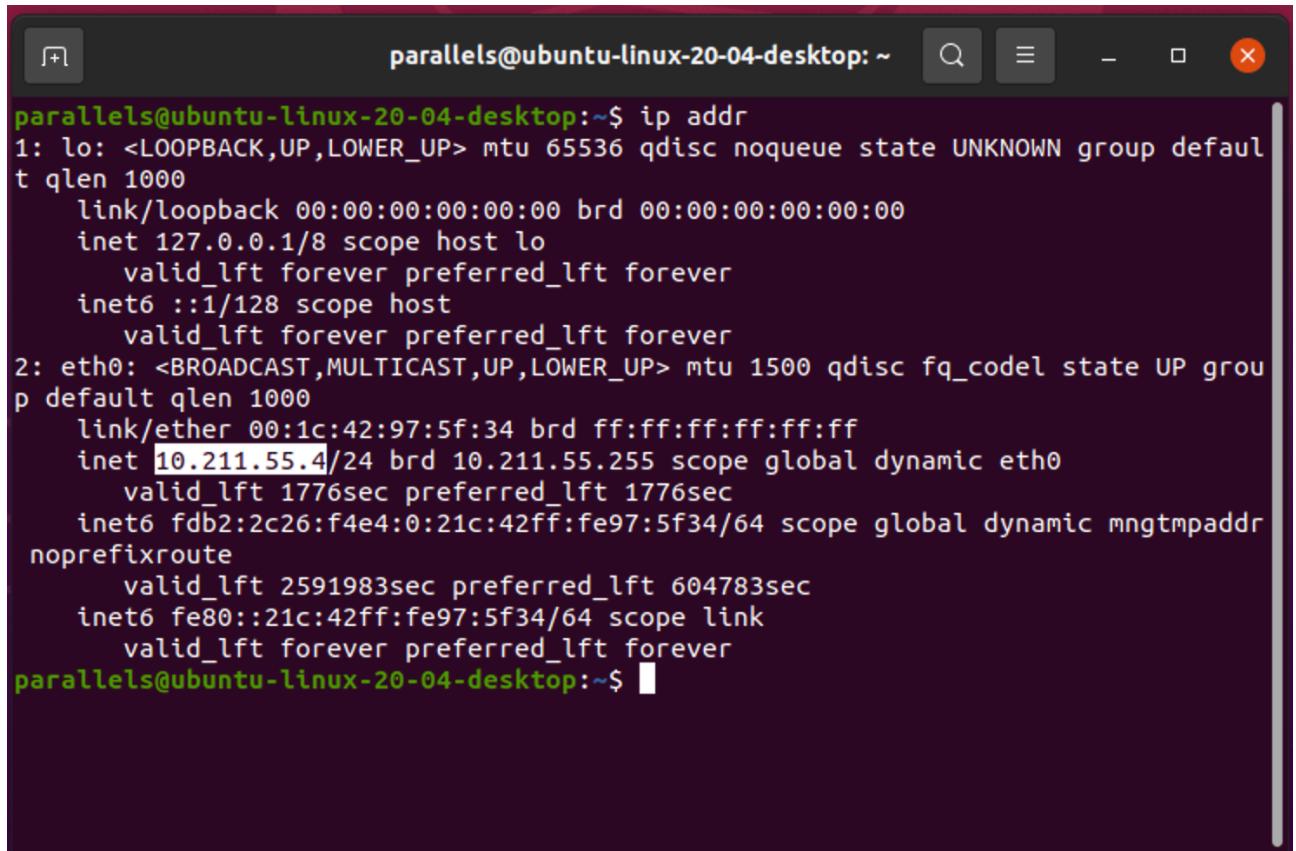
CLIENT:


```

naman2341 — zsh — 80x24

en0: flags=8863<UP,BROADCAST,SMART,RUNNING,SIMPLEX,MULTICAST> mtu 1500
      ether f8:4d:89:5f:83:f9
      inet 192.168.0.10/24 brd 192.168.0.255 en0
awdl0: flags=8943<UP,BROADCAST,RUNNING,PROMISC,SIMPLEX,MULTICAST> mtu 1500
      ether 5a:8d:32:d2:55:74
      inet6 fe80::588d:32ff:fed2:5574/64 scopeid 0x10
llw0: flags=8863<UP,BROADCAST,SMART,RUNNING,SIMPLEX,MULTICAST> mtu 1500
      ether 5a:8d:32:d2:55:74
      inet6 fe80::588d:32ff:fed2:5574/64 scopeid 0x11
utun0: flags=8051<UP,POINTOPOINT,RUNNING,MULTICAST> mtu 1380
      inet6 fe80::d6b3:3f33:37de:636e/64 scopeid 0x12
utun1: flags=8051<UP,POINTOPOINT,RUNNING,MULTICAST> mtu 2000
      inet6 fe80::290f:3bc2:6836:7110/64 scopeid 0x13
utun2: flags=8051<UP,POINTOPOINT,RUNNING,MULTICAST> mtu 1000
      inet6 fe80::ce81:b1c:bd2c:69e/64 scopeid 0x14
bridge100: flags=8863<UP,BROADCAST,SMART,RUNNING,SIMPLEX,MULTICAST> mtu 1500
      ether fa:4d:89:f5:c1:64
      inet 10.211.55.2/24 brd 10.211.55.255 bridge100
      inet6 fe80::f84d:89ff:fef5:c164/64 scopeid 0x16
bridge101: flags=8863<UP,BROADCAST,SMART,RUNNING,SIMPLEX,MULTICAST> mtu 1500
      ether fa:4d:89:f5:c1:65
      inet 10.37.129.2/24 brd 10.37.129.255 bridge101
      inet6 fe80::f84d:89ff:fef5:c165/64 scopeid 0x18
naman2341@Namans-MacBook-Pro ~ %

