AI+x 인재양성 확대를 위한 교수자 연수

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- 4강
MNIST 손글씨

-MNIST 손 글씨 데이터를 분류해본다

한국폴리텍대학
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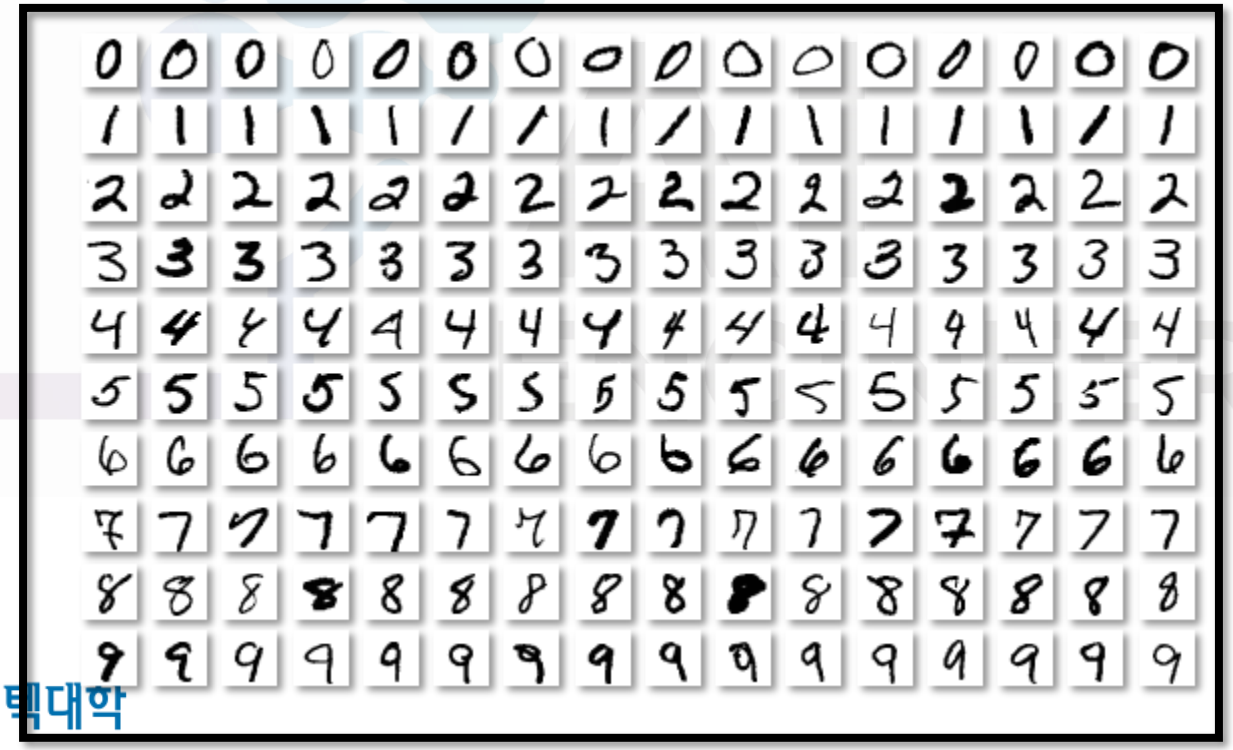
MNIST

◆MNIST 데이터베이스

- NIST – 미국 국립표준기술 연구소
- National Institute of Standards and Technology
- Modified NIST 데이터 베이스



MNIST Data

- 손 글씨로 쓰여진 숫자 데이터
  - 클래스 10개
- 데이터 셋 구성
  - 트레이닝 데이터 60000개
  - 테스트 데이터 10000개
- 적절한 난이도… 기계 학습 하기에 적당하다.

Data load

- Github 에서 다운로드 가능
  - https://github.com/AI-Engineering/AI-X-2021.7/tree/main/src/mnist/dataset

```
def load_dataset(online=False):
    if online:
        (tr_data, tr_label), (te_data, te_label) = tf.keras.datasets.mnist.load_data()

    else:
        path = "D:/Project/Mnist/dataset/mnist.npz"
        (tr_data, tr_label), (te_data, te_label) = tf.keras.datasets.mnist.load_data(path)

    print("학습 데이터 {0}개 로드".format(tr_data.shape[0]))
    print("테스트 데이터 {0}개 로드".format(te_data.shape[0]))

    return (tr_data, tr_label), (te_data, te_label)
```

