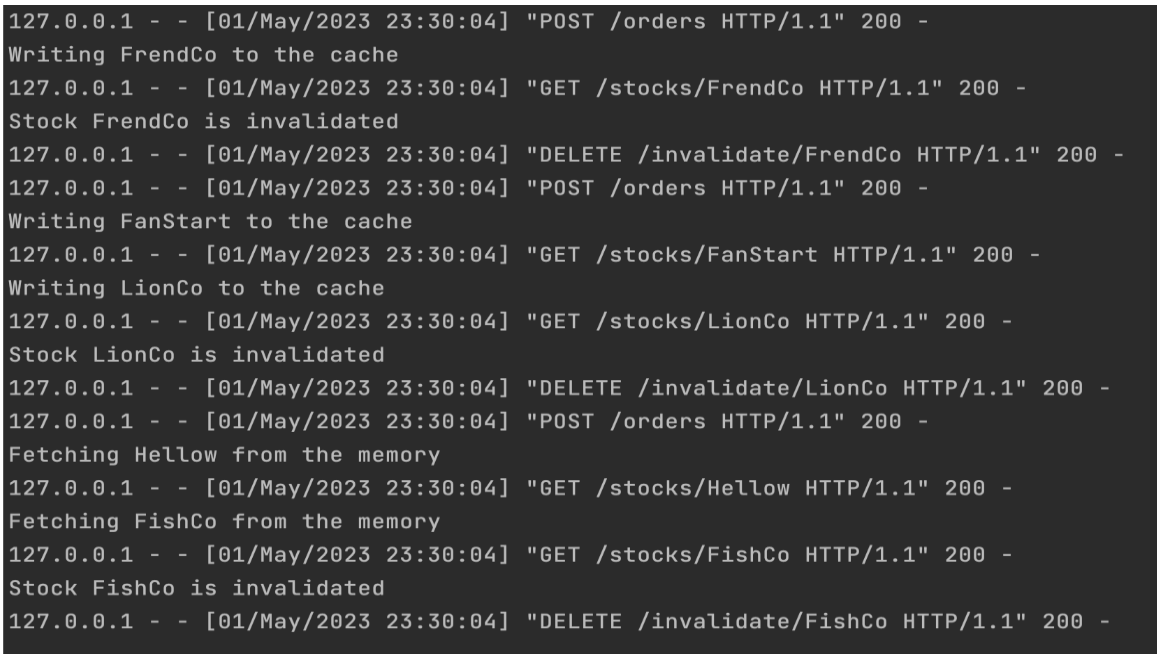
Output

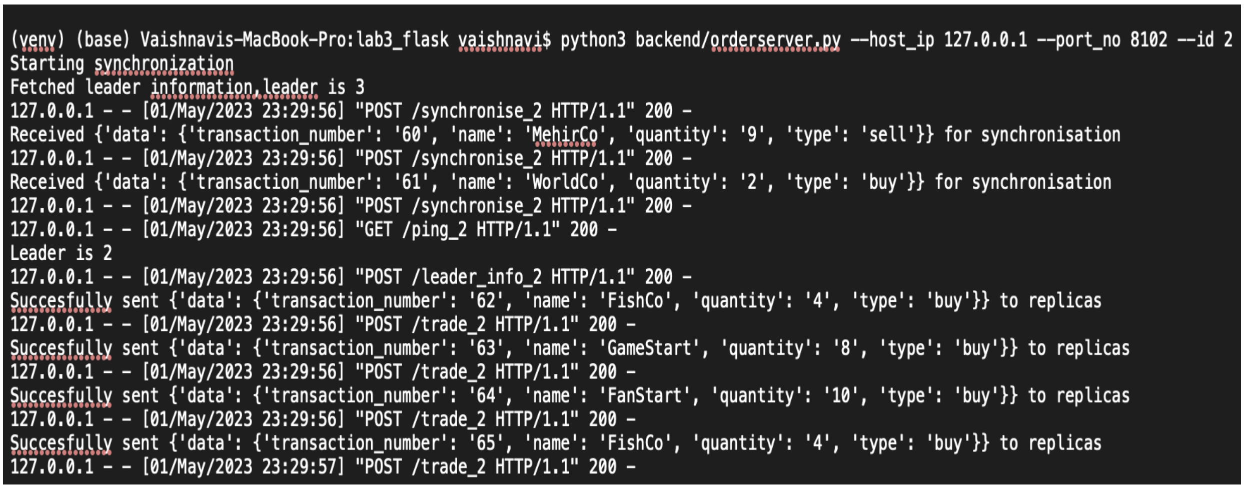
1. Frontend server outputs with cache enabled



```
127.0.0.1 - - [01/May/2023 23:30:04] "POST /orders HTTP/1.1" 200 -
Writing FrendCo to the cache
127.0.0.1 - - [01/May/2023 23:30:04] "GET /stocks/FrendCo HTTP/1.1" 200 -
Stock FrendCo is invalidated
127.0.0.1 - - [01/May/2023 23:30:04] "DELETE /invalidate/FrendCo HTTP/1.1" 200 -
127.0.0.1 - - [01/May/2023 23:30:04] "POST /orders HTTP/1.1" 200 -
Writing FanStart to the cache
127.0.0.1 - - [01/May/2023 23:30:04] "GET /stocks/FanStart HTTP/1.1" 200 -
Writing LionCo to the cache
127.0.0.1 - - [01/May/2023 23:30:04] "GET /stocks/LionCo HTTP/1.1" 200 -
Stock LionCo is invalidated
127.0.0.1 - - [01/May/2023 23:30:04] "DELETE /invalidate/LionCo HTTP/1.1" 200 -
127.0.0.1 - - [01/May/2023 23:30:04] "POST /orders HTTP/1.1" 200 -
Fetching Hellow from the memory
127.0.0.1 - - [01/May/2023 23:30:04] "GET /stocks/Hellow HTTP/1.1" 200 -
Fetching FishCo from the memory
127.0.0.1 - - [01/May/2023 23:30:04] "GET /stocks/FishCo HTTP/1.1" 200 -
Stock FishCo is invalidated
127.0.0.1 - - [01/May/2023 23:30:04] "DELETE /invalidate/FishCo HTTP/1.1" 200 -
