

**In The Name OF GOD, The Merciful, The Beneficent**

**Report:**

**Third Project OF Machine Learning**

**Project Title:**

**SVM Classifier (Linear and RBF kernels)**

**Programming language used:**

**Python**

**Relevant professor:**

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## importing libraries:

```
import numpy as np
from sklearn.model_selection import train_test_split
import matplotlib.pyplot as plt
import pandas as pd
from sklearn.svm import SVC
```

## load dataset:

```
# load att as dataframe:
att = pd.read_csv('Diabetes_att.txt', header = None)# load class_att as dataframe:
class_att = pd.read_csv('Diabetes_class.txt', header = None)att = np.array(att)
class_att = np.array(class_att)# change the class values "tested_positive" and "tested_negative" to
+1 and -1, respectively:
class_att = np.where((class_att == 'tested_positive'),1,-1)
```

## normalize data:

```
att = (att - np.mean(att , axis=0)) / (np.std(att , axis=0)) # normalize data
```

## split data to train , validation and test:

```
x_train_validation, x_test, y_train_validation, y_test = train_test_split(att, class_att, test_size=0.2
, random_state=0 ,shuffle=True)
x_train, x_validation, y_train, y_validation = train_test_split(x_train_validation, y_train_validation,
on, test_size=0.25, random_state=0 ,shuffle=True)
```

## Linear\_kernel\_SVC:

### tuning hyperparameters:

```
c = [0.0001,0.001,0.01,0.1,1,10,100,1000]    # different values for C(hyperparameter)
best_validation_acc = 0
best_validation_C_linear = 0
train_acc_best_C = 0
for i in c:
    Linear_kernel = SVC(C=i , kernel='linear')
    Linear_kernel.fit(x_train, y_train)
    train_acc = Linear_kernel.score(x_train,y_train)
    validation_acc = Linear_kernel.score(x_validation,y_validation)
    if validation_acc > best_validation_acc:
        train_acc_best_C = train_acc
        best_validation_acc = validation_acc
        best_validation_C_linear = i
    print('for C={ } : train_acc: { } , validation_acc:{ }'.format(i , train_acc , validation_acc))
print('train_acc_best_C: { } , best_validation_acc: { } , best_validation_C_linear: { }'.format(trai
n_acc_best_C,best_validation_acc,best_validation_C_linear))
```

## searching for best C:

```
for C=0.0001 : train_acc: 0.6434782608695652 , validation_acc:0.6298701298701299
for C=0.001 : train_acc: 0.6434782608695652 , validation_acc:0.6298701298701299
for C=0.01 : train_acc: 0.7695652173913043 , validation_acc:0.7467532467532467
for C=0.1 : train_acc: 0.7695652173913043 , validation_acc:0.7402597402597403
for C=1 : train_acc: 0.7652173913043478 , validation_acc:0.7467532467532467
for C=10 : train_acc: 0.7652173913043478 , validation_acc:0.7467532467532467
for C=100 : train_acc: 0.7652173913043478 , validation_acc:0.7467532467532467
for C=1000 : train_acc: 0.7652173913043478 , validation_acc:0.7467532467532467
```

## This search found this result for best C:

**C = 0.01**

train\_acc\_best\_C: 0.7695652173913043 , best\_validation\_acc: 0.7467532467532467 ,  
best\_validation\_C\_linear: 0.01

## Now search deeper for best C in an interval:

```
c = np.linspace(0.005,0.05,50) # searching C in best interval
best_validation_acc = 0
best_validation_C_linear_new = 0
train_acc_best_C = 0
for i in c:
    Linear_kernel = SVC(C=i , kernel='linear')
    Linear_kernel.fit(x_train, y_train)
    train_acc = Linear_kernel.score(x_train,y_train)
    validation_acc = Linear_kernel.score(x_validation,y_validation)
    if validation_acc > best_validation_acc:
        train_acc_best_C = train_acc
        best_validation_acc = validation_acc
        best_validation_C_linear_new = i
    print('for C={ } : train_acc: { } , validation_acc:{ }'.format(i , train_acc , validation_acc))
print('train_acc_best_C: { } , best_validation_acc: { } , best_validation_C_linear_new: { }'.form
at(train_acc_best_C,best_validation_acc,best_validation_C_linear_new))
```

## searching for best C in best interval:

```
for C=0.005 : train_acc: 0.7326086956521739 , validation_acc:0.7272727272727273
for C=0.005918367346938775 : train_acc: 0.741304347826087 , validation_acc:0.7662337662337663
for C=0.0068367346938775515 : train_acc: 0.7608695652173914 , validation_acc:0.7597402597402597
for C=0.007755102040816327 : train_acc: 0.7673913043478261 , validation_acc:0.7467532467532467
for C=0.008673469387755102 : train_acc: 0.7717391304347826 , validation_acc:0.7467532467532467
for C=0.009591836734693878 : train_acc: 0.7717391304347826 , validation_acc:0.7467532467532467
for C=0.010510204081632654 : train_acc: 0.7695652173913043 , validation_acc:0.7402597402597403
for C=0.01142857142857143 : train_acc: 0.7652173913043478 , validation_acc:0.7402597402597403
for C=0.012346938775510205 : train_acc: 0.7695652173913043 , validation_acc:0.7402597402597403
for C=0.013265306122448979 : train_acc: 0.7695652173913043 , validation_acc:0.7402597402597403
for C=0.014183673469387755 : train_acc: 0.7695652173913043 , validation_acc:0.7402597402597403
for C=0.015102040816326531 : train_acc: 0.7739130434782608 , validation_acc:0.7402597402597403
for C=0.016020408163265307 : train_acc: 0.7717391304347826 , validation_acc:0.7337662337662337
for C=0.016938775510204084 : train_acc: 0.7739130434782608 , validation_acc:0.7337662337662337
for C=0.01785714285714286 : train_acc: 0.7739130434782608 , validation_acc:0.7337662337662337
for C=0.018775510204081632 : train_acc: 0.7739130434782608 , validation_acc:0.7402597402597403
for C=0.01969387755102041 : train_acc: 0.7695652173913043 , validation_acc:0.7402597402597403
for C=0.020612244897959184 : train_acc: 0.7695652173913043 , validation_acc:0.7402597402597403
for C=0.02153061224489796 : train_acc: 0.7695652173913043 , validation_acc:0.7402597402597403
```

for C=0.022448979591836737 : train\_acc: 0.7695652173913043 , validation\_acc:0.7402597402597403  
for C=0.023367346938775513 : train\_acc: 0.7695652173913043 , validation\_acc:0.7337662337662337  
for C=0.02428571428571429 : train\_acc: 0.7695652173913043 , validation\_acc:0.7337662337662337  
for C=0.025204081632653065 : train\_acc: 0.7695652173913043 , validation\_acc:0.7337662337662337  
for C=0.026122448979591838 : train\_acc: 0.7717391304347826 , validation\_acc:0.7337662337662337  
for C=0.027040816326530614 : train\_acc: 0.7739130434782608 , validation\_acc:0.7402597402597403  
for C=0.02795918367346939 : train\_acc: 0.7739130434782608 , validation\_acc:0.7402597402597403  
for C=0.028877551020408166 : train\_acc: 0.7717391304347826 , validation\_acc:0.7467532467532467  
for C=0.029795918367346942 : train\_acc: 0.7739130434782608 , validation\_acc:0.7467532467532467  
for C=0.03071428571428572 : train\_acc: 0.7739130434782608 , validation\_acc:0.7532467532467533  
for C=0.03163265306122449 : train\_acc: 0.7739130434782608 , validation\_acc:0.7532467532467533  
for C=0.03255102040816327 : train\_acc: 0.7739130434782608 , validation\_acc:0.7467532467532467  
for C=0.03346938775510204 : train\_acc: 0.7739130434782608 , validation\_acc:0.7467532467532467  
for C=0.03438775510204082 : train\_acc: 0.7739130434782608 , validation\_acc:0.7467532467532467  
for C=0.03530612244897959 : train\_acc: 0.7717391304347826 , validation\_acc:0.7467532467532467  
for C=0.03622448979591837 : train\_acc: 0.7695652173913043 , validation\_acc:0.7467532467532467  
for C=0.037142857142857144 : train\_acc: 0.7695652173913043 , validation\_acc:0.7467532467532467  
for C=0.03806122448979592 : train\_acc: 0.7695652173913043 , validation\_acc:0.7467532467532467  
for C=0.038979591836734696 : train\_acc: 0.7695652173913043 , validation\_acc:0.7467532467532467  
for C=0.03989795918367347 : train\_acc: 0.7717391304347826 , validation\_acc:0.7467532467532467  
for C=0.04081632653061224 : train\_acc: 0.7717391304347826 , validation\_acc:0.7532467532467533  
for C=0.04173469387755102 : train\_acc: 0.7739130434782608 , validation\_acc:0.7532467532467533  
for C=0.042653061224489794 : train\_acc: 0.7760869565217391 , validation\_acc:0.7467532467532467  
for C=0.04357142857142857 : train\_acc: 0.7760869565217391 , validation\_acc:0.7467532467532467  
for C=0.044489795918367346 : train\_acc: 0.7760869565217391 , validation\_acc:0.7402597402597403  
for C=0.045408163265306126 : train\_acc: 0.7760869565217391 , validation\_acc:0.7402597402597403  
for C=0.0463265306122449 : train\_acc: 0.7760869565217391 , validation\_acc:0.7402597402597403  
for C=0.04724489795918367 : train\_acc: 0.7760869565217391 , validation\_acc:0.7402597402597403  
for C=0.04816326530612245 : train\_acc: 0.7760869565217391 , validation\_acc:0.7337662337662337  
for C=0.04908163265306122 : train\_acc: 0.7760869565217391 , validation\_acc:0.7337662337662337  
for C=0.05 : train\_acc: 0.7739130434782608 , validation\_acc:0.7337662337662337

**This search found this result for best C:**

**C = 0.005918367346938775**

train\_acc\_best\_C: 0.741304347826087 , best\_validation\_acc: 0.7662337662337663 ,  
best\_validation\_C\_linear\_new: 0.005918367346938775

**RBF\_kernel\_SVC:**

**tuning hyperparameters:**

```
c = [0.0001,0.001,0.01,0.1,1,10,100,1000]    # diffrent values for C(hyperparameter)
g = [0.0001,0.001,0.01,0.1,1,10,100,1000]    # diffrent values for gamma(hyperparameter)
best_validation_acc = 0
best_validation_C_RBF = 0
best_gamma_RBF = None
train_acc_best_C_gamma = 0
for j in g:
    for i in c:
        RBF_kernel = SVC(C=i , kernel='rbf' ,gamma=j)
        RBF_kernel.fit(x_train, y_train)
        train_acc = RBF_kernel.score(x_train,y_train)
        validation_acc = RBF_kernel.score(x_validation,y_validation)
        if validation_acc > best_validation_acc:
            train_acc_best_C_gamma = train_acc
            best_validation_acc = validation_acc
            best_validation_C_RBF = i
```

```

best_gamma_RBF = j
print('for gamma={ } and C={ } : train_acc: { } , validation_acc:{ }'.format(j , i , train_acc , validation_acc))
print('train_acc_best_C_gamma: { } , best_validation_acc: { } , best_validation_C_RBF: { } , best_gamma_RBF: { }'.format(train_acc_best_C_gamma,best_validation_acc,best_validation_C_RBF,best_gamma_RBF))

