Step 1:

Mp4

```
simon@simon-virtual-machine:~/Desktop/09$ ./client 127.0.0.1 -v 1.mp4
Server's IP address : 127.0.0.1
Server's port: 4950
====Start the three-way handshake=====
Send a package(SYN) to 127.0.0.1 : 4950
Receive package(SYN/ACK) from 127.0.0.1 : 4950
         Receive a package ( seq_num = 2520, ack_num = 2293 )
Send a package(ACK) to 127.0.0.1 : 4950
====Complete the three-way handshake====
        Receive a packet (SYN)
        Receive a packet ( seg num = 6890, ack num = 6686 )
request: 1 -f 3.mp4
Sent a packet to 127.0.0.1 ( seq_num = 6686, ack_num = 6891 )
Sent a packet to 127.0.0.1 ( seq_num = 6687, ack_num = 6892 )
        Receive a packet ( seq_num = 6892, ack_num = 6688 )
Sent a packet to 127.0.0.1 ( seq_num = 6688, ack_num = 6893
Sent a packet to 127.0.0.1 ( seq_num = 6689, ack_num = 6894
        Receive a packet ( seq_num = 6894, ack_num = 6690 )
Sent a packet to 127.0.0.1 ( seq_num = 6690, ack_num = 6895 )
Sent a packet to 127.0.0.1 ( seq_num = 6691, ack_num = 6896 )
        Receive a packet ( seq_num = 6896, ack_num = 6692 )
Sent a packet to 127.0.0.1 ( seq_num = 6692, ack_num = 6897 )
Sent a packet to 127.0.0.1 ( seq_num = 6693, ack_num = 6898 )
```

Receive a packet (seq_num = 6898, ack_num = 6694)

DNS

```
Receive a packet (SYN)
Receive a packet ( seq_num = 9141, ack_num = 5705 )
==Start finding: google.com to 127.0.0.1 : 4952
Send a packet to 127.0.0.1 :
Receive a packet ( seq_num = 9142, ack_num = 5706 )
==Finishing finding==
Finish
```

Add

```
Receive a packet (SYN)
Receive a packet ( seq_num = 3183, ack_num = 795 )
Send a packet to 127.0.0.1 :
Receive a packet ( seq_num = 3184, ack_num = 796 )
Finish
```

Sub

```
Receive a packet (SYN)
Receive a packet (seq_num = 5728, ack_num = 1650)
Send a packet to 127.0.0.1:
Receive a packet (seq_num = 5729, ack_num = 1651)
Finish
```

Mul:

```
Finish
Receive a packet (SYN)
Receive a packet ( seq_num = 3729, ack_num = 2973 )
Send a packet to 127.0.0.1 :
Receive a packet ( seq_num = 3730, ack_num = 2974 )
Finish
```

```
simon@simon-virtual-machine:~/Desktop/09$ ./client 127.0.0.1 -div 10/5
Server's IP address : 127.0.0.1
Server's port: 4950
=====Start the three-way handshake======
Send a package(SYN) to 127.0.0.1 : 4950
Receive package(SYN/ACK) from 127.0.0.1 : 4950
Receive a package ( seq_num = 5389, ack_num = 9751 )
Send a package(ACK) to 127.0.0.1 : 4950
====Complete the three-way handshake====
Receive a calculation result from 127.0.0.1 : 4950
Receive a packet ( seq_num = 5390, ack_num = 9752 )
result: 10/5 = 2.00000
Receive a packet (SYN)
Receive a packet ( seq_num = 9751, ack_num = 5390 )
```

```
Finish
Pow
```

Send a packet to 127.0.0.1 :

Receive a packet (seq_num = 9752, ack_num = 5391)

```
Receive a packet (SYN)
Receive a packet ( seq_num = 655, ack_num = 9760 )
Send a packet to 127.0.0.1 :
Receive a packet ( seq_num = 656, ack_num = 9761 )
Finish
```

Sqr

```
Receive a packet (SYN)
Receive a packet ( seq_num = 6119, ack_num = 1944 )
Send a packet to 127.0.0.1 :
Receive a packet ( seq_num = 6120, ack_num = 1945 )
<u>F</u>inish
```

Multiple:

```
simon@simon-virtual-machine:~/Desktop/09$ ./client 127.0.0.1 -sqr 4 -add 3+4 -DN
S google.com
Server's IP address : 127.0.0.1
Server's port: 4950
====Start the three-way handshake=====
Send a package(SYN) to 127.0.0.1 : 4950
Receive package(SYN/ACK) from 127.0.0.1 : 4950
        Receive a package ( seq_num = 28, ack_num = 6113 )
Send a package(ACK) to 127.0.0.1 : 4950
====Complete the three-way handshake====
Receive a calculation result from 127.0.0.1 : 4950
        Receive a packet ( seq_num = 29, ack_num = 6114 ) result: 4^{(1/2)} = 2.00000
Receive a calculation result from 127.0.0.1 : 4950
        Receive a packet ( seq_num = 30, ack_num = 6115 )
        result: 3+4 = 7.00000
Finding IP address of google.com by 127.0.0.1 : 4950
        Receive a packet ( seq_num = 31, ack_num = 6116 )
Result : 142.251.42.238
Send a packet(ACK) to 127.0.0.1 : 4950
Finishing finding
google.com
```

```
Receive a packet ( seq_num = 655, ack_num = 9760 )
Send a packet to 127.0.0.1 :
       Receive a packet ( seq_num = 656, ack_num = 9761 )
Finish
       Receive a packet (SYN)
       Receive a packet ( seq_num = 6119, ack_num = 1944 )
Send a packet to 127.0.0.1:
       Receive a packet ( seq_num = 6120, ack_num = 1945 )
inish
       Receive a packet (SYN)
       Receive a packet ( seq_num = 7888, ack_num = 4713 )
Send a packet to 127.0.0.1:
       Receive a packet ( seq_num = 7889, ack_num = 4714 )
Send a packet to 127.0.0.1:
       Receive a packet ( seq_num = 7890, ack_num = 4715 )
Finish
       Receive a packet (SYN)
       Receive a packet ( seq_num = 6113, ack_num = 29 )
Send a packet to 127.0.0.1:
       Receive a packet ( seq_num = 6114, ack_num = 30 )
Send a packet to 127.0.0.1 :
       Receive a packet ( seq_num = 6115, ack_num = 31 )
==Start finding: google.com to 127.0.0.1 : 4962
Send a packet to 127.0.0.1:
       Receive a packet ( seq_num = 6116, ack_num = 32 )
==Finishing finding==
inish
```

```
Result : 142.251.42.238
Send a packet(ACK) to 127.0.0.1 : 4950
Finishing finding
                                                                                                     simon@simon-virtual-machine:~/Desktop/09$ ./cl
                                                                                                    27.0.0.1 -f 1.mp4
                                                                                                    Server's IP address : 127.0.0.1
Server's port: 4950
 google.com

=====Start the three-way handshake=====

simon@simon-virtual-machine:~/Desktop/09$ ./client
Send a package(SYN) to 127.0.0.1 : 4950
Receive package(SYN/ACK) from 127.0.0.1 : 4950
Receive a package (seq_num = 5857, ack
  google.com
  Server's port: 4950
=====Start the three-way handshake=====
                                                                                                    = 4058 )
                                                                                                   Send a package(ACK) to 127.0.0.1 : 4950 ====Complete the three-way handshake==== Invaild flag.
 Send a package(SYN) to 127.0.0.1 : 4950
Receive package(SYN/ACK) from 127.0.0.1 : 4950
                Receive a package ( seq_num = 3724, ack_numsimon@simon-virtual-machine:~/Desktop/09$
  Send a package(ACK) to 127.0.0.1 : 4950
 send a package(ACK) to 127.0.0.1 . 4930
====Complete the three-way handshake====
Receive a calculation result from 127.0.0.1 : 4950
Receive a packet ( seq_num = 3725, ack_num
 result: 4^(1/2) = 2.00000
simon@simon-virtual-machine:~/Desktop/09$
 Finish
 Receive a packet (SYN)

Receive a packet ( seq_num = 7888, ack_num = 4/13 )
Send a packet to 127.0.0.1 :
 Receive a packet ( seq_num = 7889, ack_num = 4714 )
Send a packet to 127.0.0.1 :
                Receive a packet ( seq_num = 7890, ack_num = 4715 )
Text Editor

Receive a packet (SYN)

Receive a packet (seq_num = 6113, ack_num = 29)

Send a packet to 127.0.0.1:

Receive a packet (seq_num = 6114, ack_num = 30)

Send a packet to 127.0.0.1:

Receive a packet (seq_num = 6115, ack_num = 31)

==Start finding: google.com to 127.0.0.1: 4962

Send a packet to 127.0.0.1:

Receive a packet (seq_num = 6116, ack_num = 32)

==Finishing finding==

Finish
 F Text Editor
 Finish
Receive a packet (SYN)
Receive a packet (seq_num = 2545, ack_num = 3725 )
Send a packet to 127.0.0.1 :
Receive a packet (seq_num = 2546, ack_num = 3726 )
 Finish
                Receive a packet (SYN)
Receive a packet ( seq_num = 4058, ack_num = 5858 )
```

Step 4:

```
simon@simon-virtual-machine: ~/Desktop/09
                                                            Q | =
Receive package(SYN/ACK) from 127.0.0.1 : 4950
        Receive a package ( seq_num = 4777, ack_num = 487 )
Send a package(ACK) to 127.0.0.1 : 4950
====Complete the three-way handshake====
Receiving 2.mp4 form 127.0.0.1 : 4950
Receive 1 packet from 127.0.0.1 : 4950
         Receive a packet ( seq_num = 4778, ack_num = 488 )
Receive 2 packet from 127.0.0.1 : 4950
         Receive a packet ( seq_num = 4779, ack_num = 489 )
Receive 4 packet from 127.0.0.1 : 4950
         Receive a packet ( seq_num = 4781, ack_num = 491 )
Packet loss ( seq num = 4784, ack num = 494 )
Receive 1 packet from 127.0.0.1 : 4950
         Receive a packet ( seq_num = 4785, ack_num = 495 )
Receive 2 packet from 127.0.0.1 : 4950
        Receive a packet ( seq_num = 4786, ack_num = 496 )
Receive 3 packet from 127.0.0.1 : 4950
        Receive a packet ( seq_num = 4788, ack_num = 498 )
Receive 4 packet from 127.0.0.1 : 4950
        Receive a packet ( seq num = 4791. ack num = 501 )
        Receive a packet ( seq_num = 2473, ack_num = 6764 )
        Receive a packet ( seq_num = 2474, ack_num = 6765
        Receive a packet ( seq_num = 2475, ack_num = 6766
        Receive a packet ( seq_num = 2476, ack_num = 6767
        Receive a packet ( seq_num = 2477, ack_num = 6768
        Receive a packet ( seq_num = 2478, ack_num = 6769
        Receive a packet ( seq_num = 2479, ack_num = 6770
        Receive a packet ( seq_num = 2480, ack_num = 6771
        Receive a packet ( seq_num = 2481, ack_num = 6772
        Receive a packet ( seq_num = 2482, ack_num = 6773
        Receive a packet ( seq_num = 2483, ack_num = 6774
        Receive a packet ( seq_num = 2484, ack_num = 6775
        Receive a packet ( seq_num = 2485, ack_num = 6776
        Receive a packet ( seq_num = 2486, ack_num = 6777
        Receive a packet ( seq_num = 2487, ack_num = 6778
        Receive a packet ( seq_num = 2488, ack_num = 6779
        Receive a packet ( seq_num = 2489, ack_num = 6780
        Receive a packet ( seq_num = 2490, ack_num = 6781
 Receive a packet (seq_num = 2491, ack_num = 6782

Receive a packet (seq_num = 2492, ack_num = 6783

Peceive a packet (seq_num = 2493, ack_num = 6784

Show Applications a packet (seq_num = 2494, ack_num = 6785

Receive a packet (seq_num = 2495, ack_num = 6786
```

Step 5:

```
simon@simon-virtual-machine: ~/Desktop/09
                                                          Q
Receiving 1.mp4 form 127.0.0.1 : 4950
Receive 1 packet from 127.0.0.1 : 4950
        Receive a packet ( seq num = 2089, ack num = 8551 )
Receive 2 packet from 127.0.0.1 : 4950
        Receive a packet ( seq_num = 2090, ack_num = 8552 )
Receive 4 packet from 127.0.0.1 : 4950
        Receive a packet ( seq_num = 2092, ack_num = 8554 )
Packet loss ( seq_num = 2095, ack_num = 8557 )
Receive 1 packet from 127.0.0.1 : 4950
        Receive a packet ( seq_num = 2096, ack_num = 8558 )
Receive 2 packet from 127.0.0.1:4950
        Receive a packet ( seq_num = 2097, ack_num = 8559 )
Receive 3 packet from 127.0.0.1 : 4950
        Receive a packet ( seq_num = 2099, ack_num = 8561 )
Receive 4 packet from 127.0.0.1 : 4950
        Receive a packet ( seq_num = 2102, ack_num = 8564 )
Receive 2 packet from 127.0.0.1 : 4950
        Receive a packet ( seq_num = 2106, ack_num = 8568 )
Receive 3 packet from 127.0.0.1 : 4950
        Receive a packet ( seq_num = 2108, ack_num = 8570 )
cwnd = 1, ssthresh = 2
Send a packet at 1024 byte( seq_num = 2528, ack_num = 2301 )
        Receive a packet ( seq_num = 2301, ack_num = 2529 )
cwnd = 2, ssthresh = 2
Send a packet at 1024 byte( seq_num = 2529, ack_num = 2302 )
Send a packet at 1024 byte( seq_num = 2530, ack_num = 2303 )
Receive a packet ( seq_num = 2302, ack_num = 2530 )
        Receive a packet ( seq_num = 2303, ack_num = 2531 )
cwnd = 3, ssthresh = 2
Send a packet at 1024 byte( seq_num = 2531, ack_num = 2304 )
Send a packet at 1024 byte( seq_num = 2532, ack_num = 2305
Send a packet at 1024 byte( seq_num = 2533, ack_num = 2306 )
        Receive a packet ( seq_num = 2304, ack_num = 2532 )
        Receive a packet ( seq_num = 2305, ack_num = 2533 )
        Receive a packet ( seq_num = 2306, ack_num = 2534 )
cwnd = 4, ssthresh = 2
Send a packet at 1024 byte( seq_num = 2534, ack_num = 2307 )
Send a packet at 1024 byte( seq_num = 2535, ack_num = 2308
Send a packet at 1024 byte( seq_num = 2536, ack_num = 2309
Send a packet at 1024 byte( seq_num = 2537, ack_num = 2310
```

Step 6:

```
Ħ
                   simon@simon-virtual-machine: ~/Desktop/09
                                                               Q
Receiving 1.mp4 form 127.0.0.1 : 4950
Receive 1 packet from 127.0.0.1 : 4950
                                                                                            is
         Receive a packet ( seq_num = 2089, ack_num = 8551 )
Receive 2 packet from 127.0.0.1 : 4950
         Receive a packet ( seq_num = 2090, ack_num = 8552 )
Receive 4 packet from 127.0.0.1 : 4950
         Receive a packet ( seq num = 2092, ack num = 8554 )
Packet loss ( seq num = 2095, ack num = 8557 )
Receive 1 packet from 127.0.0.1 : 4950
         Receive a packet ( seq_num = 2096, ack_num = 8558 )
Receive 2 packet from 127.0.0.1 : 4950
         Receive a packet ( seq_num = 2097, ack_num = 8559 )
Receive 3 packet from 127.0.0.1 : 4950
         Receive a packet ( seq_num = 2099, ack_num = 8561 )
Receive 4 packet from 127.0.0.1 : 4950
Receive a packet ( seq_num = 2102, ack_num = 8564 )
Receive 2 packet from 127.0.0.1 : 4950
         Receive a packet ( seq_num = 2106, ack_num = 8568 )
Receive 3 packet from 127.0.0.1 : 4950
         Receive a packet ( seq_num = 2108, ack_num = 8570 )
Send a packet at 1024 byte( seq_num = 4782, ack_num = 492 )
Send a packet at 1024 byte( seq_num = 4783, ack_num = 493 )
Send a packet at 1024 byte( seq_num = 4784, ack_num = 494 )
         Receive a packet ( seq_num = 491, ack_num = 4782 )
         Receive a packet ( seq_num = 492, ack_num = 4783 )
         Receive a packet ( seq_num = 493, ack_num = 4784 )
Receive three duplicate ACKs
cwnd = 1, ssthresh = 2
Send a packet at 1024 byte( seg num = 4785, ack num = 495 )
         Receive a packet ( seq_num = 495, ack_num = 4786 )
cwnd = 2, ssthresh = 2
Send a packet at 1024 byte( seq_num = 4786, ack_num = 496 )
Send a packet at 1024 byte( seq_num = 4787, ack_num = 497
         Receive a packet ( seq_num = 496, ack_num = 4787 )
Receive a packet ( seq_num = 497, ack_num = 4788 )
cwnd = 3, ssthresh = 2
Send a packet at 1024 byte( seq_num = 4788, ack_num = 498
Send a packet at 1024 byte( seq_num = 4789, ack_num = 499 )
Send a packet at 1024 byte( seq_num = 4790, ack_num = 500 )
         Receive a packet ( seq_num = 498, ack_num = 4789 )
```

Step 7:

```
simon@simon-virtual-machine: ~/Desktop/09
                                                          Q
Receiving 1.mp4 form 127.0.0.1 : 4950
Receive 1 packet from 127.0.0.1 : 4950
        Receive a packet ( seg num = 2089, ack num = 8551 )
Receive 2 packet from 127.0.0.1:4950
        Receive a packet ( seq num = 2090, ack num = 8552 )
Receive 4 packet from 127.0.0.1 : 4950
        Receive a packet ( seq_num = 2092, ack_num = 8554 )
Receive 1 packet from 127.0.0.1 : 4950
        Receive a packet ( seq_num = 2096, ack_num = 8558 )
Receive 2 packet from 127.0.0.1 : 4950
        Receive a packet ( seq_num = 2097, ack_num = 8559 )
Receive 3 packet from 127.0.0.1 : 4950
        Receive a packet ( seq_num = 2099, ack_num = 8561 )
Receive 4 packet from 127.0.0.1 : 4950
        Receive a packet ( seq_num = 2102, ack_num = 8564 )
Receive 2 packet from 127.0.0.1 : 4950
        Receive a packet ( seq_num = 2106, ack_num = 8568 )
Receive 3 packet from 127.0.0.1 : 4950
        Receive a packet ( seq_num = 2108, ack_num = 8570 )
Send a packet at 1024 byte( Seq_num = 4792, ack_num = 502
Send a packet at 1024 byte( seq_num = 4793, ack_num = 503
Send a packet at 1024 byte( seq_num = 4794, ack_num = 504
        Receive a packet ( seq_num = 501, ack_num = 4792 )
Receive a packet ( seq_num = 502, ack_num = 4793 )
        Receive a packet ( seq_num = 503, ack_num = 4794 )
Receive three duplicate ACKs
 Terminal gestion avoidance*****
cwnd = 2, ssthresh = 2
Send a packet at 1024 byte( seq_num = 4795, ack_num = 505 )
Send a packet at 1024 byte( seq_num = 4796, ack_num = 506 )
        Receive a packet (seq_num = 505, ack_num = 4796)
Receive a packet (seq_num = 506, ack_num = 4797)
cwnd = 3, ssthresh = 2
Send a packet at 1024 byte( seq_num = 4798, ack_num = 508 )
Send a packet at 1024 byte( seq_num = 4799, ack_num = 509 )
        Receive a packet ( seq_num = 507, ack_num = 4798 )
Receive a packet ( seq_num = 508, ack_num = 4799 )
        Receive a packet ( seq_num = 509, ack_num = 4800 )
cwnd = 4, ssthresh = 2
Send a packet at 1024 byte( seq_num = 4800, ack_num = 510 )
```

Step 8:

