Київський політехнічний інститут імені Ігоря Сікорського

Фізико-технічний інститут

Проектування розподілених систем

Проект "Replicated log"

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Iteration 0

```
PS F:\project> python .\iteration_0\client.py
Enter your message and press Enter to send. Type 'exit' to quit.
Your message: Hello server!
2025-06-06 14:06:38,712 - INFO - Server response: {'status': 'Message received successfully!'}
Your message: []
```

```
PS F:\project> python .\iteration_0\server.py
INFO:     Started server process [10420]
INFO:     Waiting for application startup.
INFO:     Application startup complete.
INFO:     Uvicorn running on http://0.0.0.0:8000 (Press CTRL+C to quit)
2025-06-06 14:06:38,711 - INFO - Received message: 'Hello server!'
INFO:     127.0.0.1:54008 - "POST / HTTP/1.1" 200 OK
[]
```

Iteration 1

Підняв усі ноди.

```
[+] Running 4/4
√ Network iteration_1_replicated_log_net   Created
√ Container iteration_1-secondary1-1        Started
√ Container iteration_1-master-1            Started
√ Container iteration_1-secondary2-1        Started
* Terminal will be reused by tasks, press any key to close it.
```

```
iteration_1-secon...     2025-06-06 14:26:51 iteration_1-secondary2-1 | INFO:     Started server process [1]
iteration_1-secondar     2025-06-06 14:26:51 iteration_1-secondary1-1 | INFO:     Started server process [1]
Running                  2025-06-06 14:26:51 iteration_1-secondary1-1 | INFO:     Waiting for application startup.
                         2025-06-06 14:26:51 iteration_1-secondary2-1 | INFO:     Waiting for application startup.
iteration_1-secon...     2025-06-06 14:26:51 iteration_1-secondary1-1 | INFO:     Application startup complete.
iteration_1-secondar     2025-06-06 14:26:51 iteration_1-secondary2-1 | INFO:     Application startup complete.
Running                  2025-06-06 14:26:51 iteration_1-secondary1-1 | INFO:     Uvicorn running on http://0.0.0.0:8001 (Press CTRL+C to quit)
                         2025-06-06 14:26:51 iteration_1-secondary2-1 | INFO:     Uvicorn running on http://0.0.0.0:8001 (Press CTRL+C to quit)
iteration_1-master...    2025-06-06 14:26:51 iteration_1-master-1     | 2025-06-06 11:26:51,470 - MASTER - INFO - Initialized with secondaries: ['secondary1:8001', 'secondary2:8001']
iteration_1-master       2025-06-06 14:26:51 iteration_1-master-1     | INFO:     Started server process [1]
Running                  2025-06-06 14:26:51 iteration_1-master-1     | INFO:     Waiting for application startup.
8000:8000                2025-06-06 14:26:51 iteration_1-master-1     | INFO:     Application startup complete.
                         2025-06-06 14:26:51 iteration_1-master-1     | INFO:     Uvicorn running on http://0.0.0.0:8000 (Press CTRL+C to quit)
```

Далі протестую, у однієї секондарі ноди має бути затримка 3с, у іншої 0с:

```
In [1]: from iteration_1.test_client import *

In [2]: post_message("Hello World")

Sending message: 'Hello World'...
Response from master: {'status': 'Message appended and replicated to all secondaries.'}
Request took 3.06 seconds.

In [3]: get_master_messages()

Getting messages from master...
Master messages: {'messages': ['Hello World']}

In [4]: post_message("Test 123")

Sending message: 'Test 123'...
Response from master: {'status': 'Message appended and replicated to all secondaries.'}
Request took 3.03 seconds.

In [5]: get_master_messages()

Getting messages from master...
Master messages: {'messages': ['Hello World', 'Test 123']}

In [6]: []
```

То ж тут бачимо без затримок:

```
2025-06-06 14:32:23 iteration_1-secondary1-1 | 2025-06-06 11:32:23,144 - SECONDARY - INFO - Received replication request for message: 'Hello World'. Applying 0s delay...
2025-06-06 14:32:23 iteration_1-secondary1-1 | 2025-06-06 11:32:23,144 - SECONDARY - INFO - Successfully replicated message: 'Hello World'. Sending ACK.
2025-06-06 14:32:23 iteration_1-secondary1-1 | INFO:     172.21.0.3:56832 - "POST /replicate HTTP/1.1" 200 OK
```

А тут уже із 3с затримкою:

```
2025-06-06 14:32:23 iteration_1-secondary2-1 | 2025-06-06 11:32:23,147 - SECONDARY - INFO - Received replication request for message: 'Hello World'. Applying 3s delay...
2025-06-06 14:32:26 iteration_1-secondary2-1 | 2025-06-06 11:32:26,147 - SECONDARY - INFO - Successfully replicated message: 'Hello World'. Sending ACK.
2025-06-06 14:32:26 iteration_1-secondary2-1 | INFO:     172.21.0.3:57712 - "POST /replicate HTTP/1.1" 200 OK
```

