

# **Computer Networks Laboratory**

**UE23CS252B**

**4th Semester, Academic Year 2025**

Date:20/02/2025

Name: Pranav Hemanth	SRN: PES1UG23CS433	Section: G
----------------------	--------------------	------------

Week# 3 Task Number: 1

**TITLE: USING DIG ON WEBSITES**

## Part 1:

### 1. Observe DNS Caching:

```
pranavhemanth@Pranav's-MacBook-Pro-M3 ~ %dig google.com

; <>> DiG 9.20.7 <>> google.com
;; global options: +cmd
;; Got answer:
;; ->>HEADER<<- opcode: QUERY, status: NOERROR, id: 11250
;; flags: qr rd ra; QUERY: 1, ANSWER: 1, AUTHORITY: 0, ADDITIONAL: 1

;; OPT PSEUDOSECTION:
;; EDNS: version: 0, flags:; udp: 1280
;; QUESTION SECTION:
;google.com.           IN      A

;; ANSWER SECTION:
google.com.        61      IN      A      142.250.196.174

;; Query time: 21 msec
;; SERVER: 2401:4900:6314:f3ae::92#53(2401:4900:6314:f3ae::92) (UDP)
;; WHEN: Wed Apr 30 21:53:33 IST 2025
;; MSG SIZE rcvd: 55

mem.c:367: INSIST(s >= size) failed, back trace
0 libisc-9.20.7.dylib          0x000000010499bf3c default_callback + 72
1 libisc-9.20.7.dylib          0x000000010499bed4 isc_assertion_failed + 20
2 libisc-9.20.7.dylib          0x00000001049af30 isc__mem_strdup + 0
3 libxml2.2.dylib              0x00000001a5388764 xmlCleanupCharEncodingHandlers + 96
4 libxml2.2.dylib              0x00000001a53a6cac xmlCleanupParser + 36
5 libisc-9.20.7.dylib          0x00000001049c2688 isc__xml_shutdown + 12
6 libisc-9.20.7.dylib          0x00000001049a98c0 isc__shutdown + 20
7 libsystem_c.dylib             0x000000019bc45944 __cxa_finalize_ranges + 480
8 libsystem_c.dylib             0x000000019bc45704 exit + 44
9 libdyld.dylib                 0x000000019bd97dc8 _ZNK5dyld416LibSystemHelpers6getenvEPKc + 0
10 dyld                         0x000000019b9eec60 _ZNK5dyld423LibSystemHelpersWrapper4exitEi + 172
11 dyld                         0x000000019b9eeb7c start + 6048

zsh: abort      dig google.com
```

```
[pranavhemanth@Pranav's-MacBook-Pro-M3 ~ %dig google.com

; <>> DiG 9.20.7 <>> google.com
;; global options: +cmd
;; Got answer:
;; ->>HEADER<<- opcode: QUERY, status: NOERROR, id: 44710
;; flags: qr rd ra ad; QUERY: 1, ANSWER: 1, AUTHORITY: 0, ADDITIONAL: 0

;; QUESTION SECTION:
;google.com.           IN      A

;; ANSWER SECTION:
google.com.        33      IN      A      142.250.196.174

;; Query time: 5 msec
;; SERVER: 2401:4900:6314:f3ae::92#53(2401:4900:6314:f3ae::92) (UDP)
;; WHEN: Wed Apr 30 21:54:02 IST 2025
;; MSG SIZE rcvd: 44

mem.c:367: INSIST(s >= size) failed, back trace
0  libisc-9.20.7.dylib          0x0000000102687f3c default_callback + 72
1  libisc-9.20.7.dylib          0x0000000102687ed4 isc_assertion_failed + 20
2  libisc-9.20.7.dylib          0x000000010269bd30 isc__mem_strdup + 0
3  libxml2.2.dylib              0x00000001a5388764 xmlCleanupCharEncodingHandlers + 96
4  libxml2.2.dylib              0x00000001a53a6cac xmlCleanupParser + 36
5  libisc-9.20.7.dylib          0x00000001026aae688 isc__xml_shutdown + 12
6  libisc-9.20.7.dylib          0x00000001026958c0 isc__shutdown + 20
7  libsystem_c.dylib             0x000000019bc45944 __cxa_finalize_ranges + 480
8  libsystem_c.dylib             0x000000019bc45704 exit + 44
9  libdyld.dylib                 0x000000019bd97dc8 _ZNK5dyld416LibSystemHelpers6getenvEPKc + 0
10 dyld                          0x000000019b9eec60 _ZNK5dyld423LibSystemHelpersWrapper4exitEi + 172
11 dyld                          0x000000019b9eeb7c start + 6048
zsh: abort      dig google.com
pranavhemanth@Pranav's-MacBook-Pro-M3 ~ %
```

