

# An Exploration of Washington D.C for Young Adults

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Coursera Capstone

Isabel Laurenceau

## Introduction

Large cities are often a popular relocation destination for young adults. The move to a new city however can be difficult when one is not familiar with the area. Washington D.C is a not only the capital of the United States but has also been ranked one of the best cities for Black women<sup>1</sup>.

As a young black woman, myself I have a strong interest in Washington D.C and though I have spent some time there I am curious about the different neighborhoods. In general, cities and neighborhoods have certain areas that serve different purposes. Take New York City as an example where the area around "Wall Street" would be more industrial than a residential neighborhood in Brooklyn or the more tourist show district around Broadway. It can be assumed that Washington D.C may have similar neighborhood divides.

Considering that there are over 130 official named neighborhoods<sup>2</sup> it's safe to say that spending time investigating each one on foot would not be very efficient. Instead, this project is meant to fast-track the process of looking at the city by dividing it up based on venues into three main groups: *Residential*, *Tourist*, and *Industrial*. Clusters produced in this method will be compared as to clusters produced when running K-Nearest Neighbor and potentially other algorithms.

## Data

Neighborhood Names and location data is provided from the OpenData DC dataset<sup>3</sup>. Each neighborhood will be assigned a label either *Residential*, *Tourist*, or

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<sup>1</sup> <https://www.essence.com/news/best-metro-areas-black-women/> && <https://www.bloomberg.com/news/articles/2020-01-09/the-best-and-worst-cities-for-black-women> && <https://travelnoire.com/best-worst-cities-black-women-relocate>

<sup>2</sup> <https://opendata.dc.gov/datasets/neighborhood-labels>

<sup>3</sup> <https://opendata.dc.gov/datasets/neighborhood-labels>

*Industrial* based on the majority type of venue that it contains. See Table A.1 in Appendix for list of all Neighborhood Names.

Venue data is pulled from the Foursquare API<sup>4</sup>. Over 302 unique categories were pulled using this API. The top ten overall venue types, a subset of the categories, is provided in Table 1. For this investigation many of the categories such as “BBQ Joint”, “Diner”, “Korean Restaurant” and “Salad Place” can be combined into label *Restaurant*. The new labels and their contents can be found in Tables A.2 – A.5.

As this was an exploration to create a guide for someone looking to live in the area the first cluster of interest was residential. As D.C is the capital of the United States it is also a popular tourist spot therefore tourism and potential “tourist neighborhoods” also became a target cluster. The third cluster was industry.

## Methodology

Two overall methods were used for this exploration. The first is an algorithm written specifically to filter out specific venues, hereby referred to as *alg* verses the K-Means clustering algorithm provided by scikit-learn referred to as *kmeans*.

*Alg* made use of context and the fact that the clusters of interests were known ahead of time as well as prior knowledge of the area. After the data was cleaned and relabelled as said in the Data section above the number of each type of venue was aggregated for each neighborhood. The neighborhood was based on whichever class has the majority of establishments. Pseudocode can be found in Figure X.

```
# each neighborhood has an overall label
# for each neighborhood
    # each neighborhood has an overall residential, industrial and tourist
    count
    #count how many residential, industrial and tourist establishments there
    are.
    #if an establishment is labeled as “rtboth” it gets a point in both residential
    and tourist.
#   neighborhood is assigned label based on majority of establishments.

# cluster neighborhoods based on labels
```

