MapOfScience_solution

December 31, 2018

1 Solution of 5.9.2, Map of Science

1.0.1 Read the file `pubmed_results.txt`, and extract all the US ZIP codes.

First, import the modules we'll need.

```
In [1]: import re
        import csv
```

Now read the whole file, and store it into a string.

```
In [2]: with open('../data/MapOfScience/pubmed_results.txt') as f:
            my_text = f.read()

In [3]: len(my_text)

Out[3]: 4941404
```

Note that the zipcode could be broken over two lines, as in line 43 of `pubmed_results.txt`

```
AD  - Biological and Biomedical Sciences Program, Harvard Medical School, Boston, MA
      02115, USA. Department of Genetics, Harvard Medical School, Boston, MA 02115,
      USA.
```

To avoid problems, replace each newline followed by 6 spaces with a single space.

```
In [4]: my_text = re.sub(r'\n\s{6}', ' ', my_text)
```

We should now have every entry in a single line. Let's look at part of an entry:

```
In [5]: print(my_text[:2000])


PMID- 26721686
OWN - NLM
STAT- Publisher
DA  - 20160101
LR  - 20160102
IS  - 1095-9203 (Electronic)
```

```
IS  - 0036-8075 (Linking)
DP  - 2015 Dec 31
TI  - In vivo gene editing in dystrophic mouse muscle and muscle stem cells.
LID - aad5177 [pii]
AB  - Frame-disrupting mutations in the DMD gene, encoding dystrophin, compromise myofiber inte
CI  - Copyright (c) 2015, American Association for the Advancement of Science.
FAU - Tabebordbar, Mohammadsharif
AU  - Tabebordbar M
AD  - Department of Stem Cell and Regenerative Biology, Harvard University and Harvard  Stem Ce
FAU - Zhu, Kexian
AU  - Zhu K
AD  - Department of Stem Cell and Regenerative Biology, Harvard University and Harvard  Stem Ce
FAU - Cheng, Jason K W
AU  - Cheng JK
AD  - Department of Stem Cell and Regenerative Biology, Harvard University and Harvard  Stem Ce
```

Now write a regular expression that creates a list of zipcodes:

```
In [6]: zipcodes = re.findall(r'[A-Z]{2}\s(\d{5}), USA', my_text)
```

The anatomy of the regular expression:

```
[A-Z]{2}  -> two capital letters (for the state)
\s -> followed by a space
\d{5} -> followed by exactly 5 digits
, USA -> follwed by the string ", USA"
```

Note that we use a group (`\d{5}`) to capture exclusively the zipcode proper.

```
In [7]: len(zipcodes)

Out[7]: 5198

In [8]: zipcodes[:10]

Out[8]: ['02138',
         '02115',
         '02138',
         '02138',
         '02138',
         '02115',
         '02115',
         '02115',
         '02142',
         '02139']
```

Extract the unique zipcodes

```
In [9]: unique_zipcodes = list(set(zipcodes))
```

```
In [10]: unique_zipcodes.sort()

In [11]: unique_zipcodes[:10]

Out[11]: ['00680',
          '01002',
          '01003',
          '01605',
          '01609',
          '01610',
          '01655',
          '01772',
          '01854',
          '01887']

In [12]: len(unique_zipcodes)

Out[12]: 462
```

Now create a dictionary with the latitude and longitude for each zipcode:

```
In [13]: zip_coordinates = {}
         with open('../data/MapOfScience/zipcodes_coordinates.txt') as f:
             csvr = csv.DictReader(f)
             for row in csvr:
                 zip_coordinates[row['ZIP']] = [float(row['LAT']),
                                                float(row['LNG'])]
```

1.0.2 Create the lists `zip_code`, containing the ZIP codes, `zip_long`, `zip_lat`, and `zip_count`, containing the unique ZIP codes, their longitude, latitude, and count (number of occurrences in Science), respectively.

