9 Clustering

In [1]:
```
import pandas as pd
import numpy as np
import sklearn
%matplotlib notebook
import matplotlib.pyplot as plt
import seaborn
from mpl_toolkits.mplot3d import Axes3D
plt.rcParams['font.size'] = 14
```

1. DBSCAN

Using DBSCAN iterate (for-loop) through different values of `min_samples` (1 to 10) and `epsilon` (.05 to .5, in steps of .01) to find clusters in the road-data used in the Lesson and calculate the Silohouette Coeff for `min_samples` and `epsilon`. Plot ***one*** line plot with the multiple lines generated from the min_samples and epsilon values. Use a 2D array to store the SilCoeff values, one dimension represents `min_samples`, the other represents epsilon.

In [2]:
```
X = pd.read_csv('../data/3D_spatial_network.txt.gz', header=None, names=['osm',
X = X.drop(['osm'], axis=1).sample(10000)
X.head()
```

Out[2]:

	lat	lon	alt
37171	9.962756	57.577387	27.476864
322496	9.748761	56.936618	39.690242
424114	9.189720	56.697273	9.957343
198526	9.891963	57.026230	41.835966
53791	9.654846	57.129256	2.847309

In [3]:
```
XX = X.copy()
XX['alt'] = (X.alt - X.alt.mean())/X.alt.std()
XX['lat'] = (X.lat - X.lat.mean())/X.lat.std()
XX['lon'] = (X.lon - X.lon.mean())/X.lon.std()
```

In [4]:
```
df = pd.DataFrame(np.zeros((10, 46)), np.arange(1, 11, 1), np.arange(.05, .51, .0
df
```

Out[4]:

	0.05	0.06	0.07	0.08	0.09	0.10	0.11	0.12	0.13	0.14	...	0.41	0.42	0.43	0.44	0.45	0.46
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	...	0.0	0.0	0.0	0.0	0.0	0.0
2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	...	0.0	0.0	0.0	0.0	0.0	0.0
3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	...	0.0	0.0	0.0	0.0	0.0	0.0
4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	...	0.0	0.0	0.0	0.0	0.0	0.0
5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	...	0.0	0.0	0.0	0.0	0.0	0.0
6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	...	0.0	0.0	0.0	0.0	0.0	0.0
7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	...	0.0	0.0	0.0	0.0	0.0	0.0
8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	...	0.0	0.0	0.0	0.0	0.0	0.0
9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	...	0.0	0.0	0.0	0.0	0.0	0.0
10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	...	0.0	0.0	0.0	0.0	0.0	0.0

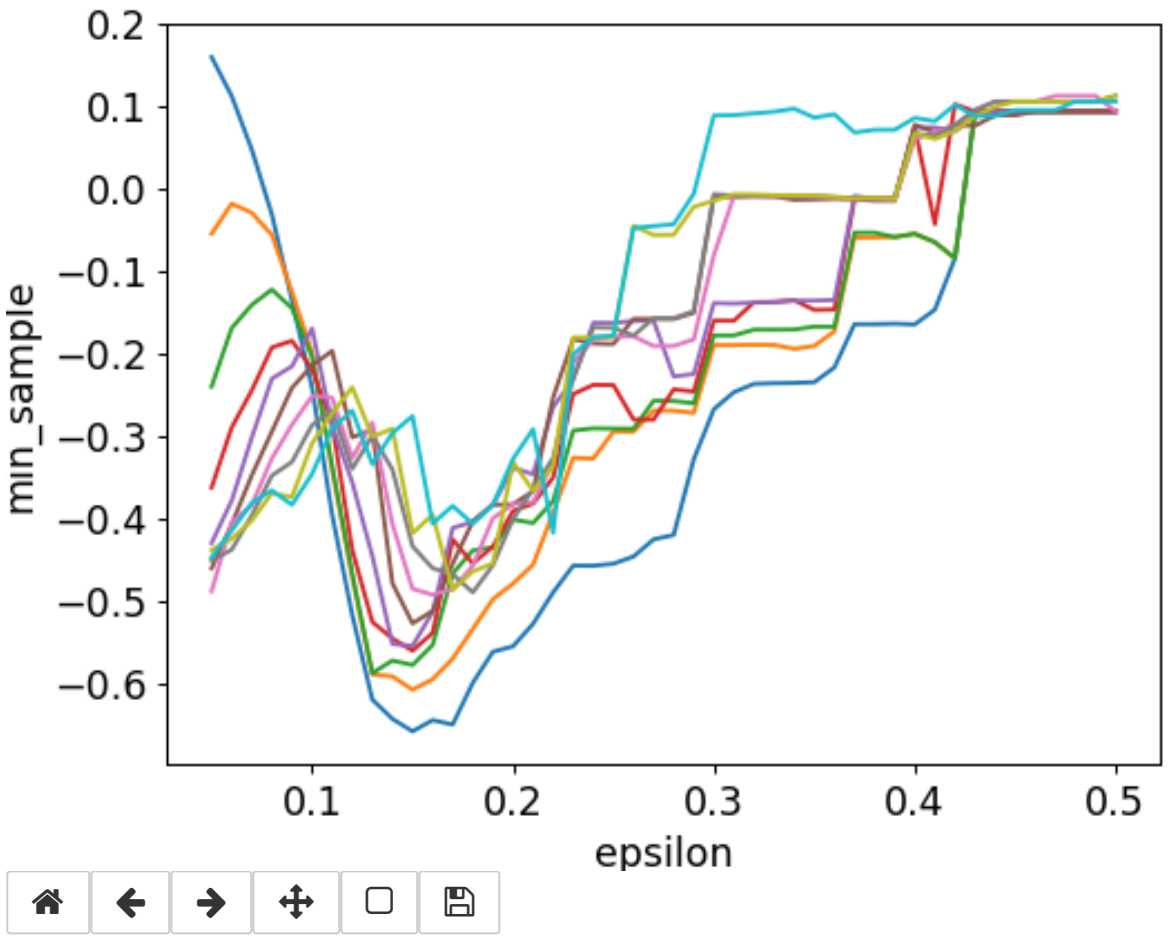
10 rows × 46 columns

In [5]:
```
from sklearn.cluster import DBSCAN
from sklearn import metrics

for min_samples in np.arange(1, 11, 1):
    for eps in np.arange(.05, .51, .01):
        dbscan = DBSCAN(eps = eps, min_samples = min_samples)
        XX.cluster = dbscan.fit_predict(XX[['lat','lon', 'alt']])
        df.loc[min_samples, eps] = sklearn.metrics.silhouette_score(XX[['lat','lo
```

```
C:\Users\samvt\anaconda3\lib\site-packages\ipykernel_launcher.py:7: UserWarnin
g: Pandas doesn't allow columns to be created via a new attribute name - see ht
tps://pandas.pydata.org/pandas-docs/stable/indexing.html#attribute-access (http
s://pandas.pydata.org/pandas-docs/stable/indexing.html#attribute-access)
  import sys
```

In [6]:
```
plt.figure()
for i in np.arange(1, 11, 1):
    plt.plot(df.loc[i,:])

plt.xlabel('epsilon')
plt.ylabel('min_sample')
```

Figure 1



Out[6]:
```
Text(0, 0.5, 'min_sample')
```

2. Clustering your own data

Using your own data, find relevant clusters/groups within your data. If your data is labeled already, with a class that you are attempting to predict, be sure to not use it in fitting/training/predicting.

You may use the labels to compare with predictions to show how well the clustering performed using one of the clustering metrics (http://scikit-learn.org/stable/modules/clustering.html#clustering-performance-evaluation (http://scikit-learn.org/stable/modules/clustering.html#clustering-performance-evaluation)).

If you don't have labels, use the silhouette coefficient to show performance. Find the optimal fit for your data but you don't need to be as exhaustive as above.

Additionally, show the clusters in 2D and 3D plots.

For bonus, try using PCA first to condense your data from N columns to less than N.

