Conceptos y comandos básicos de la replicación en bases de datos NoSQL.

Actividad 2 – Unidad 2

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Resultados de las Pruebas de Replicación

1. Preparación del entorno de pruebas

- Creación de directorios para los nodos de replicación

```
PS C:\Users\Santiago> md /data/mongo/rs1

    Directory: C:\data\mongo

Mode                 LastWriteTime         Length Name
----                 -------------         ------ ----
d----        01/12/2024 11:50 p. m.                rs1

PS C:\Users\Santiago> md /data/mongo/rs2

    Directory: C:\data\mongo

Mode                 LastWriteTime         Length Name
----                 -------------         ------ ----
d----        01/12/2024 11:50 p. m.                rs2

PS C:\Users\Santiago> md /data/mongo/rs3

    Directory: C:\data\mongo

Mode                 LastWriteTime         Length Name
----                 -------------         ------ ----
d----        01/12/2024 11:50 p. m.                rs3
```

- Creación del nodo “rs1” en el puerto 27017 para el replication set “rs0”

```
PS C:\Users\Santiago> mongod --bind_ip localhost --port 27017 --dbpath C:\data\mongo\rs1 --replSet "rs0"
{"t":{"$date":"2024-12-02T00:04:25.730-05:00"},"s":"I",  "c":"CONTROL",  "id":23285,   "ctx":"thread1","msg":"Automatically disabling TLS 1.0, to force-enable TLS 1.0 specify --sslDisabledProtocols 'none'"}
{"t":{"$date":"2024-12-02T00:04:25.731-05:00"},"s":"I",  "c":"CONTROL",  "id":5945603, "ctx":"thread1","msg":"Multi threading initialized"}
{"t":{"$date":"2024-12-02T00:04:25.732-05:00"},"s":"I",  "c":"NETWORK",  "id":4648601, "ctx":"thread1","msg":"Implicit TCP FastOpen unavailable. If TCP FastOpen is required, set at least one of the related parameters","attr":{"relatedParameters":["tcpFastOpenServer","tcpFastOpenClient","tcpFastOpenQueueSize"]}}
{"t":{"$date":"2024-12-02T00:04:25.733-05:00"},"s":"I",  "c":"NETWORK",  "id":4915701, "ctx":"thread1","msg":"Initialized wire specification","attr":{"spec":{"incomingExternalClient":{"minWireVersion":0,"maxWireVersion":25},"incomingInternalClient":{"minWireVersion":0,"maxWireVersion":25},"outgoing":{"minWireVersion":6,"maxWireVersion":25},"isInternalClient":true}}}
{"t":{"$date":"2024-12-02T00:04:25.737-05:00"},"s":"I",  "c":"TENANT_M", "id":7091600, "ctx":"thread1","msg":"Starting TenantMigrationAccessBlockerRegistry"}
{"t":{"$date":"2024-12-02T00:04:25.737-05:00"},"s":"I",  "c":"CONTROL",  "id":4615611, "ctx":"initandlisten","msg":"MongoDB starting","attr":{"pid":15020,"port":27017,"dbPath":"C:/data/mongo/rs1","architecture":"64-bit","host":"santiago-s145"}}
{"t":{"$date":"2024-12-02T00:04:25.737-05:00"},"s":"I",  "c":"CONTROL",  "id":23398,   "ctx":"initandlisten","msg":"Target operating system minimum version","attr":{"targetMinOS":"Windows 7/Windows Server 2008 R2"}}
{"t":{"$date":"2024-12-02T00:04:25.737-05:00"},"s":"I",  "c":"CONTROL",  "id":23403,   "ctx":"initandlisten","msg":"Build Info","attr":{"buildInfo":{"version":"8.0.3","gitVersion":"89d97f2744a2b9851ddfb51bdf22f687562d9b06","modules":[],"allocator":"tcmalloc-gperf","environment":{"distmod":"windows","distarch":"x86_64","target_arch":"x86_64"}}}}
{"t":{"$date":"2024-12-02T00:04:25.737-05:00"},"s":"I",  "c":"CONTROL",  "id":51765,   "ctx":"initandlisten","msg":"Operating System","attr":{"os":{"name":"Microsoft Windows 10","version":"10.0 (build 26100)"}}}
{"t":{"$date":"2024-12-02T00:04:25.738-05:00"},"s":"I",  "c":"CONTROL",  "id":21951,   "ctx":"initandlisten","msg":"Options set by command line","attr":{"options":{"net":{"bindIp":"localhost","port":27017},"replication":{"replSet":"rs0"},"storage":{"dbPath":"C:\\data\\mongo\\rs1"}}}}
{"t":{"$date":"2024-12-02T00:04:25.745-05:00"},"s":"I",  "c":"STORAGE",  "id":22270,   "ctx":"initandlisten","msg":"Storage engine to use detected by data files","attr":{"dbpath":"C:/data/mongo/rs1","storageEngine":"wiredTiger"}}
{"t":{"$date":"2024-12-02T00:04:25.745-05:00"},"s":"I",  "c":"STORAGE",  "id":22315,   "ctx":"initandlisten","msg":"Opening WiredTiger","attr":{"config":"create,cache_size=4546M,session_max=33000,eviction=(threads_min=4,threads_max=4),config_base=false,statistics=(fast),log=(enabled=true,remove=true,path=journal,compressor=snappy),builtin_extension_config=(zstd=(compression_level=6)),file_manager=(close_idle_time=600,close_scan_interval=10,close_handle_minimum=2000),statistics_log=(wait=0),json_output=(error,message),verbose=[recovery_progress:1,checkpoint_progress:1,compact_progress:1
```