## 2. Query for Other Record Types:

```
[pranavhemanth@Pranav's-MacBook-Pro-M3 ~ %dig google.com AAAA

; <>> DiG 9.20.7 <>> google.com AAAA
;; global options: +cmd
;; Got answer:
;; ->>HEADER<<- opcode: QUERY, status: NOERROR, id: 39528
;; flags: qr rd ra; QUERY: 1, ANSWER: 1, AUTHORITY: 0, ADDITIONAL: 1

;; OPT PSEUDOSECTION:
; EDNS: version: 0, flags:; udp: 1280
;; QUESTION SECTION:
;google.com.           IN      AAAA

;; ANSWER SECTION:
google.com.        236     IN      AAAA    2404:6800:4007:82c::200e

;; Query time: 36 msec
;; SERVER: 2401:4900:6314:f3ae::92#53(2401:4900:6314:f3ae::92) (UDP)
;; WHEN: Wed Apr 30 21:55:39 IST 2025
;; MSG SIZE rcvd: 67

mem.c:367: INSIST(s >= size) failed, back trace
0  libisc-9.20.7.dylib          0x0000000104ba7f3c default_callback + 72
1  libisc-9.20.7.dylib          0x0000000104ba7ed4 isc_assertion_failed + 20
2  libisc-9.20.7.dylib          0x0000000104bbbd30 isc__mem_strdup + 0
3  libxml2.2.dylib              0x00000001a5388764 xmlCleanupCharEncodingHandlers + 96
4  libxml2.2.dylib              0x00000001a53a6cac xmlCleanupParser + 36
5  libisc-9.20.7.dylib          0x0000000104bce688 isc__xml_shutdown + 12
6  libisc-9.20.7.dylib          0x0000000104bb58c0 isc__shutdown + 20
7  libsystem_c.dylib             0x000000019bc45944 __cxa_finalize_ranges + 480
8  libsystem_c.dylib             0x000000019bc45704 exit + 44
9  libdyld.dylib                 0x000000019bd97dc8 _ZNK5dyld416LibSystemHelpers6getenvEPKc + 0
10 dyld                          0x000000019b9eec60 _ZNK5dyld423LibSystemHelpersWrapper4exitEi + 172
11 dyld                          0x000000019b9eeb7c start + 6048
zsh: abort      dig google.com AAAA
pranavhemanth@Pranav's-MacBook-Pro-M3 ~ %
```

```

[pranavhemanth@Pranav's-MacBook-Pro-M3 ~ %dig google.com MX

; <>> DiG 9.20.7 <>> google.com MX
;; global options: +cmd
;; Got answer:
;; ->>HEADER<<- opcode: QUERY, status: NOERROR, id: 64263
;; flags: qr rd ra; QUERY: 1, ANSWER: 1, AUTHORITY: 0, ADDITIONAL: 10

;; OPT PSEUDOSECTION:
;; EDNS: version: 0, flags:; udp: 1280
;; QUESTION SECTION:
;google.com.           IN      MX

;; ANSWER SECTION:
google.com.        300    IN      MX      10 smtp.google.com.

;; ADDITIONAL SECTION:
smtp.google.com.   300    IN      A       142.251.10.26
smtp.google.com.   300    IN      A       142.251.12.26
smtp.google.com.   300    IN      A       142.251.12.27
smtp.google.com.   300    IN      A       172.217.194.27
smtp.google.com.   300    IN      A       172.217.194.26
smtp.google.com.   300    IN      AAAA   2404:6800:4003:c0f::1b
smtp.google.com.   300    IN      AAAA   2404:6800:4003:c11::1b
smtp.google.com.   300    IN      AAAA   2404:6800:4003:c11::1a
smtp.google.com.   300    IN      AAAA   2404:6800:4003:c04::1b

;; Query time: 81 msec
;; SERVER: 2401:4900:6314:f3ae::92#53(2401:4900:6314:f3ae::92) (UDP)
;; WHEN: Wed Apr 30 21:56:12 IST 2025
;; MSG SIZE rcvd: 252

mem.c:367: INSIST(s >= size) failed, back trace
0 libisc-9.20.7.dylib          0x00000001007b7f3c default_callback + 72
1 libisc-9.20.7.dylib          0x00000001007b7ed4 isc_assertion_failed + 20
2 libisc-9.20.7.dylib          0x00000001007cbd30 isc__mem_strdup + 0
3 libxml2.2.dylib              0x00000001a5388764 xmlCleanupCharEncodingHandlers + 96
4 libxml2.2.dylib              0x00000001a53a6cac xmlCleanupParser + 36
5 libisc-9.20.7.dylib          0x00000001007de688 isc__xml_shutdown + 12
6 libisc-9.20.7.dylib          0x00000001007c58c0 isc__shutdown + 20
7 libsystem_c.dylib             0x000000019bc45944 __cxa_finalize_ranges + 480
8 libsystem_c.dylib             0x000000019bc45704 exit + 44
9 libdyld.dylib                0x000000019bd97dc8 _ZNK5dyld416LibSystemHelpers6getenvEPKc + 0
10 dyld                         0x000000019b9eec60 _ZNK5dyld423LibSystemHelpersWrapper4exitEi + 172
11 dyld                         0x000000019b9eeb7c start + 6048

zsh: abort      dig google.com MX
pranavhemanth@Pranav's-MacBook-Pro-M3 ~ %

