딥러닝/클라우드

Chapter 11

Keras Deep Neural Network – MNIST

오 세 종

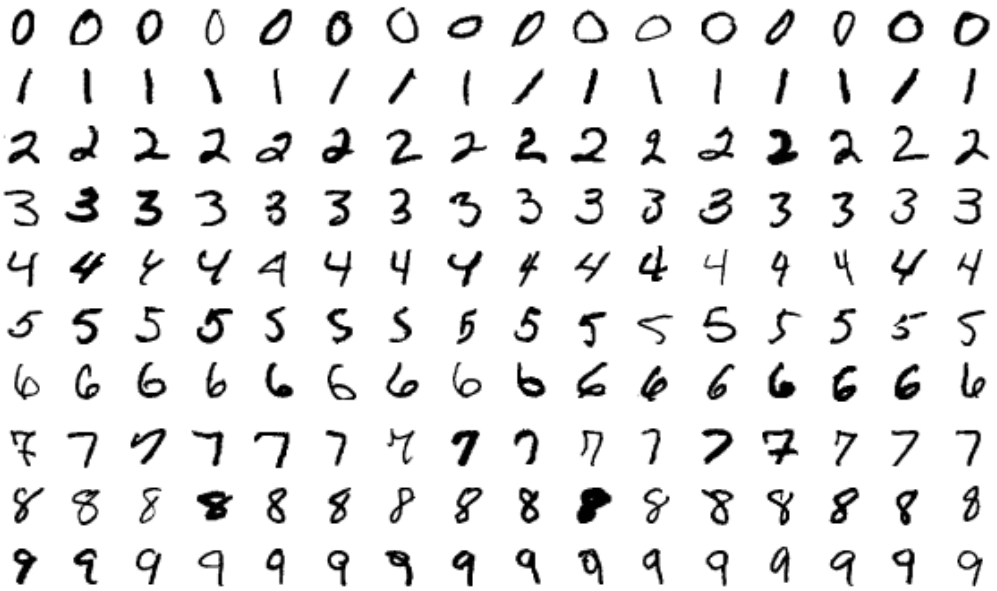
DANKOOK UNIVERSITY

Contents

1. MNIST dataset
2. Prepare dataset
3. Model setup
4. Model compile & fitting
5. Test

1. MNIST dataset

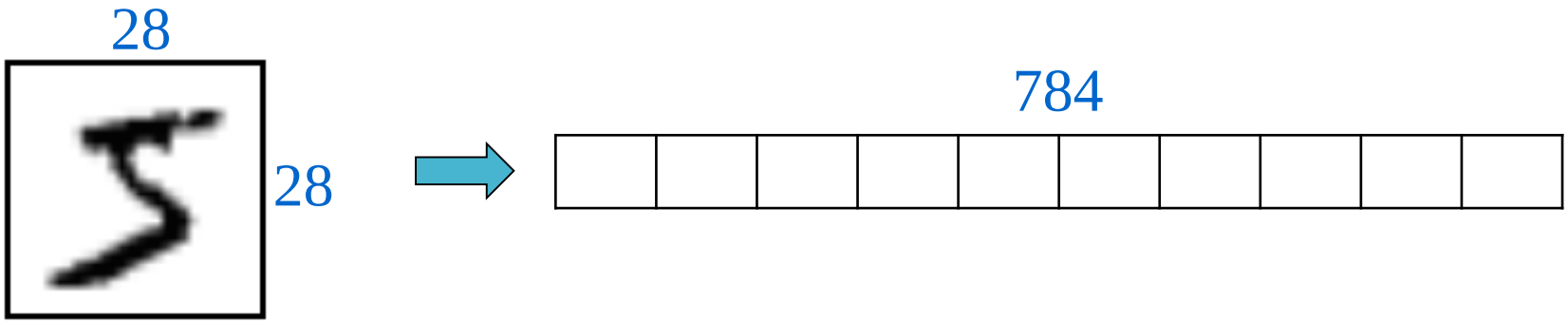
- MNIST database (Modified National Institute of Standards and Technology database)
  - 손으로 쓴 숫자들로 이루어진 대형 데이터베이스이며, 다양한 영상 처리 시스템을 트레이닝하기 위해 일반적으로 사용
  - Training, test 데이터를 별도로 제공
  - http://yann.lecun.com/exdb/mnist/
  - Keras 에도 포함되어 있음



