OUTPUT

Client, front-end, catalog and order services running on localhost:
- **All three order services running:**

- **Behaviour when leader service is killed:**

- **Behaviour when a stopped service restarts:**

```
error: NO_ERROR
stockname: "FishCo"
price: 23.34
quantity: 1914

Leader Id set to :  6
error: NO_ERROR
stockname: "CarCo"
price: 45
quantity: 1994

error: NO_ERROR
stockname: "TheaterCo"
price: 91.99
quantity: 1987
```
```
Trying to connect downed order services if any...
Connecting to catalog service at host:0.0.0.0 ,port: 6000
Trying to connect downed order services if any...
Invalidating stockname: TheaterCo from cache
127.0.0.1 - - [02/May/2023 22:27:01] "GET /stocksCache/TheaterCo HTTP/1.1" 200 -
cur_thread: Thread-16
client address_string: ('127.0.0.1', 63993)
cur_thread: Thread-16
client address_string: ('127.0.0.1', 63993)
Response received from the back-end Order service:
error: NO_ERROR
transaction_number: 238

127.0.0.1 - - [02/May/2023 22:27:01] "POST /orders HTTP/1.1" 200 -
cur_thread: Thread-1
client address_string: ('127.0.0.1', 63325)
```
```
    wait_fn(timeout=timeout)
  File "/Users/rajatgade/opt/anaconda3/lib/python3.9/threading.py", line 581, in wait
    signaled = self._cond.wait(timeout)
  File "/Users/rajatgade/opt/anaconda3/lib/python3.9/threading.py", line 316, in wait
    gotit = waiter.acquire(True, timeout)
KeyboardInterrupt

(venv) rajatgade@Rajats-Macbook-Pro order % python orderService.py
Running order service on host: 0.0.0.0 , port: 6003 with id 8
Sync database
Orderservice with id 8 conneced to catalog service !
Order service running on:
0.0.0.0 6003
Leader Id set to :  6
Update follower
Update follower
```
```
Update follower
Update follower
Update follower
Update follower
Update follower
Update follower
Leader Id set to :  6
Update follower
Update follower
Update follower
Update follower
Update follower
Update follower
Update follower
Update follower
```
```
data:
{'data': {'transaction_number': 236}}
Sending Lookup request for stockname: CarCo
200 OK 11
data:
{'data': {'name': 'CarCo', 'price': 45.0, 'quantity': 1994}}
Stock Quantity: 1994
Sending Trade request for stockname: CarCo , type: sell
response.status, response.reason, response.version :
200 OK 11
data:
{'data': {'transaction_number': 237}}
Sending Lookup request for stockname: TheaterCo
200 OK 11
data:
{'data': {'name': 'TheaterCo', 'price': 91.98999786376953, 'quantity': 1987}}
Stock Quantity: 1987
Sending Trade request for stockname: TheaterCo , type: buy
response.status, response.reason, response.version :
200 OK 11
data:
{'data': {'transaction_number': 238}}
```

- **Client Output:**

```
200 OK 11
data:
{'data': {'number': 158.0, 'name': 'TheaterCo', 'type': 'sell', 'quantity': 1}}
Client side transaction_number: 159, name: GameStart, quantity: 1, type: sell
Sending Lookup Order request for ordernumber: 159
200 OK 11
data:
{'data': {'number': 159.0, 'name': 'GameStart', 'type': 'sell', 'quantity': 1}}
Client side transaction_number: 160, name: MenhirCo, quantity: 1, type: sell
Sending Lookup Order request for ordernumber: 160
200 OK 11
data:
{'data': {'number': 160.0, 'name': 'MenhirCo', 'type': 'sell', 'quantity': 1}}
Client side transaction_number: 161, name: ConStock, quantity: 1, type: buy
Sending Lookup Order request for ordernumber: 161
200 OK 11
data:
{'data': {'number': 161.0, 'name': 'ConStock', 'type': 'buy', 'quantity': 1}}
Client side transaction_number: 162, name: TheaterCo, quantity: 1, type: sell
Sending Lookup Order request for ordernumber: 162
200 OK 11
data:
{'data': {'number': 162.0, 'name': 'TheaterCo', 'type': 'sell', 'quantity': 1}}
Total stock lookup requests: 200
Average stock lookup time : 4.546844959259033ms
Total trade requests: 162
Average trade time : 19.380454663877135ms
Total order lookup requests: 162
Average order lookup time: 0.8959313969553253ms
(venv) rajatgade@Rajats-Macbook-Pro client %
```

Client running on localhost, front-end, catalog, and order services running on AWS EC2 instance:

```
0 updates can be applied immediately.

New release '20.04.6 LTS' available.
Run 'do-release-upgrade' to upgrade to it.


Last login: Wed May  3 02:29:52 2023 from 71.235.142.74
To run a command as administrator (user "root"), use "sudo <command>".
See "man sudo_root" for details.

[ubuntu@ip-172-31-24-151:~$ cd spring23-lab-3-677-lab3/src/order/
[ubuntu@ip-172-31-24-151:~/spring23-lab-3-677-lab3/src/order$ SERVICE_ID="8" ORDER_HOST="0.0.0.0" ORDER_PORT=6003 CATALOG_HOST="0.0.0.0" CATALOG_PORT=6000 ORDER_ID="5,6,8" FILE_PATH="../data/" ORDER_PORTS="6001,6002
,6003" ORDER_HOSTS="0.0.0.0,0.0.0.0,0.0.0.0" python3 orderService.py
Running order service on host: 0.0.0.0 , port: 6003 with id 8
Sync database
Orderservice with id 8 conneced to catalog service !
Order service running on:
0.0.0.0 6003
Leader Id set to :  8
error: NO_ERROR
stockname: "GameStart"
price: 15.99
quantity: 9072

error: NO_ERROR
stockname: "GameStart"
price: 15.99
quantity: 9073

error: NO_ERROR
stockname: "BoarCo"
price: 34.34
quantity: 1153
```

```
[ubuntu@ip-172-31-24-151:~$ cd spring23-lab-3-677-lab3/src/order/
[ubuntu@ip-172-31-24-151:~/spring23-lab-3-677-lab3/src/order$ SERVICE_ID="6" ORDER_HOST="0.0.0.0" ORDER_PORT=6002 CATALOG_HOST="0.0.0.0" CATALOG_PORT=6000 ORDER_ID="5,6,8" FILE_PATH="../data/" ORDER_PORTS="6001,6002
,6003" ORDER_HOSTS="0.0.0.0,0.0.0.0,0.0.0.0" python3 orderService.py
Running order service on host: 0.0.0.0 , port: 6002 with id 6
Sync database
Orderservice with id 6 conneced to catalog service !
Order service running on:
0.0.0.0 6002
Leader Id set to :  8
Update follower
Update follower
Update follower
Update follower
Update follower
Update follower
Update follower
Update follower
```

```
[ubuntu@ip-172-31-24-151:~/spring23-lab-3-677-lab3/src/catalog$ CATALOG_HOST="0.0.0.0" CATALOG_PORT=6000 python3 catalogService.py
Catalog service running on:
0.0.0.0:6000
Send cache invalidation request to front-end service
Send cache invalidation request to front-end service
Send cache invalidation request to front-end service
Send cache invalidation request to front-end service
```

```
[ubuntu@ip-172-31-24-151:~$ cd spring23-lab-3-677-lab3/src/front-end/
[ubuntu@ip-172-31-24-151:~/spring23-lab-3-677-lab3/src/front-end$ CACHE_SIZE=5 FRONTEND_HOST="0.0.0.0" FRONTEND_PORT=8000 CATALOG_HOST="0.0.0.0" CATALOG_PORT=6000 ORDER_HOSTS="0.0.0.0,0.0.0.0,0.0.0.0" ORDER_ID="5,6,
8" ORDER_PORTS="6001,6002,6003" python3 front-end-http-server.py
Connecting to :  5 0.0.0.0 6001
Connecting to :  6 0.0.0.0 6002
Running Front-End Service on host: 0.0.0.0 , port:8000
Connecting to catalog service at host:0.0.0.0 ,port: 6000
Trying to connect downed order services if any...
Inside stocks lookup
Stockname : InvalidStockName not in cache, making lookup call to Catalog service
Response received from the back-end Catalog service:
error: INVALID_STOCKNAME

71.235.142.74 - - [03/May/2023 02:40:51] "GET /stocks/InvalidStockName HTTP/1.1" 404 -
cur_thread: Thread-1
client address_string: ('71.235.142.74', 2644)
Inside stocks lookup
Stockname : InvalidStockName not in cache, making lookup call to Catalog service
Response received from the back-end Catalog service:
error: INVALID_STOCKNAME

71.235.142.74 - - [03/May/2023 02:40:56] "GET /stocks/InvalidStockName HTTP/1.1" 404 -
cur_thread: Thread-1
client address_string: ('71.235.142.74', 2644)
Inside stocks lookup
Stockname : InvalidStockName not in cache, making lookup call to Catalog service
Response received from the back-end Catalog service:
error: INVALID_STOCKNAME

71.235.142.74 - - [03/May/2023 02:41:01] "GET /stocks/InvalidStockName HTTP/1.1" 404 -
cur_thread: Thread-1
client address_string: ('71.235.142.74', 2644)
Inside stocks lookup
Stockname : FishCo not in cache, making lookup call to Catalog service
Response received from the back-end Catalog service:
error: NO_ERROR
stockname: "FishCo"
price: 23.34
quantity: 1942
```

```
[shreyadubey@Shreyas-MacBook-Pro test % python3 latencyTest.py "3.84.137.177" 8000
Probability p: 1
Total stock lookup requests: 200
Average stock lookup time : 64.55180168151855ms
Total trade requests: 160
Average trade time : 76.81950628757477ms
Total order lookup requests: 160
Average order lookup time: 78.76510918140411ms
Probability p: 0.8
Total stock lookup requests: 200
Average stock lookup time : 60.62765598297119ms
Total trade requests: 120
Average trade time : 73.18808436393738ms
Total order lookup requests: 120
Average order lookup time: 72.20473686854044ms
Probability p: 0.6
Total stock lookup requests: 200
Average stock lookup time : 65.66105127334595ms
Total trade requests: 88
Average trade time : 76.36974345554006ms
Total order lookup requests: 88
Average order lookup time: 77.60420441627502ms
Probability p: 0.4
Total stock lookup requests: 200
Average stock lookup time : 65.53163528442383ms
Total trade requests: 60
Average trade time : 76.1860728263855ms
Total order lookup requests: 60
Average order lookup time: 75.54608980814616ms
Probability p: 0.2
Total stock lookup requests: 200
Average stock lookup time : 64.61419582366943ms
Total trade requests: 29
Average trade time : 104.62367123570935ms
Total order lookup requests: 29
Average order lookup time: 78.58435038862558ms
Probability p: 0
Total stock lookup requests: 200
Average stock lookup time : 61.11002564430237ms
Total trade requests: 0
Average trade time : 0ms
Total order lookup requests: 0
Average order lookup time: 0ms
shreyadubey@Shreyas-MacBook-Pro test %
```

```
python3 client.py "3.84.137.177" 8000

shreyadubey@Shreyas-MacBook-Pro client % python3 client.py "3.84.137.177" 8000
Probability p: 1
Sending Lookup request for stockname: ConStock
200 OK 11
data:
{'data': {'name': 'ConStock', 'price': 23.43000030517578, 'quantity': 2032}}
Stock Quantity: 2032
Sending Trade request for stockname: ConStock , type: sell
response.status, response.reason, response.version :
200 OK 11
data:
{'data': {'transaction_number': 2201}}
Sending Lookup request for stockname: CarCo
200 OK 11
data:
{'data': {'name': 'CarCo', 'price': 45.0, 'quantity': 2002}}
Stock Quantity: 2002
Sending Trade request for stockname: CarCo , type: buy
response.status, response.reason, response.version :
200 OK 11
data:
{'data': {'transaction_number': 2205}}
Sending Lookup request for stockname: BoarCo
200 OK 11
data:
{'data': {'name': 'BoarCo', 'price': 34.34000015258789, 'quantity': 1154}}
Stock Quantity: 1154
Sending Trade request for stockname: BoarCo , type: buy
response.status, response.reason, response.version :
200 OK 11
data:
{'data': {'transaction_number': 2207}}
Sending Lookup request for stockname: ConStock
200 OK 11
data:
{'data': {'name': 'ConStock', 'price': 23.43000030517578, 'quantity': 2034}}
Stock Quantity: 2034
Sending Trade request for stockname: ConStock , type: sell
response.status, response.reason, response.version :
200 OK 11
data:
{'data': {'transaction_number': 2210}}
Sending Lookup request for stockname: CarCo
200 OK 11
data:
{'data': {'name': 'CarCo', 'price': 45.0, 'quantity': 2001}}
```

```
Last login: Tue May  2 22:41:17 on ttys031
[shreyadubey@Shreyas-MacBook-Pro client % python3 client.py "3.84.137.177" 8000
Probability p: 1
Sending Lookup request for stockname: BoarCo
200 OK 11
data:
{'data': {'name': 'BoarCo', 'price': 34.34000015258789, 'quantity': 1154}}
Stock Quantity: 1154
Sending Trade request for stockname: BoarCo , type: buy
response.status, response.reason, response.version :
200 OK 11
data:
{'data': {'transaction_number': 2127}}
Sending Lookup request for stockname: FishCo
200 OK 11
data:
{'data': {'name': 'FishCo', 'price': 23.34000015258789, 'quantity': 1944}}
Stock Quantity: 1944
Sending Trade request for stockname: FishCo , type: buy
response.status, response.reason, response.version :
200 OK 11
data:
{'data': {'transaction_number': 2130}}
Sending Lookup request for stockname: ConStock
200 OK 11
data:
{'data': {'name': 'ConStock', 'price': 23.43000030517578, 'quantity': 2035}}
Stock Quantity: 2035
Sending Trade request for stockname: ConStock , type: buy
response.status, response.reason, response.version :
200 OK 11
```

Sending Lookup Order request for ordernumber: 3821
200 OK 11
data:
{'data': {'number': 3821.0, 'name': 'BoarCo', 'type': 'sell', 'quantity': 1}}
Client side transaction_number: 3823, name: FishCo, quantity: 1, type: sell
Sending Lookup Order request for ordernumber: 3823
200 OK 11
data:
{'data': {'number': 3823.0, 'name': 'FishCo', 'type': 'sell', 'quantity': 1}}
Client side transaction_number: 3825, name: GameStart, quantity: 1, type: sell
Sending Lookup Order request for ordernumber: 3825
200 OK 11
data:
{'data': {'number': 3825.0, 'name': 'GameStart', 'type': 'sell', 'quantity': 1}}
Client side transaction_number: 3828, name: CarCo, quantity: 1, type: buy
Sending Lookup Order request for ordernumber: 3828
200 OK 11
data:
{'data': {'number': 3828.0, 'name': 'CarCo', 'type': 'buy', 'quantity': 1}}
Client side transaction_number: 3832, name: MenhirCo, quantity: 1, type: sell
Sending Lookup Order request for ordernumber: 3832
200 OK 11
data:
{'data': {'number': 3832.0, 'name': 'MenhirCo', 'type': 'sell', 'quantity': 1}}
Client side transaction_number: 3839, name: GameStart, quantity: 1, type: buy
Sending Lookup Order request for ordernumber: 3839
200 OK 11
data:
{'data': {'number': 3839.0, 'name': 'GameStart', 'type': 'buy', 'quantity': 1}}
Client side transaction_number: 3843, name: CarCo, quantity: 1, type: sell
Sending Lookup Order request for ordernumber: 3843
200 OK 11
data:
{'data': {'number': 3843.0, 'name': 'CarCo', 'type': 'sell', 'quantity': 1}}
Client side transaction_number: 3848, name: GameStart, quantity: 1, type: sell
Sending Lookup Order request for ordernumber: 3848
200 OK 11
data:
{'data': {'number': 3848.0, 'name': 'GameStart', 'type': 'sell', 'quantity': 1}}
Client side transaction_number: 3853, name: TheaterCo, quantity: 1, type: sell
Sending Lookup Order request for ordernumber: 3853