Data 확인

```
(train_set, train_label), (test_set, test_label) = load_dataset()

print(train_set.shape)
print(train_set[0].shape)
print(train_label.shape)
print(train_label[0].shape)
print(test_set.shape)
print(test_label.shape)
```

28x28 인 2차원 배열이 6만개

28x28 인 2차원 배열이 1만개

```
(60000, 28, 28)
(28, 28)
(60000,)
()
(10000, 28, 28)
(10000,)
```

Data 확인

- **학습 데이터**
  - 28x28 사이즈의 이미지
  - 각 픽셀의 값은 0 ~ 255
- **정답 데이터**
  - 0 ~ 9 사이의 숫자

```
print(train_set[0])
print(train_label[:100])
```

Data 확인

```
[[  0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0]
 [  0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0]
 [  0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0]
 [  0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0]
 [  0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0]
 [  0   0   0   0   0   0   0   0   0   0   0   0   3  18  18  18 126 136 175  26 166 255 247 127   0   0   0   0]
 [  0   0   0   0   0   0   0   0  30  36  94 154 170 253 253 253 253 253 225 172 253 242 195  64   0   0   0   0]
 [  0   0   0   0   0   0   0  49 238 253 253 253 253 253 253 253 253 251  93  82  82  56  39   0   0   0   0   0]
 [  0   0   0   0   0   0   0  18 219 253 253 253 253 253 198 182 247 241   0   0   0   0   0   0   0   0   0   0]
 [  0   0   0   0   0   0   0   0  80 156 107 253 253 205  11   0  43 154   0   0   0   0   0   0   0   0   0   0]
 [  0   0   0   0   0   0   0   0   0  14   1 154 253  90   0   0   0   0   0   0   0   0   0   0   0   0   0   0]
 [  0   0   0   0   0   0   0   0   0   0   0 139 253 190   2   0   0   0   0   0   0   0   0   0   0   0   0   0]
 [  0   0   0   0   0   0   0   0   0   0   0  11 190 253  70   0   0   0   0   0   0   0   0   0   0   0   0   0]
 [  0   0   0   0   0   0   0   0   0   0   0   0  35 241 225 160 108   1   0   0   0   0   0   0   0   0   0   0]
 [  0   0   0   0   0   0   0   0   0   0   0   0   0  81 240 253 253 119  25   0   0   0   0   0   0   0   0   0]
 [  0   0   0   0   0   0   0   0   0   0   0   0   0   0  45 186 253 253 150  27   0   0   0   0   0   0   0   0]
 [  0   0   0   0   0   0   0   0   0   0   0   0   0   0   0  16  93 252 253 187   0   0   0   0   0   0   0   0]
 [  0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0 249 253 249  64   0   0   0   0   0   0   0]
 [  0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0  46 130 183 253 253 207   2   0   0   0   0   0   0   0]
 [  0   0   0   0   0   0   0   0   0   0   0   0   0   0  39 148 229 253 253 253 250 182   0   0   0   0   0   0   0   0]
 [  0   0   0   0   0   0   0   0   0   0   0  24 114 221 253 253 253 253 201  78   0   0   0   0   0   0   0   0   0]
 [  0   0   0   0   0   0   0   0   0  23  66 213 253 253 253 253 198  81   2   0   0   0   0   0   0   0   0   0   0]
 [  0   0   0   0   0   0   0  18 171 219 253 253 253 253 195  80   9   0   0   0   0   0   0   0   0   0   0   0   0]
 [  0   0   0   0  55 172 226 253 253 253 253 244 133  11   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0]
 [  0   0   0   0 136 253 253 253 212 135 132  16   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0]
 [  0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0]
 [  0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0]
 [  0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0]]
```

무엇 처럼 보이는가?!