```

SERVER:


```

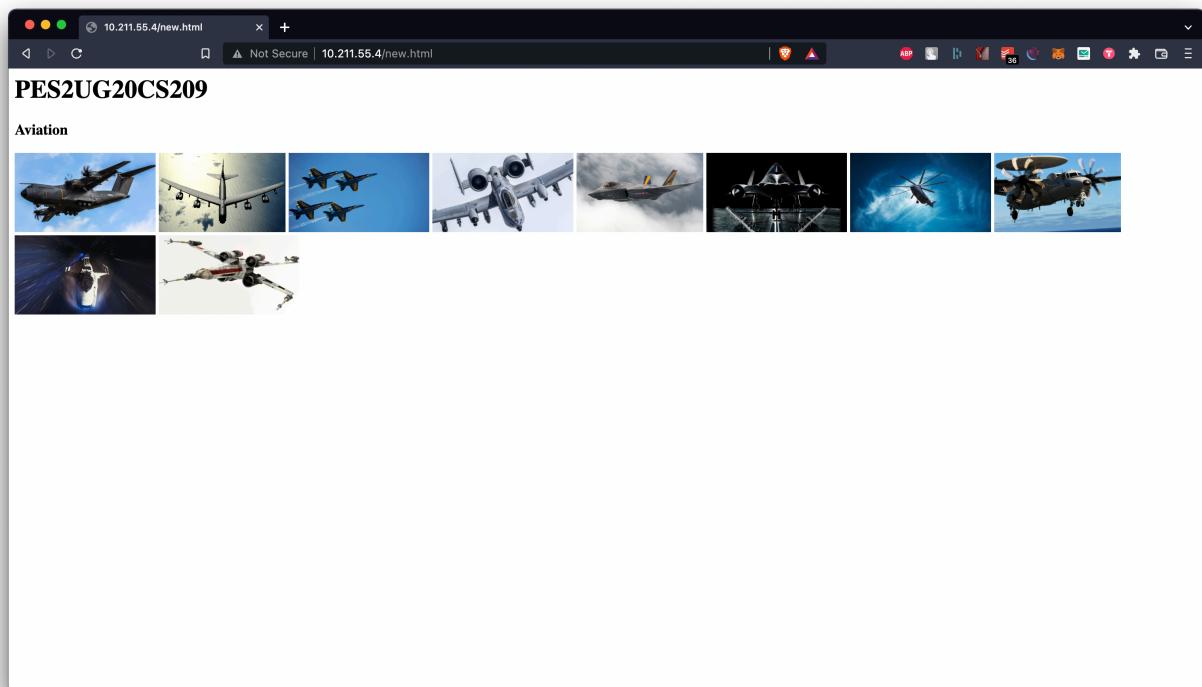
parallels@ubuntu-linux-20-04-desktop:~$ ip addr
1: lo: <LOOPBACK,UP,LOWER_UP> mtu 65536 qdisc noqueue state UNKNOWN group default
  qlen 1000
    link/loopback 00:00:00:00:00:00 brd 00:00:00:00:00:00
    inet 127.0.0.1/8 scope host lo
      valid_lft forever preferred_lft forever
    inet6 ::1/128 scope host
      valid_lft forever preferred_lft forever
2: eth0: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc fq_codel state UP group default
  qlen 1000
    link/ether 00:1c:42:97:5f:34 brd ff:ff:ff:ff:ff:ff
    inet 10.211.55.4/24 brd 10.211.55.255 scope global dynamic eth0
      valid_lft 1776sec preferred_lft 1776sec
    inet6 fdb2:2c26:f4e4:0:21c:42ff:fe97:5f34/64 scope global dynamic mngtmpaddr
      noprefixroute
      valid_lft 2591983sec preferred_lft 604783sec
    inet6 fe80::21c:42ff:fe97:5f34/64 scope link
      valid_lft forever preferred_lft forever
parallels@ubuntu-linux-20-04-desktop:~$

