Week5-B

January 2, 2020

1 Segmenting and Clustering Neighborhoods in Kyoto, Japan

[1]:
```
! pip install lxml html5lib beautifulsoup4
```

```
Collecting lxml
  Downloading https://files.pythonhosted.org/packages/68/30/affd16b77edf95
37f5be051905f33527021e20d563d013e8c42c7fd01949/lxml-4.4.2-cp36-cp36m-manylinux1_
x86_64.whl (5.8MB)
     |                  | 5.8MB 8.4MB/s eta 0:00:01
Requirement already satisfied: html5lib in
/home/jupyterlab/conda/envs/python/lib/python3.6/site-packages (0.9999999)
Collecting beautifulsoup4
  Downloading https://files.pythonhosted.org/packages/cb/a1/c698cf319e9cfe
d6b17376281bd0efc6bfc8465698f54170ef60a485ab5d/beautifulsoup4-4.8.2-py3-none-
any.whl (106kB)
     |                  | 112kB 33.7MB/s eta 0:00:01
Requirement already satisfied: six in
/home/jupyterlab/conda/envs/python/lib/python3.6/site-packages (from html5lib)
(1.13.0)
Collecting soupsieve>=1.2 (from beautifulsoup4)
  Downloading https://files.pythonhosted.org/packages/81/94/03c0f04471fc245d08d0
a99f7946ac228ca98da4fa75796c507f61e688c2/soupsieve-1.9.5-py2.py3-none-any.whl
Installing collected packages: lxml, soupsieve, beautifulsoup4
Successfully installed beautifulsoup4-4.8.2 lxml-4.4.2 soupsieve-1.9.5
```

[2]:
```
# geopy
!conda install -c conda-forge geopy --yes
```

```
Solving environment: done


==> WARNING: A newer version of conda exists. <==
  current version: 4.5.11
  latest version: 4.8.0

Please update conda by running

    $ conda update -n base -c defaults conda
```

```
## Package Plan ##

  environment location: /home/jupyterlab/conda/envs/python

  added / updated specs:
    - geopy


The following packages will be downloaded:

    package                    |            build
    ---------------------------|-----------------
    certifi-2019.11.28         |           py36_0         149 KB  conda-forge
    scikit-learn-0.20.1        |   py36h22eb022_0         5.7 MB
    liblapack-3.8.0            |      11_openblas          10 KB  conda-forge
    liblapacke-3.8.0           |      11_openblas          10 KB  conda-forge
    geographiclib-1.50         |            py_0          34 KB  conda-forge
    libopenblas-0.3.6          |       h5a2b251_2         7.7 MB
    numpy-1.17.3               |   py36h95a1406_0         5.2 MB  conda-forge
    scipy-1.4.1                |   py36h921218d_0        18.9 MB  conda-forge
    libcblas-3.8.0             |      11_openblas          10 KB  conda-forge
    libblas-3.8.0              |      11_openblas          10 KB  conda-forge
    geopy-1.20.0               |            py_0          57 KB  conda-forge
    blas-2.11                  |         openblas          10 KB  conda-forge
    ------------------------------------------------------------
                                           Total:        37.8 MB

The following NEW packages will be INSTALLED:

    geographiclib: 1.50-py_0                              conda-forge
    geopy:         1.20.0-py_0                            conda-forge
    libblas:       3.8.0-11_openblas                      conda-forge
    libcblas:      3.8.0-11_openblas                      conda-forge
    liblapack:     3.8.0-11_openblas                      conda-forge
    liblapacke:    3.8.0-11_openblas                      conda-forge
    libopenblas:   0.3.6-h5a2b251_2

The following packages will be UPDATED:

    blas:          1.1-openblas                           conda-forge -->
2.11-openblas         conda-forge
    certifi:       2019.9.11-py36_0                       conda-forge -->
2019.11.28-py36_0     conda-forge
    numpy:         1.16.2-py36_blas_openblash1522bff_0    conda-forge
[blas_openblas] --> 1.17.3-py36h95a1406_0 conda-forge
```

```
    scipy:          1.2.1-py36_blas_openblash1522bff_0     conda-forge
[blas_openblas] --> 1.4.1-py36h921218d_0  conda-forge

The following packages will be DOWNGRADED:

    scikit-learn:  0.20.1-py36_blas_openblashebff5e3_1200 conda-forge
[blas_openblas] --> 0.20.1-py36h22eb022_0


Downloading and Extracting Packages
certifi-2019.11.28   | 149 KB    | ##################################### | 100%
scikit-learn-0.20.1  | 5.7 MB    | ##################################### | 100%
liblapack-3.8.0      | 10 KB     | ##################################### | 100%
liblapacke-3.8.0     | 10 KB     | ##################################### | 100%
geographiclib-1.50   | 34 KB     | ##################################### | 100%
libopenblas-0.3.6    | 7.7 MB    | ##################################### | 100%
numpy-1.17.3         | 5.2 MB    | ##################################### | 100%
scipy-1.4.1          | 18.9 MB   | ##################################### | 100%
libcblas-3.8.0       | 10 KB     | ##################################### | 100%
libblas-3.8.0        | 10 KB     | ##################################### | 100%
geopy-1.20.0         | 57 KB     | ##################################### | 100%
blas-2.11            | 10 KB     | ##################################### | 100%
Preparing transaction: done
Verifying transaction: done
Executing transaction: done
```

[3]:
```
# Foursquare API
!conda install -c conda-forge folium=0.5.0 --yes
```

```
Solving environment: done


==> WARNING: A newer version of conda exists. <==
  current version: 4.5.11
  latest version: 4.8.0

Please update conda by running

    $ conda update -n base -c defaults conda



# All requested packages already installed.
```

[4]:
```
import pandas as pd
import numpy as np
```

```
from geopy.geocoders import Nominatim # convert an address into latitude and␣
↪longitude values
from geopy.extra.rate_limiter import RateLimiter
from geopy.exc import GeocoderTimedOut

import requests # library to handle requests

# Matplotlib and associated plotting modules
import matplotlib.cm as cm
import matplotlib.colors as colors
import matplotlib.pyplot as plt

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

# Foursquare API
import folium # map rendering library
```

1.1 1. Download data and clean it up

1.1.1 Download Japan postal code data from JAPAN POST Co.,Ltd.

[5]:
```
# Download Japan postal code data if not yet downloaded
!wget -q -O 'japan_postal_codes.zip' https://www.post.japanpost.jp/zipcode/dl/
↪roman/ken_all_rome.zip?190712
print('Data downloaded!')
```

[6]:
```
!unzip -o 'japan_postal_codes.zip'
```

```
Archive:  japan_postal_codes.zip
  inflating: KEN_ALL_ROME.CSV
```

[7]:
```
# read csv.
# 1. assign header to the columns. the addresses are written in both Japanese␣
↪and English.
# 2. latitude and longitude are not available in this csv. they will be filled␣
↪later using geopy.
df = pd.read_csv('KEN_ALL_ROME.CSV', names =['PostalCode', 'Prefecture-JP',␣
↪'Borough-JP', 'Neighborhood-JP', 'Prefecture', 'Borough', 'Neighborhood',␣
↪'Latitude', 'Longitude'], encoding="SHIFT-JIS")
df.head()
```

[7]:

	PostalCode	Prefecture-JP	Borough-JP	Neighborhood-JP	Prefecture	\
0	600000				HOKKAIDO	
1	640941				HOKKAIDO	
2	600041				HOKKAIDO	

```
3      600042                                    HOKKAIDO
4      640820                                   HOKKAIDO

                Borough              Neighborhood  Latitude  Longitude
0  SAPPORO SHI CHUO KU     IKANIKEISAIGANAIBAAI       NaN        NaN
1  SAPPORO SHI CHUO KU                ASAHIGAOKA       NaN        NaN
2  SAPPORO SHI CHUO KU              ODORIHIGASHI       NaN        NaN
3  SAPPORO SHI CHUO KU   ODORINISHI(1-19-CHOME)       NaN        NaN
4  SAPPORO SHI CHUO KU  ODORINISHI(20-28-CHOME)       NaN        NaN
```

1.1.2 If neighborhood value is not assigned (='IKANIKEISAIGANAIBAAI'), it is a less populated area. Drop them.

[8]:
```
# Check
df[df['Neighborhood'] == 'IKANIKEISAIGANAIBAAI'].shape
```

[8]:
```
(1874, 9)
```

[9]:
```
# Drom them
df = df[df['Neighborhood'] != 'IKANIKEISAIGANAIBAAI']
# Verify
df[df['Neighborhood'] == 'IKANIKEISAIGANAIBAAI'].shape
```

[9]:
```
(0, 9)
```

1.1.3 Print the number of rows

[10]:
```
df.shape
```

[10]:
```
(122396, 9)
```

1.2 2. Explore and cluster the neighborhoods in Kyoto, Japan

1.2.1 Work with only boroughs in the central area of Kyoto city (='KYOTO SHI KAMIGYO KU' or 'KYOTO SHI NAKAGYO KU')

[11]:
```
kyoto_data = df[df['Borough'].str.contains('KYOTO SHI KAMIGYO KU') |␣
 ↪df['Borough'].str.contains('KYOTO SHI NAKAGYO KU')].reset_index(drop=True)
kyoto_data.head()
```

[11]:
```
   PostalCode Prefecture-JP Borough-JP Neighborhood-JP Prefecture  \
0     6020827                                          KYOTO FU
1     6028278                                          KYOTO FU
2     6020054                                          KYOTO FU
3     6020923                                          KYOTO FU
4     6028165                                          KYOTO FU
```

```
                Borough       Neighborhood  Latitude  Longitude
0  KYOTO SHI KAMIGYO KU            AIOICHO       NaN        NaN
1  KYOTO SHI KAMIGYO KU          AIZENJICHO       NaN        NaN
2  KYOTO SHI KAMIGYO KU           ASUKAICHO       NaN        NaN
3  KYOTO SHI KAMIGYO KU  ABURAHASHIZUMECHO       NaN        NaN
4  KYOTO SHI KAMIGYO KU   AMAGASAKIYOKOCHO       NaN        NaN
```

[12]:
```
kyoto_data.shape
```

[12]:
```
(1206, 9)
```

1.2.2 Use geopy library to get the latitude and longitude values of the neighborhoods

[15]:
```
for index, row in kyoto_data.iterrows():
    address = '{}, {}, {}'.format(row['Neighborhood-JP'], row['Borough-JP'],␣
 ↪row['Prefecture-JP'])
    loc = geocode(address)
    if (loc != None):
        kyoto_data.at[index, 'Latitude'] = loc.latitude
        kyoto_data.at[index, 'Longitude'] = loc.longitude
        #print(row)

kyoto_data.head(10)
```

[15]:
```
   PostalCode Prefecture-JP Borough-JP Neighborhood-JP Prefecture  \
0     6020827                                          KYOTO FU
1     6028278                                          KYOTO FU
2     6020054                                          KYOTO FU
3     6020923                                          KYOTO FU
4     6028165                                          KYOTO FU
5     6028424                                          KYOTO FU
6     6020803                                          KYOTO FU
7     6028074                                          KYOTO FU
8     6028472                                          KYOTO FU
9     6020064                                          KYOTO FU

                Borough       Neighborhood   Latitude   Longitude
0  KYOTO SHI KAMIGYO KU            AIOICHO  35.031141  135.769037
1  KYOTO SHI KAMIGYO KU          AIZENJICHO  35.023407  135.743734
2  KYOTO SHI KAMIGYO KU           ASUKAICHO        NaN         NaN
3  KYOTO SHI KAMIGYO KU  ABURAHASHIZUMECHO        NaN         NaN
4  KYOTO SHI KAMIGYO KU   AMAGASAKIYOKOCHO  35.021582  135.742720
5  KYOTO SHI KAMIGYO KU          AMIDAJICHO        NaN         NaN
6  KYOTO SHI KAMIGYO KU      AMIDAJIMAECHO  35.033264  135.766436
7  KYOTO SHI KAMIGYO KU          ARIHARUCHO        NaN         NaN
8  KYOTO SHI KAMIGYO KU            ARIMACHO  35.030387  135.745635
9  KYOTO SHI KAMIGYO KU      ANRAKUKOJICHO  35.032808  135.755731
```

[16]:
```
# save current data to file
kyoto_data.to_csv('kyoto.csv')
print('Saved CSV')
```

```
Saved CSV
```

[5]:
```
kyoto_data = pd.read_csv('kyoto.csv')
```

[6]:
```
# Drop neighborhoods that could not get latitude and longitude from geopy
kyoto_data = kyoto_data.dropna(subset=['Latitude', 'Latitude']).
 ↪reset_index(drop=True)
kyoto_data.head()
```

[6]:

	Unnamed: 0	PostalCode	Prefecture-JP	Borough-JP	Neighborhood-JP	Prefecture	\
0	0	6020827				KYOTO FU	
1	1	6028278				KYOTO FU	
2	4	6028165				KYOTO FU	
3	6	6020803				KYOTO FU	
4	8	6028472				KYOTO FU	

