8 E&F

March 11, 2022

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
```

[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]:
```
# you can write your code here
# Split the data into      (60),     (20),      (20)
from sklearn.model_selection import train_test_split

X_tr,X_test,y_tr,y_test=train_test_split(X,y,random_state=42,test_size=0.2)
X_train,X_cv,y_train,y_cv=train_test_split(X_tr,y_tr,random_state=42,test_size=0.
 ↪25)
print(X_train.shape,X_test.shape,X_cv.shape)

clf=SVC(   =0.001, =100)
clf.fit(X_train,y_train)

f_cv=clf.decision_function(X_cv)



intercept=clf.intercept_
dual_coef=clf.dual_coef_
```

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

[4]:
```
g=0.001
def custom_de(X_cv,g):
    from tqdm import tqdm
    inter=clf.intercept_
    sup_vecs=clf.support_vectors_
```

```
    dual_coef=clf.dual_coef_
    ans=0
    for Xq in tqdm(X_cv):
        for i in range(np.shape(sup_vecs)[0]):
            k=np.linalg.norm(sup_vecs[i,:]-Xq)
            ans =+  dual_coef[0,i]  *  np.exp(-g*(k**2))
        ans =+ inter
        fcv=np.append(f_cv,ans)
    fcv = np.delete(fcv, -1)
    return fcv
fcv=custom_de(X_cv,g)

head, *tail= fcv
print("Custom decision function output only first value is printed =",head)
head1, *tail1= f_cv
print("Built-in decision function output only first value is printed =",head1)
```

```
100%|
  | 1000/1000 [00:23<00:00, 42.55it/s]

Custom decision function output only first value is printed = 0.8772503226216477
Built-in decision function output only first value is printed =
0.8772503226216477
```

[6]:
```
print(f_cv.shape,fcv.shape,X_cv.shape)
print(f_cv[-1],fcv[-1])
```

```
(1000,) (1000,) (1000, 5)
1.6044245082713067 1.6044245082713067
```

2 Task F

[5]:
```
def convter(data):
    x=[]
    for i in data:
        if i==0:
            x.append(y_n)
        else:
            x.append(y_p)
    return x

N_p=list(y_cv).count(1)  # N+
N_n=list(y_cv).count(0)  # N-

y_n=(1/(N_n+2))
y_p=((N_n+1)/(N_n+2))
```

```
u_cv=convter(y_cv)


y_p,y_n,N_n,N_p
```

[5]:
```
(0.9985855728429985, 0.0014144271570014145, 705, 295)
```

[15]:
```
def initialize_weights(row_vector):
    ''' In this function, we will initialize our weights and bias'''
    w=np.zeros_like(row_vector)
    b=0
    return w,b

def sigmoid(z):
    s=1/(1+(np.exp(-z)))
    return s\

def logloss(y_true,y_pred):
    sum = 0
    for i in range(len(y_true)):
        sum +=(y_true[i] * np.log10(y_pred[i])) + ((1-y_true[i]) * np.
 ↪log10(1-y_pred[i]))
    loss = -1 * (1 / len(y_true)) * sum
    return np.round(loss,8)

def gradient_dw(x,y,w,b,alpha,N):
    '''In this function, we will compute the gardient w.r.to w '''
    dw=(x * (y-sigmoid(np.dot(w.T,x)+b)) )-((alpha/N)* w)
    return np.round(dw,7)

def gradient_db(x,y,w,b):
    '''In this function, we will compute gradient w.r.to b '''
    db = y-sigmoid(np.dot(w.T,x)+b)
    return np.round(db,6)

def pred(w,b, X):
    N = len(X)
    predict = []
    for i in range(N):
        z=np.dot(w,X[i])+b
        predict.append(sigmoid(z))
    return np.array(predict)

from tqdm import tqdm
def train(X_train,y_train,epochs,alpha,eta0):
    ''' In this function, we will implement logistic regression'''
```

```
    train_loss = []
    test_loss = []
    w,b = initialize_weights(X_train[0])
    for epoch in tqdm(range(epochs)):
        for i in range(len(X_train)):
            dw=gradient_dw(X_train[i],y_train[i],w,b,alpha,N)
            db=gradient_db(X_train[i],y_train[i],w,b)
            w= w + (alpha * dw)
            b= b + (alpha * db)

        y_pred_train=pred(w,b,X_train)
        y_pred_train=np.clip(y_pred_train, 1e-15, 0.9999999)
        loss1=logloss(y_train,y_pred_train)
        train_loss.append(loss1)

    return w,b,train_loss
```

[16]:
```
alpha=0.001
eta0=0.001
epochs=20
N=len(u_cv)
w1,b1,train_loss1 = train(f_cv ,u_cv , epochs , alpha , eta0)
```

```
100%|
    | 20/20 [00:01<00:00, 13.91it/s]
```

[17]:
```
print(w1,b1,train_loss1)
f_test  = clf.decision_function( X_test )
```

```
1.717345057699997 -0.12020956500000061 [0.13645507, 0.10723418, 0.09567136,
0.08959355, 0.08591252, 0.08348546, 0.08179203, 0.08056178, 0.0796406,
0.07893446, 0.07838295, 0.07794558, 0.07759431, 0.07730918, 0.07707563,
0.07688282, 0.07672256, 0.07658857, 0.07647595, 0.07638085]
```

[18]:
```
def prob(w1,b1,f_test):
    z=w1*f_test+b1
    s=1/(1+(np.exp(-z)))
    return s
prob(w1,b1,f_test)
```

[18]:
```
array([7.45379818e-02, 8.61052549e-02, 2.25649580e-01, 1.17019703e-02,
       1.86016397e-03, 7.67324003e-01, 9.40208710e-01, 4.90609210e-02,
       1.40565920e-03, 6.01429186e-01, 9.80972981e-01, 3.65749257e-03,
       2.12765976e-01, 2.73385885e-01, 1.60283717e-01, 9.40612907e-01,
       5.32939406e-03, 7.33744156e-03, 8.32663140e-03, 4.89312904e-02,
       2.72725723e-02, 1.05114219e-03, 9.77865786e-01, 9.25617248e-01,
       1.14564159e-02, 5.38831158e-03, 1.23509468e-03, 1.19619683e-01,
       1.44069403e-01, 8.33250604e-01, 1.17119266e-02, 2.35633659e-03,
```

1.05036635e-03, 4.20119297e-03, 9.41246158e-01, 4.98298532e-01,
4.41957904e-01, 2.32993815e-02, 7.22959207e-01, 8.95951428e-01,
3.39076741e-03, 5.52662777e-01, 5.97103674e-01, 4.98460307e-01,
5.15000379e-03, 9.52774826e-01, 8.02014647e-03, 2.56617967e-03,
8.53987095e-01, 9.64231696e-01, 3.81602761e-01, 5.90080703e-02,
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7.20668628e-03, 1.79215027e-02, 1.03488800e-02, 7.97089106e-03,
7.59090124e-04, 2.59834744e-03, 6.88420940e-01, 9.39802804e-01,
4.39702335e-02, 7.12873002e-01, 9.26352479e-01, 2.32802094e-03,
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3.21846915e-02, 9.31504608e-01, 1.84488654e-03, 2.71195164e-02,
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4.37003848e-02, 5.20526997e-02, 4.51332636e-02, 9.42537573e-01,
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1.97058090e-01, 9.41706101e-01, 1.30946004e-03, 5.12735613e-03,
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6.02107186e-02, 7.09388773e-02, 2.29604390e-01, 8.48704785e-01,
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