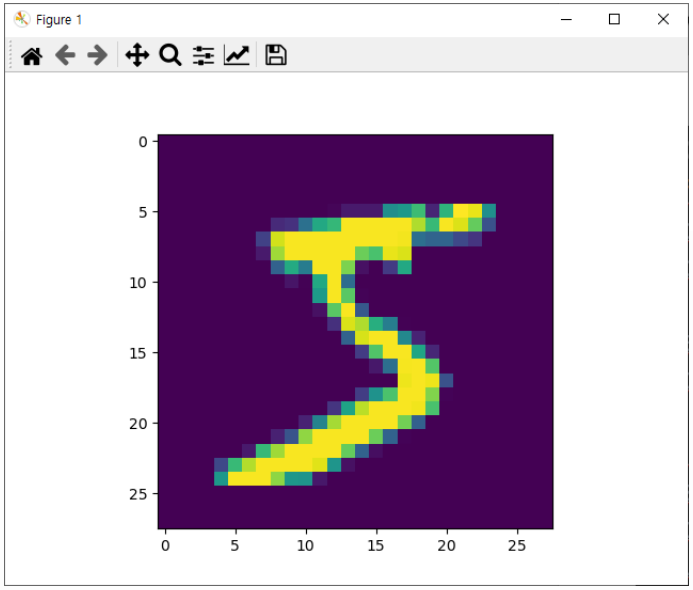
픽셀의 밝기 값을
0 ~ 255 사이로 표현

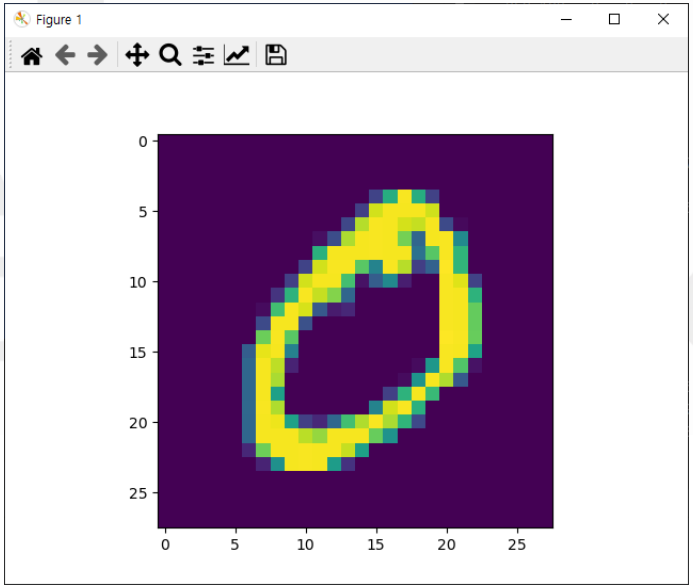
Image Show

```
# 이미지로 보고 싶을 때
def show_image(index):
    plt.imshow(train_set[index])
    plt.show()

userInput = ""
data_num = 0

while userInput != "q":
    show_image(data_num)
    data_num += 1
    userInput = input("next: ")
```