```

SERVER RUNNING:

```
parallels@ubuntu-linux-20-04-desktop:~$ sudo service apache2 status
● apache2.service - The Apache HTTP Server
   Loaded: loaded (/lib/systemd/system/apache2.service; enabled; vendor prese>
   Active: active (running) since Fri 2022-02-18 22:22:07 IST; 22s ago
     Docs: https://httpd.apache.org/docs/2.4/
 Main PID: 78710 (apache2)
    Tasks: 55 (limit: 4594)
   Memory: 5.4M
      CGrou: /system.slice/apache2.service
              └─78710 /usr/sbin/apache2 -k start
                  ├─78711 /usr/sbin/apache2 -k start
                  ├─78712 /usr/sbin/apache2 -k start

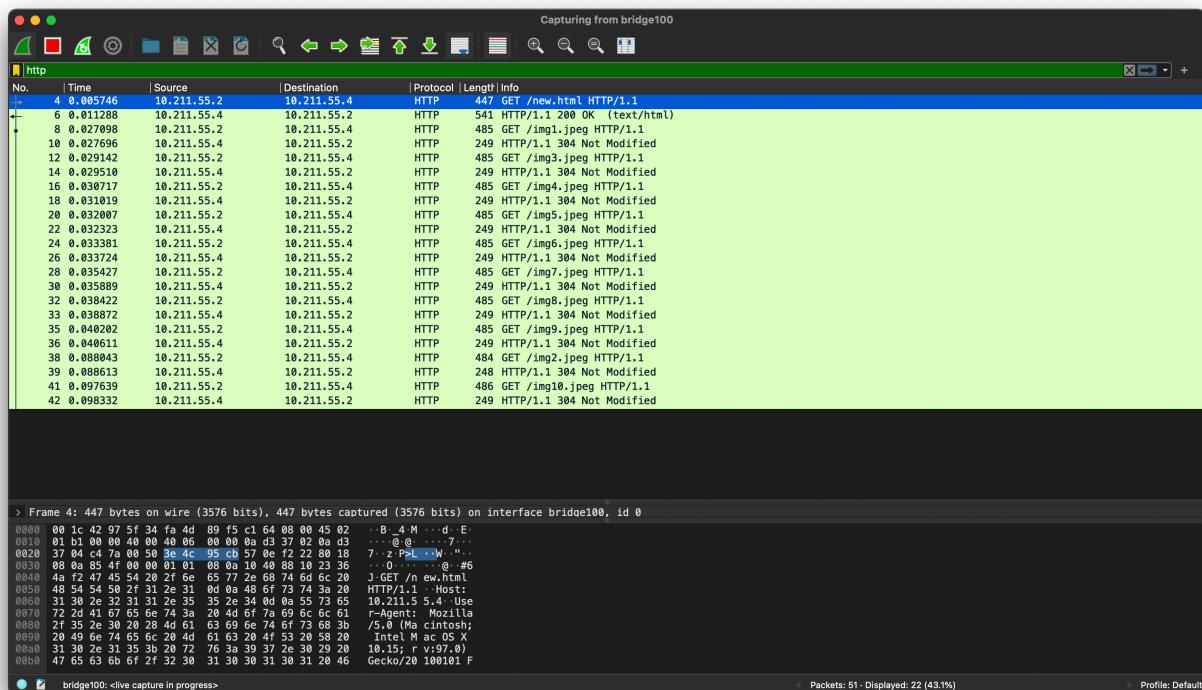
Feb 18 22:22:07 ubuntu-linux-20-04-desktop systemd[1]: Starting The Apache HTTP>
Feb 18 22:22:07 ubuntu-linux-20-04-desktop apachectl[78687]: AH00558: apache2: >
Feb 18 22:22:07 ubuntu-linux-20-04-desktop systemd[1]: Started The Apache HTTP >
lines 1-15/15 (END)
```

IN BROWSER:

Observation (Wireshark Capture and Time taken to capture all 10 images)

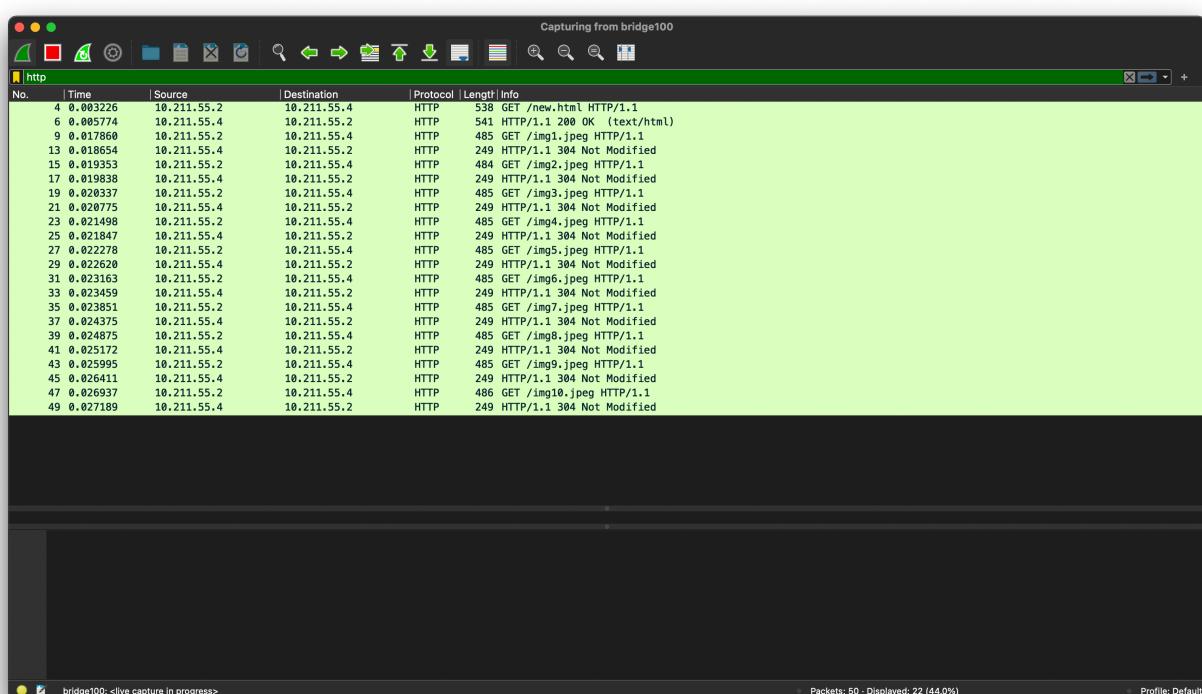
NON PERSISTENT CONNECTION:

Time Taken: $0.098332 - 0.005746 = 0.092586$



2 PERSISTENT CONNECTION:

Time Taken: $0.027189 - 0.003226 = 0.023963$



4 PERSISTENT CONNECTION:

Time Taken: $0.035509 - 0.003771 = 0.031738$

Capturing from bridge100						
No.	Time	Source	Destination	Protocol	Length	Info
4	0.003771	10.211.55.2	10.211.55.4	HTTP	538	GET /new.html HTTP/1.1
6	0.005907	10.211.55.4	10.211.55.2	HTTP	541	HTTP/1.1 200 OK (text/html)
17	0.023082	10.211.55.2	10.211.55.4	HTTP	485	GET /img1.jpeg HTTP/1.1
19	0.023786	10.211.55.4	10.211.55.2	HTTP	249	HTTP/1.1 304 Not Modified
21	0.024693	10.211.55.2	10.211.55.4	HTTP	485	GET /img3.jpeg HTTP/1.1
22	0.024728	10.211.55.2	10.211.55.4	HTTP	484	GET /img2.jpeg HTTP/1.1
23	0.024747	10.211.55.2	10.211.55.4	HTTP	485	GET /img4.jpeg HTTP/1.1
27	0.025326	10.211.55.4	10.211.55.2	HTTP	249	HTTP/1.1 304 Not Modified
29	0.025353	10.211.55.4	10.211.55.2	HTTP	250	HTTP/1.1 304 Not Modified
31	0.026254	10.211.55.4	10.211.55.2	HTTP	250	HTTP/1.1 304 Not Modified
33	0.029264	10.211.55.2	10.211.55.4	HTTP	485	GET /img5.jpeg HTTP/1.1
35	0.038416	10.211.55.4	10.211.55.2	HTTP	249	HTTP/1.1 304 Not Modified
37	0.038692	10.211.55.2	10.211.55.4	HTTP	485	GET /img6.jpeg HTTP/1.1
38	0.038723	10.211.55.2	10.211.55.4	HTTP	485	GET /img7.jpeg HTTP/1.1
41	0.031158	10.211.55.4	10.211.55.2	HTTP	249	HTTP/1.1 304 Not Modified
43	0.031192	10.211.55.4	10.211.55.2	HTTP	249	HTTP/1.1 304 Not Modified
45	0.031784	10.211.55.2	10.211.55.4	HTTP	485	GET /img8.jpeg HTTP/1.1
47	0.032411	10.211.55.4	10.211.55.2	HTTP	249	HTTP/1.1 304 Not Modified
49	0.034922	10.211.55.2	10.211.55.4	HTTP	486	GET /img10.jpeg HTTP/1.1
50	0.034957	10.211.55.2	10.211.55.4	HTTP	485	GET /img9.jpeg HTTP/1.1
53	0.035486	10.211.55.4	10.211.55.2	HTTP	249	HTTP/1.1 304 Not Modified
55	0.035509	10.211.55.4	10.211.55.2	HTTP	249	HTTP/1.1 304 Not Modified

6 PERSISTENT CONNECTION:

Time Taken: $0.037153 - 0.004797 = 0.032356$

Capturing from bridge100						
No.	Time	Source	Destination	Protocol	Length	Info
4	0.004797	10.211.55.2	10.211.55.4	HTTP	538	GET /new.html HTTP/1.1
6	0.006679	10.211.55.4	10.211.55.2	HTTP	541	HTTP/1.1 200 OK (text/html)
23	0.023743	10.211.55.2	10.211.55.4	HTTP	485	GET /img1.jpeg HTTP/1.1
25	0.024346	10.211.55.4	10.211.55.2	HTTP	249	HTTP/1.1 304 Not Modified
27	0.024693	10.211.55.2	10.211.55.4	HTTP	485	GET /img6.jpeg HTTP/1.1
29	0.025352	10.211.55.4	10.211.55.2	HTTP	250	HTTP/1.1 304 Not Modified
31	0.025873	10.211.55.2	10.211.55.4	HTTP	485	GET /img5.jpeg HTTP/1.1
32	0.025967	10.211.55.2	10.211.55.4	HTTP	485	GET /img3.jpeg HTTP/1.1
35	0.026324	10.211.55.4	10.211.55.2	HTTP	250	HTTP/1.1 304 Not Modified
37	0.026675	10.211.55.4	10.211.55.2	HTTP	250	HTTP/1.1 304 Not Modified
39	0.027705	10.211.55.2	10.211.55.4	HTTP	484	GET /img2.jpeg HTTP/1.1
40	0.027778	10.211.55.2	10.211.55.4	HTTP	485	GET /img4.jpeg HTTP/1.1
43	0.028496	10.211.55.4	10.211.55.2	HTTP	250	HTTP/1.1 304 Not Modified
45	0.029288	10.211.55.4	10.211.55.2	HTTP	249	HTTP/1.1 304 Not Modified
47	0.032274	10.211.55.2	10.211.55.4	HTTP	485	GET /img7.jpeg HTTP/1.1
49	0.032871	10.211.55.4	10.211.55.2	HTTP	249	HTTP/1.1 304 Not Modified
51	0.033684	10.211.55.2	10.211.55.4	HTTP	485	GET /img8.jpeg HTTP/1.1
53	0.034585	10.211.55.4	10.211.55.2	HTTP	249	HTTP/1.1 304 Not Modified
55	0.035930	10.211.55.2	10.211.55.4	HTTP	485	GET /img9.jpeg HTTP/1.1
57	0.036718	10.211.55.2	10.211.55.4	HTTP	486	GET /img10.jpeg HTTP/1.1
58	0.036754	10.211.55.4	10.211.55.2	HTTP	249	HTTP/1.1 304 Not Modified
61	0.037153	10.211.55.4	10.211.55.2	HTTP	249	HTTP/1.1 304 Not Modified

