Master Tehnologii Informatice
Administrarea Bazelor de Date
Anul universitar 2023-2024

Administarea Bazelor de Date

-Proiect MongoDB-

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Sesiunea: Iunie 2024

Overview

The goal of the project is to assess the MongoDB database skills of the student. The project has a medium difficulty level and is relevant to industry employers of today.

Project description

You are required to make several statistical computations on some US Zips dataset using MongoDB as the database platform.

Prerequisites:

- Download the latest US Zips dataset from (choose the free tier). The dataset has approximately 33k entries.
- Create a MongoDB instance. You may use your own MongoDB Atlas instance in cloud or use a local instance. For local instances Docker is preferred, but you may also choose to install MongoDB as a standalone server on your OS.
- Import the dataset into the MongoDB instance.

Requirements

a) Get the states with a total population of over 10 million.

b) Get the average city population by state.

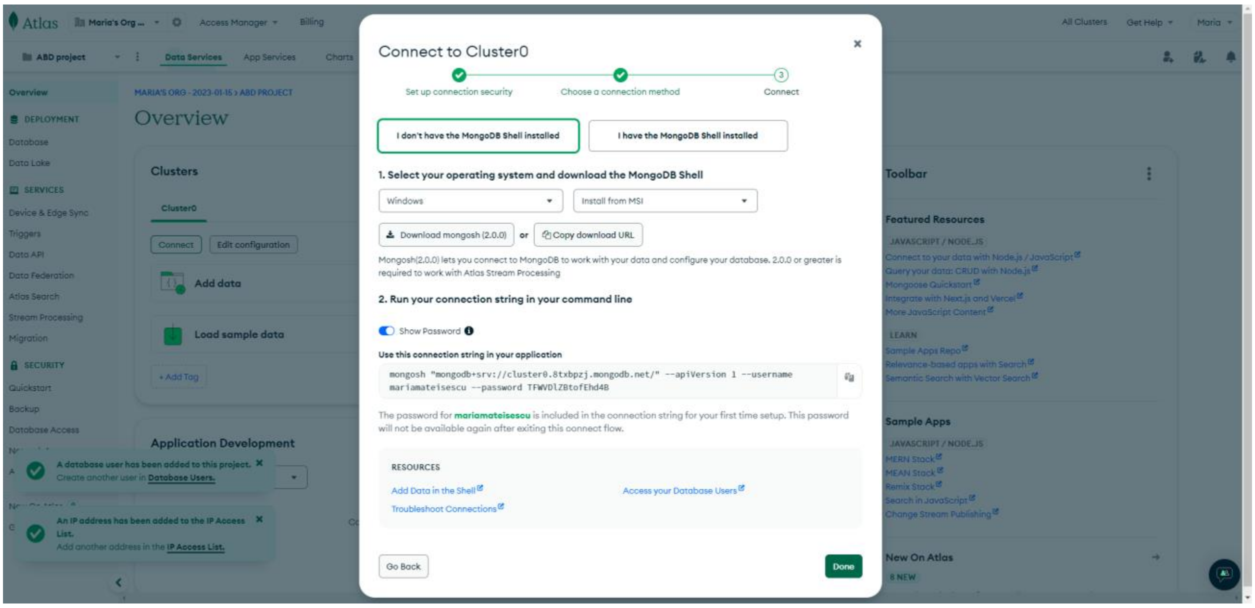
c) Get the largest and the smallest city in each state.

d) Get the largest and the smallest counties in each state.

e) Get the nearest 10 zips from one of Chicago's landmarks, the Willis Tower situated at coordinates 41.878876, -87.635918.

f) Get the total population situated between 50 and 200 kms around New York's landmark, the Statue of Liberty at coordinates 40.689247, -74.044502.

Primul pas a fost instalarea utilitarului MongoShell si a uneltelor MongoDB Database Tools pentru sistemul meu de operare (Windows 10). Ulterior, am creat un cluster in MongoDB Atlas, in proiectul denumit „ABD project”.


Connect to Cluster0
Set up connection security
Choose a connection method
Connect
I don't have the MongoDB Shell installed
I have the MongoDB Shell installed

1. Select your operating system and download the MongoDB Shell

Windows ▾ Install from MSI ▾

Download mongosh (2.0.0) or Copy download URL

Mongosh(2.0.0) lets you connect to MongoDB to work with your data and configure your database. 2.0.0 or greater is required to work with Atlas Stream Processing

2. Run your connection string in your command line

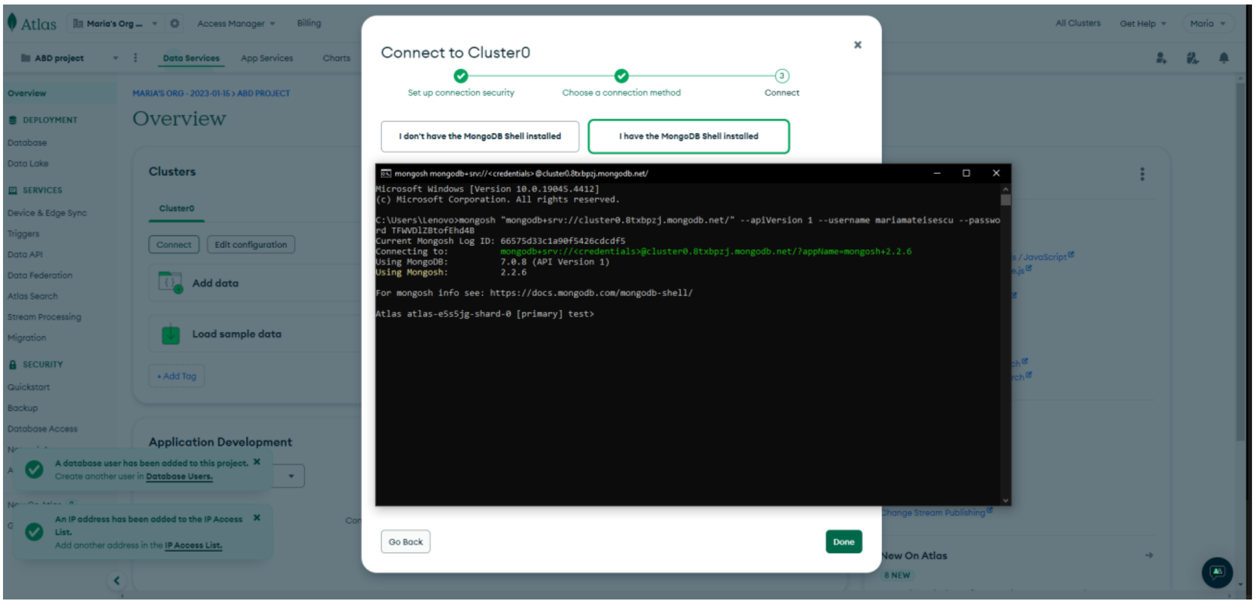
Show Password

Use this connection string in your application

```
mongosh "mongodb+srv://cluster0.8txbpzj.mongodb.net/" --apiVersion 1 --username
mariamateisescu --password TFWVDlZBtofEhd4B
```

The password for mariamateisescu is included in the connection string for your first time setup. This password will not be available again after exiting this connect flow.

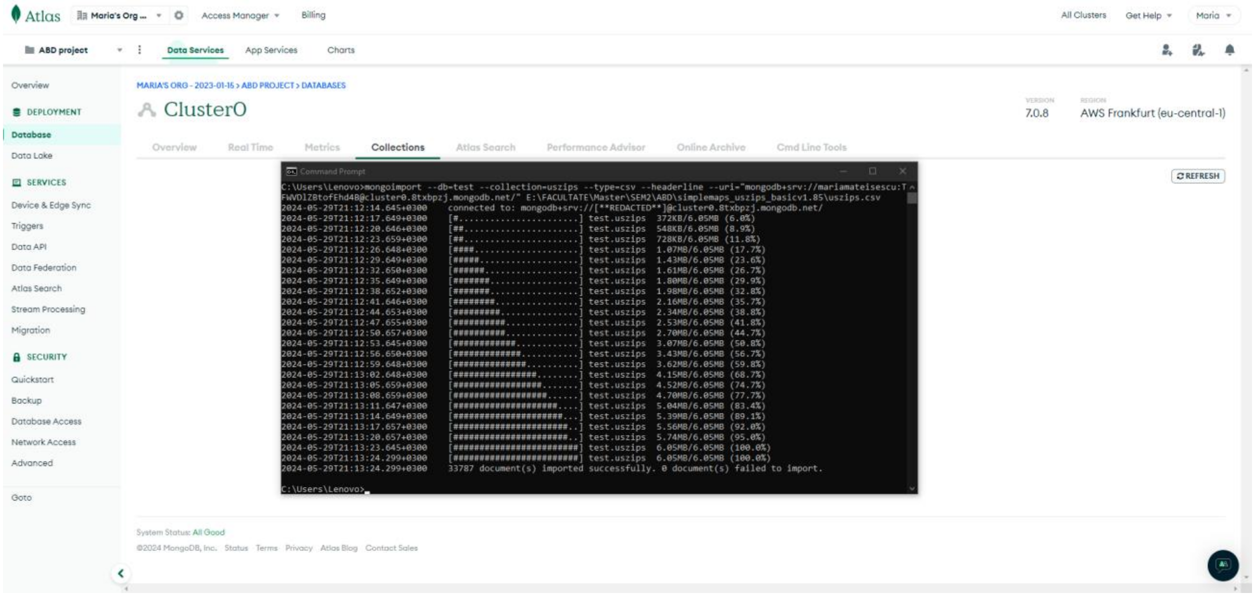
Pentru a ma conecta la instanta din cloud MongoDB Atlas am folosit connection string-ul obtinut anterior, care contine username-ul si parola.


Connect to Cluster0
Set up connection security
Choose a connection method
Connect
I don't have the MongoDB Shell installed
I have the MongoDB Shell installed
mongosh mongodb+srv://<credentials>@cluster0.8txbpzj.mongodb.net/
Go Back
Done

```
Microsoft Windows [Version 10.0.19045.4412]
(c) Microsoft Corporation. All rights reserved.

C:\Users\Lenovo>mongosh "mongodb+srv://cluster0.8txbpzj.mongodb.net/" --apiVersion 1 --username mariamateisescu --passwo
rd TFWVDlZBtofEhd4B
Current Mongosh Log ID: 66575d33c1a90f5426cdcdf5
Connecting to:          mongodb+srv://<credentials>@cluster0.8txbpzj.mongodb.net/?appName=mongosh+2.2.6
Using MongoDB:          7.0.8 (API Version 1)
Using Mongosh:          2.2.6

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

Atlas atlas-e5s5jg-shard-0 [primary] test>
```

