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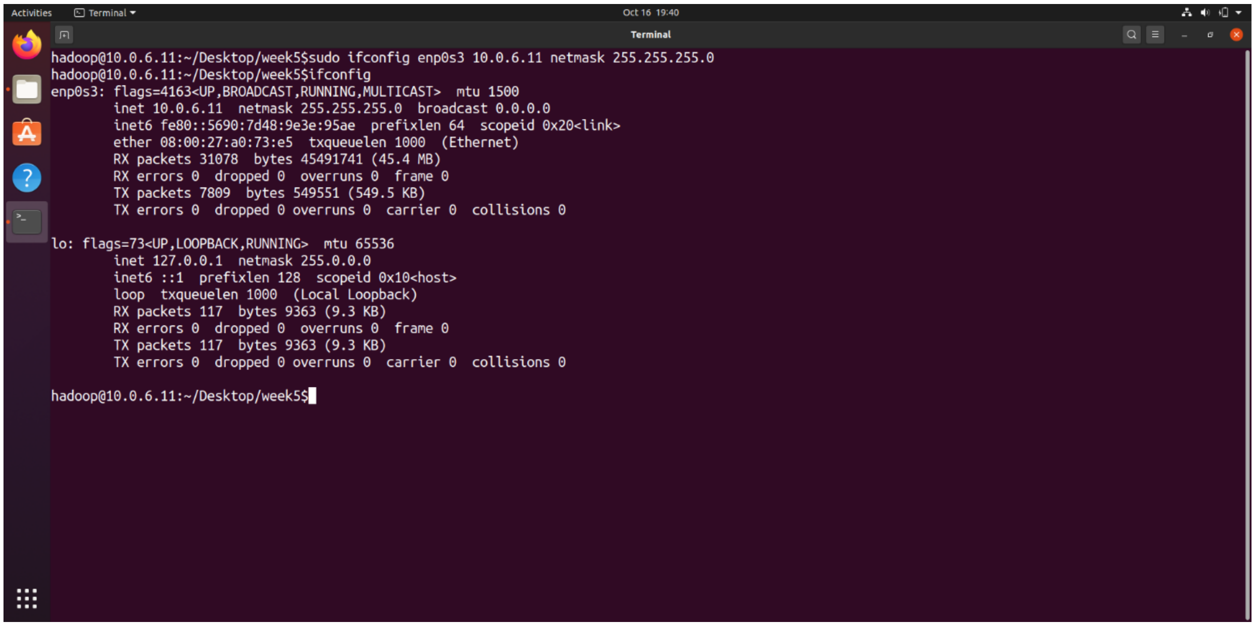
Week number: 5

Name of experiment: Simple Client-Server Application using Network Socket Programming

Date: 19-10-2020

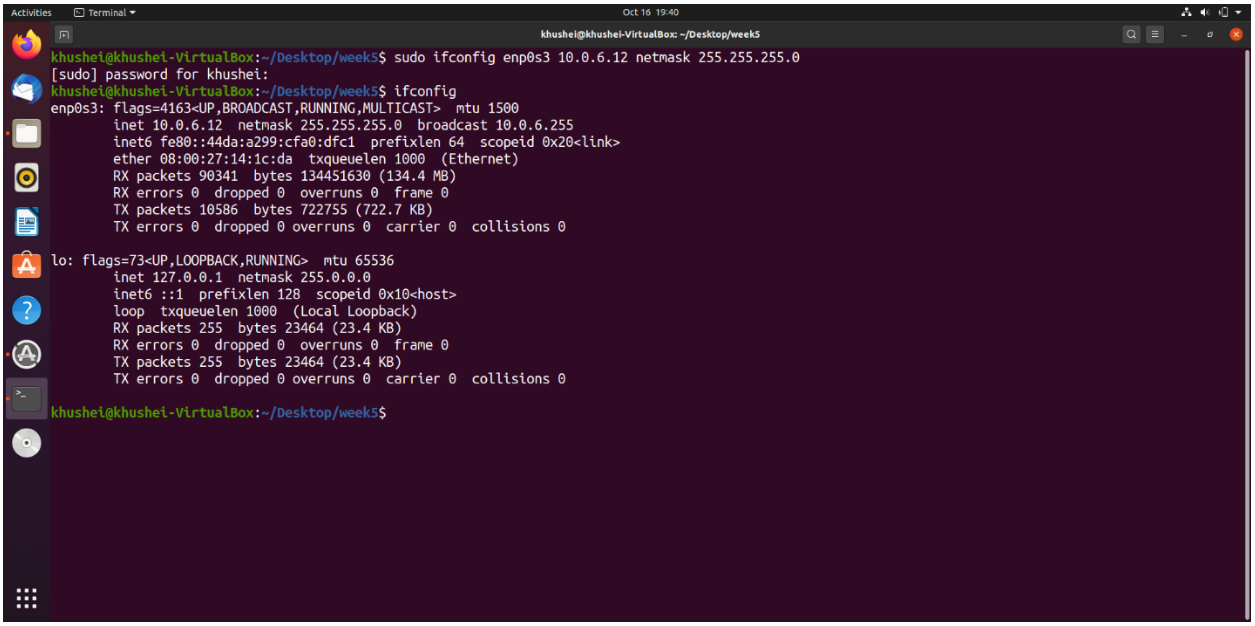
Objectives of the experiment: To develop a simple Client-Server application using TCP and UDP.
Pre requisites:

Client IP: set to 10.0.6.11



```
hadoop@10.0.6.11:~/Desktop/week5$sudo ifconfig enp0s3 10.0.6.11 netmask 255.255.255.0
hadoop@10.0.6.11:~/Desktop/week5$ifconfig
enp0s3: flags=4163<UP,BROADCAST,RUNNING,MULTICAST>  mtu 1500
        inet 10.0.6.11  netmask 255.255.255.0  broadcast 0.0.0.0
        inet6 fe80::5690:7d48:9e3e:95ae  prefixlen 64  scopeid 0x20<link>
        ether 08:00:27:a0:73:e5  txqueuelen 1000  (Ethernet)
        RX packets 31078  bytes 45491741 (45.4 MB)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 7809  bytes 549551 (549.5 KB)
        TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0

lo: flags=73<UP,LOOPBACK,RUNNING>  mtu 65536
        inet 127.0.0.1  netmask 255.0.0.0
        inet6 ::1  prefixlen 128  scopeid 0x10<host>
        loop  txqueuelen 1000  (Local Loopback)
        RX packets 117  bytes 9363 (9.3 KB)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 117  bytes 9363 (9.3 KB)
        TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0

hadoop@10.0.6.11:~/Desktop/week5$
```

Server IP: set to 10.0.6.12

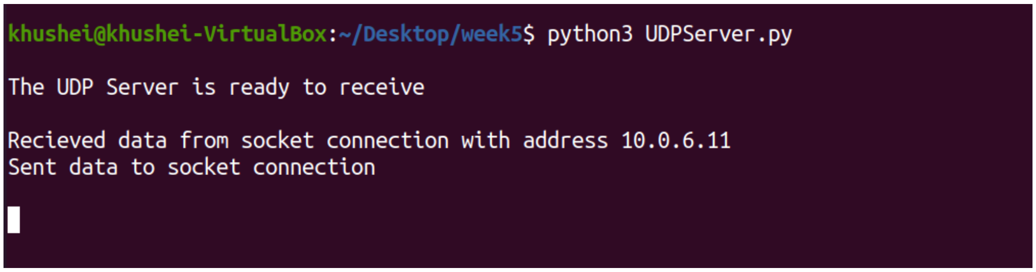


```
khushei@khushei-VirtualBox:~/Desktop/week5$ sudo ifconfig enp0s3 10.0.6.12 netmask 255.255.255.0
[sudo] password for khushei:
khushei@khushei-VirtualBox:~/Desktop/week5$ ifconfig
enp0s3: flags=4163<UP,BROADCAST,RUNNING,MULTICAST>  mtu 1500
        inet 10.0.6.12  netmask 255.255.255.0  broadcast 10.0.6.255
        inet6 fe80::44da:a299:cfa0:dfc1  prefixlen 64  scopeid 0x20<link>
        ether 08:00:27:14:1c:da  txqueuelen 1000  (Ethernet)
        RX packets 90341  bytes 134451630 (134.4 MB)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 10586  bytes 722755 (722.7 KB)
        TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0

lo: flags=73<UP,LOOPBACK,RUNNING>  mtu 65536
        inet 127.0.0.1  netmask 255.0.0.0
        inet6 ::1  prefixlen 128  scopeid 0x10<host>
        loop  txqueuelen 1000  (Local Loopback)
        RX packets 255  bytes 23464 (23.4 KB)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 255  bytes 23464 (23.4 KB)
        TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0

khushei@khushei-VirtualBox:~/Desktop/week5$
```

Task 1:

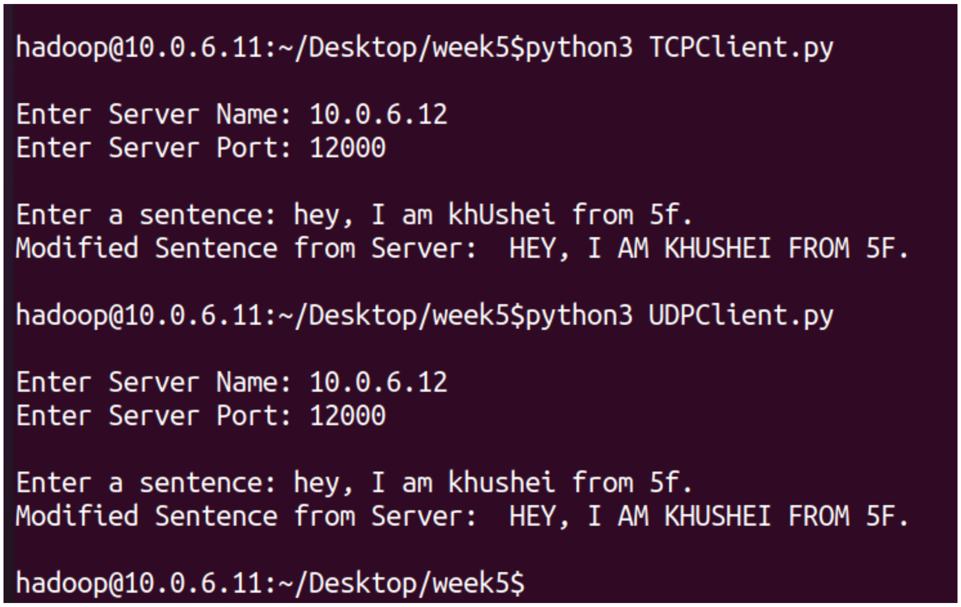
Socket Programming with UDP

Server:



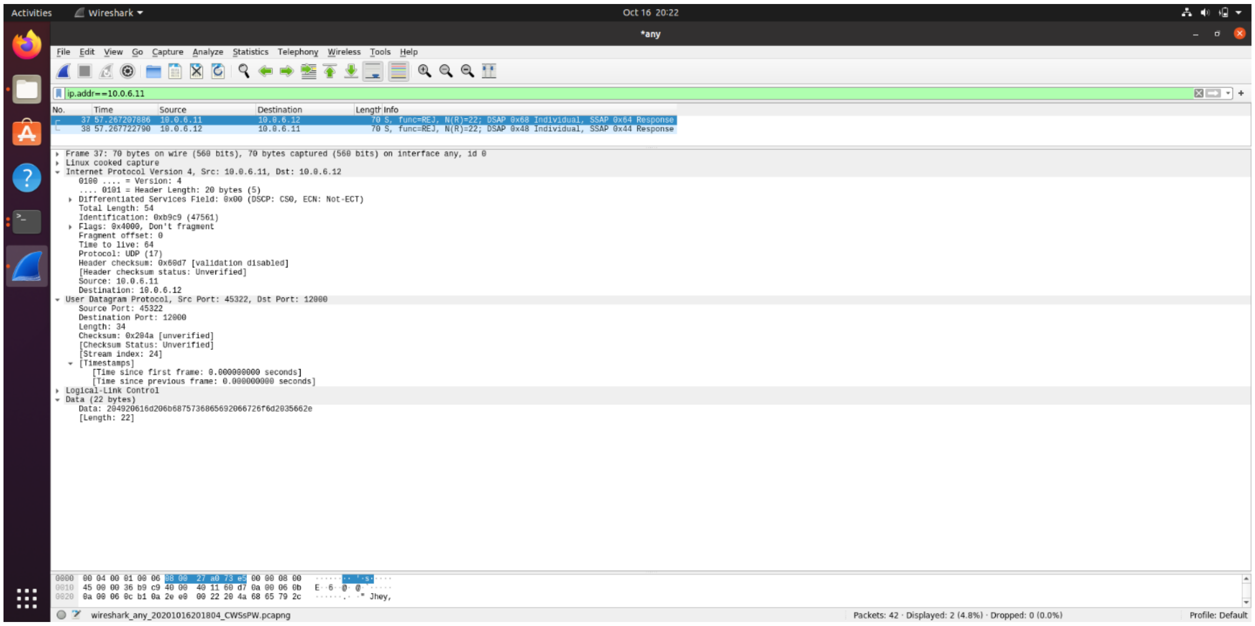
```
khushei@khushei-VirtualBox:~/Desktop/week5$ python3 UDPServer.py

The UDP Server is ready to receive

Recieved data from socket connection with address 10.0.6.11
Sent data to socket connection
```

Client:



```
hadoop@10.0.6.11:~/Desktop/week5$python3 TCPClient.py

Enter Server Name: 10.0.6.12
Enter Server Port: 12000

Enter a sentence: hey, I am khUshei from 5f.
Modified Sentence from Server:  HEY, I AM KHUSHEI FROM 5F.

hadoop@10.0.6.11:~/Desktop/week5$python3 UDPClient.py

Enter Server Name: 10.0.6.12
Enter Server Port: 12000

Enter a sentence: hey, I am khushei from 5f.
Modified Sentence from Server:  HEY, I AM KHUSHEI FROM 5F.

hadoop@10.0.6.11:~/Desktop/week5$
```

Wireshark-



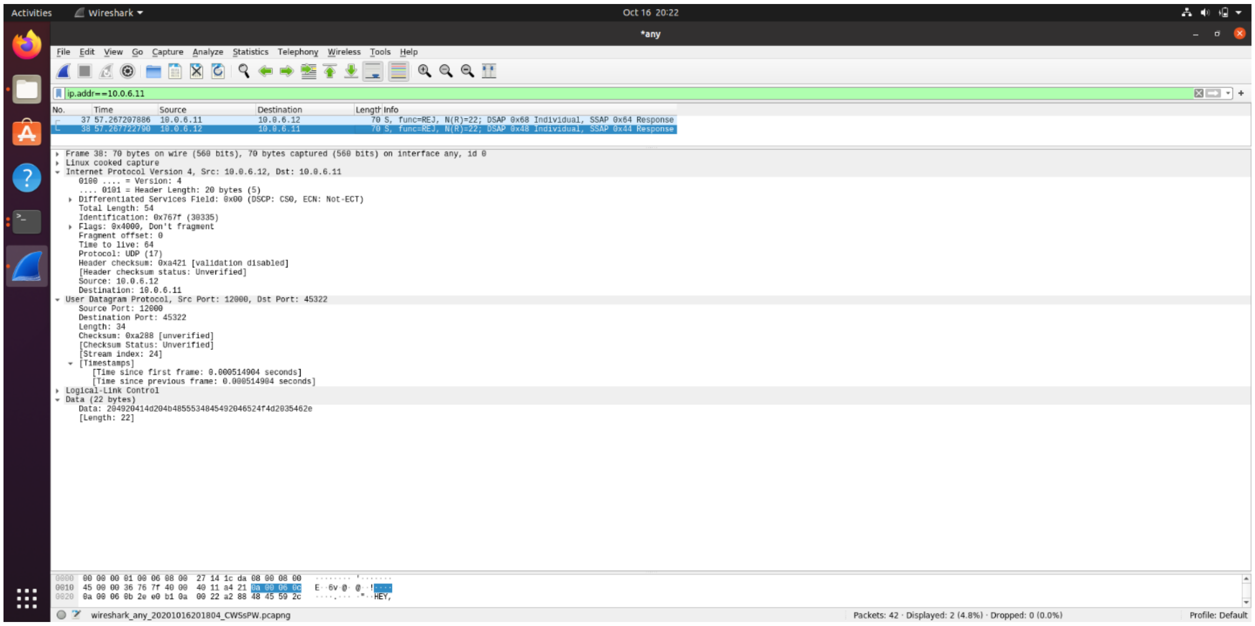
```
ip.addr==10.0.6.11
```

```
No.  Time          Source     Destination  Length Info
  37 57.267207886  10.0.6.11  10.0.6.12      70 S, func=REJ, N(R)=22; DSAP 0x68 Individual, SSAP 0x64 Response
  38 57.267722790  10.0.6.12  10.0.6.11      70 S, func=REJ, N(R)=22; DSAP 0x48 Individual, SSAP 0x44 Response
```

```
▸ Frame 37: 70 bytes on wire (560 bits), 70 bytes captured (560 bits) on interface any, id 0
▸ Linux cooked capture
▾ Internet Protocol Version 4, Src: 10.0.6.11, Dst: 10.0.6.12
    0100 .... = Version: 4
    .... 0101 = Header Length: 20 bytes (5)
  ▸ Differentiated Services Field: 0x00 (DSCP: CS0, ECN: Not-ECT)
    Total Length: 54
    Identification: 0xb9c9 (47561)
  ▸ Flags: 0x4000, Don't fragment
    Fragment offset: 0
    Time to live: 64
    Protocol: UDP (17)
    Header checksum: 0x60d7 [validation disabled]
    [Header checksum status: Unverified]
    Source: 10.0.6.11
    Destination: 10.0.6.12
▾ User Datagram Protocol, Src Port: 45322, Dst Port: 12000
    Source Port: 45322
    Destination Port: 12000
    Length: 34
    Checksum: 0x204a [unverified]
    [Checksum Status: Unverified]
    [Stream index: 24]
  ▾ [Timestamps]
      [Time since first frame: 0.000000000 seconds]
      [Time since previous frame: 0.000000000 seconds]
▸ Logical-Link Control
▾ Data (22 bytes)
    Data: 204920616d206b68757368656920666726f6d2035662e
    [Length: 22]
```

```
0000  00 04 00 01 00 06 08 00  27 a0 73 e5 00 00 08 00   ········'·s·····
0010  45 00 00 36 b9 c9 40 00  40 11 60 d7 0a 00 06 0b   E··6··@·@·`·····
0020  0a 00 06 0c b1 0a 2e e0  00 22 20 4a 68 65 79 2c   ·······.·" Jhey,
```

```
wireshark_any_20201016201804_CWSsPW.pcapng          Packets: 42 · Displayed: 2 (4.8%) · Dropped: 0 (0.0%)          Profile: Default
```



```
ip.addr==10.0.6.11
```

```
No.   Time          Source       Destination  Length Info
   37 57.267207886  10.0.6.11    10.0.6.12        70 S, func=REJ, N(R)=22; DSAP 0x68 Individual, SSAP 0x64 Response
   38 57.267722790  10.0.6.12    10.0.6.11        70 S, func=REJ, N(R)=22; DSAP 0x48 Individual, SSAP 0x44 Response
```

```
Frame 38: 70 bytes on wire (560 bits), 70 bytes captured (560 bits) on interface any, id 0
Linux cooked capture
Internet Protocol Version 4, Src: 10.0.6.12, Dst: 10.0.6.11
    0100 .... = Version: 4
    .... 0101 = Header Length: 20 bytes (5)
    Differentiated Services Field: 0x00 (DSCP: CS0, ECN: Not-ECT)
    Total Length: 54
    Identification: 0x767f (30335)
    Flags: 0x4000, Don't fragment
    Fragment offset: 0
    Time to live: 64
    Protocol: UDP (17)
    Header checksum: 0xa421 [validation disabled]
    [Header checksum status: Unverified]
    Source: 10.0.6.12
    Destination: 10.0.6.11
User Datagram Protocol, Src Port: 12000, Dst Port: 45322
    Source Port: 12000
    Destination Port: 45322
    Length: 34
    Checksum: 0xa288 [unverified]
    [Checksum Status: Unverified]
    [Stream index: 24]
    [Timestamps]
        [Time since first frame: 0.000514904 seconds]
        [Time since previous frame: 0.000514904 seconds]
Logical-Link Control
Data (22 bytes)
    Data: 204920414d204b48555348454920465224f4d2035462e
    [Length: 22]
```

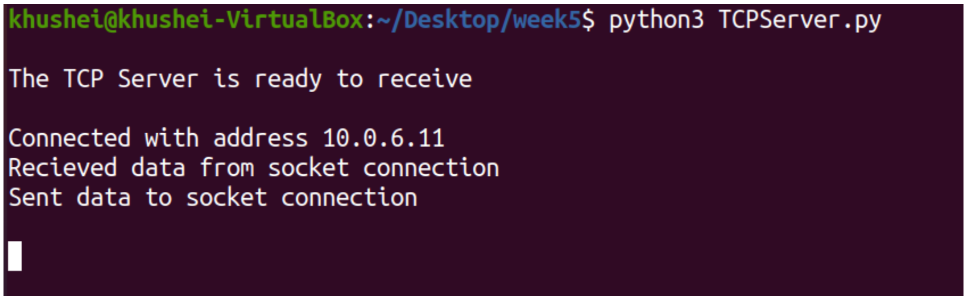
```
0000  00 00 00 01 00 06 08 00  27 14 1c da 08 00 08 00   ········'·······
0010  45 00 00 36 76 7f 40 00  40 11 a4 21 0a 00 06 0c   E··6v·@·@··!····
0020  0a 00 06 0b 2e e0 b1 0a  00 22 a2 88 48 45 59 2c   ····.····"··HEY,
```

```
wireshark_any_20201016201804_CWSsPW.pcapng        Packets: 42 · Displayed: 2 (4.8%) · Dropped: 0 (0.0%)        Profile: Default
```

In UDP there is no handshaking process. The client attaches the server's IP address and port number with each packet of data. The server extracts the client IP address and port number. It gets the data, converts it to upper case and sends it to the client.

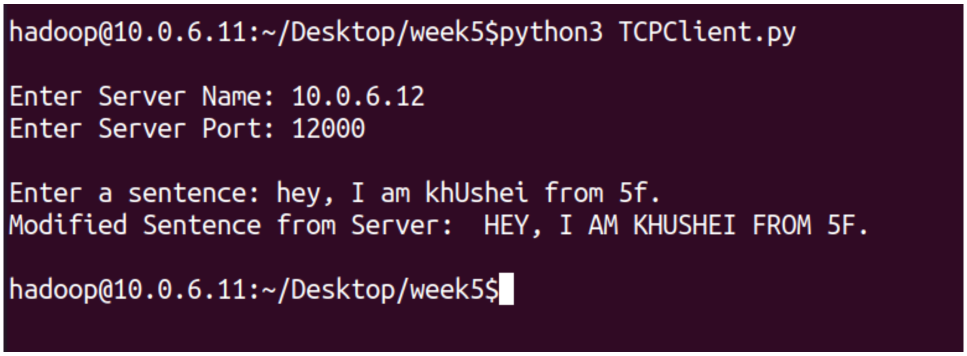
Socket Programming with TCP

Server:



```
khushei@khushei-VirtualBox:~/Desktop/week5$ python3 TCPServer.py

The TCP Server is ready to receive

Connected with address 10.0.6.11
Recieved data from socket connection
Sent data to socket connection

█
```

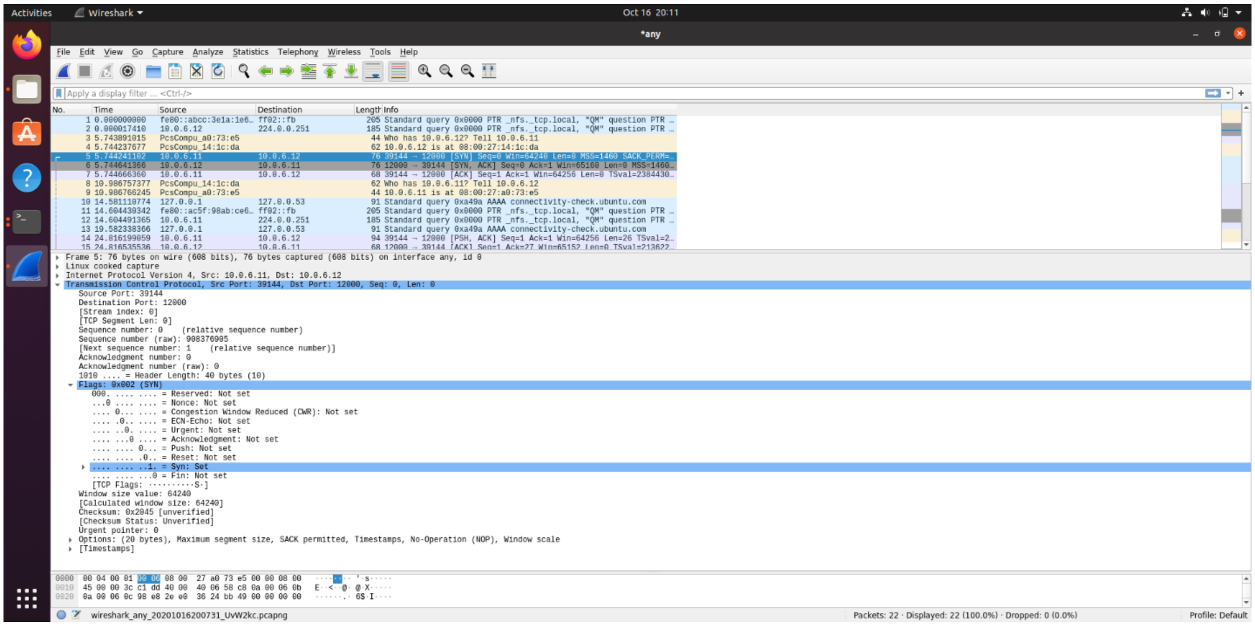
Client:



```
hadoop@10.0.6.11:~/Desktop/week5$python3 TCPClient.py

Enter Server Name: 10.0.6.12
Enter Server Port: 12000

Enter a sentence: hey, I am khUshei from 5f.
Modified Sentence from Server:  HEY, I AM KHUSHEI FROM 5F.

hadoop@10.0.6.11:~/Desktop/week5$
```

Wireshark-

SYN:


Activities
Wireshark
Oct 16 20:11
*any
File Edit View Go Capture Analyze Statistics Telephony Wireless Tools Help
Apply a display filter ... <Ctrl-/>

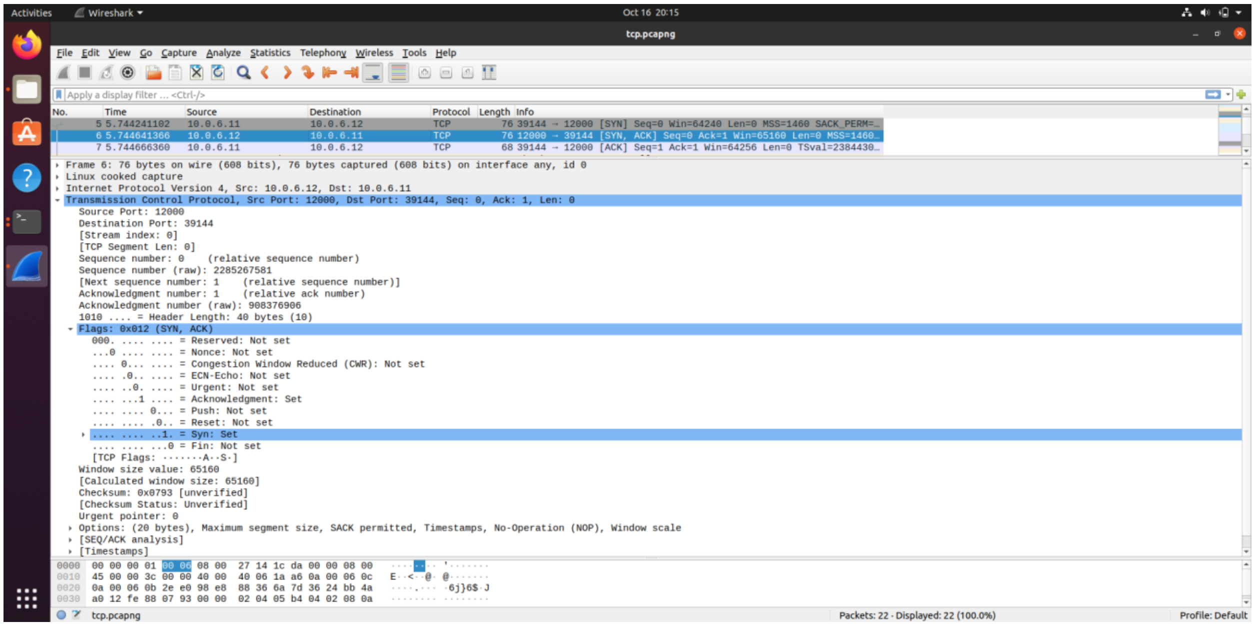
```
No.  Time         Source                Destination   Length Info
  1 0.000000000   fe80::abcc:3e1a:1e6…  ff02::fb       205 Standard query 0x0000 PTR _nfs._tcp.local, "QM" question PTR …
  2 0.000017410   10.0.6.12             224.0.0.251    185 Standard query 0x0000 PTR _nfs._tcp.local, "QM" question PTR …
  3 5.743891015   PcsCompu_a0:73:e5                     44 Who has 10.0.6.12? Tell 10.0.6.11
  4 5.744237677   PcsCompu_14:1c:da                     62 10.0.6.12 is at 08:00:27:14:1c:da
  5 5.744241102   10.0.6.11             10.0.6.12       76 39144 → 12000 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 SACK_PERM=…
  6 5.744641366   10.0.6.12             10.0.6.11       76 12000 → 39144 [SYN, ACK] Seq=0 Ack=1 Win=65160 Len=0 MSS=1460…
  7 5.744666360   10.0.6.11             10.0.6.12       68 39144 → 12000 [ACK] Seq=1 Ack=1 Win=64256 Len=0 TSval=2384430…
  8 10.986757377  PcsCompu_14:1c:da                     62 Who has 10.0.6.11? Tell 10.0.6.12
  9 10.986766245  PcsCompu_a0:73:e5                     44 10.0.6.11 is at 08:00:27:a0:73:e5
 10 14.581110774  127.0.0.1             127.0.0.53      91 Standard query 0xa49a AAAA connectivity-check.ubuntu.com
 11 14.604430342  fe80::ac5f:98ab:ce6…  ff02::fb       205 Standard query 0x0000 PTR _nfs._tcp.local, "QM" question PTR …
 12 14.604491365  10.0.6.11             224.0.0.251    185 Standard query 0x0000 PTR _nfs._tcp.local, "QM" question PTR …
 13 19.582338366  127.0.0.1             127.0.0.53      91 Standard query 0xa49a AAAA connectivity-check.ubuntu.com
 14 24.816199059  10.0.6.11             10.0.6.12       94 39144 → 12000 [PSH, ACK] Seq=1 Ack=1 Win=64256 Len=26 TSval=2…
 15 24.816535536  10.0.6.12             10.0.6.11       68 12000 → 39144 [ACK] Seq=1 Ack=27 Win=65152 Len=0 TSval=213622…
```

```
▸ Frame 5: 76 bytes on wire (608 bits), 76 bytes captured (608 bits) on interface any, id 0
▸ Linux cooked capture
▸ Internet Protocol Version 4, Src: 10.0.6.11, Dst: 10.0.6.12
▾ Transmission Control Protocol, Src Port: 39144, Dst Port: 12000, Seq: 0, Len: 0
    Source Port: 39144
    Destination Port: 12000
    [Stream index: 0]
    [TCP Segment Len: 0]
    Sequence number: 0    (relative sequence number)
    Sequence number (raw): 908376905
    [Next sequence number: 1    (relative sequence number)]
    Acknowledgment number: 0
    Acknowledgment number (raw): 0
    1010 .... = Header Length: 40 bytes (10)
  ▾ Flags: 0x002 (SYN)
      000. .... .... = Reserved: Not set
      ...0 .... .... = Nonce: Not set
      .... 0... .... = Congestion Window Reduced (CWR): Not set
      .... .0.. .... = ECN-Echo: Not set
      .... ..0. .... = Urgent: Not set
      .... ...0 .... = Acknowledgment: Not set
      .... .... 0... = Push: Not set
      .... .... .0.. = Reset: Not set
    ▸ .... .... ..1. = Syn: Set
      .... .... ...0 = Fin: Not set
      [TCP Flags: ··········S·]
    Window size value: 64240
    [Calculated window size: 64240]
    Checksum: 0x2045 [unverified]
    [Checksum Status: Unverified]
    Urgent pointer: 0
  ▸ Options: (20 bytes), Maximum segment size, SACK permitted, Timestamps, No-Operation (NOP), Window scale
  ▸ [Timestamps]
```

```
0000  00 04 00 01 00 06 08 00  27 a0 73 e5 00 00 08 00   ········ '·s·····
0010  45 00 00 3c c1 dd 40 00  40 06 58 c8 0a 00 06 0b   E··<··@· @·X·····
0020  0a 00 06 0c 98 e8 2e e0  36 24 bb 49 00 00 00 00   ·······.· 6$·I····
```

wireshark_any_20201016200731_UvW2kc.pcapng   Packets: 22 · Displayed: 22 (100.0%) · Dropped: 0 (0.0%)   Profile: Default

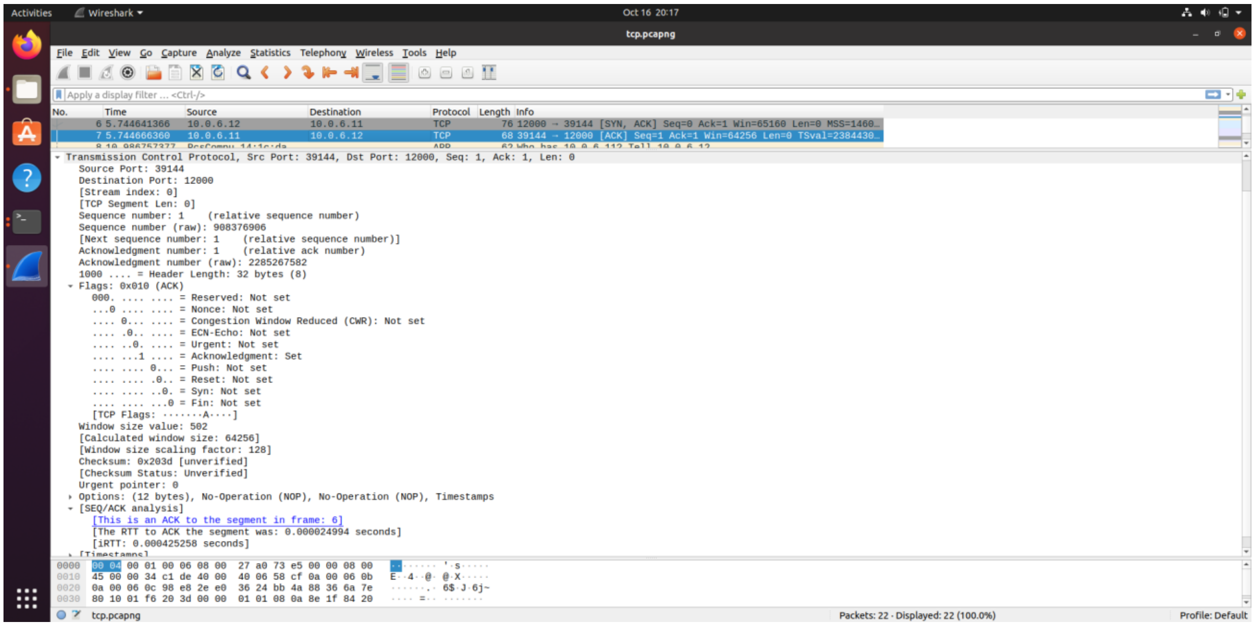
SYN ACK:



```
No.  Time           Source      Destination  Protocol  Length  Info
   5 5.744241102    10.0.6.11   10.0.6.12    TCP           76  39144 → 12000 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 SACK_PERM=…
   6 5.744641366    10.0.6.12   10.0.6.11    TCP           76  12000 → 39144 [SYN, ACK] Seq=0 Ack=1 Win=65160 Len=0 MSS=1460…
   7 5.744666360    10.0.6.11   10.0.6.12    TCP           68  39144 → 12000 [ACK] Seq=1 Ack=1 Win=64256 Len=0 TSval=2384430…

▸ Frame 6: 76 bytes on wire (608 bits), 76 bytes captured (608 bits) on interface any, id 0
▸ Linux cooked capture
▸ Internet Protocol Version 4, Src: 10.0.6.12, Dst: 10.0.6.11
▾ Transmission Control Protocol, Src Port: 12000, Dst Port: 39144, Seq: 0, Ack: 1, Len: 0
    Source Port: 12000
    Destination Port: 39144
    [Stream index: 0]
    [TCP Segment Len: 0]
    Sequence number: 0    (relative sequence number)
    Sequence number (raw): 2285267581
    [Next sequence number: 1    (relative sequence number)]
    Acknowledgment number: 1    (relative ack number)
    Acknowledgment number (raw): 908376906
    1010 .... = Header Length: 40 bytes (10)
  ▾ Flags: 0x012 (SYN, ACK)
      000. .... .... = Reserved: Not set
      ...0 .... .... = Nonce: Not set
      .... 0... .... = Congestion Window Reduced (CWR): Not set
      .... .0.. .... = ECN-Echo: Not set
      .... ..0. .... = Urgent: Not set
      .... ...1 .... = Acknowledgment: Set
      .... .... 0... = Push: Not set
      .... .... .0.. = Reset: Not set
    ▸ .... .... ..1. = Syn: Set
      .... .... ...0 = Fin: Not set
      [TCP Flags: ·······A··S·]
    Window size value: 65160
    [Calculated window size: 65160]
    Checksum: 0x0793 [unverified]
    [Checksum Status: Unverified]
    Urgent pointer: 0
  ▸ Options: (20 bytes), Maximum segment size, SACK permitted, Timestamps, No-Operation (NOP), Window scale
  ▸ [SEQ/ACK analysis]
  ▸ [Timestamps]

0000  00 00 00 01 00 06 08 00  27 14 1c da 00 00 08 00   ········ '·······
0010  45 00 00 3c 00 00 40 00  40 06 1a a6 0a 00 06 0c   E··<··@· @·······
0020  0a 00 06 0b 2e e0 98 e8  88 36 6a 7d 36 24 bb 4a   ····.··· ·6j}6$·J
0030  a0 12 fe 88 07 93 00 00  02 04 05 b4 04 02 08 0a   ········ ········
```

Activities
Wireshark
Oct 16 20:15
tcp.pcapng
File Edit View Go Capture Analyze Statistics Telephony Wireless Tools Help
Apply a display filter … <Ctrl-/>
tcp.pcapng
Packets: 22 · Displayed: 22 (100.0%)
Profile: Default

ACK:



```
No.  Time           Source      Destination  Protocol  Length  Info
   6 5.744641366    10.0.6.12   10.0.6.11    TCP           76  12000 → 39144 [SYN, ACK] Seq=0 Ack=1 Win=65160 Len=0 MSS=1460…
   7 5.744666360    10.0.6.11   10.0.6.12    TCP           68  39144 → 12000 [ACK] Seq=1 Ack=1 Win=64256 Len=0 TSval=2384430…

▾ Transmission Control Protocol, Src Port: 39144, Dst Port: 12000, Seq: 1, Ack: 1, Len: 0
    Source Port: 39144
    Destination Port: 12000
    [Stream index: 0]
    [TCP Segment Len: 0]
    Sequence number: 1    (relative sequence number)
    Sequence number (raw): 908376906
    [Next sequence number: 1    (relative sequence number)]
    Acknowledgment number: 1    (relative ack number)
    Acknowledgment number (raw): 2285267582
    1000 .... = Header Length: 32 bytes (8)
  ▾ Flags: 0x010 (ACK)
      000. .... .... = Reserved: Not set
      ...0 .... .... = Nonce: Not set
      .... 0... .... = Congestion Window Reduced (CWR): Not set
      .... .0.. .... = ECN-Echo: Not set
      .... ..0. .... = Urgent: Not set
      .... ...1 .... = Acknowledgment: Set
      .... .... 0... = Push: Not set
      .... .... .0.. = Reset: Not set
      .... .... ..0. = Syn: Not set
      .... .... ...0 = Fin: Not set
      [TCP Flags: ·······A····]
    Window size value: 502
    [Calculated window size: 64256]
    [Window size scaling factor: 128]
    Checksum: 0x203d [unverified]
    [Checksum Status: Unverified]
    Urgent pointer: 0
  ▸ Options: (12 bytes), No-Operation (NOP), No-Operation (NOP), Timestamps
  ▾ [SEQ/ACK analysis]
      [This is an ACK to the segment in frame: 6]
      [The RTT to ACK the segment was: 0.000024994 seconds]
      [iRTT: 0.000425258 seconds]
  ▸ [Timestamps]

0000  00 04 00 01 00 06 08 00  27 a0 73 e5 00 00 08 00   ········ '·s·····
0010  45 00 00 34 c1 de 40 00  40 06 58 cf 0a 00 06 0b   E··4··@· @·X·····
0020  0a 00 06 0c 98 e8 2e e0  36 24 bb 4a 88 36 6a 7e   ·······.· 6$·J·6j~
0030  80 10 01 f6 20 3d 00 00  01 01 08 0a 8e 1f 84 20   ···· =·· ········
```

Activities
Wireshark
Oct 16 20:17
tcp.pcapng
File Edit View Go Capture Analyze Statistics Telephony Wireless Tools Help
Apply a display filter … <Ctrl-/>
tcp.pcapng
Packets: 22 · Displayed: 22 (100.0%)
Profile: Default

There is a three-way handshaking step to establish the TCP connection between the client and the server for which SYN and ACK packets are sent between the client and server as seen above.

Questions/Answers:

1. Suppose you run TCPClient before you run TCPServer. What happens? Why?

We get a ConnectionRefused error at the client side. This is because the server process is not running at this point of time and so when the client tries to establish connection with the server, it fails in doing so.

2. Suppose you run UDPClient before you run UDPServer. What happens? Why?

If we run the client program before the server, we do not get any error. We can enter a sentence as well, and the terminal keeps waiting for input without any errors.

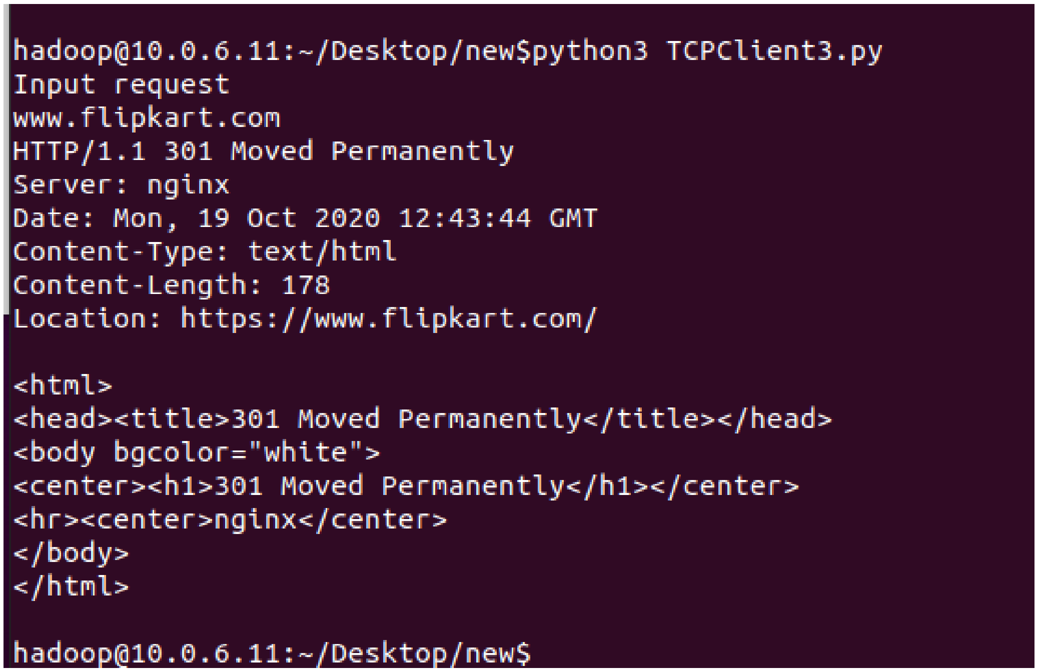
3. What happens if you use different port numbers for the client and server sides?
The client tries to establish a connection with a non-existing or wrong process. This will result in an error.

Task 3: Multi-Threaded Web Proxy

For this task, I used only one vm and two terminals- one as client and other as server. I changed the vm's IP address back to the original 10.0.2.4.

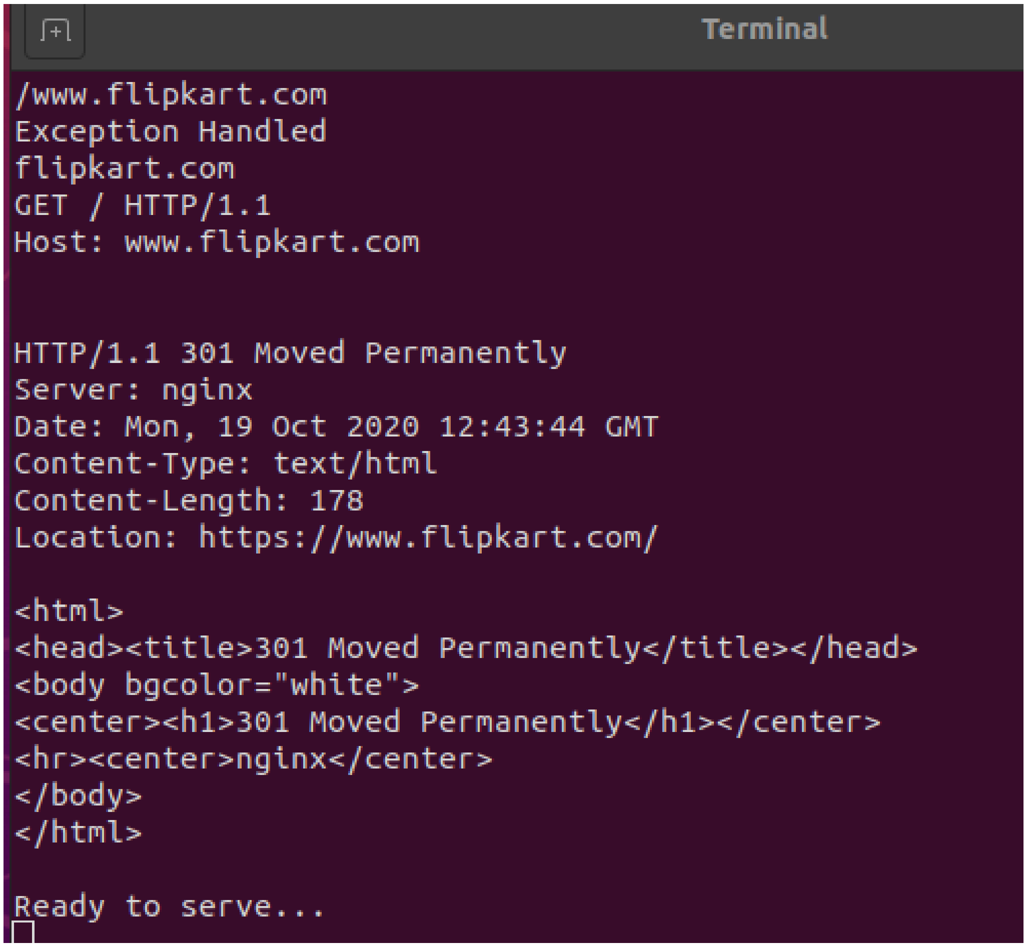
When www.flipkart.com was requested the first time,

Client terminal-



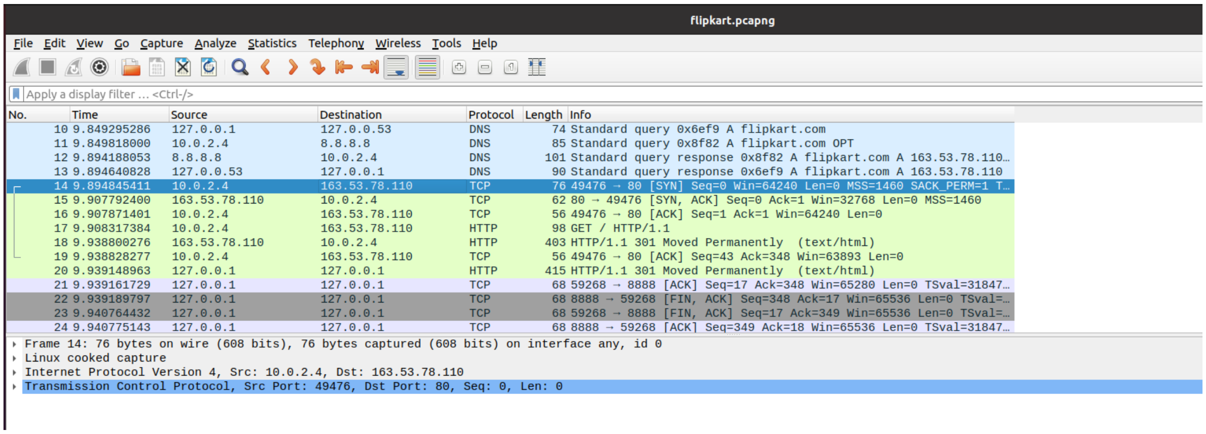
```
hadoop@10.0.6.11:~/Desktop/new$python3 TCPClient3.py
Input request
www.flipkart.com
HTTP/1.1 301 Moved Permanently
Server: nginx
Date: Mon, 19 Oct 2020 12:43:44 GMT
Content-Type: text/html
Content-Length: 178
Location: https://www.flipkart.com/

<html>
<head><title>301 Moved Permanently</title></head>
<body bgcolor="white">
<center><h1>301 Moved Permanently</h1></center>
<hr><center>nginx</center>
</body>
</html>

hadoop@10.0.6.11:~/Desktop/new$
```

Server terminal-



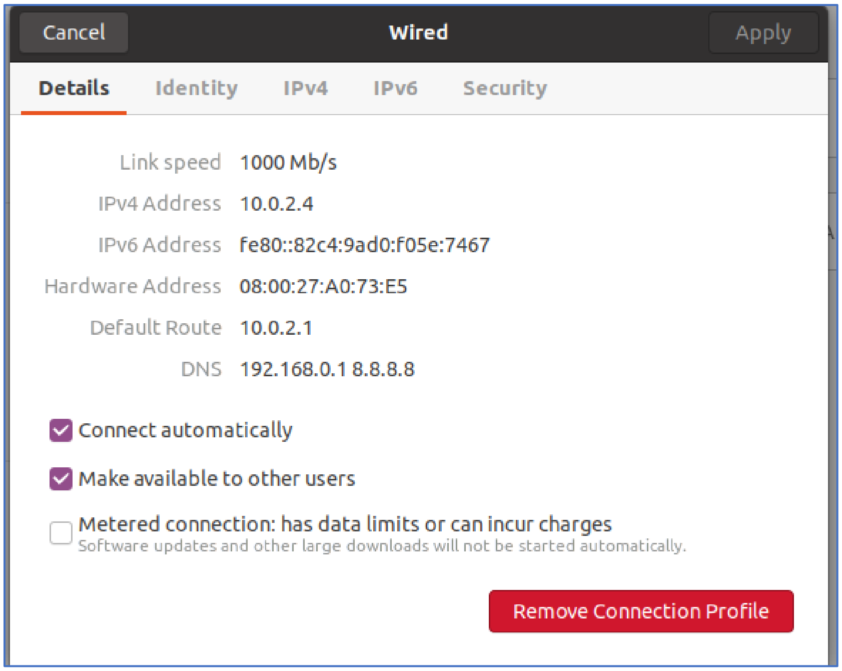
```
/www.flipkart.com
Exception Handled
flipkart.com
GET / HTTP/1.1
Host: www.flipkart.com


HTTP/1.1 301 Moved Permanently
Server: nginx
Date: Mon, 19 Oct 2020 12:43:44 GMT
Content-Type: text/html
Content-Length: 178
Location: https://www.flipkart.com/

<html>
<head><title>301 Moved Permanently</title></head>
<body bgcolor="white">
<center><h1>301 Moved Permanently</h1></center>
<hr><center>nginx</center>
</body>
</html>

Ready to serve...
```

Wireshark-


flipkart.pcapng
File Edit View Go Capture Analyze Statistics Telephony Wireless Tools Help
Apply a display filter … <Ctrl-/>

No.	Time	Source	Destination	Protocol	Length	Info
10	9.849295286	127.0.0.1	127.0.0.53	DNS	74	Standard query 0x6ef9 A flipkart.com
11	9.849818000	10.0.2.4	8.8.8.8	DNS	85	Standard query 0x8f82 A flipkart.com OPT
12	9.894188053	8.8.8.8	10.0.2.4	DNS	101	Standard query response 0x8f82 A flipkart.com A 163.53.78.110…
13	9.894640828	127.0.0.53	127.0.0.1	DNS	90	Standard query response 0x6ef9 A flipkart.com A 163.53.78.110
14	9.894845411	10.0.2.4	163.53.78.110	TCP	76	49476 → 80 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 SACK_PERM=1 T…
15	9.907792400	163.53.78.110	10.0.2.4	TCP	62	80 → 49476 [SYN, ACK] Seq=0 Ack=1 Win=32768 Len=0 MSS=1460
16	9.907871401	10.0.2.4	163.53.78.110	TCP	56	49476 → 80 [ACK] Seq=1 Ack=1 Win=64240 Len=0
17	9.908317384	10.0.2.4	163.53.78.110	HTTP	98	GET / HTTP/1.1
18	9.938800276	163.53.78.110	10.0.2.4	HTTP	403	HTTP/1.1 301 Moved Permanently (text/html)
19	9.938828277	10.0.2.4	163.53.78.110	TCP	56	49476 → 80 [ACK] Seq=43 Ack=348 Win=63893 Len=0
20	9.939148963	127.0.0.1	127.0.0.1	HTTP	415	HTTP/1.1 301 Moved Permanently (text/html)
21	9.939161729	127.0.0.1	127.0.0.1	TCP	68	59268 → 8888 [ACK] Seq=17 Ack=348 Win=65280 Len=0 TSval=31847…
22	9.939189797	127.0.0.1	127.0.0.1	TCP	68	8888 → 59268 [FIN, ACK] Seq=348 Ack=17 Win=65536 Len=0 TSval=…
23	9.940764432	127.0.0.1	127.0.0.1	TCP	68	59268 → 8888 [FIN, ACK] Seq=17 Ack=349 Win=65536 Len=0 TSval=…
24	9.940775143	127.0.0.1	127.0.0.1	TCP	68	8888 → 59268 [ACK] Seq=349 Ack=18 Win=65536 Len=0 TSval=31847…

```
▸ Frame 14: 76 bytes on wire (608 bits), 76 bytes captured (608 bits) on interface any, id 0
▸ Linux cooked capture
▸ Internet Protocol Version 4, Src: 10.0.2.4, Dst: 163.53.78.110
▸ Transmission Control Protocol, Src Port: 49476, Dst Port: 80, Seq: 0, Len: 0
```



Link speed 1000 Mb/s

IPv4 Address 10.0.2.4

IPv6 Address fe80::82c4:9ad0:f05e:7467

Hardware Address 08:00:27:A0:73:E5

Default Route 10.0.2.1

DNS 192.168.0.1 8.8.8.8

☑ Connect automatically

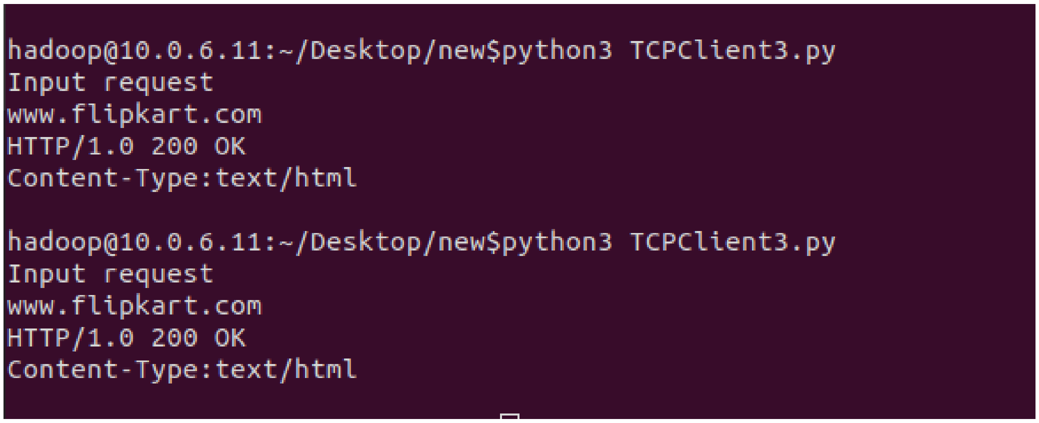
☑ Make available to other users

□ Metered connection: has data limits or can incur charges
Software updates and other large downloads will not be started automatically.

DNS request from 127.0.0.1 to 127.0.0.53. Notice the response come from 8.8.8.8 which is present as local DNS in the network settings as shown above. The same vm- 10.0.2.4 establishes a TCP connection with 163.53.78.110 (www.flipkart.com). The request and response message interactions are between the same two IPs.

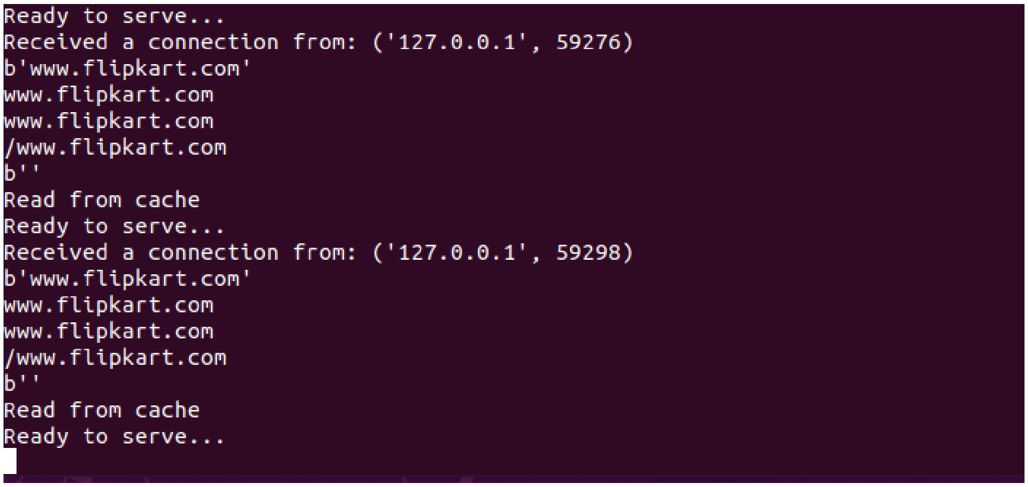
When we requested for www.flipkart.com again from the client terminal, it was read from cache as can be seen in the server terminal's screenshot.

Client-

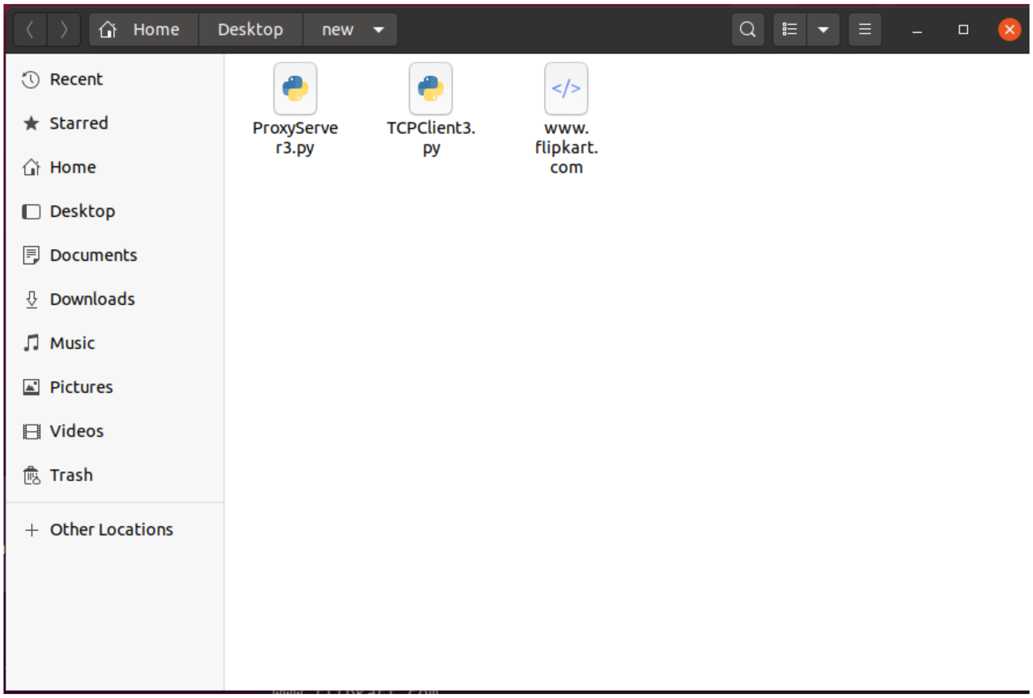


```
hadoop@10.0.6.11:~/Desktop/new$python3 TCPClient3.py
Input request
www.flipkart.com
HTTP/1.0 200 OK
Content-Type:text/html

hadoop@10.0.6.11:~/Desktop/new$python3 TCPClient3.py
Input request
www.flipkart.com
HTTP/1.0 200 OK
Content-Type:text/html
```

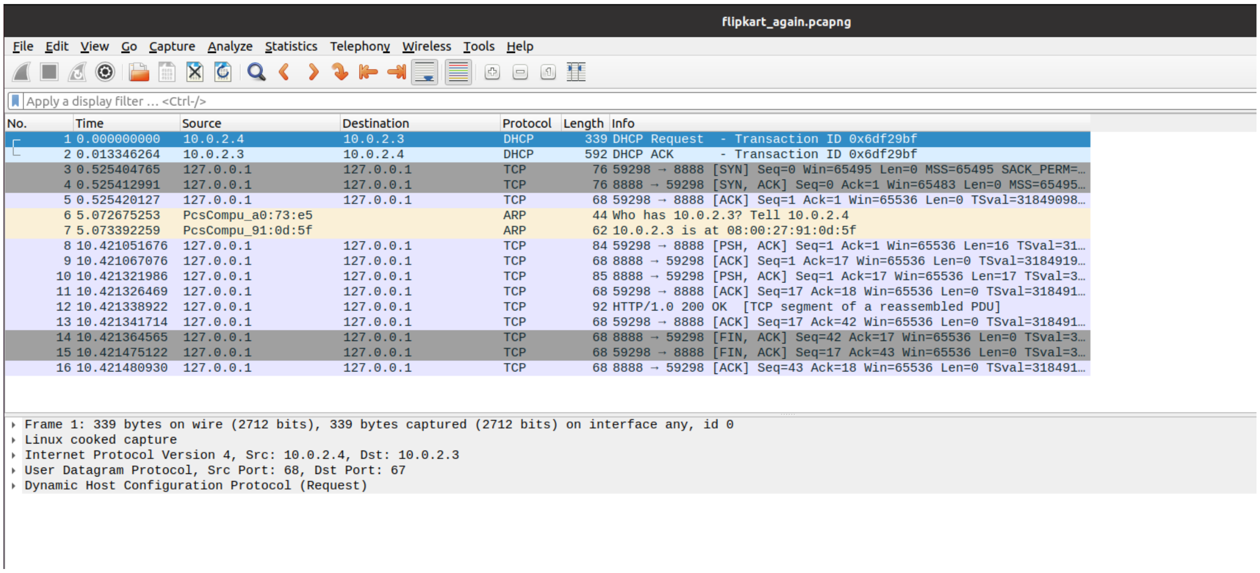
Server-



```
Ready to serve...
Received a connection from: ('127.0.0.1', 59276)
b'www.flipkart.com'
www.flipkart.com
www.flipkart.com
/www.flipkart.com
b''
Read from cache
Ready to serve...
Received a connection from: ('127.0.0.1', 59298)
b'www.flipkart.com'
www.flipkart.com
www.flipkart.com
/www.flipkart.com
b''
Read from cache
Ready to serve...
```



Wireshark-


flipkart_again.pcapng
File Edit View Go Capture Analyze Statistics Telephony Wireless Tools Help
Apply a display filter … <Ctrl-/>

```
No.        Time         Source             Destination        Protocol Length Info
         1 0.000000000  10.0.2.4           10.0.2.3           DHCP      339 DHCP Request  - Transaction ID 0x6df29bf
         2 0.013346264  10.0.2.3           10.0.2.4           DHCP      592 DHCP ACK      - Transaction ID 0x6df29bf
         3 0.525404765  127.0.0.1          127.0.0.1          TCP        76 59298 → 8888 [SYN] Seq=0 Win=65495 Len=0 MSS=65495 SACK_PERM=…
         4 0.525412991  127.0.0.1          127.0.0.1          TCP        76 8888 → 59298 [SYN, ACK] Seq=0 Ack=1 Win=65483 Len=0 MSS=65495…
         5 0.525420127  127.0.0.1          127.0.0.1          TCP        68 59298 → 8888 [ACK] Seq=1 Ack=1 Win=65536 Len=0 TSval=31849098…
         6 5.072675253  PcsCompu_a0:73:e5                     ARP        44 Who has 10.0.2.3? Tell 10.0.2.4
         7 5.073392259  PcsCompu_91:0d:5f                     ARP        62 10.0.2.3 is at 08:00:27:91:0d:5f
         8 10.421051676 127.0.0.1          127.0.0.1          TCP        84 59298 → 8888 [PSH, ACK] Seq=1 Ack=1 Win=65536 Len=16 TSval=31…
         9 10.421067076 127.0.0.1          127.0.0.1          TCP        68 8888 → 59298 [ACK] Seq=1 Ack=17 Win=65536 Len=0 TSval=3184919…
        10 10.421321986 127.0.0.1          127.0.0.1          TCP        85 8888 → 59298 [PSH, ACK] Seq=1 Ack=17 Win=65536 Len=17 TSval=3…
        11 10.421326469 127.0.0.1          127.0.0.1          TCP        68 59298 → 8888 [ACK] Seq=17 Ack=18 Win=65536 Len=0 TSval=318491…
        12 10.421338922 127.0.0.1          127.0.0.1          TCP        92 HTTP/1.0 200 OK  [TCP segment of a reassembled PDU]
        13 10.421341714 127.0.0.1          127.0.0.1          TCP        68 59298 → 8888 [ACK] Seq=17 Ack=42 Win=65536 Len=0 TSval=318491…
        14 10.421364565 127.0.0.1          127.0.0.1          TCP        68 8888 → 59298 [FIN, ACK] Seq=42 Ack=17 Win=65536 Len=0 TSval=3…
        15 10.421475122 127.0.0.1          127.0.0.1          TCP        68 59298 → 8888 [FIN, ACK] Seq=17 Ack=43 Win=65536 Len=0 TSval=3…
        16 10.421480930 127.0.0.1          127.0.0.1          TCP        68 8888 → 59298 [ACK] Seq=43 Ack=18 Win=65536 Len=0 TSval=318491…
```

```
› Frame 1: 339 bytes on wire (2712 bits), 339 bytes captured (2712 bits) on interface any, id 0
› Linux cooked capture
› Internet Protocol Version 4, Src: 10.0.2.4, Dst: 10.0.2.3
› User Datagram Protocol, Src Port: 68, Dst Port: 67
› Dynamic Host Configuration Protocol (Request)
```

Notice that because of the caching step, the request doesn’t go to 163.53.78.110 (www.flipkart.com).