

Capstone Project - The Battle of Neighborhoods (London)

Topic: Finding the best place to open an Indian Restaurant in London

Author: Subbarayudu T

1. Description of the Problem

The idea of this study is to help people planning to open a new Indian restaurant in London to choose the right location by providing data about the income and population of each neighborhood as well as the competitors already present on the same regions.

One of the big concerns for any Entrepreneur is the competition that already present in the market. So, he has to study the market to finalize the location where he intended to open a new business. Therefore in this project, I intend to **explore different neighborhoods of London and find the best area to build a new Indian Restaurant in London** to solve this persistent problem and to find a new business opportunity. This research is expected to benefit the entrepreneurs looking for a profitable location for opening a business (Indian Restaurant in this project) in London.

2. Data Acquisition and Preprocessing

In this project, I will be using the following datasets to help solve my problem - List of London Boroughs (from Wikipedia page), and Foursquare API.

Let's have a look at them.

List of London Boroughs

- Information on boroughs and their population & coordinates
 - Population can be used to calculate the ratio of reported crime to population for better comparison.
 - Coordinates can be used to get neighborhood data from Foursquare.
- source: Wikipedia
- url: https://en.wikipedia.org/wiki/List_of_London_boroughs
(https://en.wikipedia.org/wiki/List_of_London_boroughs)

In [5]:

```
import pandas as pd
import numpy as np
import requests
import lxml
from bs4 import BeautifulSoup
```

In [6]:

```
# Obtaining data from Wikipedia
URL="https://en.wikipedia.org/wiki/List_of_London_boroughs"
source = requests.get(URL).text
soup = BeautifulSoup(source, 'lxml')
soup.encode("utf-8-sig")
```

Out[6]:

```
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f England">local authority districts</a> within <a href="/wiki/Greater_Lon  
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i/London_boroughs" title="London boroughs">London boroughs</a> and the <a  
href="/wiki/City_of_London" title="City of London">City of London</a>. The  
London boroughs were all created on 1 April 1965. Upon creation, twelve we  
re designated <a href="/wiki/Inner_London" title="Inner London">Inner Lond  
on</a> boroughs and the remaining twenty were designated <a href="/wiki/Ou  
ter_London" title="Outer London">Outer London</a> boroughs. The <a href="/  
wiki/Office_for_National_Statistics" title="Office for National Statistic  
s">Office for National Statistics</a> has amended the designations of thre  
e boroughs for statistics purposes only. Three boroughs have been granted  
the designation <a class="mw-redirect" href="/wiki/Royal_borough" title="R  
oyal borough">royal borough</a> and one has <a href="/wiki/City_status_in_  
the_United_Kingdom" title="City status in the United Kingdom">city status  
</a>. For planning purposes, in addition to the boroughs and City there ar  
e also two active development corporations, the <a href="/wiki/London_Lega  
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London Legacy Development Corporation</a> and <a href="/wiki/Old_Oak_and_P  
ark_Royal_Development_Corporation" title="Old Oak and Park Royal Developme
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nt Corporation">Old Oak and Park Royal Development Corporation.\n</p>\n<div class="toc" id="toc"><input class="toctogglecheckbox" id="toctogglecheckbox" role="button" style="display:none" type="checkbox"/><div class="toctitle" dir="ltr" lang="en"><h2>Contents</h2><label class="toctogglelabel" for="toctogglecheckbox"></label></div>\n\n<li class="toclevel-1 tocsection-1">1 List of boroughs and local authorities\n<li class="toclevel-1 tocsection-2">2 City of London\n<li class="toclevel-1 tocsection-3">3 See also\n<li class="toclevel-1 tocsection-4">4 Notes\n<li class="toclevel-1 tocsection-5">5 References\n<li class="toclevel-1 tocsection-6">6 External links\n\n</div>\n<h2>List of boroughs and local authoritiesedit</h2>\n<table class="wikitable sortable" style="font-size:100%" width="100%">\n<tbody><tr>\n<th>Borough</th>\n<th>Inner</th>\n<th>Status</th>\n<th>Local authority</th>\n<th>Political control</th>\n<th>Headquarters</th>\n<th>Area (sq mi)</th>\n<th>Population (2013 est)^{[1]}</th>\n<th>Coordinates</th>\n<th> Nr. in map </th>\n<tr>\n<td>Barking and Dagenham ^{[note 1]}</td>\n<td></td>\n<td></td>\n<td>Barking and Dagenham London Borough Council</td>\n<td>Labour</td>\n<td>Town Hall, 1 Town Square</td>\n<td>13.93</td>\n<td>194,352</td>\n<td>51^{\xc2\xbd}33^{\xe2\x80\xb3}239^{\xe2\x80\xb3}3N</sup> 0^{\xc2\xbd}09^{\xe2\x80\xb3}221^{\xe2\x80\xb3}3E</sup>\xf0\bb\xbf / \xf0\bb\xbf51.5607^{\xc2\xbd}0 N 0.1557^{\xc2\xbd}0 E</sup>\xf0\bb\xbf / 51.5607; 0.1557\xf0\bb\xbf (Barking and Dagenham</td>\n<td>25</td>\n<tr>\n<td>Barnet</td>\n<td></td>\n<td></td>\n<td>Barnet London Borough Council</td>\n<td>Conservative</td>\n<td>North London Business Park, Oakleigh Road South</td>\n<td>33.49</td>\n<td>369,088</td>\n<td><span class="plainlinks nourlexpansi

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[Haringey](/wiki/London_Borough_of_Haringey "London Borough of Haringey")

[\[note 3\]](#cite_note-note2-4)

[Haringey London Borough Council](/wiki/Haringey_London_Borough_Council "Haringey London Borough Council")

[Labour](/wiki/Labour_Party_(UK) "Labour Party (UK)")

[>Civic Centre](/w/index.php?title=Haringey_Civic_Centre&action=edit&redlink=1 "Haringey Civic Centre (page does not exist)"), High Road

11.42

263,386

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[Harrow](/wiki/London_Borough_of_Harrow "London Borough of Harrow")

[Harrow London Borough Council](/wiki/Harrow_London_Borough_Council "Harrow London Borough Council")

[Labour](/wiki/Labour_Party_(UK) "Labour Party (UK)")

[>Civic Centre](/w/index.php?title=Harrow_Civic_Centre&action=edit&redlink=1 "Harrow Civic Centre (page does not exist)"), Station Road

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[Havering](/wiki/London_Borough_of_Havering "London Borough of Havering")

[Havering London Borough Council](/wiki/Havering_London_Borough_Council "Havering London Borough Council")

[>Conservative](/wiki/Conservative_Party_(UK) "Conservative Party (UK)") (council

[>NOC](/wiki/No_overall_control "No overall control")

[>Town Hall](/w/index.php?title=Havering_Town_Hall&action=edit&redlink=1 "Havering Town Hall (page does not exist)"), Main Road

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Council\n</td>\n<td><a href="/wiki/Labour_Party_(UK)" title="Labour Pa
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slington_Municipal_Offices&action=edit&redlink=1" title="Islington
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Street\n</td>\n<td>5.74\n</td>\n<td>215,667\n</td>\n<td><span class="plain
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ult"><span class="geo-dms" title="Maps, aerial photos, and other data for
this location">51\xc2\xb032\xe2\x80\xb230\xe2\x80\x

12/62

localhost:8888/nbconvert/html/DS/Untitled Folder/Untitled Folder/The Battle of Neighborhoods London.ipynb?download=false

s, aerial photos, and other data for this location">51\xc2\xb024\xe2\x80\xb205\xe2\x80\xb3N 0\xc2\xb011\xe2\x80\xb245\xe2\x80\xb3W\xef\xbb\xbf / \xef\xbb\xbf51.4014\xc2\xb0N 0.1958\xc2\xb0W\xef\xbb\xbf / 51.4014; -0.1958\xef\xbb\xbf (Merton\n</td>\n<td>17\n</td></tr>\n<tr>\n<td>Newham\n</td>\n<td>^{[note 3]}\n</td>\n<td>\n</td>\n<td>Newham London Borough Council\n</td>\n<td>Labour\n</td>\n<td>Newham Dockside, 1000 Dockside Road\n</td>\n<td>13.98\n</td>\n<td>318,227\n</td>\n<td>51\xc2\xb030\xe2\x80\xb228\xe2\x80\xb3N 0\xc2\xb002\xe2\x80\xb249\xe2\x80\xb3E\xef\xbb\xbf / \xef\xbb\xbf51.5077\xc2\xb0N 0.0469\xc2\xb0E\xef\xbb\xbf / 51.5077; 0.0469\xef\xbb\xbf (Newham\n</td>\n<td>27\n</td></tr>\n<tr>\n<td>Redbridge\n</td>\n<td>\n</td>\n<td>\n</td>\n<td>Redbridge London Borough Council\n</td>\n<td>Labour\n</td>\n<td>Town Hall, 128-142 High Road\n</td>\n<td>21.78\n</td>\n<td>288,272\n</td>\n<td>51\xc2\xb033\xe2\x80\xb232\xe2\x80\xb3N 0\xc2\xb004\xe2\x80\xb227\xe2\x80\xb3E\xef\xbb\xbf / \xef\xbb\xbf51.5590\xc2\xb0N 0.0741\xc2\xb0E\xef\xbb\xbf / 51.5590; 0.0741\xef\xbb\xbf (Redbridge\n</td>\n<td>26\n</td></tr>\n<tr>\n<td>Richmond upon Thames\n</td>\n<td>\n</td>\n<td>\n</td>\n<td>Richmond upon Thames London Borough Council\n</td>\n<td>Liberal\ÐDemocrat\n</td>\n<td>Civic Centre, 44 York Street\n</td>\n<td>22.17\n</td>\n<td>191,365\n</td>\n</tr>

[Richmond upon Thames](//tools.wmflabs.org/geohack/geohack.php?pagename=List_of_London_boroughs¶ms=51.4479_N_0.326_W_region:GB_type:city&title=Richmond+upon+Thames)

Maps, aerial photos, and other data for this location

51.4479, -0.3260

Richmond upon Thames

15

[London Borough of Southwark](/wiki/London_Borough_of_Southwark)



Southwark London Borough Council

[Labour Party \(UK\)](/wiki/Labour_Party_(UK))

[160 Tooley Street \(page does not exist\)](/w/index.php?title=160_Tooley_Street&action=edit&redlink=1)

11.14, 298,464

[Southwark](//tools.wmflabs.org/geohack/geohack.php?pagename=List_of_London_boroughs¶ms=51.5035_N_0.0804_W_region:GB_type:city&title=Southwark)

Maps, aerial photos, and other data for this location

51.5035, -0.0804

Southwark

7

[London Borough of Sutton](/wiki/London_Borough_of_Sutton)

[Sutton London Borough Council](/wiki/Sutton_London_Borough_Council)

[Liberal Democrats \(UK\)](/wiki/Liberal_Democrats_(UK))

[Sutton Civic Offices \(page does not exist\)](/w/index.php?title=Sutton_Civic_Offices&action=edit&redlink=1)

16.93, 195,914

[Sutton](//tools.wmflabs.org/geohack/geohack.php?pagename=List_of_London_boroughs¶ms=51.3618_N_0.1945_W_region:GB_type:city&title=Sutton)

Maps, aerial photos, and other data for this location

51.3618, -0.1945

Sutton

18

[Tower Hamlets](/wiki/London_Borough_of_Tower_Hamlets)

title="London Borough of Tower Hamlets">Tower Hamlets\n</td>\n<td>Y\n</td>\n<td>\n<td>Tower Hamlets London Borough Council\n</td>\n<td>Labour\n</td>\n<td>Town Hall, Mulberry Place, 5 Clove Crescent\n</td>\n<td>7.63\n</td>\n<td>272,890\n</td>\n<td>51\x2\xb030\xe2\x80\xb236\xe2\x80\xb3N 0\x2\xb000\xe2\x80\xb221\xe2\x80\xb3W\xef\xbb\xbf / \xef\xbb\xbf51.5099\x2\xb0N 0.0059\x2\xb0W\xef\xbb\xbf / 51.5099; -0.0059\xef\xbb\xbf (Tower Hamlets\n</td>\n<td>8\n</td></tr>\n<tr>\n<td>Waltham Forest\n</td>\n<td>\n</td>\n<td>\n</td>\n<td>Waltham Forest London Borough Council\n</td>\n<td>Labour\n</td>\n<td>Waltham Forest Town Hall, Forest Road\n</td>\n<td>14.99\n</td>\n<td>265,797\n</td>\n<td>51\x2\xb035\xe2\x80\xb227\xe2\x80\xb3N 0\x2\xb000\xe2\x80\xb248\xe2\x80\xb3W\xef\xbb\xbf / \xef\xbb\xbf51.5908\x2\xb0N 0.0134\x2\xb0W\xef\xbb\xbf / 51.5908; -0.0134\xef\xbb\xbf (Waltham Forest\n</td>\n<td>28\n</td></tr>\n<tr>\n<td>Wandsworth\n</td>\n<td>Y\n</td>\n<td>\n</td>\n<td>Wandsworth London Borough Council\n</td>\n<td>Conservative\n</td>\n<td>The Town Hall, <a href="/wiki/Wandsworth_High_Street" title="Wandsworth High Street

Wandsworth High Street\n<td>\n<td>13.23\n</td>\n<td>310,516\n</td>\n<td>51\xc2\xb027\ xe2\x80\xb224\ xe2\x80\xb3N 0\ xc2\xb011\ xe2\x80\xb228\ xe2\x80\xb3W\ xef\xbb\xbf / \ xef\xbb\xbf51.4567\ xc2\xb0N 0.1910\ xc2\xb0W\ xef\xbb\xbf / 51.4567; -0.1910\ xef\xbb\xbf (Wandsworth\n</td>\n<td>5\n</td></tr>\n<tr>\n<td>Westminster\n</td>\n<td>Y\n</td>\n<td>City\n</td>\n<td>Westminster City Council\n</td>\n<td>Conservative\n</td>\n<td>Westminster City Hall, 64 Victoria Street\n</td>\n<td>8.29\n</td>\n<td>226,841\n</td>\n<td>51\ xc2\xb029\ xe2\x80\xb250\ xe2\x80\xb3N 0\ xc2\xb008\ xe2\x80\xb214\ xe2\x80\xb3W\ xef\xbb\xbf / \ xef\xbb\xbf51.4973\ xc2\xb0N 0.1372\ xc2\xb0W\ xef\xbb\xbf / 51.4973; -0.1372\ xef\xbb\xbf (Westminster\n</td>\n<td>2\n</td></tr></tbody></table>\n<h2>City of London[edit]</h2>\n<p>The City of London is the 33rd principal division of Greater London but it is not a London borough.\n</p>\n<table class="wikitable sortable" style="font-size:95%" width="100%">\n<tbody><tr>\n<th width="100px"><i>\ xe2\x80\x98Borough\ xe2\x80\x99</i>\n</th>\n<th>Inner\n</th>\n<th width="100px">Status\n</th>\n<th>Local authority\n</th>\n<th>Political control\n</th>\n<th width="120px">Headquarters\n</th>\n<th>Area
(sq\ xc2\xa0mi)\n</th>\n<th>Population
(2011 est)\n</th>\n<th width="20px">Co-ordinates\n</th>\n<th> Nr. in
map \n</th></tr>\n<tr>\n<td>City of London\n</td>\n<td>"Release Edition Reference Tables". <i>Webarchive.nationalarchives.gov.uk</i>. Retrieved 5 February 2019.</cite><link href="mw-data:TemplateStyles:r886058088" rel="mw-deduplicated-inline-style"/><n<n</div></div><n<h2>External linksedit</h2><nLondon Councils: List of inner/outer London boroughs<nLondon Boroughs Map<n<div aria-labelledby="Governance_of_Greater_London" class="navbox" role="navigation" style="padding:3px"><table class="nowraplinks hlist mw-collapsible mw-collapsed navbox-inner" style="border-spacing:0;background:transparent;color:inherit"><tbody><tr><th class="navbox-title" colspan="2" scope="col"><div class="plainlinks hlist navbar mini"><li class="nv-view"><abbr style=";;background:none transparent;border:none;-moz-box-shadow:none;-webkit-box-shadow:none;box-shadow:none; padding:0;" title="View this template">v</abbr><li class="nv-talk"><abbr style=";;background:none transparent;border:none;-moz-box-shadow:none;-webkit-box-shadow:none;box-shadow:none; padding:0;" title="Discuss this template">t</abbr><li class="nv-edit"><abbr style=";;background:none transparent;border:none;-moz-box-shadow:none;-webkit-box-shadow:none;box-shadow:none; padding:0;" title="Edit this template">e</abbr></div><div id="Governance_of_Greater_London" style="font-size:114%;margin:0 4em">Governance of Greater London</div></th></tr><tr><td class="navbox-abovebelow" colspan="2"><div id="*_City_of_London&#10;*_London"><nCity of London<nLondon<n</div></td></tr><tr><th class="navbox-group" scope="row" style="width:1%">Regional</th><td class="navbox-list navbox-odd" style="text-align:left;border-left-width:2px;border-left-style:solid;width:100%;padding:0px"><div style="padding:0em 0.25em"><nGreater London Authority: London Assembly<nMayor of London<n</div></td></tr><tr><th class="navbox-group" scope="row" style="width:1%">Boroughs
list</th><td class="navbox-list navbox-even" style="text-align:left;border-left-width:2px;border-left-style:solid;width:100%;padding:0px"><div style="padding:0em 0.25em"><nLondon Councils: Barking and Dagenham<n<a href="/wiki/London_Borough_of_Barnet" title="London Borough of

(MBW) 1855\x2\x80\x931889\nLondon County Council

22/62

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="/w/index.php?title=Special:UserLogin&returnto=List+of+London+boroughs" title="You're encouraged to log in; however, it's not mandatory."
[o]">Log in</a></li> </ul>\n</div>\n<div id="left-navigation">\n<div aria-
labelledby="p-namespaces-label" class="vectorTabs " id="p-namespaces" rol
e="navigation">\n<h3 id="p-namespaces-label">Namespaces</h3>\n<ul>\n<li cl
ass="selected" id="ca-nstab-main"><a accesskey="c" href="/wiki/List_of_Lon
don_boroughs" title="View the content page [c]">Article</a></li><li id="ca-
talk"><a accesskey="t" href="/wiki/Talk:List_of_London_boroughs" rel="dis
cussion" title="Discussion about the content page [t]">Talk</a></li>\n</ul>
>\n</div>\n<div aria-labelledby="p-variants-label" class="vectorMenu empty
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iants-label" class="vectorMenuCheckbox" type="checkbox"/>\n<h3 id="p-varia
nts-label">\n<span>Variants</span>\n</h3>\n<ul class="menu">\n</ul>\n</div>
>\n</div>\n<div id="right-navigation">\n<div aria-labelledby="p-views-labe
l" class="vectorTabs " id="p-views" role="navigation">\n<h3 id="p-views-la
bel">Views</h3>\n<ul>\n<li class="collapsible selected" id="ca-view"><a hr
ef="/wiki/List_of_London_boroughs">Read</a></li><li class="collapsible" id
="ca-edit"><a accesskey="e" href="/w/index.php?title=List_of_London_boroug
hs&action=edit" title="Edit this page [e]">Edit</a></li><li class="col
lapsible" id="ca-history"><a accesskey="h" href="/w/index.php?title=List_o
f_London_boroughs&action=history" title="Past revisions of this page
[h]">View history</a></li>\n</ul>\n</div>\n<div aria-labelledby="p-cactio
ns-label" class="vectorMenu emptyPortlet" id="p-cactions" role="navigatio
n">\n<input aria-labelledby="p-cactions-label" class="vectorMenuCheckbox"
type="checkbox"/>\n<h3 id="p-cactions-label"><span>More</span></h3>\n<ul
class="menu">\n</ul>\n</div>\n<div id="p-search" role="search">\n<h3>\n<l
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ia [f]" type="search"/>\n<input name="title" type="hidden" value="Special:
Search"/>\n<input class="searchButton mw-fallbackSearchButton" id="mw-sear
chButton" name="fulltext" title="Search Wikipedia for this text" type="sub
mit" value="Search"/>\n<input class="searchButton" id="searchButton" name
="go" title="Go to a page with this exact name if it exists" type="submit"
value="Go"/>\n</div>\n</form>\n</div>\n</div>\n</div>\n<div id="mw-panel">
\n<div id="p-logo" role="banner"><a class="mw-wiki-logo" href="/wiki/Main_
Page" title="Visit the main page"></a></div>\n<div aria-labelledby="p-navi
gation-label" class="portal" id="p-navigation" role="navigation">\n<h3 id
="p-navigation-label">Navigation</h3>\n<div class="body">\n<ul>\n<li id="n
-mainpage-description"><a accesskey="z" href="/wiki/Main_Page" title="Visi
t the main page [z]">Main page</a></li><li id="n-contents"><a href="/wiki/
Wikipedia:Contents" title="Guides to browsing Wikipedia">Contents</a></li>
<li id="n-featuredcontent"><a href="/wiki/Wikipedia:Featured_content" titl
e="Featured content \xe2\x80\x93 the best of Wikipedia">Featured content</
a></li><li id="n-currentevents"><a href="/wiki/Portal:Current_events" titl
e="Find background information on current events">Current events</a></li><
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oad a random article [x]">Random article</a></li><li id="n-sitesupport"><a
href="https://donate.wikimedia.org/wiki/Special:FundraiserRedirector?utm_s
ource=donate&utm_medium=sidebar&utm_campaign=C13_en.wikipedia.org&
amp;uselang=en" title="Support us">Donate to Wikipedia</a></li><li id="n-s
hoplink"><a href="//shop.wikimedia.org" title="Visit the Wikipedia store">
Wikipedia store</a></li> </ul>\n</div>\n</div>\n<div aria-labelledby="p-in
teraction-label" class="portal" id="p-interaction" role="navigation">\n<h3
id="p-interaction-label">Interaction</h3>\n<div class="body">\n<ul>\n<li i
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edit Wikipedia">Help</a></li><li id="n-aboutsite"><a href="/wiki/Wikipedi
a:About" title="Find out about Wikipedia">About Wikipedia</a></li><li id
="n-portal"><a href="/wiki/Wikipedia:Community_portal" title="About the pr
oject, what you can do, where to find things">Community portal</a></li><li
id="n-recentchanges"><a accesskey="r" href="/wiki/Special:RecentChanges" t
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itle="A list of recent changes in the wiki [r]">Recent changes<li id="n-contactpage">Contact page \n</div>\n</div>\n<div aria-labelledby="p-tb-label" class="portal" id="p-tb" role="navigation">\n<h3 id="p-tb-label">Tools</h3>\n<div class="body">\n\n<li id="t-whatlinkshere">What links here<li id="t-recentchangeslinked">Related changes<li id="t-upload">Upload file<li id="t-specialpages">Special pages<li id="t-permalink">Permanent link<li id="t-info">Page information<li id="t-wikibase">Wikidata item<li id="t-cite">Cite this page \n</div>\n</div>\n<div aria-labelledby="p-coll-print-export-label" class="portal" id="p-coll-print-export" role="navigation">\n<h3 id="p-coll-print-export-label">Print/export</h3>\n<div class="body">\n\n<li id="coll-create_a_book">Create a book<li id="coll-download-as-r1">Download as PDF<li id="t-print">Printable version \n</div>\n</div>\n<div aria-labelledby="p-lang-label" class="portal" id="p-lang" role="navigation">\n<h3 id="p-lang-label">Languages</h3>\n<div class="body">\n\n<li class="interlanguage-link interwiki-ru">\xd0\xa0\xd1\x83\xd1\x81\xd1\x81\xd0\xba\xd0xb8\xd0xb9 \n<div class="after-portlet after-portlet-lang">Edit links</div> </div>\n</div>\n</div>\n<div id="footer" role="contentinfo">\n<ul id="footer-info">\n<li id="footer-info-lastmod"> This page was last edited on 20 December 2019, at 13:29\xc2\xa0(UTC).\n<li id="footer-info-copyright">Text is available under the Creative Commons Attribution-ShareAlike License;\nadditional terms may apply. By using this site, you agree to the Terms of Use and Privacy Policy. Wikipedia\xc2\xae is a registered trademark of the Wikimedia Foundation, Inc., a non-profit organization.\n\n<ul id="footer-places">\n<li id="footer-places-privacy">Privacy policy


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</a></li>\n<li id="footer-places-about"><a href="/wiki/Wikipedia:About" ti
tle="Wikipedia:About">About Wikipedia</a></li>\n<li id="footer-places-disc
laimer"><a href="/wiki/Wikipedia:General_disclaimer" title="Wikipedia:Gene
ral disclaimer">Disclaimers</a></li>\n<li id="footer-places-contact"><a hr
ef="//en.wikipedia.org/wiki/Wikipedia:Contact_us">Contact Wikipedia</a></l
i>\n<li id="footer-places-developers"><a href="https://www.mediawiki.org/w
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t</a></li>\n<li id="footer-places-mobileview"><a class="noprint stopMobile
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n_boroughs&mobileaction=toggle_view_mobile">Mobile view</a></li>\n</ul
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t":1500000},"postexpandincludesize":{"value":79370,"limit":2097152},"templ
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7% 115.696      2 Template:London_Gazette"," 30.79% 109.369      2 Templ
ate:Cite_magazine"," 20.17% 71.646      33 Template:Coord"," 12.80% 45.
464      1 Template:Use_dmy_dates"," 12.23% 43.434      33 Template:Engli
sh_district_control"," 5.75% 20.411      1 Template:London"," 5.05%
17.934      2 Template:DMCA"," 4.35% 15.460      2 Template:Dated_main
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dy>\n</html>\n'
```

In [7]:

```
BoroughName = []
Population = []
Coordinates = []

for row in soup.find('table').find_all('tr'):
    cells = row.find_all('td')
    if len(cells) > 0:
        BoroughName.append(cells[0].text.rstrip('\n'))
        Population.append(cells[7].text.rstrip('\n'))
        Coordinates.append(cells[8].text.rstrip('\n'))
```

In [8]:

```
# Form a dataframe
dict = {'BoroughName' : BoroughName,
        'Population' : Population,
        'Coordinates': Coordinates}
info = pd.DataFrame.from_dict(dict)
info.head()
```

Out[8]:

	BoroughName	Population	Coordinates
0	Barking and Dagenham [note 1]	194,352	51°33'39"N 0°09'21"E / 51.5607°N 0.1557°E /...
1	Barnet	369,088	51°37'31"N 0°09'06"W / 51.6252°N 0.1517°W /...
2	Bexley	236,687	51°27'18"N 0°09'02"E / 51.4549°N 0.1505°E /...
3	Brent	317,264	51°33'32"N 0°16'54"W / 51.5588°N 0.2817°W /...
4	Bromley	317,899	51°24'14"N 0°01'11"E / 51.4039°N 0.0198°E /...

In [9]:

```
# Strip unwanted texts
info['BoroughName'] = info['BoroughName'].map(lambda x: x.rstrip(' '))
info['BoroughName'] = info['BoroughName'].map(lambda x: x.rstrip('1234567890.'))
info['BoroughName'] = info['BoroughName'].str.replace('note', '')
info['BoroughName'] = info['BoroughName'].map(lambda x: x.rstrip(' '))
info.head()
```

Out[9]:

	BoroughName	Population	Coordinates
0	Barking and Dagenham	194,352	51°33'39"N 0°09'21"E / 51.5607°N 0.1557°E /...
1	Barnet	369,088	51°37'31"N 0°09'06"W / 51.6252°N 0.1517°W /...
2	Bexley	236,687	51°27'18"N 0°09'02"E / 51.4549°N 0.1505°E /...
3	Brent	317,264	51°33'32"N 0°16'54"W / 51.5588°N 0.2817°W /...
4	Bromley	317,899	51°24'14"N 0°01'11"E / 51.4039°N 0.0198°E /...

In [10]:

```
# Clean coordinates
info[['Coordinates1', 'Coordinates2', 'Coordinates3']] = info['Coordinates'].str.split(
    '/', expand=True)
info.head()
```

Out[10]:

	BoroughName	Population	Coordinates	Coordinates1	Coordinates2	Coordinates
0	Barking and Dagenham	194,352	51°33'39"N 0°09'21"E / 51.5607°N 0.1557°E / ...	51°33'39"N 0°09'21"E	51.5607°N 0.1557°E	51.5607; 0.1557 (Barking and Dagenham)
1	Barnet	369,088	51°37'31"N 0°09'06"W / 51.6252°N 0.1517°W / ...	51°37'31"N 0°09'06"W	51.6252°N 0.1517°W	51.6252; -0.1517 (Barnet)
2	Bexley	236,687	51°27'18"N 0°09'02"E / 51.4549°N 0.1505°E / ...	51°27'18"N 0°09'02"E	51.4549°N 0.1505°E	51.4549; 0.1505 (Bexley)
3	Brent	317,264	51°33'32"N 0°16'54"W / 51.5588°N 0.2817°W / ...	51°33'32"N 0°16'54"W	51.5588°N 0.2817°W	51.5588; -0.2817 (Brent)
4	Bromley	317,899	51°24'14"N 0°01'11"E / 51.4039°N 0.0198°E / ...	51°24'14"N 0°01'11"E	51.4039°N 0.0198°E	51.4039; 0.0198 (Bromley)

In [11]:

```
info.drop(labels=['Coordinates', 'Coordinates1', 'Coordinates2'], axis=1, inplace = True)
info[['Latitude', 'Longitude']] = info['Coordinates3'].str.split(';', expand=True)
info.head()
```

Out[11]:

	BoroughName	Population	Coordinates3	Latitude	Longitude
0	Barking and Dagenham	194,352	51.5607; 0.1557 (Barking and Dagenham)	51.5607	0.1557 (Barking and Dagenham)
1	Barnet	369,088	51.6252; -0.1517 (Barnet)	51.6252	-0.1517 (Barnet)
2	Bexley	236,687	51.4549; 0.1505 (Bexley)	51.4549	0.1505 (Bexley)
3	Brent	317,264	51.5588; -0.2817 (Brent)	51.5588	-0.2817 (Brent)
4	Bromley	317,899	51.4039; 0.0198 (Bromley)	51.4039	0.0198 (Bromley)

In [12]:

```

info.drop(labels=['Coordinates3'], axis=1,inplace = True)
info['Latitude'] = info['Latitude'].map(lambda x: x.rstrip(u'\ufeff'))
info['Latitude'] = info['Latitude'].map(lambda x: x.lstrip())
info['Longitude'] = info['Longitude'].map(lambda x: x.rstrip(' '))
info['Longitude'] = info['Longitude'].map(lambda x: x.rstrip('abcdefghijklmnopqrstuvwxyzABCDEFGHIJKLMNOPQRSTUVWXYZ '))
info['Longitude'] = info['Longitude'].map(lambda x: x.rstrip(' ( '))
info['Longitude'] = info['Longitude'].map(lambda x: x.rstrip(u'\ufeff'))
info['Longitude'] = info['Longitude'].map(lambda x: x.lstrip())
info['Population'] = info['Population'].str.replace(',','')
info.head()

```

Out[12]:

	BoroughName	Population	Latitude	Longitude
0	Barking and Dagenham	194352	51.5607	0.1557
1	Barnet	369088	51.6252	-0.1517
2	Bexley	236687	51.4549	0.1505
3	Brent	317264	51.5588	-0.2817
4	Bromley	317899	51.4039	0.0198

In [13]:

```

#Find the unique Boroughs
info['BoroughName'].unique()

```

Out[13]:

```

array(['Barking and Dagenham', 'Barnet', 'Bexley', 'Brent', 'Bromley',
      'Camden', 'Croydon', 'Ealing', 'Enfield', 'Greenwich', 'Hackney',
      'Hammersmith and Fulham', 'Haringey', 'Harrow', 'Havering',
      'Hillingdon', 'Hounslow', 'Islington', 'Kensington and Chelsea',
      'Kingston upon Thames', 'Lambeth', 'Lewisham', 'Merton', 'Newham',
      'Redbridge', 'Richmond upon Thames', 'Southwark', 'Sutton',
      'Tower Hamlets', 'Waltham Forest', 'Wandsworth', 'Westminster'],
      dtype=object)

```

*Foursquare API

- List of top 50 popular places in the neighborhood
- source: Foursquare
- url: <https://api.foursquare.com> (<https://api.foursquare.com>)

In [14]:

```
# Foursquare credentials
CLIENT_ID = 'FDTRVYJUIMW5NIUX1P05QXRCVBYF44E2GGER5C4JR32JO21U'
CLIENT_SECRET = '1GBIIWCMLOMCHNWN2LBH5WVGZDY1LL2MHCD2MFF4FFGLKLJV'
VERSION = '20180605'

print('Your credentials:')
print('CLIENT_ID: ' + CLIENT_ID)
print('CLIENT_SECRET: ' + CLIENT_SECRET)
```

Your credentials:

```
CLIENT_ID: FDTRVYJUIMW5NIUX1P05QXRCVBYF44E2GGER5C4JR32JO21U
CLIENT_SECRET: 1GBIIWCMLOMCHNWN2LBH5WVGZDY1LL2MHCD2MFF4FFGLKLJV
```

In [15]:

```
#Create a function to explore all borough
def getNearbyVenues(names, latitudes, longitudes, radius=500):

    venues_list=[]
    for name, lat, lng in zip(names, latitudes, longitudes):
        print(name)

        # create the API request URL
        url = 'https://api.foursquare.com/v2/venues/explore?&client_id={}&client_secret
={}&v={}&ll={}&radius={}&limit={}'.format(
            CLIENT_ID,
            CLIENT_SECRET,
            VERSION,
            lat,
            lng,
            radius,
            LIMIT)

        # make the GET request
        results = requests.get(url).json()["response"]['groups'][0]['items']

        # return only relevant information for each nearby venue
        venues_list.append([(
            name,
            lat,
            lng,
            v['venue']['name'],
            v['venue']['location']['lat'],
            v['venue']['location']['lng'],
            v['venue']['categories'][0]['name']) for v in results])

    nearby_venues = pd.DataFrame([item for venue_list in venues_list for item in venue_
list])
    nearby_venues.columns = ['BoroughName',
                            'Borough Latitude',
                            'Borough Longitude',
                            'Venue',
                            'Venue Latitude',
                            'Venue Longitude',
                            'Venue Category']

    return(nearby_venues)
```

In [16]:

```
#Get top 50 venues in 500m radius of the center of each Borough
LIMIT = 50
venues = getNearbyVenues(names=info['BoroughName'],
                           latitudes=info['Latitude'],
                           longitudes=info['Longitude']
                           )
```

Barking and Dagenham
Barnet
Bexley
Brent
Bromley
Camden
Croydon
Ealing
Enfield
Greenwich
Hackney
Hammersmith and Fulham
Haringey
Harrow
Havering
Hillingdon
Hounslow
Islington
Kensington and Chelsea
Kingston upon Thames
Lambeth
Lewisham
Merton
Newham
Redbridge
Richmond upon Thames
Southwark
Sutton
Tower Hamlets
Waltham Forest
Wandsworth
Westminster

In [17]:

```
print(venues.shape)
venues.head()
```

(1145, 7)

Out[17]:

	BoroughName	Borough Latitude	Borough Longitude	Venue	Venue Latitude	Venue Longitude	Venue Category
0	Barking and Dagenham	51.5607	0.1557	Central Park	51.559560	0.161981	Park
1	Barking and Dagenham	51.5607	0.1557	Beacontree Heath Leisure Centre	51.560997	0.148932	Gym / Fitness Center
2	Barking and Dagenham	51.5607	0.1557	Crowlands Heath Golf Course	51.562457	0.155818	Golf Course
3	Barking and Dagenham	51.5607	0.1557	Robert Clack Leisure Centre	51.560808	0.152704	Martial Arts Dojo
4	Barking and Dagenham	51.5607	0.1557	Beacontree Heath Bus Station	51.561065	0.150998	Bus Station

3. Methodology

In this section, we will explore the cleansed data more thoroughly using visualizations. Then, we will conduct cluster analysis to classify the boroughs into different levels of preference.

a. Exploratory Analysis

In [18]:

```
info.head()
```

Out[18]:

	BoroughName	Population	Latitude	Longitude
0	Barking and Dagenham	194352	51.5607	0.1557
1	Barnet	369088	51.6252	-0.1517
2	Bexley	236687	51.4549	0.1505
3	Brent	317264	51.5588	-0.2817
4	Bromley	317899	51.4039	0.0198

In [19]:

```
venues.head()
```

Out[19]:

	BoroughName	Borough Latitude	Borough Longitude	Venue	Venue Latitude	Venue Longitude	Venue Category
0	Barking and Dagenham	51.5607	0.1557	Central Park	51.559560	0.161981	Park
1	Barking and Dagenham	51.5607	0.1557	Beacontree Heath Leisure Centre	51.560997	0.148932	Gym / Fitness Center
2	Barking and Dagenham	51.5607	0.1557	Crowlands Heath Golf Course	51.562457	0.155818	Golf Course
3	Barking and Dagenham	51.5607	0.1557	Robert Clack Leisure Centre	51.560808	0.152704	Martial Arts Dojo
4	Barking and Dagenham	51.5607	0.1557	Beacontree Heath Bus Station	51.561065	0.150998	Bus Station

In [20]:

```
venues.groupby('BoroughName').count()
```

Out[20]:

	Borough Latitude	Borough Longitude	Venue	Venue Latitude	Venue Longitude	Venue Category
BoroughName						
Barking and Dagenham	7	7	7	7	7	7
Barnet	4	4	4	4	4	4
Bexley	30	30	30	30	30	30
Brent	50	50	50	50	50	50
Bromley	41	41	41	41	41	41
Camden	50	50	50	50	50	50
Croydon	40	40	40	40	40	40
Ealing	50	50	50	50	50	50
Enfield	50	50	50	50	50	50
Greenwich	40	40	40	40	40	40
Hackney	50	50	50	50	50	50
Hammersmith and Fulham	50	50	50	50	50	50
Haringey	22	22	22	22	22	22
Harrow	8	8	8	8	8	8
Havering	41	41	41	41	41	41
Hillingdon	50	50	50	50	50	50
Hounslow	4	4	4	4	4	4
Islington	50	50	50	50	50	50
Kensington and Chelsea	50	50	50	50	50	50
Kingston upon Thames	50	50	50	50	50	50
Lambeth	50	50	50	50	50	50
Lewisham	31	31	31	31	31	31
Merton	18	18	18	18	18	18
Newham	12	12	12	12	12	12
Redbridge	37	37	37	37	37	37
Richmond upon Thames	50	50	50	50	50	50
Southwark	50	50	50	50	50	50
Sutton	37	37	37	37	37	37

	Borough Latitude	Borough Longitude	Venue	Venue Latitude	Venue Longitude	Venue Category
BoroughName						
Tower Hamlets	18	18	18	18	18	18
Waltham Forest	13	13	13	13	13	13
Wandsworth	42	42	42	42	42	42
Westminster	50	50	50	50	50	50

In [21]:

```
print('There are {} uniques categories.'.format(len(venues['Venue Category'].unique())))
```

There are 180 uniques categories.

In [22]:

```
from geopy.geocoders import Nominatim
```

In [23]:

```
address = 'London, United Kingdom'

geolocator = Nominatim(user_agent="ld_explorer")
location = geolocator.geocode(address)
latitude = location.latitude
longitude = location.longitude
print('The geograpical coordinate of London are {}, {}'.format(latitude, longitude))
```

The geograpical coordinate of London are 51.5073219, -0.1276474.

In [25]:

```
import folium
```

In [35]:

```
info.dtypes
```

Out[35]:

```
BoroughName    object
Population     object
Latitude       float64
Longitude      float64
dtype: object
```

In [34]:

```
#update the Latitude and Longitude data types to float as they are oh object datatype
info = info.astype({"Latitude": float, "Longitude": float})
```

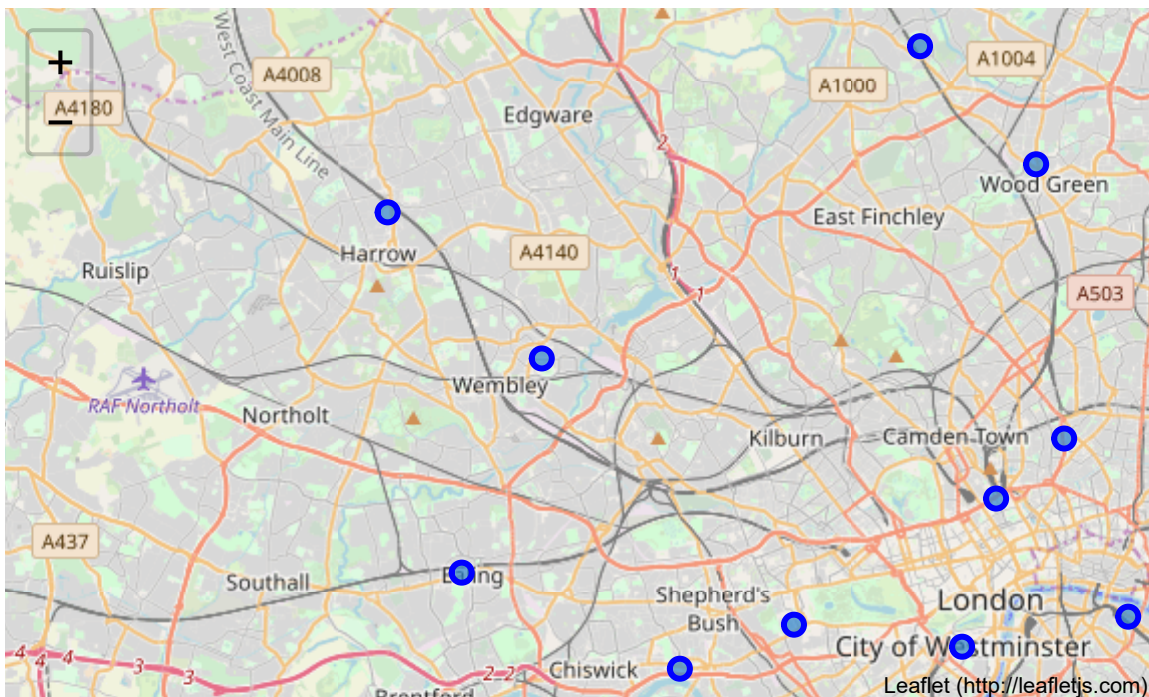
In [36]:

```
# make a map of London using folium
map = folium.Map(location=[latitude, longitude], zoom_start=11)

# add markers to map
for lat, lng, borough in zip(info['Latitude'], info['Longitude'], info['BoroughName']):
    label = folium.Popup(borough, parse_html=True)
    folium.CircleMarker(
        [lat, lng],
        radius=5,
        popup=label,
        color='blue',
        fill=True,
        fill_color='#3186cc',
        fill_opacity=0.7,
        parse_html=False).add_to(map)
```

map

Out[36]:



b. Cluster Analysis

In this part, we will conduct K-means clustering to group the boroughs according to what convenience facilities they have using Foursquare data.

In [37]:

```
print('There are {} uniques categories.'.format(len(venues['Venue Category'].unique())))
```

There are 180 uniques categories.

In [38]:

```
# One hot encoding before clustering
kut_onehot = pd.get_dummies(venues[['Venue Category']], prefix="", prefix_sep="")

# add boroughname column back to dataframe
kut_onehot['BoroughName'] = venues['BoroughName']

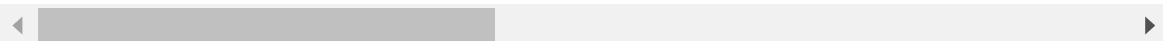
# move boroughname column to the first column
fixed_columns = [kut_onehot.columns[-1]] + list(kut_onehot.columns[:-1])
kut_onehot = kut_onehot[fixed_columns]

kut_onehot.head()
```

Out[38]:

	BoroughName	African Restaurant	Airport	Airport Lounge	Airport Service	American Restaurant	Argentinian Restaurant	Gall
0	Barking and Dagenham	0	0	0	0	0	0	0
1	Barking and Dagenham	0	0	0	0	0	0	0
2	Barking and Dagenham	0	0	0	0	0	0	0
3	Barking and Dagenham	0	0	0	0	0	0	0
4	Barking and Dagenham	0	0	0	0	0	0	0

5 rows × 181 columns



In [39]:

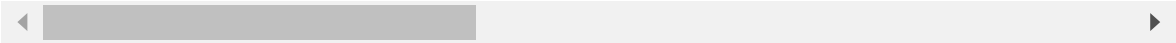
```
# Group rows by borough and take the mean of frequency of each venue category  
kut_grouped = kut_onehot.groupby('BoroughName').mean().reset_index()  
kut_grouped
```

Out[39]:

	BoroughName	African Restaurant	Airport	Airport Lounge	Airport Service	American Restaurant	Argentinian Restaurant
0	Barking and Dagenham	0.000	0.000000	0.000000	0.000000	0.000000	0.00
1	Barnet	0.000	0.000000	0.000000	0.000000	0.000000	0.00
2	Bexley	0.000	0.000000	0.000000	0.000000	0.033333	0.00
3	Brent	0.000	0.000000	0.000000	0.000000	0.040000	0.00
4	Bromley	0.000	0.000000	0.000000	0.000000	0.000000	0.00
5	Camden	0.000	0.000000	0.000000	0.000000	0.000000	0.00
6	Croydon	0.000	0.000000	0.000000	0.000000	0.000000	0.00
7	Ealing	0.000	0.000000	0.000000	0.000000	0.000000	0.00
8	Enfield	0.000	0.000000	0.000000	0.000000	0.000000	0.00
9	Greenwich	0.025	0.000000	0.000000	0.000000	0.000000	0.00
10	Hackney	0.000	0.000000	0.000000	0.000000	0.000000	0.00
11	Hammersmith and Fulham	0.000	0.000000	0.000000	0.000000	0.000000	0.00
12	Haringey	0.000	0.000000	0.000000	0.000000	0.000000	0.00
13	Harrow	0.000	0.000000	0.000000	0.000000	0.000000	0.00
14	Havering	0.000	0.000000	0.000000	0.000000	0.000000	0.00
15	Hillingdon	0.000	0.000000	0.000000	0.000000	0.000000	0.00
16	Hounslow	0.000	0.000000	0.000000	0.000000	0.000000	0.00
17	Islington	0.000	0.000000	0.000000	0.000000	0.000000	0.00
18	Kensington and Chelsea	0.000	0.000000	0.000000	0.000000	0.000000	0.00
19	Kingston upon Thames	0.000	0.000000	0.000000	0.000000	0.000000	0.00
20	Lambeth	0.020	0.000000	0.000000	0.000000	0.000000	0.00
21	Lewisham	0.000	0.000000	0.000000	0.000000	0.000000	0.00
22	Merton	0.000	0.000000	0.000000	0.000000	0.000000	0.00
23	Newham	0.000	0.083333	0.083333	0.083333	0.000000	0.00
24	Redbridge	0.000	0.000000	0.000000	0.000000	0.000000	0.00
25	Richmond upon Thames	0.000	0.000000	0.000000	0.000000	0.000000	0.00
26	Southwark	0.000	0.000000	0.000000	0.000000	0.020000	0.02

	BoroughName	African Restaurant	Airport	Airport Lounge	Airport Service	American Restaurant	Argentinian Restaurant
27	Sutton	0.000	0.000000	0.000000	0.000000	0.000000	0.00
28	Tower Hamlets	0.000	0.000000	0.000000	0.000000	0.000000	0.00
29	Waltham Forest	0.000	0.000000	0.000000	0.000000	0.000000	0.00
30	Wandsworth	0.000	0.000000	0.000000	0.000000	0.000000	0.00
31	Westminster	0.000	0.000000	0.000000	0.000000	0.000000	0.00

32 rows × 181 columns



In [40]:

```
kut_grouped.shape
```

Out[40]:

(32, 181)

In [41]:

```
# top 5 venues for each neighborhood
num_top_venues = 5

for hood in kut_grouped['BoroughName']:
    print("----"+hood+"----")
    temp = kut_grouped[kut_grouped['BoroughName'] == hood].T.reset_index()
    temp.columns = ['venue', 'freq']
    temp = temp.iloc[1:]
    temp['freq'] = temp['freq'].astype(float)
    temp = temp.round({'freq': 2})
    print(temp.sort_values('freq', ascending=False).reset_index(drop=True).head(num_top_venues))
    print('\n')
```

----Barking and Dagenham----

	venue	freq
0	Pool	0.14
1	Park	0.14
2	Bus Station	0.14
3	Supermarket	0.14
4	Golf Course	0.14

----Barnet----

	venue	freq
0	Café	0.50
1	Bus Stop	0.25
2	Recording Studio	0.25
3	African Restaurant	0.00
4	Park	0.00

----Bexley----

	venue	freq
0	Clothing Store	0.13
1	Pub	0.10
2	Coffee Shop	0.10
3	Furniture / Home Store	0.07
4	Fast Food Restaurant	0.07

----Brent----

	venue	freq
0	Coffee Shop	0.12
1	Hotel	0.10
2	Grocery Store	0.06
3	Sporting Goods Shop	0.06
4	Clothing Store	0.06

----Bromley----

	venue	freq
0	Clothing Store	0.12
1	Coffee Shop	0.12
2	Burger Joint	0.05
3	Gym / Fitness Center	0.05
4	Pizza Place	0.05

----Camden----

	venue	freq
0	Hotel	0.12
1	Café	0.08
2	Coffee Shop	0.06
3	Tapas Restaurant	0.04
4	Breakfast Spot	0.04

----Croydon----

	venue	freq
0	Coffee Shop	0.10
1	Pub	0.10
2	Indian Restaurant	0.05
3	Portuguese Restaurant	0.05
4	Gym / Fitness Center	0.05

----Ealing----

	venue	freq
0	Coffee Shop	0.10
1	Pub	0.04
2	Pizza Place	0.04
3	Burger Joint	0.04
4	Vietnamese Restaurant	0.04

----Enfield----

	venue	freq
0	Clothing Store	0.08
1	Coffee Shop	0.08
2	Optical Shop	0.04
3	Turkish Restaurant	0.04
4	Bookstore	0.04

----Greenwich----

	venue	freq
0	Coffee Shop	0.08
1	Pub	0.08
2	Clothing Store	0.08
3	Fast Food Restaurant	0.08
4	Supermarket	0.08

----Hackney----

	venue	freq
0	Pub	0.10
1	Coffee Shop	0.08
2	Bakery	0.06
3	Café	0.06
4	Cocktail Bar	0.06

----Hammersmith and Fulham----

	venue	freq
0	Pub	0.14
1	Indian Restaurant	0.08
2	Italian Restaurant	0.08
3	Gastropub	0.06
4	Clothing Store	0.04

----Haringey----

	venue	freq
0	Fast Food Restaurant	0.09
1	Café	0.09
2	Pub	0.05
3	Mediterranean Restaurant	0.05
4	Portuguese Restaurant	0.05

----Harrow----

	venue	freq
0	Indian Restaurant	0.25
1	Coffee Shop	0.25
2	Indie Movie Theater	0.12

3	Platform	0.12
4	Convenience Store	0.12

----Haverling----

	venue	freq
0	Clothing Store	0.12
1	Coffee Shop	0.10
2	Shopping Mall	0.07
3	Hotel	0.07
4	Pub	0.05

----Hillingdon----

	venue	freq
0	Coffee Shop	0.16
1	Italian Restaurant	0.08
2	Clothing Store	0.08
3	Pharmacy	0.04
4	Burger Joint	0.04

----Hounslow----

	venue	freq
0	Park	0.25
1	Pizza Place	0.25
2	Café	0.25
3	Bed & Breakfast	0.25
4	Outlet Store	0.00

----Islington----

	venue	freq
0	Pub	0.14
1	Cocktail Bar	0.06
2	Mediterranean Restaurant	0.06
3	Bakery	0.06
4	Theater	0.04

----Kensington and Chelsea----

	venue	freq
0	Café	0.06
1	Restaurant	0.04
2	English Restaurant	0.04
3	Burger Joint	0.04
4	Modern European Restaurant	0.04

----Kingston upon Thames----

	venue	freq
0	Coffee Shop	0.10
1	Café	0.08
2	Clothing Store	0.06
3	Department Store	0.06
4	Pub	0.04

----Lambeth----

	venue	freq
0	Caribbean Restaurant	0.08

1	Market	0.06
2	Cocktail Bar	0.04
3	Restaurant	0.04
4	Indian Restaurant	0.04

----Lewisham----

	venue	freq
0	Supermarket	0.13
1	Grocery Store	0.10
2	Coffee Shop	0.06
3	Train Station	0.06
4	Platform	0.06

----Merton----

	venue	freq
0	Supermarket	0.11
1	Café	0.11
2	Park	0.11
3	Grocery Store	0.06
4	Sandwich Place	0.06

----Newham----

	venue	freq
0	Hotel	0.33
1	Chinese Restaurant	0.08
2	Airport Lounge	0.08
3	Airport Service	0.08
4	Currency Exchange	0.08

----Redbridge----

	venue	freq
0	Fast Food Restaurant	0.11
1	Clothing Store	0.11
2	Supermarket	0.05
3	Grocery Store	0.05
4	Hotel	0.05

----Richmond upon Thames----

	venue	freq
0	Pub	0.16
1	Coffee Shop	0.12
2	Italian Restaurant	0.10
3	Indian Restaurant	0.06
4	Café	0.04

----Southwark----

	venue	freq
0	Coffee Shop	0.08
1	Hotel	0.06
2	Pub	0.06
3	Hotel Bar	0.04
4	English Restaurant	0.04

----Sutton----

	venue	freq
0	Clothing Store	0.11
1	Pub	0.11
2	Coffee Shop	0.08
3	Pizza Place	0.05
4	Café	0.05

----Tower Hamlets----

	venue	freq
0	Café	0.11
1	Italian Restaurant	0.11
2	Coffee Shop	0.11
3	Hotel	0.11
4	Fried Chicken Joint	0.06

----Waltham Forest----

	venue	freq
0	Pub	0.15
1	Pool	0.08
2	Tea Room	0.08
3	Beer Store	0.08
4	Gym	0.08

----Wandsworth----

	venue	freq
0	Coffee Shop	0.10
1	Pub	0.10
2	Clothing Store	0.07
3	Breakfast Spot	0.05
4	Pizza Place	0.05

----Westminster----

	venue	freq
0	Coffee Shop	0.12
1	Hotel	0.12
2	Sandwich Place	0.10
3	Theater	0.08
4	Sushi Restaurant	0.06

In [42]:

```
# Put into pandas dataframe
def return_most_common_venues(row, num_top_venues):
    row_categories = row.iloc[1:]
    row_categories_sorted = row_categories.sort_values(ascending=False)

    return row_categories_sorted.index.values[0:num_top_venues]
```

In [43]:

```
num_top_venues = 10
indicators = ['st', 'nd', 'rd']

# create columns according to number of top venues
columns = ['BoroughName']
for ind in np.arange(num_top_venues):
    try:
        columns.append('{}{} Most Common Venue'.format(ind+1, indicators[ind]))
    except:
        columns.append('{}th Most Common Venue'.format(ind+1))

# create a new dataframe
neighborhoods_venues_sort = pd.DataFrame(columns=columns)
neighborhoods_venues_sort['BoroughName'] = kut_grouped['BoroughName']

for ind in np.arange(kut_grouped.shape[0]):
    neighborhoods_venues_sort.iloc[ind, 1:] = return_most_common_venues(kut_grouped.iloc[ind, :], num_top_venues)

neighborhoods_venues_sort
```


Out[43]:

	BoroughName	1st Most Common Venue	2nd Most Common Venue	3rd Most Common Venue	4th Most Common Venue	5th Most Common Venue
0	Barking and Dagenham	Golf Course	Pool	Bus Station	Gym / Fitness Center	Park
1	Barnet	Café	Bus Stop	Recording Studio	Yoga Studio	Dumpling Restaurant
2	Bexley	Clothing Store	Coffee Shop	Pub	Furniture / Home Store	Supermarket
3	Brent	Coffee Shop	Hotel	Sporting Goods Shop	Grocery Store	Clothing Store
4	Bromley	Clothing Store	Coffee Shop	Pizza Place	Burger Joint	Bar
5	Camden	Hotel	Café	Coffee Shop	Pizza Place	Train Station
6	Croydon	Coffee Shop	Pub	Indian Restaurant	Portuguese Restaurant	Gym / Fitness Center
7	Ealing	Coffee Shop	Pub	Italian Restaurant	Vietnamese Restaurant	Park
8	Enfield	Coffee Shop	Clothing Store	Optical Shop	Café	Supermarket
9	Greenwich	Clothing Store	Supermarket	Fast Food Restaurant	Pub	Coffee Shop
10	Hackney	Pub	Coffee Shop	Café	Cocktail Bar	Bakery
11	Hammersmith and Fulham	Pub	Italian Restaurant	Indian Restaurant	Gastropub	Clothing Store
12	Haringey	Fast Food Restaurant	Café	Playground	Pub	Portuguese Restaurant
13	Harrow	Indian Restaurant	Coffee Shop	Indie Movie Theater	Supermarket	Platform
14	Havering	Clothing Store	Coffee Shop	Hotel	Shopping Mall	Café
15	Hillingdon	Coffee Shop	Italian Restaurant	Clothing Store	Sandwich Place	Burger Joint

	BoroughName	1st Most Common Venue	2nd Most Common Venue	3rd Most Common Venue	4th Most Common Venue	5th Most Common Venue
16	Hounslow	Pizza Place	Park	Café	Bed & Breakfast	Yoga Studio
17	Islington	Pub	Cocktail Bar	Bakery	Mediterranean Restaurant	Burger Joint
18	Kensington and Chelsea	Café	Gym / Fitness Center	Restaurant	English Restaurant	Burger Joint
19	Kingston upon Thames	Coffee Shop	Café	Clothing Store	Department Store	Burger Joint
20	Lambeth	Caribbean Restaurant	Market	Tapas Restaurant	Burger Joint	Pub
21	Lewisham	Supermarket	Grocery Store	Platform	Coffee Shop	Train Station
22	Merton	Supermarket	Café	Park	Garden Center	Fast Food Restaurant
23	Newham	Hotel	Currency Exchange	Airport	Airport Lounge	Airport Service
24	Redbridge	Clothing Store	Fast Food Restaurant	Hotel	Grocery Store	Sandwich Place
25	Richmond upon Thames	Pub	Coffee Shop	Italian Restaurant	Indian Restaurant	Café
26	Southwark	Coffee Shop	Hotel	Pub	Theater	Hotel Bar
27	Sutton	Clothing Store	Pub	Coffee Shop	Italian Restaurant	Café
28	Tower Hamlets	Café	Hotel	Italian Restaurant	Coffee Shop	Convenience Store
29	Waltham Forest	Pub	Coffee Shop	Gym / Fitness Center	Concert Hall	Pool
30	Wandsworth	Pub	Coffee Shop	Clothing Store	Supermarket	Breakfast Spot
31	Westminster	Coffee Shop	Hotel	Sandwich Place	Theater	Sushi Restaurant



In [44]:

```
# import k-means from clustering stage
from sklearn.cluster import KMeans

# set number of clusters
kclusters = 5

kut_grouped_clustering = kut_grouped.drop('BoroughName', 1)

# run k-means clustering
kmeans = KMeans(n_clusters=kclusters, random_state=0).fit(kut_grouped_clustering)

# check cluster labels generated for each row in the dataframe
kmeans.labels_[0:10]
```

Out[44]:

```
array([4, 2, 3, 0, 3, 0, 0, 0, 3, 3])
```

In [45]:

```
# add clustering labels
neighborhoods_venues_sort.insert(0, 'Cluster Labels', kmeans.labels_)

kut_merged = info

# merge london_grouped with london_data to add latitude/longitude for each neighborhood
kut_merged = kut_merged.join(neighborhoods_venues_sort.set_index('BoroughName'), on='BoroughName')

kut_merged.head() # check the last columns!
```

Out[45]:

	BoroughName	Population	Latitude	Longitude	Cluster Labels	1st Most Common Venue	2nd Most Common Venue	3rd Most Common Venue
0	Barking and Dagenham	194352	51.5607	0.1557	4	Golf Course	Pool	Bus Station
1	Barnet	369088	51.6252	-0.1517	2	Café	Bus Stop	Recreation Studio
2	Bexley	236687	51.4549	0.1505	3	Clothing Store	Coffee Shop	Pub
3	Brent	317264	51.5588	-0.2817	0	Coffee Shop	Hotel	Sport Goods Shop
4	Bromley	317899	51.4039	0.0198	3	Clothing Store	Coffee Shop	Pizza Place



In [46]:

```
kut_merged.info()
```

```
<class 'pandas.core.frame.DataFrame'>  
RangeIndex: 32 entries, 0 to 31  
Data columns (total 15 columns):  
BoroughName      32 non-null object  
Population        32 non-null object  
Latitude          32 non-null float64  
Longitude         32 non-null float64  
Cluster Labels    32 non-null int32  
1st Most Common Venue  32 non-null object  
2nd Most Common Venue  32 non-null object  
3rd Most Common Venue  32 non-null object  
4th Most Common Venue  32 non-null object  
5th Most Common Venue  32 non-null object  
6th Most Common Venue  32 non-null object  
7th Most Common Venue  32 non-null object  
8th Most Common Venue  32 non-null object  
9th Most Common Venue  32 non-null object  
10th Most Common Venue 32 non-null object  
dtypes: float64(2), int32(1), object(12)  
memory usage: 3.7+ KB
```

In [47]:

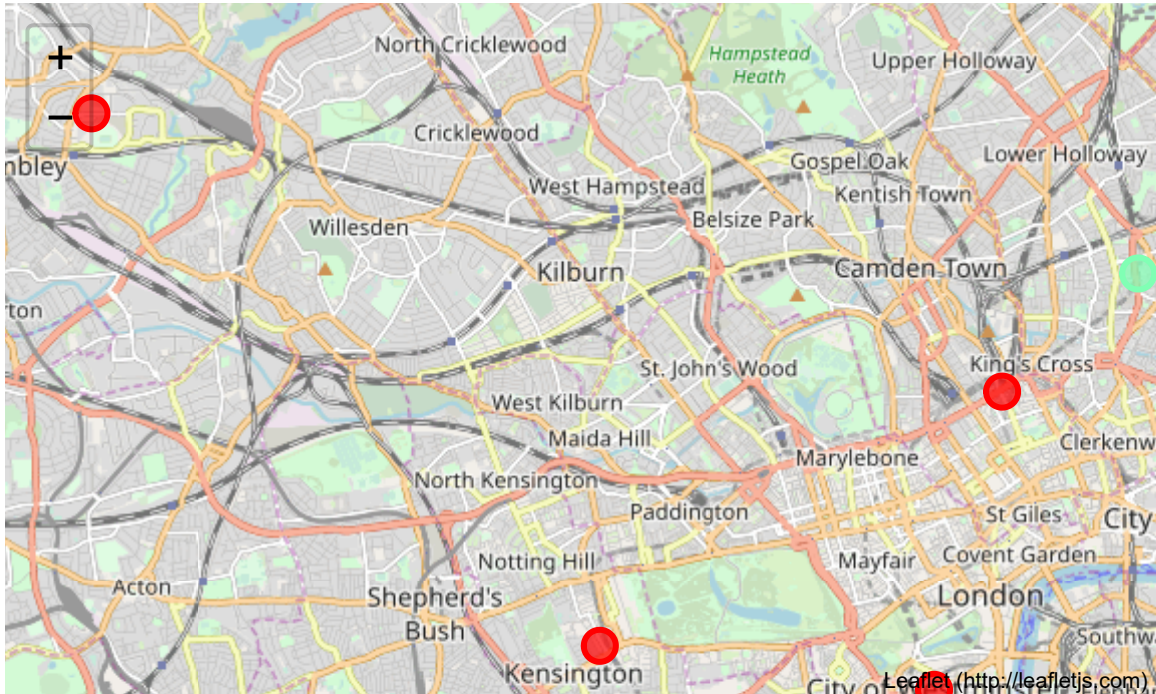
```
# create map
import matplotlib.cm as cm
import matplotlib.colors as colors
map_clusters = folium.Map(location=[latitude, longitude], zoom_start=11.5)

# set color scheme for the clusters
x = np.arange(kclusters)
ys = [i + x + (i*x)**2 for i in range(kclusters)]
colors_array = cm.rainbow(np.linspace(0, 1, len(ys)))
rainbow = [colors.rgb2hex(i) for i in colors_array]

# add markers to the map
markers_colors = []
for lat, lon, poi, cluster in zip(kut_merged['Latitude'], kut_merged['Longitude'], kut_
merged['BoroughName'], kut_merged['Cluster Labels']):
    label = folium.Popup(str(poi) + ' Cluster ' + str(cluster), parse_html=True)
    folium.CircleMarker(
        [lat, lon],
        radius=8,
        popup=label,
        color=rainbow[cluster-1],
        fill=True,
        fill_color=rainbow[cluster-1],
        fill_opacity=0.7).add_to(map_clusters)

map_clusters
```

Out[47]:



Now let's observe each clusters and name them according to their characteristics

In [48]:

```
# Cluster:0 - This cluster is filled with Restaurants and Pubs.
#Also, two of the boroughs Croydon (3rd most common venue) and Lambeth (6th most common venue) are Indian Restaurants.
kut_merged[kut_merged['Cluster Labels'] == 0]
```

Out[48]:

	BoroughName	Population	Latitude	Longitude	Cluster Labels	1st Most Common Venue	2nd Most Common Venue	3rd Most Common Venue
3	Brent	317264	51.5588	-0.2817	0	Coffee Shop	Hotel	Spa
5	Camden	229719	51.5290	-0.1255	0	Hotel	Café	Coffee Shop
6	Croydon	372752	51.3714	-0.0977	0	Coffee Shop	Pub	Indian Restaurant
7	Ealing	342494	51.5130	-0.3089	0	Coffee Shop	Pub	Italian Restaurant
13	Harrow	243372	51.5898	-0.3346	0	Indian Restaurant	Coffee Shop	Indian Restaurant
18	Kensington and Chelsea	155594	51.5020	-0.1947	0	Café	Gym / Fitness Center	Restaurant
20	Lambeth	314242	51.4607	-0.1163	0	Caribbean Restaurant	Market	Ta
23	Newham	318227	51.5077	0.0469	0	Hotel	Currency Exchange	Air
26	Southwark	298464	51.5035	-0.0804	0	Coffee Shop	Hotel	Pub
28	Tower Hamlets	272890	51.5099	-0.0059	0	Café	Hotel	Italian Restaurant
29	Waltham Forest	265797	51.5908	-0.0134	0	Pub	Coffee Shop	Gym / Fitness Center
31	Westminster	226841	51.4973	-0.1372	0	Coffee Shop	Hotel	Spa

In [49]:

```
# Cluster:2 - This cluster can be a good place to open an Indian Restaurant.
kut_merged[kut_merged['Cluster Labels'] == 1]
```

Out[49]:

	BoroughName	Population	Latitude	Longitude	Cluster Labels	1st Most Common Venue	2nd Most Common Venue	3rd Common Venue
16	Hounslow	262407	51.4746	-0.368	1	Pizza Place	Park	Café

In [50]:

```
# Cluster:3 - This cluster can be a good place to open an Indian Restaurant.
kut_merged[kut_merged['Cluster Labels'] == 2]
```

Out[50]:

	BoroughName	Population	Latitude	Longitude	Cluster Labels	1st Most Common Venue	2nd Most Common Venue	3rd Common Venue
1	Barnet	369088	51.6252	-0.1517	2	Café	Bus Stop	Recreation Studio

In [51]:

```
# Cluster:2 - This cluster is filled with Pubs and Restaurants similar to cluster 1.  
kut_merged[kut_merged['Cluster Labels'] == 3]
```

Out[51]:

	BoroughName	Population	Latitude	Longitude	Cluster Labels	1st Most Common Venue	2nd Most Common Venue
2	Bexley	236687	51.4549	0.1505	3	Clothing Store	Coffee Shop
4	Bromley	317899	51.4039	0.0198	3	Clothing Store	Coffee Shop
8	Enfield	320524	51.6538	-0.0799	3	Coffee Shop	Clothing Store
9	Greenwich	264008	51.4892	0.0648	3	Clothing Store	Supermarket
10	Hackney	257379	51.5450	-0.0553	3	Pub	Coffee Shop
11	Hammersmith and Fulham	178685	51.4927	-0.2339	3	Pub	Italian Restaurant
12	Haringey	263386	51.6000	-0.1119	3	Fast Food Restaurant	Café
14	Havering	242080	51.5812	0.1837	3	Clothing Store	Coffee Shop
15	Hillingdon	286806	51.5441	-0.4760	3	Coffee Shop	Italian Restaurant
17	Islington	215667	51.5416	-0.1022	3	Pub	Cocktail Bar
19	Kingston upon Thames	166793	51.4085	-0.3064	3	Coffee Shop	Café
21	Lewisham	286180	51.4452	-0.0209	3	Supermarket	Grocery Store
22	Merton	203223	51.4014	-0.1958	3	Supermarket	Café
24	Redbridge	288272	51.5590	0.0741	3	Clothing Store	Fast Food Restaurant
25	Richmond upon Thames	191365	51.4479	-0.3260	3	Pub	Coffee Shop
27	Sutton	195914	51.3618	-0.1945	3	Clothing Store	Pub
30	Wandsworth	310516	51.4567	-0.1910	3	Pub	Coffee Shop

In [52]:

```
kut_merged[kut_merged['Cluster Labels'] == 4]
```

Out[52]:

	BoroughName	Population	Latitude	Longitude	Cluster Labels	1st Most Common Venue	2nd Most Common Venue	3rd Most Common Venue
0	Barking and Dagenham	194352	51.5607	0.1557	4	Golf Course	Pool	Bus Station

4. Results & Recommendation

Now we will review all the analysis made in this project before we make a conclusion on which area will be a good location to start an Indian Restaurant.

Like mentioned in the beginning, our key criteria of location decision will be based on less competition.

From the cluster analysis made above, we will give each clusters a name according to the characteristics inferable from the popular venues.

According to my interpretation, **Cluster 0** has Restaurants, pubs, coffee shops and grocery stores as popular places.

In [55]:

```
kut_merged.loc[kut_merged['Cluster Labels'] == 0].BoroughName.unique()
```

Out[55]:

```
array(['Brent', 'Camden', 'Croydon', 'Ealing', 'Harrow',
       'Kensington and Chelsea', 'Lambeth', 'Newham', 'Southwark',
       'Tower Hamlets', 'Waltham Forest', 'Westminster'], dtype=object)
```

According to my interpretation, **Cluster 1** has only one borough and it has no Indian Restaurant in that region.

In [58]:

```
kut_merged.loc[kut_merged['Cluster Labels'] == 1].BoroughName.unique()
```

Out[58]:

```
array(['Hounslow'], dtype=object)
```

According to my interpretation, **Cluster 2** has only one borough and it has no Indian Restaurant in that region.

In [59]:

```
kut_merged.loc[kut_merged['Cluster Labels'] == 2].BoroughName.unique()
```

Out[59]:

```
array(['Barnet'], dtype=object)
```

According to my interpretation, **Cluster 3** has Restaurants, pubs, coffee shops and grocery stores as popular places.

In [62]:

```
kut_merged.loc[kut_merged['Cluster Labels'] == 3].BoroughName.unique()
```

Out[62]:

```
array(['Bexley', 'Bromley', 'Enfield', 'Greenwich', 'Hackney',  
      'Hammersmith and Fulham', 'Haringey', 'Havering', 'Hillingdon',  
      'Islington', 'Kingston upon Thames', 'Lewisham', 'Merton',  
      'Redbridge', 'Richmond upon Thames', 'Sutton', 'Wandsworth'],  
      dtype=object)
```

According to my interpretation, **Cluster 4** has only one borough and it has no Indian Restaurant in that region.

In [63]:

```
kut_merged.loc[kut_merged['Cluster Labels'] == 4].BoroughName.unique()
```

Out[63]:

```
array(['Barking and Dagenham'], dtype=object)
```

5. Conclusion

From our analysis, we have found that the boroughs below are the best places to open an Indian Restaurant, based on the availability of Indian Restaurants and other type of restaurants available in the neighborhoods.

In [71]:

```
london_top_boroughs = kut_merged[kut_merged['Cluster Labels'].isin([1,2,4])]
```

In [72]:

london_top_boroughs

Out[72]:

	BoroughName	Population	Latitude	Longitude	Cluster Labels	1st Most Common Venue	2nd Most Common Venue	3rd Common Venue
0	Barking and Dagenham	194352	51.5607	0.1557	4	Golf Course	Pool	Bus Station
1	Barnet	369088	51.6252	-0.1517	2	Café	Bus Stop	Recreation Ground
16	Hounslow	262407	51.4746	-0.3680	1	Pizza Place	Park	Café



In [74]:

```
# make a map of London using folium
map = folium.Map(location=[latitude, longitude], zoom_start=10)

# add markers to map
for lat, lng, borough in zip(london_top_boroughs['Latitude'], london_top_boroughs['Longitude'], london_top_boroughs['BoroughName']):
    label = '{}'.format(borough)
    label2 = folium.Popup(label, parse_html=True)
    folium.CircleMarker(
        [lat, lng],
        radius=5,
        popup=label2,
        color='blue',
        fill=True,
        fill_color='#3186cc',
        fill_opacity=0.7,
        parse_html=False).add_to(map)

map
```

Out[74]:

