

Coll: Number of packet collisions detected.

2. Use 'netstat -nr' or 'netstat -r' to find the local routing (forwarding) table. Examine the output and explain the following categories from the output: Destination, Gateway, GenMask, Flags and the meanings of various flags which are set, MSS, Window and 'irrtt'.

```
cemkilinc@Cems-MacBook-Pro ~ % netstat -nr
Routing tables

Internet:
Destination      Gateway           Flags             Netif Expire
default          192.168.1.1      UGScg             en0
127              127.0.0.1        UCS               lo0
127.0.0.1        127.0.0.1        UH                lo0
169.254          link#6           UCS               en0
192.168.1        link#6           UCS               en0
192.168.1.1/32   link#6           UCS               en0
192.168.1.1      5c:63:bf:ac:46:f4 UHLWIir           en0 1189
192.168.1.107/32 link#6           UCS               en0
192.168.1.108    50:bc:96:d6:65:85 UHLWii            en0 1196
192.168.1.110    8e:26:54:aa:65:19 UHLWii            en0 1011
224.0.0.4        link#6           UCS               en0
224.0.0.251      1:0:5e:0:0:fb    UHmLWI            en0
239.255.255.250 1:0:5e:7f:ff:fa  UHmLWI            en0
255.255.255.255/32 link#6           UCS               en0

Internet6:
Destination      Gateway           Flags             Net
if Expire
default          fe80::%utun0      UGcIg             utu
n0
default          fe80::%utun1      UGcIg             utu
n1
default          fe80::%utun2      UGcIg             utu
n2
default          fe80::%utun3      UGcIg             utu
n3
::1              ::1              UHL               1
o0
fe80::%lo0/64    fe80::%lo0        UCI               1
o0
fe80::%lo0        link#1            UHLI              1
o0
fe80::%en3/64    link#4            UCI               e
n3
fe80::aede:48ff:fe00:1122%en3 ac:de:48:0:11:22  UHLI              1
o0
fe80::aede:48ff:fe33:4455%en3 ac:de:48:33:44:55 UHLWii            e
n3
fe80::%en0/64    link#6            UCI               e
n0
fe80::cc7:dae4:f512:1658%en0 a4:83:e7:23:c:c1  UHLI              1
o0
fe80::%awd10/64   link#11           UCI               awd
l0
fe80::9c10:3bff:fe6c:a1e4%awd10 9e:10:3b:6c:a1:e4 UHLI              1
o0
fe80::%llw0/64    link#12           UCI               ll
w0
fe80::9c10:3bff:fe6c:a1e4%llw0 9e:10:3b:6c:a1:e4 UHLI              1
o0
fe80::%utun0/64   fe80::5d39:6f98:5d6f:270e%utun0 UCI               utu
n0
fe80::5d39:6f98:5d6f:270e%utun0 link#13           UHLI              1
```

Although I did not receive all of the categories, I also included their explanation below.

Destination: It represents the destination network.

Gateway: The address of the outgoing interface.

GenMask: It shows the generality of the route.

Flags: The flags are used to describe the route each U, G, H... describe a situation such as

- G: The route is to a gateway
- U: The interface to be used is up.
- H: Only the single host can be reached through the route
- M: This route is modified.
- L: The link-level address is present
- C: Access to this route creates a cloned route

MSS: Maximum segment size which is the size of the largest datagram will be constructed for transmission via this route.

Window: is the maximum amount of data the system will accept in a single burst

from a remote host.

Irrt: initial round trip time that is determined by looking at the TCP Three Way Handshake.

(Source : <https://tldp.org/LDP/nag2/x-087-2-iface.netstat.html>)

3. Open your assigned URL in the web browser. Find out the corresponding TCP socket using the netstat command with the appropriate command line options/arguments.

