8D_LR_SVM

January 28, 2021

0.1 Task-D: Collinear features and their effect on linear models

[ ]:
```
%matplotlib inline
import warnings
warnings.filterwarnings("ignore")
import pandas as pd
import numpy as np
from sklearn.datasets import load_iris
from sklearn.linear_model import SGDClassifier
from sklearn.model_selection import GridSearchCV
import seaborn as sns
import matplotlib.pyplot as plt
```

[ ]:
```
from google.colab import drive
drive.mount('/content/drive')
```

```
Drive already mounted at /content/drive; to attempt to forcibly remount, call
drive.mount("/content/drive", force_remount=True).
```

[ ]:
```
data = pd.read_csv('/content/drive/MyDrive/AAIC/Assignments/10.Behavior of␣
↪Linear Models/practice/task_d.csv')
```

[ ]:
```
data.head()
```

[ ]:

	x	y	z	...	2*z+3*x*x	w	target
0	-0.581066	0.841837	-1.012978	...	-0.665927	-0.536277	0
1	-0.894309	-0.207835	-1.012978	...	-0.917054	-0.522364	0
2	-1.207552	0.212034	-1.082312	...	-1.166507	0.205738	0
3	-1.364174	0.002099	-0.943643	...	-1.266540	-0.665720	0
4	-0.737687	1.051772	-1.012978	...	-0.792746	-0.735054	0

[5 rows x 8 columns]

[ ]:
```
X = data.drop(['target'], axis=1).values
Y = data['target'].values
```

0.1.1 Doing perturbation test to check the presence of collinearity

Task: 1 Logistic Regression

Task: 2 Linear SVM Do write the observations based on the results you get from the deviations of weights in both Logistic Regression and linear SVM

1 TASK-1 (Logistic Regression)

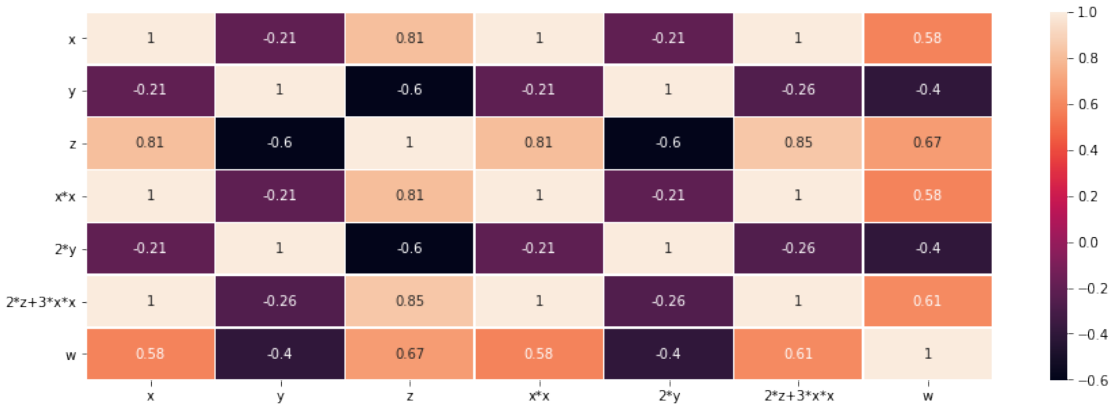
[ ]:
```
pip install colorama
```

```
Requirement already satisfied: colorama in /usr/local/lib/python3.6/dist-
packages (0.4.4)
```

[ ]:
```
from sklearn.metrics import log_loss,␣
 ↪make_scorer,hinge_loss,roc_auc_score,confusion_matrix,accuracy_score
import seaborn as sns
#import colorama
from colorama import Fore, Style
import math as m

def plot(r,x_ax):
  plt.xlabel('Hyper-Param\'s in Log-space')
  plt.ylabel('AUC-Score')
  plt.plot(x_ax,r['mean_train_score'],'-o',label='tr-scores')
  plt.plot(x_ax,r['mean_test_score'],'-o',label='cv-scores')
  plt.grid()
  plt.legend()
  plt.show()
  return

def fun(best_model,X_train,Y_train,X_test,Y_test):
  best_model.fit(X_train,Y_train)
  W = best_model.coef_
  print('*'*100)
  print(f"{Fore.BLUE}Best_Model:{Style.RESET_ALL}") #https://stackoverflow.com/
 ↪questions/39473297/how-do-i-print-colored-output-with-python-3
  print(best_model.get_params)
  print('*'*100)
  print(f"{Fore.BLUE}Best_Model_Weights:{Style.RESET_ALL}",'\n',W)
  print('*'*100)
  #cm = (confusion_matrix(Y_test,best_model.predict(X_test)))
  #sns.heatmap(cm,annot=True)
  #plt.show()
  best_model_accuracy = accuracy_score(Y_test,best_model.predict(X_test))
  print(f"{Fore.BLUE}Best_Model_Accuracy:{Style.
 ↪RESET_ALL}",'\n',best_model_accuracy)
  print('*'*100)
  return W,best_model_accuracy
```

