San Jose OpenStreetMap Project using MongoDB

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Introduction

In this project, I choose San Jose, California, US as the target area (https://www.openstreetmap.org/relation/112143) and perform data wrangling on unstructured map data in XML files downloaded directly from the web. Map information in the database is systematically investigated and a few interesting facts are discovered during the investigation.

Part 1: Challenges in the Map Data

a) **Unexpected tags**

I employed mapparser.py to count occurrences of each tag, with a result:

- bounds: 1
- member: 6468
- nd: 944840
- node: 801525
- osm: 1
- relation: 662
- tag: 468411
- way: 100334

There are additional functionality added to mapparser.py to examine the keys stored in each tag child-element of 'node' and 'way', in the k attribute. Unexpectedly, I found the tag keys 'type' and 'address':

('type', 29), ('address', 4)

Compared to the total number of node and way, the tag key 'type' and 'address' appeared quite fewer. Since these 2 tag keys conflict with the keys I am about to use in the dataset, I will remit these 2 tags from populating into the database.

b) Duplicated Zip Codes

Zip codes are commonly used search criteria. For node, zip code was presented in tag 'addr:postcode'; For way, zip codes were presented in the data under various permutations of tiger:zip_left, tiger:zip_right. The zip_left and right are for the left and right side of the road, if you are driving along it in the direction of the way.

For node zip code, there are several formats: '95037-4209', 'CA 94035', '95070', 'CA 94088-3453'. To clean the data, I decide to use 5-digit zip code as a standard rule, which requires stripping all leading and trailing characters before and after the main 5-digit zip code. After cleaning, the postcode will be stored in node[‘address’][‘postcode’].

For way zip code, tiger:zip_left and tiger:zip_right are defined as semicolon delimited lists or colon delimited ranges, like: '94538; 95035', '94085', '94538:95035'. Since way usually contains more than one zip code, I thought that it would be a good idea to collect and serialize all zipcodes from sources into a single array, and populate this into the base of the node under zipcodes, or node[‘zipcodes’].

c) Inconsistent Format of Phone Numbers

Phone numbers were formatted inconsistently. For example,

'+1 408-782-8201'

+1 (408) 376-3516'

'+1 408 739 7717'

'+ 408 980 6400'

'4084507990'

'+1.408.559.6900'

'(408) 277-4625'

u'+1 408-500-3000 \u200e'

I used the Python module phonenumbers to parse all phone numbers and re-format them to the standard (123) 456-7890. However, for '+ 408 980 6400’, I cannot use phonenumbers module to re-format it. So I’ll use python regular expression to find this kind of phone number and re-format it.

In addition, there are 2 tag keys for phone number: ‘phone’ and ‘contact:phone’. As part of the cleaning process, I’ll store all phone numbers in ‘phone’ key in the dataset.

d) Abbreviated Street Names

I employed audit.py to look for street name abbreviations. I updated all substrings in problematic address strings, such that “1425 E Dunne Ave” becomes “1425 E Dunne Avenue”.

Part 2: Data Overview

This section contains basic statistics about the dataset and the MongoDB queries used to gather them.

File sizes:

- san-jose_california.osm: 173 MB
- san-jose_california.osm.json: 198 MB

Number of documents:

```
> db.sanjose.count()
901859
```

Number of nodes and ways:

```
> db.sanjose.find({'type':'node'}).count()
801525
> db.sanjose.find({'type':'way'}).count()
100334
```