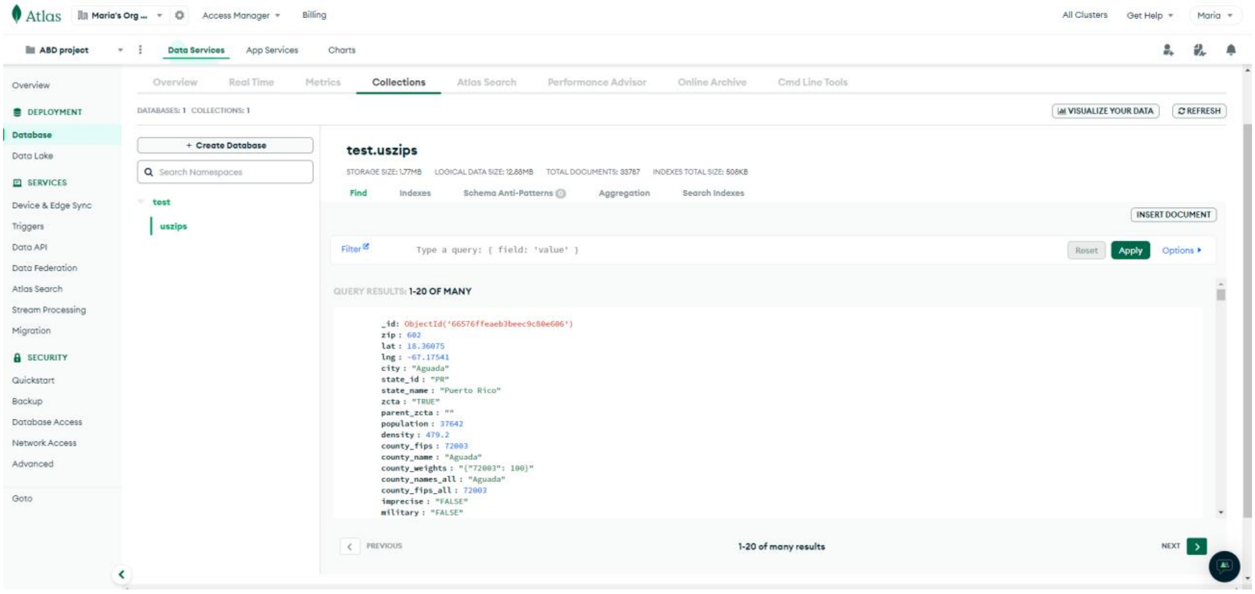
Unitatea de stocare a bazelor de date non-relationale este colectia, deci in baza de date vor fi date stocate sub forma de colectii, spre deosebire de bazele de date relationale unde exista tabele.

Folosind comanda „mongoimport” pusa la dispozitie de tool-uri am importat fisierul denumit „uszips” cu extensia .csv in baza de date „test”, iar colectia am denumit-o „uszips”. In total s-au importat cu succes 33787 de documente.



```
C:\Users\Lenovo>mongoimport --db=test --collection=uszips --type=csv --headerline --uri="mongodb+srv://mariamateisescu:T
FWVDlZBtofEhd4B@cluster0.8txbpzj.mongodb.net/" E:\FACULTATE\Master\SEM2\ABD\simplemaps_uszips_basicv1.85\uszips.csv
2024-05-29T21:12:14.645+0300    connected to: mongodb+srv://[**REDACTED**]@cluster0.8txbpzj.mongodb.net/
2024-05-29T21:12:17.649+0300    [#.......................] test.uszips  372KB/6.05MB (6.0%)
2024-05-29T21:12:20.646+0300    [##......................] test.uszips  548KB/6.05MB (8.9%)
2024-05-29T21:12:23.659+0300    [##......................] test.uszips  728KB/6.05MB (11.8%)
2024-05-29T21:12:26.648+0300    [####....................] test.uszips  1.07MB/6.05MB (17.7%)
2024-05-29T21:12:29.649+0300    [#####...................] test.uszips  1.43MB/6.05MB (23.6%)
2024-05-29T21:12:32.650+0300    [######..................] test.uszips  1.61MB/6.05MB (26.7%)
2024-05-29T21:12:35.649+0300    [#######.................] test.uszips  1.80MB/6.05MB (29.9%)
2024-05-29T21:12:38.652+0300    [#######.................] test.uszips  1.98MB/6.05MB (32.8%)
2024-05-29T21:12:41.646+0300    [########................] test.uszips  2.16MB/6.05MB (35.7%)
2024-05-29T21:12:44.653+0300    [#########...............] test.uszips  2.34MB/6.05MB (38.8%)
2024-05-29T21:12:47.655+0300    [##########..............] test.uszips  2.53MB/6.05MB (41.8%)
2024-05-29T21:12:50.657+0300    [##########..............] test.uszips  2.70MB/6.05MB (44.7%)
2024-05-29T21:12:53.645+0300    [############............] test.uszips  3.07MB/6.05MB (50.8%)
2024-05-29T21:12:56.650+0300    [#############...........] test.uszips  3.43MB/6.05MB (56.7%)
2024-05-29T21:12:59.648+0300    [##############..........] test.uszips  3.62MB/6.05MB (59.8%)
2024-05-29T21:13:02.648+0300    [################........] test.uszips  4.15MB/6.05MB (68.7%)
2024-05-29T21:13:05.659+0300    [#################.......] test.uszips  4.52MB/6.05MB (74.7%)
2024-05-29T21:13:08.659+0300    [##################......] test.uszips  4.70MB/6.05MB (77.7%)
2024-05-29T21:13:11.647+0300    [####################....] test.uszips  5.04MB/6.05MB (83.4%)
2024-05-29T21:13:14.649+0300    [#####################...] test.uszips  5.39MB/6.05MB (89.1%)
2024-05-29T21:13:17.657+0300    [######################..] test.uszips  5.56MB/6.05MB (92.0%)
2024-05-29T21:13:20.657+0300    [######################..] test.uszips  5.74MB/6.05MB (95.0%)
2024-05-29T21:13:23.645+0300    [########################] test.uszips  6.05MB/6.05MB (100.0%)
2024-05-29T21:13:24.299+0300    [########################] test.uszips  6.05MB/6.05MB (100.0%)
2024-05-29T21:13:24.299+0300    33787 document(s) imported successfully. 0 document(s) failed to import.

C:\Users\Lenovo>
```

Dupa finalizarea importului, documentele din colectie pot fi vizualizate structurat in MongoDB Atlas. Pentru fiecare document se genereaza in mod automat campul _id de tipul ObjectId, reprezentand identificatorul unic.

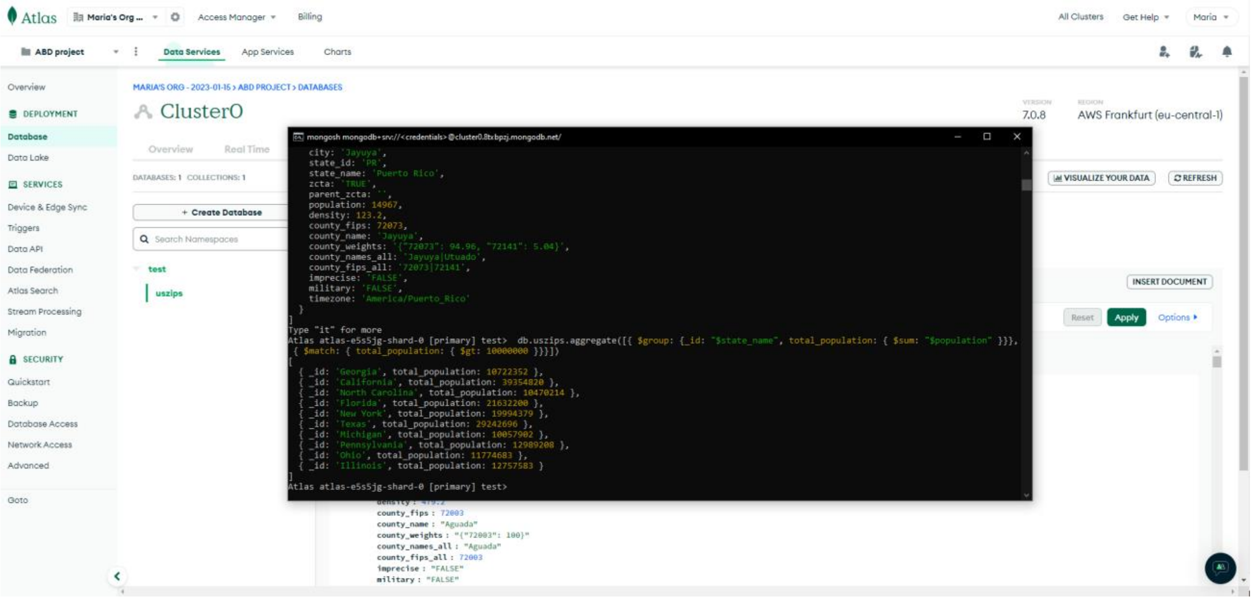


```
_id: ObjectId('66576ffeaeb3beec9c80e606')
zip : 602
lat : 18.36075
lng : -67.17541
city : "Aguada"
state_id : "PR"
state_name : "Puerto Rico"
zcta : "TRUE"
parent_zcta : ""
population : 37642
density : 479.2
county_fips : 72003
county_name : "Aguada"
county_weights : "{"72003": 100}"
county_names_all : "Aguada"
county_fips_all : 72003
imprecise : "FALSE"
military : "FALSE"
```

a) Obtineti statele cu o populatie totala de peste 10 milioane

Folosind comanda db.usizps.find().pretty() se obtin documentele intr-un format mai usor de citit. Pentru a obtine statele cu populatie totala de peste 10 milioane am folosit comanda:

db.uszips.aggregate([{ $group: {_id: "$state_name", total_population: { $sum: "$population" }}}, { $match: { total_population: { $gt: 10000000 }}}])



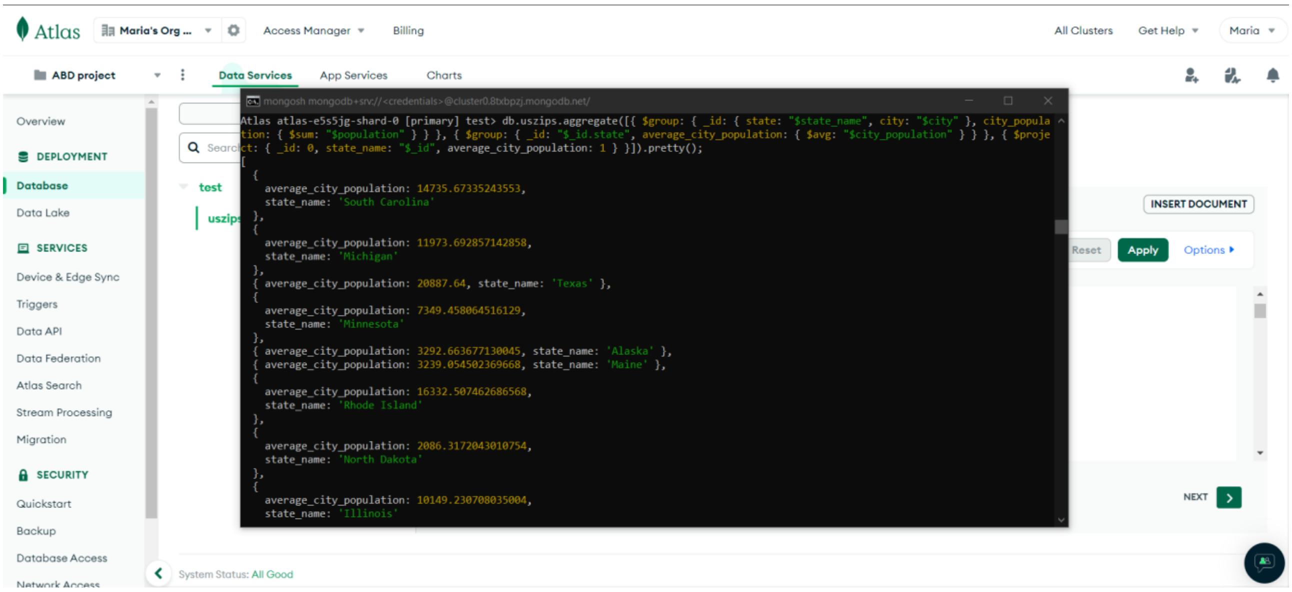
```
    city: 'Jayuya',
    state_id: 'PR',
    state_name: 'Puerto Rico',
    zcta: 'TRUE',
    parent_zcta: '',
    population: 14967,
    density: 123.2,
    county_fips: 72073,
    county_name: 'Jayuya',
    county_weights: '{"72073": 94.96, "72141": 5.04}',
    county_names_all: 'Jayuya|Utuado',
    county_fips_all: '72073|72141',
    imprecise: 'FALSE',
    military: 'FALSE',
    timezone: 'America/Puerto_Rico'
  }
]
Type "it" for more
Atlas atlas-e5s5jg-shard-0 [primary] test>  db.uszips.aggregate([{ $group: {_id: "$state_name", total_population: { $sum: "$population" }}},
 { $match: { total_population: { $gt: 10000000 }}}])
[
  { _id: 'Georgia', total_population: 10722352 },
  { _id: 'California', total_population: 39354820 },
  { _id: 'North Carolina', total_population: 10470214 },
  { _id: 'Florida', total_population: 21632200 },
  { _id: 'New York', total_population: 19994379 },
  { _id: 'Texas', total_population: 29242696 },
  { _id: 'Michigan', total_population: 10057902 },
  { _id: 'Pennsylvania', total_population: 12989208 },
  { _id: 'Ohio', total_population: 11774683 },
  { _id: 'Illinois', total_population: 12757583 }
]
Atlas atlas-e5s5jg-shard-0 [primary] test>
```

```
county_fips : 72003
county_name : "Aguada"
county_weights : "{"72003": 100}"
county_names_all : "Aguada"
county_fips_all : 72003
imprecise : "FALSE"
military : "FALSE"
```

