COL334 Assignment 2

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1 Introduction

We have established a TCP Socket connection to vayu.iitd.ac.in on port 9801 to download a textfile with 1000 lines by sending SENDLINE requests to which the servers returns by sending a random line.

As the number of unique lines read increases, it becomes less likely to receive a unique line and hence the time taken to read the full document increases.

To optimise the time taken, we add more clients that connect to the server, download the lines from it and then communicate amongst themselves to share the parts of the file and then finally reassembling the entire file.

P2P scenario: The internal communication between the clients is a Peer-to-Peer network architecture which is a versatile method to distribute and share resources information amongst peers.

ncat command:
One method to connect to server vayu.iitd.ac.in at Port 9801 is through the ncat command. The server responds with a random line number and the corresponding line.

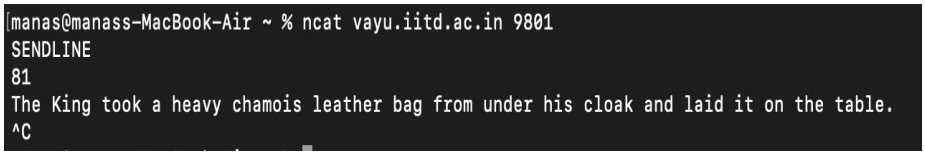


Figure 1: ncat and SENDLINE on Terminal

Using Python:
We can also establish a TCP socket using the below code and it also succesfully returns an arbitrary response.

```
import socket

server_host = "vayu.iitd.ac.in"
server_port = 9801

command = "SENDLINE\n"

client_socket = socket.socket(socket.AF_INET, socket.SOCK_STREAM)

client_socket.connect((server_host, server_port))

client_socket.send(command.encode())

response = client_socket.recv(1024).decode()
print("Server response:", response)

client_socket.close()
```

```
manas@manass-MacBook-Air COL334 % python3 mysocket.py
Server response: 851
"We must sit without light. He would see it through the ventilator."
```

Figure 2: Using Python Code

Reading the entire file

```
import socket
import time

server_host = "vayu.iitd.ac.in"
server_port = 9801
command = "SENDLINE\n"
total_lines = 1000
lines_per_second = 100
time_interval = 1/lines_per_second
client_socket = socket.socket(socket.AF_INET, socket.SOCK_STREAM)
client_socket.connect((server_host, server_port))
received_lines = 0
start_time = time.time()
dic = {}

while received_lines!= total_lines :
    client_socket.send(command.encode())
    response = client_socket.recv(1024).decode()
    if (not(response[0]<='9' and response[0]>='0')) :
        continue
    newtime = time.time()
```

```
    input_string = response
    newline_index = input_string.index("\n")
    number_str = input_string[:newline_index]
    # print(number_str)
    number = int(number_str)
    if number not in dic:
        received_lines += 1
        dic[number] = 1
        print(f"Received line {number}")
    elapsed_time = time.time() - newtime
    if (received_lines % 50 == 0):
        print("time to read", received_lines, "unique lines")
        print(time.time() - start_time)
    if elapsed_time < time_interval:
        time.sleep(time_interval - elapsed_time)

client_socket.close()
end_time = time.time()
total_time = end_time - start_time
print(f"Total time taken: {total_time:.2f} seconds")
```

