MNIST using PCA and kNN

PinkLAB Edu

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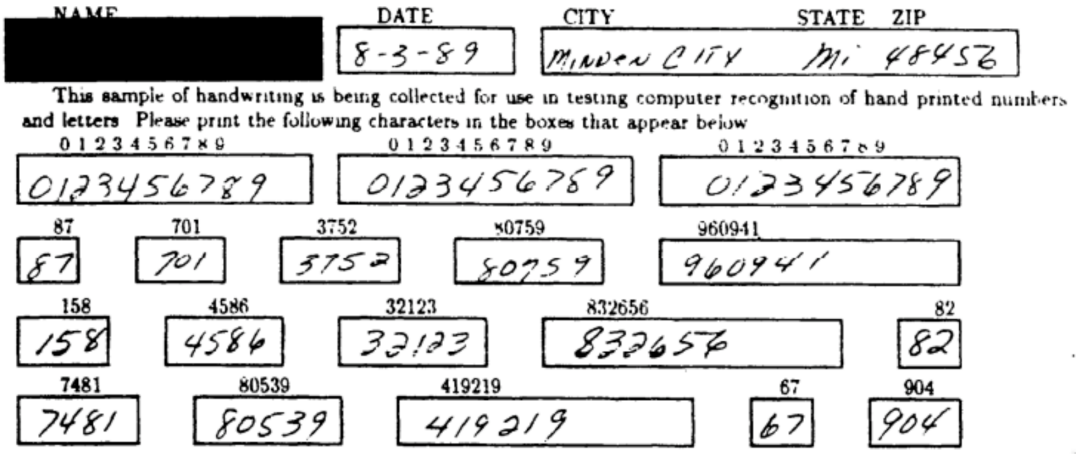
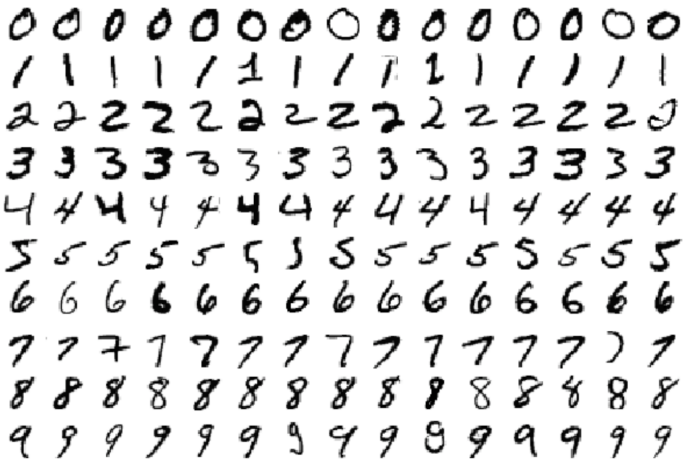
1.1 NIST



