assignment05

May 29, 2018

1 Assignment 5

1.1 Due May 29th

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```
In [1]: %matplotlib inline
        import matplotlib.pyplot as plt
        import numpy as np
        import pandas as pd
        import pickle

        from sklearn.neighbors import KNeighborsClassifier
        from sklearn.linear_model import LogisticRegression
        from sklearn.datasets import make_classification
        from sklearn.model_selection import GridSearchCV
        from sklearn.svm import LinearSVC

        np.random.seed(42)
```

1.2 Exercise 1

1.2.1 a)

```
In [166]: candy = pd.read_csv("candy-data.csv")
          names = candy['competitorname']
          Y = candy['chocolate']
          idx = ['fruity', 'caramel', 'peanutyalmondy', 'nougat',
                 'crispedricewafer', 'hard', 'bar', 'pluribus', 'sugarpercent']
          X = candy[idx]
```

1.2.2 b)

```
In [132]: itrain = int(np.round(len(X)/3*2, decimals=0))
          X_train = X.ix[0:itrain]
          X_test = X.ix[itrain:len(X)]
          Y_train = Y.ix[0:itrain]
          Y_test = Y.ix[itrain:len(Y)]
```

1.2.3 c)

```
In [133]: from sklearn.preprocessing import StandardScaler
          sc = StandardScaler()
          sc.fit(X_train)
          X_train_std = sc.transform(X_train)
          X_test_std = sc.transform(X_test)

          X_combined_std = np.vstack((X_train_std, X_test_std))
          y_combined = np.hstack((Y_train, Y_test))

          from sklearn.linear_model import LogisticRegression
          lr = LogisticRegression()
          lr.fit(X_train_std, Y_train)

          Y_predict = lr.predict(X_test)

          ids = Y_test.loc[Y_test == Y_predict]

          accuracy = len(ids)/len(Y_test)
          print('accuracy: {:.2f}'.format(accuracy))
```

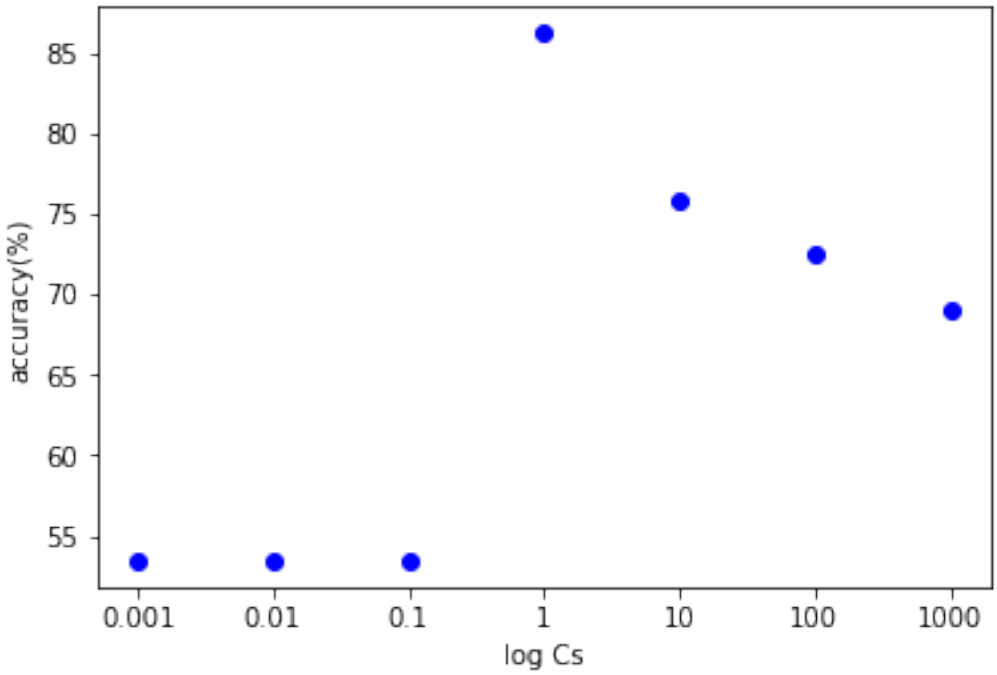
```
accuracy: 0.75
```

1.2.4 d)