	Borough	Neighborhood	Latitude	Longitude
0	KYOTO SHI KAMIGYO KU	AIOICHO	35.031141	135.769037
1	KYOTO SHI KAMIGYO KU	AIZENJICHO	35.023407	135.743734
2	KYOTO SHI KAMIGYO KU	AMAGASAKIYOKOCHO	35.021582	135.742720
3	KYOTO SHI KAMIGYO KU	AMIDAJIMAECHO	35.033264	135.766436
4	KYOTO SHI KAMIGYO KU	ARIMACHO	35.030387	135.745635

[7]:
```
kyoto_data.shape
```

[7]:
```
(389, 10)
```

1.2.3 Create a map of Kyoto with neighborhoods superimposed on top.

[8]:
```
address = 'Kyoto, JP' # Kyoto city

geolocator = Nominatim(user_agent="kyoto_city_explorer")
geocode = RateLimiter(geolocator.geocode, min_delay_seconds=2)
location = geocode(address)
latitude = location.latitude
longitude = location.longitude
print('The geograpical coordinate of Kyoto are {}, {}.'.format(latitude,␣
 ↪longitude))
```

```
The geograpical coordinate of Kyoto are 35.021041, 135.7556075.
```

[9]:
```
# create map of New York using latitude and longitude values
map_kyoto = folium.Map(location=[latitude, longitude], zoom_start=14)
```

```
map_kyoto
```

[9]: <folium.folium.Map at 0x7f2c1d066b00>

[10]:
```
# add markers to map
for lat, lng, borough, neighborhood in zip(kyoto_data['Latitude'],␣
 ↪kyoto_data['Longitude'], kyoto_data['Borough'], kyoto_data['Neighborhood']):
    label = '{}, {}'.format(neighborhood, borough)
    label = folium.Popup(label, 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_kyoto)

map_kyoto
```

[10]: <folium.folium.Map at 0x7f2c1d066b00>

1.2.4 Explore neighborhoods in Kyoyo

[11]:
```
CLIENT_ID = '1RMX12RQK31ECDMFK1LGOOK4FA50VEWF30KYCGFE5WMU0IFL' # your␣
 ↪Foursquare ID
CLIENT_SECRET = 'Y2YMCUJBNTHJTKILQMMKZHXOO53SB5N4AUTBGUBCSW0LKG3Y' # your␣
 ↪Foursquare Secret
VERSION = '20180605' # Foursquare API version
LIMIT = 100 # limit of number of venues returned by Foursquare API
```

[12]:
```
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 = ['Neighborhood',
                  'Neighborhood Latitude',
                  'Neighborhood Longitude',
                  'Venue',
                  'Venue Latitude',
                  'Venue Longitude',
                  'Venue Category']

    return(nearby_venues)
```

[13]:
```
kyoto_venues = getNearbyVenues(names=kyoto_data['Neighborhood'],␣
↪latitudes=kyoto_data['Latitude'], longitudes=kyoto_data['Longitude'])
```

```
AIOICHO
AIZENJICHO
AMAGASAKIYOKOCHO
AMIDAJIMAECHO
ARIMACHO
ANRAKUKOJICHO
ISEDONOKAMAECHO
ISEYACHO
IDACHO
ISSHIKICHO
ISSHINCHO
ITOYACHO
INUICHO
IBACHO
IMASHINZAIKECHO
UCHIGAMAECHO
```

UBAGAENOKICHO
UBAGAKITAMACHI
UBAGATERANOMAECHO
URATSUKIJICHO
URAFUROCHO
EMMAMAECHO
OIMATSUCHO
OKAKUENCHO
OKAMINOCHO
OKITAKOJIHIGASHICHO
OHARAGUCHICHO
OHARAGUCHITSUKINUKECHO
OKAMATSUCHO
KAGAYACHO
KAJIICHO
KASHIWAKIYOMORICHO
KASUGACHO
KATAHARACHO
KAMIOGAWACHO
KAMIKATAHARACHO
KAMIKINOSHITACHO
KAMIGORYONAKAMACHI
KAMIGORYOBABACHO
KAMIGORYOMAECHO
KAMIDACHIURICHO
KAMIDACHIURIHIGASHICHO
KAMITENJINCHO
KAMIYANAGIHARACHO
KAMEKICHO
GANSUINCHO
KITAISEDONOKAMAECHO
KITAINOKUMACHO
KITAKANEYASUCHO
KITAGEMBACHO
KITASHINZAIKECHO
KITANAKANOCHO
KITANOBECHO
KITAFUNAHASHICHO
KITAYOKOCHO
KINOSHITATSUKINUKECHO
KYUKENCHO
KYOTOGYOEN
KIRINOKICHO
KEIKOINCHO
GEMBACHO
KOZAICHO
KODOUCHICHO
KODONOCHICHO

KODOMAENOCHO
KOTOKUJICHO
GOSANGENCHO
GOSHOHACHIMANCHO
GOCHOMECHO
KONOEDENOMOTECHO
KONOEDENKITAGUCHICHO
GOBANCHO
KOYAMACHO
KONTAKACHO
SAIINCHO
SAKUANCHO
SAKURAGICHO
SATAKECHO
SANNOCHO
JISSOINCHO
SHINANOCHO
SHIBANOCHO
SHIBAYAKUSHICHO
SHIMOKINOSHITACHO
SHIMOSEIZOGUCHICHO
SHIMOTENJINCHO
SHIMOTONODANCHO
SHIMOMARUYACHO
SHIMOYANAGIHARAKITAHANCHO
SHIMOYANAGIHARAMINAMIHANCHO
SHAKENAGAYACHO
JUNENJIMAECHO
JUYONKENCHO
JOZENJICHO
SHOTENCHO
SHIROGANECHO
SHININOKUMACHO
SHININOKUMAHIGASHICHO
SHINEBISUCHO
SHINGOKOCHO
SHINGORYOGUCHICHO
SHINSEICHO
SHINCHO
SHINNYODO TSUKINUKECHO
SHINNYODO MAECHO
ZUIKOIMMAECHO
SUEHIROCHO
SUGIMOTOCHO
SUJIKAIBASHICHO
ZENSHOINCHO
SOMEDONOCHO
DAISHININCHO

TAIDOKATAHARACHO
TAIDOCHO
DAIMONJICHO
TAKEZONOCHO
TAKEYACHO
TANAKACHO
TABATACHO
TAMARUCHO
TAMURABIZENCHO
TAMONCHO
TAMBAYACHO
CHIEKOIMMAENOCHO
TSUKIYAMA KITAHANCHO
TSUKIYAMA MINAMIHANCHO
TSUCHIDACHO
TSURUYAMACHO
TENJINKITAMACHI
TOZAITAWARAYACHO
TOZAICHO
DOSHOCHO
TOKIWAI DONOCHO
DODOCHO
TORIIMAECHO
NAITOCHO
NAKAINOKUMACHO
NAKAOGAWACHO
NAKAGORYOZUSHICHO
NAKAGORYOCHO
NAKAGORYOCHO
NAKATSUKASACHO
NAYACHO
NISHIITSUTSUJI KITACHO
NISHIITSUTSUJI HIGASHIMACHI
NISHIIMACHO
NISHIJOZENJICHO
NISHISHIMMEICHO
NISHITOMINAKACHO
NISHIHASHIZUMECHO
NISHIFUNAHASHICHO
NISHIYANAGICHO
NISHIROZANJICHO
NISHIWAKAMIYA KITAHANCHO
NISHIWAKAMIYA MINAMIHANCHO
NISHINCHO
NIHOMMATSUCHO
HASHINOECHO
HASECHO
HATAKEYAMACHO

HATANAKACHO
HANAKURUMACHO
HARIYACHO
HANSHUIMMAECHO
HIGASHIISHIBASHICHO
HIGASHIISHIYACHO
HIGASHIIMACHO
HIGASHISAKURACHO
HIGASHIJOZENJICHO
HIGASHISHIMMEICHO
HIGASHITSUCHIMIKADOCHO
HIGASHIYANAGICHO
HIGASHIWAKAMIYACHO
HISHIMARUCHO
BISHAMONYOKOCHO
HYAKUMAMBENCHO
HYOTANZUSHICHO
FUKUSHIMACHO
FUKUMOTOCHO
FUJINOKICHO
FUDOMAECHO
FURUKICHO
FUROYACHO
BUNDOCHO
BENZAITENCHO
BENTENCHO
HOKYOINHIGASHIMACHI
BOKEHARACHO
BOTAMBOKOCHO
HORINOECHO
HORIMATSUCHO
HOMPOJIMAECHO
MAKURACHO
MATSUYACHO
MIZUOCHICHO
MIZOMAECHO
MINAMIKANEYASUCHO
MINAMISATAKECHO
MINAMIJOZENJICHO
MINAMICHO
MINAMIFUNAHASHICHO
MINAMIMONZENCHO
MIYAGAKICHO
MYOKENJIMAECHO
MYORENJIMAECHO
MIYOSHICHO
MURAKUMOCHO
MUROMACHIKASHIRACHO

MOTOKANNONCHO
MOTOSHINZAIKECHO
MOTOZUSHICHO
MOTOHOMMANJICHO
MORINOKICHO
YAKUSHIMAECHO
YASHIROTSUKINUKECHO
YASHIROYOKOCHO
YANAGINOZUSHICHO
YABUNOSHITACHO
YAMANACHO
YAMAMOTOCHO
YOANCHO
ROKUBANCHO
WAKAMIYAYOKOCHO
ANEINOKUMACHO
ANEOMIYACHO HIGASHIGAWA
ANEOMIYACHO NISHIGAWA
ANENISHICHO
ANENISHINOTOINCHO
ANENISHIHORIKAWACHO
ANEHIGASHIHORIKAWACHO
IKESUCHO
ICHINOCHO
INABACHO
IMASHINZAIKE HIGASHICHO
IMASHINZAIKE NISHICHO
IWAGAMICHO
UOYACHO
UBAYANAGICHO
ECHIGOCHO
ECHIGOTSUKINUKECHO
ENOKICHO
EBISUCHO
EBOSHIYACHO
ENNOGYOJACHO
EMPUKUJICHO
OGIYACHO
OTSUCHO
ORIMONOYACHO
OWARICHO
ONTOMOCHO
KAKIMOTOCHO
KAJICHO
KANAYACHO
KAMANZACHO
KAMIKAWARACHO
KAMIKUROMONCHO

KAMIHACHIMONJICHO
KAMIYACHO
KAWARASHICHO
KANNONCHO
KANROCHO
KINUYACHO
KIYACHO
KUENIMMAECHO
KURAMOTOCHO
KOIYAMACHO
GOCHOME
KOROMONOTANACHO
KOMBUYACHO
SAKAMOTOCHO
SASHIMONOCHO
SASHIMONOYACHO
SANJO ABURANOKOJICHO
SANJO INOKUMACHO
SANJO OMIYACHO
SANJOCHO
SAMBO OMIYACHO
SAMBO NISHINOTOINCHO
SAMBO HORIKAWACHO
SAMBOINOKUMACHO KITAGUMI
SAMBOINOKUMACHO MINAMIGUMI
SAMBONGICHO
SHIKIAMICHO
SHICHIKANNONCHO
SHICHIKENCHO
SHIBO OMIYACHO
SHIMOICHIMONJICHO
SHIMOKAWARACHO
SHIMOKUROMONCHO
SHIMOGORYOMAECHO
SHIMOHACHIMONJICHO
SHAKINCHO
JURAKUMAWARI HIGASHIMACHI
SHOSHOICHO
SHOJOCHO
SHINSENENCHO
SHINNYODOCHO
SHIMMEICHO
SUGIYACHO
SUMIKURACHO
SEIDOCHO
SEIMEICHO
SORINCHO
TAKEYACHO

TATAMIYACHO
TACHIBANAYANAGICHO
TARUYACHO
CHOJIYACHO
TSUGARUCHO
TENSHUCHO
TOJIJICHO
TOKIWAGICHO
TORAISHICHO
TORAYACHO
NAGAHAMACHO
NISHIKIINOKUMACHO
NISHIKIOMIYACHO
NISHIKYUKENCHO
NISHIKODOCHO
NISHISAMBO HORIKAWACHO
NISHINOKYO IKENOCHICHO
NISHINOKYO EMMACHI
NISHINOKYO OIGOMONCHO
NISHINOKYO KASUGACHO
NISHINOKYO KANGAKUINCHO
NISHINOKYO KITAEMMACHI
NISHINOKYO KITATSUBOICHO
NISHINOKYO SANJOBOCHO
NISHINOKYO SHIMANOCHICHO
NISHINOKYO SHIMOAICHO
NISHINOKYO SHOKUSHICHO
NISHINOKYO TSUKAMOTOCHO
NISHINOKYO TSUKINOWACHO
NISHINOKYO NAKAHOCHO
NISHINOKYO NAKAMIKADONISHIMACHI
NISHINOKYO NAKAMIKADOHIGASHIMACHI
NISHINOKYO NANSEICHO
NISHINOKYO NISHIEMMACHI
NISHINOKYO HAKURAKUCHO
NISHINOKYO BADAICHO
NISHINOKYO HARAMACHI
NISHINOKYO HIGASHITOGANOCHO
NISHINOKYO HOKUSEICHO
NISHINOKYO MIKOSHIGAOKACHO
NISHINOKYO MINAMIOIGOMONCHO
NISHINOKYO MINAMIKAMIAICHO
NISHINOKYO MINAMITSUBOICHO
NISHIROKKAKUCHO
HASHIURACHO
HASHINISHICHO
HASHIHIGASHIZUMECHO
HASHIBENKEICHO

```
HIIRAGICHO
HIGASHIKYUKENCHO
HIGASHISAWARAGICHO
FUKUYACHO
FUJIOKACHO
FUJIKICHO
FUDOCHO
FUNAYACHO
HOKODENCHO
HOTEIYACHO
HONEYACHO
HONNOJICHO
MACHIGASHIRACHO
MATSURACHO
MARUTACHO
MIKURACHO
MIBU SHUJAKUCHO
MIBU BAMBACHO
MIBU BOJOCHO
MIYAGICHO
MIYAMOTOCHO
MYOMANJIMAECHO
MOGAMICHO
MOTOHONNOJICHO
MOTOHONNOJIMINAMICHO
MONZENCHO
YAMANAKACHO
YAMAMOTOCHO
YOHOJIMAECHO
YOSHINOCHO
YONCHOME
RYUSUICHO
RYOTONZUSHICHO
ROKUCHOME
ROKKAKU INOKUMACHO
ROKKAKU OMIYACHO
ROKKAKUCHO
```

[14]:
```
kyoto_venues.head()
```

[14]:

	Neighborhood	Neighborhood Latitude	Neighborhood Longitude	\
0	AIOICHO	35.031141	135.769037	
1	AIOICHO	35.031141	135.769037	
2	AIOICHO	35.031141	135.769037	
3	AIOICHO	35.031141	135.769037	
4	AIOICHO	35.031141	135.769037	

```
                                        Venue  Venue Latitude  \
0                      Demachi Futaba (   )       35.030044
1                             Demachiza ( )       35.030267
2               Usagiyama Shotengai (    )       35.030313
3         boulangerie Artisan'Halles (   )       35.029307
4  Demachi-Masugata Shopping Street (    )       35.030302

   Venue Longitude Venue Category
0       135.769883  Wagashi Place
1       135.769093  Movie Theater
2       135.769581  Shopping Mall
3       135.768453         Bakery
4       135.768969  Shopping Mall
```

[15]:
```
kyoto_venues.shape
```

[15]:
```
(16519, 7)
```

[16]:
```
# save current data to file
kyoto_venues.to_csv('kyoto_venues.csv')
print('Saved CSV')
```

```
Saved CSV
```

[17]:
```
kyoto_venues = pd.read_csv('kyoto_venues.csv')
```

1.2.5 Check how many venues were returned for each neighborhood

[18]:
```
kyoto_venues.groupby('Neighborhood').count()
```

[18]:
```
                      Unnamed: 0  Neighborhood Latitude  \
Neighborhood
AIOICHO                       60                    60
AIZENJICHO                    35                    35
AMAGASAKIYOKOCHO              27                    27
AMIDAJIMAECHO                 21                    21
ANEHIGASHIHORIKAWACHO         33                    33
…                            …                     …
YOHOJIMAECHO                  48                    48
YONCHOME                      45                    45
YOSHINOCHO                    72                    72
ZENSHOINCHO                   17                    17
ZUIKOIMMAECHO                 22                    22

                      Neighborhood Longitude  Venue  Venue Latitude  \
Neighborhood
AIOICHO                                   60     60              60
```

```
AIZENJICHO                          35     35              35
AMAGASAKIYOKOCHO                    27     27              27
AMIDAJIMAECHO                       21     21              21
ANEHIGASHIHORIKAWACHO               33     33              33
…                                  …      …               …
YOHOJIMAECHO                        48     48              48
YONCHOME                            45     45              45
YOSHINOCHO                          72     72              72
ZENSHOINCHO                         17     17              17
ZUIKOIMMAECHO                       22     22              22

                    Venue Longitude  Venue Category
Neighborhood
AIOICHO                          60              60
AIZENJICHO                       35              35
AMAGASAKIYOKOCHO                 27              27
AMIDAJIMAECHO                    21              21
ANEHIGASHIHORIKAWACHO            33              33
…                               …               …
YOHOJIMAECHO                     48              48
YONCHOME                         45              45
YOSHINOCHO                       72              72
ZENSHOINCHO                      17              17
ZUIKOIMMAECHO                    22              22

[386 rows x 7 columns]
```

1.2.6 Group rows by neighborhood and by taking the mean of the frequency of occurrence of each category

[19]:
```
# one hot encoding
kyoto_onehot = pd.get_dummies(kyoto_venues[['Venue Category']], prefix="",␣
 ↪prefix_sep="")

# add neighborhood column back to dataframe
kyoto_onehot['Neighborhood'] = kyoto_venues['Neighborhood']

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

kyoto_onehot.head()
```

[19]:
```
  Neighborhood  ATM  Afghan Restaurant  Arcade  Art Gallery  Art Museum  \
0      AIOICHO    0                  0       0            0           0
1      AIOICHO    0                  0       0            0           0
2      AIOICHO    0                  0       0            0           0
```

```
3      AIOICHO    0                   0       0            0           0
4      AIOICHO    0                   0       0            0           0

   Arts & Crafts Store  Asian Restaurant  BBQ Joint  Bakery  …  \
0                    0                 0          0       0  …
1                    0                 0          0       0  …
2                    0                 0          0       0  …
3                    0                 0          0       1  …
4                    0                 0          0       0  …

   Udon Restaurant  Vegetarian / Vegan Restaurant  Video Store  \
0                0                              0            0
1                0                              0            0
2                0                              0            0
3                0                              0            0
4                0                              0            0

   Vietnamese Restaurant  Wagashi Place  Waterfront  Whisky Bar  Wine Bar  \
0                      0              1           0           0         0
1                      0              0           0           0         0
2                      0              0           0           0         0
3                      0              0           0           0         0
4                      0              0           0           0         0

   Yakitori Restaurant  Yoshoku Restaurant
0                    0                   0
1                    0                   0
2                    0                   0
3                    0                   0
4                    0                   0

[5 rows x 174 columns]
```

[20]:
```
kyoto_grouped = kyoto_onehot.groupby('Neighborhood').mean().reset_index()
kyoto_grouped
```

[20]:
```
              Neighborhood  ATM  Afghan Restaurant  Arcade  Art Gallery  \
0                   AIOICHO  0.0                0.0     0.0     0.000000
1                 AIZENJICHO  0.0                0.0     0.0     0.000000
2           AMAGASAKIYOKOCHO  0.0                0.0     0.0     0.000000
3              AMIDAJIMAECHO  0.0                0.0     0.0     0.000000
4      ANEHIGASHIHORIKAWACHO  0.0                0.0     0.0     0.000000
..                       …  …                  …       …       …
381             YOHOJIMAECHO  0.0                0.0     0.0     0.000000
382                YONCHOME  0.0                0.0     0.0     0.000000
383              YOSHINOCHO  0.0                0.0     0.0     0.000000
384             ZENSHOINCHO  0.0                0.0     0.0     0.058824
```

```
385          ZUIKOIMMAECHO  0.0                0.0     0.0     0.000000

     Art Museum  Arts & Crafts Store  Asian Restaurant  BBQ Joint    Bakery  \
0      0.000000             0.000000               0.0   0.033333  0.050000
1      0.000000             0.000000               0.0   0.085714  0.000000
2      0.000000             0.000000               0.0   0.037037  0.037037
3      0.047619             0.000000               0.0   0.000000  0.095238
4      0.000000             0.000000               0.0   0.000000  0.121212
..          …                    …                 …         …       …
381    0.000000             0.020833               0.0   0.000000  0.062500
382    0.000000             0.000000               0.0   0.000000  0.044444
383    0.000000             0.000000               0.0   0.013889  0.013889
384    0.000000             0.000000               0.0   0.058824  0.000000
385    0.000000             0.000000               0.0   0.045455  0.000000

     …  Udon Restaurant  Vegetarian / Vegan Restaurant  Video Store  \
0    …              0.0                            0.0          0.0
1    …              0.0                            0.0          0.0
2    …              0.0                            0.0          0.0
3    …              0.0                            0.0          0.0
4    …              0.0                            0.0          0.0
..   …              …                              …            …
381  …              0.0                            0.0          0.0
382  …              0.0                            0.0          0.0
383  …              0.0                            0.0          0.0
384  …              0.0                            0.0          0.0
385  …              0.0                            0.0          0.0

     Vietnamese Restaurant  Wagashi Place  Waterfront  Whisky Bar  Wine Bar  \
0                      0.0       0.050000    0.016667         0.0       0.0
1                      0.0       0.000000    0.000000         0.0       0.0
2                      0.0       0.000000    0.000000         0.0       0.0
3                      0.0       0.095238    0.000000         0.0       0.0
4                      0.0       0.060606    0.000000         0.0       0.0
..                     …            …          …          …       …
381                    0.0       0.000000    0.000000         0.0       0.0
382                    0.0       0.000000    0.000000         0.0       0.0
383                    0.0       0.013889    0.000000         0.0       0.0
384                    0.0       0.058824    0.000000         0.0       0.0
385                    0.0       0.045455    0.000000         0.0       0.0

     Yakitori Restaurant  Yoshoku Restaurant
0               0.000000            0.000000
1               0.000000            0.000000
2               0.000000            0.000000
3               0.000000            0.000000
4               0.000000            0.000000
```

```
..                  …                   …
381            0.000000            0.020833
382            0.000000            0.022222
383            0.013889            0.000000
384            0.000000            0.000000
385            0.000000            0.000000

[386 rows x 174 columns]
```

1.2.7 Create the new dataframe and display the top 10 venues for each neighborhood.

[21]:
```
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]
```

[22]:
```
num_top_venues = 10

indicators = ['st', 'nd', 'rd']

# create columns according to number of top venues
columns = ['Neighborhood']
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_sorted = pd.DataFrame(columns=columns)
neighborhoods_venues_sorted['Neighborhood'] = kyoto_grouped['Neighborhood']

for ind in np.arange(kyoto_grouped.shape[0]):
    neighborhoods_venues_sorted.iloc[ind, 1:] =␣
 ↪return_most_common_venues(kyoto_grouped.iloc[ind, :], num_top_venues)

neighborhoods_venues_sorted.head()
```

[22]:
```
            Neighborhood 1st Most Common Venue 2nd Most Common Venue  \
0                 AIOICHO                  Café   Japanese Restaurant
1              AIZENJICHO     Convenience Store          Intersection
2       AMAGASAKIYOKOCHO     Convenience Store      Ramen Restaurant
3          AMIDAJIMAECHO         Shopping Mall         Wagashi Place
4  ANEHIGASHIHORIKAWACHO   Japanese Restaurant         Historic Site

  3rd Most Common Venue 4th Most Common Venue 5th Most Common Venue  \
```

```
0     Convenience Store           Coffee Shop                Bakery
1             BBQ Joint   Japanese Restaurant                 Café
2   Japanese Restaurant        Discount Store         Historic Site
3    Chinese Restaurant     Convenience Store                Bakery
4                 Café                Bakery     Convenience Store

  6th Most Common Venue 7th Most Common Venue 8th Most Common Venue  \
0         Shopping Mall         Wagashi Place         Train Station
1                Hostel    Chinese Restaurant              Bus Stop
2             Bus Stop           Fish Market    Chinese Restaurant
3           Coffee Shop            Restaurant         Movie Theater
4         Wagashi Place           Coffee Shop      Ramen Restaurant

  9th Most Common Venue 10th Most Common Venue
0             BBQ Joint     Chinese Restaurant
1      Ramen Restaurant         Discount Store
2  Fast Food Restaurant        Pachinko Parlor
3      Sushi Restaurant         Clothing Store
4                Shrine     Chinese Restaurant
```

1.2.8 Cluster Neighborhoods. Create a new dataframe with the top 10 venues for each neighborhood.

[23]:
```
# set number of clusters
kclusters = 5

kyoto_grouped_clustering = kyoto_grouped.drop('Neighborhood', 1)

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

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

[23]:
```
array([4, 3, 0, 4, 4, 4, 4, 4, 1, 4], dtype=int32)
```

[24]:
```
# add clustering labels
neighborhoods_venues_sorted.insert(0, 'Cluster Labels', kmeans.labels_)

kyoto_merged = kyoto_data

# merge kyoto_grouped with kyoto_data to add latitude/longitude for each␣
 ↪neighborhood
kyoto_merged = kyoto_merged.join(neighborhoods_venues_sorted.
 ↪set_index('Neighborhood'), on='Neighborhood')
```

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

[24]:
```
   Unnamed: 0  PostalCode Prefecture-JP Borough-JP Neighborhood-JP Prefecture  \
0           0     6020827                                            KYOTO FU
1           1     6028278                                            KYOTO FU
2           4     6028165                                            KYOTO FU
3           6     6020803                                            KYOTO FU
4           8     6028472                                            KYOTO FU