- **NIST** 데이터 셋 **(National Institute of Standards and Technology)**

1.2 MNIST

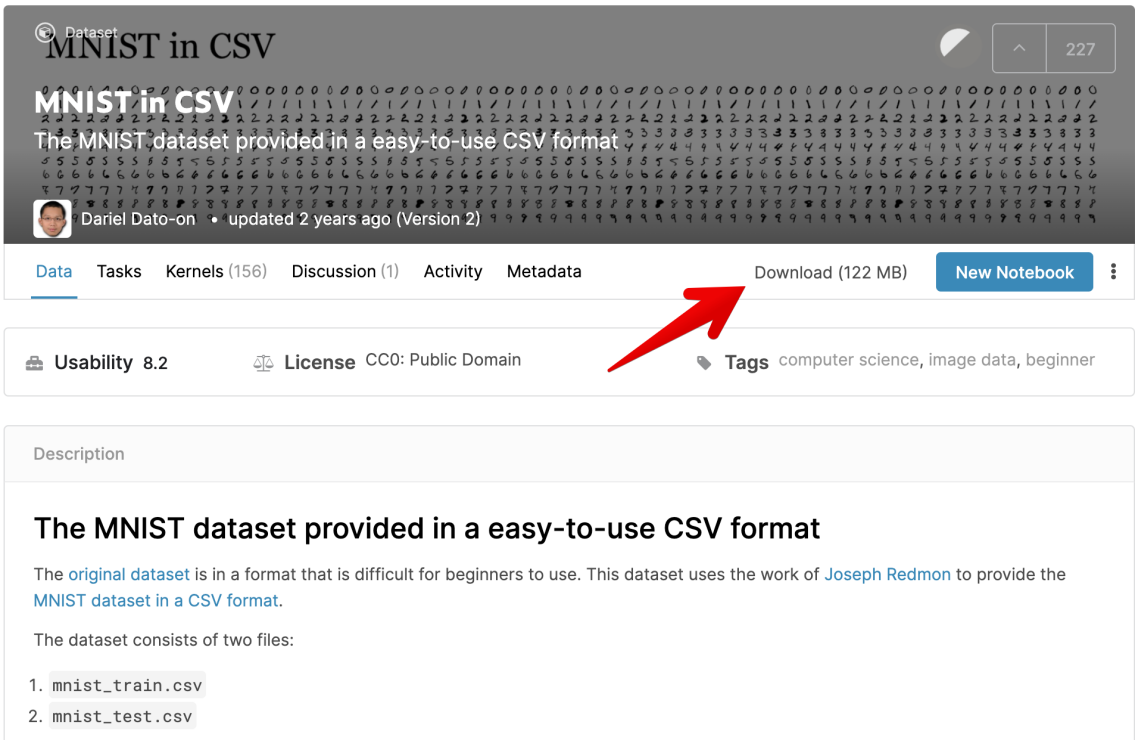


- **MNIST** 데이터 셋 **(Modified National Institute of Standards and Technology)**

- **28*28** 픽셀의 **0~9** 사이의 숫자 이미지와 레이블로 구성된 셋
- 머신 러닝을 공부하는 사람들이 입문용으로 사용함
- **60000**개의 훈령용 셋과 **10000**개의 실험용 셋으로 구성

1.3 kaggle에서 받기

- https://www.kaggle.com/oddrationale/mnist-in-csv



2 using PCA and kNN

2.1 데이터 읽기

```
import pandas as pd

df_train = pd.read_csv('./data/mnist_train.csv')
df_test = pd.read_csv('./data/mnist_test.csv')


df_train.shape, df_test.shape
```

✓ 2.0s Python

```
((60000, 785), (10000, 785))
```

2.2 train 데이터의 생긴 모양

```
df_train
```

✓ 0.0s Python

	label	1x1	1x2	1x3	1x4	1x5	1x6	1x7	1x8	1x9	...	28x19	28x20	28x21	28x22	28x
0	5	0	0	0	0	0	0	0	0	0	...	0	0	0	0	
1	0	0	0	0	0	0	0	0	0	0	...	0	0	0	0	
2	4	0	0	0	0	0	0	0	0	0	...	0	0	0	0	
3	1	0	0	0	0	0	0	0	0	0	...	0	0	0	0	
4	9	0	0	0	0	0	0	0	0	0	...	0	0	0	0	
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
59995	8	0	0	0	0	0	0	0	0	0	...	0	0	0	0	
59996	3	0	0	0	0	0	0	0	0	0	...	0	0	0	0	
59997	5	0	0	0	0	0	0	0	0	0	...	0	0	0	0	
59998	6	0	0	0	0	0	0	0	0	0	...	0	0	0	0	
59999	8	0	0	0	0	0	0	0	0	0	...	0	0	0	0	