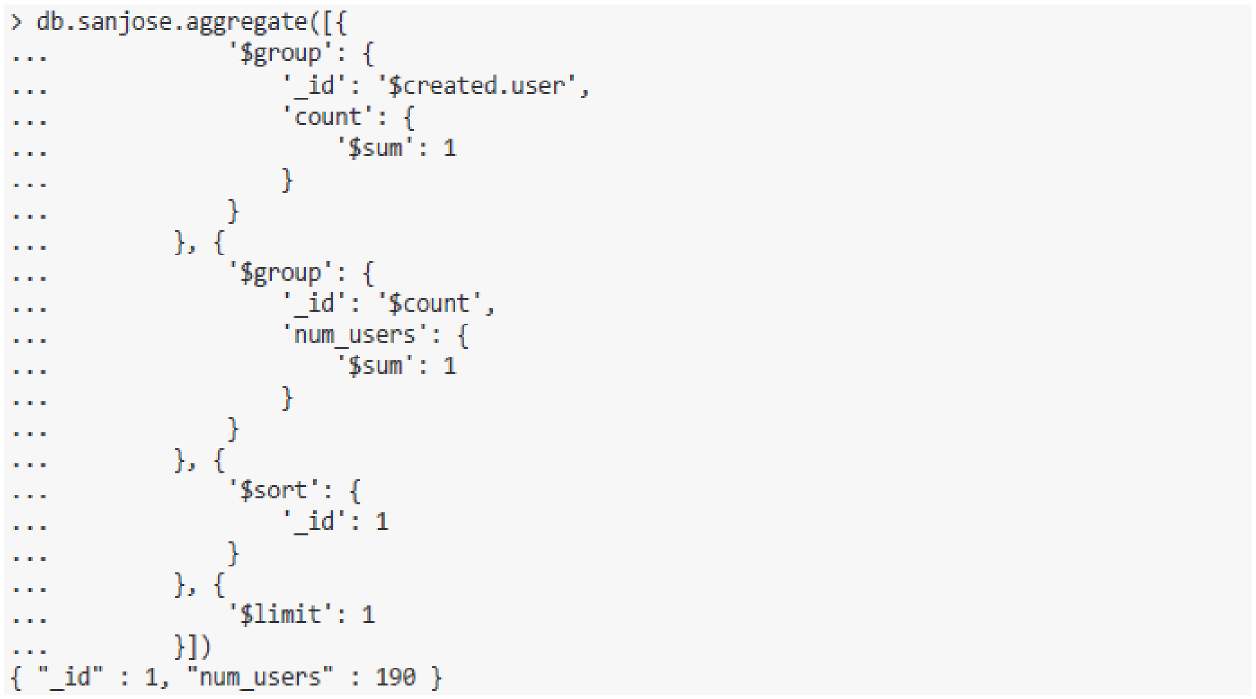
Number of unique users:

```
db.sanjose.distinct("created.user").length
955
```

Top Contributing user:

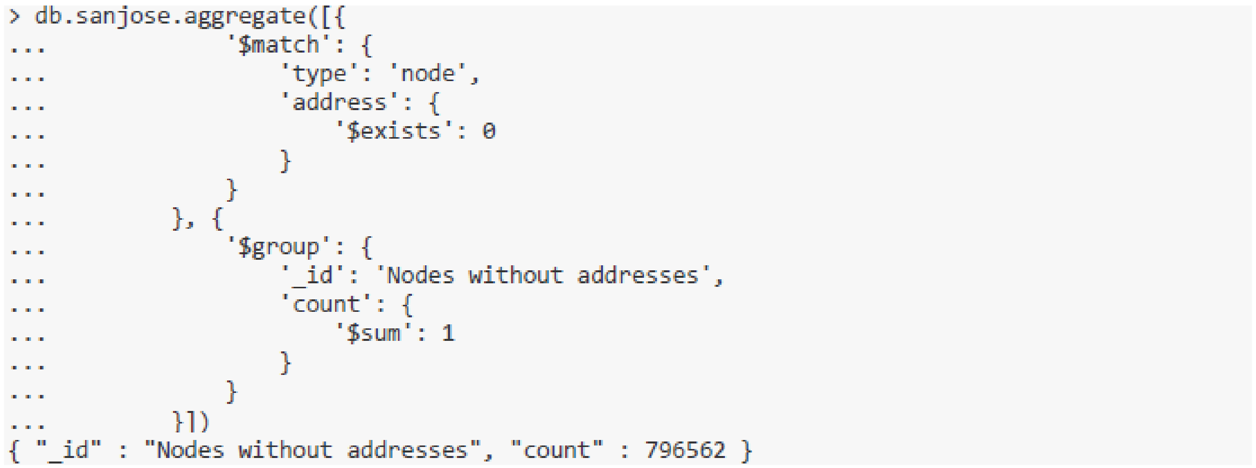
```
> db.sanjose.aggregate([{
...             '$group': {
...                 '_id': '$created.user',
...                 'count': {
...                     '$sum': 1
...                 }
...             }
...         }, {
...             '$sort': {
...                 'count': -1
...             }
...         }, {
...             '$limit': 1
...         }])
{ "_id" : "nmixter", "count" : 207683 }
```

Number of users contributing only once:



```
> db.sanjose.aggregate([{
...             '$group': {
...                 '_id': '$created.user',
...                 'count': {
...                     '$sum': 1
...                 }
...             }
...         }, {
...             '$group': {
...                 '_id': '$count',
...                 'num_users': {
...                     '$sum': 1
...                 }
...             }
...         }, {
...             '$sort': {
...                 '_id': 1
...             }
...         }, {
...             '$limit': 1
...         }])
{ "_id" : 1, "num_users" : 190 }
```

Nodes without address:



```
> db.sanjose.aggregate([{
...             '$match': {
...                 'type': 'node',
...                 'address': {
...                     '$exists': 0
...                 }
...             }
...         }, {
...             '$group': {
...                 '_id': 'Nodes without addresses',
...                 'count': {
...                     '$sum': 1
...                 }
...             }
...         }])
{ "_id" : "Nodes without addresses", "count" : 796562 }
```

