Small data technique

Practice Session 15

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January 26, 2024

Outline

Implementation of random forests

Tasks: Iris plants classification

California housing price prediction

Handwritten digit classification

Random forests for Iris plants classification

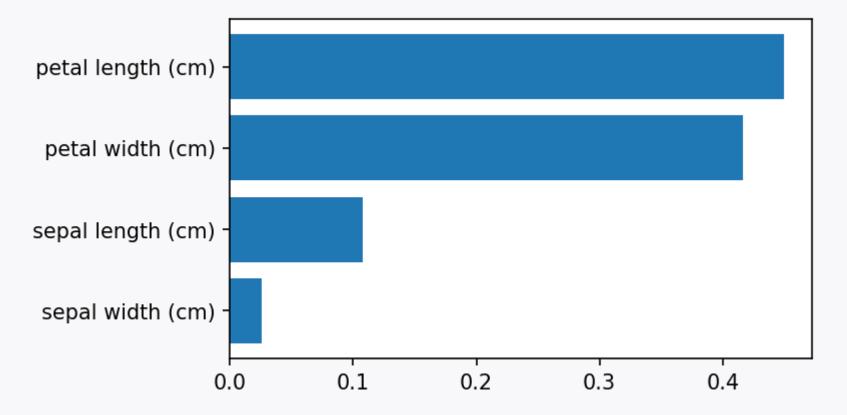
```
from sklearn.datasets import load_iris
Iris = load_iris()
X = Iris.data
y = Iris.target
from sklearn.model_selection import train_test_split
from sklearn.ensemble import RandomForestClassifier
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2)
rnd_clf = RandomForestClassifier(n_estimators=500, max_leaf_nodes=16, n_jobs=-1)
                                        use all available CPU's
rnd_clf.fit(X_train, y_train)
y_pred = rnd_clf.predict(X_test)
print(rnd_clf.score(X_test,y_test))
                                         0.966666666666666
```

Feature importance

```
for name, score in zip(iris.feature_names, rnd_clf.feature_importances_):
    print(name, score)
```

```
sepal length (cm) 0.08955824422368722
sepal width (cm) 0.02154267813628801
petal length (cm) 0.4454233433559405
petal width (cm) 0.44347573428408404
```

Feature importance visualization



Random forests for Cali House Price Pred.

```
from sklearn.datasets import fetch_california_housing
cali_prices = fetch_california_housing()
X_reg = cali_prices.data
y_reg = cali_prices.target
from sklearn.model_selection import train_test_split
from sklearn.ensemble import RandomForestRegressor
from sklearn.metrics import mean_squared_error
X_train, X_test, y_train, y_test = train_test_split(X_reg, y_reg, test_size = 0.01)
for_reg = RandomForestRegressor()
for_reg.fit(X_train, y_train)
y_pred_train = for_reg.predict(X_train)
y_pred_test = for_reg.predict(X_test)
print(mean_squared_error(y_pred_train, y_train))
print(mean_squared_error(y_pred_test, y_test))
```

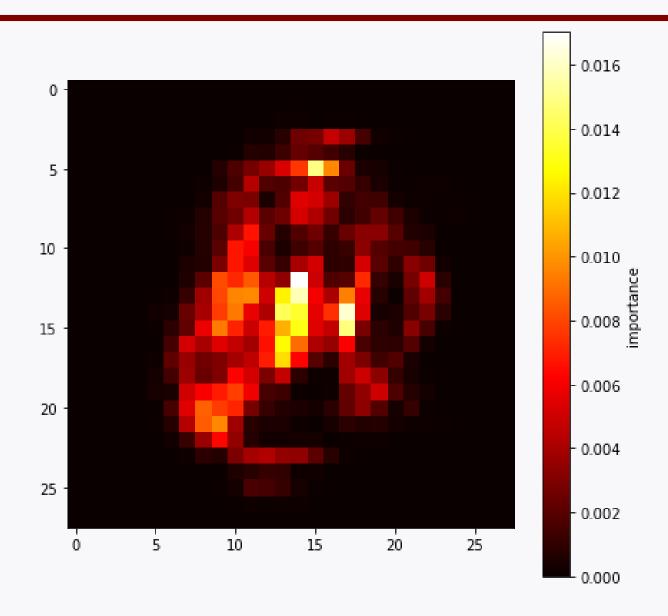
- 0.03454954220428868
- 0.3383040535545396

Random forests for MNIST classification

```
from keras.datasets import mnist
from sklearn.model_selection import train_test_split
(X_train, y_train), (X_test, y_test) = mnist.load_data()
X_{train}, X_{test} = X_{train} / 255., X_{test} / 255.
X_{train} = X_{train.reshape}(-1, 28*28)
X_{\text{test}} = X_{\text{test.reshape}}(-1, 28*28)
from sklearn.ensemble import RandomForestClassifier
rnd_clf = RandomForestClassifier(n_estimators=500,
                                   max_leaf_nodes=16,
                                   n iobs=-1
rnd_clf.fit(X_train, y_train)
y_pred = rnd_clf.predict(X_test)
print(rnd_clf.score(X_test,y_test))
0.8298
```

Feature importance visualization

Feature importance visualization



Hyperparameter search: GridSearchCV

```
from sklearn.datasets import load_iris
from sklearn.model_selection import train_test_split
lris = load_iris()
X = Iris.data
y = Iris.target
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2)
from sklearn.model_selection import GridSearchCV
param\_grid = \{ 'n\_estimators' : [3, 10, 100, 500], \}
               'max features': [0.25, 0.5, 0.75, 1]}
forest_clf = RandomForestClassifier(max_depth=2)
grid_search = GridSearchCV(forest_clf,param_grid,cv=5,scoring='accuracy')
grid_search.fit(X_train, y_train)
```

Hyperparameter search: GridSearchCV

```
print(grid_search.best_params_)
{'max_features': 0.75, 'n_estimators': 10}
print(grid_search.best_estimator_)
 RandomForestClassifier(max_depth=2, max_features=0.75, n_estimators=10)
print(grid_search.best_score_)
                                       0.96666666666666
feature_importances = grid_search.best_estimator_.feature_importances_
print(feature_importances)
 [0.
                   0.31446851 0.68553149]
```

Hyperparameter search: GridSearchCV

```
from sklearn.metrics import accuracy_score
y_pred = grid_search.best_estimator_.predict(X_test)
print(accuracy_score(y_pred, y_test))
0.9333333333333333
print(grid search.best estimator .score(X test,y test))
0.9333333333333333
```

RandomizedSearchCV

```
from sklearn.model_selection import RandomizedSearchCV
param_distributions = { 'n_estimators': range(500),
                        'max_features': range(1, 5)}
forest_clf = RandomForestClassifier(max_depth=2)
randomized_search = RandomizedSearchCV(forest_clf,
                                      param_distributions,
                                      cv=4. n iter = 50.
                                      scoring='accuracy')
randomized_search.fit(X_train, y_train)
```

RandomizedSearchCV

```
print(randomized_search.best_params_)
{'n_estimators': 419, 'max_features': 2}
print(randomized_search.best_estimator_)
RandomForestClassifier(max_depth=2, max_features=2, n_estimators=419)
print(randomized_search.best_score_)
0.9333333333333333
feature_importances = randomized_search.best_estimator_.feature_importances_
print(feature_importances)
[0.10610445 0.018726 0.41529867 0.45987088]
```

RandomizedSearchCV

```
y_pred = randomized_search.best_estimator_.predict(X_test)
print(accuracy_score(y_pred, y_test))
0.9666666666666667

print(randomized_search.best_estimator_.score(X_test,y_test))
0.9666666666666667
```