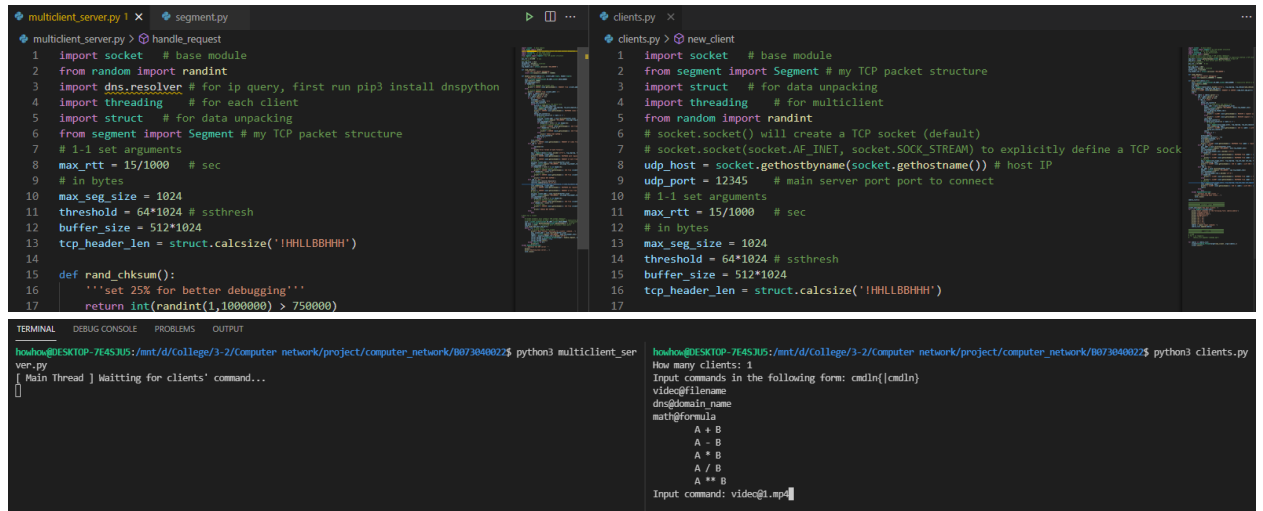


Computer Network Homework

Step 1:

• 1.



```
multiclent_server.py x segment.py
1 import socket # base module
2 from random import randint
3 import dns_resolver # for ip query, first run pip3 install dnspython
4 import threading # for each client
5 import struct # for data unpacking
6 from segment import Segment # my TCP packet structure
7 # 1-1 set arguments
8 max_rtt = 15/1000 # sec
9 # in bytes
10 max_seg_size = 1024
11 threshold = 64*1024 # ssthresh
12 buffer_size = 512*1024
13 tcp_header_len = struct.calcsize('!HHLLBBHH')
14
15 def rand_chksum():
16     '''set 25% for better debugging'''
17     return int(randint(1,1000000) > 750000)

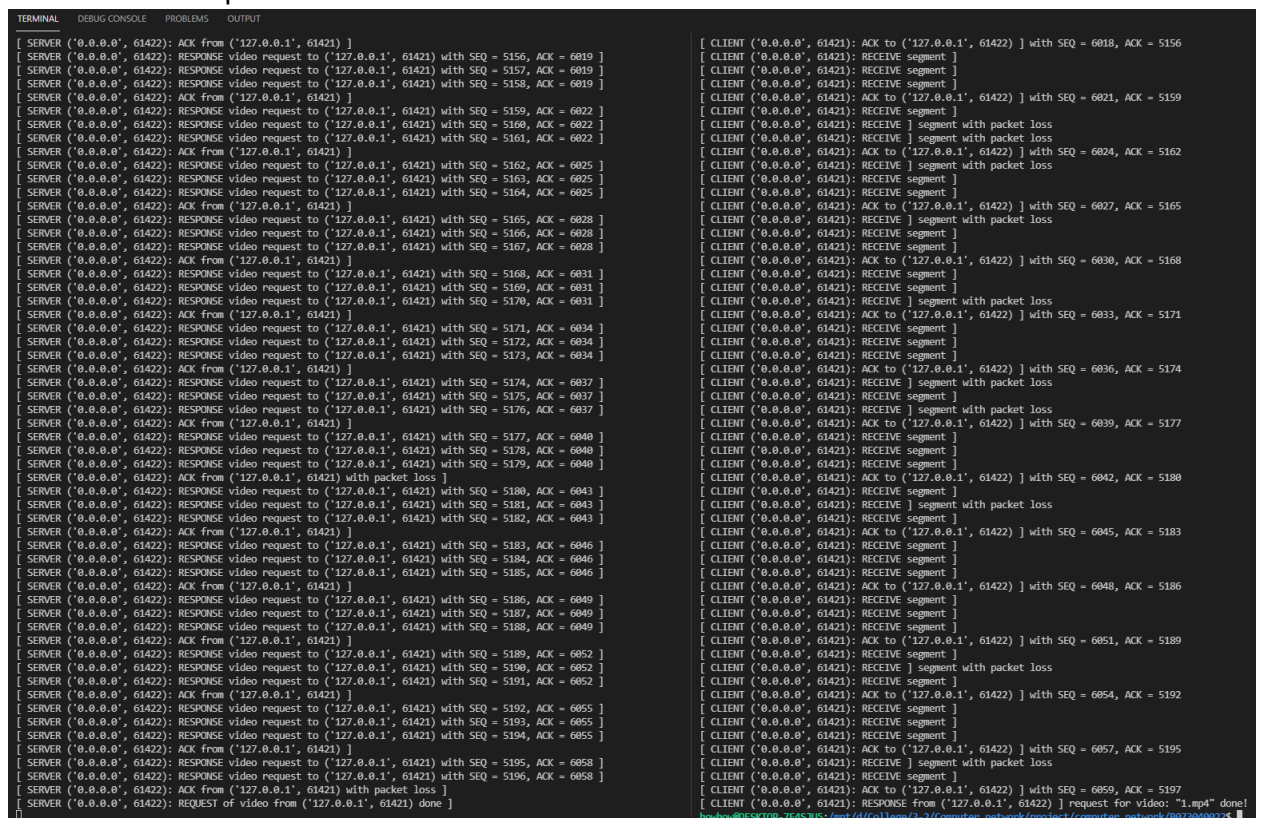
clients.py x
1 import socket # base module
2 from segment import Segment # my TCP packet structure
3 import struct # for data unpacking
4 import threading # for multiclent
5 from random import randint
6 # socket.socket() will create a TCP socket (default)
7 # socket.socket(socket.AF_INET, socket.SOCK_STREAM) to explicitly define a TCP sock
8 udp_host = socket.gethostbyname(socket.gethostname()) # host IP
9 udp_port = 12345 # main server port port to connect
10 # 1-1 set arguments
11 max_rtt = 15/1000 # sec
12 # in bytes
13 max_seg_size = 1024
14 threshold = 64*1024 # ssthresh
15 buffer_size = 512*1024
16 tcp_header_len = struct.calcsize('!HHLLBBHH')
17

TERMINAL DEBUG CONSOLE PROBLEMS OUTPUT
howhow@DESKTOP-7E4S3U5:/mnt/d/College/3-2/Computer network/project/computer_network/B073040022$ python3 multiclent_server.py
[ Main Thread ] Waiting for clients' command...

howhow@DESKTOP-7E4S3U5:/mnt/d/College/3-2/Computer network/project/computer_network/B073040022$ python3 clients.py
How many clients: 1
Input commands in the following form: cmdIn[cmdIn]
video@filename
dns@domain name
math@formula
A + B
A - B
A * B
A / B
A ** B
Input command: video@i.mp4
```

• 2.

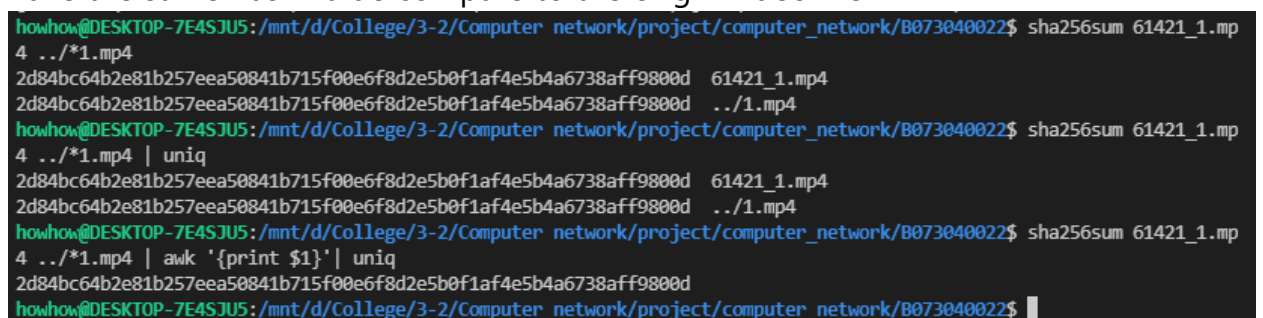
after a few output...



```
TERMINAL DEBUG CONSOLE PROBLEMS OUTPUT
[ SERVER ('0.0.0.0', 61422): ACK from ('127.0.0.1', 61421) ]
[ SERVER ('0.0.0.0', 61422): RESPONSE video request to ('127.0.0.1', 61421) with SEQ = 5156, ACK = 6019 ]
[ SERVER ('0.0.0.0', 61422): RESPONSE video request to ('127.0.0.1', 61421) with SEQ = 5157, ACK = 6019 ]
[ SERVER ('0.0.0.0', 61422): RESPONSE video request to ('127.0.0.1', 61421) with SEQ = 5158, ACK = 6019 ]
[ SERVER ('0.0.0.0', 61422): ACK from ('127.0.0.1', 61421) ]
[ SERVER ('0.0.0.0', 61422): RESPONSE video request to ('127.0.0.1', 61421) with SEQ = 5159, ACK = 6022 ]
[ SERVER ('0.0.0.0', 61422): RESPONSE video request to ('127.0.0.1', 61421) with SEQ = 5160, ACK = 6022 ]
[ SERVER ('0.0.0.0', 61422): RESPONSE video request to ('127.0.0.1', 61421) with SEQ = 5161, ACK = 6022 ]
[ SERVER ('0.0.0.0', 61422): ACK from ('127.0.0.1', 61421) ]
[ SERVER ('0.0.0.0', 61422): RESPONSE video request to ('127.0.0.1', 61421) with SEQ = 5162, ACK = 6025 ]
[ SERVER ('0.0.0.0', 61422): RESPONSE video request to ('127.0.0.1', 61421) with SEQ = 5163, ACK = 6025 ]
[ SERVER ('0.0.0.0', 61422): RESPONSE video request to ('127.0.0.1', 61421) with SEQ = 5164, ACK = 6025 ]
[ SERVER ('0.0.0.0', 61422): ACK from ('127.0.0.1', 61421) ]
[ SERVER ('0.0.0.0', 61422): RESPONSE video request to ('127.0.0.1', 61421) with SEQ = 5165, ACK = 6028 ]
[ SERVER ('0.0.0.0', 61422): RESPONSE video request to ('127.0.0.1', 61421) with SEQ = 5166, ACK = 6028 ]
[ SERVER ('0.0.0.0', 61422): RESPONSE video request to ('127.0.0.1', 61421) with SEQ = 5167, ACK = 6028 ]
[ SERVER ('0.0.0.0', 61422): ACK from ('127.0.0.1', 61421) ]
[ SERVER ('0.0.0.0', 61422): RESPONSE video request to ('127.0.0.1', 61421) with SEQ = 5168, ACK = 6031 ]
[ SERVER ('0.0.0.0', 61422): RESPONSE video request to ('127.0.0.1', 61421) with SEQ = 5169, ACK = 6031 ]
[ SERVER ('0.0.0.0', 61422): RESPONSE video request to ('127.0.0.1', 61421) with SEQ = 5170, ACK = 6031 ]
[ SERVER ('0.0.0.0', 61422): ACK from ('127.0.0.1', 61421) ]
[ SERVER ('0.0.0.0', 61422): RESPONSE video request to ('127.0.0.1', 61421) with SEQ = 5171, ACK = 6034 ]
[ SERVER ('0.0.0.0', 61422): RESPONSE video request to ('127.0.0.1', 61421) with SEQ = 5172, ACK = 6034 ]
[ SERVER ('0.0.0.0', 61422): RESPONSE video request to ('127.0.0.1', 61421) with SEQ = 5173, ACK = 6034 ]
[ SERVER ('0.0.0.0', 61422): ACK from ('127.0.0.1', 61421) ]
[ SERVER ('0.0.0.0', 61422): RESPONSE video request to ('127.0.0.1', 61421) with SEQ = 5174, ACK = 6037 ]
[ SERVER ('0.0.0.0', 61422): RESPONSE video request to ('127.0.0.1', 61421) with SEQ = 5175, ACK = 6037 ]
[ SERVER ('0.0.0.0', 61422): RESPONSE video request to ('127.0.0.1', 61421) with SEQ = 5176, ACK = 6037 ]
[ SERVER ('0.0.0.0', 61422): ACK from ('127.0.0.1', 61421) ]
[ SERVER ('0.0.0.0', 61422): RESPONSE video request to ('127.0.0.1', 61421) with SEQ = 5177, ACK = 6040 ]
[ SERVER ('0.0.0.0', 61422): RESPONSE video request to ('127.0.0.1', 61421) with SEQ = 5178, ACK = 6040 ]
[ SERVER ('0.0.0.0', 61422): RESPONSE video request to ('127.0.0.1', 61421) with SEQ = 5179, ACK = 6040 ]
[ SERVER ('0.0.0.0', 61422): ACK from ('127.0.0.1', 61421) ]
[ SERVER ('0.0.0.0', 61422): RESPONSE video request to ('127.0.0.1', 61421) with SEQ = 5180, ACK = 6043 ]
[ SERVER ('0.0.0.0', 61422): RESPONSE video request to ('127.0.0.1', 61421) with SEQ = 5181, ACK = 6043 ]
[ SERVER ('0.0.0.0', 61422): RESPONSE video request to ('127.0.0.1', 61421) with SEQ = 5182, ACK = 6043 ]
[ SERVER ('0.0.0.0', 61422): ACK from ('127.0.0.1', 61421) ]
[ SERVER ('0.0.0.0', 61422): RESPONSE video request to ('127.0.0.1', 61421) with SEQ = 5183, ACK = 6046 ]
[ SERVER ('0.0.0.0', 61422): RESPONSE video request to ('127.0.0.1', 61421) with SEQ = 5184, ACK = 6046 ]
[ SERVER ('0.0.0.0', 61422): RESPONSE video request to ('127.0.0.1', 61421) with SEQ = 5185, ACK = 6046 ]
[ SERVER ('0.0.0.0', 61422): ACK from ('127.0.0.1', 61421) ]
[ SERVER ('0.0.0.0', 61422): RESPONSE video request to ('127.0.0.1', 61421) with SEQ = 5186, ACK = 6049 ]
[ SERVER ('0.0.0.0', 61422): RESPONSE video request to ('127.0.0.1', 61421) with SEQ = 5187, ACK = 6049 ]
[ SERVER ('0.0.0.0', 61422): RESPONSE video request to ('127.0.0.1', 61421) with SEQ = 5188, ACK = 6049 ]
[ SERVER ('0.0.0.0', 61422): ACK from ('127.0.0.1', 61421) ]
[ SERVER ('0.0.0.0', 61422): RESPONSE video request to ('127.0.0.1', 61421) with SEQ = 5189, ACK = 6052 ]
[ SERVER ('0.0.0.0', 61422): RESPONSE video request to ('127.0.0.1', 61421) with SEQ = 5190, ACK = 6052 ]
[ SERVER ('0.0.0.0', 61422): RESPONSE video request to ('127.0.0.1', 61421) with SEQ = 5191, ACK = 6052 ]
[ SERVER ('0.0.0.0', 61422): ACK from ('127.0.0.1', 61421) ]
[ SERVER ('0.0.0.0', 61422): RESPONSE video request to ('127.0.0.1', 61421) with SEQ = 5192, ACK = 6055 ]
[ SERVER ('0.0.0.0', 61422): RESPONSE video request to ('127.0.0.1', 61421) with SEQ = 5193, ACK = 6055 ]
[ SERVER ('0.0.0.0', 61422): RESPONSE video request to ('127.0.0.1', 61421) with SEQ = 5194, ACK = 6055 ]
[ SERVER ('0.0.0.0', 61422): ACK from ('127.0.0.1', 61421) ]
[ SERVER ('0.0.0.0', 61422): RESPONSE video request to ('127.0.0.1', 61421) with SEQ = 5195, ACK = 6058 ]
[ SERVER ('0.0.0.0', 61422): RESPONSE video request to ('127.0.0.1', 61421) with SEQ = 5196, ACK = 6058 ]
[ SERVER ('0.0.0.0', 61422): ACK from ('127.0.0.1', 61421) with packet loss ]
[ SERVER ('0.0.0.0', 61422): REQUEST of video from ('127.0.0.1', 61421) done ]

[ CLIENT ('0.0.0.0', 61421): ACK to ('127.0.0.1', 61422) ] with SEQ = 6018, ACK = 5156
[ CLIENT ('0.0.0.0', 61421): RECEIVE segment ]
[ CLIENT ('0.0.0.0', 61421): RECEIVE segment ]
[ CLIENT ('0.0.0.0', 61421): RECEIVE segment ]
[ CLIENT ('0.0.0.0', 61421): ACK to ('127.0.0.1', 61422) ] with SEQ = 6021, ACK = 5159
[ CLIENT ('0.0.0.0', 61421): RECEIVE ] segment with packet loss
[ CLIENT ('0.0.0.0', 61421): RECEIVE ] segment with packet loss
[ CLIENT ('0.0.0.0', 61421): ACK to ('127.0.0.1', 61422) ] with SEQ = 6024, ACK = 5162
[ CLIENT ('0.0.0.0', 61421): RECEIVE ] segment with packet loss
[ CLIENT ('0.0.0.0', 61421): RECEIVE segment ]
[ CLIENT ('0.0.0.0', 61421): RECEIVE segment ]
[ CLIENT ('0.0.0.0', 61421): RECEIVE segment ]
[ CLIENT ('0.0.0.0', 61421): ACK to ('127.0.0.1', 61422) ] with SEQ = 6027, ACK = 5165
[ CLIENT ('0.0.0.0', 61421): RECEIVE ] segment with packet loss
[ CLIENT ('0.0.0.0', 61421): RECEIVE segment ]
[ CLIENT ('0.0.0.0', 61421): ACK to ('127.0.0.1', 61422) ] with SEQ = 6030, ACK = 5168
[ CLIENT ('0.0.0.0', 61421): RECEIVE segment ]
[ CLIENT ('0.0.0.0', 61421): RECEIVE segment ]
[ CLIENT ('0.0.0.0', 61421): RECEIVE ] segment with packet loss
[ CLIENT ('0.0.0.0', 61421): ACK to ('127.0.0.1', 61422) ] with SEQ = 6033, ACK = 5171
[ CLIENT ('0.0.0.0', 61421): RECEIVE segment ]
[ CLIENT ('0.0.0.0', 61421): RECEIVE segment ]
[ CLIENT ('0.0.0.0', 61421): RECEIVE segment ]
[ CLIENT ('0.0.0.0', 61421): ACK to ('127.0.0.1', 61422) ] with SEQ = 6036, ACK = 5174
[ CLIENT ('0.0.0.0', 61421): RECEIVE ] segment with packet loss
[ CLIENT ('0.0.0.0', 61421): RECEIVE segment ]
[ CLIENT ('0.0.0.0', 61421): RECEIVE ] segment with packet loss
[ CLIENT ('0.0.0.0', 61421): ACK to ('127.0.0.1', 61422) ] with SEQ = 6039, ACK = 5177
[ CLIENT ('0.0.0.0', 61421): RECEIVE segment ]
[ CLIENT ('0.0.0.0', 61421): RECEIVE segment ]
[ CLIENT ('0.0.0.0', 61421): RECEIVE segment ]
[ CLIENT ('0.0.0.0', 61421): ACK to ('127.0.0.1', 61422) ] with SEQ = 6042, ACK = 5180
[ CLIENT ('0.0.0.0', 61421): RECEIVE segment ]
[ CLIENT ('0.0.0.0', 61421): RECEIVE ] segment with packet loss
[ CLIENT ('0.0.0.0', 61421): RECEIVE segment ]
[ CLIENT ('0.0.0.0', 61421): ACK to ('127.0.0.1', 61422) ] with SEQ = 6045, ACK = 5183
[ CLIENT ('0.0.0.0', 61421): RECEIVE segment ]
[ CLIENT ('0.0.0.0', 61421): RECEIVE segment ]
[ CLIENT ('0.0.0.0', 61421): RECEIVE segment ]
[ CLIENT ('0.0.0.0', 61421): ACK to ('127.0.0.1', 61422) ] with SEQ = 6048, ACK = 5186
[ CLIENT ('0.0.0.0', 61421): RECEIVE segment ]
[ CLIENT ('0.0.0.0', 61421): RECEIVE segment ]
[ CLIENT ('0.0.0.0', 61421): RECEIVE segment ]
[ CLIENT ('0.0.0.0', 61421): ACK to ('127.0.0.1', 61422) ] with SEQ = 6051, ACK = 5189
[ CLIENT ('0.0.0.0', 61421): RECEIVE ] segment with packet loss
[ CLIENT ('0.0.0.0', 61421): RECEIVE segment ]
[ CLIENT ('0.0.0.0', 61421): ACK to ('127.0.0.1', 61422) ] with SEQ = 6054, ACK = 5192
[ CLIENT ('0.0.0.0', 61421): RECEIVE segment ]
[ CLIENT ('0.0.0.0', 61421): RECEIVE segment ]
[ CLIENT ('0.0.0.0', 61421): RECEIVE segment ]
[ CLIENT ('0.0.0.0', 61421): ACK to ('127.0.0.1', 61422) ] with SEQ = 6057, ACK = 5195
[ CLIENT ('0.0.0.0', 61421): RECEIVE ] segment with packet loss
[ CLIENT ('0.0.0.0', 61421): RECEIVE segment ]
[ CLIENT ('0.0.0.0', 61421): ACK to ('127.0.0.1', 61422) ] with SEQ = 6059, ACK = 5197
[ CLIENT ('0.0.0.0', 61421): RESPONSE from ('127.0.0.1', 61422) ] request for video: "1.mp4" done!
howhow@DESKTOP-7E4S3U5:/mnt/d/College/3-2/Computer network/project/computer_network/B073040022$
```

have the same hash value compare to the origin video file



```
howhow@DESKTOP-7E4S3U5:/mnt/d/College/3-2/Computer network/project/computer_network/B073040022$ sha256sum 61421_1.mp4
4 ../1.mp4
2d84bc64b2e81b257eea50841b715f00e6f8d2e5b0f1af4e5b4a6738aff9800d 61421_1.mp4
2d84bc64b2e81b257eea50841b715f00e6f8d2e5b0f1af4e5b4a6738aff9800d ../1.mp4
howhow@DESKTOP-7E4S3U5:/mnt/d/College/3-2/Computer network/project/computer_network/B073040022$ sha256sum 61421_1.mp4
4 ../1.mp4 | uniq
2d84bc64b2e81b257eea50841b715f00e6f8d2e5b0f1af4e5b4a6738aff9800d 61421_1.mp4
2d84bc64b2e81b257eea50841b715f00e6f8d2e5b0f1af4e5b4a6738aff9800d ../1.mp4
howhow@DESKTOP-7E4S3U5:/mnt/d/College/3-2/Computer network/project/computer_network/B073040022$ sha256sum 61421_1.mp4
4 ../1.mp4 | awk '{print $1}' | uniq
2d84bc64b2e81b257eea50841b715f00e6f8d2e5b0f1af4e5b4a6738aff9800d
howhow@DESKTOP-7E4S3U5:/mnt/d/College/3-2/Computer network/project/computer_network/B073040022$
```

clients each do multiple jobs

```
TERMINAL  DEBUG CONSOLE  PROBLEMS  OUTPUT
houhou@DESKTOP-7E45J05:/mnt/d/College/3-2/Computer network/project/computer_network/8073040022$ python3 multiclient_server.py
[ Main Thread ] Waiting for clients' command...
[ Main Thread ] Waiting for clients' command...
[ REQUEST from ('127.0.0.1', 55557) ]
[ SERVER ('0.0.0.0', 55559): RESPONSE math request to ('127.0.0.1', 55557) ] with SEQ = 8432, ACK = 373
[ SERVER ('0.0.0.0', 55559): REQUEST of math from ('127.0.0.1', 55557) done ]
[ Main Thread ] Waiting for clients' command...
[ REQUEST from ('127.0.0.1', 55558) ]
[ SERVER ('0.0.0.0', 55560): RESPONSE math request to ('127.0.0.1', 55558) ] with SEQ = 3859, ACK = 3418
[ SERVER ('0.0.0.0', 55560): REQUEST of math from ('127.0.0.1', 55558) done ]
[ SERVER ('0.0.0.0', 55559): ACK from ('127.0.0.1', 55557) with packet loss ]
[ SERVER ('0.0.0.0', 55559): RESPONSE math request to ('127.0.0.1', 55557) ] with SEQ = 8433, ACK = 374
[ SERVER ('0.0.0.0', 55559): REQUEST of math from ('127.0.0.1', 55557) done ]
[ SERVER ('0.0.0.0', 55560): ACK from ('127.0.0.1', 55558) ]
[ SERVER ('0.0.0.0', 55560): RESPONSE math request to ('127.0.0.1', 55558) ] with SEQ = 3860, ACK = 3419
[ SERVER ('0.0.0.0', 55560): REQUEST of math from ('127.0.0.1', 55558) done ]
[ SERVER ('0.0.0.0', 55559): ACK from ('127.0.0.1', 55557) ]
[ SERVER ('0.0.0.0', 55560): ACK from ('127.0.0.1', 55558) ]
]

houhou@DESKTOP-7E45J05:/mnt/d/College/3-2/Computer network/project/computer_network/8073040022$ python3 clients.py
How many clients: 2
Input commands in the following form: cmdIn[cmdIn]
video@filename
dns@domain name
math@formula
A + B
A - B
A * B
A / B
A ** B
Input command: math@5+2-3*2/6|math@5+2**0.5
Input commands in the following form: cmdIn[cmdIn]
video@filename
dns@domain name
math@formula
A + B
A - B
A * B
A / B
A ** B
Input command: math@5+2**0.5|math@5+2-3*2/6
[ CLIENT ('0.0.0.0', 55557): REQUEST to SERVER ('127.0.0.1', 12345) ] with SEQ = 372, ACK = 0
[ CLIENT ('0.0.0.0', 55558): REQUEST to SERVER ('127.0.0.1', 12345) ] with SEQ = 3417, ACK = 0
[ CLIENT ('0.0.0.0', 55557): RESPONSE from ('127.0.0.1', 55559) ] 5+2-3*2/6 = 6.0
[ CLIENT ('0.0.0.0', 55557): ACK to ('127.0.0.1', 55559) ] with SEQ = 373, ACK = 8433
[ CLIENT ('0.0.0.0', 55558): RESPONSE from ('127.0.0.1', 55560) ] (5+2)**0.5 = 5.0 with packet loss
[ CLIENT ('0.0.0.0', 55558): ACK to ('127.0.0.1', 55560) ] with SEQ = 3418, ACK = 3860
[ CLIENT ('0.0.0.0', 55557): RESPONSE from ('127.0.0.1', 55559) ] (5+2)**0.5 = 5.0
[ CLIENT ('0.0.0.0', 55557): ACK to ('127.0.0.1', 55559) ] with SEQ = 374, ACK = 8434
[ CLIENT ('0.0.0.0', 55558): RESPONSE from ('127.0.0.1', 55560) ] 5+2-3*2/6 = 6.0
[ CLIENT ('0.0.0.0', 55558): ACK to ('127.0.0.1', 55560) ] with SEQ = 3419, ACK = 3861
houhou@DESKTOP-7E45J05:/mnt/d/College/3-2/Computer network/project/computer_network/8073040022$

TERMINAL  DEBUG CONSOLE  PROBLEMS  OUTPUT
houhou@DESKTOP-7E45J05:/mnt/d/College/3-2/Computer network/project/computer_network/8073040022$ python3 multiclient_server.py
[ Main Thread ] Waiting for clients' command...
[ Main Thread ] Waiting for clients' command...
[ REQUEST from ('127.0.0.1', 52541) ]
[ SERVER ('0.0.0.0', 52543): RESPONSE dns request to ('127.0.0.1', 52541) ] with SEQ = 9698, ACK = 3491
[ SERVER ('0.0.0.0', 52543): REQUEST of dns from ('127.0.0.1', 52541) done ]
[ SERVER ('0.0.0.0', 52543): ACK from ('127.0.0.1', 52541) ]
]

houhou@DESKTOP-7E45J05:/mnt/d/College/3-2/Computer network/project/computer_network/8073040022$ python3 clients.py
How many clients: 1
Input commands in the following form: cmdIn[cmdIn]
video@filename
dns@domain name
math@formula
A + B
A - B
A * B
A / B
A ** B
Input command: dns@google.com
[ CLIENT ('0.0.0.0', 52541): REQUEST to SERVER ('127.0.0.1', 12345) ] with SEQ = 3490, ACK = 0
[ CLIENT ('0.0.0.0', 52541): RESPONSE from ('127.0.0.1', 52543) ] The IP address of "google.com" is 216.58.200.46 with packet loss
[ CLIENT ('0.0.0.0', 52541): ACK to ('127.0.0.1', 52543) ] with SEQ = 3491, ACK = 9699
houhou@DESKTOP-7E45J05:/mnt/d/College/3-2/Computer network/project/computer_network/8073040022$
```

- 3.

- 4. above covered (Step 1:3)
- 5. above covered
- 6. above covered

Step 2.

- above covered (Step 1:2-4)

Step 3.

- above covered (Step 1:2-4)

Step 4.

- above covered (modified the rate to 25% to better present)

Step 5.

- above covered(Step 1:2-2)

Step 9. (Partial)

- 2. code:

```
#####
##### standard input #####
#####
# client_num=input('How many clients: ')
# for i in range(int(client_num)):
#     print('Input commands in the following form: cmdln{|cmdln}')
#     print('video@filename')
#     print('dns@domain_name')
#     print('math@formula')
#     print('\tA + B')
#     print('\tA - B')
#     print('\tA * B')
#     print('\tA / B')
#     print('\tA ** B')
#     cmdlns = input('Input command: ')
#     cmdlns_list.append(cmdlns)

#####
##### n clients #####
#####
n=100
for i in range(n):
    cmdlns_list.append('video@1.mp4')
```

have the same hash value compare to the origin video file

```
howhow@DESKTOP-7E4SJU5:/mnt/d/College/3-2/Computer network/project/computer_network/B073040022$ sha256sum *.mp4 ../1.mp4 | awk '{print $1}' | uniq
2d84bc64b2e81b257eea50841b715f00e6f8d2e5b0f1af4e5b4a6738aff9800d
howhow@DESKTOP-7E4SJU5:/mnt/d/College/3-2/Computer network/project/computer_network/B073040022$
```