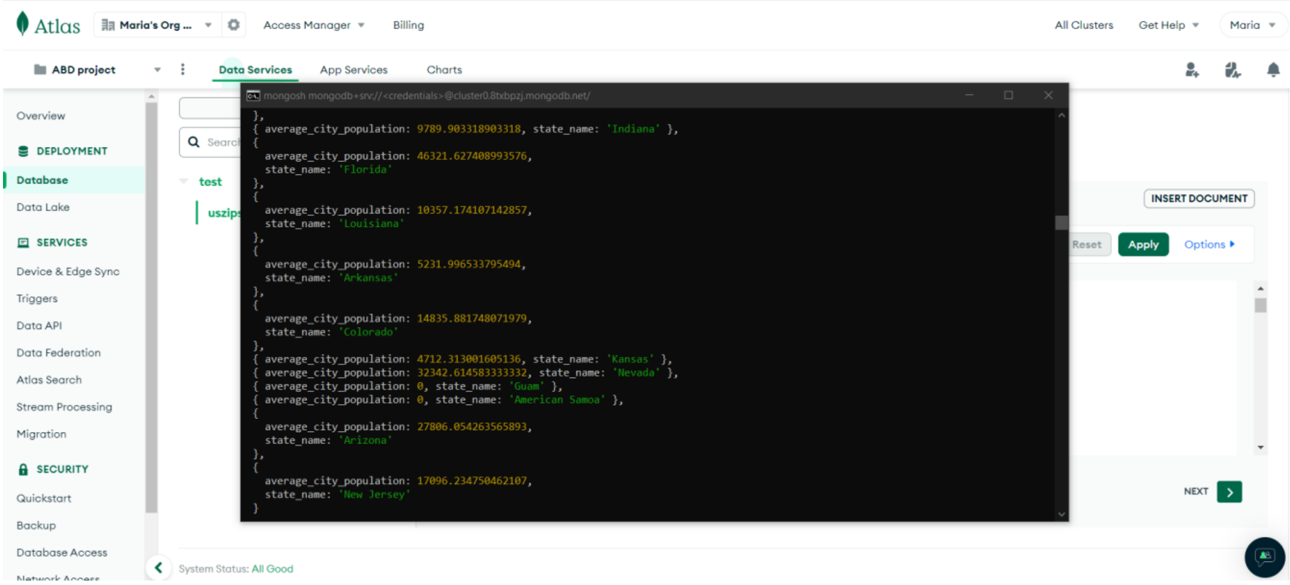
b) Obtineti populatia medie pe oras in functie de stat

Am folosit comanda:

db.uszips.aggregate([{ $group: { _id: { state: "$state_name", city: "$city" }, city_population: { $sum: "$population" } } }, { $group: { _id: "$_id.state", average_city_population: { $avg: "$city_population" } } }, { $project: { _id: 0, state_name: "$_id", average_city_population: 1 } }]).pretty()

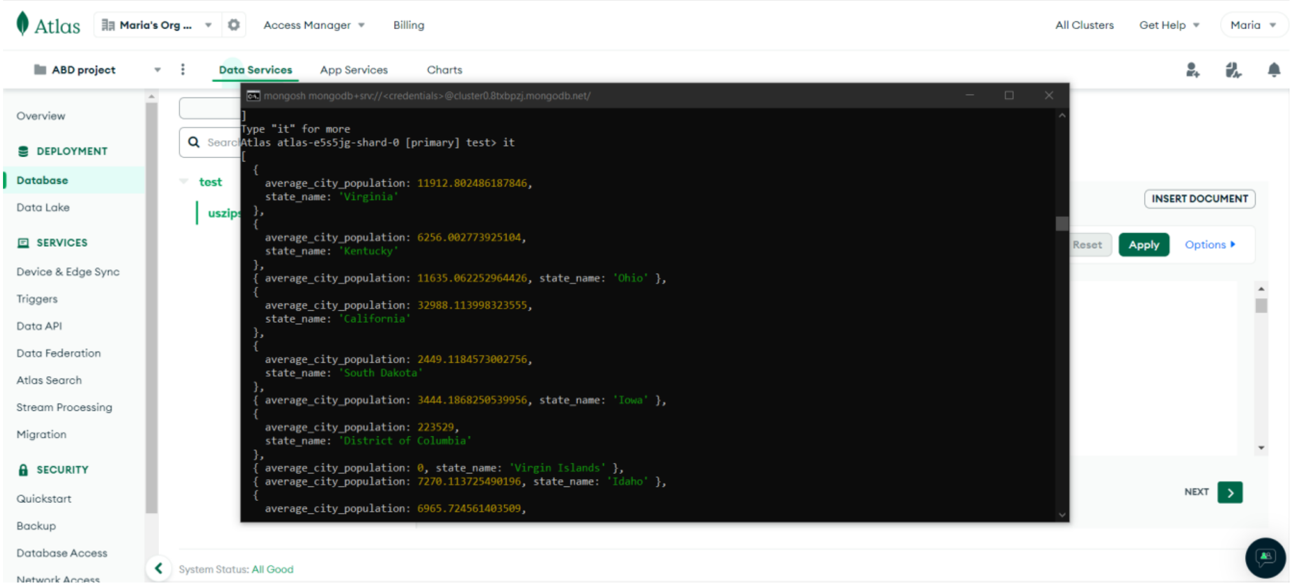


```
Atlas atlas-e5s5jg-shard-0 [primary] test> db.uszips.aggregate([{ $group: { _id: { state: "$state_name", city: "$city" }, city_popula
tion: { $sum: "$population" } } }, { $group: { _id: "$_id.state", average_city_population: { $avg: "$city_population" } } }, { $proje
ct: { _id: 0, state_name: "$_id", average_city_population: 1 } }]).pretty();
[
  {
    average_city_population: 14735.67335243553,
    state_name: 'South Carolina'
  },
  {
    average_city_population: 11973.692857142858,
    state_name: 'Michigan'
  },
  { average_city_population: 20887.64, state_name: 'Texas' },
  {
    average_city_population: 7349.458064516129,
    state_name: 'Minnesota'
  },
  { average_city_population: 3292.663677130045, state_name: 'Alaska' },
  { average_city_population: 3239.054502369668, state_name: 'Maine' },
  {
    average_city_population: 16332.507462686568,
    state_name: 'Rhode Island'
  },
  {
    average_city_population: 2086.3172043010754,
    state_name: 'North Dakota'
  },
  {
    average_city_population: 10149.230708035004,
    state_name: 'Illinois'
```



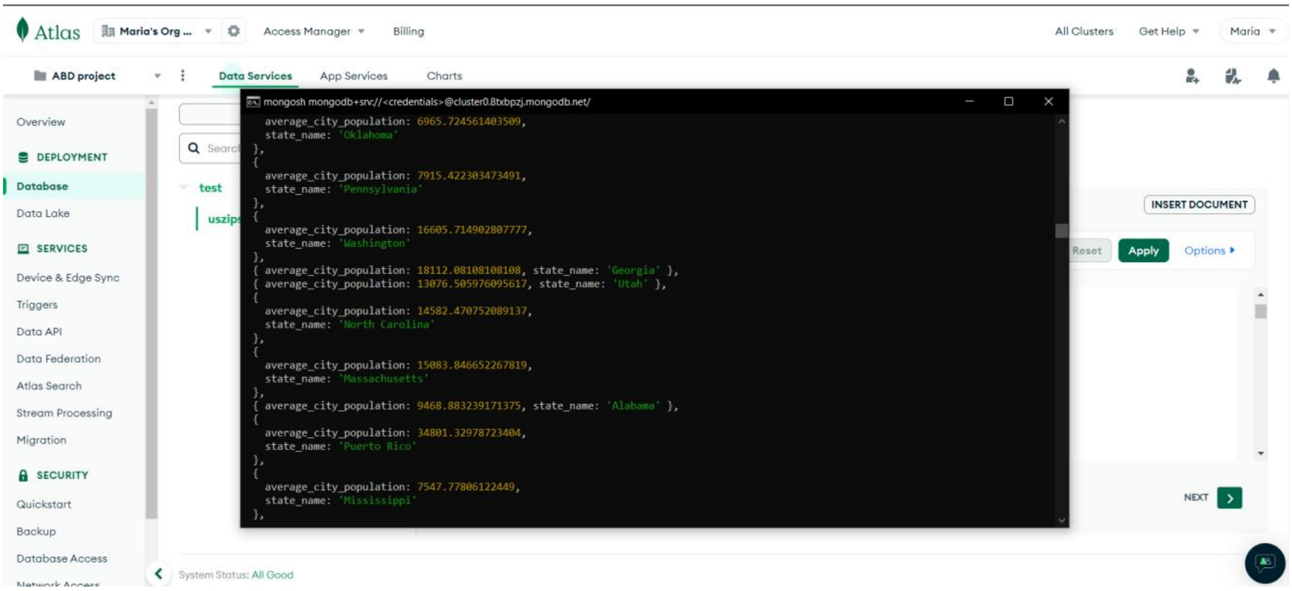
mongosh mongodb+srv://<credentials>@cluster0.8txbpzj.mongodb.net/

```
},
{ average_city_population: 9789.903318903318, state_name: 'Indiana' },
{
  average_city_population: 46321.627408993576,
  state_name: 'Florida'
},
{
  average_city_population: 10357.174107142857,
  state_name: 'Louisiana'
},
{
  average_city_population: 5231.996533795494,
  state_name: 'Arkansas'
},
{
  average_city_population: 14835.881748071979,
  state_name: 'Colorado'
},
{ average_city_population: 4712.313001605136, state_name: 'Kansas' },
{ average_city_population: 32342.614583333332, state_name: 'Nevada' },
{ average_city_population: 0, state_name: 'Guam' },
{ average_city_population: 0, state_name: 'American Samoa' },
{
  average_city_population: 27806.054263565893,
  state_name: 'Arizona'
},
{
  average_city_population: 17096.234750462107,
  state_name: 'New Jersey'
}
```



