P3 - Openstreetmap Porto

January 14, 2016

1 Map Area: Porto, Portugal

https://s3.amazonaws.com/metro-extracts.mapzen.com/porto_portugal.osm.bz2

```
In [1]: %matplotlib inline

        import xml.etree.cElementTree as ET
        from collections import defaultdict
        import re
        import pprint
        import codecs
        import json
        import os
        from pymongo import MongoClient
        import matplotlib.pyplot as plt

        import seaborn as sns
        sns.set_style("whitegrid")

In [2]: OSMFILE = "porto_portugal.osm"

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

In [3]: street_type_re = re.compile(r'^\b\S+\.?', re.IGNORECASE)

        changes = {'Rua Dragoes Sandinenses': u'Rua Drag\xe3es Sandinenses',
                   'Rua S. Pedro': u'Rua S\xe3o Pedro'}

        expected = ["Rua", "Avenida", "Alameda", "Caminho", "Largo", "Cais", "Campo", u'Cal\xe7ada', "C
                    "Esplanada", "Estrada", "Ladeira", "Lugar", "Praceta", "Travessa", "Via", "Viela",
                    "Zona", "Mercado"]

        # UPDATE THIS VARIABLE
        mapping = {
            '25': 'Rua 25',
            'Av': 'Avenida',
            'Av.': 'Avenida',
            'Brito': 'Rua Brito',
            'Calcada': u'Cal\xe7ada',
            'Costa': 'Rua Costa',
            'EN' : 'Estrada Nacional',
            'Nacional' : 'Estrada Nacional',
            'Nossa' : 'Rua Nossa',
            'Padre' : 'Rua Padre',
            'Paramos' : 'Rua Paramos',
            u'Pra\xe7a' : 'Praceta',
            u'Pra\xe7eta': 'Praceta',
            u'P\xe1tio' : u'P\xe1tio',
            'R' : 'Rua',
            'R.': 'Rua',
            'RUA': 'Rua',
            'R.S.Pedro': 'Rua S. Pedro',
            u'Urbaniza\xe7\xe3o': u'Urbaniza\xe7\xe3o',
            'da': 'Rua da',
            'do' : 'Rua do',
            'Medas': 'Rua Medas',
            'Largo': 'Largo',
            'Rua' : 'Rua',
            'Avenida': 'Avenida',
            'Alameda': 'Alameda',
            'Caminho': 'Caminho',
            'Cais': 'Cais',
            'Campo': 'Campo',
            'Ciclovia': 'Ciclovia',
            'Esplanada': 'Esplanada',
            'Estrada': 'Estrada',
            'Ladeira': 'Ladeira',
            'Lugar': 'Lugar',
            'Praceta' : 'Praceta',
            'Travessa': 'Travessa',
            'Via': 'Via',
            'Viela': 'Vieta',
            'Zona' : 'Zona',
            'Mercado': 'Mercado',
            u'Cal\xe7ada': u'Cal\xe7ada'}

        #pprint.pprint(mapping)
```

```
In [4]: def audit_street_type(street_types, street_name):
            m = street_type_re.search(street_name)
            if m:
                street_type = m.group()
                if street_type not in expected:
                    street_types[street_type].add(street_name)

        def is_street_name(elem):
            return (elem.attrib['k'] == "addr:street")

        def is_postcode(elem):
            return (elem.attrib['k'] == "addr:postcode")

        def audit(osmfile):
            osm_file = open(osmfile, "r")
            street_types = defaultdict(set)
            postcodes = set()
            for event, elem in ET.iterparse(osm_file, events=("start",)):
                if elem.tag == "node" or elem.tag == "way":
                    for tag in elem.iter("tag"):
                        if is_street_name(tag):
                            audit_street_type(street_types, tag.attrib['v'])
                        if is_postcode(tag):
                            postcodes.add(tag.attrib['v'])

            elem.clear()
            return (street_types, postcodes)

        def update_name(name, mapping):
            '''Update each street name with the replacement ending in the mapping dictionary'''
            match = re.search(street_type_re,name)
            name = re.sub(street_type_re,mapping[match.group()],name).title()
            return name

        (st_types, pcodes) = audit(OSMFILE)
```

```
In [5]: #pprint.pprint(dict(st_types))
        #print pcodes

        print "Number of types: {}".format(len(dict(st_types)))
```

```
Number of types: 22
```

```
In [6]: for st_type, ways in st_types.iteritems():
            #print "'{}': '{}'".format(st_type.encode('utf-8'), st_type.encode('utf-8'))
            for name in ways:
                better_name = update_name(name, mapping)
                print name, "=>", better_name
```

```
RUA DRAGOES SANDINENSES => Rua Dragoes Sandinenses
RUA Central de Gens => Rua Central De Gens
RUA CONDE FERREIRA => Rua Conde Ferreira
Costa Padrão => Rua Costa Padrão
Nacional 1 => Estrada Nacional 1
Nacional 1/IC2 => Estrada Nacional 1/Ic2
25 Abril => Rua 25 Abril
Medas => Rua Medas
Av. da Pedra Verde => Avenida Da Pedra Verde
Av. 24 => Avenida 24
Av. Pedra Verde => Avenida Pedra Verde
Av. Principal => Avenida Principal
Av. Menéres => Avenida Menéres
Paramos => Rua Paramos
Praçeta Professor Sampaio => Praceta Professor Sampaio
EN 204/5 => Estrada Nacional 204/5
Padre Ricardo Neto => Rua Padre Ricardo Neto
do Sol => Rua Do Sol
da fonte => Rua Da Fonte
Praça da Liberdade => Praceta Da Liberdade
Praça Vasco da Gama => Praceta Vasco Da Gama
Praça do Almada => Praceta Do Almada
Praça Mouzinho de Albuquerque => Praceta Mouzinho De Albuquerque
```

```
Praça Dom Afonso V => Praceta Dom Afonso V
Praça dos Poveiros => Praceta Dos Poveiros
Praça da Ribeira => Praceta Da Ribeira
Praça Coronel Pacheco => Praceta Coronel Pacheco
Praça Dona Filipa de Lencastre => Praceta Dona Filipa De Lencastre
