solution10

November 10, 2020

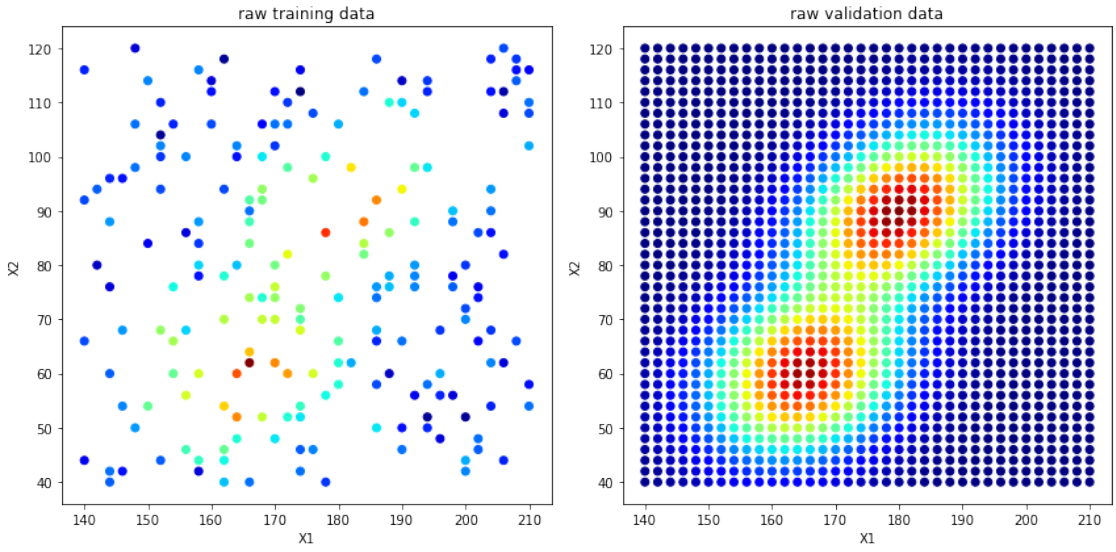
Exercise Sheet 10 **Support Vector Regression**

import numpy as np from mpl_toolkits.mplot3d import Axes3D import matplotlib.pyplot as plt

[2]:
```
from sklearn import svm
from sklearn.svm import NuSVR
from sklearn.metrics import mean_squared_error as mse
from sklearn.model_selection import GridSearchCV
```

10.2: Regression with the ν-SVR

[3]:
```
# importing the data
TrainingData = np.genfromtxt('TrainingRidge.csv',
                             delimiter=',',skip_header=1).T
ValidationData = np.genfromtxt('ValidationRidge.csv',
                               delimiter=',',skip_header=1).T

Xt = TrainingData[0:2,:].T
Yt = TrainingData[2,:].T
Xv = ValidationData[0:2,:].T
Yv = ValidationData[2,:].T

# plotting the raw data
plt.figure(figsize=(12,6))
plt.subplot(1,2,1)
plt.scatter(Xt[:,0],Xt[:,1],c=Yt,cmap='jet')
plt.xlabel('X1')
plt.ylabel('X2')
plt.title('raw training data')
plt.subplot(1,2,2)
plt.scatter(Xv[:,0],Xv[:,1],c=Yv,cmap='jet')
plt.xlabel('X1')
plt.ylabel('X2')
plt.title('raw validation data')
plt.tight_layout()
plt.show()
```

