LeNet-5와 Convolution 신경망을 사용한 MNIST 인식 비교

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LeNet-5를 통한 MNIST 인식

```python
import numpy as np
import tensorflow as tf
from tensorflow.keras.datasets import mnist
from tensorflow.keras.models import Sequential
from tensorflow.keras.layers import Conv2D,MaxPooling2D,Flatten,Dense
from tensorflow.keras.optimizers import Adam

# MNIST 데이터셋을 읽고 신경망에 입력할 형태로 변환
(x_train,y_train),(x_test,y_test)= mnist.load_data()
x_train=x_train.reshape(60000,28,28,1)
x_test=x_test.reshape(10000,28,28,1)
x_train=x_train.astype(np.float32)/255.0
x_test=x_test.astype(np.float32)/255.0
y_train=tf.keras.utils.to_categorical(y_train,10)
y_test=tf.keras.utils.to_categorical(y_test,10)

# LeNet-5 신경망 모델 설계
cnn=Sequential()
cnn.add(Conv2D(6,(5,5),padding='same',activation='relu',input_shape=(28,28,1)))
cnn.add(MaxPooling2D(pool_size=(2,2)))
cnn.add(Conv2D(16,(5,5),padding='same',activation='relu'))
cnn.add(MaxPooling2D(pool_size=(2,2)))
cnn.add(Conv2D(120,(5,5),padding='same',activation='relu'))
cnn.add(Flatten())
cnn.add(Dense(84,activation='relu'))
cnn.add(Dense(10,activation='softmax'))

# 신경망 모델 학습
cnn.compile(loss='categorical_crossentropy',optimizer=Adam(),metrics=['accuracy'])
hist=cnn.fit(x_train,y_train,batch_size=128,epochs=30,validation_data=(x_test,y_test),verbose=2)

# 신경망 모델 정확률 평가
res=cnn.evaluate(x_test,y_test,verbose=0)
print("정확률은",res[1]*100)

import matplotlib.pyplot as plt

# 정확률 그래프
plt.plot(hist.history['accuracy'])
plt.plot(hist.history['val_accuracy'])
plt.title('Model accuracy')
plt.ylabel('Accuracy')
plt.xlabel('Epoch')
plt.legend(['Train','Validation'],loc='best')
plt.grid()
plt.show()

# 손실 함수 그래프
plt.plot(hist.history['loss'])
plt.plot(hist.history['val_loss'])
plt.title('Model loss')
plt.ylabel('Loss')
plt.xlabel('Epoch')
plt.legend(['Train','Validation'],loc='best')
plt.grid()
plt.show()
```

코드 차이점

Convolution Neural Network를 통한 MNIST 인식

```python
import numpy as np
import tensorflow as tf
from tensorflow.keras.datasets import mnist
from tensorflow.keras.models import Sequential
from tensorflow.keras.layers import Conv2D,MaxPooling2D,Flatten,Dense,Dropout
from tensorflow.keras.optimizers import Adam

# MNIST 데이터셋을 읽고 신경망에 입력할 형태로 변환
(x_train,y_train),(x_test,y_test)=mnist.load_data()
x_train=x_train.reshape(60000,28,28,1)
x_test=x_test.reshape(10000,28,28,1)
x_train=x_train.astype(np.float32)/255.0
x_test=x_test.astype(np.float32)/255.0
y_train=tf.keras.utils.to_categorical(y_train,10)
y_test=tf.keras.utils.to_categorical(y_test,10)

# 신경망 모델 설계
cnn=Sequential()
cnn.add(Conv2D(32,(3,3),activation='relu',input_shape=(28,28,1)))
cnn.add(Conv2D(64,(3,3),activation='relu'))
cnn.add(MaxPooling2D(pool_size=(2,2)))
cnn.add(Dropout(0.25))
cnn.add(Flatten())
cnn.add(Dense(128,activation='relu'))
cnn.add(Dropout(0.5))
cnn.add(Dense(10,activation='softmax'))

# 신경망 모델 학습
cnn.compile(loss='categorical_crossentropy',optimizer=Adam(),metrics=['accuracy'])
hist=cnn.fit(x_train,y_train,batch_size=128,epochs=12,validation_data=(x_test,y_test),verbose=2)

# 신경망 모델 정확률 평가
res=cnn.evaluate(x_test,y_test,verbose=0)
print("정확률은",res[1]*100)

import matplotlib.pyplot as plt

# 정확률 그래프
plt.plot(hist.history['accuracy'])
plt.plot(hist.history['val_accuracy'])
plt.title('Model accuracy')
plt.ylabel('Accuracy')
plt.xlabel('Epoch')
plt.legend(['Train','Validation'], loc='best')
plt.grid()
plt.show()

# 손실 함수 그래프
plt.plot(hist.history['loss'])
plt.plot(hist.history['val_loss'])
plt.title('Model loss')
plt.ylabel('Loss')
plt.xlabel('Epoch')
plt.legend(['Train','Validation'], loc='best')
plt.grid()
plt.show()
```

공통 구성

```
# MNIST 데이터셋을 읽고 신경망에 입력할 형태로 변환
(x_train,y_train),(x_test,y_test)= mnist.load_data()
x_train=x_train.reshape(60000,28,28,1)
x_test=x_test.reshape(10000,28,28,1)
x_train=x_train.astype(np.float32)/255.0
x_test=x_test.astype(np.float32)/255.0
y_train=tf.keras.utils.to_categorical(y_train,10)
y_test=tf.keras.utils.to_categorical(y_test,10)
```

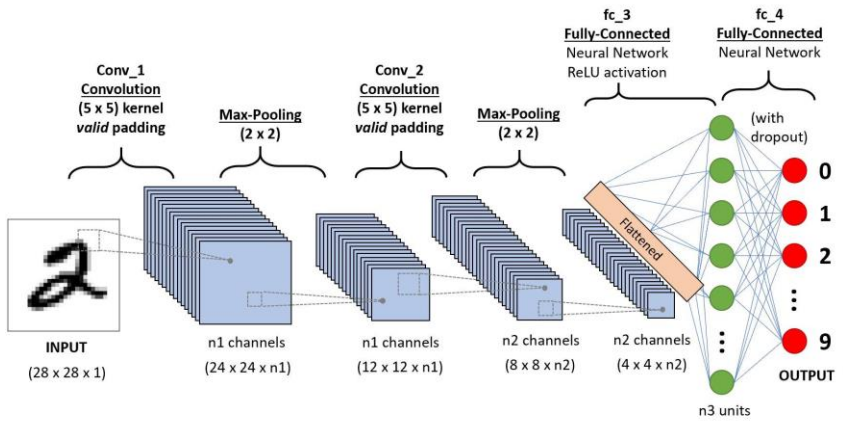
1. x_train : 28X28 크기 글자 60,000개 구성
2. x_test : 28X28 크기 글자 10,000개 구성
3. 256개의 값으로 된 데이터를 0, 1로 변환
4. One-hot code 시행
5. y_train : 글자 인식 결과 구성

LeNet-5를 통한 MNIST 인식

```
# LeNet-5 신경망 모델 설계
cnn=Sequential()
cnn.add(Conv2D(6,(5,5),padding='same',activation='relu',input_shape=(28,28,1)))
cnn.add(MaxPooling2D(pool_size=(2,2)))
cnn.add(Conv2D(16,(5,5),padding='same',activation='relu'))
cnn.add(MaxPooling2D(pool_size=(2,2)))
cnn.add(Conv2D(120,(5,5),padding='same',activation='relu'))
cnn.add(Flatten())
cnn.add(Dense(84,activation='relu'))
cnn.add(Dense(10,activation='softmax'))
```

```
# 신경망 모델 학습
cnn.compile(loss='categorical_crossentropy',optimizer=Adam(),metrics=['accuracy'])
hist=cnn.fit(x_train,y_train,batch_size=128,epochs=30,validation_data=(x_test,y_test),verbose=2)
```

Convolution	Pooling	Convolution	Pooling	Convolution	FC	FC



1. Convolution과 Pooling을 반복하며 필터를 거침
2. MaxPooling은 MxN 크기로 변환 후 가장 큰 값을 뽑아냄
3. 5x5 필터를 6개 , 16개, 120개 순으로 증가시킴
4. 마지막은 Softmax를 통한 정규화

Convolution Neural Network를 통한 MNIST 인식

```
# 신경망 모델 설계
cnn=Sequential()
cnn.add(Conv2D(32,(3,3),activation='relu',input_shape=(28,28,1)))
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cnn.add(Dropout(0.25))
cnn.add(Flatten())
cnn.add(Dense(128,activation='relu'))
cnn.add(Dropout(0.5))
cnn.add(Dense(10,activation='softmax'))
```
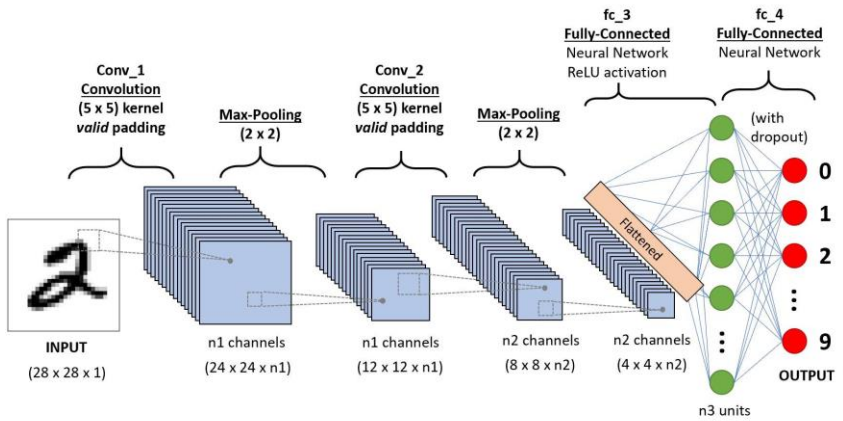

```
# 신경망 모델 학습
cnn.compile(loss='categorical_crossentropy',optimizer=Adam(),metrics=['accuracy'])
hist=cnn.fit(x_train,y_train,batch_size=128,epochs=12,validation_data=(x_test,y_test),verbose=2)
```

Convolution	Convolution	Pooling	Dropout	FC	Dropout	FC



1. Convolution과 Pooling을 반복하며 필터를 거침
2. MaxPooling은 MxN 크기로 변환 후 가장 큰 값을 뽑아냄
3. 3x3 필터를 32개 , 64개로 설정
4. Dropout은 뉴런을 임의로 삭제하며 학습 (over-fit 방지)
5. 마지막은 Softmax를 통한 정규화

```python
# 신경망 모델 학습
cnn.compile(loss='categorical_crossentropy',optimizer=Adam(),metrics=['accuracy'])
hist=cnn.fit(x_train,y_train,batch_size=128,epochs=30,validation_data=(x_test,y_test),verbose=2)

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plt.ylabel('Accuracy')
plt.xlabel('Epoch')
plt.legend(['Train','Validation'],loc='best')
plt.grid()
plt.show()

# 손실 함수 그래프
plt.plot(hist.history['loss'])
plt.plot(hist.history['val_loss'])
plt.title('Model loss')
plt.ylabel('Loss')
plt.xlabel('Epoch')
plt.legend(['Train','Validation'],loc='best')
plt.grid()
plt.show()
```
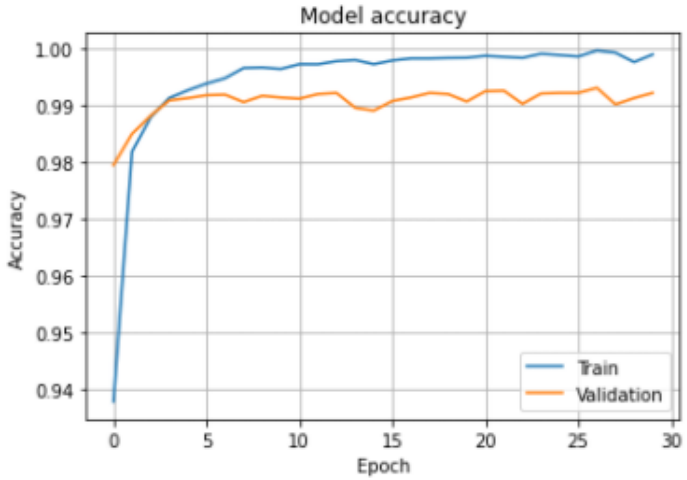
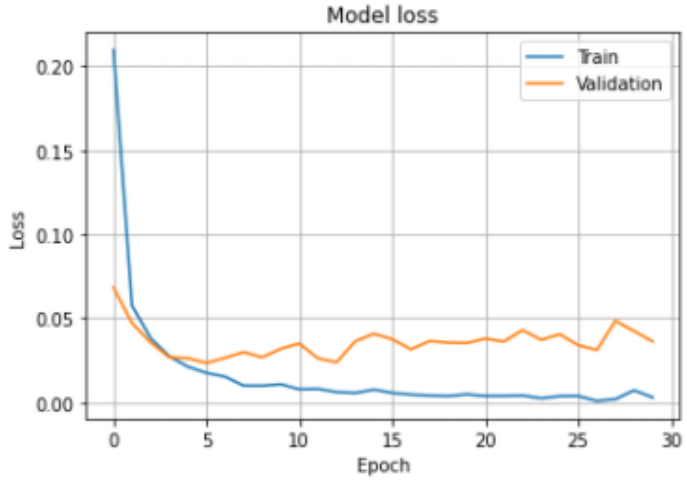

1. Loss = categorical_crossentropy
   다중 분류 손실함수
2. Optimizer = Adam
   알고리즘 최적화 방법중 Adam 선택
3. Metric : Accuracy
   평가 지표를 정확도로 선택

4. Epochs : 학습 반복 횟수
5. Verbose : 상세도

LeNet-5를 통한 MNIST 인식

```
Epoch 30/30
469/469 - 62s - loss: 0.0031 - accuracy: 0.9991 - val_loss: 0.0364 - val_accuracy: 0.9923
정확률은 99.22999739646912
```





Convolution Neural Network를 통한 MNIST 인식

```
Epoch 12/12
469/469 - 138s - loss: 0.0205 - accuracy: 0.9934 - val_loss: 0.0297 - val_accuracy: 0.9916
정확률은 99.1599977016449
```