                Borough      Neighborhood   Latitude   Longitude  …  \
0  KYOTO SHI KAMIGYO KU           AIOICHO  35.031141  135.769037  …
1  KYOTO SHI KAMIGYO KU        AIZENJICHO  35.023407  135.743734  …
2  KYOTO SHI KAMIGYO KU  AMAGASAKIYOKOCHO  35.021582  135.742720  …
3  KYOTO SHI KAMIGYO KU     AMIDAJIMAECHO  35.033264  135.766436  …
4  KYOTO SHI KAMIGYO KU           ARIMACHO  35.030387  135.745635  …

   1st Most Common Venue 2nd Most Common Venue 3rd Most Common Venue  \
0                   Café   Japanese Restaurant     Convenience Store
1      Convenience Store          Intersection             BBQ Joint
2      Convenience Store      Ramen Restaurant   Japanese Restaurant
3          Shopping Mall         Wagashi Place    Chinese Restaurant
4                   Café     Convenience Store                Bakery

  4th Most Common Venue 5th Most Common Venue 6th Most Common Venue  \
0           Coffee Shop                Bakery         Shopping Mall
1   Japanese Restaurant                 Café               Hostel
2        Discount Store         Historic Site             Bus Stop
3     Convenience Store                Bakery           Coffee Shop
4    Chinese Restaurant      Ramen Restaurant          Intersection

  7th Most Common Venue 8th Most Common Venue 9th Most Common Venue  \
0         Wagashi Place         Train Station             BBQ Joint
1    Chinese Restaurant              Bus Stop      Ramen Restaurant
2          Fish Market    Chinese Restaurant  Fast Food Restaurant
3           Restaurant         Movie Theater      Sushi Restaurant
4   Japanese Restaurant    Yoshoku Restaurant                  Park

  10th Most Common Venue
0     Chinese Restaurant
1         Discount Store
2        Pachinko Parlor
3         Clothing Store
4        Soba Restaurant

[5 rows x 21 columns]
```

1.2.9 Visualize the resulting clusters

[25]:
```
# create map
map_clusters = folium.Map(location=[latitude, longitude], zoom_start=14)

# 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]
print(rainbow)

# add markers to the map
markers_colors = []
for lat, lon, poi, cluster in zip(kyoto_merged['Latitude'],␣
 ↪kyoto_merged['Longitude'], kyoto_merged['Neighborhood'],␣
 ↪kyoto_merged['Cluster Labels']):
    label = folium.Popup(str(poi) + ' Cluster ' + str(cluster), parse_html=True)
    folium.CircleMarker(
        [lat, lon],
        radius=5,
        popup=label,
        color=rainbow[cluster-1],
        fill=True,
        fill_color=rainbow[cluster-1],
        fill_opacity=0.7).add_to(map_clusters)

map_clusters
```

```
['#8000ff', '#00b5eb', '#80ffb4', '#ffb360', '#ff0000']
```

[25]:
```
<folium.folium.Map at 0x7f2bf91d3198>
```

1.2.10 Examine Clusters

Cluster 1

[26]:
```
cluster1 = kyoto_merged.loc[kyoto_merged['Cluster Labels'] == 0, kyoto_merged.
 ↪columns[[1] + list(range(5, kyoto_merged.shape[1]))]]
cluster1
```

[26]:

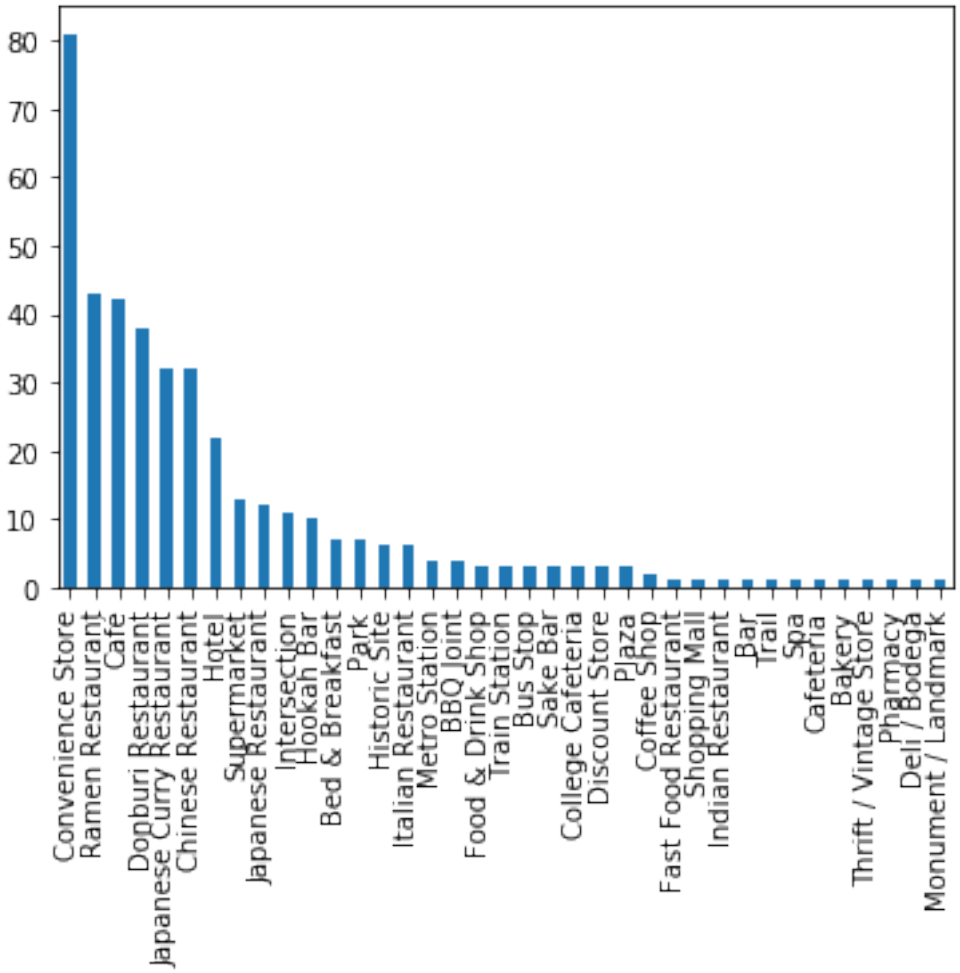
	PostalCode	Prefecture	Borough	Neighborhood	\
2	6028165	KYOTO FU	KYOTO SHI KAMIGYO KU	AMAGASAKIYOKOCHO	
15	6020012	KYOTO FU	KYOTO SHI KAMIGYO KU	UCHIGAMAECHO	
19	6020031	KYOTO FU	KYOTO SHI KAMIGYO KU	URATSUKIJICHO	
20	6020025	KYOTO FU	KYOTO SHI KAMIGYO KU	URAFUROCHO	
28	6020032	KYOTO FU	KYOTO SHI KAMIGYO KU	OKAMATSUCHO	
..	…	…	…	…	

```
370     6048804   KYOTO FU  KYOTO SHI NAKAGYO KU        MIBU BOJOCHO
372     6048353   KYOTO FU  KYOTO SHI NAKAGYO KU         MIYAMOTOCHO
381     6048361   KYOTO FU  KYOTO SHI NAKAGYO KU          YOSHINOCHO
386     6048342   KYOTO FU  KYOTO SHI NAKAGYO KU  ROKKAKU INOKUMACHO
387     6048344   KYOTO FU  KYOTO SHI NAKAGYO KU    ROKKAKU OMIYACHO

      Latitude   Longitude  Cluster Labels 1st Most Common Venue  \
2    35.021582  135.742720               0     Convenience Store
15   35.036254  135.759068               0     Convenience Store
19   35.031174  135.758258               0     Convenience Store
20   35.032636  135.757088               0     Convenience Store
28   35.029636  135.759454               0     Convenience Store
..         …          …              …                 …
370  35.004948  135.746555               0     Convenience Store
372  35.005455  135.751381               0     Convenience Store
381  35.004899  135.751456               0     Convenience Store
386  35.006686  135.750799               0     Convenience Store
387  35.006686  135.749280               0     Convenience Store

    2nd Most Common Venue      3rd Most Common Venue 4th Most Common Venue  \
2        Ramen Restaurant        Japanese Restaurant        Discount Store
15                  Café  Japanese Curry Restaurant     Food & Drink Shop
19       Ramen Restaurant         Donburi Restaurant                 Café
20     Donburi Restaurant  Japanese Curry Restaurant                 Café
28                  Café              Historic Site    Donburi Restaurant
..                   …                        …                    …
370      Ramen Restaurant                    Café    Chinese Restaurant
372                 Hotel        Japanese Restaurant       Bed & Breakfast
381                 Hotel        Japanese Restaurant       Bed & Breakfast
386    Chinese Restaurant                    Café      Ramen Restaurant
387    Chinese Restaurant           Ramen Restaurant                 Café

         5th Most Common Venue 6th Most Common Venue  \
2                Historic Site              Bus Stop
15          Donburi Restaurant      Ramen Restaurant
19               Historic Site              Sake Bar
20                   Sake Bar      Ramen Restaurant
28   Japanese Curry Restaurant              Sake Bar
..                         …                    …
370                    Hotel             BBQ Joint
372         Chinese Restaurant      Ramen Restaurant
381         Chinese Restaurant                 Café
386                    Hotel       Bed & Breakfast
387                    Hotel              Sake Bar

         7th Most Common Venue 8th Most Common Venue 9th Most Common Venue  \
2                 Fish Market    Chinese Restaurant  Fast Food Restaurant
```

```
15          College Cafeteria                  Park    Chinese Restaurant
19   Japanese Curry Restaurant           Art Gallery  Fast Food Restaurant
20               Intersection                  Park              Bus Stop
28           Ramen Restaurant                 Diner               Theater
..                         …                     …                   …
370       Yakitori Restaurant  Fast Food Restaurant              Sake Bar
372                    Café  Fast Food Restaurant              Sake Bar
381              Intersection     Ramen Restaurant  Fast Food Restaurant
386        Donburi Restaurant          Intersection              Sake Bar
387      Fast Food Restaurant    Donburi Restaurant       Bed & Breakfast

    10th Most Common Venue
2          Pachinko Parlor
15                     Spa
19                  Bakery
20    Fast Food Restaurant
28              Steakhouse
..                      …
370        Bed & Breakfast
372     Donburi Restaurant
381            Coffee Shop
386   Fast Food Restaurant
387          Shopping Mall