{'data': {'number': 2817.0, 'name': 'ConStock', 'type': 'buy', 'quantity': 1}}
Client side transaction_number: 2818, name: Wheely, quantity: 1, type: buy
Sending Lookup Order request for ordernumber: 2818
200 OK 11
data:
{'data': {'number': 2818.0, 'name': 'Wheely', 'type': 'buy', 'quantity': 1}}
Total stock lookup requests: 200
Average stock lookup time : 65.23939847946167ms
Total trade requests: 150
Average trade time : 74.85799948374431ms
Total order lookup requests: 150
Average order lookup time: 72.60278542836507ms
Probability p: 0.8
Sending Lookup request for stockname: FishCo
200 OK 11
data:
{'data': {'name': 'FishCo', 'price': 23.34000015258789, 'quantity': 1933}}
Stock Quantity: 1933
Sending Lookup request for stockname: InvalidStockName
404 Not Found 11
data:
{'error': {'code': 404, 'message': 'stock not found'}}
Sending Lookup request for stockname: TheaterCo
200 OK 11

```
[shreyadubey@Shreyas-MacBook-Pro test % python3 latencyTest.py "3.84.137.177" 8000
Probability p: 1
Total stock lookup requests: 200
Average stock lookup time : 60.978801250457764ms
Total trade requests: 147
Average trade time : 68.20844955184832ms
Total order lookup requests: 147
Average order lookup time: 67.5786255168266ms
Probability p: 0.8
Total stock lookup requests: 200
Average stock lookup time : 64.64371681213379ms
Total trade requests: 133
Average trade time : 75.37950967487537ms
Total order lookup requests: 133
Average order lookup time: 51.362968028936166ms
Probability p: 0.6
Total stock lookup requests: 200
Average stock lookup time : 59.05776500701904ms
Total trade requests: 94
Average trade time : 68.71852976210575ms
Total order lookup requests: 94
Average order lookup time: 52.490183647642745ms
Probability p: 0.4
Total stock lookup requests: 200
Average stock lookup time : 60.526771545410156ms
Total trade requests: 59
Average trade time : 70.62234312801039ms
Total order lookup requests: 59
Average order lookup time: 75.02286717043084ms
Probability p: 0.2
Total stock lookup requests: 200
Average stock lookup time : 63.28652620315552ms
Total trade requests: 32
Average trade time : 73.05673509836197ms
Total order lookup requests: 32
Average order lookup time: 76.7182856798172ms
Probability p: 0
Total stock lookup requests: 200
Average stock lookup time : 60.129263401031494ms
Total trade requests: 0
Average trade time : 0ms
Total order lookup requests: 0
Average order lookup time: 0ms
```

