

```
Command Prompt
Microsoft Windows [Version 10.0.17134.345]
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C:\Users\Kostas>cd "C:\Program Files\MongoDB\Server\4.0\bin"

C:\Program Files\MongoDB\Server\4.0\bin>mongoimport --db aisdata --collection nari_dynamic --type csv --file C:\aisdata_nari_dynamic_cleaned.csv --headerline
2020-01-12T16:16:00.411+0200    connected to: localhost
2020-01-12T16:16:00.831+0200    imported 10000 documents

C:\Program Files\MongoDB\Server\4.0\bin>mongoimport --db aisdata --collection nari_dynamic_sar --type csv --file C:\aisdata_nari_dynamic_sar_cleaned.csv --headerline
2020-01-12T16:17:05.357+0200    connected to: localhost
2020-01-12T16:17:05.669+0200    imported 4566 documents

C:\Program Files\MongoDB\Server\4.0\bin>mongoimport --db aisdata --collection nari_static --type csv --file C:\aisdata_nari_static_cleaned.csv --headerline
2020-01-12T16:18:04.427+0200    connected to: localhost
2020-01-12T16:18:06.412+0200    [###.....] aisdata.nari_static 3.17MB/34.2MB (9.3%)
2020-01-12T16:18:09.413+0200    [#####.....] aisdata.nari_static 8.78MB/34.2MB (25.7%)
2020-01-12T16:18:12.412+0200    [#####.....] aisdata.nari_static 14.2MB/34.2MB (41.5%)
2020-01-12T16:18:15.413+0200    [#####.....] aisdata.nari_static 19.7MB/34.2MB (57.6%)
2020-01-12T16:18:18.413+0200    [#####.....] aisdata.nari_static 25.3MB/34.2MB (73.9%)
2020-01-12T16:18:21.414+0200    [#####.....] aisdata.nari_static 30.8MB/34.2MB (89.9%)
2020-01-12T16:18:23.324+0200    [#####.....] aisdata.nari_static 34.2MB/34.2MB (100.0%)
2020-01-12T16:18:23.324+0200    imported 660423 documents

C:\Program Files\MongoDB\Server\4.0\bin>
```

Activate Windows
Go to Settings to activate Windows.

Σχήμα 1. Εισαγωγή-αποθήκευση των δεδομένων στη βάση της MongoDB

```
> db.nari_dynamic.find().sort({"speedoverground" :-1}).limit(2).pretty()
{
  "_id" : ObjectId("5e1b2a20fb826e68ef6a5d8b"),
  "n" : 1265,
  "sourcemmsi" : 228190592,
  "speedoverground" : 51.3,
  "lon" : -4.326832,
  "lat" : 48.508247
}
{
  "_id" : ObjectId("5e1b2a20fb826e68ef6a7eee"),
  "n" : 9803,
  "sourcemmsi" : 228374000,
  "speedoverground" : 15.3,
  "lon" : -4.773598000000001,
  "lat" : 48.04535
}
```

Σχήμα 2. Ένρεση των δυο σκαφών με τη μεγαλύτερη ταχύτητα

```
C:\Program Files\MongoDB\Server\4.0\bin\mongo.exe
>
> db.nari_dynamic.find({$and: [{"lon": {$gte:-4.497, $lte:-4.496}}, {"lat":{$gt:48.382, $lte:48.383}}]}).explain("executionStats")
{
  "queryPlanner" : {
    "plannerVersion" : 1,
    "namespace" : "nari_dynamic",
    "indexFilterSet" : false,
    "parsedQuery" : {
      "$and" : [
        {
          "lat" : {
            "$lte" : 48.383
          }
        },
        {
          "lon" : {
            "$lte" : -4.496
          }
        },
        {
          "lat" : {
            "$gt" : 48.382
          }
        },
        {
          "lon" : {
            "$gte" : -4.497
          }
        }
      ]
    }
  },
  "winningPlan" : {
    "stage" : "COLLSCAN",
    "filter" : {
      "$and" : [
        {
          "lat" : {
            "$lte" : 48.383
          }
        },
        {
          "lon" : {
            "$lte" : -4.496
          }
        }
      ]
    }
  }
}
```

Σχήμα 3. Εκτέλεση ερωτήματος (use case2), χωρίς index (a)

```
C:\Program Files\MongoDB\Server\4.0\bin\mongo.exe
{
  "lat" : {
    "$gt" : 48.382
  }
},
{
  "lon" : {
    "$gte" : -4.497
  }
}
],
  "direction" : "forward"
},
  "rejectedPlans" : [ ]
},
  "executionStats" : {
    "executionSuccess" : true,
    "nReturned" : 809,
    "executionTimeMillis" : 15,
    "totalKeysExamined" : 0,
    "totalDocsExamined" : 10000,
    "executionStages" : {
      "stage" : "COLLSCAN",
      "filter" : {
        "$and" : [
          {
            "lat" : {
              "$lte" : 48.383
            }
          },
          {
            "lon" : {
              "$lte" : -4.496
            }
          },
          {
            "lat" : {
              "$gt" : 48.382
            }
          },
          {
            "lon" : {
              "$gte" : -4.497
            }
          }
        ]
      }
    }
  }
}
```

Σχήμα 4. Εκτέλεση ερωτήματος (use case 2), χωρίς index (b)

```
C:\Program Files\MongoDB\Server\4.0\bin\mongo.exe
> db.nari_dynamic.createIndex({"lon":1, "lat":1})
{
  "createdCollectionAutomatically" : false,
  "numIndexesBefore" : 1,
  "numIndexesAfter" : 2,
  "ok" : 1
}
> db.nari_dynamic.find({$and: [{"lon": {$gte:-4.497, $lte:-4.496}}, {"lat":{$gt:48.382, $lte:48.383}}]}).explain("executionStats")
{
  "queryPlanner" : {
    "plannerVersion" : 1,
    "namespace" : "aisdata.nari_dynamic",
    "indexFilterSet" : false,
    "parsedQuery" : {
      "$and" : [
        {
          "lat" : {
            "$lte" : 48.383
          }
        },
        {
          "lon" : {
            "$lte" : -4.496
          }
        },
        {
          "lat" : {
            "$gt" : 48.382
          }
        },
        {
          "lon" : {
            "$gte" : -4.497
          }
        }
      ]
    },
    "winningPlan" : {
      "stage" : "FETCH",
      "inputStage" : {
        "stage" : "IXSCAN",

```

Σχήμα 5. Εκτέλεση ερωτήματος (use case 2), με index (a)

```
C:\Program Files\MongoDB\Server\4.0\bin\mongo.exe
  "inputStage" : {
    "stage" : "IXSCAN",
    "keyPattern" : {
      "lon" : 1,
      "lat" : 1
    },
    "indexName" : "lon_1_lat_1",
    "isMultiKey" : false,
    "multiKeyPaths" : {
      "lon" : [ ],
      "lat" : [ ]
    },
    "isUnique" : false,
    "isSparse" : false,
    "isPartial" : false,
    "indexVersion" : 2,
    "direction" : "forward",
    "indexBounds" : {
      "lon" : [
        [-4.497, -4.496]
      ],
      "lat" : [
        (48.382, 48.383]
      ]
    }
  },
  "rejectedPlans" : [ ]
},
"executionStats" : {
  "executionSuccess" : true,
  "nReturned" : 809,
  "executionTimeMillis" : 5,
  "totalKeysExamined" : 812,
  "totalDocsExamined" : 809,
  "executionStages" : {
    "stage" : "FETCH",
    "nReturned" : 809,
    "executionTimeMillisEstimate" : 0,
    "works" : 812,
    "advanced" : 809,
    "needTime" : 2,
    "needYield" : 0,
    "saveState" : 6,

```

Σχήμα 6. Εκτέλεση ερωτήματος (use case 2), με index (b)

```
C:\Program Files\MongoDB\Server\4.0\bin\mongo.exe
> db.nari_dynamic.find({"$and": [{"lon": {"$gte": -4.497, "$lte": -4.496}}, {"lat": {"$gt": 48.382, "$lte": 48.383}}]}).pretty()
{
  "_id" : ObjectId("5e1b2a20fb826e68ef6a7325"),
  "m" : 6790,
  "sourcecmssi" : 227705102,
  "speedoverground" : 0,
  "lon" : -4.4966316,
  "lat" : 48.382397

  "_id" : ObjectId("5e1b2a20fb826e68ef6a6998"),
  "m" : 4347,
  "sourcecmssi" : 227705102,
  "speedoverground" : 0,
  "lon" : -4.496630000000001,
  "lat" : 48.38241

  "_id" : ObjectId("5e1b2a20fb826e68ef6a7320"),
  "m" : 6785,
  "sourcecmssi" : 227705102,
  "speedoverground" : 0.1,
  "lon" : -4.496630000000001,
  "lat" : 48.38241

  "_id" : ObjectId("5e1b2a20fb826e68ef6a72c8"),
  "m" : 6697,
  "sourcecmssi" : 227705102,
  "speedoverground" : 0.1,
  "lon" : -4.496625,
  "lat" : 48.38238

  "_id" : ObjectId("5e1b2a20fb826e68ef6a04"),
  "m" : 4455,
  "sourcecmssi" : 227705102,
  "speedoverground" : 0.1,
  "lon" : -4.496625,
  "lat" : 48.38241

  "_id" : ObjectId("5e1b2a20fb826e68ef6a70f5"),
```

Σχήμα 7. Εύρεση στοιχείων σκαφών εντός της περιοχής αναζήτησης (use case 2)

```
Administrator Command Prompt - mongo --port 27017
}
}
rs2schools:PRIMARY> rs.status()
{
  "set" : "rs2schools",
  "date" : ISODate("2020-01-13T21:44:58.524Z"),
  "myState" : 1,
  "term" : NumberLong(1),
  "syncingTo" : "",
  "syncSourceHost" : "",
  "syncSourceId" : -1,
  "heartbeatIntervalMillis" : NumberLong(2000),
  "optimes" : {
    "lastCommittedOpTime" : {
      "ts" : Timestamp(1578951895, 1),
      "t" : NumberLong(1)
    },
    "readConcernMajorityOpTime" : {
      "ts" : Timestamp(1578951895, 1),
      "t" : NumberLong(1)
    },
    "appliedOpTime" : {
      "ts" : Timestamp(1578951895, 1),
      "t" : NumberLong(1)
    },
    "durableOpTime" : {
      "ts" : Timestamp(1578951895, 1),
      "t" : NumberLong(1)
    }
  },
  "lastStableCheckpointTimestamp" : Timestamp(1578951835, 1),
  "electionCandidateMetrics" : {
    "lastElectionReason" : "electionTimeout",
    "lastElectionDate" : ISODate("2020-01-13T19:15:58.591Z"),
    "electionTerm" : NumberLong(1),
    "lastCommittedOpTimeAtElection" : {
      "ts" : Timestamp(0, 0),
      "t" : NumberLong(-1)
    }
  }
}
```

Σχήμα 8. Εμφάνιση των replications (A)

```
Administrator: Command Prompt - mongo --port 27017
{
  "lastSeenOptimeAtElection" : {
    "ts" : Timestamp(1578942958, 1),
    "t" : NumberLong(-1)
  },
  "numVotesNeeded" : 1,
  "priorityAtElection" : 1,
  "electionTimeoutMillis" : NumberLong(10000),
  "newTermStartDate" : ISODate("2020-01-13T19:16:00.633Z"),
  "majorityWriteAvailabilityDate" : ISODate("2020-01-13T19:16:00.862Z")
},
"members" : [
  {
    "_id" : 0,
    "name" : "localhost:27017",
    "health" : 1,
    "state" : 1,
    "stateStr" : "PRIMARY",
    "uptime" : 9410,
    "optime" : {
      "ts" : Timestamp(1578951895, 1),
      "t" : NumberLong(1)
    },
    "optimeDate" : ISODate("2020-01-13T21:44:55Z"),
    "syncingTo" : "",
    "syncSourceHost" : "",
    "syncSourceId" : -1,
    "infoMessage" : "",
    "electionTime" : Timestamp(1578942958, 2),
    "electionDate" : ISODate("2020-01-13T19:15:58Z"),
    "configVersion" : 3,
    "self" : true,
    "lastHeartbeatMessage" : ""
  },
  {
    "_id" : 1,
    "name" : "localhost:27020",
    "health" : 1,
    "state" : 2,
    "stateStr" : "SECONDARY",
    "uptime" : 284,
    "optime" : {
      "ts" : Timestamp(1578951895, 1),
      "t" : NumberLong(1)
    },
    "optimeDurable" : {
      "ts" : Timestamp(1578951895, 1),
      "t" : NumberLong(1)
    },
    "optimeDate" : ISODate("2020-01-13T21:44:55Z"),
    "optimeDurableDate" : ISODate("2020-01-13T21:44:55Z"),
    "lastHeartbeat" : ISODate("2020-01-13T21:44:56.974Z"),
    "lastHeartbeatRecv" : ISODate("2020-01-13T21:44:58.514Z"),
    "pingMs" : NumberLong(0),
    "lastHeartbeatMessage" : "",
    "syncingTo" : "localhost:27017",
    "syncSourceHost" : "localhost:27017",
    "syncSourceId" : 0,
    "infoMessage" : "",
    "configVersion" : 3
  },
  {
    "_id" : 2,
    "name" : "localhost:27021",
    "health" : 1,
    "state" : 2,
    "stateStr" : "SECONDARY",
    "uptime" : {
      "ts" : Timestamp(1578951895, 1),
      "t" : NumberLong(1)
    },
    "optimeDurable" : {
      "ts" : Timestamp(1578951895, 1),
      "t" : NumberLong(1)
    },
    "optimeDate" : ISODate("2020-01-13T21:44:55Z"),
    "optimeDurableDate" : ISODate("2020-01-13T21:44:55Z"),
    "lastHeartbeat" : ISODate("2020-01-13T21:44:58.129Z"),
    "lastHeartbeatRecv" : ISODate("2020-01-13T21:44:58.129Z"),
    "pingMs" : NumberLong(0),
    "lastHeartbeatMessage" : "",
    "syncingTo" : "localhost:27017",
    "syncSourceHost" : "localhost:27017",
    "syncSourceId" : 0,
    "infoMessage" : "",
    "configVersion" : 3
  }
]
```

Σχήμα 8. Εμφάνιση των replications (B)

```
Administrator: Command Prompt - mongo --port 27017
{
  "uptime" : 284,
  "optime" : {
    "ts" : Timestamp(1578951895, 1),
    "t" : NumberLong(1)
  },
  "optimeDurable" : {
    "ts" : Timestamp(1578951895, 1),
    "t" : NumberLong(1)
  },
  "optimeDate" : ISODate("2020-01-13T21:44:55Z"),
  "optimeDurableDate" : ISODate("2020-01-13T21:44:55Z"),
  "lastHeartbeat" : ISODate("2020-01-13T21:44:56.974Z"),
  "lastHeartbeatRecv" : ISODate("2020-01-13T21:44:58.514Z"),
  "pingMs" : NumberLong(0),
  "lastHeartbeatMessage" : "",
  "syncingTo" : "localhost:27017",
  "syncSourceHost" : "localhost:27017",
  "syncSourceId" : 0,
  "infoMessage" : "",
  "configVersion" : 3
},
{
  "_id" : 2,
  "name" : "localhost:27021",
  "health" : 1,
  "state" : 2,
  "stateStr" : "SECONDARY",
  "uptime" : {
    "ts" : Timestamp(1578951895, 1),
    "t" : NumberLong(1)
  },
  "optimeDurable" : {
    "ts" : Timestamp(1578951895, 1),
    "t" : NumberLong(1)
  },
  "optimeDate" : ISODate("2020-01-13T21:44:55Z"),
  "optimeDurableDate" : ISODate("2020-01-13T21:44:55Z"),
  "lastHeartbeat" : ISODate("2020-01-13T21:44:58.129Z"),
  "lastHeartbeatRecv" : ISODate("2020-01-13T21:44:58.129Z"),
  "pingMs" : NumberLong(0),
  "lastHeartbeatMessage" : "",
  "syncingTo" : "localhost:27017",
  "syncSourceHost" : "localhost:27017",
  "syncSourceId" : 0,
  "infoMessage" : "",
  "configVersion" : 3
}
```

Σχήμα 8. Εμφάνιση των replications (C)

κληση των ρεπλικετιονς και προσβαση στα σεκονταρι

```
Windows\system32>mongo --port 27020
MongoDB shell version v4.0.14
connecting to mongo://localhost:27020/
Implicit session: session { "id" : UUID("397c7f06-4349-443f-93ef-94ce196d115c") }
MongoDB server version: 4.0.14
Server has startup warnings:
2020-01-13T23:08:16.065+0200 I CONTROL [initandlisten]
2020-01-13T23:08:16.065+0200 I CONTROL [initandlisten] ** WARNING: Access control is not enabled for the database.
2020-01-13T23:08:16.065+0200 I CONTROL [initandlisten] **      Read and write access to data and configuration is unrestricted.
2020-01-13T23:08:16.066+0200 I CONTROL [initandlisten]
2020-01-13T23:08:16.066+0200 I CONTROL [initandlisten] ** WARNING: This server is bound to localhost.
2020-01-13T23:08:16.066+0200 I CONTROL [initandlisten] **      Remote systems will be unable to connect to this server.
2020-01-13T23:08:16.066+0200 I CONTROL [initandlisten] **      Start the server with --bind_ip <address> to specify which IP
2020-01-13T23:08:16.066+0200 I CONTROL [initandlisten] **      addresses it should serve responses from, or with --bind_ip_all to
2020-01-13T23:08:16.066+0200 I CONTROL [initandlisten] **      bind to all interfaces. If this behavior is desired, start the
2020-01-13T23:08:16.067+0200 I CONTROL [initandlisten] **      server with --bind_ip 127.0.0.1 to disable this warning.
2020-01-13T23:08:16.067+0200 I CONTROL [initandlisten]
---
Enable MongoDB's free cloud-based monitoring service, which will then receive and display
metrics about your deployment (disk utilization, CPU, operation statistics, etc).

The monitoring data will be available on a MongoDB website with a unique URL accessible to you
and anyone you share the URL with. MongoDB may use this information to make product
improvements and to suggest MongoDB products and deployment options to you.

To enable free monitoring, run the following command: db.enableFreeMonitoring()
To permanently disable this reminder, run the following command: db.disableFreeMonitoring()
---
r2schools:SECONDARY> rs.slaveOk()
r2schools:SECONDARY> show dbs
admin            0.000GB
aisdata          0.034GB
bookstore        0.000GB
company          0.001GB
config           0.000GB
labdb            0.000GB
local            0.000GB
r2schools:SECONDARY>
```

Σχήμα 8. Πρόσβαση στα secondaries

```
Windows\system32>mongo --port 27021
MongoDB shell version v4.0.14
connecting to mongo://localhost:27021/
Implicit session: session { "id" : UUID("bffe2f26-1ab1-459a-92ec-9976bffcdb75") }
MongoDB server version: 4.0.14
Server has startup warnings:
2020-01-13T23:44:01.468+0200 I CONTROL [initandlisten]
2020-01-13T23:44:01.468+0200 I CONTROL [initandlisten] ** WARNING: Access control is not enabled for the database.
2020-01-13T23:44:01.468+0200 I CONTROL [initandlisten] **      Read and write access to data and configuration is unrestricted.
2020-01-13T23:44:01.468+0200 I CONTROL [initandlisten]
2020-01-13T23:44:01.468+0200 I CONTROL [initandlisten] ** WARNING: This server is bound to localhost.
2020-01-13T23:44:01.469+0200 I CONTROL [initandlisten] **      Remote systems will be unable to connect to this server.
2020-01-13T23:44:01.469+0200 I CONTROL [initandlisten] **      Start the server with --bind_ip <address> to specify which IP
2020-01-13T23:44:01.469+0200 I CONTROL [initandlisten] **      addresses it should serve responses from, or with --bind_ip_all to
2020-01-13T23:44:01.469+0200 I CONTROL [initandlisten] **      bind to all interfaces. If this behavior is desired, start the
2020-01-13T23:44:01.469+0200 I CONTROL [initandlisten] **      server with --bind_ip 127.0.0.1 to disable this warning.
2020-01-13T23:44:01.469+0200 I CONTROL [initandlisten]
---
Enable MongoDB's free cloud-based monitoring service, which will then receive and display
metrics about your deployment (disk utilization, CPU, operation statistics, etc).

The monitoring data will be available on a MongoDB website with a unique URL accessible to you
and anyone you share the URL with. MongoDB may use this information to make product
improvements and to suggest MongoDB products and deployment options to you.

To enable free monitoring, run the following command: db.enableFreeMonitoring()
To permanently disable this reminder, run the following command: db.disableFreeMonitoring()
---
r2schools:SECONDARY> rs.slaveOk()
r2schools:SECONDARY> show dbs
admin            0.000GB
aisdata          0.034GB
bookstore        0.000GB
company          0.001GB
config           0.000GB
labdb            0.000GB
local            0.000GB
r2schools:SECONDARY>
```

Σχήμα 9. Πρόσβαση στα secondaries


```
Administrator: Command Prompt - mongo --port 27020
2020-01-13T23:08:16.065+0200 I CONTROL [initandlisten]
2020-01-13T23:08:16.065+0200 I CONTROL [initandlisten] ** WARNING: Access control is not enabled for the database.
2020-01-13T23:08:16.065+0200 I CONTROL [initandlisten] **      Read and write access to data and configuration is unrestricted.
2020-01-13T23:08:16.066+0200 I CONTROL [initandlisten]
2020-01-13T23:08:16.066+0200 I CONTROL [initandlisten] ** WARNING: This server is bound to localhost.
2020-01-13T23:08:16.066+0200 I CONTROL [initandlisten] **      Remote systems will be unable to connect to this server.
2020-01-13T23:08:16.066+0200 I CONTROL [initandlisten] **      Start the server with --bind_ip <address> to specify which IP
2020-01-13T23:08:16.066+0200 I CONTROL [initandlisten] **      addresses it should serve responses from, or with --bind_ip_all to
2020-01-13T23:08:16.066+0200 I CONTROL [initandlisten] **      bind to all interfaces. If this behavior is desired, start the
2020-01-13T23:08:16.067+0200 I CONTROL [initandlisten] **      server with --bind_ip 127.0.0.1 to disable this warning.
2020-01-13T23:08:16.067+0200 I CONTROL [initandlisten]
---
Enable MongoDB's free cloud-based monitoring service, which will then receive and display
metrics about your deployment (disk utilization, CPU, operation statistics, etc).

The monitoring data will be available on a MongoDB website with a unique URL accessible to you
and anyone you share the URL with. MongoDB may use this information to make product
improvements and to suggest MongoDB products and deployment options to you.

To enable free monitoring, run the following command: db.enableFreeMonitoring()
To permanently disable this reminder, run the following command: db.disableFreeMonitoring()
---

r2schools:SECONDARY> rs.slaveOk()
r2schools:SECONDARY> show dbs
admin            0.000GB
aisdata          0.034GB
bookstore        0.000GB
company          0.001GB
config           0.000GB
labdb            0.000GB
local            0.000GB
r2schools:SECONDARY> use aisdata
switched to db aisdata
r2schools:SECONDARY> db.nari_dynamic.find({"_id":1265})
{ "_id" : ObjectId("5e1b2a20fb826e68ef6a5d8b"), "" : 1265, "sourcemsi" : 228190592, "speedoverground" : 51.3, "lon" : -4.326832, "lat":48.508277 }
r2schools:SECONDARY>
```

Σχήμα 10. Δοκιμή κλήσης του πλοίου με την μεγαλύτερη ταχύτητα ("" :1265) απο το secondary port 27020. Έλεγχος λειτουργίας replication.