Machine Learning HW6 - support vector machine

library

scikit learn

PCA

SVM (C-SVC)

GridSearchCV

pyplot

What I have done?

First, I try using sklearn.svm.SVC() with no argument.

panalty parameter C: 1.0

kernel: rbf

gamma: 1/n_feature And have a not bad score 95.32% accuracy!

By default, parameters are:

```
In [4]: model = svm.SVC()
        model.fit(X_train_np, T_train_np)

Out[4]: SVC(C=1.0, cache_size=200, class_weight=None, coef0=0.0,
          decision_function_shape='ovr', degree=3, gamma='auto', kernel='rbf',
          max_iter=-1, probability=False, random_state=None, shrinking=True,
          tol=0.001, verbose=False)

In [7]: model.score(X_test, T_test)

Out[7]: 0.95320000000000005
```

Use grid search sklearn.model_selection.GridSearchCV() to find best parameters

Visualize the result by using PCA to project data onto 2D space

Take me so much time waiting…

```
In [*]: model_cv = GridSearchCV(svm.SVC(), param_grid, cv=5)
        model_cv.fit(X_train_np, T_train_np)

In [24]: model_cv.best_params_

Out[24]: {'C': 2.0, 'gamma': 0.0004, 'kernel': 'rbf'}
```

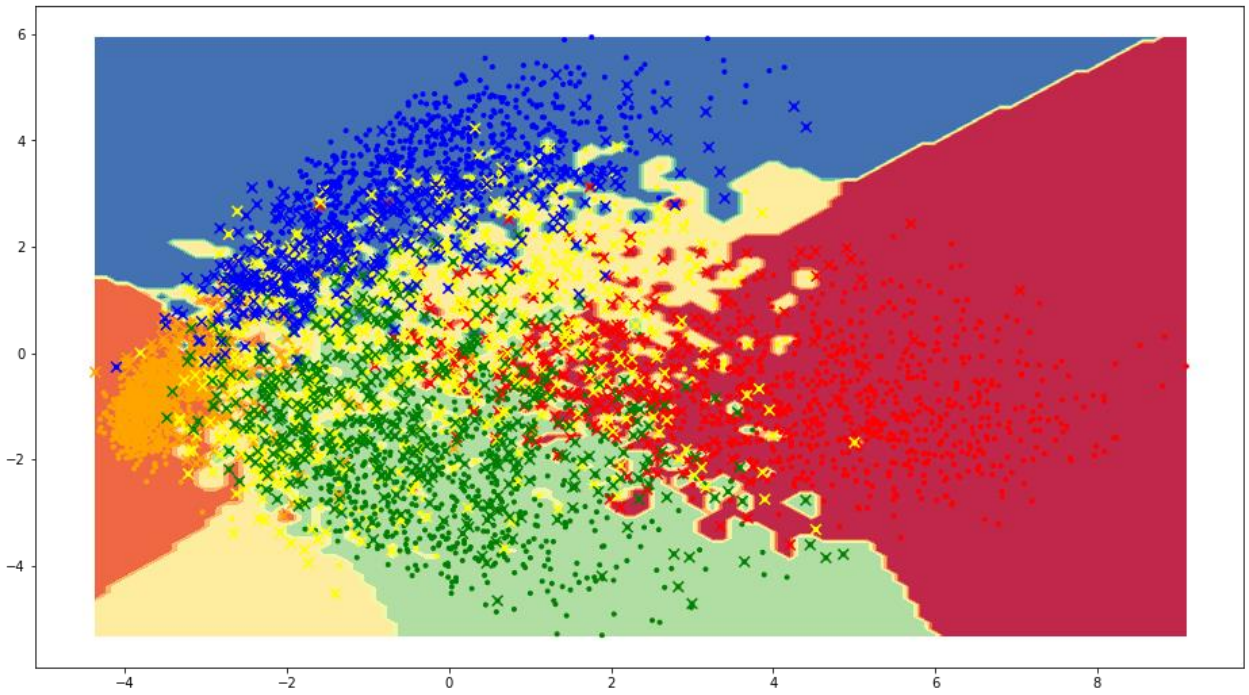
pca_2d = PCA(n_components=2, copy=True) X_train_2d = pca_2d.fit_transform(X_train_np) x_2d, y_2d = zip(*X_train_2d)

Scatter data points (use cross marker to identify support vectors)

plt.scatter(x_2d, y_2d, color=colors, marker='.') plt.scatter(x_SVs_2d, y_SVs_2d, color=color_SVs, marker='x', s=size)