Увесь лог:

```
2025-06-06 14:32:23 iteration_1-master-1      | 2025-06-06 11:32:23,092 - MASTER - INFO - Received message: 'Hello World'. Appending to master log.
2025-06-06 14:32:23 iteration_1-master-1      | 2025-06-06 11:32:23,138 - MASTER - INFO - Replicating message to secondary1:8001...
2025-06-06 14:32:23 iteration_1-secondary1-1  | 2025-06-06 11:32:23,144 - SECONDARY - INFO - Received replication request for message: 'Hello World'. Applying 0s delay...
2025-06-06 14:32:23 iteration_1-secondary1-1  | 2025-06-06 11:32:23,144 - SECONDARY - INFO - Successfully replicated message: 'Hello World'. Sending ACK.
2025-06-06 14:32:23 iteration_1-secondary1-1  | INFO:     172.21.0.3:56832 - "POST /replicate HTTP/1.1" 200 OK
2025-06-06 14:32:23 iteration_1-master-1      | 2025-06-06 11:32:23,145 - MASTER - INFO - HTTP Request: POST http://secondary1:8001/replicate "HTTP/1.1 200 OK"
2025-06-06 14:32:23 iteration_1-master-1      | 2025-06-06 11:32:23,145 - MASTER - INFO - Successfully replicated message to secondary1:8001. ACK received.
2025-06-06 14:32:23 iteration_1-master-1      | 2025-06-06 11:32:23,145 - MASTER - INFO - Replicating message to secondary2:8001...
2025-06-06 14:32:23 iteration_1-secondary2-1  | 2025-06-06 11:32:23,147 - SECONDARY - INFO - Received replication request for message: 'Hello World'. Applying 3s delay...
2025-06-06 14:32:26 iteration_1-secondary2-1  | 2025-06-06 11:32:26,147 - SECONDARY - INFO - Successfully replicated message: 'Hello World'. Sending ACK.
2025-06-06 14:32:26 iteration_1-secondary2-1  | INFO:     172.21.0.3:57712 - "POST /replicate HTTP/1.1" 200 OK
2025-06-06 14:32:26 iteration_1-master-1      | 2025-06-06 11:32:26,149 - MASTER - INFO - HTTP Request: POST http://secondary2:8001/replicate "HTTP/1.1 200 OK"
2025-06-06 14:32:26 iteration_1-master-1      | 2025-06-06 11:32:26,149 - MASTER - INFO - Successfully replicated message to secondary2:8001. ACK received.
2025-06-06 14:32:26 iteration_1-master-1      | INFO:     172.21.0.1:55676 - "POST /messages HTTP/1.1" 200 OK
2025-06-06 14:32:29 iteration_1-master-1      | 2025-06-06 11:32:29,024 - MASTER - INFO - Returning all messages from master.
2025-06-06 14:32:29 iteration_1-master-1      | INFO:     172.21.0.1:55690 - "GET /messages HTTP/1.1" 200 OK
2025-06-06 14:32:39 iteration_1-master-1      | 2025-06-06 11:32:39,569 - MASTER - INFO - Received message: 'Test 123'. Appending to master log.
2025-06-06 14:32:39 iteration_1-master-1      | 2025-06-06 11:32:39,586 - MASTER - INFO - Replicating message to secondary1:8001...
2025-06-06 14:32:39 iteration_1-secondary1-1  | 2025-06-06 11:32:39,588 - SECONDARY - INFO - Received replication request for message: 'Test 123'. Applying 0s delay...
2025-06-06 14:32:39 iteration_1-secondary1-1  | 2025-06-06 11:32:39,588 - SECONDARY - INFO - Successfully replicated message: 'Test 123'. Sending ACK.
2025-06-06 14:32:39 iteration_1-secondary1-1  | INFO:     172.21.0.3:60626 - "POST /replicate HTTP/1.1" 200 OK
2025-06-06 14:32:39 iteration_1-master-1      | 2025-06-06 11:32:39,589 - MASTER - INFO - HTTP Request: POST http://secondary1:8001/replicate "HTTP/1.1 200 OK"
2025-06-06 14:32:39 iteration_1-master-1      | 2025-06-06 11:32:39,590 - MASTER - INFO - Successfully replicated message to secondary1:8001. ACK received.
2025-06-06 14:32:39 iteration_1-master-1      | 2025-06-06 11:32:39,590 - MASTER - INFO - Replicating message to secondary2:8001...
2025-06-06 14:32:39 iteration_1-secondary2-1  | 2025-06-06 11:32:39,592 - SECONDARY - INFO - Received replication request for message: 'Test 123'. Applying 3s delay...
2025-06-06 14:32:42 iteration_1-secondary2-1  | 2025-06-06 11:32:42,592 - SECONDARY - INFO - Successfully replicated message: 'Test 123'. Sending ACK.
2025-06-06 14:32:42 iteration_1-secondary2-1  | INFO:     172.21.0.3:54654 - "POST /replicate HTTP/1.1" 200 OK
2025-06-06 14:32:42 iteration_1-master-1      | 2025-06-06 11:32:42,593 - MASTER - INFO - HTTP Request: POST http://secondary2:8001/replicate "HTTP/1.1 200 OK"
2025-06-06 14:32:42 iteration_1-master-1      | 2025-06-06 11:32:42,594 - MASTER - INFO - Successfully replicated message to secondary2:8001. ACK received.
2025-06-06 14:32:42 iteration_1-master-1      | INFO:     172.21.0.1:33744 - "POST /messages HTTP/1.1" 200 OK
2025-06-06 14:32:44 iteration_1-master-1      | 2025-06-06 11:32:44,400 - MASTER - INFO - Returning all messages from master.
2025-06-06 14:32:44 iteration_1-master-1      | INFO:     172.21.0.1:49152 - "GET /messages HTTP/1.1" 200 OK
```

