Wrangle OpenStreetMap Data in MongoDB

Map Area:

Beijing,China
https://www.openstreetmap.org/relation/912940
https://mapzen.com/data/metro-extracts/
Beijing is my hometown. I’m familiar with the city and I can easily find out the error in xml data. I also like to discover what the map database reveals.

Problems Encountered in the Map

I initially downloaded 10% of osmxml data of Beijing and run it against data_mongo.py; I noticed there were some problems with the data:

1. Nodes name tags like <tag k="name:af" v="Beijing" />,<tag k="name:an" v="Pequín" /> are many language versions and they should be converted as {"name": {"af": "Beijing", “an”:” Pequín”…}}.
2. Address Postcode Tags like <tag k="addr:postcode" v="10043" /> have error value like “10043”, all postcode should be 6 digit numbers begin with “1”.
3. Address City Tags like <tag k="addr:city" v="北京市海淀区" /> have values should be “北京”、“北京市” or ”Beijing”，“beijing” , there’re some error city values like “北京市海淀区”,”怀柔区雁栖镇”
4. Roof Colour Tags like <tag k="roof:colour" v="orange" /> ,have values should be hex code begin with “#”, some error values are colors : ”orange”,”grey”,”green”,”red”,”brown”,”blue”,”gray” ,”black”,”white”

Processing the problems

1. Correcting Name tags

I. Name tags like <tag k="name:af" v="Beijing" />,<tag k="name:an" v="Pequín" /> be converted as {"name": {"af": "Beijing", “an”:” Pequín”…}} ,the same processing strategy with ‘addr:’.
For “name” without following “:” like <tag k="name" v="统军庄新路口" />, they are converted as {“name”:”name”}. Here’s my code in data_mongo.py:

```
for tag in element.iter("tag"):
            if re.match(problemchars,tag.attrib['k'])==None:
                if tag.attrib['k'].find(':')>=0:
                    if tag.attrib['k'].find('addr:')>=0:
```

```
                                        if tag.attrib['k'][tag.attrib['k'].find(':')+5:].find(':')<0:

    address[tag.attrib['k'][tag.attrib['k'].find('addr:')+5:]]=tag.attrib['v']

                                elif tag.attrib['k'].find('name:')>=0:
                                        if tag.attrib['k'][tag.attrib['k'].find(':')+5:].find(':')<0:

    name[tag.attrib['k'][tag.attrib['k'].find('name:')+5:]]=tag.attrib['v']

                                else:

                                        node[tag.attrib['k']]=tag.attrib['v']



                        else:
                                if tag.attrib['k']=='name':
                                        name['name']=tag.attrib['v']
                                node[tag.attrib['k']]=tag.attrib['v']
                        if name!={}:
                                node['name']=name
                        if address!={}:
                                node['address']=address
```

2.Correcting Postcode

I found several postcodes were wrong with 5 numbers, such as “10043”,”10080”,I corrected them from 100XX to 1000XX. Here’s my code in osm_bj_1_mongodb.py:

```
postcode=db.beijingfull.find({'address.postcode':{'$regex':'^[0-9]{0,5}$'}},{'address.postcode':1,'i
d':1})
for p in postcode:
    print "id{} postcode {} not correct".format(p['id'],p['address'])
    if p['address']['postcode'].find('100')>=0:
        p['address']['postcode']=p['address']['postcode'].replace('100','1000')
        db.beijingfull.save(p)
        print 'id{} postcode is corrected to {}'.format(p['id'],p['address'])
```

Note that postcode not in 100XX format can’t be corrected. There’s one postcode with 4 digits can’t be corrected.

