OpenStreetMap Project Data Wrangling with SQL

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1. Problems encountered in the map

In this study, I first group node tag keys into four tag categories in a dictionary:

- "lower", for tags that contain only lowercase letters and are valid
- "lower_colon", for otherwise valid tags with a colon in their names
- "problemchars", for tags with problematic characters
- "other", for other tags that do not fall into the other three categories

```
lower = re.compile(r'^([a-z]|_)*$', re.IGNORECASE)
lower_colon = re.compile(r'^([a-z]|_)*:([a-z]|_)*$', re.IGNORECASE)
problemchars = re.compile(r'[=\+/&<>;\'"\?%#$@\,\. \t\r\n]', re.IGNORECASE)
```

Using `audit_node_tags.py`, we can tell

```
The number of keys for each type is:
{'lower': 280, 'lower colon': 176, 'others': 53, 'problemchars': 9, 'total': 518}
```

By auditing each tag category and values, I found the following problems

1.1 FIXME or fixme

These tags represent values that are either missing or uncertain.

`audit_prob_node_key.py`

1.1.1 "FIXME": map the rest of series brass plaques

```
node id, user id, tags containing 'FIXME':
('3579300780', '139424', {'k': 'FIXME', 'v': 'series of brass plaques set into sidewalk; need to map the rest an
d add desriptions, please (and pics to Wikimedia Commons!)'})
('3579300781', '139424', {'k': 'FIXME', 'v': 'series of brass plaques set into sidewalk; need to map the rest an
d add desriptions, please (and pics to Wikimedia Commons!)'})
('3579300782', '139424', {'k': 'FIXME', 'v': 'series of brass plaques set into sidewalk; need to map the rest an
d add desriptions, please (and pics to Wikimedia Commons!)'})
```

These 3 nodes have consecutive ids and same user id. They are series of brass plaques set into sidewalk and need to map the rest and add descriptions. These nodes themselves are accurate, so I decide to include them in my data.

1.1.2 "fixme": estimated bicycle parking position

Part of the output:

```
node id, user id, tags containing 'fixme'
('419360249', '158826', {'k': 'fixme', 'v': 'really located on the street ?'})
 ('419360607', '91056', {'k': 'fixme', 'v': 'position'})
('419361445', '345833', {'k': 'fixme', 'v': 'resurvey'})
```

All of these nodes represent bicycle_parking. Some of them are cityracks. Fixme information suggests the location may not be accurate, on the street or by the street. The accuracy of these tags is in question, and the problem seems to be that the location coordinate is ON the street, not BY the street, which I think is okay for a general purpose mapping. So I decide to include them.

1.1.3 "fixme": store under reconstruction

```
node id, user id, tags containing 'fixme'
('2818577524', '3779040', {'k': 'fixme', 'v': 'The former C-Town has been demolished along w/ the adjacent parki
ng lot. Construction ongoing until Spring 2017, planned multi-story residential w/ new C-Town on ground floor.
'})
```

Because the new store will be open in 2017, I will keep this node.

1.1.4 “fixme”: FIKA coffee shop position uncertain

Part of the output

```
node id, user id, tags containing 'fixme'
('3792495211', '3435069', {'k': 'fixme', 'v': 'Check position'})
```

An example node:

```
<node id="3792495211" lat="40.7384625" lon="-73.9962727" version="2" timestamp="2015-12-05T04:29:58Z" changeset=
"35762084" uid="3435069" user="Myle Ott">
    <tag k="name" v="FIKA 6th Avenue"/>
    <tag k="fixme" v="Check position"/>
    …
</node>
```

I checked on Google map with the given coordinates and name of the store, and found the position is correct or within 100 ft of the coffee shop.

1.1.5 “fixme”: a grocery shop position uncertain

```
node id, user id, tags containing 'fixme'
 ('3819506465', '336460', {'k': 'fixme', 'v': 'position'})
```

An example node:

```
<node id="3819506465" lat="40.7226087" lon="-73.9830098" version="2" timestamp="2016-02-10T09:11:27Z" changeset=
"37119476" uid="336460" user="robgeb">
    <tag k="name" v="Ben's Deli and Groceries"/>
    <tag k="shop" v="supermarket"/>
    <tag k="fixme" v="position"/>
    …
</node>
```

The position is actually correct (https://www.yelp.com/biz/bens-deli-new-york) I will include this node.

1.1.6 “fixme”: continue

Part of the output:

```
node id, user id, tags containing 'fixme'
 ('1721287290', '238370', {'k': 'fixme', 'v': 'continue'})
```

Nodes that constitute the final known point in a way. These suggests these nodes may need to include 'noexit' in the tag key, and 'yes' as a value. http://wiki.openstreetmap.org/wiki/Key:noexit

I will keep these nodes and add to these nodes a new tag:

```
<tag k="noexit" v="yes"/>
```

1.1.7 “fixme”: missing address & hour information

```
node id, user id, tags containing 'fixme'
('4431954764', '1190762', {'k': 'fixme', 'v': 'address & hours'})
```

After checking Google map(https://www.google.com/maps/place/Dunkin'+Donuts/@40.6768651,-73.9182797,17z/data=!4m18!1m12!4m11!1m6!1m2!1s0x89c25c689b2d2961:0x7ffba5dd29409a4d!2sDunkin'+Donuts,+1993+Atlantic+Avenue,+Brooklyn,+NY+11233!2m2!1d-73.9160848!2d40.6770271!1m3!2m2!1d-73.9160551!2d40.6769856!3m4!1s0x89c25c689b2d2961:0x7ffba5dd29409a4d!8m2!3d40.6770271!4d-73.9160848), I found that it is open 24 hours and address is 1993 Atlantic Ave, Brooklyn, NY 11233. I will keep this node and add the following tags

```
<tag k="'addr:city” v="Brooklyn"/>
<tag k="'addr:country” v="US"/>
<tag k="'addr:housenumber” v="1993"/>
<tag k="'addr:postcode” v="11233"/>
<tag k="'addr:state” v="NY"/>
<tag k="'addr:street” v=" Atlantic Ave "/>
<tag k="opening_hours” v="24/7"/>
```

1.1.8 “fixme”: missing all details

Part of the output

```
node id, user id, tags containing 'fixme'
('4431954765', '1190762', {'k': 'fixme', 'v': 'all details'})
```

These nodes have consecutive ids and same user id. They seem to be a series of shops added by the same user. I will include these nodes in my data.

"FIXME" or "fixme" auditing summary

Of keys that contain "FIXME" or "fixme", most of the values are in fact correct except 1.1.8 where there is missing information. Node tags for 1.1.6 and 1.1.7 could be updated, as shown in 2.1.1.

1.2 Node keys containing problem chars

```
node tag keys with problem chars
set(['Rehearsal space',
     'cityracks.housenum',
     'cityracks.installed',
     'cityracks.large',
     'cityracks.rackid',
     'cityracks.small',
     'cityracks.street',
     'geographical feature',
     'service area'])
```

These keys contain white space or '.'To make the data consistent, it may be better to convert white space to underscore and convert"." to colon.

- "Rehearsal space" --> "Rehearsal_space"
- "cityracks.housenum" -->"cityracks:housenum"

1.3 Node keys in other category

- Some keys contain number such as `'name_1'`
- Some keys contain more than 1 colon such as `"railway:maxspeed:diverging"`
- The key `'alt_name:1'` does not seem to be consistent with `'name_1'` to represent different names. It may be better to convert it to `'alt_name_1"`

1.4 Audit street names of nodes and ways

`audit_street_names.py`

```
expected = ["Street", "Avenue", "Boulevard", "Drive", "Court", "Place", "Square", "Lane", "Road",
"Trail","Parkway","Alley","Plaza","Commons","Broadway","Expressway","Terrace","Center","Circle","Crescent","High
way","Way"]
```

1.4.1 addr:street contains more than street information

Example output:

```
'11217': set(['305 Schermerhorn St., Brooklyn, NY 11217']),
```

An example code:

```
<node id="3875234457" lat="40.6876305" lon="-73.9819376" version="1" timestamp="2015-12-03T21:43:30Z" changeset=
"35736421" uid="3430001" user="DrDanielleSheypuk">
        <tag k="name" v="Govinda&#39;s Vegetarian"/>
        tag k="amenity" v="restaurant"/>
        <tag k="wheelchair" v="no"/>
        <tag k="addr:street" v="305 Schermerhorn St., Brooklyn, NY 11217"/>
        <tag k="wheelchair:description" v="My colleagues frequent this restaurant in a Brooklyn ashram known for
         their delicious eggplant lasagna. But, there is a HUGE step to get in. So easy to put a ramp- shame on
        you Hare Krishna!"/>
</node>
```

When I check this node, I found there is no other addr: information except the addr:street. One idea is to convert the address to different addr tags.

1.4.2 Variation of expected street names: abbreviation and typos

There are different variations and typos of these expected street names, and I will convert variations to the expected names.

- Avenue: Ave, Ave., Avene, Aveneu, ave, avenue
- Boulevard: Blv., Blvd, blvd
- Broadway: Broadway.
- Center: Ctr
- Parkway:Pkwy:

- Plaze: Plz:
- Road: Rd
- Street: ST, St, St., Steet, Streeet, st, street

1.4.3 Numbered street name without “street”

```
'27th': set(['W 27th']),
'42nd': set(['West 42nd']),
```

Because there are many streets named by numbers, the addr:street may only contain the number, without “street”. I decide add “Street” to these addr:street values ending with “st”, “nd”, “rd”, “th” and not containing “street” or “Street”.

1.4.4 End with direction “East”, “West”, “South”, “North” abbreviation

```
'Williamsburg Street East'
'Central Park North'
'Central Park South'
'Central Park West'
```

I notice there is abbreviation of “South” to “S” at the end of the street name

```
'S': set(['Central Park S', 'Park Avenue S', 'Van Cortlandt Park S']),
```

I will convert direction to its full name.

1.5 Audit postcode inconsistency

```
audit_postcode.py
postcode_re = re.compile(r'^\d{5}([\-]?\d{4})?$')

unexpected postcode values:
'(718) 778-0140',
```

wrong value, should be the phone number

```
'100014',
```

typo, should be 10014

```
'11201;11231',
```

a range of postcodes of ways

```
'320','83',
```

number, not sure what it means, could be housenumber

```
'NY 10002',
```

contain both state and postcode, may need to add a new tag for state

```
'New York, NY 10065'
```

contain both city, state, and postcode, may need to add new tags

2. Overview of the data

2.1 Clean XML data

2.1.1 Clean node tag keys

Clean data as discussed in 1.1, 1.2 and 1.3 with `clean_node_tag_keys.py` and output XML to a new file named `manhattan_clean_node_tag_keys.osm`

Run `audit_node_tags.py` on `manhattan_clean_node_tag_keys.osm`

```
The number of keys for each type is:

{'lower': 279, 'lower colon': 179, 'others': 53, 'problemchars': 0, 'total': 511}
```

Compare with original osm file

```
The number of keys for each type is:
{'lower': 280, 'lower colon': 176, 'others': 53, 'problemchars': 9, 'total': 518}
```

Others keys containing numbers and multiple colons will also be included in further analysis.

2.1.2 Clean street names and postcode

Clean data as discussed in 1.4 and 1.5 with `clean_street_names_postcode.py` on `manhattan_clean_node_tag_keys.osm and` output XML to a new file named `manhattan_cleaned.osm`

Run `audit_street_names.py` and `audit_postcodes.py` on `manhattan_cleaned.osm` to check the street names and postcode after cleaning.

2.2 Export XML data to csv

Export XML file to csv files with defined schema in `myschema.py` using `export_to_csv_schema.py`

```
process_map(SAMPLE_PATH, validate=True)
process_map(OSM_PATH, validate=False)
    # Note: Validation is ~ 10X slower. For the project consider using a small
    # sample of the map when validating.
```

Because in `nodes_tags.csv`, each node id may have multiple tags, and there is no unique primary unique key in the file, I decide to append one column called id to assign a unique INTEGER id to each row using function. Same approach is used for `ways_tags.csv` and `ways_nodes.csv`. I also remove header from csv files to import the data to database. I create new csv files without header.

`skip_csv_header.py`

2.3 Import csv to database

I use SQLite command line to create database, as recorded in `create_db.txt`

2.4 Dataset general information

filename	Size (KB)	size (MB)
Manhattan original.osm	467,193 KB	456 MB
manhattan_clean_node_tag_keys.osm	473,283 KB	462 MB
manhattan cleaned.osm	473,245 KB	462 MB
Manhattan.db	291,982 KB	285 MB
sample.osm (k = 100)	4,739 KB	4.62 MB
nodes.csv	165,124 KB	161 MB
nodes noheader.csv	163,333 KB	159 MB
nodes_tags.csv	10,888 KB	10.6 MB
nodes tags id.csv	12,557 KB	12.2 MB
nodes_tags_noheader.csv	12,557 KB	12.2 MB
ways.csv	20,671 KB	20.1 MB
ways_noheader.csv	20,365 KB	19.8 MB
ways tags.csv	53,457 KB	52.2 MB
ways_tags_id.csv	63,553 KB	62.0 MB
ways tags noheader.csv	63,553 KB	62.0 MB
ways_nodes.csv	62,776 KB	61.3 MB
ways nodes id.csv	79,216 KB	77.3 MB
ways_nodes_noheader.csv	79,216 KB	77.3 MB

2.5 Explore the database with SQL query

1) How many nodes and ways are there?

```
SELECT COUNT(*)
FROM Node;

SELECT COUNT(*)
FROM Way;
```

There are 1,834,638 nodes and 313,418 ways in the dataset.

2) How many nodes are historic? How many nodes are shops?

```
SELECT COUNT(*)
FROM Node_tag
WHERE Key = "historic";


SELECT COUNT(*)
```

```
FROM Node_tag
WHERE Key = "shop";
```

There are 281 historic nodes, 2042 shops in the dataset.

3) How many distinct street names? What are the top 5 common street names?

```
SELECT COUNT(DISTINCT(Value))
FROM Node_tag
WHERE Key = "street";

SELECT Value, COUNT(*) as num
FROM Node_tag
WHERE Key = "street"
GROUP BY Value
ORDER BY num DESC
LIMIT 5;
```

There are 2306 unique street names in the dataset and the top 5 common street names are

```
Broadway|2305
3rd Avenue|825
Amsterdam Avenue|610
Lexington Avenue|587
5th Avenue|580
```

Broadway, which runs north-to-south through Manhattan island, is the most common street name.

4) How many unique users?

```
SELECT COUNT(DISTINCT(subq.UserId))
FROM (SELECT UserId FROM Node UNION ALL SELECT UserId FROM Way) AS subq;
```

There are 2114 unique users.

5) Who are the top 10 contributors?

```
SELECT subq.UserName, COUNT(*) AS num
FROM (SELECT UserName FROM Node UNION ALL SELECT UserName FROM Way) AS subq
GROUP BY subq.UserName
ORDER BY num DESC
LIMIT 10;

Rub21_nycbuildings|1112566
ediyes_nycbuildings|124625
ingalls_nycbuildings|111472
smlevine|104442
lxbarth_nycbuildings|90579
minewman|67737
robgeb|66625
celosia_nycbuildings|56789
Korzun|34533
mikercpc|20702
```

As we could see here, most top contributors are nycbuildings.

3. Other ideas about the datasets

CityRacks: where to park my bike?

DOT's CityRacks provide free sidewalk bicycle parking racks throughout the five boroughs. CityRacks are a convenience for the entire cycling community. Also, the availability of CityRacks parking discourages cyclists from parking at mailboxes, parking meters, trees, and other sidewalk structures.

There are 3944 CityRacks in this dataset.

```
SELECT COUNT(DISTINCT(NodeId))
FROM Node_tag
WHERE Type = "cityracks";

3944
```

```
SELECT Key, COUNT(*)
FROM Node_tag
WHERE Type = "cityracks"
GROUP BY Key;

housenum|3944
installed|1745
large|3944
rackid|3944
small|3944
street|3944
```

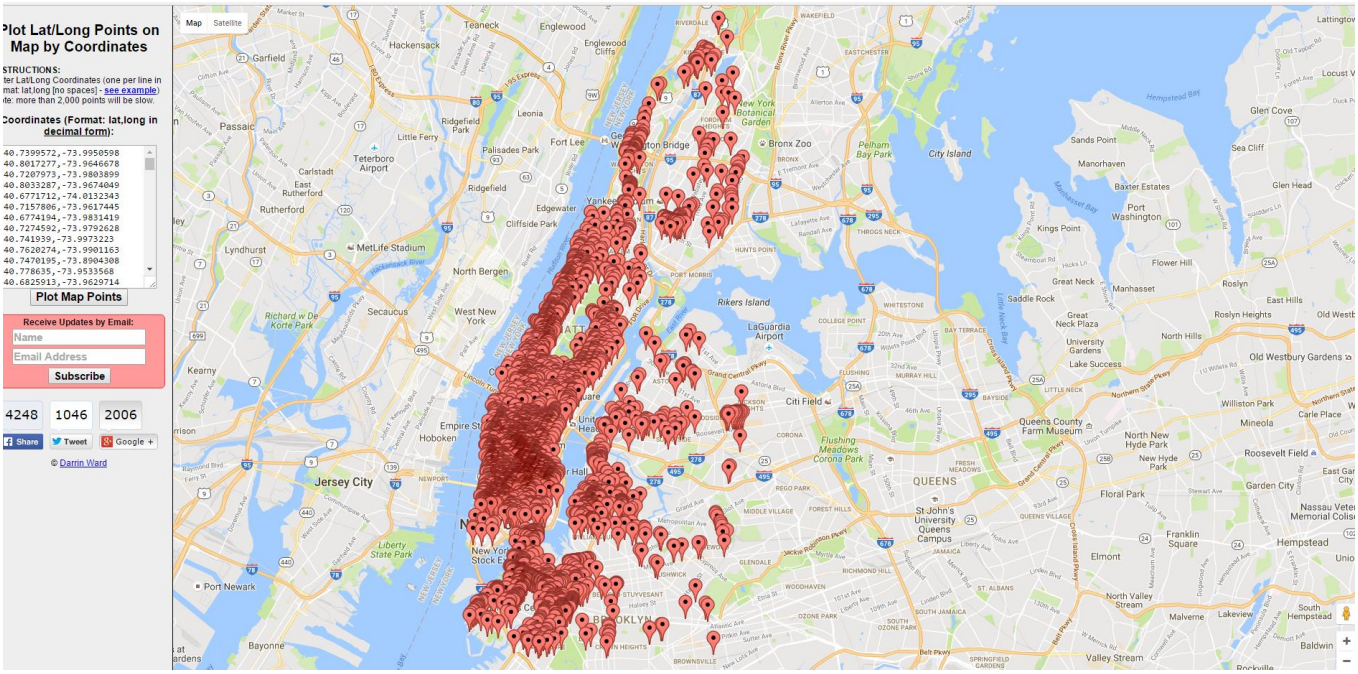
Join Table Node and Node_tag, I can get the Longitude and Latitude of every CityRack. And by plotting the data on Google Map, I can visualize the location of each CityRack.

Export Sqlite query to csv file.

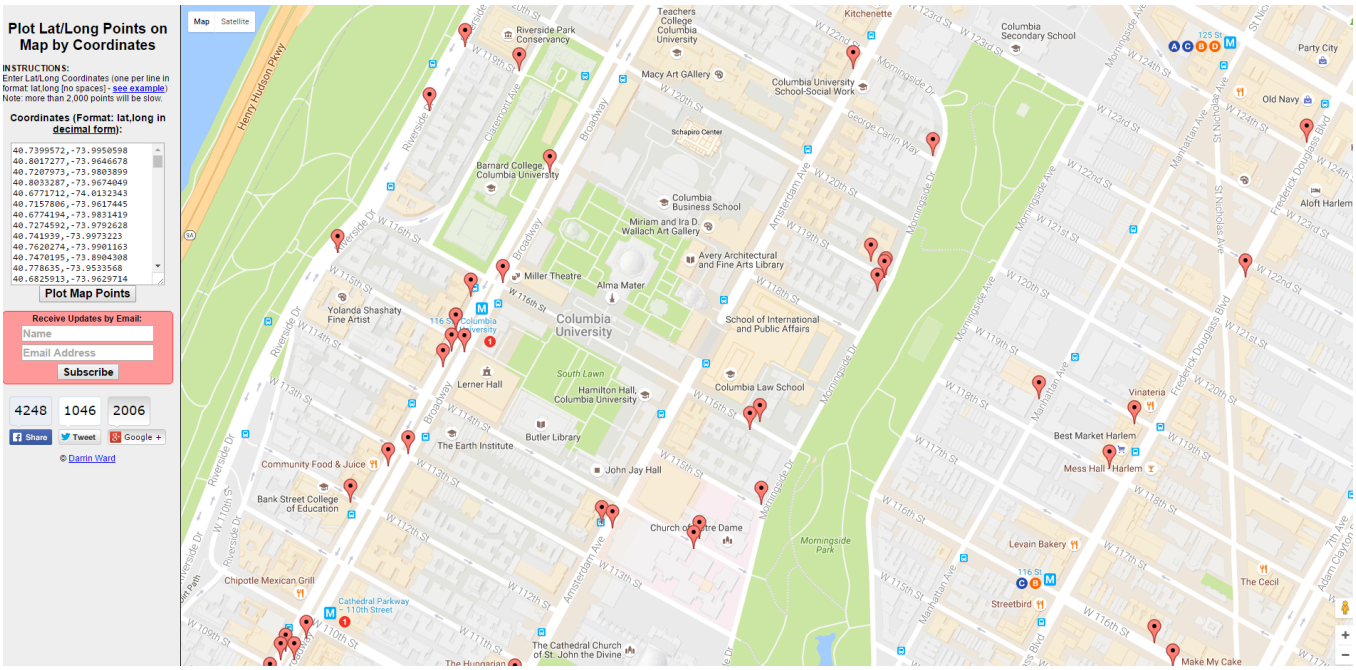
```
.headers on
.mode csv
.output cityracks_loc.csv

SELECT Node.Latitude, Node.Longitude
FROM Node,(SELECT DISTINCT(Node_tag.NodeId)
FROM Node_tag WHERE Node_tag.Type = "cityracks") AS subq
WHERE Node.NodeId = subq.NodeId;
```

I plot `cityracks_loc.csv` on Google Map here http://www.darrinward.com/lat-long/?id=2433672



Near Columbia University where I am studying, I find there are many CityRacks.



Such location information can be used to create mobile Apps to help people find nearby racks to park their bicycles.

At each node location, there could be multiple racks. Each rack has a unique rack id and other features. It will be very helpful if we can get a real time availability of all cityracks and provide users information on where to find an available rack in real time.