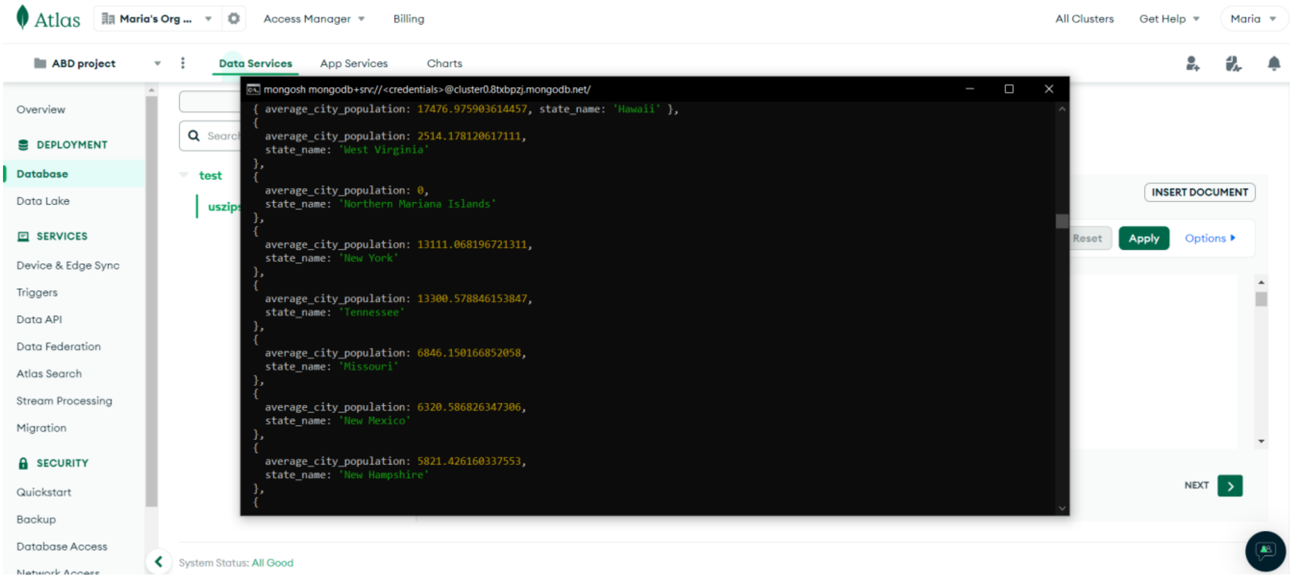
mongosh mongodb+srv://<credentials>@cluster0.8txbpzj.mongodb.net/

```
]
Type "it" for more
Atlas atlas-e5s5jg-shard-0 [primary] test> it
[
  {
    average_city_population: 11912.802486187846,
    state_name: 'Virginia'
  },
  {
    average_city_population: 6256.002773925104,
    state_name: 'Kentucky'
  },
  { average_city_population: 11635.062252964426, state_name: 'Ohio' },
  {
    average_city_population: 32988.113998323555,
    state_name: 'California'
  },
  {
    average_city_population: 2449.1184573002756,
    state_name: 'South Dakota'
  },
  { average_city_population: 3444.1868250539956, state_name: 'Iowa' },
  {
    average_city_population: 223529,
    state_name: 'District of Columbia'
  },
  { average_city_population: 0, state_name: 'Virgin Islands' },
  { average_city_population: 7270.113725490196, state_name: 'Idaho' },
  {
    average_city_population: 6965.724561403509,
```



mongosh mongodb+srv://<credentials>@cluster0.8txbpzj.mongodb.net/

```
    average_city_population: 6965.724561403509,
    state_name: 'Oklahoma'
  },
  {
    average_city_population: 7915.422303473491,
    state_name: 'Pennsylvania'
  },
  {
    average_city_population: 16605.714902807777,
    state_name: 'Washington'
  },
  { average_city_population: 18112.08108108108, state_name: 'Georgia' },
  { average_city_population: 13076.505976095617, state_name: 'Utah' },
  {
    average_city_population: 14582.470752089137,
    state_name: 'North Carolina'
  },
  {
    average_city_population: 15083.846652267819,
    state_name: 'Massachusetts'
  },
  { average_city_population: 9468.883239171375, state_name: 'Alabama' },
  {
    average_city_population: 34801.32978723404,
    state_name: 'Puerto Rico'
  },
  {
    average_city_population: 7547.77806122449,
    state_name: 'Mississippi'
  },
```

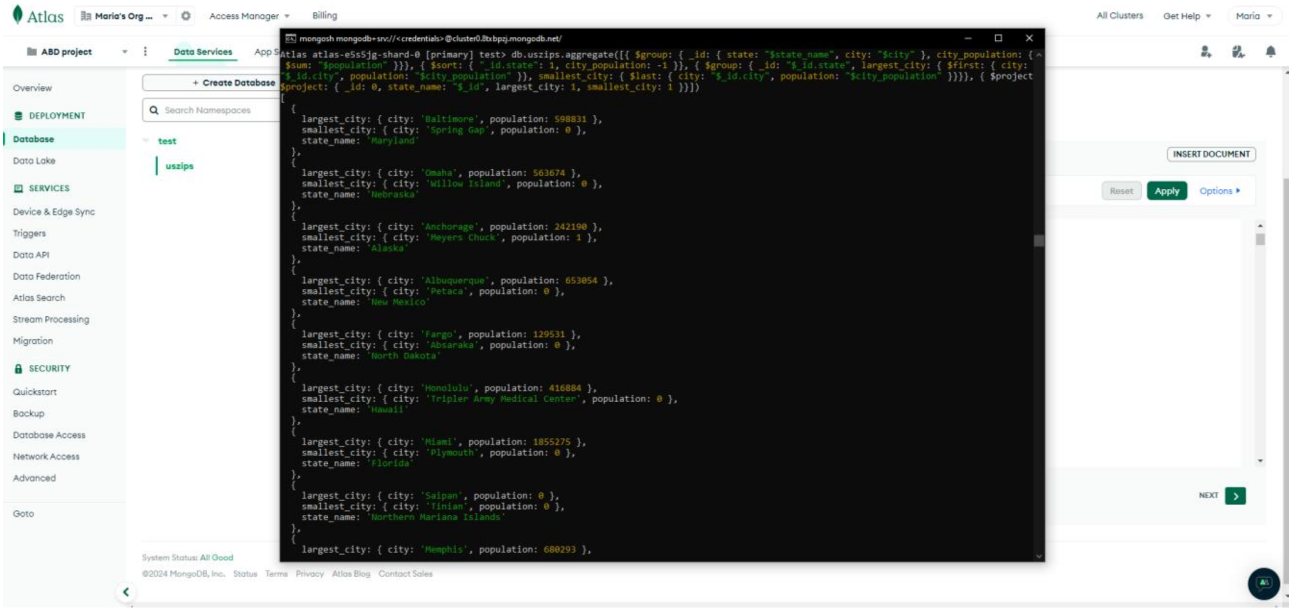


```
{ average_city_population: 17476.975903614457, state_name: 'Hawaii' },
{
  average_city_population: 2514.178120617111,
  state_name: 'West Virginia'
},
{
  average_city_population: 0,
  state_name: 'Northern Mariana Islands'
},
{
  average_city_population: 13111.068196721311,
  state_name: 'New York'
},
{
  average_city_population: 13300.578846153847,
  state_name: 'Tennessee'
},
{
  average_city_population: 6846.150166852058,
  state_name: 'Missouri'
},
{
  average_city_population: 6320.586826347306,
  state_name: 'New Mexico'
},
{
  average_city_population: 5821.426160337553,
  state_name: 'New Hampshire'
},
{
```

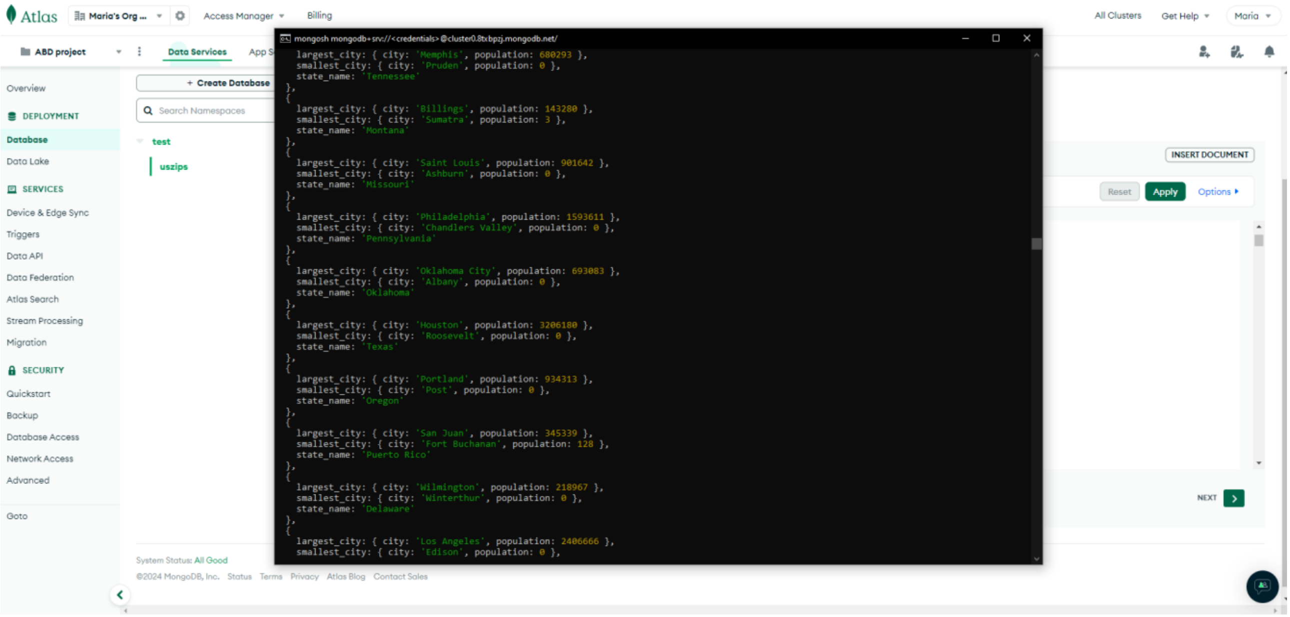
c) Obtineti cel mai mare si cel mai mic oras din fiecare stat