```

The above code shows outputs for get,post and delete requests sent to the frontend server. The stocks are fetched from the memory if they are present. The stocks are invalidated if an invalidation request comes from the catalog server.The stock is cached into the memory if it is received as a response from frontend server.

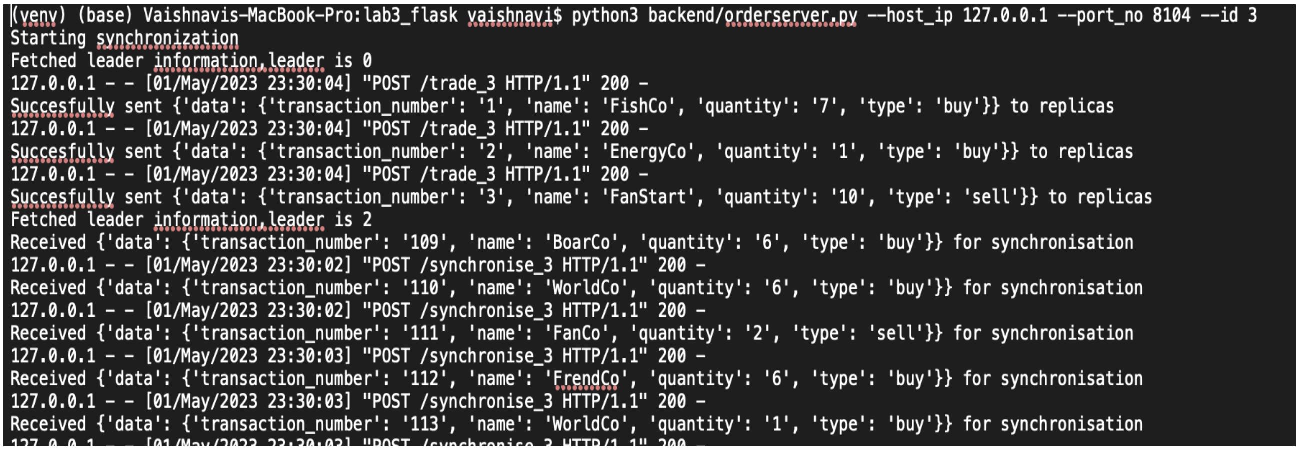
2.Order server replica 2 output



```
(venv) (base) Vaishnavis-MacBook-Pro:lab3_flask vaishnavi$ python3 backend/orderserver.py --host_ip 127.0.0.1 --port_no 8102 --id 2
Starting synchronization
Fetched leader information,leader is 3
127.0.0.1 - - [01/May/2023 23:29:56] "POST /synchronise_2 HTTP/1.1" 200 -
Received {'data': {'transaction_number': '60', 'name': 'MehirCo', 'quantity': '9', 'type': 'sell'}} for synchronisation
127.0.0.1 - - [01/May/2023 23:29:56] "POST /synchronise_2 HTTP/1.1" 200 -
Received {'data': {'transaction_number': '61', 'name': 'WorldCo', 'quantity': '2', 'type': 'buy'}} for synchronisation
127.0.0.1 - - [01/May/2023 23:29:56] "POST /synchronise_2 HTTP/1.1" 200 -
127.0.0.1 - - [01/May/2023 23:29:56] "GET /ping_2 HTTP/1.1" 200 -
Leader is 2
127.0.0.1 - - [01/May/2023 23:29:56] "POST /leader_info_2 HTTP/1.1" 200 -
Succesfully sent {'data': {'transaction_number': '62', 'name': 'FishCo', 'quantity': '4', 'type': 'buy'}} to replicas
127.0.0.1 - - [01/May/2023 23:29:56] "POST /trade_2 HTTP/1.1" 200 -
Succesfully sent {'data': {'transaction_number': '63', 'name': 'GameStart', 'quantity': '8', 'type': 'buy'}} to replicas
127.0.0.1 - - [01/May/2023 23:29:56] "POST /trade_2 HTTP/1.1" 200 -
Succesfully sent {'data': {'transaction_number': '64', 'name': 'FanStart', 'quantity': '10', 'type': 'buy'}} to replicas
127.0.0.1 - - [01/May/2023 23:29:56] "POST /trade_2 HTTP/1.1" 200 -
Succesfully sent {'data': {'transaction_number': '65', 'name': 'FishCo', 'quantity': '4', 'type': 'buy'}} to replicas
127.0.0.1 - - [01/May/2023 23:29:57] "POST /trade_2 HTTP/1.1" 200 -
```

The above code shows the working of the order server replica 2.The leader is initially order server 3.This server receives synchronization messages from the frontend server for different trades. After a while,the server 3 crashes and the leader is now server 2.This server then becomes the leader and sends trade requests to the other replicas.

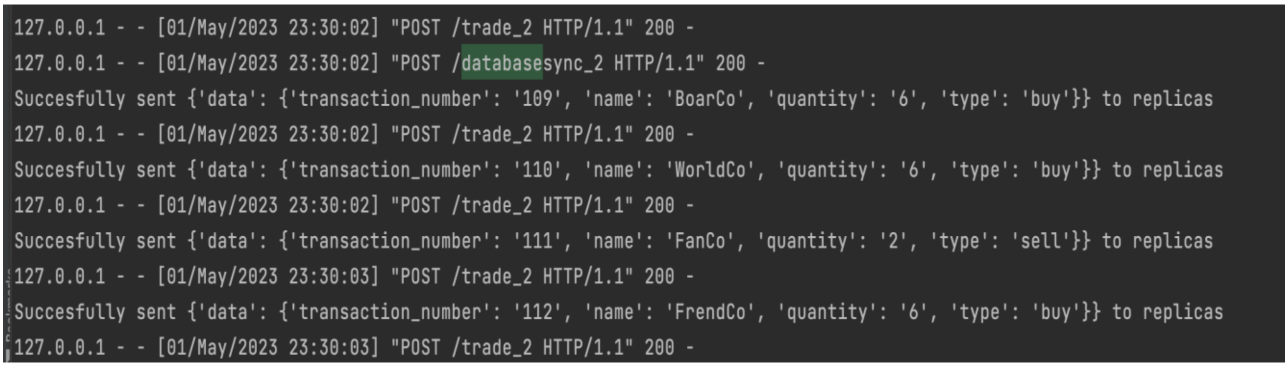
3. Order server replica 3 output with fault tolerance



```
(venv) (base) Vaishnavis-MacBook-Pro:lab3_flask vaishnavi$ python3 backend/orderserver.py --host_ip 127.0.0.1 --port_no 8104 --id 3
Starting synchronization
Fetched leader information,leader is 0
127.0.0.1 - - [01/May/2023 23:30:04] "POST /trade_3 HTTP/1.1" 200 -
Succesfully sent {'data': {'transaction_number': '1', 'name': 'FishCo', 'quantity': '7', 'type': 'buy'}} to replicas
127.0.0.1 - - [01/May/2023 23:30:04] "POST /trade_3 HTTP/1.1" 200 -
Succesfully sent {'data': {'transaction_number': '2', 'name': 'EnergyCo', 'quantity': '1', 'type': 'buy'}} to replicas
127.0.0.1 - - [01/May/2023 23:30:04] "POST /trade_3 HTTP/1.1" 200 -
Succesfully sent {'data': {'transaction_number': '3', 'name': 'FanStart', 'quantity': '10', 'type': 'sell'}} to replicas
Fetched leader information,leader is 2
Received {'data': {'transaction_number': '109', 'name': 'BoarCo', 'quantity': '6', 'type': 'buy'}} for synchronisation
127.0.0.1 - - [01/May/2023 23:30:02] "POST /synchronise_3 HTTP/1.1" 200 -
Received {'data': {'transaction_number': '110', 'name': 'WorldCo', 'quantity': '6', 'type': 'buy'}} for synchronisation
127.0.0.1 - - [01/May/2023 23:30:02] "POST /synchronise_3 HTTP/1.1" 200 -
Received {'data': {'transaction_number': '111', 'name': 'FanCo', 'quantity': '2', 'type': 'sell'}} for synchronisation
127.0.0.1 - - [01/May/2023 23:30:03] "POST /synchronise_3 HTTP/1.1" 200 -
Received {'data': {'transaction_number': '112', 'name': 'FrendCo', 'quantity': '6', 'type': 'buy'}} for synchronisation
127.0.0.1 - - [01/May/2023 23:30:03] "POST /synchronise_3 HTTP/1.1" 200 -
Received {'data': {'transaction_number': '113', 'name': 'WorldCo', 'quantity': '1', 'type': 'buy'}} for synchronisation
127.0.0.1 - - [01/May/2023 23:30:03] "POST /synchronise_3 HTTP/1.1" 200 -
```

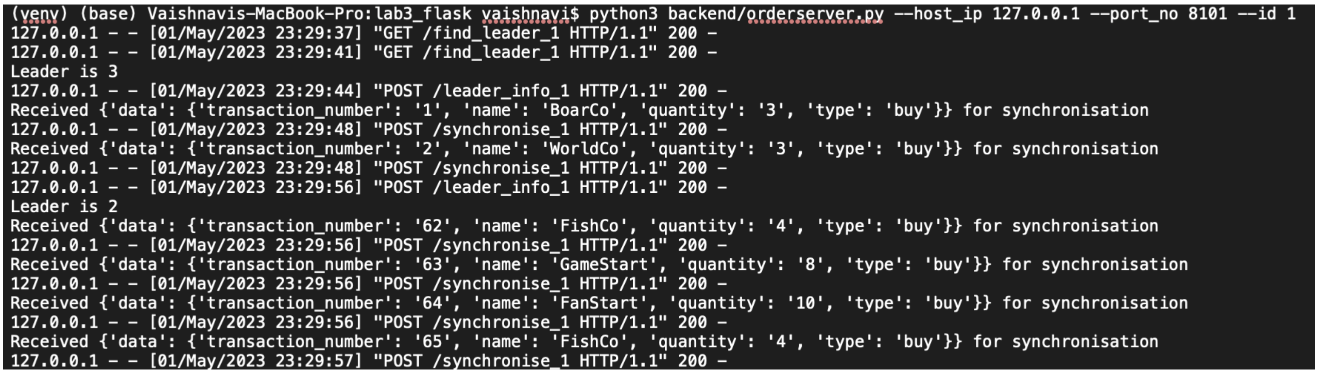
The above code shows the working of the order server replica 3.The leader is initially 0 as the frontend server has not started yet. This takes trade requests and sends the synchronization to the replicas. After a while the server crashes and is restarted. The server then gets the leader information and receives synchronization messages from the leader.

Below is the corresponding order server 2’s output which gets the database sync request and also sends the transactions.



```
127.0.0.1 - - [01/May/2023 23:30:02] "POST /trade_2 HTTP/1.1" 200 -
127.0.0.1 - - [01/May/2023 23:30:02] "POST /databasesync_2 HTTP/1.1" 200 -
Succesfully sent {'data': {'transaction_number': '109', 'name': 'BoarCo', 'quantity': '6', 'type': 'buy'}} to replicas
127.0.0.1 - - [01/May/2023 23:30:02] "POST /trade_2 HTTP/1.1" 200 -
Succesfully sent {'data': {'transaction_number': '110', 'name': 'WorldCo', 'quantity': '6', 'type': 'buy'}} to replicas
127.0.0.1 - - [01/May/2023 23:30:02] "POST /trade_2 HTTP/1.1" 200 -
Succesfully sent {'data': {'transaction_number': '111', 'name': 'FanCo', 'quantity': '2', 'type': 'sell'}} to replicas
127.0.0.1 - - [01/May/2023 23:30:03] "POST /trade_2 HTTP/1.1" 200 -
Succesfully sent {'data': {'transaction_number': '112', 'name': 'FrendCo', 'quantity': '6', 'type': 'buy'}} to replicas
127.0.0.1 - - [01/May/2023 23:30:03] "POST /trade_2 HTTP/1.1" 200 -
```

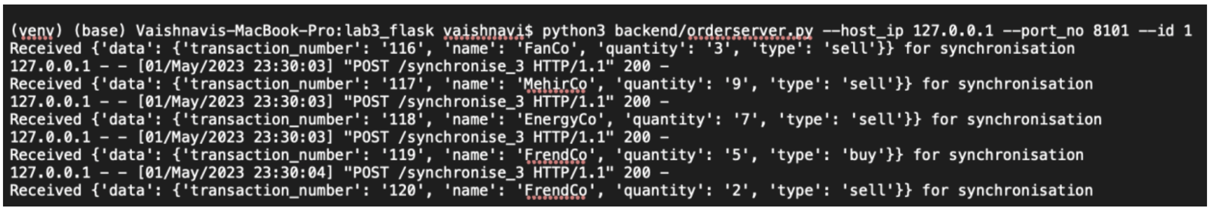
4. Order server replica 1 output



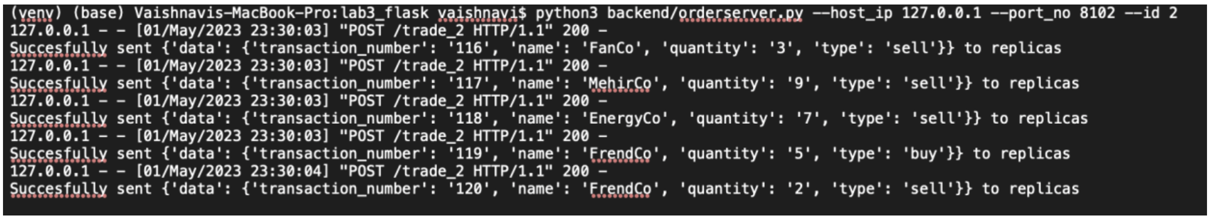
```
(venv) (base) Vaishnavis-MacBook-Pro:lab3_flask vaishnavi$ python3 backend/orderserver.py --host_ip 127.0.0.1 --port_no 8101 --id 1
127.0.0.1 - - [01/May/2023 23:29:37] "GET /find_leader_1 HTTP/1.1" 200 -
127.0.0.1 - - [01/May/2023 23:29:41] "GET /find_leader_1 HTTP/1.1" 200 -
Leader is 3
127.0.0.1 - - [01/May/2023 23:29:44] "POST /leader_info_1 HTTP/1.1" 200 -
Received {'data': {'transaction_number': '1', 'name': 'BoarCo', 'quantity': '3', 'type': 'buy'}} for synchronisation
127.0.0.1 - - [01/May/2023 23:29:48] "POST /synchronise_1 HTTP/1.1" 200 -
Received {'data': {'transaction_number': '2', 'name': 'WorldCo', 'quantity': '3', 'type': 'buy'}} for synchronisation
127.0.0.1 - - [01/May/2023 23:29:48] "POST /synchronise_1 HTTP/1.1" 200 -
127.0.0.1 - - [01/May/2023 23:29:56] "POST /leader_info_1 HTTP/1.1" 200 -
Leader is 2
Received {'data': {'transaction_number': '62', 'name': 'FishCo', 'quantity': '4', 'type': 'buy'}} for synchronisation
127.0.0.1 - - [01/May/2023 23:29:56] "POST /synchronise_1 HTTP/1.1" 200 -
Received {'data': {'transaction_number': '63', 'name': 'GameStart', 'quantity': '8', 'type': 'buy'}} for synchronisation
127.0.0.1 - - [01/May/2023 23:29:56] "POST /synchronise_1 HTTP/1.1" 200 -
Received {'data': {'transaction_number': '64', 'name': 'FanStart', 'quantity': '10', 'type': 'buy'}} for synchronisation
127.0.0.1 - - [01/May/2023 23:29:56] "POST /synchronise_1 HTTP/1.1" 200 -
Received {'data': {'transaction_number': '65', 'name': 'FishCo', 'quantity': '4', 'type': 'buy'}} for synchronisation
127.0.0.1 - - [01/May/2023 23:29:57] "POST /synchronise_1 HTTP/1.1" 200 -
```

The above code shows the working of the order server replica 1. The leader is initially 3.It takes trade synchronizations from server 3. After a while , server 3 crashes and the leader is 2.It now takes synchronization requests from server 2.

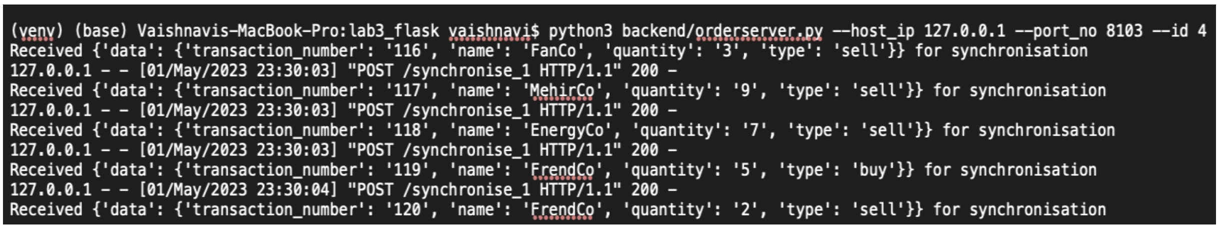
5. All the replica servers with data: The order server 2 is the leader and it sends synchronization messages to both replicas 1 and 2.The below screenshots show the data sent and received at the replicas during a trade transaction.



```
(venv) (base) Vaishnavis-MacBook-Pro:lab3_flask vaishnavi$ python3 backend/orderserver.py --host_ip 127.0.0.1 --port_no 8101 --id 1
Received {'data': {'transaction_number': '116', 'name': 'FanCo', 'quantity': '3', 'type': 'sell'}} for synchronisation
127.0.0.1 - - [01/May/2023 23:30:03] "POST /synchronise_3 HTTP/1.1" 200 -
Received {'data': {'transaction_number': '117', 'name': 'MehirCo', 'quantity': '9', 'type': 'sell'}} for synchronisation
127.0.0.1 - - [01/May/2023 23:30:03] "POST /synchronise_3 HTTP/1.1" 200 -
Received {'data': {'transaction_number': '118', 'name': 'EnergyCo', 'quantity': '7', 'type': 'sell'}} for synchronisation
127.0.0.1 - - [01/May/2023 23:30:03] "POST /synchronise_3 HTTP/1.1" 200 -
Received {'data': {'transaction_number': '119', 'name': 'FrendCo', 'quantity': '5', 'type': 'buy'}} for synchronisation
127.0.0.1 - - [01/May/2023 23:30:04] "POST /synchronise_3 HTTP/1.1" 200 -
Received {'data': {'transaction_number': '120', 'name': 'FrendCo', 'quantity': '2', 'type': 'sell'}} for synchronisation
```



```
(venv) (base) Vaishnavis-MacBook-Pro:lab3_flask vaishnavi$ python3 backend/orderserver.py --host_ip 127.0.0.1 --port_no 8102 --id 2
127.0.0.1 - - [01/May/2023 23:30:03] "POST /trade_2 HTTP/1.1" 200 -
Succesfully sent {'data': {'transaction_number': '116', 'name': 'FanCo', 'quantity': '3', 'type': 'sell'}} to replicas
127.0.0.1 - - [01/May/2023 23:30:03] "POST /trade_2 HTTP/1.1" 200 -
Succesfully sent {'data': {'transaction_number': '117', 'name': 'MehirCo', 'quantity': '9', 'type': 'sell'}} to replicas
127.0.0.1 - - [01/May/2023 23:30:03] "POST /trade_2 HTTP/1.1" 200 -
Succesfully sent {'data': {'transaction_number': '118', 'name': 'EnergyCo', 'quantity': '7', 'type': 'sell'}} to replicas
127.0.0.1 - - [01/May/2023 23:30:03] "POST /trade_2 HTTP/1.1" 200 -
Succesfully sent {'data': {'transaction_number': '119', 'name': 'FrendCo', 'quantity': '5', 'type': 'buy'}} to replicas
127.0.0.1 - - [01/May/2023 23:30:04] "POST /trade_2 HTTP/1.1" 200 -
Succesfully sent {'data': {'transaction_number': '120', 'name': 'FrendCo', 'quantity': '2', 'type': 'sell'}} to replicas
```



```
(venv) (base) Vaishnavis-MacBook-Pro:lab3_flask vaishnavi$ python3 backend/orderserver.py --host_ip 127.0.0.1 --port_no 8103 --id 4
Received {'data': {'transaction_number': '116', 'name': 'FanCo', 'quantity': '3', 'type': 'sell'}} for synchronisation
127.0.0.1 - - [01/May/2023 23:30:03] "POST /synchronise_1 HTTP/1.1" 200 -
Received {'data': {'transaction_number': '117', 'name': 'MehirCo', 'quantity': '9', 'type': 'sell'}} for synchronisation
127.0.0.1 - - [01/May/2023 23:30:03] "POST /synchronise_1 HTTP/1.1" 200 -
Received {'data': {'transaction_number': '118', 'name': 'EnergyCo', 'quantity': '7', 'type': 'sell'}} for synchronisation
127.0.0.1 - - [01/May/2023 23:30:03] "POST /synchronise_1 HTTP/1.1" 200 -
Received {'data': {'transaction_number': '119', 'name': 'FrendCo', 'quantity': '5', 'type': 'buy'}} for synchronisation
127.0.0.1 - - [01/May/2023 23:30:04] "POST /synchronise_1 HTTP/1.1" 200 -
Received {'data': {'transaction_number': '120', 'name': 'FrendCo', 'quantity': '2', 'type': 'sell'}} for synchronisation
```