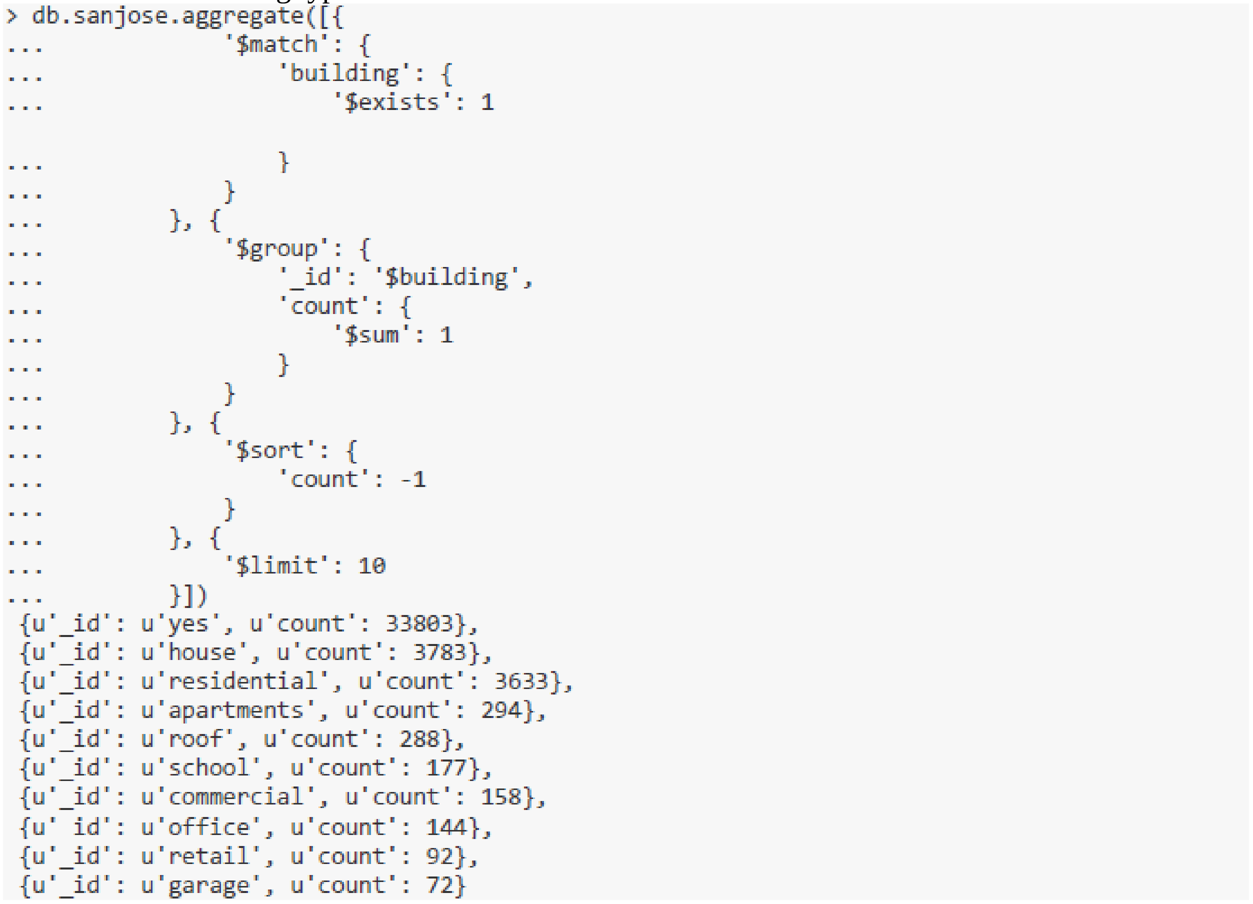
Popular cuisines in San Jose:

```
db.sanjose.aggregate([{
...              '$match': {
...                  'cuisine': {
...                      '$exists': 1
...                  },
                      'amenity':'restaurant'
...              }
...          }, {
...              '$group': {
...                  '_id': '$cuisine',
                     'count': {
...                      '$sum': 1
...                  }
...              }
...          }, {
...              '$sort': {
...                  'count': -1
...              }
...          }, {
...              '$limit': 3
...          }])
 {u'_id': u'mexican', u'count': 67},
 {u'_id': u'chinese', u'count': 58},
 {u'_id': u'pizza', u'count': 43},
```

Zip codes in San Jose:

```
db.sanjose.aggregate([{
...              '$match': {
...                  'zipcodes': {
...                      '$exists': 1
...                  }
...              }
...          }, {
...              '$unwind': '$zipcodes'
...          }, {
...              '$group': {
...                  '_id': '$zipcodes'
...              }
...          }, {
...              '$group': {
...                  '_id': 'Zip Codes in San Jose',
...                  'count': {
...                      '$sum': 1
...                  },
...                  'zipcodes': {
...                      '$push': '$_id'
...                  },
...              }
...          }])
{ "_id" : "Zip Codes in San Jose", "count" : 1108, "zipcodes": [ "94041",
... # truncated
"94770", "94466", "94100", "94955", "94615"] }
```

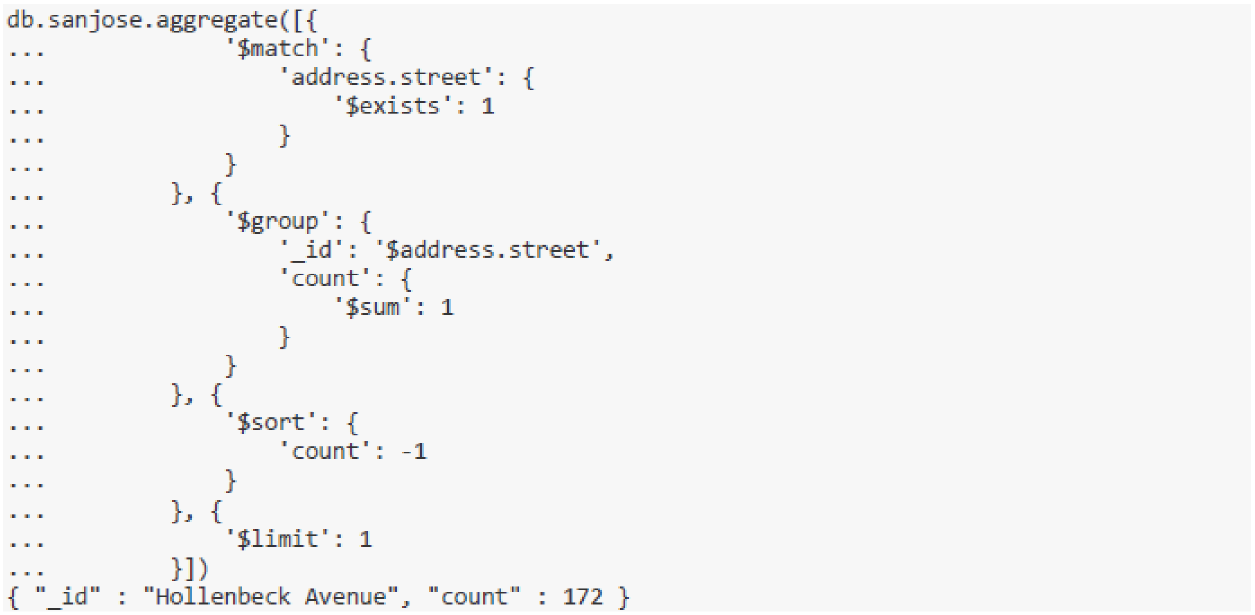
Most common building types/entries:



```
> db.sanjose.aggregate([{
...             '$match': {
...                 'building': {
...                     '$exists': 1

...                 }
...             }
...         }, {
...             '$group': {
...                 '_id': '$building',
...                 'count': {
...                     '$sum': 1
...                 }
...             }
...         }, {
...             '$sort': {
...                 'count': -1
...             }
...         }, {
...             '$limit': 10
...         }])
 {u'_id': u'yes', u'count': 33803},
 {u'_id': u'house', u'count': 3783},
 {u'_id': u'residential', u'count': 3633},
 {u'_id': u'apartments', u'count': 294},
 {u'_id': u'roof', u'count': 288},
 {u'_id': u'school', u'count': 177},
 {u'_id': u'commercial', u'count': 158},
 {u'_id': u'office', u'count': 144},
 {u'_id': u'retail', u'count': 92},
 {u'_id': u'garage', u'count': 72}
```

Most common street address:



```
db.sanjose.aggregate([{
...             '$match': {
...                 'address.street': {
...                     '$exists': 1
...                 }
...             }
...         }, {
...             '$group': {
...                 '_id': '$address.street',
...                 'count': {
...                     '$sum': 1
...                 }
...             }
...         }, {
...             '$sort': {
...                 'count': -1
...             }
...         }, {
...             '$limit': 1
...         }])
{ "_id" : "Hollenbeck Avenue", "count" : 172 }
```

Part 3: Conclusions

After performing data queries using MongoDB, I systematically checked map information in the database. There are in total 801,525 nodes and 100,334 ways included in the database provided by 955 unique users. There are a few interesting facts which were discovered during the query journey: the most popular cuisine in San Jose area is Mexican food followed by Chinese food; the zip code ‘94041’ is contained in the most entries; apartment is the most common building type in the area; ‘Hollenbeck Avenue’ is the most popular street name.