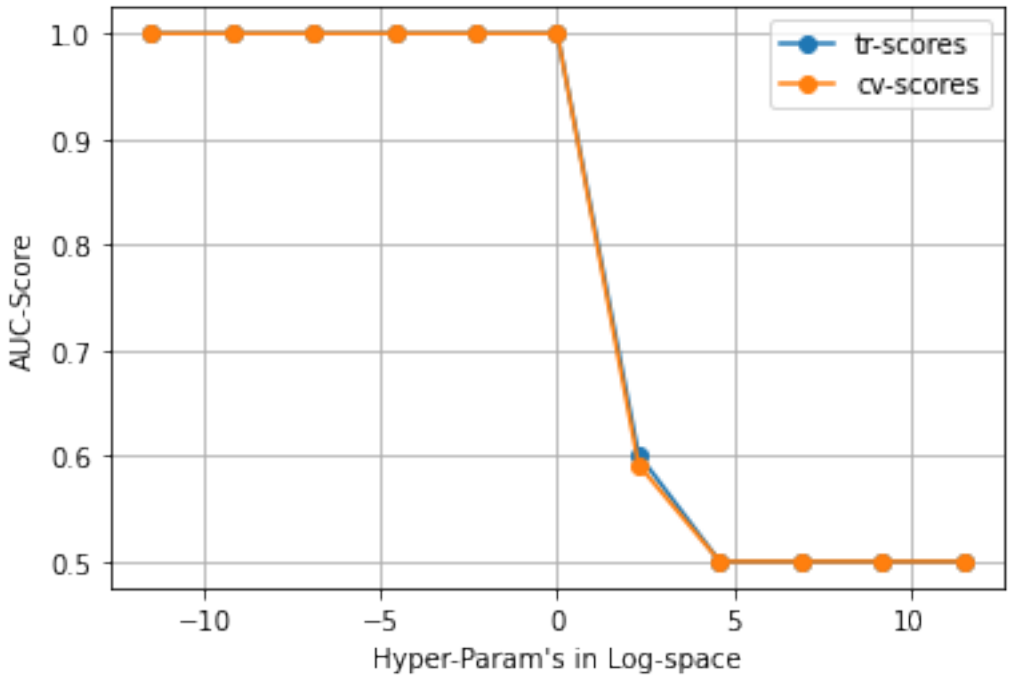
```
def train(loss_,X_train,Y_train,X_test,Y_test):
  params = {'alpha': [1e-5,1e-4,1e-3,1e-2,1e-1,1,10,100,1000,10000,100000],
            #'eta0' : [1e-5,1e-4,1e-3,1e-2,1e-1,1,10,100,1000,10000,100000]
            }
  x_ax = [m.log(x) for x in params['alpha']]
  if loss_== log_loss:
    l = 'log'
  else:
    l = 'hinge'

  model = GridSearchCV(estimator=SGDClassifier(loss=l,n_jobs=-1),
                       ␣
 ↪return_train_score=True,param_grid=params,scoring=make_scorer(roc_auc_score),
                       n_jobs=-1,cv=10
                       )
  model.fit(X_train,Y_train)
  r = pd.DataFrame(model.cv_results_)
  plot(r,x_ax)
  best_model = model.best_estimator_

  return best_model
```

[ ]:
```
X = data.drop(['target'], axis=1)
Y = data['target']

fig, ax = plt.subplots(figsize=(15,5))
sns.heatmap(X.corr(), annot=True, linewidths=.5, ax=ax)
plt.show()
```