Stopping the leader:

```
Update follower
Update follower
Update follower
Update follower
Update follower
Update follower
Update follower
Update follower
Leader Id set to :  6
error: NO_ERROR
stockname: "CarCo"
price: 45
quantity: 2001

error: NO_ERROR
stockname: "MenhirCo"
price: 234.3
quantity: 1254

error: NO_ERROR
stockname: "GameStart"
price: 15.99
quantity: 9080

error: NO_ERROR
stockname: "TheaterCo"
price: 91.99
quantity: 2030
```

After leader order service with service id 8, the order service with service id 6 becomes the leader.

Once the leader is restarted, it becomes the follower while service id 6 still remains the leader.

The order service replica database after it was stopped:

The order service replica database after it was restarted- it synchrnizes and updates its database using the replicas:

```
9869 — Stockname: TheaterCo  Quantity: 1 Order: buy
9870 — Stockname: MenhirCo  Quantity: 1 Order: buy
9871 — Stockname: Wheely  Quantity: 1 Order: buy
9872 — Stockname: BoarCo  Quantity: 1 Order: sell
9873 — Stockname: MenhirCo  Quantity: 1 Order: sell
9874 — Stockname: MenhirCo  Quantity: 1 Order: buy
9875 — Stockname: CarCo  Quantity: 1 Order: sell
9876 — Stockname: MenhirCo  Quantity: 1 Order: buy
9877 — Stockname: CarCo  Quantity: 1 Order: sell
9878 — Stockname: MenhirCo  Quantity: 1 Order: buy
9879 — Stockname: GameStart  Quantity: 1 Order: buy
9880 — Stockname: TheaterCo  Quantity: 1 Order: sell
9881 — Stockname: TheaterCo  Quantity: 1 Order: sell
9882 — Stockname: GameStart  Quantity: 1 Order: sell
9883 — Stockname: MenhirCo  Quantity: 1 Order: buy
9884 — Stockname: MenhirCo  Quantity: 1 Order: sell
9885 — Stockname: MenhirCo  Quantity: 1 Order: buy
9886 — Stockname: Wheely  Quantity: 1 Order: sell
9887 — Stockname: CarCo  Quantity: 1 Order: buy
9888 — Stockname: CarCo  Quantity: 1 Order: buy
9889 — Stockname: BoarCo  Quantity: 1 Order: buy
9890 — Stockname: MenhirCo  Quantity: 1 Order: buy
9891 — Stockname: ConStock  Quantity: 1 Order: sell
```