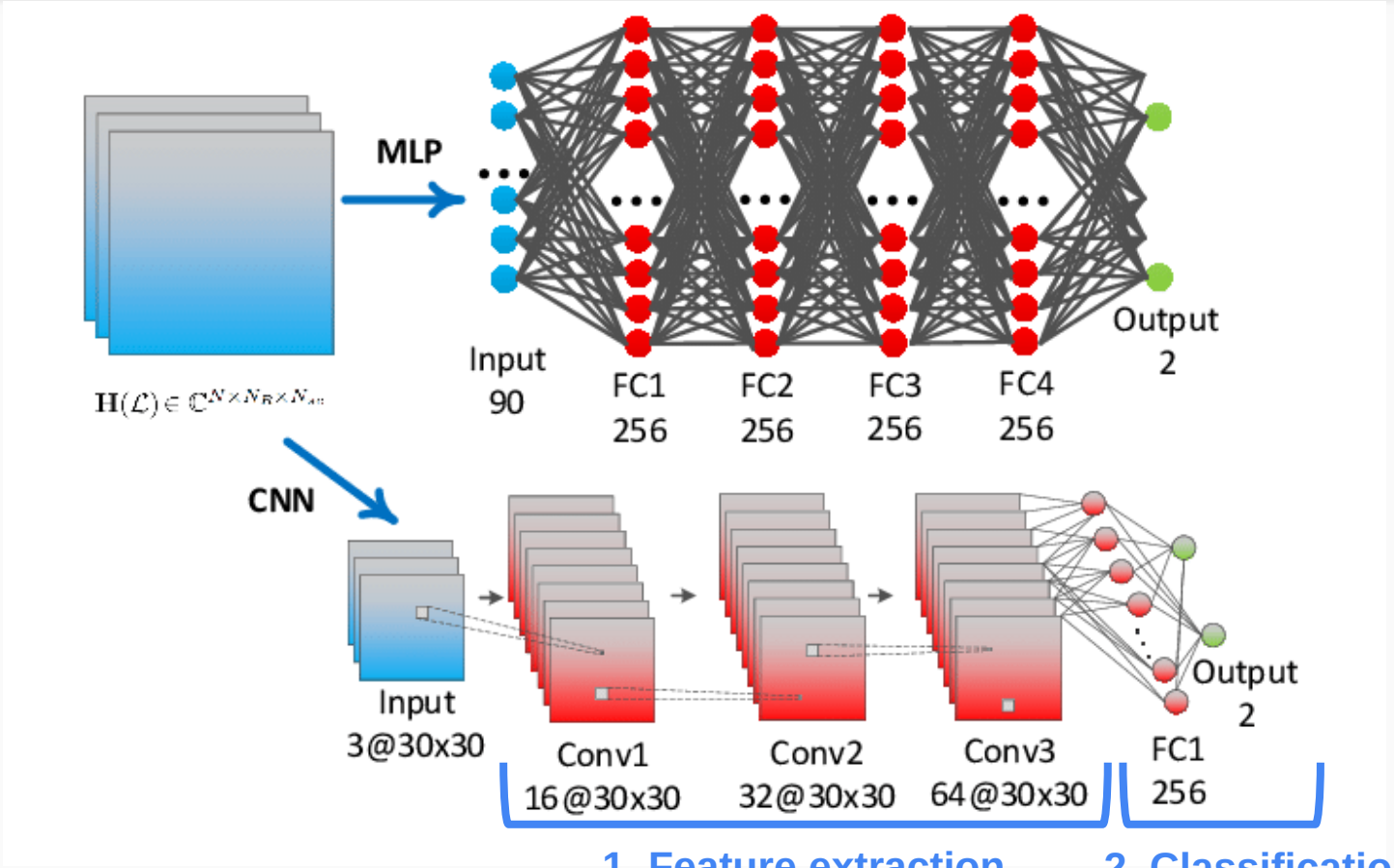
Pip install keras
Pip install Numpy
Pip install Matplotlib
Pip install opencv-python