Two items are expected:

- Metric Evaluation Plot
- Plots of the clustered data

In [7]:
```
tweets = pd.read_csv('../data/snow_tweets.csv', index_col=0)
tweets.time = pd.to_datetime(tweets.time, infer_datetime_format=True)
```

In [8]:
```
tweets['hour_of_day'] = (tweets.time.dt.hour)
tweets = tweets.drop(['time'], axis=1)
```

In [9]:
```
tweets.head()
```

Out[9]:

	lat	lon	hour_of_day
0	39.284713	-76.620452	22
1	38.776676	-77.176680	22
2	38.898603	-77.014398	22
3	39.424571	-76.572547	22
4	38.898603	-77.014398	22

In [10]:
```
tweets.dtypes
```

Out[10]:
```
lat            float64
lon            float64
hour_of_day      int64
dtype: object
```

In [11]:
```
len(tweets)
```

Out[11]:
```
209312
```

In [12]:
```
trunc = tweets[(tweets.lon<-76) & (tweets.lon>-78) & (tweets.lat>38.4)&(tweets.la
```

In [13]:
```
len(trunc)
```

Out[13]:
```
161719
```

In [14]:
```
trunc.hour_of_day.unique()
```

Out[14]:
```
array([22, 23,  0,  1,  2,  3,  4,  5,  6,  7,  8,  9, 10, 11, 12, 13, 14,
       15, 16, 17, 18, 19, 20, 21], dtype=int64)
```

In [15]:
```
trunc.head()
```

Out[15]:

	lat	lon	hour_of_day
0	39.284713	-76.620452	22
1	38.776676	-77.176680	22
2	38.898603	-77.014398	22
3	39.424571	-76.572547	22
4	38.898603	-77.014398	22

In [16]:
```
# K-means with N clusters
N = 7 # using 7 clusters
from sklearn.cluster import KMeans
km = KMeans(n_clusters=N, random_state=1)
km.fit(trunc)
```

Out[16]:
```
KMeans(n_clusters=7, random_state=1)
```

In [17]:
```
set(km.labels_) # seven labels for the seven clusters
```

Out[17]:
```
{0, 1, 2, 3, 4, 5, 6}
```

In [18]:
```
trunc['cluster'] = km.predict(trunc) # stores predictions in a column of datafram
```

```
C:\Users\samvt\anaconda3\lib\site-packages\ipykernel_launcher.py:1: SettingWith
CopyWarning:
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: https://pandas.pydata.org/pandas-docs/sta
ble/user_guide/indexing.html#returning-a-view-versus-a-copy (https://pandas.pyd
ata.org/pandas-docs/stable/user_guide/indexing.html#returning-a-view-versus-a-c
opy)
  """Entry point for launching an IPython kernel.
```

In [19]:
```
trunc.head()
```

Out[19]:

	lat	lon	hour_of_day	cluster
0	39.284713	-76.620452	22	4
1	38.776676	-77.176680	22	4
2	38.898603	-77.014398	22	4
3	39.424571	-76.572547	22	4
4	38.898603	-77.014398	22	4

In [20]:
```
trunc.cluster.unique()
```

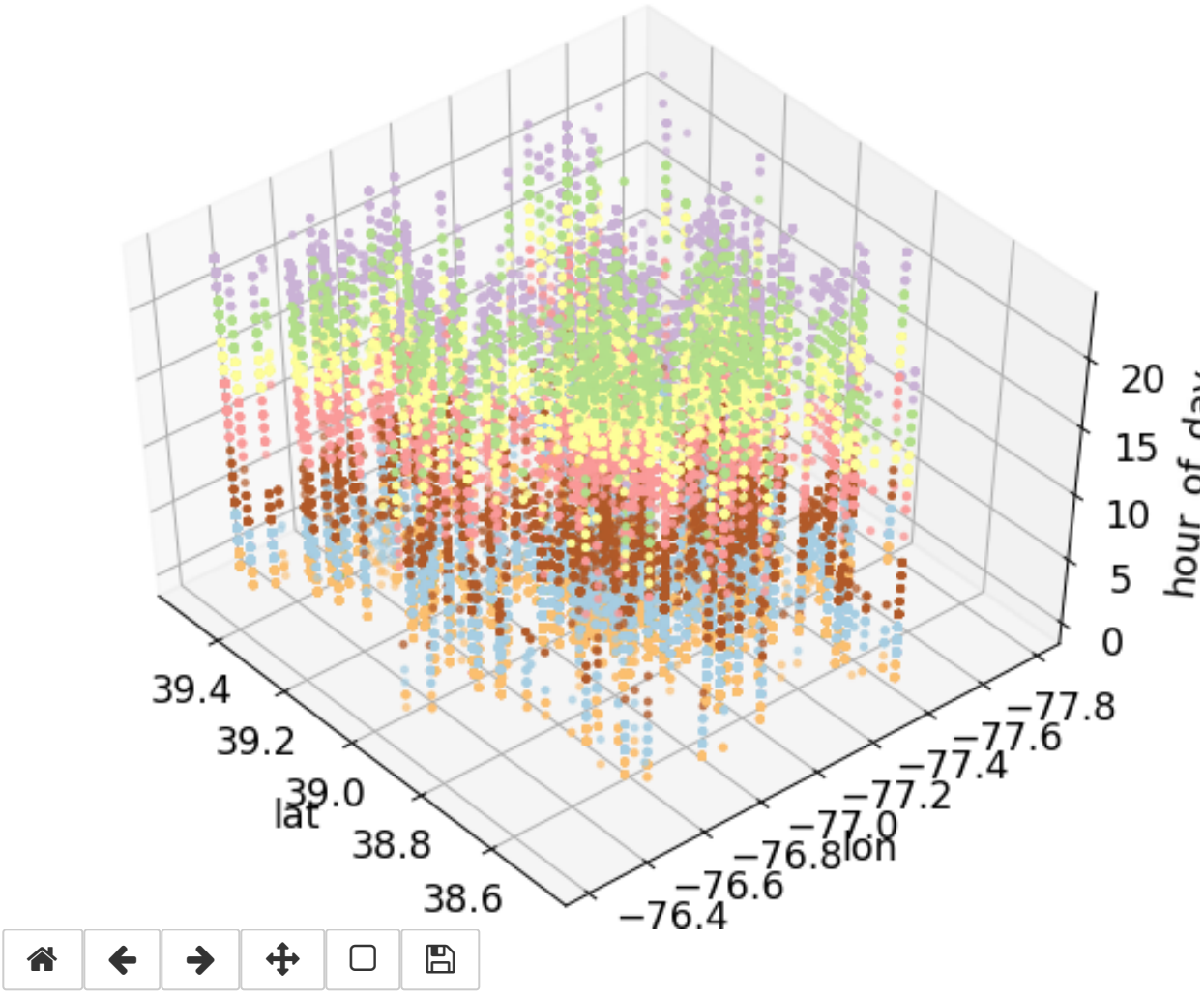
Out[20]:
```
array([4, 3, 0, 6, 2, 5, 1])
```

In [21]:
```
trunc.cluster.value_counts()
```

Out[21]:
```
0    40797
3    25216
5    22197
1    20663
4    19524
6    18527
2    14795
Name: cluster, dtype: int64
```

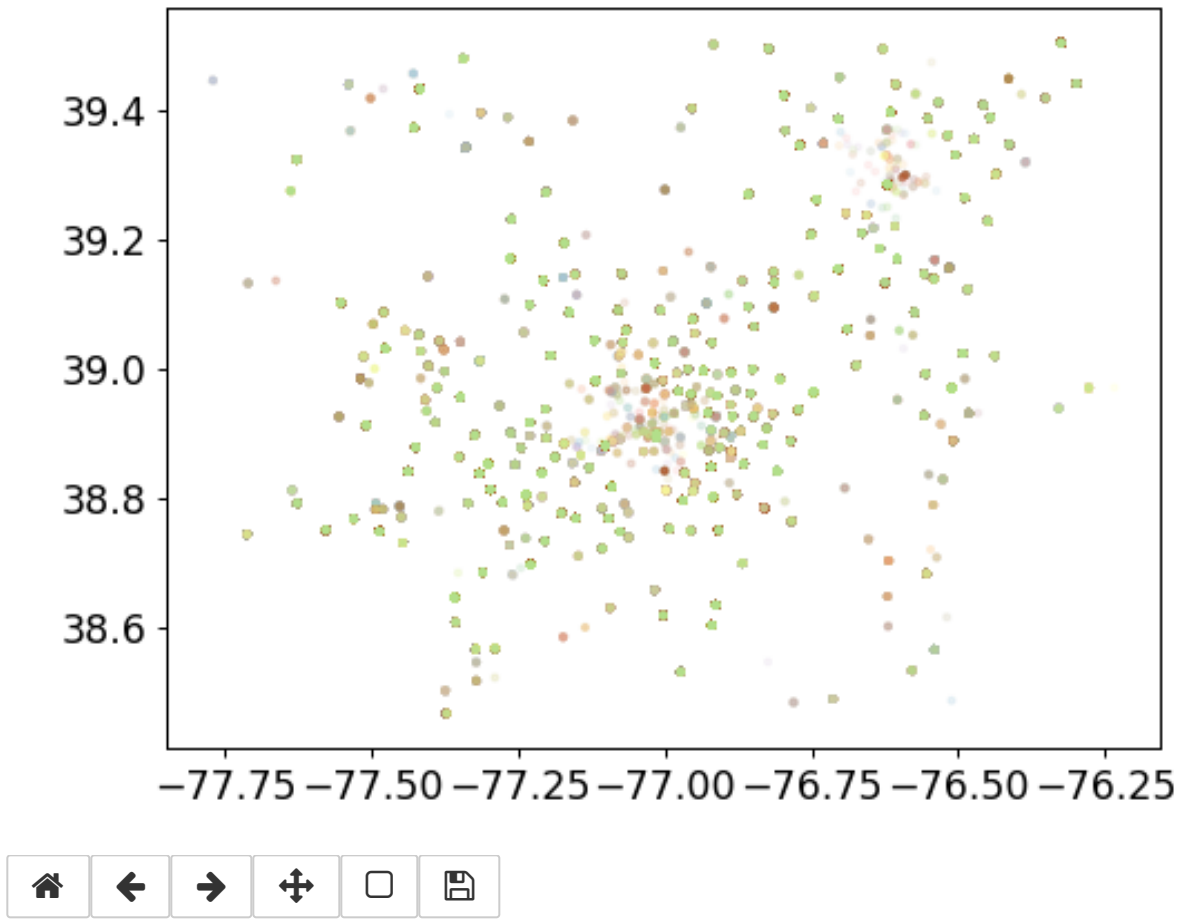
In [22]:
```
fig = plt.figure()
plt.clf()
ax = Axes3D(fig, rect=[0, 0, .95, 1], elev=48, azim=140)

plt.cla()

ax.scatter(trunc['lat'], trunc['lon'], trunc['hour_of_day'], c=trunc.cluster, s=5

ax.set_xlabel('lat')
ax.set_ylabel('lon')
ax.set_zlabel('hour_of_day')
plt.show()
```

Figure 2



In [23]:
```
fig = plt.figure()
plt.scatter(trunc.lon, trunc.lat, c=trunc.cluster, alpha=.1, s=5, cmap="Paired")
```

Figure 3



Out[23]: `<matplotlib.collections.PathCollection at 0x1e6e7b84f08>`

Note

You may use any for both parts 1 and 2, I only recommend using the data I used in the Lesson for part 1. I've included several new datasets in the `data/` folder, such as `beers.csv`, `snow_tweets.csv`, `data/USCensus1990.data.txt.gz`. You do not need to unzip or ungzip any data files. Pandas can open these files on its own.