https://tensorflow.blog/2018/03/13/%EB%8B%A4%EC%A4%91-%ED%8F%89%EA%B0%80-%EC%A7%80%ED%91%9C-cross_validate/ (https://tensorflow.blog/2018/03/13/%EB%8B%A4%EC%A4%91-%ED%8F%89%EA%B0%80-%EC%A7%80%ED%91%9C-cross_validate/)

In [1]:

```
import pandas as pd
import numpy as np
from sklearn.datasets import load_digits
from sklearn.model_selection import train_test_split, cross_val_score
```

In [2]:

```
digits = load_digits()
X_train, X_test, y_train, y_test = train_test_split(digits.data, digits.target == 9, random_stat
e=42)
```

In [3]:

```
from sklearn.svm import SVC
```

In [4]:

```
cross_val_score(SVC(), X_train, y_train)
```

```
C:\Anaconda\lib\site-packages\sklearn\model_selection\_split.py:1978: FutureWarnin
g: The default value of cv will change from 3 to 5 in version 0.22. Specify it exp
licitly to silence this warning.
  warnings.warn(CV_WARNING, FutureWarning)
C:\Anaconda\lib\site-packages\sklearn\svm\base.py:193: FutureWarning: The default
value of gamma will change from 'auto' to 'scale' in version 0.22 to account bette
r for unscaled features. Set gamma explicitly to 'auto' or 'scale' to avoid this w
arning.
  "avoid this warning.", FutureWarning)
C:\Anaconda\lib\site-packages\sklearn\svm\base.py:193: FutureWarning: The default
value of gamma will change from 'auto' to 'scale' in version 0.22 to account bette
r for unscaled features. Set gamma explicitly to 'auto' or 'scale' to avoid this w
arning.
  "avoid this warning.", FutureWarning)
C:\Anaconda\lib\site-packages\sklearn\svm\base.py:193: FutureWarning: The default
value of gamma will change from 'auto' to 'scale' in version 0.22 to account bette
r for unscaled features. Set gamma explicitly to 'auto' or 'scale' to avoid this w
arning.
  "avoid this warning.", FutureWarning)
```

Out[4]:

```
array([0.90200445, 0.90200445, 0.90200445])
```

In [5]:

```
cross_val_score(SVC(), X_train, y_train, scoring='accuracy')
```

```
C:\Anaconda\lib\site-packages\sklearn\model_selection\_split.py:1978: FutureWarnin
g: The default value of cv will change from 3 to 5 in version 0.22. Specify it exp
licitly to silence this warning.
  warnings.warn(CV_WARNING, FutureWarning)
C:\Anaconda\lib\site-packages\sklearn\svm\base.py:193: FutureWarning: The default
value of gamma will change from 'auto' to 'scale' in version 0.22 to account bette
r for unscaled features. Set gamma explicitly to 'auto' or 'scale' to avoid this w
arning.
  "avoid this warning.", FutureWarning)
C:\Anaconda\lib\site-packages\sklearn\svm\base.py:193: FutureWarning: The default
value of gamma will change from 'auto' to 'scale' in version 0.22 to account bette
r for unscaled features. Set gamma explicitly to 'auto' or 'scale' to avoid this w
arning.
  "avoid this warning.", FutureWarning)
C:\Anaconda\lib\site-packages\sklearn\svm\base.py:193: FutureWarning: The default
value of gamma will change from 'auto' to 'scale' in version 0.22 to account bette
r for unscaled features. Set gamma explicitly to 'auto' or 'scale' to avoid this w
arning.
  "avoid this warning.", FutureWarning)
```

Out[5]:

```
array([0.90200445, 0.90200445, 0.90200445])
```

In [6]:

```
from sklearn.model_selection import cross_validate
```

In [7]:

```
cross_validate(SVC(), X_train, y_train,
               scoring=['accuracy', 'roc_auc'],
               return_train_score=True)
```

```
C:₩Anaconda₩lib₩site-packages₩sklearn₩model_selection₩_split.py:1978: FutureWarnin
g: The default value of cv will change from 3 to 5 in version 0.22. Specify it exp
licitly to silence this warning.
  warnings.warn(CV_WARNING, FutureWarning)
C:₩Anaconda₩lib₩site-packages₩sklearn₩svm₩base.py:193: FutureWarning: The default
value of gamma will change from 'auto' to 'scale' in version 0.22 to account bette
r for unscaled features. Set gamma explicitly to 'auto' or 'scale' to avoid this w
arning.
  "avoid this warning.", FutureWarning)
C:₩Anaconda₩lib₩site-packages₩sklearn₩svm₩base.py:193: FutureWarning: The default
value of gamma will change from 'auto' to 'scale' in version 0.22 to account bette
r for unscaled features. Set gamma explicitly to 'auto' or 'scale' to avoid this w
arning.
  "avoid this warning.", FutureWarning)
C:₩Anaconda₩lib₩site-packages₩sklearn₩svm₩base.py:193: FutureWarning: The default
value of gamma will change from 'auto' to 'scale' in version 0.22 to account bette
r for unscaled features. Set gamma explicitly to 'auto' or 'scale' to avoid this w
arning.
  "avoid this warning.", FutureWarning)
```

Out[7]:

```
{'fit_time': array([0.05805779, 0.05904937, 0.05804777]),
 'score_time': array([0.04703951, 0.04703856, 0.04703975]),
 'test_accuracy': array([0.90200445, 0.90200445, 0.90200445]),
 'train_accuracy': array([1., 1., 1.]),
 'test_roc_auc': array([0.99657688, 0.99814815, 0.99943883]),
 'train_roc_auc': array([1., 1., 1.])}
```

In [8]:

```
cross_validate(SVC(), X_train, y_train,
               scoring=['accuracy'],
               return_train_score=False)['test_accuracy']
```

```
C:₩Anaconda₩lib₩site-packages₩sklearn₩model_selection₩_split.py:1978: FutureWarnin
g: The default value of cv will change from 3 to 5 in version 0.22. Specify it exp
licitly to silence this warning.
  warnings.warn(CV_WARNING, FutureWarning)
C:₩Anaconda₩lib₩site-packages₩sklearn₩svm₩base.py:193: FutureWarning: The default
value of gamma will change from 'auto' to 'scale' in version 0.22 to account bette
r for unscaled features. Set gamma explicitly to 'auto' or 'scale' to avoid this w
arning.
  "avoid this warning.", FutureWarning)
C:₩Anaconda₩lib₩site-packages₩sklearn₩svm₩base.py:193: FutureWarning: The default
value of gamma will change from 'auto' to 'scale' in version 0.22 to account bette
r for unscaled features. Set gamma explicitly to 'auto' or 'scale' to avoid this w
arning.
  "avoid this warning.", FutureWarning)
C:₩Anaconda₩lib₩site-packages₩sklearn₩svm₩base.py:193: FutureWarning: The default
value of gamma will change from 'auto' to 'scale' in version 0.22 to account bette
r for unscaled features. Set gamma explicitly to 'auto' or 'scale' to avoid this w
arning.
  "avoid this warning.", FutureWarning)
```

Out[8]:

```
array([0.90200445, 0.90200445, 0.90200445])
```

In [9]:

```
cross_validate(SVC(), X_train, y_train,
               scoring={'acc':'accuracy', 'ra':'roc_auc'},
               return_train_score=False)
```

```
C:₩Anaconda₩lib₩site-packages₩sklearn₩model_selection₩_split.py:1978: FutureWarnin
g: The default value of cv will change from 3 to 5 in version 0.22. Specify it exp
licitly to silence this warning.
  warnings.warn(CV_WARNING, FutureWarning)
C:₩Anaconda₩lib₩site-packages₩sklearn₩svm₩base.py:193: FutureWarning: The default
value of gamma will change from 'auto' to 'scale' in version 0.22 to account bette
r for unscaled features. Set gamma explicitly to 'auto' or 'scale' to avoid this w
arning.
  "avoid this warning.", FutureWarning)
C:₩Anaconda₩lib₩site-packages₩sklearn₩svm₩base.py:193: FutureWarning: The default
value of gamma will change from 'auto' to 'scale' in version 0.22 to account bette
r for unscaled features. Set gamma explicitly to 'auto' or 'scale' to avoid this w
arning.
  "avoid this warning.", FutureWarning)
C:₩Anaconda₩lib₩site-packages₩sklearn₩svm₩base.py:193: FutureWarning: The default
value of gamma will change from 'auto' to 'scale' in version 0.22 to account bette
r for unscaled features. Set gamma explicitly to 'auto' or 'scale' to avoid this w
arning.
  "avoid this warning.", FutureWarning)
```

Out[9]:

```
{'fit_time': array([0.05905843, 0.05905795, 0.05803967]),
 'score_time': array([0.04703116, 0.04603934, 0.04704857]),
 'test_acc': array([0.90200445, 0.90200445, 0.90200445]),
 'test_ra': array([0.99657688, 0.99814815, 0.99943883])}
```

In [10]:

```
from sklearn.model_selection import GridSearchCV
```

In [11]:

```
param_grid = {'gamma': [0.0001, 0.01, 0.1, 1, 10]}
```

In [12]:

```
grid = GridSearchCV(SVC(), param_grid=param_grid,
                    scoring=['accuracy'], refit='accuracy',
                    return_train_score=True)
grid.fit(X_train, y_train)
```

```
C:₩Anaconda₩lib₩site-packages₩sklearn₩model_selection₩_split.py:1978: FutureWarnin
g: The default value of cv will change from 3 to 5 in version 0.22. Specify it exp
licitly to silence this warning.
  warnings.warn(CV_WARNING, FutureWarning)
```

Out[12]:

```
GridSearchCV(cv='warn', error_score='raise-deprecating',
             estimator=SVC(C=1.0, cache_size=200, class_weight=None, coef0=0.0,
                           decision_function_shape='ovr', degree=3,
                           gamma='auto_deprecated', kernel='rbf', max_iter=-1,
                           probability=False, random_state=None, shrinking=True,
                           tol=0.001, verbose=False),
             iid='warn', n_jobs=None,
             param_grid={'gamma': [0.0001, 0.01, 0.1, 1, 10]},
             pre_dispatch='2*n_jobs', refit='accuracy', return_train_score=True,
             scoring=['accuracy'], verbose=0)
```

In [13]:

```
grid.best_params_
```

Out[13]:

```
{'gamma': 0.0001}
```

In [14]:

```
grid.best_score_
```

Out[14]:

```
0.9651076466221232
```

In [15]:

```
np.transpose(pd.DataFrame(grid.cv_results_))
```

Out[15]:

	0	1	2	3	4
mean_fit_time	0.0110118	0.0560466	0.058375	0.100358	0.100081
std_fit_time	3.88849e-06	2.24783e-07	0.000475978	0.000388257	4.51249e-06
mean_score_time	0.00500409	0.0230227	0.0236967	0.0440365	0.0440366
std_score_time	1.12392e-07	4.49566e-06	0.000472269	2.9736e-07	3.89336e-07
param_gamma	0.0001	0.01	0.1	1	10
params	{'gamma': 0.0001}	{'gamma': 0.01}	{'gamma': 0.1}	{'gamma': 1}	{'gamma': 10}
split0_test_accuracy	0.966592	0.902004	0.902004	0.902004	0.902004
split1_test_accuracy	0.96882	0.902004	0.902004	0.902004	0.902004
split2_test_accuracy	0.959911	0.902004	0.902004	0.902004	0.902004
mean_test_accuracy	0.965108	0.902004	0.902004	0.902004	0.902004
std_test_accuracy	0.00378546	0	0	0	0
rank_test_accuracy	1	2	2	2	2
split0_train_accuracy	0.975501	1	1	1	1
split1_train_accuracy	0.962138	1	1	1	1
split2_train_accuracy	0.974388	1	1	1	1
mean_train_accuracy	0.970676	1	1	1	1
std_train_accuracy	0.00605401	0	0	0	0