```

### 3. Modify DNS Servers:

Changed DNS server to cloudflare 1.1.1.1

```
[pranavhemanth@Pranavs-MacBook-Pro-M3 ~ %dig google.com

; <>> DiG 9.20.7 <>> google.com
;; global options: +cmd
;; Got answer:
;; ->>HEADER<<- opcode: QUERY, status: NOERROR, id: 22032
;; flags: qr rd ra; QUERY: 1, ANSWER: 1, AUTHORITY: 0, ADDITIONAL: 1

;; OPT PSEUDOSECTION:
; EDNS: version: 0, flags:; udp: 1232
;; QUESTION SECTION:
;google.com.           IN      A

;; ANSWER SECTION:
google.com.        125     IN      A       142.250.205.238

;; Query time: 37 msec
;; SERVER: 1.1.1.1#53(1.1.1.1) (UDP)
;; WHEN: Wed Apr 30 22:01:15 IST 2025
;; MSG SIZE rcvd: 55

mem.c:367: INSIST(s >= size) failed, back trace
0  libisc-9.20.7.dylib          0x0000000100d3ff3c default_callback + 72
1  libisc-9.20.7.dylib          0x0000000100d3bed4 isc_assertion_failed + 20
2  libisc-9.20.7.dylib          0x0000000100d4fd30 isc__mem_strdup + 0
3  libxml2.2.dylib              0x00000001a5388764 xmlCleanupCharEncodingHandlers + 96
4  libxml2.2.dylib              0x00000001a53a6cac xmlCleanupParser + 36
5  libisc-9.20.7.dylib          0x0000000100d62688 isc__xml_shutdown + 12
6  libisc-9.20.7.dylib          0x0000000100d498c0 isc__shutdown + 20
7  libsystem_c.dylib             0x000000019bc45944 __cxa_finalize_ranges + 480
8  libsystem_c.dylib             0x000000019bc45704 exit + 44
9  libdyld.dylib                0x000000019bd97dc8 _ZNK5dyld416LibSystemHelpers6getenvEPKc + 0
10 dyld                          0x000000019b9eec60 _ZNK5dyld423LibSystemHelpersWrapper4exitEi + 172
11 dyld                          0x000000019b9eeb7c start + 6048

zsh: abort      dig google.com
```

```
[pranavhemanth@Pranavs-MacBook-Pro-M3 ~ %dig google.com

; <>> DiG 9.20.7 <>> google.com
;; global options: +cmd
;; Got answer:
;; ->>HEADER<<- opcode: QUERY, status: NOERROR, id: 44286
;; flags: qr rd ra; QUERY: 1, ANSWER: 1, AUTHORITY: 0, ADDITIONAL: 1

;; OPT PSEUDOSECTION:
; EDNS: version: 0, flags:; udp: 1232
;; QUESTION SECTION:
;google.com.           IN      A

;; ANSWER SECTION:
google.com.        67      IN      A       142.250.205.238

;; Query time: 32 msec
;; SERVER: 1.1.1.1#53(1.1.1.1) (UDP)
;; WHEN: Wed Apr 30 22:02:34 IST 2025
;; MSG SIZE rcvd: 55

mem.c:367: INSIST(s >= size) failed, back trace
0  libisc-9.20.7.dylib          0x0000000104b13f3c default_callback + 72
1  libisc-9.20.7.dylib          0x0000000104b13ed4 isc_assertion_failed + 20
2  libisc-9.20.7.dylib          0x0000000104b27d30 isc__mem_strdup + 0
3  libxml2.2.dylib              0x00000001a5388764 xmlCleanupCharEncodingHandlers + 96
4  libxml2.2.dylib              0x00000001a53a6cac xmlCleanupParser + 36
5  libisc-9.20.7.dylib          0x0000000104b3a688 isc__xml_shutdown + 12
6  libisc-9.20.7.dylib          0x0000000104b218c0 isc__shutdown + 20
7  libsystem_c.dylib             0x000000019bc45944 __cxa_finalize_ranges + 480
8  libsystem_c.dylib             0x000000019bc45704 exit + 44
9  libdyld.dylib                0x000000019bd97dc8 _ZNK5dyld416LibSystemHelpers6getenvEPKc + 0
10 dyld                          0x000000019b9eec60 _ZNK5dyld423LibSystemHelpersWrapper4exitEi + 172
11 dyld                          0x000000019b9eeb7c start + 6048

zsh: abort      dig google.com
pranavhemanth@Pranavs-MacBook-Pro-M3 ~ %
```