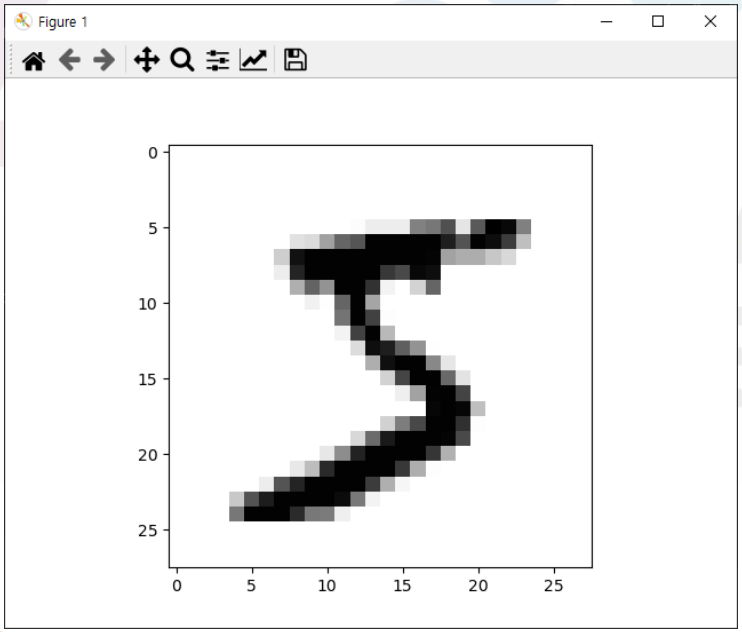


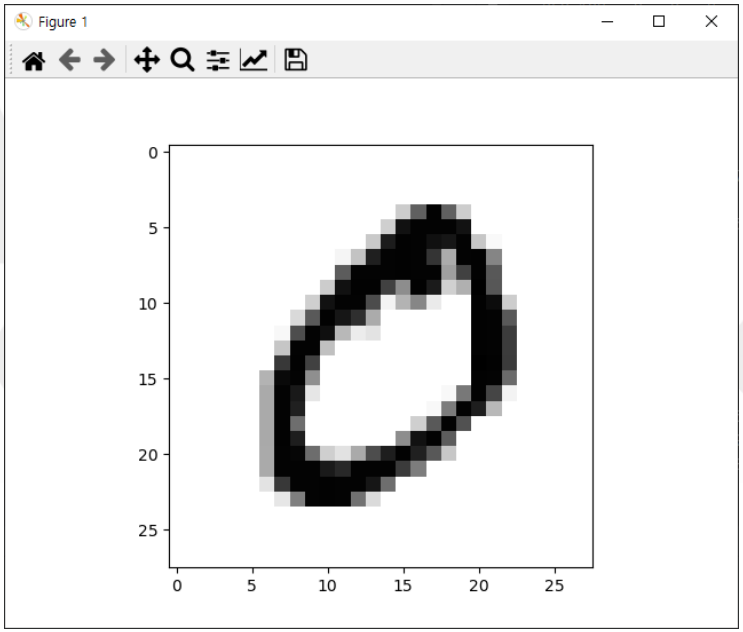


살짝 데코레이션

◆ 글자가 검정인 편이 익숙하니까? ㅎ_ㅎ

```
plt.imshow(255-train_set[index], cmap="gray")
```





데이터 분포

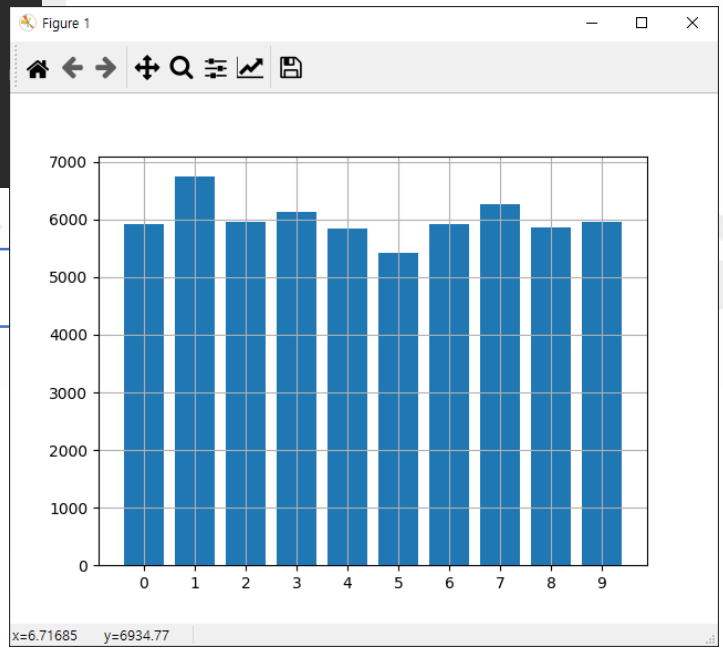
<class 'numpy.ndarray'>

```
print(type(train_label))

count_value = np.bincount(train_label)
print(count_value)
plt.bar(np.arange(0, 10), count_value)
plt.xticks(np.arange(0, 10))
plt.grid()
plt.show()
```

Pandas의 value_counts 같은 것

[5923 6742 5958 6131 5842 5421 5918 6265 5851 5949]

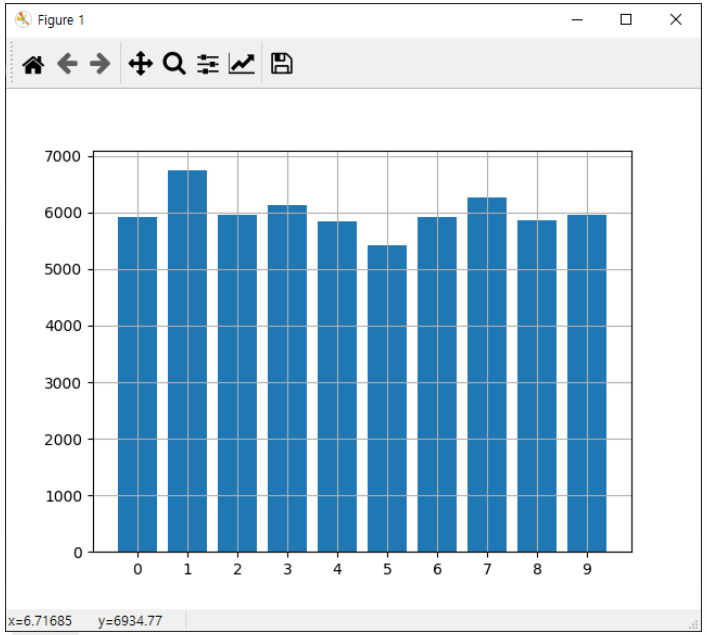


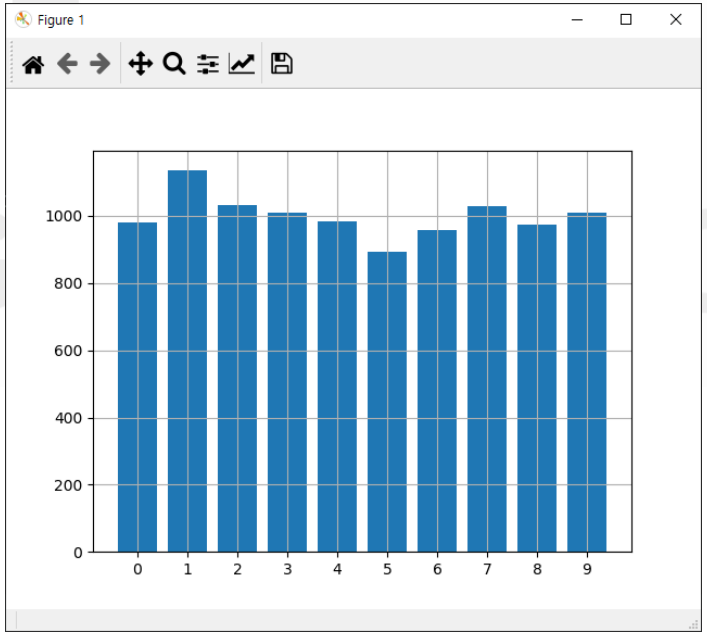
데이터 분포

```
def show_data_values(label):
    count_value = np.bincount(label)
    print(count_value)
    plt.bar(np.arange(0, 10), count_value)
    plt.xticks(np.arange(0, 10))
    plt.grid()
    plt.show()
```

```
# 메인
if __name__ == "__main__":
    (train_set, train_label), (test_set,
test_label) = load_dataset()

    show_data_values(train_label)
    show_data_values(test_label)
```





데이터 변환

◆ 차원 변환

- ➢ 2차원 (28 x 28) → 1차원 784로
- ➢ 0 ~ 255 uint → 0~1 float 으로

```
# 데이터 변환
train_set = train_set.reshape(60000, 784)
train_set = train_set.astype("float32")
train_set /= 255

# 짧게 쓰면 이렇게...
test_set = test_set.reshape(10000, 784).astype("float32") / 255
```

