Assignment No.4

Problem Statement:

Implement Berkeley algorithm for clock synchronization.

Code:

 # Python program imitating a client process

```
from timeit import default_timer as timer
from dateutil import parser
import threading
import datetime
import socket
import time


# client thread function used to send time at client side
def startSendingTime(slave_client):
	while True:
		# provide server with clock time at the client
		slave_client.send(str(datetime.datetime.now()).encode())
		print("Recent time sent successfully",end = "\n\n")
		time.sleep(5)
# client thread function used to receive synchronized time
def startReceivingTime(slave_client):
	while True:
		# receive data from the server
		Synchronized_time = parser.parse(slave_client.recv(1024).decode())
		print("Synchronized time at the client is: " + \str(Synchronized_time),end = "\n\n")
# function used to Synchronize client process time
def initiateSlaveClient(port = 8080):
	slave_client = socket.socket()
	# connect to the clock server on local computer
	slave_client.connect(('127.0.0.1', port))
```

```
        # start sending time to server
        print("Starting to receive time from server\n")
        send_time_thread = threading.Thread(target = startSendingTime,args = (slave_client, ))
        send_time_thread.start()
        # start receiving synchronized from server
        print("Starting to receiving " + \"synchronized time from server\n")
        receive_time_thread = threading.Thread(target = startReceivingTime, args = (slave_client, ))
        receive_time_thread.start()
# Driver function
if __name__ == '__main__':
        # initialize the Slave / Client
        initiateSlaveClient(port = 8080)
```

 # Python program imitating a clock server

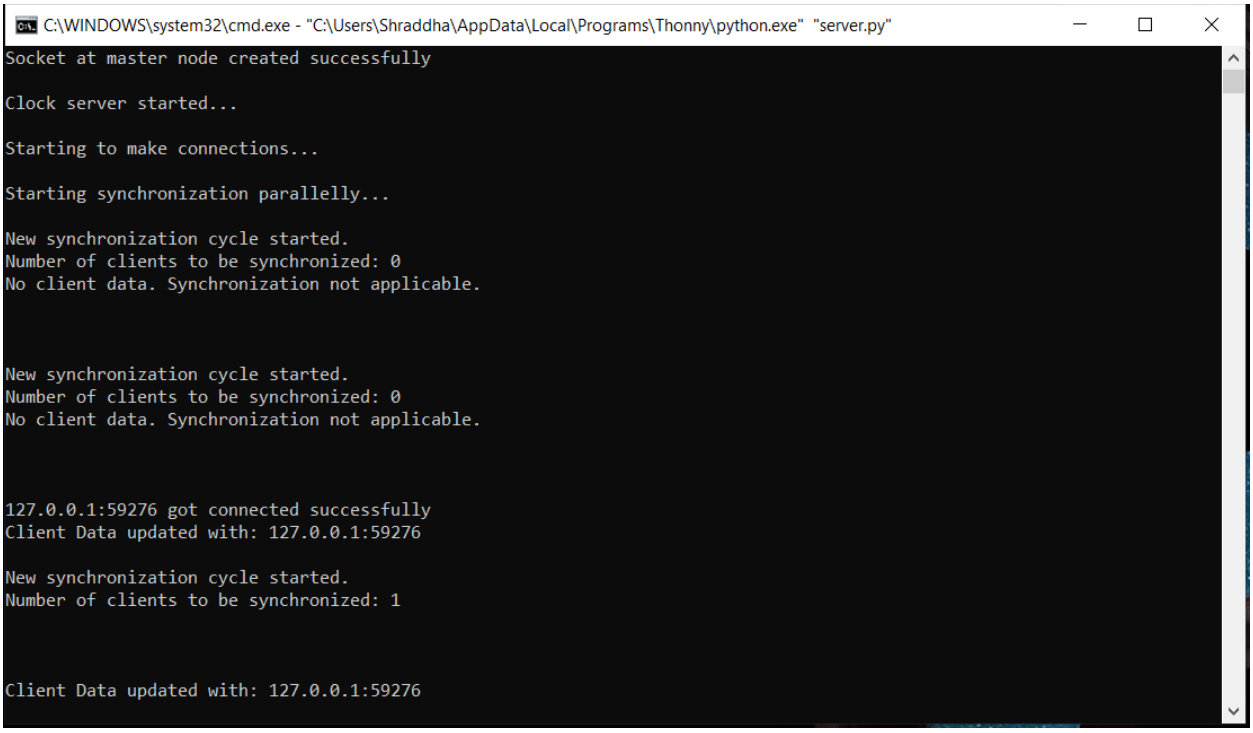
```
from functools import reduce
from dateutil import parser
import threading
import datetime
import socket
import time
# datastructure used to store client address and clock data
client_data = {}
''' nested thread function used to receive
clock time from a connected client '''
def startReceivingClockTime(connector, address):
        while True:
                # receive clock time
                clock_time_string = connector.recv(1024).decode()
                clock_time = parser.parse(clock_time_string)
                clock_time_diff = datetime.datetime.now() - \clock_time
                client_data[address] = {
```

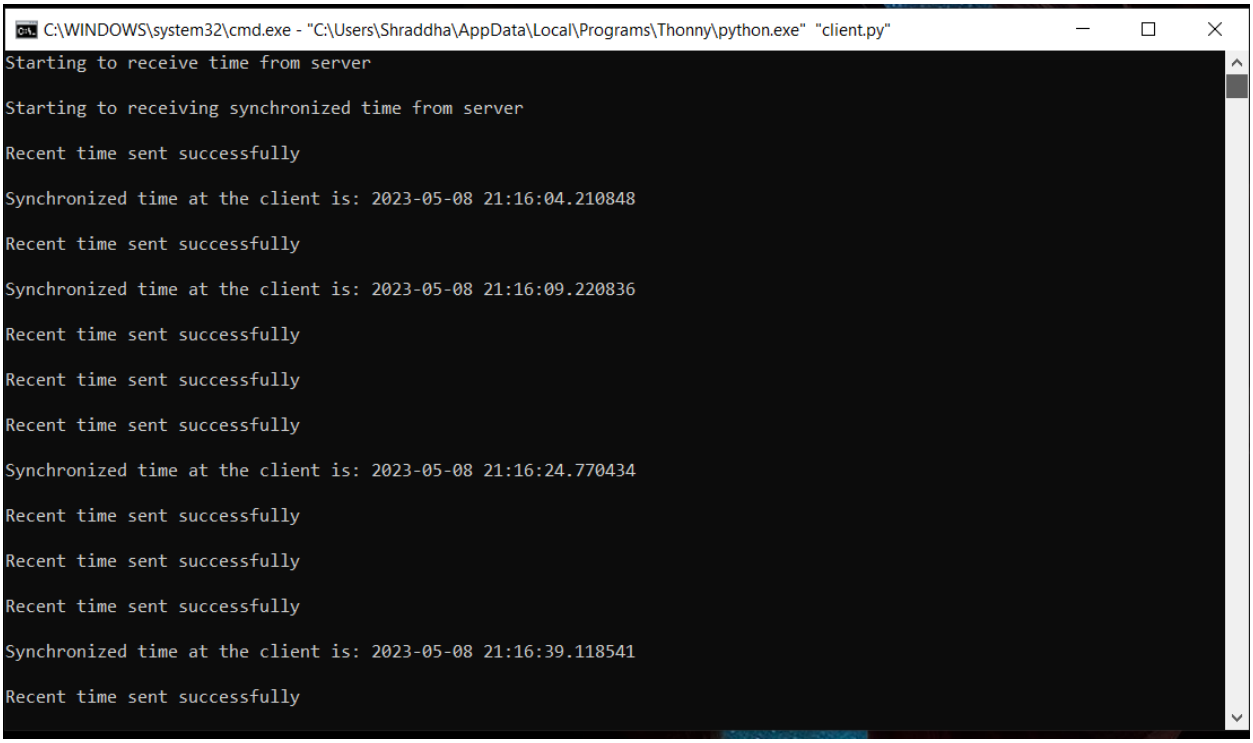
```
                                        "clock_time"      : clock_time,
                                        "time_difference" : clock_time_diff,
                                        "connector"       : connector
                                        }
                print("Client Data updated with: "+ str(address),end = "\n\n")
                time.sleep(5)
''' master thread function used to open portal for
accepting clients over given port '''
def startConnecting(master_server):
        # fetch clock time at slaves / clients
        while True:
                # accepting a client / slave clock client
                master_slave_connector, addr = master_server.accept()
                slave_address = str(addr[0]) + ":" + str(addr[1])
                print(slave_address + " got connected successfully")
                current_thread = threading.Thread(
                                                target = startReceivingClockTime,
                                                args = (master_slave_connector,slave_address, ))
                current_thread.start()

# subroutine function used to fetch average clock difference
def getAverageClockDiff():
        current_client_data = client_data.copy()
        time_difference_list = list(client['time_difference']
        for client_addr, client in client_data.items())
                sum_of_clock_difference = sum(time_difference_list, \datetime.timedelta(0, 0))
                average_clock_difference = sum_of_clock_difference \
                / len(client_data)
        return average_clock_difference
''' master sync thread function used to generate
cycles of clock synchronization in the network '''
def synchronizeAllClocks():
        while True:
```

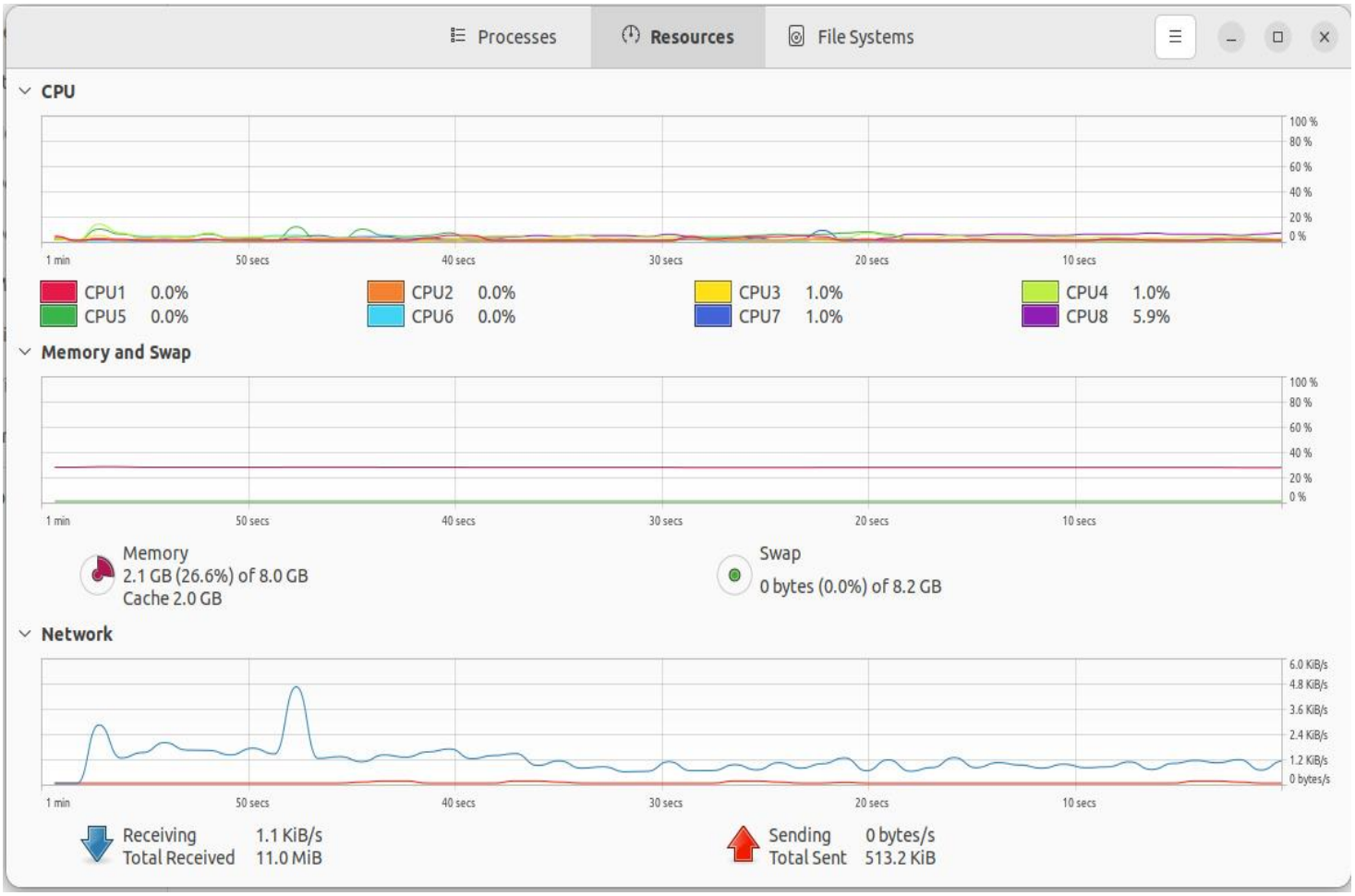
```
                print("New synchronization cycle started.")
                print("Number of clients to be synchronized: " + \str(len(client_data)))
                if len(client_data) > 0:
                        average_clock_difference = getAverageClockDiff()
                        for client_addr, client in client_data.items():
                                try:
                                        synchronized_time = \
                                                datetime.datetime.now() + \
                                                                        average_clock_difference
                                                client['connector'].send(str(
                                                synchronized_time).encode())
                                except Exception as e:
                                        print("Something went wrong while " + \
                                                "sending synchronized time " + \
                                                "through " + str(client_addr))

                else :
                        print("No client data." + \" Synchronization not applicable.")
                        print("\n\n")
                        time.sleep(5)
# function used to initiate the Clock Server / Master Node
def initiateClockServer(port = 8080):
        master_server = socket.socket()
        master_server.setsockopt(socket.SOL_SOCKET,socket.SO_REUSEADDR, 1)
        print("Socket at master node created successfully\n")
        master_server.bind(('', port))

        # Start listening to requests
        master_server.listen(10)
        print("Clock server started...\n")

        # start making connections
        print("Starting to make connections...\n")
```

```
        master_thread = threading.Thread(target = startConnecting,args = (master_server, ))
        master_thread.start()
        # start synchronization
        print("Starting synchronization parallelly...\n")
        sync_thread = threading.Thread(target = synchronizeAllClocks,args = ())
        sync_thread.start()
# Driver function
if __name__ == '__main__':

        # Trigger the Clock Server
        initiateClockServer(port = 8080)
```

