

The features the I achieved in this assignment including:

- 1.3-way handshake(SYN,SYN-ACK,ACK)
- 2.Fin segment for termination
- 3.timer in client side
- 4.TimeoutInterval in client side
- 5.PLD module
- 6.Sequence number and acknowledge number
- 7.fast retransmission
- 8.checksum

Client side

I initialize the connection by executing three-way handshake handshake() by sending SYN = 1 to the server when connection is established , firstly, starting the receiving threading and sending threading simultaneously , senderThreading() for sending segments depend on PLD module and whether it is received the duplicate ack or whether the segments that received is ,or it is timeout, receiverThreading() for receiving the ack packets from server and use the information that containing to determine senderTreading()' actions. When file transmission finished, client side will send FIN flag to initialize close action when receive ack of the FIN packet, the connection will close and all process finish.

Server side

In server side, firstly, I also initialize the connection by executing the handshake() to wait for receiving SYN ,and send back the SYN/ACK, after connection established, there is loop for receiving the packets that sent by client, and check whether the sequence number is in order, if in order, sending the ack of the packet that server received successfully, otherwise, sending the packet ack that server want to receive from the client. When client finishing all the packets transmission , server will receive FIN and start to terminate all the process.

In may header, I set up the standard version of TCP header including the following :

```
class Segment:
    def __init__(self, SYN = 0, ACK = 0, Fin = 0, seq = 0, ack = 0, data = '', checksum = 0, cur_time = 0.0):
        self.SYN = SYN
        self.ACK = ACK
        self.Fin = Fin
        self.seq = seq
        self.ack = ack
        self.data = data
        self.checksum = checksum
        self.cur_time = cur_time
        #ack value :the next sequence number
        #fin flag use to iustify the fin segemnt, it is for the termination
        #sequence number
        #acknowledge number
        #data
        #hex string that for checksum function
        #for calculating the SampleRTT
```

The header is the class including three types of flags which are SYN,ACK,and Fin

And following with sequence, acknowledge number .

There also contain the checksum for detect byterror as well as the time flag for calculating the SampleRTT that can be use in the timeout setting.

Source Port		Destination Port	
sequence number			
acknowledge number			
SYN	FIN	ACK	
checksum			

data
send time

(a)

