ASSIGNMENT 2:-

Name - Sibasish Rout(2020CS10386)

Design Implementation

For server the functions defined are: -

1)sDataTCP: Send data over TCP to specific client

2)rDataTCP: Receive data over TCP from specific client

3)sDataUDP: Send data over UDP to specific client

4)rDataUDP: Receive data over UDP from specific client

5)sDatabroad: Send data over broadcast UDP port to specific client

6)rDatabroad: Receive data over broadcast UDP from specific client

7)handle_broadcast: handles the broadcast sockets for requesting chunks from clients

8)queries: Handles queries by different clients

9)make_chunks :- Divides the files into chunks of fixed size

10)send_initial_chunks:-Sends the chunks in round robin fashion

11)broadcastForChunk:-Broadcast to different client for a chunk not in the cache

For Clients the function 1-6 are same and the additional files are

1)getChunk: Receive the initial chunks from the servers in a threaded manner

2)getAllchunks: Request and get the missing chunks from the server

3)handle_broadcast:- Sends the chunks requested by the server if present

LRU Cache: Uses dictionary to store key value pairs

Credits to Geek for geeks for code of LRU CACHE

Packet drop

I have handled packet drop by keeping an acknowledgement UDP signal once a message is received. The program does not move ahead until the acknowledgement for a packet sent via UDP is received

Analysis

Question 1:

For part 1:

```
sibasish@LAPTOP-BKAEH353:/mnt/c/Users/HP/Desktop/SEM 5/COL334/Assignment/Assignment2$ python3 2020CS10386_cl
ient.py
Start time 1663696913.3846166
get one chunk thread joined
Get chunk thread joined
Client connections ended
Average RTT for part 1 0.015324807374373726
end time 1663696914.6632416
time elaplsed 1.2786250114440918
```

RTT for part 1=1.27862s

For part 2:

```
sibasish@LAPTOP-BKAEH353:/mnt/c/Users/HP/Desktop/SEM 5/COL334/Assignment/Assignement2part2$ time python3 cli
ent.py
Start time 1663696211.1853979
get one chunk thread joined
Get chunk thread joined
Average RTT for part 2 0.04365255936332371
Server 9f9d1c257fe1733f6095a8336372616e
Client 0 9f9d1c257fe1733f6095a8336372616e
Client 1 6e34279b0b78721977bae9e7fd1118c1
Client 2 9f9d1c257fe1733f6095a8336372616e
Client 3 58ecec035397d8bcfffe189dd101409b
Client 4 9f9d1c257fe1733f6095a8336372616e
Client connections ended
end time 1663696215.7833347
time elaplsed 4.5979368686676025
```

RTT for part 2=0.04365255936332371s

RTT for part 1 is higher because TCP data transfer is complex and generally takes more time

Question 2:

For part 1

Start time 1663697432.8385906

get one chunk thread joined

Get chunk thread joined

Client connections ended

Average RTT for part 1 0.019514017934384554

Time for Chunk0: 0.005942535400390625

Time for Chunk1: 0.0047457218170166016

Time for Chunk2: 0.005423259735107422

Time for Chunk3: 0.004686546325683594

Time for Chunk4: 0.005525016784667968

Time for Chunk5: 0.005657720565795899

Time for Chunk6: 0.005463027954101562

Time for Chunk7: 0.00486288070678711

Time for Chunk8: 0.005351352691650391

Time for Chunk9: 0.005329704284667969

Time for Chunk10: 0.005544900894165039

Time for Chunk11: 0.00599822998046875

Time for Chunk12: 0.005452203750610352

Time for Chunk13: 0.0056307315826416016

Time for Chunk14: 0.005704164505004883

Time for Chunk15: 0.005300331115722656

Time for Chunk16: 0.06144790649414063

Time for Chunk17: 0.01991591453552246

Time for Chunk18: 0.08283147811889649

Time for Chunk19: 0.04357943534851074

Time for Chunk20: 0.02502589225769043

Time for Chunk21: 0.04488062858581543

Time for Chunk22: 0.08388409614562989

Time for Chunk23: 0.033859968185424805

Time for Chunk24: 0.04249563217163086

Time for Chunk25: 0.027069854736328124

Time for Chunk26: 0.034698486328125

Time for Chunk27: 0.011063671112060547

Time for Chunk28: 0.0067120552062988285

Time for Chunk29: 0.015409898757934571

Time for Chunk30: 0.010080099105834961

Time for Chunk31: 0.03515605926513672

Time for Chunk32: 0.02169966697692871

Time for Chunk33: 0.009378433227539062

Time for Chunk34: 0.0501220703125

Time for Chunk35: 0.01896967887878418

Time for Chunk36: 0.019936275482177735

Time for Chunk37: 0.038095712661743164

Time for Chunk38: 0.017551136016845704

Time for Chunk39: 0.0503654956817627

Time for Chunk40: 0.008139419555664062

Time for Chunk41: 0.03820557594299316

Time for Chunk42: 0.02012925148010254

Time for Chunk43: 0.048444509506225586

Time for Chunk44: 0.0282193660736084

Time for Chunk45: 0.020503473281860352

Time for Chunk46: 0.01135406494140625

Time for Chunk47: 0.016760730743408205

Time for Chunk48: 0.018529891967773438

Time for Chunk49: 0.01936030387878418

Time for Chunk50: 0.024319887161254883

Time for Chunk51: 0.015933418273925783

Time for Chunk52: 0.006868314743041992

Time for Chunk53: 0.023940563201904297

Time for Chunk54: 0.006562089920043946

Time for Chunk55: 0.015958261489868165

Time for Chunk56: 0.007810020446777343

Time for Chunk57: 0.023984527587890624

Time for Chunk58: 0.01748347282409668

Time for Chunk59: 0.00824437141418457

Time for Chunk60: 0.028182554244995116

Time for Chunk61: 0.023880624771118165

Time for Chunk62: 0.009312820434570313

Time for Chunk63: 0.011994457244873047

Time for Chunk64: 0.03065323829650879

Time for Chunk65: 0.017205524444580077

Time for Chunk66: 0.06039133071899414

Time for Chunk67: 0.045124149322509764

Time for Chunk68: 0.03799877166748047

Time for Chunk69: 0.012956333160400391

Time for Chunk70: 0.010396146774291992

Time for Chunk71: 0.020488739013671875

Time for Chunk72: 0.03772978782653809

Time for Chunk73: 0.02319035530090332

Time for Chunk74: 0.013639593124389648

Time for Chunk75: 0.015050411224365234

Time for Chunk76: 0.011925029754638671

Time for Chunk77: 0.00816802978515625

Time for Chunk78: 0.009227609634399414

Time for Chunk79: 0.018121910095214844

Time for Chunk80: 0.015570259094238282

Time for Chunk81: 0.011232709884643555

Time for Chunk82: 0.009076356887817383

Time for Chunk83: 0.011409568786621093

Time for Chunk84: 0.016937065124511718

Time for Chunk85: 0.008716154098510741

Time for Chunk86: 0.010664415359497071

Time for Chunk87: 0.012699604034423828

Time for Chunk88: 0.01950826644897461

Time for Chunk89: 0.011108732223510743

Time for Chunk90: 0.02571239471435547

Time for Chunk101: 0.008809232711791992

Time for Chunk102: 0.008726119995117188

Time for Chunk103: 0.017084836959838867

Time for Chunk104: 0.02588348388671875

Time for Chunk105: 0.011214065551757812

Time for Chunk106: 0.020056915283203126

Time for Chunk107: 0.018369054794311522

Time for Chunk108: 0.008723258972167969

Time for Chunk109: 0.01845836639404297

Time for Chunk110: 0.017486095428466797

end time 1663697434.627815

No abnormality in RTT is noted

For Part 2:

Start time 1663697529.6438801

get one chunk thread joined

Get chunk thread joined

Average RTT for part 2 0.03201604387034541

RTT for Chunk 0: 0.0064887523651123045

RTT for Chunk 1: 0.006496953964233399

RTT for Chunk 2: 0.006179428100585938

RTT for Chunk 3: 0.015614604949951172

RTT for Chunk 4: 0.006899785995483398

RTT for Chunk 5: 0.017281436920166017

RTT for Chunk 6: 0.02532086372375488

RTT for Chunk 7: 0.014938688278198243

RTT for Chunk 8: 0.026515626907348634

RTT for Chunk 9: 0.010337924957275391

RTT for Chunk 10: 0.027255678176879884

RTT for Chunk 11: 0.016122961044311525

RTT for Chunk 12: 0.017334365844726564

RTT for Chunk 13: 0.03711237907409668

RTT for Chunk 14: 0.026157045364379884

RTT for Chunk 15: 0.010435676574707032

RTT for Chunk 16: 0.027147388458251952

RTT for Chunk 17: 0.04569664001464844

RTT for Chunk 18: 0.01927804946899414

RTT for Chunk 19: 0.06869711875915527

RTT for Chunk 20: 0.02637629508972168

RTT for Chunk 21: 0.01931166648864746

RTT for Chunk 22: 0.0572573184967041

RTT for Chunk 23: 0.03804535865783691

RTT for Chunk 24: 0.032637834548950195

RTT for Chunk 25: 0.02736515998840332

RTT for Chunk 26: 0.01064753532409668

RTT for Chunk 27: 0.008283710479736328

RTT for Chunk 28: 0.02714388458251952

RTT for Chunk 29: 0.02906179428100586

RTT for Chunk 30: 0.02998342514038086

RTT for Chunk 31: 0.01670365333557129

RTT for Chunk 32: 0.01768202781677246

RTT for Chunk 33: 0.024621057510375976

RTT for Chunk 34: 0.029217290878295898

RTT for Chunk 35: 0.047205018997192386

RTT for Chunk 36: 0.028968191146850585

RTT for Chunk 37: 0.02184720039367676

RTT for Chunk 38: 0.009724187850952148

RTT for Chunk 39: 0.019815444946289062

RTT for Chunk 40: 0.0561009407043457

RTT for Chunk 41: 0.03536100387573242

RTT for Chunk 42: 0.01446065902709961

RTT for Chunk 43: 0.019222831726074217

RTT for Chunk 44: 0.020524120330810545

RTT for Chunk 45: 0.04719457626342773

RTT for Chunk 46: 0.0461176872253418

RTT for Chunk 47: 0.04697327613830567

RTT for Chunk 48: 0.021850442886352538

RTT for Chunk 49: 0.011217021942138672

RTT for Chunk 50: 0.020436906814575197

RTT for Chunk 51: 0.019424819946289064

RTT for Chunk 52: 0.04848403930664062

RTT for Chunk 53: 0.029069852828979493

RTT for Chunk 54: 0.02111530303955078

RTT for Chunk 55: 0.020084428787231445

RTT for Chunk 56: 0.021117973327636718

RTT for Chunk 57: 0.028180313110351563

RTT for Chunk 58: 0.029415655136108398

RTT for Chunk 59: 0.030666875839233398

RTT for Chunk 60: 0.03142328262329101

RTT for Chunk 61: 0.01121826171875

RTT for Chunk 62: 0.03894758224487305

RTT for Chunk 63: 0.04794502258300781

RTT for Chunk 64: 0.015076065063476562

RTT for Chunk 65: 0.03820815086364746

RTT for Chunk 66: 0.029931116104125976

RTT for Chunk 67: 0.0386909008026123

RTT for Chunk 68: 0.05085282325744629

RTT for Chunk 69: 0.04935998916625976

RTT for Chunk 70: 0.023042631149291993

RTT for Chunk 71: 0.025053071975708007

RTT for Chunk 72: 0.018441486358642577

RTT for Chunk 73: 0.03943619728088379

RTT for Chunk 74: 0.05320167541503906

RTT for Chunk 75: 0.04116578102111816

RTT for Chunk 76: 0.03924074172973633

RTT for Chunk 77: 0.04097585678100586

RTT for Chunk 78: 0.0321312427520752

RTT for Chunk 79: 0.030580854415893553

RTT for Chunk 80: 0.05919084548950195

RTT for Chunk 81: 0.03944606781005859

RTT for Chunk 82: 0.01208195686340332

RTT for Chunk 83: 0.021514463424682616

RTT for Chunk 84: 0.06000375747680664

RTT for Chunk 85: 0.04858508110046387