Iteration 2

Запустив ноди:

```
iteration_2
F:\project\iteration_2

iteration_2-secon…
iteration_2-secondar
Running
9001:8001

iteration_2-master…
iteration_2-master
Running
8000:8000

iteration_2-secon…
iteration_2-secondar
Running
9002:8001

iteration_2-secondary2-1  | INFO:     Started server process [1]
iteration_2-secondary2-1  | INFO:     Waiting for application startup.
iteration_2-secondary2-1  | INFO:     Application startup complete.
iteration_2-secondary2-1  | INFO:     Uvicorn running on http://0.0.0.0:8001 (Press CTRL+C to quit)
iteration_2-secondary1-1  | INFO:     Started server process [1]
iteration_2-secondary1-1  | INFO:     Waiting for application startup.
iteration_2-secondary1-1  | INFO:     Application startup complete.
iteration_2-secondary1-1  | INFO:     Uvicorn running on http://0.0.0.0:8001 (Press CTRL+C to quit)
iteration_2-master-1      | 2025-06-06 12:06:20,431 - MASTER - INFO - Initialized with secondaries: ['secondary1:8001', 'secondary2:8001']
iteration_2-master-1      | INFO:     Started server process [1]
iteration_2-master-1      | INFO:     Waiting for application startup.
iteration_2-master-1      | INFO:     Application startup complete.
iteration_2-master-1      | INFO:     Uvicorn running on http://0.0.0.0:8000 (Press CTRL+C to quit)
```

```
In [2]: post_message("Msg1", w=1)

---> Sending message: 'Msg1' with W=1
Response from master: {'status': 'Message appended to master.', 'message': {'id': '42a268b7-50ee-4890-a3d2-bb27943deb62', 'seq': 1, 'text': 'Msg1'}}
Request took 0.01 seconds.

In [3]: post_message("Msg2", w=2)

---> Sending message: 'Msg2' with W=2
Response from master: {'status': 'Message replicated with W=2.', 'message': {'id': '8093d05d-685e-425a-9384-820bb42390c1', 'seq': 2, 'text': 'Msg2'}}
Request took 1.05 seconds.

In [4]: check_all_nodes()

<--- Getting messages from Master (http://localhost:8000)
Master messages: {'messages': [{'id': '42a268b7-50ee-4890-a3d2-bb27943deb62', 'seq': 1, 'text': 'Msg1'}, {'id': '8093d05d-685e-425a-9384-820bb42390c1', 'seq': 2, 'text': 'Msg2'}]}

<--- Getting messages from Secondary-1 (http://localhost:9001)
Secondary-1 messages: {'messages': [{'id': '42a268b7-50ee-4890-a3d2-bb27943deb62', 'seq': 1, 'text': 'Msg1'}, {'id': '8093d05d-685e-425a-9384-820bb42390c1', 'seq': 2, 'text': 'Msg2'}]}

<--- Getting messages from Secondary-2 (http://localhost:9002)
Secondary-2 messages: {'messages': [{'id': '42a268b7-50ee-4890-a3d2-bb27943deb62', 'seq': 1, 'text': 'Msg1'}]}

In [5]: check_all_nodes()

<--- Getting messages from Master (http://localhost:8000)
Master messages: {'messages': [{'id': '42a268b7-50ee-4890-a3d2-bb27943deb62', 'seq': 1, 'text': 'Msg1'}, {'id': '8093d05d-685e-425a-9384-820bb42390c1', 'seq': 2, 'text': 'Msg2'}]}

<--- Getting messages from Secondary-1 (http://localhost:9001)
Secondary-1 messages: {'messages': [{'id': '42a268b7-50ee-4890-a3d2-bb27943deb62', 'seq': 1, 'text': 'Msg1'}, {'id': '8093d05d-685e-425a-9384-820bb42390c1', 'seq': 2, 'text': 'Msg2'}]}

<--- Getting messages from Secondary-2 (http://localhost:9002)
Secondary-2 messages: {'messages': [{'id': '42a268b7-50ee-4890-a3d2-bb27943deb62', 'seq': 1, 'text': 'Msg1'}, {'id': '8093d05d-685e-425a-9384-820bb42390c1', 'seq': 2, 'text': 'Msg2'}]}

In [6]:
```