Am folosit comanda:

db.uszips.aggregate([{ $group: { _id: { state: "$state_name", city: "$city" }, city_population: { $sum: "$population" }}}, { $sort: { "_id.state": 1, city_population: -1 }}, { $group: { _id: "$_id.state", largest_city: { $first: { city: "$_id.city", population: "$city_population" }}, smallest_city: { $last: { city: "$_id.city", population: "$city_population" }}}}, { $project: { _id: 0, state_name: "$_id", largest_city: 1, smallest_city: 1 }}])



```
Atlas atlas-e5s5jg-shard-0 [primary] test> db.uszips.aggregate([{ $group: { _id: { state: "$state_name", city: "$city" }, city_population: {
 $sum: "$population" }}}, { $sort: { "_id.state": 1, city_population: -1 }}, { $group: { _id: "$_id.state", largest_city: { $first: { city:
"$_id.city", population: "$city_population" }}, smallest_city: { $last: { city: "$_id.city", population: "$city_population" }}}}, { $project
$project: { _id: 0, state_name: "$_id", largest_city: 1, smallest_city: 1 }}])
[
  {
    largest_city: { city: 'Baltimore', population: 598831 },
    smallest_city: { city: 'Spring Gap', population: 0 },
    state_name: 'Maryland'
  },
  {
    largest_city: { city: 'Omaha', population: 563674 },
    smallest_city: { city: 'Willow Island', population: 0 },
    state_name: 'Nebraska'
  },
  {
    largest_city: { city: 'Anchorage', population: 242190 },
    smallest_city: { city: 'Meyers Chuck', population: 1 },
    state_name: 'Alaska'
  },
  {
    largest_city: { city: 'Albuquerque', population: 653054 },
    smallest_city: { city: 'Petaca', population: 0 },
    state_name: 'New Mexico'
  },
  {
    largest_city: { city: 'Fargo', population: 129531 },
    smallest_city: { city: 'Absaraka', population: 0 },
    state_name: 'North Dakota'
  },
  {
    largest_city: { city: 'Honolulu', population: 416884 },
    smallest_city: { city: 'Tripler Army Medical Center', population: 0 },
    state_name: 'Hawaii'
  },
  {
    largest_city: { city: 'Miami', population: 1855275 },
    smallest_city: { city: 'Plymouth', population: 0 },
    state_name: 'Florida'
  },
  {
    largest_city: { city: 'Saipan', population: 0 },
    smallest_city: { city: 'Tinian', population: 0 },
    state_name: 'Northern Mariana Islands'
  },
  {
    largest_city: { city: 'Memphis', population: 680293 },
```

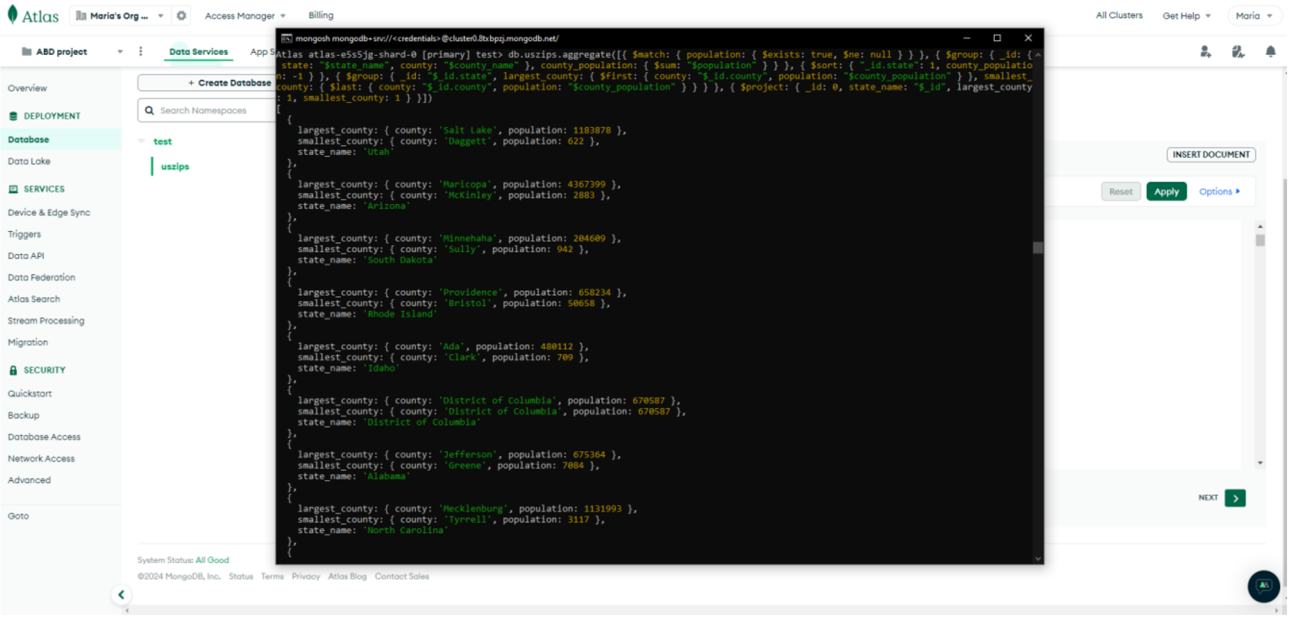


```
mongosh mongodb+srv://<credentials>@cluster0.8txbpzj.mongodb.net/
    largest_city: { city: 'Memphis', population: 680293 },
    smallest_city: { city: 'Pruden', population: 0 },
    state_name: 'Tennessee'
  },
  {
    largest_city: { city: 'Billings', population: 143280 },
    smallest_city: { city: 'Sumatra', population: 3 },
    state_name: 'Montana'
  },
  {
    largest_city: { city: 'Saint Louis', population: 901642 },
    smallest_city: { city: 'Ashburn', population: 0 },
    state_name: 'Missouri'
  },
  {
    largest_city: { city: 'Philadelphia', population: 1593611 },
    smallest_city: { city: 'Chandlers Valley', population: 0 },
    state_name: 'Pennsylvania'
  },
  {
    largest_city: { city: 'Oklahoma City', population: 693083 },
    smallest_city: { city: 'Albany', population: 0 },
    state_name: 'Oklahoma'
  },
  {
    largest_city: { city: 'Houston', population: 3206180 },
    smallest_city: { city: 'Roosevelt', population: 0 },
    state_name: 'Texas'
  },
  {
    largest_city: { city: 'Portland', population: 934313 },
    smallest_city: { city: 'Post', population: 0 },
    state_name: 'Oregon'
  },
  {
    largest_city: { city: 'San Juan', population: 345339 },
    smallest_city: { city: 'Fort Buchanan', population: 128 },
    state_name: 'Puerto Rico'
  },
  {
    largest_city: { city: 'Wilmington', population: 218967 },
    smallest_city: { city: 'Winterthur', population: 0 },
    state_name: 'Delaware'
  },
  {
    largest_city: { city: 'Los Angeles', population: 2406666 },
    smallest_city: { city: 'Edison', population: 0 },
```

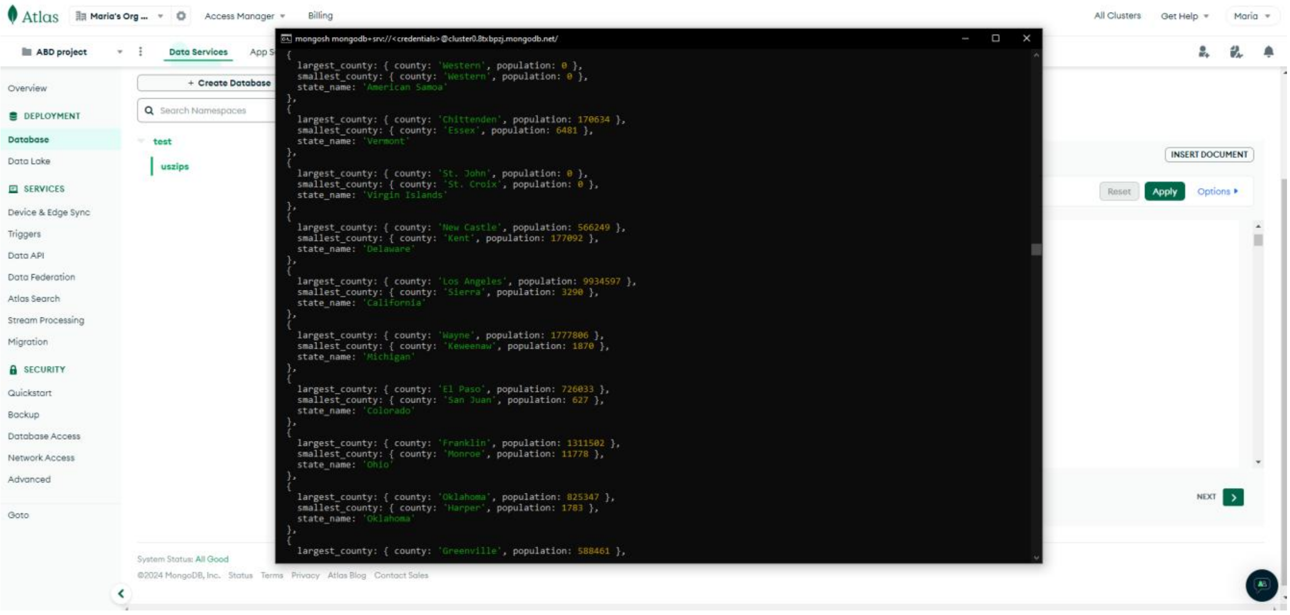
d) Obtineti cel mai mare si cel mai mic judet din fiecare stat

Am folosit comanda:

db.uszips.aggregate([{ $match: { population: { $exists: true, $ne: null } } }, { $group: { _id: { state: "$state_name", county: "$county_name" }, county_population: { $sum: "$population" } } }, { $sort: { "_id.state": 1, county_population: -1 } }, { $group: { _id: "$_id.state", largest_county: { $first: { county: "$_id.county", population: "$county_population" } }, smallest_county: { $last: { county: "$_id.county", population: "$county_population" } } } }, { $project: { _id: 0, state_name: "$_id", largest_county: 1, smallest_county: 1 } }])



```
mongosh mongodb+srv://<credentials>@cluster0.8txbpzj.mongodb.net/
Atlas atlas-e5s5jg-shard-0 [primary] test> db.uszips.aggregate([{ $match: { population: { $exists: true, $ne: null } } }, { $group: { _id: {
 state: "$state_name", county: "$county_name" }, county_population: { $sum: "$population" } } }, { $sort: { "_id.state": 1, county_populatio
n: -1 } }, { $group: { _id: "$_id.state", largest_county: { $first: { county: "$_id.county", population: "$county_population" } }, smallest_
county: { $last: { county: "$_id.county", population: "$county_population" } } } }, { $project: { _id: 0, state_name: "$_id", largest_county
: 1, smallest_county: 1 } }])
[
  {
    largest_county: { county: 'Salt Lake', population: 1183878 },
    smallest_county: { county: 'Daggett', population: 622 },
    state_name: 'Utah'
  },
  {
    largest_county: { county: 'Maricopa', population: 4367399 },
    smallest_county: { county: 'McKinley', population: 2883 },
    state_name: 'Arizona'
  },
  {
    largest_county: { county: 'Minnehaha', population: 204609 },
    smallest_county: { county: 'Sully', population: 942 },
    state_name: 'South Dakota'
  },
  {
    largest_county: { county: 'Providence', population: 658234 },
    smallest_county: { county: 'Bristol', population: 50658 },
    state_name: 'Rhode Island'
  },
  {
    largest_county: { county: 'Ada', population: 480112 },
    smallest_county: { county: 'Clark', population: 709 },
    state_name: 'Idaho'
  },
  {
    largest_county: { county: 'District of Columbia', population: 670587 },
    smallest_county: { county: 'District of Columbia', population: 670587 },
    state_name: 'District of Columbia'
  },
  {
    largest_county: { county: 'Jefferson', population: 675364 },
    smallest_county: { county: 'Greene', population: 7084 },
    state_name: 'Alabama'
  },
  {
    largest_county: { county: 'Mecklenburg', population: 1131993 },
    smallest_county: { county: 'Tyrrell', population: 3117 },
    state_name: 'North Carolina'
  },
  {
```



```
{
  largest_county: { county: 'Western', population: 0 },
  smallest_county: { county: 'Western', population: 0 },
  state_name: 'American Samoa'
},
{
  largest_county: { county: 'Chittenden', population: 170634 },
  smallest_county: { county: 'Essex', population: 6481 },
  state_name: 'Vermont'
},
{
  largest_county: { county: 'St. John', population: 0 },
  smallest_county: { county: 'St. Croix', population: 0 },
  state_name: 'Virgin Islands'
},
{
  largest_county: { county: 'New Castle', population: 566249 },
  smallest_county: { county: 'Kent', population: 177092 },
  state_name: 'Delaware'
},
{
  largest_county: { county: 'Los Angeles', population: 9934597 },
  smallest_county: { county: 'Sierra', population: 3290 },
  state_name: 'California'
},
{
  largest_county: { county: 'Wayne', population: 1777806 },
  smallest_county: { county: 'Keweenaw', population: 1870 },
  state_name: 'Michigan'
},
{
  largest_county: { county: 'El Paso', population: 726033 },
  smallest_county: { county: 'San Juan', population: 627 },
  state_name: 'Colorado'
},
{
  largest_county: { county: 'Franklin', population: 1311502 },
  smallest_county: { county: 'Monroe', population: 11778 },
  state_name: 'Ohio'
},
{
  largest_county: { county: 'Oklahoma', population: 825347 },
  smallest_county: { county: 'Harper', population: 1783 },
  state_name: 'Oklahoma'
},
{
  largest_county: { county: 'Greenville', population: 588461 },
```

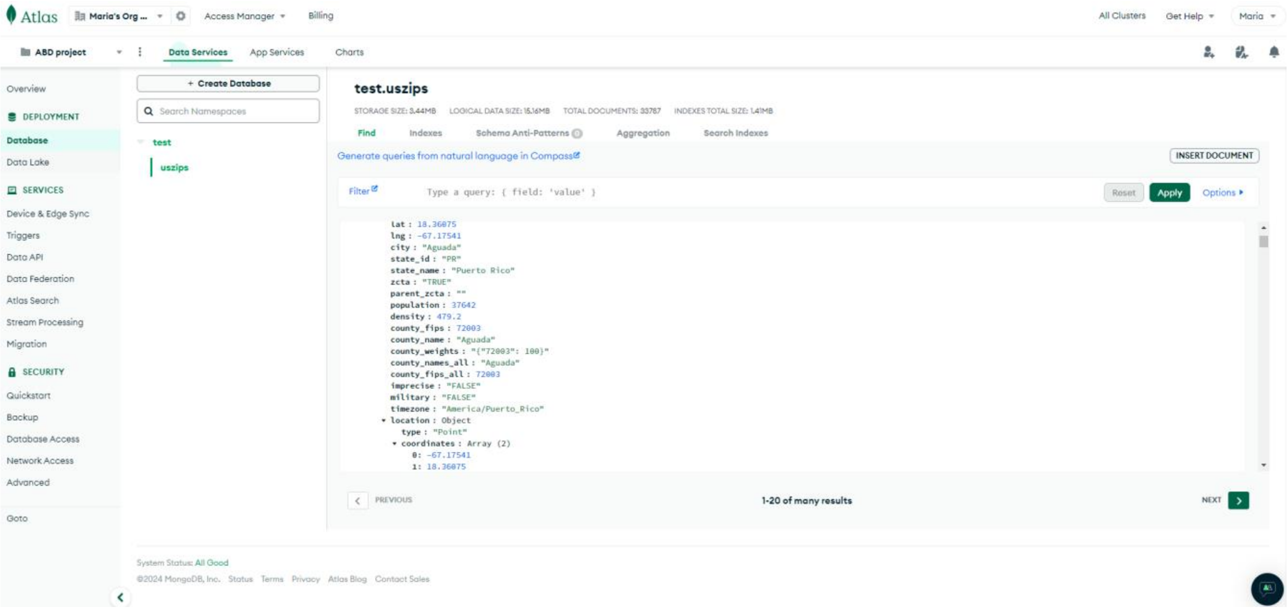
e) Obtineti cele mai apropiate 10 zip-uri de la unul dintre reperele din Chicago, Turnul Willis, situat la coordonatele 41.878876, -87.635918

Pentru a putea folosi capabilitatile geospatiale puse la dispozitie de MongoDB, am adaugat o noua proprietate GeoJSON pentru fiecare document, de forma: "location": { "type": "Point", "coordinates": [-87.6375, 41.8822] }

Am obtinut acest lucru folosind comanda:

db.uszips.updateMany({}, [{ $set: { location: { type: "Point", coordinates: ["$lng", "$lat"] } } }])

Dupa modificari, documentele vor avea urmatoarea forma:



test.uszips

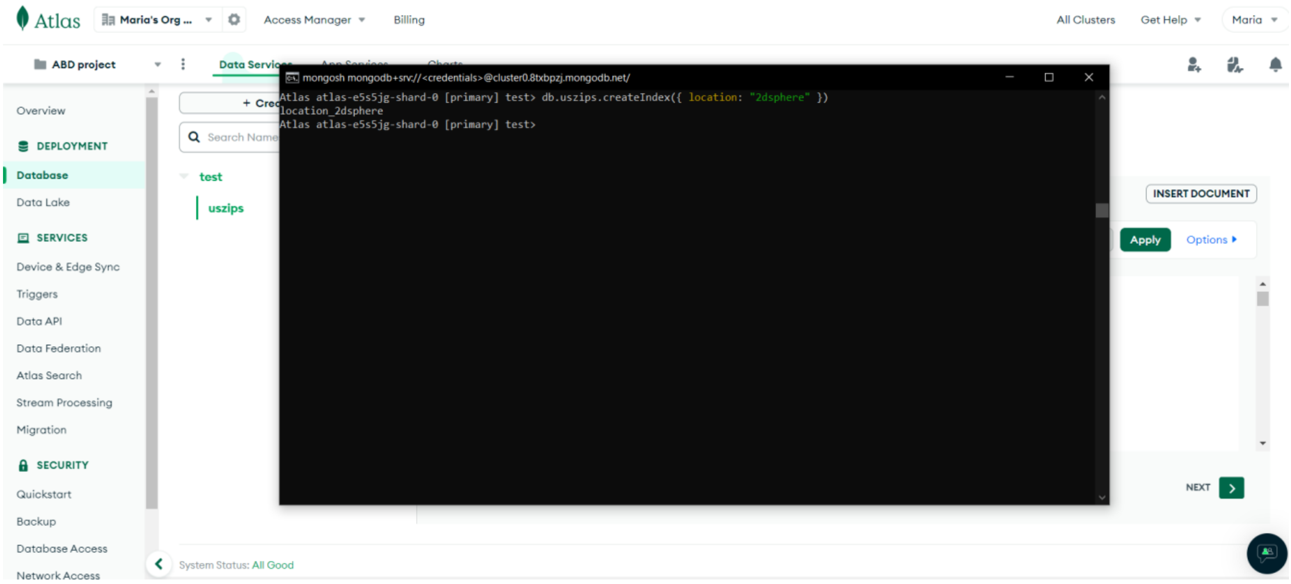
STORAGE SIZE: 3.44MB LOGICAL DATA SIZE: 15.16MB TOTAL DOCUMENTS: 33787 INDEXES TOTAL SIZE: 1.41MB

```
    lat : 18.36075
    lng : -67.17541
    city : "Aguada"
    state_id : "PR"
    state_name : "Puerto Rico"
    zcta : "TRUE"
    parent_zcta : ""
    population : 37642
    density : 479.2
    county_fips : 72003
    county_name : "Aguada"
    county_weights : "{"72003": 100}"
    county_names_all : "Aguada"
    county_fips_all : 72003
    imprecise : "FALSE"
    military : "FALSE"
    timezone : "America/Puerto_Rico"
  ▾ location : Object
      type : "Point"
    ▾ coordinates : Array (2)
        0: -67.17541
        1: 18.36075
```

1-20 of many results

Pentru a cauta cele mai apropiate coduri postale de coordonatele turnului Wiilis, trebuie sa creem un index pentru noua proprietate creata „location”.

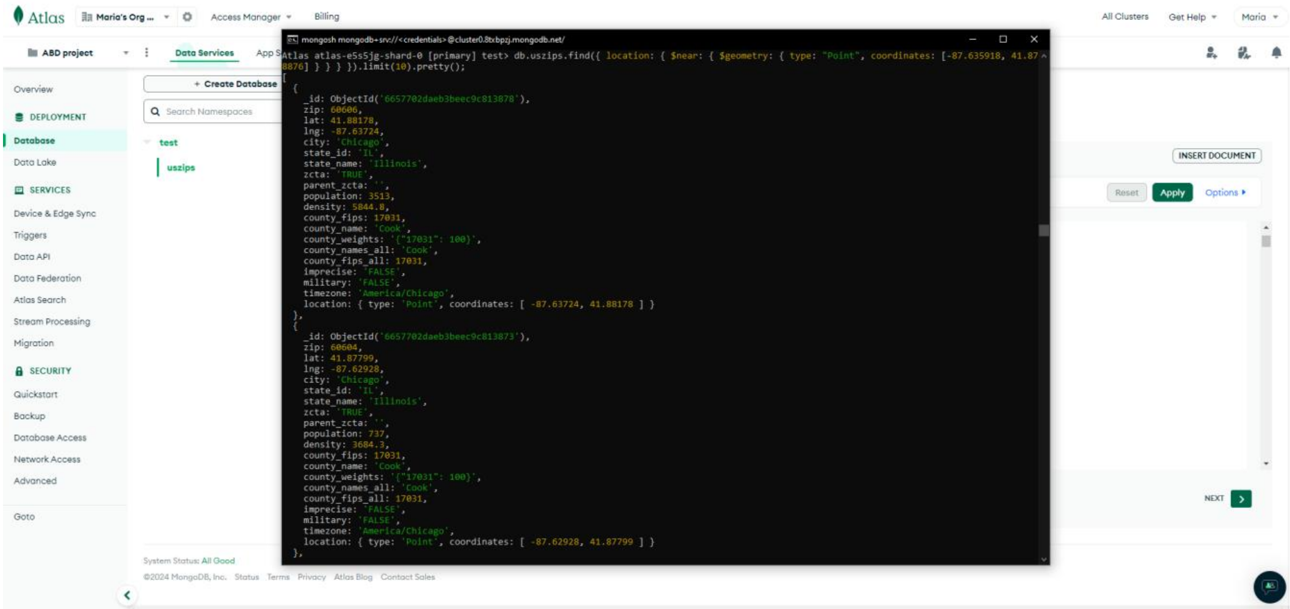
db.uszips.createIndex({ location: "2dsphere" })



