Task 6 - Реплікация у Cassandra

1. Сконфігурувати кластер з 3-х нод:

- https://hub.docker.com/_/cassandra
- https://gokhanatil.com/2018/02/build-a-cassandra-cluster-on-docker.html
- https://www.jamescoyle.net/how-to/2448-create-a-simple-cassandra-cluster-with-3-nodes
- https://www.digitalocean.com/community/tutorials/how-to-run-a-multi-node-cluster-database-with-cassandra-on-ubuntu-14-04

```
alexe@DESKTOP-MMMMMMMMMMMMMMMMM ~
> docker run --name lab6-cas-cl1 -m=2g -p 127.0.0.1:9051:9042 --network lab6-net -e CASSANDRA_CLUSTER_NAME=Lab6-Cluster
-e CASSANDRA_ENDPOINT_SNITCH=GossipingPropertyFileSnitch -d cassandra:latest
3b1dd15440d172f9f364b4117bccf01f9ba0da976d655b48b36ca92c17f50ef3
alexe@DESKTOP-MMMMMMMMMMMMMMMMM ~
> docker run --name lab6-cas-cl2 -m=2g  -p 127.0.0.1:9052:9042 --network lab6-net -e CASSANDRA_SEEDS="$(docker inspect -
f '{{range.NetworkSettings.Networks}}{{.IPAddress}}{{end}}' lab6-cas-cl1)" -e CASSANDRA_CLUSTER_NAME=Lab6-Cluster -e CAS
SANDRA_ENDPOINT_SNITCH=GossipingPropertyFileSnitch -d cassandra:latest
80abf6fc47a48e028e075fbf297dd19776b7542261aa3026ea241a7a79096e83
alexe@DESKTOP-MMMMMMMMMMMMMMMMM ~
> docker run --name lab6-cas-cl3 -m=2g -p 127.0.0.1:9053:9042 --network lab6-net -e CASSANDRA_SEEDS="$(docker inspect -f
 '{{range.NetworkSettings.Networks}}{{.IPAddress}}{{end}}' lab6-cas-cl1)" -e CASSANDRA_CLUSTER_NAME=Lab6-Cluster -e CASS
ANDRA_ENDPOINT_SNITCH=GossipingPropertyFileSnitch -d cassandra:latest
ba3531dd80d8672dfef32c45885172babf2ec546c347d24b34a9545bb0fb96ca
```

```
alexe@DESKTOP-MMMMMMMMMMMMMMMMM ~
> docker network create lab6-net --driver bridge
a1184fb0ba0698e06ac2ea0b22abede5fd514ea6e9f70f3b9da576ab17a07245
```

2. Перевірити правильність конфігурації за допомогою *nodetool status*

```
alexe@DESKTOP-MMMMMMMMMMMMMMMMM ~
> docker exec -it lab6-cas-cl1 nodetool status
Datacenter: dc1
===============
Status=Up/Down
|/ State=Normal/Leaving/Joining/Moving
--  Address     Load       Tokens  Owns (effective)  Host ID                               Rack
UN  172.18.0.4  74.03 KiB  16      76.0%             b5e0e99b-5570-4e7e-aa78-c9b5520d948d  rack1
UN  172.18.0.3  69.06 KiB  16      59.3%             b838397e-0015-4c8e-b3ff-e54b2b98c2d6  rack1
UN  172.18.0.2  74.1 KiB   16      64.7%             b4184882-e005-4694-b427-71ea3a85544e  rack1
```

3. Використовуючи *cqlsh*, створити три *Keyspace* з replication factor 1, 2, 3
https://www.tutorialspoint.com/cassandra/cassandra_create_keyspace.htm
Див код та аутпут

4. В кожному з кейспейсів створити таблиці
https://docs.datastax.com/en/cql/3.1/cql/cql_reference/create_table_r.html
https://www.tutorialspoint.com/cassandra/cassandra_create_table.htm

Див код та аутпут

```
cqlsh> describe tables

Keyspace lab6_ks1
-----------------
lab6_table

Keyspace lab6_ks2
-----------------
lab6_table

Keyspace lab6_ks3
-----------------
lab6_table
```

5. Спробуйте писати і читати на / та з різних нод.

