In [1]:

```
#Import packages
import geopy
from geopy.geocoders import Nominatim
from geopy.distance import distance
import numpy as np
import time
import matplotlib.pyplot as plt
import pandas as pd
from shapely import wkt
import csv
from pathlib import Path
from shapely.geometry import Point, Polygon, LinearRing
from Assignment_2_Functions import *
```

read stations.csv data from OCF, and read grid_points_alameda.csv produced in find_grid_points.ipynb

In [2]:

```
stations = pd.read_csv('stations.csv')
stations.head()
```

Out[2]:

	Unnamed: 0	ID	LATITUDE	LONGITUDE	ELEVATION	STATE	NAM
0	50462	US1CAAL0001	37.8123	-122.2160	113.4	CA	PIEDMONT 1.0 SE
1	50463	US1CAAL0002	37.7075	-122.0687	87.5	CA	CASTRO VALLEY 0.5 WSW
2	50464	US1CAAL0003	37.7169	-122.0585	163.4	CA	CASTRO VALLEY 0.4 NNE
3	50465	US1CAAL0004	37.6483	-121.8745	107.0	CA	PLEASANTC 1.8 SSE
4	50466	US1CAAL0006	37.8319	-122.2503	58.2	CA	OAKLAND 4 NNW

In [3]:

```
geolocator = Nominatim(user_agent='stat159-group_assignment2')
```

In [4]:

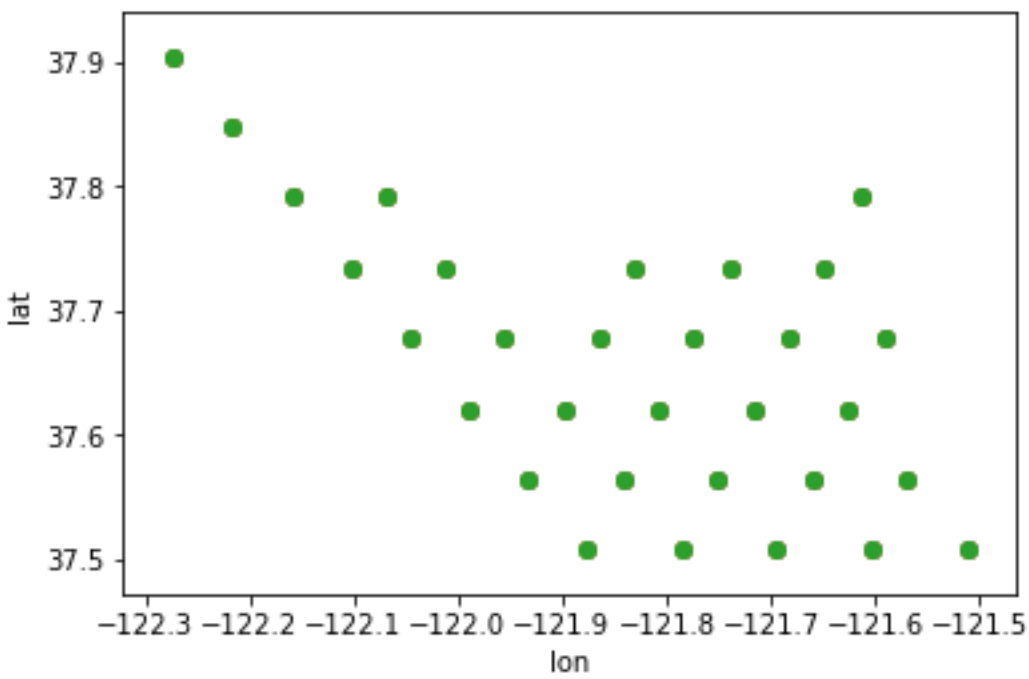
```
locations_alameda = pd.read_csv("grid_points_alameda.csv")
locations_alameda.head()
```

Out[4]:

	Unnamed: 0	name	lat	lon
0	0	399, Vassar Avenue, Cragmont, Berkeley, Alamed...	37.904360	-122.272787
1	1	6599, Gwin Road, Oakland, Alameda County, Cali...	37.847646	-122.216073
2	2	Denton Place, Oakland, Alameda County, Califor...	37.790932	-122.159359
3	3	Towhee Trail, Ashland, Alameda County, Califor...	37.734218	-122.102645
4	4	24499, Sarita Street, Fairview, Alameda County...	37.677504	-122.045931

In [20]:

```
#scatter plot of grid points overlaying Alameda to get the shape of Alameda
plt.scatter(locations_alameda.lon, locations_alameda.lat)
plt.xlabel('lon')
plt.ylabel('lat')
plt.show();
```



Write code to identify all weather stations within x miles of Alameda County:

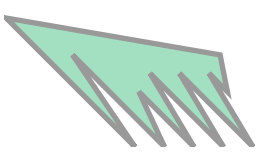
Here we use two methods:

1. Method of polygon (we did 5 miles instead of 10 miles for polygon):

In [6]:

```
polygon = Polygon(zip(locations_alameda.lon,locations_alameda.lat))
polygon
```

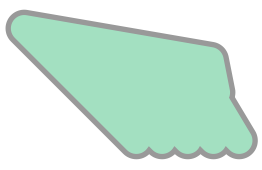
Out[6]:



In [7]:

```
# buffering the original polygon by 5 miles (adjusted from the The Shapely User Manual)
coords = [(x,y)for x,y in zip(locations_alameda.lon,locations_alameda.lat)]
r = LinearRing(coords)
s = Polygon(r)
t = Polygon(s.buffer(0.056713928273561295), [r])
t
```

Out[7]:



In [8]:

```
within = []
for x,y in zip(stations.LONGITUDE,stations.LATITUDE):
    point = Point(x,y)
    within.append(point.within(t))
```

In [9]:

```
stations_within_5miles = stations[within]
stations_within_5miles.head()
```

Out[9]:

	Unnamed: 0	ID	LATITUDE	LONGITUDE	ELEVATION	STATE	NAM
0	50462	US1CAAL0001	37.8123	-122.2160	113.4	CA	PIEDMONT 1.0 SE
1	50463	US1CAAL0002	37.7075	-122.0687	87.5	CA	CASTRO VALLEY 0.5 WSW
2	50464	US1CAAL0003	37.7169	-122.0585	163.4	CA	CASTRO VALLEY 0.4 NNE
3	50465	US1CAAL0004	37.6483	-121.8745	107.0	CA	PLEASANTC 1.8 SSE
4	50466	US1CAAL0006	37.8319	-122.2503	58.2	CA	OAKLAND 4 NNW

2. Method of grid points:

Please see function 'within_alameda' in .py file

Identify all weather stations within 10 miles (not Ranson's 50 miles) of Alameda county:

In [10]:

```
stations_lat = stations['LATITUDE']
stations_lon = stations['LONGITUDE']
```

In [11]:

```
#Get index of weather stations within 10 miles of Alameda using function 'within
_alameda'
mask = [within_alameda(10, lat, lon, locations_alameda) for lat, lon in zip(stat
ions_lat, stations_lon)]

#Extract weather stations within 10 miles of Alameda
stations_within_10miles_alameda = stations.loc[mask]
stations_within_10miles_alameda.head()
```

Out[11]:

	Unnamed: 0	ID	LATITUDE	LONGITUDE	ELEVATION	STATE	NAM
0	50462	US1CAAL0001	37.8123	-122.2160	113.4	CA	PIEDMONT 1.0 SE
1	50463	US1CAAL0002	37.7075	-122.0687	87.5	CA	CASTRO VALLEY 0.5 WSW
2	50464	US1CAAL0003	37.7169	-122.0585	163.4	CA	CASTRO VALLEY 0.4 NNE
3	50465	US1CAAL0004	37.6483	-121.8745	107.0	CA	PLEASANTC 1.8 SSE
4	50466	US1CAAL0006	37.8319	-122.2503	58.2	CA	OAKLAND 4 NNW

In [12]:

```
#number of weather stations within 10 miles of Alameda
len(stations_within_10miles_alameda)
```

Out[12]:

```
88
```

In [13]:

```
#save to .csv for later use
stations_within_10miles_alameda.iloc[:,1:].to_csv("stations_within_10miles_alame
da.csv")
```

Find the weighted average inverse distance from each station to the points in the county grid:

In [14]:

```
#get a list of tuples that contains the latitude and longtitude of the weather s
tations
loc_stations = list(zip(stations_within_10miles_alameda['LATITUDE'], stations_wi
thin_10miles_alameda['LONGITUDE']))

#get a list of tuples that contains the latitude and longtitude of all the grid
points in Alameda.
loc_alameda = list(zip(locations_alameda.lat, locations_alameda.lon))
```

In [15]:

```
#get the weighted average inverse distance for each station by function 'idwa'
weg_avg_inv_dist = idwa(loc_stations, loc_alameda)
```

In [16]:

```
weg_avg_inv_dist[:10]
```

Out[16]:

```
[0.06789401406379811,
 0.09583860468168928,
 0.0975522997706836,
 0.12340823956560336,
 0.062878813363866O7,
 0.080514616188782 67,
 0.0835226593030135,
 0.07125996836250492,
 0.131019045865 67004,
 0.0649451405965993]
```

In [17]:

```
# save the inverse distance for future assignment
stations_within_10miles_alameda['INVDIST'] = weg_avg_inv_dist
```

```
/Users/glance/anaconda3/lib/python3.6/site-packages/ipykernel_launch
er.py:2: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: http://pandas.pydata.org/panda
s-docs/stable/indexing.html#indexing-view-versus-copy
```

In [18]:

```
stations_within_10miles_alameda.to_csv("stations_within_10miles_alameda.csv")
```