In [16]:

```
grid = GridSearchCV(SVC(), param_grid=param_grid,
                    scoring={'acc':'accuracy', 'ra':'roc_auc'}, refit='ra',
                    return_train_score=True)
grid.fit(X_train, y_train)
```

```
C:WAnacondaWlibWsite-packagesWsklearnWmodel_selectionW_split.py:1978: FutureWarnin
g: The default value of cv will change from 3 to 5 in version 0.22. Specify it exp
licitly to silence this warning.
  warnings.warn(CV_WARNING, FutureWarning)
```

Out[16]:

```
GridSearchCV(cv='warn', error_score='raise-deprecating',
             estimator=SVC(C=1.0, cache_size=200, class_weight=None, coef0=0.0,
                           decision_function_shape='ovr', degree=3,
                           gamma='auto_deprecated', kernel='rbf', max_iter=-1,
                           probability=False, random_state=None, shrinking=True,
                           tol=0.001, verbose=False),
             iid='warn', n_jobs=None,
             param_grid={'gamma': [0.0001, 0.01, 0.1, 1, 10]},
             pre_dispatch='2*n_jobs', refit='ra', return_train_score=True,
             scoring={'acc': 'accuracy', 'ra': 'roc_auc'}, verbose=0)
```

In [17]:

```
grid.best_params_
```

Out[17]:

```
{'gamma': 0.01}
```

In [18]:

```
grid.best_score_
```

Out[18]:

```
0.9983352038907595
```

In [19]:

```
np.transpose(pd.DataFrame(grid.cv_results_))
```

Out[19]:

	0	1	2	3	4
mean_fit_time	0.0110088	0.0553826	0.0590529	0.100415	0.10117
std_fit_time	7.60535e-06	0.00046981	0.000813521	0.00124911	0.000113794
mean_score_time	0.0100088	0.0470335	0.0473766	0.0880806	0.0883288
std_score_time	7.69123e-06	4.22479e-06	0.000476765	3.99109e-06	0.00035999
param_gamma	0.0001	0.01	0.1	1	10
params	{'gamma': 0.0001}	{'gamma': 0.01}	{'gamma': 0.1}	{'gamma': 1}	{'gamma': 10}
split0_test_acc	0.966592	0.902004	0.902004	0.902004	0.902004
split1_test_acc	0.96882	0.902004	0.902004	0.902004	0.902004
split2_test_acc	0.959911	0.902004	0.902004	0.902004	0.902004
mean_test_acc	0.965108	0.902004	0.902004	0.902004	0.902004
std_test_acc	0.00378546	0	0	0	0
rank_test_acc	1	2	2	2	2
split0_train_acc	0.975501	1	1	1	1
split1_train_acc	0.962138	1	1	1	1
split2_train_acc	0.974388	1	1	1	1
mean_train_acc	0.970676	1	1	1	1
std_train_acc	0.00605401	0	0	0	0
split0_test_ra	0.98367	0.997419	0.934007	0.5	0.5
split1_test_ra	0.987149	0.998148	0.912458	0.5	0.5
split2_test_ra	0.994388	0.999439	0.910494	0.5	0.5
mean_test_ra	0.988403	0.998335	0.918986	0.5	0.5
std_test_ra	0.00446456	0.000835283	0.0106514	0	0
rank_test_ra	2	1	3	4	4
split0_train_ra	0.992017	1	1	1	1
split1_train_ra	0.994935	1	1	1	1
split2_train_ra	0.98945	1	1	1	1
mean_train_ra	0.992134	1	1	1	1
std_train_ra	0.00224093	0	6.40988e-17	0	0

In [20]:

```
grid.best_estimator_
```

Out[20]:

```
SVC(C=1.0, cache_size=200, class_weight=None, coef0=0.0,
    decision_function_shape='ovr', degree=3, gamma=0.01, kernel='rbf',
    max_iter=-1, probability=False, random_state=None, shrinking=True,
    tol=0.001, verbose=False)
```

In [ ]: