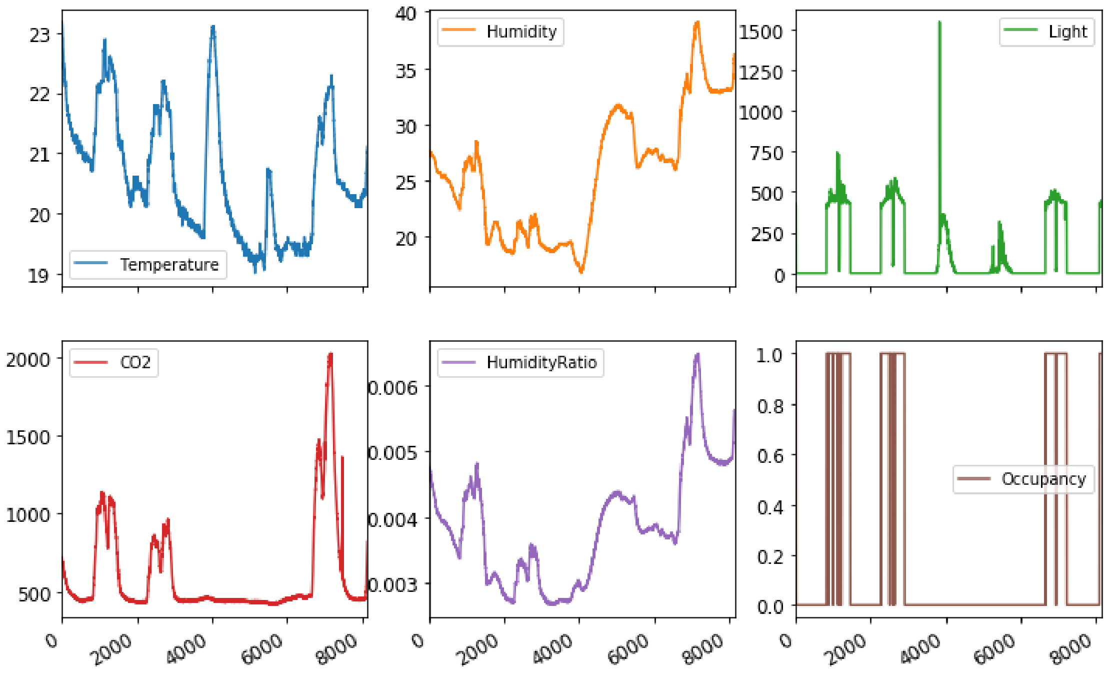
hw2

September 17, 2017

```
In [1]: #%%writefile read_data.py
        #%load read_data.py
        import pandas as pd
        import os
        def load_data(filename):
            csv_path = os.path.join(".", filename)
            return pd.read_csv(csv_path)

        room_data = load_data('train_data.txt')
        room_data.head()
```

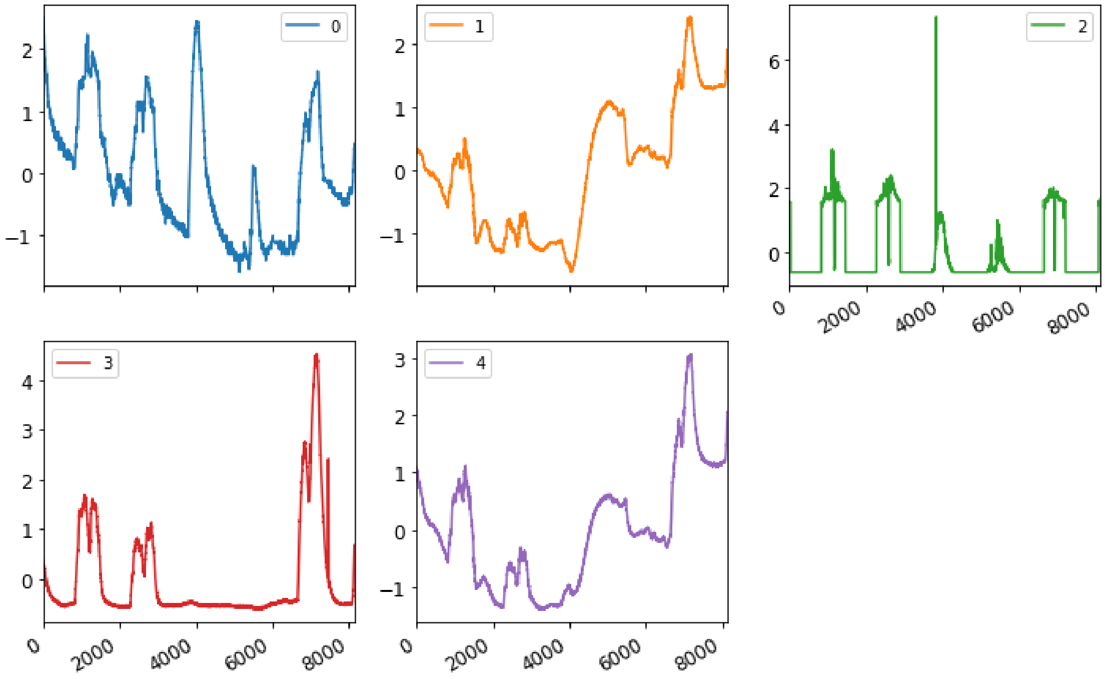
```
Out[1]:                  date  Temperature  Humidity  Light     CO2  HumidityRatio  \
        1  2015-02-04 17:51:00        23.18   27.2720  426.0  721.25       0.004793
        2  2015-02-04 17:51:59        23.15   27.2675  429.5  714.00       0.004783
        3  2015-02-04 17:53:00        23.15   27.2450  426.0  713.50       0.004779
        4  2015-02-04 17:54:00        23.15   27.2000  426.0  708.25       0.004772
        5  2015-02-04 17:55:00        23.10   27.2000  426.0  704.50       0.004757

           Occupancy
        1          1
        2          1
        3          1
        4          1
        5          1
```

```
In [2]: #%%writefile plot_data.py
        #%load plot_data.py
        %matplotlib inline
        import matplotlib
        import matplotlib.pyplot as plt
        plt.rcParams['axes.labelsize'] = 14
        plt.rcParams['xtick.labelsize'] = 12
        plt.rcParams['ytick.labelsize'] = 12
        room_data.plot(subplots=True, layout=(2,3), figsize=(12, 8));
```



```
In [3]: #%%writefile preprocess_data.py
        # %load preprocess_data.py

        from sklearn import preprocessing
        from sklearn.base import BaseEstimator, TransformerMixin
        from sklearn.pipeline import Pipeline
        from sklearn.preprocessing import StandardScaler
        import numpy as np
        import re
        room_data.describe()

        #attributes = [attr for attr in list(data) if not re.search(attr, r'date|Occupancy')]
        # Create a class to select numerical or categorical columns
        # since Scikit-Learn doesn't handle DataFrames yet
        class DataFrameSelector(BaseEstimator, TransformerMixin):
            def __init__(self, attribute_names):
                self.attribute_names = attribute_names
            def fit(self, X, y=None):
                return self
            def transform(self, X):
                return X[self.attribute_names].values

        # list of attributes for the DataFrameSelector (pandas to numpy)
        room_attrib = [attr for attr in list(room_data) if not re.search(attr, r'date|Occupanc
        pipeline = Pipeline([
            ('selector', DataFrameSelector(room_attrib)),
            ('std_scaler', StandardScaler()),
        ])

        room_prepared = pipeline.fit_transform(room_data)
        print(np.shape(room_prepared))
        print(room_prepared[0])
        df = pd.DataFrame(room_prepared)
        df.plot(subplots=True, layout=(2,3), figsize=(12, 8));
```

```
(8143, 5)
[ 2.51847007  0.27852622  1.57376283  0.36494808  1.09175697]
```