## Changed DNS server to google 8.8.8.8

```
zsh: abort      dig google.com
[pranavhemanth@Pranav's-MacBook-Pro-M3 ~ %dig google.com

; <>> DiG 9.20.7 <>> google.com
;; global options: +cmd
;; Got answer:
;; ->>HEADER<- opcode: QUERY, status: NOERROR, id: 39924
;; flags: qr rd ra; QUERY: 1, ANSWER: 1, AUTHORITY: 0, ADDITIONAL: 1

;; OPT PSEUDOSECTION:
;; EDNS: version: 0, flags:; udp: 1232
;; QUESTION SECTION:
;google.com.           IN      A

;; ANSWER SECTION:
google.com.        246     IN      A      142.250.195.78

;; Query time: 22 msec
;; SERVER: 1.1.1.1#53(1.1.1.1) (UDP)
;; WHEN: Wed Apr 30 22:03:49 IST 2025
;; MSG SIZE rcvd: 55

mem.c:367: INSIST(s >= size) failed, back trace
0 libisc-9.20.7.dylib          0x0000000010413ff3c default_callback + 72
1 libisc-9.20.7.dylib          0x0000000010413fed4 isc_assertion_failed + 20
2 libisc-9.20.7.dylib          0x00000000104153d30 isc__mem_strdup + 0
3 libxml2.2.dylib              0x000000001a5388764 xmlCleanupCharEncodingHandlers + 96
4 libxml2.2.dylib              0x000000001a53a6cac xmlCleanupParser + 36
5 libisc-9.20.7.dylib          0x00000000104166688 isc__xml_shutdown + 12
6 libisc-9.20.7.dylib          0x0000000010414d8c0 isc__shutdown + 20
7 libsystem_.dylib              0x0000000019bc45944 __cxa_finalize_ranges + 480
8 libsystem_c.dylib             0x0000000019bc45704 exit + 44
9 libdyld.dylib                 0x0000000019bd97dc8 _ZNK5dyld416LibSystemHelpers6getenvEPKc + 0
10 dyld                         0x0000000019b9ecc60 _ZNK5dyld423LibSystemHelpersWrapper4exitEi + 172
11 dyld                         0x0000000019b9eeb7c start + 6048

zsh: abort      dig google.com
[pranavhemanth@Pranav's-MacBook-Pro-M3 ~ %
```

```

[pranavhemanth@Pranav's-MacBook-Pro-M3 ~ %dig google.com

; <>> DiG 9.20.7 <>> google.com
;; global options: +cmd
;; Got answer:
;; ->>HEADER<- opcode: QUERY, status: NOERROR, id: 47597
;; flags: qr rd ra; QUERY: 1, ANSWER: 1, AUTHORITY: 0, ADDITIONAL: 1

;; OPT PSEUDOSECTION:
; EDNS: version: 0, flags:; udp: 1232
;; QUESTION SECTION:
;google.com.           IN      A

;; ANSWER SECTION:
google.com.        234     IN      A       142.250.195.78

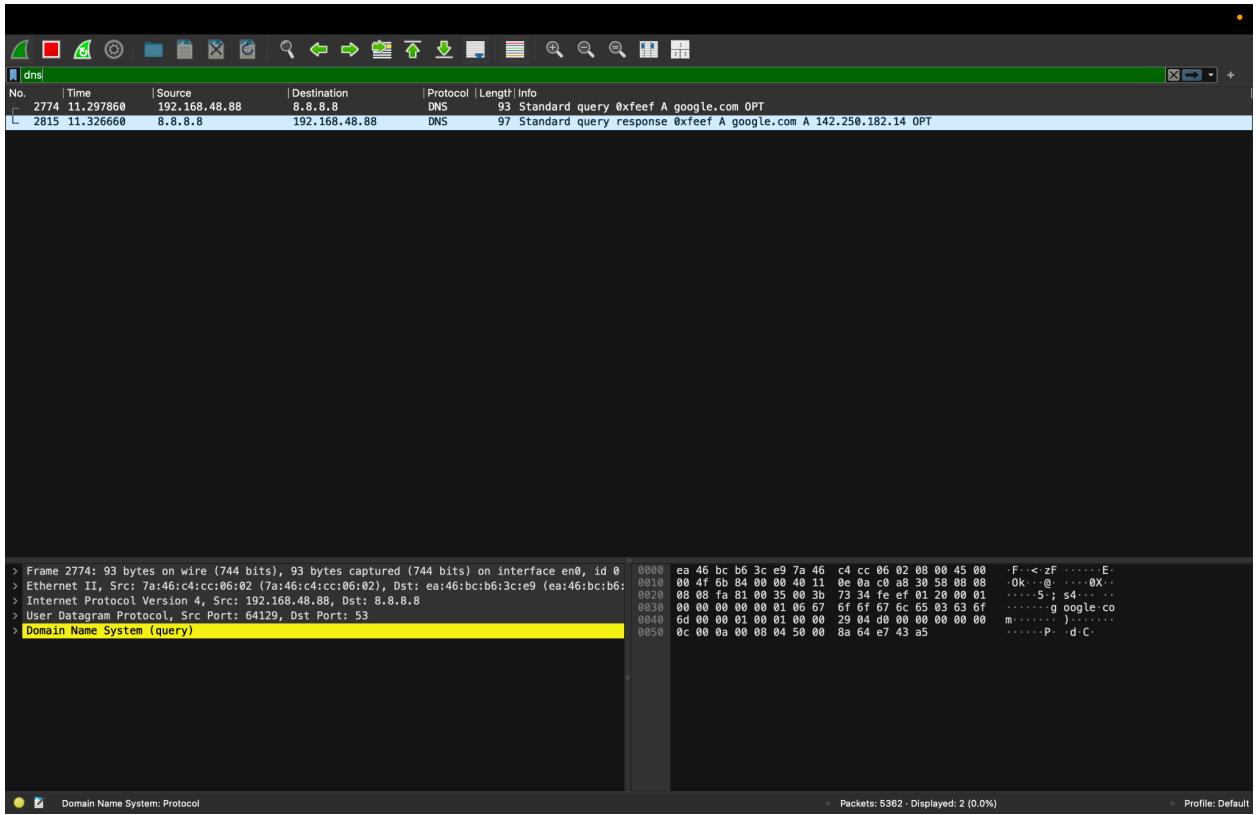
;; Query time: 18 msec
;; SERVER: 1.1.1.1#53(1.1.1.1) (UDP)
;; WHEN: Wed Apr 30 22:04:08 IST 2025
;; MSG SIZE rcvd: 55

mem.c:367: INSIST(s >= size) failed, back trace
0 libisc-9.20.7.dylib          0x0000000102457f3c default_callback + 72
1 libisc-9.20.7.dylib          0x0000000102457ed4 isc_assertion_failed + 20
2 libisc-9.20.7.dylib          0x000000010246bd30 isc__mem_strdup + 0
3 libxml2.2.dylib              0x00000001a5388764 xmlCleanupCharEncodingHandlers + 96
4 libxml2.2.dylib              0x00000001a53a6cac xmlCleanupParser + 36
5 libisc-9.20.7.dylib          0x000000010247e688 isc__xml_shutdown + 12
6 libisc-9.20.7.dylib          0x00000001024658c0 isc__shutdown + 20
7 libsystem_c.dylib             0x000000019bc45944 __cxa_finalize_ranges + 480
8 libsystem_c.dylib             0x000000019bc45704 exit + 44
9 libdyld.dylib                 0x000000019bd97dc8 _ZNK5dyld416LibSystemHelpers6getenvEPKc + 0
10 dyld                         0x000000019b9eec60 _ZNK5dyld423LibSystemHelpersWrapper4exitEi + 172
11 dyld                         0x000000019b9eeb7c start + 6048

zsh: abort      dig google.com
pranavhemanth@Pranav's-MacBook-Pro-M3 ~ %

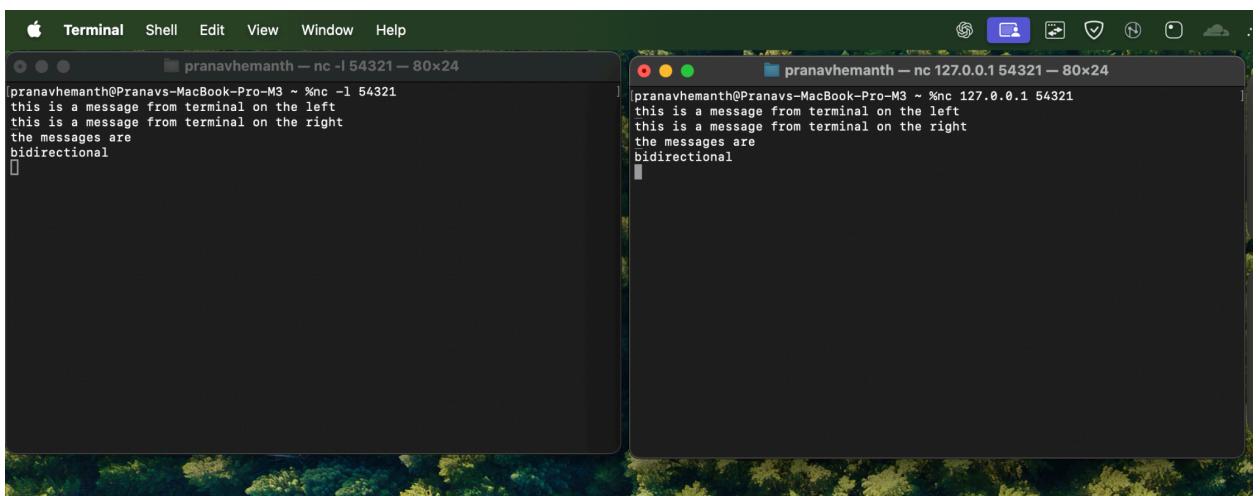
```

