НАЦІОНАЛЬНИЙ ТЕХНІЧНИЙ УНІВЕРСИТЕТ УКРАЇНИ
«КИЇВСЬКИЙ ПОЛІТЕХНІЧНИЙ ІНСТИТУТ
імені ІГОРЯ СІКОРСЬКОГО»
Інститут прикладного системного аналізу

ЛАБОРАТОРНА РОБОТА №3

з дисципліни «Високопродуктивні розподілені обчислювальні системи»

на тему: «Building MongoDB Environment»

Варіант №9

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MongoDB sharding

docker-compose.yaml

```
version: '3'
services:

## Router
  router:
    image: mongo
    container_name: router-01
                      command:      mongos      --port      27017      --configdb
rs-config-server/configsvr01:27017,configsvr02:27017,configsvr03:27017
--bind_ip_all
    ports:
      - 27117:27017
    restart: always
    volumes:
      - ./scripts:/scripts
      - router_db:/data/db
      - router_config:/data/configdb

## Config Servers
  configsvr01:
    image: mongo
    container_name: mongo-config-01
    command: mongod --port 27017 --configsvr --replSet rs-config-server
    volumes:
      - ./scripts:/scripts
      - configsvr01_db:/data/db
      - configsvr01_config:/data/configdb
    ports:
      - 27119:27017
    restart: always

  configsvr02:
    image: mongo
    container_name: mongo-config-02
    command: mongod --port 27017 --configsvr --replSet rs-config-server
    volumes:
      - ./scripts:/scripts
      - configsvr02_db:/data/db
      - configsvr02_config:/data/configdb
    ports:
```

```
    - 27120:27017
  restart: always

configsvr03:
  image: mongo
  container_name: mongo-config-03
  command: mongod --port 27017 --configsvr --replSet rs-config-server
  volumes:
    - ./scripts:/scripts
    - configsvr03_db:/data/db
    - configsvr03_config:/data/configdb
  ports:
    - 27121:27017
  restart: always


shard01-a:
  image: mongo
  container_name: shard-01-node-a
  command: mongod --port 27017 --shardsvr --replSet rs-shard-01
  volumes:
    - ./scripts:/scripts
    - shard01_a_db:/data/db
    - shard01_a_config:/data/configdb
  ports:
    - 27122:27017
  restart: always

shard01-b:
  image: mongo
  container_name: shard-01-node-b
  command: mongod --port 27017 --shardsvr --replSet rs-shard-01
  volumes:
    - ./scripts:/scripts
    - shard01_b_db:/data/db
    - shard01_b_config:/data/configdb
  ports:
    - 27123:27017
  restart: always

shard01-c:
  image: mongo
```

```
    container_name: shard-01-node-c
    command: mongod --port 27017 --shardsvr --replSet rs-shard-01
    volumes:
      - ./scripts:/scripts
      - shard01_c_db:/data/db
      - shard01_c_config:/data/configdb
    ports:
      - 27124:27017
    restart: always

  shard02-a:
    image: mongo
    container_name: shard-02-node-a
    command: mongod --port 27017 --shardsvr --replSet rs-shard-02
    volumes:
      - ./scripts:/scripts
      - shard02_a_db:/data/db
      - shard02_a_config:/data/configdb
    ports:
      - 27125:27017
    restart: always

  shard02-b:
    image: mongo
    container_name: shard-02-node-b
    command: mongod --port 27017 --shardsvr --replSet rs-shard-02
    volumes:
      - ./scripts:/scripts
      - shard02_b_db:/data/db
      - shard02_b_config:/data/configdb
    ports:
      - 27126:27017
    restart: always

  shard02-c:
    image: mongo
    container_name: shard-02-node-c
    command: mongod --port 27017 --shardsvr --replSet rs-shard-02
    volumes:
      - ./scripts:/scripts
      - shard02_c_db:/data/db
      - shard02_c_config:/data/configdb
```

```yaml
    ports:
      - 27127:27017
    restart: always

  shard03-a:
    image: mongo
    container_name: shard-03-node-a
    command: mongod --port 27017 --shardsvr --replSet rs-shard-03
    volumes:
      - ./scripts:/scripts
      - shard03_a_db:/data/db
      - shard03_a_config:/data/configdb
    ports:
      - 27128:27017
    restart: always

  shard03-b:
    image: mongo
    container_name: shard-03-node-b
    command: mongod --port 27017 --shardsvr --replSet rs-shard-03
    volumes:
      - ./scripts:/scripts
      - shard03_b_db:/data/db
      - shard03_b_config:/data/configdb
    ports:
      - 27129:27017
    restart: always

  shard03-c:
    image: mongo
    container_name: shard-03-node-c
    command: mongod --port 27017 --shardsvr --replSet rs-shard-03
    volumes:
      - ./scripts:/scripts
      - shard03_c_db:/data/db
      - shard03_c_config:/data/configdb
    ports:
      - 27130:27017
    restart: always

  shard04-a:
    image: mongo
```

```
    container_name: shard-04-node-a
    command: mongod --port 27017 --shardsvr --replSet rs-shard-04
    volumes:
      - ./scripts:/scripts
      - shard04_a_db:/data/db
      - shard04_a_config:/data/configdb
    ports:
      - 27131:27017
    restart: always

  shard04-b:
    image: mongo
    container_name: shard-04-node-b
    command: mongod --port 27017 --shardsvr --replSet rs-shard-04
    volumes:
      - ./scripts:/scripts
      - shard04_b_db:/data/db
      - shard04_b_config:/data/configdb
    ports:
      - 27132:27017
    restart: always

  shard04-c:
    image: mongo
    container_name: shard-04-node-c
    command: mongod --port 27017 --shardsvr --replSet rs-shard-04
    volumes:
      - ./scripts:/scripts
      - shard04_c_db:/data/db
      - shard04_c_config:/data/configdb
    ports:
      - 27133:27017
    restart: always

volumes:
  router_db:
  router_config:

  configsvr01_db:
  configsvr01_config:

  configsvr02_db:
```

```
configsvr02_config:

configsvr03_db:
configsvr03_config:

shard01_a_db:
shard01_a_config:

shard01_b_db:
shard01_b_config:

shard01_c_db:
shard01_c_config:

shard02_a_db:
shard02_a_config:

shard02_b_db:
shard02_b_config:

shard02_c_db:
shard02_c_config:

shard03_a_db:
shard03_a_config:

shard03_b_db:
shard03_b_config:

shard03_c_db:
shard03_c_config:

shard04_a_db:
shard04_a_config:

shard04_b_db:
shard04_b_config:

shard04_c_db:
shard04_c_config:
```

docker-compose up -d

```
C:\docker\mongoDB>docker-compose up -d
[+] Building 0.0s (0/0)                                                    docker:default
[+] Running 17/17
 ✔ Network mongodb_default     Created                                              0.0s
 ✔ Container shard-04-node-c   Started                                              0.2s
 ✔ Container shard-02-node-c   Started                                              0.1s
 ✔ Container shard-04-node-a   Created                                              0.2s
 ✔ Container shard-01-node-b   Created                                              0.2s
 ✔ Container shard-03-node-a   Created                                              0.2s
 ✔ Container shard-04-node-b   Started                                              0.2s
 ✔ Container shard-03-node-b   Created                                              0.2s
 ✔ Container mongo-config-02   Created                                              0.2s
 ✔ Container mongo-config-03   Started                                              0.2s
 ✔ Container shard-01-node-c   Started                                              0.1s
 ✔ Container shard-02-node-a   Started                                              0.2s
 ✔ Container shard-02-node-b   Created                                              0.2s
 ✔ Container router-01         Created                                              0.1s
 ✔ Container mongo-config-01   Created                                              0.1s
 ✔ Container shard-03-node-c   Created                                              0.1s
 ✔ Container shard-01-node-a   Started                                              0.2s
```

Initializing shards

docker-compose exec configsvr01 sh -c "mongosh < /scripts/init-configserver.js"

```
C:\docker\local\lab3\other1>docker-compose exec configsvr01 sh -c "mongosh < /scripts/init-configserver.js"
Current Mongosh Log ID: 657f48584eedc5e8f2c1127f
Connecting to:          mongodb://127.0.0.1:27017/?directConnection=true&serverSelectionTimeoutMS=2000&appName=mongosh+1.5.4
Using MongoDB:          6.0.1
Using Mongosh:          1.5.4

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

------
   The server generated these startup warnings when booting
   2023-12-17T19:11:15.992+00:00: Using the XFS filesystem is strongly recommended with the WiredTiger storage engine. See http://dochub.mongodb.org/core/prodnotes-filesystem
   2023-12-17T19:11:17.395+00:00: Access control is not enabled for the database. Read and write access to data and configuration is unrestricted
   2023-12-17T19:11:17.395+00:00: /sys/kernel/mm/transparent_hugepage/enabled is 'always'. We suggest setting it to 'never'
   2023-12-17T19:11:17.395+00:00: vm.max_map_count is too low
------

------
   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()
------

rs-config-server [direct: secondary] test> rs.initiate(
...     {
.....       _id: "rs-config-server",
.....       configsvr: true,
.....       version: 1,
.....       members: [
.....          { _id: 0, host : "configsvr01:27017" },
.....          { _id: 1, host : "configsvr02:27017" },
.....          { _id: 2, host : "configsvr03:27017" }
.....       ]
.....     }
```

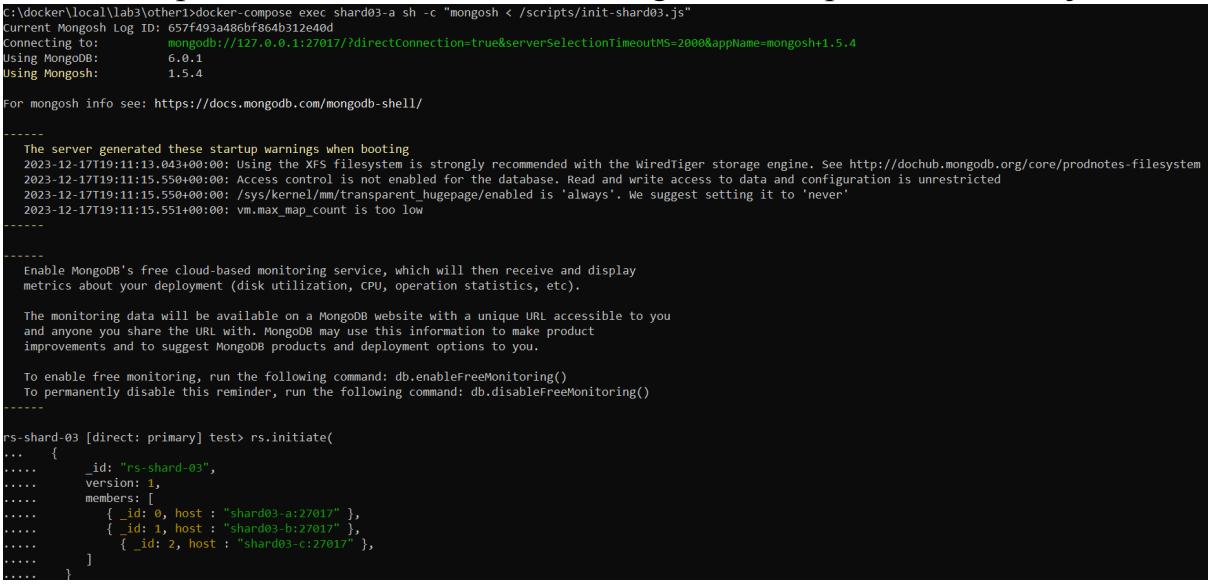
docker-compose exec shard01-a sh -c "mongosh < /scripts/init-shard01.js"

```
C:\docker\local\lab3\other1>docker-compose exec shard01-a sh -c "mongosh < /scripts/init-shard01.js"
Current Mongosh Log ID: 657f48a1c4a3c13cc1cdc287
Connecting to:          mongodb://127.0.0.1:27017/?directConnection=true&serverSelectionTimeoutMS=2000&appName=mongosh+1.5.4
Using MongoDB:          6.0.1
Using Mongosh:          1.5.4

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

------
   The server generated these startup warnings when booting
   2023-12-17T19:11:13.210+00:00: Using the XFS filesystem is strongly recommended with the WiredTiger storage engine. See http://dochub.mongodb.org/core/prodnotes-filesystem
   2023-12-17T19:11:15.801+00:00: Access control is not enabled for the database. Read and write access to data and configuration is unrestricted
   2023-12-17T19:11:15.802+00:00: /sys/kernel/mm/transparent_hugepage/enabled is 'always'. We suggest setting it to 'never'
   2023-12-17T19:11:15.803+00:00: vm.max_map_count is too low
------

------
   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()
------

rs-shard-01 [direct: secondary] test> rs.initiate(
...     {
.....       _id: "rs-shard-01",
.....       version: 1,
.....       members: [
.....          { _id: 0, host : "shard01-a:27017" },
.....          { _id: 1, host : "shard01-b:27017" },
.....            { _id: 2, host : "shard01-c:27017" },
.....       ]
.....     }
```

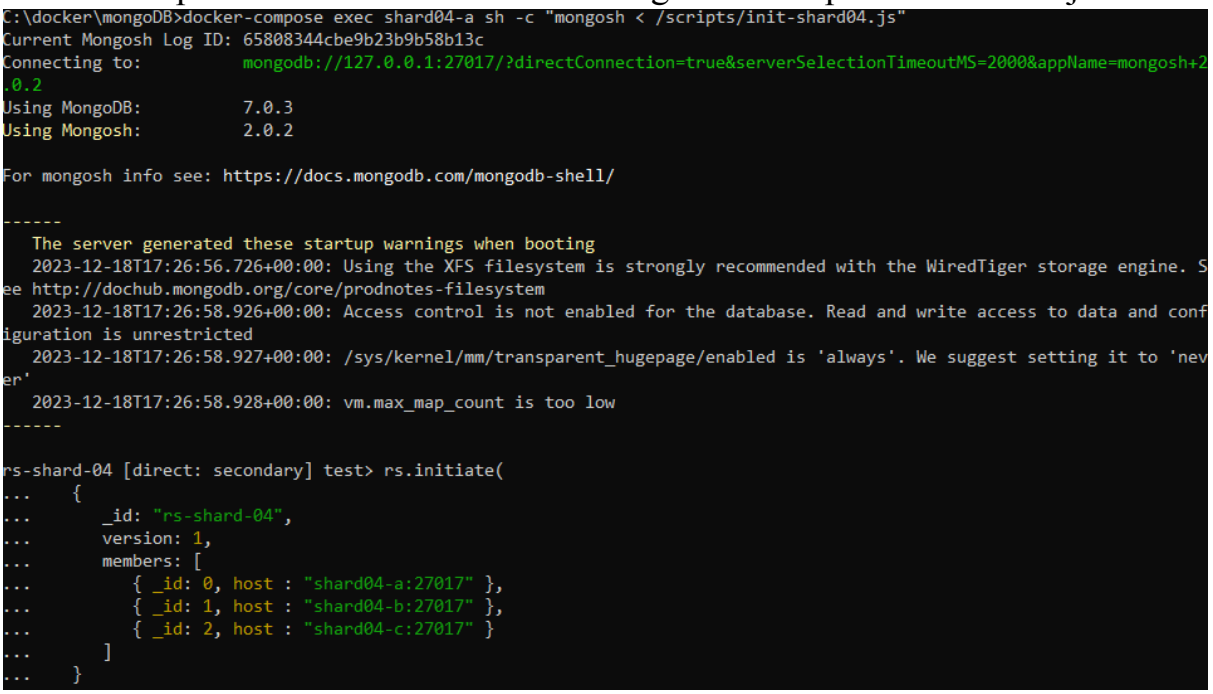
docker-compose exec shard02-a sh -c "mongosh < /scripts/init-shard02.js"

```
C:\docker\local\lab3\other1>docker-compose exec shard02-a sh -c "mongosh < /scripts/init-shard02.js"
Current Mongosh Log ID: 657f48fac0c59e28cda999bd
Connecting to:          mongodb://127.0.0.1:27017/?directConnection=true&serverSelectionTimeoutMS=2000&appName=mongosh+1.5.4
Using MongoDB:          6.0.1
Using Mongosh:          1.5.4

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

------
   The server generated these startup warnings when booting
   2023-12-17T19:11:13.045+00:00: Using the XFS filesystem is strongly recommended with the WiredTiger storage engine. See http://dochub.mongodb.org/core/prodnotes-filesystem
   2023-12-17T19:11:15.224+00:00: Access control is not enabled for the database. Read and write access to data and configuration is unrestricted
   2023-12-17T19:11:15.224+00:00: /sys/kernel/mm/transparent_hugepage/enabled is 'always'. We suggest setting it to 'never'
   2023-12-17T19:11:15.225+00:00: vm.max_map_count is too low
------

------
   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()
------

rs-shard-02 [direct: primary] test> rs.initiate(
...     {
.....       _id: "rs-shard-02",
.....       version: 1,
.....       members: [
.....          { _id: 0, host : "shard02-a:27017" },
.....          { _id: 1, host : "shard02-b:27017" },
.....            { _id: 2, host : "shard02-c:27017" },
.....       ]
.....     }
```

docker-compose exec shard03-a sh -c "mongosh < /scripts/init-shard03.js"



docker-compose exec shard04-a sh -c "mongosh < /scripts/init-shard04.js"



Initializing router

docker-compose exec router sh -c "mongosh < /scripts/init-router.js"

```
    signature: {
      hash: Binary.createFromBase64("AAAAAAAAAAAAAAAAAAAAAAAAAAA=", 0),
      keyId: Long("0")
    }
  },
  operationTime: Timestamp({ t: 1702921081, i: 1 })
}
[direct: mongos] test>

[direct: mongos] test> sh.addShard("rs-shard-04/shard04-a:27017")
{
  shardAdded: 'rs-shard-04',
  ok: 1,
  '$clusterTime': {
    clusterTime: Timestamp({ t: 1702921081, i: 1 }),
    signature: {
      hash: Binary.createFromBase64("AAAAAAAAAAAAAAAAAAAAAAAAAAA=", 0),
      keyId: Long("0")
    }
  },
  operationTime: Timestamp({ t: 1702921081, i: 1 })
}
[direct: mongos] test> sh.addShard("rs-shard-04/shard04-b:27017")
{
  shardAdded: 'rs-shard-04',
  ok: 1,
  '$clusterTime': {
    clusterTime: Timestamp({ t: 1702921081, i: 1 }),
    signature: {
      hash: Binary.createFromBase64("AAAAAAAAAAAAAAAAAAAAAAAAAAA=", 0),
      keyId: Long("0")
    }
  },
  operationTime: Timestamp({ t: 1702921081, i: 1 })
}
[direct: mongos] test> sh.addShard("rs-shard-04/shard04-c:27017"){
  shardAdded: 'rs-shard-04',
  ok: 1,
  '$clusterTime': {
    clusterTime: Timestamp({ t: 1702921081, i: 1 }),
    signature: {
      hash: Binary.createFromBase64("AAAAAAAAAAAAAAAAAAAAAAAAAAA=", 0),
      keyId: Long("0")
    }
  },
  operationTime: Timestamp({ t: 1702921081, i: 1 })
}
[direct: mongos] test> sh.addShard("rs-shard-04/shard04-c:27017")
```

Importing data

docker-compose exec router sh -c "mongosh < /scripts/enable-sharding.js"

```
      hash: Binary(Buffer.from("0000000000000000000000000000000000000000", "hex"), 0),
      keyId: Long("0")
    }
  },
  operationTime: Timestamp({ t: 1702840682, i: 2 })
}
[direct: mongos] test> sh.addShard("rs-shard-03/shard03-c:27017")
C:\docker\local\lab3\other1>docker-compose exec router sh -c "mongosh < /scripts/enable-sharding.js"
Current Mongosh Log ID: 657f49df2228a65e6f683e7f
Connecting to:          mongodb://127.0.0.1:27017/?directConnection=true&serverSelectionTimeoutMS=2000&appName=mongosh+1.5.4
Using MongoDB:          6.0.1
Using Mongosh:          1.5.4

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

------
   The server generated these startup warnings when booting
   2023-12-17T19:11:15.525+00:00: Access control is not enabled for the database. Read and write access to data and configuration is unrestricted
------

[direct: mongos] test> sh.enableSharding('taxi')
{
  ok: 1,
  '$clusterTime': {
    clusterTime: Timestamp({ t: 1702840798, i: 10 }),
    signature: {
      hash: Binary(Buffer.from("0000000000000000000000000000000000000000", "hex"), 0),
      keyId: Long("0")
    }
  },
  operationTime: Timestamp({ t: 1702840798, i: 10 })
}
[direct: mongos] test> sh.shardCollection('taxi.rides', {start_latitude: "hashed"}){
  collectionsharded: 'taxi.rides',
  ok: 1,
  '$clusterTime': {
    clusterTime: Timestamp({ t: 1702840800, i: 8 }),
    signature: {
      hash: Binary(Buffer.from("0000000000000000000000000000000000000000", "hex"), 0),
      keyId: Long("0")
    }
  },
  operationTime: Timestamp({ t: 1702840800, i: 4 })
}
[direct: mongos] test> sh.shardCollection('taxi.rides', {start_latitude: "hashed"})
```

docker-compose exec router sh -c "mongoimport --port 27017 -d taxi -c rides --type csv --file scripts/rides.csv --headerline"

```
C:\docker\local\lab3\other1>docker-compose exec router sh -c "mongoimport --port 27017 -d taxi -c rides --type csv --file scripts/rides.csv --headerline"
2023-12-17T19:20:51.259+0000    connected to: mongodb://localhost:27017/
2023-12-17T19:20:54.260+0000    [##......................] taxi.rides   6.97MB/80.2MB (8.7%)
2023-12-17T19:20:57.260+0000    [####....................] taxi.rides   14.2MB/80.2MB (17.8%)
2023-12-17T19:21:00.259+0000    [######..................] taxi.rides   21.8MB/80.2MB (27.1%)
2023-12-17T19:21:03.259+0000    [########................] taxi.rides   29.0MB/80.2MB (36.1%)
2023-12-17T19:21:06.258+0000    [##########..............] taxi.rides   36.1MB/80.2MB (45.0%)
2023-12-17T19:21:09.258+0000    [############............] taxi.rides   43.4MB/80.2MB (54.1%)
2023-12-17T19:21:12.258+0000    [###############.........] taxi.rides   50.8MB/80.2MB (63.4%)
2023-12-17T19:21:15.258+0000    [#################.......] taxi.rides   55.5MB/80.2MB (69.3%)
2023-12-17T19:21:18.259+0000    [###################.....] taxi.rides   61.7MB/80.2MB (77.0%)
2023-12-17T19:21:21.259+0000    [#####################...] taxi.rides   68.8MB/80.2MB (85.8%)
2023-12-17T19:21:24.258+0000    [######################..] taxi.rides   75.6MB/80.2MB (94.3%)
2023-12-17T19:21:26.339+0000    [########################] taxi.rides   80.2MB/80.2MB (100.0%)
2023-12-17T19:21:26.340+0000    500000 document(s) imported successfully. 0 document(s) failed to import.
```

Querying data

docker-compose exec router sh -c "mongosh < /scripts/query-data.js"


```
{
  _id: '"Driver was talking on the phone loudly in a language passengers couldnt understand."',
  Length: 85
},
{
  _id: 'Cab had a strange odor; it was extremely unpleasant during the entire ride.',
  Length: 75
},
{
  _id: 'Cab had a strange rattling noise that persisted throughout the entire trip.',
  Length: 75
},
{
  _id: 'Taxi had a strange vibration that made it difficult to hold a conversation.',
  Length: 75
},
{
  _id: 'The driver was constantly checking their phone for messages while driving.',
  Length: 74
},
{
  _id: 'Waited for the taxi for an extended period; the tardiness was frustrating.',
  Length: 74
},
{
  _id: '"Taxi was excessively hot; the air conditioning wasnt working properly."',
  Length: 72
},
{
  _id: 'Driver was playing loud music without considering passenger preferences.',
  Length: 72
},
{
  _id: 'Unexplained additional charges on the fare; unclear billing practices.',
  Length: 70
},
{
  _id: 'Taxi was not properly cleaned; there were crumbs and trash everywhere.',
  Length: 70
}
```