Convolutional Neural Network

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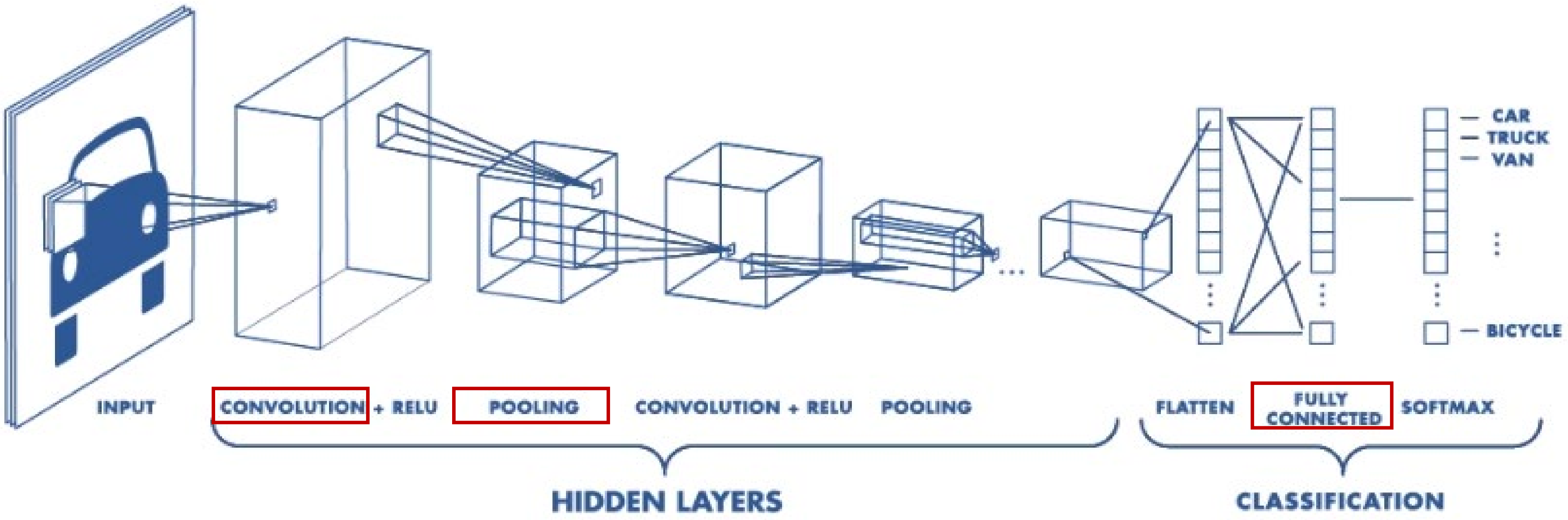
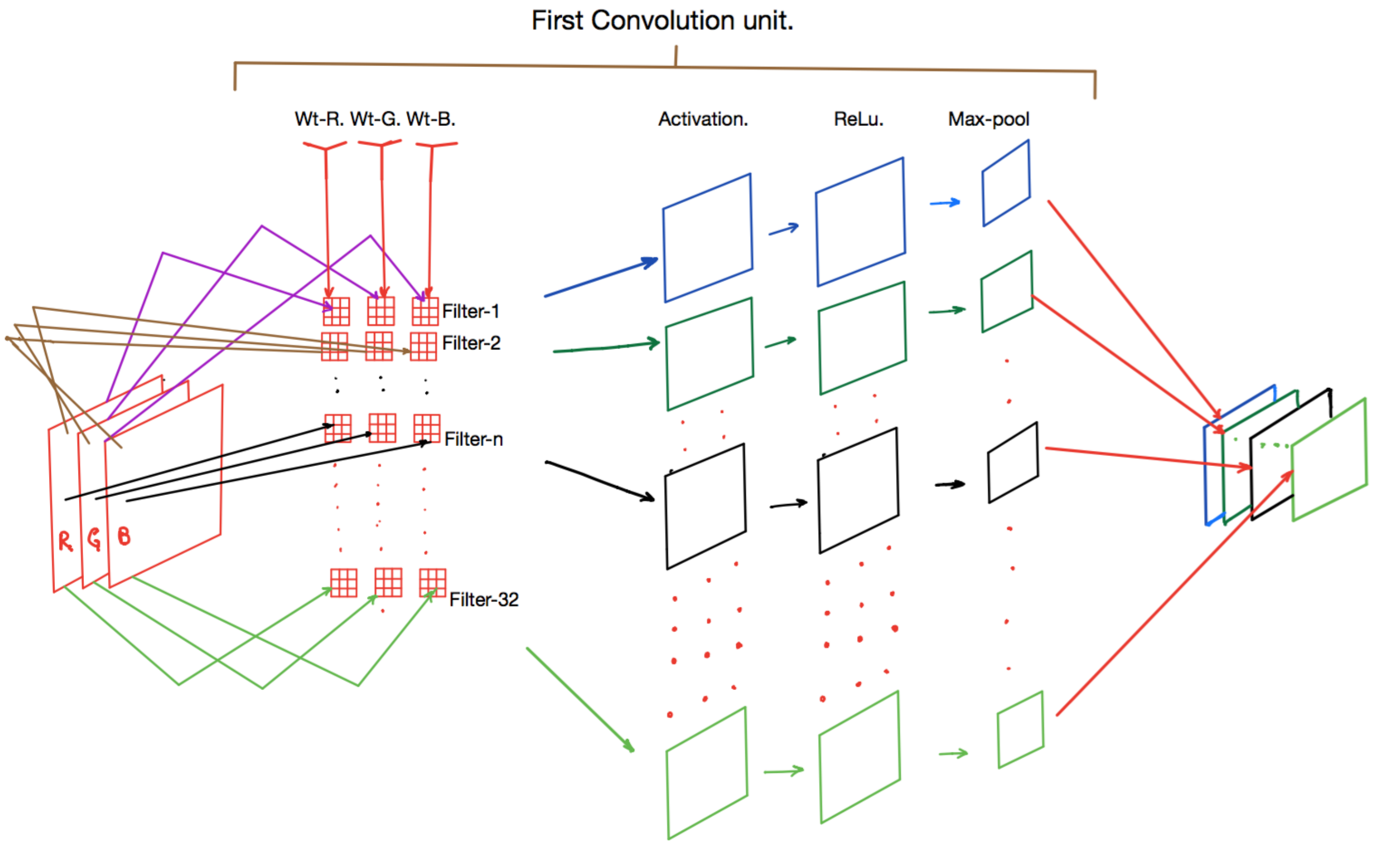


