KFold Cross Validation Python Tutorial

Which Machine Learning model should I use to solve my problem?

Cross-validation is a technique to evaluate machine learning models on a limited data sample.

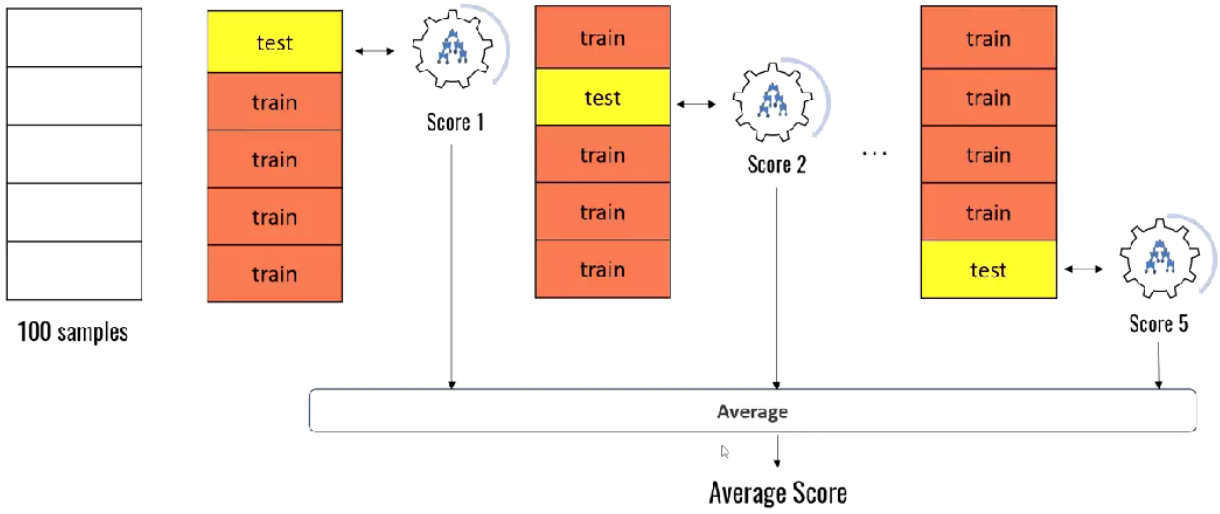
Option 1: Use all available data for training and test on same dataset.

There is no point to use all the data.

Option 2: Split available dataset into training and test sets.

Maybe there is not enough information about test data so the model is not performed well.

Option 3: K fold cross calidation



Cross-validation is a resampling procedure used to evaluate machine learning models on a limited data sample. The procedure has a single parameter called k that refers to the number of groups that a given data sample is to be split into. As such, the procedure is often called k-fold cross-validation.

Purpose: Clasify the digits datasets with different algorithms & evaluate them

In [1]:
```
from sklearn.linear_model import LogisticRegression
from sklearn.svm import SVC
from sklearn.ensemble import RandomForestClassifier
import numpy as np
from sklearn.datasets import load_digits
import matplotlib.pyplot as plt
digits = load_digits()
```

train test split

In [2]:
```
from sklearn.model_selection import train_test_split
X_train, X_test, y_train, y_test = train_test_split(digits.data,digits.target,test
```

Logistic Regression

In [3]:
```
lr = LogisticRegression(solver='liblinear',multi_class='ovr')
lr.fit(X_train, y_train)
lr.score(X_test, y_test)
```

Out[3]:
```
0.9462962962962963
```

SVM

In [4]:
```
svm = SVC(gamma='auto')
svm.fit(X_train, y_train)
svm.score(X_test, y_test)
```

Out[4]:
```
0.5481481481481482
```

Random Forest

In [5]:
```
rf = RandomForestClassifier(n_estimators=40)
rf.fit(X_train, y_train)
rf.score(X_test, y_test)
```

Out[5]:
```
0.9685185185185186
```

KFold cross validation

Basic example

In [6]:
```
from sklearn.model_selection import KFold
kf = KFold(n_splits=3)
kf
```

Out[6]:
```
KFold(n_splits=3, random_state=None, shuffle=False)
```

In [7]:
```
for train_index, test_index in kf.split([1,2,3,4,5,6,7,8,9]):
    print(train_index, test_index)
```

```
[3 4 5 6 7 8] [0 1 2]
[0 1 2 6 7 8] [3 4 5]
[0 1 2 3 4 5] [6 7 8]
```

Function get_score for measuring scores

In [8]:
```
def get_score(model, X_train, X_test, y_train, y_test):
    model.fit(X_train, y_train)
    return model.score(X_test, y_test)
```

Use KFold for our digits example

In [9]:
```
from sklearn.model_selection import StratifiedKFold
folds = StratifiedKFold(n_splits=3)
```

In [10]:
```
scores_lr = []
scores_svm = []
scores_rf = []

for train_index, test_index in folds.split(digits.data,digits.target):
    X_train, X_test, y_train, y_test = digits.data[train_index], digits.data[test_
                                       digits.target[train_index], digits.target[t
    scores_lr.append(get_score(LogisticRegression(solver='liblinear',multi_class='
    scores_svm.append(get_score(SVC(gamma='auto'), X_train, X_test, y_train, y_tes
    scores_rf.append(get_score(RandomForestClassifier(n_estimators=40), X_train, X
```

In [11]:
```
scores_lr
```

Out[11]:
```
[0.8948247078464107, 0.9532554257095158, 0.9098497495826378]
```

In [12]:
```
scores_svm
```

Out[12]:
```
[0.3806343906510851, 0.41068447412353926, 0.5125208681135225]
```

In [13]:
```
scores_rf
```

Out[13]:
```
[0.9315525876460768, 0.9616026711185309, 0.9398998330550918]
```

In real Machine Learning problem you don't need that much code for cross validation score function.

cross_val_score function

In [14]:
```
from sklearn.model_selection import cross_val_score
```

Logistic regression model performance using cross_val_score

In [15]:
```
# This line doing the same thing like for loop mentioned before
cross_val_score(LogisticRegression(solver='liblinear',multi_class='ovr'), digits.d
```

Out[15]:
```
array([0.89482471, 0.95325543, 0.90984975])
```

svm model performance using cross_val_score

In [16]:
```
cross_val_score(SVC(gamma='auto'), digits.data, digits.target,cv=3)
```

Out[16]:
```
array([0.38063439, 0.41068447, 0.51252087])
```

random forest performance using cross_val_score

In [17]:
```
cross_val_score(RandomForestClassifier(n_estimators=40),digits.data, digits.target
```

Out[17]:
```
array([0.93489149, 0.94991653, 0.92320534])
```

cross_val_score uses stratifield kfold by default

Parameter tunning using k fold cross validation

In [18]:
```
scores1 = cross_val_score(RandomForestClassifier(n_estimators=5),digits.data, digi
np.average(scores1)
```

Out[18]:
```
0.8864804469273743
```

In [19]:
```
scores2 = cross_val_score(RandomForestClassifier(n_estimators=20),digits.data, dig
np.average(scores2)
```

Out[19]:
```
0.939891371818746
```

In [20]:
```
scores3 = cross_val_score(RandomForestClassifier(n_estimators=30),digits.data, dig
np.average(scores3)
```

Out[20]:
```
0.9471073867163252
```

In [21]:
```
scores4 = cross_val_score(RandomForestClassifier(n_estimators=40),digits.data, dig
np.average(scores4)
```

Out[21]:
```
0.9482402234636871
```

Here we used cross_val_score to fine tune our random forest classifier and figured that having around 40 trees in random forest gives best result.

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