impro_v2

June 21, 2018

```
In [1]: from IPython.core.interactiveshell import InteractiveShell
        InteractiveShell.ast_node_interactivity = "all"
```

```
In [155]: import numpy as np
          import matplotlib.pyplot as plt
          %matplotlib inline
          from sklearn.linear_model import LinearRegression
          from sklearn.metrics import accuracy_score
```

```
In [2]: # Data loading...
        #C1 (records not containing acute hypotensive episodes)
        #C2 (AHE, but not in forecast window)
        #H1 (acute hypotensive episode in forecast window, treated with pressors)
        #H2 (AHE in forecast window, not treated with pressors)
        c1 = np.loadtxt('c1_matrix.txt') #14x600
        c2 = np.loadtxt('c2_matrix.txt') #14x600
        h1 = np.loadtxt('h1_matrix.txt') #14x600
        h2 = np.loadtxt('h2_matrix.txt') #15x600
        c1_afterT0=np.loadtxt('c1_matrix_afterT0.txt') #14x60
        c2_afterT0=np.loadtxt('c2_matrix_afterT0.txt') #14x60
        h1_afterT0=np.loadtxt('h1_matrix_afterT0.txt') #14x60
        h2_afterT0=np.loadtxt('h2_matrix_afterT0.txt') #15x60
        labels=np.loadtxt('labels.txt')
```

1 Feature Extraction– way 1 Linear Regression

```
In [133]: #used to store the features
          list_feature=[]
          #store the predictions after T0
          pred_afterT0=[]

          Dict={'C1':c1,'C2':c2,'H1':h1,'H2':h2}
          print('mean of ABPmean above the line\nmean below the line\nsize+\nsize-\n')
          for k,v in Dict.items():
              print('This is',k)
              for i in range(len(v)):
                  y=v[i]
```

```
            cond=np.where(((y>130)|(y<10)),-1,y)
            y=np.delete(cond,np.argwhere(cond==-1))

            x=np.arange(len(y))
            model = LinearRegression()

            model.fit(np.reshape(x,[len(x),1]), np.reshape(y,[len(y),1]))
            x_test=x_test=np.arange(len(x),len(x)+60)
            y_pred = model.predict(np.reshape(x_test,[len(x_test),1]))

            w = model.coef_[0][0] # parameters of model
            b = model.intercept_[0] #intercept of model

            g1=np.where(y>w*x+b,y,-1).flatten()
            g11=np.delete(g1,np.argwhere(g1==-1))
            g11_mean=np.mean(g11)

            g2=np.where(y<w*x+b,y,-1).flatten()
            g21=np.delete(g2,np.argwhere(g2==-1))
            g21_mean=np.mean(g21)
    #         list_feature.append([g11_mean,g21_mean,len(g11),len(g21)])
            list_feature.append([g11_mean,g21_mean,len(g11)])
            pred_afterT0.append(y_pred.flatten())
            print('Patient',i+1, 'in C1:','%0.2f'%g11_mean,'%0.2f'%g21_mean,len(g11),len

    #convert into the type of numpy.arry
    list_feature=np.array(list_feature)
    pred_afterT0=np.array(pred_afterT0)
```

```
mean of ABPmean above the line
mean below the line
size+
size-

This is C1
Patient 1 in C1: 97.18 85.80 282 318
Patient 2 in C1: 90.99 85.00 307 292
Patient 3 in C1: 112.81 90.68 290 266
Patient 4 in C1: 111.21 104.33 355 242
Patient 5 in C1: 105.50 94.76 274 318
Patient 6 in C1: 101.90 98.96 267 331
Patient 7 in C1: 109.74 90.02 313 287
Patient 8 in C1: 109.63 102.79 248 315
Patient 9 in C1: 92.36 77.30 321 279
Patient 10 in C1: 101.29 81.69 310 289
Patient 11 in C1: 84.00 75.87 299 301
Patient 12 in C1: 103.56 94.93 281 319
Patient 13 in C1: 82.05 75.45 242 357
Patient 14 in C1: 82.92 75.27 259 341
This is C2
Patient 1 in C1: 78.56 70.49 296 304
Patient 2 in C1: 92.29 84.19 307 292
Patient 3 in C1: 87.49 77.11 255 337
Patient 4 in C1: 75.39 62.84 270 323
