

8E&F_LR_SVM_Assignment

June 12, 2020

8E: Implementing Decision Function of SVM RBF Kernel

0.1 Task E

```
[1]: import numpy as np
import pandas as pd
from sklearn.datasets import make_classification
import numpy as np
from sklearn.svm import SVC
import math
```

```
[2]: X, y = make_classification(n_samples=5000, n_features=5, n_redundant=2,
                               n_classes=2, weights=[0.7], class_sep=0.7,
                               random_state=15)
```

```
[3]: # train test split
from sklearn.model_selection import train_test_split

X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2,
                                                    stratify=y)
X_train, X_cv, y_train, y_cv = train_test_split(X_train, y_train, test_size=0.
                                                    random_state=25, stratify=y_train)
```

```
[4]: print(X_train.shape,y_train.shape)
print(X_cv.shape,y_cv.shape)
print(X_test.shape,y_test.shape)
```

```
(3000, 5) (3000,)
(1000, 5) (1000,)
(1000, 5) (1000,)
```

```
[5]: clf=SVC(kernel='rbf',gamma=0.001,C=100)
clf.fit(X_train, y_train)
```

```
[5]: SVC(C=100, break_ties=False, cache_size=200, class_weight=None, coef0=0.0,
        decision_function_shape='ovr', degree=3, gamma=0.001, kernel='rbf',
        max_iter=-1, probability=False, random_state=None, shrinking=True,
        tol=0.001, verbose=False)
```

```
[6]: intercept=clf.intercept_

weights=clf.dual_coef_[0]

sv=clf.support_vectors_

params=clf.get_params()
gamma=params['gamma']
```

```
[7]: def kernel(sv,xq,gamma):
      return math.exp(-gamma*np.linalg.norm(sv-xq)**2)
```

```
[8]: def decision_function(X_cv,w,intercept,sv,gamma):
      df=[]
      for x in range(len(X_cv)):
          summation=0
          for i in range(len(sv)):
              summation+=(w[i]*kernel(sv[i],X_cv[x],gamma))
          summation+=intercept
          df.extend(summation)
      return df
```

```
[9]: fcv=decision_function(X_cv,weights,intercept,sv,gamma)
      print(fcv)
```

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[11]: ftest=decision_function(X_test,weights,intercept,sv,gamma)  
print(ftest)
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```

8F: Implementing Platt Scaling to find $P(Y=1|X)$

0.2 TASK F

```
[13]: n_plus=np.count_nonzero(y_train==0)
      n_minus=np.count_nonzero(y_train==1)

      y_plus=(n_plus+1)/(n_plus+2)
      y_minus=1/(n_minus+2)
```

```
[14]: print(y_plus)
      print(y_minus)
```

```
0.9995224450811844
0.001098901098901099
```



```
[15]: y_cv_m=[]
      for value in y_cv:
          if value==1:
              y_cv_m.append(y_plus)
          else:
              y_cv_m.append(y_minus)
```

Applying SGD algorithm with (f_{cv}, y_{cv})

0.2.1 Logistic Regression with SGD and L2 regularization

```
[16]: w = np.zeros_like(fcv[0])
      b = 0
      eta0 = 0.0001    #learning rating for updation of weight (alpha)
      alpha = 0.0001   #lambda=alpha
      N = len(fcv)
```

```
[17]: def sigmoid(w,x,b):
      z=np.dot(x,w)+b
      den=1+np.exp(-z)
      return 1/den
```

```
[18]: def logloss(w,b,X,Y):
      leng=len(X)
      loss=0
      for i in range(leng):
          sigma=sigmoid(w,X[i],b)
          loss+=-Y[i]*math.log(sigma)-(1-Y[i])*math.log(1-sigma)
      return loss/leng
```

```
[19]: currloss_cv=logloss(w,b,fcv,y_cv_m)

      lr=eta0 #learning rate
      lam=alpha #lambda
      epoch=1000 #no of iterations

      index=np.arange(N)
      np.random.shuffle(index) #shuffling indices of CV data
      for i in range(1,epoch): #for every epoch
          for j in index:
              X_r=fcv[j] #fcv obtained from decision function
              Y_r=y_cv_m[j] #modified y_CV

              gradient=(X_r*(sigmoid(w,X_r,b)-Y_r))+((lam*w)/N) #gradient of loss w.r.
              ↪ t w
              gradient_intercept=(sigmoid(w,X_r,b)-Y_r) #gradient of intercept w.r.t
              ↪ b
```

```

    coeff=w-lr*gradient #updating weight vector (wt1=wt-lr*gradient)
    intercept=b-lr*gradient_intercept #updating intecept
    ↪ (bt1=bt=lr*gradientintercept)

    w=coeff #storing wt=wt1 for next iteration
    b=intercept #storing bt=bt1 for next iteration
    prevloss_cv=currloss_cv

    currloss_cv=logloss(coeff,intercept,fcv,y_cv_m) #log loss for fcv with
    ↪ updated weight vector and intercept

    if round(currloss_cv,4)==round(prevloss_cv,4): #comparing previousloss and
    ↪ currentloss
        epoch_value=i
        print("training stoped at epoch value {}".format(epoch_value))
        break

print("weight vector")
print(w) #final weight vector
print("intercept")
print(b) #final interceopt

```

training stoped at epoch value 124

weight vector

1.5803390920347105

intercept

-0.026179045106336885

$P(Y=1|X)$ For X_{test}

```

[20]: proba=[]
      for i in range(len(ftest)):
          z=(w*ftest[i])+b
          den=1+np.exp(-z)
          proba.append(1/den)

```

```

[21]: print(proba)

```

```

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