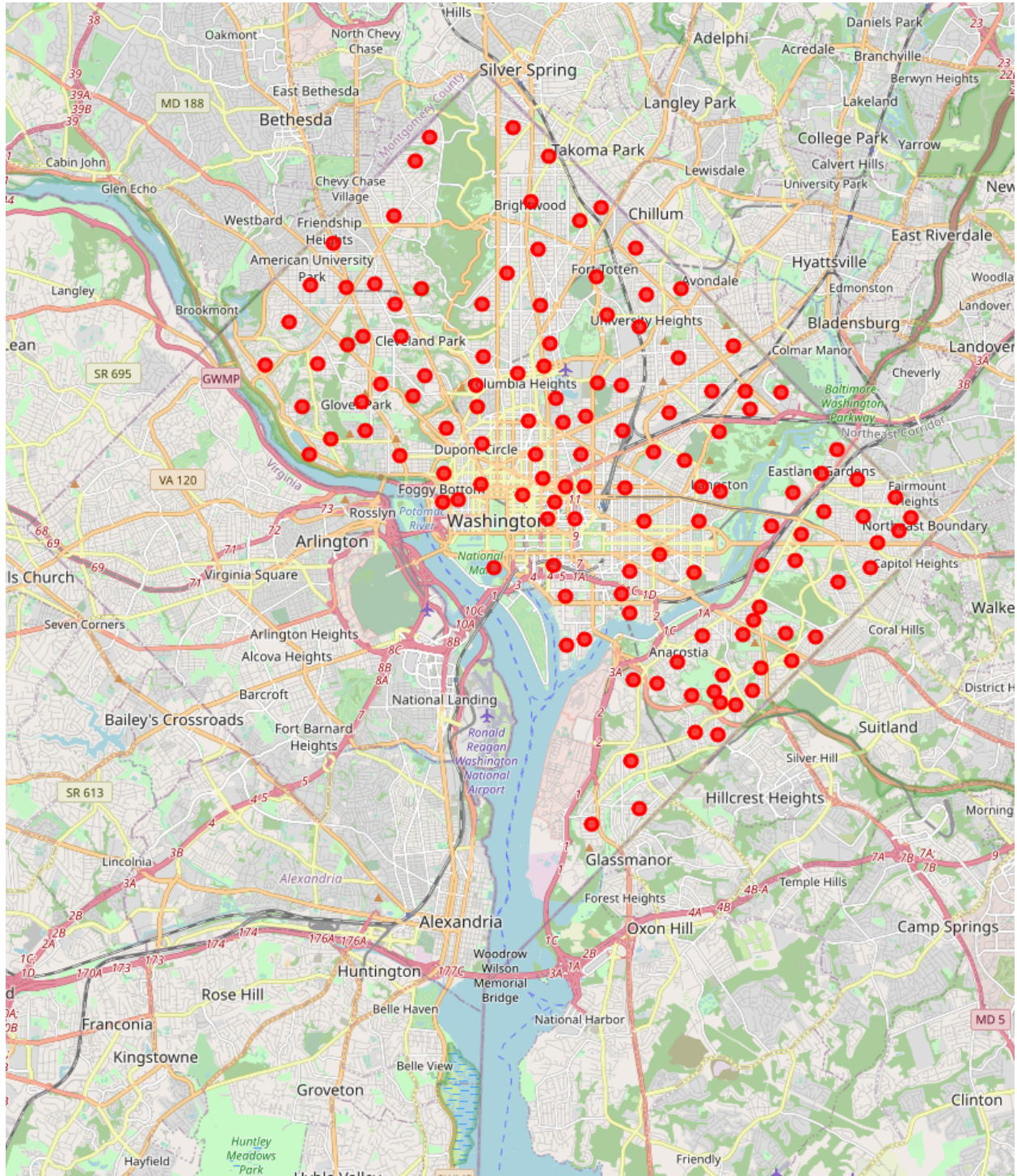
*Kmeans* was also used to cluster the neighborhoods. *Kmeans* was originally meant to be ran only on the cleaned data but very unbalanced clustering led

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<sup>4</sup> <https://foursquare.com>