3.Processing Errors in tags key=“addr:city”

I replace all noncity values with ‘BEIJING’ though code in osm_bj_1_mongodb.py:

```
element=db.beijingfull.find({'$and':[{'address.city':{'$ne':'beijing'}},{'address.city':{
'$ne':'Beijing'}},{'address.city':{'$exists':1}},{'address.city':{'$ne':'北京'}}
,{'address.city':{'$ne':'北京市'}}]},{'_id':0,'id':1,'address.city':1})
print 'address.city need to correct:\n'
for e in element:
    pprint (e)
db.beijingfull.update({'$and':[{'address.city':{'$ne':'beijing'}},{'address.city':{
'$ne':'Beijing'}},{'address.city':{'$exists':1}},{'address.city':{'$ne':'北京'}}
,{'address.city':{'$ne':'北京市'}}]},{'$set':{'address.city':'BEIJING'}},multi=True)
print "address:city have been corrected to 'BEIJING'."
```

4.Processing Errors in tags key= “roof:colour”

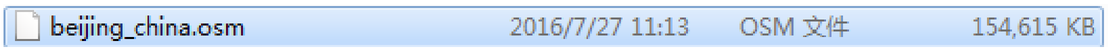
I replace all error roof:colour values with correct color hex from: http://www.colorhexa.com/
At first trial with k=10(10% sampling), I found error color values of ”orange””grey””green””red”, and at the trial with k=5(20% sampling), I added ”brown””blue””gray”, and finally trial with full dataset, I added ‘black’’white’.
code in osm_bj_1_mongodb.py:

```
db.beijing5.update({'roof:colour':'red'},{'$set':{'roof:colour':'#ff0000'}},multi=True)
print "roof:colour red have been corrected."
db.beijing5.update({'roof:colour':'orange'},{'$set':{'roof:colour':'#ffa500'}},multi=True)
print "roof:colour orange have been corrected."
db.beijing5.update({'roof:colour':'green'},{'$set':{'roof:colour':'#00ff00'}},multi=True)
print "roof:colour green have been corrected."
db.beijing5.update({'roof:colour':'blue'},{'$set':{'roof:colour':'#0000ff'}},multi=True)
print "roof:colour blue have been corrected."
db.beijing5.update({'roof:colour':'brown'},{'$set':{'roof:colour':'#a52a2a'}},multi=True)
print "roof:colour brown have been corrected."
db.beijing5.update({'roof:colour':'black'},{'$set':{'roof:colour':'#000000'}},multi=True)
print "roof:colour black have been corrected."
db.beijing5.update({'roof:colour':'white'},{'$set':{'roof:colour':'#ffffff'}},multi=True)
print "roof:colour white have been corrected."
db.beijing5.update({'$or':[{'roof:colour':'grey'},{'roof:colour':'gray'}]},{'$set':{'roof:colour':'#80808
0'}},multi=True)
print "roof:colour grey and gray have been corrected."
```

Data Processing

Download original data file

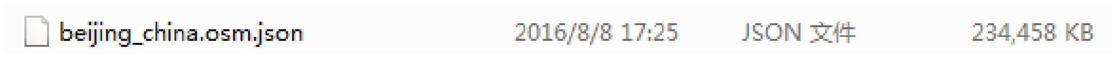
Here's the full osm xml file



```
beijing_china.osm    2016/7/27 11:13    OSM 文件    154,615 KB
```

Run data_mongo.py to get the json

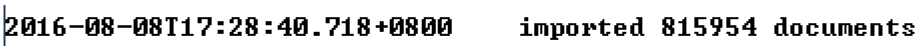
JSON file after processing by data_mongo.py



```
beijing_china.osm.json    2016/8/8 17:25    JSON 文件    234,458 KB
```

Import json the mongodb

C:\Program Files\MongoDB\Server\3.2\bin>mongoimport -d osm -c beijingfull --file
  beijing_china.osm.json



```
2016-08-08T17:28:40.718+0800    imported 815954 documents
```

Run osm_bj_1_mongodb.py to correct errors:

Data Overview and Additional Ideas

Data statistics:

Number of nodes
db.beijingfull.find({'type':'node'}).count()
710867
Number of ways
db.beijingfull.find({'type':'way'}).count()
105072
Number of unique users
len(db.beijingfull.distinct('created.uid'))
1409
Top 10 contributing users
pipeline=[
{'$group':{'_id':{'uid':'$created.uid','name':'$created.user'},'count':{'$sum':1}}},
{'$sort':{'count':-1}},

```
{'$limit':10}]
top10user=db.beijingfull.aggregate(pipeline)
```

```
Top 10 contributing users:
{u'count': 194009, u'_id': {u'uid': u'288524', u'name': u'Chen Jia'}}
{u'count': 151236, u'_id': {u'uid': u'376715', u'name': u'R438'}}
{u'count': 52067, u'_id': {u'uid': u'139957', u'name': u'ij_'}}
{u'count': 47776, u'_id': {u'uid': u'499500', u'name': u'hanchao'}}
{u'count': 24052, u'_id': {u'uid': u'17497', u'name': u'katpatuka'}}
{u'count': 21995, u'_id': {u'uid': u'486052', u'name': u'm17design'}}
{u'count': 19065, u'_id': {u'uid': u'83557', u'name': u'Esperanza36'}}
{u'count': 17230, u'_id': {u'uid': u'75424', u'name': u'nuklearerWintersturm'}}
{u'count': 14490, u'_id': {u'uid': u'2639622', u'name': u'RationalTangle'}}
{u'count': 9411, u'_id': {u'uid': u'421504', u'name': u'u_kubota'}}
```

Number of users appearing least

```
pipeline=[
{'$group':{'_id':{'uid':'$created.uid','user':'$created.user'},'count':{'$sum':1}}},
{'$group':{'_id':'$count','num_users':{'$sum':1}}},
{'$sort':{'_id':1}},
{'$limit':1}
]
num1post=db.beijingfull.aggregate(pipeline)
```

```
Number of users appearing least
{u'num_users': 283, u'_id': 1}
```

Additional Ideas:

I explored the top appearing amenities; the most appearing amenity is restaurant. The most popular cuisines of restaurants is Chinese, Japanese and Italy food are also very popular. I also have a trial to use $near and $maxDistance to get the nearest restaurants in radians=200m of Capital Airports[116.5849695,40.0711596](<lon>,<lat>)

Top 10 appearing amenities

code in osm_bj_1_mongodb.py:

```
pipeline=[
{"$match":{"amenity":{"$exists":1}}},
{"$group":{"_id":"$amenity","count":{"$sum":1}}},
{"$sort":{"count":-1}},
{"$limit":10}
]
amenities=db.beijingfull.aggregate(pipeline)
```

result:

```
top 10 appearing amenities:
{u'count': 1047, u'_id': u'restaurant'}
```

```
{u'count': 615, u'_id': u'parking'}
{u'count': 371, u'_id': u'bank'}
{u'count': 354, u'_id': u'school'}
{u'count': 338, u'_id': u'toilets'}
{u'count': 278, u'_id': u'fuel'}
{u'count': 258, u'_id': u'fast_food'}
{u'count': 185, u'_id': u'cafe'}
{u'count': 156, u'_id': u'hospital'}
{u'count': 152, u'_id': u'telephone'}
```

Most popular cuisines:

code in osm_bj_1_mongodb.py:

```
pipeline=[
{"$match":{"amenity":{"$exists":1}, "amenity":"restaurant",'cuisine':{'$exists':1}}},
{"$group":{"_id":"$cuisine", "count":{"$sum":1}}},
{"$sort":{"count":-1}},
{"$limit":3}
]
cuisine=db.beijingfull.aggregate(pipeline)
```

result:

```
most popular cuisines:
{u'count': 119, u'_id': u'chinese'}
{u'count': 12, u'_id': u'japanese'}
{u'count': 10, u'_id': u'pizza'}
{u'count': 10, u'_id': u'regional'}
{u'count': 9, u'_id': u'italian'}
```

The nearest 10 restaurants to 'Capital Airport'

