

# Deep Neural Networks for Visual Recognition Final Project

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# Paper References

- Lin, Tsung-Yi, et al., “Focal loss for dense object detection,” *IEEE TPAMI*, 2018
- Zherzdev, Sergey, and Gruzdev, Alexey, “LPRNet: License Plate Recognition via Deep Neural Networks,” *Pattern Recognition Letters*, 2018

# Outline

- **Proposed approach**
- **Evaluation result**
- **Conclusion**

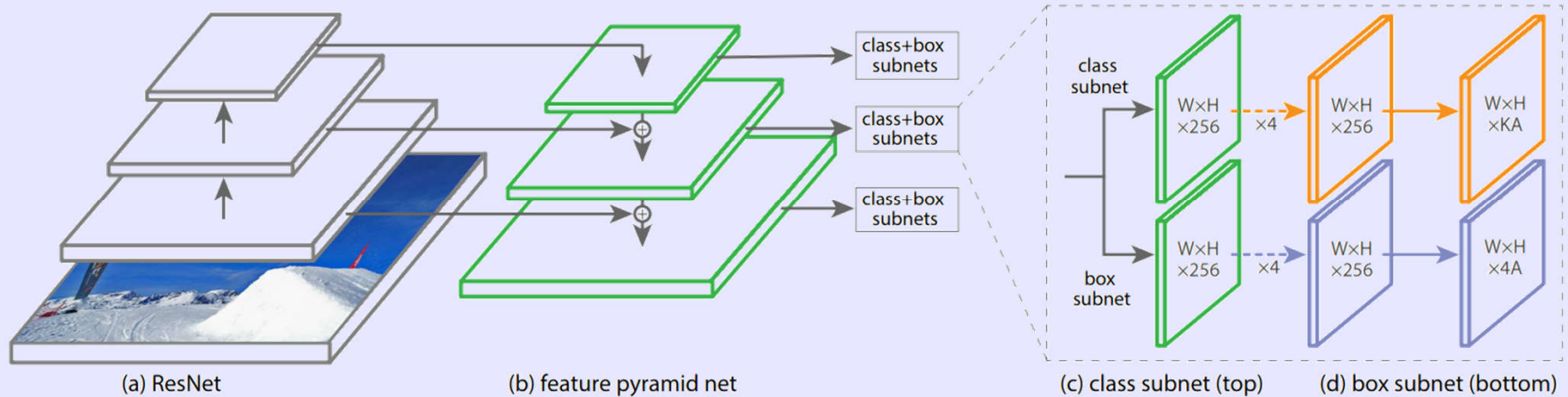
# Proposed approach

## ■ Overall framework



# Car-plate detection

## ■ Network



# Car-plate detection



Platform	Keras
Data format	<code>&lt;/path/to/training/data/&gt;&lt;box information&gt;&lt;class&gt;</code>
Dataset	Both parking and cctv full-size image
Learning rate	1e-5
Optimizer	Adam
Batch size	1
Epoch	15 ( 15,000 steps )

# Car-plate recognition

## ■ LPR Net



Figure 1. Example of LPRNet recognitions

# Car-plate recognition

## ■ Modify dataset for korean car plate

Type	License Plate	Type	
1	52가 3108	P1	→ 52<가>3108
2	39나 2764	P2	→ 39<나>2764
3	서울 52 바 3108 서울52바3108	✗	Recognizing plate type is not our task
4	서울 52 바 3108 서울52바3108	✗	
5	43가 6510 43가6510	P5	→ 43<가>6510
6	부산 27 무 6662 부산27무6662	✗	



# Car-plate recognition

## ■ Network

Layer Type	Parameters
Input	94x24 pixels RGB image
Convolution	#64 3x3 stride 1
MaxPooling	#64 3x3 stride 1
Small basic block	#128 3x3 stride 1
MaxPooling	#64 3x3 stride (2, 1)
Small basic block	#256 3x3 stride 1
Small basic block	#256 3x3 stride 1
MaxPooling	#64 3x3 stride (2, 1)
Dropout	0.5 ratio
Convolution	#256 4x1 stride 1
Dropout	0.5 ratio
Convolution	# class_number 1x13 stride 1



# Car-plate recognition



Platform	Tensorflow
Data format	Carplate_info.png (ex. 01_A04_6539.png)
Dataset	Both parking and cctv cropped plate image ( P1, P2, and P5 )
Learning rate	1e-3 and decay 90% per 2,000 iteration
Optimizer	Adam
Batch size	50
Epoch	300 ( 120,000 steps but chose model with steps 55,000 )



# Evaluation result

## ■ Parking

ResNet-50	
num_bbox_examples	285
num_bbox_corrects	243
bbox_accuracy	85.26%
num_rec_examples	285
num_rec_corrects	168
rec_accuracy	58.95%
avg_pt	192.97 ms
score	<b>134.91</b>

VGG-16	
num_bbox_examples	285
num_bbox_corrects	238
bbox_accuracy	83.51%
num_rec_examples	285
num_rec_corrects	163
rec_accuracy	57.19%
avg_pt	178.07 ms
score	132.89



# Evaluation result

## ■ cctv

ResNet-50	
num_bbox_examples	451
num_bbox_corrects	410
bbox_accuracy	90.91%
num_rec_examples	436
num_rec_corrects	264
rec_accuracy	60.55%
avg_pt	202.49 ms
score	<b>141.21</b>

VGG-16	
num_bbox_examples	451
num_bbox_corrects	385
bbox_accuracy	85.37%
num_rec_examples	436
num_rec_corrects	250
rec_accuracy	57.34%
avg_pt	214.61 ms
score	131.24



# Conclusion

- one-stage object detection approach for car-plate detection
- Fast and robust license plate recognition without using RNN
- Total score: **276.12**

**Thank You**  
**Q & A**