60000 rows × 785 columns

2.3 test 데이터의 생긴 모양

```
df_test
```

Python

	label	1x1	1x2	1x3	1x4	1x5	1x6	1x7	1x8	1x9	...	28x19	28x20	28x21	28x22	28x2
0	7	0	0	0	0	0	0	0	0	0	...	0	0	0	0	
1	2	0	0	0	0	0	0	0	0	0	...	0	0	0	0	
2	1	0	0	0	0	0	0	0	0	0	...	0	0	0	0	
3	0	0	0	0	0	0	0	0	0	0	...	0	0	0	0	
4	4	0	0	0	0	0	0	0	0	0	...	0	0	0	0	
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
9995	2	0	0	0	0	0	0	0	0	0	...	0	0	0	0	
9996	3	0	0	0	0	0	0	0	0	0	...	0	0	0	0	
9997	4	0	0	0	0	0	0	0	0	0	...	0	0	0	0	
9998	5	0	0	0	0	0	0	0	0	0	...	0	0	0	0	
9999	6	0	0	0	0	0	0	0	0	0	...	0	0	0	0	

10000 rows × 785 columns

2.4 데이터 정리

```
import numpy as np

X_train = np.array(df_train.iloc[:, 1:])
y_train = np.array(df_train['label'])

X_test = np.array(df_test.iloc[:, 1:])
y_test = np.array(df_test['label'])

X_train.shape , y_train.shape, X_test.shape,  y_test.shape
```

Python

```
((60000, 784), (60000,), (10000, 784), (10000,))
```

2.5 근데 어떻게 생긴 데이터인지 확인해볼까

```python
import random

samples = random.choices(population = range(0, 60000), k = 16)
samples
```

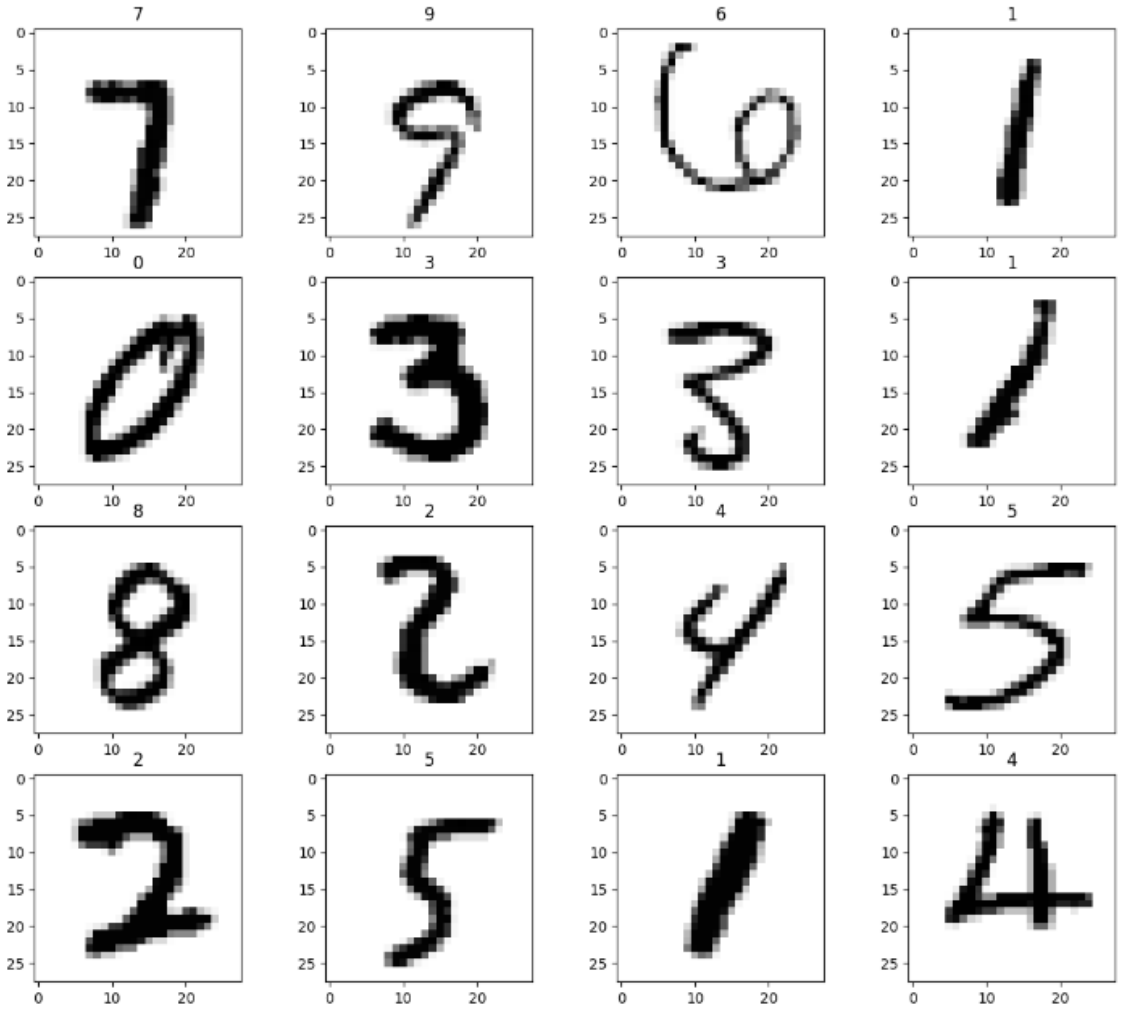
✓ 0.0s Python

```
[1564,
 54334,
 15404,
 27256,
 18357,
 8537,
 25855,
 34053,
 11067,
 21952,
 3399,
 31435,
 8632,
 18167,
 15316,
 1220]
```