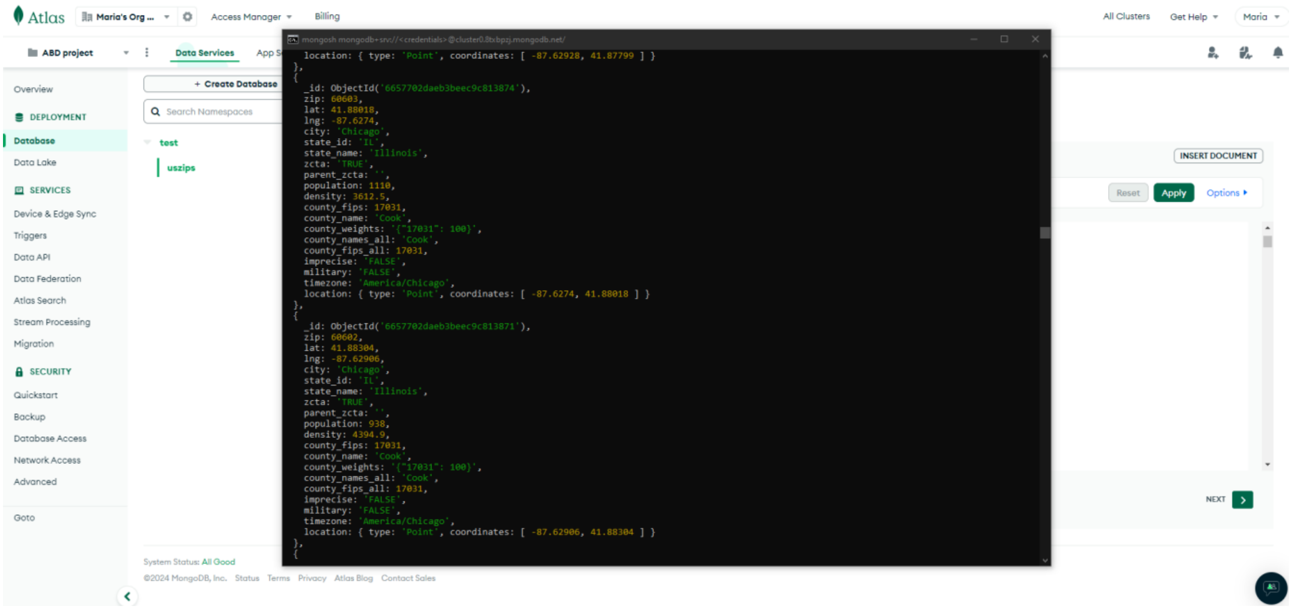
```
mongosh mongodb+srv://<credentials>@cluster0.8txbpzj.mongodb.net/
Atlas atlas-e5s5jg-shard-0 [primary] test> db.uszips.createIndex({ location: "2dsphere" })
location_2dsphere
Atlas atlas-e5s5jg-shard-0 [primary] test>
```

In continuare am utilizat operatorul $near pentru a gasi cele 10 documente necesare, folosind comanda:

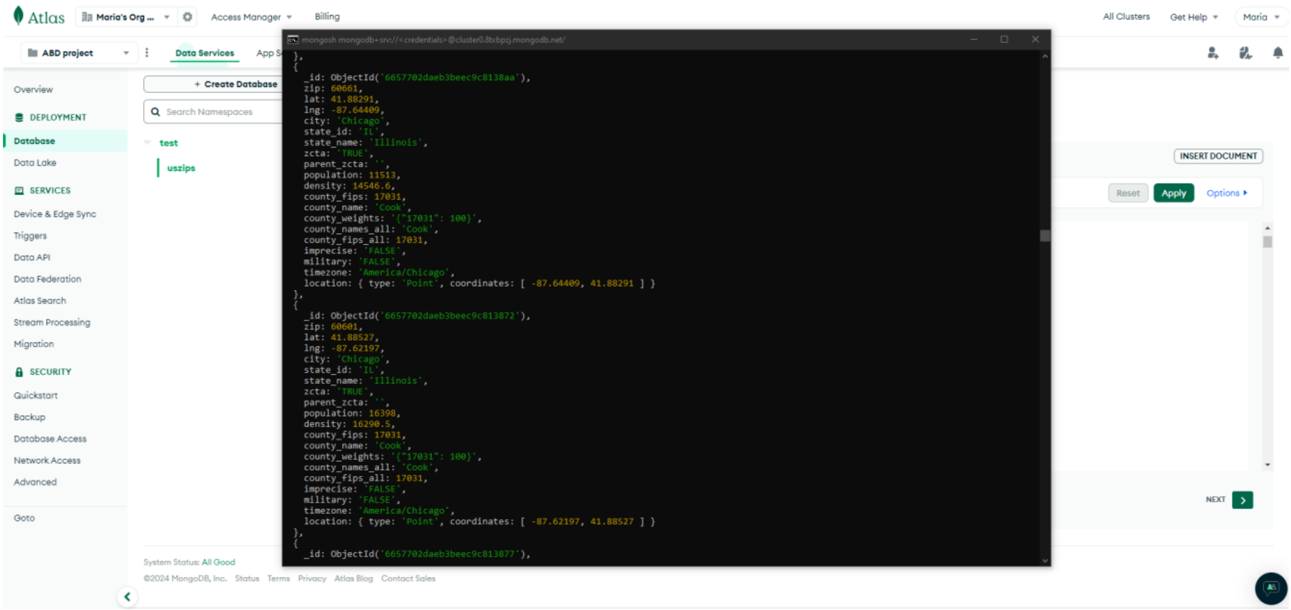
db.uszips.find({ location: { $near: { $geometry: { type: "Point", coordinates: [-87.635918, 41.878876] } } } }).limit(10).pretty()



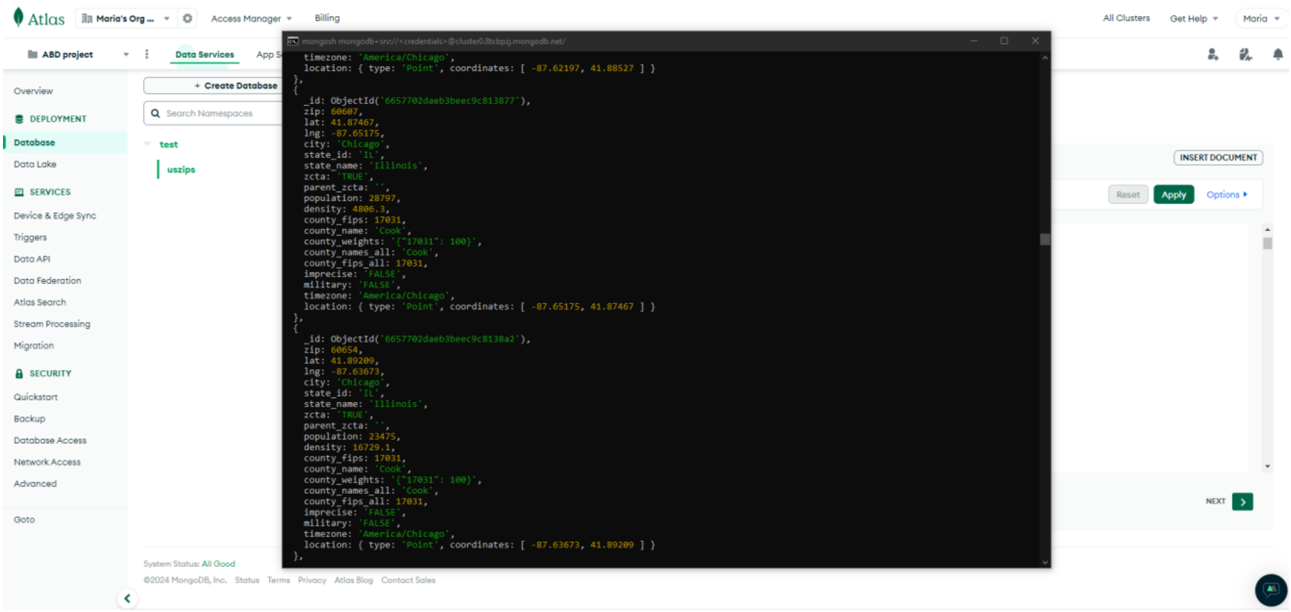
```
mongosh mongodb+srv://<credentials>@cluster0.8txbpzj.mongodb.net/
Atlas atlas-e5s5jg-shard-0 [primary] test> db.uszips.find({ location: { $near: { $geometry: { type: "Point", coordinates: [-87.635918, 41.87
8876] } } } }).limit(10).pretty();
[
  {
    _id: ObjectId('6657702daeb3beec9c813878'),
    zip: 60606,
    lat: 41.88178,
    lng: -87.63724,
    city: 'Chicago',
    state_id: 'IL',
    state_name: 'Illinois',
    zcta: 'TRUE',
    parent_zcta: '',
    population: 3513,
    density: 5844.8,
    county_fips: 17031,
    county_name: 'Cook',
    county_weights: '{"17031": 100}',
    county_names_all: 'Cook',
    county_fips_all: 17031,
    imprecise: 'FALSE',
    military: 'FALSE',
    timezone: 'America/Chicago',
    location: { type: 'Point', coordinates: [ -87.63724, 41.88178 ] }
  },
  {
    _id: ObjectId('6657702daeb3beec9c813873'),
    zip: 60604,
    lat: 41.87799,
    lng: -87.62928,
    city: 'Chicago',
    state_id: 'IL',
    state_name: 'Illinois',
    zcta: 'TRUE',
    parent_zcta: '',
    population: 737,
    density: 3684.3,
    county_fips: 17031,
    county_name: 'Cook',
    county_weights: '{"17031": 100}',
    county_names_all: 'Cook',
    county_fips_all: 17031,
    imprecise: 'FALSE',
    military: 'FALSE',
    timezone: 'America/Chicago',
    location: { type: 'Point', coordinates: [ -87.62928, 41.87799 ] }
  },
```