```
In [140]: Cs =  [0.001, 0.01, 0.1, 1, 10, 100, 1000]

          from sklearn import svm
          svc = svm.SVC()
          parameters = {'C':Cs}
          clf = GridSearchCV(svc, parameters)
          clf.fit(X_train, Y_train)
          y_predict = clf.predict(X_test)
          scores = clf.cv_results_['mean_test_score']
          print('d. scores:\n{}'.format(scores))
          plt.plot(np.log10(Cs), scores*100, 'bo');
          plt.xticks([-3, -2, -1, 0, 1, 2, 3], Cs);
          plt.xlabel('log Cs');
          plt.ylabel('accuracy(%)');

          # use score to check
          accuracies = []
          for c in Cs:
              lr = LogisticRegression(C=c)
              lr.fit(X_train_std, Y_train)
              Y_predict = lr.predict(X_test)
              # check accuracy
```

```
            ac = np.round(lr.score(X_test, Y_test), decimals=4)
            accuracies.append(ac)
        # print('accuracies:\n{}'.format(accuracies))
```

```
d. scores:
[0.53448276 0.53448276 0.53448276 0.86206897 0.75862069 0.72413793
 0.68965517]
```



From the graph, we can knows, that $C = 1$ is the best.

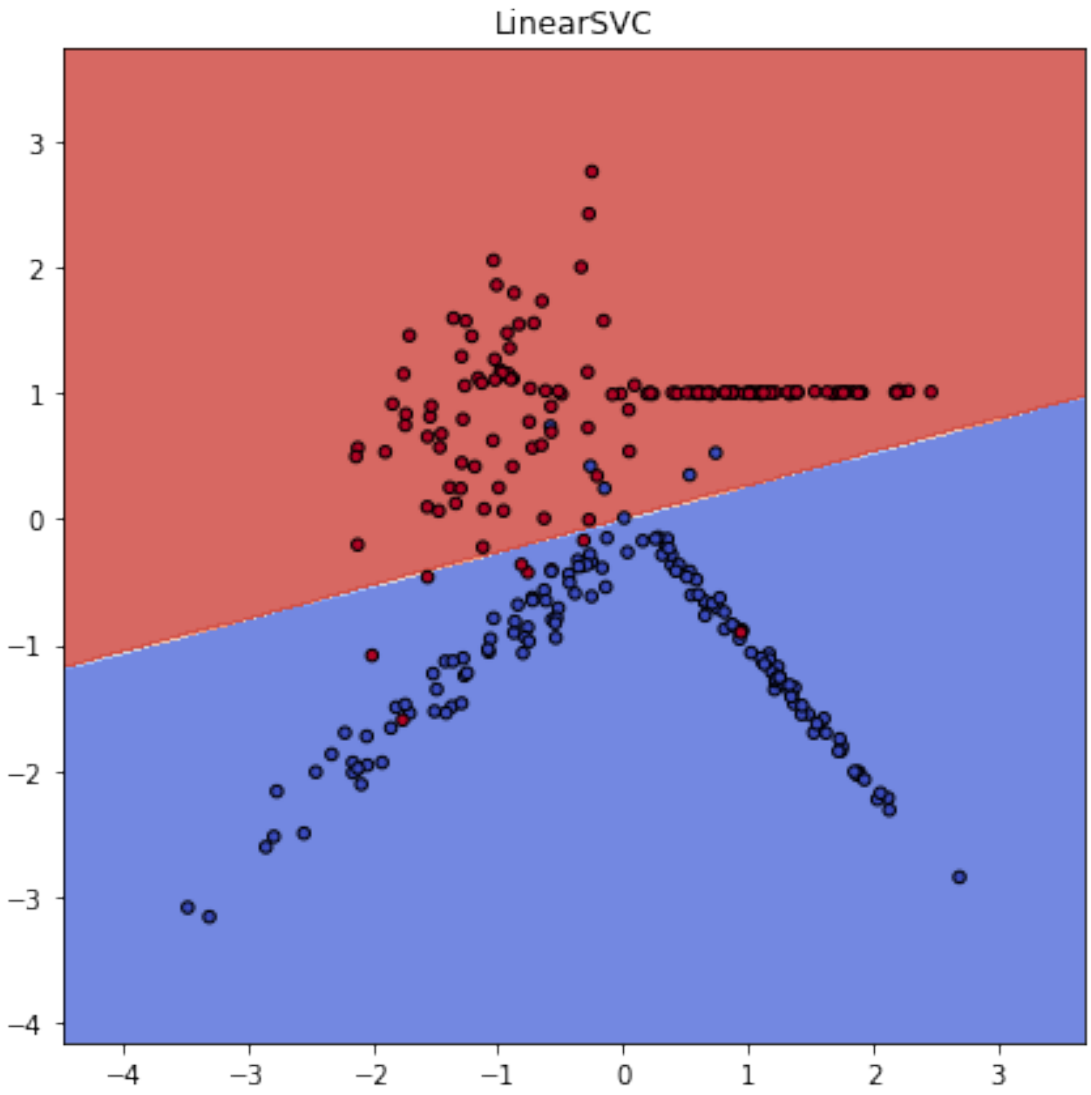
1.3 Exercise 2

```
In [30]: X, Y = make_classification(n_samples=1000, n_features=2,
                                    n_informative=2, n_redundant=0,
                                    n_repeated=0, n_classes=2,
                                    n_clusters_per_class=2, random_state=300,
                                    class_sep=1)
         X_train, Y_train = X[:300], Y[:300]
         X_test, Y_test = X[300:], Y[300:]
```

1.3.1 a)

```
In [85]: def make_meshgrid(x, y, h=.02):
             x_min, x_max = x.min()-1, x.max()+1
             y_min, y_max = y.min()-1, y.max()+1
```

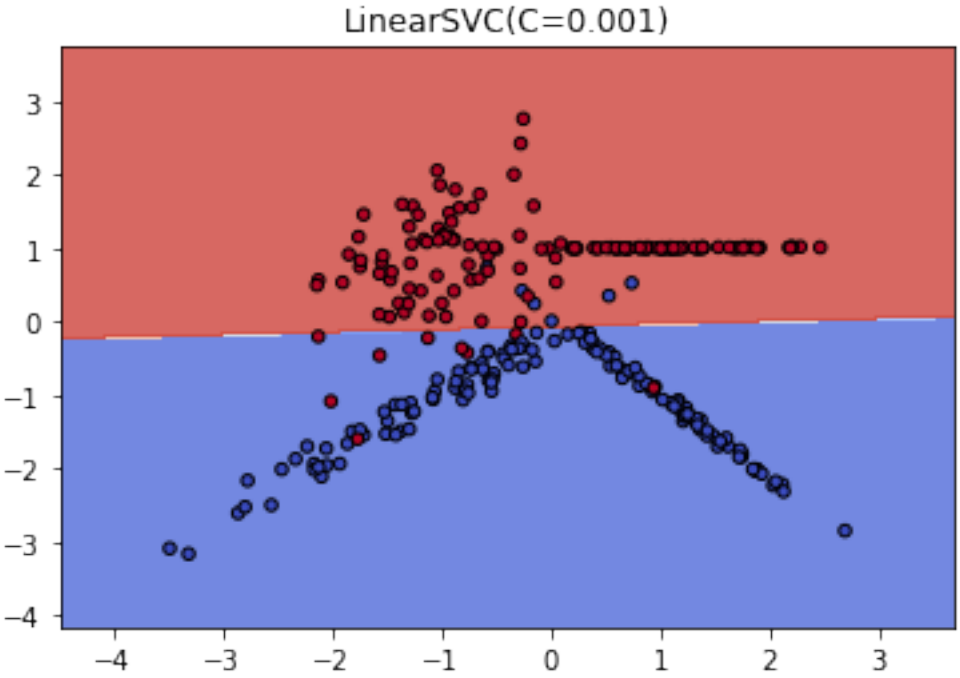
```
    xx, yy = np.meshgrid(np.arange(x_min, x_max, h),
                         np.arange(y_min, y_max, h))
    return xx, yy

C = 1.0
ls = LinearSVC(C=C);
ls.fit(X_train, Y_train)
titles = 'LinearSVC'

X0, X1 = X_train[:,0], X_train[:,1];
xx, yy = make_meshgrid(X0, X1);

fig = plt.figure(figsize=(7,7))
# plot_counters(fig, models, xx, yy, cmap=plt.cm.coolwarm, alpha=0.8)
Z = ls.predict(np.c_[xx.ravel(), yy.ravel()])
# print('Z.shape:{}, xx.shape:{}'.format(Z.shape, xx.shape))
Z = Z.reshape(xx.shape)
out = plt.contourf(xx, yy, Z, cmap=plt.cm.coolwarm, alpha=0.8)
# print('X0:{}, X1:{}, xx:{}, yy:{}'.format(X0.shape, X1.shape, xx.shape, yy.shape))
plt.scatter(X0, X1, c=Y_train, cmap=plt.cm.coolwarm, s=20, edgecolors='k')
plt.title(titles)
plt.show()
```

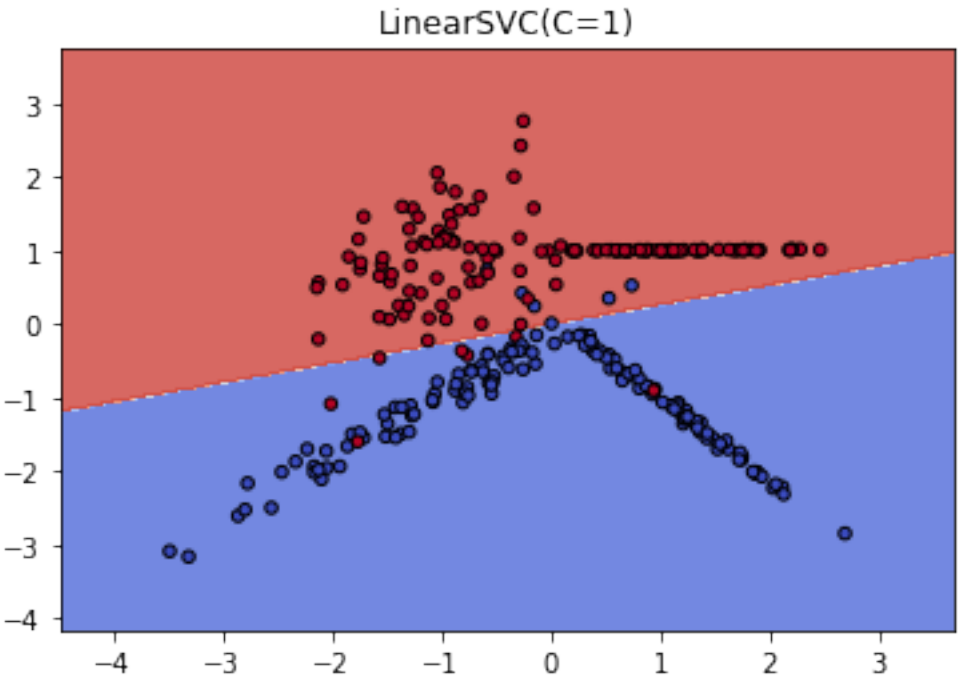


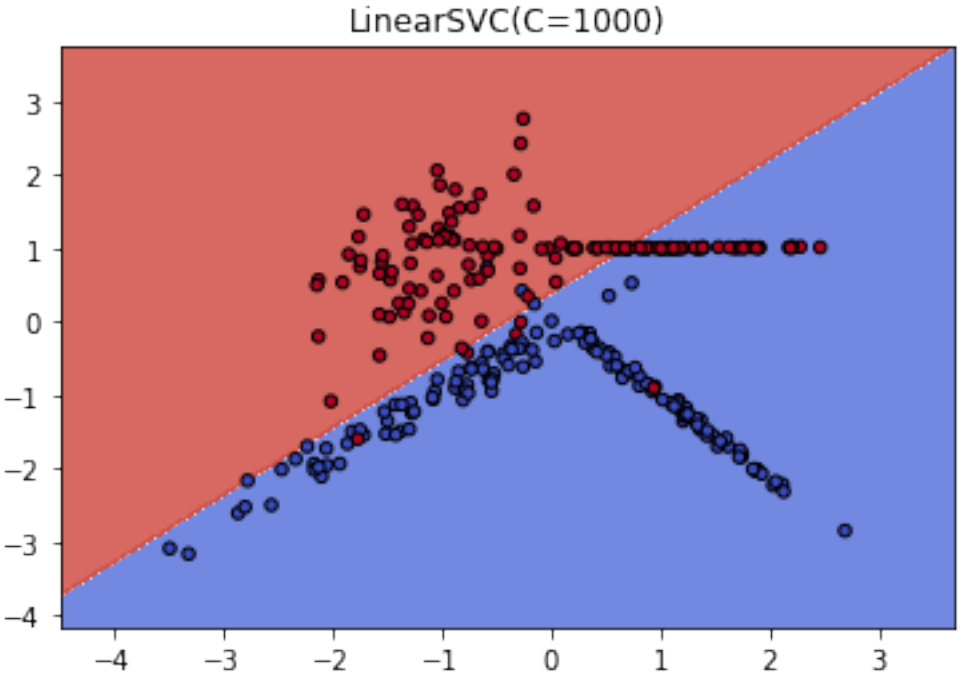
1.3.2 b)