2.6 random하게 16개만~

```
import matplotlib.pyplot as plt

plt.figure(figsize=(14, 12))

for idx, n in enumerate(samples):
    plt.subplot(4, 4, idx + 1)
    plt.imshow(X_train[n].reshape(28, 28), cmap="Greys", interpolation="nearest")
    plt.title(y_train[n])

plt.show()
```

✓ 1.1s Python



2.7 일단 fit

```python
from sklearn.neighbors import KNeighborsClassifier
import time

start_time = time.time()

clf = KNeighborsClassifier(n_neighbors=5)
clf.fit(X_train, y_train)

print("FIt time : ", time.time() - start_time)
```

✓ 0.7s Python

```
FIt time :  0.13118720054626465
```

2.8 test 데이터 predict

```python
from sklearn.metrics import accuracy_score

start_time = time.time()
pred = clf.predict(X_test)
print("Fit time : ", time.time() - start_time)
print(accuracy_score(y_test, pred))
```

✓ 13.3s Python

```
Fit time :  13.377159118652344
0.9688
```

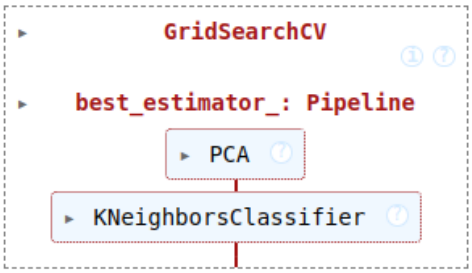
2.9 kNN은 차원의 저주가 있다~~~

2.10 PCA로 차원을 줄여주자

```python
from sklearn.pipeline import Pipeline
from sklearn.decomposition import PCA
from sklearn.model_selection import GridSearchCV, StratifiedKFold

pipe = Pipeline(
    [
        ("pca", PCA()),
        ("clf", KNeighborsClassifier()),
    ]
)

parameters = {"pca__n_components": [2, 5, 10], "clf__n_neighbors": [5, 10, 15]}


kf = StratifiedKFold(n_splits=5, shuffle=True, random_state=13)
grid = GridSearchCV(pipe, parameters, cv=kf, n_jobs=-1, verbose=1)
grid.fit(X_train, y_train)
```

✓ 1m 4.2s Python

```
Fitting 5 folds for each of 9 candidates, totalling 45 fits
```



2.11 best score

```python
print("Best score : %0.3f" % grid.best_score_)
print("Best parameters set : ")

best_parameters = grid.best_estimator_.get_params()
for param_name in sorted(parameters.keys()):
    print("\t%s: %r" % (param_name, best_parameters[param_name]))
```

✓ 0.0s Python

```
Best score : 0.931
Best parameters set :
        clf__n_neighbors: 10
        pca__n_components: 10
```

2.12 단지 이정도 수준으로 약 93%의 acc가 확보된다

```
accuracy_score(y_test, grid.best_estimator_.predict(X_test))
```

Python

```
0.9291
```

2.13 결과확인

```
def results(y_pred, y_test):
    from sklearn.metrics import classification_report

    print(classification_report(y_test, y_pred))


results(grid.predict(X_train), y_train)
```

✓ 7.3s Python

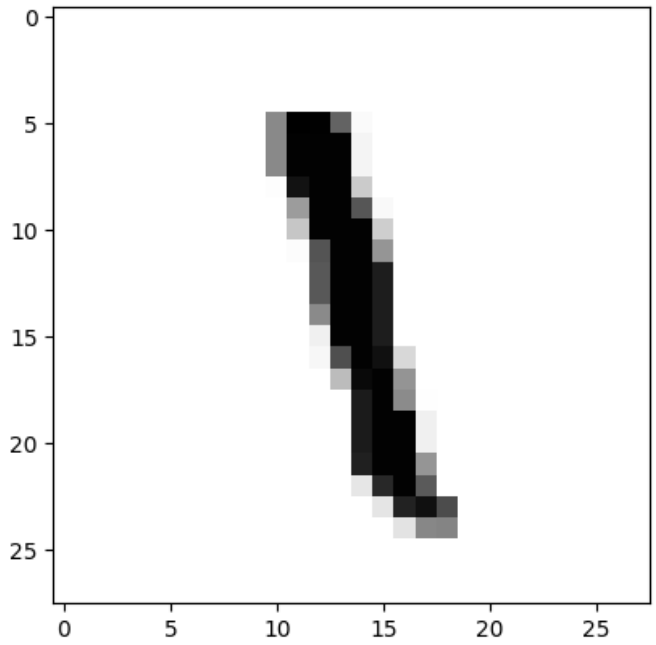
2.14 골고루 잘 맞추고 있다

```
              precision    recall  f1-score   support

           0       0.96      0.98      0.97      5923
           1       0.98      0.99      0.98      6742
           2       0.96      0.96      0.96      5958
           3       0.94      0.90      0.92      6131
           4       0.94      0.93      0.93      5842
           5       0.93      0.94      0.93      5421
           6       0.96      0.98      0.97      5918
           7       0.96      0.95      0.96      6265
           8       0.92      0.91      0.91      5851
           9       0.90      0.91      0.90      5949

    accuracy                           0.94     60000
   macro avg       0.94      0.94      0.94     60000
weighted avg       0.94      0.94      0.94     60000
```

2.15 숫자를 다시 확인하고 싶다면

```
n = 700
plt.imshow(X_test[n].reshape(28, 28), cmap="Greys", interpolation="nearest")
plt.show()

print("Answer is  : ", grid.best_estimator_.predict(X_test[n].reshape(1, 784)))
print("Real Label is : ", y_test[n])
```

✓ 0.0s Python




```
Answer is  :  [1]
Real Label is :  1
```

2.16 틀린 데이터가 어떻게 생겼는지 확인해보자

```
preds = grid.best_estimator_.predict(X_test)
preds
```

✓ 1.2s Python

```
array([7, 2, 1, ..., 4, 5, 6], shape=(10000,))
```

```
y_test
```

✓ 0.0s Python

```
array([7, 2, 1, ..., 4, 5, 6], shape=(10000,))
```

2.17 틀린 데이터를 추려서

```python
wrong_results = X_test[y_test != preds]
samples = random.choices(population=range(0, wrong_results.shape[0]), k=16)

plt.figure(figsize=(14, 12))

for idx, n in enumerate(samples):
    plt.subplot(4, 4, idx + 1)
    plt.imshow(
        wrong_results[n].reshape(28, 28),
        cmap="Greys",
        interpolation="nearest"
        )
    plt.title(grid.best_estimator_.predict(wrong_results[n].reshape(1, 784))[0])

plt.show()
```

Python

2.18 틀릴만 한 것도 있다