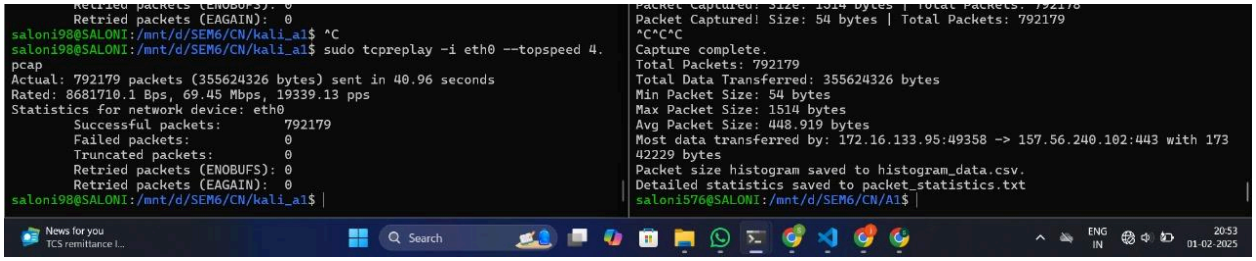
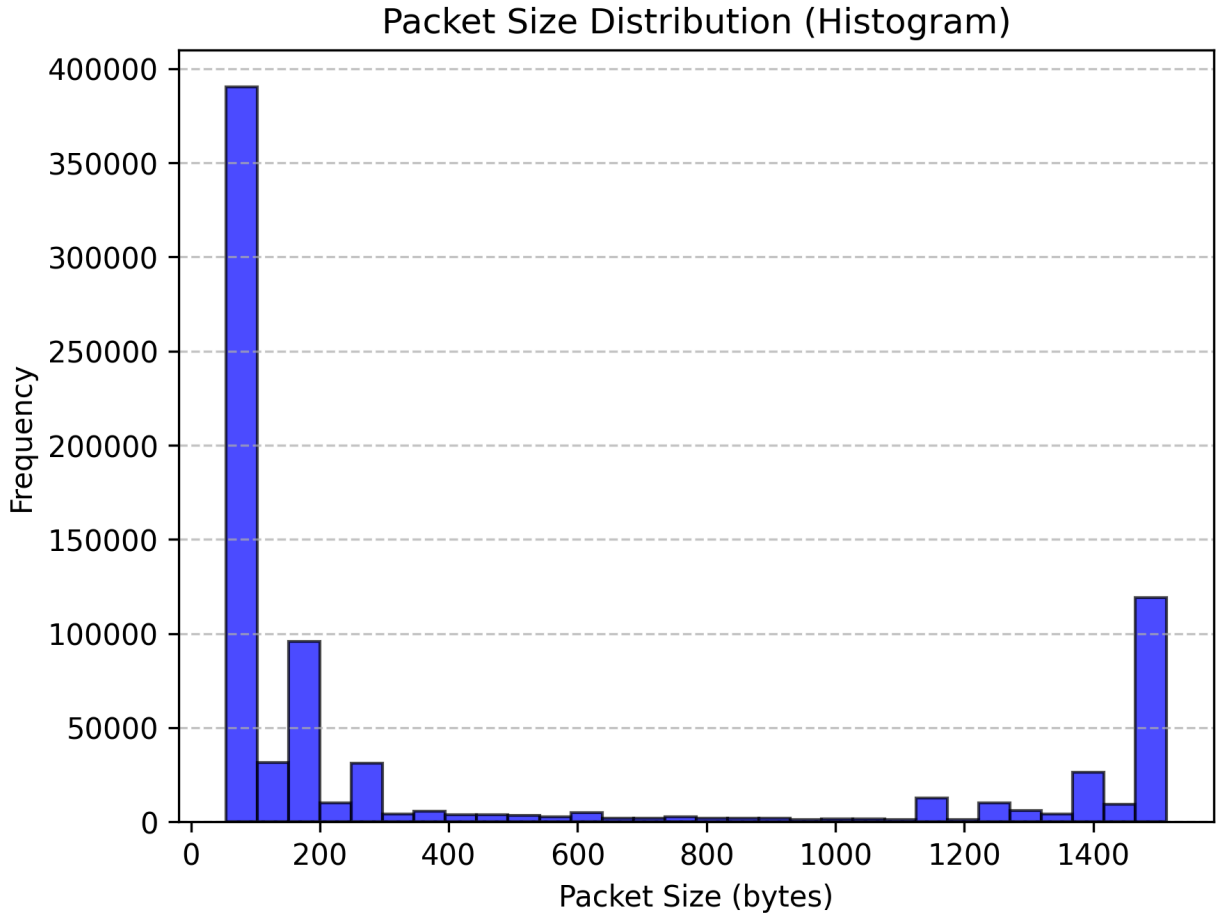
CS 331: Computer Networks
Assignment 1

[Github Link]

Part 1: Metrics and Plots

1.





2

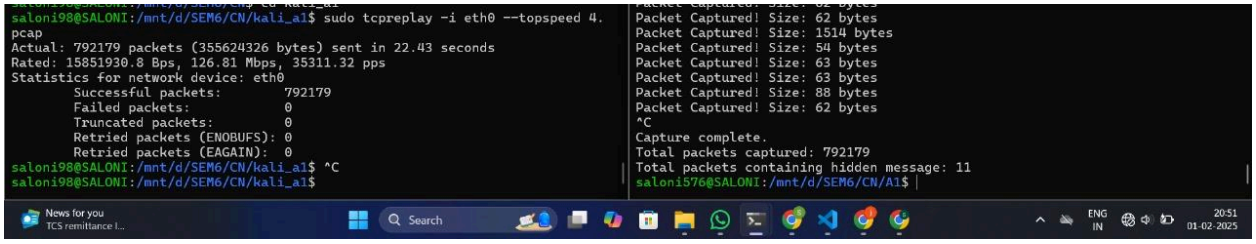
Dictionary of unique source-destination pairs are stored in packet_statistics.txt.

