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

In [1]:

```
%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
```

In [2]:

```
data = pd.read_csv('task_d.csv')
```

In [3]:

```
data.head()
```

Out[3]:

	x	y	z	x*x	2*y	2*z+3*x*x	w	target
0	-0.581066	0.841837	-1.012978	-0.604025	0.841837	-0.665927	-0.536277	0
1	-0.894309	-0.207835	-1.012978	-0.883052	-0.207835	-0.917054	-0.522364	0
2	-1.207552	0.212034	-1.082312	-1.150918	0.212034	-1.166507	0.205738	0
3	-1.364174	0.002099	-0.943643	-1.280666	0.002099	-1.266540	-0.665720	0
4	-0.737687	1.051772	-1.012978	-0.744934	1.051772	-0.792746	-0.735054	0

In [4]:

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

Doing perturbation test to check the presence of collinearity

Task: 1 Logistic Regression

```
1. Finding the Correlation between the features
    a. check the correlation between the features
    b. plot heat map of correlation matrix using seaborn heatmap
2. Finding the best model for the given data
    a. Train Logistic regression on data(X,Y) that we have created in the above cell
    b. Find the best hyper prameter alpha with hyper parameter tuning using k-fold cross validation (grid search CV or
    random search CV make sure you choose the alpha in log space)
    c. Creat a new Logistic regression with the best alpha
    (search for how to get the best hyper parameter value), name the best model as 'best_model'

3. Getting the weights with the original data
    a. train the 'best_model' with X, Y
    b. Check the accuracy of the model 'best_model_accuracy'
    c. Get the weights W using best_model.coef_

4. Modifying original data
    a. Add a noise(order of 10^-2) to each element of X
    and get the new data set X' (X' = X + e)
    b. Train the same 'best_model' with data (X', Y)
    c. Check the accuracy of the model 'best_model_accuracy_edited'
    d. Get the weights W' using best_model.coef_

5.  Checking deviations in metric and weights
    a. find the difference between 'best_model_accuracy_edited' and 'best_model_accuracy'
    b. find the absolute change between each value of W and W' ==> |(W-W')|
    c. print the top 4 features which have higher % change in weights
    compare to the other feature
```

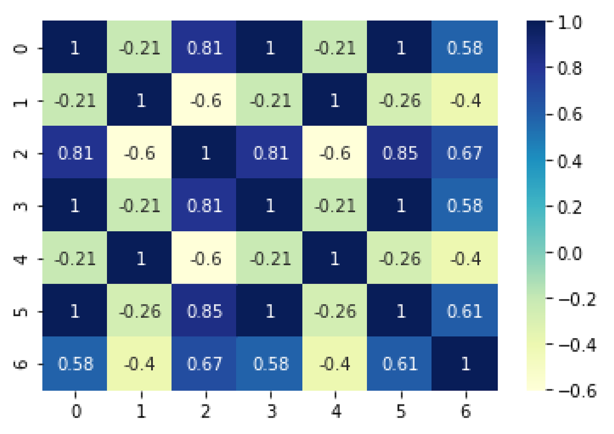
Task: 2 Linear SVM

```
1. Do the same steps (2, 3, 4, 5) we have done in the above task 1.
```

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

In [5]:

```
#Heat map for finding correlation
dataplot=sns.heatmap(pd.DataFrame(X).corr(),cmap='YlGnBu',annot=True)
plt.show()
```



In [6]:

```
#From the above heatmap i can say that (3,5) columns are highly correlated feature
#and among them i can choose one of the feature from them
#(4,1),(5,1),(5,0),(3,0),(3,5) these set of features are highly correlated among these i can drop 0 and 3 features
```

In [7]:

```
#Finding the best model for the given data
from sklearn.linear_model import LogisticRegression
clf=LogisticRegression(n_jobs=-1)
```

In [8]:

```
from sklearn.model_selection import RandomizedSearchCV
def get_best_para(est,param,X,Y):
    clf=RandomizedSearchCV(est,param,n_iter=10,n_jobs=-1)
    clf.fit(X,Y)
    return  clf.best_params_,clf.best_score_
```

In [9]:

```
param={'C':[0.1,1,10,100,0.001,0.2]}
get_best_para(clf,param,X,Y)
```

Out[9]:

```
({'C': 0.1}, 1.0)
```

In [10]:

```
best_model=LogisticRegression(n_jobs=-1,C=0.1)
best_model.fit(X,Y)
```

Out[10]:

```
LogisticRegression(C=0.1, n_jobs=-1)
```

In [11]:

```
#Calculating accuracy of a model
def acc(Y_true,Y_pred):
    from sklearn.metrics import confusion_matrix
    #print(confusion_matrix(Y_true,Y_pred))
    TN,FP,FN,TP = confusion_matrix(Y_true,Y_pred).ravel()
    #print(TN,FP,FN,TP)
    #Precision = TP/(TP+FP)
    #Sensitivity(recall)=TP/(TP+FN)
    #Specificity=TN/(TN+FP)
    Accuracy=(TP+TN)/(TP+TN+FP+FN)
    return Accuracy
```

In [12]:

```
Acc_best_model=acc(Y,best_model.predict(X).reshape(-1,1))
```

In [13]:

```
print(Acc_best_model)
```

```
1.0
```

In [14]:

```
#Weight of the model
best_model_coeff=best_model.coef_
```

In [15]:

```
#Adding noise to the X with e=10^-2
import random as rn
X1=X+rn.uniform(0.01,0.1)
```

In [16]:

```
#Retraining the model with Noise points
best_model.fit(X1,Y)
best_model_edited_coeff=best_model.coef_
```

In [17]:

```
Acc_best_model_edited=acc(Y,best_model.predict(X).reshape(-1,1))
```

In [18]:

```
print(Acc_best_model)
```

```
1.0
```

In [19]:

```
def diff_weight(w1,w2):
    W=(abs(w1-w2)/w1)*100
    return list(np.argsort(W)[0][0:4])
```

In [20]:

```
#Accuracy of model_1 aand model_2
print(f'The difference in accuracy of the model are {abs(Acc_best_model_edited-Acc_best_model)}')
```

```
The difference in accuracy of the model are 0.0
```

In [21]:

```
#Getting top 4 features which have highest change
l=diff_weight(best_model_coeff,Acc_best_model_edited)
temp=np.array(data.columns)
print(f'{temp[l]} are the  top 4 features whoes weight has changed')
```

```
['y' '2*y' 'z' '2*z+3*x*x'] are the  top 4 features whoes weight has changed
```

In [22]:

```
#Linear SVM
from sklearn.svm import LinearSVC
SVC=LinearSVC()
```

In [23]:

```
para={'C':[0.001,0.001,0.01,0.1,1,10,100]}
get_best_para(SVC,para,X,Y)
```

Out[23]:

```
({'C': 0.001}, 1.0)
```

In [24]:

```
#Best For LinearSVM
best_model_SVM=LinearSVC(C=0.001)
best_model_SVM.fit(X,Y)
```

Out[24]:

```
LinearSVC(C=0.001)
```

In [25]:

```
Acc_best_model_SVM=acc(Y,best_model_SVM.predict(X).reshape(-1,1))
print(Acc_best_model)
```

```
1.0
```

In [26]:

```
#Weight of the model
best_model_SVM_coeff=best_model_SVM.coef_
```

In [27]:

```
#Retraining the model with Noise points
best_model_SVM.fit(X1,Y)
best_model_edited_SVM_coeff=best_model.coef_
```

In [28]:

```
Acc_best_model_edited_SVM=acc(Y,best_model_SVM.predict(X).reshape(-1,1))
```

In [29]:

```
#Accuracy of model_1 aand model_2
print(f'The difference in accuracy of the model are {abs(Acc_best_model_edited_SVM-Acc_best_model_SVM)}')
```

```
The difference in accuracy of the model are 0.0
```

In [31]:

```
#Getting top 4 features which have highest change
l=diff_weight(best_model_SVM_coeff,Acc_best_model_edited_SVM)
temp=np.array(data.columns)
print(f'{temp[l]} are the  top 4 features whoes weight has changed')
```

```
['y' '2*y' 'z' '2*z+3*x*x'] are the  top 4 features whoes weight has changed
```

Observation

In both the cases when we use different model the same features have the high percentage change in the weight