[81 rows x 17 columns]
```

plot common venues in this cluster

[36]:
```
cluster1_top3 = cluster1[['1st Most Common Venue', '2nd Most Common Venue',␣
↪'3rd Most Common Venue', '4th Most Common Venue', '5th Most Common Venue']]
pd.concat([cluster1_top3[col] for col in cluster1_top3]).value_counts().plot.
↪bar()
plt.show()
```



Cluster 2

[28]:
```
cluster2 = kyoto_merged.loc[kyoto_merged['Cluster Labels'] == 1, kyoto_merged.
 ↪columns[[1] + list(range(5, kyoto_merged.shape[1]))]]
cluster2
```

[28]:

	PostalCode	Prefecture	Borough	Neighborhood
227	6048273	KYOTO FU	KYOTO SHI NAKAGYO KU	ANENISHINOTOINCHO
230	6048216	KYOTO FU	KYOTO SHI NAKAGYO KU	IKESUCHO
237	6048213	KYOTO FU	KYOTO SHI NAKAGYO KU	UBAYANAGICHO
238	6048256	KYOTO FU	KYOTO SHI NAKAGYO KU	ECHIGOCHO
242	6048165	KYOTO FU	KYOTO SHI NAKAGYO KU	EBOSHIYACHO
243	6048174	KYOTO FU	KYOTO SHI NAKAGYO KU	ENNOGYOJACHO
244	6048175	KYOTO FU	KYOTO SHI NAKAGYO KU	EMPUKUJICHO
250	6048173	KYOTO FU	KYOTO SHI NAKAGYO KU	KAKIMOTOCHO
253	6048241	KYOTO FU	KYOTO SHI NAKAGYO KU	KAMANZACHO
265	6048163	KYOTO FU	KYOTO SHI NAKAGYO KU	KOIYAMACHO

267	6048203	KYOTO FU	KYOTO SHI	NAKAGYO KU	KOROMONOTANACHO
272	6048251	KYOTO FU	KYOTO SHI	NAKAGYO KU	SANJO ABURANOKOJICHO
275	6048205	KYOTO FU	KYOTO SHI	NAKAGYO KU	SANJOCHO
277	6048277	KYOTO FU	KYOTO SHI	NAKAGYO KU	SAMBO NISHINOTOINCHO
283	6048162	KYOTO FU	KYOTO SHI	NAKAGYO KU	SHICHIKANNONCHO
294	6048246	KYOTO FU	KYOTO SHI	NAKAGYO KU	SHOJOCHO
297	6048207	KYOTO FU	KYOTO SHI	NAKAGYO KU	SHIMMEICHO
300	6048274	KYOTO FU	KYOTO SHI	NAKAGYO KU	SEIDOCHO
302	6048262	KYOTO FU	KYOTO SHI	NAKAGYO KU	SORINCHO
308	6048271	KYOTO FU	KYOTO SHI	NAKAGYO KU	TSUGARUCHO
314	6048201	KYOTO FU	KYOTO SHI	NAKAGYO KU	NAGAHAMACHO
347	6048217	KYOTO FU	KYOTO SHI	NAKAGYO KU	NISHIROKKAKUCHO
350	6048258	KYOTO FU	KYOTO SHI	NAKAGYO KU	HASHIHIGASHIZUMECHO
351	6048151	KYOTO FU	KYOTO SHI	NAKAGYO KU	HASHIBENKEICHO
358	6048215	KYOTO FU	KYOTO SHI	NAKAGYO KU	FUDOCHO
362	6048164	KYOTO FU	KYOTO SHI	NAKAGYO KU	HONEYACHO
363	6048243	KYOTO FU	KYOTO SHI	NAKAGYO KU	HONNOJICHO
364	6048206	KYOTO FU	KYOTO SHI	NAKAGYO KU	MACHIGASHIRACHO
367	6048166	KYOTO FU	KYOTO SHI	NAKAGYO KU	MIKURACHO
371	6048275	KYOTO FU	KYOTO SHI	NAKAGYO KU	MIYAGICHO
375	6048244	KYOTO FU	KYOTO SHI	NAKAGYO KU	MOTOHONNOJICHO
376	6048231	KYOTO FU	KYOTO SHI	NAKAGYO KU	MOTOHONNOJIMINAMICHO
383	6048242	KYOTO FU	KYOTO SHI	NAKAGYO KU	RYUSUICHO
384	6048204	KYOTO FU	KYOTO SHI	NAKAGYO KU	RYOTONZUSHICHO
388	6048212	KYOTO FU	KYOTO SHI	NAKAGYO KU	ROKKAKUCHO

	Latitude	Longitude	Cluster Labels	1st Most Common Venue
227	35.009271	135.755482	1	Japanese Restaurant
230	35.006743	135.755519	1	Japanese Restaurant
237	35.006024	135.757394	1	Japanese Restaurant
238	35.007615	135.752939	1	Convenience Store
242	35.007887	135.758435	1	Coffee Shop
243	35.009203	135.758314	1	Japanese Restaurant
244	35.010401	135.758277	1	Japanese Restaurant
250	35.009445	135.758974	1	Japanese Restaurant
253	35.008516	135.756058	1	Coffee Shop
265	35.006763	135.758209	1	Coffee Shop
267	35.008544	135.757678	1	Japanese Restaurant
272	35.007925	135.754100	1	Japanese Restaurant
275	35.007918	135.756876	1	Japanese Restaurant
277	35.010420	135.755543	1	Japanese Restaurant
283	35.006732	135.759526	1	Coffee Shop
294	35.007916	135.754607	1	Japanese Restaurant
297	35.010418	135.756745	1	Japanese Restaurant
300	35.009150	135.754605	1	Café
302	35.009148	135.753634	1	Japanese Restaurant
308	35.010322	135.756002	1	Japanese Restaurant

314	35.010359	135.757528	1	Japanese Restaurant
347	35.007213	135.756155	1	Japanese Restaurant
350	35.008507	135.752899	1	Café
351	35.006183	135.759135	1	Coffee Shop
358	35.006086	135.755927	1	Japanese Restaurant
362	35.007428	135.758936	1	Coffee Shop
363	35.007279	135.754766	1	Hotel
364	35.009210	135.756801	1	Japanese Restaurant
367	35.008399	135.758926	1	Japanese Restaurant
371	35.009796	135.754551	1	Bakery
375	35.006734	135.754741	1	Japanese Restaurant
376	35.005877	135.754787	1	Convenience Store
383	35.007905	135.755661	1	Japanese Restaurant
384	35.007951	135.757700	1	Coffee Shop
388	35.006681	135.756884	1	Coffee Shop

	2nd Most Common Venue	3rd Most Common Venue	4th Most Common Venue
227	Coffee Shop	Hotel	Bakery
230	Hotel	Coffee Shop	Ramen Restaurant
237	Ramen Restaurant	Coffee Shop	Hotel
238	Japanese Restaurant	Bakery	Ramen Restaurant
242	Japanese Restaurant	Ramen Restaurant	Bakery
243	Café	Coffee Shop	Bakery
244	Café	Bakery	Coffee Shop
250	Café	Coffee Shop	Bakery
253	Japanese Restaurant	Bakery	Hotel
265	Japanese Restaurant	Ramen Restaurant	Café
267	Coffee Shop	Café	Bakery
272	Hotel	Ramen Restaurant	Bakery
275	Coffee Shop	Ramen Restaurant	Café
277	Bakery	Café	Hotel
283	Café	Japanese Restaurant	Ramen Restaurant
294	Hotel	Coffee Shop	Café
297	Café	Hotel	Bakery
300	Bakery	Hotel	Japanese Restaurant
302	Café	Bakery	Convenience Store
308	Hotel	Bakery	Café
314	Café	Coffee Shop	Bakery
347	Hotel	Coffee Shop	Ramen Restaurant
350	Bakery	Japanese Restaurant	Convenience Store
351	Japanese Restaurant	Ramen Restaurant	Café
358	Coffee Shop	Hotel	Ramen Restaurant
362	Japanese Restaurant	Café	Ramen Restaurant
363	Japanese Restaurant	Ramen Restaurant	Coffee Shop
364	Coffee Shop	Hotel	Café
367	Coffee Shop	Café	Bakery
371	Café	Japanese Restaurant	Historic Site

375	Hotel	Ramen Restaurant	Café	
376	Hotel	Japanese Restaurant	Café	
383	Hotel	Coffee Shop	Café	
384	Japanese Restaurant	Ramen Restaurant	Bakery	
388	Japanese Restaurant	Hotel	Ramen Restaurant	

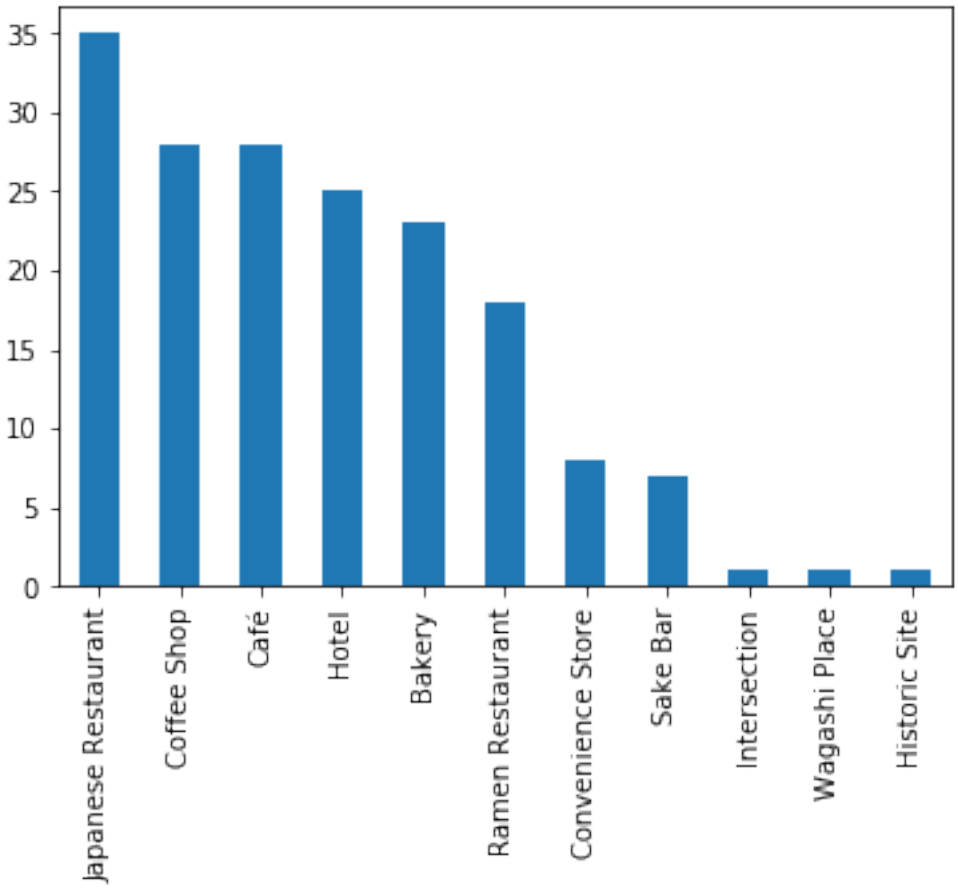
	5th Most Common Venue	6th Most Common Venue	7th Most Common Venue	\
227	Café	Ramen Restaurant	Convenience Store	
230	Convenience Store	Café	Sake Bar	
237	Sake Bar	Café	Bakery	
238	Intersection	Café	Wagashi Place	
242	Café	Sake Bar	Hotel	
243	Hotel	Sake Bar	Wagashi Place	
244	Hotel	Sake Bar	Ramen Restaurant	
250	Hotel	Wagashi Place	Sake Bar	
253	Café	Ramen Restaurant	Sake Bar	
265	Sake Bar	Bakery	Hotel	
267	Hotel	Ramen Restaurant	Sake Bar	
272	Coffee Shop	Convenience Store	Café	
275	Sake Bar	Bakery	Hotel	
277	Coffee Shop	Ramen Restaurant	Wagashi Place	
283	Sake Bar	Bakery	Hotel	
294	Ramen Restaurant	Convenience Store	Bakery	
297	Coffee Shop	Sake Bar	Wagashi Place	
300	Convenience Store	Coffee Shop	Ramen Restaurant	
302	Hotel	Historic Site	Wagashi Place	
308	Coffee Shop	Convenience Store	Wagashi Place	
314	Hotel	Sake Bar	Ramen Restaurant	
347	Bakery	Café	Sake Bar	
350	Wagashi Place	Coffee Shop	Ramen Restaurant	
351	Bakery	Hotel	Sake Bar	
358	Convenience Store	Bakery	Sake Bar	
362	Bakery	Sake Bar	Hotel	
363	Café	Convenience Store	Bakery	
364	Bakery	Sake Bar	Ramen Restaurant	
367	Sake Bar	Hotel	Ramen Restaurant	
371	Hotel	Coffee Shop	Ramen Restaurant	
375	Convenience Store	Coffee Shop	Bakery	
376	Ramen Restaurant	Coffee Shop	Bakery	
383	Sake Bar	Bakery	Convenience Store	
384	Café	Sake Bar	Hotel	
388	Sake Bar	Café	Bakery	

	8th Most Common Venue	9th Most Common Venue	10th Most Common Venue
227	Wagashi Place	Korean Restaurant	Shrine
230	Bakery	Chinese Restaurant	Wagashi Place
237	Beer Bar	Furniture / Home Store	Convenience Store

238	Hotel	Coffee Shop	Chinese Restaurant
242	Wagashi Place	Art Gallery	Bookstore
243	Ramen Restaurant	Museum	Art Gallery
244	Soba Restaurant	Dessert Shop	Bookstore
250	Ramen Restaurant	Museum	Chocolate Shop
253	Chinese Restaurant	Convenience Store	Wagashi Place
265	Furniture / Home Store	Museum	Italian Restaurant
267	Bookstore	Wagashi Place	Museum
272	Chinese Restaurant	Intersection	Wagashi Place
275	Italian Restaurant	Wagashi Place	Bookstore
277	Convenience Store	Historic Site	Bookstore
283	Furniture / Home Store	Chocolate Shop	Museum
294	Chinese Restaurant	Wagashi Place	Sake Bar
297	Ramen Restaurant	Mexican Restaurant	Donburi Restaurant
300	Wagashi Place	Bookstore	Sake Bar
302	Coffee Shop	Korean Restaurant	Shrine
308	Ramen Restaurant	Diner	Soba Restaurant
314	Dessert Shop	Wagashi Place	Museum
347	Convenience Store	Wagashi Place	Bookstore
350	Italian Restaurant	Hotel	Historic Site
351	Furniture / Home Store	Italian Restaurant	Japanese Curry Restaurant
358	Café	Chinese Restaurant	Furniture / Home Store
362	Wagashi Place	Furniture / Home Store	Italian Restaurant
363	Sake Bar	Chinese Restaurant	Intersection
364	Italian Restaurant	Art Gallery	Wagashi Place
367	Wagashi Place	Italian Restaurant	Bookstore
371	Convenience Store	Wagashi Place	Donburi Restaurant
375	Sake Bar	Chinese Restaurant	Wagashi Place
376	Chinese Restaurant	Sake Bar	Bed & Breakfast
383	Ramen Restaurant	Wagashi Place	Chinese Restaurant
384	Wagashi Place	Museum	Convenience Store
388	Furniture / Home Store	Convenience Store	Chinese Restaurant

plot common venues in this cluster

[37]:
```
cluster2_top3 = cluster2[['1st Most Common Venue', '2nd Most Common Venue',␣
↪'3rd Most Common Venue', '4th Most Common Venue', '5th Most Common Venue']]
pd.concat([cluster2_top3[col] for col in cluster2_top3]).value_counts().plot.
↪bar()
plt.show()
```



Cluster 3

[30]:
```
cluster3 = kyoto_merged.loc[kyoto_merged['Cluster Labels'] == 2, kyoto_merged.
 ↪columns[[1] + list(range(5, kyoto_merged.shape[1]))]]
cluster3
```

[30]:

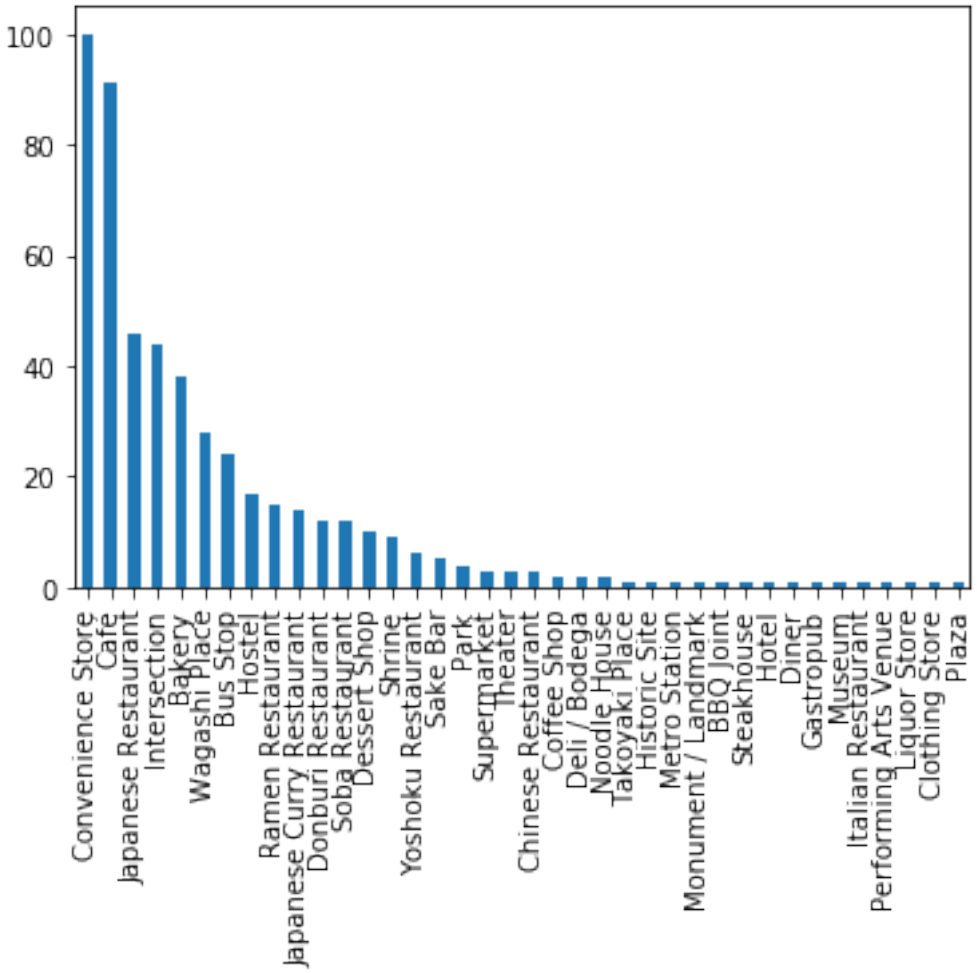
	PostalCode	Prefecture	Borough	Neighborhood	\
4	6028472	KYOTO FU	KYOTO SHI KAMIGYO KU	ARIMACHO	
5	6020064	KYOTO FU	KYOTO SHI KAMIGYO KU	ANRAKUKOJICHO	
8	6028302	KYOTO FU	KYOTO SHI KAMIGYO KU	IDACHO	
9	6028471	KYOTO FU	KYOTO SHI KAMIGYO KU	ISSHIKICHO	
12	6028497	KYOTO FU	KYOTO SHI KAMIGYO KU	INUICHO	
..	…	…	…	…	
217	6020806	KYOTO FU	KYOTO SHI KAMIGYO KU	YABUNOSHITACHO	
218	6028422	KYOTO FU	KYOTO SHI KAMIGYO KU	YAMANACHO	
222	6020084	KYOTO FU	KYOTO SHI KAMIGYO KU	WAKAMIYAYOKOCHO	
327	6048435	KYOTO FU	KYOTO SHI NAKAGYO KU	NISHINOKYO SANJOBOCHO	
348	6048257	KYOTO FU	KYOTO SHI NAKAGYO KU	HASHIURACHO	

```
      Latitude   Longitude  Cluster Labels 1st Most Common Venue  \
4    35.030387  135.745635               2                 Café
5    35.032808  135.755731               2                 Café
8    35.034755  135.742916               2                 Café
9    35.031081  135.745440               2                 Café
12   35.035214  135.744312               2     Convenience Store
..         …          …              …                   …
217  35.033546  135.764612               2     Convenience Store
218  35.031525  135.751536               2     Convenience Store
222  35.039036  135.748975               2     Convenience Store
327  35.008920  135.731438               2     Convenience Store
348  35.007892  135.752046               2     Convenience Store

    2nd Most Common Venue 3rd Most Common Venue 4th Most Common Venue  \
4       Convenience Store               Bakery    Chinese Restaurant
5       Convenience Store         Intersection         Metro Station
8               Bus Stop         Intersection                Hostel
9       Convenience Store         Intersection                Bakery
12                  Café         Intersection                Hostel
..                   …                 …                   …
217                 Café         Liquor Store   Monument / Landmark
218                 Café   Japanese Restaurant                Bakery
222                 Café             Bus Stop       Soba Restaurant
327                 Café         Intersection      Ramen Restaurant
348                 Café   Japanese Restaurant                 Hotel

    5th Most Common Venue 6th Most Common Venue 7th Most Common Venue  \
4       Ramen Restaurant          Intersection   Japanese Restaurant
5     Donburi Restaurant                 Plaza      Ramen Restaurant
8                   Park     Convenience Store                Bakery
9     Chinese Restaurant      Ramen Restaurant          Liquor Store
12                Bakery       Soba Restaurant              Bus Stop
..                   …                 …                   …
217       Clothing Store           Steakhouse            Art Museum
218        Wagashi Place      Ramen Restaurant          Intersection
222              Bakery                   Spa     Food & Drink Shop
327           Gastropub             Tea Room                   Gym
348     Ramen Restaurant          Intersection         Wagashi Place

        8th Most Common Venue 9th Most Common Venue  \
4          Yoshoku Restaurant                  Park
5   Japanese Curry Restaurant     Food & Drink Shop
8                   Sake Bar          Liquor Store
9             Soba Restaurant              Sake Bar
12         Yoshoku Restaurant          Liquor Store
..                        …                   …
217       Dumpling Restaurant     French Restaurant
```

```
218  Japanese Curry Restaurant                Shrine
222                  Sake Bar            Bath House
327                 Rock Club            Restaurant
348         Chinese Restaurant              Sake Bar

        10th Most Common Venue
4                Soba Restaurant
5             Italian Restaurant
8                         Diner
9                      Pharmacy
12                        Diner
..                          …
217                      Forest
218       Performing Arts Venue
222  Japanese Curry Restaurant
327                       Diner
348         Donburi Restaurant

[101 rows x 17 columns]
```

plot common venues in this cluster

[38]:
```
cluster3_top3 = cluster3[['1st Most Common Venue', '2nd Most Common Venue',␣
↪'3rd Most Common Venue', '4th Most Common Venue', '5th Most Common Venue']]
pd.concat([cluster3_top3[col] for col in cluster3_top3]).value_counts().plot.
↪bar()
plt.show()
```



Cluster 4

[32]:
```
cluster4 = kyoto_merged.loc[kyoto_merged['Cluster Labels'] == 3, kyoto_merged.
 ↪columns[[1] + list(range(5, kyoto_merged.shape[1]))]]
cluster4
```

[32]:

	PostalCode	Prefecture	Borough	Neighborhood
1	6028278	KYOTO FU	KYOTO SHI KAMIGYO KU	AIZENJICHO
6	6028297	KYOTO FU	KYOTO SHI KAMIGYO KU	ISEDONOKAMAECHO
14	6028292	KYOTO FU	KYOTO SHI KAMIGYO KU	IMASHINZAIKECHO
29	6028281	KYOTO FU	KYOTO SHI KAMIGYO KU	KAGAYACHO
44	6028272	KYOTO FU	KYOTO SHI KAMIGYO KU	KAMEKICHO
46	6028296	KYOTO FU	KYOTO SHI KAMIGYO KU	KITAISEDONOKAMAECHO
50	6028207	KYOTO FU	KYOTO SHI KAMIGYO KU	KITASHINZAIKECHO
63	6028299	KYOTO FU	KYOTO SHI KAMIGYO KU	KODONOCHICHO
64	6028275	KYOTO FU	KYOTO SHI KAMIGYO KU	KODOMAENOCHO
65	6020801	KYOTO FU	KYOTO SHI KAMIGYO KU	KOTOKUJICHO

71	6028342	KYOTO FU	KYOTO SHI	KAMIGYO KU	GOBANCHO	
72	6028157	KYOTO FU	KYOTO SHI	KAMIGYO KU	KOYAMACHO	
73	6028179	KYOTO FU	KYOTO SHI	KAMIGYO KU	KONTAKACHO	
74	6028151	KYOTO FU	KYOTO SHI	KAMIGYO KU	SAIINCHO	
78	6028274	KYOTO FU	KYOTO SHI	KAMIGYO KU	SANNOCHO	
80	6028277	KYOTO FU	KYOTO SHI	KAMIGYO KU	SHINANOCHO	
87	6028176	KYOTO FU	KYOTO SHI	KAMIGYO KU	SHIMOMARUYACHO	
92	6028164	KYOTO FU	KYOTO SHI	KAMIGYO KU	JUYONKENCHO	
95	6028178	KYOTO FU	KYOTO SHI	KAMIGYO KU	SHIROGANECHO	
99	6028161	KYOTO FU	KYOTO SHI	KAMIGYO KU	SHINGOKOCHO	
106	6028312	KYOTO FU	KYOTO SHI	KAMIGYO KU	SUEHIROCHO	
107	6028246	KYOTO FU	KYOTO SHI	KAMIGYO KU	SUGIMOTOCHO	
112	6028455	KYOTO FU	KYOTO SHI	KAMIGYO KU	TAIDOKATAHARACHO	
113	6028298	KYOTO FU	KYOTO SHI	KAMIGYO KU	TAIDOCHO	
117	6028163	KYOTO FU	KYOTO SHI	KAMIGYO KU	TANAKACHO	
119	6028288	KYOTO FU	KYOTO SHI	KAMIGYO KU	TAMARUCHO	
120	6028177	KYOTO FU	KYOTO SHI	KAMIGYO KU	TAMURABIZENCHO	
121	6028261	KYOTO FU	KYOTO SHI	KAMIGYO KU	TAMONCHO	
122	6028287	KYOTO FU	KYOTO SHI	KAMIGYO KU	TAMBAYACHO	
129	6028294	KYOTO FU	KYOTO SHI	KAMIGYO KU	TOZAITAWARAYACHO	
139	6028283	KYOTO FU	KYOTO SHI	KAMIGYO KU	NAKAGORYOCHO	
140	6020857	KYOTO FU	KYOTO SHI	KAMIGYO KU	NAKAGORYOCHO	
141	6028158	KYOTO FU	KYOTO SHI	KAMIGYO KU	NAKATSUKASACHO	
147	6028169	KYOTO FU	KYOTO SHI	KAMIGYO KU	NISHISHIMMEICHO	
148	6028282	KYOTO FU	KYOTO SHI	KAMIGYO KU	NISHITOMINAKACHO	
149	6028138	KYOTO FU	KYOTO SHI	KAMIGYO KU	NISHIHASHIZUMECHO	
156	6028167	KYOTO FU	KYOTO SHI	KAMIGYO KU	NIHOMMATSUCHO	
158	6028273	KYOTO FU	KYOTO SHI	KAMIGYO KU	HASECHO	
164	6028295	KYOTO FU	KYOTO SHI	KAMIGYO KU	HIGASHIISHIBASHICHO	
169	6028162	KYOTO FU	KYOTO SHI	KAMIGYO KU	HIGASHISHIMMEICHO	
173	6028266	KYOTO FU	KYOTO SHI	KAMIGYO KU	HISHIMARUCHO	
175	6028276	KYOTO FU	KYOTO SHI	KAMIGYO KU	HYAKUMAMBENCHO	
177	6028166	KYOTO FU	KYOTO SHI	KAMIGYO KU	FUKUSHIMACHO	
178	6028291	KYOTO FU	KYOTO SHI	KAMIGYO KU	FUKUMOTOCHO	
180	6020807	KYOTO FU	KYOTO SHI	KAMIGYO KU	FUDOMAECHO	
182	6028313	KYOTO FU	KYOTO SHI	KAMIGYO KU	FUROYACHO	
183	6028174	KYOTO FU	KYOTO SHI	KAMIGYO KU	BUNDOCHO	
185	6028168	KYOTO FU	KYOTO SHI	KAMIGYO KU	BENTENCHO	
193	6028465	KYOTO FU	KYOTO SHI	KAMIGYO KU	MATSUYACHO	
197	6028327	KYOTO FU	KYOTO SHI	KAMIGYO KU	MINAMISATAKECHO	
221	6028351	KYOTO FU	KYOTO SHI	KAMIGYO KU	ROKUBANCHO	
292	6048404	KYOTO FU	KYOTO SHI	NAKAGYO KU	JURAKUMAWARI HIGASHIMACHI	
328	6048443	KYOTO FU	KYOTO SHI	NAKAGYO KU	NISHINOKYO SHIMANOCHICHO	
329	6048436	KYOTO FU	KYOTO SHI	NAKAGYO KU	NISHINOKYO SHIMOAICHO	
332	6048444	KYOTO FU	KYOTO SHI	NAKAGYO KU	NISHINOKYO TSUKINOWACHO	

```
      Latitude   Longitude  Cluster Labels 1st Most Common Venue  \
```

1	35.023407	135.743734	3	Convenience Store
6	35.026528	135.743878	3	Convenience Store
14	35.025669	135.746352	3	Convenience Store
29	35.024975	135.744959	3	Convenience Store
44	35.023078	135.746352	3	Convenience Store
46	35.026557	135.743093	3	Convenience Store
50	35.026583	135.746378	3	Convenience Store
63	35.026368	135.745043	3	Convenience Store
64	35.023100	135.742934	3	Convenience Store
65	35.036348	135.764505	3	Plaza
71	35.023925	135.741883	3	Convenience Store
72	35.018917	135.743111	3	Convenience Store
73	35.022695	135.745751	3	Convenience Store
74	35.018803	135.747054	3	Ramen Restaurant
78	35.023152	135.744131	3	Convenience Store
80	35.023820	135.743535	3	Convenience Store
87	35.020121	135.745836	3	Convenience Store
92	35.020791	135.743044	3	Convenience Store
95	35.021957	135.745761	3	Intersection
99	35.022700	135.744790	3	Convenience Store
106	35.031606	135.741424	3	Convenience Store
107	35.022551	135.746625	3	Intersection
112	35.027343	135.742849	3	Convenience Store
113	35.026495	135.744503	3	Convenience Store
117	35.020257	135.744136	3	Convenience Store
119	35.024949	135.743980	3	Convenience Store
120	35.021283	135.746040	3	Convenience Store
121	35.025059	135.746748	3	Café
122	35.024980	135.743385	3	Convenience Store
129	35.025749	135.744560	3	Convenience Store
139	35.024180	135.742843	3	Convenience Store
140	35.023552	135.768662	3	Convenience Store
141	35.018882	135.745246	3	Convenience Store
147	35.021382	135.743827	3	Convenience Store
148	35.024211	135.743954	3	Convenience Store
149	35.020066	135.751571	3	Convenience Store
156	35.022471	135.743734	3	Convenience Store
158	35.023073	135.745150	3	Japanese Restaurant
164	35.025814	135.742950	3	Convenience Store
169	35.021305	135.744608	3	Convenience Store
173	35.024246	135.745295	3	Café
175	35.023816	135.742859	3	Convenience Store
177	35.022208	135.742328	3	Convenience Store
178	35.026834	135.745493	3	Convenience Store
180	35.035105	135.764826	3	Trail
182	35.030743	135.741921	3	Convenience Store
183	35.020701	135.746652	3	Convenience Store

185	35.022094	135.744335	3	Convenience Store
193	35.028850	135.742224	3	Convenience Store
197	35.029179	135.741599	3	Convenience Store
221	35.022506	135.741636	3	Convenience Store
292	35.017384	135.742559	3	Ramen Restaurant
328	35.009109	135.725200	3	Convenience Store
329	35.010322	135.731564	3	Convenience Store
332	35.011620	135.724972	3	Japanese Restaurant

	2nd Most Common Venue	3rd Most Common Venue	4th Most Common Venue
1	Intersection	BBQ Joint	Japanese Restaurant
6	Café	Japanese Restaurant	Intersection
14	Café	Japanese Restaurant	Chinese Restaurant
29	Café	Japanese Restaurant	Intersection
44	Café	Intersection	BBQ Joint
46	Japanese Restaurant	Café	Intersection
50	Café	Intersection	Japanese Restaurant
63	Café	Intersection	Japanese Restaurant
64	Intersection	BBQ Joint	Japanese Restaurant
65	Art Museum	Spa	Monument / Landmark
71	Japanese Restaurant	Intersection	Chinese Restaurant
72	Ramen Restaurant	Japanese Restaurant	Intersection
73	Intersection	BBQ Joint	Japanese Restaurant
74	Convenience Store	Japanese Restaurant	Hostel
78	Intersection	BBQ Joint	Japanese Restaurant
80	Japanese Restaurant	BBQ Joint	Intersection
87	Japanese Restaurant	Ramen Restaurant	Intersection
92	Japanese Restaurant	Ramen Restaurant	Hostel
95	Convenience Store	Japanese Restaurant	BBQ Joint
99	Intersection	BBQ Joint	Café
106	Japanese Restaurant	Dessert Shop	Noodle House
107	Convenience Store	BBQ Joint	Japanese Restaurant
112	Chinese Restaurant	Intersection	BBQ Joint
113	Café	Japanese Restaurant	Intersection
117	Hostel	Ramen Restaurant	Intersection
119	Café	Japanese Restaurant	BBQ Joint
120	Japanese Restaurant	Ramen Restaurant	Hostel
121	Convenience Store	Japanese Restaurant	Intersection
122	Japanese Restaurant	Café	BBQ Joint
129	Café	Japanese Restaurant	Chinese Restaurant
139	Japanese Restaurant	Café	Intersection
140	Japanese Restaurant	Café	Intersection
141	Ramen Restaurant	Hostel	Japanese Restaurant
147	Ramen Restaurant	Intersection	BBQ Joint
148	Japanese Restaurant	BBQ Joint	Chinese Restaurant
149	Japanese Curry Restaurant	Intersection	Hostel
156	Japanese Restaurant	Ramen Restaurant	BBQ Joint

158	Convenience Store	Intersection	BBQ Joint
164	Japanese Restaurant	Intersection	Café
169	Ramen Restaurant	Intersection	Japanese Restaurant
173	Convenience Store	Intersection	BBQ Joint
175	Japanese Restaurant	Intersection	Café
177	Ramen Restaurant	BBQ Joint	Japanese Restaurant
178	Café	Intersection	Japanese Restaurant
180	Art Museum	Spa	Monument / Landmark
182	Dessert Shop	Intersection	Japanese Restaurant
183	Japanese Restaurant	Intersection	Hostel
185	Ramen Restaurant	BBQ Joint	Japanese Restaurant
193	Japanese Restaurant	Intersection	Café
197	Japanese Restaurant	Dessert Shop	Intersection
221	Japanese Restaurant	Ramen Restaurant	Discount Store
292	Convenience Store	Sake Bar	Japanese Restaurant
328	Japanese Restaurant	Yoshoku Restaurant	Bakery
329	Intersection	Ramen Restaurant	Chinese Restaurant
332	Convenience Store	Intersection	Tea Room

	5th Most Common Venue	6th Most Common Venue	\
1	Café	Hostel	
6	Chinese Restaurant	BBQ Joint	
14	Intersection	BBQ Joint	
29	BBQ Joint	Chinese Restaurant	
44	Japanese Restaurant	Chinese Restaurant	
46	BBQ Joint	Chinese Restaurant	
50	Chinese Restaurant	Ramen Restaurant	
63	Ramen Restaurant	BBQ Joint	
64	Chinese Restaurant	Café	
65	Convenience Store	Trail	
71	BBQ Joint	Bus Stop	
72	Hostel	Diner	
73	Café	Hostel	
74	Castle	Japanese Curry Restaurant	
78	Café	Hostel	
80	Café	Chinese Restaurant	
87	Hostel	Discount Store	
92	Discount Store	Bus Stop	
95	Ramen Restaurant	Chinese Restaurant	
99	Japanese Restaurant	Hostel	
106	Takoyaki Place	Sushi Restaurant	
107	Café	Chinese Restaurant	
112	Café	Dessert Shop	
113	Chinese Restaurant	BBQ Joint	
117	Chinese Restaurant	Japanese Restaurant	
119	Chinese Restaurant	Intersection	
120	Intersection	Chinese Restaurant	

121	BBQ Joint	Chinese Restaurant
122	Chinese Restaurant	Intersection
129	Intersection	BBQ Joint
139	Chinese Restaurant	Ramen Restaurant
140	Chinese Restaurant	Ramen Restaurant
141	Diner	Intersection
147	Japanese Restaurant	Hostel
148	Intersection	Café
149	Japanese Restaurant	Chinese Restaurant
156	Intersection	Bus Stop
158	Café	Hostel
164	Chinese Restaurant	BBQ Joint
169	Hostel	BBQ Joint
173	Japanese Restaurant	Chinese Restaurant
175	BBQ Joint	Bus Stop
177	Intersection	Bus Stop
178	Chinese Restaurant	Ramen Restaurant
180	Convenience Store	Music Venue
182	Sushi Restaurant	Supermarket
183	Ramen Restaurant	Discount Store
185	Hostel	Intersection
193	Chinese Restaurant	Dessert Shop
197	Café	Pharmacy
221	Chinese Restaurant	Gourmet Shop
292	Japanese Curry Restaurant	Diner
328	Grocery Store	Tea Room
329	Café	Metro Station
332	Metro Station	Grocery Store

	7th Most Common Venue	8th Most Common Venue
1	Chinese Restaurant	Bus Stop
6	Ramen Restaurant	Bus Stop
14	Bakery	Ramen Restaurant
29	Bus Stop	Ramen Restaurant
44	Bus Stop	Ramen Restaurant
46	Ramen Restaurant	Sake Bar
50	Bakery	Bus Stop
63	Chinese Restaurant	Bus Stop
64	Bus Stop	Ramen Restaurant
65	Music Venue	Deli / Bodega
71	Café	Ramen Restaurant
72	Park	Café
73	Chinese Restaurant	Bus Stop
74	Café	Diner
78	Chinese Restaurant	Bus Stop
80	Bus Stop	Ramen Restaurant
87	Park	Bus Stop

92	Park	Chinese Restaurant
95	Hostel	Bus Stop
99	Chinese Restaurant	Bus Stop
106	Supermarket	Bus Stop
107	Bus Stop	Fast Food Restaurant
112	Pharmacy	Ramen Restaurant
113	Ramen Restaurant	Bakery
117	BBQ Joint	Discount Store
119	Bus Stop	Ramen Restaurant
120	BBQ Joint	Park
121	Supermarket	Karaoke Bar
122	Bus Stop	Ramen Restaurant
129	Bus Stop	Ramen Restaurant
139	BBQ Joint	Coffee Shop
140	BBQ Joint	Coffee Shop
141	Japanese Curry Restaurant	Brewery
147	Bus Stop	Chinese Restaurant
148	Bus Stop	Ramen Restaurant
149	Sushi Restaurant	Coffee Shop
156	Chinese Restaurant	Hostel
158	Chinese Restaurant	Bus Stop
164	Bus Stop	Ramen Restaurant
169	Bus Stop	Chinese Restaurant
173	Bus Stop	Ramen Restaurant
175	Chinese Restaurant	Ramen Restaurant
177	Fast Food Restaurant	Chinese Restaurant
178	Bakery	Bus Stop
180	Plaza	Intersection
182	Soba Restaurant	Bus Stop
183	Park	Diner
185	Chinese Restaurant	Café
193	Sake Bar	Supermarket
197	Supermarket	Bus Stop
221	Monument / Landmark	Bus Stop
292	Intersection	Soba Restaurant
328	Train Station	Intersection
329	Drugstore	Restaurant
332	Gastropub	Noodle House

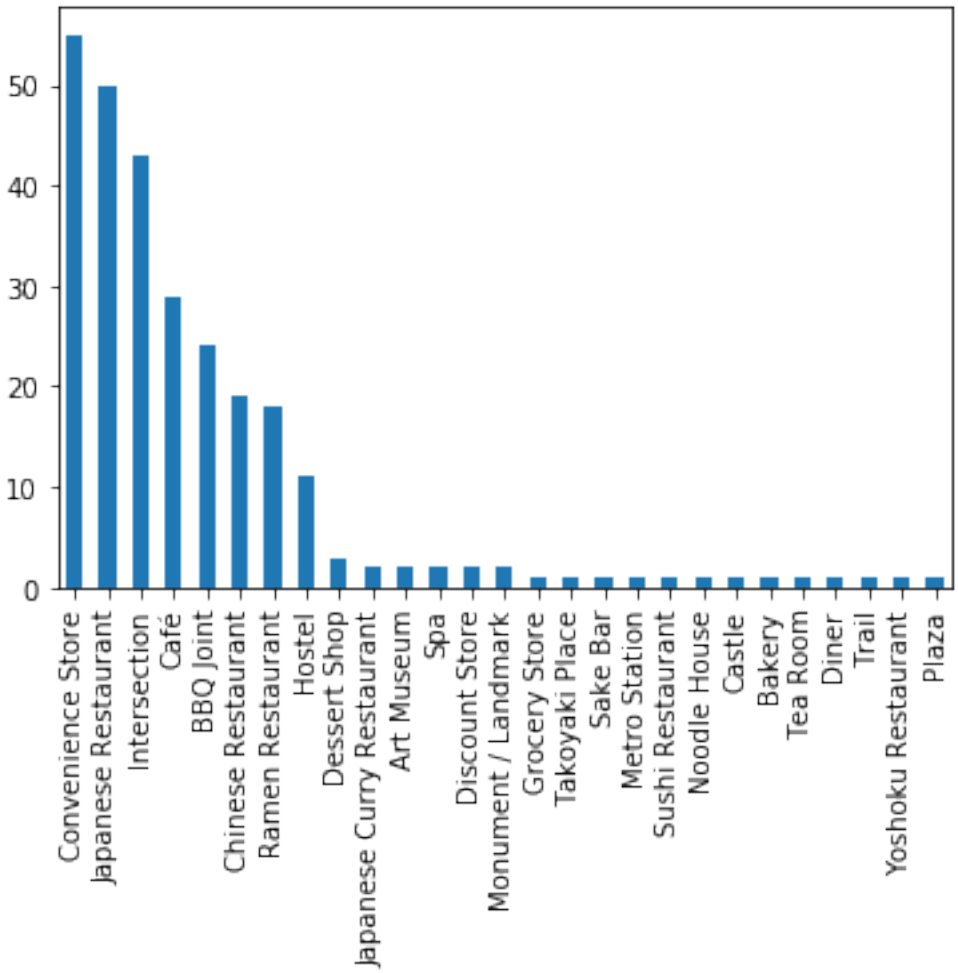
	9th Most Common Venue	10th Most Common Venue
1	Ramen Restaurant	Discount Store
6	Sake Bar	Monument / Landmark
14	Donburi Restaurant	Sushi Restaurant
29	Donburi Restaurant	Sake Bar
44	Vegetarian / Vegan Restaurant	Takoyaki Place
46	Bus Stop	Supermarket
50	BBQ Joint	Sushi Restaurant

63	Bakery	Tea Room
64	Donburi Restaurant	Drugstore
65	Intersection	Fast Food Restaurant
71	Hostel	Drugstore
72	Soba Restaurant	Sake Bar
73	Ramen Restaurant	Takoyaki Place
74	Garden	Tea Room
78	Ramen Restaurant	Discount Store
80	Grocery Store	Clothing Store
87	Diner	Fish Market
92	Nabe Restaurant	Fish Market
95	Fast Food Restaurant	Brewery
99	Ramen Restaurant	Donburi Restaurant
106	Candy Store	Yoshoku Restaurant
107	Drugstore	Fish Market
112	Japanese Restaurant	Bus Station
113	Bus Stop	Drugstore
117	Bus Stop	Fish Market
119	Grocery Store	Clothing Store
120	Bus Stop	Fish Market
121	Fast Food Restaurant	Drugstore
122	Takoyaki Place	Clothing Store
129	Monument / Landmark	Sushi Restaurant
139	Supermarket	Brewery
140	Supermarket	Brewery
141	Castle	Café
147	Brewery	Donburi Restaurant
148	Grocery Store	Clothing Store
149	Spa	Café
156	Café	Takoyaki Place
158	Ramen Restaurant	Donburi Restaurant
164	Supermarket	Dessert Shop
169	Discount Store	Fast Food Restaurant
173	Donburi Restaurant	Sake Bar
175	Hostel	Drugstore
177	Hostel	Historic Site
178	BBQ Joint	Tea Room
180	Discount Store	Fast Food Restaurant
182	Chinese Restaurant	Ramen Restaurant
183	Fish Market	Takoyaki Place
185	Bus Stop	Fast Food Restaurant
193	Park	Bus Stop
197	Shopping Mall	Sake Bar
221	Nabe Restaurant	Fast Food Restaurant
292	Bed & Breakfast	Café
328	BBQ Joint	Asian Restaurant
329	Sake Bar	Cafeteria

```
332                          Food            Dessert Shop
```

plot common venues in this cluster

[39]:
```
cluster4_top3 = cluster4[['1st Most Common Venue', '2nd Most Common Venue',␣
↪'3rd Most Common Venue', '4th Most Common Venue', '5th Most Common Venue']]
pd.concat([cluster4_top3[col] for col in cluster4_top3]).value_counts().plot.
↪bar()
plt.show()
```



Cluster 5

[34]:
```
cluster5 = kyoto_merged.loc[kyoto_merged['Cluster Labels'] == 4, kyoto_merged.
↪columns[[1] + list(range(5, kyoto_merged.shape[1]))]]
cluster5
```

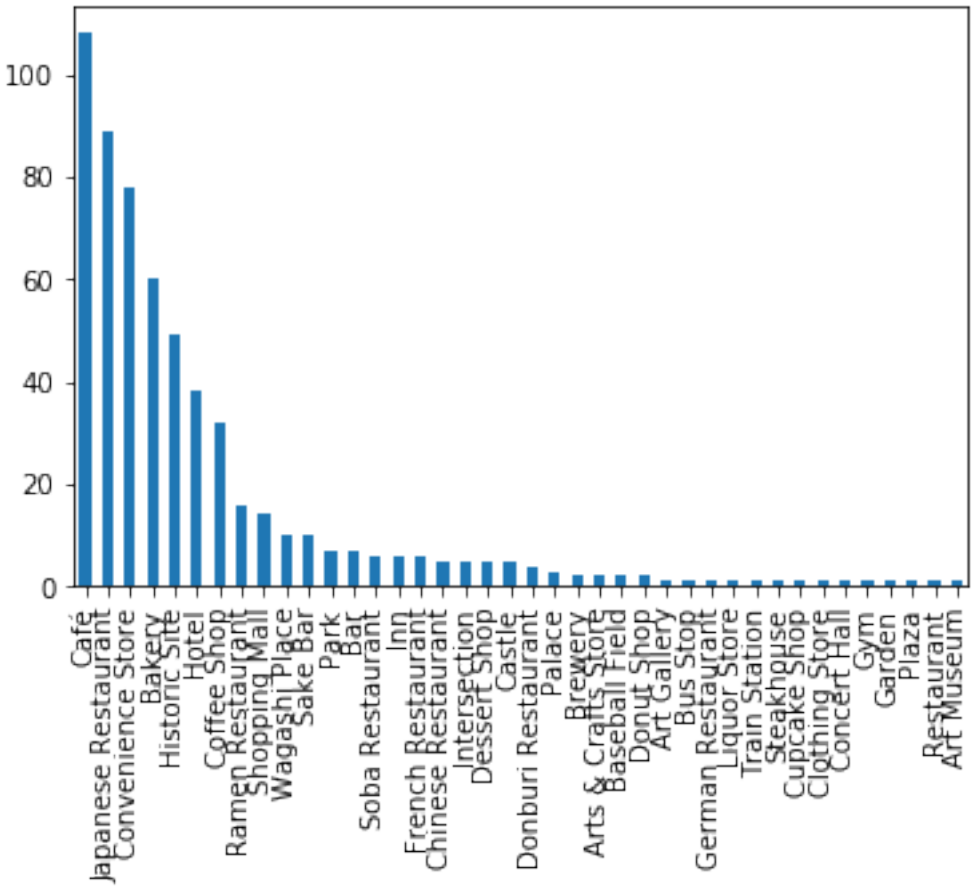
[34]:

	PostalCode	Prefecture	Borough	Neighborhood	Latitude	Longitude	Cluster Labels	1st Most Common Venue	2nd Most Common Venue	3rd Most Common Venue	4th Most Common Venue	5th Most Common Venue	6th Most Common Venue	7th Most Common Venue
0	6020827	KYOTO FU	KYOTO SHI KAMIGYO KU	AIOICHO	35.031141	135.769037	4	Café	Japanese Restaurant	Convenience Store	Coffee Shop	Bakery	Shopping Mall	Wagashi Place
3	6020803	KYOTO FU	KYOTO SHI KAMIGYO KU	AMIDAJIMAECHO	35.033264	135.766436	4	Shopping Mall	Wagashi Place	Chinese Restaurant	Convenience Store	Bakery	Coffee Shop	Restaurant
7	6020873	KYOTO FU	KYOTO SHI KAMIGYO KU	ISEYACHO	35.017109	135.769349	4	Café	Japanese Restaurant	Convenience Store	Intersection	Bakery	Bar	French Restaurant
10	6020824	KYOTO FU	KYOTO SHI KAMIGYO KU	ISSHINCHO	35.029704	135.768777	4	Café	Japanese Restaurant	Bakery	Convenience Store	Coffee Shop	Shopping Mall	Wagashi Place
11	6028238	KYOTO FU	KYOTO SHI KAMIGYO KU	ITOYACHO	35.028766	135.768710	4	Café	Japanese Restaurant	Coffee Shop	Bakery	Train Station	Shopping Mall	Convenience Store
..	…	…	…	…	…	…	…	…	…	…	…	…	…	…
378	6040815	KYOTO FU	KYOTO SHI NAKAGYO KU	YAMANAKACHO	35.014897	135.761490	4	Japanese Restaurant	Café	Convenience Store	Historic Site	Bakery	Donburi Restaurant	Dessert Shop
379	6040933	KYOTO FU	KYOTO SHI NAKAGYO KU	YAMAMOTOCHO	35.012881	135.766715	4	Café	Japanese Restaurant	Bakery	Hotel	Chinese Restaurant		
380	6040916	KYOTO FU	KYOTO SHI NAKAGYO KU	YOHOJIMAECHO	35.014309	135.767380	4	Café	Japanese Restaurant	Inn	Bakery	Hotel		
382	6040974	KYOTO FU	KYOTO SHI NAKAGYO KU	YONCHOME	35.016866	135.764322	4	Café	Historic Site	Park	Donburi Restaurant	Restaurant		
385	6040965	KYOTO FU	KYOTO SHI NAKAGYO KU	ROKUCHOME	35.014324	135.763980	4	Café	Japanese Restaurant	Bakery	Inn	Steakhouse		

```
379     Convenience Store          Intersection
380     French Restaurant                   Bar
382     French Restaurant               Bakery
385               Sake Bar     Convenience Store

             8th Most Common Venue 9th Most Common Venue  \
0                    Train Station             BBQ Joint
3                    Movie Theater      Sushi Restaurant
7                 Ramen Restaurant               Brewery
10                   Train Station             BBQ Joint
11                   Wagashi Place            Donut Shop
..                             …                     …
378                Soba Restaurant    Yoshoku Restaurant
379                            Bar                   Inn
380  Paper / Office Supplies Store    Chinese Restaurant
382              Convenience Store          Dessert Shop
385                     Beer Bar           Dessert Shop

    10th Most Common Venue
0       Chinese Restaurant
3           Clothing Store
7               Steakhouse
10      Chinese Restaurant
11               BBQ Joint
..                     …
378              Beer Bar
379              BBQ Joint
380         Chocolate Shop
382         Science Museum
385     Donburi Restaurant

[117 rows x 17 columns]
```

plot common venues in this cluster

[40]:
```
cluster5_top3 = cluster5[['1st Most Common Venue', '2nd Most Common Venue',␣
↪'3rd Most Common Venue', '4th Most Common Venue', '5th Most Common Venue']]
pd.concat([cluster5_top3[col] for col in cluster5_top3]).value_counts().plot.
↪bar()
plt.show()
```


100
80
60
40
20
0
Café
Japanese Restaurant
Convenience Store
Bakery
Historic Site
Hotel
Coffee Shop
Ramen Restaurant
Shopping Mall
Wagashi Place
Sake Bar
Park
Bar
Soba Restaurant
Inn
French Restaurant
Chinese Restaurant
Intersection
Dessert Shop
Castle
Donburi Restaurant
Palace
Brewery
Arts & Crafts Store
Baseball Field
Donut Shop
Art Gallery
Bus Stop
German Restaurant
Liquor Store
Train Station
Steakhouse
Cupcake Shop
Clothing Store
Concert Hall
Gym
Garden
Plaza
Restaurant
Art Museum

[ ]:

[ ]: