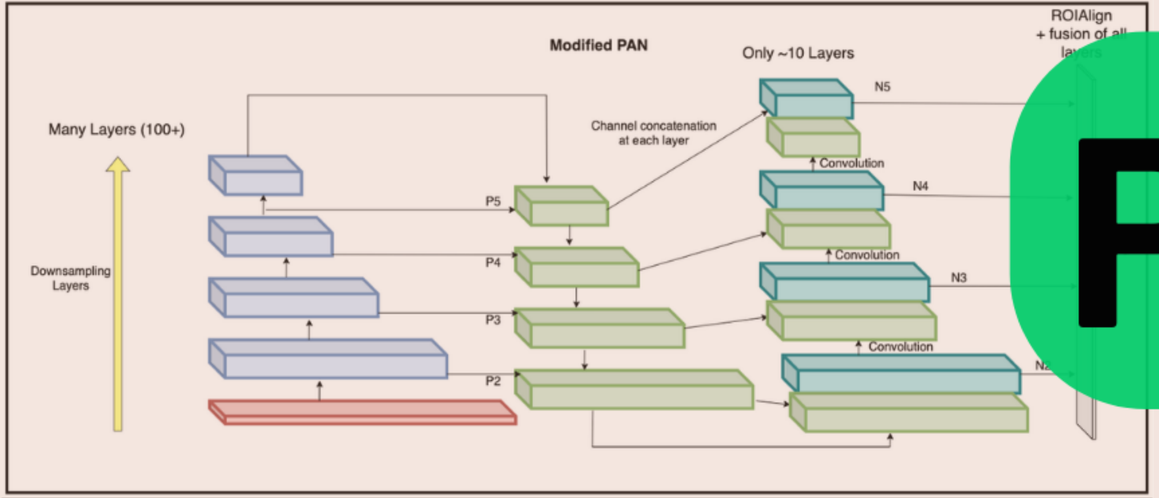
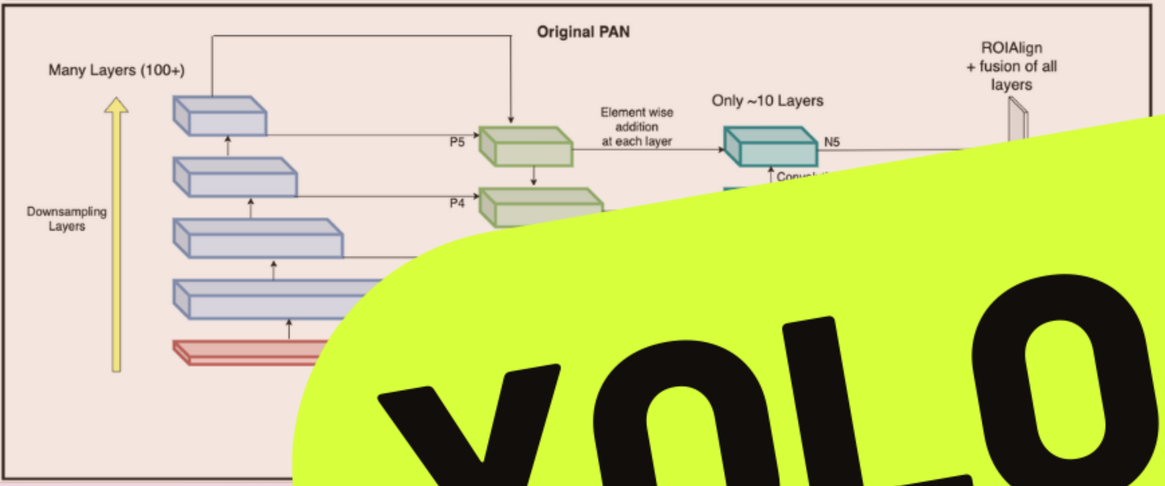
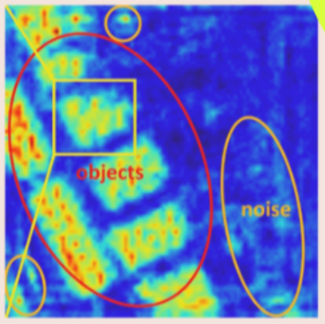
Part-2