Patient 5 in C1: 97.46 81.67 331 268
Patient 6 in C1: 89.66 76.51 314 285
Patient 7 in C1: 90.78 74.59 321 279
Patient 8 in C1: 119.54 95.32 194 158
Patient 9 in C1: 71.75 66.34 251 349
Patient 10 in C1: 80.31 67.58 310 288
Patient 11 in C1: 79.54 69.30 306 289
Patient 12 in C1: 71.56 63.08 268 332
Patient 13 in C1: 82.79 72.40 265 335
Patient 14 in C1: 79.15 70.38 264 334
This is H1
Patient 1 in C1: 100.17 85.10 262 165
Patient 2 in C1: 119.83 102.14 162 156
Patient 3 in C1: 96.45 66.21 222 368
Patient 4 in C1: 68.91 63.28 277 323
Patient 5 in C1: 97.21 67.95 322 276
Patient 6 in C1: 92.53 84.20 306 292
Patient 7 in C1: 87.72 75.27 291 307
Patient 8 in C1: 70.49 63.73 299 296
Patient 9 in C1: 72.96 67.51 270 329
Patient 10 in C1: 72.51 60.92 246 354
Patient 11 in C1: 92.43 69.96 275 324
Patient 12 in C1: 117.86 107.02 269 290
Patient 13 in C1: 90.07 86.16 305 291
Patient 14 in C1: 93.43 75.96 279 305
This is H2
Patient 1 in C1: 77.98 70.43 248 349
Patient 2 in C1: 72.04 63.90 292 307
Patient 3 in C1: 68.07 62.11 298 300
Patient 4 in C1: 73.40 61.98 228 368
Patient 5 in C1: 70.82 63.47 236 364
Patient 6 in C1: 80.47 71.39 302 297
Patient 7 in C1: 87.61 70.00 286 310
Patient 8 in C1: 74.67 64.91 282 313
Patient 9 in C1: 125.79 115.42 194 207
Patient 10 in C1: 122.43 109.64 206 263
Patient 11 in C1: 76.86 62.15 316 282
Patient 12 in C1: 73.16 67.34 271 329
Patient 13 in C1: 77.22 65.37 249 351
Patient 14 in C1: 84.31 73.74 217 381
Patient 15 in C1: 96.82 74.26 301 292
```

2 Classification –Random Forest

```
In [71]: import pandas as pd
         import numpy as np
         from sklearn.ensemble import RandomForestClassifier
         from sklearn.model_selection import GridSearchCV
         from sklearn import cross_validation, metrics
         import matplotlib.pylab as plt
         %matplotlib inline
```

```
In [41]: list_feature.shape
         testsize=10
         # testIdx=np.random.choice(len(list_feature), testsize,replace=False)
         idx=np.random.permutation(len(list_feature))
         trainIdx=idx[testsize:]
         testIdx=idx[:testsize]

         print(testIdx)
         x_train=list_feature[trainIdx]
         x_test=list_feature[testIdx]
         print(trainXset.shape,testXset.shape)
         y_train=labels[trainIdx]
         y_test=labels[testIdx]
         print(trainYset.shape,testYset.shape)
```

```
[ 2  0  3 55 14 30 17 23 16 12]
(47, 4) (10, 4)
(47,) (10,)
```

```
In [42]: from sklearn.ensemble import RandomForestClassifier
         from sklearn.metrics import accuracy_score
         rf = RandomForestClassifier()
         rf.fit(x_train,y_train)
         RandomForestClassifier(bootstrap=True, class_weight=None, criterion='gini',
                     max_depth=None, max_features='auto', max_leaf_nodes=None,
                     min_samples_leaf=1, min_samples_split=2,
                     min_weight_fraction_leaf=0.0, n_estimators=10, n_jobs=1,
                     oob_score=False, random_state=None, verbose=0,
                     warm_start=False)
         y_pred=rf.predict(testXset)
         print (y_pred)
         print(y_test)
         print('the accuracy is:',accuracy_score(y_test,y_pred))
```

```
[0. 0. 1. 0. 0. 0. 0. 0. 1. 1.]
[0. 0. 0. 1. 0. 1. 0. 0. 0. 0.]
the accuracy is: 0.5
```

```
In [102]: # fit without any custom parameters
          rf0 = RandomForestClassifier(oob_score=True, random_state=10)
          rf0.fit(list_feature,labels)
          #use out-of-bag samples to estimate the generalization accuracy.
          print (rf0.oob_score_)
          y_predprob = rf0.predict_proba(list_feature)[:,1]
          # print(y_predprob)
          #use auc score to evaluate the classifier
          # print ("AUC Score (Train): %f" % metrics.roc_auc_score(labels,y_predprob) )
```

```
0.6491228070175439
```

```
In [135]: #use GridSearchCV to choose the optimal n_estimators(The number of trees in the fore
          param_test1= {'n_estimators':np.arange(3,72,3)}
          gsearch1= GridSearchCV(estimator = RandomForestClassifier(max_depth=8,max_features='
                                 param_grid =param_test1, scoring='roc_auc',cv=5)
          gsearch1.fit(list_feature,labels)
          # print(gsearch1.grid_scores_)
          # print(gsearch1.cv_results_.values())
          print(gsearch1.best_params_)
          print('Mean cross-validated score of the best_estimator :',gsearch1.best_score_)
```

```
{'n_estimators': 57}
Mean cross-validated score of the best_estimator : 0.7461988304093566
```

```
In [104]: param_test2= {'max_depth':np.arange(2,16,2), 'min_samples_split':np.arange(2,10,2)}
          gsearch2= GridSearchCV(estimator = RandomForestClassifier(n_estimators= 57,oob_score
                                 param_grid = param_test2,scoring='roc_auc',iid=False, cv=5)
          gsearch2.fit(list_feature,labels)
          # print(gsearch2.cv_results_)
          print(gsearch2.best_params_)
          print(gsearch2.best_score_ )
```

```
{'max_depth': 8, 'min_samples_split': 2}
0.7405555555555556
```

```
In [118]: # fit without any custom parameters
          rf1= RandomForestClassifier(n_estimators=57, max_depth=8,criterion='gini',oob_score=
          rf1.fit(list_feature,labels)
          #use out-of-bag samples to estimate the generalization accuracy.
          print (rf1.oob_score_)```````````````````````````````````````````````````````
          y_predprob = rf1.predict_proba(list_feature)[:,1]
          # print(y_predprob)
          #use auc score to evaluate the classifier
          # print ("AUC Score (Train): %f" % metrics.roc_auc_score(labels,y_predprob) )
```

```
0.6491228070175439
```

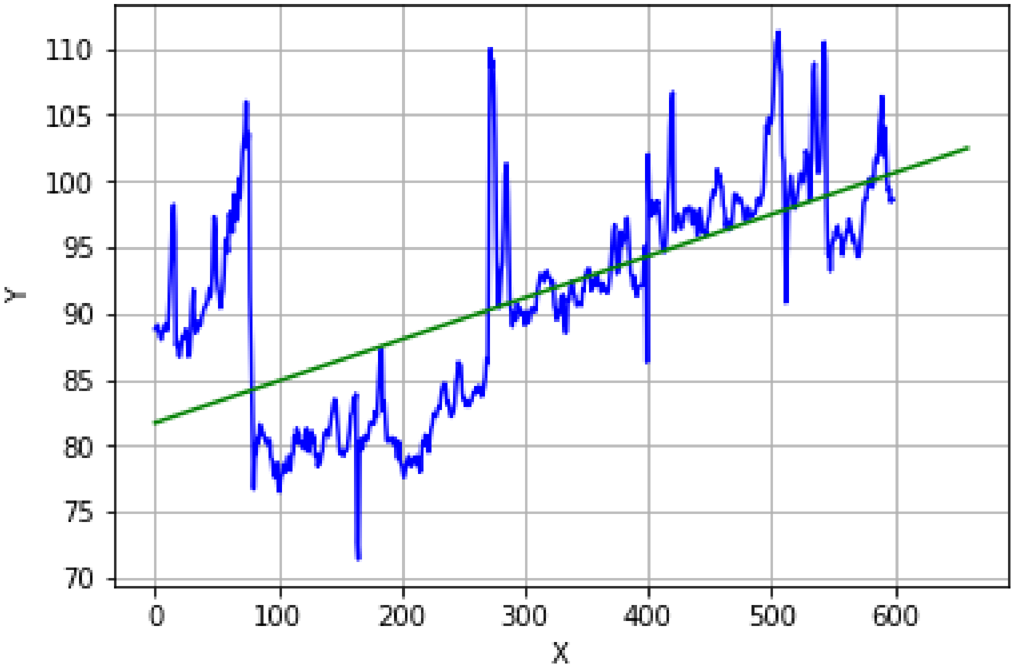
3 Linear Regression–>predict

```
In [154]: #Example
          #the first patient in c1
          y=c1[0]
          #select the value between 10 and 130
          cond=np.where(((y>130)|(y<10)),-1,y).flatten()
          y=np.delete(cond,np.argwhere(cond==-1))
          print(y.shape)
          x=np.arange(len(y))

          model = LinearRegression()
          model.fit(np.reshape(x,[len(x),1]), np.reshape(y,[len(y),1]))
          # x_test=np.arange(len(x),len(x)+60)
          x_test=np.arange(len(x)+60)
          y_pred = model.predict(np.reshape(x_test,[len(x_test),1]))
          w = model.coef_[0][0] # parameters of model
          b = model.intercept_[0] #intercept of model

          plt.figure()
          plt.xlabel('X')
          plt.ylabel('Y')
          plt.grid(True)
          plt.plot(x,y,'b')
          plt.plot(x_test,y_pred,'g-')
          plt.show()
```

```
(600,)
```



```
In [149]: pred_afterT0.shape

Out[149]: (57, 60)

In [170]: s=np.where(pred_afterT0>87,0,1)
          counts=s.sum(axis=1)
          #any period of 30 minutes or more during which at least 90% of
          #the MAP measurements were at or below 60 mmHg.