```

## searching for best C and gamma:

```

for gamma=0.0001 and C=0.0001 : train_acc: 0.6434782608695652 , validation_acc:0.6298701298701299
for gamma=0.0001 and C=0.001 : train_acc: 0.6434782608695652 , validation_acc:0.6298701298701299
for gamma=0.0001 and C=0.01 : train_acc: 0.6434782608695652 , validation_acc:0.6298701298701299
for gamma=0.0001 and C=0.1 : train_acc: 0.6434782608695652 , validation_acc:0.6298701298701299
for gamma=0.0001 and C=1 : train_acc: 0.6434782608695652 , validation_acc:0.6298701298701299
for gamma=0.0001 and C=10 : train_acc: 0.6434782608695652 , validation_acc:0.6298701298701299
for gamma=0.0001 and C=100 : train_acc: 0.7695652173913043 , validation_acc:0.7402597402597403
for gamma=0.0001 and C=1000 : train_acc: 0.7652173913043478 , validation_acc:0.7467532467532467
for gamma=0.001 and C=0.0001 : train_acc: 0.6434782608695652 , validation_acc:0.6298701298701299
for gamma=0.001 and C=0.001 : train_acc: 0.6434782608695652 , validation_acc:0.6298701298701299
for gamma=0.001 and C=0.01 : train_acc: 0.6434782608695652 , validation_acc:0.6298701298701299
for gamma=0.001 and C=0.1 : train_acc: 0.6434782608695652 , validation_acc:0.6298701298701299
for gamma=0.001 and C=1 : train_acc: 0.6434782608695652 , validation_acc:0.6298701298701299
for gamma=0.001 and C=10 : train_acc: 0.7695652173913043 , validation_acc:0.7337662337662337

for gamma=0.001 and C=100 : train_acc: 0.7717391304347826 , validation_acc:0.7467532467532467
for gamma=0.001 and C=1000 : train_acc: 0.7782608695652173 , validation_acc:0.7727272727272727
for gamma=0.01 and C=0.0001 : train_acc: 0.6434782608695652 , validation_acc:0.6298701298701299
for gamma=0.01 and C=0.001 : train_acc: 0.6434782608695652 , validation_acc:0.6298701298701299
for gamma=0.01 and C=0.01 : train_acc: 0.6434782608695652 , validation_acc:0.6298701298701299
for gamma=0.01 and C=0.1 : train_acc: 0.6434782608695652 , validation_acc:0.6298701298701299
for gamma=0.01 and C=1 : train_acc: 0.7695652173913043 , validation_acc:0.7532467532467533
for gamma=0.01 and C=10 : train_acc: 0.7760869565217391 , validation_acc:0.7792207792207793
for gamma=0.01 and C=100 : train_acc: 0.8152173913043478 , validation_acc:0.7597402597402597
for gamma=0.01 and C=1000 : train_acc: 0.8434782608695652 , validation_acc:0.7597402597402597
for gamma=0.1 and C=0.0001 : train_acc: 0.6434782608695652 , validation_acc:0.6298701298701299
for gamma=0.1 and C=0.001 : train_acc: 0.6434782608695652 , validation_acc:0.6298701298701299
for gamma=0.1 and C=0.01 : train_acc: 0.6434782608695652 , validation_acc:0.6298701298701299

for gamma=0.1 and C=0.1 : train_acc: 0.7304347826086957 , validation_acc:0.7077922077922078
for gamma=0.1 and C=1 : train_acc: 0.8065217391304348 , validation_acc:0.7792207792207793
for gamma=0.1 and C=10 : train_acc: 0.8652173913043478 , validation_acc:0.7727272727272727
for gamma=0.1 and C=100 : train_acc: 0.9369565217391305 , validation_acc:0.7272727272727273
for gamma=0.1 and C=1000 : train_acc: 0.9869565217391304 , validation_acc:0.7012987012987013
for gamma=1 and C=0.0001 : train_acc: 0.6434782608695652 , validation_acc:0.6298701298701299
for gamma=1 and C=0.001 : train_acc: 0.6434782608695652 , validation_acc:0.6298701298701299
for gamma=1 and C=0.01 : train_acc: 0.6434782608695652 , validation_acc:0.6298701298701299
for gamma=1 and C=0.1 : train_acc: 0.6434782608695652 , validation_acc:0.6298701298701299

for gamma=1 and C=1 : train_acc: 0.9630434782608696 , validation_acc:0.7142857142857143
for gamma=1 and C=10 : train_acc: 1.0 , validation_acc:0.7272727272727273
for gamma=1 and C=100 : train_acc: 1.0 , validation_acc:0.7272727272727273
for gamma=1 and C=1000 : train_acc: 1.0 , validation_acc:0.7272727272727273

for gamma=10 and C=0.0001 : train_acc: 0.6434782608695652 , validation_acc:0.6298701298701299
for gamma=10 and C=0.001 : train_acc: 0.6434782608695652 , validation_acc:0.6298701298701299
for gamma=10 and C=0.01 : train_acc: 0.6434782608695652 , validation_acc:0.6298701298701299
for gamma=10 and C=0.1 : train_acc: 0.6434782608695652 , validation_acc:0.6298701298701299
for gamma=10 and C=1 : train_acc: 1.0 , validation_acc:0.6298701298701299
for gamma=10 and C=10 : train_acc: 1.0 , validation_acc:0.6298701298701299
for gamma=10 and C=100 : train_acc: 1.0 , validation_acc:0.6298701298701299

for gamma=10 and C=1000 : train_acc: 1.0 , validation_acc:0.6298701298701299
for gamma=100 and C=0.0001 : train_acc: 0.6434782608695652 , validation_acc:0.6298701298701299
for gamma=100 and C=0.001 : train_acc: 0.6434782608695652 , validation_acc:0.6298701298701299
for gamma=100 and C=0.01 : train_acc: 0.6434782608695652 , validation_acc:0.6298701298701299
for gamma=100 and C=0.1 : train_acc: 0.6434782608695652 , validation_acc:0.6298701298701299
for gamma=100 and C=1 : train_acc: 1.0 , validation_acc:0.6298701298701299
for gamma=100 and C=10 : train_acc: 1.0 , validation_acc:0.6298701298701299
for gamma=100 and C=100 : train_acc: 1.0 , validation_acc:0.6298701298701299

```

```

for gamma=100 and C=1000 : train_acc: 1.0 , validation_acc:0.6298701298701299
for gamma=1000 and C=0.0001 : train_acc: 0.6434782608695652 , validation_acc:0.6298701298701299
for gamma=1000 and C=0.001 : train_acc: 0.6434782608695652 , validation_acc:0.6298701298701299
for gamma=1000 and C=0.01 : train_acc: 0.6434782608695652 , validation_acc:0.6298701298701299
for gamma=1000 and C=0.1 : train_acc: 0.6434782608695652 , validation_acc:0.6298701298701299
for gamma=1000 and C=1 : train_acc: 1.0 , validation_acc:0.6298701298701299
for gamma=1000 and C=10 : train_acc: 1.0 , validation_acc:0.6298701298701299
for gamma=1000 and C=100 : train_acc: 1.0 , validation_acc:0.6298701298701299
for gamma=1000 and C=1000 : train_acc: 1.0 , validation_acc:0.6298701298701299

```

**This search found this result for best C and gamma:**

**C = 10 and gamma=0.01**

train\_acc\_best\_C\_gamma: 0.7760869565217391 , best\_validation\_acc: 0.7792207792207793 ,  
best\_validation\_C\_RBF: 10 , best\_gamma\_RBF: 0.01

**Now search deeper for best C and gamma in best intervals:**

```

c = np.linspace(5,15,50)      # searching C in best interval
g = np.linspace(0.005,0.5,50) # searching gamma in best interval
best_validation_acc = 0
best_validation_C_RBF_new = 0
best_gamma_RBF_new = None
train_acc_best_C_gamma = 0
for j in g:
    for i in c:
        RBF_kernel = SVC(C=i , kernel='rbf' , gamma=j)
        RBF_kernel.fit(x_train, y_train)
        train_acc = RBF_kernel.score(x_train,y_train)
        validation_acc = RBF_kernel.score(x_validation,y_validation)
        if validation_acc > best_validation_acc:
            train_acc_best_C_gamma = train_acc
            best_validation_acc = validation_acc
            best_validation_C_RBF_new = i
            best_gamma_RBF_new = j
    print('for gamma={ } and C={ } : train_acc: { } , validation_acc:{ }'.format(j , i , train_acc , val
    idation_acc))
print('train_acc_best_C_gamma: { } , best_validation_acc: { } , best_validation_C_RBF_new:
{ } , best_gamma_RBF_new: { }'.format(train_acc_best_C_gamma,best_validation_acc,best_val
idation_C_RBF_new,best_gamma_RBF_new))

```

**searching for best C and gamma in best intervals:**

```

for gamma=0.005 and C=5.0 : train_acc: 0.7739130434782608 , validation_acc:0.7597402597402597
for gamma=0.005 and C=5.204081632653061 : train_acc: 0.7760869565217391 , validation_acc:0.7597402597402597
for gamma=0.005 and C=5.408163265306122 : train_acc: 0.7782608695652173 , validation_acc:0.7597402597402597
for gamma=0.005 and C=5.612244897959184 : train_acc: 0.7739130434782608 , validation_acc:0.7597402597402597
for gamma=0.005 and C=5.816326530612245 : train_acc: 0.7739130434782608 , validation_acc:0.7597402597402597
for gamma=0.005 and C=6.020408163265306 : train_acc: 0.7739130434782608 , validation_acc:0.7597402597402597
for gamma=0.005 and C=6.224489795918368 : train_acc: 0.7739130434782608 , validation_acc:0.7597402597402597
for gamma=0.005 and C=6.428571428571429 : train_acc: 0.7760869565217391 , validation_acc:0.7597402597402597
for gamma=0.005 and C=6.63265306122449 : train_acc: 0.7760869565217391 , validation_acc:0.7597402597402597
for gamma=0.005 and C=6.836734693877551 : train_acc: 0.7760869565217391 , validation_acc:0.7597402597402597

```

[illegible]