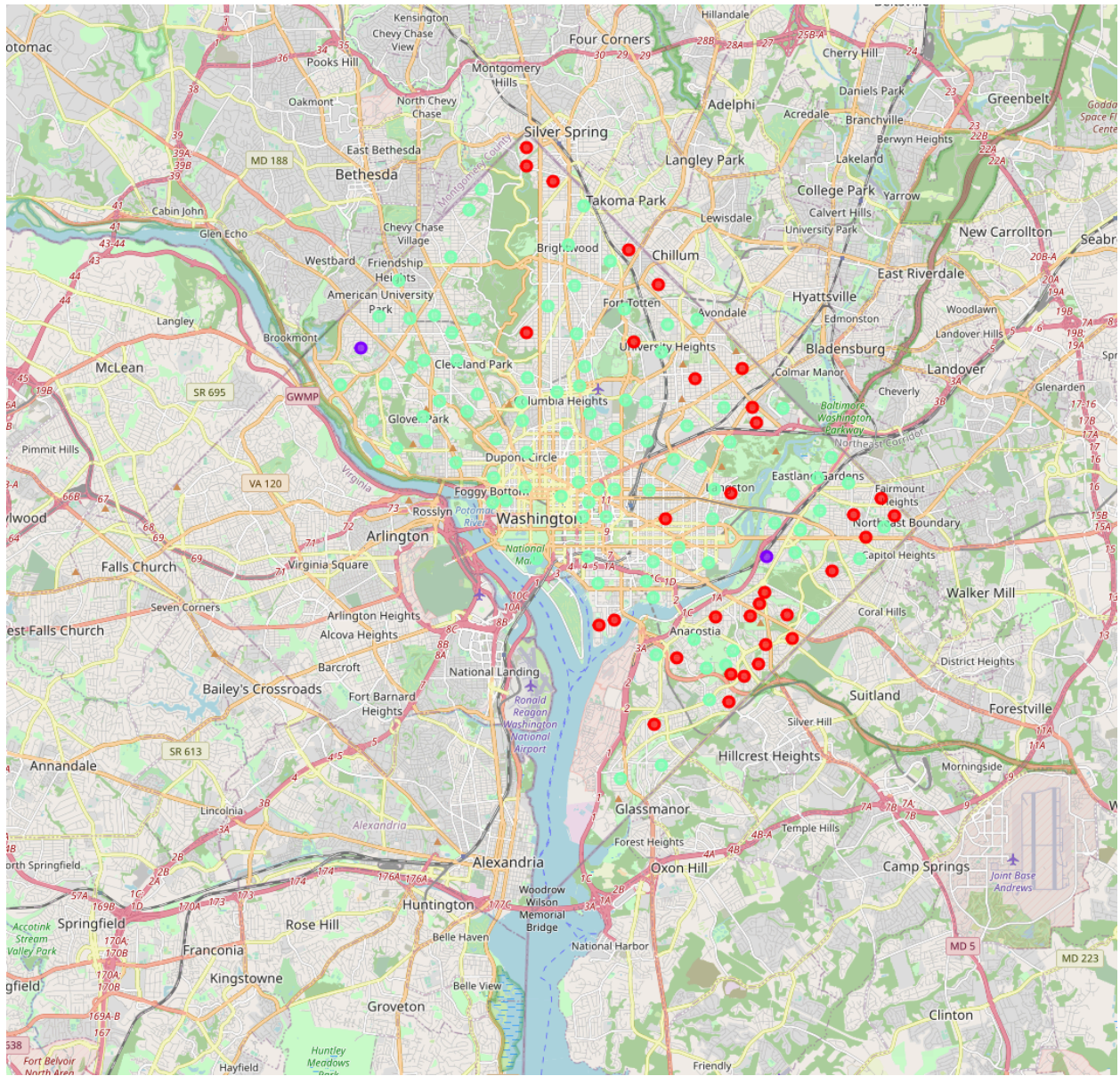
exploration of Kmeans with cluster sizes from 3-10 to see when neighborhoods started to differentiate each other.

## Results



**Figure1. Manual Algorithm**





**Figure2. KMeans K = 3**



**Figure3. Manual Algorithm v. KMeans K = 3**

For the manual algorithm, all neighborhoods were classified in the same group as “residential.” The KMeans algorithm also clustered most neighborhoods in one class and the smallest class only had two neighborhoods on opposite ends of the city (see purple in Figure one). It is not until the number of clusters is set to 8 that any real differentiation between the neighborhoods can be seen (see Figure 4)



**Figure 2. KMeans K = 4, 5, 6**



**Figure 3. KMeans K = 7,8**



**Figure 4. KMeans K = 9,10**



## Discussion

Though the results are surprising on first look further consideration supports the results. Only foursquare data was used for both clustering algorithms. With that said it makes sense that very few venues were labelled as "industrial" as foursquare started its data collection from a social media perspective. Therefore, it is less likely that people would "check-in" and provide data on industrial venues.

## Conclusion

Overall Washington D.C neighborhoods were very ubiquitous in terms of Foursquare data. To really implement a program which can help someone who is moving determine differences between neighborhoods more data would need to be collected.

## Appendix

**Table A.1 Washington D.C Neighborhoods**

| Neighborhood Name        | Longitude  | Latitude   |
|--------------------------|------------|------------|
| 16th Street Heights      | -77.033559 | 38.9503145 |
| Adams Morgan             | -77.042391 | 38.9204722 |
| American University Park | -77.09025  | 38.9476116 |
| Arboretum                | -76.97249  | 38.9148598 |
| Barnaby Woods            | -77.060174 | 38.9754334 |
| Barry Farm               | -76.997281 | 38.8592553 |
| Bellevue                 | -77.009271 | 38.8269524 |
| Benning                  | -76.948884 | 38.8918849 |
| Benning Ridge            | -76.938203 | 38.8811615 |
| Bloomingdale             | -77.011159 | 38.9182264 |
| Brentwood                | -76.987035 | 38.9189773 |
| Brightwood               | -77.026874 | 38.9663793 |
| Brightwood Park          | -77.024871 | 38.9557476 |
| Brookland                | -76.984414 | 38.9314044 |
| Burleith/Hillandale      | -77.074566 | 38.915003  |
| Burrville                | -76.921802 | 38.900243  |
| Buzzard Point            | -77.011425 | 38.8683001 |
| Capitol Hill             | -76.998477 | 38.8836208 |
| Capitol View             | -76.927086 | 38.8899785 |
| Cardozo/Shaw             | -77.02755  | 38.9171683 |
| Carver                   | -76.97785  | 38.9024653 |

|                              |            |            |
|------------------------------|------------|------------|
| Cathedral Heights            | -77.07986  | 38.9342724 |
| Central NE                   | -76.942277 | 38.8970345 |
| Chevy Chase                  | -77.066478 | 38.9631465 |
| Chinatown                    | -77.020135 | 38.8991512 |
| Cleveland Park               | -77.064402 | 38.9360979 |
| Colonial Village             | -77.041094 | 38.9867896 |
| Columbia Heights             | -77.030586 | 38.9280083 |
| Congress Heights             | -76.99795  | 38.8410773 |
| Connecticut Avenue/K Street  | -77.041134 | 38.9029518 |
| Crestwood                    | -77.041097 | 38.9433271 |
| Deanwood                     | -76.932801 | 38.9041073 |
| Douglass                     | -76.979645 | 38.8475715 |
| Downtown                     | -77.029175 | 38.9005261 |
| Downtown East                | -77.014234 | 38.8954282 |
| Dupont Circle                | -77.040984 | 38.9121281 |
| Dupont Park                  | -76.962818 | 38.8726304 |
| Eastland Gardens             | -76.94307  | 38.9053294 |
| Eckington                    | -77.000425 | 38.9152018 |
| Edgewood                     | -77.000739 | 38.9251989 |
| Fairfax Village              | -76.95163  | 38.8634527 |
| Fairlawn                     | -76.977452 | 38.8691585 |
| Foggy Bottom                 | -77.052436 | 38.8990217 |
| Forest Hills                 | -77.058462 | 38.9468927 |
| Fort Davis Park              | -76.94467  | 38.8689012 |
| Fort Dupont                  | -76.950685 | 38.8860167 |
| Fort Lincoln                 | -76.954749 | 38.9236098 |
| Fort McNair                  | -77.016438 | 38.8669433 |
| Fort Stanton                 | -76.980348 | 38.8556577 |
| Fort Totten                  | -77.008128 | 38.9494299 |
| Foxhall Crescents            | -77.092767 | 38.9204865 |
| Foxhall Village              | -77.084407 | 38.9132471 |
| Friendship Heights           | -77.083854 | 38.9569068 |
| Garfield Heights             | -76.972213 | 38.8540851 |
| Gateway                      | -76.963846 | 38.9197568 |
| George Washington University | -77.047928 | 38.8996277 |
| Georgetown                   | -77.064796 | 38.9095558 |
| Georgetown Reservoir         | -77.090677 | 38.9096371 |
| Glover Park                  | -77.075738 | 38.9215308 |
| Grant Park                   | -76.920638 | 38.8927065 |

|                       |            |            |
|-----------------------|------------|------------|
| Greenway              | -76.960181 | 38.8847875 |
| Hawthorne             | -77.055934 | 38.9808826 |
| Hill East             | -76.979951 | 38.88333   |
| Hillcrest             | -76.960688 | 38.8617945 |
| Hillsdale             | -76.990561 | 38.8584234 |
| Historic Anacostia    | -76.984678 | 38.8631857 |
| Howard University     | -77.01961  | 38.9223548 |
| Ivy City              | -76.991627 | 38.9103895 |
| Kalorama Heights      | -77.051195 | 38.9156604 |
| Kenilworth            | -76.938586 | 38.9106788 |
| Kingman Park          | -76.978437 | 38.8948866 |
| Knox Hill/Buena Vista | -76.96766  | 38.8536881 |
| Lamond Riggs          | -77.006445 | 38.9650697 |
| Langdon               | -76.974689 | 38.924017  |
| Langston              | -76.972367 | 38.9013363 |
| Lanier Heights        | -77.042694 | 38.9252488 |
| Le Droit Park         | -77.017605 | 38.9168316 |
| Lincoln Heights       | -76.931097 | 38.8958052 |
| Lincoln Park          | -76.98971  | 38.8872107 |
| Logan Circle/Shaw     | -77.02534  | 38.9098163 |
| Manor Park            | -77.012657 | 38.9620616 |
| Marshall Heights      | -76.929122 | 38.8843719 |
| Mass. Ave. Heights    | -77.070075 | 38.9253988 |
| Mayfair               | -76.951295 | 38.9011156 |
| McLean Gardens        | -77.075296 | 38.9361512 |
| Michigan Park         | -76.983772 | 38.9469341 |
| Monumental Core       | -77.037334 | 38.8844631 |
| Mount Pleasant        | -77.040656 | 38.9317415 |
| Mount Vernon Square   | -77.023313 | 38.9043398 |
| Mount Vernon Triangle | -77.016879 | 38.902417  |
| Navy Yard             | -76.998462 | 38.8742684 |
| Naylor Gardens        | -76.963046 | 38.8567244 |
| NE Boundary           | -76.917389 | 38.8954508 |
| Near Northeast        | -76.999734 | 38.9023748 |
| Near Southeast        | -77.000627 | 38.8783845 |
| North Capitol Street  | -77.011275 | 38.9025322 |
| North Cleveland Park  | -77.071774 | 38.9478787 |
| North Michigan Park   | -76.993666 | 38.9456442 |
| North Portal Estates  | -77.040877 | 38.991765  |



|                           |            |            |
|---------------------------|------------|------------|
| Palisades                 | -77.10352  | 38.9298077 |
| Park View                 | -77.021444 | 38.9346043 |
| Penn Branch               | -76.953424 | 38.8695602 |
| Penn Quarter              | -77.022181 | 38.8953704 |
| Petworth                  | -77.024017 | 38.9430391 |
| Pleasant Hill             | -77.004804 | 38.9410792 |
| Pleasant Plains           | -77.023101 | 38.929473  |
| Queens Chapel             | -76.996591 | 38.95607   |
| Randle Highlands          | -76.965804 | 38.8693357 |
| River Terrace             | -76.957681 | 38.8937045 |
| Shepherd Park             | -77.032126 | 38.9829801 |
| Shipley                   | -76.972902 | 38.8468601 |
| Skyland                   | -76.971703 | 38.860267  |
| South Central             | -76.965043 | 38.9239855 |
| Southwest Employment Area | -77.020317 | 38.8850166 |
| Southwest/Waterfront      | -77.016903 | 38.8779084 |
| Spring Valley             | -77.096724 | 38.9393114 |
| Stanton Park              | -76.994242 | 38.8948978 |
| Stronghold                | -77.007767 | 38.9257756 |
| Takoma                    | -77.021558 | 38.9764616 |
| Tenleytown                | -77.080163 | 38.9471274 |
| Trinidad                  | -76.982737 | 38.9084625 |
| Truxton Circle            | -77.012394 | 38.9096673 |
| Twining                   | -76.960847 | 38.8755879 |
| University Heights        | -76.995762 | 38.9382488 |
| Van Ness                  | -77.066106 | 38.9433906 |
| Washington Highlands      | -76.995636 | 38.8302374 |
| Wesley Heights            | -77.088325 | 38.9299808 |
| West End                  | -77.051882 | 38.9055503 |
| Woodland                  | -76.973926 | 38.8565542 |
| Woodland-Normanstone      | -77.060753 | 38.92285   |
| Woodley Park              | -77.057483 | 38.9272653 |
| Woodridge                 | -76.96864  | 38.934021  |

Neighborhood Data obtained from Open Data DC:

(<https://opendata.dc.gov/datasets/neighborhood-labels/data?geometry=-77.596%2C38.816%2C-76.425%2C39.003>) 01/17/2021

**Table A.2 Residential Codes**

| Grocery | Health/ Wellness | Home | Athletics & Sports |
|---------|------------------|------|--------------------|
|---------|------------------|------|--------------------|

|                   |                         |  |                         |
|-------------------|-------------------------|--|-------------------------|
| Bakery            | Chiropractor            | Dog Run                                  | Athletics & Sports      |
| Bagel Shop        | Health & Beauty Service | Dry Cleaner                              | Baseball Field          |
| Chocolate Shop    | Hospital                | Home Service                             | Basketball Court        |
| Convenience Store | Massage Studio          | Laundromat                               | Basketball Stadium      |
| Cupcake Shop      | Nail Salon              | Locksmith                                | Boxing Gym              |
| Deli / Bodega     | Spa                     | Moving Target                            | Cycle Studio            |
| Dessert Shop      | Salon / Barbershop      | Other Repair Shop                        | Dance Studio            |
| Donut Shop        |                         | Pet Service                              | Field                   |
| Drugstore         |                         | Shoe Repair                              | Golf Course             |
| Farmers Market    |                         | Storage Facility                         | Gym                     |
| Food              |                         | Tailor Shop                              | Gym / Fitness Center    |
| Food & Drink Shop |                         | Residential Building (Apartment / Condo) | Gym Pool                |
| Gourmet Shop      |                         |  | Gymnastics Gym          |
| Grocery Store     |                         |  | Harbor / Marina         |
| Liquor Store      |                         |  | Heliport                |
| Market            |                         |  | Lake                    |
| Organic Grocery   |                         |  | Martial Arts School     |
| Pharmacy          |                         |  | Pilates Studio          |
| Smoothie Shop     |                         |  | Playground              |
| Snack Place       |                         |  | Skating Rink            |
| Supermarket       |                         |  | Soccer Field            |
| Supplement Shop   |                         |  | Soccer Stadium          |
| Wine Shop         |                         |  | Sports Club             |
| Beer Store        |                         |  | State / Provincial Park |
|                   |                         |  | Volleyball Court        |
|                   |                         |  | Yoga Studio             |
|                   |                         |  | Recreation Center       |

|  |  |  |       |
|--|--|--|-------|
|  |  |  | Track |
|--|--|--|-------|

Venues with these labels are assigned as "residential"

**Table A.3 Residential & Tourism Codes**

| <b>Shopping</b>     | <b>Bar</b>      | <b>Restaurant</b>         | <b>Culture</b>        | <b>Banking</b>        | <b>Entertainment</b> | <b>Transportation</b>    |
|---------------------|-----------------|---------------------------|-----------------------|-----------------------|----------------------|--------------------------|
| Accessories Store   | Bar             | Afghan Restaurant         | Art Gallery           | ATM                   | Hookah Bar           | Bike Rental / Bike Share |
| Antique Shop        | Beer Bar        | American Restaurant       | Art Museum            | Bank                  | Lounge               | Boat or Ferry            |
| Arts & Crafts Store | Beer Garden     | Arepa Restaurant          | Botanical Garden      | Check Cashing Service | Nightclub            | Border Crossing          |
| Automotive Shop     | Brewery         | Asian Restaurant          | Comedy Club           | Credit Union          | Nightlife Spot       | Bridge                   |
| Big Box Store       | Cocktail Bar    | BBQ Joint                 | Escape Room           |                       | Roof Deck            | Bus Line                 |
| Bookstore           | Dive Bar        | Belgian Restaurant        | Exhibit               |                       | Event Space          | Bus Station              |
| Boutique            | Gastropub       | Bistro                    | Fountain              |                       |                      | Bus Stop                 |
| Camera Store        | Gay Bar         | Brazilian Restaurant      | Garden                |                       |                      | Gas Station              |
| Christmas Market    | Irish Pub       | Breakfast Spot            | General Entertainment |                       |                      | Metro Station            |
| Clothing Store      | Karaoke Bar     | Burger Joint              | Historic Site         |                       |                      | Rental Car Location      |
| Comic Shop          | Pub             | Burrito Place             | History Museum        |                       |                      | Trail                    |
| Cosmetics Shop      | Speakeasy       | Café                      | Indie Movie Theater   |                       |                      | Train Station            |
| Department Store    | Sports Bar      | Cajun / Creole Restaurant | Memorial Site         |                       |                      | Tunnel                   |
| Discount Store      | Thai Restaurant | Cantonese Restaurant      | Monument / Landmark   |                       |                      |                          |
| Electronics Store   | Tiki Bar        | Caribbean Restaurant      | Movie Theater         |                       |                      |                          |
| Flea Market         | Whisky Bar      | Cheese Shop               | Museum                |                       |                      |                          |



|                               |          |                             |                       |  |  |  |
|-------------------------------|----------|-----------------------------|-----------------------|--|--|--|
| Flower Shop                   | Wine Bar | Chinese Restaurant          | Music Venue           |  |  |  |
| Furniture / Home Store        |          | Coffee Shop                 | Opera House           |  |  |  |
| Gift Shop                     |          | Comfort Food Restaurant     | Outdoor Sculpture     |  |  |  |
| Hardware Store                |          | Cuban Restaurant            | Park                  |  |  |  |
| Herbs & Spices Store          |          | Diner                       | Pedestrian Plaza      |  |  |  |
| Jewelry Store                 |          | Dumpling Restaurant         | Performing Arts Venue |  |  |  |
| Kids Store                    |          | Eastern European Restaurant | Planetarium           |  |  |  |
| Kitchen Supply Store          |          | Empanada Restaurant         | Plaza                 |  |  |  |
| Leather Goods Store           |          | Ethiopian Restaurant        | Public Art            |  |  |  |
| Lingerie Store                |          | Falafel Restaurant          | Rock Club             |  |  |  |
| Mattress Store                |          | Fast Food Restaurant        | Scenic Lookout        |  |  |  |
| Men's Store                   |          | Filipino Restaurant         | Science Museum        |  |  |  |
| Miscellaneous Shop            |          | Fish & Chips Shop           | Sculpture Garden      |  |  |  |
| Mobile Phone Shop             |          | Food Court                  | Synagogue             |  |  |  |
| Music Store                   |          | Food Service                | Theater               |  |  |  |
| Optical Shop                  |          | Food Truck                  | Winery                |  |  |  |
| Paper / Office Supplies Store |          | French Restaurant           | Zoo Exhibit           |  |  |  |
| Pet Store                     |          | Fried Chicken Joint         |                       |  |  |  |

|                        |  |                           |  |  |  |  |
|------------------------|--|---------------------------|--|--|--|--|
| Photography Lab        |  | Frozen Yogurt Shop        |  |  |  |  |
| Record Shop            |  | German Restaurant         |  |  |  |  |
| Shipping Store         |  | Gluten-free Restaurant    |  |  |  |  |
| Shoe Store             |  | Greek Restaurant          |  |  |  |  |
| Shop & Service         |  | Hot Dog Joint             |  |  |  |  |
| Shopping Mall          |  | Ice Cream Shop            |  |  |  |  |
| Shopping Plaza         |  | Indian Restaurant         |  |  |  |  |
| Smoke Shop             |  | Israeli Restaurant        |  |  |  |  |
| Souvenir Shop          |  | Italian Restaurant        |  |  |  |  |
| Sporting Goods Shop    |  | Japanese Restaurant       |  |  |  |  |
| Thrift / Vintage Store |  | Juice Bar                 |  |  |  |  |
| Toy / Game Store       |  | Korean Restaurant         |  |  |  |  |
| Video Store            |  | Latin American Restaurant |  |  |  |  |
| Warehouse Store        |  | Mediterranean Restaurant  |  |  |  |  |
| Women's Store          |  | Mexican Restaurant        |  |  |  |  |
|                        |  | Middle Eastern Restaurant |  |  |  |  |
|                        |  | New American Restaurant   |  |  |  |  |
|                        |  | Noodle House              |  |  |  |  |
|                        |  | Peruvian Restaurant       |  |  |  |  |

|  |  |                                 |  |  |  |  |
|--|--|---------------------------------|--|--|--|--|
|  |  | Pizza Place                     |  |  |  |  |
|  |  | Poke Place                      |  |  |  |  |
|  |  | Portuguese Restaurant           |  |  |  |  |
|  |  | Puerto Rican Restaurant         |  |  |  |  |
|  |  | Ramen Restaurant                |  |  |  |  |
|  |  | Restaurant                      |  |  |  |  |
|  |  | Salad Place                     |  |  |  |  |
|  |  | Salvadoran Restaurant           |  |  |  |  |
|  |  | Sandwich Place                  |  |  |  |  |
|  |  | Scandinavian Restaurant         |  |  |  |  |
|  |  | Seafood Restaurant              |  |  |  |  |
|  |  | South American Restaurant       |  |  |  |  |
|  |  | Southern / Soul Food Restaurant |  |  |  |  |
|  |  | Spanish Restaurant              |  |  |  |  |
|  |  | Steakhouse                      |  |  |  |  |
|  |  | Street Food Gathering           |  |  |  |  |
|  |  | Sushi Restaurant                |  |  |  |  |
|  |  | Taco Place                      |  |  |  |  |
|  |  | Tapas Restaurant                |  |  |  |  |
|  |  | Tea Room                        |  |  |  |  |
|  |  | Tex-Mex Restaurant              |  |  |  |  |
|  |  | Turkish Restaurant              |  |  |  |  |
|  |  | Vegetarian / Vegan Restaurant   |  |  |  |  |



|  |  |                       |  |  |  |  |
|--|--|-----------------------|--|--|--|--|
|  |  | Vietnamese Restaurant |  |  |  |  |
|  |  | Wings Joint           |  |  |  |  |
|  |  | Xinjiang Restaurant   |  |  |  |  |

Venues with these labels are assigned both a residential and a tourism label.

**Table A.4 Tourism Codes**

| <b>Lodging</b>  | <b>Tourism</b>             |
|-----------------|----------------------------|
| Bed & Breakfast | Tour Provider              |
| Hostel          | Tourist Information Center |
| Hotel           |                            |
| Hotel Bar       |                            |
| Hotel Pool      |                            |

Venues with these labels are assigned a tourism label.

**Table A.5 Industrial Codes**

| <b>Business</b>            | <b>Infrastructure</b> | <b>College</b>                  |
|----------------------------|-----------------------|---------------------------------|
| Building                   | Intersection          | College Administrative Building |
| Business Service           | Reservoir             | College Basketball Court        |
| Construction & Landscaping | River                 | College Bookstore               |
| Government Building        | Road                  | College Library                 |
| Insurance Office           |                       | College Quad                    |
| Lawyer                     |                       | General College & University    |
| Light Rail Station         |                       |                                 |
| Office                     |                       |                                 |
| Post Office                |                       |                                 |

Venues with these labels are assigned an industrial code.