```
In [4]: #%%writefile train.py
        # %load train.py
        import os as os
        import numpy as np
        import scipy.io
        import scipy.optimize as optimization

        N_EPOCH = 100

        n_mis = []
        def dwp(w,d,X):
```

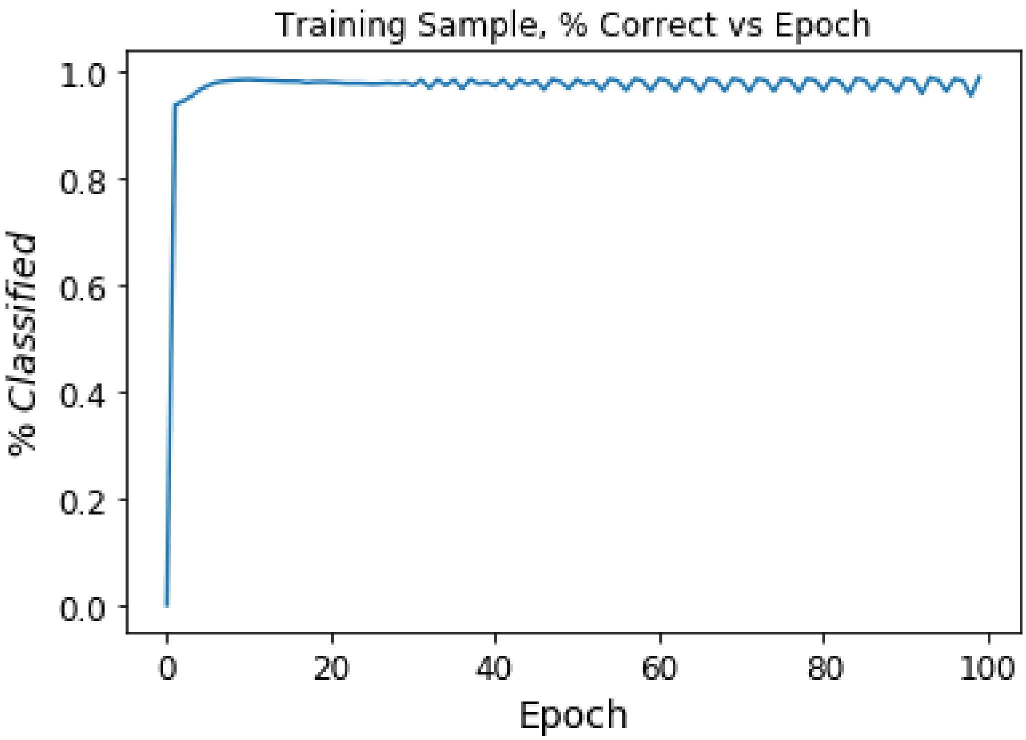
```
    # using numpy einstein summation to vectorize the computation
    # calculating w.x.d -- w.x.d < 0 => incorrect classification
    C = d*np.einsum('i,ji->j', w, X) # shape is (100,)
    # use enumerate for the equivalent to each_with_index (Ruby)
    xd = [ d[i]*X[i] for i,c in enumerate(C) if c <= 0]
    # the error is the number of misclassified teachers
    E = len(xd)/float(len(d))
    # sum xd element-wise
    # dw is x.t summed over misclassified teachers
    dw =  np.einsum('ij->j',xd) if(len(xd) > 0) else 0
    return dw, E

def train():
    # data
    room_with_bias = np.full((len(room_prepared),6),1.0)
    room_with_bias[:,1:] = room_prepared
    # shape is (nrow, 6)
    X = room_with_bias
    #print(np.shape(X))
    # use domain -1,1 for teachers so we can use x.w.d<0 for the classification test
    # shpae is (nrow,1)
    t = [z if z == 1 else -1 for z in room_data['Occupancy']]
    #print(np.shape(t))
    # starting vector of weights
    w = np.zeros((np.shape(room_with_bias)[1]))
    perf = []
    # sweep through the data N_EPOCH times
    for _ in range(N_EPOCH):
         dw, E = dwp(w,t,X)
         w += dw
         perf.append(1-E)
    return w, perf

# invoke main
w_trained, performance = train()
```

In [5]:

```
#%%writefile plot_train_perf.py
# To plot pretty figures
%matplotlib inline
import matplotlib
import matplotlib.pyplot as plt
plt.rcParams['axes.labelsize'] = 14
plt.rcParams['xtick.labelsize'] = 12
plt.rcParams['ytick.labelsize'] = 12

plt.ylabel(r'$\%\ Classified$')
plt.xlabel('Epoch')
plt.title('Training Sample, % Correct vs Epoch')
```

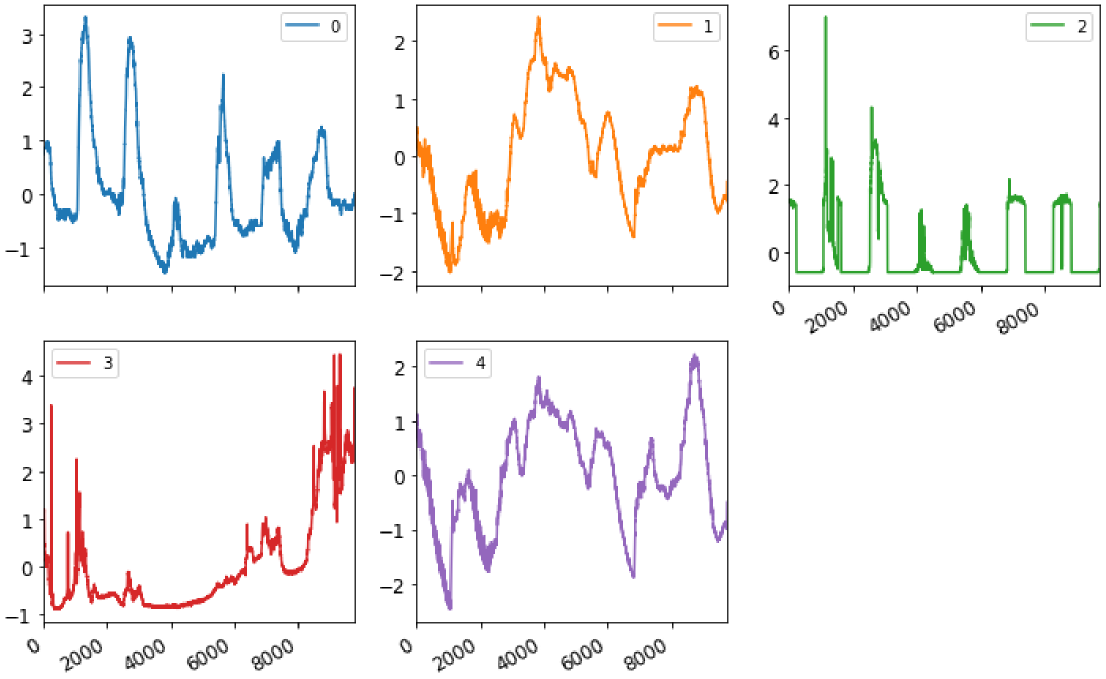
```
        plt.plot(performance)
```

```
Out[5]: [<matplotlib.lines.Line2D at 0x115ca8390>]
```



```
In [6]: #%%writefile test.py
        def test(w):
            test_data = load_data('test_data.txt')
            # same transform pipeline on the test data as the training data
            test_prepared = pipeline.fit_transform(test_data)
            df = pd.DataFrame(test_prepared)
            df.plot(subplots=True, layout=(2,3), figsize=(12, 8));
            # add a bias to the prepared test data
            test_with_bias = np.full((len(test_prepared),6),1.0)
            test_with_bias[:,1:] = test_prepared
            # shape is (nrow, 6)
            X = test_with_bias
            t = [z if z == 1 else -1 for z in test_data['Occupancy']]
            # all we care about here is E
            _, E = dwp(w, t, X)
            print(1-E)

        test(w_trained)
```

```
0.9520098441345365
```


0
3
2
1
0
−1
1
2
1
0
−1
−2
2
6
4
2
0
0
2000
4000
6000
8000
3
4
3
2
1
0
−1
0
2000
4000
6000
8000
4
2
1
0
−1
−2
0
2000
4000
6000
8000