[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

for gamma=0.11612244897959184 and C=9.081632653061224	: train_acc: 0.8760869565217392 , validation_acc: 0.7727272727272727
for gamma=0.11612244897959184 and C=9.285714285714285	: train_acc: 0.8760869565217392 , validation_acc: 0.7727272727272727
for gamma=0.11612244897959184 and C=9.489795918367347	: train_acc: 0.8760869565217392 , validation_acc: 0.7792207792207793
for gamma=0.11612244897959184 and C=9.693877551020408	: train_acc: 0.8782608695652174 , validation_acc: 0.7792207792207793
for gamma=0.11612244897959184 and C=9.89795918367347	: train_acc: 0.8782608695652174 , validation_acc: 0.7857142857142857
for gamma=0.11612244897959184 and C=10.10204081632653	: train_acc: 0.8804347826086957 , validation_acc: 0.7857142857142857
for gamma=0.11612244897959184 and C=10.306122448979592	: train_acc: 0.8804347826086957 , validation_acc: 0.7857142857142857
for gamma=0.11612244897959184 and C=10.510204081632654	: train_acc: 0.8804347826086957 , validation_acc: 0.7857142857142857
for gamma=0.11612244897959184 and C=10.714285714285715	: train_acc: 0.8826086956521739 , validation_acc: 0.7857142857142857
for gamma=0.11612244897959184 and C=10.918337346938776	: train_acc: 0.8826086956521739 , validation_acc: 0.7857142857142857
for gamma=0.11612244897959184 and C=11.122448979591837	: train_acc: 0.8826086956521739 , validation_acc: 0.7792207792207793
for gamma=0.11612244897959184 and C=11.326530612244898	: train_acc: 0.8826086956521739 , validation_acc: 0.7792207792207793
for gamma=0.11612244897959184 and C=11.53061224489796	: train_acc: 0.8826086956521739 , validation_acc: 0.7792207792207793
for gamma=0.11612244897959184 and C=11.73469387755102	: train_acc: 0.8826086956521739 , validation_acc: 0.7727272727272727
for gamma=0.11612244897959184 and C=11.938775510204081	: train_acc: 0.8847826086956522 , validation_acc: 0.7727272727272727
for gamma=0.11612244897959184 and C=12.142857142857142	: train_acc: 0.8847826086956522 , validation_acc: 0.7727272727272727
for gamma=0.11612244897959184 and C=12.346938775510203	: train_acc: 0.8847826086956522 , validation_acc: 0.7727272727272727
for gamma=0.11612244897959184 and C=12.551020408163264	: train_acc: 0.8847826086956522 , validation_acc: 0.7727272727272727
for gamma=0.11612244897959184 and C=12.755102040816327	: train_acc: 0.8847826086956522 , validation_acc: 0.7727272727272727
for gamma=0.11612244897959184 and C=12.959183673469388	: train_acc: 0.8869565217391304 , validation_acc: 0.7792207792207793
for gamma=0.11612244897959184 and C=13.16326530612245	: train_acc: 0.8891304347826087 , validation_acc: 0.7792207792207793
for gamma=0.11612244897959184 and C=13.36734693877551	: train_acc: 0.8913043478260869 , validation_acc: 0.7792207792207793
for gamma=0.11612244897959184 and C=13.571428571428571	: train_acc: 0.8913043478260869 , validation_acc: 0.7857142857142857
for gamma=0.11612244897959184 and C=13.775510204081632	: train_acc: 0.8913043478260869 , validation_acc: 0.7857142857142857
for gamma=0.11612244897959184 and C=13.979591836734695	: train_acc: 0.8913043478260869 , validation_acc: 0.7857142857142857
for gamma=0.11612244897959184 and C=14.183673469387756	: train_acc: 0.8913043478260869 , validation_acc: 0.7857142857142857
for gamma=0.11612244897959184 and C=14.387755102040817	: train_acc: 0.8913043478260869 , validation_acc: 0.7857142857142857
for gamma=0.11612244897959184 and C=14.591836734693878	: train_acc: 0.8913043478260869 , validation_acc: 0.7857142857142857
for gamma=0.11612244897959184 and C=14.795918367346939	: train_acc: 0.8913043478260869 , validation_acc: 0.7857142857142857
for gamma=0.11612244897959184 and C=15.0	: train_acc: 0.8913043478260869 , validation_acc: 0.7857142857142857
for gamma=0.12622448979591835 and C=5.0	: train_acc: 0.8652173913043478 , validation_acc: 0.7727272727272727
for gamma=0.12622448979591835 and C=5.204081632653061	: train_acc: 0.8652173913043478 , validation_acc: 0.7662337662337663
for gamma=0.12622448979591835 and C=5.408163265306122	: train_acc: 0.8673913043478261 , validation_acc: 0.7662337662337663
for gamma=0.12622448979591835 and C=5.612244897959184	: train_acc: 0.8695652173913043 , validation_acc: 0.7597402597402597
for gamma=0.12622448979591835 and C=5.816326530612245	: train_acc: 0.8695652173913043 , validation_acc: 0.7597402597402597
for gamma=0.12622448979591835 and C=6.020408163265306	: train_acc: 0.8695652173913043 , validation_acc: 0.7662337662337663
for gamma=0.12622448979591835 and C=6.224489795918368	: train_acc: 0.8717391304347826 , validation_acc: 0.7662337662337663
for gamma=0.12622448979591835 and C=6.428571428571429	: train_acc: 0.8717391304347826 , validation_acc: 0.7727272727272727
for gamma=0.12622448979591835 and C=6.63265306122449	: train_acc: 0.8717391304347826 , validation_acc: 0.7727272727272727
for gamma=0.12622448979591835 and C=6.836734693877551	: train_acc: 0.8717391304347826 , validation_acc: 0.7727272727272727
for gamma=0.12622448979591835 and C=7.040816326530612	: train_acc: 0.8739130



[illegible]

[illegible]

for gamma=0.15653061224489795 and C=11.122448979591837	: train_acc: 0.8978260869565218 , validation_acc: 0.7792207792207793
for gamma=0.15653061224489795 and C=11.326530612244898	: train_acc: 0.9 , validation_acc: 0.7727272727272727
for gamma=0.15653061224489795 and C=11.5306122448979	: train_acc: 0.9 , validation_acc: 0.7727272727272727
for gamma=0.15653061224489795 and C=11.73469387755102	: train_acc: 0.9 , validation_acc: 0.7727272727272727
for gamma=0.15653061224489795 and C=11.938775510204081	: train_acc: 0.9 , validation_acc: 0.7727272727272727
for gamma=0.15653061224489795 and C=12.142857142857142	: train_acc: 0.9 , validation_acc: 0.7727272727272727
for gamma=0.15653061224489795 and C=12.346938775510203	: train_acc: 0.9 , validation_acc: 0.7662337662337663
for gamma=0.15653061224489795 and C=12.551020408163264	: train_acc: 0.9 , validation_acc: 0.7662337662337663
for gamma=0.15653061224489795 and C=12.755102040816327	: train_acc: 0.9 , validation_acc: 0.7597402597402597
for gamma=0.15653061224489795 and C=12.959183673469388	: train_acc: 0.9 , validation_acc: 0.7597402597402597
for gamma=0.15653061224489795 and C=13.16326530612245	: train_acc: 0.9 , validation_acc: 0.7597402597402597
for gamma=0.15653061224489795 and C=13.36734693877551	: train_acc: 0.9 , validation_acc: 0.7597402597402597
for gamma=0.15653061224489795 and C=13.571428571428571	: train_acc: 0.9021739130434783 , validation_acc: 0.7597402597402597
for gamma=0.15653061224489795 and C=13.775510204081632	: train_acc: 0.9021739130434783 , validation_acc: 0.7597402597402597
for gamma=0.15653061224489795 and C=13.979591836734695	: train_acc: 0.9021739130434783 , validation_acc: 0.7597402597402597
for gamma=0.15653061224489795 and C=14.183673469387756	: train_acc: 0.9021739130434783 , validation_acc: 0.7467532467532467
for gamma=0.15653061224489795 and C=14.387755102040817	: train_acc: 0.9021739130434783 , validation_acc: 0.7467532467532467
for gamma=0.15653061224489795 and C=14.591836734693878	: train_acc: 0.9021739130434783 , validation_acc: 0.7467532467532467
for gamma=0.15653061224489795 and C=14.795918367346939	: train_acc: 0.9021739130434783 , validation_acc: 0.7467532467532467
for gamma=0.15653061224489795 and C=15.0 : train_acc:	0.9 , validation_acc: 0.7467532467532467
for gamma=0.1666326530612245 and C=5.0 : train_acc:	0.8826086956521739 , validation_acc: 0.7792207792207793
for gamma=0.1666326530612245 and C=5.204081632653061	: train_acc: 0.8847826086956522 , validation_acc: 0.7792207792207793
for gamma=0.1666326530612245 and C=5.408163265306122	: train_acc: 0.8869565217391304 , validation_acc: 0.7792207792207793
for gamma=0.1666326530612245 and C=5.612248979591837	: train_acc: 0.8913043478260869 , validation_acc: 0.7792207792207793
for gamma=0.1666326530612245 and C=5.816326530612245	: train_acc: 0.8934782608695652 , validation_acc: 0.7857142857142857
for gamma=0.1666326530612245 and C=6.020408163265306	: train_acc: 0.8934782608695652 , validation_acc: 0.7857142857142857
for gamma=0.1666326530612245 and C=6.224489795918368	: train_acc: 0.8956521739130435 , validation_acc: 0.7857142857142857
for gamma=0.1666326530612245 and C=6.428571428571429	: train_acc: 0.8978260869565218 , validation_acc: 0.7922077922077922
for gamma=0.1666326530612245 and C=6.63265306122449	: train_acc: 0.8978260869565218 , validation_acc: 0.7922077922077922
for gamma=0.1666326530612245 and C=6.836734693877551	: train_acc: 0.8978260869565218 , validation_acc: 0.7922077922077922
for gamma=0.1666326530612245 and C=7.040816326530612	: train_acc: 0.8978260869565218 , validation_acc: 0.7922077922077922
for gamma=0.1666326530612245 and C=7.244897959183674	: train_acc: 0.9 , validation_acc: 0.7857142857142857
for gamma=0.1666326530612245 and C=7.448979591836735	: train_acc: 0.8978260869565218 , validation_acc: 0.7857142857142857
for gamma=0.1666326530612245 and C=7.653061224489796	: train_acc: 0.8978260869565218 , validation_acc: 0.7857142857142857
for gamma=0.1666326530612245 and C=7.857142857142858	: train_acc: 0.8978260869565218 , validation_acc: 0.7857142857142857
for gamma=0.1666326530612245 and C=8.061224489795919	: train_acc: 0.8978260869565218 , validation_acc: 0.7857142857142857
for gamma=0.1666326530612245 and C=8.26530612244898	: train_acc: 0.8978260869565218 , validation_acc: 0.7857142857142857
for gamma=0.1666326530612245 and C=8.46938775510204	: train_acc: 0.8978260869565218 , validation_acc: 0.7857142857142857
for gamma=0.1666326530612245 and C=8.673469387755102	: train_acc: 0.8978260869565218 , validation_acc: 0.7857142857142857
for gamma=0.1666326530612245 and C=8.877551020408163	: train_acc: 0.8978260869565218 , validation_acc: 0.7857142857142857
for gamma=0.1666326530612245 and C=9.081632653061224	: train_acc: 0.8978260869565218 , validation_acc: 0.7857142857142857
for gamma=0.1666326530612245 and C=9.285714285714285	: train_acc: 0.8978260869565218 , validation_acc: 0.7857142857142857
for gamma=0.1666326530612245 and C=9.489795918367347	: train_acc: 0.8978260869565218 , validation_acc: 0.77922

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for gamma=0.18683673469387754 and C=9.081632653061224	: train_acc: 0.9043478260869565 , validation_acc: 0.7727272727272727
for gamma=0.18683673469387754 and C=9.285714285714285	: train_acc: 0.9043478260869565 , validation_acc: 0.7727272727272727
for gamma=0.18683673469387754 and C=9.489795918367347	: train_acc: 0.9043478260869565 , validation_acc: 0.75797402597402597
for gamma=0.18683673469387754 and C=9.693877551020408	: train_acc: 0.9043478260869565 , validation_acc: 0.75797402597402597
for gamma=0.18683673469387754 and C=9.89795918367347	: train_acc: 0.9043478260869565 , validation_acc: 0.7467532467532467
for gamma=0.18683673469387754 and C=10.10204081632653	: train_acc: 0.9043478260869565 , validation_acc: 0.7467532467532467
for gamma=0.18683673469387754 and C=10.306122448979592	: train_acc: 0.9043478260869565 , validation_acc: 0.7467532467532467
for gamma=0.18683673469387754 and C=10.510204081632654	: train_acc: 0.9043478260869565 , validation_acc: 0.7467532467532467
for gamma=0.18683673469387754 and C=10.714285714285715	: train_acc: 0.9130434782608695 , validation_acc: 0.7467532467532467
for gamma=0.18683673469387754 and C=10.918367346938776	: train_acc: 0.9130434782608695 , validation_acc: 0.7467532467532467
for gamma=0.18683673469387754 and C=11.122448979591837	: train_acc: 0.9130434782608695 , validation_acc: 0.7467532467532467
for gamma=0.18683673469387754 and C=11.326530612244898	: train_acc: 0.9130434782608695 , validation_acc: 0.7467532467532467
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for gamma=0.18683673469387754 and C=11.73469387755102	: train_acc: 0.9130434782608695 , validation_acc: 0.7467532467532467
for gamma=0.18683673469387754 and C=11.938775510204081	: train_acc: 0.9130434782608695 , validation_acc: 0.7467532467532467
for gamma=0.18683673469387754 and C=12.142857142857142	: train_acc: 0.9152173913043479 , validation_acc: 0.7402597402597403
for gamma=0.18683673469387754 and C=12.346938775510203	: train_acc: 0.9173913043478261 , validation_acc: 0.7402597402597403
for gamma=0.18683673469387754 and C=12.551020408163264	: train_acc: 0.9195652173913044 , validation_acc: 0.7402597402597403
for gamma=0.18683673469387754 and C=12.755102040816327	: train_acc: 0.9217391304347826 , validation_acc: 0.7402597402597403
for gamma=0.18683673469387754 and C=12.959183673469388	: train_acc: 0.9217391304347826 , validation_acc: 0.7402597402597403
for gamma=0.18683673469387754 and C=13.16326530612245	: train_acc: 0.9239130434782609 , validation_acc: 0.7467532467532467
for gamma=0.18683673469387754 and C=13.36734693877551	: train_acc: 0.9239130434782609 , validation_acc: 0.7467532467532467
for gamma=0.18683673469387754 and C=13.571428571428571	: train_acc: 0.9260869565217391 , validation_acc: 0.7467532467532467
for gamma=0.18683673469387754 and C=13.775510204081632	: train_acc: 0.9282608695652174 , validation_acc: 0.7467532467532467
for gamma=0.18683673469387754 and C=13.979591836734695	: train_acc: 0.9282608695652174 , validation_acc: 0.7467532467532467
for gamma=0.18683673469387754 and C=14.183673469387756	: train_acc: 0.9282608695652174 , validation_acc: 0.7402597402597403
for gamma=0.18683673469387754 and C=14.387755102040817	: train_acc: 0.9304347826086956 , validation_acc: 0.7402597402597403
for gamma=0.18683673469387754 and C=14.591836734693878	: train_acc: 0.9304347826086956 , validation_acc: 0.7402597402597403
for gamma=0.18683673469387754 and C=14.795918367346939	: train_acc: 0.9304347826086956 , validation_acc: 0.7402597402597403
for gamma=0.18683673469387754 and C=15.0	: train_acc: 0.9304347826086956 , validation_acc: 0.7402597402597403
for gamma=0.19693877551020408 and C=5.0	: train_acc: 0.8978260869565218 , validation_acc: 0.7922077922077922
for gamma=0.19693877551020408 and C=5.204081632653061	: train_acc: 0.9 , validation_acc: 0.7922077922077922
for gamma=0.19693877551020408 and C=5.408163265306122	: train_acc: 0.9 , validation_acc: 0.7922077922077922
for gamma=0.19693877551020408 and C=5.612244897959184	: train_acc: 0.9 , validation_acc: 0.7922077922077922
for gamma=0.19693877551020408 and C=5.816326530612245	: train_acc: 0.9 , validation_acc: 0.7922077922077922
for gamma=0.19693877551020408 and C=6.020408163265306	: train_acc: 0.9 , validation_acc: 0.7857142857142857
for gamma=0.19693877551020408 and C=6.224489795918368	: train_acc: 0.9021739130434783 , validation_acc: 0.7857142857142857
for gamma=0.19693877551020408 and C=6.428571428571429	: train_acc: 0.9021739130434783 , validation_acc: 0.7857142857142857
for gamma=0.19693877551020408 and C=6.63265306122449	: train_acc: 0.9021739130434783 , validation_acc: 0.7857142857142857
for gamma=0.19693877551020408 and C=6.836734693877551	: train_acc: 0.9043478260869565 , validation_acc: 0.7792207792207793
for gamma=0.19693877551020408 and C=7.040816326530612	: train_acc: 0.9043478260869565 , validation_acc: 0.7792207792207793
for gamma=0.19693877551020408 and C=7.24489	

for gamma=0.19693877551020408 and C=13.16326530612245 : train\_acc: 0.9304347826086956 , validation\_acc: 0.7402597402597403  
for gamma=0.19693877551020408 and C=13.36734693877551 : train\_acc: 0.9304347826086956 , validation\_acc: 0.7337662337662337  
for gamma=0.19693877551020408 and C=13.571428571428571 : train\_acc: 0.9304347826086956 , validation\_acc: 0.7402597402597403  
for gamma=0.19693877551020408 and C=13.775510204081632 : train\_acc: 0.9326086956521739 , validation\_acc: 0.7402597402597403  
for gamma=0.19693877551020408 and C=13.979591836734695 : train\_acc: 0.9326086956521739 , validation\_acc: 0.7402597402597403  
for gamma=0.19693877551020408 and C=14.183673469387756 : train\_acc: 0.9326086956521739 , validation\_acc: 0.7402597402597403  
for gamma=0.19693877551020408 and C=14.387755102040817 : train\_acc: 0.9326086956521739 , validation\_acc: 0.7402597402597403  
for gamma=0.19693877551020408 and C=14.591836734693878 : train\_acc: 0.9326086956521739 , validation\_acc: 0.7402597402597403  
for gamma=0.19693877551020408 and C=14.795918367346939 : train\_acc: 0.9347826086956522 , validation\_acc: 0.7337662337662337  
for gamma=0.19693877551020408 and C=15.0 : train\_acc: 0.9347826086956522 , validation\_acc: 0.7337662337662337  
for gamma=0.2070408163265306 and C=5.0 : train\_acc: 0.9021739130434783 , validation\_acc: 0.7922077922077922  
for gamma=0.2070408163265306 and C=5.204081632653061 : train\_acc: 0.9021739130434783 , validation\_acc: 0.7922077922077922  
for gamma=0.2070408163265306 and C=5.408163265306122 : train\_acc: 0.9021739130434783 , validation\_acc: 0.7922077922077922  
for gamma=0.2070408163265306 and C=5.612244897959184 : train\_acc: 0.9021739130434783 , validation\_acc: 0.7857142857142857  
for gamma=0.2070408163265306 and C=5.816326530612245 : train\_acc: 0.9021739130434783 , validation\_acc: 0.7857142857142857  
for gamma=0.2070408163265306 and C=6.020408163265306 : train\_acc: 0.9043478260869565 , validation\_acc: 0.7792207792207793  
for gamma=0.2070408163265306 and C=6.224489795918368 : train\_acc: 0.9043478260869565 , validation\_acc: 0.7792207792207793  
for gamma=0.2070408163265306 and C=6.428571428571429 : train\_acc: 0.9043478260869565 , validation\_acc: 0.7792207792207793  
for gamma=0.2070408163265306 and C=6.63265306122449 : train\_acc: 0.9043478260869565 , validation\_acc: 0.7792207792207793  
for gamma=0.2070408163265306 and C=6.836734693877551 : train\_acc: 0.9065217391304348 , validation\_acc: 0.7727272727272727  
for gamma=0.2070408163265306 and C=7.040816326530612 : train\_acc: 0.9065217391304348 , validation\_acc: 0.7727272727272727  
for gamma=0.2070408163265306 and C=7.244897959183674 : train\_acc: 0.9065217391304348 , validation\_acc: 0.7727272727272727  
for gamma=0.2070408163265306 and C=7.448979591836735 : train\_acc: 0.9065217391304348 , validation\_acc: 0.7662337662337663  
for gamma=0.2070408163265306 and C=7.653061224489796 : train\_acc: 0.9065217391304348 , validation\_acc: 0.7662337662337663  
for gamma=0.2070408163265306 and C=7.857142857142858 : train\_acc: 0.908695652173913 , validation\_acc: 0.7662337662337663  
for gamma=0.2070408163265306 and C=8.061224489795919 : train\_acc: 0.908695652173913 , validation\_acc: 0.7597402597402597  
for gamma=0.2070408163265306 and C=8.26530612244898 : train\_acc: 0.908695652173913 , validation\_acc: 0.7532467532467533  
for gamma=0.2070408163265306 and C=8.46938775510204 : train\_acc: 0.908695652173913 , validation\_acc: 0.7467532467532467  
for gamma=0.2070408163265306 and C=8.673469387755102 : train\_acc: 0.9108695652173913 , validation\_acc: 0.7467532467532467  
for gamma=0.2070408163265306 and C=8.877551020408163 : train\_acc: 0.9152173913043479 , validation\_acc: 0.7467532467532467  
for gamma=0.2070408163265306 and C=9.081632653061224 : train\_acc: 0.9152173913043479 , validation\_acc: 0.7402597402597403  
for gamma=0.2070408163265306 and C=9.285714285714285 : train\_acc: 0.9152173913043479 , validation\_acc: 0.7402597402597403  
for gamma=0.2070408163265306 and C=9.489795918367347 : train\_acc: 0.9152173913043479 , validation\_acc: 0.7402597402597403  
for gamma=0.2070408163265306 and C=9.693877551020408 : train\_acc: 0.9152173913043479 , validation\_acc: 0.7402597402597403  
for gamma=0.2070408163265306 and C=9.89795918367347 : train\_acc: 0.9195652173913044 , validation\_acc: 0.7402597402597403  
for gamma=0.2070408163265306 and C=10.10204081632653 : train\_acc: 0.9239130434782609 , validation\_acc: 0.7337662337662337  
for gamma=0.2070408163265306 and C=10.306122448979592 : train\_acc: 0.9260869565217391 , validation\_acc: 0.7402597402597403  
for gamma=0.2070408163265306 and C=10.510204081632654 : train\_acc: 0.9282608695652174 , validation\_acc: 0.7402597402597403  
for gamma=0.2070408163265306 and C=10.714285714285715 : train\_acc: 0.9282608695652174 , validation\_acc: 0.7402597402597403  
for gamma=0.2070408163265306 and C=10.918367346938776 : train\_acc: 0.9282608695652174 , validation\_acc: 0.7402597402597403  
for gamma=0.2070408163265306 and C=11.122448979591837 : train\_acc: 0.9282608695652174 , validation\_acc: 0.7402597402597403  
for gamma=0.2070408163265306 and C=11.326530612244898 : train\_acc: 0.9282608695652174 , validation\_acc: 0.7402597402597403  
for gamma=0.2070408163265306 and C=11.53061224489796 : train\_acc: 0.9304347826086956 , validation\_acc: 0.7402597402597403  
for gamma=0.2070408163265306 and C=11.73469387755102 : train\_acc: 0.9304347826086956 , validation\_acc: 0.7402597402597403  
for gamma=0.2070408163265306 and C=11.938775510204081 : train\_acc: 0.9304347826086956 , validation\_acc: 0.7402597402597403  
for gamma=0.2070408163265306 and C=12.142857142857142 : train\_acc: 0.9326086956521739 , validation\_acc: 0.7467532467532467  
for gamma=0.20704

for gamma=0.21714285714285714 and C=7.040816326530612	: train_acc: 0.908695652173913 , validation_acc: 0.7662337662337663
for gamma=0.21714285714285714 and C=7.244897959183674	: train_acc: 0.908695652173913 , validation_acc: 0.7662337662337663
for gamma=0.21714285714285714 and C=7.448979591836735	: train_acc: 0.908695652173913 , validation_acc: 0.7532467532467533
for gamma=0.21714285714285714 and C=7.653061224489796	: train_acc: 0.908695652173913 , validation_acc: 0.7532467532467533
for gamma=0.21714285714285714 and C=7.857142857142858	: train_acc: 0.9108695652173913 , validation_acc: 0.7402597402597403
for gamma=0.21714285714285714 and C=8.061224489795919	: train_acc: 0.9152173913043479 , validation_acc: 0.7402597402597403
for gamma=0.21714285714285714 and C=8.26530612244898	: train_acc: 0.9173913043478261 , validation_acc: 0.7402597402597403
for gamma=0.21714285714285714 and C=8.46938775510204	: train_acc: 0.9173913043478261 , validation_acc: 0.7402597402597403
for gamma=0.21714285714285714 and C=8.673469387755102	: train_acc: 0.9173913043478261 , validation_acc: 0.7402597402597403
for gamma=0.21714285714285714 and C=8.877551020408163	: train_acc: 0.9217391304347826 , validation_acc: 0.7402597402597403
for gamma=0.21714285714285714 and C=9.081632653061224	: train_acc: 0.9260869565217391 , validation_acc: 0.7467532467532467
for gamma=0.21714285714285714 and C=9.285714285714285	: train_acc: 0.9304347826086956 , validation_acc: 0.7467532467532467
for gamma=0.21714285714285714 and C=9.489795918367347	: train_acc: 0.9304347826086956 , validation_acc: 0.7402597402597403
for gamma=0.21714285714285714 and C=9.693877551020408	: train_acc: 0.9282608695652174 , validation_acc: 0.7402597402597403
for gamma=0.21714285714285714 and C=9.89795918367347	: train_acc: 0.9282608695652174 , validation_acc: 0.7402597402597403
for gamma=0.21714285714285714 and C=10.10204081632653	: train_acc: 0.9282608695652174 , validation_acc: 0.7402597402597403
for gamma=0.21714285714285714 and C=10.306122448979592	: train_acc: 0.9304347826086956 , validation_acc: 0.7402597402597403
for gamma=0.21714285714285714 and C=10.510204081632654	: train_acc: 0.9304347826086956 , validation_acc: 0.7402597402597403
for gamma=0.21714285714285714 and C=10.714285714285715	: train_acc: 0.9326086956521739 , validation_acc: 0.7402597402597403
for gamma=0.21714285714285714 and C=10.918367346938776	: train_acc: 0.9326086956521739 , validation_acc: 0.7402597402597403
for gamma=0.21714285714285714 and C=11.122448979591837	: train_acc: 0.9326086956521739 , validation_acc: 0.7402597402597403
for gamma=0.21714285714285714 and C=11.326530612244898	: train_acc: 0.9326086956521739 , validation_acc: 0.7402597402597403
for gamma=0.21714285714285714 and C=11.53061224489796	: train_acc: 0.9347826086956522 , validation_acc: 0.7402597402597403
for gamma=0.21714285714285714 and C=11.73469387755102	: train_acc: 0.9347826086956522 , validation_acc: 0.7402597402597403
for gamma=0.21714285714285714 and C=11.938775510204081	: train_acc: 0.9369565217391305 , validation_acc: 0.7402597402597403
for gamma=0.21714285714285714 and C=12.142857142857142	: train_acc: 0.9391304347826087 , validation_acc: 0.7467532467532467
for gamma=0.21714285714285714 and C=12.346938775510203	: train_acc: 0.941304347826087 , validation_acc: 0.7532467532467533
for gamma=0.21714285714285714 and C=12.551020408163264	: train_acc: 0.9434782608695652 , validation_acc: 0.7467532467532467
for gamma=0.21714285714285714 and C=12.755102040816327	: train_acc: 0.9434782608695652 , validation_acc: 0.7467532467532467
for gamma=0.21714285714285714 and C=12.959183673469388	: train_acc: 0.9434782608695652 , validation_acc: 0.7467532467532467
for gamma=0.21714285714285714 and C=13.163265306122445	: train_acc: 0.9434782608695652 , validation_acc: 0.7467532467532467
for gamma=0.21714285714285714 and C=13.36734693877551	: train_acc: 0.9434782608695652 , validation_acc: 0.7467532467532467
for gamma=0.21714285714285714 and C=13.571428571428571	: train_acc: 0.9434782608695652 , validation_acc: 0.7467532467532467
for gamma=0.21714285714285714 and C=13.775510204081632	: train_acc: 0.9434782608695652 , validation_acc: 0.7467532467532467
for gamma=0.21714285714285714 and C=13.979591836734695	: train_acc: 0.9434782608695652 , validation_acc: 0.7467532467532467
for gamma=0.21714285714285714 and C=14.183673469387756	: train_acc: 0.9434782608695652 , validation_acc: 0.7532467532467533
for gamma=0.21714285714285714 and C=14.387755102040817	: train_acc: 0.9434782608695652 , validation_acc: 0.7532467532467533
for gamma=0.21714285714285714 and C=14.591836734693878	: train_acc: 0.9478260869565217 , validation_acc: 0.7532467532467533
for gamma=0.21714285714285714 and C=14.795918367346939	: train_acc: 0.95 , validation_acc: 0.7467532467532467
for gamma=0.21714285714285714 and C=15.0	: train_acc: 0.9521739130434783 , validation_acc: 0.7467532467532467
for gamma=0.22724489795918368 and C=5.0	: train_acc: 0.9043478260869565 , validation_acc: 0.772

for gamma=0.22724489795918368 and C=11.122448979591837	: train_acc: 0.9434782608695652 , validation_acc:0.7467532467532467
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for gamma=0.22724489795918368 and C=12.959183673469388	: train_acc: 0.9456521739130435 , validation_acc:0.7467532467532467
for gamma=0.22724489795918368 and C=13.16326530612245	: train_acc: 0.9478260869565217 , validation_acc:0.7467532467532467
for gamma=0.22724489795918368 and C=13.36734693877551	: train_acc: 0.95 , validation_acc:0.7467532467532467
for gamma=0.22724489795918368 and C=13.571428571428571	: train_acc: 0.9521739130434783 , validation_acc:0.7532467532467533
for gamma=0.22724489795918368 and C=13.775510204081632	: train_acc: 0.9521739130434783 , validation_acc:0.7467532467532467
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for gamma=0.22724489795918368 and C=14.183673469387756	: train_acc: 0.9521739130434783 , validation_acc:0.7402597402597403
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for gamma=0.22724489795918368 and C=15.0 : train_acc: 0.9521739130434783 , validation_acc:0.7402597402597403	
for gamma=0.2373469387755102 and C=5.0 : train_acc: 0.908695652173913 , validation_acc:0.7662337662337663	
for gamma=0.2373469387755102 and C=5.204081632653061	: train_acc: 0.908695652173913 , validation_acc:0.7662337662337663
for gamma=0.2373469387755102 and C=5.408163265306122	: train_acc: 0.908695652173913 , validation_acc:0.7662337662337663
for gamma=0.2373469387755102 and C=5.61224897959184	: train_acc: 0.9108695652173913 , validation_acc:0.7662337662337663
for gamma=0.2373469387755102 and C=5.816326530612245	: train_acc: 0.908695652173913 , validation_acc:0.7597402597402597
for gamma=0.2373469387755102 and C=6.020408163265306	: train_acc: 0.908695652173913 , validation_acc:0.7597402597402597
for gamma=0.2373469387755102 and C=6.224489795918368	: train_acc: 0.908695652173913 , validation_acc:0.7597402597402597
for gamma=0.2373469387755102 and C=6.428571428571429	: train_acc: 0.9130434782608695 , validation_acc:0.7402597402597403
for gamma=0.2373469387755102 and C=6.63265306122449	: train_acc: 0.9130434782608695 , validation_acc:0.7402597402597403
for gamma=0.2373469387755102 and C=6.836734693877551	: train_acc: 0.9152173913043479 , validation_acc:0.7402597402597403
for gamma=0.2373469387755102 and C=7.040816326530612	: train_acc: 0.9173913043478261 , validation_acc:0.7402597402597403
for gamma=0.2373469387755102 and C=7.244897959183674	: train_acc: 0.9239130434782609 , validation_acc:0.7467532467532467
for gamma=0.2373469387755102 and C=7.448979591836735	: train_acc: 0.9260869565217391 , validation_acc:0.7467532467532467
for gamma=0.2373469387755102 and C=7.653061224489796	: train_acc: 0.9304347826086956 , validation_acc:0.7467532467532467
for gamma=0.2373469387755102 and C=7.857142857142858	: train_acc: 0.9304347826086956 , validation_acc:0.7467532467532467
for gamma=0.2373469387755102 and C=8.061224489795919	: train_acc: 0.9326086956521739 , validation_acc:0.7467532467532467
for gamma=0.2373469387755102 and C=8.26530612244898	: train_acc: 0.9326086956521739 , validation_acc:0.7467532467532467
for gamma=0.2373469387755102 and C=8.46938775510204	: train_acc: 0.9326086956521739 , validation_acc:0.7467532467532467
for gamma=0.2373469387755102 and C=8.673469387755102	: train_acc: 0.9347826086956522 , validation_acc:0.7467532467532467
for gamma=0.2373469387755102 and C=8.877551020408163	: train_acc: 0.9369565217391305 , validation_acc:0.7467532467532467
for gamma=0.2373469387755102 and C=9.081632653061224	: train_acc: 0.9369565217391305 , validation_acc:0.7467532467532467
for gamma=0.2373469387755102 and C=9.285714285714285	: train