Praça do Exército Libertador => Praceta Do Exército Libertador
Praça de Carlos Alberto => Praceta De Carlos Alberto
Praça da Batalha => Praceta Da Batalha
Praça Marquês de Pombal => Praceta Marquês De Pombal
Praça Manuel Guedes => Praceta Manuel Guedes
Praça Dom João I => Praceta Dom João I
Praça Cid. Salvador => Praceta Cid. Salvador
Praça 5 de Outubro => Praceta 5 De Outubro
Praça da República => Praceta Da República
Praça General Humberto Delgado => Praceta General Humberto Delgado
R Escola Preparatória => Rua Escola Preparatória
Calcada da Feira dos Dez => Calçada Da Feira Dos Dez
R. Adelino Amaro da Costa => Rua Adelino Amaro Da Costa
R. Silva Brinco => Rua Silva Brinco
Pátio das Escadas do Monte dos Judeus => Pátio Das Escadas Do Monte Dos Judeus
Brito Capelo => Rua Brito Capelo
Nossa Senhora do Amparo => Rua Nossa Senhora Do Amparo
Av Luís de Camões => Avenida Luís De Camões
Urbanização Industrial do Soeiro => Urbanização Industrial Do Soeiro
Urbanização Industrial da Carriça => Urbanização Industrial Da Carriça
R.S.Pedro de Formariz => Rua S. Pedro De Formariz
```

```
In [7]: def shape_element(element):
            """Takes a top level element or tag such as way, node, etc and iterates through each elemen
            and 2nd level tag (if applicable). Returns one cleaned
            node (could be a 'way' as well) which is a dictionary of all the fields later
            to be converted to a JSON document.
            """
            if element.tag == "node" or element.tag == "way":
                node = {}
                #1st level tags
                node['type'] = element.tag
                for attrName, attrValue in element.attrib.items(): #iterate through each 1st level attr
                    if attrName == "lat":
                        if 'pos' not in node.keys():
                            node['pos']= [float(1),float(1)]
                        node['pos'][0] = float(attrValue)
                        continue
                    if attrName == "lon":
                        if 'pos' not in node.keys():
                            node['pos']= [float(1),float(1)]
                        node['pos'][1] = float(attrValue)
                        continue
                    if attrName == "" or attrValue == "": #avoid importing any blank keys or values
                        continue
                    if attrName == 'id': #id is a first level attribute
                        node['_id'] = attrValue #doing this ensures this _id replaces ObjectId in mongo
                        continue
                    node[attrName] = attrValue
                #2nd level tags
                ndtags = element.findall("./*")
                for ndtag in ndtags: #iterate through each 2nd level tag
                    kvalue, vvalue, refvalue = ['','','']
                    for aName, aValue in ndtag.attrib.items():
                        if aName == "k":
                            kvalue = aValue
                        if aName == "v":
                            vvalue = aValue
                        if aName == "ref":
                            refvalue = aValue
                    if kvalue == 'type':
                        continue
                    dc,pc,lc = [double_colon.search(kvalue),problemchars.search(kvalue),lower_colon.sea

                #if second level tag "k" value contains problematic characters, it should be ignored
                    if vvalue in changes:
                        vvalue = changes[vvalue]
                    if kvalue.startswith("addr:"):
                        if kvalue == "addr:street":
                            vvalue = update_name(vvalue, mapping)
                        if 'address' not in node.keys():
                            node['address'] = {}
                        node['address'][kvalue.split("addr:")[1]] = vvalue
                        continue
                    if lc:
                        kvalue = re.sub(":"," ",kvalue) #replace the colon with an space
                        node[kvalue] = vvalue
                        continue
                    if kvalue.startswith("geobase:"):
                        kvalue = kvalue.split("geobase:")[1]
                        node[kvalue] = vvalue
                        continue
                    if kvalue == "" or vvalue == "": #avoid blank fields and values
                        continue
                    if element.tag == "way" and refvalue != "" :
                        if "node_refs" not in node.keys():
                            node['node_refs'] = []
                        node["node_refs"].append(refvalue)
                    node[kvalue] = vvalue
                return node
            else:
                return None
```

```
In [8]: def process_map(file_in, pretty = False):
            # You do not need to change this file
            file_out = "{0}.json".format(file_in)
            data = []
            counter = 0 #added counter to show status when creating json file
            with codecs.open(file_out, "w") as fo:
                for _, element in ET.iterparse(file_in):
                    el = shape_element(element)
                    counter += 1
                    if el:
                        data.append(el)
                        if pretty:
                            fo.write(json.dumps(el, indent=2)+"\n")
                        else:
                            fo.write(json.dumps(el) + "\n")
            print counter
            return data

        data = process_map(OSMFILE, False)
```

```
1965653
```