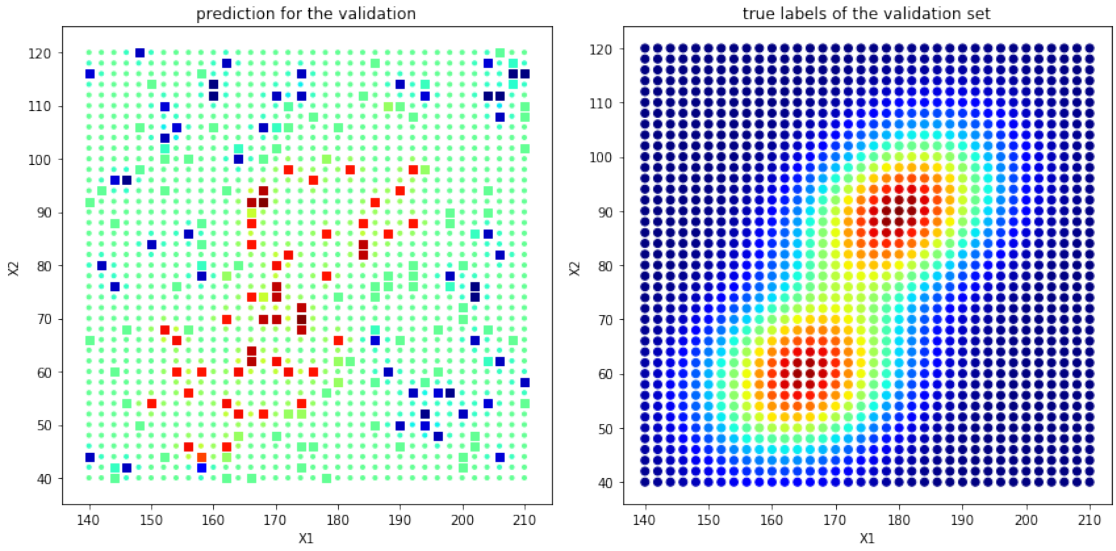


[4]:
```
# the model
NuSVR_model_def = svm.NuSVR(nu=0.5,
                  C=1.0,
                  kernel='rbf',
                  degree=3,
                  gamma='auto',
                  coef0=0.0,
                  shrinking=True,
                  tol=1e-3,
                  cache_size=200,
                  verbose=False,
                  max_iter=-1)
```

[5]:
```
# fitting the model
NuSVR_model_def.fit(Xt, Yt)

# prediction
yt_predict = NuSVR_model_def.predict(Xt)
yv_predict = NuSVR_model_def.predict(Xv)
```

[6]:
```
# plotting training vs prediction
plt.figure(figsize=(12,6))
plt.subplot(1,2,1)

plt.scatter(Xv[:,0],Xv[:,1],
            c=yv_predict,cmap='jet',