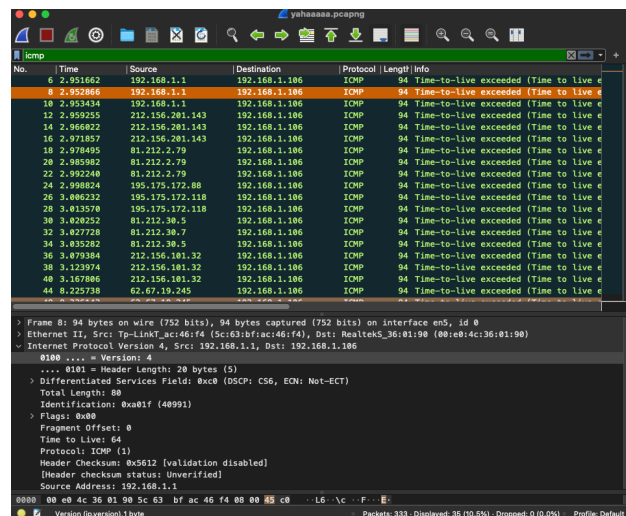
```
cemkilinc@Cems-MacBook-Pro ~ % netstat -a
-- netstat -a
Last login: Sun May 23 21:18:43 on ttys000
cemkilinc@Cems-MacBook-Pro ~ % nslookup www.ucla.edu
Server:      192.168.1.1
Address:      192.168.1.1#53

Non-authoritative answer:
www.ucla.edu canonical name = gateway.lb.it.ucla.edu.
Name:        gateway.lb.it.ucla.edu.
Address:      164.67.228.152

cemkilinc@Cems-MacBook-Pro ~ % netstat -a
Active Internet connections (including servers)
Proto Recv-Q Send-Q Local Address           Foreign Address         (state)
tcp4   0      0  192.168.1.107.54097    ocypete.stmos.uc.https ESTABLISHED
tcp4   0      0  192.168.1.107.54096    gateway.lb.it.uc.https ESTABLISHED
tcp4   0      0  192.168.1.107.54095    gateway.lb.it.uc.https ESTABLISHED
tcp4   0      0  192.168.1.107.54094    gateway.lb.it.uc.https ESTABLISHED
tcp4   0      0  192.168.1.107.54093    ec2-18-156-205-8.https ESTABLISHED
tcp4   0      0  192.168.1.107.54090    whatsapp-cdn-shv.https ESTABLISHED
tcp4   0      0  192.168.1.107.54089    sof02s44-in-f14.https ESTABLISHED
tcp4   0      0  192.168.1.107.54088    sof02s44-in-f14.https ESTABLISHED
tcp4   24      0  192.168.1.107.54082    a28-b6-07-vip.re.https CLOSE_WAIT
tcp4   0      0  192.168.1.107.54045    25.224.186.35.bc-https ESTABLISHED
tcp4   0      0  192.168.1.107.53958    192.168.1.102.49425    ESTABLISHED
```

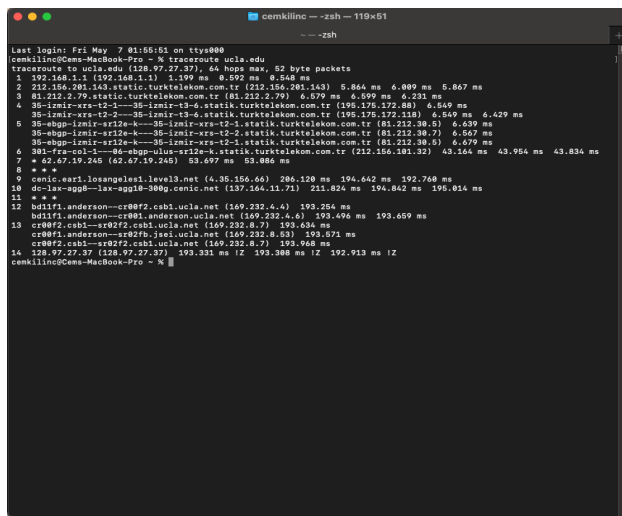
I used nslookup command to learn the name of my URL, then by using netstat -a command and saw 192.168.1.107.54094 socket is assigned to this.

4. What is TTL and its significance? Under which layer header can you find the value of TTL?



No.	Time	Source	Destination	Protocol	Length	Info
6	2.951662	192.168.1.1	192.168.1.106	ICMP	94	Time-to-live exceeded (Time to live e
8	2.952866	192.168.1.1	192.168.1.106	ICMP	94	Time-to-live exceeded (Time to live e
10	2.953434	192.168.1.1	192.168.1.106	ICMP	94	Time-to-live exceeded (Time to live e
12	2.959255	212.156.201.143	192.168.1.106	ICMP	94	Time-to-live exceeded (Time to live e
14	2.966822	212.156.201.143	192.168.1.106	ICMP	94	Time-to-live exceeded (Time to live e
16	2.971857	212.156.201.143	192.168.1.106	ICMP	94	Time-to-live exceeded (Time to live e
18	2.978495	81.212.2.79	192.168.1.106	ICMP	94	Time-to-live exceeded (Time to live e
20	2.985982	81.212.2.79	192.168.1.106	ICMP	94	Time-to-live exceeded (Time to live e
22	2.992248	81.212.2.79	192.168.1.106	ICMP	94	Time-to-live exceeded (Time to live e
24	2.998824	195.175.172.88	192.168.1.106	ICMP	94	Time-to-live exceeded (Time to live e
26	3.006232	195.175.172.118	192.168.1.106	ICMP	94	Time-to-live exceeded (Time to live e
28	3.013578	195.175.172.118	192.168.1.106	ICMP	94	Time-to-live exceeded (Time to live e
30	3.028252	81.212.38.5	192.168.1.106	ICMP	94	Time-to-live exceeded (Time to live e
32	3.027728	81.212.38.7	192.168.1.106	ICMP	94	Time-to-live exceeded (Time to live e
34	3.035282	81.212.38.5	192.168.1.106	ICMP	94	Time-to-live exceeded (Time to live e
36	3.079384	212.156.101.32	192.168.1.106	ICMP	94	Time-to-live exceeded (Time to live e
38	3.123974	212.156.101.32	192.168.1.106	ICMP	94	Time-to-live exceeded (Time to live e
40	3.167886	212.156.101.32	192.168.1.106	ICMP	94	Time-to-live exceeded (Time to live e
42	8.225738	62.67.19.245	192.168.1.106	ICMP	94	Time-to-live exceeded (Time to live e
44	8.225738	62.67.19.245	192.168.1.106	ICMP	94	Time-to-live exceeded (Time to live e

Frame 8: 94 bytes on wire (752 bits), 94 bytes captured (752 bits) on interface en0, id 0
Ethernet II, Src: Tp-LinkT_ac:46:f4 (Sc:63:b1:ac:46:f4), Dst: Realtek5_36:01:90 (08:00:4c:36:01:90)
Internet Protocol Version 4, Src: 192.168.1.1, Dst: 192.168.1.106
ICMP Echo (ping) Request, ID: 0, Seq: 0
... 0101 = Header Length: 20 bytes (5)
> Differentiated Services Field: 0x00 (DSCP: CS0, ECN: Not-ECT)
Total Length: 88
Identification: 0xab1f (40991)
> Flags: 0x00
Fragment Offset: 0
Time to Live: 64
Protocol: ICMP (1)
Header Checksum: 0x5612 (validation disabled)
[Header checksum status: Unverified]
Source Address: 192.168.1.1
0800 00 00 4c 36 01 90 5c 63 bf ac 46 f4 00 00 00 00 ...L6 .\c .F...E..