MINST 테스트 데이터셋의 샘플 이미지

1. MNIST dataset

- 데이터 형태
  - 28 x 28 사이즈의 흑백 이미지
  - 1 pixel 은 0~255 의 값 저장
  - 2 차원 형태의 데이터는 학습을 할 수 없으므로 1x784 형태의 1차원 이미지로 변경하여 사용



  - 0~255 사이의 픽셀값은 0~1 사이로 변환하여 사용
  - Class 레이블 개수 : 10개 (0~9)

2. Prepare dataset

11.dnn_mnist.py

```
# load required modules
from keras.datasets import mnist
from keras import optimizers
from keras.models import Sequential
from keras.layers import Dense, Input
from keras.layers import Flatten
from keras.layers import Dropout
from keras.utils import to_categorical

import matplotlib.pyplot as plt
import numpy as np

import sys
import os
sys.path.append(os.path.abspath("D:/source_code"))
import TrainPlot                    # call TrainPlot.py
```

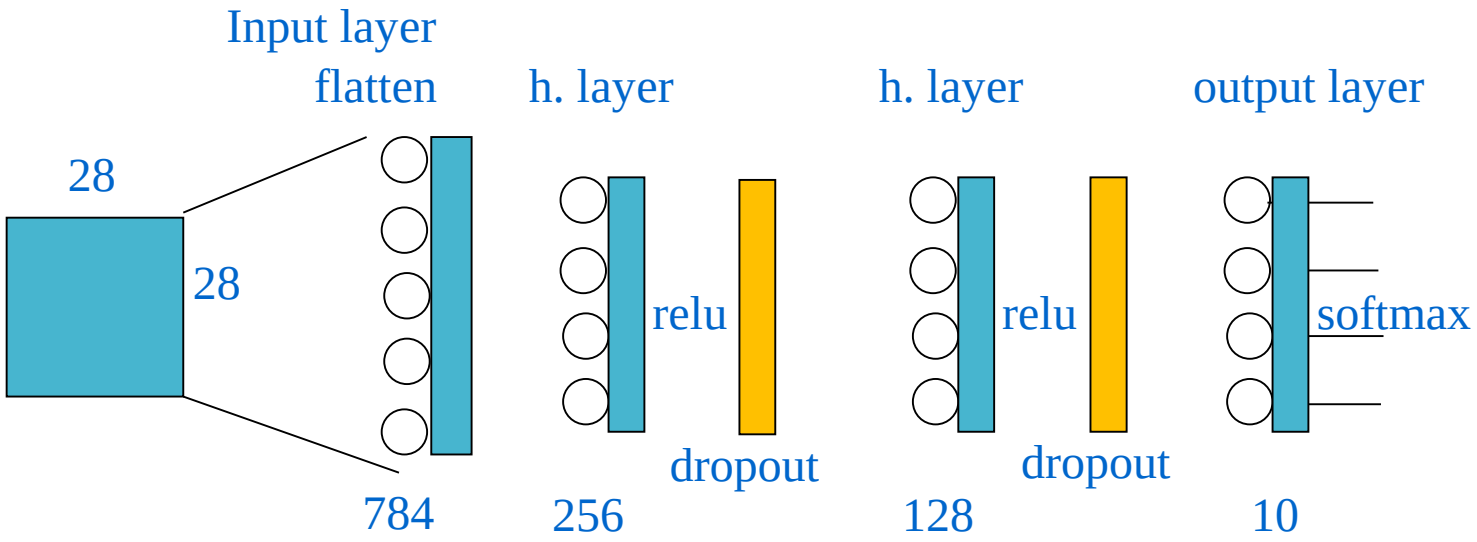
2. Prepare dataset

```
# load dataset
(train_X, train_y), (test_X, test_y) = mnist.load_data()
train_X, test_X = train_X / 255.0, test_X / 255.0

# one hot encoding
train_y = categorical(train_y)
test_y = categorical(test_y)
```

3. Model setup

- Network design

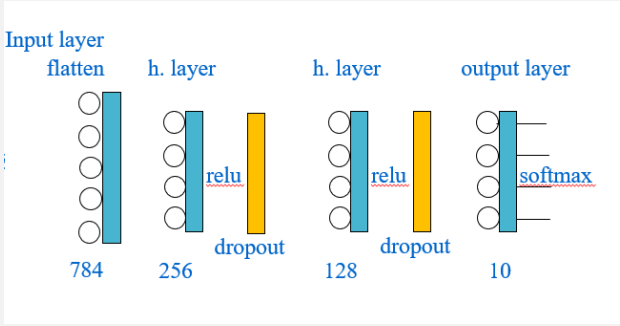


3. Model setup

```
# define model (DNN structure)
epochs = 20
batch_size = 128
learning_rate = 0.01

model = Sequential()
model.add(Input(shape=(28,28)))
model.add(Flatten())
model.add(Dense(256, activation='relu'))
model.add(Dropout(rate = 0.4))
model.add(Dense(128, activation='relu'))
model.add(Dropout(rate = 0.3))
model.add(Dense(10, activation='softmax'))

model.summary()  # show model structure
```