Cluster 1:

```
cqlsh> Insert into lab6_ks1.lab6_table(id, text) values (1, 'Some Text From Cluster 1');
cqlsh> Insert into lab6_ks2.lab6_table(id, text) values (1, 'Some Text From Cluster 1');
cqlsh> Insert into lab6_ks3.lab6_table(id, text) values (1, 'Some Text From Cluster 1');
cqlsh> Select * from lab6_ks1.lab6_table
```

```
cqlsh> Select * from lab6_ks1.lab6_table;

 id | text
----+--------------------------
  1 | Some Text From Cluster 1
  2 | Some Text From Cluster 2
  3 | Some Text From Cluster 3

(3 rows)
cqlsh> Select * from lab6_ks2.lab6_table;

 id | text
----+--------------------------
  1 | Some Text From Cluster 1
  2 | Some Text From Cluster 2
  3 | Some Text From Cluster 3

(3 rows)
cqlsh> Select * from lab6_ks3.lab6_table;

 id | text
----+--------------------------
  1 | Some Text From Cluster 1
  2 | Some Text From Cluster 2
  3 | Some Text From Cluster 3
```

Cluster 2:

```
alexe@DESKTOP-MMMMMMMMMMMMMMMMM ~ ✖125
> docker exec -it lab6-cas-cl2 cqlsh
Connected to Lab6-Cluster at 127.0.0.1:9042
[cqlsh 6.0.0 | Cassandra 4.0.1 | CQL spec 3.4.5 | Native protocol v5]
Use HELP for help.
cqlsh> Insert into lab6_ks1.lab6_table(id, text) values (2, 'Some Text From Cluster 2') IF NOT EXISTS;

 [applied]
-----------
      True

cqlsh> Insert into lab6_ks2.lab6_table(id, text) values (2, 'Some Text From Cluster 2') IF NOT EXISTS;

 [applied]
-----------
      True

cqlsh> Insert into lab6_ks3.lab6_table(id, text) values (2, 'Some Text From Cluster 2') IF NOT EXISTS;

 [applied]
-----------
      True
```

```
cqlsh> Insert into lab6_ks3.lab6_table(id, text) values (2, 'Some Text From Cluster 2') IF NOT EXISTS;

 [applied]
-----------
      True

cqlsh> Select * from lab6_ks1.lab6_table;

 id | text
----+--------------------------
  1 | Some Text From Cluster 1
  2 | Some Text From Cluster 2
  3 | Some Text From Cluster 3

(3 rows)
cqlsh> Select * from lab6_ks2.lab6_table;

 id | text
----+--------------------------
  1 | Some Text From Cluster 1
  2 | Some Text From Cluster 2
  3 | Some Text From Cluster 3

(3 rows)
cqlsh> Select * from lab6_ks3.lab6_table;

 id | text
----+--------------------------
  1 | Some Text From Cluster 1
  2 | Some Text From Cluster 2
  3 | Some Text From Cluster 3
```

Cluster 3:

```
alexe@DESKTOP-MMMMMMMMMMMMMMMMM ~
> docker exec -it lab6-cas-cl3 cqlsh
Connected to Lab6-Cluster at 127.0.0.1:9042
[cqlsh 6.0.0 | Cassandra 4.0.1 | CQL spec 3.4.5 | Native protocol v5]
Use HELP for help.
cqlsh> Insert into lab6_ks1.lab6_table(id, text) values (3, 'Some Text From Cluster 3') IF NOT EXISTS;

 [applied]
-----------
      True

cqlsh> Insert into lab6_ks2.lab6_table(id, text) values (3, 'Some Text From Cluster 3') IF NOT EXISTS;

 [applied]
-----------
      True

cqlsh> Insert into lab6_ks3.lab6_table(id, text) values (3, 'Some Text From Cluster 3') IF NOT EXISTS;

 [applied]
-----------
      True

cqlsh> Insert into lab6_ks3.lab6_table(id, text) values (3, 'Some Text From Cluster 3') IF NOT EXISTS;

 [applied]
-----------
      True

cqlsh> Select * from lab6_ks1.lab6_table;

 id | text
----+--------------------------
  1 | Some Text From Cluster 1
  2 | Some Text From Cluster 2
  3 | Some Text From Cluster 3

(3 rows)
cqlsh> Select * from lab6_ks2.lab6_table;

 id | text
----+--------------------------
  1 | Some Text From Cluster 1
  2 | Some Text From Cluster 2
  3 | Some Text From Cluster 3

(3 rows)
cqlsh> Select * from lab6_ks3.lab6_table;

 id | text
----+--------------------------
  1 | Some Text From Cluster 1
  2 | Some Text From Cluster 2
  3 | Some Text From Cluster 3
```

6. Вставте дані в створені таблиці і подивіться на їх розподіл по вузлах кластера (для кожного з кейспесов - *nodetool status*)
https://docs.datastax.com/en/cql/3.1/cql/cql_reference/insert_r.html
https://docs.datastax.com/en/cql/3.1/cql/cql_reference/select_r.html
https://www.tutorialspoint.com/cassandra/cassandra_create_data.htm
https://www.tutorialspoint.com/cassandra/cassandra_read_data.htm

```
Note: Non-system keyspaces don't have the same replication settings, effective ownership information i
root@22822cb7d723:/# nodetool status lab6_ks1
Datacenter: dc1
===============
Status=Up/Down
|/ State=Normal/Leaving/Joining/Moving
--  Address     Load        Tokens  Owns (effective)  Host ID                               Rack
UN  172.18.0.4  294.62 KiB  16      35.7%             a1dce472-ca5a-40fc-ad37-572dbc3ee4f0  rack1
UN  172.18.0.3  258.25 KiB  16      31.6%             4fae7ac4-95a2-4778-8b66-864fb21b3b19  rack1
UN  172.18.0.2  221.01 KiB  16      32.7%             2dd90c55-2c38-47db-909b-de5000eeeef1  rack1

root@22822cb7d723:/# nodetool status lab6_ks2
Datacenter: dc1
===============
Status=Up/Down
|/ State=Normal/Leaving/Joining/Moving
--  Address     Load        Tokens  Owns (effective)  Host ID                               Rack
UN  172.18.0.4  294.62 KiB  16      76.0%             a1dce472-ca5a-40fc-ad37-572dbc3ee4f0  rack1
UN  172.18.0.3  258.25 KiB  16      59.3%             4fae7ac4-95a2-4778-8b66-864fb21b3b19  rack1
UN  172.18.0.2  221.01 KiB  16      64.7%             2dd90c55-2c38-47db-909b-de5000eeeef1  rack1

root@22822cb7d723:/# nodetool status lab6_ks3
Datacenter: dc1
===============
Status=Up/Down
|/ State=Normal/Leaving/Joining/Moving
--  Address     Load        Tokens  Owns (effective)  Host ID                               Rack
UN  172.18.0.4  294.62 KiB  16      100.0%            a1dce472-ca5a-40fc-ad37-572dbc3ee4f0  rack1
UN  172.18.0.3  258.25 KiB  16      100.0%            4fae7ac4-95a2-4778-8b66-864fb21b3b19  rack1
UN  172.18.0.2  221.01 KiB  16      100.0%            2dd90c55-2c38-47db-909b-de5000eeeef1  rack1

root@22822cb7d723:/#
```

7. Для якогось запису з кожного з кейспейсу виведіть ноди на яких зберігаються дані https://docs.datastax.com/en/dse/5.1/dse-admin/datastax_enterprise/tools/nodetool/toolsGetEndPoints.html

```
root@22822cb7d723:/# nodetool getendpoints lab6_ks1 lab6_table 1
172.18.0.3
root@22822cb7d723:/# nodetool getendpoints lab6_ks1 lab6_table 2
172.18.0.4
root@22822cb7d723:/# nodetool getendpoints lab6_ks1 lab6_table 3
172.18.0.3
root@22822cb7d723:/# nodetool getendpoints lab6_ks2 lab6_table 1
172.18.0.3
172.18.0.2
root@22822cb7d723:/# nodetool getendpoints lab6_ks2 lab6_table 2
172.18.0.4
172.18.0.2
root@22822cb7d723:/# nodetool getendpoints lab6_ks2 lab6_table 3
172.18.0.3
172.18.0.4
root@22822cb7d723:/# nodetool getendpoints lab6_ks3 lab6_table 1
172.18.0.3
172.18.0.2
172.18.0.4
root@22822cb7d723:/# nodetool getendpoints lab6_ks3 lab6_table 2
172.18.0.4
172.18.0.2
172.18.0.3
root@22822cb7d723:/# nodetool getendpoints lab6_ks3 lab6_table 3
172.18.0.3
172.18.0.4
172.18.0.2
```

8. Відключиіть одну з нод. Для кожного з кейспейсів визначить з якими рівнями *consistency* можемо читати та писати, і які з них забезпечують *strong consistency* https://docs.datastax.com/en/cql/3.1/cql/cql_reference/consistency_r.html

```
alexe@DESKTOP-MMMMMMMMMMMMMMMMM ~
> docker stop lab6-cas-cl2
lab6-cas-cl2
alexe@DESKTOP-MMMMMMMMMMMMMMMMM ~
```

```
root@22822cb7d723:/# nodetool status
Datacenter: dc1
===============
Status=Up/Down
|/ State=Normal/Leaving/Joining/Moving
--  Address     Load        Tokens  Owns  Host ID                               Rack
UN  172.18.0.4  294.62 KiB  16      ?     a1dce472-ca5a-40fc-ad37-572dbc3ee4f0  rack1
DN  172.18.0.3  258.25 KiB  16      ?     4fae7ac4-95a2-4778-8b66-864fb21b3b19  rack1
UN  172.18.0.2  221.01 KiB  16      ?     2dd90c55-2c38-47db-909b-de5000eeeef1  rack1
```

```
cqlsh> use lab6_ks1
   ... ;
cqlsh:lab6_ks1> COnsistency
Current consistency level is ONE.
cqlsh:lab6_ks1> use lab6_ks2;
cqlsh:lab6_ks2> COnsistency
Current consistency level is ONE.
cqlsh:lab6_ks2> use lab6_ks3;
cqlsh:lab6_ks3> COnsistency
Current consistency level is ONE.
cqlsh:lab6_ks3>
```

9. Зробить так щоб три ноди працювали, але не бачили одна одну по мережі (відключити зв'язок між ними)

```
alexe@DESKTOP-MMMMMMMMMMMMMMMMM ~
> docker network disconnect lab6-net lab6-cas-cl1
alexe@DESKTOP-MMMMMMMMMMMMMMMMM ~
> docker network disconnect lab6-net lab6-cas-cl2
alexe@DESKTOP-MMMMMMMMMMMMMMMMM ~
> docker network disconnect lab6-net lab6-cas-cl3
alexe@DESKTOP-MMMMMMMMMMMMMMMMM ~
>
```

10. Для кейспейсу з *replication factor* 3 задайте рівень consistency рівним 1. Виконайте запис одного й того самого значення, з однаковим primary key, але різними іншими значенням на кожну з нод (тобто створіть конфлікт)

Cluster 1:

```
cqlsh:lab6_ks3> Insert into lab6_ks1.lab6_table(id, text) values (4, 'Some Conflict Text From Cluster 1') IF NOT EXISTS;

 [applied]
-----------
      True

cqlsh:lab6_ks3> Insert into lab6_ks2.lab6_table(id, text) values (4, 'Some Conflict Text From Cluster 1') IF NOT EXISTS;
NoHostAvailable: ('Unable to complete the operation against any hosts', {<Host: 127.0.0.1:9042 dc1>: Unavailable('Error
from server: code=1000 [Unavailable exception] message="Cannot achieve consistency level SERIAL" info={\'consistency\':
\'SERIAL\', \'required_replicas\': 2, \'alive_replicas\': 1}')})
cqlsh:lab6_ks3> Insert into lab6_ks2.lab6_table(id, text) values (4, 'Some Conflict Text From Cluster 1');
cqlsh:lab6_ks3> Insert into lab6_ks3.lab6_table(id, text) values (4, 'Some Conflict Text From Cluster 1');
```

Cluster 2:

```
NE\', \'required_replicas\': 1, \'alive_replicas\': 0}')})
cqlsh> Insert into lab6_ks3.lab6_table(id, text) values (4, 'Some Conflict Text From Cluster 2');
```

Cluster 3:

```
cqlsh> Insert into lab6_ks2.lab6_table(id, text) values (4, 'Some Conflict Text From Cluster 3');
cqlsh> Insert into lab6_ks3.lab6_table(id, text) values (4, 'Some Conflict Text From Cluster 3');
```

11. Об’єднайте ноди в кластер і визначте яке значення було прийнято кластером та за яким принципом

```
alexe@DESKTOP-MMMMMMMMMMMMMMMMM ~
> docker network connect lab6-net lab6-cas-cl1
alexe@DESKTOP-MMMMMMMMMMMMMMMMM ~
> docker network connect lab6-net lab6-cas-cl2
alexe@DESKTOP-MMMMMMMMMMMMMMMMM ~
> docker network connect lab6-net lab6-cas-cl3
```

```
root@22822cb7d723:/# nodetool status
Datacenter: dc1
==============
Status=Up/Down
|/ State=Normal/Leaving/Joining/Moving
--  Address     Load        Tokens  Owns  Host ID                               Rack
UN  172.18.0.4  294.62 KiB  16      ?     a1dce472-ca5a-40fc-ad37-572dbc3ee4f0  rack1
UN  172.18.0.3  231.51 KiB  16      ?     4fae7ac4-95a2-4778-8b66-864fb21b3b19  rack1
UN  172.18.0.2  221.01 KiB  16      ?     2dd90c55-2c38-47db-909b-de5000eeeef1  rack1
```

```
cqlsh> Select * from lab6_ks1.lab6_table;

 id | text
----+-----------------------------------
  1 |           Some Text From Cluster 1
  2 |           Some Text From Cluster 2
  4 | Some Conflict Text From Cluster 1
  3 |           Some Text From Cluster 3

(4 rows)
cqlsh> Select * from lab6_ks2.lab6_table;

 id | text
----+-----------------------------------
  1 |           Some Text From Cluster 1
  2 |           Some Text From Cluster 2
  4 | Some Conflict Text From Cluster 3
  3 |           Some Text From Cluster 3

(4 rows)
cqlsh> Select * from lab6_ks3.lab6_table;

 id | text
----+-----------------------------------
  1 |           Some Text From Cluster 1
  2 |           Some Text From Cluster 2
  4 | Some Conflict Text From Cluster 3
  3 |           Some Text From Cluster 3
```

12. Перевірте поведінку *lightweight transactions* для попередніх пунктів у розділеному на три частини кластері https://docs.datastax.com/en/cql-oss/3.3/cql/cql_using/useInsertLWT.html