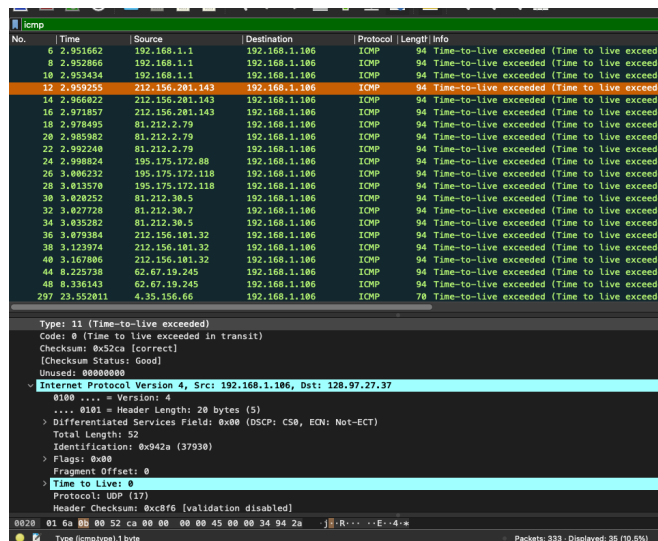
```
cmkillinc@Cens-MacBook-Pro ~ % tracert ucla.edu
Tracert to ucla.edu [128.97.27.37], 94 hops max, 62 byte packets
 0 192.168.1.1 [192.168.1.1] 1.109 ms 0.892 ms 0.548 ms
 1 212.156.201.143 [212.156.201.143] 5.804 ms 6.089 ms 5.867 ms
 2 81.212.2.79 [81.212.2.79] 6.579 ms 6.459 ms 6.231 ms
 3 35-izmir-xrs-t2-1 [35-izmir-t3-6.statistik.turktelekom.com.tr] 196.176.172.88 6.549 ms
 4 35-izmir-xrs-t2-1 [35-izmir-t3-6.statistik.turktelekom.com.tr] 195.175.172.118 6.549 ms 6.429 ms
 5 35-abgp-izmir-r12a-k [35-izmir-xrs-t2-1.statistik.turktelekom.com.tr] 81.212.38.5 6.639 ms
 6 35-abgp-izmir-r12a-k [35-izmir-xrs-t2-1.statistik.turktelekom.com.tr] 81.212.38.7 6.567 ms
 7 35-abgp-izmir-r12a-k [35-izmir-xrs-t2-1.statistik.turktelekom.com.tr] 81.212.38.5 6.679 ms
 8 35-izmir-xrs-t2-1 [35-izmir-xrs-t2-1.statistik.turktelekom.com.tr] 212.156.101.32 43.164 ms 43.954 ms 43.834 ms
 9 * * *
10 62.67.19.245 [62.67.19.245] 93.697 ms 93.884 ms
11 * * *
12 62.67.19.245 [62.67.19.245] 93.697 ms 93.884 ms
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81 62.67.19.245 [62.67.19.245] 93.697 ms 93.884 ms
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89 62.67.19.245 [62.67.19.245] 93.697 ms 93.884 ms
90 62.67.19.245 [62.67.19.245] 93.697 ms 93.884 ms
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93 62.67.19.245 [62.67.19.245] 93.697 ms 93.884 ms
94 62.67.19.245 [62.67.19.245] 93.697 ms 93.884 ms
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TTL (Time to live) represents the maximum number of hops that a packet can exist before being discarded. It limits the lifespan of data. One can find the TTL value under the internet protocol version 4 header.

5. Why is it that an ICMP packet does not have source and destination port numbers?

ICMP packets does not have source and destination port numbers because they are not designed to communicate network-layer data between application layers of two hosts but rather they are designed to transfer data between hosts and routers. Thus, no port numbers are required.

6. Find the minimum TTL below which the traceroute messages do not reach your particular URL destination.



No.	Time	Source	Destination	Protocol	Length	Info
6	2.951662	192.168.1.1	192.168.1.106	ICMP	94	Time-to-live exceeded (Time to live exceede
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42	8.225738	62.67.19.245	192.168.1.106	ICMP	94	Time-to-live exceeded (Time to live exceede
44	8.225738	62.67.19.245	192.168.1.106	ICMP	94	Time-to-live exceeded (Time to live exceede
46	8.225738	62.67.19.245	192.168.1.106	ICMP	94	Time-to-live exceeded (Time to live exceede
48	8.225738	62.67.19.245	192.168.1.106	ICMP	94	Time-to-live exceeded (Time to live exceede
50	8.225738	62.67.19.245	192.168.1.106	ICMP	94	Time-to-live exceeded (Time to live exceede
52	8.225738	62.67.19.245	192.168.1.106	ICMP	94	Time-to-live exceeded (Time to live exceede
54	8.225738	62.67.19.245	192.168.1.106	ICMP	94	Time-to-live exceeded (Time to live exceede
56	8.225738	62.67.19.245	192.168.1.106	ICMP	94	Time-to-live exceeded (Time to live exceede
58	8.225738	62.67.19.245	192.168.1.106	ICMP	94	Time-to-live exceeded (Time to live exceede
60	8.225738	62.67.19.245	192.168.1.106	ICMP	94	Time-to-live exceeded (Time to live exceede
62	8.225738	62.67.19.245	192.168.1.106	ICMP	94	Time-to-live exceeded (Time to live exceede
64	8.225738	62.67.19.245	192.168.1.106	ICMP	94	Time-to-live exceeded (Time to live exceede
66	8.225738	62.67.19.245	192.168.1.106	ICMP	94	Time-to-live exceeded (Time to live exceede
68	8.225738	62.67.19.245	192.168.1.106	ICMP	94	Time-to-live exceeded (Time to live exceede
70	8.225738	62.67.19.245	192.168.1.106	ICMP	94	Time-to-live exceeded (Time to live exceede
72	8.225738	62.67.19.245	192.168.1.106	ICMP	94	Time-to-live exceeded (Time to live exceede
74	8.225738	62.67.19.245	192.168.1.106	ICMP	94	Time-to-live exceeded (Time to live exceede
76	8.225738	62.67.19.245	192.168.1.106	ICMP	94	Time-to-live exceeded (Time to live exceede
78	8.225738	62.67.19.245	192.168.1.106	ICMP	94	Time-to-live exceeded (Time to live exceede
80	8.225738	62.67.19.245	192.168.1.106	ICMP	94	Time-to-live exceeded (Time to live exceede
82	8.225738	62.67.19.245	192.168.1.106	ICMP	94	Time-to-live exceeded (Time to live exceede
84	8.225738	62.67.19.245	192.168.1.106	ICMP	94	Time-to-live exceeded (Time to live exceede
86	8.225738	62.67.19.245	192.168.1.106	ICMP	94	Time-to-live exceeded (Time to live exceede
88	8.225738	62.67.19.245	192.168.1.106	ICMP	94	Time-to-live exceeded (Time to live exceede
90	8.225738	62.67.19.245	192.168.1.106	ICMP	94	Time-to-live exceeded (Time to live exceede
92	8.225738	62.67.19.245	192.168.1.106	ICMP	94	Time-to-live exceeded (Time to live exceede
94	8.225738	62.67.19.245	192.168.1.106	ICMP	94	Time-to-live exceeded (Time to live exceede
96	8.225738	62.67.19.245	192.168.1.106	ICMP	94	Time-to-live exceeded (Time to live exceede
98	8.225738	62.67.19.245	192.168.1.106	ICMP	94	Time-to-live exceeded (Time to live exceede
100	8.225738	62.67.19.245	192.168.1.106	ICMP	94	Time-to-live exceeded (Time to live exceede

Frame 12: 94 bytes on wire (752 bits), 94 bytes captured (752 bits) on interface en0, id 0
Ethernet II, Src: Tp-LinkT_ac:46:f4 (Sc:63:b1:ac:46:f4), Dst: Realtek5_36:01:90 (08:00:4c:36:01:90)
Internet Protocol Version 4, Src: 192.168.1.1, Dst: 192.168.1.106
ICMP Echo (ping) Request, ID: 0, Seq: 0
... 0101 = Header Length: 20 bytes (5)
> Differentiated Services Field: 0x00 (DSCP: CS0, ECN: Not-ECT)
Total Length: 52
Identification: 0x942a (37930)
> Flags: 0x00
Fragment Offset: 0
Time to Live: 0
Protocol: UDP (17)
Header Checksum: 0xc8f6 (validation disabled)
0800 01 6a 00 00 52 ca 00 00 00 00 45 00 00 34 94 2a ...R...E...a

In the packet with number 12 which is an ICMP type message, TTL value is 0 which is the minimum.

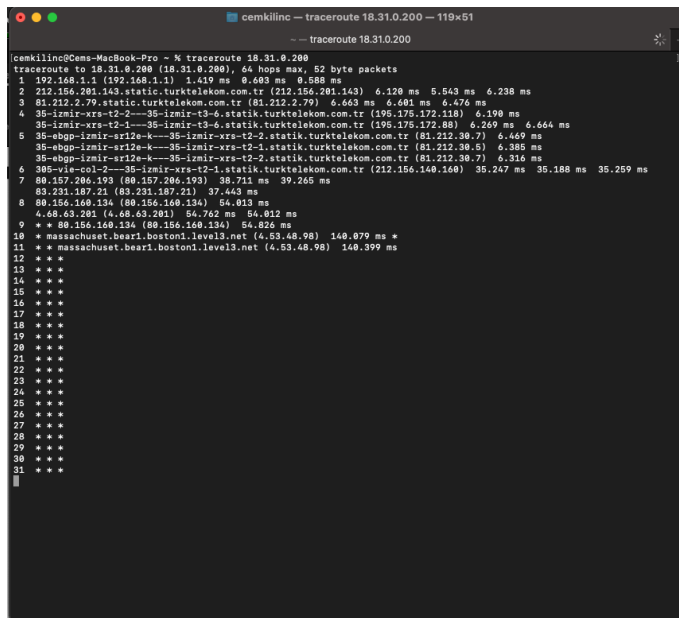
7. How does your computer (the source) learn the IP address of a router along the path from a TTL exceeded packet?

The source makes echo message request to the destination whose path is probed. Thanks to the TTL exceeded messages which are sent from routers to the source as a response, source can learn the IP address of a router by checking ipv4 header.

8. How many times is each router along the path probed by traceroute?

Traceroute generally probes each router 3 times in case of packet loss.

9. Find the route to the IP Address: 18.31.0.200. What is different about the results for this address?



```
cemkilinc ~ -- traceroute 18.31.0.200 -- 119x51
-- traceroute 18.31.0.200
cemkilinc@Cems-MacBook-Pro ~ % traceroute 18.31.0.200
traceroute to 18.31.0.200 (18.31.0.200), 64 hops max, 52 byte packets
 1 192.168.1.1 (192.168.1.1) 1.419 ms 0.683 ms 0.508 ms
 2 212.156.201.143.static.turktelekom.com.tr (212.156.201.143) 6.128 ms 5.543 ms 6.238 ms
 3 81.212.2.79.static.turktelekom.com.tr (81.212.2.79) 6.663 ms 6.601 ms 6.476 ms
 4 35-izmir-xrs-t2-2---35-izmir-t3-6.static.turktelekom.com.tr (190.176.172.110) 6.100 ms
 5 35-izmir-xrs-t2-1---35-izmir-t3-6.static.turktelekom.com.tr (190.176.172.108) 6.249 ms 6.644 ms
 6 35-ebgp-izmir-sr12e-k---35-izmir-xrs-t2-2.static.turktelekom.com.tr (81.212.30.7) 6.469 ms
 7 35-ebgp-izmir-sr12e-k---35-izmir-xrs-t2-1.static.turktelekom.com.tr (81.212.30.6) 6.385 ms
 8 35-ebgp-izmir-sr12e-k---35-izmir-xrs-t2-2.static.turktelekom.com.tr (81.212.30.7) 6.316 ms
 9 305-vie-col-2---35-izmir-xrs-t2-1.static.turktelekom.com.tr (212.156.140.140) 35.247 ms 35.188 ms 35.259 ms
10 80.157.206.193 (80.157.206.193) 36.711 ms 39.265 ms
11 83.231.187.21 (83.231.187.21) 37.443 ms
12 80.156.160.134 (80.156.160.134) 54.013 ms
13 4.68.63.281 (4.68.63.281) 54.762 ms 54.012 ms
14 * * *
15 * * *
16 * * *
17 * * *
18 * * *
19 * * *
20 * * *
21 * * *
22 * * *
23 * * *
24 * * *
25 * * *
26 * * *
27 * * *
28 * * *
29 * * *
30 * * *
31 * * *
```

As can be seen from the image it does not return anything, it is called black hole in the networking terminology.

10. What is a Routing Blackhole? Provide a scenario where Routing Blackholes may be used beneficially.

Routing Blackhole term is used when incoming or outgoing network is being eliminated without sending a response message to the sender, thus sender does not receive ICMP error (I execute wireshark and saw no ICMP messages when it entered the blackhole). Blackholes can be used to mitigate DDos attacks. When an attack is detected, all attack traffic can be discarded by routing Blackholes.

11. Use 'mtr *yourURL*' to find continuous statistics of the traceroute. Run the mtr command with three different of 4 fields each (you can find the information from 'man' pages) and explain the output.

For these two question my laptop does not even execute mtr command with my URL even if I brew reinstall.

12. Record the packets using 'mtr yourURL' through Wireshark. What is the difference between the Wireshark capture of traceroute and 'mtr'?

Traceroute is an util which prints the route packages go through their destination in a connection. With mtr we can also trace the route for destination but also we can use it to see where exactly the packet loss happen in realtime, also it shows the loss percentage on hosts. Due to MTR using ICMP ECHO requests, it can work where traceroute command is not working. (Source: <https://blog.zenlab.it/traceroute-vs-ping-vs-mtr/>)