3

Dictionary of source IP flow counts and destination IP flow counts is also stored in packet_statistics.txt.

Part 2: Catch Me If You Can

4.pcap



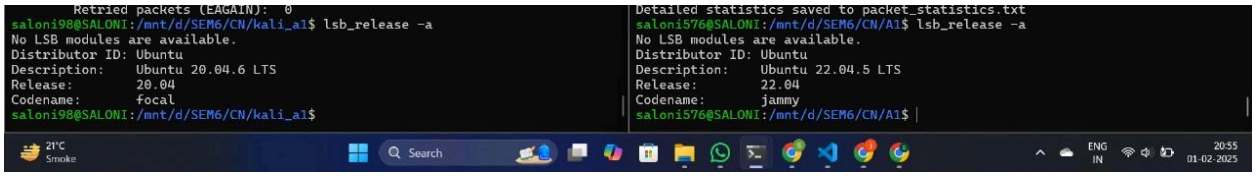
Q.1 Hidden Message: Welcome to Computer Networks CS331

Q.2 Total packets containing the hidden message: 11

Q.3 Protocol Used:TCP

Q.4 TCP Checksum:0xf049

Note: To run the programs, I used two different versions of Ubuntu while doing Part 1 and Part 2 of the assignment.



Part 3: Capture the Packets

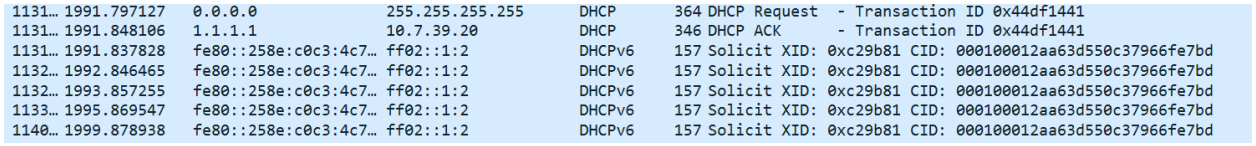
Q.1.a.
Application layers captured by Wireshark are as follows:

1. MDNS (Multicast DNS)

87105	1308.510222	10.1.0.10	224.0.0.251	MDNS	315	Standard query 0x0000 ANY _afpovertcp._tcp.local, "QM" questio
1132…	1992.357321	10.7.39.20	224.0.0.251	MDNS	81	Standard query 0x0000 ANY DESKTOP-DCD9693.local, "QM" question
1132…	1992.358243	fe80::258e:c0c3:4c7…	ff02::fb	MDNS	101	Standard query 0x0000 ANY DESKTOP-DCD9693.local, "QM" question
1132…	1992.362833	fe80::258e:c0c3:4c7…	ff02::fb	MDNS	139	Standard query response 0x0000 AAAA fe80::258e:c0c3:4c7:934f A
1132…	1992.364846	10.7.39.20	224.0.0.251	MDNS	119	Standard query response 0x0000 AAAA fe80::258e:c0c3:4c7:934f A
1132…	1992.709605	10.7.39.20	224.0.0.251	MDNS	95	Standard query 0x0000 ANY DESKTOP-DCD9693._display._tcp.local,
1132…	1992.710598	fe80::258e:c0c3:4c7…	ff02::fb	MDNS	115	Standard query 0x0000 ANY DESKTOP-DCD9693._display._tcp.local,
1132…	1992.972987	10.7.39.20	224.0.0.251	MDNS	95	Standard query 0x0000 ANY DESKTOP-DCD9693._display._tcp.local,

Operation: MDNS allows devices on a local network to resolve hostnames to IP addresses without requiring a DNS server. It's commonly used for service discovery on home networks.
Layer: Application (Layer 7)
RFC: RFC 6762

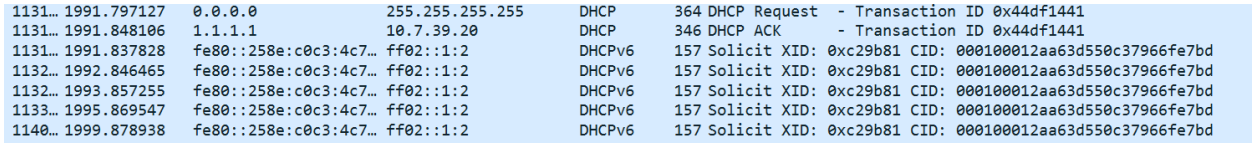
2. DHCPv6 (Dynamic Host Configuration Protocol for IPv6)



1131…	1991.797127	0.0.0.0	255.255.255.255	DHCP	364	DHCP Request - Transaction ID 0x44df1441
1131…	1991.848106	1.1.1.1	10.7.39.20	DHCP	346	DHCP ACK - Transaction ID 0x44df1441
1131…	1991.837828	fe80::258e:c0c3:4c7…	ff02::1:2	DHCPv6	157	Solicit XID: 0xc29b81 CID: 000100012aa63d550c37966fe7bd
1132…	1992.846465	fe80::258e:c0c3:4c7…	ff02::1:2	DHCPv6	157	Solicit XID: 0xc29b81 CID: 000100012aa63d550c37966fe7bd
1132…	1993.857255	fe80::258e:c0c3:4c7…	ff02::1:2	DHCPv6	157	Solicit XID: 0xc29b81 CID: 000100012aa63d550c37966fe7bd
1133…	1995.869547	fe80::258e:c0c3:4c7…	ff02::1:2	DHCPv6	157	Solicit XID: 0xc29b81 CID: 000100012aa63d550c37966fe7bd
1140…	1999.878938	fe80::258e:c0c3:4c7…	ff02::1:2	DHCPv6	157	Solicit XID: 0xc29b81 CID: 000100012aa63d550c37966fe7bd

Operation: DHCPv6 is a protocol used to assign IPv6 addresses to devices on a network and provide configuration information such as DNS servers and prefixes.
Layer: Application (Layer 7)
RFC: RFC 8415

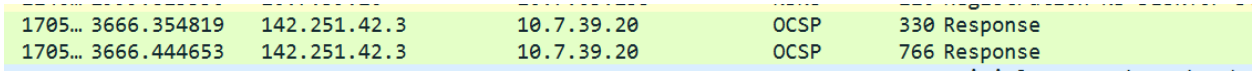
3. DHCP (Dynamic Host Configuration Protocol)



1131…	1991.797127	0.0.0.0	255.255.255.255	DHCP	364	DHCP Request - Transaction ID 0x44df1441
1131…	1991.848106	1.1.1.1	10.7.39.20	DHCP	346	DHCP ACK - Transaction ID 0x44df1441
1131…	1991.837828	fe80::258e:c0c3:4c7…	ff02::1:2	DHCPv6	157	Solicit XID: 0xc29b81 CID: 000100012aa63d550c37966fe7bd
1132…	1992.846465	fe80::258e:c0c3:4c7…	ff02::1:2	DHCPv6	157	Solicit XID: 0xc29b81 CID: 000100012aa63d550c37966fe7bd
1132…	1993.857255	fe80::258e:c0c3:4c7…	ff02::1:2	DHCPv6	157	Solicit XID: 0xc29b81 CID: 000100012aa63d550c37966fe7bd
1133…	1995.869547	fe80::258e:c0c3:4c7…	ff02::1:2	DHCPv6	157	Solicit XID: 0xc29b81 CID: 000100012aa63d550c37966fe7bd
1140…	1999.878938	fe80::258e:c0c3:4c7…	ff02::1:2	DHCPv6	157	Solicit XID: 0xc29b81 CID: 000100012aa63d550c37966fe7bd

Operation: DHCP assigns IPv4 addresses and other network configuration parameters, such as the gateway and DNS server, to devices on a network.
Layer: Application (Layer 7)
RFC: RFC 2131

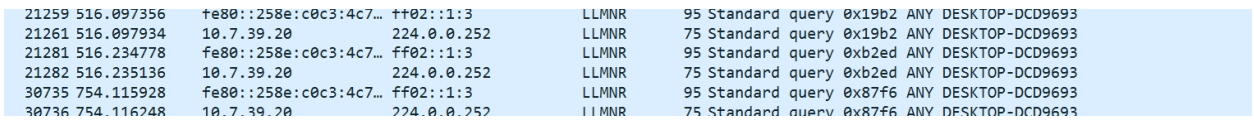
4. OCSP (Online Certificate Status Protocol)



1705…	3666.354819	142.251.42.3	10.7.39.20	OCSP	330	Response
1705…	3666.444653	142.251.42.3	10.7.39.20	OCSP	766	Response

Operation: OCSP is used to check the revocation status of digital certificates in real time, enhancing the security of SSL/TLS connections.
Layer: Application (Layer 7)
RFC: RFC 6960

5. **LLMNR (Link-Local Multicast Name Resolution)**

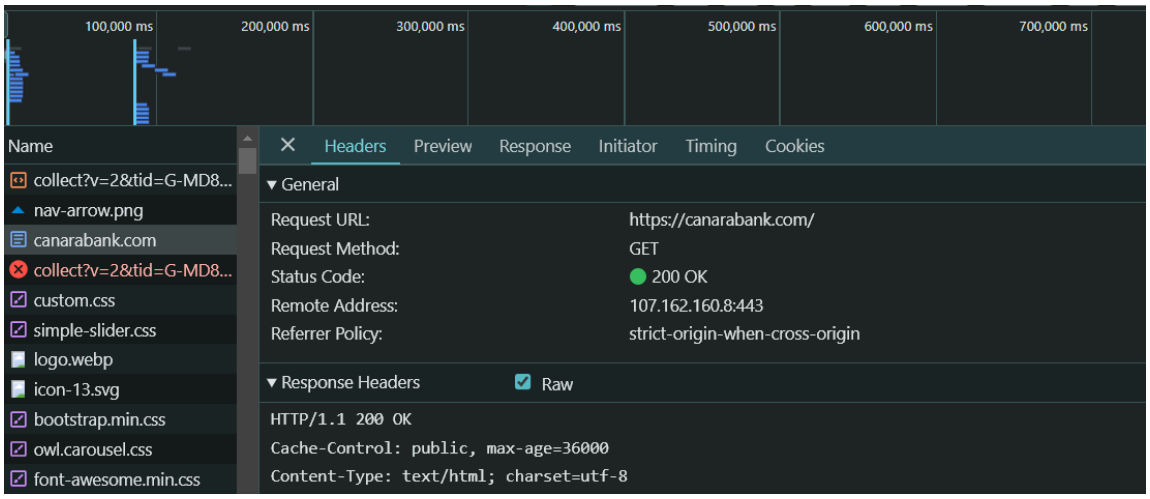


21259	516.097356	fe80::258e:c0c3:4c7…	ff02::1:3	LLMNR	95	Standard query 0x19b2 ANY DESKTOP-DCD9693
21261	516.097934	10.7.39.20	224.0.0.252	LLMNR	75	Standard query 0x19b2 ANY DESKTOP-DCD9693
21281	516.234778	fe80::258e:c0c3:4c7…	ff02::1:3	LLMNR	95	Standard query 0xb2ed ANY DESKTOP-DCD9693
21282	516.235136	10.7.39.20	224.0.0.252	LLMNR	75	Standard query 0xb2ed ANY DESKTOP-DCD9693
30735	754.115928	fe80::258e:c0c3:4c7…	ff02::1:3	LLMNR	95	Standard query 0x87f6 ANY DESKTOP-DCD9693
30736	754.116248	10.7.39.20	224.0.0.252	LLMNR	75	Standard query 0x87f6 ANY DESKTOP-DCD9693

Operation: LLMNR allows devices on the same local network to resolve hostnames without requiring a DNS server. It enables communication between devices on link-local IPv4 or IPv6 networks.
Layer: Application (Layer 7)
RFC: RFC 4795

Q.2.a

1.Canarabank.com
Request line:GET / HTTP/1.1
IP address:107.162.160.8:443
Connection: keep-alive (in request header)
Connection:close (in response header)

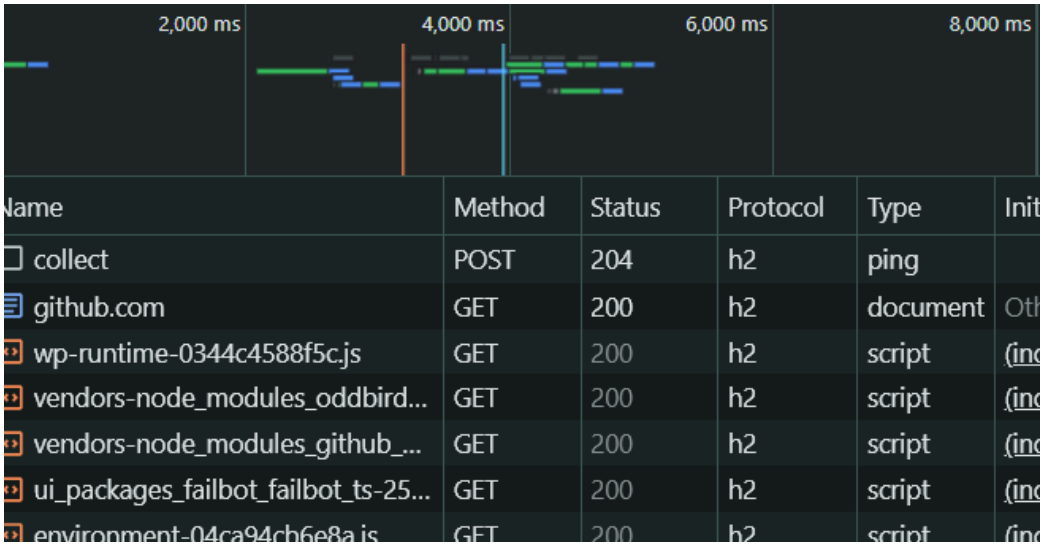


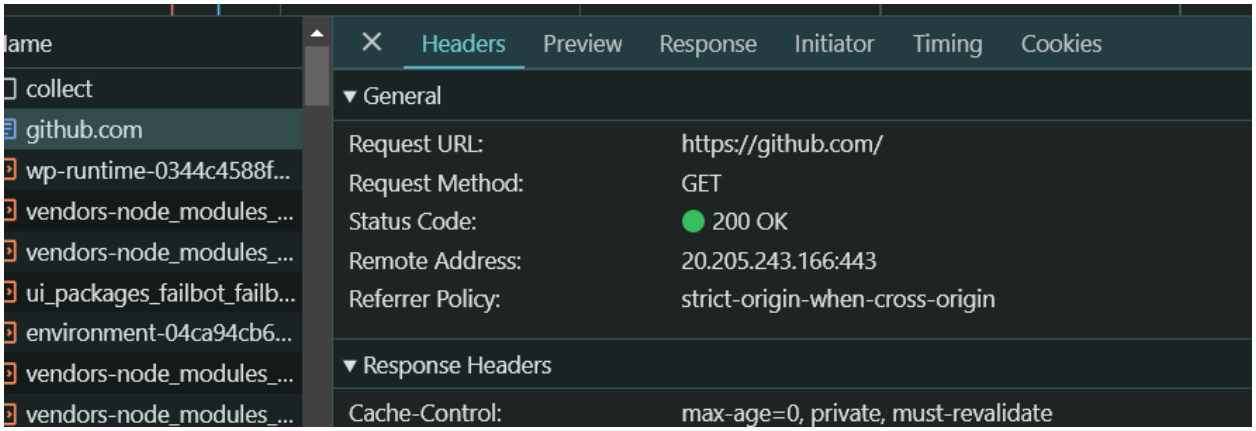
The client (Google Chrome) requested a persistent connection by sending the Connection: keep-alive header. However, the server responded with Connection: close, indicating that it will terminate the connection after completing the response. Therefore, the connection is **not persistent** for this page.

2.Github.com
Protocol: HTTP/2
IP Address: 20.205.243.166:443

Since GitHub uses HTTP/2, there is no traditional request line. Instead, HTTP/2 employs pseudo-headers to carry essential information in a binary format, which is more efficient than the conventional request structure.

Connection Details:
HTTP/2 assumes persistent connections by default, eliminating the need for explicit headers such as Connection: keep-alive. Therefore, the connection is inherently **persistent** for GitHub.

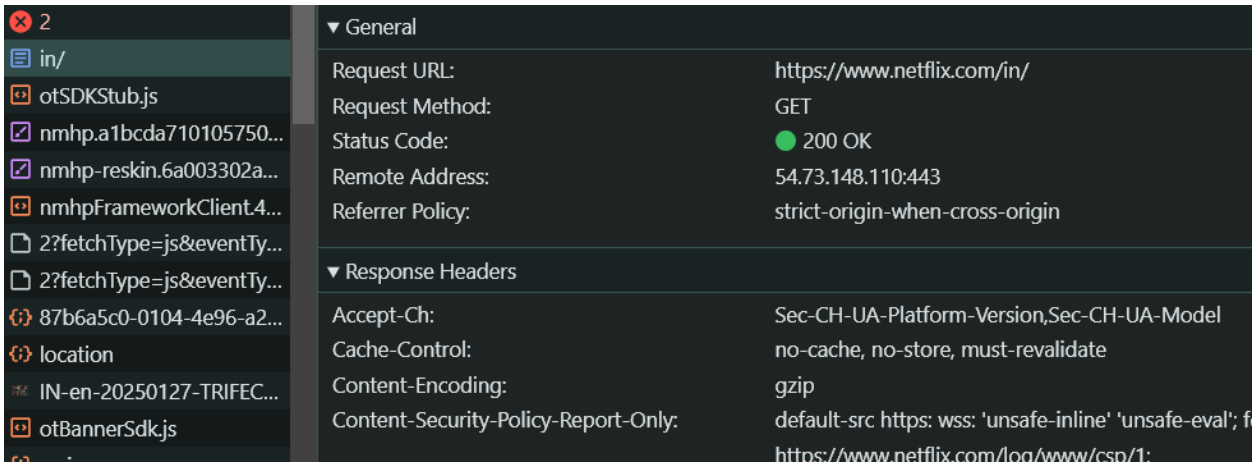




3.Netflix.com

Protocol: HTTP/2
IP Address: 54.73.148.110:443

Similar to GitHub, Netflix utilizes HTTP/2, which replaces traditional request lines with pseudo-headers for efficiency.



Connection Details:
Since HTTP/2 implicitly supports persistent connections, the connection remains **persistent** without the need for explicit headers

Q.2.b
Request header:

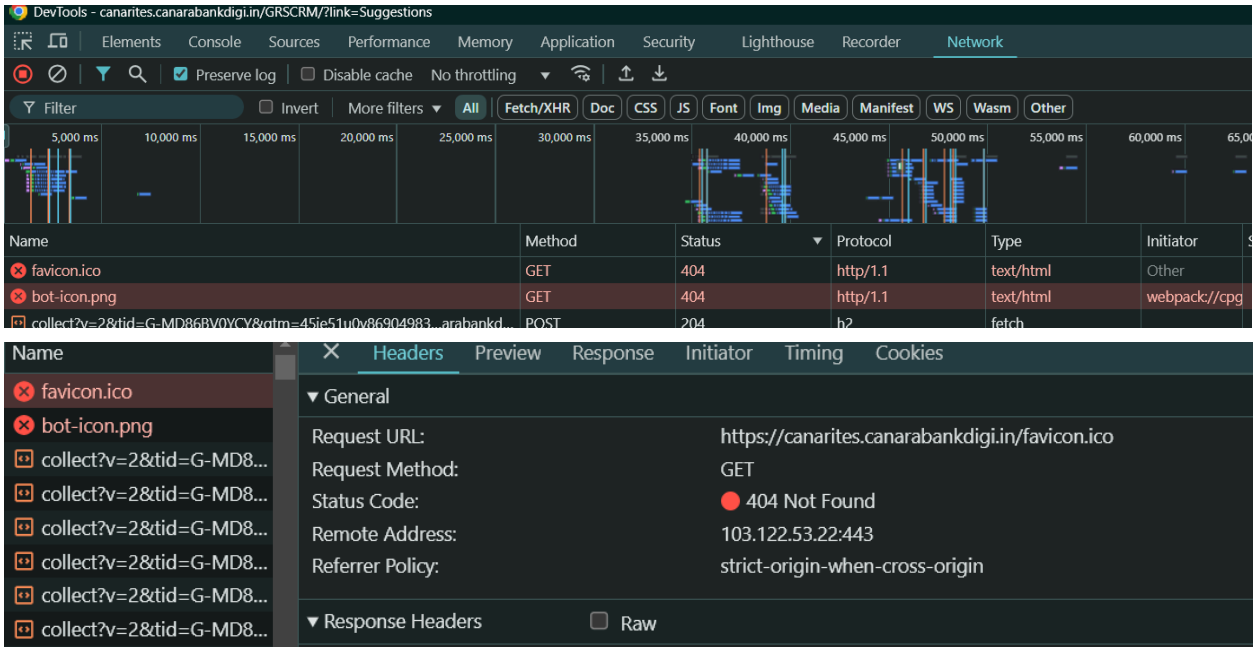
Header file	**Value**
authority	github.com
method	GET
user-agent	Mozilla/5.0 (Windows NT 10.0; Win64; x64) AppleWebKit/537.36 (KHTML, like Gecko) Chrome/132.0.0.0 Safari/537.36

Response header:

Header file	**Value**
Content type	text/html; charset=utf-8
Server	GitHub.com
Cache-Control	max-age=0, private, must-revalidate

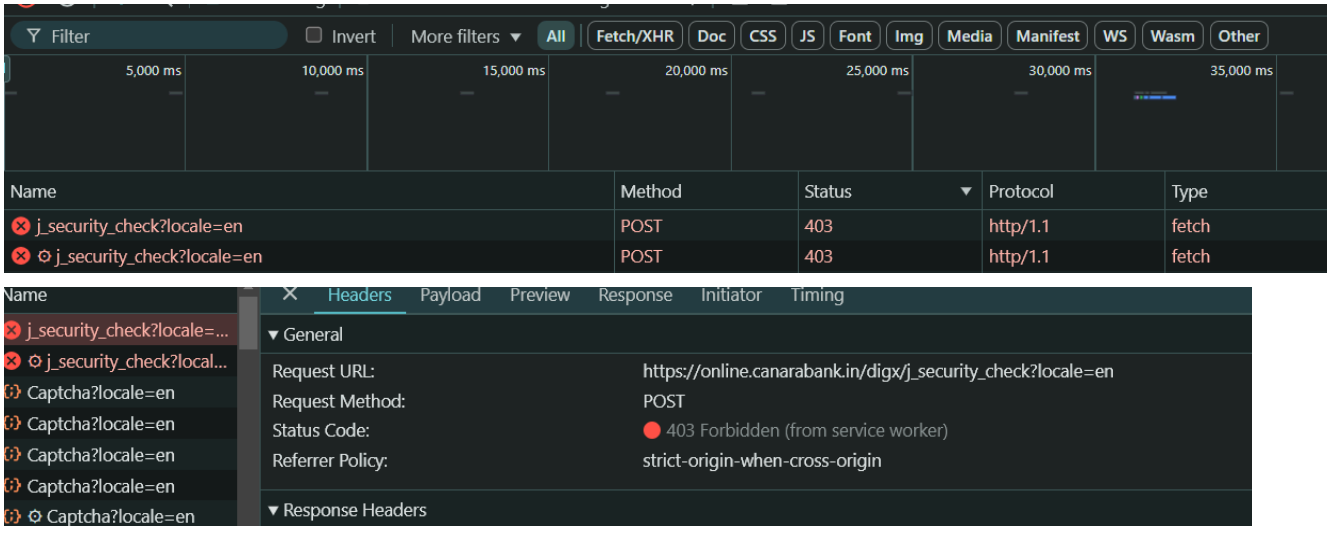
HTTP error codes:

1.404 Not Found



This error occurs when the server cannot find the requested resource. It usually happens when the URL is incorrect or the resource (like a webpage or file) has been moved or deleted.

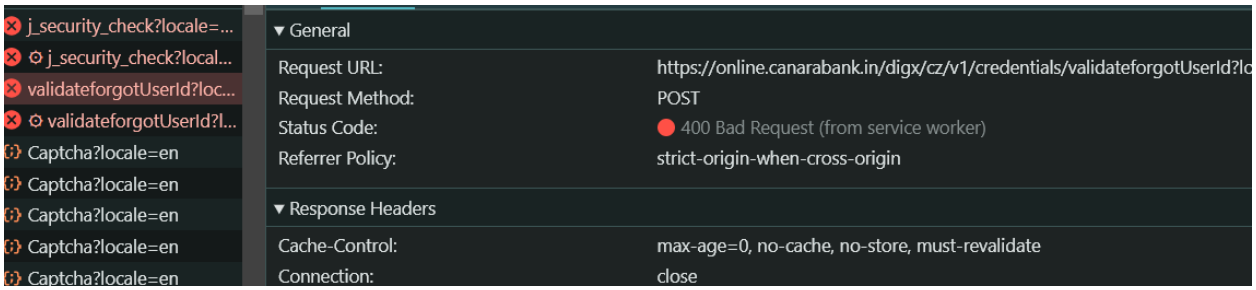
2. 403 Forbidden error



A 403 error means that access to the requested resource is denied for some reason, even though the request was understood by the server. The server is actively refusing to fulfill the request.

3.400 Bad Request

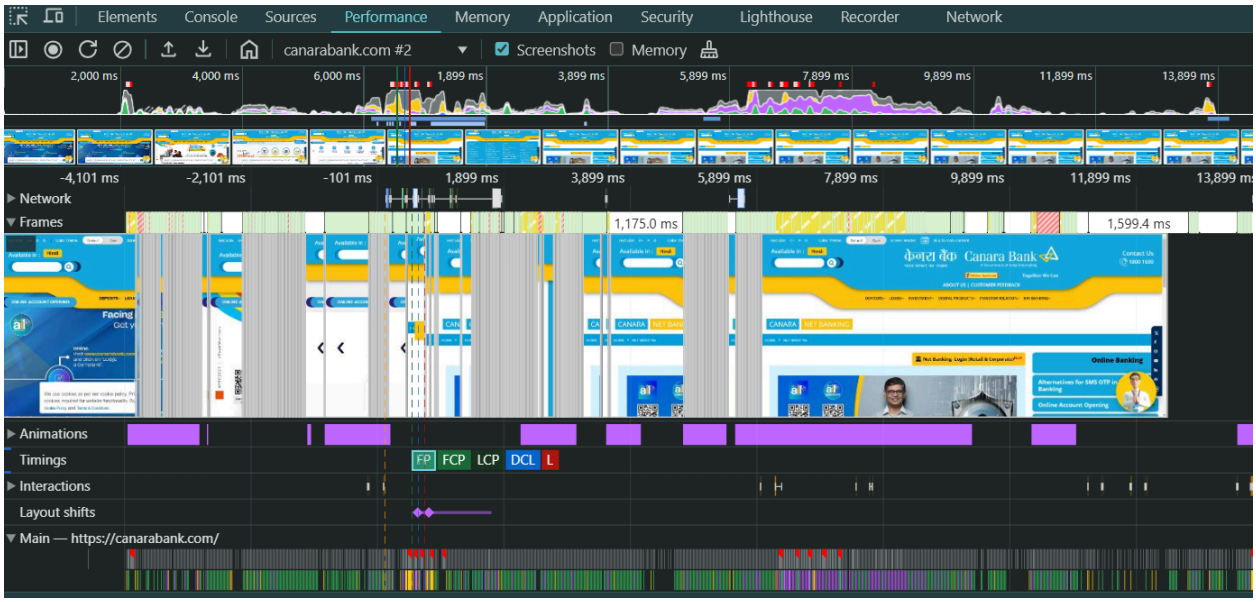
A 400 Bad Request error means that the server was unable to process the request because it was malformed in some way. This is a client-side error, meaning that the problem lies with the request sent by the client (the browser or application).

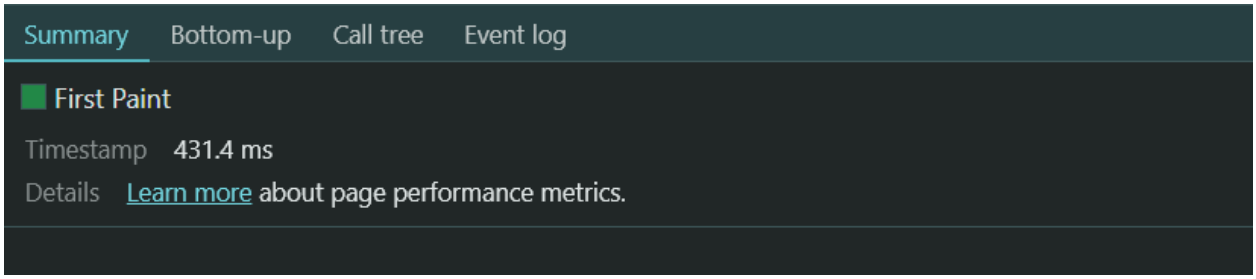


Q.2.c

Performance metrics and cookies

1. Canarabank.com

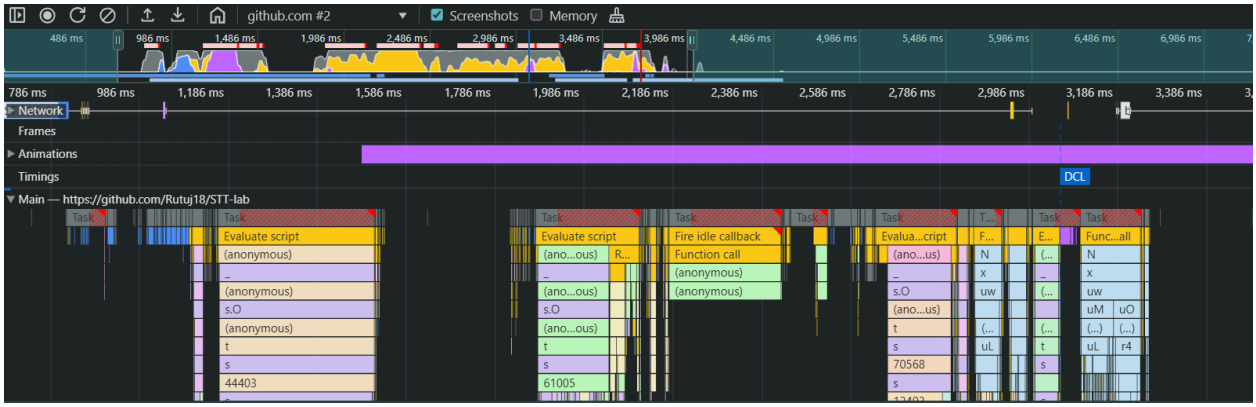


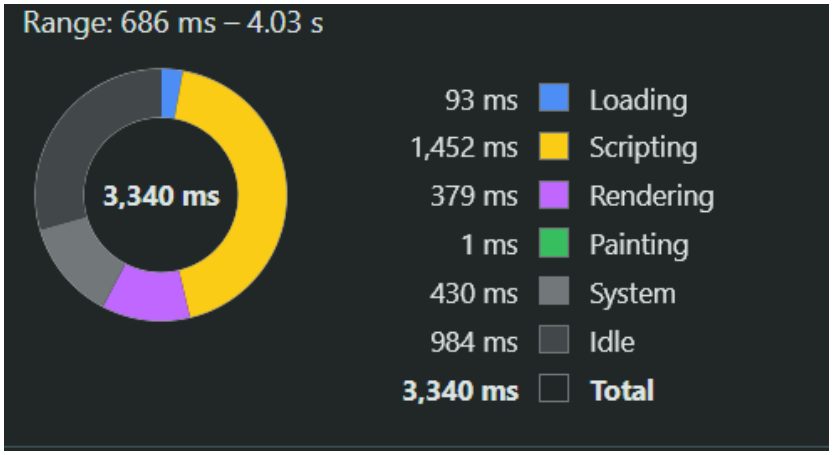


FP: 431.42 ms
FCP: 431.42 ms
LCP: 431.42

DCL:542.66
L:642.66
Browser used: Google Chrome

2. github.com

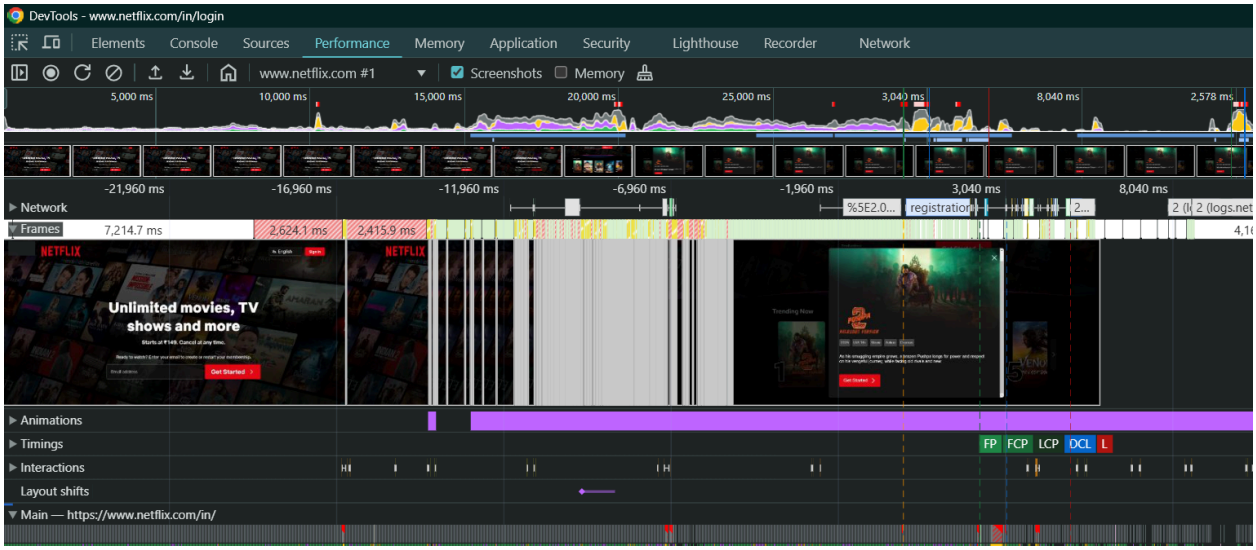


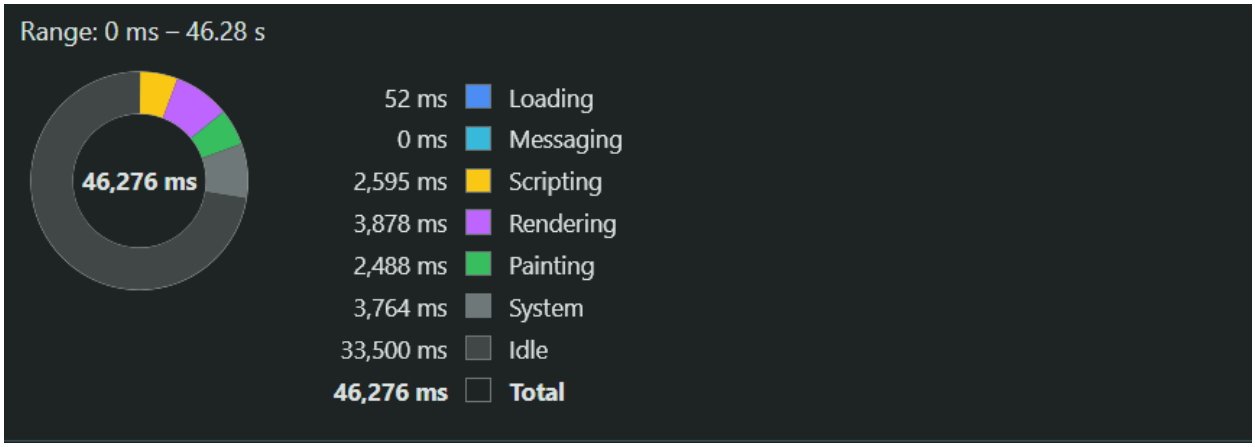


.

DCL: 3.06s
L: 3.71s
Browser used : Google Chrome

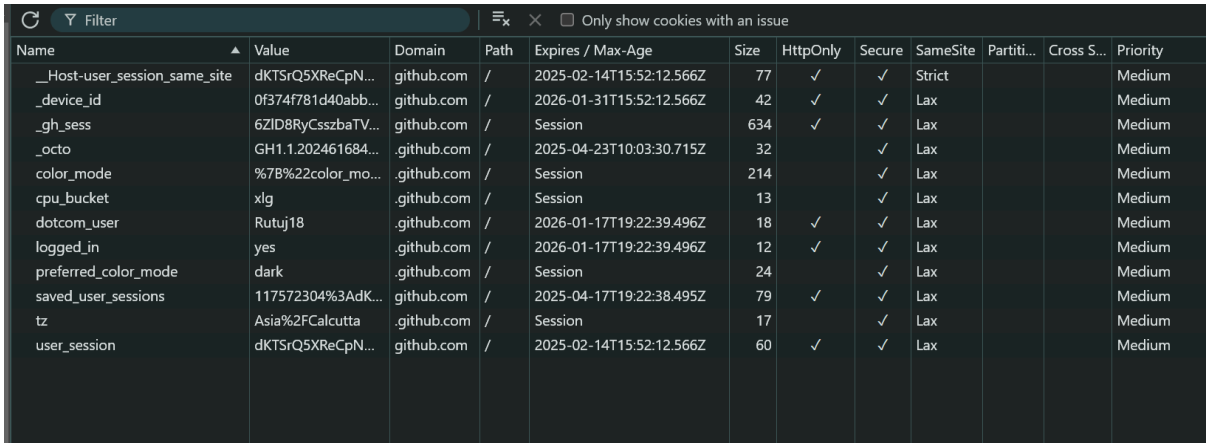
3. Netflix.com





FP : 2.26s
FCP: 2.26s
LCP : 2.26s
DCL: 3.07s
L: 5.00s
Browser used: Google Chrome

Cookies for github.com



Name	Value	Domain	Path	Expires / Max-Age	Size	HttpOnly	Secure	SameSite	Partiti...	Cross S...	Priority
__Host-user_session_same_site	dKTSrQ5XReCpN...	github.com	/	2025-02-14T15:52:12.566Z	77	✓	✓	Strict			Medium
_device_id	0f374f781d40abb...	github.com	/	2026-01-31T15:52:12.566Z	42	✓	✓	Lax			Medium
_gh_sess	6ZID8RyCsszbaTV...	github.com	/	Session	634	✓	✓	Lax			Medium
_octo	GH1.1.202461684...	.github.com	/	2025-04-23T10:03:30.715Z	32		✓	Lax			Medium
color_mode	%7B%22color_mo...	.github.com	/	Session	214		✓	Lax			Medium
cpu_bucket	xlg	.github.com	/	Session	13		✓	Lax			Medium
dotcom_user	Rutuj18	.github.com	/	2026-01-17T19:22:39.496Z	18	✓	✓	Lax			Medium
logged_in	yes	.github.com	/	2026-01-17T19:22:39.496Z	12	✓	✓	Lax			Medium
preferred_color_mode	dark	.github.com	/	Session	24		✓	Lax			Medium
saved_user_sessions	117572304%3AdK...	github.com	/	2025-04-17T19:22:38.495Z	79	✓	✓	Lax			Medium
tz	Asia%2FCalcutta	.github.com	/	Session	17		✓	Lax			Medium
user_session	dKTSrQ5XReCpN...	github.com	/	2025-02-14T15:52:12.566Z	60	✓	✓	Lax			Medium

1. _Host-user_session_same_site
   Flags: HttpOnly,Secure, Samesite(strict)

2. _device_id
   Flags:HttpOnly,Secure, SameSite(Lax)

3. _gh_sess
   Flags:HttpOnly,Secure, SameSite(Lax)

4. _octo
   Flags:Secure, SameSite(Lax)

5. color_mode
   Flags:Secure, SameSite(Lax)

6. cpu_bucket
   Flags:,Secure, SameSite(Lax)

7. dotcom_user
   Flags:HttpOnly,Secure, SameSite(Lax)

8. logged_in
   Flags:HttpOnly,Secure, SameSite(Lax)

9. preferred_color_mode
   Flags:Secure, SameSite(Lax)

10. saved_user_sessions
    Flags:HttpOnly,Secure, SameSite(Lax)

11. tz

Flags:Secure, SameSite(Lax)

12. user_session
    Flags:HttpOnly,Secure, SameSite(Lax)