            marker='.')
```

```
plt.scatter(Xt[:,0],Xt[:,1],
            c=yt_predict,cmap='jet',
            marker='s')

plt.xlabel('X1')
plt.ylabel('X2')
plt.title('prediction for the validation')
plt.subplot(1,2,2)
plt.scatter(Xv[:,0],Xv[:,1],
            c=Yv,cmap='jet')

plt.xlabel('X1')
plt.ylabel('X2')
plt.title('true labels of the validation set')
plt.tight_layout()
plt.show()
```



[7]:
```
mset_def = mse(Yv, yv_predict)
print('total mean squared error (MSE) between model prediction'
      ' and true labels of the validation = %d' % mset_def)
```

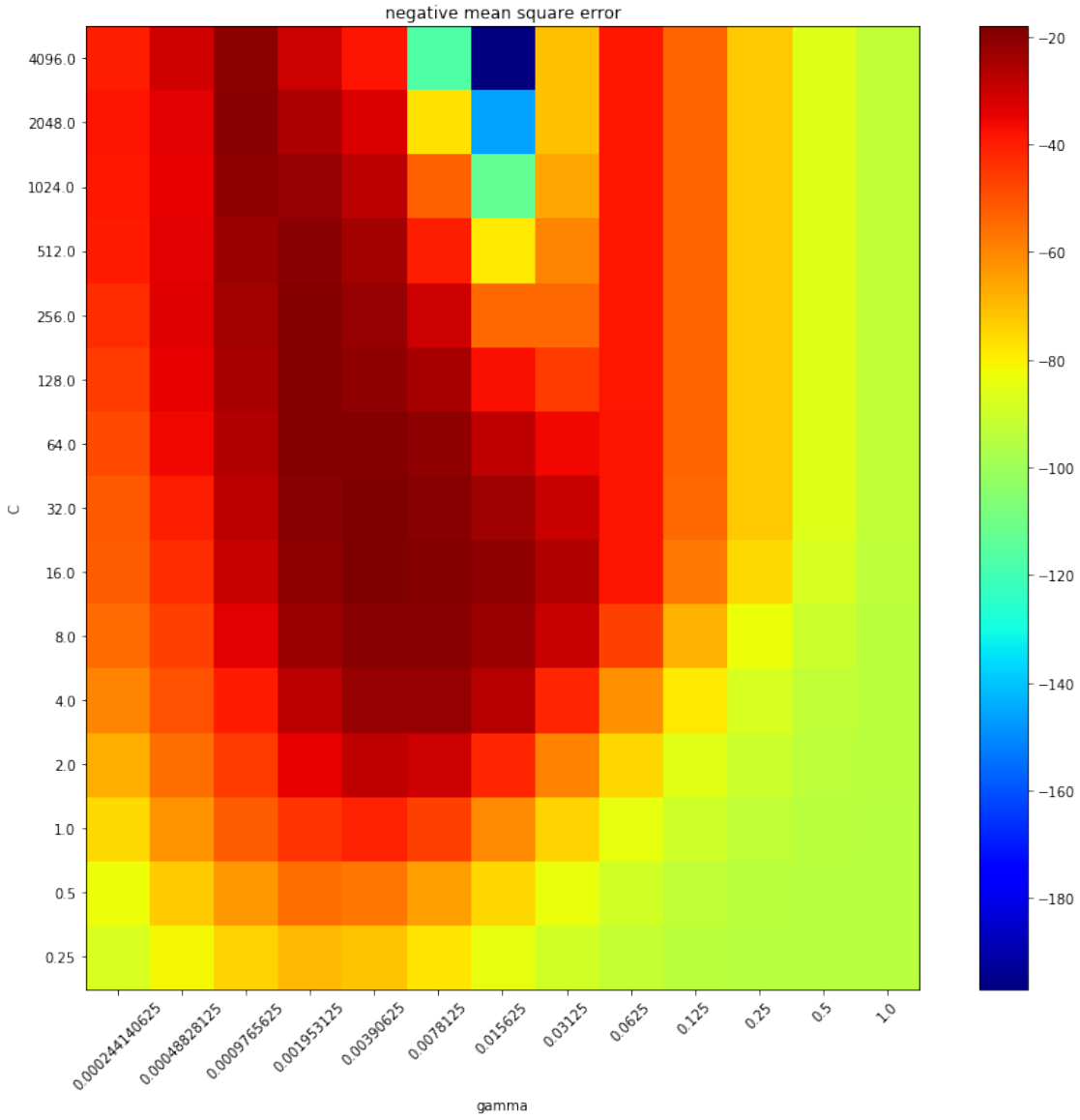
```
total mean squared error (MSE) between model prediction and true labels of the
validation = 76
```

[8]:
```
# the steps of one is considered for better search
C_range = np.logspace(-2,12,15,endpoint=True,base=2)
 _range = np.logspace(-12,0,13,endpoint=True,base=2)
```

[9]:
```
# grid search
param_grid = dict(gamma= _range, C=C_range)
grid = GridSearchCV(NuSVR(), param_grid=param_grid, cv=10,
                    scoring='neg_mean_squared_error')
grid.fit(Xt, Yt)
print("The best parameters are %s"% grid.best_params_)
```

```
The best parameters are {'C': 16.0, 'gamma': 0.00390625}
```

[10]:
```
scores = grid.cv_results_['mean_test_score'].reshape(len(C_range),
                                                     len( _range))
plt.figure(figsize=(16, 12))
plt.subplots_adjust(left=.2, right=0.95, bottom=0.15, top=0.95)
plt.imshow(scores, interpolation='nearest', cmap='jet',
           origin='lower')
plt.xlabel('gamma')
plt.ylabel('C')
plt.colorbar()
plt.xticks(np.arange(len( _range)),  _range, rotation=45)
plt.yticks(np.arange(len(C_range)), C_range)
plt.title('negative mean square error')
plt.show()
```

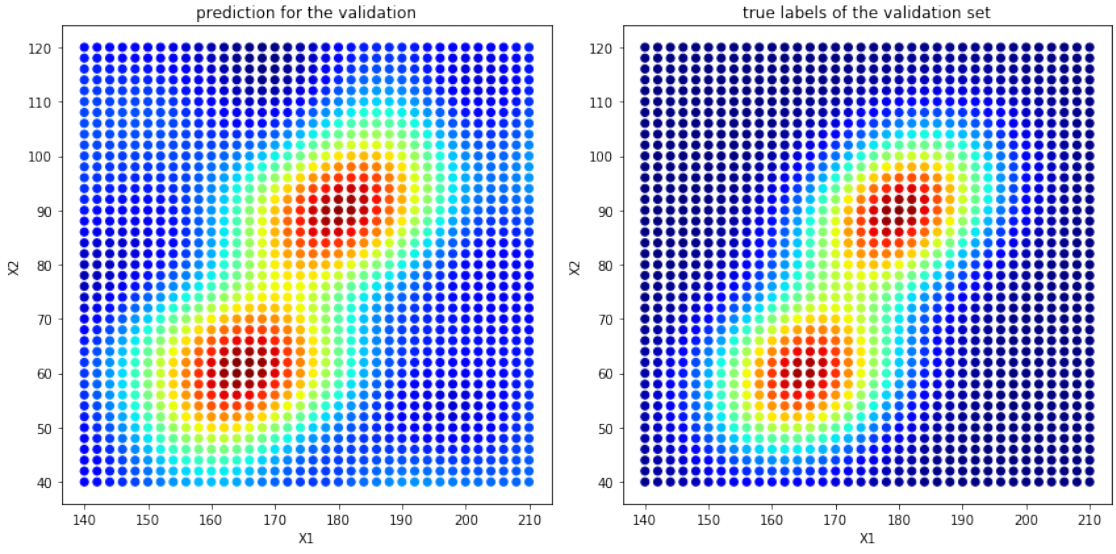


[11]:
```
# the model
NuSVR_model_opt = svm.NuSVR(nu=0.5,
                  C=16,
                  kernel='rbf',
                  degree=3,
                  gamma=2**-8,
                  coef0=0.0,
                  shrinking=True,
                  tol=1e-3,
                  cache_size=200,
                  verbose=False,
```

```
                    max_iter=-1)
```

[12]:
```
# fitting the model
NuSVR_model_opt.fit(Xt, Yt)

# prediction
yt_predict_opt = NuSVR_model_opt.predict(Xt)
yv_predict_opt = NuSVR_model_opt.predict(Xv)
```

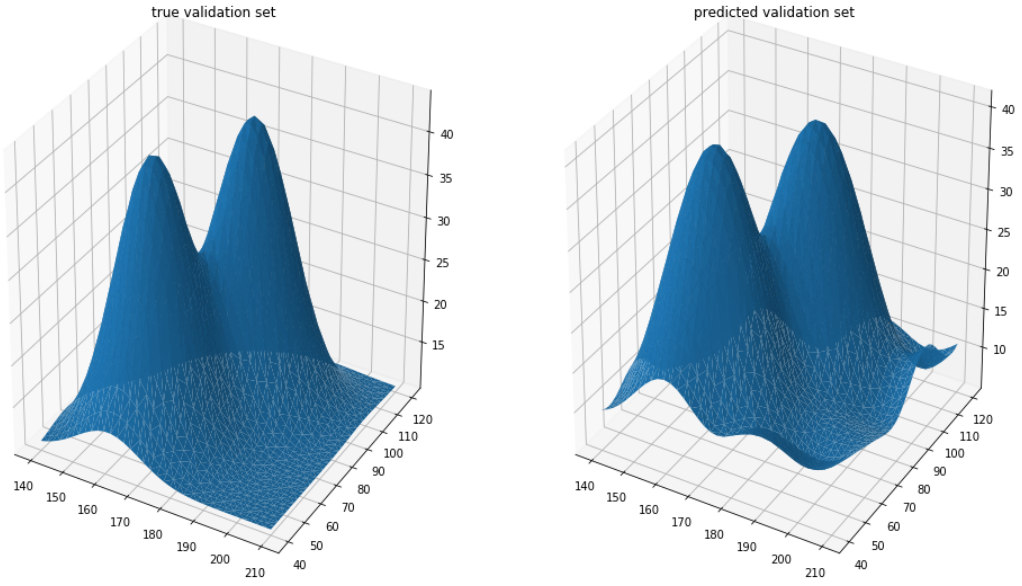
[13]:
```
# plotting training vs prediction
plt.figure(figsize=(12,6))
plt.subplot(1,2,1)

plt.scatter(Xv[:,0],Xv[:,1],
            c=yv_predict_opt, cmap='jet')

plt.xlabel('X1')
plt.ylabel('X2')
plt.title('prediction for the validation')
plt.subplot(1,2,2)
plt.scatter(Xv[:,0],Xv[:,1],
            c=Yv,cmap='jet')

plt.xlabel('X1')
plt.ylabel('X2')
plt.title('true labels of the validation set')
plt.tight_layout()
plt.show()
```



[14]:
```
mset_opt = mse(Yv, yv_predict_opt)
print('total mean squared error (MSE) between model prediction'
      ' and true labels of the validation = %d' % mset_opt)
```

```
total mean squared error (MSE) between model prediction and true labels of the
validation = 2
```

[15]:
```
fig = plt.figure(figsize=(14,8))
ax = fig.add_subplot(1, 2, 1, projection='3d')
ax.plot_trisurf(Xv[:,0],Xv[:,1], Yv)
plt.title('true validation set')
ax = fig.add_subplot(1, 2, 2, projection='3d')
ax.plot_trisurf(Xv[:,0],Xv[:,1], yv_predict_opt)
plt.title('predicted validation set')
plt.tight_layout()
plt.show()
```



[16]:
```
print('the mean squre error of using default parameters = %d \n'
      'the mean squre error of using optimum parameters = %d'
      % (mset_def, mset_opt))
```

```
the mean squre error of using default parameters = 76
the mean squre error of using optimum parameters = 2
```

[ ]:
```

```