- Creación del nodo “rs2” en el puerto 27018 para el replication set “rs0”

```
PS C:\Users\Santiago> mongod --bind_ip localhost --port 27018 --dbpath C:\data\mongo\rs2 --replSet "rs0"
{"t":{"$date":"2024-12-02T00:04:42.376-05:00"},"s":"I",  "c":"CONTROL",  "id":23285,   "ctx":"thread1","msg":"Automatically disabling TLS 1.0, to force-enable TLS 1.0 specify --sslDisabledProtocols 'none'"}
{"t":{"$date":"2024-12-02T00:04:44.179-05:00"},"s":"I",  "c":"CONTROL",  "id":5945603, "ctx":"thread1","msg":"Multi threading initialized"}
{"t":{"$date":"2024-12-02T00:04:44.179-05:00"},"s":"I",  "c":"NETWORK",  "id":4648601, "ctx":"thread1","msg":"Implicit TCP FastOpen unavailable. If TCP FastOpen is required, set at least one of the related parameters","attr":{"relatedParameters":["tcpFastOpenServer","tcpFastOpenClient","tcpFastOpenQueueSize"]}}
{"t":{"$date":"2024-12-02T00:04:44.181-05:00"},"s":"I",  "c":"NETWORK",  "id":4915701, "ctx":"thread1","msg":"Initialized wire specification","attr":{"spec":{"incomingExternalClient":{"minWireVersion":0,"maxWireVersion":25},"incomingInternalClient":{"minWireVersion":0,"maxWireVersion":25},"outgoing":{"minWireVersion":6,"maxWireVersion":25},"isInternalClient":true}}}
{"t":{"$date":"2024-12-02T00:04:44.183-05:00"},"s":"I",  "c":"TENANT_M", "id":7091600, "ctx":"thread1","msg":"Starting TenantMigrationAccessBlockerRegistry"}
{"t":{"$date":"2024-12-02T00:04:44.183-05:00"},"s":"I",  "c":"CONTROL",  "id":4615611, "ctx":"initandlisten","msg":"MongoDB starting","attr":{"pid":18864,"port":27018,"dbPath":"C:/data/mongo/rs2","architecture":"64-bit","host":"santiago-s145"}}
{"t":{"$date":"2024-12-02T00:04:44.183-05:00"},"s":"I",  "c":"CONTROL",  "id":23398,   "ctx":"initandlisten","msg":"Target operating system minimum version","attr":{"targetMinOS":"Windows 7/Windows Server 2008 R2"}}
{"t":{"$date":"2024-12-02T00:04:44.183-05:00"},"s":"I",  "c":"CONTROL",  "id":23403,   "ctx":"initandlisten","msg":"Build Info","attr":{"buildInfo":{"version":"8.0.3","gitVersion":"89d97f2744a2b9851ddfb51bdf22f687562d9b06","modules":[],"allocator":"tcmalloc-gperf","environment":{"distmod":"windows","distarch":"x86_64","target_arch":"x86_64"}}}}
{"t":{"$date":"2024-12-02T00:04:44.183-05:00"},"s":"I",  "c":"CONTROL",  "id":51765,   "ctx":"initandlisten","msg":"Operating System","attr":{"os":{"name":"Microsoft Windows 10","version":"10.0 (build 26100)"}}}
{"t":{"$date":"2024-12-02T00:04:44.183-05:00"},"s":"I",  "c":"CONTROL",  "id":21951,   "ctx":"initandlisten","msg":"Options set by command line","attr":{"options":{"net":{"bindIp":"localhost","port":27018},"replication":{"replSet":"rs0"},"storage":{"dbPath":"C:\\data\\mongo\\rs2"}}}}
{"t":{"$date":"2024-12-02T00:04:44.190-05:00"},"s":"I",  "c":"STORAGE",  "id":22270,   "ctx":"initandlisten","msg":"Storage engine to use detected by data files","attr":{"dbpath":"C:/data/mongo/rs2","storageEngine":"wiredTiger"}}
{"t":{"$date":"2024-12-02T00:04:44.191-05:00"},"s":"I",  "c":"STORAGE",  "id":22315,   "ctx":"initandlisten","msg":"Opening WiredTiger","attr":{"config":"create,cache_size=4546M,session_max=33000,eviction=(threads_min=4,threads_max=4),config_base=false,statistics=(fast),log=(enabled=true,remove=true,path=journal,compressor=snappy),builtin_extension_config=(zstd=(compression_level=6)),file_manager=(close_idle_time=600,close_scan_interval=10,close_handle_minimum=2000),statistics_log=(wait=0),json_output=(error,message),verbose=[recovery_progress:1,checkpoint_progress:1,compact_progress:1
```

- Creación del nodo “rs3” en el puerto 27019 para el replication set “rs0”

```
PS C:\Users\Santiago> mongod --bind_ip localhost --port 27019 --dbpath C:\data\mongo\rs3 --replSet "rs0"
{"t":{"$date":"2024-12-02T00:04:55.801-05:00"},"s":"I",  "c":"CONTROL",  "id":23285,   "ctx":"thread1","msg":"Automatically disabling TLS 1.0, to force-enable TLS 1.0 specify --sslDisabledProtocols 'none'"}
{"t":{"$date":"2024-12-02T00:04:57.825-05:00"},"s":"I",  "c":"CONTROL",  "id":5945603, "ctx":"thread1","msg":"Multi threading initialized"}
{"t":{"$date":"2024-12-02T00:04:57.826-05:00"},"s":"I",  "c":"NETWORK",  "id":4648601, "ctx":"thread1","msg":"Implicit TCP FastOpen unavailable. If TCP FastOpen is required, set at least one of the related parameters","attr":{"relatedParameters":["tcpFastOpenServer","tcpFastOpenClient","tcpFastOpenQueueSize"]}}
{"t":{"$date":"2024-12-02T00:04:57.829-05:00"},"s":"I",  "c":"NETWORK",  "id":4915701, "ctx":"thread1","msg":"Initialized wire specification","attr":{"spec":{"incomingExternalClient":{"minWireVersion":0,"maxWireVersion":25},"incomingInternalClient":{"minWireVersion":0,"maxWireVersion":25},"outgoing":{"minWireVersion":6,"maxWireVersion":25},"isInternalClient":true}}}
{"t":{"$date":"2024-12-02T00:04:57.831-05:00"},"s":"I",  "c":"TENANT_M", "id":7091600, "ctx":"thread1","msg":"Starting TenantMigrationAccessBlockerRegistry"}
{"t":{"$date":"2024-12-02T00:04:57.831-05:00"},"s":"I",  "c":"CONTROL",  "id":4615611, "ctx":"initandlisten","msg":"MongoDB starting","attr":{"pid":11088,"port":27019,"dbPath":"C:/data/mongo/rs3","architecture":"64-bit","host":"santiago-s145"}}
{"t":{"$date":"2024-12-02T00:04:57.831-05:00"},"s":"I",  "c":"CONTROL",  "id":23398,   "ctx":"initandlisten","msg":"Target operating system minimum version","attr":{"targetMinOS":"Windows 7/Windows Server 2008 R2"}}
{"t":{"$date":"2024-12-02T00:04:57.831-05:00"},"s":"I",  "c":"CONTROL",  "id":23403,   "ctx":"initandlisten","msg":"Build Info","attr":{"buildInfo":{"version":"8.0.3","gitVersion":"89d97f2744a2b9851ddfb51bdf22f687562d9b06","modules":[],"allocator":"tcmalloc-gperf","environment":{"distmod":"windows","distarch":"x86_64","target_arch":"x86_64"}}}}
{"t":{"$date":"2024-12-02T00:04:57.831-05:00"},"s":"I",  "c":"CONTROL",  "id":51765,   "ctx":"initandlisten","msg":"Operating System","attr":{"os":{"name":"Microsoft Windows 10","version":"10.0 (build 26100)"}}}
{"t":{"$date":"2024-12-02T00:04:57.831-05:00"},"s":"I",  "c":"CONTROL",  "id":21951,   "ctx":"initandlisten","msg":"Options set by command line","attr":{"options":{"net":{"bindIp":"localhost","port":27019},"replication":{"replSet":"rs0"},"storage":{"dbPath":"C:\\data\\mongo\\rs3"}}}}
{"t":{"$date":"2024-12-02T00:04:57.838-05:00"},"s":"I",  "c":"STORAGE",  "id":22270,   "ctx":"initandlisten","msg":"Storage engine to use detected by data files","attr":{"dbpath":"C:/data/mongo/rs3","storageEngine":"wiredTiger"}}
{"t":{"$date":"2024-12-02T00:04:57.839-05:00"},"s":"I",  "c":"STORAGE",  "id":22315,   "ctx":"initandlisten","msg":"Opening WiredTiger","attr":{"config":"create,cache_size=4546M,session_max=33000,eviction=(threads_min=4,threads_max=4),config_base=false,statistics=(fast),log=(enabled=true,remove=true,path=journal,compressor=snappy),builtin_extension_config=(zstd=(compression_level=6)),file_manager=(close_idle_time=600,close_scan_interval=10,close_handle_minimum=2000),statistics_log=(wait=0),json_output=(error,message),verbose=[recovery_progress:1,checkpoint_progress:1,compact_progress:1
```

- Conectarse al nodo 1 en el puerto 27017

```
PS C:\Users\Santiago> mongosh --port 27017
Current Mongosh Log ID: 674d3d145f6fffffc7893bf7
Connecting to:          mongodb://127.0.0.1:27017/?directConnection=true&serverSelectionTimeoutMS=2000&appName=mongosh+2.3.4
Using MongoDB:          8.0.3
Using Mongosh:          2.3.4

For mongosh info see: https://www.mongodb.com/docs/mongodb-shell/

------
   The server generated these startup warnings when booting
   2024-12-01T23:51:46.619-05:00: Access control is not enabled for the database. Read and write access to data and configuration is unrestricted
------
```

- Iniciación del replication set “rs0” con todos los nodos miembros (primario y secundarios)

```
test> rs.initiate({ _id: "rs0", members: [ { _id: 0, host: "localhost:27017" }, { _id: 1, host: "localhost:27018" }, { _id: 2, host: "localhost:2701
9" }] });
{
  ok: 1,
  '$clusterTime': {
    clusterTime: Timestamp({ t: 1733115900, i: 1 }),
    signature: {
      hash: Binary.createFromBase64('AAAAAAAAAAAAAAAAAAAAAAAAAAA=', 0),
      keyId: Long('0')
    }
  },
  operationTime: Timestamp({ t: 1733115900, i: 1 })
}
rs0 [direct: secondary] test> rs.initiate({ _id: "rs0", members: [ { _id: 0, host: "localhost:27017" }, { _id: 1, host: "localhost:27018" }, { _id:
2, host: "localhost:27019" }] });
MongoServerError[AlreadyInitialized]: already initialized
```

- Ver estado del set “rs0” donde se ve su información y sus miembros

```
rs0 [direct: primary] test> rs.status();
{
  set: 'rs0',
  date: ISODate('2024-12-02T05:05:40.191Z'),
  myState: 1,
  term: Long('1'),
  syncSourceHost: '',
  syncSourceId: -1,
  heartbeatIntervalMillis: Long('2000'),
  majorityVoteCount: 2,
  writeMajorityCount: 2,
  votingMembersCount: 3,
  writableVotingMembersCount: 3,
  optimes: {
    lastCommittedOpTime: { ts: Timestamp({ t: 1733115931, i: 1 }), t: Long('1') },
    lastCommittedWallTime: ISODate('2024-12-02T05:05:31.148Z'),
    readConcernMajorityOpTime: { ts: Timestamp({ t: 1733115931, i: 1 }), t: Long('1') },
    appliedOpTime: { ts: Timestamp({ t: 1733115931, i: 1 }), t: Long('1') },
    durableOpTime: { ts: Timestamp({ t: 1733115931, i: 1 }), t: Long('1') },
    writtenOpTime: { ts: Timestamp({ t: 1733115931, i: 1 }), t: Long('1') },
    lastAppliedWallTime: ISODate('2024-12-02T05:05:31.148Z'),
    lastDurableWallTime: ISODate('2024-12-02T05:05:31.148Z'),
    lastWrittenWallTime: ISODate('2024-12-02T05:05:31.148Z')
  },
  lastStableRecoveryTimestamp: Timestamp({ t: 1733115900, i: 1 }),
  electionCandidateMetrics: {
    lastElectionReason: 'electionTimeout',
    lastElectionDate: ISODate('2024-12-02T05:05:11.042Z'),
    electionTerm: Long('1'),
    lastCommittedOpTimeAtElection: { ts: Timestamp({ t: 1733115900, i: 1 }), t: Long('-1') },
    lastSeenWrittenOpTimeAtElection: { ts: Timestamp({ t: 1733115900, i: 1 }), t: Long('-1') },
    lastSeenOpTimeAtElection: { ts: Timestamp({ t: 1733115900, i: 1 }), t: Long('-1') },
    numVotesNeeded: 2,
    priorityAtElection: 1,
    electionTimeoutMillis: Long('10000'),
```

```
members: [
  {
    _id: 0,
    name: 'localhost:27017',
    health: 1,
    state: 1,
    stateStr: 'PRIMARY',
    uptime: 77,
    optime: { ts: Timestamp({ t: 1733115931, i: 1 }), t: Long('1') },
    optimeDate: ISODate('2024-12-02T05:05:31.000Z'),
    optimeWritten: { ts: Timestamp({ t: 1733115931, i: 1 }), t: Long('1') },
    optimeWrittenDate: ISODate('2024-12-02T05:05:31.000Z'),
    lastAppliedWallTime: ISODate('2024-12-02T05:05:31.148Z'),
    lastDurableWallTime: ISODate('2024-12-02T05:05:31.148Z'),
    lastWrittenWallTime: ISODate('2024-12-02T05:05:31.148Z'),
    syncSourceHost: '',
    syncSourceId: -1,
    infoMessage: 'Could not find member to sync from',
    electionTime: Timestamp({ t: 1733115911, i: 1 }),
    electionDate: ISODate('2024-12-02T05:05:11.000Z'),
    configVersion: 1,
    configTerm: 1,
    self: true,
    lastHeartbeatMessage: ''
  },
  {
    _id: 1,
    name: 'localhost:27018',
    health: 1,
    state: 2,
    stateStr: 'SECONDARY',
    uptime: 39,
    optime: { ts: Timestamp({ t: 1733115931, i: 1 }), t: Long('1') },
    optimeDurable: { ts: Timestamp({ t: 1733115931, i: 1 }), t: Long('1') },
    optimeWritten: { ts: Timestamp({ t: 1733115931, i: 1 }), t: Long('1') },
```

```
    optimeDate: ISODate('2024-12-02T05:05:31.000Z'),
    optimeDurableDate: ISODate('2024-12-02T05:05:31.000Z'),
    optimeWrittenDate: ISODate('2024-12-02T05:05:31.000Z'),
    lastAppliedWallTime: ISODate('2024-12-02T05:05:31.148Z'),
    lastDurableWallTime: ISODate('2024-12-02T05:05:31.148Z'),
    lastWrittenWallTime: ISODate('2024-12-02T05:05:31.148Z'),
    lastHeartbeat: ISODate('2024-12-02T05:05:39.083Z'),
    lastHeartbeatRecv: ISODate('2024-12-02T05:05:40.087Z'),
    pingMs: Long('0'),
    lastHeartbeatMessage: '',
    syncSourceHost: 'localhost:27017',
    syncSourceId: 0,
    infoMessage: '',
    configVersion: 1,
    configTerm: 1
  },
  {
    _id: 2,
    name: 'localhost:27019',
    health: 1,
    state: 2,
    stateStr: 'SECONDARY',
    uptime: 39,
    optime: { ts: Timestamp({ t: 1733115931, i: 1 }), t: Long('1') },
    optimeDurable: { ts: Timestamp({ t: 1733115931, i: 1 }), t: Long('1') },
    optimeWritten: { ts: Timestamp({ t: 1733115931, i: 1 }), t: Long('1') },
    optimeDate: ISODate('2024-12-02T05:05:31.000Z'),
    optimeDurableDate: ISODate('2024-12-02T05:05:31.000Z'),
    optimeWrittenDate: ISODate('2024-12-02T05:05:31.000Z'),
    lastAppliedWallTime: ISODate('2024-12-02T05:05:31.148Z'),
    lastDurableWallTime: ISODate('2024-12-02T05:05:31.148Z'),
    lastWrittenWallTime: ISODate('2024-12-02T05:05:31.148Z'),
    lastHeartbeat: ISODate('2024-12-02T05:05:39.082Z'),
    lastHeartbeatRecv: ISODate('2024-12-02T05:05:40.081Z'),
    pingMs: Long('0'),
```

2. Resultados de las Pruebas

2.1. Caso de Prueba 1: Verificar replicación exitosa

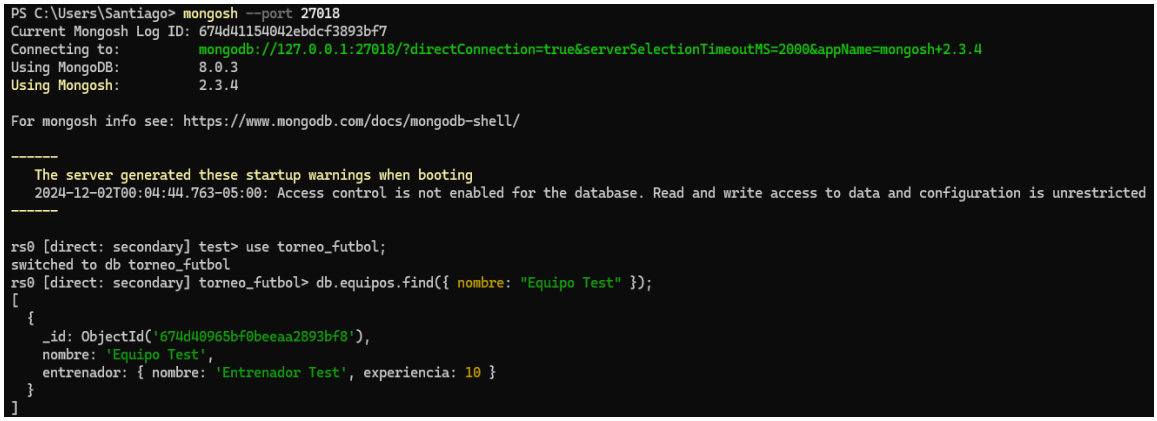
Objetivo: Comprobar que los datos insertados en el nodo primario son replicados correctamente en los secundarios.

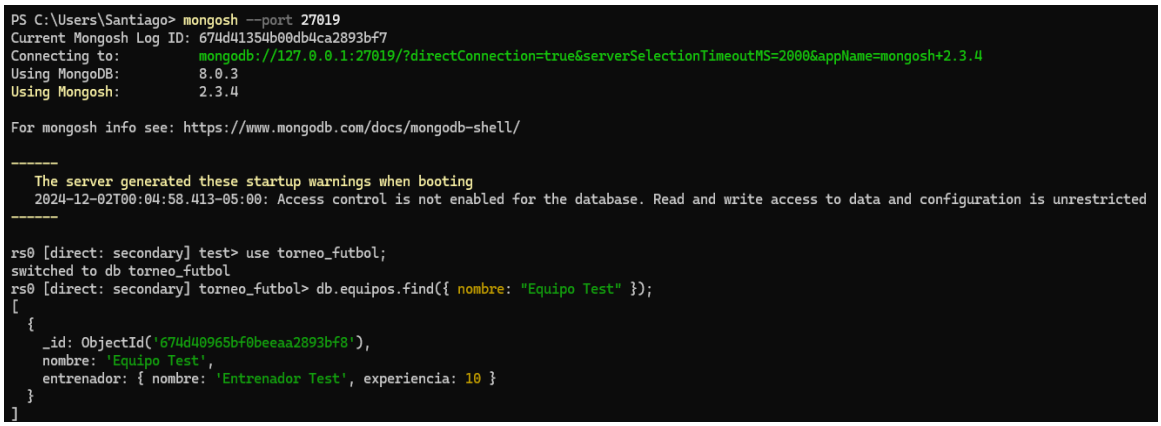
Evidencias:

1. Captura del comando ejecutado para insertar el documento en el nodo primario:

```
rs0 [direct: primary] test> use torneo_futbol;
switched to db torneo_futbol
rs0 [direct: primary] torneo_futbol> db.equipos.insertOne({ nombre: "Equipo Test", entrenador: { nombre: "Entrenador Test", experiencia: 10 } });
{
  acknowledged: true,
  insertedId: ObjectId('674d40965bf0beeaa2893bf8')
}
```

2. Capturas de los nodos secundarios mostrando que el documento aparece replicado:





Análisis: El documento insertado en el nodo primario aparece correctamente en ambos nodos secundarios, demostrando que la replicación funciona según lo esperado.

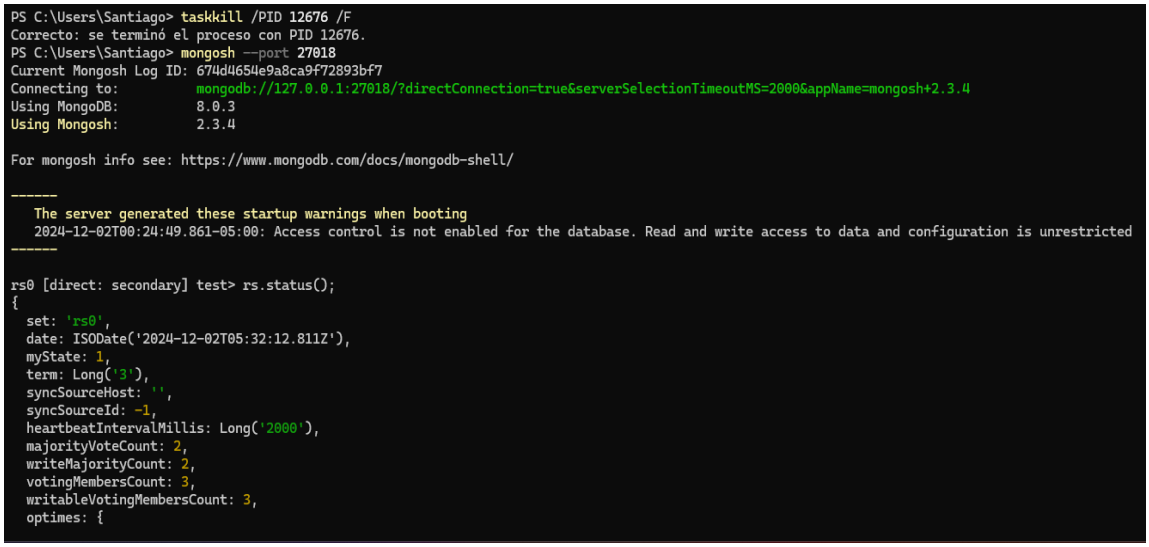
2.2. Caso de Prueba 2: Simular failover automático

Objetivo:

Verificar que, tras detener el nodo primario, uno de los secundarios asume el rol de primario automáticamente.

Evidencias:

1. Captura de la ejecución del comando para detener el nodo primario (taskkill).



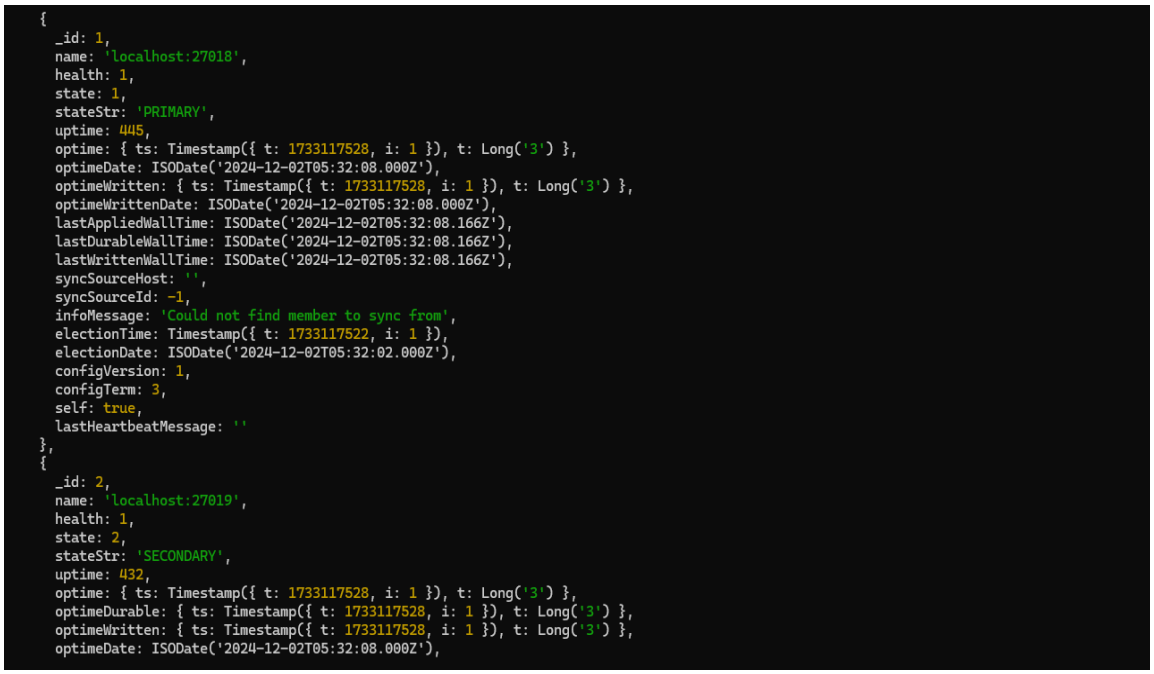
```
PS C:\Users\Santiago> taskkill /PID 12676 /F
Correcto: se terminó el proceso con PID 12676.
PS C:\Users\Santiago> mongosh --port 27018
Current Mongosh Log ID: 674d4654e9a8ca9f72893bf7
Connecting to:          mongodb://127.0.0.1:27018/?directConnection=true&serverSelectionTimeoutMS=2000&appName=mongosh+2.3.4
Using MongoDB:          8.0.3
Using Mongosh:          2.3.4

For mongosh info see: https://www.mongodb.com/docs/mongodb-shell/

------
   The server generated these startup warnings when booting
   2024-12-02T00:24:49.861-05:00: Access control is not enabled for the database. Read and write access to data and configuration is unrestricted
------

rs0 [direct: secondary] test> rs.status();
{
  set: 'rs0',
  date: ISODate('2024-12-02T05:32:12.811Z'),
  myState: 1,
  term: Long('3'),
  syncSourceHost: '',
  syncSourceId: -1,
  heartbeatIntervalMillis: Long('2000'),
  majorityVoteCount: 2,
  writeMajorityCount: 2,
  votingMembersCount: 3,
  writableVotingMembersCount: 3,
  optimes: {
```

2. Captura del comando rs.status() ejecutado en los nodos secundarios:



```
  {
    _id: 1,
    name: 'localhost:27018',
    health: 1,
    state: 1,
    stateStr: 'PRIMARY',
    uptime: 445,
    optime: { ts: Timestamp({ t: 1733117528, i: 1 }), t: Long('3') },
    optimeDate: ISODate('2024-12-02T05:32:08.000Z'),
    optimeWritten: { ts: Timestamp({ t: 1733117528, i: 1 }), t: Long('3') },
    optimeWrittenDate: ISODate('2024-12-02T05:32:08.000Z'),
    lastAppliedWallTime: ISODate('2024-12-02T05:32:08.166Z'),
    lastDurableWallTime: ISODate('2024-12-02T05:32:08.166Z'),
    lastWrittenWallTime: ISODate('2024-12-02T05:32:08.166Z'),
    syncSourceHost: '',
    syncSourceId: -1,
    infoMessage: 'Could not find member to sync from',
    electionTime: Timestamp({ t: 1733117522, i: 1 }),
    electionDate: ISODate('2024-12-02T05:32:02.000Z'),
    configVersion: 1,
    configTerm: 3,
    self: true,
    lastHeartbeatMessage: ''
  },
  {
    _id: 2,
    name: 'localhost:27019',
    health: 1,
    state: 2,
    stateStr: 'SECONDARY',
    uptime: 432,
    optime: { ts: Timestamp({ t: 1733117528, i: 1 }), t: Long('3') },
    optimeDurable: { ts: Timestamp({ t: 1733117528, i: 1 }), t: Long('3') },
    optimeWritten: { ts: Timestamp({ t: 1733117528, i: 1 }), t: Long('3') },
    optimeDate: ISODate('2024-12-02T05:32:08.000Z'),
```

Análisis: El sistema realizó el failover automáticamente en menos de 10 segundos. El nuevo primario asumió su rol sin interrupciones perceptibles en el sistema.

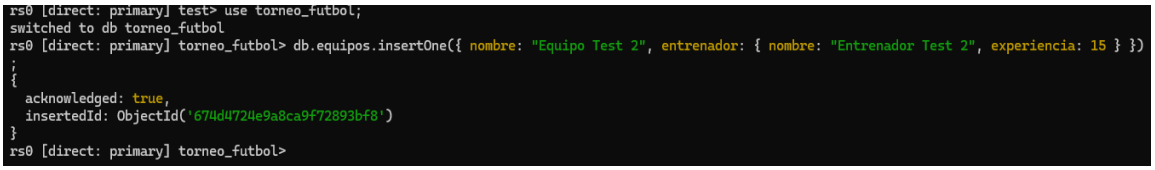
2.3. Caso de Prueba 3: Verificar consistencia de datos después del failover

Objetivo:

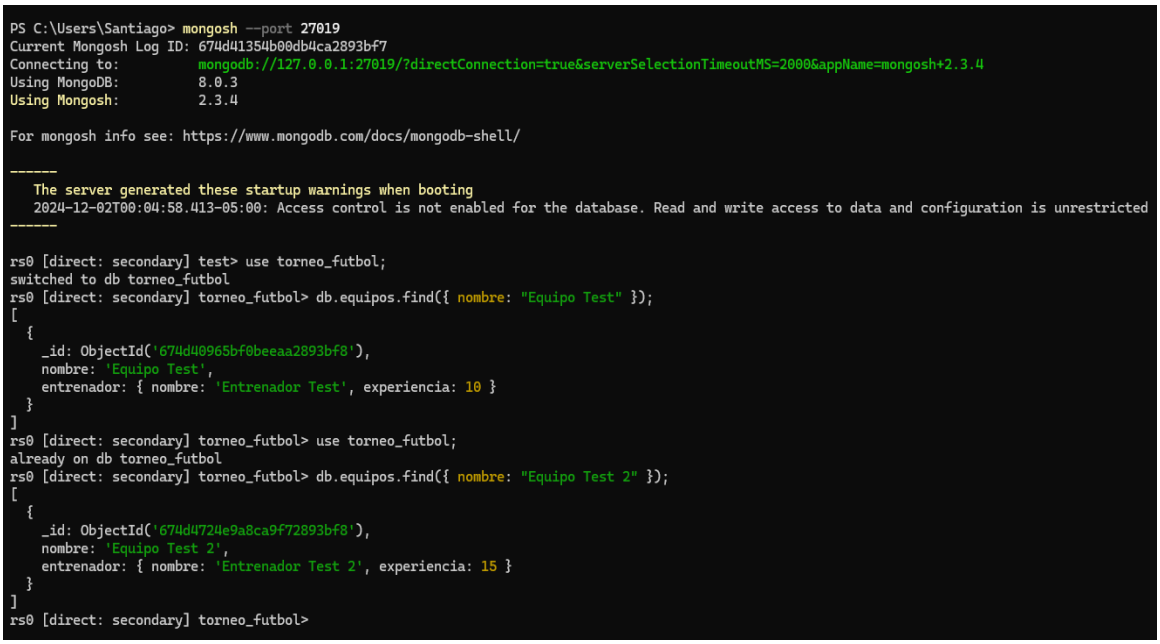
Garantizar que la replicación continúa tras la transición del primario.

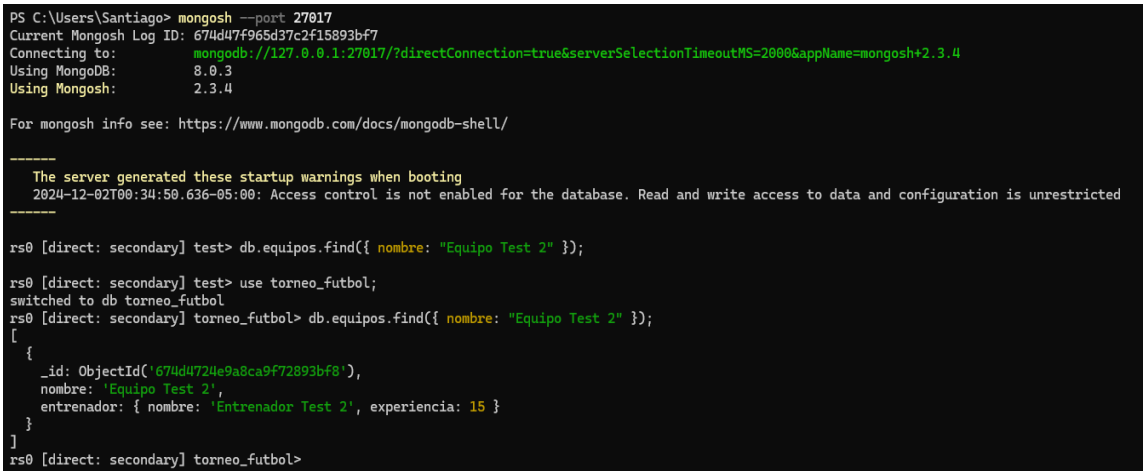
Evidencias:

1. Captura del comando ejecutado para insertar un documento en el nuevo primario:



2. Capturas de los nodos secundarios mostrando que el nuevo documento se replicó correctamente:





Análisis: Los nodos secundarios reflejan correctamente los datos insertados en el nuevo primario, lo que demuestra que el sistema mantiene consistencia tras un failover.