Cluster 1:

```
cqlsh:lab6_ks3> Insert into lab6_ks3.lab6_table(id, text) values (4, 'Some Conflict Text From Cluster 1') IF NOT EXISTS;
NoHostAvailable: ('Unable to complete the operation against any hosts', {<Host: 127.0.0.1:9042 dc1>: Unavailable('Error
from server: code=1000 [Unavailable exception] message="Cannot achieve consistency level SERIAL" info={\'consistency\':
\'SERIAL\', \'required_replicas\': 2, \'alive_replicas\': 1}')})
cqlsh:lab6_ks3> Insert into lab6_ks1.lab6_table(id, text) values (4, 'Some Conflict Text From Cluster 1') IF NOT EXISTS;

 [applied]
-----------
      True

cqlsh:lab6_ks3> Insert into lab6_ks2.lab6_table(id, text) values (4, 'Some Conflict Text From Cluster 1') IF NOT EXISTS;
NoHostAvailable: ('Unable to complete the operation against any hosts', {<Host: 127.0.0.1:9042 dc1>: Unavailable('Error
from server: code=1000 [Unavailable exception] message="Cannot achieve consistency level SERIAL" info={\'consistency\':
\'SERIAL\', \'required_replicas\': 2, \'alive_replicas\': 1}')})
cqlsh:lab6_ks3>
```

Cluster 2:

```
cqlsh> Insert into lab6_ks1.lab6_table(id, text) values (4, 'Some Conflict Text From Cluster 2') IF NOT EXISTS;
NoHostAvailable: ('Unable to complete the operation against any hosts', {<Host: 127.0.0.1:9042 dc1>: Unavailable('Error
from server: code=1000 [Unavailable exception] message="Cannot achieve consistency level SERIAL" info={\'consistency\':
\'SERIAL\', \'required_replicas\': 1, \'alive_replicas\': 0}')})
cqlsh> Insert into lab6_ks3.lab6_table(id, text) values (4, 'Some Conflict Text From Cluster 2') IF NOT EXISTS;
NoHostAvailable: ('Unable to complete the operation against any hosts', {<Host: 127.0.0.1:9042 dc1>: Unavailable('Error
from server: code=1000 [Unavailable exception] message="Cannot achieve consistency level SERIAL" info={\'consistency\':
\'SERIAL\', \'required_replicas\': 2, \'alive_replicas\': 1}')})
cqlsh> Insert into lab6_ks2.lab6_table(id, text) values (4, 'Some Conflict Text From Cluster 2') IF NOT EXISTS;
NoHostAvailable: ('Unable to complete the operation against any hosts', {<Host: 127.0.0.1:9042 dc1>: Unavailable('Error
from server: code=1000 [Unavailable exception] message="Cannot achieve consistency level SERIAL" info={\'consistency\':
\'SERIAL\', \'required_replicas\': 2, \'alive_replicas\': 0}')})
```

Cluster 3:

```
(3 rows)
cqlsh> Insert into lab6_ks1.lab6_table(id, text) values (4, 'Some Conflict Text From Cluster 3') IF NOT EXISTS;
NoHostAvailable: ('Unable to complete the operation against any hosts', {<Host: 127.0.0.1:9042 dc1>: Unavailable('Error
from server: code=1000 [Unavailable exception] message="Cannot achieve consistency level SERIAL" info={\'consistency\':
\'SERIAL\', \'required_replicas\': 1, \'alive_replicas\': 0}')})
cqlsh> Insert into lab6_ks2.lab6_table(id, text) values (4, 'Some Conflict Text From Cluster 3') IF NOT EXISTS;
NoHostAvailable: ('Unable to complete the operation against any hosts', {<Host: 127.0.0.1:9042 dc1>: Unavailable('Error
from server: code=1000 [Unavailable exception] message="Cannot achieve consistency level SERIAL" info={\'consistency\':
\'SERIAL\', \'required_replicas\': 2, \'alive_replicas\': 1}')})
cqlsh> Insert into lab6_ks3.lab6_table(id, text) values (4, 'Some Conflict Text From Cluster 3') IF NOT EXISTS;
NoHostAvailable: ('Unable to complete the operation against any hosts', {<Host: 127.0.0.1:9042 dc1>: Unavailable('Error
from server: code=1000 [Unavailable exception] message="Cannot achieve consistency level SERIAL" info={\'consistency\':
\'SERIAL\', \'required_replicas\': 2, \'alive_replicas\': 1}')})
cqlsh>
```