```
In [106]: Cs = [0.001, 1, 1000]
          for i, C in enumerate(Cs):
              ls = LinearSVC(C=C);
              ls.fit(X_train, Y_train)
              titles = 'LinearSVC(C={})'.format(C)

              X0, X1 = X_train[:,0], X_train[:,1];
              xx, yy = make_meshgrid(X0, X1);

              # plot_counters(fig, models, xx, yy, cmap=plt.cm.coolwarm, alpha=0.8)
              Z = ls.predict(np.c_[xx.ravel(), yy.ravel()])
```

```
# print('Z.shape:{}, xx.shape:{}'.format(Z.shape, xx.shape))
Z = Z.reshape(xx.shape)
out = plt.contourf(xx, yy, Z, cmap=plt.cm.coolwarm, alpha=0.8)
# print('X0:{}, X1:{}, xx:{}, yy:{}'.format(X0.shape, X1.shape, xx.shape, yy.sha
plt.scatter(X0, X1, c=Y_train, cmap=plt.cm.coolwarm, s=20, edgecolors='k')
plt.title(titles)
plt.show()
```



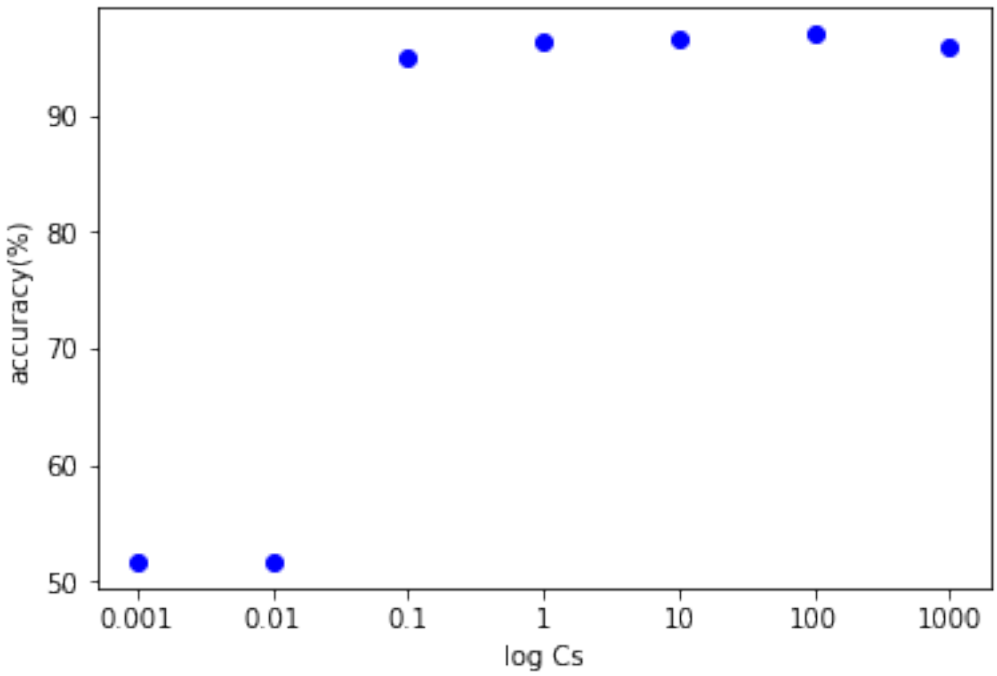

LinearSVC(C=1)
3
2
1
0
−1
−2
−3
−4
−4
−3
−2
−1
0
1
2
3


LinearSVC(C=1000)
3
2
1
0
−1
−2
−3
−4
−4
−3
−2
−1
0
1
2
3

1.3.3 c)

```
In [127]: Cs =  [0.001, 0.01, 0.1, 1, 10, 100, 1000]
          svc = svm.SVC()
          parameters = {'C':Cs}
          clf = GridSearchCV(svc, parameters)
          clf.fit(X_train, Y_train)
          y_predict = clf.predict(X_test)
          scores = clf.cv_results_['mean_test_score']
          print('d. scores:\n{}'.format(np.round(scores, decimals=4)))
          plt.plot(np.log10(Cs), scores*100, 'bo');
          plt.xticks([-3, -2, -1, 0, 1, 2, 3], Cs);
          plt.xlabel('log Cs');
          plt.ylabel('accuracy(%)');
```

```
d. scores:
[0.5167 0.5167 0.95   0.9633 0.9667 0.97   0.96  ]
```

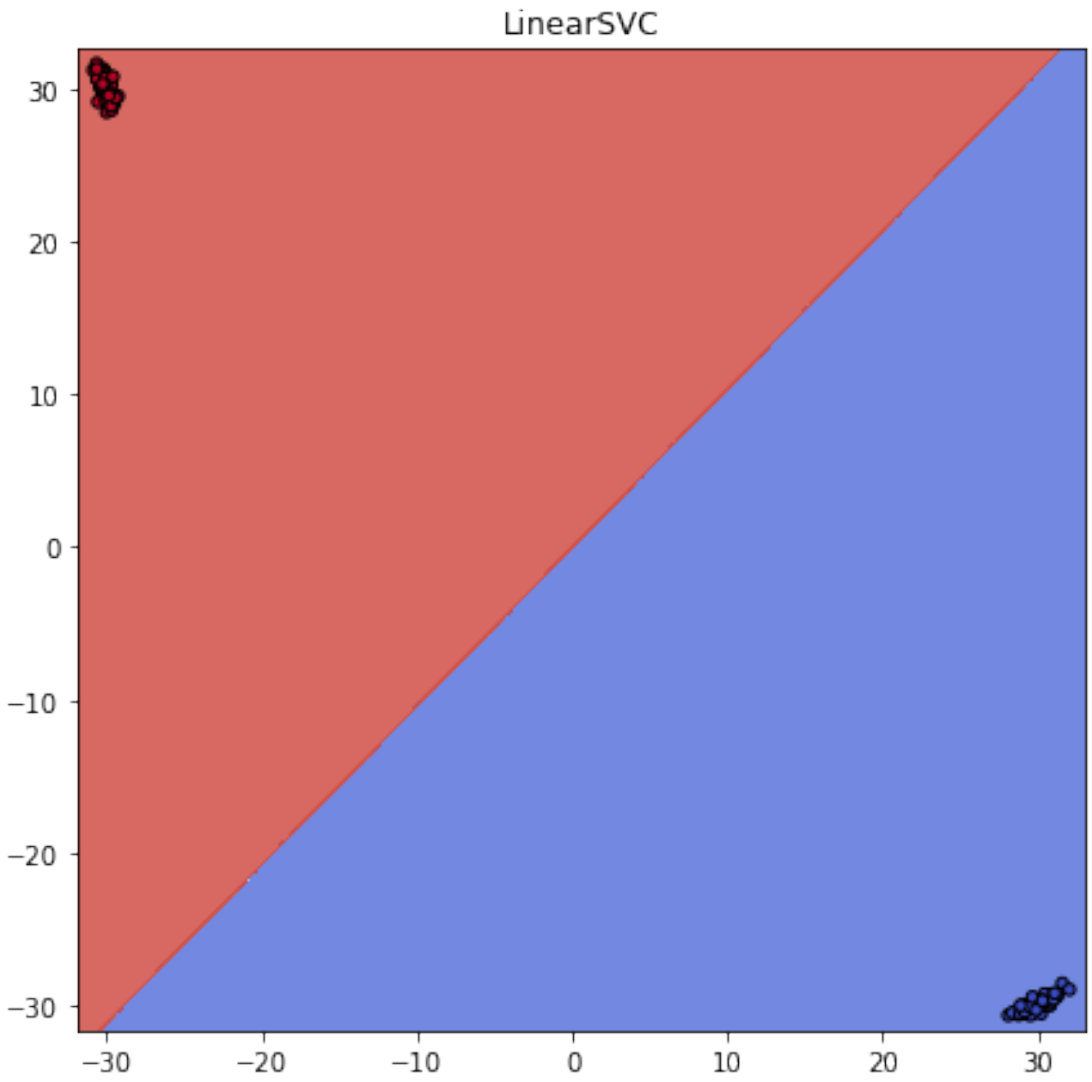


From the graph we can konws, that $C = 100$ is the best.

1.3.4 d)

```
In [163]: with open("dataset_1.pickle", "rb") as f:
              X_1, Y_1 = pickle.load(f)
          X_1_train, Y_1_train = X_1[:100], Y_1[:100]
```

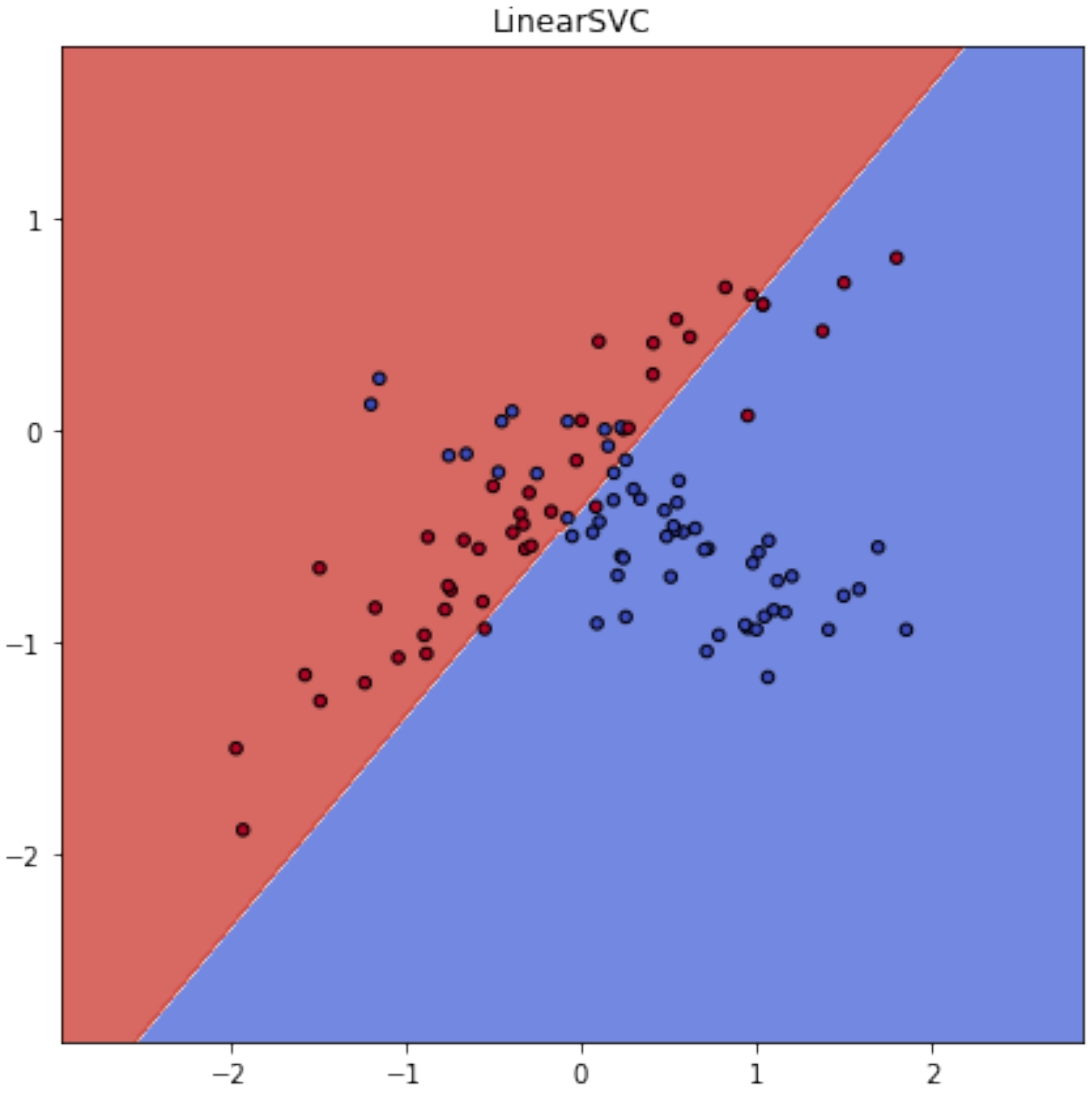
```
X_1_test, Y_1_test = X_1[100:], Y_1[100:]
# print(Y_1_train)