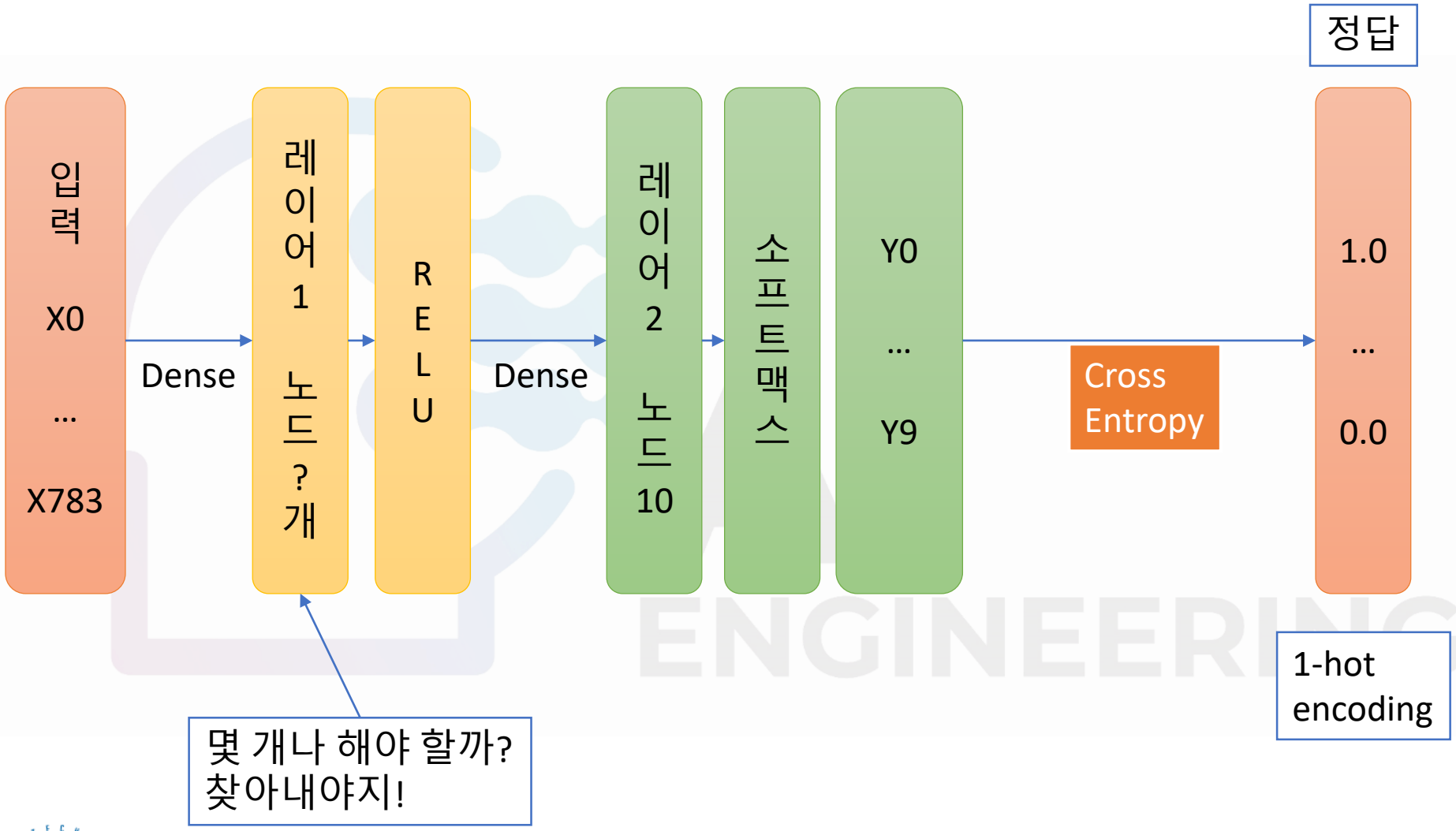
One-Hot Encoding

- 정답만 1로 나머지는 0으로..
  - 1 → [0, 1, 0, 0, 0, 0, 0, 0, 0, 0]
  - 5 → [0, 0, 0, 0, 0, 1, 0, 0, 0, 0]

```
# 정답은 one-hot encoding
train_label = tf.keras.utils.to_categorical(train_label, 10)
test_label = tf.keras.utils.to_categorical(test_label, 10)

print(train_label[0])
```

모델 설계



모델 구현

```
from tensorflow.keras.models import Sequential
from tensorflow.keras.layers import Dense

def make_model():
    model = Sequential()
    model.add(Dense(512, input_dim=784, activation="relu"))
    model.add(Dense(10, activation="softmax"))
    model.summary()
    model.compile(loss="categorical_crossentropy",
                  optimizer="adam",
                  metrics=["accuracy"])

    return model
```

```
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
dense (Dense)                (None, 512)               401920
_________________________________________________________________
dense_1 (Dense)              (None, 10)                5130
=================================================================
Total params: 407,050
Trainable params: 407,050
Non-trainable params: 0
_________________________________________________________________
```

40만 7천개 정도야... 흣

학습과 저장

```
# 하이퍼 파라메터
MY_EPOCH = 30
MY_BATCHSIZE = 200

def train(model, x, y):
    history = model.fit(x, y, epochs=MY_EPOCH, batch_size=MY_BATCHSIZE)

    model.save("./model/mlp_hd512.h5")

    return history
```

```
# 모델 생성
mlp = make_model()

# 학습
train(mlp, train_set, train_label)
```