[illegible]

for gamma=0.25755102040816324 and C=9.081632653061224	: train_acc: 0.9456521739130435 , validation_acc: 0.7532467532467533
for gamma=0.25755102040816324 and C=9.285714285714285	: train_acc: 0.9478260869565217 , validation_acc: 0.7467532467532467
for gamma=0.25755102040816324 and C=9.489795918367347	: train_acc: 0.9456521739130435 , validation_acc: 0.7467532467532467
for gamma=0.25755102040816324 and C=9.69877551020408	: train_acc: 0.9478260869565217 , validation_acc: 0.7467532467532467
for gamma=0.25755102040816324 and C=9.89795918367347	: train_acc: 0.9478260869565217 , validation_acc: 0.7467532467532467
for gamma=0.25755102040816324 and C=10.10204081632653	: train_acc: 0.95 , validation_acc: 0.7467532467532467
for gamma=0.25755102040816324 and C=10.306122448979592	: train_acc: 0.95 , validation_acc: 0.7467532467532467
for gamma=0.25755102040816324 and C=10.510204081632654	: train_acc: 0.9521739130434783 , validation_acc: 0.7467532467532467
for gamma=0.25755102040816324 and C=10.714285714285715	: train_acc: 0.9521739130434783 , validation_acc: 0.7467532467532467
for gamma=0.25755102040816324 and C=10.918367346938776	: train_acc: 0.9521739130434783 , validation_acc: 0.7467532467532467
for gamma=0.25755102040816324 and C=11.122448979591837	: train_acc: 0.9521739130434783 , validation_acc: 0.7402597402597403
for gamma=0.25755102040816324 and C=11.326530612244898	: train_acc: 0.9521739130434783 , validation_acc: 0.7337662337662337
for gamma=0.25755102040816324 and C=11.53061224489796	: train_acc: 0.9521739130434783 , validation_acc: 0.7337662337662337
for gamma=0.25755102040816324 and C=11.73469387755102	: train_acc: 0.9521739130434783 , validation_acc: 0.7337662337662337
for gamma=0.25755102040816324 and C=11.938775510204081	: train_acc: 0.9521739130434783 , validation_acc: 0.7337662337662337
for gamma=0.25755102040816324 and C=12.142857142857142	: train_acc: 0.9521739130434783 , validation_acc: 0.7337662337662337
for gamma=0.25755102040816324 and C=12.346938775510203	: train_acc: 0.9521739130434783 , validation_acc: 0.7337662337662337
for gamma=0.25755102040816324 and C=12.551020408163264	: train_acc: 0.9521739130434783 , validation_acc: 0.7337662337662337
for gamma=0.25755102040816324 and C=12.755102040816327	: train_acc: 0.9521739130434783 , validation_acc: 0.7337662337662337
for gamma=0.25755102040816324 and C=12.959183673469388	: train_acc: 0.9521739130434783 , validation_acc: 0.7337662337662337
for gamma=0.25755102040816324 and C=13.16326530612245	: train_acc: 0.95 , validation_acc: 0.7337662337662337
for gamma=0.25755102040816324 and C=13.36734693877551	: train_acc: 0.9521739130434783 , validation_acc: 0.7337662337662337
for gamma=0.25755102040816324 and C=13.571428571428571	: train_acc: 0.9521739130434783 , validation_acc: 0.7337662337662337
for gamma=0.25755102040816324 and C=13.775510204081632	: train_acc: 0.9521739130434783 , validation_acc: 0.7272727272727273
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for gamma=0.25755102040816324 and C=14.183673469387756	: train_acc: 0.9521739130434783 , validation_acc: 0.7272727272727273
for gamma=0.25755102040816324 and C=14.387755102040817	: train_acc: 0.9521739130434783 , validation_acc: 0.7272727272727273
for gamma=0.25755102040816324 and C=14.591836734693878	: train_acc: 0.9543478260869566 , validation_acc: 0.7337662337662337
for gamma=0.25755102040816324 and C=14.795918367346939	: train_acc: 0.9565217391304348 , validation_acc: 0.7402597402597403
for gamma=0.25755102040816324 and C=15.0	: train_acc: 0.9565217391304348 , validation_acc: 0.7402597402597403
for gamma=0.2676530612244898 and C=5.0	: train_acc: 0.9152173913043479 , validation_acc: 0.7662337662337663
for gamma=0.2676530612244898 and C=5.204081632653061	: train_acc: 0.9152173913043479 , validation_acc: 0.7532467532467533
for gamma=0.2676530612244898 and C=5.408163265306122	: train_acc: 0.9195652173913044 , validation_acc: 0.7467532467532467
for gamma=0.2676530612244898 and C=5.612244897959184	: train_acc: 0.9239130434782609 , validation_acc: 0.7532467532467533
for gamma=0.2676530612244898 and C=5.816326530612245	: train_acc: 0.9260869565217391 , validation_acc: 0.7402597402597403
for gamma=0.2676530612244898 and C=6.020408163265306	: train_acc: 0.9282608695652174 , validation_acc: 0.7402597402597403
for gamma=0.2676530612244898 and C=6.224489795918368	: train_acc: 0.9304347826086956 , validation_acc: 0.7402597402597403
for gamma=0.2676530612244898 and C=6.428571428571429	: train_acc: 0.9304347826086956 , validation_acc: 0.7467532467532467
for gamma=0.2676530612244898 and C=6.63265306122449	: train_acc: 0.9326086956521739 , validation_acc: 0.7467532467532467
for gamma=0.26765306	

for gamma=0.2676530612244898 and C=1.16326530612245 : train\_acc: 0.9521739130434783, validation\_acc: 0.7272727272727273  
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for gamma=0.2777551020408163 and C=5.408163265306122 : train\_acc: 0.9260869565217391, validation\_acc: 0.7532467532467533  
for gamma=0.2777551020408163 and C=5.612244897959184 : train\_acc: 0.9282608695652174, validation\_acc: 0.7532467532467533  
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for gamma=0.2777551020408163 and C=6.63265306122449 : train\_acc: 0.941304347826087, validation\_acc: 0.7532467532467533  
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for gamma=0.2777551020408163 and C=8.061224489795919 : train\_acc: 0.9478260869565217, validation\_acc: 0.7532467532467533  
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for gamma=0.2777551020408163 and C=8.46938775510204 : train\_acc: 0.95, validation\_acc: 0.7467532467532467  
for gamma=0.2777551020408163 and C=8.673469387755102 : train\_acc: 0.9521739130434783, validation\_acc: 0.7467532467532467  
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for gamma=0.2777551020408163 and C=10.918367346938776 : train\_acc: 0.9521739130434783, validation\_acc: 0.7337662337662337  
for gamma=0.2777551020408163 and C=11.122448979591837 : train\_acc: 0.95, validation\_acc: 0.7337662337662337  
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for gamma=0.27775510204

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for gamma=0.28785714285714287 and C=7.7448979591836735	: train_acc: 0.95 , validation_acc: 0.7532467532467533
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for gamma=0.28785714285714287 and C=8.877551020408163	: train_acc: 0.9543478260869566 , validation_acc: 0.7467532467532467
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for gamma=0.2979591836734694 and C=5.0 : train_acc:	0.9282608695652174 , validation_acc: 0.7532467532467533
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[illegible]

[illegible]

[illegible]

[illegible]



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for gamma=0.3686734693877551 and C=13.16326530612245	: train_acc: 0.9826086956521739, validation_acc: 0.7207792207792207
for gamma=0.3686734693877551 and C=13.36734693877551	: train_acc: 0.9826086956521739, validation_acc: 0.7207792207792207
for gamma=0.3686734693877551 and C=13.571428571428571	: train_acc: 0.9847826086956522, validation_acc: 0.7207792207792207
for gamma=0.3686734693877551 and C=13.775510204081632	: train_acc: 0.9847826086956522, validation_acc: 0.7272727272727273
for gamma=0.3686734693877551 and C=13.979591836734695	: train_acc: 0.9847826086956522, validation_acc: 0.7272727272727273
for gamma=0.3686734693877551 and C=14.183673469387756	: train_acc: 0.9847826086956522, validation_acc: 0.7272727272727273
for gamma=0.3686734693877551 and C=14.387755102040817	: train_acc: 0.9847826086956522, validation_acc: 0.7272727272727273
for gamma=0.3686734693877551 and C=14.591836734693878	: train_acc: 0.9869565217391304, validation_acc: 0.7272727272727273
for gamma=0.3686734693877551 and C=14.795918367346939	: train_acc: 0.9869565217391304, validation_acc: 0.7272727272727273
for gamma=0.3686734693877551 and C=15.0 : train_acc: 0.9869565217391304, validation_acc: 0.7272727272727273	
for gamma=0.3787755102040816 and C=5.0 : train_acc: 0.9565217391304348, validation_acc: 0.7467532467532467	
for gamma=0.3787755102040816 and C=5.204081632653061	: train_acc: 0.9565217391304348, validation_acc: 0.7467532467532467
for gamma=0.3787755102040816 and C=5.408163265306122	: train_acc: 0.9586956521739131, validation_acc: 0.7402597402597403
for gamma=0.3787755102040816 and C=5.612244897959184	: train_acc: 0.9586956521739131, validation_acc: 0.7337662337662337
for gamma=0.3787755102040816 and C=5.816326530612245	: train_acc: 0.9586956521739131, validation_acc: 0.7272727272727273
for gamma=0.3787755102040816 and C=6.020408163265306	: train_acc: 0.9586956521739131, validation_acc: 0.7272727272727273
for gamma=0.3787755102040816 and C=6.224489795918368	: train_acc: 0.9586956521739131, validation_acc: 0.7207792207792207
for gamma=0.3787755102040816 and C=6.428571428571429	: train_acc: 0.9565217391304348, validation_acc: 0.7207792207792207
for gamma=0.3787755102040816 and C=6.63265306122449	: train_acc: 0.9586956521739131, validation_acc: 0.7207792207792207
for gamma=0.3787755102040816 and C=6.836734693877551	: train_acc: 0.9630434782608696, validation_acc: 0.7207792207792207
for gamma=0.3787755102040816 and C=7.040816326530612	: train_acc: 0.9630434782608696, validation_acc: 0.7207792207792207
for gamma=0.3787755102040816 and C=7.244897959183674	: train_acc: 0.9652173913043478, validation_acc: 0.7207792207792207
for gamma=0.3787755102040816 and C=7.448979591836735	: train_acc: 0.9652173913043478, validation_acc: 0.7272727272727273
for gamma=0.3787755102040816 and C=7.653061224489796	: train_acc: 0.9652173913043478, validation_acc: 0.7272727272727273
for gamma=0.3787755102040816 and C=7.857142857142858	: train_acc: 0.9695652173913043, validation_acc: 0.7272727272727273
for gamma=0.3787755102040816 and C=8.061224489795919	: train_acc: 0.9717391304347827, validation_acc: 0.7337662337662337
for gamma=0.3787755102040816 and C=8.26530612244898	: train_acc: 0.9717391304347827, validation_acc: 0.7337662337662337
for gamma=0.3787755102040816 and C=8.46938775510204	: train_acc: 0.9760869565217392, validation_acc: 0.7337662337662337
for gamma=0.3787755102040816 and C=8.673469387755102	: train_acc: 0.9760869565217392, validation_acc: 0.7337662337662337
for gamma=0.3787755102040816 and C=8.877551020408163	: train_acc: 0.9760869565217392, validation_acc: 0.7337662337662337
for gamma=0.378775510204081	

[illegible]

for gamma=0.3989795918367347 and C=9.081632653061224	: train_acc: 0.9782608695652174 , validation_acc: 0.72727272727273
for gamma=0.3989795918367347 and C=9.285714285714285	: train_acc: 0.9804347826086957 , validation_acc: 0.72727272727273
for gamma=0.3989795918367347 and C=9.489795918367347	: train_acc: 0.9804347826086957 , validation_acc: 0.72727272727273
for gamma=0.3989795918367347 and C=9.693877551020408	: train_acc: 0.9804347826086957 , validation_acc: 0.7337662337662337
for gamma=0.3989795918367347 and C=9.89795918367347	: train_acc: 0.9804347826086957 , validation_acc: 0.7337662337662337
for gamma=0.3989795918367347 and C=10.10204081632653	: train_acc: 0.9826086956521739 , validation_acc: 0.7337662337662337
for gamma=0.3989795918367347 and C=10.306122448979592	: train_acc: 0.9826086956521739 , validation_acc: 0.7337662337662337
for gamma=0.3989795918367347 and C=10.510204081632654	: train_acc: 0.9826086956521739 , validation_acc: 0.72727272727273
for gamma=0.3989795918367347 and C=10.714285714285715	: train_acc: 0.9826086956521739 , validation_acc: 0.7207792207792207
for gamma=0.3989795918367347 and C=10.918367346938776	: train_acc: 0.9826086956521739 , validation_acc: 0.7207792207792207
for gamma=0.3989795918367347 and C=11.122448979591837	: train_acc: 0.9826086956521739 , validation_acc: 0.7207792207792207
for gamma=0.3989795918367347 and C=11.326530612244898	: train_acc: 0.9826086956521739 , validation_acc: 0.7207792207792207
for gamma=0.3989795918367347 and C=11.53061224489796	: train_acc: 0.9826086956521739 , validation_acc: 0.7207792207792207
for gamma=0.3989795918367347 and C=11.73469387755102	: train_acc: 0.9847826086956522 , validation_acc: 0.7207792207792207
for gamma=0.3989795918367347 and C=11.938775510204081	: train_acc: 0.9869565217391304 , validation_acc: 0.7207792207792207
for gamma=0.3989795918367347 and C=12.142857142857142	: train_acc: 0.9869565217391304 , validation_acc: 0.72727272727273
for gamma=0.3989795918367347 and C=12.346938775510203	: train_acc: 0.9869565217391304 , validation_acc: 0.72727272727273
for gamma=0.3989795918367347 and C=12.551020408163264	: train_acc: 0.9869565217391304 , validation_acc: 0.72727272727273
for gamma=0.3989795918367347 and C=12.755102040816327	: train_acc: 0.9869565217391304 , validation_acc: 0.7207792207792207
for gamma=0.3989795918367347 and C=12.959183673469388	: train_acc: 0.9869565217391304 , validation_acc: 0.7207792207792207
for gamma=0.3989795918367347 and C=13.16326530612245	: train_acc: 0.9869565217391304 , validation_acc: 0.7207792207792207
for gamma=0.3989795918367347 and C=13.36734693877551	: train_acc: 0.9869565217391304 , validation_acc: 0.7207792207792207
for gamma=0.3989795918367347 and C=13.571428571428571	: train_acc: 0.9869565217391304 , validation_acc: 0.7207792207792207
for gamma=0.3989795918367347 and C=13.775510204081632	: train_acc: 0.9869565217391304 , validation_acc: 0.7207792207792207
for gamma=0.3989795918367347 and C=13.979591836734695	: train_acc: 0.9869565217391304 , validation_acc: 0.7207792207792207
for gamma=0.3989795918367347 and C=14.183673469387756	: train_acc: 0.9891304347826086 , validation_acc: 0.7207792207792207
for gamma=0.3989795918367347 and C=14.387755102040817	: train_acc: 0.9891304347826086 , validation_acc: 0.7207792207792207
for gamma=0.3989795918367347 and C=14.591836734693878	: train_acc: 0.9891304347826086 , validation_acc: 0.7207792207792207
for gamma=0.3989795918367347 and C=14.795918367346939	: train_acc: 0.9891304347826086 , validation_acc: 0.7207792207792207
for gamma=0.3989795918367347 and C=15.0 : train_acc: 0.9891304347826086 , validation_acc: 0.7207792207792207	
for gamma=0.4090816326530612 and C=5.0 : train_acc: 0.9586956521739131 , validation_acc: 0.7337662337662337	
for gamma=0.4090816326530612 and C=5.204081632653061	: train_acc: 0.9586956521739131 , validation_acc: 0.72727272727273
for gamma=0.4090816326530612 and C=5.408163265306122	: train_acc: 0.9608695652173913 , validation_acc: 0.72727272727273
for gamma=0.4090816326530612 and C=5.612244897959184	: train_acc: 0.9630434782608696 , validation_acc: 0.7207792207792207
for gamma=0.4090816326530612 and C=5.816326530612245	: train_acc: 0.9608695652173913 , validation_acc: 0.7207792207792207
for gamma=0.4090816326530612 and C=6.020408163265306	: train_acc: 0.9630434782608696 , validation_acc: 0.7207792207792207
for gamma=0.4090816326530612 and C=6.224489795918368	: train_acc: 0.9652173913043478 , validation_acc: 0.7207792207792207
for gamma=0.4090816326530612 and C=6.428571428571429	: train_acc: 0.9652173913043478 , validation_acc: 0.7207792207792207
for gamma=0.4090816326530612 and C=6.63265306122449	: train_acc: 0.9695652173913043 , validation_acc: 0.72727272727273
for gamma=0.4090816326530612 and C=6.836734693877551	: train_acc: 0.9717391304347827 , validation_acc: 0.72727272727273
for gamma=0.4090816326530612 and C=7.040816326530612	: train_acc: 0.9739130434782609 , validation_acc: 0.72727272727273
for gamma=0.4090816326530612 and C=	

[illegible]

[illegible]

for gamma=0.4393877551020408 and C=11.122448979591837	: train_acc: 0.9869565217391304, validation_acc: 0.7207792207792207
for gamma=0.4393877551020408 and C=11.326530612244898	: train_acc: 0.9869565217391304, validation_acc: 0.7207792207792207
for gamma=0.4393877551020408 and C=11.53061224489796	: train_acc: 0.9891304347826086, validation_acc: 0.7142857142857143
for gamma=0.4393877551020408 and C=11.73469387755102	: train_acc: 0.9891304347826086, validation_acc: 0.7142857142857143
for gamma=0.4393877551020408 and C=11.938775510204081	: train_acc: 0.9891304347826086, validation_acc: 0.7142857142857143
for gamma=0.4393877551020408 and C=12.142857142857142	: train_acc: 0.9891304347826086, validation_acc: 0.7207792207792207
for gamma=0.4393877551020408 and C=12.346938775510203	: train_acc: 0.9891304347826086, validation_acc: 0.7207792207792207
for gamma=0.4393877551020408 and C=12.551020408163264	: train_acc: 0.9891304347826086, validation_acc: 0.7207792207792207
for gamma=0.4393877551020408 and C=12.755102040816327	: train_acc: 0.9891304347826086, validation_acc: 0.7142857142857143
for gamma=0.4393877551020408 and C=12.959183673469388	: train_acc: 0.9891304347826086, validation_acc: 0.7142857142857143
for gamma=0.4393877551020408 and C=13.16326530612245	: train_acc: 0.991304347826087, validation_acc: 0.7142857142857143
for gamma=0.4393877551020408 and C=13.36734693877551	: train_acc: 0.991304347826087, validation_acc: 0.7142857142857143
for gamma=0.4393877551020408 and C=13.571428571428571	: train_acc: 0.991304347826087, validation_acc: 0.7142857142857143
for gamma=0.4393877551020408 and C=13.775510204081632	: train_acc: 0.991304347826087, validation_acc: 0.7142857142857143
for gamma=0.4393877551020408 and C=13.979591836734695	: train_acc: 0.991304347826087, validation_acc: 0.7142857142857143
for gamma=0.4393877551020408 and C=14.183673469387756	: train_acc: 0.991304347826087, validation_acc: 0.7142857142857143
for gamma=0.4393877551020408 and C=14.387755102040817	: train_acc: 0.9934782608695653, validation_acc: 0.7142857142857143
for gamma=0.4393877551020408 and C=14.591836734693878	: train_acc: 0.9934782608695653, validation_acc: 0.7142857142857143
for gamma=0.4393877551020408 and C=14.795918367346939	: train_acc: 0.9934782608695653, validation_acc: 0.7142857142857143
for gamma=0.4393877551020408 and C=15.0 : train_acc: 0.9934782608695653, validation_acc: 0.7142857142857143	
for gamma=0.44948979591836735 and C=5.0 : train_acc: 0.9652173913043478, validation_acc: 0.7207792207792207	
for gamma=0.44948979591836735 and C=5.204081632653061	: train_acc: 0.9695652173913043, validation_acc: 0.7207792207792207
for gamma=0.44948979591836735 and C=5.408163265306122	: train_acc: 0.9717391304347827, validation_acc: 0.7207792207792207
for gamma=0.44948979591836735 and C=5.612244897959184	: train_acc: 0.9739130434782609, validation_acc: 0.7272727272727273
for gamma=0.44948979591836735 and C=5.816326530612245	: train_acc: 0.9760869565217392, validation_acc: 0.7272727272727273
for gamma=0.44948979591836735 and C=6.020408163265306	: train_acc: 0.9760869565217392, validation_acc: 0.7272727272727273
for gamma=0.44948979591836735 and C=6.224489795918368	: train_acc: 0.9760869565217392, validation_acc: 0.7272727272727273
for gamma=0.44948979591836735 and C=6.428571428571429	: train_acc: 0.9760869565217392, validation_acc: 0.7272727272727273
for gamma=0.44948979591836735 and C=6.63265306122449	: train_acc: 0.9760869565217392, validation_acc: 0.7272727272727273
for gamma=0.44948979591836735 and C=6.836734693877551	: train_acc: 0.9826086956521739, validation_acc: 0.7272727272727273
for gamma=0.44948979591836735 and C=7.040816326530612	: train_acc: 0.9826086956521739, validation_acc: 0.7272727272727273
for gamma=0.44948979591836735 and C=7.244897959183674	: train_acc: 0.9826086956521739, validation_acc: 0.7337662337662337
for gamma=0.44948979591836735 and C=7.448979591836735	: train_acc: 0.9826086956521739, validation_acc: 0.7337662337662337
for gamma=0.44948979591836735 and C=7.653061224489796	: train_acc: 0.9826086956521739, validation_acc: 0.7337662337662337
for gamma=0.44948979591836735 and C=7.857142857142858	: train_acc: 0.9826086956521739, validation_acc: 0.7337662337662337
for gamma=0.44948979591836735 and C=8.061224489795919	: train_acc: 0.9826086956521739, validation_acc: 0.7337662337662337
for gamma=0.44948979591836735 and C=8.26530612244898	: train_acc: 0.9826086956521739, validation_acc: 0.7337662337662337
for gamma=0.44948979591836735 and C=8.46938775510204	: train_acc: 0.9847826086956522, validation_acc: 0.7337662337662337
for gamma=0.44948979591836735 and C=8.673469387755102	: train_acc: 0.9847826086956522, validation_acc: 0.7337662337662337

[illegible]



[illegible]