Тут бачимо швидку відповідь при write_concern = 1 бо вона очікує підтвердження лише від master ноди. Далі при write_concern = 2 відповідь займає вже більше 1 секунди, через те що очікується відповідь від хоча б однієї secondary ноди. При цьому після відповіді явно бачимо що на secondary ноді де затримка 5 секунд ще немає нового повідомлення. Але через деякий час усі повідомлення починають відображатись у правильному порядку.

```
In [6]: post_message("Msg3", w=3)

---> Sending message: 'Msg3' with W=3
Response from master: {'status': 'Message replicated with W=3.', 'message': {'id': '8d04937b-0fb7-4153-8257-cb37f54f01e6', 'seq': 3, 'text': 'Msg3'}}
Request took 5.04 seconds.

In [7]: check_all_nodes()

<--- Getting messages from Master (http://localhost:8000)
Master messages: {'messages': [{'id': '42a260b7-50ee-4890-a3d2-bb27943deb62', 'seq': 1, 'text': 'Msg1'}, {'id': '8093d05d-685e-425a-9384-820bb42390c1', 'seq': 2, 'text': 'Msg2'}, {'id': '8d04937b-0fb7-4153-8257-cb37f54f01e6', 'seq': 3, 'text': 'Msg3'}]}
01e6', 'seq': 3, 'text': 'Msg3'}]}

<--- Getting messages from Secondary-1 (http://localhost:9001)
Secondary-1 messages: {'messages': [{'id': '42a260b7-50ee-4890-a3d2-bb27943deb62', 'seq': 1, 'text': 'Msg1'}, {'id': '8093d05d-685e-425a-9384-820bb42390c1', 'seq': 2, 'text': 'Msg2'}, {'id': '8d04937b-0fb7-4153-8257-cb37f54f01e6', 'seq': 3, 'text': 'Msg3'}]}

<--- Getting messages from Secondary-2 (http://localhost:9002)
Secondary-2 messages: {'messages': [{'id': '42a260b7-50ee-4890-a3d2-bb27943deb62', 'seq': 1, 'text': 'Msg1'}, {'id': '8093d05d-685e-425a-9384-820bb42390c1', 'seq': 2, 'text': 'Msg2'}, {'id': '8d04937b-0fb7-4153-8257-cb37f54f01e6', 'seq': 3, 'text': 'Msg3'}]}
```

write_concern = 3 очікується відповіть від усіх нод. Так як у коді реплікаційні таски запускаються одночасно, то ми очікуємо завершення лише найповільнішого, тому бачимо не 6с затримку, а лише 5 секунд. І усі повідомлення одразу є на усіх нодах.