          results=np.where(counts>27,1,0)
          print('the accuracy is:',accuracy_score(labels,results))
          print(counts)
          print(results)
          print(labels)
```

```
the accuracy is: 0.6491228070175439
[ 0  0  0  0  0  0  0  0  0  0 60  0 60 60 60  0  0 60  0  0 60  0 60 60
 60 60 60 60  0  0 60 60 60  0 60 60 60 60 60  0  0 60 36 60 60 60 60 60
 60 60  0  0 60 60 60 60  0]
[0 0 0 0 0 0 0 0 0 0 1 0 1 1 1 0 0 1 0 0 1 0 1 1 1 1 1 1 0 0 1 1 1 0 1 1 1
 1 1 0 0 1 1 1 1 1 1 1 1 1 0 0 1 1 1 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. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1.
 1. 1. 1. 1. 1. 1. 1. 1. 1.]
```

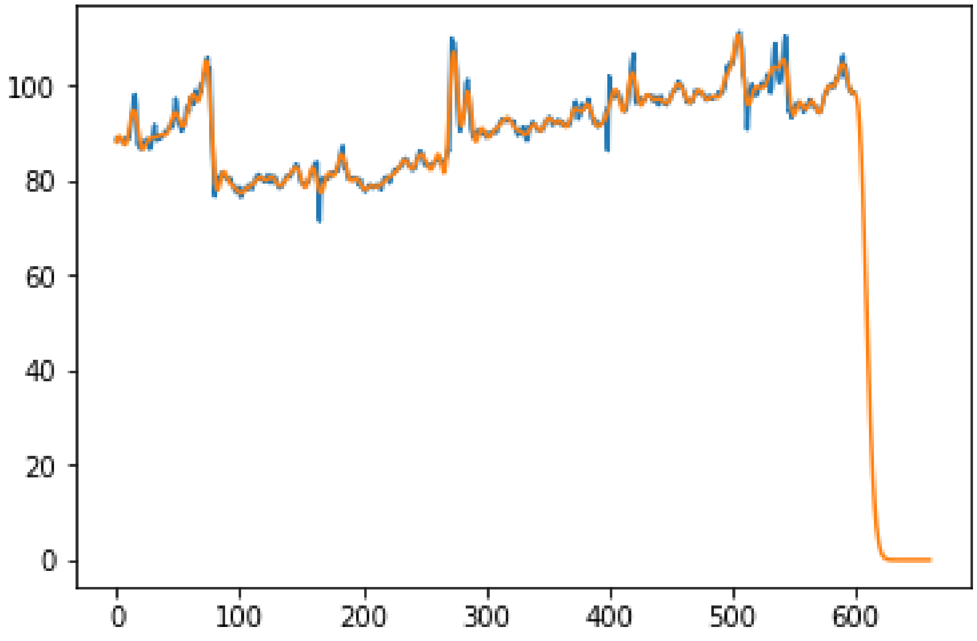
4 Kernel Ridge Regression

```
In [111]: from sklearn.model_selection import GridSearchCV
          from sklearn.kernel_ridge import KernelRidge

          #Example
          #the first patient in c1
          y=c1[0]
          #select the value between 10 and 130
          cond=np.where(((y>130)|(y<10)),-1,y).flatten()
          y=np.delete(cond,np.argwhere(cond==-1))
          print(y.shape)
          x=np.arange(len(y)).reshape(len(y),1)

          x_test=np.arange(0,len(x)+60,0.01).reshape((len(x)+60)*100,1)
          print(x_test.shape)
          train_size=600
          krr = GridSearchCV(KernelRidge(kernel='rbf', gamma=0.1), cv=5,
                             param_grid={"alpha": [1e0, 0.1, 1e-2, 1e-3],
                                         "gamma": np.logspace(-2, 2, 5)})
          krr.fit(x[:train_size], y[:train_size])
          y_pred=krr.predict(x_test)
          plt.plot(x,y)
          plt.plot(x_test,y_pred)
          plt.show()
```

```
(600,)
(66000, 1)
```


100
80
60
40
20
0
0
100
200
300
400
500
600