Image Segmentation

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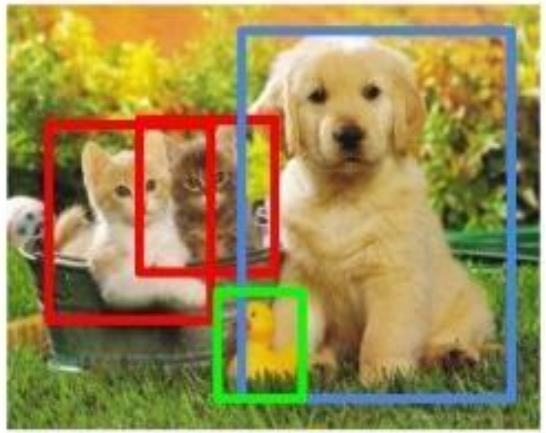
1. Image Segmentation

Image Analysis

Classification

CAT

Object Detection



CAT, DOG, DUCK

Instance Segmentation

CAT, DOG, DUCK

Image Segmentation

Input

segmented

1: Person
2: Purse
3: Plants/Grass
4: Sidewalk
5: Building/Structures

3	3	3	3	3	3	3	3	3	3	3	3	5	5	5	5	5	5
3	3	3	3	3	3	3	3	3	3	3	3	5	5	5	5	5	5
3	3	3	3	3	3	1	1	3	3	3	3	5	5	5	5	5	5
3	3	3	3	3	1	1	1	1	3	3	3	5	5	5	5	5	5
3	3	3	3	3	3	1	1	3	3	3	5	5	5	5	5	5	5
5	5	3	3	3	3	1	1	3	3	5	5	5	5	5	5	5	5
4	4	3	4	1	1	1	1	1	1	4	4	4	5	5	5	5	5
4	4	3	4	1	1	1	1	1	1	4	4	4	4	4	5	5	5
4	4	4	1	1	1	1	1	1	1	1	4	4	4	4	4	4	4
3	3	3	1	1	1	1	1	1	1	1	4	4	4	4	4	4	4
3	3	3	1	2	2	1	1	1	1	1	4	4	4	4	4	4	4
3	3	3	1	2	2	1	1	1	1	1	4	4	4	4	4	4	4

Semantic Labels

[Dense Prediction]

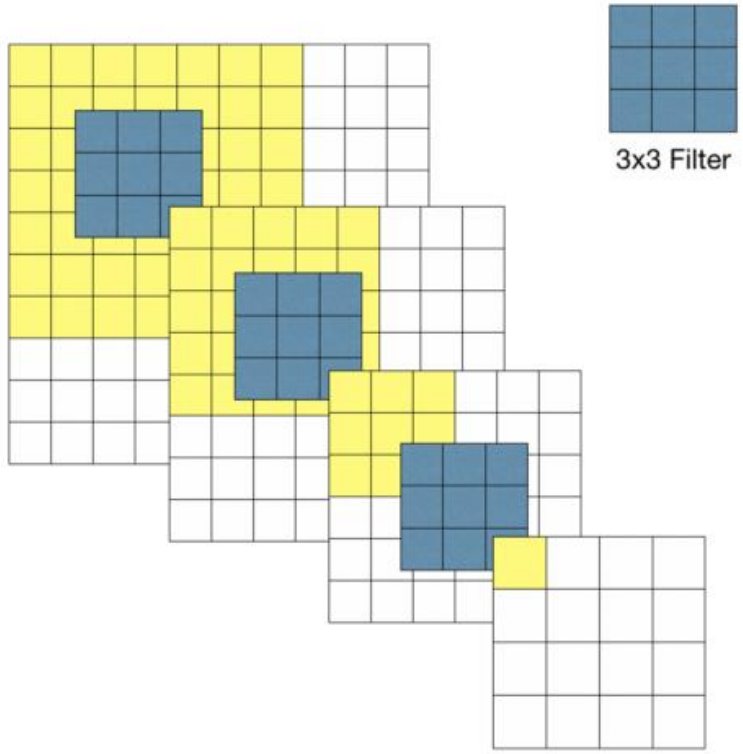
Image Segmentation

Instance Segmentation

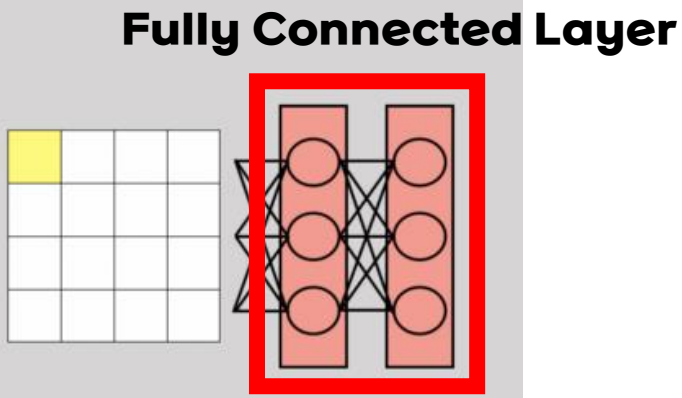
Semantic Segmentation

Classification model ➡ Segmentation model

① Convolutionalization



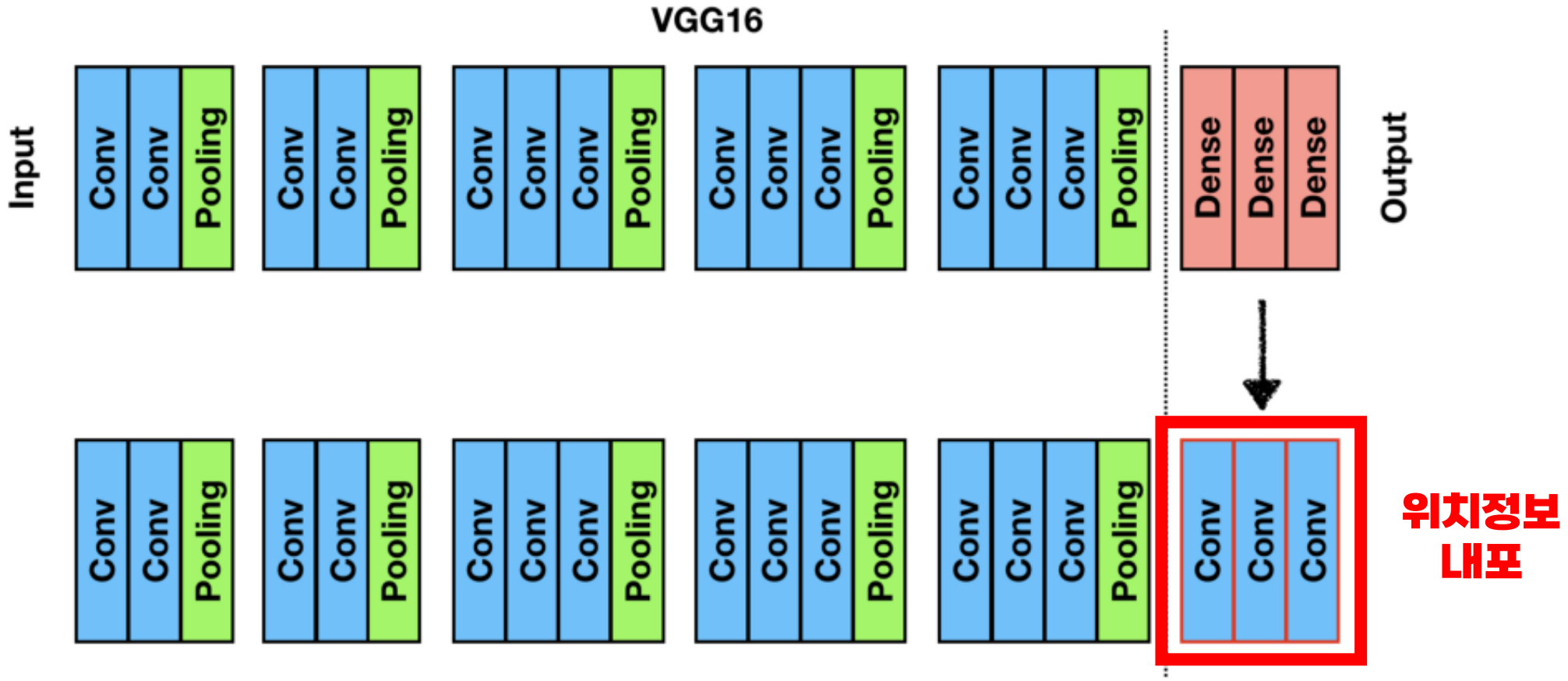
위치 정보가 유지된다.



위치정보가 사라진다.

Classification model ➡ Segmentation model

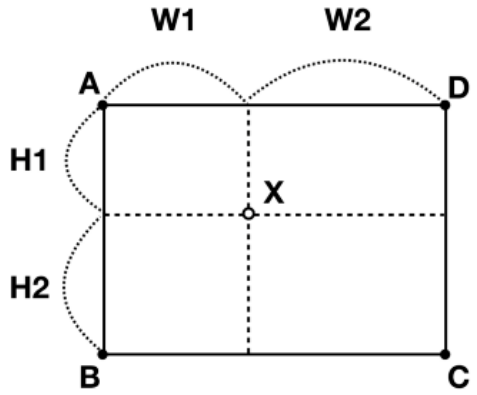
① Convolutionalization



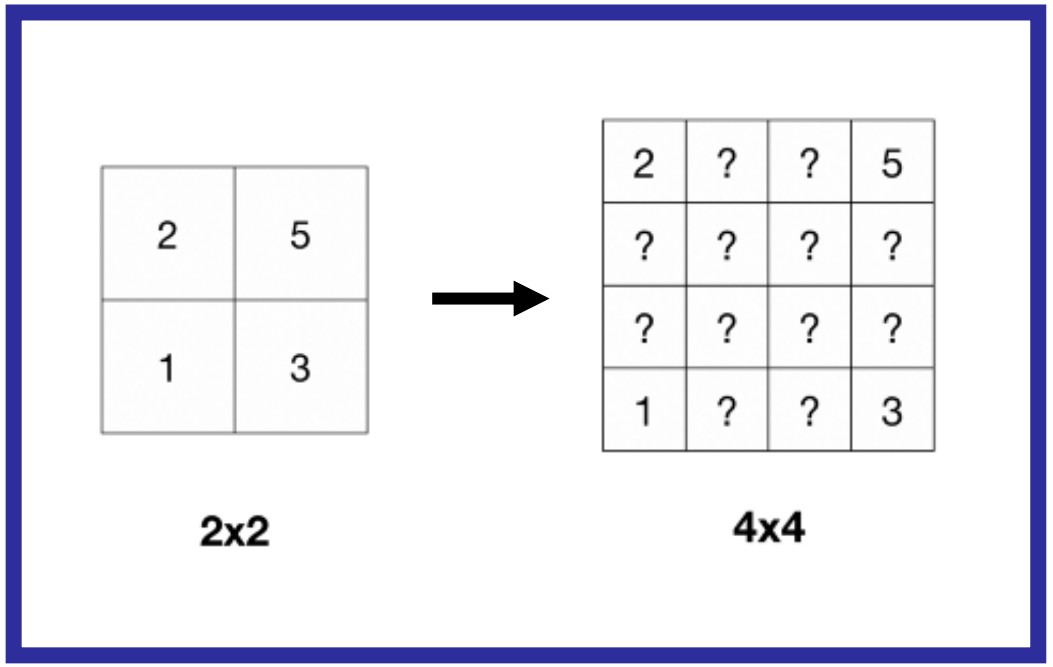
Classification model ➡ Segmentation model

② UpSampling

※ Bilinear Interpolation



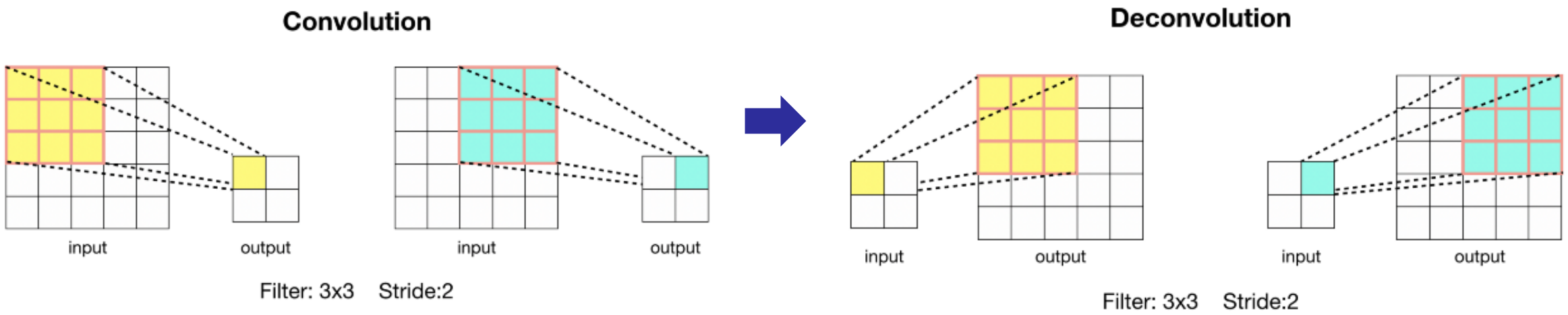
$$X = \left(A\frac{H2}{H1+H2} + B\frac{H1}{H1+H2}\right)\frac{W2}{W1+W2} + \left(D\frac{H2}{H1+H2} + C\frac{H1}{H1+H2}\right)\frac{W1}{W1+W2}$$



Classification model ➡ Segmentation model

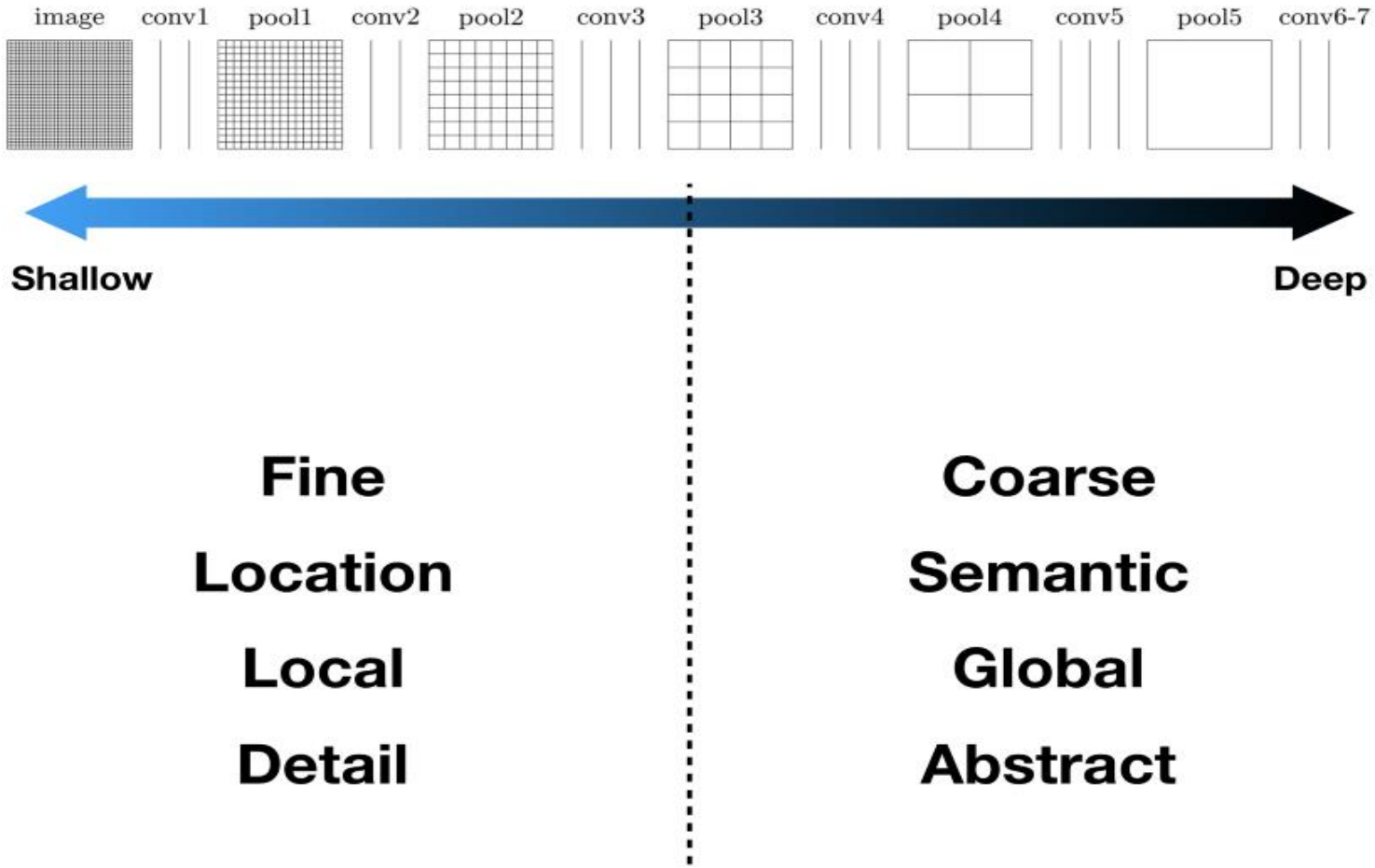
② UpSampling

※ Deconvolution



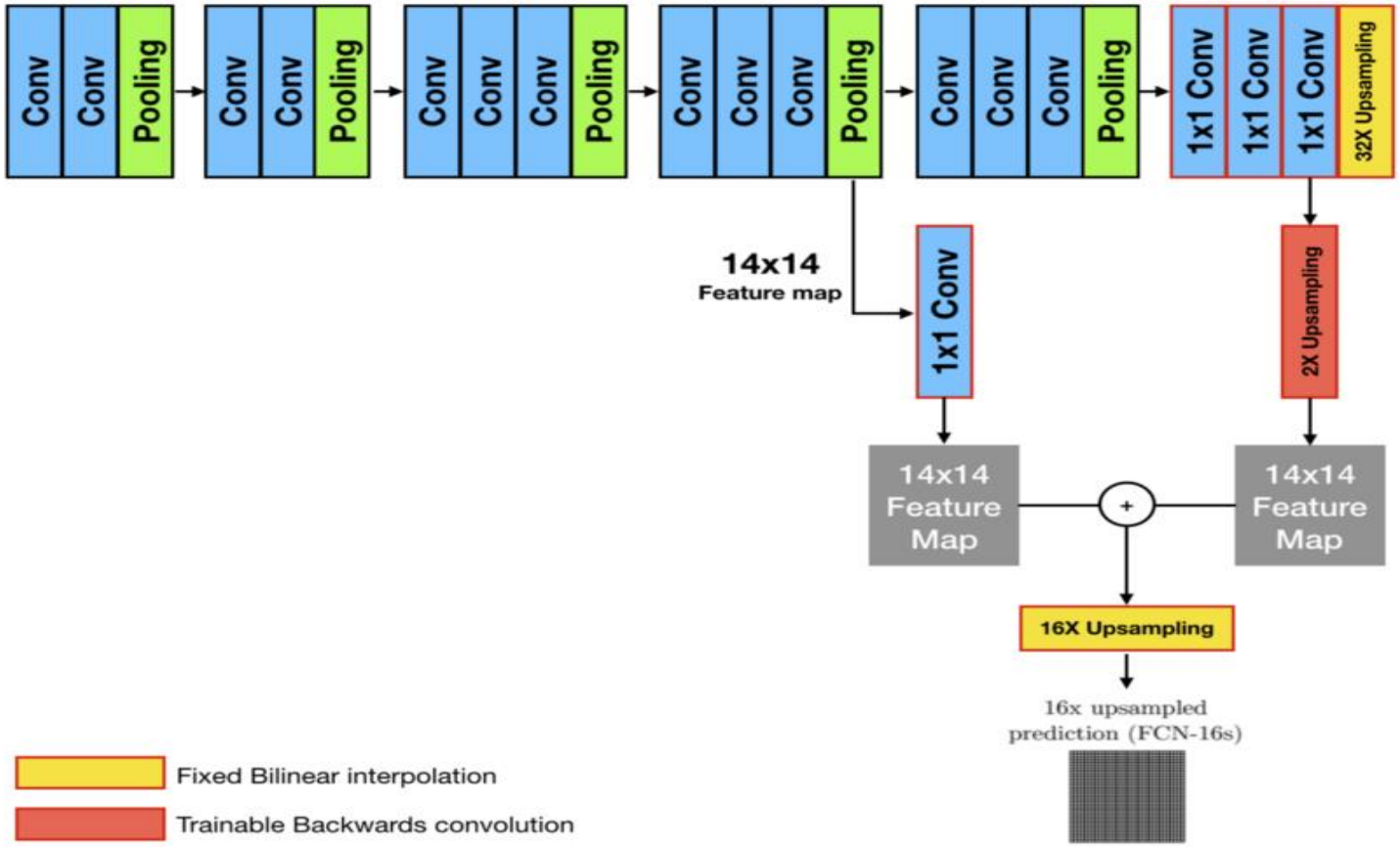
Classification model ➡ Segmentation model

③ Skip Architecture



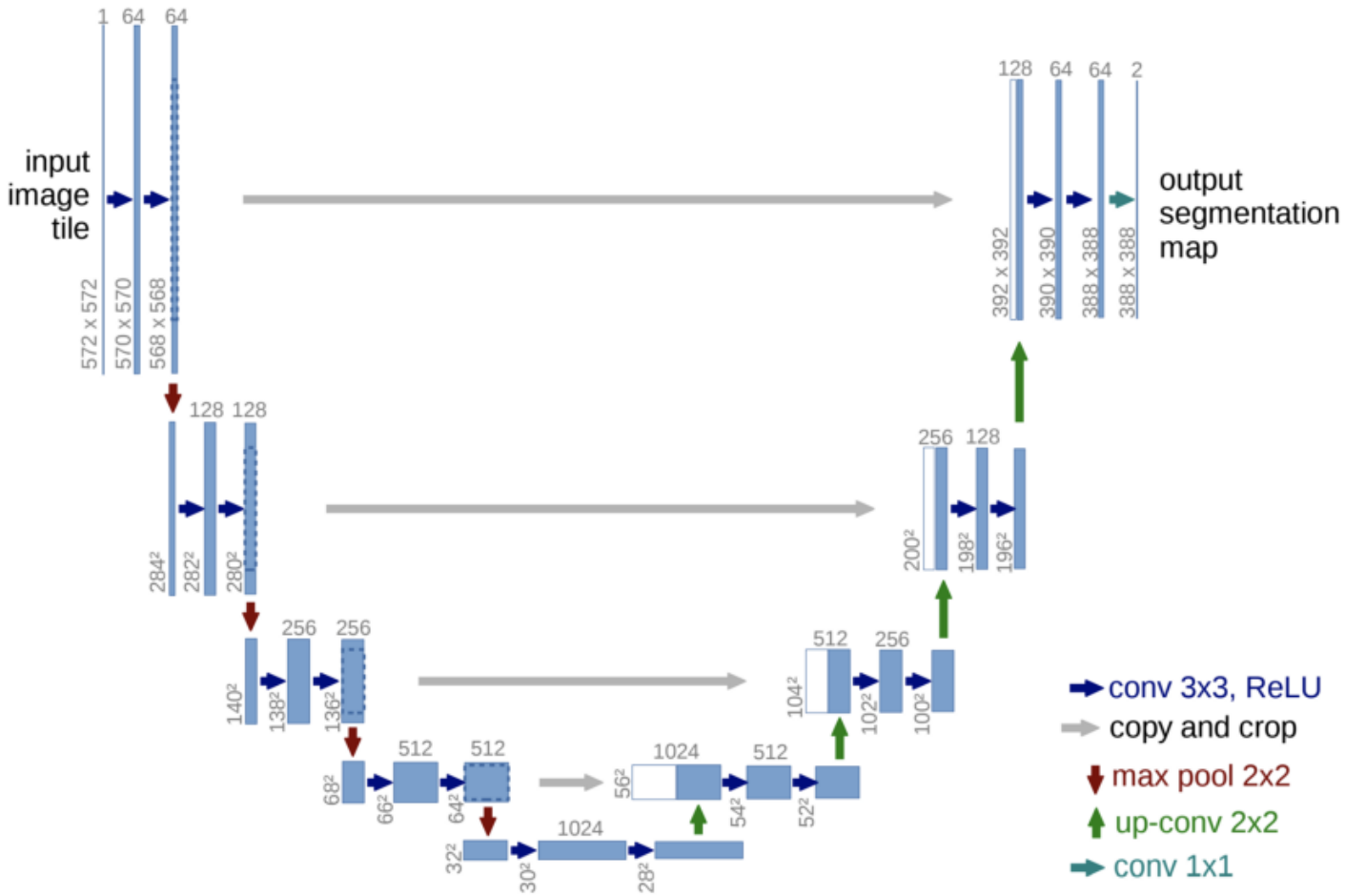
Classification model ➡ Segmentation model

③ Skip Architecture

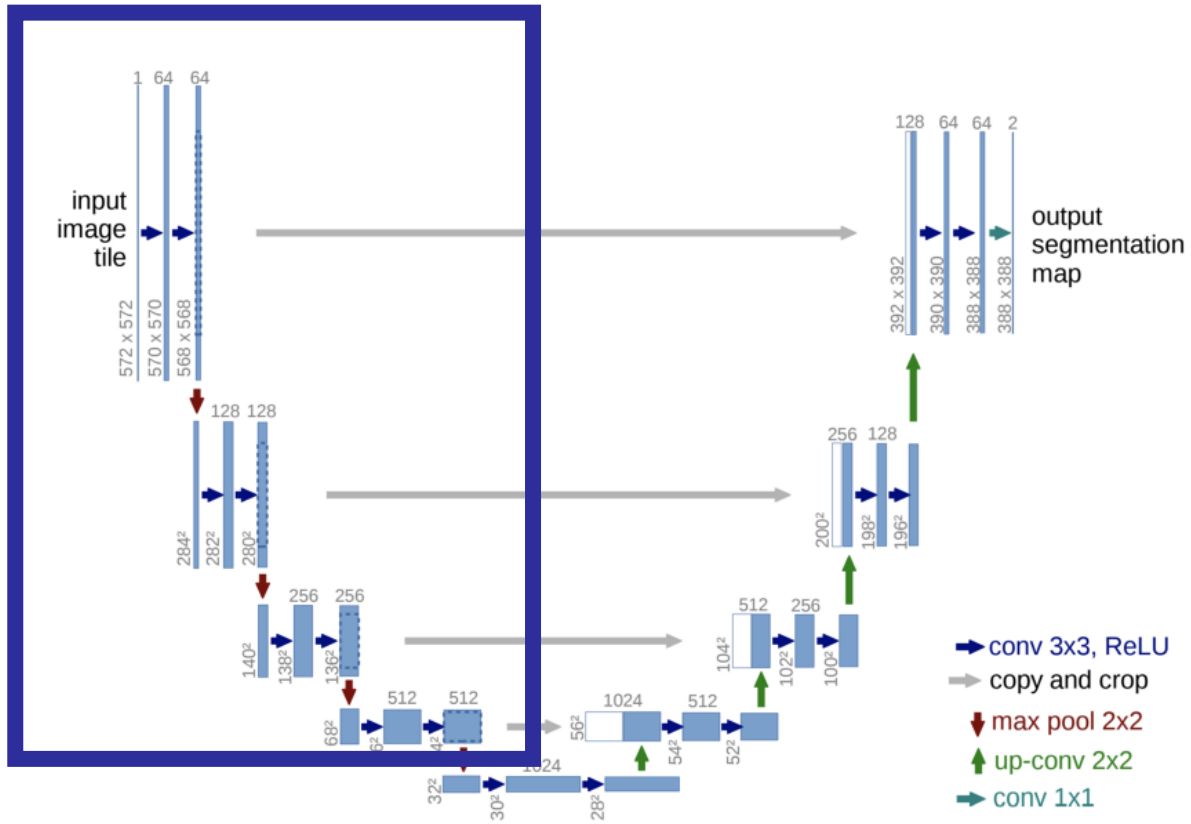


2. U-Net

U-Net


input image tile
output segmentation map
conv 3x3, ReLU
copy and crop
max pool 2x2
up-conv 2x2
conv 1x1

U-Net

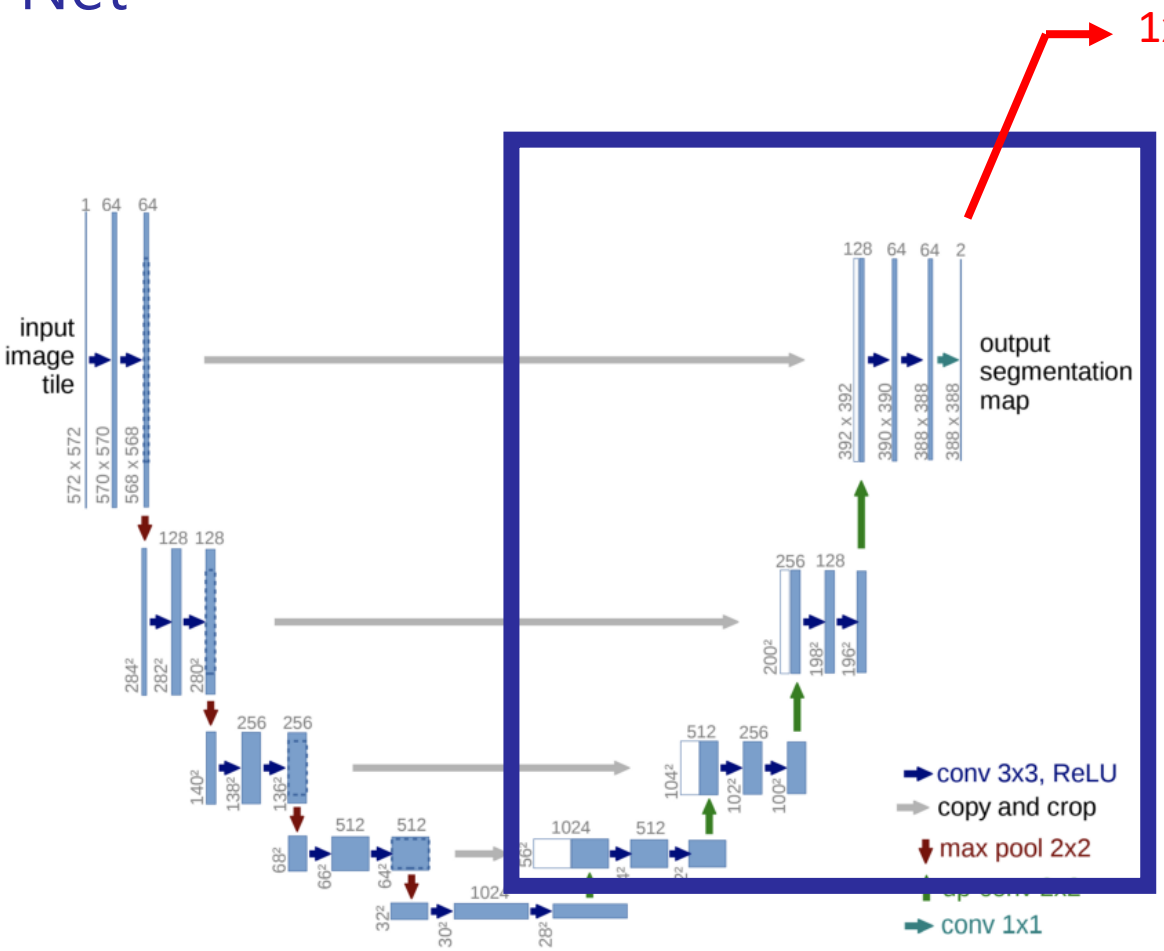


Contracting Path

: 이미지의 전반적인 Context 정보

- ✓ 3x3 convolutions 반복
- ✓ Activation Function : ReLU
- ✓ 2x2 max-pooling (stride: 2)
- ✓ Down-sampling

U-Net



Expanding Path

: 높은 해상도의 Output을 얻기 위한 Up-sampling

- ✓ 2x2 convolution (“up-convolution”)
- ✓ 3x3 convolutions 반복
- ✓ Activation Function : ReLU
- ✓ Skip Architecture

3. Analysis

0. Data

X = Original Image

Y = Masked Image

Train : 367개, Test : 101개

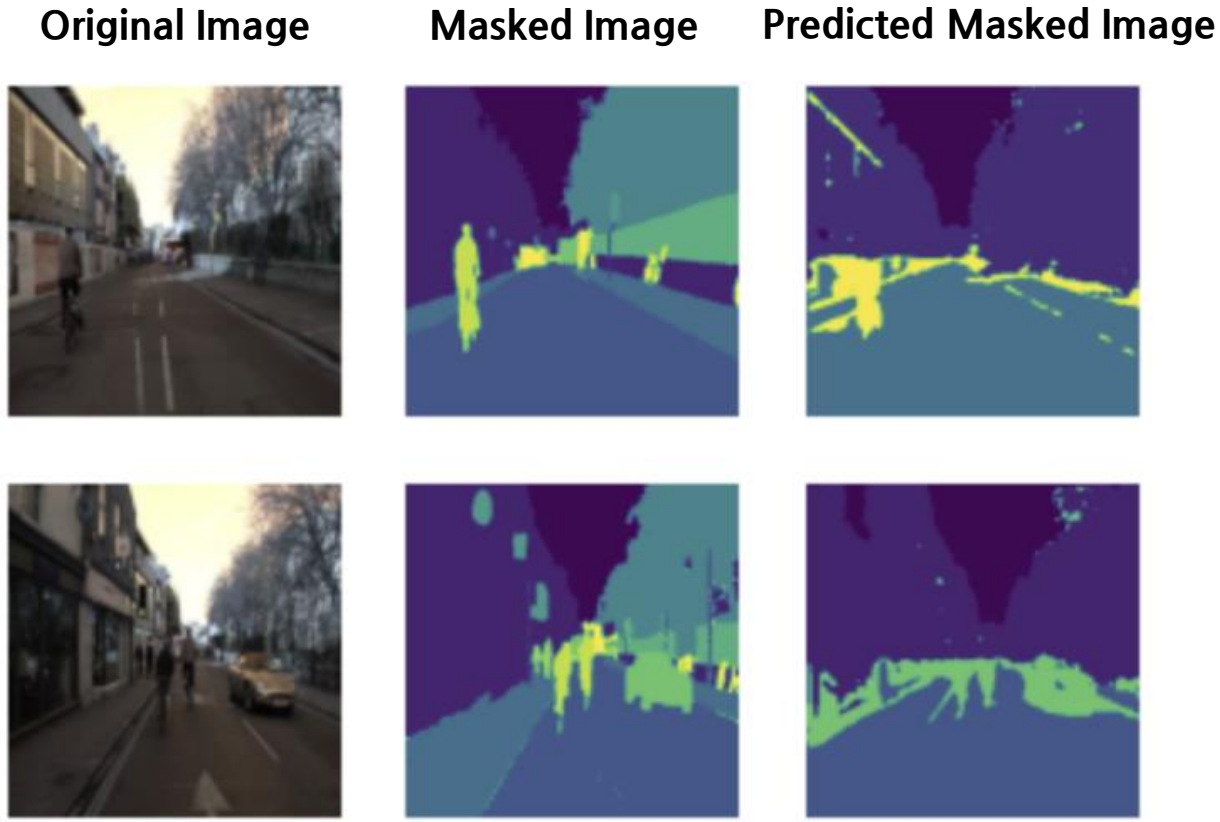
Image size : 224 × 224

Class : 12개 (사람, 건물, 자동차, 나무 등)

1. U-Net

	Train	Validation
Loss	0.9456	0.9541
Accuracy	0.7016	0.6833

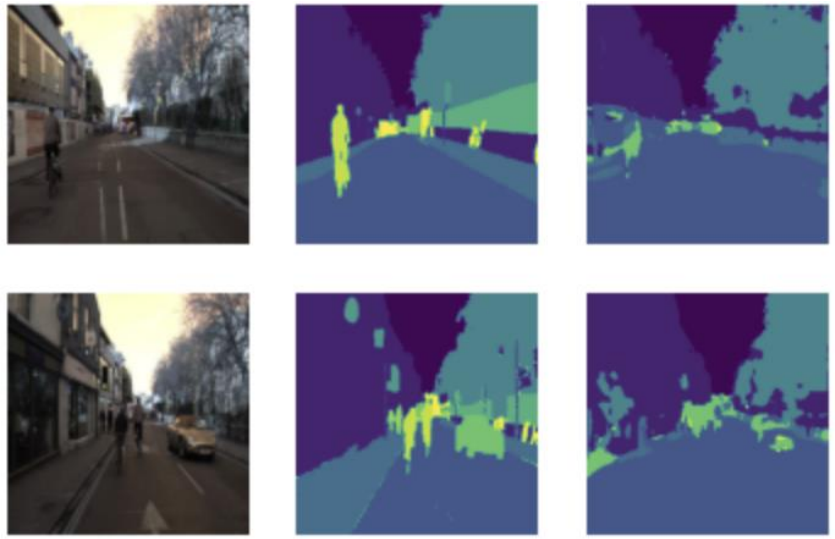
Test Accuracy : 0.5961



1. U-Net

※ Batch Normalization

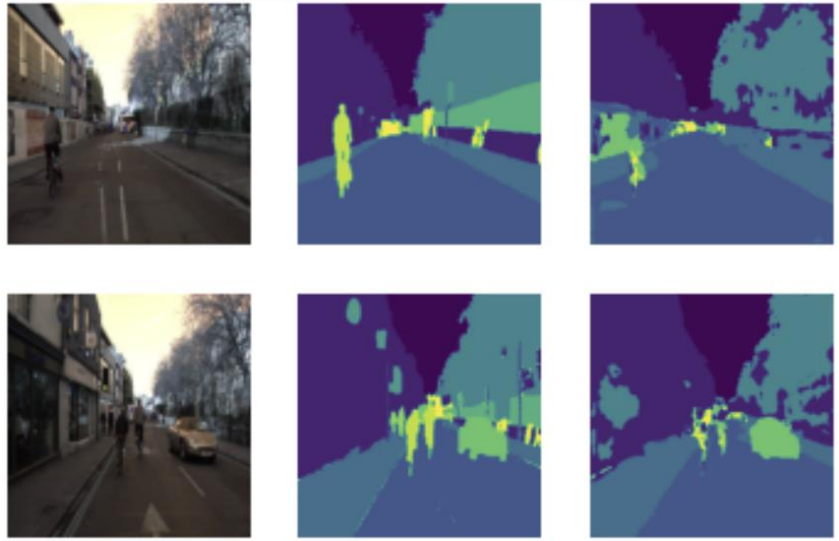
	Train	Validation
Loss	0.5300	1.0207
Accuracy	0.8435	0.7460



Test Accuracy : 0.7396

※ Batch Normalization & Dropout

	Train	Validation
Loss	0.5473	0.8628
Accuracy	0.8388	0.7478



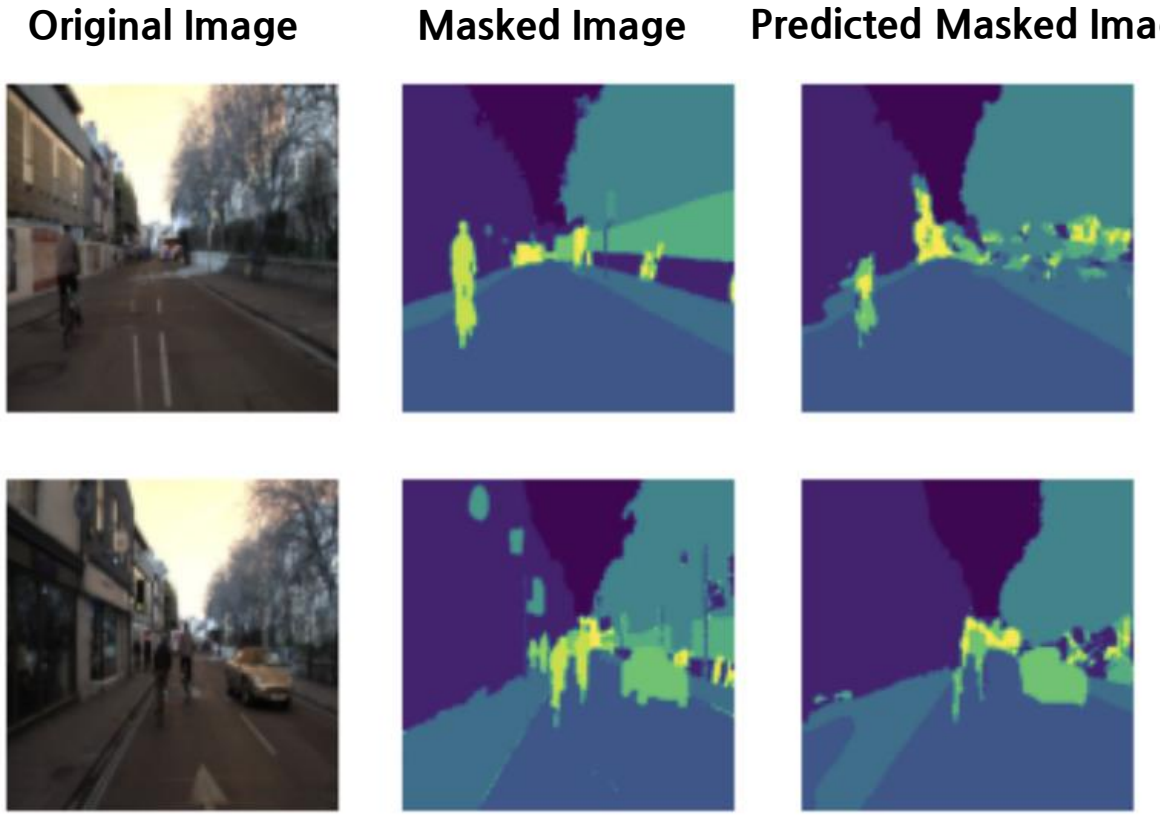
Test Accuracy : 0.8055

2. U-Net based on pretrained VGG16

※ Base Model : Pretrained VGG16

	Train	Validation
Loss	0.4270	0.4992
Accuracy	0.8788	0.8617

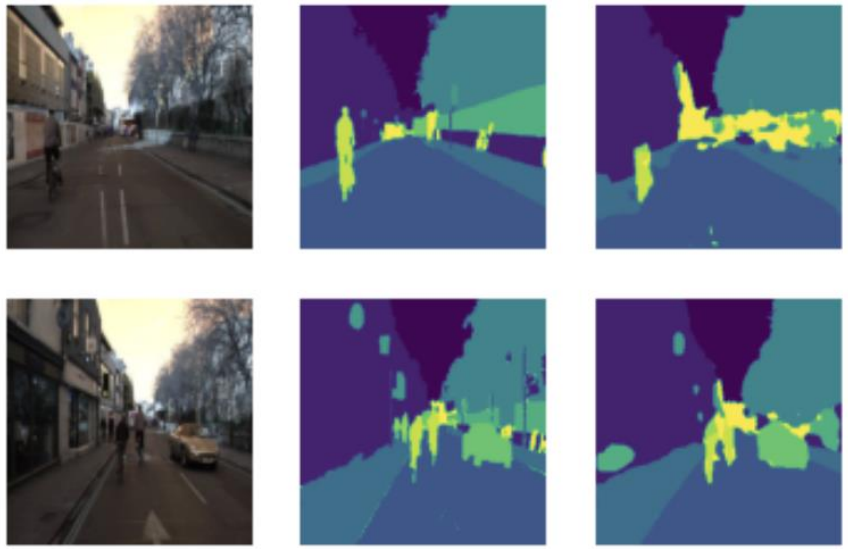
Test Accuracy : 0.8550



2. U-Net based on pretrained VGG16

※ Batch Normalization

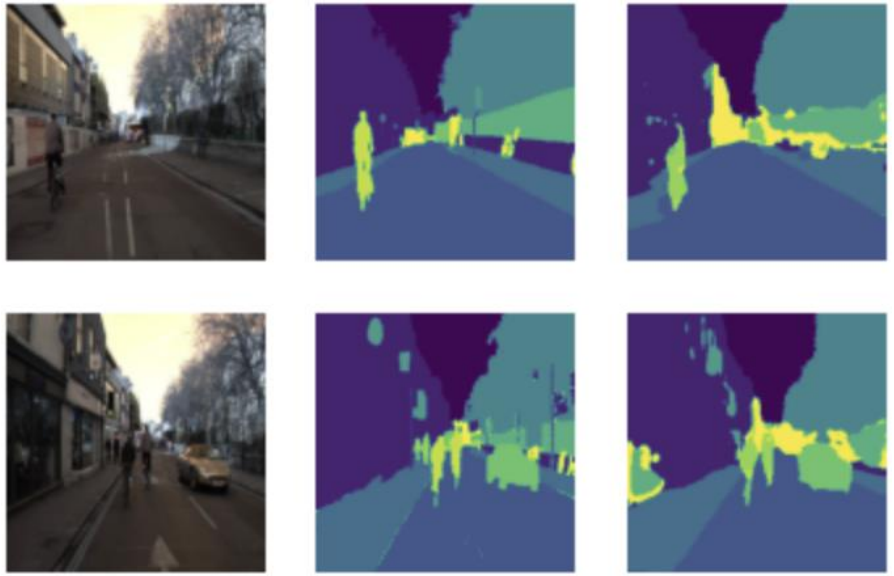
	Train	Validation
Loss	0.3464	0.4996
Accuracy	0.9001	0.8588



Test Accuracy : 0.8553

※ Batch Normalization & Dropout

	Train	Validation
Loss	0.3530	0.5465
Accuracy	0.8992	0.8345

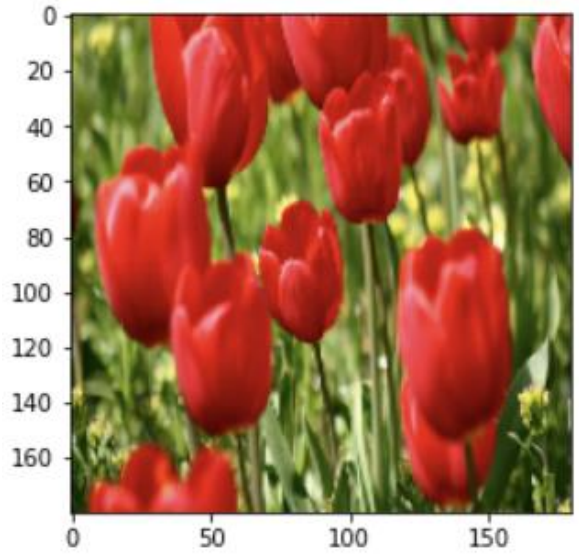


Test Accuracy : 0.8643

3. Data Augmentation

367개 Train Data → **Small Data**

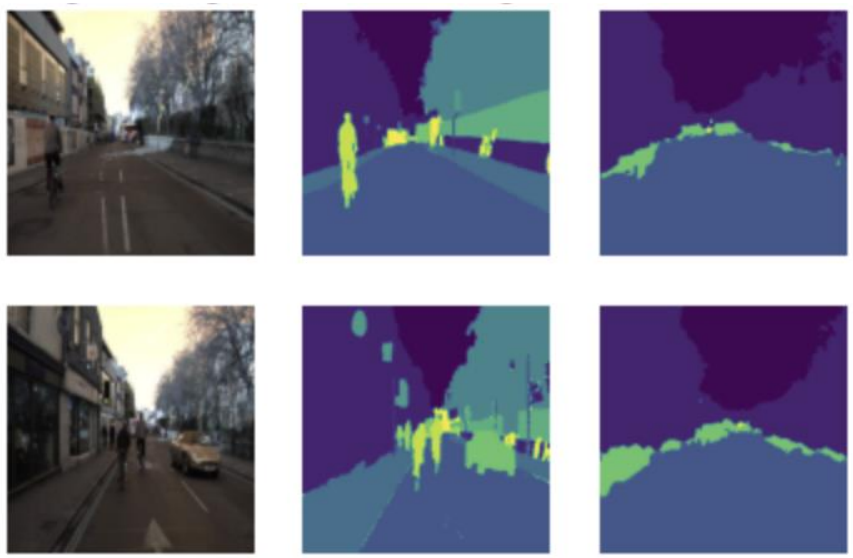
: 원본의 각종 변환을 통해 Data 개수를 증대



3. Data Augmentation

※ Rotation

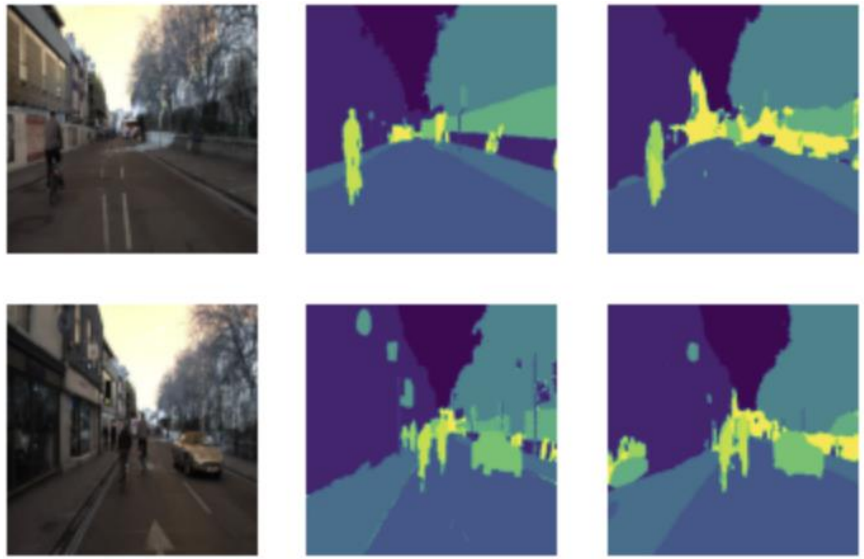
	Train	Validation
Loss	1.0262	1.0956
Accuracy	0.6660	0.6383



Test Accuracy : 0.5816

※ Bright

	Train	Validation
Loss	0.2617	0.3755
Accuracy	0.9253	0.8988

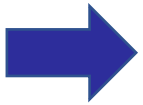


Test Accuracy : 0.8684

Conclusion

Conclusion

Test Accuracy	Basic	Batch Normalization	Batch Normalization & Dropout
U-Net	0.5961	0.7396	0.8055
VGG16 U-Net	0.8550	0.8553	0.8643



VGG16 U-Net (Batch Normalization & Dropout)	Rotation	Bright
	0.5816	0.8684

Thank You!

Code & Reference

[Code]

https://colab.research.google.com/drive/1RG5CXrgOhkt5HbLsiNJQlaSAx6HOMVFx?usp=sharing

https://colab.research.google.com/drive/1lbPIw2R4KxNkx5qXaXPlEKz_Qe841rpq?usp=sharing

[Reference]

Jonathan Long, Evan Shelhamer, Trevor Darrell. 2015.
:**Fully Convolutional Networks for Semantic Segmentation**

Olaf Ronneberger, Philipp Fischer, Thomas Brox. 2015.
:**U-Net: Convolutional Networks for Biomedical Image Segmentation**

zhixuhao. 2018. Github:unet
:**https://github.com/zhixuhao/unet/blob/master/model.py**