

**Code:**

1. server.py

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server.py
```

```
1 # Python3 program imitating a clock server
2
3 from functools import reduce
4 from dateutil import parser
5 import threading
6 import datetime
7 import socket
8 import time
9
10
11 # datastructure used to store client address and clock data
12 client_data = {}
13
14
15 ''' nested thread function used to receive
16 |   clock time from a connected client '''
17 def startReceivingClockTime(connector, address):
18
19     while True:
20         # receive clock time
21         clock_time_string = connector.recv(1024).decode()
22         clock_time = parser.parse(clock_time_string)
23         clock_time_diff = datetime.datetime.now() - \
24             clock_time
25
26         client_data[address] = {
27             "clock_time": clock_time,
28             "time_difference": clock_time_diff,
29             "connector": connector
30         }
31
32         print("Client Data updated with: "+ str(address),
```

[illegible]

server.py X client.py

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server.py > ...
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64
65
66     sum_of_clock_difference = sum(time_difference_list, \
67                                   datetime.timedelta(0, 0))
68
69     average_clock_difference = sum_of_clock_difference \
70                                / len(client_data)
71
72     return average_clock_difference
73
74
75 ''' master sync thread function used to generate
76     cycles of clock synchronization in the network '''
77 def synchronizeAllClocks():
78
79     while True:
80
81         print("New synchronization cycle started.")
82         print("Number of clients to be synchronized: " + \
83               str(len(client_data)))
84
85         if len(client_data) > 0:
86
87             average_clock_difference = getAverageClockDiff()
88
89             for client_addr, client in client_data.items():
90                 try:
91                     synchronized_time = \
92                         datetime.datetime.now() + \
93                             average_clock_difference
94
95                     client['connector'].send(str(

```

server.py X client.py

server.py > ...

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96         synchronized_time).encode())
97
98     except Exception as e:
99         print("Something went wrong while " + \
100             "sending synchronized time " + \
101             "through " + str(client_addr))
102
103     else :
104         print("No client data." + \
105             " Synchronization not applicable.")
106
107     print("\n\n")
108
109     time.sleep(5)
110
111
112 # function used to initiate the Clock Server / Master Node
113 def initiateClockServer(port = 8080):
114
115     master_server = socket.socket()
116     master_server.setsockopt(socket.SOL_SOCKET,
117                             socket.SO_REUSEADDR, 1)
118
119     print("Socket at master node created successfully\n")
120
121     master_server.bind(('', port))
122
123     # Start listening to requests
124     master_server.listen(10)
125     print("Clock server started...\n")
126
127     # start making connections
```

server.py × client.py

server.py > ...

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122
123     # Start listening to requests
124     master_server.listen(10)
125     print("Clock server started...\n")
126
127     # start making connections
128     print("Starting to make connections...\n")
129     master_thread = threading.Thread(
130         target = startConnecting,
131         args = (master_server, ))
132     master_thread.start()
133
134     # start synchronization
135     print("Starting synchronization parallelly...\n")
136     sync_thread = threading.Thread(
137         target = synchronizeAllClocks,
138         args = ())
139     sync_thread.start()
140
141
142
143     # Driver function
144     if __name__ == '__main__':
145
146         # Trigger the Clock Server
147         initiateClockServer(port = 8080)
148
```

## 2. client.py

 server.py

client.py ✕

 client.py > ...

```

1  # Python3 program imitating a client process
2
3  from timeit import default_timer as timer
4  from dateutil import parser
5  import threading
6  import datetime
7  import socket
8  import time
9
10 |
11 # client thread function used to send time at client side
12 def startSendingTime(slave_client):
13
14     while True:
15         # provide server with clock time at the client
16         slave_client.send(str(
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```

```

32         print("Synchronized time at the client is: " + \
33               str(Synchronized_time),
34               end = "\n\n")
35
36
37 # function used to Synchronize client process time
38 def initiateSlaveClient(port = 8080):
39
40     slave_client = socket.socket()
41
42     # connect to the clock server on local computer
43     slave_client.connect(('127.0.0.1', port))
44
45     # start sending time to server
46     print("Starting to receive time from server\n")
47     send_time_thread = threading.Thread(
48         target = startSendingTime,
49         args = (slave_client, ))
50     send_time_thread.start()
51
52
53     # start receiving synchronized from server
54     print("Starting to receiving " + \
55           "synchronized time from server\n")
56     receive_time_thread = threading.Thread(
57         target = startReceivingTime,
58         args = (slave_client, ))
59     receive_time_thread.start()
60
61
62 # Driver function
63 if __name__ == '__main__':
64
65     # initialize the Slave / Client
66     initiateSlaveClient(port = 8080)
67

```

## Output:

1. server.py

```
varadmash@varadmash-G3-3590: ~/LP5_lab/Assignment4
varadmash@varadmash-G3-3590:~/LP5_lab/Assignment4$ python3 server.py
Socket at master node created successfully

Clock server started...

Starting to make connections...

Starting synchronization parallelly...

New synchronization cycle started.
Number of clients to be synchronized: 0
No client data. Synchronization not applicable.

New synchronization cycle started.
Number of clients to be synchronized: 0
No client data. Synchronization not applicable.

New synchronization cycle started.
Number of clients to be synchronized: 0
No client data. Synchronization not applicable.

127.0.0.1:57914 got connected successfully
Client Data updated with: 127.0.0.1:57914

New synchronization cycle started.
Number of clients to be synchronized: 1

Client Data updated with: 127.0.0.1:57914
```



## 2. client.py

```
varadmash@varadmash-G3-3590: ~/LP5_lab/Assignment4
varadmash@varadmash-G3-3590:~/LP5_lab/Assignment4$ python3 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: 2023-04-17 08:32:50.227670

Recent time sent successfully

Synchronized time at the client is: 2023-04-17 08:32:55.233435

Recent time sent successfully

Synchronized time at the client is: 2023-04-17 08:33:00.240540

Recent time sent successfully

Synchronized time at the client is: 2023-04-17 08:33:05.244915

Recent time sent successfully

Synchronized time at the client is: 2023-04-17 08:33:10.252219

Recent time sent successfully

Synchronized time at the client is: 2023-04-17 08:33:15.259624

Recent time sent successfully

Synchronized time at the client is: 2023-04-17 08:33:20.265197

Recent time sent successfully

Synchronized time at the client is: 2023-04-17 08:33:25.271967
```