Object Detection

Part1

Presenter: Dae-Yong

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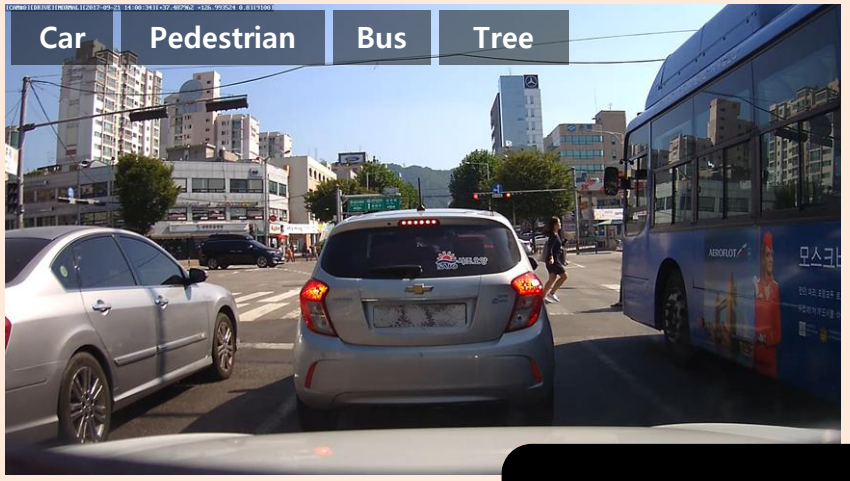
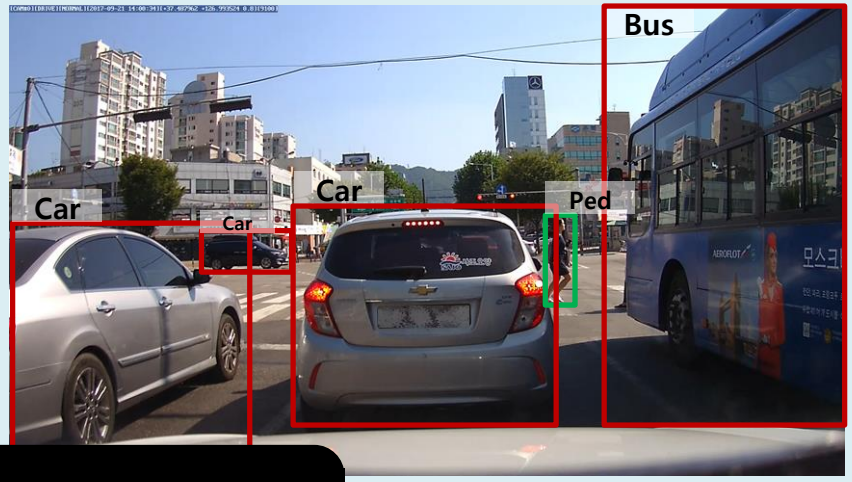
What is an Object Detection?

Object Categorization(Classification)



Object Detection



Object Recognition

Object Segmentation

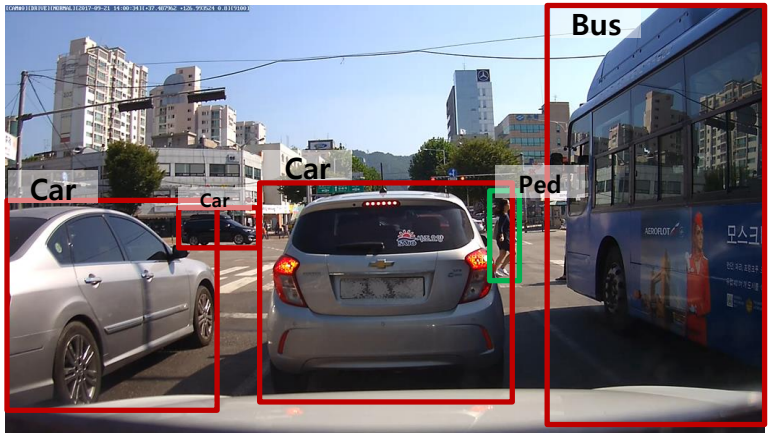
Scene Categorization

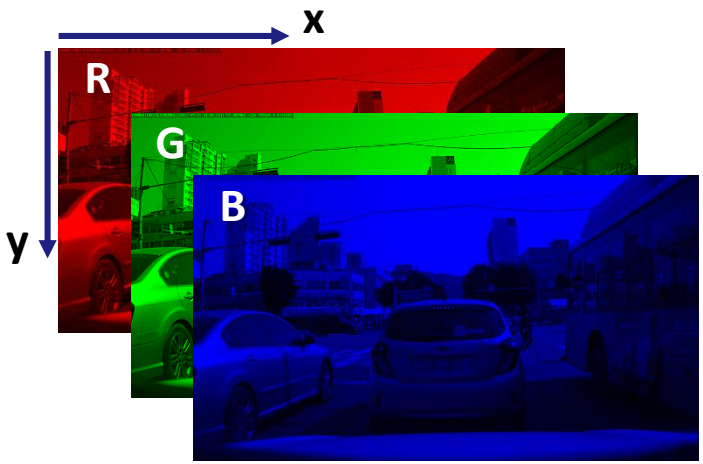
What is an Object Detection?

- Find a target object in an given image.

Input

Output





3 Channels, 2D matrices

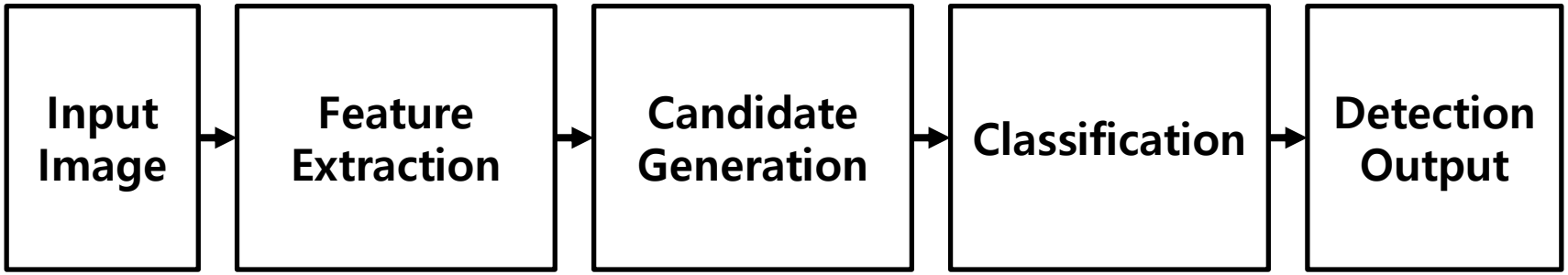
- Object Class
- Object Location(x, y, width, height)

1. Car, (0, 250, 120, 125)
2. Car, (80, 256, 60, 40)
3. Car, (140, 245, 130, 120)
4. Pedestrian, (400, 247, 20, 70)
5. Bus, (520, 0, 110, 320)

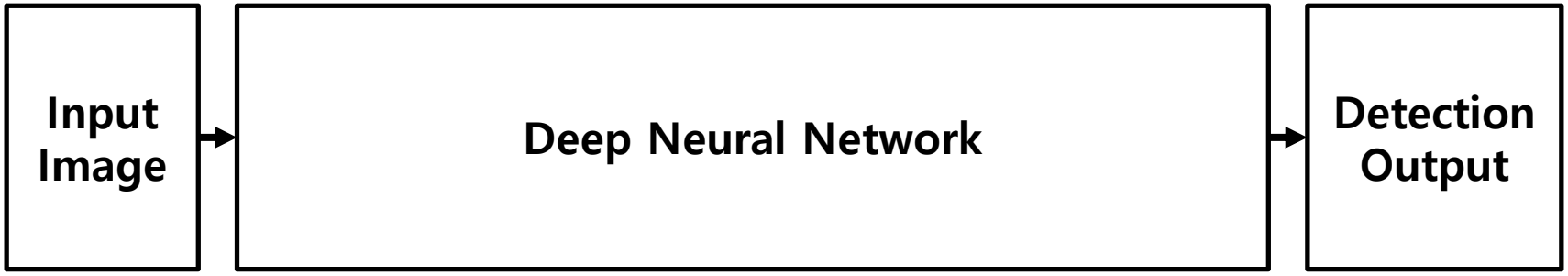
Object Detection

- How can we know where objects are and what they are?

  - Traditional approach



  - Deep Learning-based approach



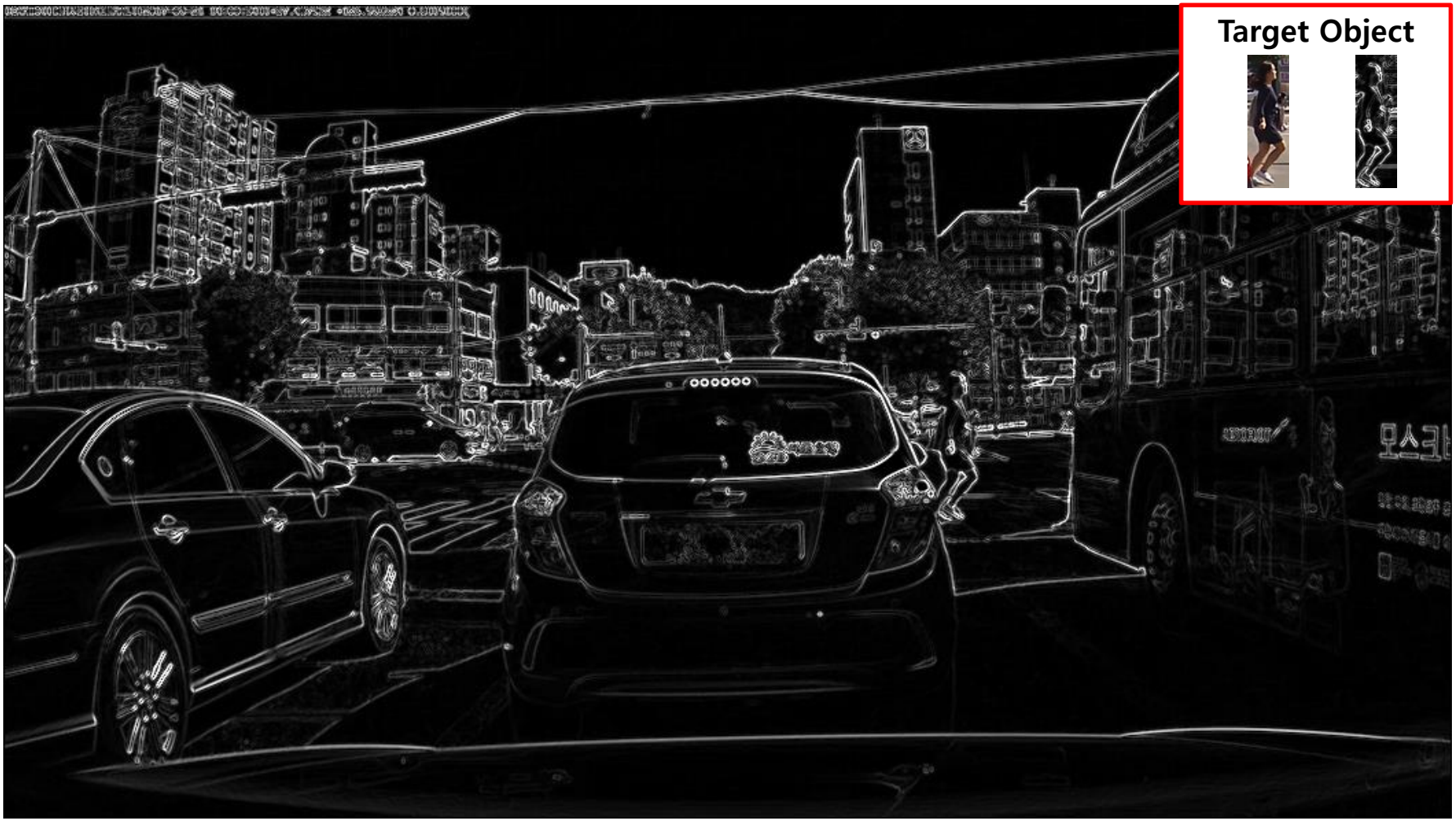
Traditional Object Detection

Traditional Object Detection

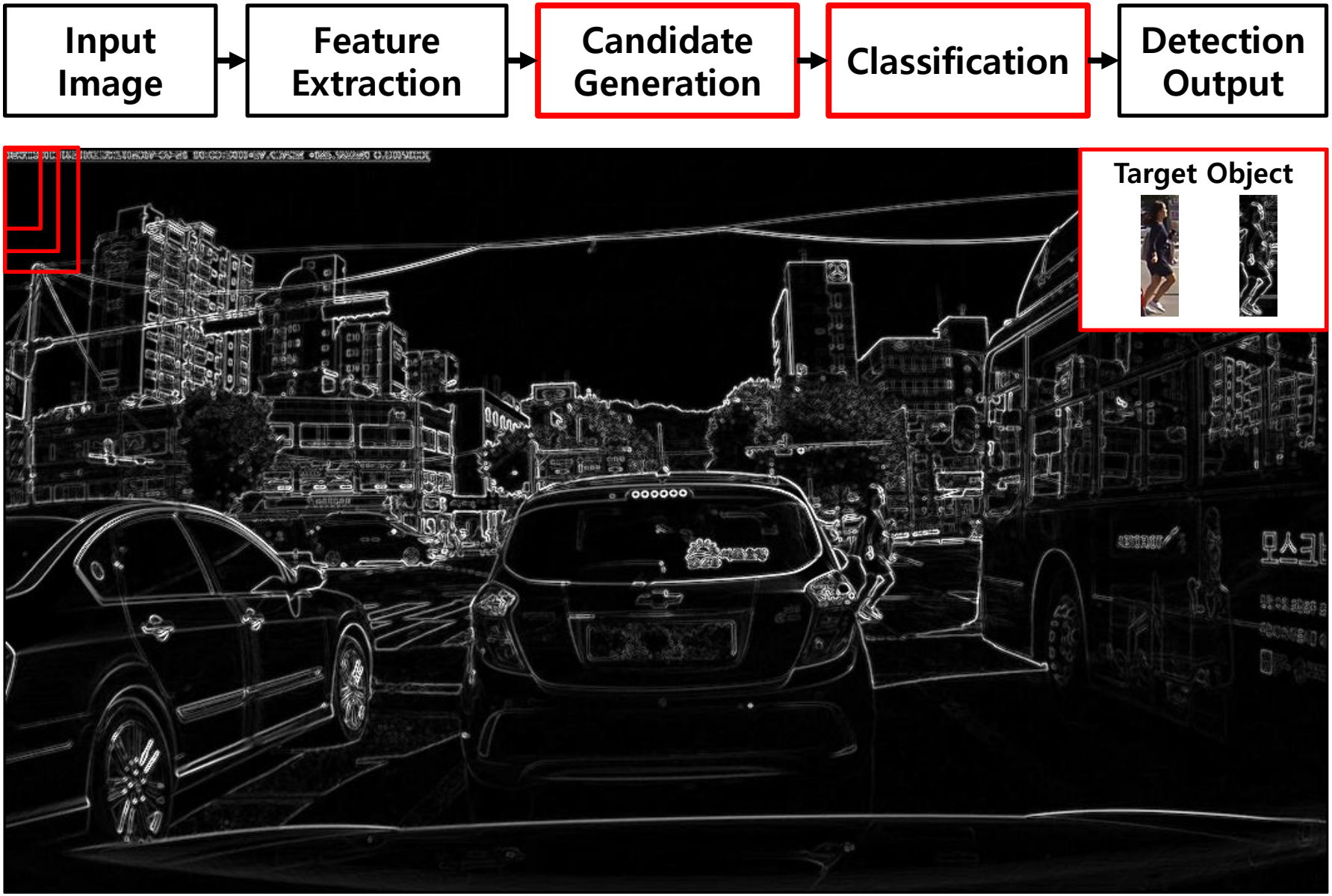
Input Image → Feature Extraction → Candidate Generation → Classification → Detection Output

Traditional Object Detection

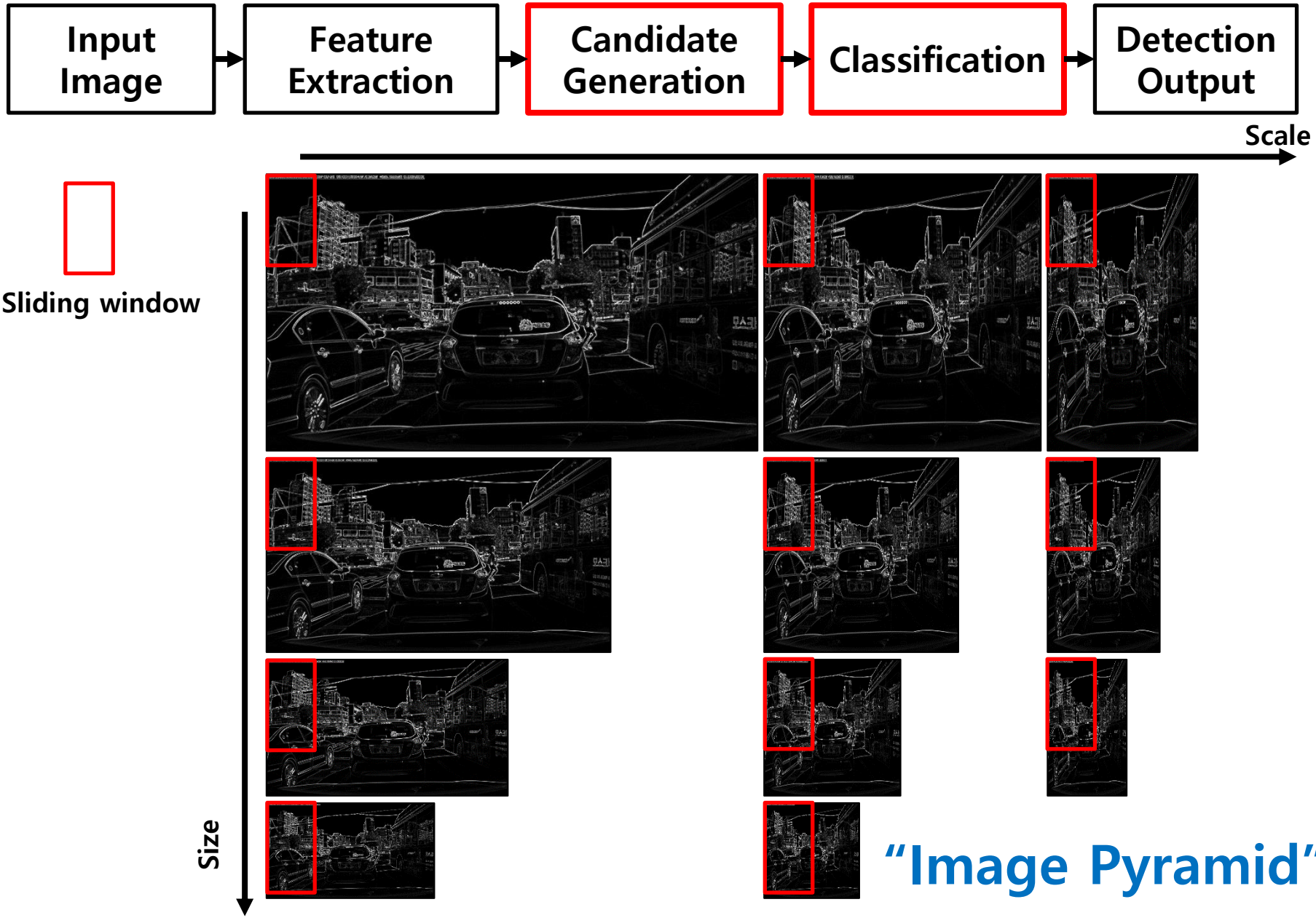
Input Image → **Feature Extraction** → Candidate Generation → Classification → Detection Output



Traditional Object Detection



Traditional Object Detection



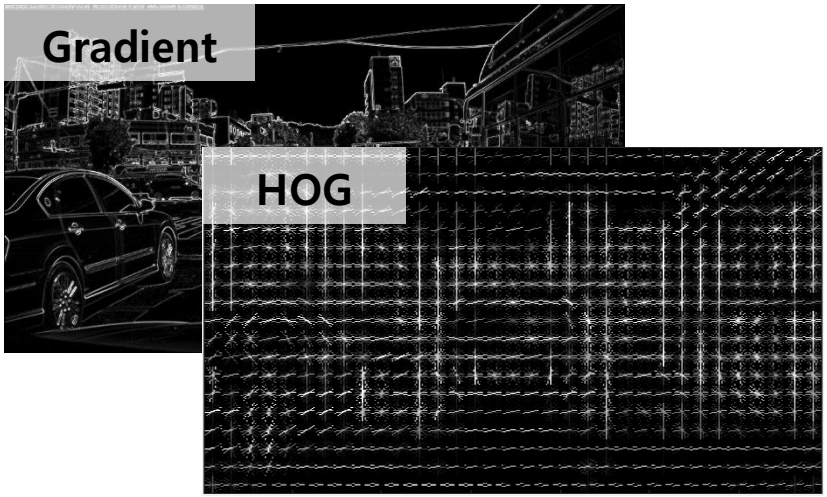
Traditional Object Detection

Input Image → Feature Extraction → Candidate Generation → Classification → Detection Output

Traditional Object Detection

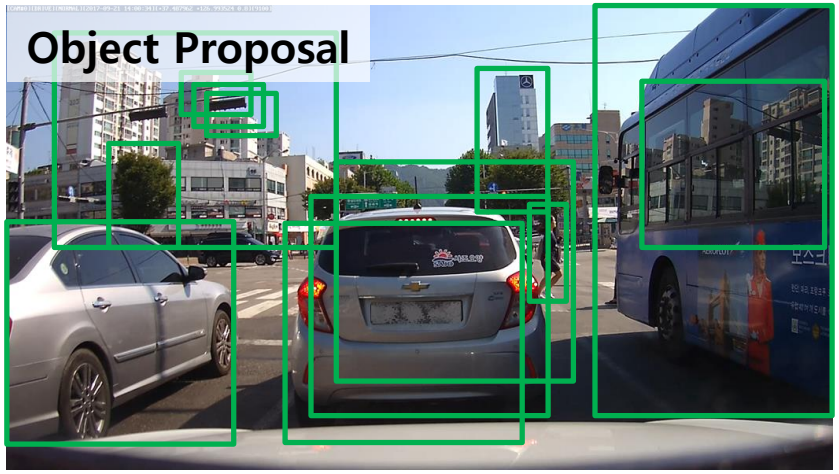
[Feature Extraction]

- Color / Brightness / Gradient
- Haar Feature
- Scale Invariant Feature Transform(SIFT)
- Local Binary Pattern(LBP)
- Histogram Oriented Gradient(HOG)

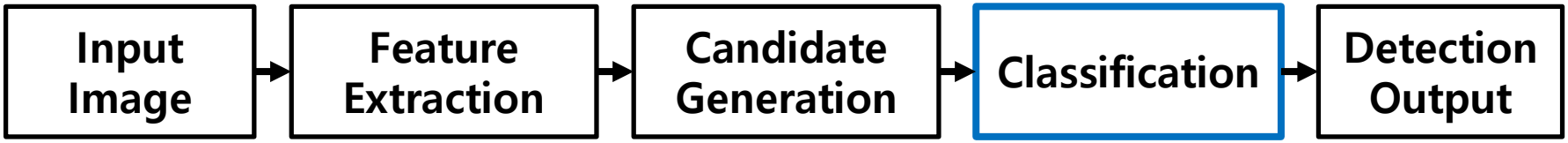


[Candidate Generation]

- Sliding Window Search
- Selective Search
- Multiscale Combinatorial Grouping (MCG)
- Edge-Box
- Binarized Normed Gradient (BING)

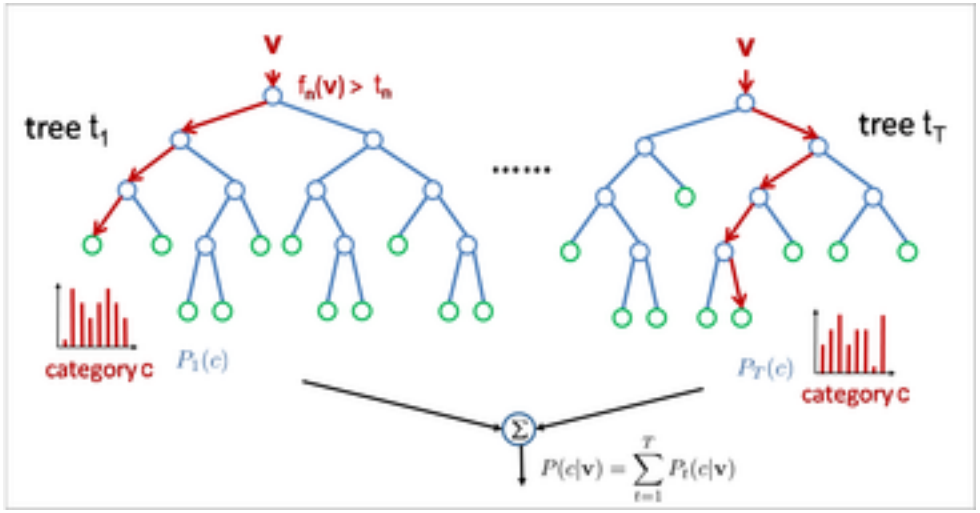


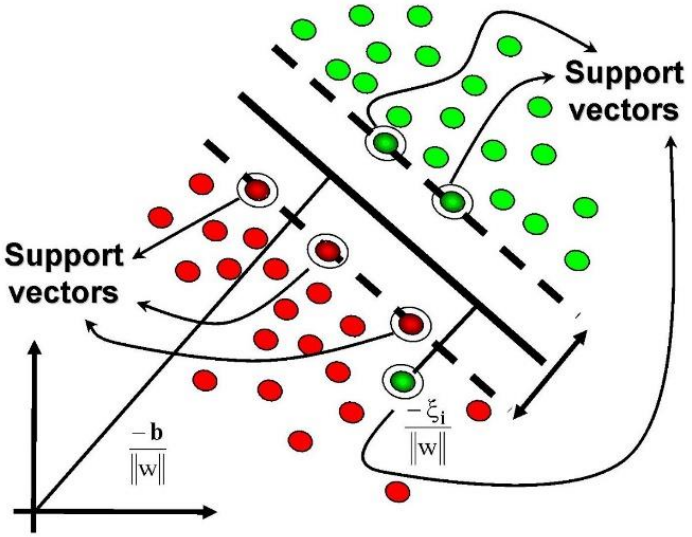
Traditional Object Detection



[Classification]

- AdaBoost
- Random Forest
- Support Vector Machine (SVM)
- Latent Support Vector Machine (L-SVM)

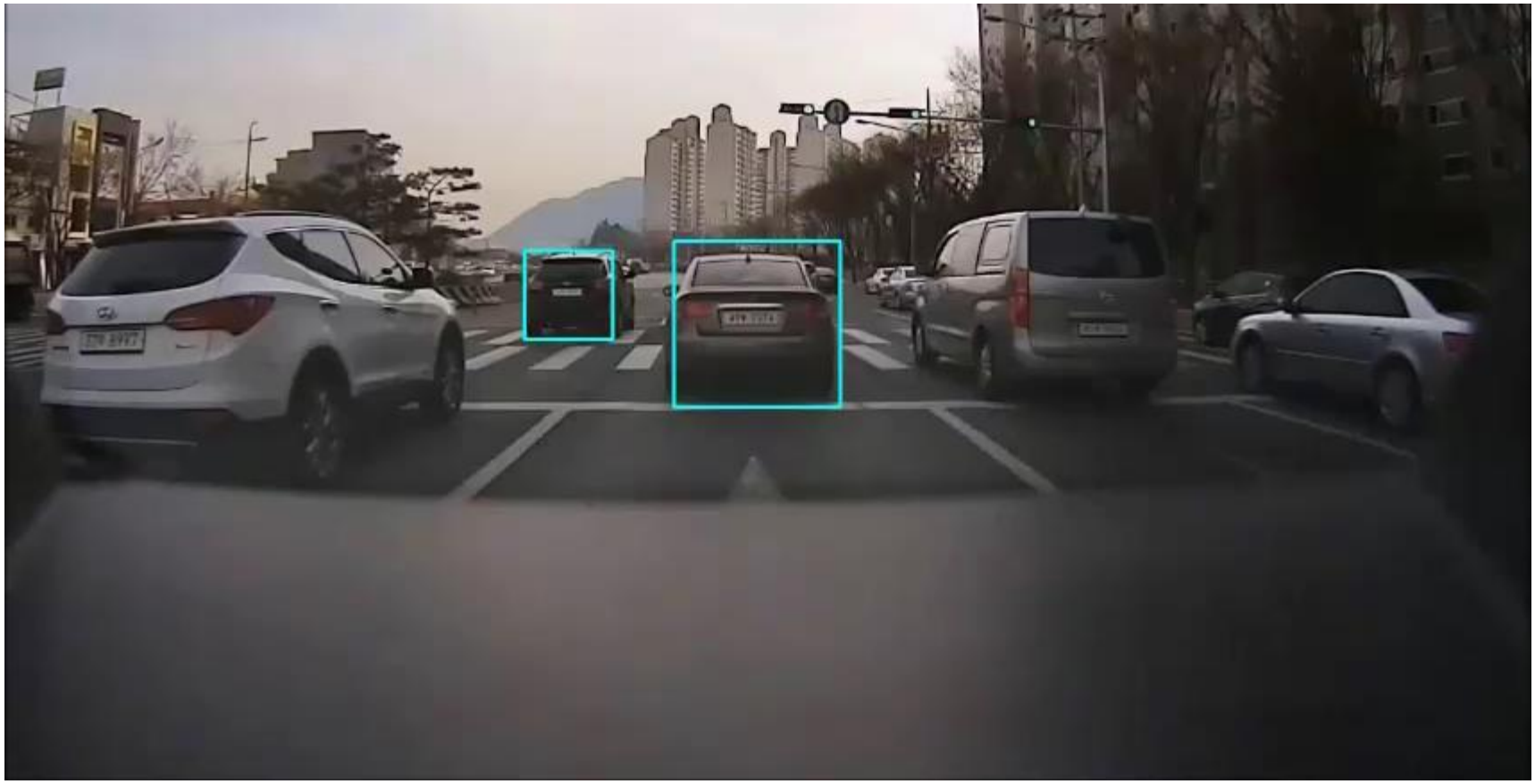




Traditional Object Detection (Demo)

Target Object: REAR Vehicle

Feature: LBP Classifier: Cascade Classifier



Deep Learning-based Object Detection

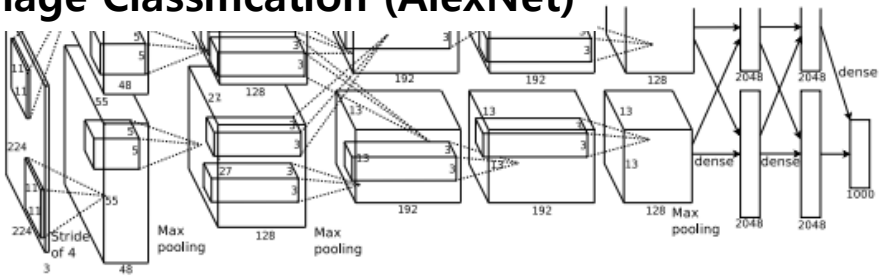
Deep Learning-based Object Detection

Input Image → Candidate Generation → **Deep Neural Network (Classification)** → Detection Output

Regions with CNN features (R-CNN), 2013

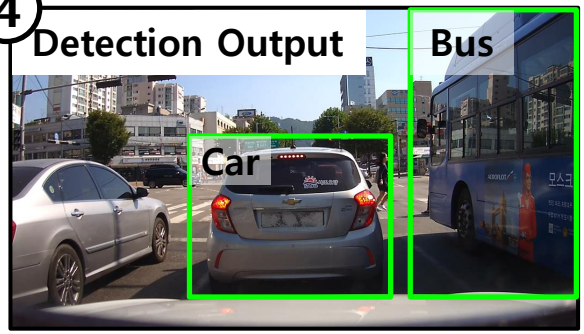
1 Input image

3 Image Classification (AlexNet)



2 Generate object candidates

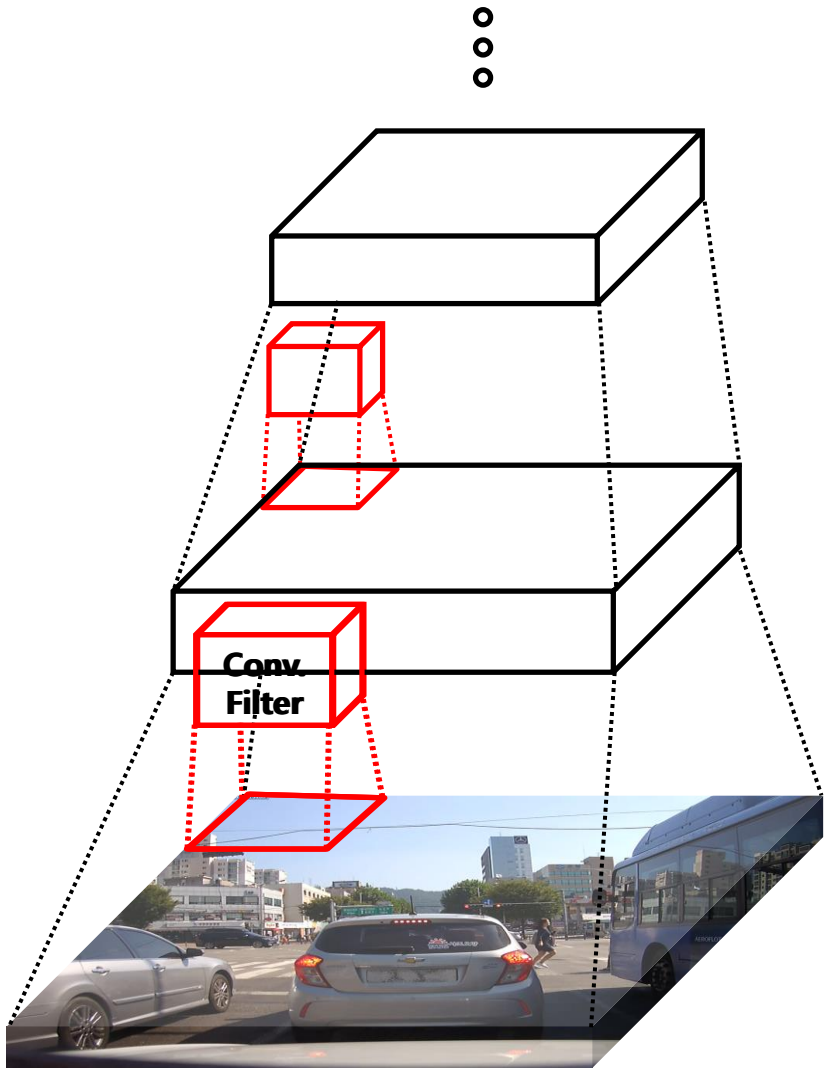
4 Detection Output



Apply image classification network to each object candidates

Deep Learning-based Object Detection

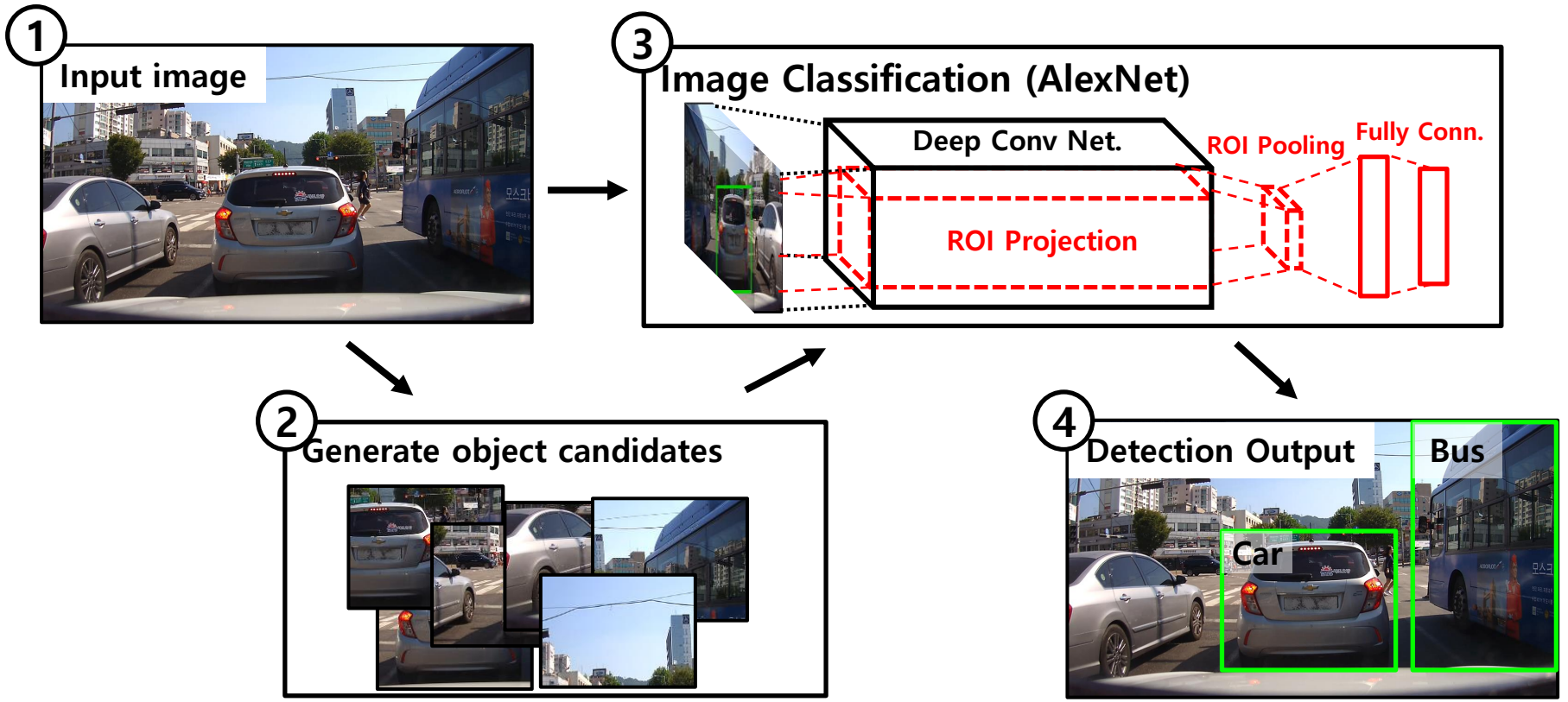
How convolutional neural network is worked on the image?



Deep Learning-based Object Detection

Input Image → Candidate Generation → **Deep Neural Network (Classification)** → Detection Output

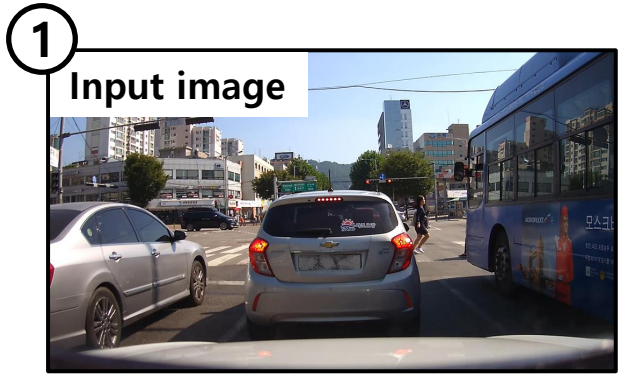
Fast Region-based Conv. Neural Net. (Fast R-CNN), April, 2015

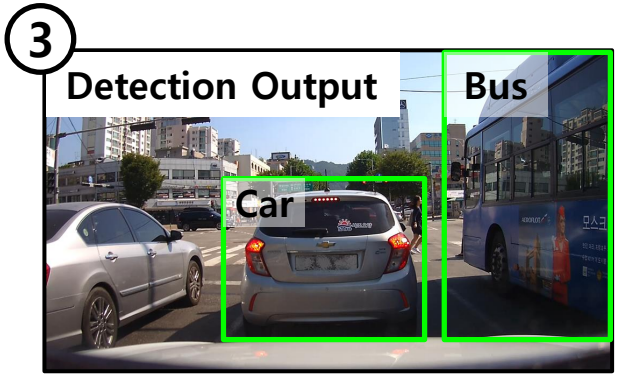


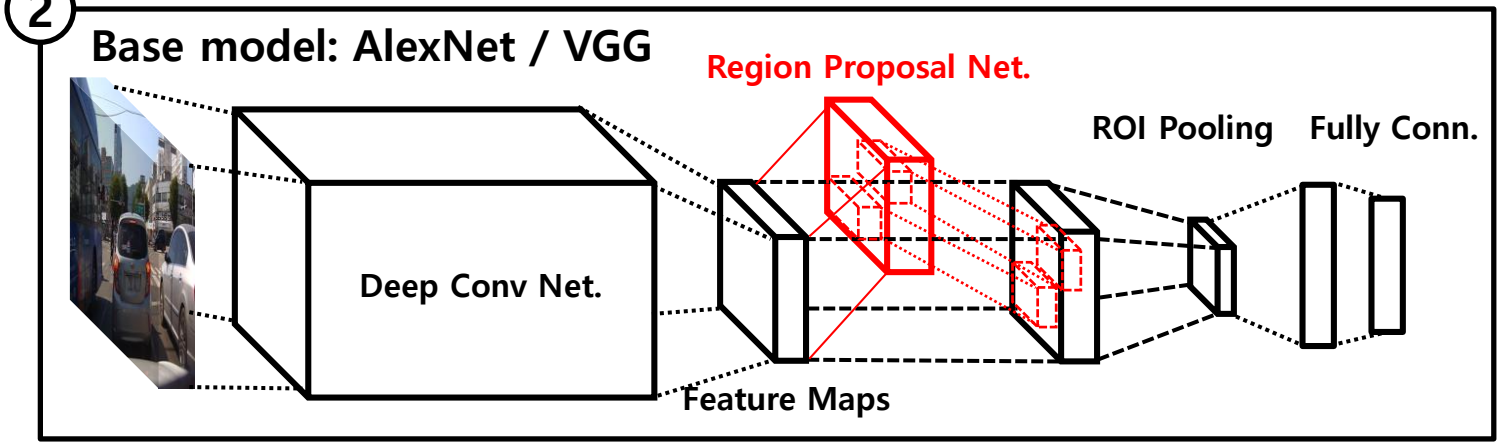
Computational cost is **proportionally increased** according to the **number of candidates**.

Deep Learning-based Object Detection

Faster Region-based Conv. Neural Net. (Faster R-CNN), June, 2015

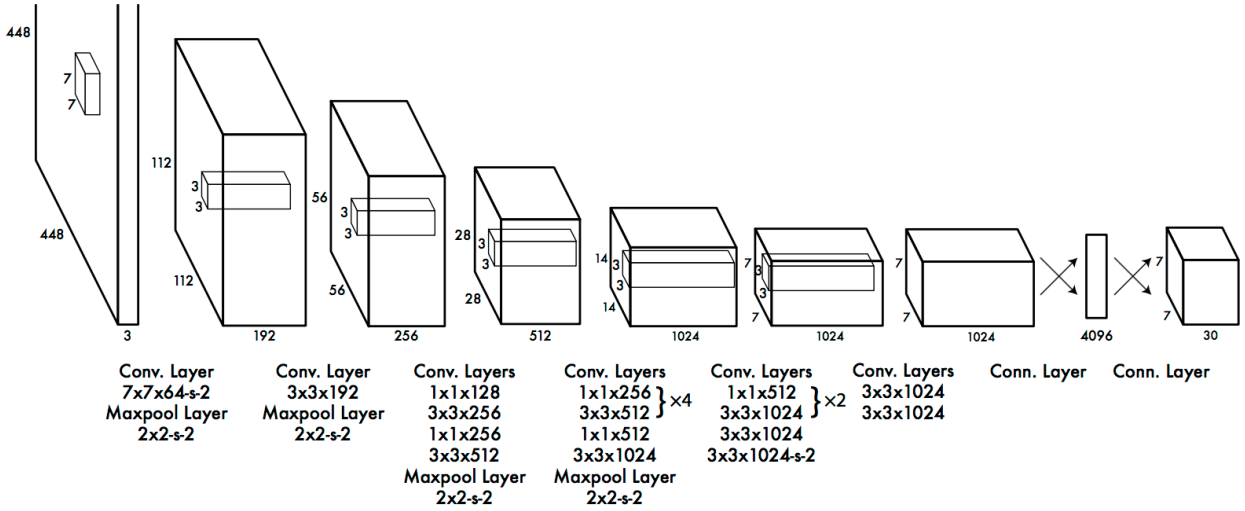




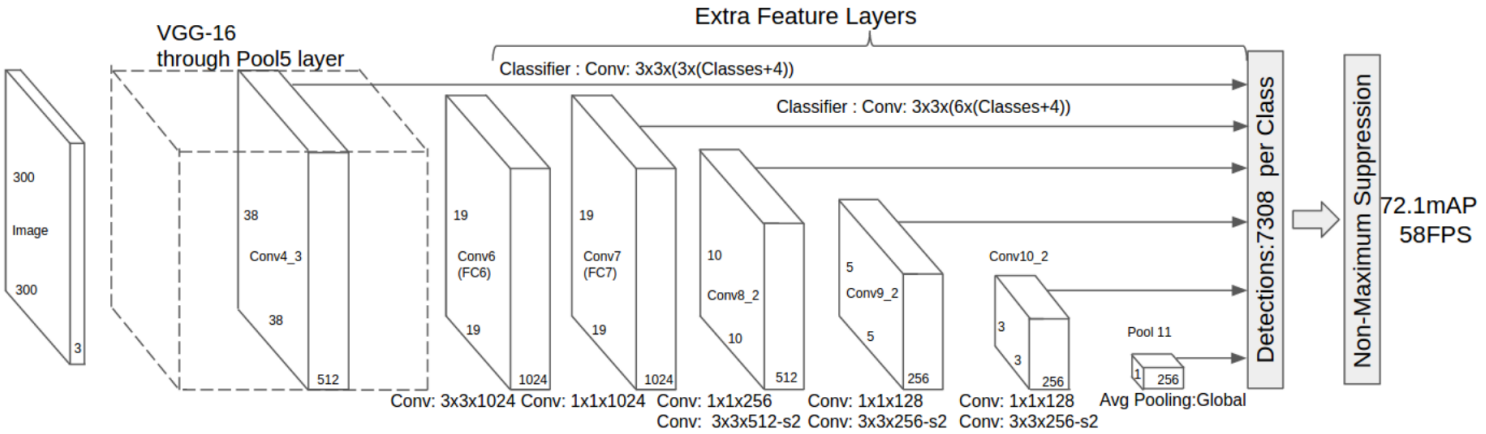


Deep Learning-based Object Detection

You Only Look Once (YOLO)



Single Shot MultiBox Detector (SSD)



Next Presentation

Part2: Traditional Object Detection from Scratch

Design Basic Object Detector
- Feature: HOG Features
- Classification: SVM
- Practice with toy example

Part3: Deep Learning-based Object Detection I

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Part4: Deep Learning-based Object Detection II

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Thank You