[illegible]

```

for gamma=0.5 and C=7.040816326530612 : train_acc: 0.9847826086956522 , validation_acc:0.7272727272727273
for gamma=0.5 and C=7.244897959183674 : train_acc: 0.9847826086956522 , validation_acc:0.7272727272727273
for gamma=0.5 and C=7.448979591836735 : train_acc: 0.9847826086956522 , validation_acc:0.7272727272727273
for gamma=0.5 and C=7.653061224489796 : train_acc: 0.9847826086956522 , validation_acc:0.7207792207792207
for gamma=0.5 and C=7.857142857142858 : train_acc: 0.9847826086956522 , validation_acc:0.7207792207792207
for gamma=0.5 and C=8.061224489795919 : train_acc: 0.9869565217391304 , validation_acc:0.7207792207792207
for gamma=0.5 and C=8.26530612244898 : train_acc: 0.9869565217391304 , validation_acc:0.7207792207792207
for gamma=0.5 and C=8.46938775510204 : train_acc: 0.9869565217391304 , validation_acc:0.7207792207792207
for gamma=0.5 and C=8.673469387755102 : train_acc: 0.9869565217391304 , validation_acc:0.7207792207792207
for gamma=0.5 and C=8.877551020408163 : train_acc: 0.9891304347826086 , validation_acc:0.7207792207792207
for gamma=0.5 and C=9.081632653061224 : train_acc: 0.9891304347826086 , validation_acc:0.7207792207792207
for gamma=0.5 and C=9.285714285714285 : train_acc: 0.9891304347826086 , validation_acc:0.7207792207792207
for gamma=0.5 and C=9.489795918367347 : train_acc: 0.991304347826087 , validation_acc:0.7207792207792207
for gamma=0.5 and C=9.693877551020408 : train_acc: 0.991304347826087 , validation_acc:0.7142857142857143
for gamma=0.5 and C=9.89795918367347 : train_acc: 0.991304347826087 , validation_acc:0.7142857142857143
for gamma=0.5 and C=10.10204081632653 : train_acc: 0.991304347826087 , validation_acc:0.7142857142857143
for gamma=0.5 and C=10.306122448979592 : train_acc: 0.991304347826087 , validation_acc:0.7142857142857143
for gamma=0.5 and C=10.510204081632654 : train_acc: 0.991304347826087 , validation_acc:0.7142857142857143
for gamma=0.5 and C=10.714285714285715 : train_acc: 0.991304347826087 , validation_acc:0.7142857142857143
for gamma=0.5 and C=10.918367346938776 : train_acc: 0.9934782608695653 , validation_acc:0.7142857142857143
for gamma=0.5 and C=11.122448979591837 : train_acc: 0.9934782608695653 , validation_acc:0.7142857142857143
for gamma=0.5 and C=11.326530612244898 : train_acc: 0.9934782608695653 , validation_acc:0.7142857142857143
for gamma=0.5 and C=11.53061224489796 : train_acc: 0.9934782608695653 , validation_acc:0.7142857142857143
for gamma=0.5 and C=11.73469387755102 : train_acc: 0.9934782608695653 , validation_acc:0.7077922077922078
for gamma=0.5 and C=11.938775510204081 : train_acc: 0.9934782608695653 , validation_acc:0.7077922077922078
for gamma=0.5 and C=12.142857142857142 : train_acc: 0.9956521739130435 , validation_acc:0.7077922077922078
for gamma=0.5 and C=12.346938775510203 : train_acc: 0.9956521739130435 , validation_acc:0.7142857142857143
for gamma=0.5 and C=12.551020408163264 : train_acc: 0.9956521739130435 , validation_acc:0.7142857142857143
for gamma=0.5 and C=12.755102040816327 : train_acc: 0.9956521739130435 , validation_acc:0.7142857142857143
for gamma=0.5 and C=12.959183673469388 : train_acc: 0.9956521739130435 , validation_acc:0.7142857142857143
for gamma=0.5 and C=13.16326530612245 : train_acc: 0.9956521739130435 , validation_acc:0.7142857142857143
for gamma=0.5 and C=13.36734693877551 : train_acc: 0.9956521739130435 , validation_acc:0.7142857142857143
for gamma=0.5 and C=13.571428571428571 : train_acc: 0.9956521739130435 , validation_acc:0.7142857142857143
for gamma=0.5 and C=13.775510204081632 : train_acc: 0.9956521739130435 , validation_acc:0.7142857142857143
for gamma=0.5 and C=13.979591836734695 : train_acc: 0.9956521739130435 , validation_acc:0.7142857142857143
for gamma=0.5 and C=14.183673469387756 : train_acc: 0.9956521739130435 , validation_acc:0.7142857142857143
for gamma=0.5 and C=14.387755102040817 : train_acc: 0.9956521739130435 , validation_acc:0.7142857142857143
for gamma=0.5 and C=14.591836734693878 : train_acc: 0.9956521739130435 , validation_acc:0.7142857142857143
for gamma=0.5 and C=14.795918367346939 : train_acc: 0.9956521739130435 , validation_acc:0.7142857142857143
for gamma=0.5 and C=15.0 : train_acc: 0.9956521739130435 , validation_acc:0.7142857142857143

```

**This search found this result for best C and gamma:**

**C = : 9.89795918367347 and gamma=0.055510204081632646**

train\_acc\_best\_C\_gamma: 0.841304347826087 , best\_validation\_acc: 0.7987012987012987 ,  
 best\_validation\_C\_RBF\_new: 9.89795918367347 , best\_gamma\_RBF\_new:  
 0.055510204081632646

**mix train and validation data:**

```

training_x = np.append(x_train,x_validation).reshape(-1,8) # mix att train and validation
training_y = np.append(y_train,y_validation).reshape(-1,1) # mix class train and validation

```

**Retrain Linear\_kernel\_SVC using combined (train + validation)**

**applying first result for C:**

```

Linear_kernel_Final = SVC(C=best_validation_C_linear , kernel='linear') # retrain model by be
st C

```

```

Linear_kernel_Final.fit(training_x,training_y)

```

```

acc_train_Linear_kernal = Linear_kernel_Final.score(training_x,training_y)
acc_test_Linear_kernal = Linear_kernel_Final.score(x_test,y_test)      # acc best model on test
data
print('acc_train_Linear_kernal: {} , acc_test_Linear_kernal: {}'.format(acc_train_Linear_kernal
,acc_test_Linear_kernal))

```

**obtained acc by this chose for C:**

**acc\_train\_Linear\_kernal: 0.7671009771986971 , acc\_test\_Linear\_kernal:  
0.8246753246753247**

**applying secound result for C:**

```

Linear_kernel_Final = SVC(C=best_validation_C_linear_new , kernel='linear') # retrain model by best C
Linear_kernel_Final.fit(training_x,training_y)
acc_train_Linear_kernal = Linear_kernel_Final.score(training_x,training_y)
acc_test_Linear_kernal = Linear_kernel_Final.score(x_test,y_test)      # acc best model on test data
print('acc_train_Linear_kernal: {} , acc_test_Linear_kernal: {}'.format(acc_train_Linear_kernal,acc_test_Lin
ear_kernal))

```

**obtained acc by this chose for C:**

**acc\_train\_Linear\_kernal: 0.7703583061889251 , acc\_test\_Linear\_kernal:  
0.8246753246753247**

**Retrain RBF\_kernel\_SVC using combined (train + validation)**

**applying first result for C and gamma:**

```

RBF_kernel_Final = SVC(C=best_validation_C_RBF , kernel='rbf' , gamma=best_gamma_RB
F) # retrain model by best C and gamma
RBF_kernel_Final.fit(training_x,training_y)
acc_train_RBF_kernal = RBF_kernel_Final.score(training_x,training_y)
acc_test_RBF_kernal = RBF_kernel_Final.score(x_test,y_test)      # acc best model on test data
print('acc_train_RBF_kernal: {} , acc_test_RBF_kernal: {}'.format(acc_train_RBF_kernal,acc_
test_RBF_kernal))

```

**obtained acc by this chose for C and gamma:**

**acc\_train\_RBF\_kernal: 0.7833876221498371 , acc\_test\_RBF\_kernal:  
0.8181818181818182**

**applying secound result for C and gamma:**

```

RBF_kernel_Final = SVC(C=best_validation_C_RBF_new , kernel='rbf' , gamma=best_gamm
a_RBF_new) # retrain model by best C and gamma
RBF_kernel_Final.fit(training_x,training_y)

```

```
acc_train_RBF_kernel = RBF_kernel_Final.score(training_x,training_y)
acc_test_RBF_kernel = RBF_kernel_Final.score(x_test,y_test)    # acc best model on test data
print('acc_train_RBF_kernel: { } , acc_test_RBF_kernel: { }'.format(acc_train_RBF_kernel,acc_
test_RBF_kernel))
```

**obtained acc by this chose for C:**

**acc\_train\_RBF\_kernel: 0.8322475570032574 , acc\_test\_RBF\_kernel:  
0.7727272727272727**

## **Explain the project process and Conclusion:**

### **Explain the project process:**

In this case, python programming language have been used. First of all, dataset loaded to python and then, data preprocessing included changing the format of classes and normalizing the data have been done. Data splitted to 60% as training set and 20% as validation set and 20% as test set.

Tuning hyperparameters for both SVM classifiers is done as follow: SVM classifier models (SVM\_linear\_kernel, SVM\_RBF\_kernel) fitted on the training data by different values for c in SVM\_linear\_kernel and different values for c and gamma in SVM\_RBF\_kernel. Each time both models getting fit, the accuracy of SVM classifier models on the validation data have been investigated to find which c in SVM\_linear\_kernel or c and gamma in SVM\_RBF\_kernel has shown max accuracy on validation data. At last the best values of c and (c,gamma) is stored.

Finally training data and validation data have been mixed together and both models is fitted on this data. The accuracy of each model is measured on the testing data by using of best hyperparameters of each model that is found in previous steps.

### **Conclusion:**

Both models are investigated on testing data by two choices for best c in SVM\_Linear\_kernel and (c, gamma) in SVM\_RBF\_kernel. At first choice values are found by random search and in the second one, values are found by using first choice and searching in specified intervals.

For SVM\_Linear\_kernel in both choices for c the accuracy on testing data is 0.8246753246753247 but the accuracy on mixed training data and validation data for first choice is a little less than second choice.

For SVM\_RBF\_kernel in first choice max accuracy on testing data is found as 0.8181818181818182 that is better than second choice 0.7727272727272727. the accuracy of this model on mixed training data for first choice is 0.7833876221498371 that is less than second choice 0.8322475570032574.

So, not only the best accuracy on testing data is obtained by using of SVM\_RBF\_kernel classifier and first choice of hyperparameters, but also the maximum accuracy on mixed training and validation data is obtained by using of SVM\_RBF\_kernel classifier and second choice of hyperparameters.

It is seen that, by use of best hyperparameters for the SVM\_RBF\_kernel model, this model has shown better results rather than SVM\_Linear\_kernel model. But, because of more hyperparameters in SVM\_RBF\_kernel rather than SVM\_Linear\_kernel, finding the best hyperparameters for SVM\_RBF\_kernel model needs more time rather than SVM\_Linear\_kernel model and has more complexity.

In cases where more accuracy is considered, SVM\_RBF\_kernel model is a good choice and in the other hand, in cases where the computational speed of action is considered, SVM\_Linear\_kernel model is better choice.