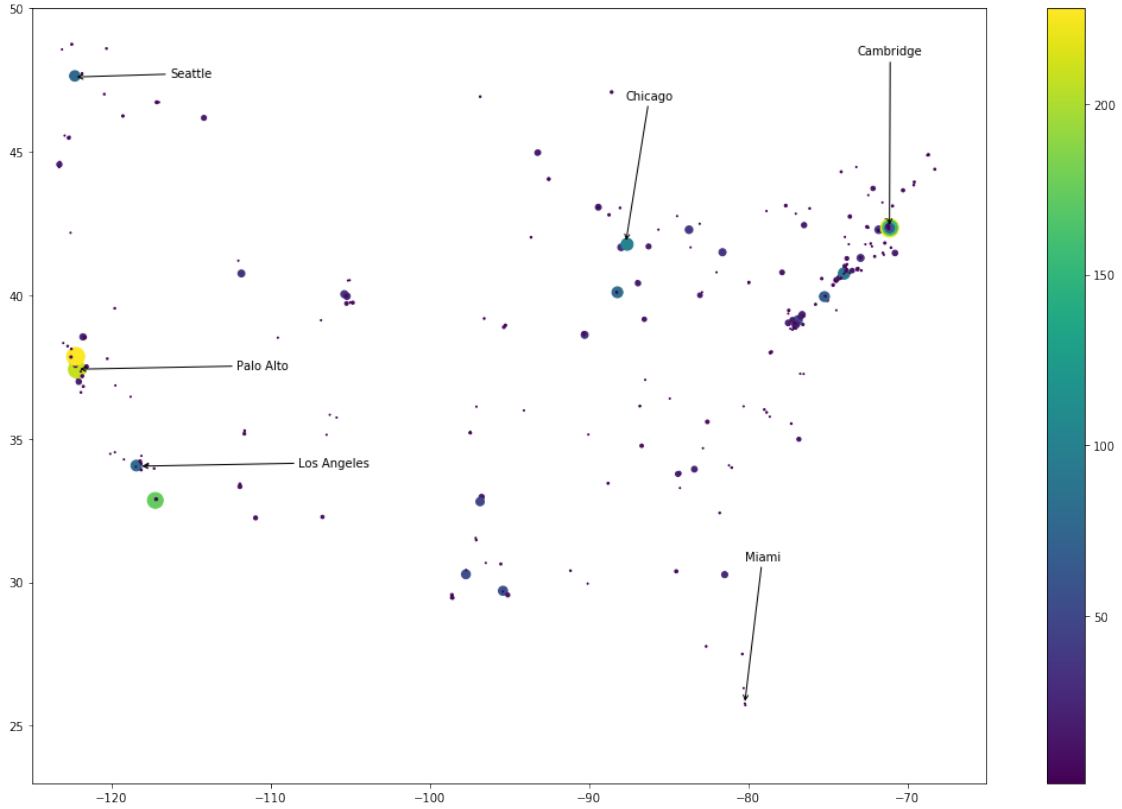
```
In [14]: zip_code = []
         zip_long = []
         zip_lat = []
         zip_count = []
```

Populate the lists:

```
In [15]: for z in unique_zipcodes:
             # if we can find the coordinates
             if z in zip_coordinates.keys():
                 zip_code.append(z)
                 zip_lat.append(zip_coordinates[z][0])
                 zip_long.append(zip_coordinates[z][1])
                 zip_count.append(zipcodes.count(z))
```

1.0.3 Plot the results using the following code:

```
In [16]: import matplotlib.pyplot as plt
         %matplotlib inline
         plt.scatter(zip_long, zip_lat, s = zip_count, c= zip_count)
         plt.colorbar()
         # only continental us without Alaska
         plt.xlim(-125,-65)
         plt.ylim(23, 50)
         # add a few cities for reference (optional)
         ard = dict(arrowstyle="->")
         plt.annotate('Los Angeles', xy = (-118.25, 34.05),
                      xytext = (-108.25, 34.05), arrowprops = ard)
         plt.annotate('Palo Alto', xy = (-122.1381, 37.4292),
                      xytext = (-112.1381, 37.4292), arrowprops= ard)
         plt.annotate('Cambridge', xy = (-71.1106, 42.3736),
                      xytext = (-73.1106, 48.3736), arrowprops= ard)
         plt.annotate('Chicago', xy = (-87.6847, 41.8369),
                      xytext = (-87.6847, 46.8369), arrowprops= ard)
         plt.annotate('Seattle', xy = (-122.33, 47.61),
                      xytext = (-116.33, 47.61), arrowprops= ard)
         plt.annotate('Miami', xy = (-80.21, 25.7753),
                      xytext = (-80.21, 30.7753), arrowprops= ard)
         params = plt.gcf()
         plSize = params.get_size_inches()
         params.set_size_inches( (plSize[0] * 3, plSize[1] * 3) )
         plt.show()
```




```
In [17]: zip_code.index('60637')
```

```
Out[17]: 215
```

```
In [18]: zip_count[215]
```

```
Out[18]: 101
```