- Main Components
  - Convolution (Shared weights, dimension reduction)
  - Nonlinearity (ReLU)
  - Max pooling (translation invariance, dimension reduction for FC layer)
  - Fully connected Layer (classification)



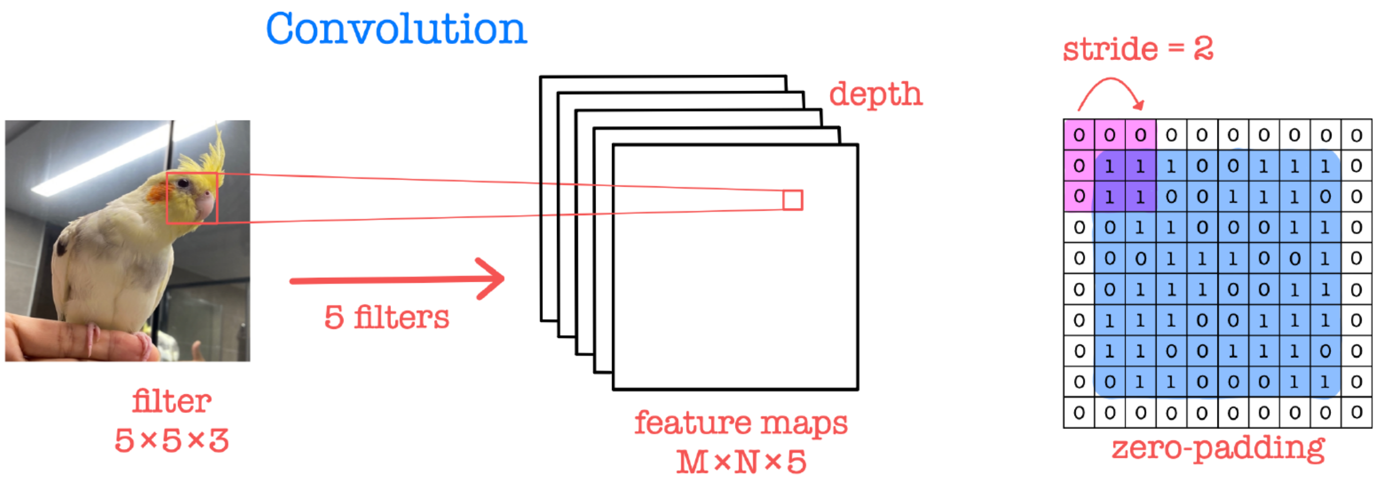
- The weights and the biases which are the components of the filters change when training the network.

1-1. Convolution Layer

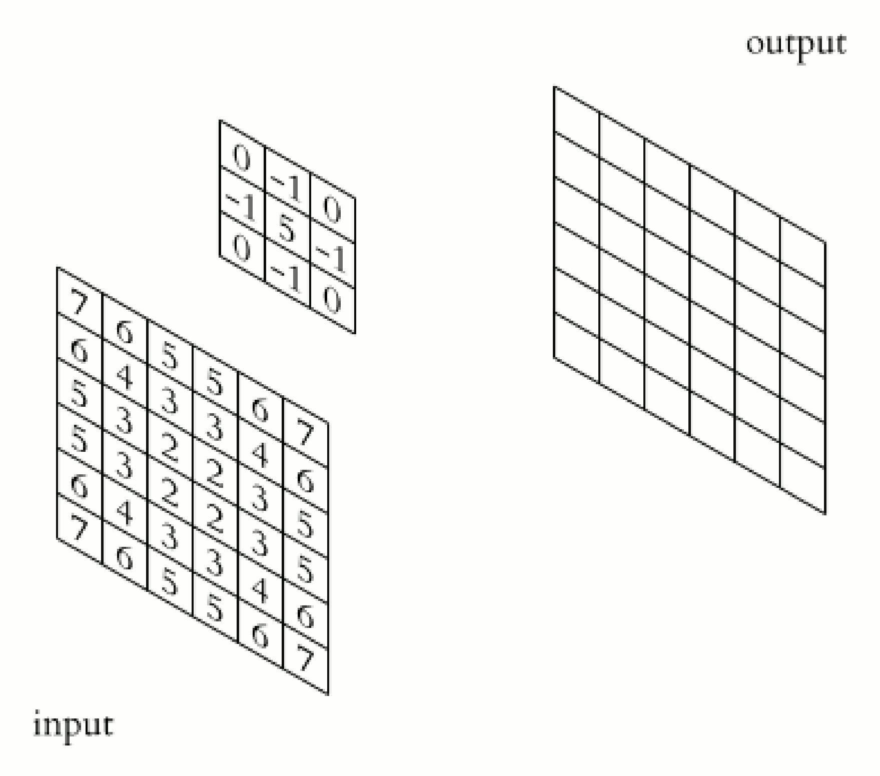
Hyperparameters on Convolution layer

- filters: number of filters (output feature maps)
- kernel size: size of kernel (convolution window: height x width)
- strides: distance between two successive kernel positions
- padding: “valid” = no padding

  “same” = padding with zeros to make the output with the same size as the input

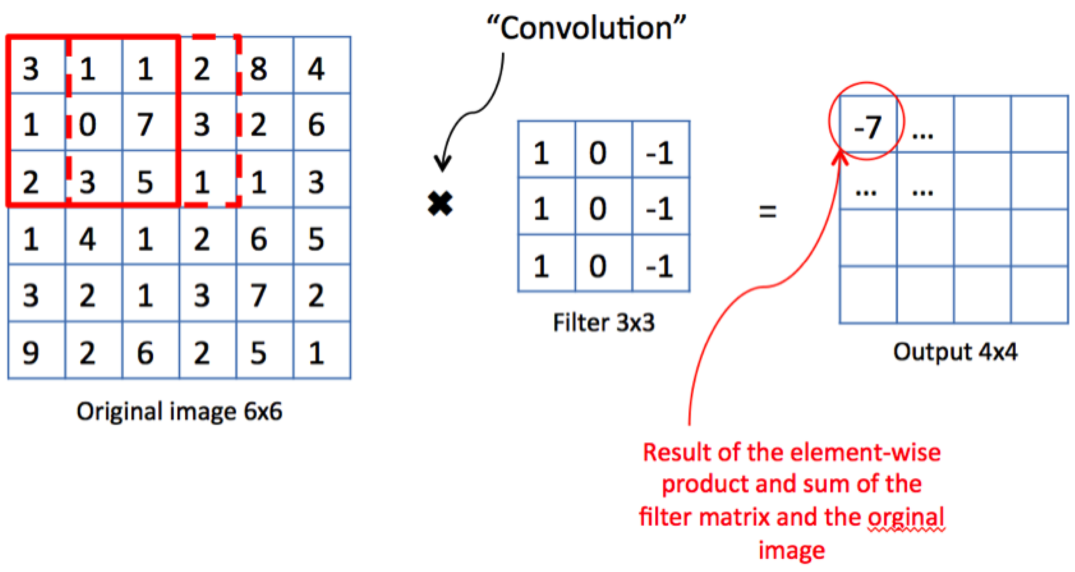


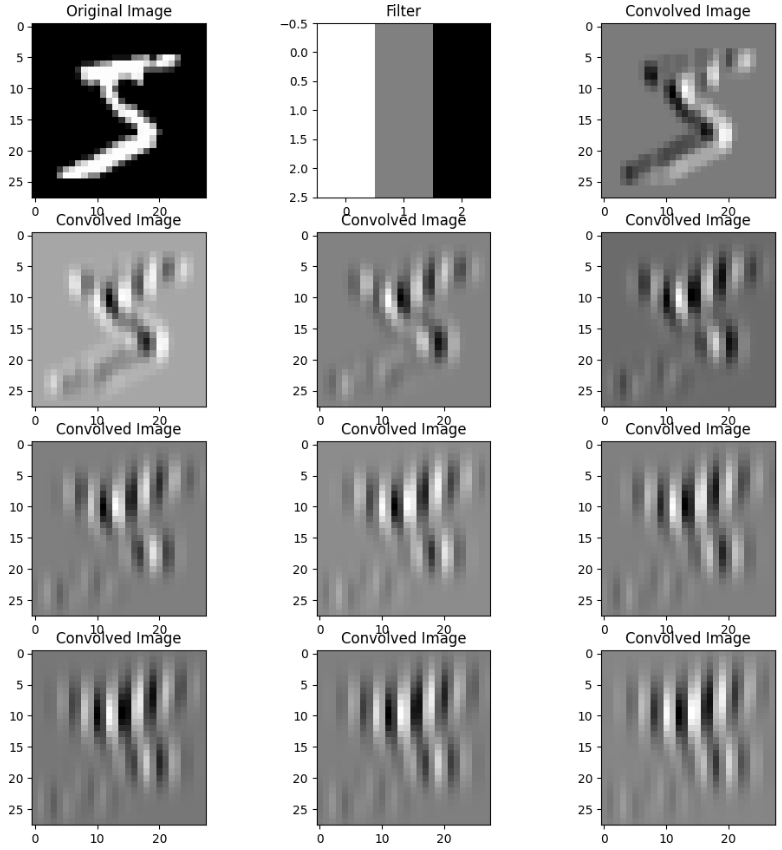
1-2. Convolution Operation



- $g(x,y) = w * f(x,y) = \sum_{i=-a}^{a}\sum_{j=-b}^{b} w(i,j)f(x-i,y-j)$

1-2. Convolution Operation – Kernel

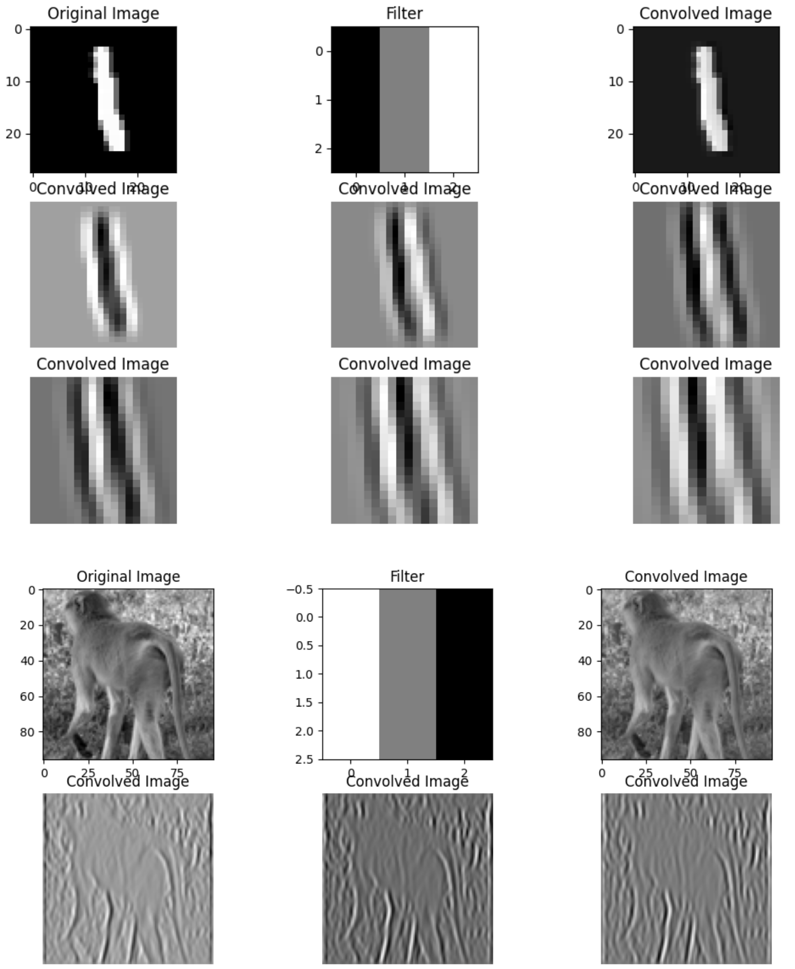




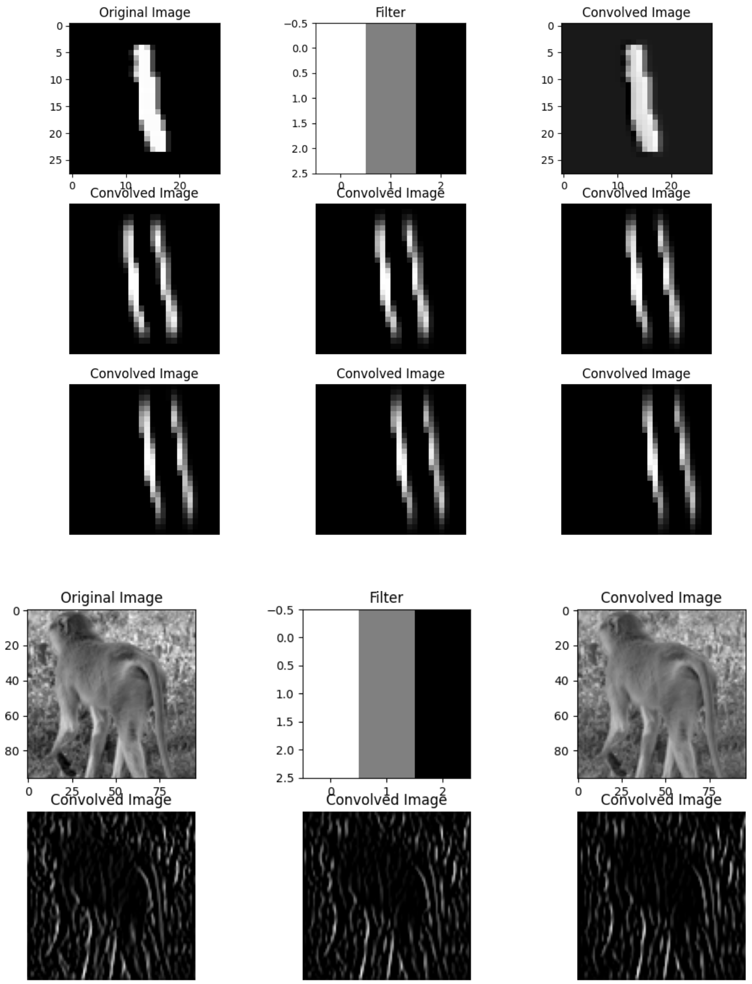
- Note that the size of the output may be different from the size of the input.
- The output of the filter will be large if the input has the feature that the filter can detect.

1-2. Convolution Operation – Some Examples of Kernel

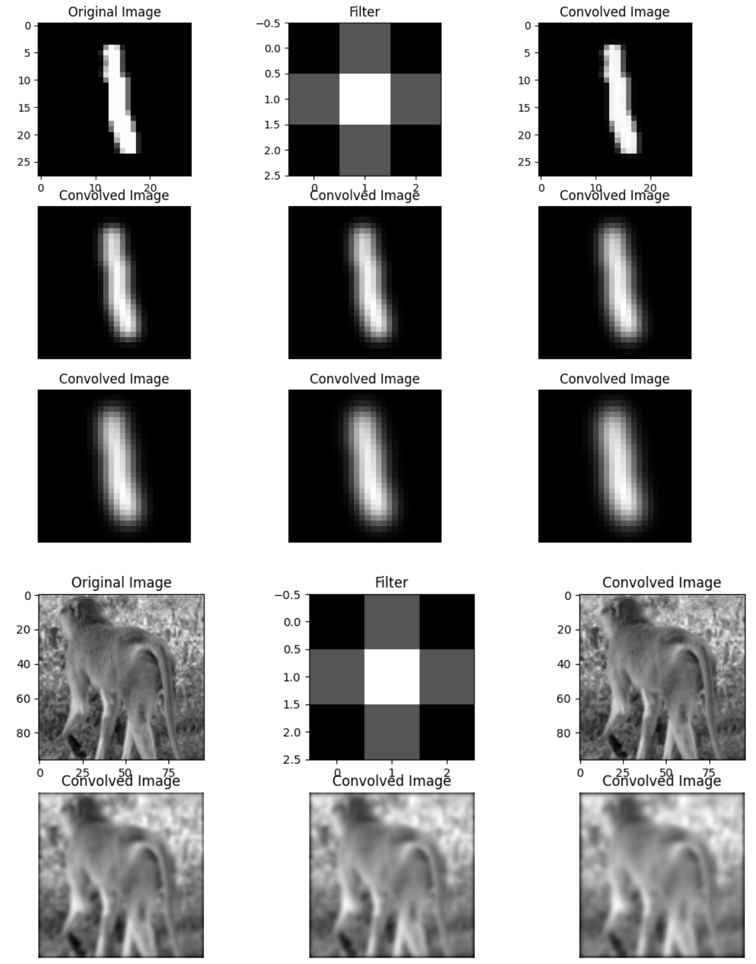
vertical filter (with padding)



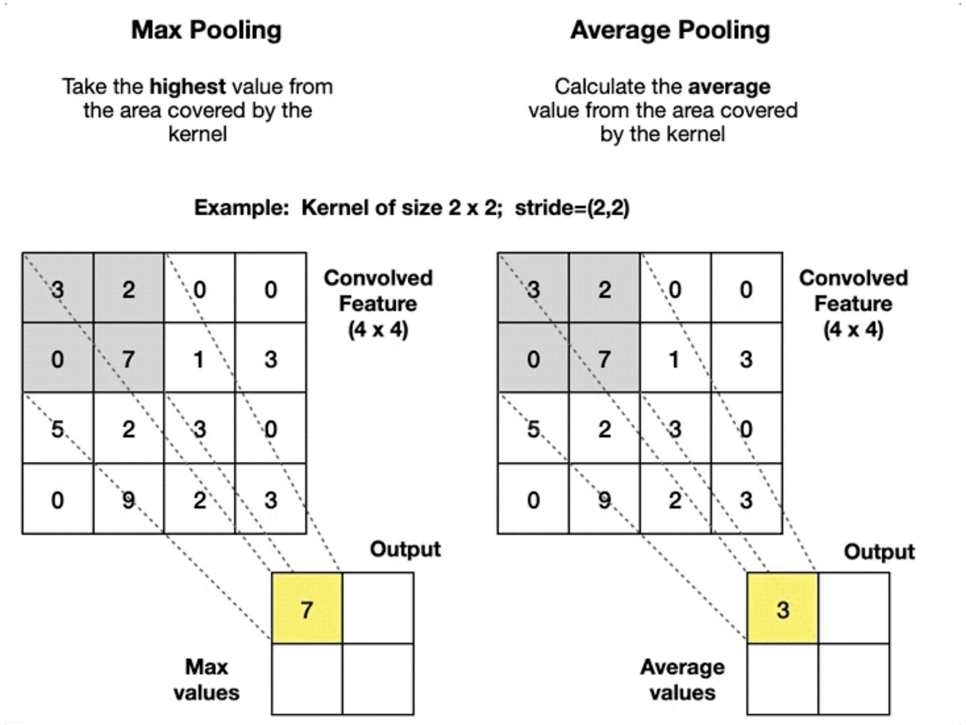
vertical filter (with padding & ReLU)



Gaussian blur filter (with padding)



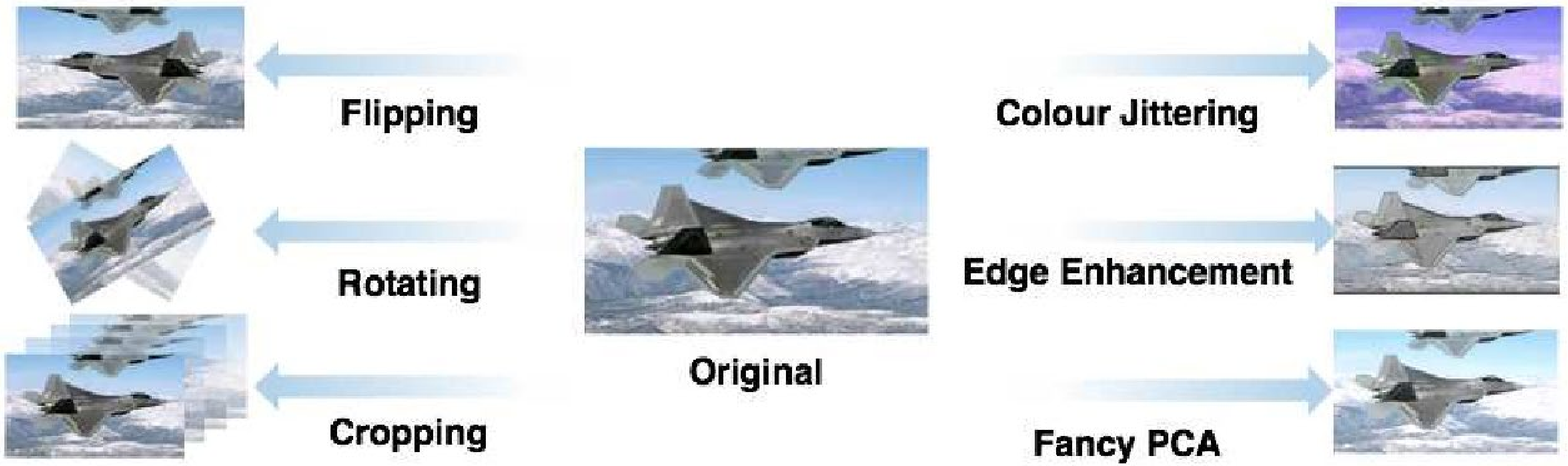
* The code is uploaded on GitHub. (convolution_operation_visualization.py)

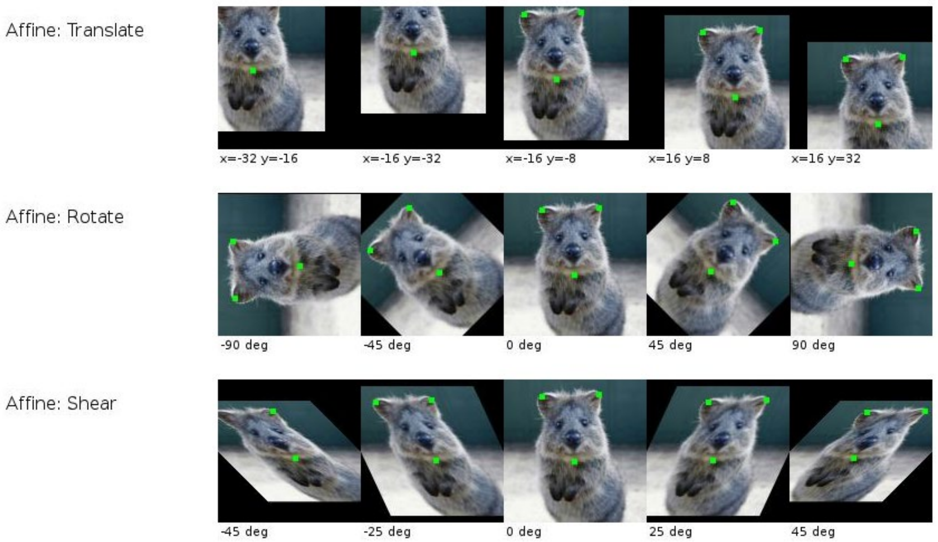


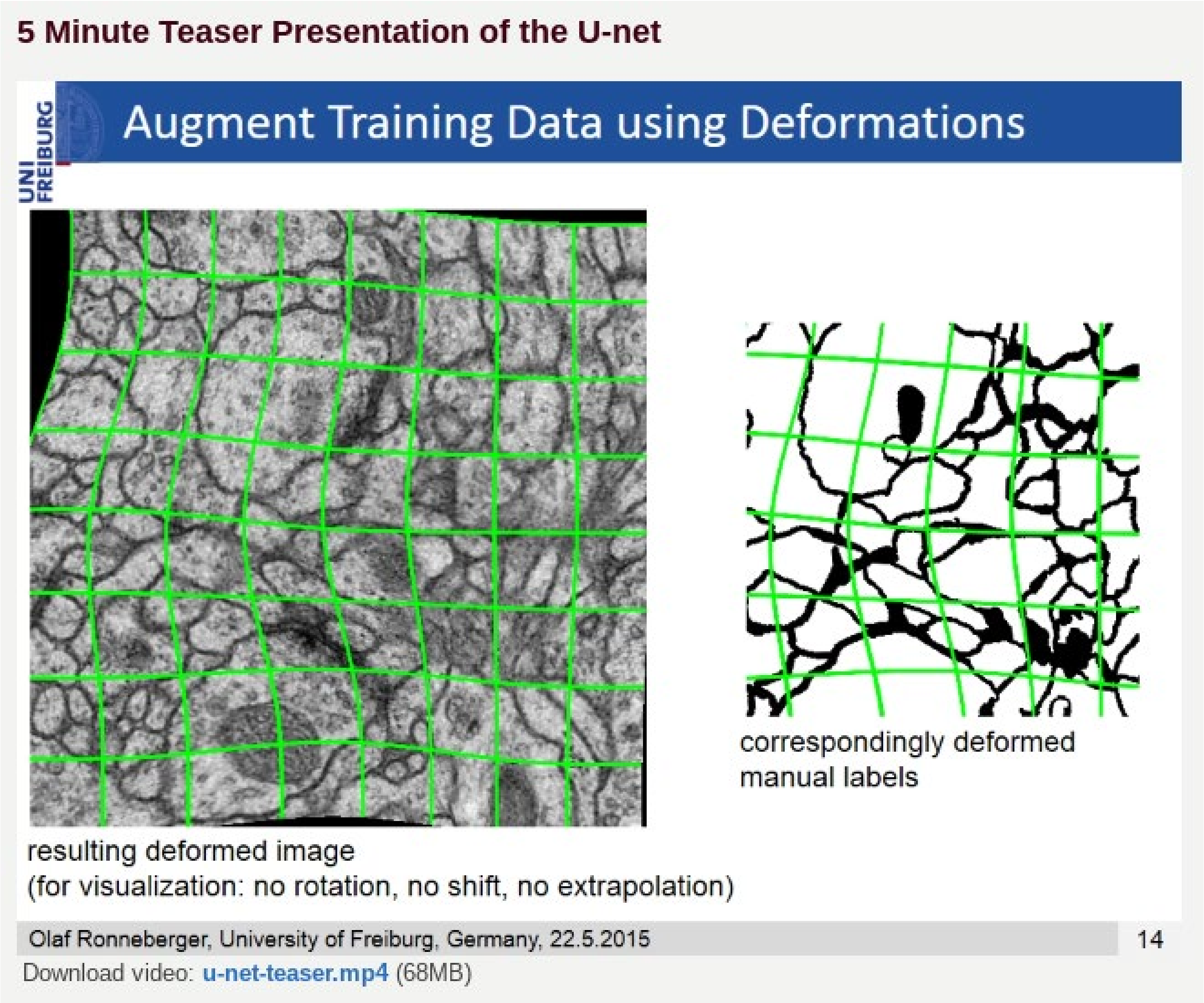
- Pooling layers reduce the dimensions of data by combining the outputs of neuron clusters at one layer into a single neuron in the next layer.
- Max pooling: Take the highest value from the area covered by the kernel
- Average pooling layer: Calculate the average value from the area covered by the kernel

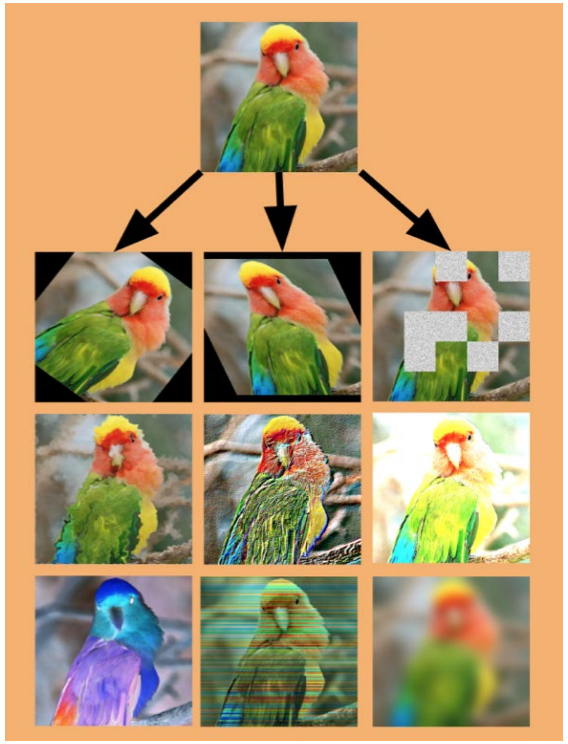
Data Augmentation

- One way of reducing overfitting.


Flipping
Rotating
Cropping
Original
Colour Jittering
Edge Enhancement
Fancy PCA


Affine: Translate
x=-32 y=-16
x=-16 y=-32
x=-16 y=-8
x=16 y=8
x=16 y=32
Affine: Rotate
-90 deg
-45 deg
0 deg
45 deg
90 deg
Affine: Shear
-45 deg
-25 deg
0 deg
25 deg
45 deg


5 Minute Teaser Presentation of the U-net
Augment Training Data using Deformations
UNI FREIBURG
correspondingly deformed manual labels
resulting deformed image
(for visualization: no rotation, no shift, no extrapolation)
Olaf Ronneberger, University of Freiburg, Germany, 22.5.2015
14
Download video: u-net-teaser.mp4 (68MB)



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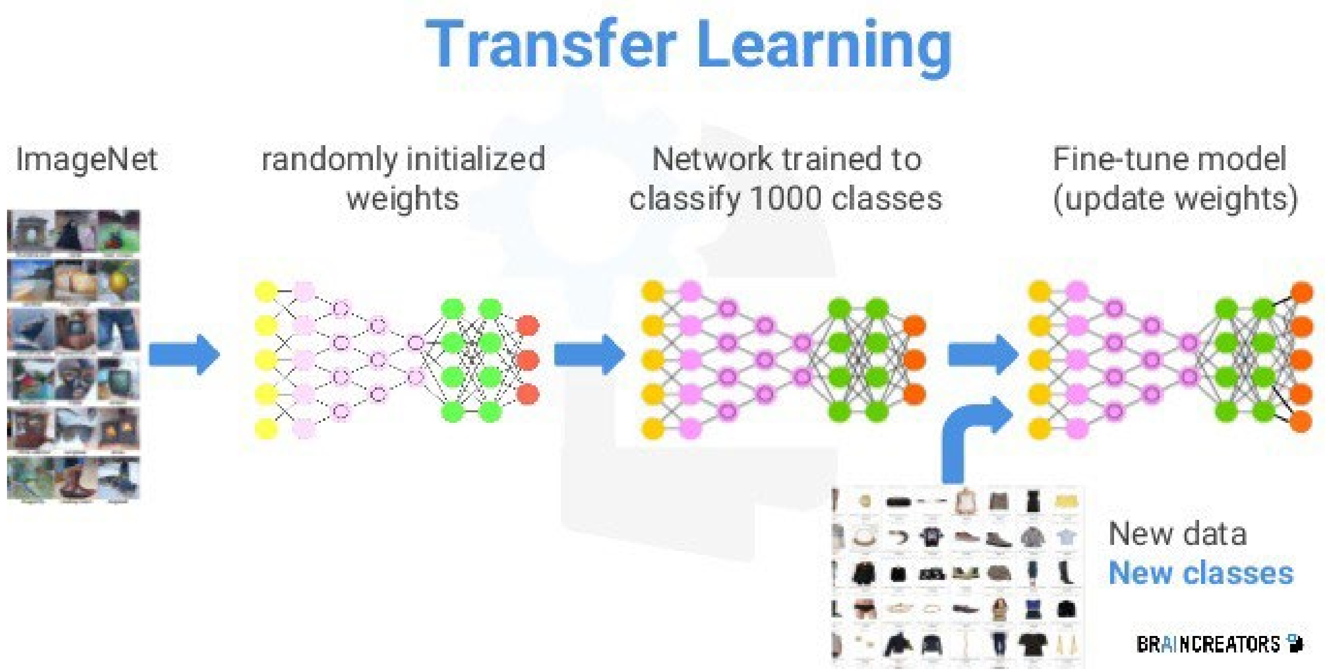

- The core idea of transfer learning is to get better initial weights to extract good visual features

3. Transfer Learning using PyTorch

```python
import torchvision.models as models
model = models.resnet50(weights=models.ResNet50_Weights.IMAGENET1K_V1).to(device)

for name, param in model.named_parameters():
    if param.requires_grad:
        print(f"Trainable parameter: {name}")
    else:
        print(f"Non-trainable parameter: {name}")
```

```python
import torchvision
for name in dir(torchvision.models):
    print(name)
```

Check pretrained models in torchvision without resnet50

- Load pretrained model at torchvision.models
- Check model's layer name & trainable / non-trainable parameters

Question

- GitHub에 공유된 코드는 직접 제작한 모델입니다. 바로 위 페이지의 코드를 참고하여 transfer learning을 직접 구현해보고, 결과를 notion에 공유해주세요.