테스트

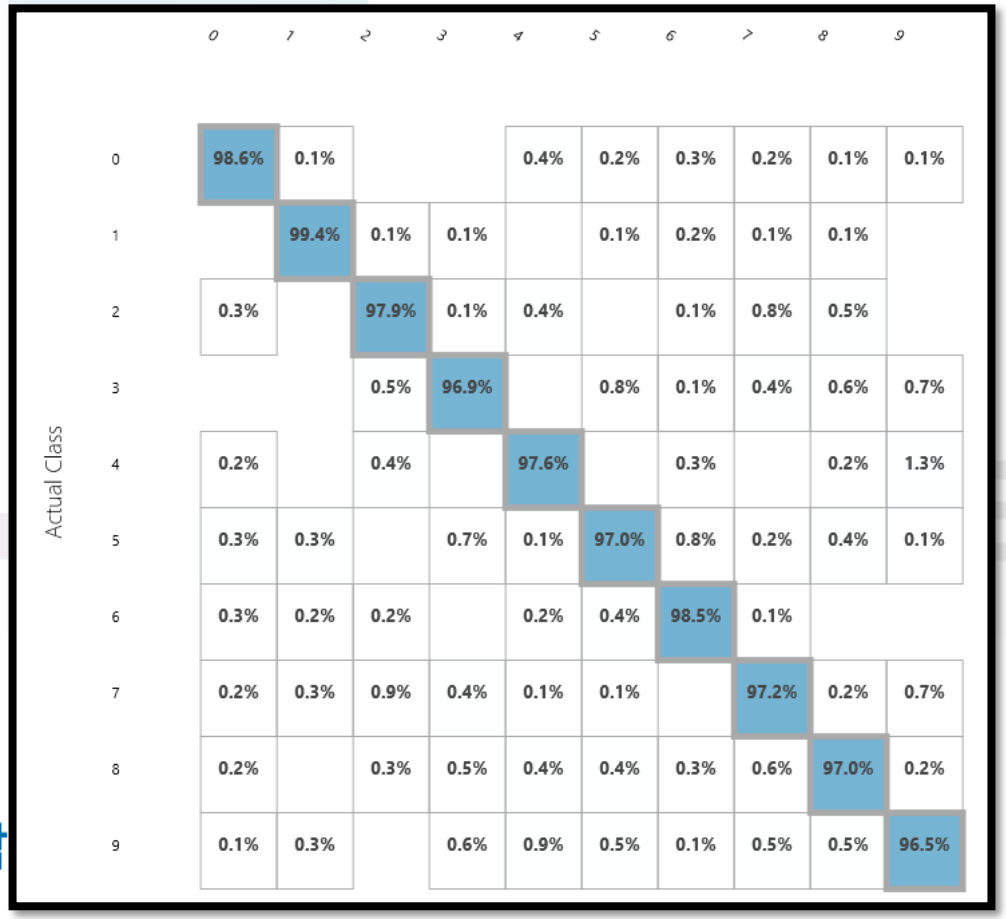
```
# 저장된 모델로 테스트 하기 테스트
from tensorflow.keras.models import load_model
mlp = load_model("./model/mlp_hd512.h5")
acc = mlp.evaluate(test_set, test_label, batch_size=MY_BATCHSIZE)

print(acc)
```

```
50/50 [==============================] - 0s 4ms/step - loss: 0.0716 -
accuracy: 0.9833
[0.07162203639745712, 0.983299970626831]
```

심화 실습

- 모델의 예측 값과 정답 레이블을 비교하여 Confusion Matrix 를 생성 하시오.



Actual Class	0	1	2	3	4	5	6	7	8	9
0	98.6%	0.1%			0.4%	0.2%	0.3%	0.2%	0.1%	0.1%
1		99.4%	0.1%	0.1%		0.1%	0.2%	0.1%	0.1%	
2	0.3%		97.9%	0.1%	0.4%		0.1%	0.8%	0.5%	
3			0.5%	96.9%		0.8%	0.1%	0.4%	0.6%	0.7%
4	0.2%		0.4%		97.6%		0.3%		0.2%	1.3%
5	0.3%	0.3%		0.7%	0.1%	97.0%	0.8%	0.2%	0.4%	0.1%
6	0.3%	0.2%	0.2%		0.2%	0.4%	98.5%	0.1%		
7	0.2%	0.3%	0.9%	0.4%	0.1%	0.1%		97.2%	0.2%	0.7%
8	0.2%		0.3%	0.5%	0.4%	0.4%	0.3%	0.6%	97.0%	0.2%
9	0.1%	0.3%		0.6%	0.9%	0.5%	0.1%	0.5%	0.5%	96.5%