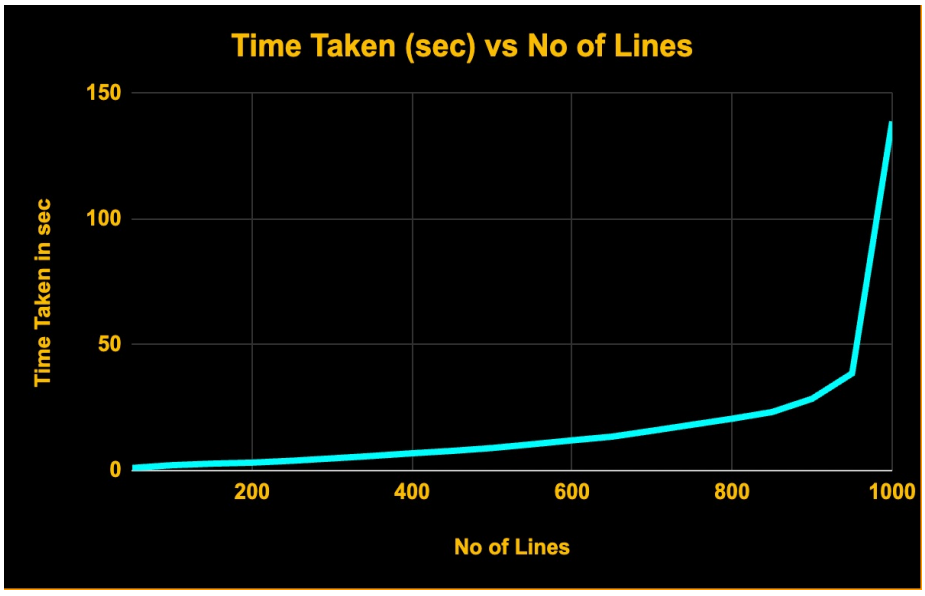
The above code iteratively requests the server to send the unique line until all the 1000 unique lines are received. We also store the time taken to read unique lines in multiples of 50.

```
Received line 860
Received line 154
Received line 193
Received line 100
Received line 776
Received line 941
Received line 858
Received line 939
Received line 831
Received line 306
Received line 375
Received line 724
Received line 804
Received line 66
Received line 59
time to read 1000 unique lines
138.85783696174622
```

Figure 3: Reading all lines

No of Lines	Time Taken (sec)
50	1.03
100	2.13
150	2.75
200	3.14
250	3.9
300	4.83
350	5.8
400	6.87
450	7.81
500	8.96
550	10.45
600	12.01
650	13.49
700	15.82
750	18.23
800	20.62
850	23.27
900	28.55
950	38.64
1000	138.85

Table 1: Time Taken for Different No of Lines



2 Optimisation using Multiple Clients

Obviously, if multiple clients work in cooperation sending SENDLINE requests to vayu parallelly, the chances of getting unique lines increases and hence the time taken to assemble the entire file reduces significantly.

Algorithm

Central Server: We create a central server that accepts unique lines from the clients working in parallel (threading is used here) and starts the text file as a dictionary storing line number and the corresponding line.
Once the entire 1000 lines have been received, the central server then sends back these lines to each of the client which then make the final submission.

Client: The clients are the ones that actually receive lines from the vayu server and then pass on the unique lines to the central server.

```
manas@manass-MacBook-Air COL334 % python3 central_server.py
Central server listening on 10.184.41.229 9805
dictionary length  50
12.34569501876831
dictionary length  100
12.812818765640259
dictionary length  150
13.393183946609497
dictionary length  200
14.192712783813477
dictionary length  250
14.767152786254883
dictionary length  300
15.876114845275879
dictionary length  350
16.649370908737183
dictionary length  400
17.572542905807495
dictionary length  450
18.30624270439148
dictionary length  500
19.655946016311646
dictionary length  550
20.56424593925476
dictionary length  600
21.49072003364563
dictionary length  650
23.35327696800232
dictionary length  700
24.43413281440735
dictionary length  750
26.92913579940796
dictionary length  800
29.255152940750122
dictionary length  850
32.9885528087616
dictionary length  900
37.75280475616455
dictionary length  950
44.26288986206055
dictionary length  1000
90.97832298278809
90.97834396362305
```

Figure 4: 1client-server

Offset: There is a time offset as it adds on the time difference between switching the central server on and then connecting the client. Here the time offset was 11 seconds.

No of Lines	**Time Taken (sec)**
50	1.34
100	1.81
150	2.39
200	3.19
250	3.76
300	4.87
350	5.64
400	6.57
450	7.3
500	8.65
550	9.56
600	10.49
650	12.35
700	13.43
750	15.92
800	18.25
850	21.98
900	26.75
950	33.26
1000	79.97

Table 2: 1 client and Central Server

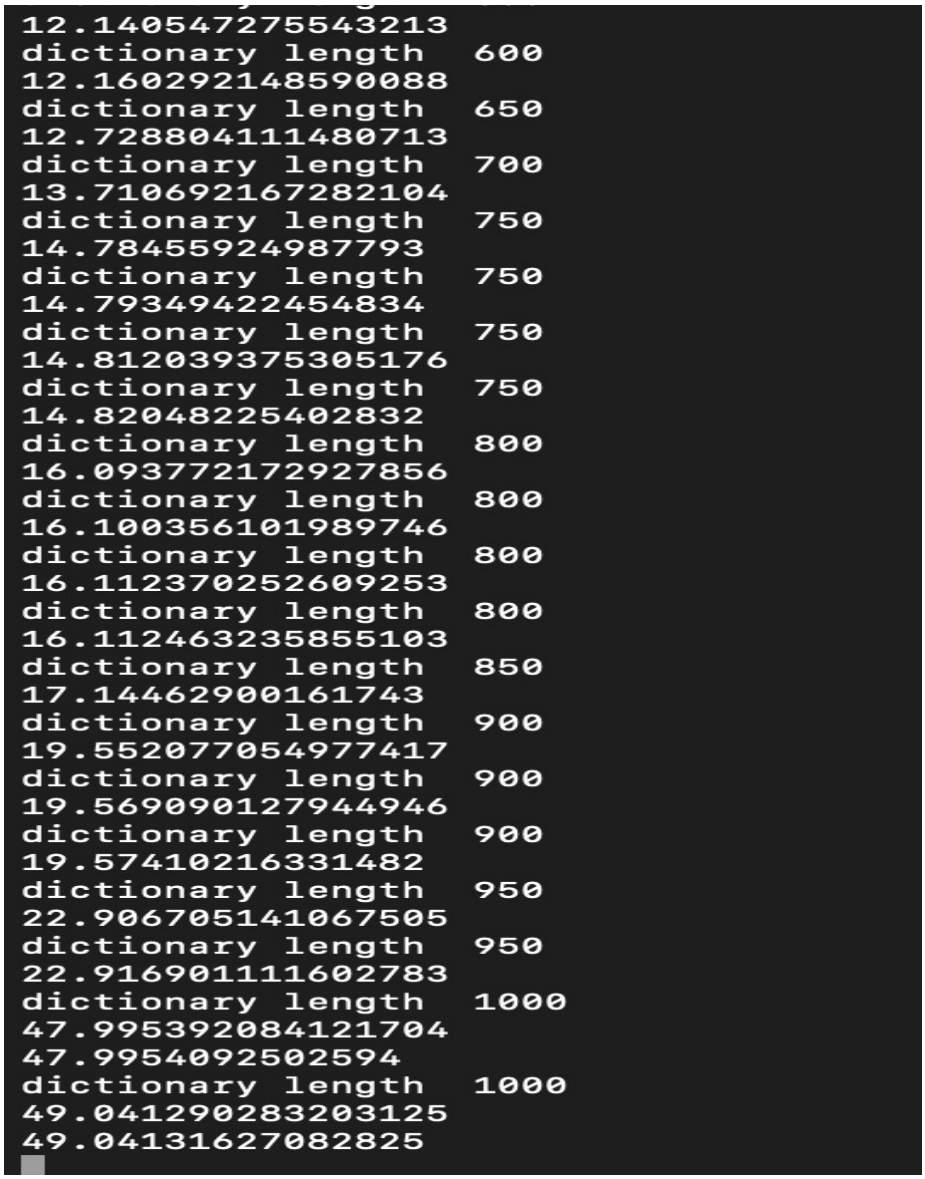


Figure 5: 2client-server

Note- In 2 clients, the time offset was 6 seconds. Following Table shows data

No of Lines	Time Taken (sec)
50	1.06
100	1.32
150	1.67
200	2.06
250	2.37
300	2.75
350	3.4
400	3.88
450	4.66
500	5.03
550	5.54
600	6.12
650	6.72
700	7.71
750	8.78
800	10.09
850	11.14
900	13.55
950	16.9
1000	41.99

Table 3: 2 client and Central Server

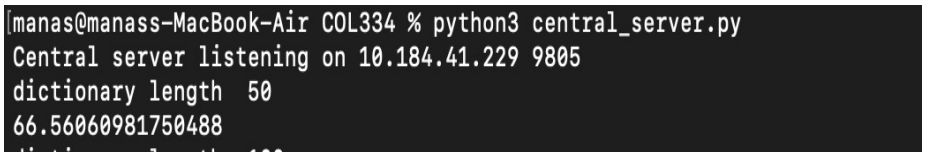


Figure 6: Central Server is Listening on my Device

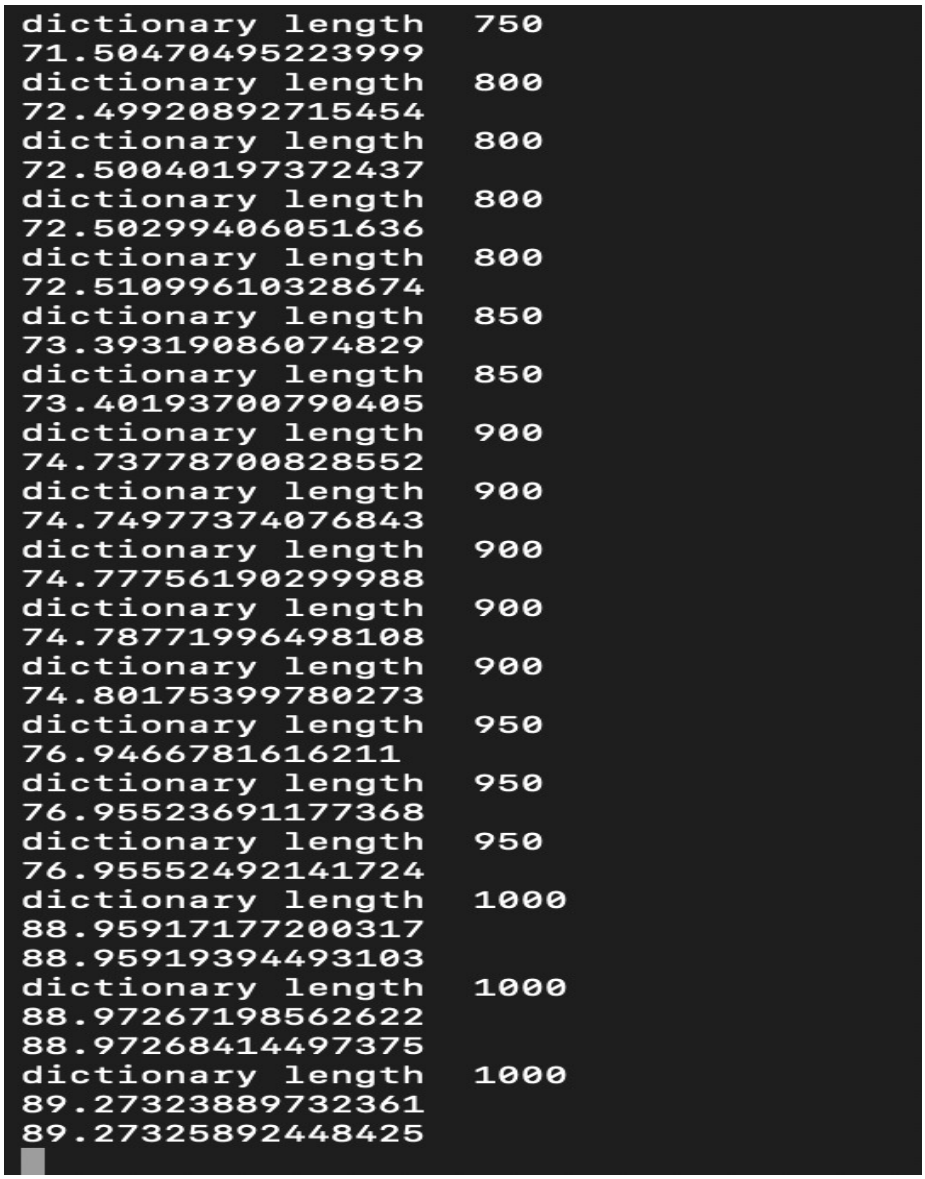


Figure 7: 3client-server

In 3 clients, the time offset was 66 seconds. Following Table shows data

No of Lines	Time Taken (sec)
50	0.56
100	0.74
150	0.99
200	1.23
250	1.48
300	1.73
350	1.96
400	2.21
450	2.52
500	2.81
550	3.22
600	3.59
650	4.22
700	4.9
750	5.5
800	6.49
850	7.39
900	8.73
950	10.94
1000	22.85

Table 4: 3 client and Central Server

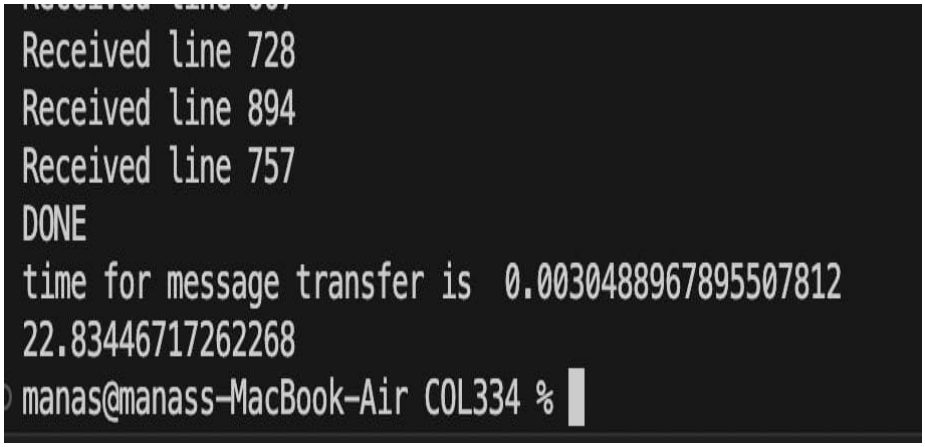


Figure 8: Successful Submission with 3 clients in 22 Seconds

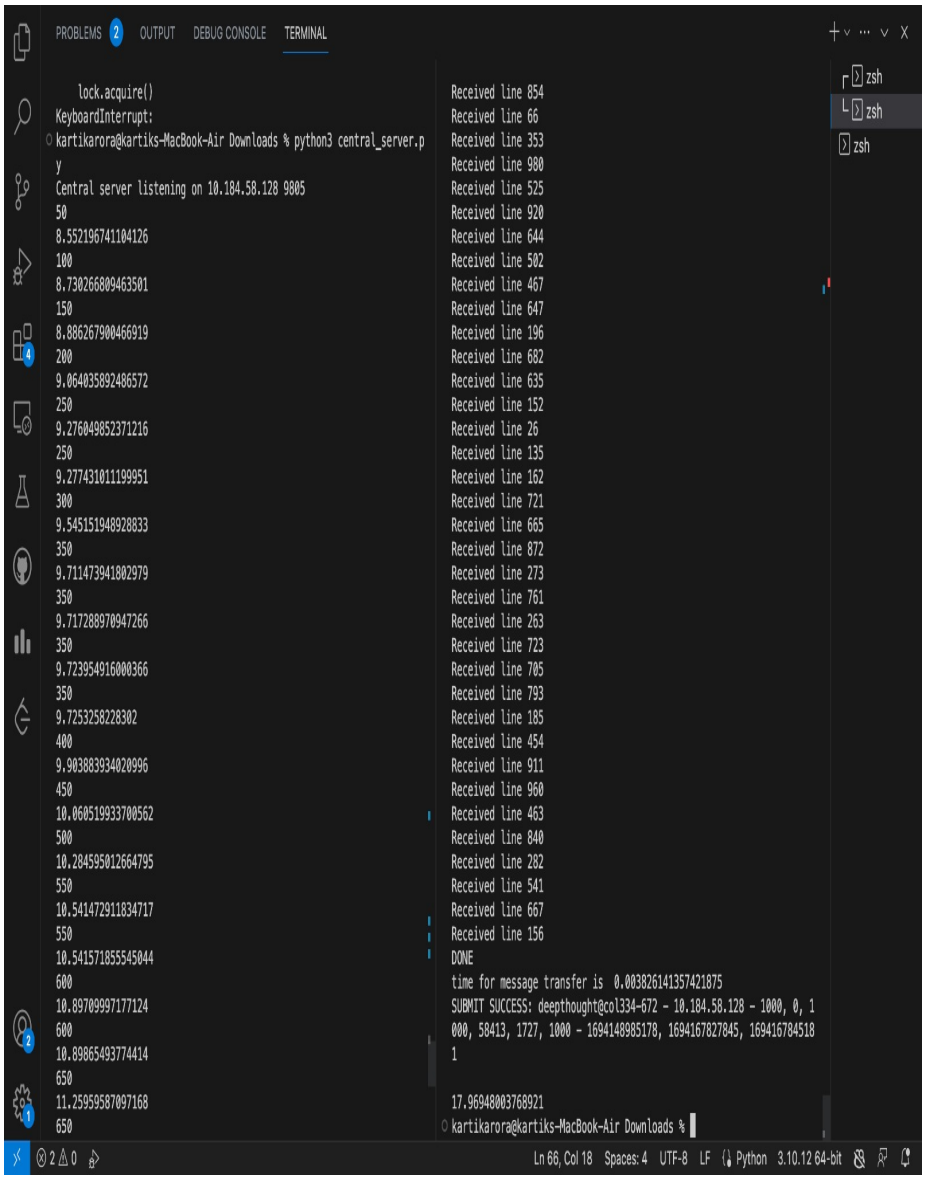


Figure 9: 4client-server

In 4 clients, the time offset was 8 seconds. Following Table shows data

No of Lines	Time Taken (sec)
50	0.55
100	0.73
150	0.88
200	1.06
250	1.27
300	1.54
350	1.71
400	1.9
450	2.06
500	2.28
550	2.54
600	2.89
650	3.25
700	3.56
750	4.14
800	4.73
850	5.55
900	6.68
950	8.28
1000	17.7

Table 5: 4 clients and Central Server

Observe that the time has been so wonderfully reduced to nearly 18 seconds. From assembling the entire using 1 client in 79 sec to just 17 seconds.

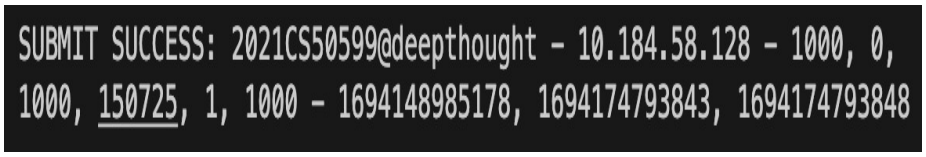


Figure 10: 2021CS50599 - Successful Submission

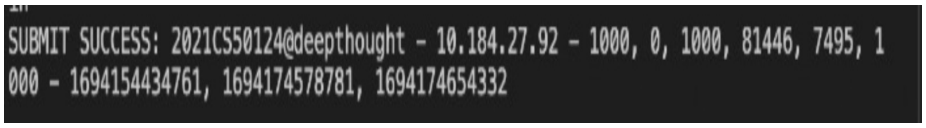


Figure 11: 2021CS50124 - Successful Submission

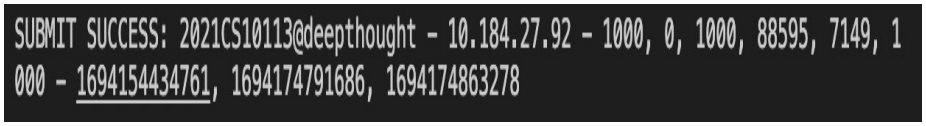


Figure 12: 2021CS10113 - Successful Submission

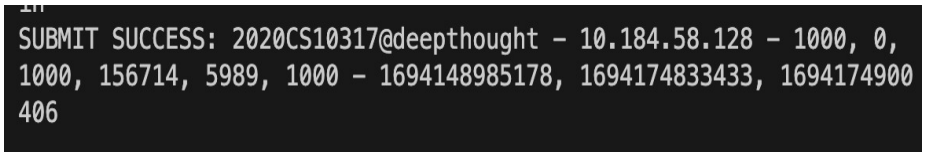


Figure 13: 2021CS10317 - Successful Submission

3 Graphs of Lines vs Time

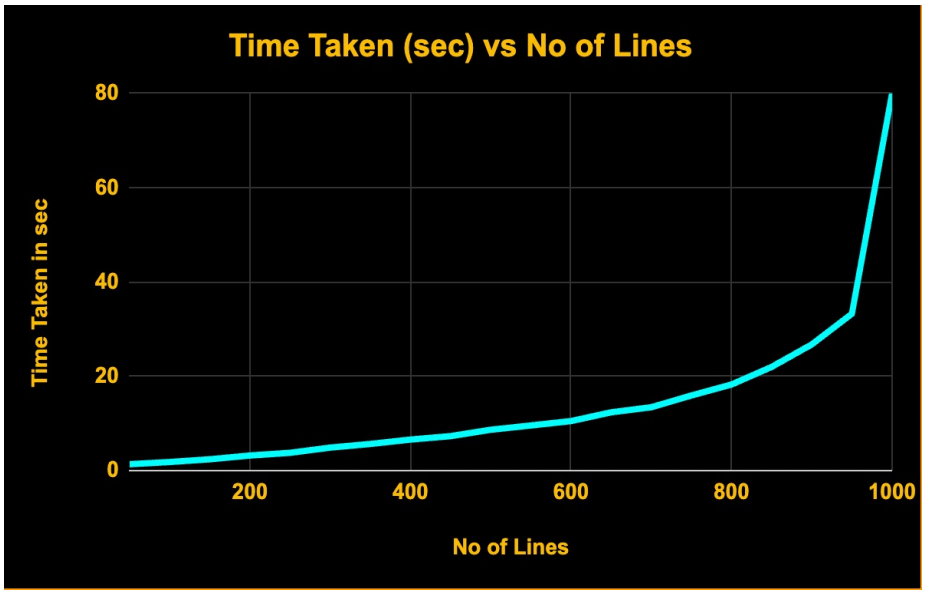


Figure 14: 1 client and Central Server - 79 Sec

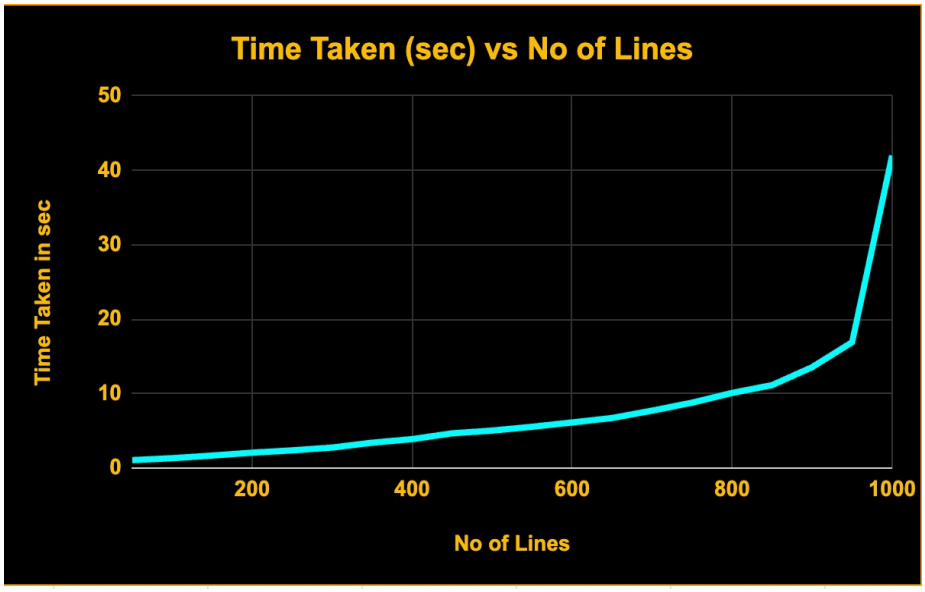


Figure 15: 2 clients and Central Server - 42 Sec

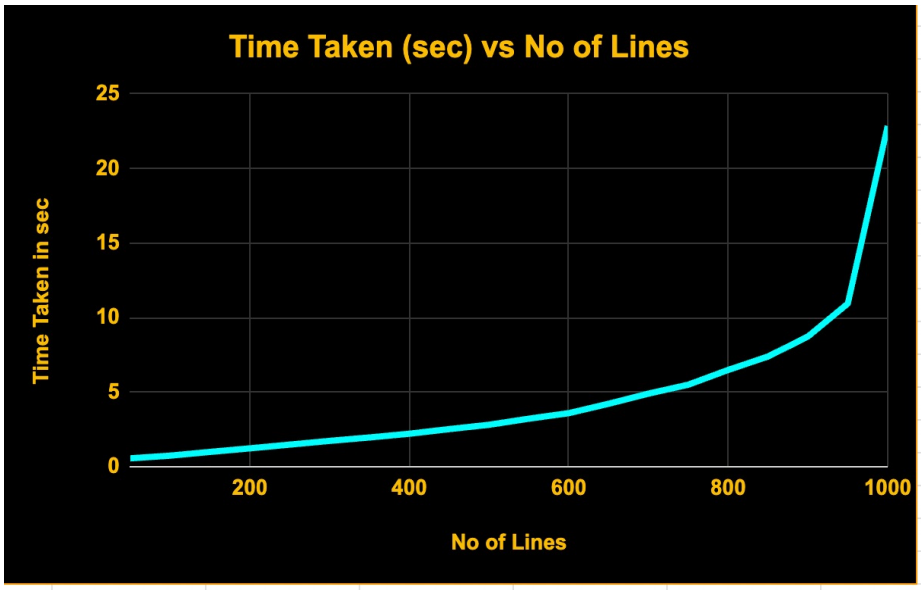


Figure 16: 3 clients and Central Server - 23 Sec

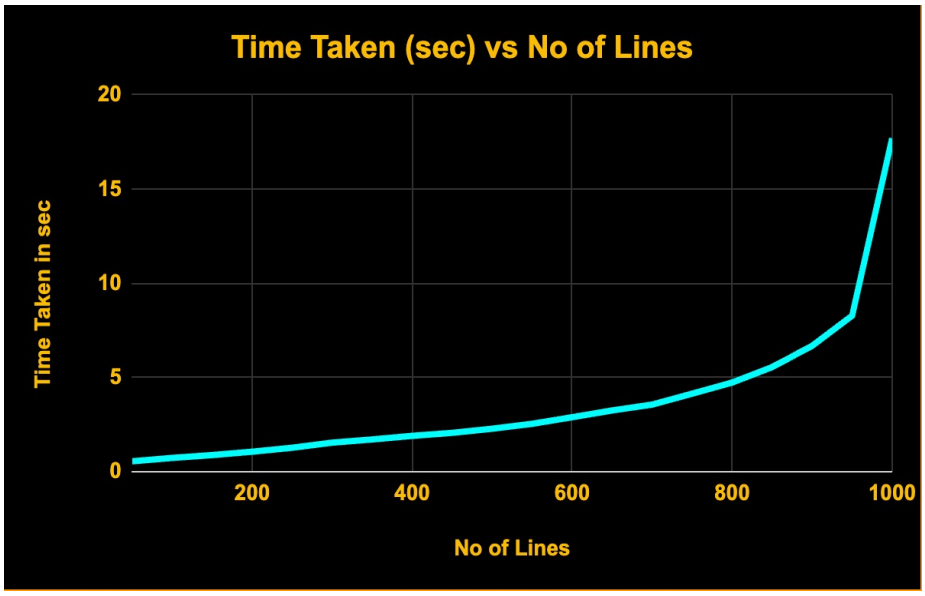


Figure 17: 4 clients and Central Server - 17 Sec