Use Voronoi diagram generated from 1-nearset neighbor as visualization of decision

boundary
resolution = 100 # 100x100 background pixels X2d_xmin, X2d_xmax = np.min(X_train_2d[:,0]), np.max(X_train_2d[:,0]) X2d_ymin, X2d_ymax = np.min(X_train_2d[:,1]), np.max(X_train_2d[:,1]) xx, yy = np.meshgrid(np.linspace(X2d_xmin, X2d_xmax, resolution), np.linspace(X2d_ymin, X2d_ymax, resolution)) # approximate Voronoi tesselation on resolution x resolution grid using 1-NN background_model = KNeighborsClassifier(n_neighbors=1).fit(X_train_2d, T_train_predict)
voronoiBackground = background_model.predict(np.c_[xx.ravel(), yy.ravel()])
voronoiBackground = voronoiBackground.reshape((resolution, resolution))
Visualization result

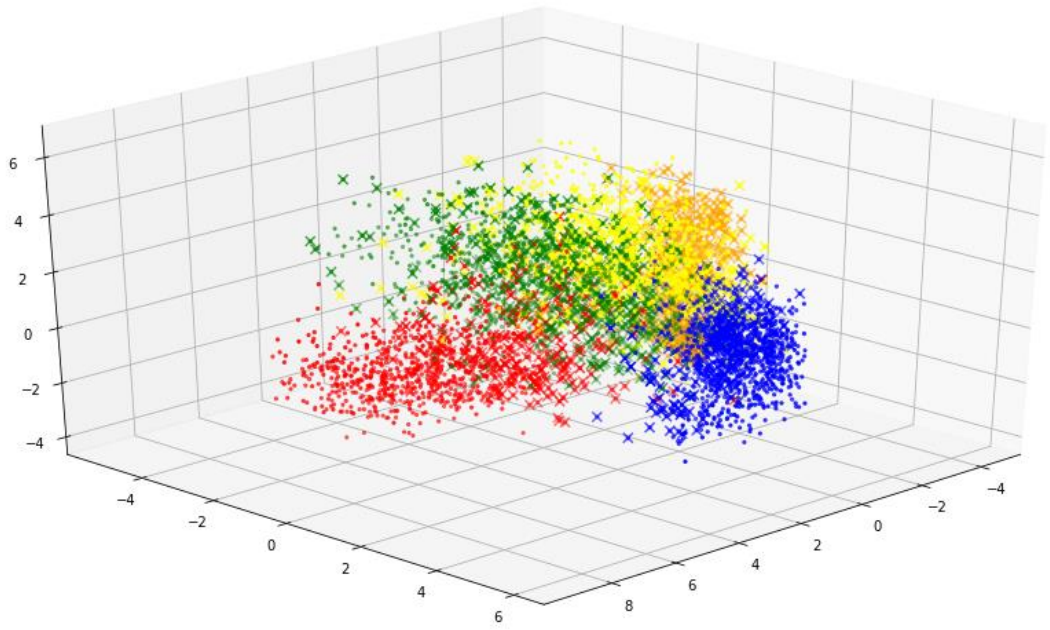


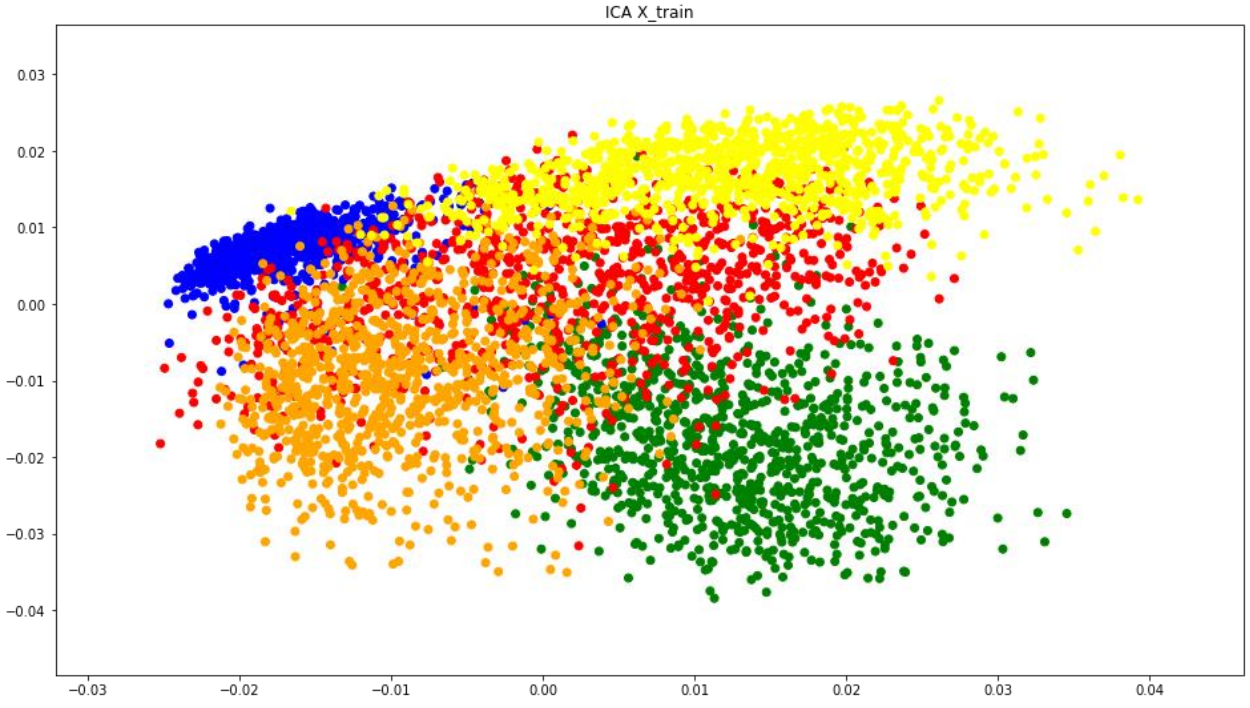
What I have learned?

There is library tools that can do grid search, I no longer need to brute-forcely write loop to try all parameters.
Effect in different hyper-parameter such as panalty C and gamma used for rbf kernel
First time use 3D plot!

Something else

Projecting to 3D space is easier to observe support vectors
ICA compare to PCA


6
4
2
0
−2
−4
−4
−2
0
2
4
6
8
−4
−2
0
2
4
6


ICA X_train
0.03
0.02
0.01
0.00
−0.01
−0.02
−0.03
−0.04
−0.03
−0.02
−0.01
0.00
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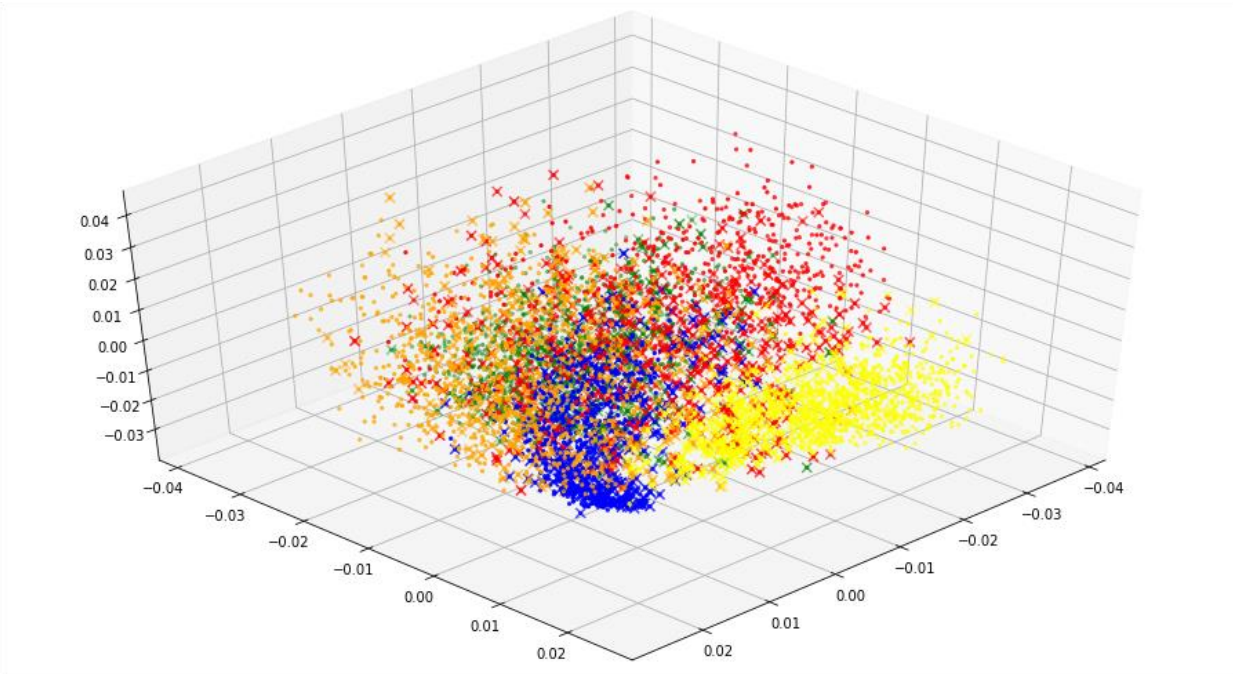
0.04


0.04
0.03
0.02
0.01
0.00
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−0.03
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