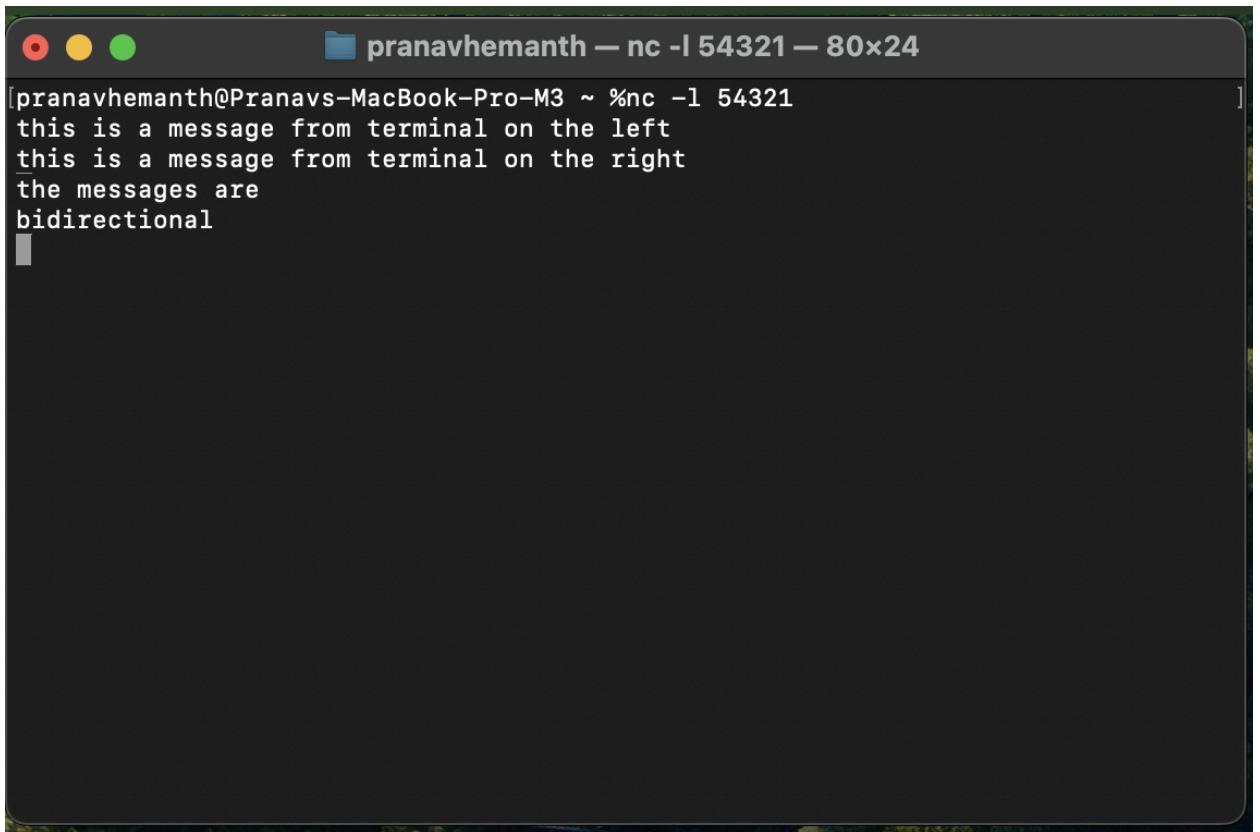
#### 4. Analyze DNS over TCP:



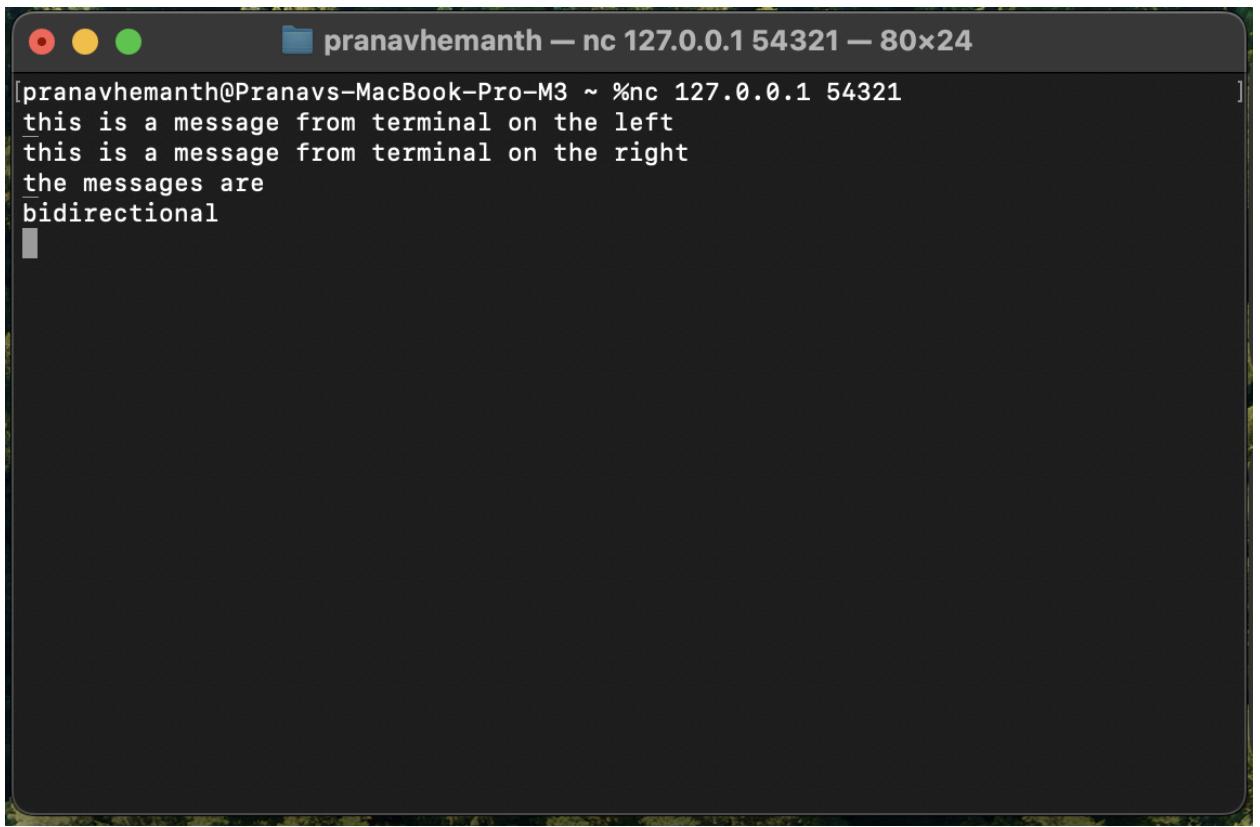
## Part 2:

### 1. Set up a UDP server using netcat on port 54321.



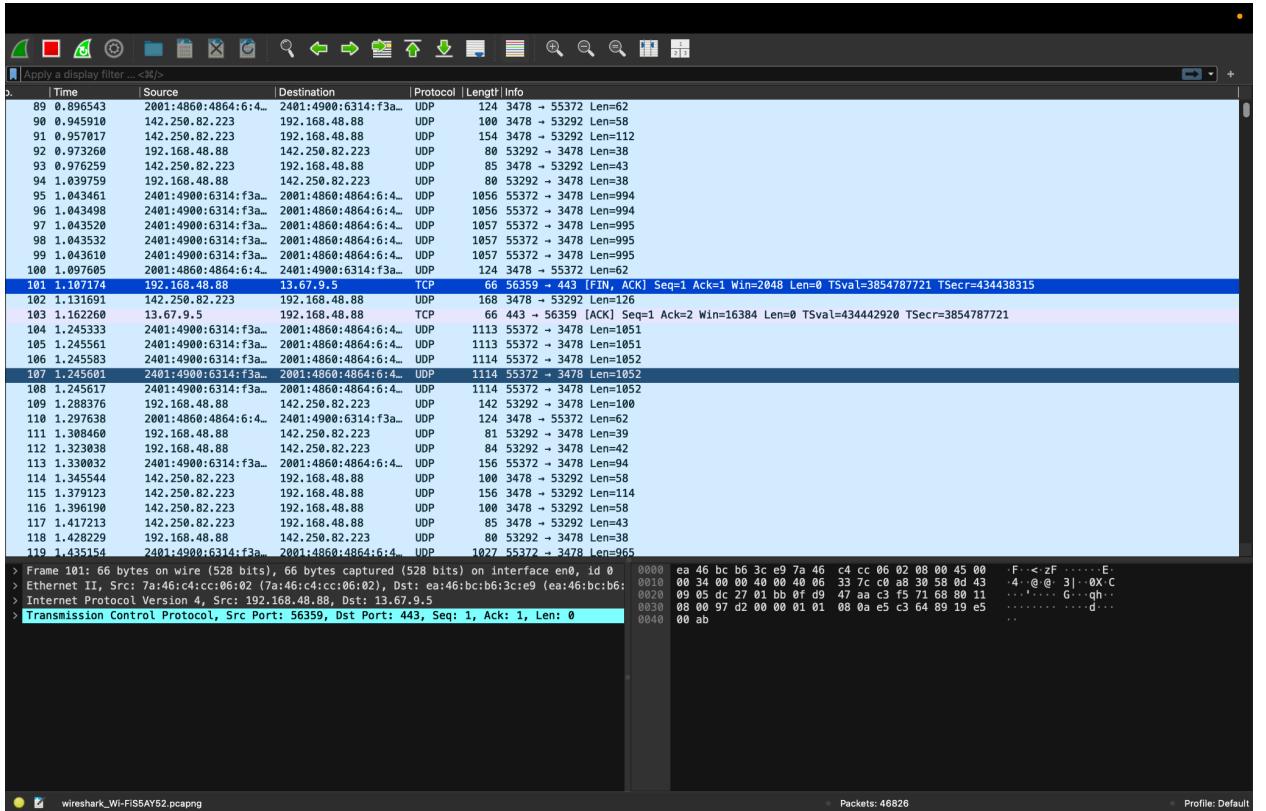


A screenshot of a terminal window titled "pranavhemanth - nc -l 54321 - 80x24". The window is dark-themed with white text. It displays the following text:  
[pranavhemanth@Pranavs-MacBook-Pro-M3 ~ %nc -l 54321  
this is a message from terminal on the left  
this is a message from terminal on the right  
the messages are  
bidirectional  
]



A screenshot of a terminal window titled "pranavhemanth - nc 127.0.0.1 54321 - 80x24". The window is dark-themed with white text. It displays the following text:  
[pranavhemanth@Pranavs-MacBook-Pro-M3 ~ %nc 127.0.0.1 54321  
this is a message from terminal on the left  
this is a message from terminal on the right  
the messages are  
bidirectional  
]

## 2. Send three distinct messages from a client and capture the traffic with Wireshark.



### **3. Write a report:**

- a. How does UDP differ from TCP?**
- b. Why is UDP suitable for DNS?**
- c. Observations about UDP traffic in Wireshark.**

### **Report:**

## **1. Differences Between UDP and TCP**

TCP (Transmission Control Protocol) is a connection-oriented protocol that guarantees reliable and ordered delivery of data. It achieves this through mechanisms such as three-way handshakes, error checking, acknowledgments, and retransmissions of lost packets. This makes TCP suitable for applications where accuracy and completeness are critical, such as file transfers and web browsing.

UDP (User Datagram Protocol), on the other hand, is connectionless and focuses on speed and low latency. It sends packets (datagrams) without first establishing a connection and does not guarantee delivery, ordering, or error correction. This lightweight nature makes UDP ideal for applications where speed is more important than reliability, such as real-time video, VoIP, and DNS.

## **2. Why UDP Is Suitable for DNS**

DNS (Domain Name System) is designed to resolve domain names into IP addresses quickly and efficiently. DNS queries are typically:

- Small in size
- Short-lived
- Time-sensitive

UDP is well-suited for DNS because:

- It introduces minimal overhead, avoiding the delay of connection setup.
- Most DNS responses fit within the 512-byte UDP limit (for traditional DNS), making fragmentation rare.

- Occasional packet loss is tolerable—clients can simply retry the request if needed.

The use of UDP allows DNS to provide fast and scalable name resolution, which is essential for modern internet performance.

### **3. Observations of UDP Traffic in Wireshark**

When observing DNS traffic over UDP in Wireshark, the following characteristics are notable:

- No connection setup (no SYN/SYN-ACK/ACK sequence as seen in TCP)
- Each request and response is a single, independent packet.
- Small packet sizes, typically under 100 bytes for standard queries.
- No retransmissions or flow control, further highlighting UDP's simplicity.
- DNS queries and responses appear as rapid exchanges, confirming UDP's suitability for real-time, lightweight communication.

This efficiency is evident when comparing DNS over UDP to TCP-based protocols in Wireshark, where the latter includes multiple packets just to establish a connection.

**Disclaimer:**

- The programs and output submitted are duly written, verified and executed by me.
- I have not copied from any of my peers nor from external resources such as the internet.
- If found plagiarized, I will abide with the disciplinary action of the University.

Name: Pranav Hemanth

SRN: PES1UG23CS433

Section: G

Date: 20/02/25