1.1 Training on Original Data

[ ]:
```
from sklearn.model_selection import train_test_split
x_train, x_test, y_train, y_test = train_test_split(X, Y,stratify=Y,test_size=0.
 ↪25,random_state=42)

best_model =␣
 ↪train(loss_=log_loss,X_train=x_train,Y_train=y_train,X_test=x_test,Y_test=y_test)
W,best_model_accuraccy = fun(best_model,x_train,y_train,x_test,y_test)
```




```
**********************************************************************************
********************
Best_Model:
<bound method BaseEstimator.get_params of SGDClassifier(alpha=1e-05,
average=False, class_weight=None,
              early_stopping=False, epsilon=0.1, eta0=0.0, fit_intercept=True,
              l1_ratio=0.15, learning_rate='optimal', loss='log', max_iter=1000,
              n_iter_no_change=5, n_jobs=-1, penalty='l2', power_t=0.5,
              random_state=None, shuffle=True, tol=0.001,
              validation_fraction=0.1, verbose=0, warm_start=False)>
**********************************************************************************
********************
Best_Model_Weights:
 [[ 20.77826339 -21.992494    27.77353984  20.28805504 -21.992494
```

```
   21.61259704  27.03731201]]
**********************************************************************
**********
Best_Model_Accuracy:
 1.0
**********************************************************************
**********
```

1.2 Training on Perturbated data

[ ]:
```
X_dash = X + (10**(-2))
x_train, x_test, y_train, y_test = train_test_split(X_dash,␣
 ↪Y,stratify=Y,test_size=0.25,random_state=42)

W_dash,best_model_accuracy_edited =␣
 ↪fun(best_model,x_train,y_train,x_test,y_test)
```

```
**********************************************************************
**********
Best_Model:
<bound method BaseEstimator.get_params of SGDClassifier(alpha=1e-05,
average=False, class_weight=None,
              early_stopping=False, epsilon=0.1, eta0=0.0, fit_intercept=True,
              l1_ratio=0.15, learning_rate='optimal', loss='log', max_iter=1000,
              n_iter_no_change=5, n_jobs=-1, penalty='l2', power_t=0.5,
              random_state=None, shuffle=True, tol=0.001,
              validation_fraction=0.1, verbose=0, warm_start=False)>
**********************************************************************
**********
Best_Model_Weights:
 [[  2.08950276 -20.30395522  19.13797837   1.41465907 -20.30395522
    3.58257832  -0.51286348]]
**********************************************************************
**********
Best_Model_Accuracy:
 0.96
**********************************************************************
**********
```

1.3 Comparing results

[ ]:
```
def top_feat(best_model_accuracy_edited,best_model_accuracy,W,W_dash):
  print(f"{Fore.BLUE}best_model_accuracy_edited - best_model_accuracy:{Style.
 ↪RESET_ALL}",'\n',best_model_accuracy_edited-best_model_accuracy,'\n')
  print(f"{Fore.BLUE}abs(W-W_dash):{Style.RESET_ALL}",'\n',abs(W-W_dash),'\n')
  ind = list((np.argsort(-(abs(W-W_dash)/W)*100))[0])
  feat = X.columns.to_list()
```

```
  print(f"{Fore.BLUE}Top-feat:{Style.RESET_ALL}",)
  return [print(feat[i]) for i in ind[:4]]
top_feat(best_model_accuraccy_edited,best_model_accuraccy,W,W_dash)
```

```
best_model_accuraccy_edited - best_model_accuraccy:
 -0.040000000000000036

abs(W-W_dash):
 [[18.68876063  1.68853879  8.63556146 18.87339596  1.68853879 18.03001872
  27.55017549]]

Top-feat:
w
x*x
x
2*z+3*x*x
```

[ ]:
```
[None, None, None, None]
```

[ ]:

[ ]:

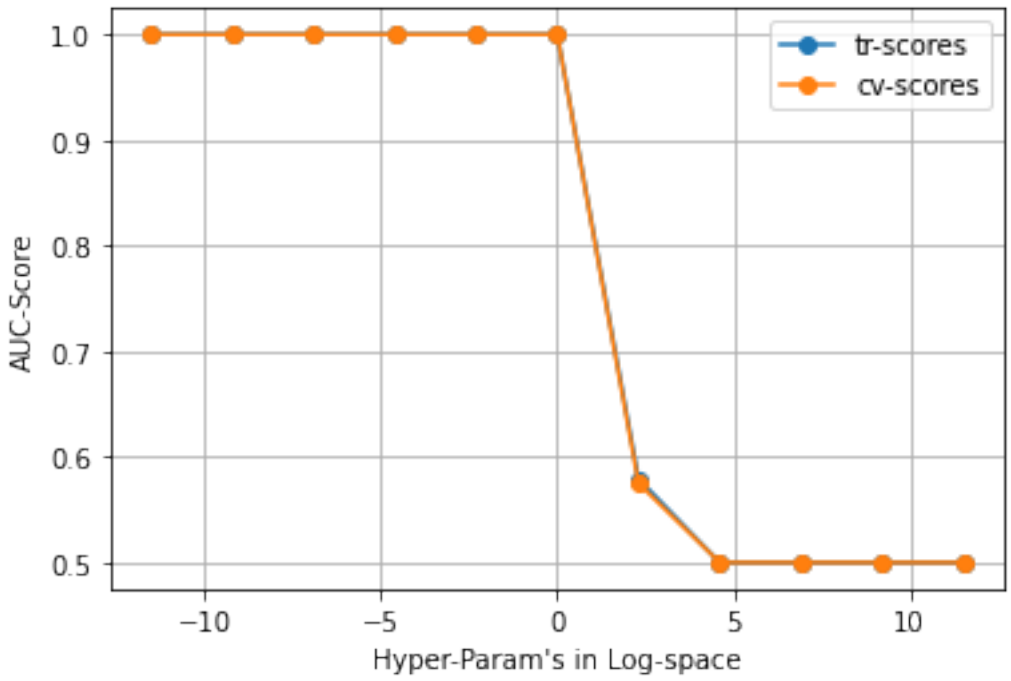
2 Task-2 (Linear SVM)

[ ]:
```
data = pd.read_csv('/content/drive/MyDrive/AAIC/Assignments/10.Behavior of␣
 ↪Linear Models/practice/task_d.csv')
X = data.drop(['target'], axis=1)
Y = data['target']
```

2.1 Training on Original Data

[ ]:

[ ]:
```
from sklearn.model_selection import train_test_split
x_train, x_test, y_train, y_test = train_test_split(X, Y,stratify=Y,test_size=0.
 ↪25,random_state=42)

best_model =␣
 ↪train(loss_=hinge_loss,X_train=x_train,Y_train=y_train,X_test=x_test,Y_test=y_test)
W,best_model_accuraccy = fun(best_model,x_train,y_train,x_test,y_test)
```




```
**************************************************************************************
**********************
Best_Model:
<bound method BaseEstimator.get_params of SGDClassifier(alpha=1e-05,
average=False, class_weight=None,
              early_stopping=False, epsilon=0.1, eta0=0.0, fit_intercept=True,
              l1_ratio=0.15, learning_rate='optimal', loss='hinge',
              max_iter=1000, n_iter_no_change=5, n_jobs=-1, penalty='l2',
              power_t=0.5, random_state=None, shuffle=True, tol=0.001,
              validation_fraction=0.1, verbose=0, warm_start=False)>
**************************************************************************************
**********************
Best_Model_Weights:
 [[  9.45220176 -23.93918264  10.83878558   9.8256722  -23.93918264
   10.15178602  22.66053126]]
**************************************************************************************
**********************
Best_Model_Accuraccy:
 0.96
**************************************************************************************
**********************
```

2.2 Training on perturbated data

[ ]:
```
X_dash = X + (10**(-2))
x_train, x_test, y_train, y_test = train_test_split(X_dash,␣
 ↪Y,stratify=Y,test_size=0.25,random_state=42)

W_dash,best_model_accuraccy_edited =␣
 ↪fun(best_model,x_train,y_train,x_test,y_test)
```

```
**********************************************************************
**********
Best_Model:
<bound method BaseEstimator.get_params of SGDClassifier(alpha=1e-05,
average=False, class_weight=None,
              early_stopping=False, epsilon=0.1, eta0=0.0, fit_intercept=True,
              l1_ratio=0.15, learning_rate='optimal', loss='hinge',
              max_iter=1000, n_iter_no_change=5, n_jobs=-1, penalty='l2',
              power_t=0.5, random_state=None, shuffle=True, tol=0.001,
              validation_fraction=0.1, verbose=0, warm_start=False)>
**********************************************************************
**********
Best_Model_Weights:
 [[ 10.19105311 -34.15004656  38.34742036  10.34878513 -34.15004656
   13.94376968  19.4740285 ]]
**********************************************************************
**********
Best_Model_Accuraccy:
 0.96
**********************************************************************
**********
```

2.3 Comparing Results

[ ]:
```
top_feat(best_model_accuraccy_edited,best_model_accuraccy,W,W_dash)
```

```
best_model_accuraccy_edited - best_model_accuraccy:
 0.0

abs(W-W_dash):
 [[ 0.73885135 10.21086392 27.50863478  0.52311293 10.21086392  3.79198365
   3.18650276]]

Top-feat:
z
2*z+3*x*x
w
x
```

[ ]:
```
[None, None, None, None]
```

[ ]:
```

```