`Dropout(rate = 0.4)`

Fraction of the input units to drop

3. Model setup

```
>>> model.summary()  # show model structure
Model: "sequential_2"
```

flatten_2 (Flatten)	(None, 784)	0
dense_4 (Dense)	(None, 256)	200,960
dropout_2 (Dropout)	(None, 256)	0
dense_5 (Dense)	(None, 128)	32,896
dropout_3 (Dropout)	(None, 128)	0
dense_6 (Dense)	(None, 10)	1,290

```
 Total params: 235,146 (918.54 KB)
 Trainable params: 235,146 (918.54 KB)
 Non-trainable params: 0 (0.00 B)
>>>
```

4. Model compile & fitting

```
# Compile model
adam = optimizers.Adam(lr=learning_rate)
model.compile(loss='categorical_crossentropy',
              optimizer=adam,
              metrics=['accuracy'])

# model fitting (learning)
disp = model.fit(train_X, train_y,
                 batch_size=batch_size,
                 epochs=epochs,
                 verbose=1,         # print fitting process
                 validation_split = 0.2)
```

```
Train on 48000 samples, validate on 12000 samples
Epoch 1/20
48000/48000 [==============================] - 2s 38us/step - loss: 0.2860 - accuracy: 0.9187 -
val_loss: 0.1352 - val_accuracy: 0.9615
Epoch 2/20
48000/48000 [==============================] - 2s 32us/step - loss: 0.2674 - accuracy: 0.9264 -
val_loss: 0.1414 - val_accuracy: 0.9613
Epoch 3/20
48000/48000 [==============================] - 2s 31us/step - loss: 0.2548 - accuracy: 0.9306 -
val_loss: 0.1464 - val_accuracy: 0.9613
Epoch 4/20
48000/48000 [==============================] - 2s 31us/step - loss: 0.2556 - accuracy: 0.9317 -
val_loss: 0.1444 - val_accuracy: 0.9643
Epoch 5/20
48000/48000 [==============================] - 2s 31us/step - loss: 0.2409 - accuracy: 0.9367 -
val_loss: 0.1325 - val_accuracy: 0.9647
Epoch 6/20
48000/48000 [==============================] - 2s 32us/step - loss: 0.2403 - accuracy: 0.9374 -
val_loss: 0.1343 - val_accuracy: 0.9657
Epoch 7/20
48000/48000 [==============================] - 2s 31us/step - loss: 0.2246 - accuracy: 0.9410 -
val_loss: 0.1366 - val_accuracy: 0.9653
Epoch 8/20
48000/48000 [==============================] - 2s 32us/step - loss: 0.2326 - accuracy: 0.9404 -
val_loss: 0.1425 - val_accuracy: 0.9628
```