rcv 2227.43 S 0 0 0 snd 2227.82 SA 0 0 0 rcv 2233.86 A 1 0 1 rcv 2.23 D 1 50 1 snd 2.23 A 1 0 51 rcv 2.23 D 51 50 1 snd 2.23 A 1 0 101 rcv 2.23 D 351 50 1 snd/DA 2.24 A 1 0 101 rcv 2.24 D 201 50 1 snd/DA 2.24 A 1 0 101 rcv 2.24 D 251 50 1 snd/DA 2.24 A 1 0 101 rcv 2.24 D 301 50 1 snd/DA 2.24 A 1 0 101 rcv 2.24 D 351 50 1 snd/DA 2.24 A 1 0 101 rcv 2.24 D 401 50 1 snd/DA 2.24 A 1 0 101 rcv 2.24 D 451 50 1 snd/DA 2.24 A 1 0 101 rcv 2.24 D 501 50 1 snd/DA 2.24 A 1 0 101 rcv 2.24 D 551 50 1 snd/DA 2.24 A 1 0 101 rcv 2.25 D 601 50 1 snd/DA 2.25 A 1 0 551 rcv 2.25 D 651 50 1 snd/DA 2.25 A 1 0 551 rcv 2.25 D 701 50 1 snd/DA 2.25 A 1 0 551 rcv 2.25 D 751 50 1 snd/DA 2.25 A 1 0 551 rcv 2.25 D 801 50 1 snd/DA 2.25 A 1 0 551 rcv 2.25 D 851 50 1 snd/DA 2.25 A 1 0 551 rcv 2.25 D 901 50 1 snd/DA 2.25 A 1 0 551 rcv 2.25 D 951 50 1 snd/DA 2.25 A 1 0 551 rcv 2.26 D 551 50 1 snd 2.26 A 1 0 751 rcv 2.27 D 1051 50 1 snd/DA 2.27 A 1 0 751 rcv 2.27 D 1201 50 1 snd/DA 2.27 A 1 0 751 rcv 3.92 D 751 50 1 snd 3.92 A 1 0 801 rcv 3.92 D 1251 50 1 snd/DA 3.92 A 1 0 801 rcv 5.57 D 801 50 1 snd 5.57 A 1 0 1001 rcv 5.58 D 1301 50 1 snd/DA 5.58 A 1 0 1001 rcv 5.58 D 1351 50 1 snd/DA 5.58 A 1 0 1001 rcv 5.58 D 1401 50 1 snd/DA 5.58 A 1 0 1001 rcv 5.59 D 1001 50 1 snd 5.59 A 1 0 1101 rcv 5.60 D 1501 50 1 snd/DA 5.60 A 1 0 1101 rcv 5.60 D 1551 50 1 snd/DA 5.60 A 1 0 1101 rcv 7.25 D 1101 50 1 snd 7.25 A 1 0 1151 rcv 7.25 D 1601 50 1 snd/DA 7.25 A 1 0 1151 rcv 8.90 D 1151 50 1 snd 8.90 A 1 0 1451 rcv 8.91 D 1651 50 1 snd/DA 8.91 A 1 0 1451 rcv 8.91 D 1751 50 1 snd/DA 8.91 A 1 0 1451 rcv 8.91 D 1801 50 1 snd/DA 8.91 A 1 0 1451 rcv 8.91 D 1901 50 1 snd/DA 8.91 A 1 0 1451 rcv 8.92 A 1 0 1701 snd/DA 8.92 A 1 0 1701 rcv 8.92 D 2101 50 1 snd/DA 8.92 A 1 0 1701 rcv 8.94 D 1701 50 1 snd 8.94 A 1 0 1851 rcv 8.94 D 2201 50 1 snd/DA 8.94 A 1 0 1851 rcv 8.94 D 2251 50 1 snd/DA 8.94 A 1 0 1851 rcv 8.94 D 2301 50 1 snd/DA 8.94 A 1 0 1851 rcv 8.95 D 1851 50 1 snd 8.95 A 1 0 2051 rcv 8.96 D 2401 50 1 snd/DA 8.96 A 1 0 2051 rcv 8.96 D 2451 50 1 snd/DA 8.96 A 1 0 2051 rcv 8.96 D 2501 50 1 snd/DA 8.96 A 1 0 2051 rcv 8.97 D 2051 50 1 snd 8.97 A 1 0 2151 rcv 10.63 D 2151 50 1 snd 10.63 A 1 0 2351 rcv 10.63 D 2451 50 1 snd/DA 10.63 A 1 0 2351 rcv 10.63 D 2751 50 1 snd/DA 10.63 A 1 0 2351 rcv 10.63 D 2801 50 1 snd/DA 10.63 A 1 0 2351 rcv 10.65 D 2351 50 1 snd 10.65 A 1 0 2551 rcv 10.65 D 2851 50 1 snd/DA 10.65 A 1 0 2551 rcv 10.65 D 3001 20 1 snd 10.65 A 1 0 2551 rcv 10.66 D 2551 50 1 snd 10.66 A 1 0 2801 rcv 12.32 D 2601 50 1 snd 12.32 A 1 0 2701 rcv 13.97 D 2701 50 1 snd 13.98 A 1 0 3029 rcv 13.98 F 3029 0 1 snd 13.98 A 1 0 3030 rcv 13.98 F 1 0 3030 snd 13.98 A 3030 0 2	rcv 1746.42 S 0 0 0 snd 1746.93 SA 0 0 0 rcv 1747.20 A 1 0 1 rcv 1.75 D 1 50 1 snd 1.75 A 1 0 51 rcv 1.75 D 51 50 1 snd 1.75 A 1 0 101 rcv 1.75 D 101 50 1 snd 1.75 A 1 0 151 rcv 1.75 D 151 50 1 snd 1.75 A 1 0 201 rcv 1.75 D 201 50 1 snd 1.75 A 1 0 251 rcv 1.75 D 251 50 1 snd 1.75 A 1 0 301 rcv 1.75 D 301 50 1 snd 1.75 A 1 0 351 rcv 1.75 D 351 50 1 snd 1.75 A 1 0 401 rcv 1.75 D 401 50 1 snd 1.75 A 1 0 451 rcv 1.75 D 451 50 1 snd 1.75 A 1 0 501 rcv 1.75 D 501 50 1 snd 1.75 A 1 0 551 rcv 1.76 D 651 50 1 snd/DA 1.76 A 1 0 551 rcv 1.76 D 701 50 1 snd/DA 1.76 A 1 0 551 rcv 1.76 D 751 50 1 snd/DA 1.76 A 1 0 551 rcv 1.76 D 801 50 1 snd/DA 1.76 A 1 0 551 rcv 1.76 D 851 50 1 snd/DA 1.76 A 1 0 551 rcv 1.76 D 901 50 1 snd/DA 1.76 A 1 0 551 rcv 1.76 D 951 50 1 snd/DA 1.76 A 1 0 551 rcv 1.76 D 1001 50 1 snd/DA 1.76 A 1 0 551 rcv 1.77 D 551 50 1 snd 1.77 A 1 0 601 rcv 1.78 D 1051 50 1 snd/DA 1.78 A 1 0 601 rcv 2.59 D 601 50 1 snd 2.59 A 1 0 851 rcv 2.60 D 1101 50 1 snd/DA 2.60 A 1 0 851 rcv 2.60 D 1151 50 1 snd/DA 2.60 A 1 0 851 rcv 2.60 D 1201 50 1 snd/DA 2.60 A 1 0 851 rcv 2.60 D 1251 50 1 snd/DA 2.60 A 1 0 851 rcv 2.60 D 1301 50 1 snd/DA 2.60 A 1 0 851 rcv 2.62 D 851 50 1 snd 2.61 A 1 0 1351 rcv 2.62 D 1351 50 1 snd 2.62 A 1 0 1401 rcv 2.62 D 1401 50 1 snd 2.62 A 1 0 1451 rcv 2.62 D 1451 50 1 snd 2.62 A 1 0 1501 rcv 2.62 D 1501 50 1 snd 2.62 A 1 0 1551 rcv 2.62 D 1601 50 1 snd/DA 2.62 A 1 0 1551 rcv 2.62 D 1651 50 1 snd/DA 2.62 A 1 0 1551 rcv 2.62 D 1701 50 1 snd/DA 2.62 A 1 0 1551 rcv 2.62 D 1751 50 1 snd/DA 2.62 A 1 0 1551 rcv 2.62 D 1851 50 1 snd/DA 2.62 A 1 0 1551 rcv 2.63 D 1551 50 1 snd 2.63 A 1 0 1801 rcv 2.65 D 1551 50 1 snd/DA 2.66 A 1 0 1801 rcv 2.66 D 2101 50 1 snd/DA 2.66 A 1 0 1801 rcv 2.66 D 2151 50 1 snd/DA 2.66 A 1 0 1801 rcv 2.66 D 2201 50 1 snd/DA 2.66 A 1 0 1801 rcv 2.66 D 2251 50 1 snd/DA 2.66 A 1 0 1801 rcv 2.66 D 2301 50 1 snd 2.66 A 1 0 2301 rcv 2.67 D 2301 50 1 snd 2.67 A 1 0 2351 rcv 2.67 D 2351 50 1 snd 2.67 A 1 0 2401 rcv 2.67 D 2401 50 1 snd 2.67 A 1 0 2451 rcv 2.67 D 2451 50 1 snd 2.67 A 1 0 2501 rcv 2.67 D 2501 50 1 snd 2.67 A 1 0 2551 rcv 2.67 D 2551 50 1 snd 2.67 A 1 0 2601 rcv 2.67 D 2601 50 1 snd 2.67 A 1 0 2651 rcv 2.67 D 2651 50 1 snd 2.67 A 1 0 2701 rcv 2.67 D 2701 50 1 snd 2.67 A 1 0 2751 rcv 2.67 D 2751 50 1 snd 2.67 A 1 0 2801 rcv 2.68 D 2801 50 1 snd 2.68 A 1 0 2851 rcv 2.68 D 2851 50 1 snd 2.68 A 1 0 2901 rcv 2.68 D 2901 50 1 snd 2.68 A 1 0 2951 rcv 2.68 D 2951 50 1 snd 2.68 A 1 0 3001 rcv 2.78 D 3001 20 1 snd 2.78 A 1 0 3029 rcv 2.78 F 3029 0 1 snd 2.78 A 1 0 3030 rcv 2.78 F 1 0 3030 snd 2.78 A 3030 0 2
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As we can see the logs above:

In rate of pDrop 0.1

Packet drop occurred in 551 601 851 1551 1801 3001

In rate of pDrop 0.3

Packet drop occurred in 101 551 751 801 1001 1151 1451 1701 1851
2051 2151 2351 2551 2601 2701

(b) Set pdrop = 0.5, MWS = 500 bytes, MSS = 50 bytes, seed = 300, pdelay = 0.2, MaxDelay = 1000 and pDuplicate, pCorrupt, pOrder,

MaxOrder all set to 0. Run three experiments with the following different gamma values:

gamma = 2

gamma = 4

gamma = 6

and transfer the file test1.pdf using STP. Show a table that indicates how many STP packets were transmitted in total and how long the overall transfer took. Discuss the results.

	Number of STP packets	Overall transfer time
gamma = 2	9283	62 minutes
gamma = 4	9342	89 minutes
gamma = 6	9338	158minutes

As we can see the result above, with the value of gamma increasing, the time need to transmit test1.pdf also increased, the reason why this happened is because the increasing value of gamma will reflect on the estimating of timeout interval, when timeout interval going up, the more time need to be spent on triggering timeout retransition.

(c) Use the following values and run STP to transfer test2.pdf. MWS=500bytes MSS=50 gamma=4 pDrop=0.1 pDuplicate=0.1 pCorrupt=0.1 pOrder=0.1 maxOrder=4 pDelay=0 maxDelay=0 seed=300

Has the file been successfully transferred?

Yes ,it is

How long the overall transfer took?

I did it serval times and it took around 10 minutes.

which of the factor (out of pDrop, pDuplicate, pCorrupt and pOrder) is the most critical contributing most in the overall transfer time?

pDrop is the most critical contributing in the overall transfer.

How have you determined this?

I reset all variables to 0 one by one and do not change other probabilities , i find when I reset pDrop to 0, the overall time that for transmitting the whole file is minimum ,so pDrop is the most critical contributing in the overall transfer process.

```
snd 0.00 S 0 0 0
rcv 0.00 SA 0 0 1
snd 0.00 A 1 0 1
snd/corrc 0.05 D 1 49 1
snd 0.05 D 51 50 1
snd/corrc 0.05 D 101 49 1
rcv 0.05 A 1 0 1
snd 0.05 D 151 50 1
snd 0.05 D 201 50 1
snd 0.05 D 251 50 1
snd/corrc 0.05 D 301 49 1
snd 0.05 D 351 50 1
snd 0.05 D 401 50 1
snd 0.05 D 451 50 1
rcv/DA 0.06 A 1 0 1
rcv/DA 0.07 A 1 0 1
rcv/DA 0.07 A 1 0 1
snd/RXT 0.07 D 1 50 1
rcv/DA 0.07 A 1 0 1
rcv/DA 0.08 A 1 0 1
```

```
rcv 2.24 S 0 0 0
snd 2.24 SA 0 0 0
rcv 2.25 A 1 0 1
drop/corrc 2.29 D 1 49 1
rcv 2.29 D 51 50 1
snd 2.29 A 1 0 1
drop/corrc 2.29 D 101 49 1
rcv 2.29 D 151 50 1
snd/DA 2.29 A 1 0 1
rcv 2.29 D 201 50 1
snd/DA 2.29 A 1 0 1
rcv 2.29 D 251 50 1
snd/DA 2.29 A 1 0 1
drop/corrc 2.29 D 301 49 1
rcv 2.29 D 351 50 1
snd/DA 2.29 A 1 0 1
rcv 2.29 D 401 50 1
snd/DA 2.29 A 1 0 1
rcv 2.29 D 451 50 1
snd/DA 2.29 A 1 0 1
```

```
snd 580.47 D 1605501 50 1
rcv/DA 580.49 A 1 1605051
snd/RXT 580.62 D 1605051 50 1
rcv 580.64 A 1 1605101
snd 580.64 D 1605551 35 1
rcv/DA 580.66 A 1 1605101
snd/RXT 580.80 D 1605101 50 1
rcv 580.82 A 1 1605251
snd/RXT 580.98 D 1605251 50 1
rcv 581.00 A 1 1605301
snd/RXT 581.16 D 1605301 50 1
rcv 581.18 A 1 1605351
snd/RXT 581.33 D 1605351 50 1
rcv 581.35 A 1 1605401
snd/RXT 581.51 D 1605401 50 1
rcv 581.53 A 1 1605506
snd 581.53 F 1605506 0 1
rcv 581.53 A 1 1605587
rcv 581.53 F 1 1605587
snd 581.53 A 1605587 0 2
```

```
=====
Size of the file (in Bytes) 1605585
Segments transmitted (including drop & RXT): 42335
Number of Segments handled by PLD 39445
Number of Segments dropped 3357
Number of Segments Corrupted 2575
Number of Segments Re-ordered 29
Number of Segments Duplicated 6862
Number of Segments Delayed 0
Number of Retransmissions due to TIMEOUT 2969
Number of FAST RETRANSMISSION 4364
Number of DUP ACKS received 21950
=====
```

```
drop/corrc 582.52 D 1605351 49 1
rcv 582.52 D 1605451 50 1
snd/DA 582.53 A 1 1605001
rcv 582.68 D 1605001 50 1
snd 582.70 A 1 1605051
rcv 582.71 D 1605501 50 1
snd/DA 582.72 A 1 1605051
rcv 582.86 D 1605051 50 1
snd 582.88 A 1 1605101
rcv 582.88 D 1605551 35 1
snd/DA 582.89 A 1 1605101
rcv 583.04 D 1605101 50 1
snd 583.05 A 1 1605251
rcv 583.22 D 1605251 50 1
snd 583.23 A 1 1605301
rcv 583.40 D 1605301 50 1
snd 583.41 A 1 1605351
rcv 583.57 D 1605351 50 1
snd 583.58 A 1 1605401
rcv 583.75 D 1605401 50 1
snd 583.76 A 1 1605506
rcv 583.77 F 1605506 0 1
snd 583.77 A 1 1605587
rcv 583.77 F 1 1605587
```

```
=====
Amount of data received (bytes) 1605585
Total Segments Received 38978
Data segments received 36308
Data segments with Bit Errors 2575
Duplicate data segments received 4287
Duplicate ACKS sent 21950
=====
```