OUTPUT:




C:\WINDOWS\system32\cmd.exe - "C:\Users\Shraddha\AppData\Local\Programs\Thonny\python.exe" "client.py"
Starting to receive time from server
Starting to receiving synchronized time from server
Recent time sent successfully
Synchronized time at the client is: 2023-05-08 21:16:04.210848
Recent time sent successfully
Synchronized time at the client is: 2023-05-08 21:16:09.220836
Recent time sent successfully
Recent time sent successfully
Recent time sent successfully
Synchronized time at the client is: 2023-05-08 21:16:24.770434
Recent time sent successfully
Recent time sent successfully
Recent time sent successfully
Synchronized time at the client is: 2023-05-08 21:16:39.118541
Recent time sent successfully


Processes
Resources
File Systems
CPU
100 %
80 %
60 %
40 %
20 %
0 %
1 min
50 secs
40 secs
30 secs
20 secs
10 secs
CPU1 0.0%
CPU2 0.0%
CPU3 1.0%
CPU4 1.0%
CPU5 0.0%
CPU6 0.0%
CPU7 1.0%
CPU8 5.9%
Memory and Swap
Memory
2.1 GB (26.6%) of 8.0 GB
Cache 2.0 GB
Swap
0 bytes (0.0%) of 8.2 GB
Network
6.0 KiB/s
4.8 KiB/s
3.6 KiB/s
2.4 KiB/s
1.2 KiB/s
0 bytes/s
Receiving 1.1 KiB/s
Total Received 11.0 MiB
Sending 0 bytes/s
Total Sent 513.2 KiB