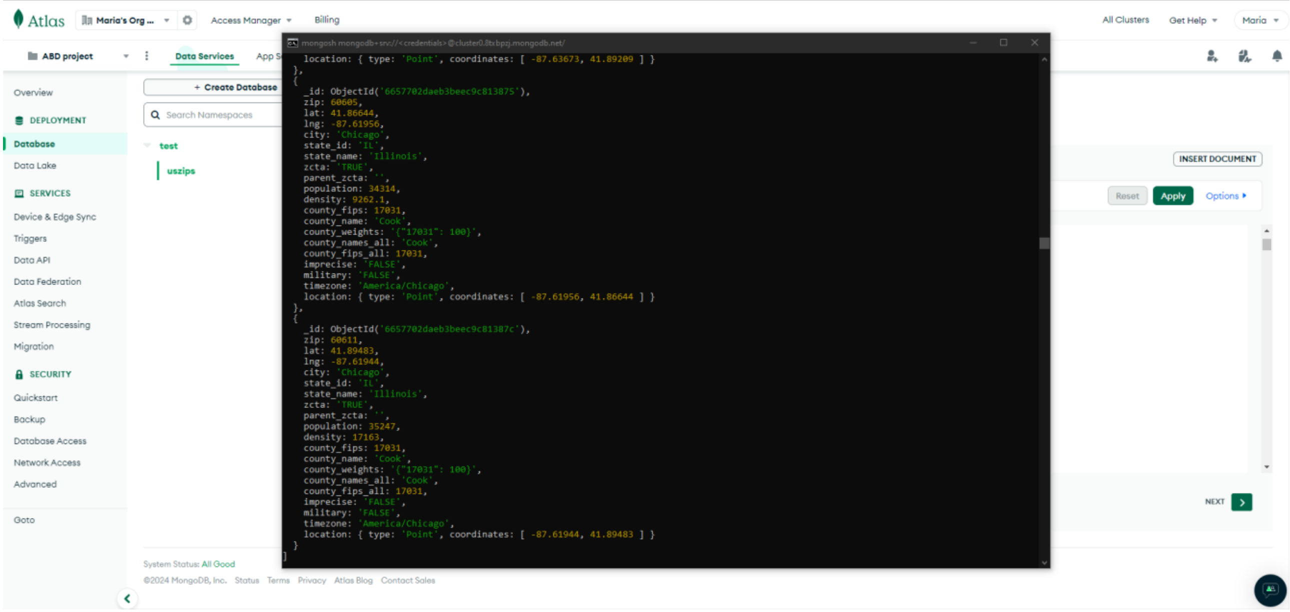
```
    location: { type: 'Point', coordinates: [ -87.62928, 41.87799 ] }
  },
  {
    _id: ObjectId('6657702daeb3beec9c813874'),
    zip: 60603,
    lat: 41.88018,
    lng: -87.6274,
    city: 'Chicago',
    state_id: 'IL',
    state_name: 'Illinois',
    zcta: 'TRUE',
    parent_zcta: '',
    population: 1110,
    density: 3612.5,
    county_fips: 17031,
    county_name: 'Cook',
    county_weights: '{"17031": 100}',
    county_names_all: 'Cook',
    county_fips_all: 17031,
    imprecise: 'FALSE',
    military: 'FALSE',
    timezone: 'America/Chicago',
    location: { type: 'Point', coordinates: [ -87.6274, 41.88018 ] }
  },
  {
    _id: ObjectId('6657702daeb3beec9c813871'),
    zip: 60602,
    lat: 41.88304,
    lng: -87.62906,
    city: 'Chicago',
    state_id: 'IL',
    state_name: 'Illinois',
    zcta: 'TRUE',
    parent_zcta: '',
    population: 938,
    density: 4394.9,
    county_fips: 17031,
    county_name: 'Cook',
    county_weights: '{"17031": 100}',
    county_names_all: 'Cook',
    county_fips_all: 17031,
    imprecise: 'FALSE',
    military: 'FALSE',
    timezone: 'America/Chicago',
    location: { type: 'Point', coordinates: [ -87.62906, 41.88304 ] }
  },
  {
```



```
  },
  {
    _id: ObjectId('6657702daeb3beec9c8138aa'),
    zip: 60661,
    lat: 41.88291,
    lng: -87.64409,
    city: 'Chicago',
    state_id: 'IL',
    state_name: 'Illinois',
    zcta: 'TRUE',
    parent_zcta: '',
    population: 11513,
    density: 14546.6,
    county_fips: 17031,
    county_name: 'Cook',
    county_weights: '{"17031": 100}',
    county_names_all: 'Cook',
    county_fips_all: 17031,
    imprecise: 'FALSE',
    military: 'FALSE',
    timezone: 'America/Chicago',
    location: { type: 'Point', coordinates: [ -87.64409, 41.88291 ] }
  },
  {
    _id: ObjectId('6657702daeb3beec9c813872'),
    zip: 60601,
    lat: 41.88527,
    lng: -87.62197,
    city: 'Chicago',
    state_id: 'IL',
    state_name: 'Illinois',
    zcta: 'TRUE',
    parent_zcta: '',
    population: 16398,
    density: 16290.5,
    county_fips: 17031,
    county_name: 'Cook',
    county_weights: '{"17031": 100}',
    county_names_all: 'Cook',
    county_fips_all: 17031,
    imprecise: 'FALSE',
    military: 'FALSE',
    timezone: 'America/Chicago',
    location: { type: 'Point', coordinates: [ -87.62197, 41.88527 ] }
  },
  {
    _id: ObjectId('6657702daeb3beec9c813877'),
```



```
    timezone: 'America/Chicago',
    location: { type: 'Point', coordinates: [ -87.62197, 41.88527 ] }
  },
  {
    _id: ObjectId('6657702daeb3beec9c813877'),
    zip: 60607,
    lat: 41.87467,
    lng: -87.65175,
    city: 'Chicago',
    state_id: 'IL',
    state_name: 'Illinois',
    zcta: 'TRUE',
    parent_zcta: '',
    population: 28797,
    density: 4806.3,
    county_fips: 17031,
    county_name: 'Cook',
    county_weights: '{"17031": 100}',
    county_names_all: 'Cook',
    county_fips_all: 17031,
    imprecise: 'FALSE',
    military: 'FALSE',
    timezone: 'America/Chicago',
    location: { type: 'Point', coordinates: [ -87.65175, 41.87467 ] }
  },
  {
    _id: ObjectId('6657702daeb3beec9c8138a2'),
    zip: 60654,
    lat: 41.89209,
    lng: -87.63673,
    city: 'Chicago',
    state_id: 'IL',
    state_name: 'Illinois',
    zcta: 'TRUE',
    parent_zcta: '',
    population: 23475,
    density: 16729.1,
    county_fips: 17031,
    county_name: 'Cook',
    county_weights: '{"17031": 100}',
    county_names_all: 'Cook',
    county_fips_all: 17031,
    imprecise: 'FALSE',
    military: 'FALSE',
    timezone: 'America/Chicago',
    location: { type: 'Point', coordinates: [ -87.63673, 41.89209 ] }
  },
```



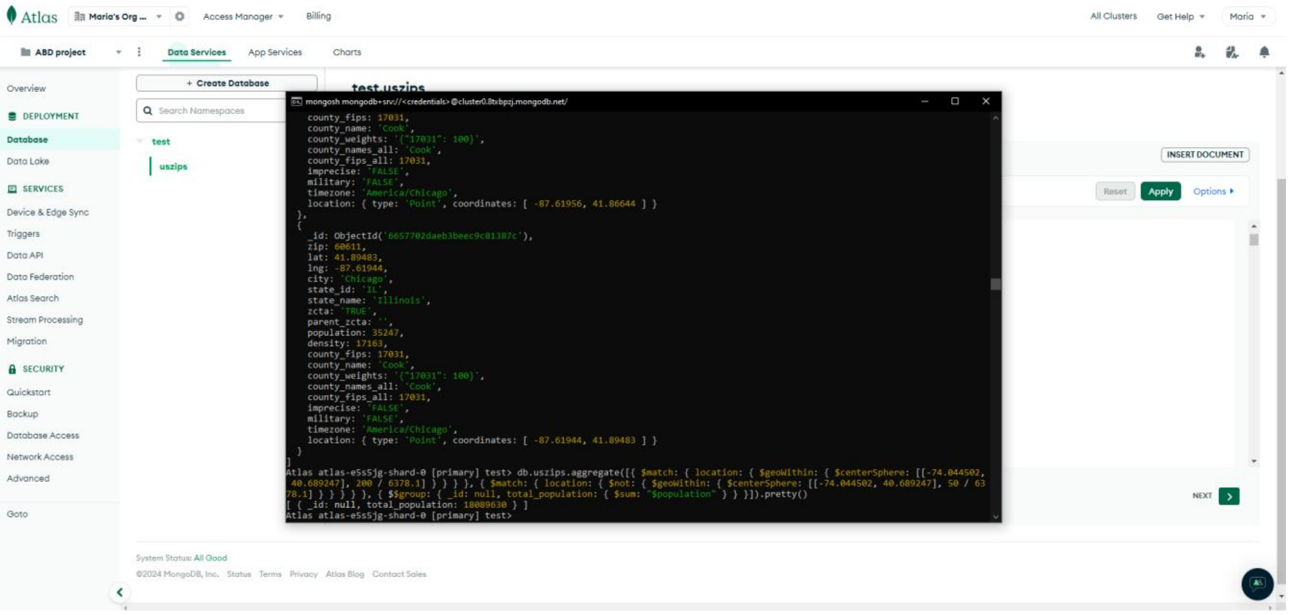
```
mongosh mongodb+srv://<credentials>@cluster0.8txbpzj.mongodb.net/
    location: { type: 'Point', coordinates: [ -87.63673, 41.89209 ] }
  },
  {
    _id: ObjectId('6657702daeb3beec9c813875'),
    zip: 60605,
    lat: 41.86644,
    lng: -87.61956,
    city: 'Chicago',
    state_id: 'IL',
    state_name: 'Illinois',
    zcta: 'TRUE',
    parent_zcta: '',
    population: 34314,
    density: 9262.1,
    county_fips: 17031,
    county_name: 'Cook',
    county_weights: '{"17031": 100}',
    county_names_all: 'Cook',
    county_fips_all: 17031,
    imprecise: 'FALSE',
    military: 'FALSE',
    timezone: 'America/Chicago',
    location: { type: 'Point', coordinates: [ -87.61956, 41.86644 ] }
  },
  {
    _id: ObjectId('6657702daeb3beec9c81387c'),
    zip: 60611,
    lat: 41.89483,
    lng: -87.61944,
    city: 'Chicago',
    state_id: 'IL',
    state_name: 'Illinois',
    zcta: 'TRUE',
    parent_zcta: '',
    population: 35247,
    density: 17163,
    county_fips: 17031,
    county_name: 'Cook',
    county_weights: '{"17031": 100}',
    county_names_all: 'Cook',
    county_fips_all: 17031,
    imprecise: 'FALSE',
    military: 'FALSE',
    timezone: 'America/Chicago',
    location: { type: 'Point', coordinates: [ -87.61944, 41.89483 ] }
  }
]
```

f) Obtineti populatia totala situata intre 50 si 200 km in jurul reperului din New York, Statuia Libertatii, la coordonatele 40.689247, -74.044502

Operatorul $geoWithin obtine documentele care se afla in interiorul unei forme geospatiale, in acest caz forma este definita de o sfera. Aceasta se obtine folosind $centerSphere, care defineste o sfera bazata pe coordonatele centrului si raza. Raza este in radiani, asa ca am impartit distanta (200km) la raza Pamantului (~6378.1 km).

Am folosit comanda:

db.uszips.aggregate([{ $match: { location: { $geoWithin: { $centerSphere: [[-74.044502, 40.689247], 200 / 6378.1] } } } }, { $match: { location: { $not: { $geoWithin: { $centerSphere: [[-74.044502, 40.689247], 50 / 6378.1] } } } } }, { $group: { _id: null, total_population: { $sum: "$population" } } }]).pretty()



```
mongosh mongodb+srv://<credentials>@cluster0.8txbpzj.mongodb.net/
    county_fips: 17031,
    county_name: 'Cook',
    county_weights: '{"17031": 100}',
    county_names_all: 'Cook',
    county_fips_all: 17031,
    imprecise: 'FALSE',
    military: 'FALSE',
    timezone: 'America/Chicago',
    location: { type: 'Point', coordinates: [ -87.61956, 41.86644 ] }
  },
  {
    _id: ObjectId('6657702daeb3beec9c81387c'),
    zip: 60611,
    lat: 41.89483,
    lng: -87.61944,
    city: 'Chicago',
    state_id: 'IL',
    state_name: 'Illinois',
    zcta: 'TRUE',
    parent_zcta: '',
    population: 35247,
    density: 17163,
    county_fips: 17031,
    county_name: 'Cook',
    county_weights: '{"17031": 100}',
    county_names_all: 'Cook',
    county_fips_all: 17031,
    imprecise: 'FALSE',
    military: 'FALSE',
    timezone: 'America/Chicago',
    location: { type: 'Point', coordinates: [ -87.61944, 41.89483 ] }
  }
]
Atlas atlas-e5s5jg-shard-0 [primary] test> db.uszips.aggregate([{ $match: { location: { $geoWithin: { $centerSphere: [[-74.044502,
 40.689247], 200 / 6378.1] } } } }, { $match: { location: { $not: { $geoWithin: { $centerSphere: [[-74.044502, 40.689247], 50 / 63
78.1] } } } } }, { $$group: { _id: null, total_population: { $sum: "$population" } } }]).pretty()
[ { _id: null, total_population: 18089630 } ]
Atlas atlas-e5s5jg-shard-0 [primary] test>
```