8 PERSISTENT CONNECTION:

Time Taken: $0.059615 - 0.002923 = 0.056692$

Capturing from bridge100						
No.	Time	Source	Destination	Protocol	Length	Info
4	0.002923	10.211.55.2	10.211.55.4	HTTP	538	GET /new.html HTTP/1.1
6	0.004915	10.211.55.4	10.211.55.2	HTTP	541	HTTP/1.1 200 OK (text/html)
8	0.020748	10.211.55.2	10.211.55.4	HTTP	485	GET /img1.jpeg HTTP/1.1
22	0.029379	10.211.55.4	10.211.55.2	HTTP	249	HTTP/1.1 304 Not Modified
33	0.045568	10.211.55.2	10.211.55.4	HTTP	485	GET /img5.jpeg HTTP/1.1
34	0.045625	10.211.55.2	10.211.55.4	HTTP	485	GET /img7.jpeg HTTP/1.1
37	0.047497	10.211.55.4	10.211.55.2	HTTP	250	HTTP/1.1 304 Not Modified
39	0.047804	10.211.55.4	10.211.55.2	HTTP	250	HTTP/1.1 304 Not Modified
41	0.048376	10.211.55.2	10.211.55.4	HTTP	484	GET /img2.jpeg HTTP/1.1
42	0.048431	10.211.55.2	10.211.55.4	HTTP	485	GET /img3.jpeg HTTP/1.1
45	0.049083	10.211.55.4	10.211.55.2	HTTP	249	HTTP/1.1 304 Not Modified
47	0.049153	10.211.55.4	10.211.55.2	HTTP	250	HTTP/1.1 304 Not Modified
49	0.050534	10.211.55.2	10.211.55.4	HTTP	485	GET /img6.jpeg HTTP/1.1
51	0.051141	10.211.55.4	10.211.55.2	HTTP	250	HTTP/1.1 304 Not Modified
53	0.051972	10.211.55.2	10.211.55.4	HTTP	485	GET /img9.jpeg HTTP/1.1
55	0.052508	10.211.55.4	10.211.55.2	HTTP	249	HTTP/1.1 304 Not Modified
57	0.056796	10.211.55.2	10.211.55.4	HTTP	485	GET /img4.jpeg HTTP/1.1
59	0.057991	10.211.55.4	10.211.55.2	HTTP	250	HTTP/1.1 304 Not Modified
61	0.058440	10.211.55.2	10.211.55.4	HTTP	486	GET /img10.jpeg HTTP/1.1
63	0.058834	10.211.55.4	10.211.55.2	HTTP	249	HTTP/1.1 304 Not Modified
65	0.058875	10.211.55.2	10.211.55.4	HTTP	485	GET /img8.jpeg HTTP/1.1
67	0.059615	10.211.55.4	10.211.55.2	HTTP	250	HTTP/1.1 304 Not Modified

10 PERSISTENT CONNECTION:

Time Taken: $0.054985 - 0.003309 = 0.051676$

Capturing from bridge100						
No.	Time	Source	Destination	Protocol	Length	Info
4	0.003309	10.211.55.2	10.211.55.4	HTTP	538	GET /new.html HTTP/1.1
6	0.005562	10.211.55.4	10.211.55.2	HTTP	541	HTTP/1.1 200 OK (text/html)
35	0.031797	10.211.55.2	10.211.55.4	HTTP	485	GET /img1.jpeg HTTP/1.1
37	0.032433	10.211.55.4	10.211.55.2	HTTP	249	HTTP/1.1 304 Not Modified
39	0.035029	10.211.55.2	10.211.55.4	HTTP	485	GET /img6.jpeg HTTP/1.1
40	0.035867	10.211.55.2	10.211.55.4	HTTP	486	GET /img10.jpeg HTTP/1.1
43	0.036466	10.211.55.4	10.211.55.2	HTTP	250	HTTP/1.1 304 Not Modified
45	0.036641	10.211.55.4	10.211.55.2	HTTP	250	HTTP/1.1 304 Not Modified
47	0.037637	10.211.55.2	10.211.55.4	HTTP	484	GET /img2.jpeg HTTP/1.1
48	0.037707	10.211.55.2	10.211.55.4	HTTP	485	GET /img9.jpeg HTTP/1.1
51	0.038390	10.211.55.4	10.211.55.2	HTTP	250	HTTP/1.1 304 Not Modified
53	0.038435	10.211.55.2	10.211.55.4	HTTP	249	HTTP/1.1 304 Not Modified
55	0.039152	10.211.55.2	10.211.55.4	HTTP	485	GET /img3.jpeg HTTP/1.1
56	0.039189	10.211.55.2	10.211.55.4	HTTP	485	GET /img5.jpeg HTTP/1.1
59	0.039821	10.211.55.4	10.211.55.2	HTTP	250	HTTP/1.1 304 Not Modified
61	0.040012	10.211.55.4	10.211.55.2	HTTP	250	HTTP/1.1 304 Not Modified
63	0.040360	10.211.55.2	10.211.55.4	HTTP	485	GET /img4.jpeg HTTP/1.1
65	0.040921	10.211.55.4	10.211.55.2	HTTP	250	HTTP/1.1 304 Not Modified
67	0.042871	10.211.55.2	10.211.55.4	HTTP	485	GET /img7.jpeg HTTP/1.1
69	0.042943	10.211.55.4	10.211.55.2	HTTP	250	HTTP/1.1 304 Not Modified
71	0.054326	10.211.55.2	10.211.55.4	HTTP	485	GET /img8.jpeg HTTP/1.1
73	0.054985	10.211.55.4	10.211.55.2	HTTP	250	HTTP/1.1 304 Not Modified

Understanding Working of HTTP Headers

Objective:

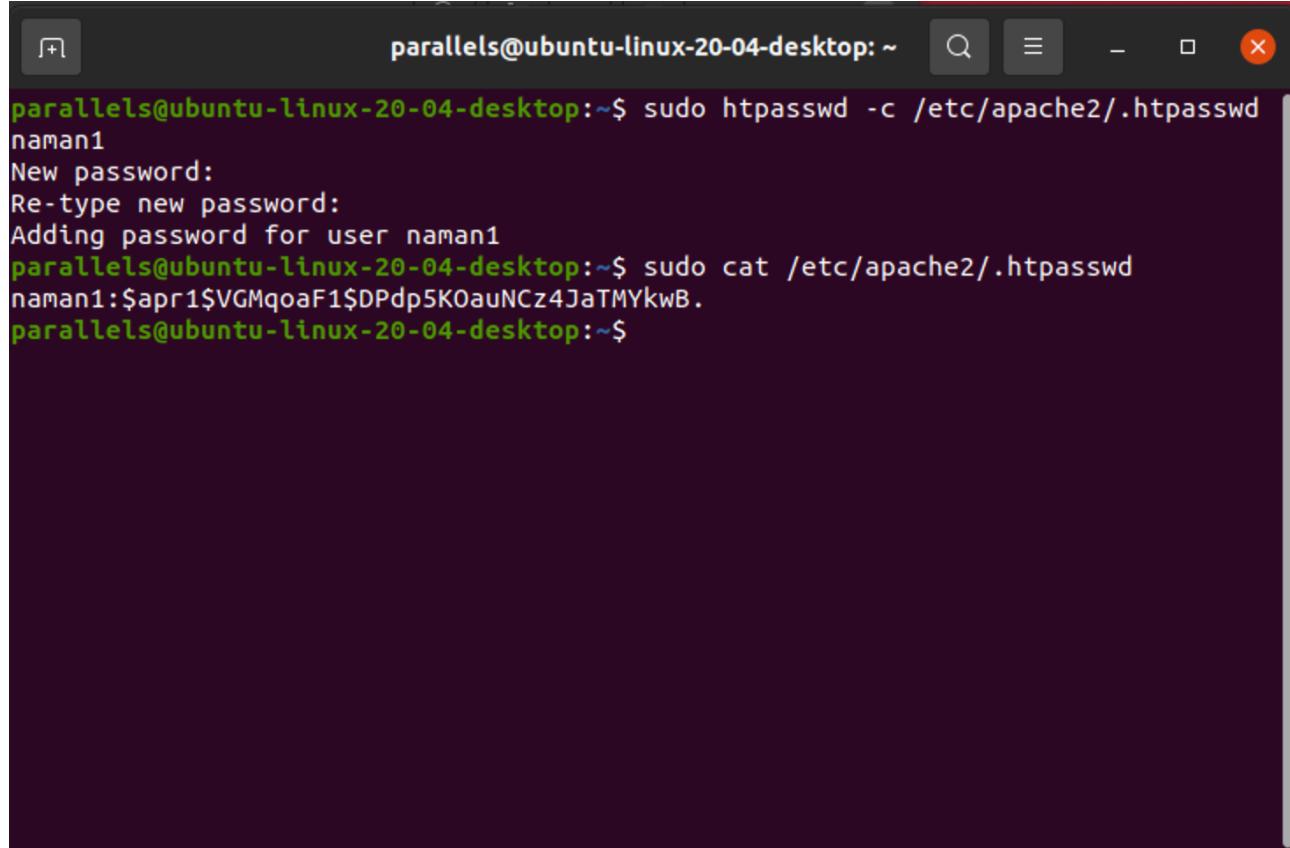
Understand working of HTTP headers: Conditional Get: If-Modified-Since HTTP Cookies: Cookie and Set-Cookie Authentication: Auth-Basic Design a web page that has one embedded page (e.g. image) and sets a cookie and enables authentication. You are required to configure the web server (e.g. apache) with authentication mechanism. Show the behavior of conditional get when embedded objects is modified and when it is not (you can just change the create date of the embedded object). Decode the Basic-Auth header using Base64 mechanism as per the password setup.

Observation:

Show the behavior of browser when cookie is set and when cookie is removed.

Task 1: Password Authentication

AUTHENTICATION:



```
parallels@ubuntu-linux-20-04-desktop:~$ sudo htpasswd -c /etc/apache2/.htpasswd naman1
New password:
Re-type new password:
Adding password for user naman1
parallels@ubuntu-linux-20-04-desktop:~$ sudo cat /etc/apache2/.htpasswd
naman1:$apr1$VGMqoaF1$DPdp5K0auNCz4JaTMYkwB.
parallels@ubuntu-linux-20-04-desktop:~$
```

WIRESHARK:

```

GET /1.html HTTP/1.1
Host: 172.16.10.1
User-Agent: Mozilla/5.0 (X11; Linux x86_64; rv:78.0) Gecko/20100101 Firefox/78.0
Accept: text/html,application/xhtml+xml,application/xml;q=0.9,image/webp,*/*;q=0.8
Accept-Language: en-US,en;q=0.5
Accept-Encoding: gzip, deflate
Connection: keep-alive
Upgrade-Insecure-Requests: 1
Authorization: Basic Y2xpZW50MTpbGllbnQx

HTTP/1.1 200 OK
Date: Mon, 14 Feb 2022 03:04:17 GMT
Server: Apache/2.4.41 (Ubuntu)
Last-Modified: Sat, 12 Feb 2022 14:11:20 GMT
ETag: "256-5d7d2c1ed4d75-gzip"
Accept-Ranges: bytes
Vary: Accept-Encoding
Content-Encoding: gzip
Content-Length: 166
Keep-Alive: timeout=5, max=2
Connection: Keep-Alive
Content-Type: text/html

.....=.0....".$.0... W.J$.. t1..d.I..g!.8.
{...ga... 1.s\.....'....v..p...Ly...
\..i-.L.C....J.J.....&.f....Z.Z.....'..g.....o...U[]rY.uz.$..e.V...GET /1.jpg HTTP/1.1
Host: 172.16.10.1
User-Agent: Mozilla/5.0 (X11; Linux x86_64; rv:78.0) Gecko/20100101 Firefox/78.0
Accept: image/webp */
2 client pkts, 95 server pkts, 3 turns.

Entire conversation (1,833 kB) Show and save data as ASCII Stream 1
Find: Find Next
Filter Out This Stream Print Save as... Back Close Help

```

Task 2: Cookie Setting**FILE CONFIG:**

```

<html>
<?php
    setcookie("namecookie","netqwerty",time()+123);
    setcookie("nickname","work");
?
<img src= "img.jpg"/>
</html>

```

WIRESHARK:

Wireshark - Follow TCP Stream (tcp.stream eq 0) - any

```

S.
R.
Pp.sQ.
....sw....s.d..+..%.*..e..+)...!.....'.H...GET /favicon.ico HTTP/1.1
Host: 172.16.10.1
User-Agent: Mozilla/5.0 (X11; Linux x86_64; rv:78.0) Gecko/20100101 Firefox/78.0
Accept: image/webp,/*
Accept-Language: en-US,en;q=0.5
Accept-Encoding: gzip, deflate
Authorization: Basic Y2xpZW50MTpjG1lbnQx
Connection: keep-alive
Cookie: namecookie=netqwerty; nickname=work

HTTP/1.1 404 Not Found
Date: Mon, 14 Feb 2022 03:49:56 GMT
Server: Apache/2.4.41 (Ubuntu)
Content-Length: 273
Keep-Alive: timeout=5, max=1
Connection: Keep-Alive
Content-Type: text/html; charset=iso-8859-1

<!DOCTYPE HTML PUBLIC "-//IETF//DTD HTML 2.0//EN">
<html><head>
<title>404 Not Found</title>
</head><body>
<h1>Not Found</h1>
<p>The requested URL was not found on this server.</p>
<hr>
<address>Apache/2.4.41 (Ubuntu) Server at 172.16.10.1 Port 80</address>

```

2 client pkts, 2 server pkts, 3 turns.

Entire conversation (1.639 bytes) Show and save data as ASCII Stream 0

Find: Find Next

FIRST GET REQUEST:

```

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: Mon, 14 Feb 2022 04:04:27 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: Sun, 13 Feb 2022 06:59:02 GMT
ETag: "173-5d7e0d5c000cb"
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.


```

1 client pkt, 1 server pkt, 1 turn.

SECOND GET REQUEST:

```
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: Sun, 13 Feb 2022 06:59:02 GMT
If-None-Match: "173-5d7e0d5c000cb"
Cache-Control: max-age=0

HTTP/1.1 304 Not Modified
Date: Mon, 14 Feb 2022 04:04:53 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=100
ETag: "173-5d7e0d5c000cb"

1 client pkt, 1 server pkt, 1 turn.

Entire conversation (739 bytes) Show and save data as ASCII Stream 9
Find: Find Next
Filter Out This Stream Print Save as... Back Close Help
```