Query in mongo console:

```
> db.beijingfull.find ( { 'pos' :{$near : [116.5849695,40.0711596],$maxDistance:
  200 },'amenity':'restaurant','name':{$exists:1}},{'_id':0,'amenity':1,'name':1,
'pos':1})
{ "amenity" : "restaurant", "name" : { "name" : "Pinnacle Plaza" }, "pos" : [ 11
6.5412853, 40.0614854 ] }
{ "amenity" : "restaurant", "name" : { "name" : "大掌勺" }, "pos" : [ 116.645611
4, 40.1141037 ] }
{ "amenity" : "restaurant", "name" : { "name" : "顺宜坊" }, "pos" : [ 116.648925
2, 40.111247 ] }
{ "amenity" : "restaurant", "name" : { "name" : "福成肥牛(火锅)" }, "pos" : [ 11
6.6502815, 40.1107706 ] }
{ "amenity" : "restaurant", "name" : { "name" : "全聚德" }, "pos" : [ 116.63464,
  40.1342102 ] }
{ "amenity" : "restaurant", "name" : { "name" : "金佰万" }, "pos" : [ 116.641309
1, 40.1285157 ] }
{ "amenity" : "restaurant", "name" : { "name" : "上一档" }, "pos" : [ 116.656838
, 40.1080809 ] }
```

```
{ "amenity" : "restaurant", "name" : { "name" : "久久嘉" }, "pos" : [ 116.658357
8, 40.1070672 ] }
{ "amenity" : "restaurant", "name" : { "name" : "红菜坊" }, "pos" : [ 116.659443
9, 40.1068962 ] }
{ "amenity" : "restaurant", "name" : { "name" : "比格皮萨顺义店" }, "pos" : [ 11
6.6458589, 40.1276162 ] }
{ "amenity" : "restaurant", "name" : { "name" : "呷哺呷哺 NO.218" }, "pos" : [ 11
6.6457338, 40.1277901 ] }
{ "amenity" : "restaurant", "name" : { "name" : "创新高" }, "pos" : [ 116.660025
, 40.1107311 ] }
{ "amenity" : "restaurant", "name" : { "zh" : "安妮", "name" : "Annie's" }, "pos
" : [ 116.5050102, 40.0232652 ] }
{ "amenity" : "restaurant", "name" : { "name" : "大厨房" }, "pos" : [ 116.658891
3, 40.1352231 ] }
{ "amenity" : "restaurant", "name" : { "name" : "IOWA" }, "pos" : [ 116.5050901,
 39.9933388 ] }
{ "amenity" : "restaurant", "name" : { "name" : "Wine Talks" }, "pos" : [ 116.50
19465, 39.9922912 ] }
{ "amenity" : "restaurant", "name" : { "name" : "Maan Coffee" }, "pos" : [ 116.5
047738, 39.971998 ] }
{ "amenity" : "restaurant", "name" : { "name" : "那家小馆" }, "pos" : [ 116.4876
527, 39.9863056 ] }
{ "amenity" : "restaurant", "name" : { "name" : "金百万" }, "pos" : [ 116.472021
5, 40.0072536 ] }
{ "amenity" : "restaurant", "name" : { "name" : "BenJia" }, "pos" : [ 116.472990
1, 40.0054086 ] }
Type "it" for more
```

How many documents created in 2016.

My code in osm_bj_1_mongodb.py:

```
year=Set([])
element=db.beijingfull.find({'created.timestamp':{'$exists':1}})
for e in element:

    year.add(e['created']['timestamp'][0:e['created']['timestamp'].find('-')])
print year
print '{} total docs from 2007'.format(db.beijingfull.find().count())
print '{} docs created in 2016'.format(db.beijingfull.find({'created.timestamp':{'$gte':'2016-01-01T00:00:00Z'}}).count())
print '{} docs created in 2015'.format(db.beijingfull.find({'created.timestamp':{'$gte':'2015-01-01T00:00:00Z','$lte':'2015-12-31T23:59:59Z'}}).count())
```

result:

```
Set([u'2009', u'2007', u'2015', u'2014', u'2008', u'2016', u'2011', u'2010', u'2
013', u'2012'])
```

815954 total docs from 2007
119271 docs created in 2016
144674 docs created in 2015
The total documents created from 2007 and 14.6% documents created in 2016, 17.7%documents created in 2015. There're 10 years since created the first document in 2007. The average growth is 10%.

Conclusion:

In the data wrangling of OpenStreetMap xml data, I found that the data quality is high in Beijing_china.osm. Data in the last 2 years rapidly grow, above average growth rate. But still far from completed. I can easily found the nodes and ways are not included in the dataset. That means the city grow very fast. The trial of get nearest restaurants from location, is very similar to common mobile application of find the nearby amenities. I'm glad I know how it is implemented.