ls = LinearSVC();
ls.fit(X_1_train, Y_1_train)
titles = 'LinearSVC'

X0, X1 = X_1_train[:,0], X_1_train[:,1];
xx, yy = make_meshgrid(X0, X1);

fig = plt.figure(figsize=(7,7))
# plot_counters(fig, models, xx, yy, cmap=plt.cm.coolwarm, alpha=0.8)
Z = ls.predict(np.c_[xx.ravel(), yy.ravel()])
# print('Z.shape:{}, xx.shape:{}'.format(Z.shape, xx.shape))
Z = Z.reshape(xx.shape)
out = plt.contourf(xx, yy, Z, cmap=plt.cm.coolwarm, alpha=0.8)
# print('X0:{}, X1:{}, xx:{}, yy:{}'.format(X0.shape, X1.shape, xx.shape, yy.shape))
plt.scatter(X0, X1, c=Y_1_train, cmap=plt.cm.coolwarm, s=20, edgecolors='k')
plt.title(titles)
plt.show()
print('score: {}%'.format(np.round(ls.score(X_1_test, Y_1_test), decimals=4)*100))
```




```
score: 99.33%
```

```
In [164]: with open("dataset_2.pickle", "rb") as f:
              X_2, Y_2 = pickle.load(f)
          X_2_train, Y_2_train = X_2[:100], Y_2[:100]
          X_2_test, Y_2_test = X_2[100:], Y_2[100:]


          ls = LinearSVC();
          ls.fit(X_2_train, Y_2_train)
          titles = 'LinearSVC'

          X0, X1 = X_2_train[:,0], X_2_train[:,1];
```

```
xx, yy = make_meshgrid(X0, X1);

fig = plt.figure(figsize=(7,7))
# plot_counters(fig, models, xx, yy, cmap=plt.cm.coolwarm, alpha=0.8)
Z = ls.predict(np.c_[xx.ravel(), yy.ravel()])
# print('Z.shape:{}, xx.shape:{}'.format(Z.shape, xx.shape))
Z = Z.reshape(xx.shape)
out = plt.contourf(xx, yy, Z, cmap=plt.cm.coolwarm, alpha=0.8)
# print('X0:{}, X1:{}, xx:{}, yy:{}'.format(X0.shape, X1.shape, xx.shape, yy.shape))
plt.scatter(X0, X1, c=Y_2_train, cmap=plt.cm.coolwarm, s=20, edgecolors='k')
plt.title(titles)
plt.show()
print('score: {}%'.format(np.round(ls.score(X_2_test, Y_2_test), decimals=4)*100))
```



```
score: 79.0%
```

The first dataset is clearly and easy to classify, and the accuracy is 99.33%.
But the second dateset is difficult to classify, and the accuracy is only 79.0%.