```
https://github.com/Homebrew/brew#donations

==> Next steps:
- Run 'brew help' to get started
- Further documentation:
  https://docs.brew.sh

[cemkilinc@Cems-MacBook-Pro ~ % brew reinstall mtr ]
==> Downloading https://ghcr.io/v2/homebrew/core/mtr/manifests/0.94
Already downloaded: /Users/cemkilinc/Library/Caches/Homebrew/downloads/2305cc81a
479a89d6d87f0d76bbfa74e4275cbd7f56fbb11df9613e63b45b0f6--mtr-0.94.bottle_manifes
t.json
==> Downloading https://ghcr.io/v2/homebrew/core/mtr/blobs/sha256:3625ac3eeb2409
fde8a84bfa25bee77920d17c249e20653a84f9d8b18b26c04101576--mtr-0.94.big_sur.bottl
e.tar.gz
==> Reinstalling mtr
==> Pouring mtr--0.94.big_sur.bottle.tar.gz
==> Caveats
mtr requires root privileges so you will need to run 'sudo mtr'.
You should be certain that you trust any software you grant root privileges.
==> Summary
📦 /usr/local/Cellar/mtr/0.94: 12 files, 255.4KB
[cemkilinc@Cems-MacBook-Pro ~ % mtr www.ucla.edu ]
mtr: Failure to start mtr-packet: Invalid argument
[cemkilinc@Cems-MacBook-Pro ~ % nano ~/.zshrc ]
[cemkilinc@Cems-MacBook-Pro ~ % mtr www.ucla.edu ]
mtr: Failure to start mtr-packet: Invalid argument
[cemkilinc@Cems-MacBook-Pro ~ % mtr ucla.edu ]
mtr: Failure to start mtr-packet: Invalid argument
[cemkilinc@Cems-MacBook-Pro ~ % ]
```