RTT for Chunk 86: 0.057689857482910153

RTT for Chunk 87: 0.03397669792175293

RTT for Chunk 88: 0.02329416275024414

RTT for Chunk 89: 0.041138315200805665

RTT for Chunk 90: 0.04887456893920898

RTT for Chunk 91: 0.031110525131225586

RTT for Chunk 92: 0.032597017288208005

RTT for Chunk 93: 0.04015793800354004

RTT for Chunk 94: 0.01269998550415039

RTT for Chunk 95: 0.03283982276916504

RTT for Chunk 96: 0.05893259048461914

RTT for Chunk 97: 0.07803483009338379

RTT for Chunk 98: 0.03214869499206543

RTT for Chunk 99: 0.04970383644104004

RTT for Chunk 100: 0.051389551162719725

RTT for Chunk 101: 0.059163808822631836

RTT for Chunk 102: 0.050977230072021484

RTT for Chunk 103: 0.03132309913635254

RTT for Chunk 104: 0.03812365531921387

RTT for Chunk 105: 0.039682769775390626

RTT for Chunk 106: 0.04952564239501953

RTT for Chunk 107: 0.05035953521728516

RTT for Chunk 108: 0.03149046897888184

RTT for Chunk 109: 0.030093955993652343

RTT for Chunk 110: 0.04791469573974609

No abnormality is recorded in the RTT times

Question 3:
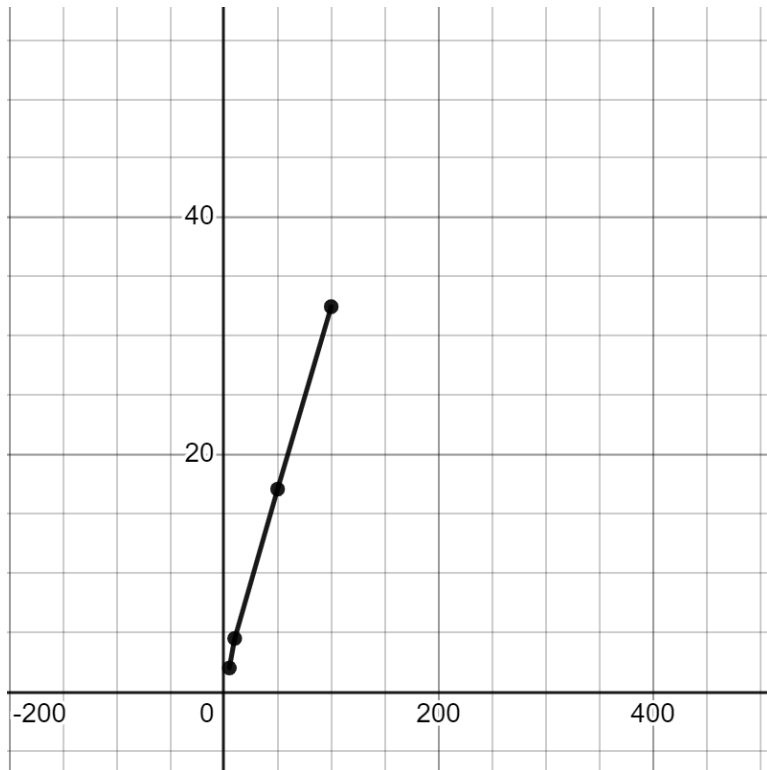
Number of clients	Time required (in s)
5	1.9996697902679443
10	4.4886767864227295
50	17.084293127059937
100	32.47239065170288

The trend is increasing almost linearly. This trend was expected because as the number of clients increase the number of total requests by the clients and the number of chunk remains constant.

Question 4:
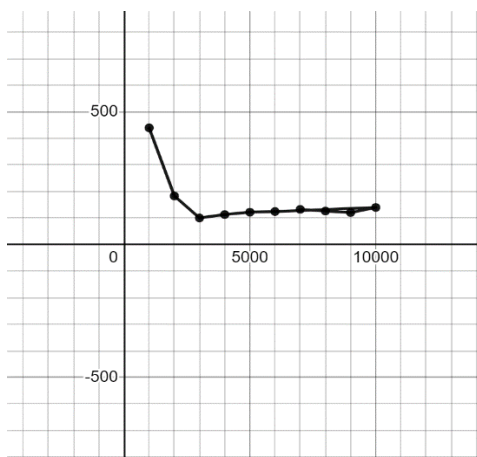
Question 5:

For random ordering:

```
C:\Users\HP\Desktop\SEM 5\COL334\Assignment\Assignment2>Bash 2020CS10386.sh
Start time 1663694020.3338811
Threads joined
get one chunk thread joined
Threads joined
Get chunk thread joined
Endin connections
Sockets closed successfully
Sockets closed
Client connections ended
end time 1663694101.4672763
time elaplsed 81.13339519500732
```

For sequential case:

```
C:\Users\HP\Desktop\SEM 5\COL334\Assignment\Assignment2>Bash 2020CS10386.sh
Start time 1663694341.1459198
get one chunk thread joined
Threads joined
Threads joined
Endin connections
Get chunk thread joined
Sockets closed successfully
Sockets closed
Client connections ended
end time 1663694386.985733
time elaplsed 45.839813232421875
```

The time for random requests is larger than that of sequential requests. This is because in sequential case many clients request a chunk one after the other and thus there are many cache hits. But this does not happen in case of random requests.

Thus temporal locality principle comes into play here and thus time in case of sequential requests decrease.

Food for Thought:

Question 1:

The advantages are: -

i)Scalability: - The PSP network is still more scalable than a traditional file distribution system as here the server only has to handle for the control signals and redirect the files coming from one client to another. Here the server need not involve in searching its database for the required files. Hence the time taken is significantly less.

ii)Higher bandwidth: -

As here different clients get requests from other clients and not the server the net bandwidth of the system is much more than traditional file distribution system

Question2:

The advantage we have got here is that there is a centralised server which can monitor the data going from one client to another and thus prevent from any client sending a malicious file to another client.

Question 3: -

In case of multiple files we would have to send another control signal with each chunk which identifies this chunk with the corresponding file.