5. Test

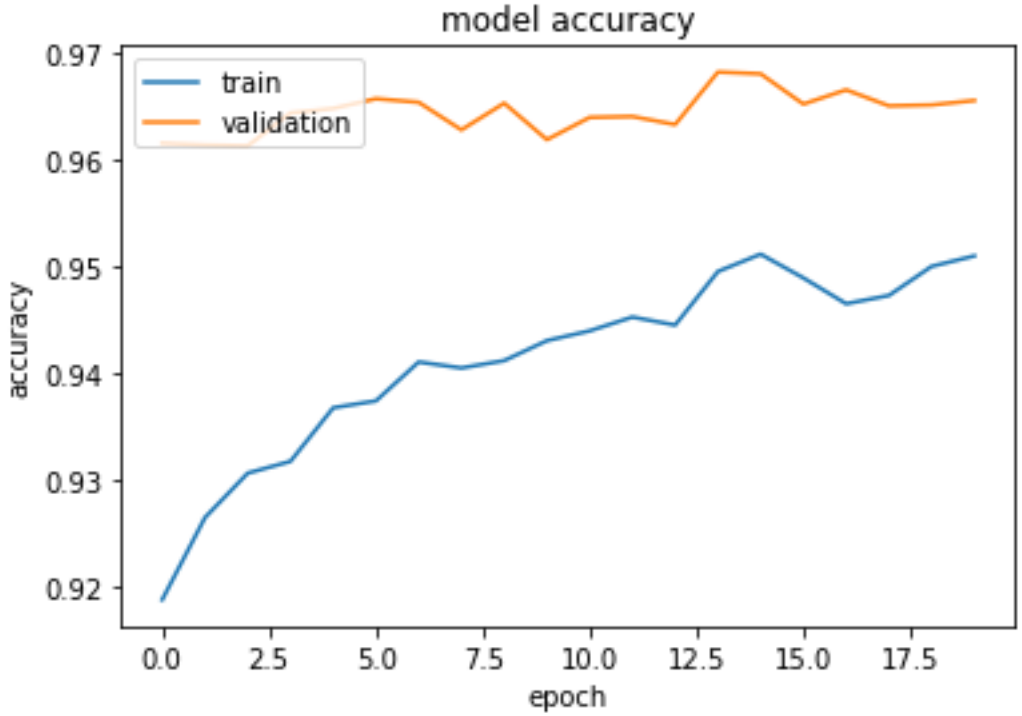
```
# Test model
pred = model.predict(test_X)
print(pred)
y_classes = [np.argmax(y, axis=None, out=None) for y in pred]
print(y_classes)   # result of prediction

# model performance
score = model.evaluate(test_X, test_y, verbose=0)
print('Test loss:', score[0])
print('Test accuracy:', score[1])

# summarize history for accuracy
plt.plot(disp.history['accuracy'])
plt.plot(disp.history['val_accuracy'])
plt.title('model accuracy')
plt.ylabel('accuracy')
plt.xlabel('epoch')
plt.legend(['train', 'validation'], loc='upper left')
plt.show()
```

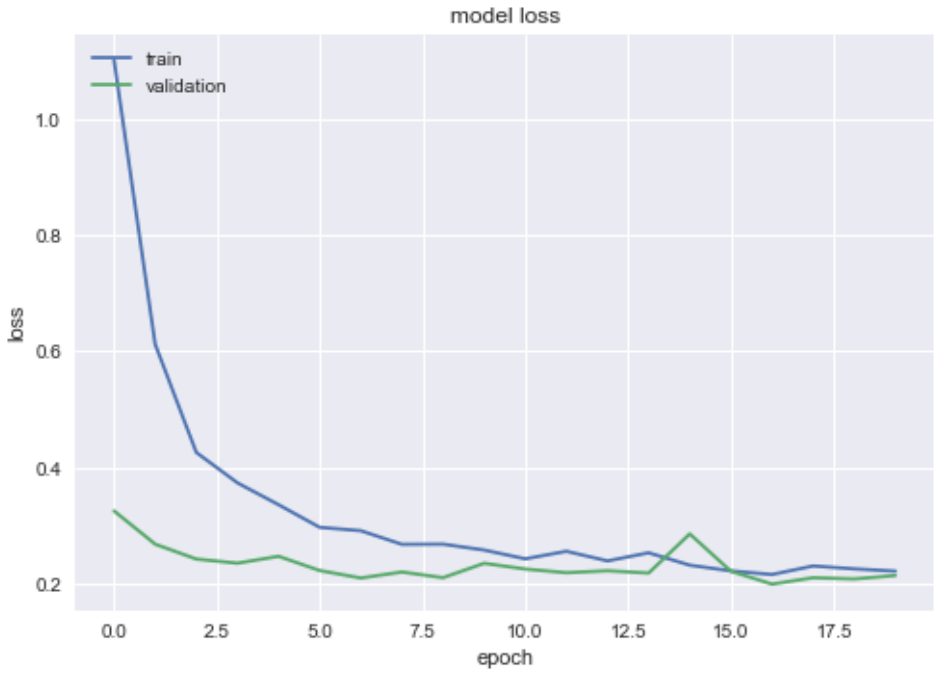
5. Test

```
In [147]: print('Test loss:', score[0])
     ...: print('Test accuracy:', score[1])
Test loss: 0.1441996557606633
Test accuracy: 0.9674000144004822
```



5. Test

```
# summarize history for loss
plt.plot(disp.history['loss'])
plt.plot(disp.history['val_loss'])
plt.title('model loss')
plt.ylabel('loss')
plt.xlabel('epoch')
plt.legend(['train', 'validation'], loc='upper left')
plt.show()
```



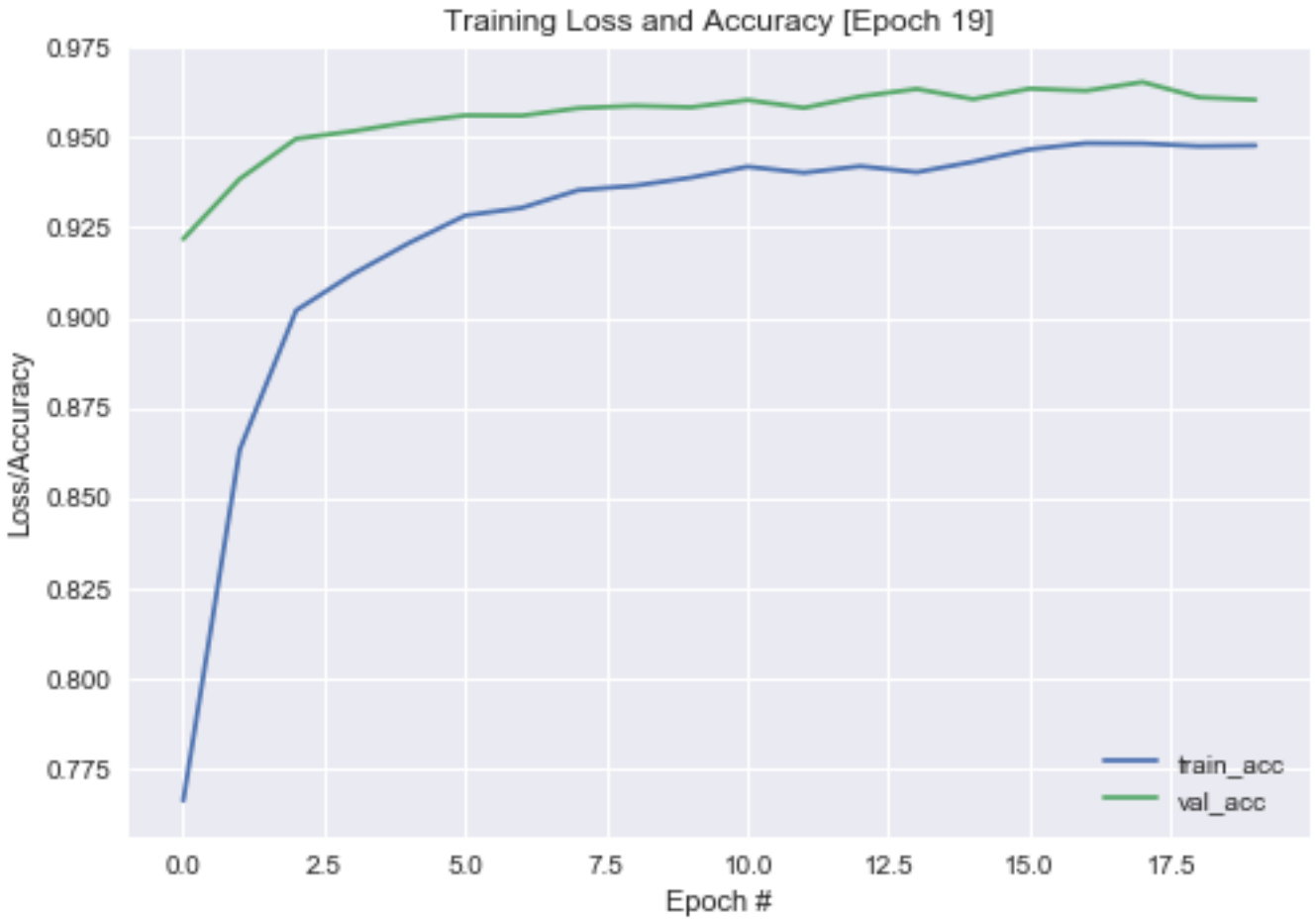
6. Monitoring fitting process

History를 이용한 학습 그래프는 학습이 모두 끝나야 얻을 수 있다.
학습이 진행되는 과정을 그래프로 모니터링 할 수 있는 방법은 없을까? -> callback 기능이용

```
…
import sys
import os
sys.path.append(os.path.abspath("D:/source_code"))
import TrainPlot                    # call TrainPlot.py
…
…
# model fitting (learning)
disp = model.fit(train_X, train_y,
                 batch_size=batch_size,
                 epochs=epochs,
                 verbose=1,          # print fitting process
                 validation_split = 0.2,
                 callbacks=[TrainPlot.TrainingPlot()])
```

TrainPlot.py 가 있는 폴더명

6. Monitoring fitting process



If you modify `TrainPlot.py`, you also can see loss plot or both acc and loss plots.