Insert into Mongodb

```
In [9]: client = MongoClient('mongodb://localhost:27017/')
        db = client.p3
```

```
In [11]: #db.porto.insert_many(data)
```

```
In [12]: db.porto.find()
```

```
Out[12]: <pymongo.cursor.Cursor at 0x1b816e310>
```

1.1 Problems encountered in the map

The Porto map has a main problem:

- Over-abbreviated street names ("R.")
- Inconsistency due to the Portuguese language (for instance, c vs ç). See the changes in the variable 'changes' of the python code.

I have not found any problem with postal codes.

1.2 Data Overview

```
In [14]: file_out = "{0}.json".format(OSMFILE)
         print ">>> File Sizes <<<"
         print "porto_portugal.osm      ... {}MB".format(os.path.getsize(OSMFILE) >> 20)
         print "porto_portugal.osm.json ... {}MB".format(os.path.getsize(file_out) >> 20)

         print "\n\n>>> Number of Documents <<<"
         print db.porto.count()

         print "\n\n>>> Number of Nodes <<<"
         print db.porto.find({"type":"node"}).count()

         print "\n\n>>> Number of Ways <<<"
         print db.porto.find({"type":"way"}).count()
```

```
>>> File Sizes <<<
porto_portugal.osm      ... 143MB
porto_portugal.osm.json ... 141MB


>>> Number of Documents <<<
```

```
778496


>>> Number of Nodes <<<
675233


>>> Number of Ways <<<
103263
```

```
In [15]: print "\n\n>>> Number of Unique Users <<<"
         print len(db.porto.distinct("user"))
```

```
>>> Number of Unique Users <<<
895
```

Top Contributing Users

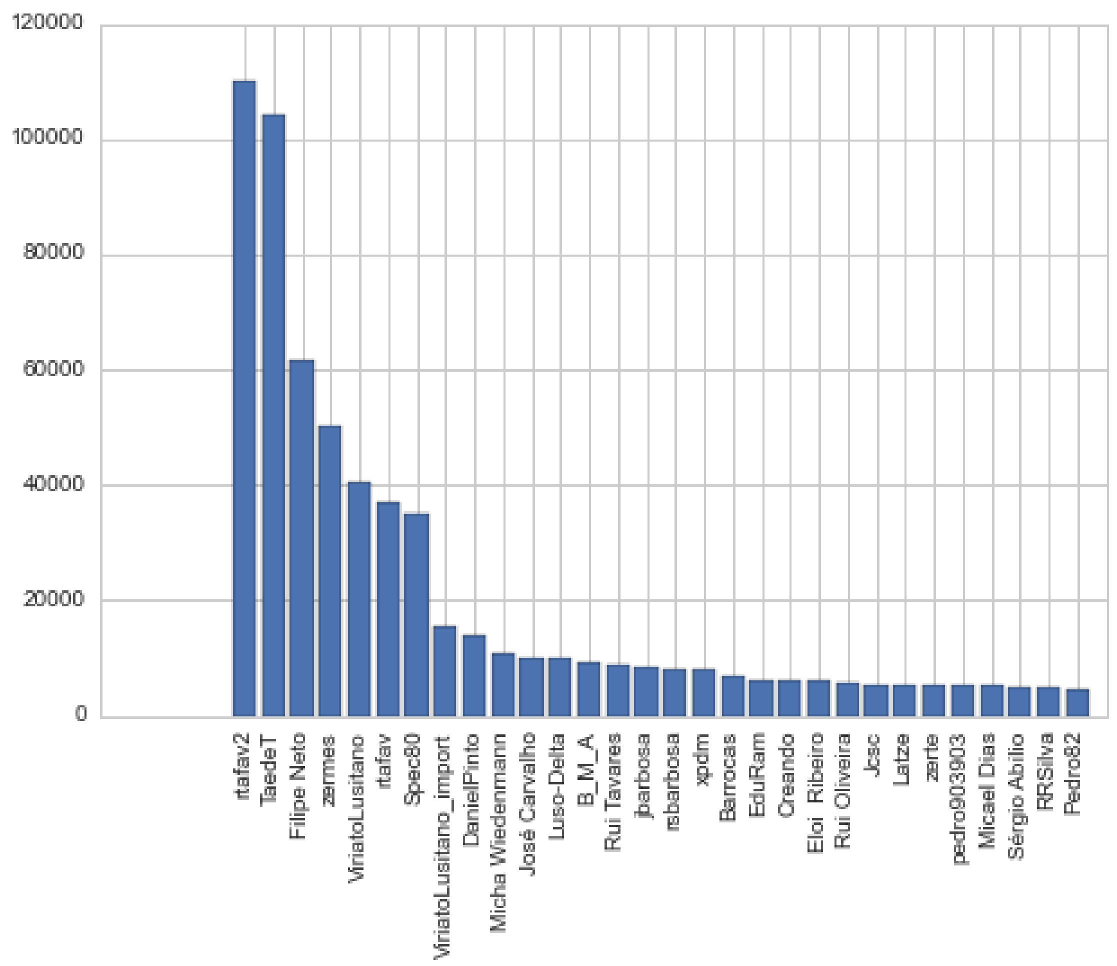
```
In [16]: pipeline = [
                 { "$group":
                      {"_id":"$user",
                       "count": { "$sum":1 }
                      }
                 },
                 { "$sort": {"count": -1 }
                 },
                 { "$limit": 30 }
             ]

         r = db.porto.aggregate( pipeline )

         lres = list(r)
         xs = [x['_id'] for x in lres]
         ys = [x['count'] for x in lres]

         plt.bar(range(len(xs)), ys, align='center')
         plt.xticks(range(len(xs)), xs)
         plt.setp(plt.xticks()[1], rotation=90)

         plt.show()
```



Number of users appearing only once (having 1 post)

```
In [17]: pipeline = [
                 {"$group":
                      {"_id": "$user",
                       "count": { "$sum":1 }
                      }
                 },
                 {"$group":
                      {"_id":"$count",
                       "num_users":{"$sum":1}
                      }
                 },
                 {"$sort":{"_id":1}
                 },
                 { "$limit":1 } ]

         rr = db.porto.aggregate( pipeline )

         users = list(rr)[0]['num_users']
```

```
        print "Users contributing only once: {}".format(users)
        print "Percentage of users: ({0:.2f}%)".format((float(users) / len(db.cities.distinct("user"))
```

```
Users contributing only once: 130
Percentage of users: (14.46%)
```

1.3 Other ideas about the dataset: exploring the dataset

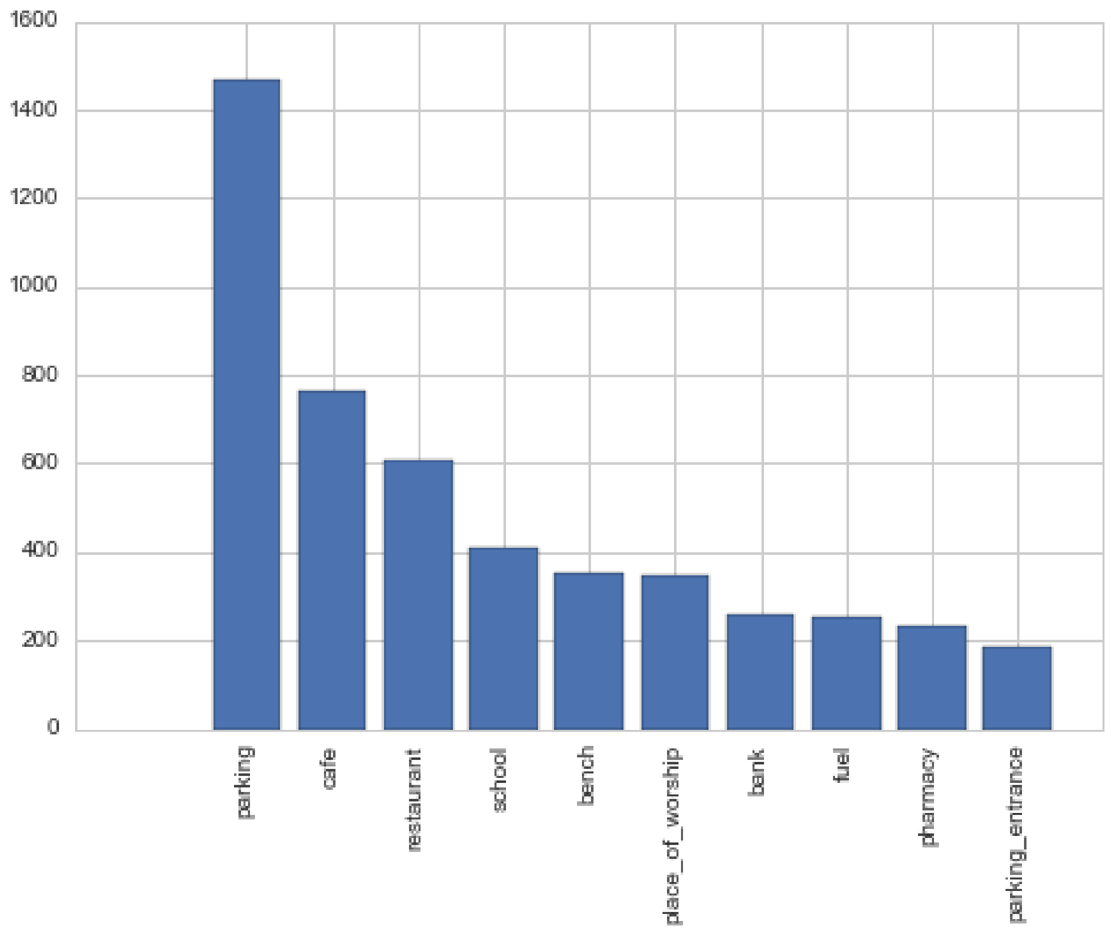
```
In [19]: pipeline = [
                 { "$match":
                      {"amenity":{"$exists":1}}
                 },
                 { "$group":
                      {"_id":"$amenity",
                       "count": {"$sum":1}
                      }
                 },
                 { "$sort": {"count": -1 }},
                 {"$limit":10}]

         amenities = db.porto.aggregate( pipeline )

         lres = list(amenities)
         xs = [x['_id'] for x in lres]
         ys = [x['count'] for x in lres]

         plt.bar(range(len(xs)), ys, align='center')
         plt.xticks(range(len(xs)), xs)
         plt.setp(plt.xticks()[1], rotation=90)

         plt.show()
```



Being in Porto, Portugal, we expect the biggest religion to be Christian, but is this really the case?

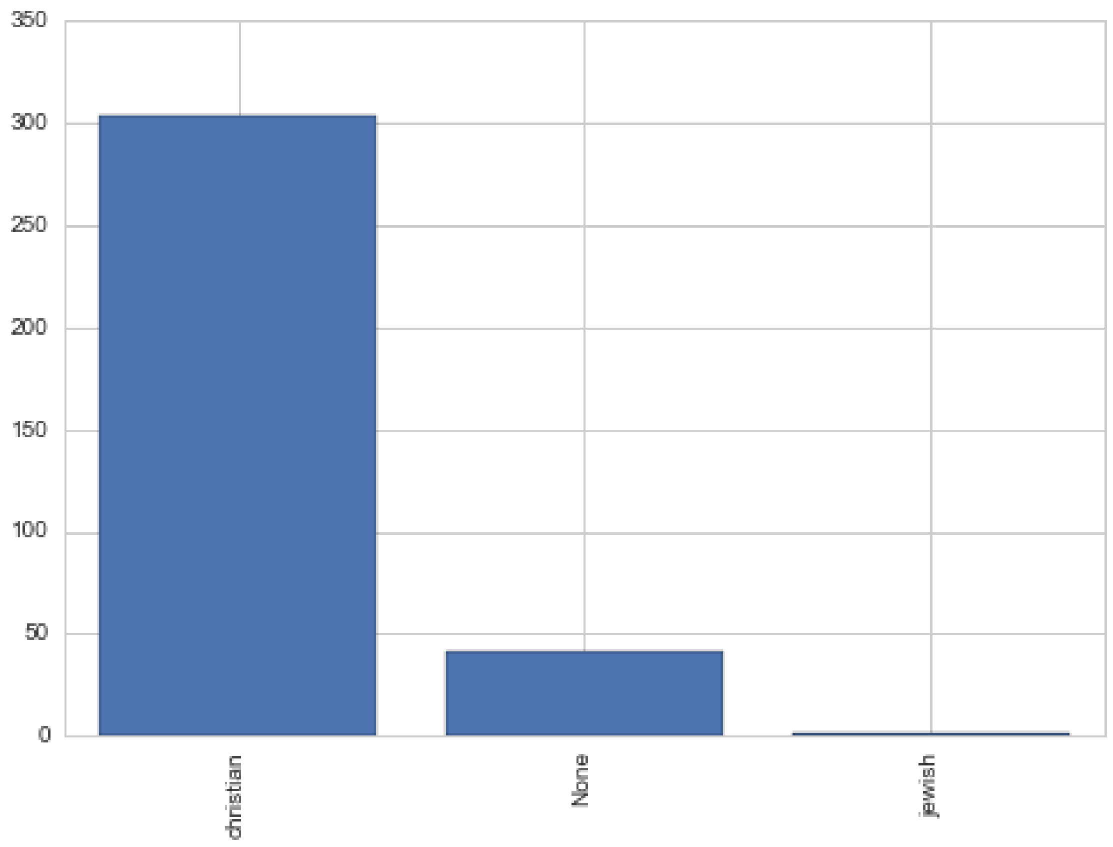
```
In [20]: pipeline = [
                 {"$match":{"amenity":{"$exists":1}, "amenity":"place_of_worship"}},
                 {"$group":{"_id":"$religion", "count":{"$sum":1}}},
                 {"$sort":{"count":-1}}, {"$limit":10}]

         religion = db.porto.aggregate( pipeline )

         lres = list(religion)
         xs = [x['_id'] for x in lres]
         ys = [x['count'] for x in lres]

         plt.bar(range(len(xs)), ys, align='center')
         plt.xticks(range(len(xs)), xs)
         plt.setp(plt.xticks()[1], rotation=90)

         plt.show()
```



Came as a surprise only two listed religions, and a few None. This suggests that the data may is incomplete.

What about cuisine?

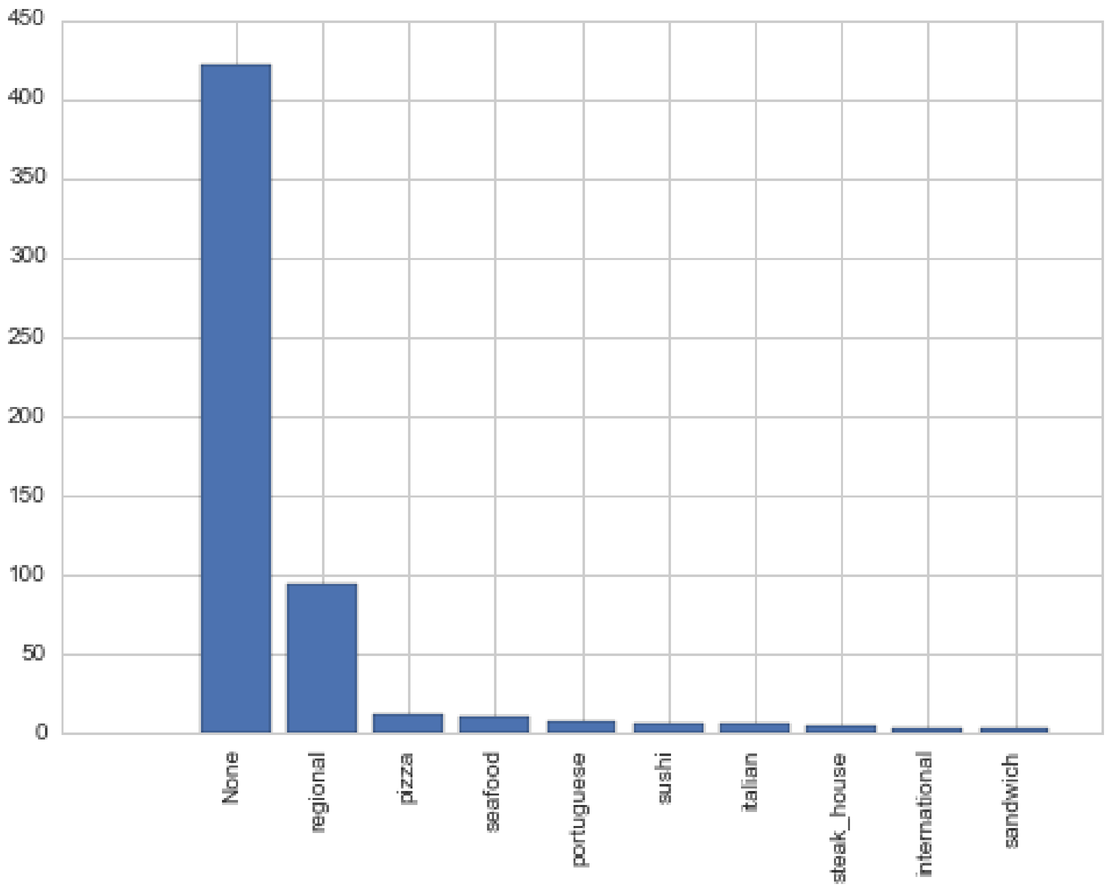
```
In [21]: pipeline = [{"$match":{"amenity":{"$exists":1}, "amenity":"restaurant"}},
                     {"$group":{"_id":"$cuisine", "count":{"$sum":1}}},
                     {"$sort":{"count":-1}}, {"$limit":10}]

         cuisine = db.porto.aggregate( pipeline )

         lres = list(cuisine)
         xs = [x['_id'] for x in lres]
         ys = [x['count'] for x in lres]

         plt.bar(range(len(xs)), ys, align='center')
         plt.xticks(range(len(xs)), xs)
         plt.setp(plt.xticks()[1], rotation=90)

         plt.show()
```



The high number of Nones suggests that the data is incomplete.

1.4 Conclusions & Additional ways of improving and analyzing the data.

After this review of the data it's obvious that the Porto area is incomplete, despite the little problems with the data.

As an attempt to improve the data one could:

- Introduce gamification into openstreetmaps or applications using openstreetmaps. This could help bring more contributions to the map, and also more people. Gamification has to include some sort of incentive. We could crowdsource that information in exchange of a give (Apple Watch) and provide online a ranking of most active (given some metrics of users). Another way that would help improve the data would be to convince Universities to include analysis of the data into their courses: students may find it interesting to contribuite.
- Many of the places could be verified using the Google API, or any other API with that kind of information available. This could be done for all places, but in particular that have 'None'.
- We could try to use the network to infer properties missing in the data (as facebook does for unfilled profile entries – forgot the name of the algorithm, but I've attended a talk about that). There might however not be interesting features to do this learning.

```
In [ ]:
```