Convolutional Neural Network

1. MLP vs CNN

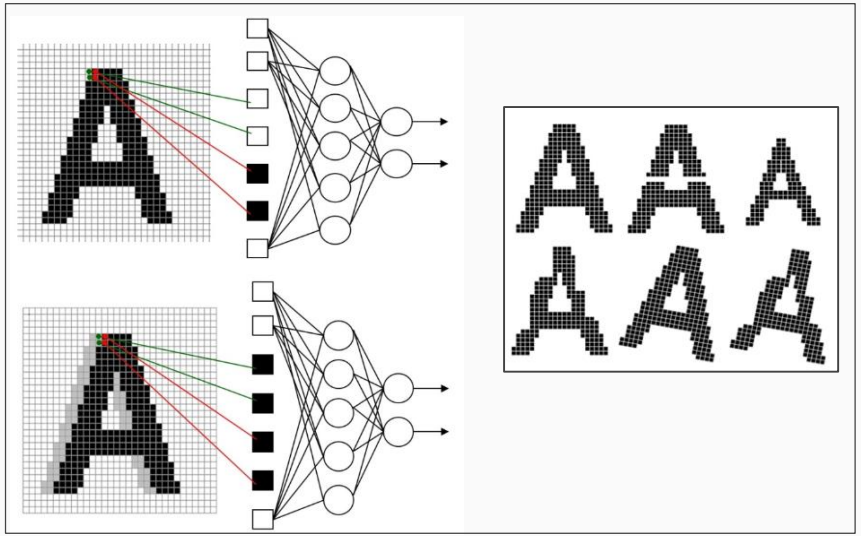
(0) Overview



Convolutional Neural Network

1. MLP vs CNN

(1) 기존 Multi-Layered Neural Network의 문제점

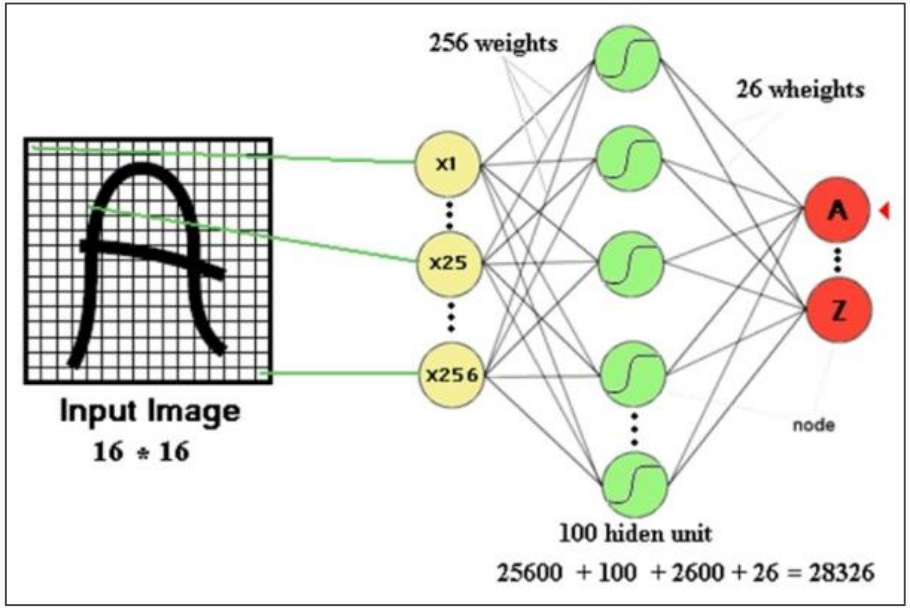


1. Did not consider spatial, temporal relationship.
➔ Need many training data to deal with many variation.

Convolutional Neural Network

1. MLP vs CNN

(1) 기존 Multi-Layered Neural Network의 문제점



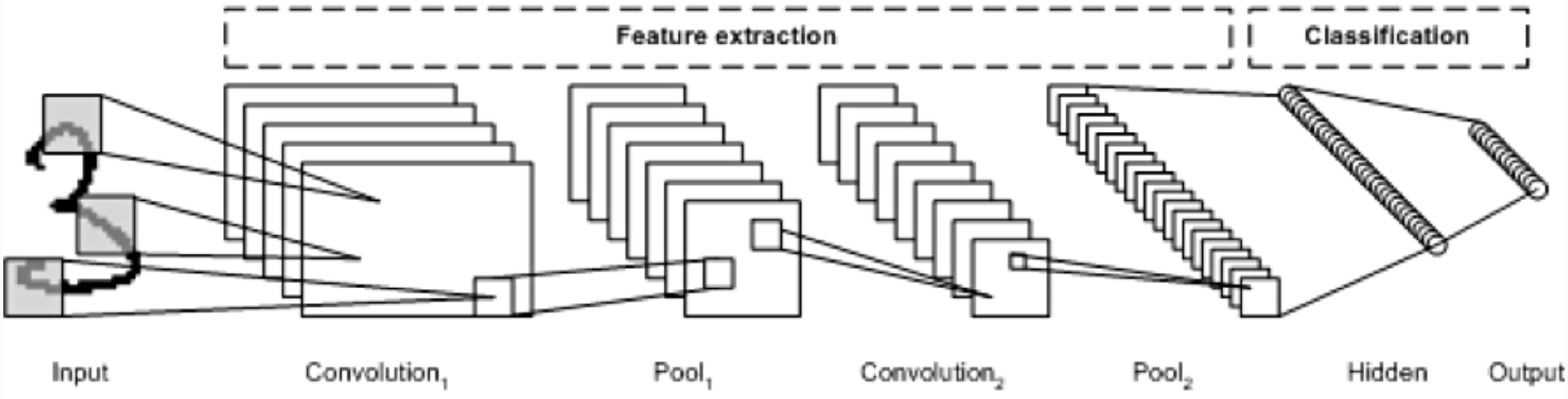
2. Number of free parameters

Convolutional Neural Network

1. MLP vs CNN

(2) Why CNN?

1. Feature Extraction (Convolution + Pooling)
➔ Translation invariant



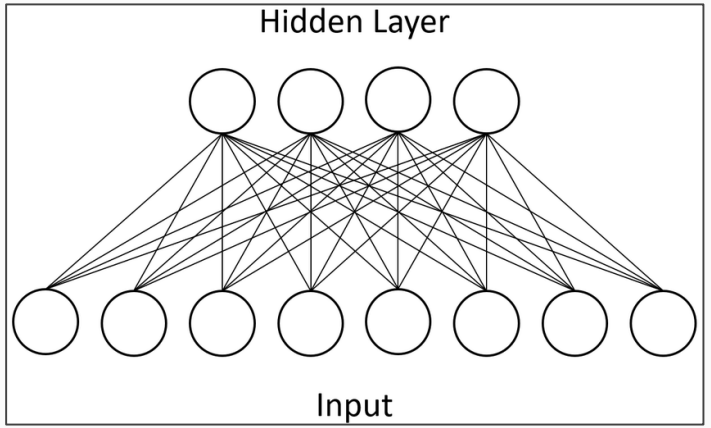
Convolutional Neural Network

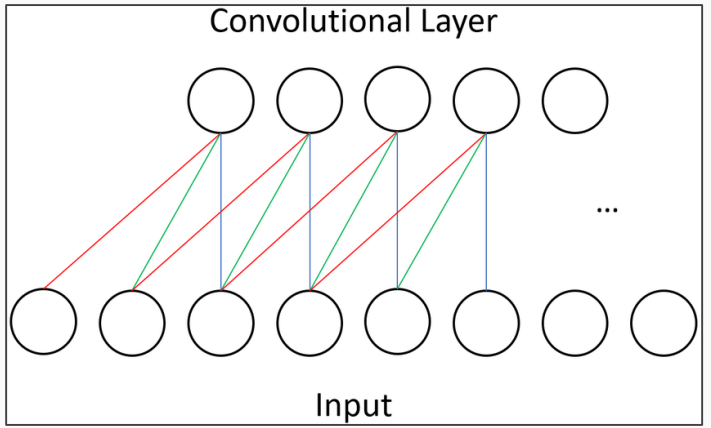
1. MLP vs CNN

(2) Why CNN?

1.Number of free parameters

- Locality (Local Connectivity) ➔ Sparse matrix
- Shared Weights

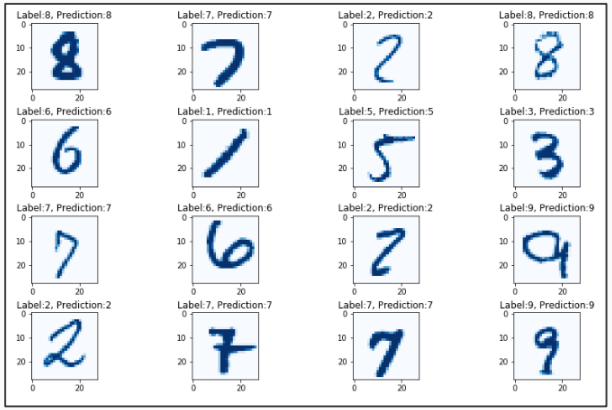




Convolutional Neural Network

1. MLP vs CNN

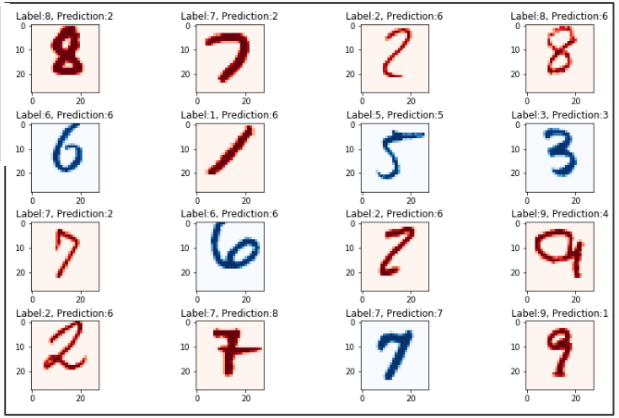
(2) Why CNN? (실습)



MLP
Correct prediction data

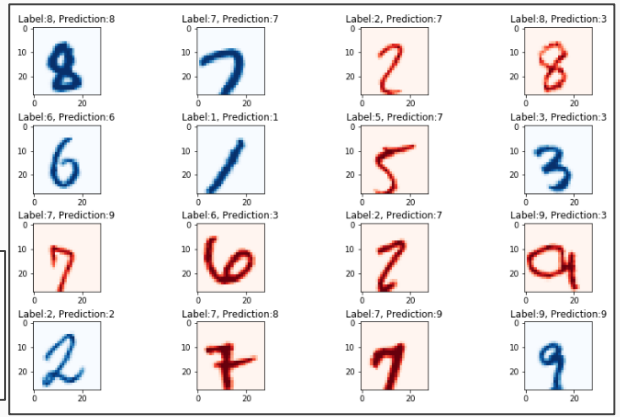
$$T = \begin{bmatrix} 1 & 0 & t_x \\ 0 & 1 & t_y \end{bmatrix}$$

Translation



Rotation

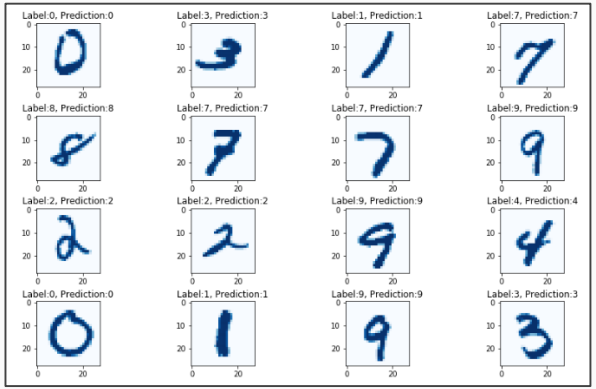
$$R = \begin{bmatrix} \cos\theta & -\sin\theta \\ \sin\theta & \cos\theta \end{bmatrix}$$



Convolutional Neural Network

1. MLP vs CNN

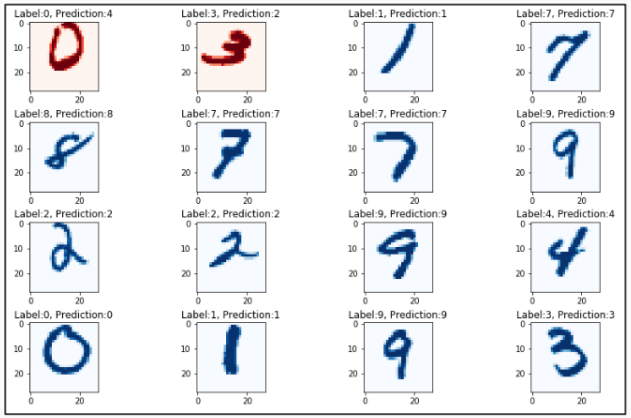
(2) Why CNN? (실습)



CNN
Correct prediction data

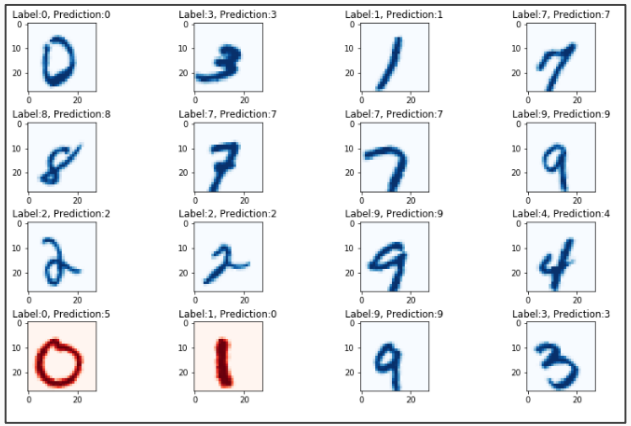
$$T = \begin{bmatrix} 1 & 0 & t_x \\ 0 & 1 & t_y \end{bmatrix}$$

Translation

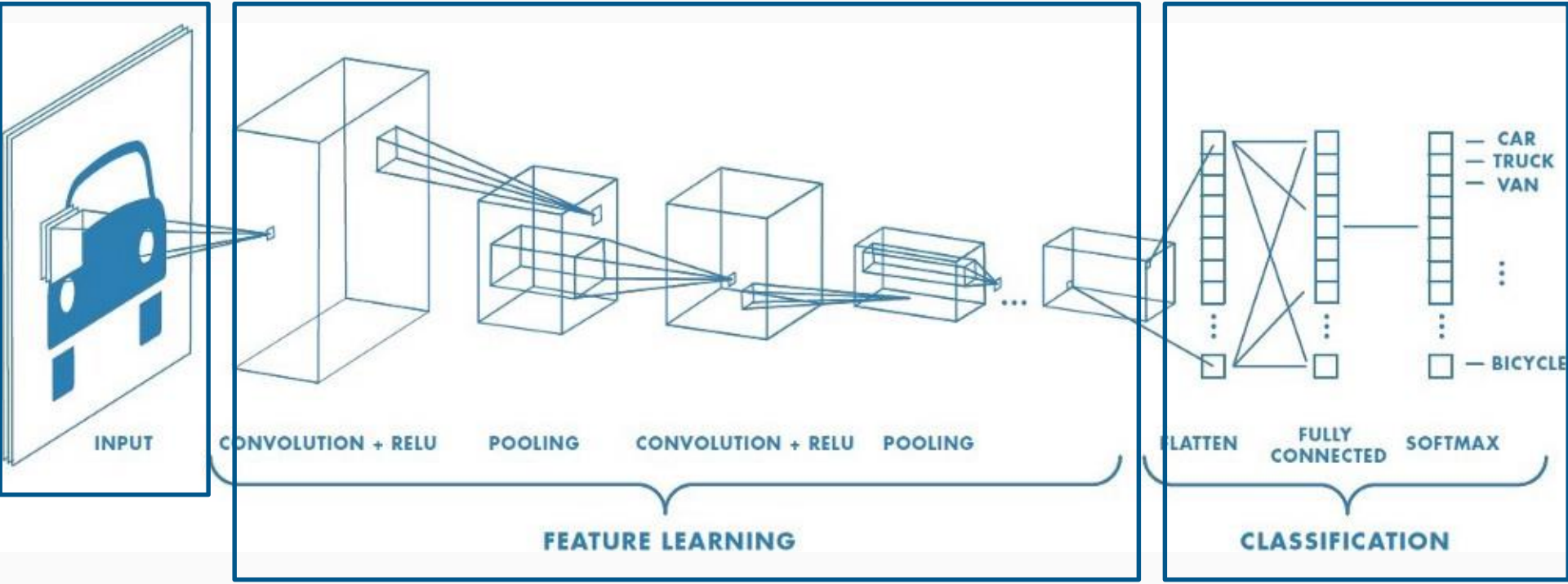


Rotation

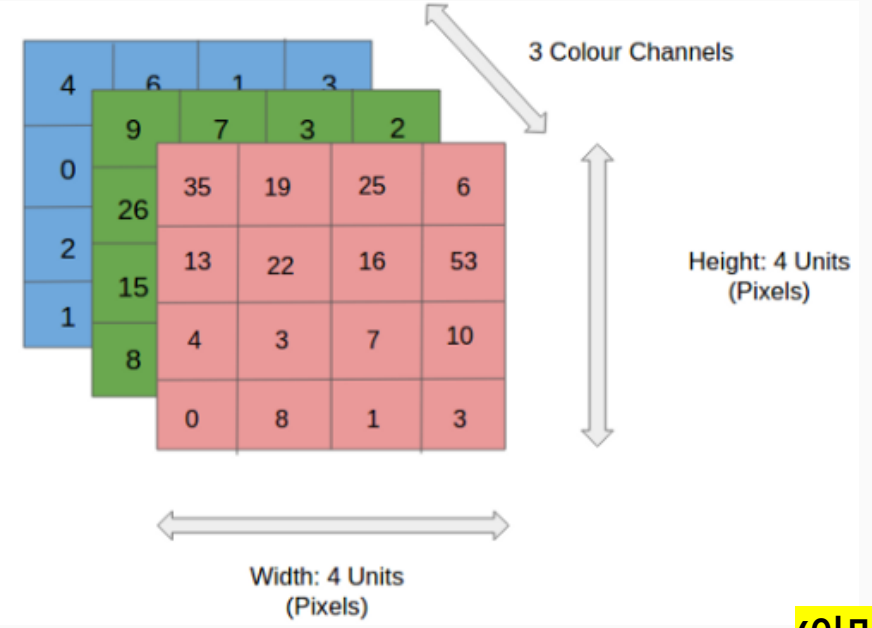
$$R = \begin{bmatrix} \cos\theta & -\sin\theta \\ \sin\theta & \cos\theta \end{bmatrix}$$



0. Overview of CNN Structure



0. Input Image

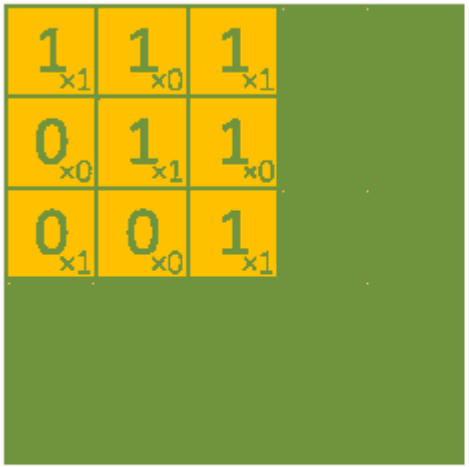


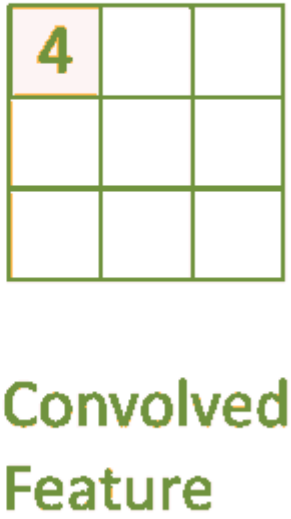
The role of the ConvNet is to

- **reduce the images** into a form which is easier to process,
- **without losing features** which are critical for getting a good prediction

(이미지 개수 ,이미지 Height,이미지 Width,이미지 Channel)

1. Feature Extraction - Convolution Layer – The Kernel

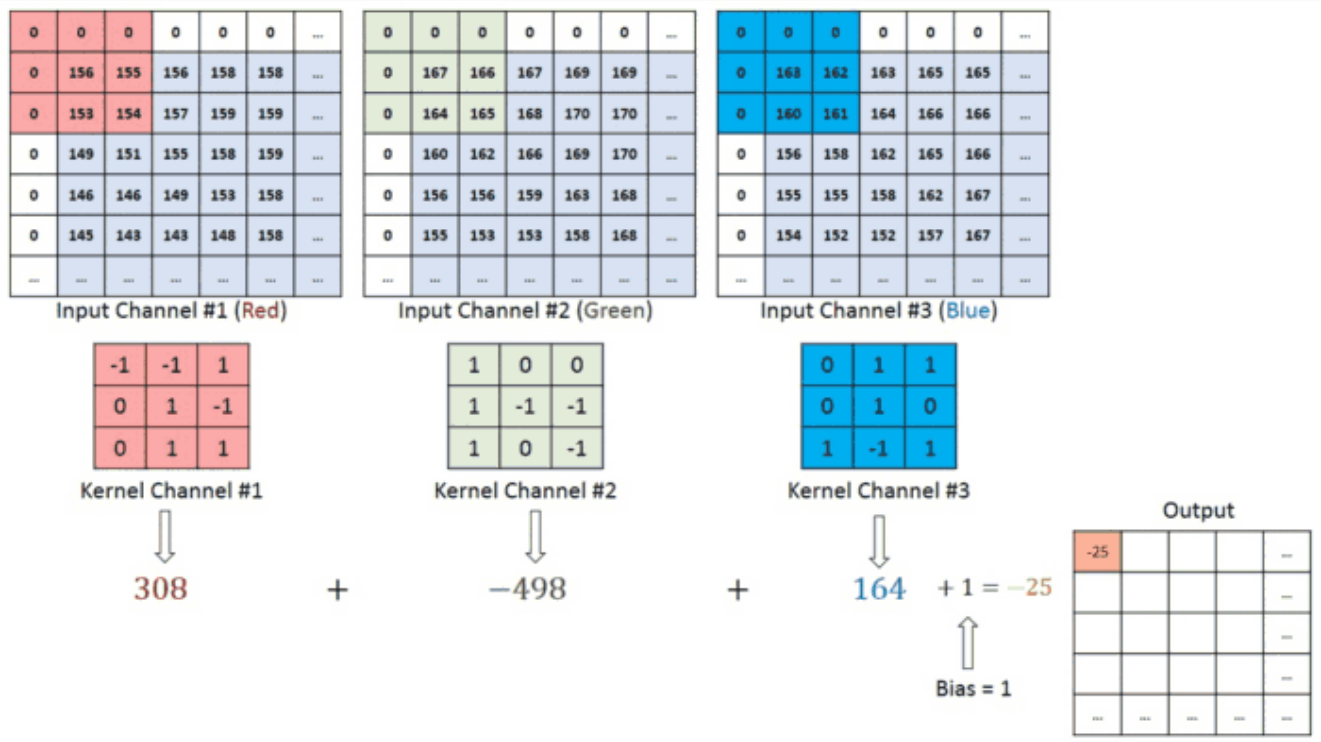




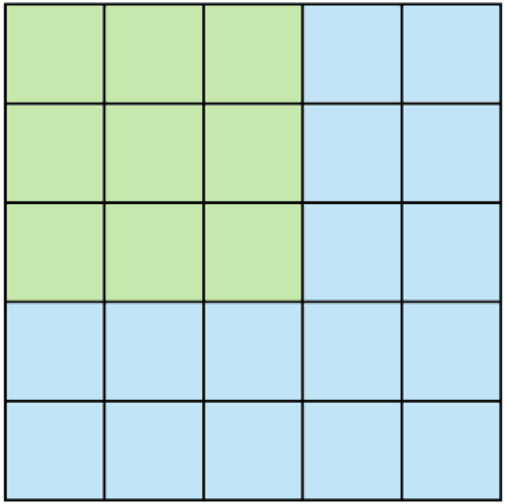
Input : 5*5*1
Kernel : 3*3*1*1
Strides : (1,1)
Padding : valid

```
Conv2D(filters = 필터갯수,
       kernel_size=(가로,세로),
       strides = (가로 이동수,세로 이동수),
       padding='same '  or padding="valid")
```

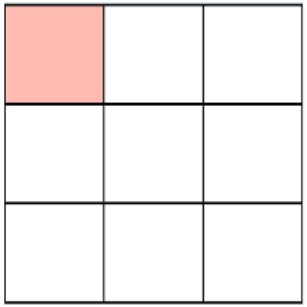
1. Feature Extraction - Convolution Layer – The Kernel



1. Feature Extraction - Convolution Layer – The Kernel - Stride



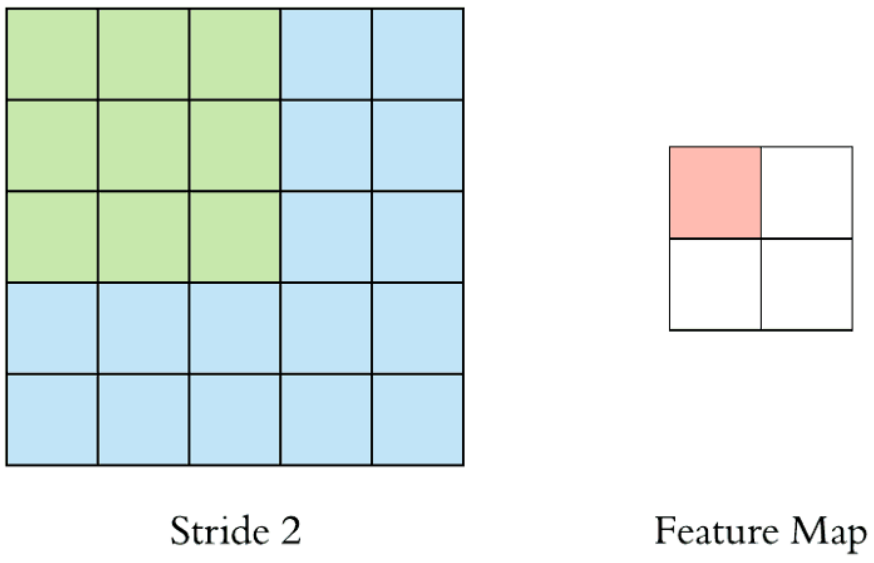
Stride 1



Feature Map

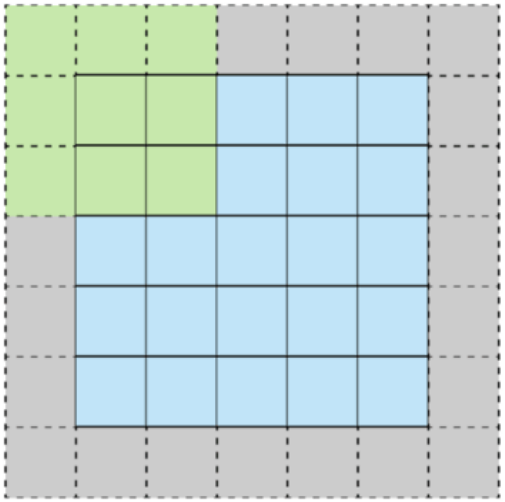
Conv2D(filters = 필터갯수,
kernel_size=(가로,세로),
strides = (가로 이동수,세로 이동수),
padding='same ' or padding="valid")

1. Feature Extraction - Convolution Layer – The Kernel - Stride

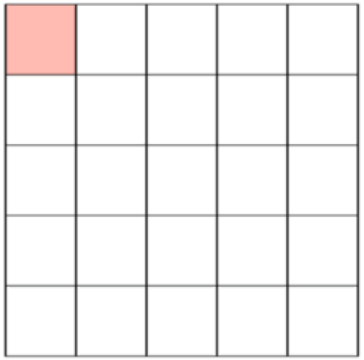



```
Conv2D(filters = 필터갯수,
       kernel_size=(가로,세로),
       strides = (가로 이동수,세로 이동수),
       padding='same '  or padding="valid")
```

1. Feature Extraction - Convolution Layer – The Kernel - Padding



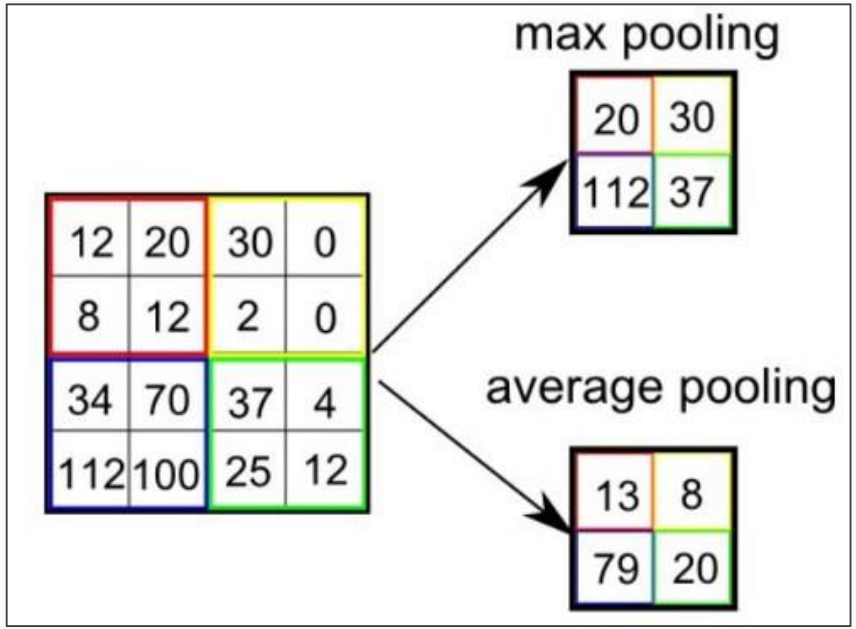
Stride 1 with Padding



Feature Map

Conv2D(filters = 필터갯수,
kernel_size=(가로,세로),
strides = (가로 이동수,세로 이동수),
padding='same ' or padding="valid")

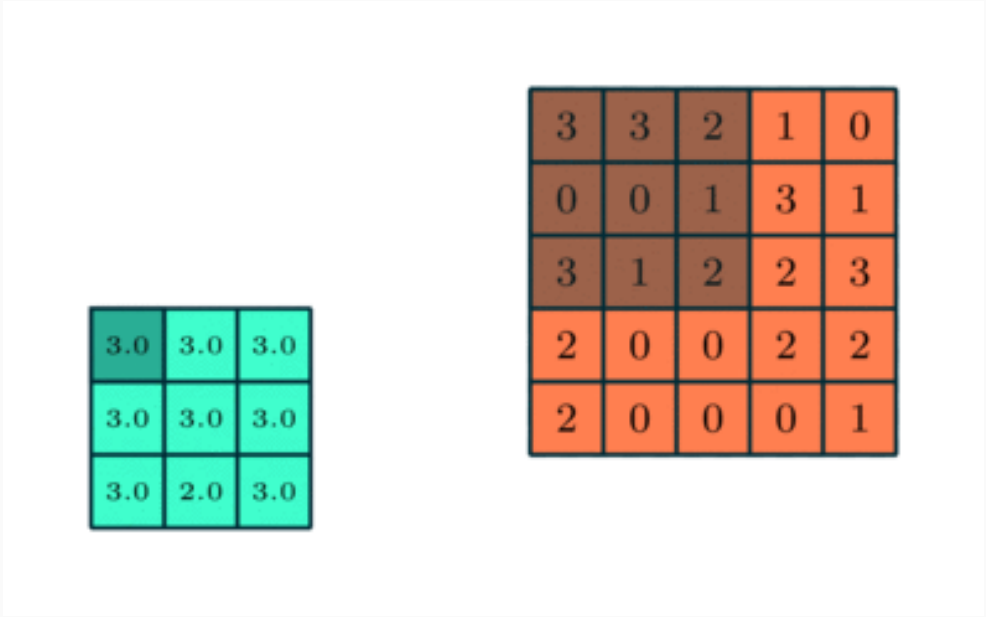
1. Feature Extraction - Pooling Layer



- Decrease the computational power
- Extracting dominant features (rotational, positional invariant)
- Noise Suppressant

```
MaxPooling2D(pool_size=(2, 2), strides=None, padding='valid', data_format=None
```

1. Feature Extraction - Pooling Layer

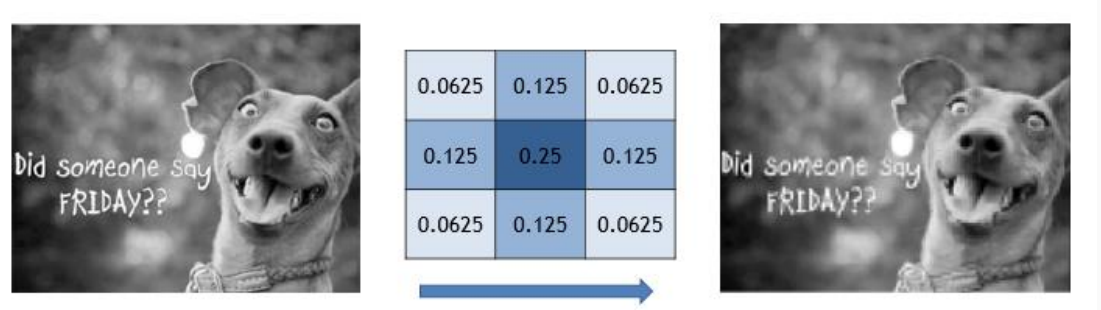


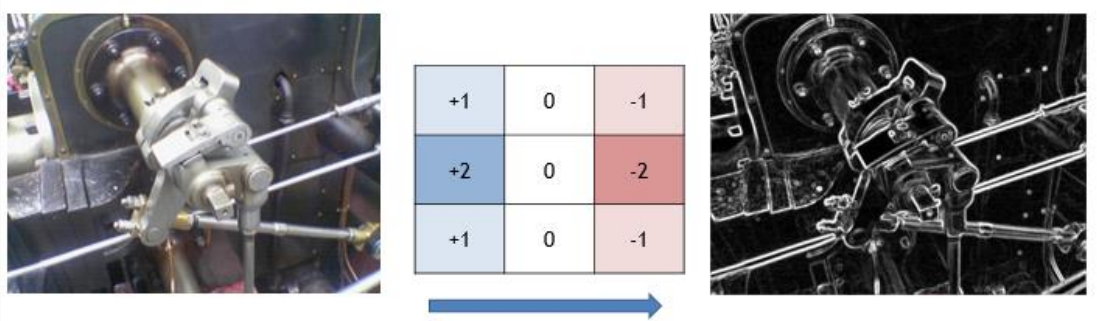

```
MaxPooling2D(pool_size=(2, 2),
strides=None, padding='valid', data_format=None
```

```
AveragePooling2D(pool_size=(2, 2), strides=None
padding='valid', data_format=None)
```

Convolutional Neural Network – 주요 용어 설명

실습





Convolutional Neural Network – 주요 용어 설명

실습

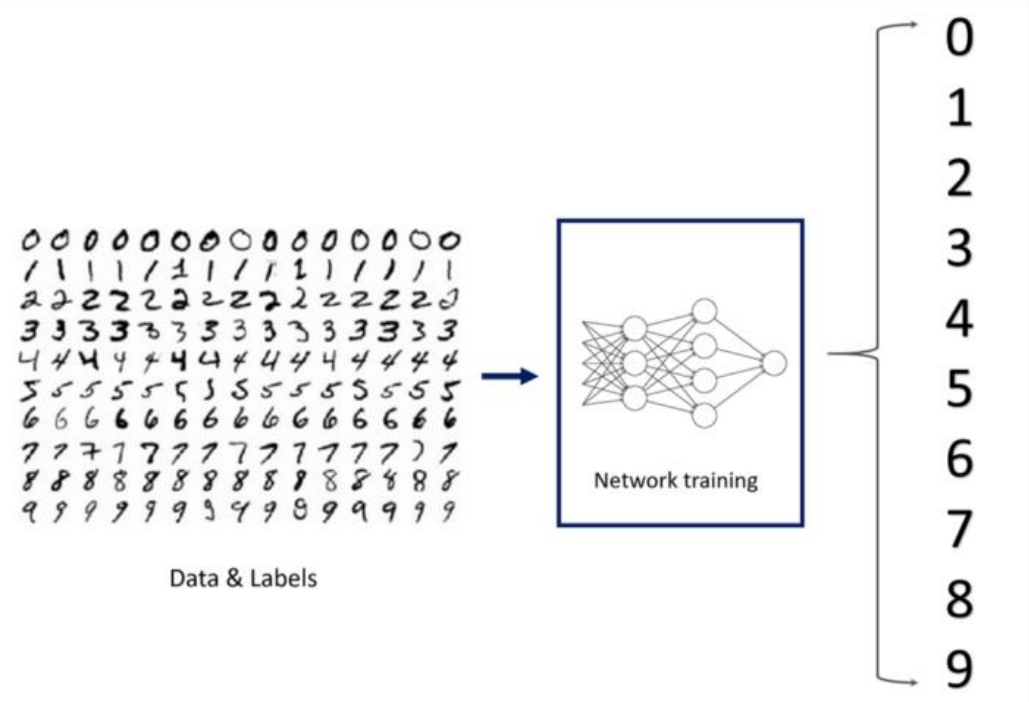
Convolution

Pooling

Let‘s have intuition first!

http://scs.ryerson.ca/~aharley/vis/conv/

Convolutional Neural Network – Mnist Dataset



size : 28 * 28
# of trainingset : 60000
# of test set : 10000

Keras, tensorflow ➔
Default로 (N,H,W,C) 순서로.
Y는 One hot-encoding

60000,28,28,1