Лог:

```
iteration_2-master-1      | 2025-06-06 12:06:42,052 - MASTER - INFO - W=1, responding to client immediately.
iteration_2-master-1      | INFO:     172.31.0.1:55384 - "POST /messages HTTP/1.1" 200 OK
iteration_2-secondary2-1  | 2025-06-06 12:06:42,126 - SECONDARY - INFO - Received replication request for Seq 1. Applying 5s delay...
iteration_2-secondary1-1  | 2025-06-06 12:06:42,126 - SECONDARY - INFO - Received replication request for Seq 1. Applying 1s delay...
iteration_2-secondary1-1  | 2025-06-06 12:06:43,127 - SECONDARY - INFO - Successfully replicated message (Seq: 1).
iteration_2-secondary1-1  | INFO:     172.31.0.4:50656 - "POST /replicate HTTP/1.1" 200 OK
iteration_2-master-1      | 2025-06-06 12:06:43,128 - MASTER - INFO - HTTP Request: POST http://secondary1:8001/replicate "HTTP/1.1 200 OK"
iteration_2-master-1      | 2025-06-06 12:06:43,129 - MASTER - INFO - ACK received from secondary1:8001 for Seq 1. Total ACKs: 1
iteration_2-secondary2-1  | 2025-06-06 12:06:47,126 - SECONDARY - INFO - Successfully replicated message (Seq: 1).
iteration_2-secondary2-1  | INFO:     172.31.0.4:40022 - "POST /replicate HTTP/1.1" 200 OK
iteration_2-master-1      | 2025-06-06 12:06:47,128 - MASTER - INFO - HTTP Request: POST http://secondary2:8001/replicate "HTTP/1.1 200 OK"
iteration_2-master-1      | 2025-06-06 12:06:47,128 - MASTER - INFO - ACK received from secondary2:8001 for Seq 1. Total ACKs: 2
iteration_2-master-1      | 2025-06-06 12:07:14,752 - MASTER - INFO - Received message 'Msg2' (Seq: 2). Write Concern W=2.
iteration_2-secondary2-1  | 2025-06-06 12:07:14,792 - SECONDARY - INFO - Received replication request for Seq 2. Applying 5s delay...
iteration_2-secondary1-1  | 2025-06-06 12:07:14,792 - SECONDARY - INFO - Received replication request for Seq 2. Applying 1s delay...
iteration_2-secondary1-1  | 2025-06-06 12:07:15,791 - SECONDARY - INFO - Successfully replicated message (Seq: 2).
iteration_2-secondary1-1  | INFO:     172.31.0.4:50736 - "POST /replicate HTTP/1.1" 200 OK
iteration_2-master-1      | 2025-06-06 12:07:15,792 - MASTER - INFO - HTTP Request: POST http://secondary1:8001/replicate "HTTP/1.1 200 OK"
iteration_2-master-1      | 2025-06-06 12:07:15,793 - MASTER - INFO - ACK received from secondary1:8001 for Seq 2. Total ACKs: 1
iteration_2-master-1      | 2025-06-06 12:07:15,793 - MASTER - INFO - Write concern W=2 met with 1 ACKs. Responding to client.
iteration_2-master-1      | INFO:     172.31.0.1:41842 - "POST /messages HTTP/1.1" 200 OK
iteration_2-master-1      | INFO:     172.31.0.1:41850 - "GET /messages HTTP/1.1" 200 OK
iteration_2-secondary1-1  | INFO:     172.31.0.1:32888 - "GET /messages HTTP/1.1" 200 OK
iteration_2-secondary2-1  | INFO:     172.31.0.1:56714 - "GET /messages HTTP/1.1" 200 OK
iteration_2-secondary2-1  | 2025-06-06 12:07:19,792 - SECONDARY - INFO - Successfully replicated message (Seq: 2).
iteration_2-secondary2-1  | INFO:     172.31.0.4:35426 - "POST /replicate HTTP/1.1" 200 OK
iteration_2-master-1      | 2025-06-06 12:07:19,793 - MASTER - INFO - HTTP Request: POST http://secondary2:8001/replicate "HTTP/1.1 200 OK"
iteration_2-master-1      | 2025-06-06 12:07:19,794 - MASTER - INFO - ACK received from secondary2:8001 for Seq 2. Total ACKs: 2
iteration_2-master-1      | INFO:     172.31.0.1:35748 - "GET /messages HTTP/1.1" 200 OK
iteration_2-secondary1-1  | INFO:     172.31.0.1:41592 - "GET /messages HTTP/1.1" 200 OK
iteration_2-secondary2-1  | INFO:     172.31.0.1:37178 - "GET /messages HTTP/1.1" 200 OK
iteration_2-master-1      | 2025-06-06 12:11:17,537 - MASTER - INFO - Received message 'Msg3' (Seq: 3). Write Concern W=3.
iteration_2-secondary2-1  | 2025-06-06 12:11:17,574 - SECONDARY - INFO - Received replication request for Seq 3. Applying 5s delay...
iteration_2-secondary1-1  | 2025-06-06 12:11:17,575 - SECONDARY - INFO - Received replication request for Seq 3. Applying 1s delay...
iteration_2-secondary1-1  | 2025-06-06 12:11:18,575 - SECONDARY - INFO - Successfully replicated message (Seq: 3).
iteration_2-secondary1-1  | INFO:     172.31.0.4:52878 - "POST /replicate HTTP/1.1" 200 OK
iteration_2-master-1      | 2025-06-06 12:11:18,576 - MASTER - INFO - HTTP Request: POST http://secondary1:8001/replicate "HTTP/1.1 200 OK"
iteration_2-master-1      | 2025-06-06 12:11:18,577 - MASTER - INFO - ACK received from secondary1:8001 for Seq 3. Total ACKs: 1
iteration_2-secondary2-1  | 2025-06-06 12:11:22,574 - SECONDARY - INFO - Successfully replicated message (Seq: 3).
iteration_2-secondary2-1  | INFO:     172.31.0.4:59470 - "POST /replicate HTTP/1.1" 200 OK
iteration_2-master-1      | 2025-06-06 12:11:22,575 - MASTER - INFO - HTTP Request: POST http://secondary2:8001/replicate "HTTP/1.1 200 OK"
iteration_2-master-1      | 2025-06-06 12:11:22,576 - MASTER - INFO - ACK received from secondary2:8001 for Seq 3. Total ACKs: 2
iteration_2-master-1      | 2025-06-06 12:11:22,576 - MASTER - INFO - Write concern W=3 met with 2 ACKs. Responding to client.
iteration_2-master-1      | INFO:     172.31.0.1:52506 - "POST /messages HTTP/1.1" 200 OK
iteration_2-master-1      | INFO:     172.31.0.1:37674 - "GET /messages HTTP/1.1" 200 OK
iteration_2-secondary1-1  | INFO:     172.31.0.1:50884 - "GET /messages HTTP/1.1" 200 OK
iteration_2-secondary2-1  | INFO:     172.31.0.1:38934 - "GET /messages HTTP/1.1" 200 OK
```
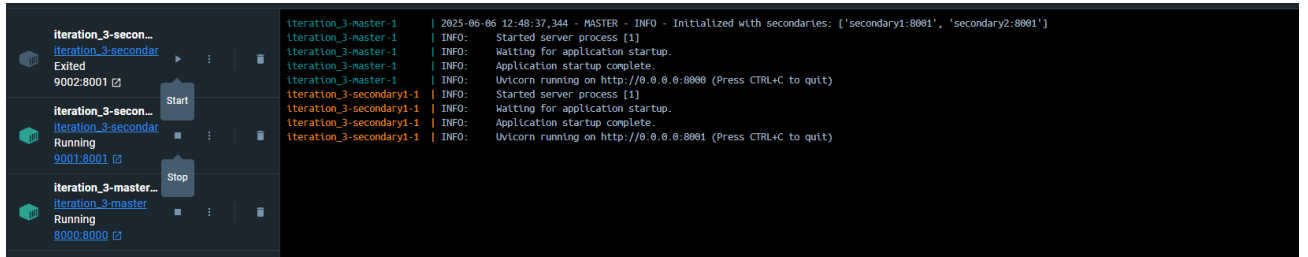
```
iteration_2-master-1      | 2025-06-06 12:11:17,537 - MASTER - INFO - Received message 'Msg3' (Seq: 3). Write Concern W=3.
iteration_2-secondary2-1  | 2025-06-06 12:11:17,574 - SECONDARY - INFO - Received replication request for Seq 3. Applying 5s delay...
iteration_2-secondary1-1  | 2025-06-06 12:11:17,575 - SECONDARY - INFO - Received replication request for Seq 3. Applying 1s delay...
iteration_2-secondary1-1  | 2025-06-06 12:11:18,575 - SECONDARY - INFO - Successfully replicated message (Seq: 3).
iteration_2-secondary1-1  | INFO:     172.31.0.4:52878 - "POST /replicate HTTP/1.1" 200 OK
iteration_2-master-1      | 2025-06-06 12:11:18,576 - MASTER - INFO - HTTP Request: POST http://secondary1:8001/replicate "HTTP/1.1 200 OK"
iteration_2-master-1      | 2025-06-06 12:11:18,577 - MASTER - INFO - ACK received from secondary1:8001 for Seq 3. Total ACKs: 1
iteration_2-secondary2-1  | 2025-06-06 12:11:22,574 - SECONDARY - INFO - Successfully replicated message (Seq: 3).
iteration_2-secondary2-1  | INFO:     172.31.0.4:59470 - "POST /replicate HTTP/1.1" 200 OK
iteration_2-master-1      | 2025-06-06 12:11:22,575 - MASTER - INFO - HTTP Request: POST http://secondary2:8001/replicate "HTTP/1.1 200 OK"
iteration_2-master-1      | 2025-06-06 12:11:22,576 - MASTER - INFO - ACK received from secondary2:8001 for Seq 3. Total ACKs: 2
iteration_2-master-1      | 2025-06-06 12:11:22,576 - MASTER - INFO - Write concern W=3 met with 2 ACKs. Responding to client.
iteration_2-master-1      | INFO:     172.31.0.1:52506 - "POST /messages HTTP/1.1" 200 OK
iteration_2-master-1      | INFO:     172.31.0.1:37674 - "GET /messages HTTP/1.1" 200 OK
iteration_2-secondary1-1  | INFO:     172.31.0.1:50884 - "GET /messages HTTP/1.1" 200 OK
iteration_2-secondary2-1  | INFO:     172.31.0.1:38934 - "GET /messages HTTP/1.1" 200 OK
```

Iteration 3

Запущені лише Master та Secondary1

Далі вже для наглядності буду тестувати через curl:
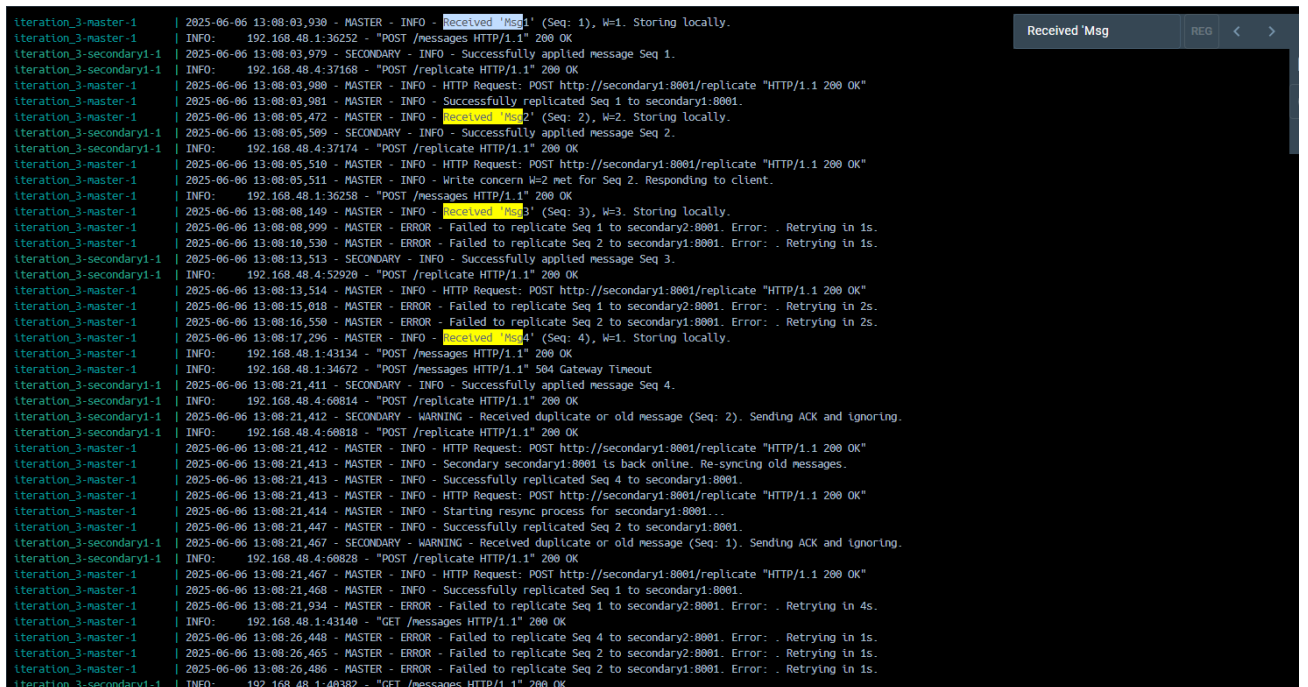
write_concern=1

```
└$ curl -X POST -H "Content-Type: application/json" -d '{"message": "Msg1", "w": 1}' http://localhost:8000/messages
{"status":"Message stored on master.","message":{"id":"256aa55e-5e98-437d-949b-9cc4e7069b6b","seq":1,"text":"Msg1"}}
```

write_concern=2, тут як і очікувано без помилок

```
└$ curl -X POST -H "Content-Type: application/json" -d '{"message": "Msg2", "w": 2}' http://localhost:8000/messages
{"status":"Message replicated with W=2.","message":{"id":"7b307593-dc50-40f5-9cd2-9d8c3ad2b6dc","seq":2,"text":"Msg2"}}
```

Далі write_concern=3, отримали таймаут

```
└$ curl -X POST -H "Content-Type: application/json" -d '{"message": "Msg3", "w": 3}' http://localhost:8000/messages
{"detail":"Timed out waiting for 2 ACKs. Got 1."}
```

write_concern=1, знову все ок

```
└$ curl -X POST -H "Content-Type: application/json" -d '{"message": "Msg4", "w": 1}' http://localhost:8000/messages
{"status":"Message stored on master.","message":{"id":"197527ed-d30b-425b-9be9-c0c3ee1c4028","seq":4,"text":"Msg4"}}
```

Лог:

Як бачимо у фоні намагається Master нода отримати відповідь від Secondary2

Ось що у нас повертає Master:

```
└$ curl http://localhost:8000/messages | jq .
  % Total    % Received % Xferd  Average Speed   Time    Time     Time  Current
                                 Dload  Upload   Total   Spent    Left  Speed
100   286  100   286    0     0   185k      0 --:--:-- --:--:-- --:--:--  279k
{
  "messages": [
    {
      "id": "256aa55e-5e98-437d-949b-9cc4e7069b6b",
      "seq": 1,
      "text": "Msg1"
    },
    {
      "id": "7b307593-dc50-40f5-9cd2-9d8c3ad2b6dc",
      "seq": 2,
      "text": "Msg2"
    },
    {
      "id": "0eaeb552-6c6f-47de-842a-5206f285c731",
      "seq": 3,
      "text": "Msg3"
    },
    {
      "id": "197527ed-d30b-425b-9be9-c0c3ee1c4028",
      "seq": 4,
      "text": "Msg4"
    }
  ]
}
```

Та Secondary1:

```
└$ curl http://localhost:9001/messages | jq .
  % Total    % Received % Xferd  Average Speed   Time    Time     Time  Current
                                 Dload  Upload   Total   Spent    Left  Speed
100   303  100   303    0     0   177k      0 --:--:-- --:--:-- --:--:--  295k
{
  "messages": [
    {
      "id": "256aa55e-5e98-437d-949b-9cc4e7069b6b",
      "seq": 1,
      "text": "Msg1"
    },
    {
      "id": "7b307593-dc50-40f5-9cd2-9d8c3ad2b6dc",
      "seq": 2,
      "text": "Msg2"
    },
    {
      "id": "0eaeb552-6c6f-47de-842a-5206f285c731",
      "seq": 3,
      "text": "Msg3"
    },
    {
      "id": "197527ed-d30b-425b-9be9-c0c3ee1c4028",
      "seq": 4,
      "text": "Msg4"
    }
  ],
  "expected_seq": 5
}
```

Вмикну Secondary2:

```
iteration_3-master-1     | 2025-06-06 13:12:09,373 - MASTER - ERROR - Failed to replicate Seq 1 to secondary2:8001. Error: . Retrying in 32s.
iteration_3-master-1     | 2025-06-06 13:12:26,816 - MASTER - ERROR - Failed to replicate Seq 4 to secondary2:8001. Error: . Retrying in 32s.
iteration_3-master-1     | 2025-06-06 13:12:26,837 - MASTER - ERROR - Failed to replicate Seq 2 to secondary2:8001. Error: . Retrying in 32s.
iteration_3-master-1     | 2025-06-06 13:12:26,857 - MASTER - ERROR - Failed to replicate Seq 2 to secondary1:8001. Error: . Retrying in 32s.
iteration_3-secondary2-1 | INFO:     Started server process [1]
iteration_3-secondary2-1 | INFO:     Waiting for application startup.
iteration_3-secondary2-1 | INFO:     Application startup complete.
iteration_3-secondary2-1 | INFO:     Uvicorn running on http://0.0.0.0:8001 (Press CTRL+C to quit)
```

```
iteration_3-secondary2-1  | 2025-06-06 13:12:41,289 - SECONDARY - INFO - Successfully applied message Seq 1.
iteration_3-secondary2-1  | INFO:     192.168.48.4:35144 - "POST /replicate HTTP/1.1" 200 OK
iteration_3-master-1      | 2025-06-06 13:12:41,290 - MASTER - INFO - HTTP Request: POST http://secondary2:8001/replicate "HTTP/1.1 200 OK"
iteration_3-master-1      | 2025-06-06 13:12:41,290 - MASTER - INFO - Secondary secondary2:8001 is back online. Re-syncing old messages.
iteration_3-master-1      | 2025-06-06 13:12:41,290 - MASTER - INFO - Successfully replicated Seq 1 to secondary2:8001.
iteration_3-master-1      | 2025-06-06 13:12:41,290 - MASTER - INFO - Starting resync process for secondary2:8001...
iteration_3-secondary2-1  | 2025-06-06 13:12:41,315 - SECONDARY - WARNING - Received duplicate or old message (Seq: 1). Sending ACK and ignoring.
iteration_3-secondary2-1  | INFO:     192.168.48.4:35150 - "POST /replicate HTTP/1.1" 200 OK
iteration_3-master-1      | 2025-06-06 13:12:41,315 - MASTER - INFO - HTTP Request: POST http://secondary2:8001/replicate "HTTP/1.1 200 OK"
iteration_3-master-1      | 2025-06-06 13:12:41,316 - MASTER - INFO - Successfully replicated Seq 1 to secondary2:8001.
iteration_3-secondary2-1  | 2025-06-06 13:12:41,335 - SECONDARY - INFO - Successfully applied message Seq 2.
iteration_3-secondary2-1  | INFO:     192.168.48.4:35166 - "POST /replicate HTTP/1.1" 200 OK
iteration_3-master-1      | 2025-06-06 13:12:41,336 - MASTER - INFO - HTTP Request: POST http://secondary2:8001/replicate "HTTP/1.1 200 OK"
iteration_3-master-1      | 2025-06-06 13:12:41,336 - MASTER - INFO - Successfully replicated Seq 2 to secondary2:8001.
iteration_3-secondary2-1  | 2025-06-06 13:12:41,355 - SECONDARY - INFO - Successfully applied message Seq 3.
iteration_3-secondary2-1  | INFO:     192.168.48.4:35178 - "POST /replicate HTTP/1.1" 200 OK
iteration_3-master-1      | 2025-06-06 13:12:41,355 - MASTER - INFO - HTTP Request: POST http://secondary2:8001/replicate "HTTP/1.1 200 OK"
iteration_3-master-1      | 2025-06-06 13:12:41,356 - MASTER - INFO - Successfully replicated Seq 3 to secondary2:8001.
iteration_3-secondary2-1  | 2025-06-06 13:12:41,378 - SECONDARY - INFO - Successfully applied message Seq 4.
iteration_3-secondary2-1  | INFO:     192.168.48.4:35186 - "POST /replicate HTTP/1.1" 200 OK
iteration_3-master-1      | 2025-06-06 13:12:41,379 - MASTER - INFO - HTTP Request: POST http://secondary2:8001/replicate "HTTP/1.1 200 OK"
iteration_3-master-1      | 2025-06-06 13:12:41,379 - MASTER - INFO - Successfully replicated Seq 4 to secondary2:8001.
iteration_3-master-1      | 2025-06-06 13:12:41,379 - MASTER - INFO - Resync process for secondary2:8001 complete.
```

І ось результат на Secondary2 після підняття ноди:

```
└─$ curl http://localhost:9002/messages | jq .
  % Total    % Received % Xferd  Average Speed   Time    Time     Time  Current
                                 Dload  Upload   Total   Spent    Left  Speed
100   303  100   303    0     0   154k      0 --:--:-- --:--:-- --:--:--  295k
{
  "messages": [
    {
      "id": "256aa55e-5e98-437d-949b-9cc4e7069b6b",
      "seq": 1,
      "text": "Msg1"
    },
    {
      "id": "7b307593-dc50-40f5-9cd2-9d8c3ad2b6dc",
      "seq": 2,
      "text": "Msg2"
    },
    {
      "id": "0eaeb552-6c6f-47de-842a-5206f285c731",
      "seq": 3,
      "text": "Msg3"
    },
    {
      "id": "197527ed-d30b-425b-9be9-c0c3ee1c4028",
      "seq": 4,
      "text": "Msg4"
    }
  ],
  "expected_seq": 5
}
```