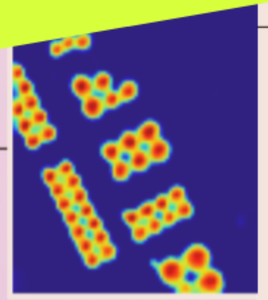
YOLO-V4

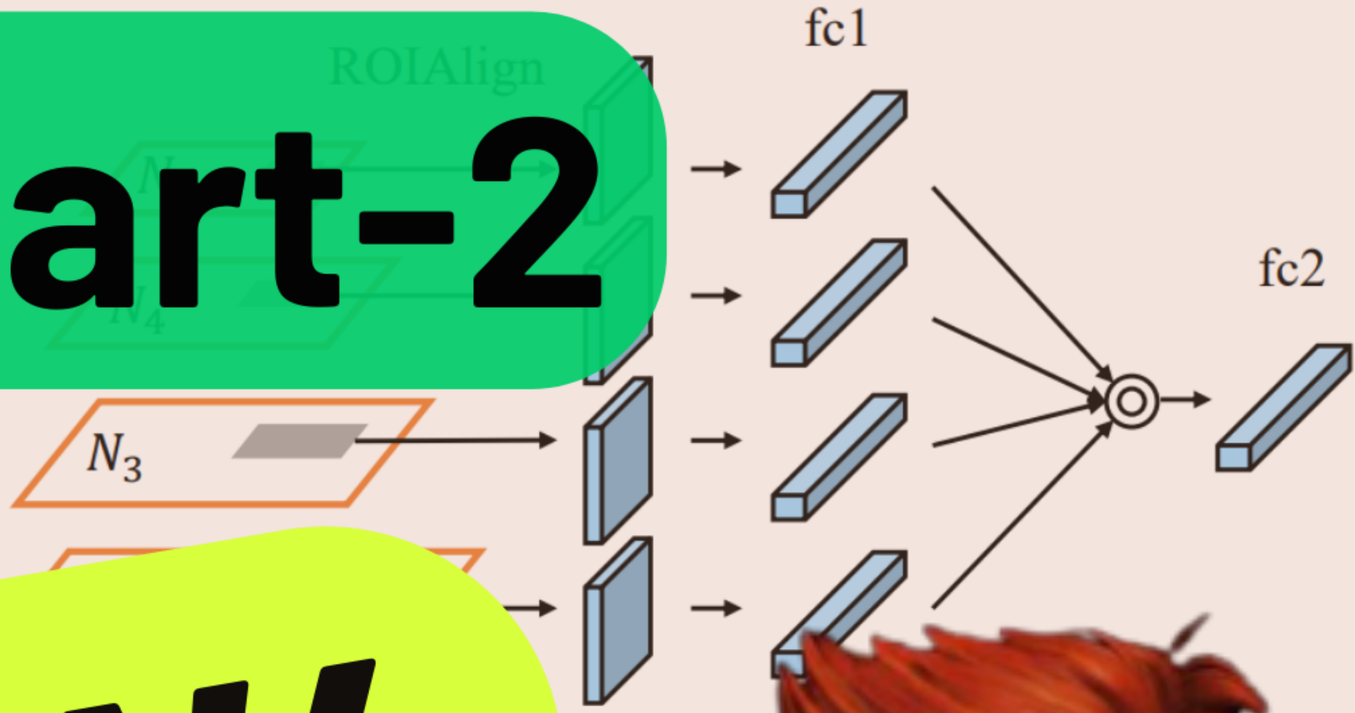


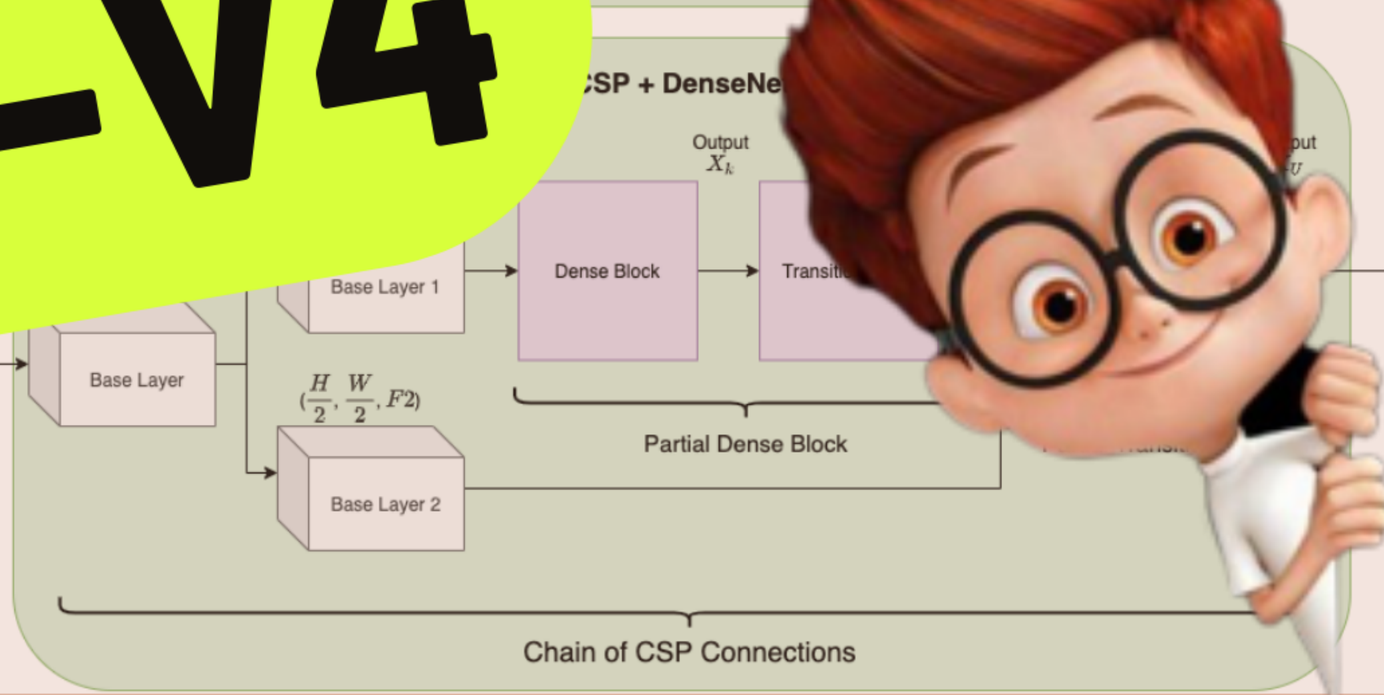




Attention







YOLOv4: Optimal Speed and Accuracy of Object Detection

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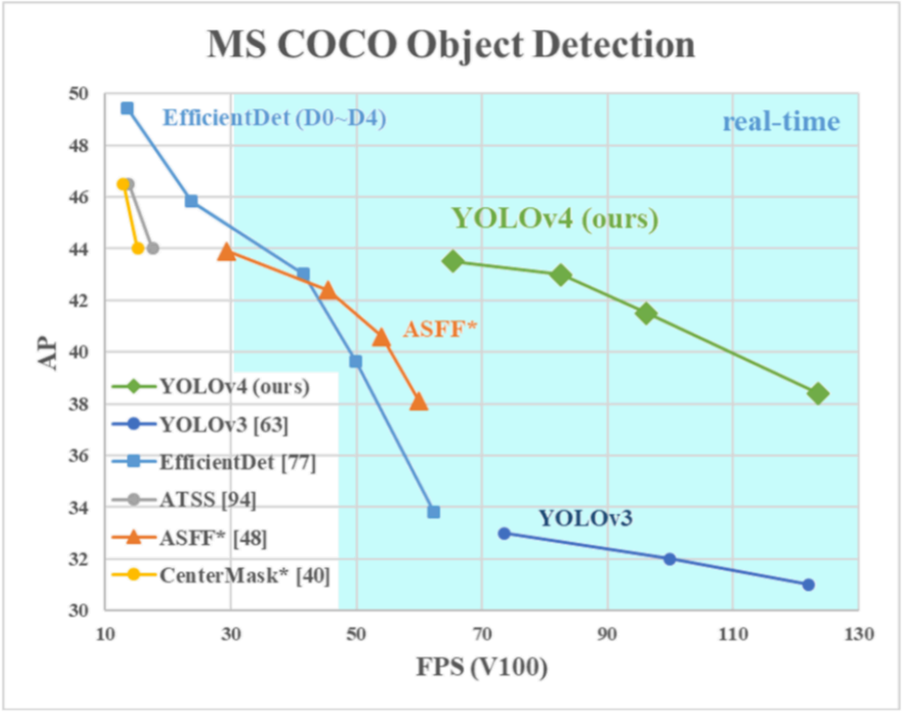
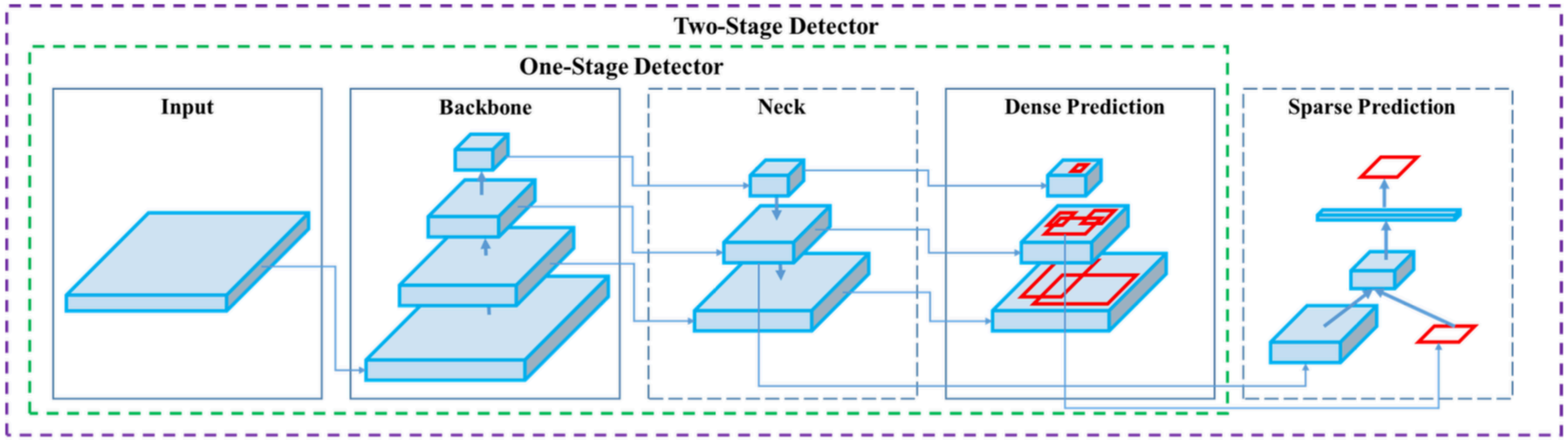
Abstract

There are a huge number of features which are said to improve Convolutional Neural Network (CNN) accuracy. Practical testing of combinations of such features on large datasets, and theoretical justification of the result, is required. Some features operate on certain models exclusively and for certain problems exclusively, or only for small-scale datasets; while some features, such as batch-normalization and residual-connections, are applicable to the majority of models, tasks, and datasets. We assume that such universal features include Weighted-Residual-Connections (WRC), Cross-Stage-Partial-connections (CSP), Cross mini-Batch Normalization (CmBN), Self-adversarial-training (SAT) and Mish-activation. We use new features: WRC, CSP, CmBN, SAT, Mish activation, Mosaic data augmentation,



Components



Input: { Image, Patches, Image Pyramid, … }

Backbone: { VGG16 [68], ResNet-50 [26], ResNeXt-101 [86], Darknet53 [63], … }

Neck: { FPN [44], PANet [49], Bi-FPN [77], … }

Head:

Dense Prediction: { RPN [64], YOLO [61, 62, 63], SSD [50], RetinaNet [45], FCOS [78], … }

Sparse Prediction: { Faster R-CNN [64], R-FCN [9], … }

CSPDarkNet53 (Backbone) => **SSP** + **PANet** (Neck)=> **YOLOv3** (head)

BoF & BoS

	Backbone	Detector
Bag of Freebies (BoF)	• CutMix • Mosaic data augmentation • DropBlock • Class label smoothing	• CIoU-loss • Cross mini-Batch Normalization • DropBlock • Mosaic data augmentation • Self-Adversarial Training • Multiple anchors for a single ground truth • Cosine annealing scheduler • Optimal hyperparameters • Random training shapes
Bag of Specials (BoS)	• Mish activation • Cross-stage partial connections (CSP) • Multi-input weighted residual connections (MiWRC)	• Mish activation • SPP-block • SAM-block • PAN path-aggregation block • DIoU-NMS

In this video..

- **Backbone**
  - **DenseNet**
  - **CSPNet**
  - **CSPDarknet-53**
- **Neck**
  - **FPN**
  - **SPP**
  - **PAN**
- **Spatial Attention Module**

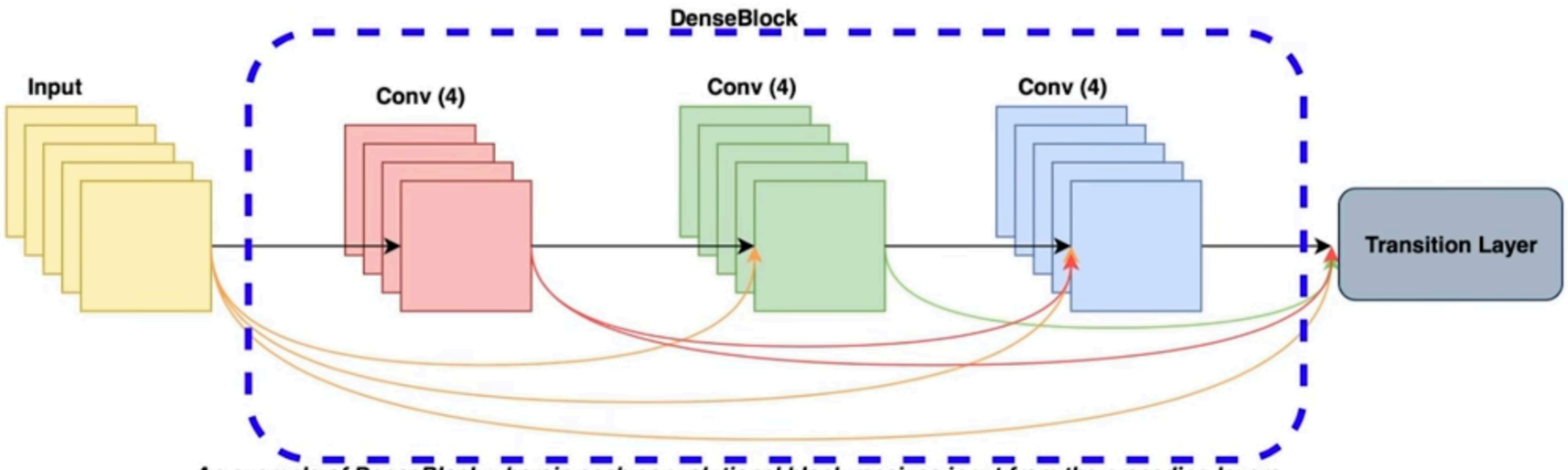
Backbone

- **Backbone**
  - **DenseNet**
  - **CSPNet**
  - **CSPDarknet-53**

Table 1: Parameters of neural networks for image classification.

Backbone model	Input network resolution	Receptive field size	Parameters	Average size of layer output (WxHxC)	BFLOPs (512x512 network resolution)	FPS (GPU RTX 2070)
CSPResNext50	512x512	425x425	20.6 M	**1058 K**	31 (15.5 FMA)	62
CSPDarknet53	512x512	725x725	**27.6 M**	950 K	52 (26.0 FMA)	**66**
EfficientNet-B3 (ours)	512x512	**1311x1311**	12.0 M	668 K	11 (5.5 FMA)	26

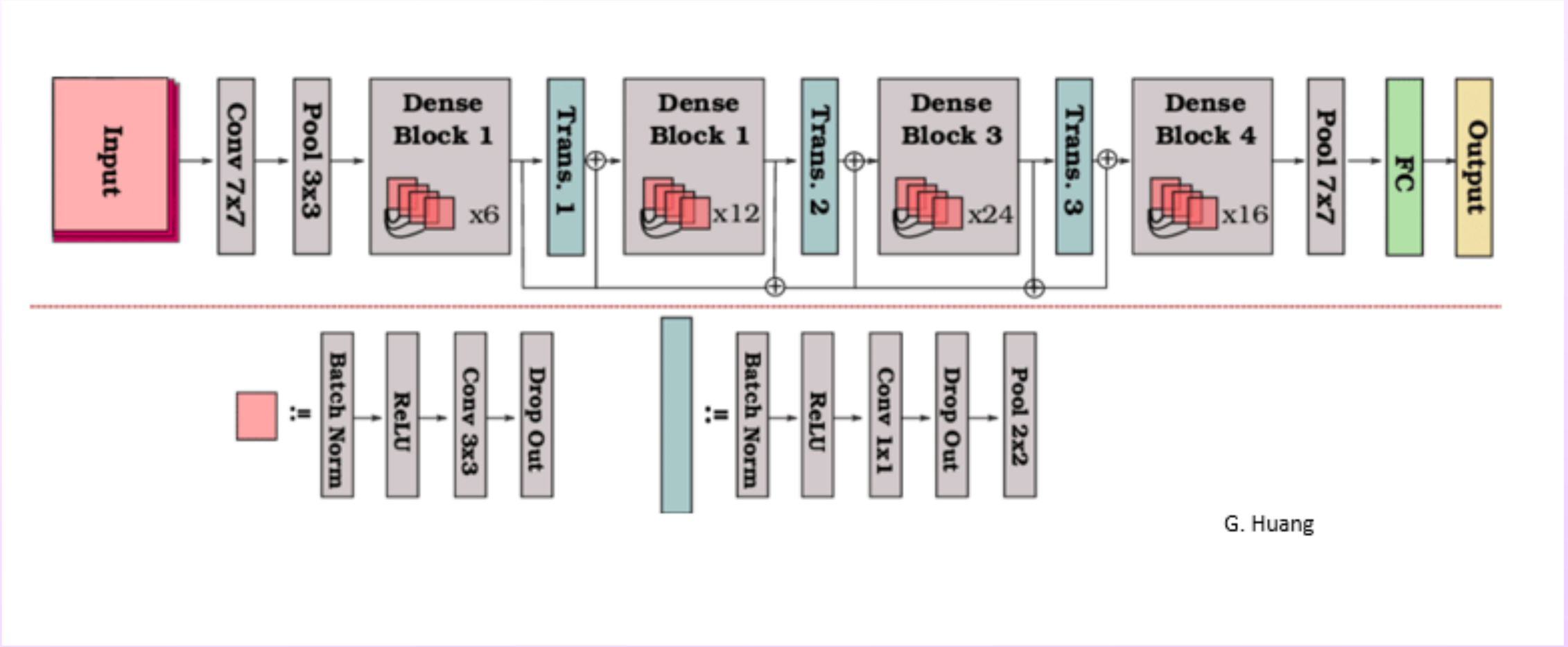
Dense Block



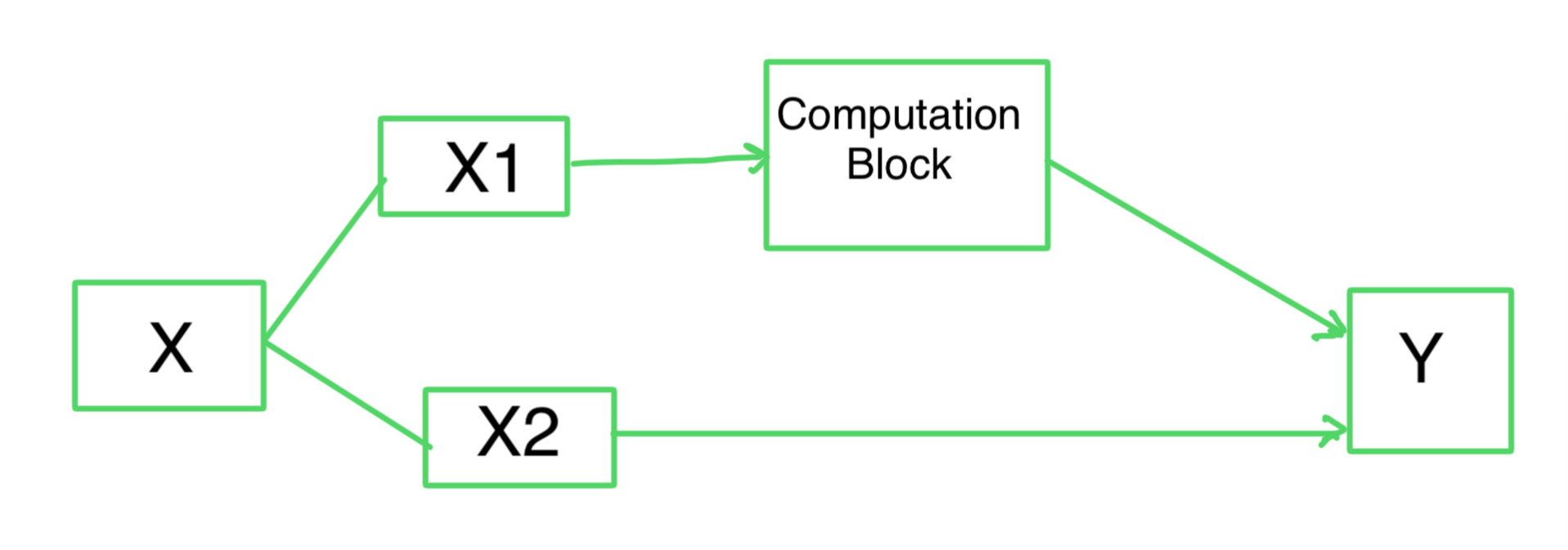
An example of DenseBlock wherein each convolutional block receives input from the preceding layers. The memory explosion is circumvented by setting the number of feature map learnt in convolutional operation to a small value (k=4).

$$x_1 = w_1 * x_0$$
$$x_2 = w_2 * [x_0, x_1]$$
$$\vdots$$
$$x_k = w_k * [x_0, x_1, \ldots, x_{k-1}]$$

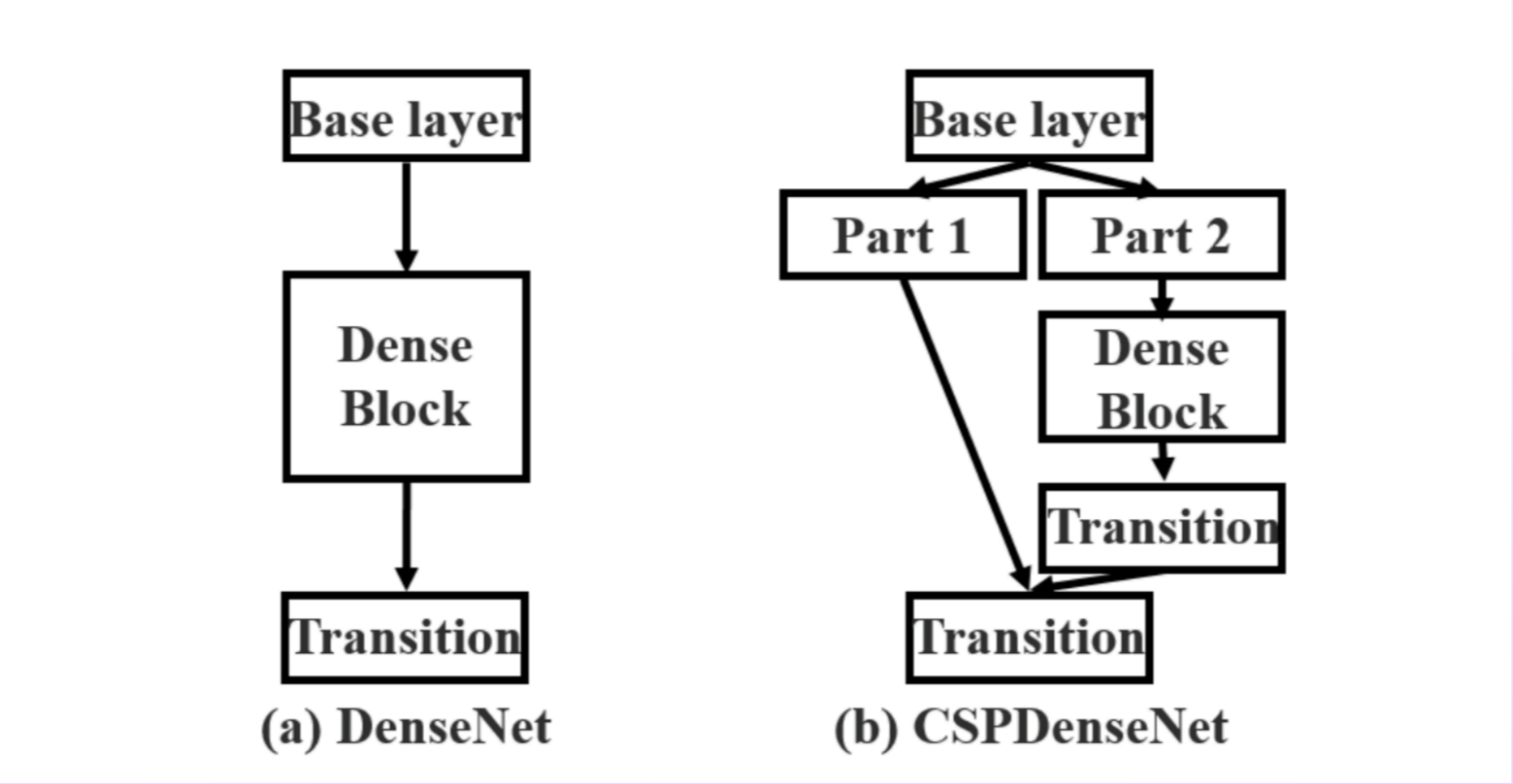
DenseNet


Input
Conv 7x7
Pool 3x3
Dense Block 1
x6
Trans. 1
Dense Block 1
x12
Trans. 2
Dense Block 3
x24
Trans. 3
Dense Block 4
x16
Pool 7x7
FC
Output
Batch Norm
ReLU
Conv 3x3
Drop Out
Batch Norm
ReLU
Conv 1x1
Drop Out
Pool 2x2
G. Huang

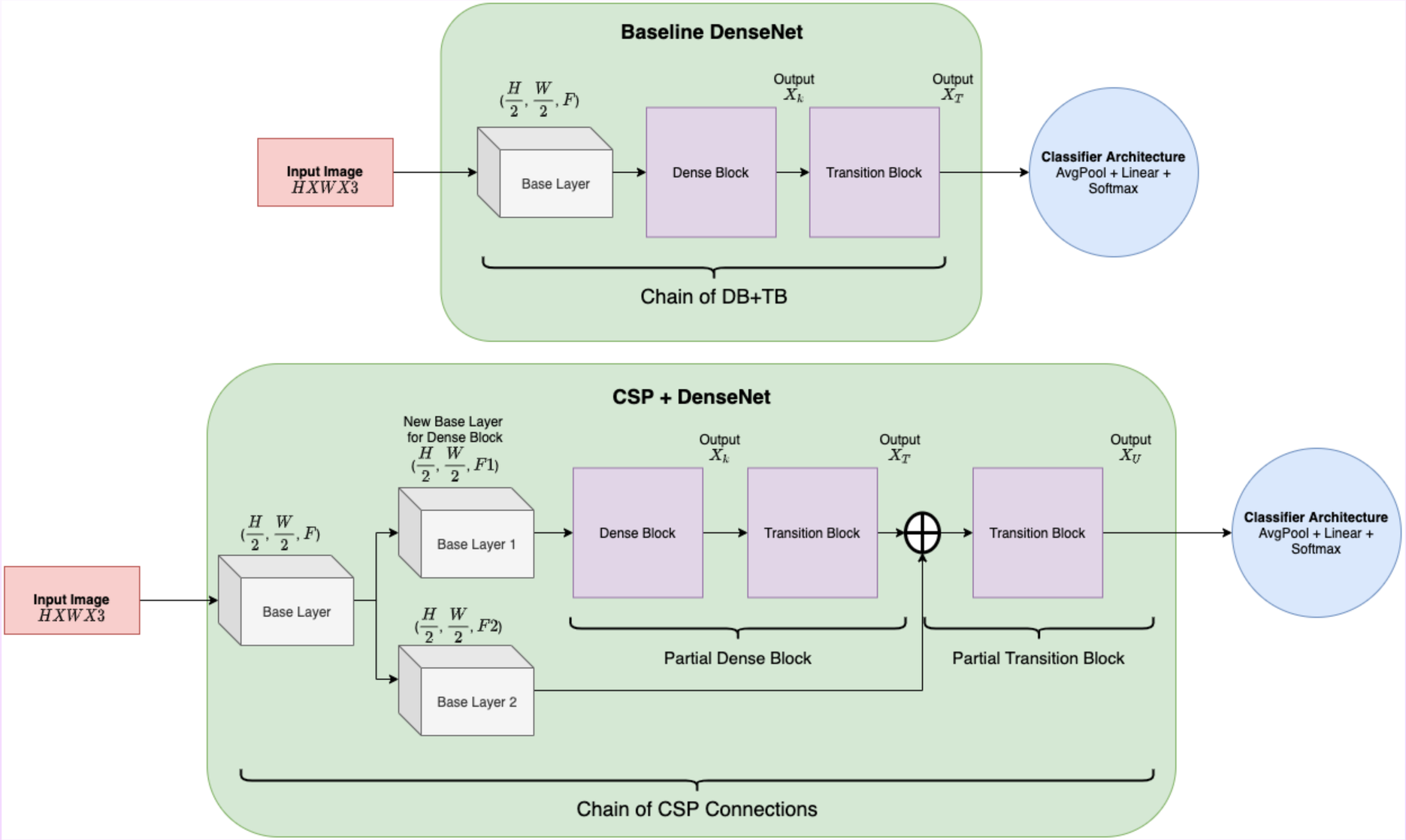
Cross Stage Partial Network (CSPNet)



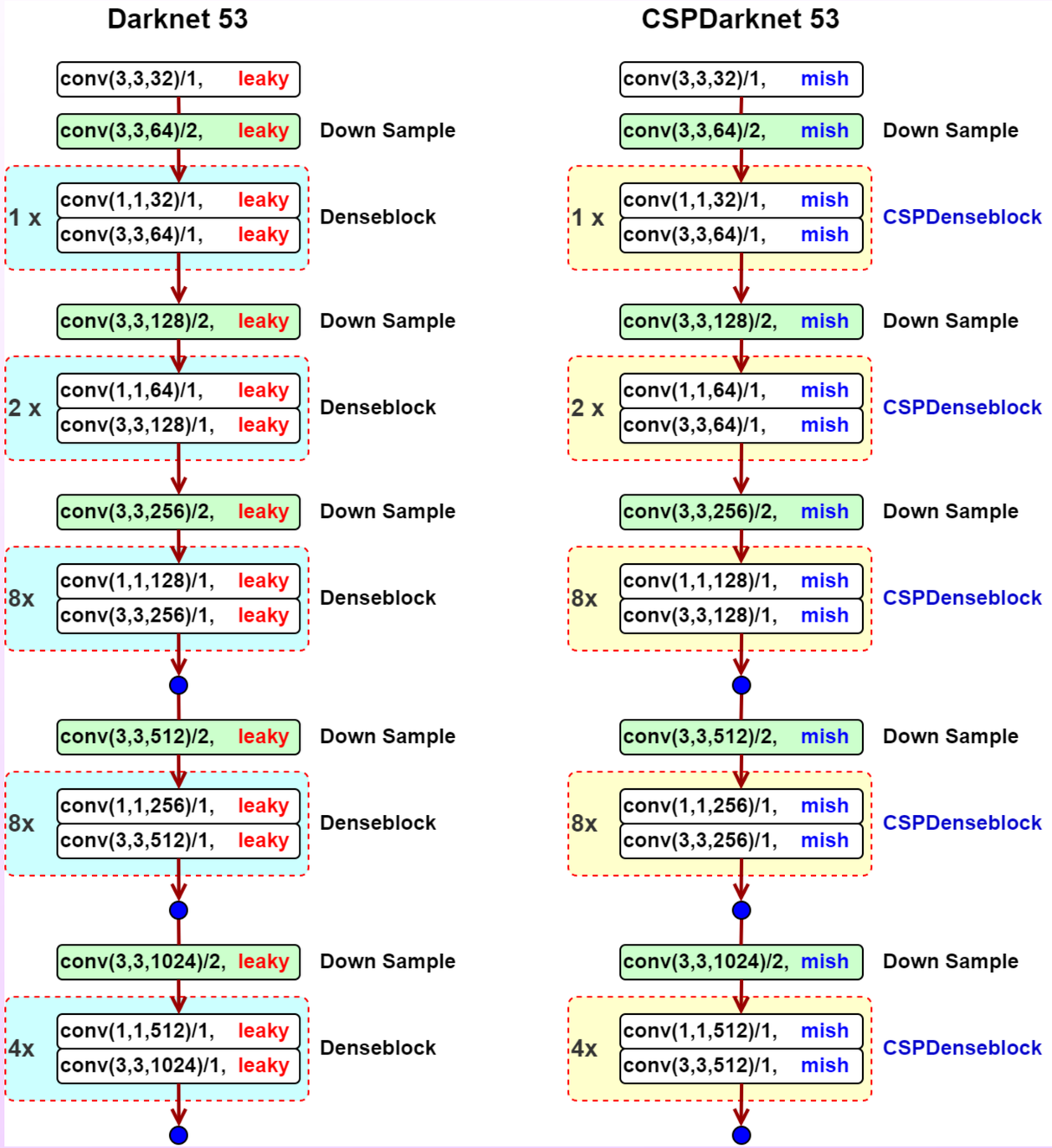
Cross Stage Partial Network (CSPNet)



Cross Stage Partial Network (CSPNet)



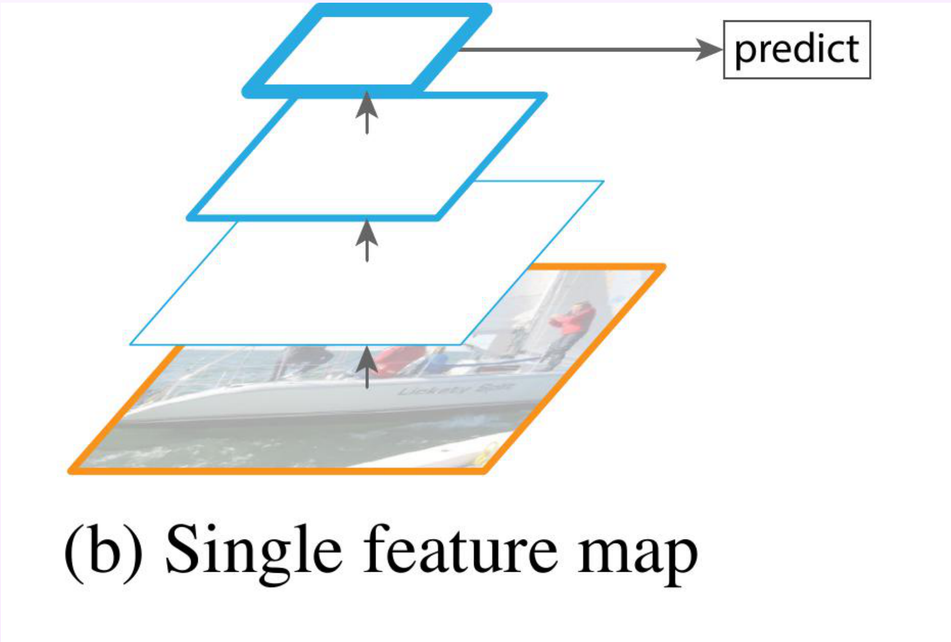
CSPDarkNet-53



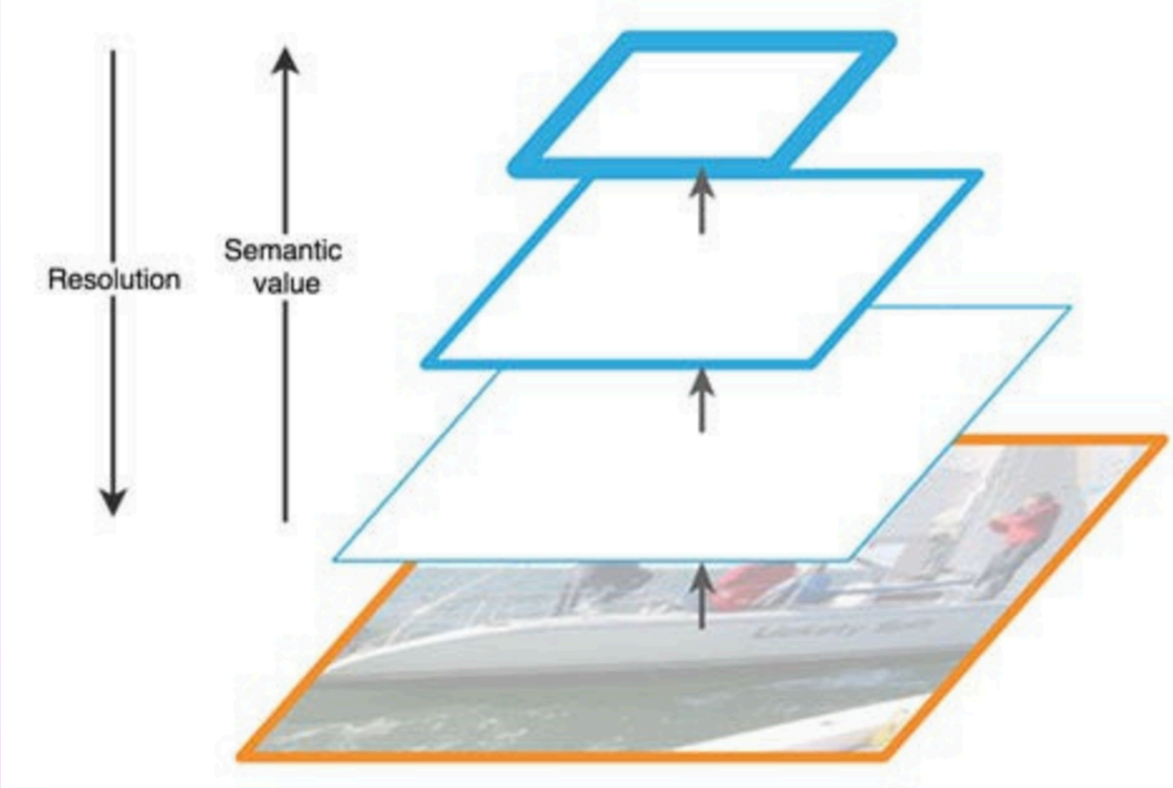
In this video..

- Backbone
  - DenseNet
  - CSPNet
  - CSPDarknet-53
- **Neck**
  - **FPN**
  - **SPP**
  - **PAN**
- **Spatial Attention Module**

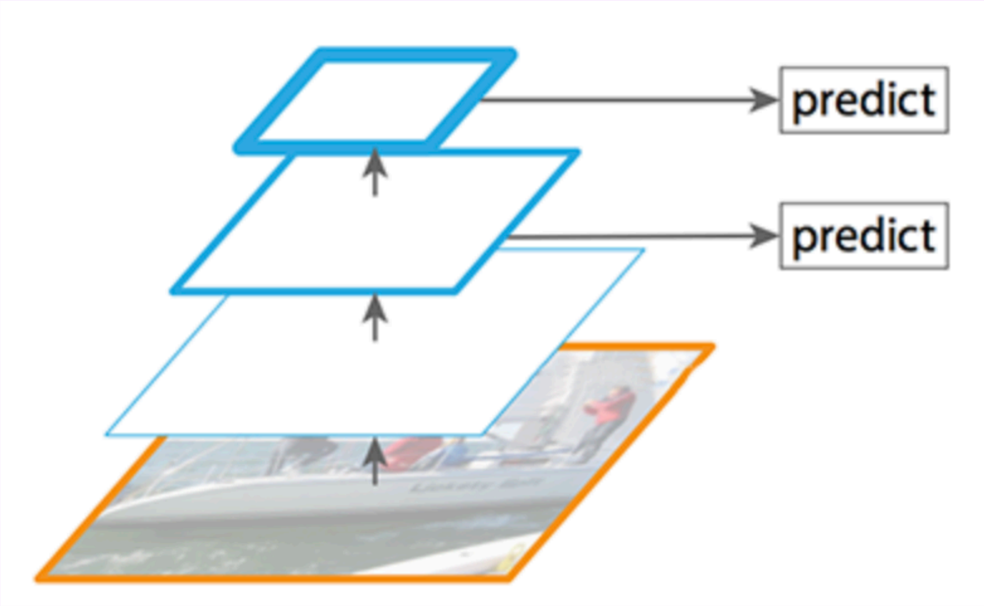
Small Objects Detection



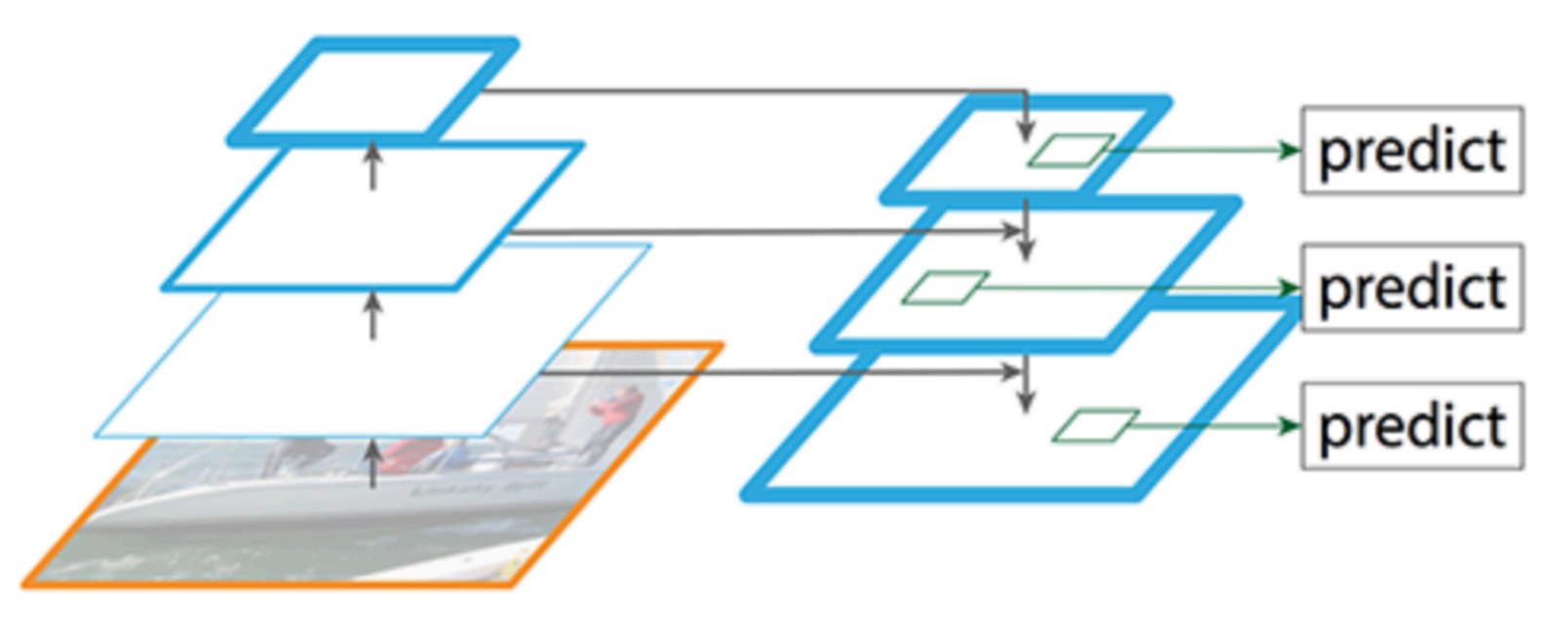
(b) Single feature map



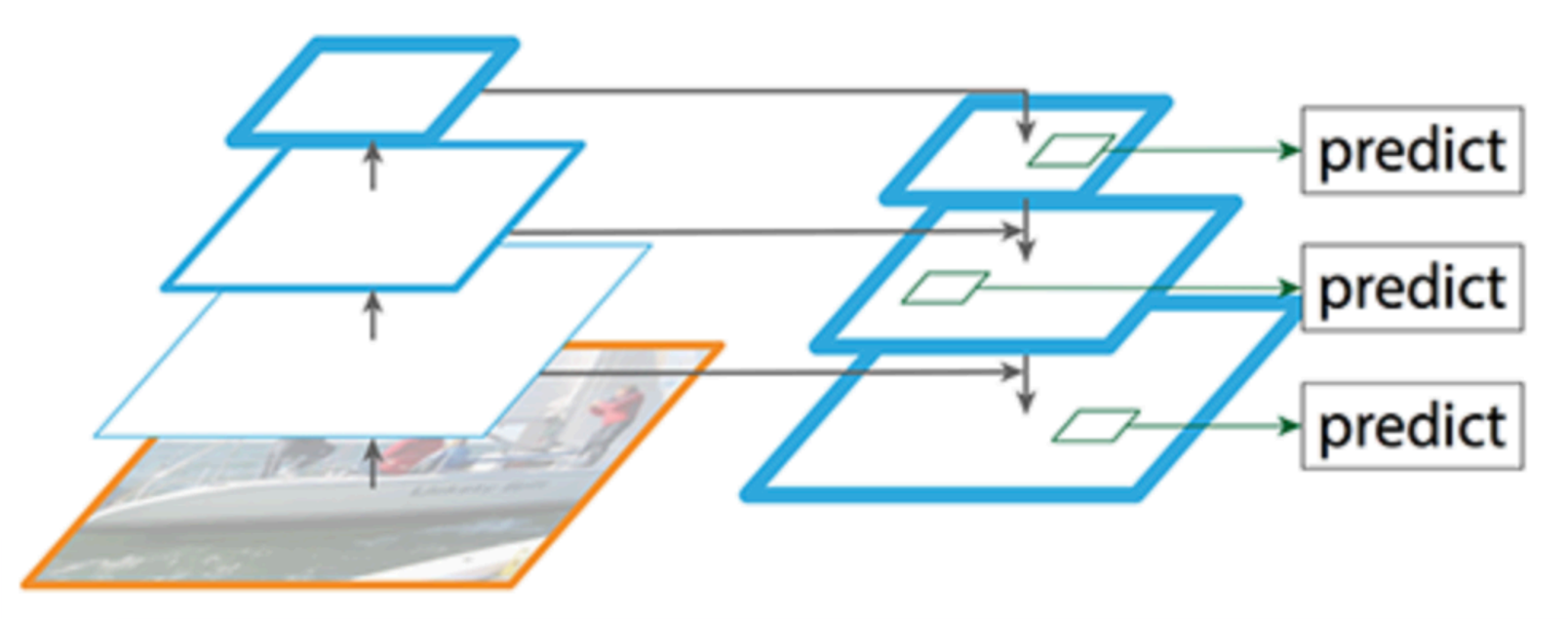
SSD



Feature Pyramid Network (FPN)



Feature Pyramid Network (FPN)



This is not used in YoloV4

Path Aggregation Network

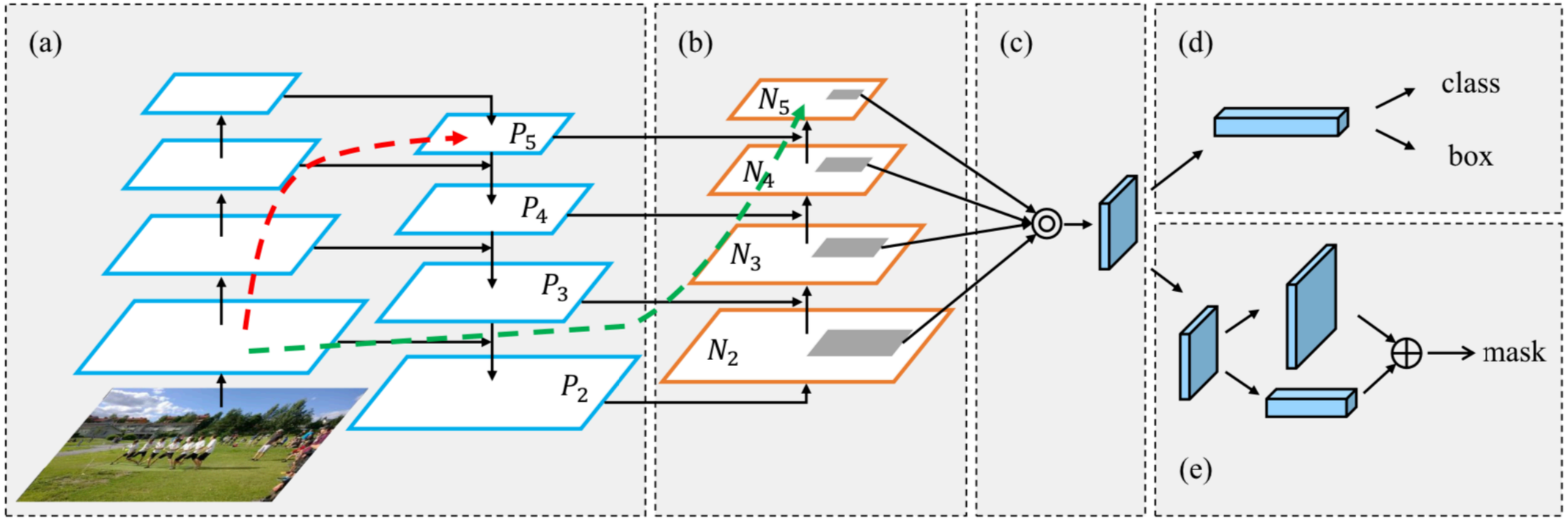
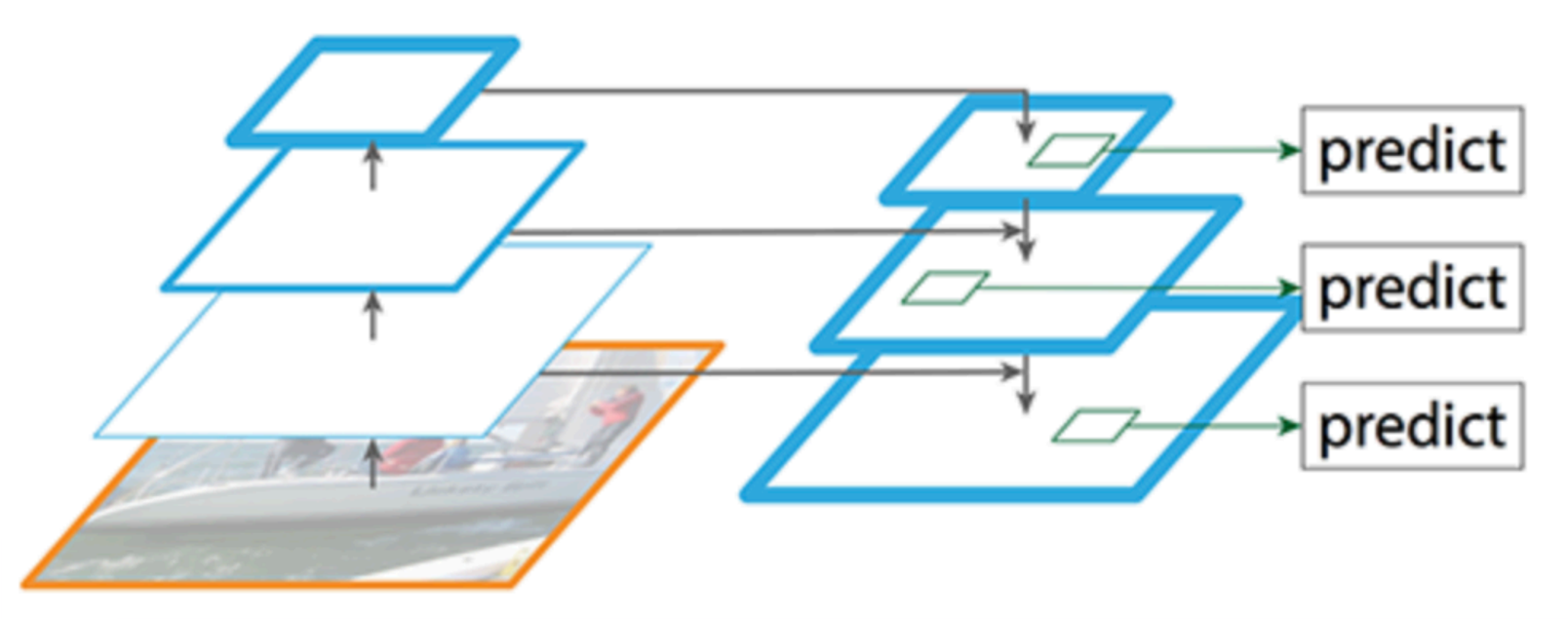


Figure 1. Illustration of our framework. (a) FPN backbone. (b) Bottom-up path augmentation. (c) Adaptive feature pooling. (d) Box branch. (e) Fully-connected fusion. Note that we omit channel dimension of feature maps in (a) and (b) for brevity.

Feature Pyramid Network (FPN)



Path Aggregation Network

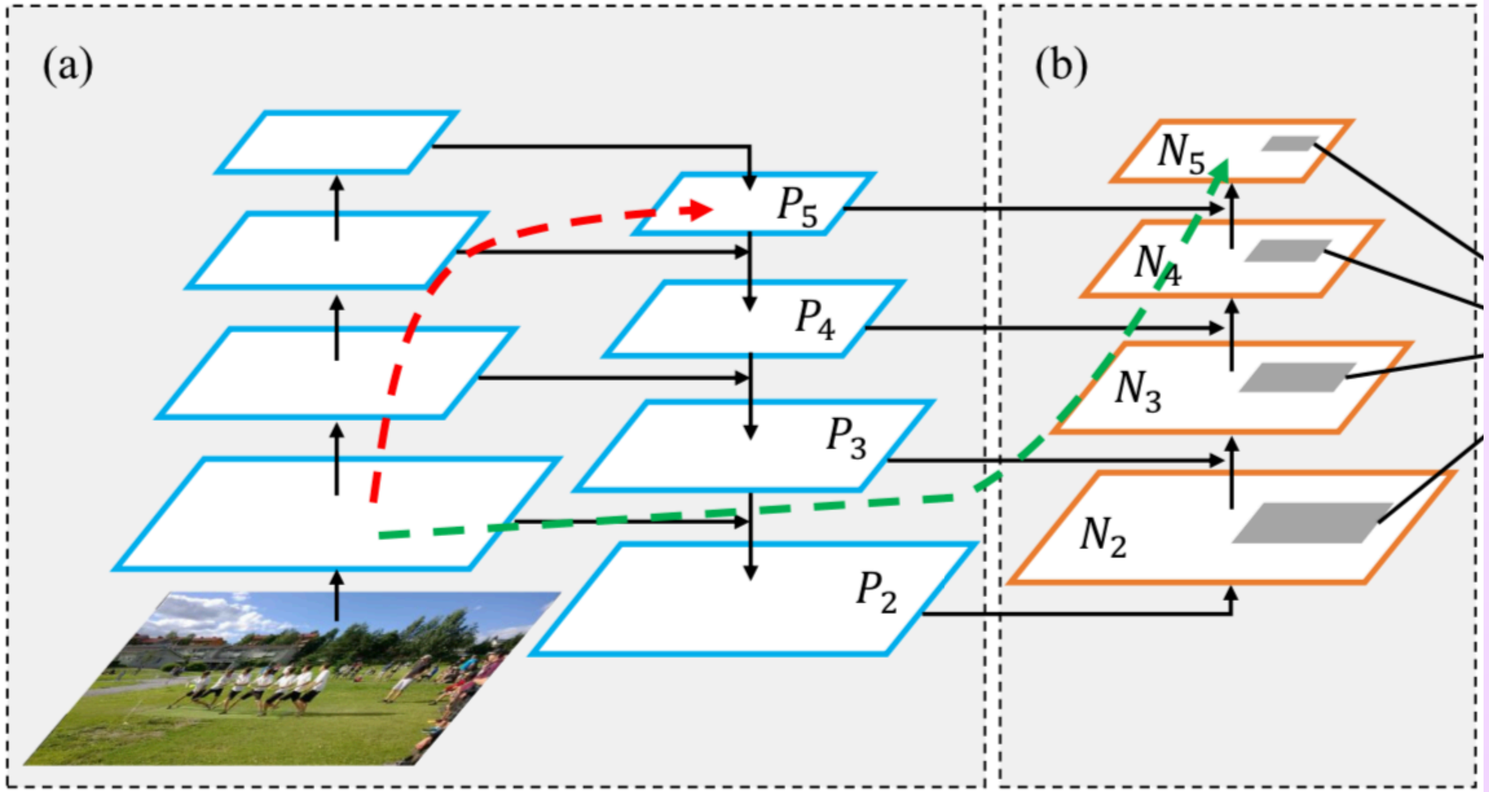
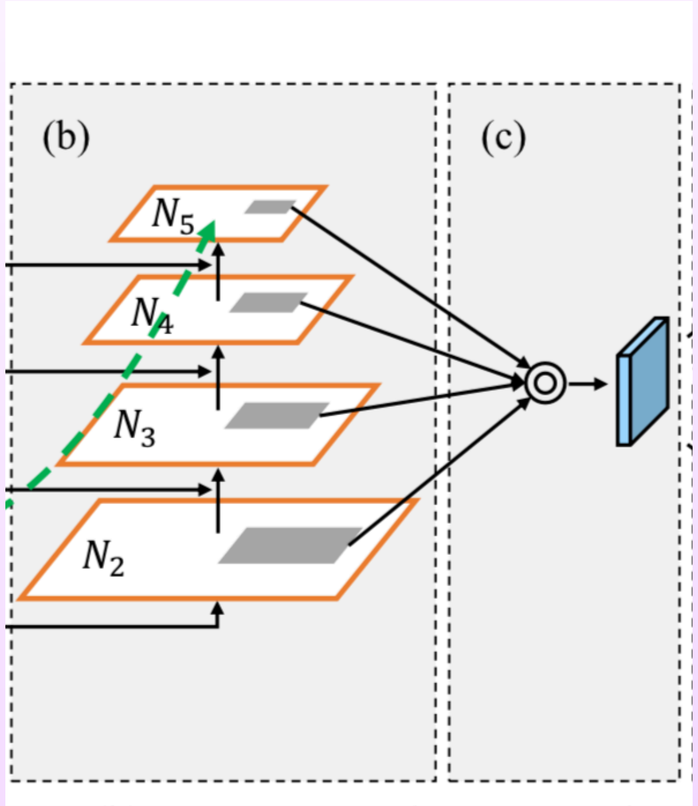


Figure 1. Illustration of our framework. (a) FPN backbone. (b) Bottom-up path
branch. (e) Fully-connected fusion. Note that we omit channel dimension of feature

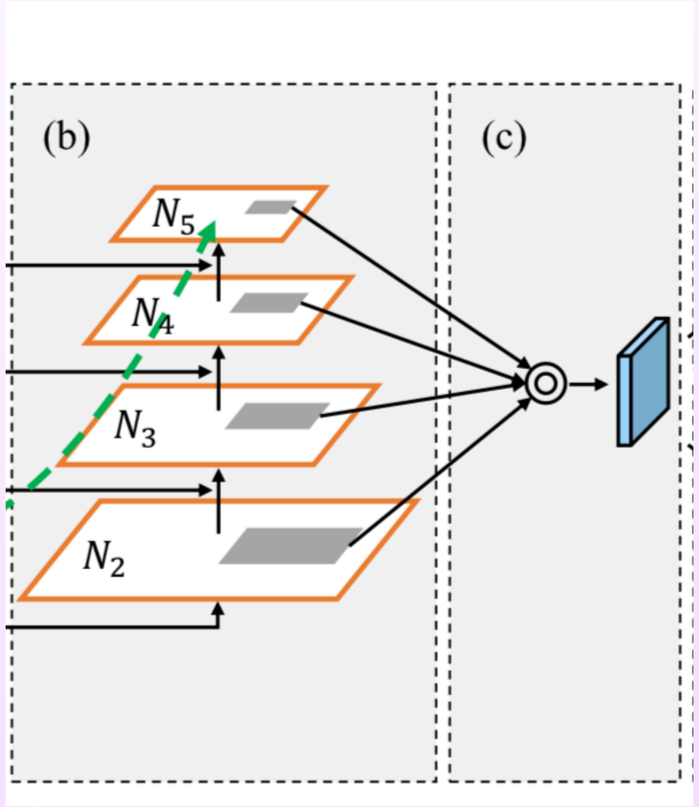
Path Aggregation Network

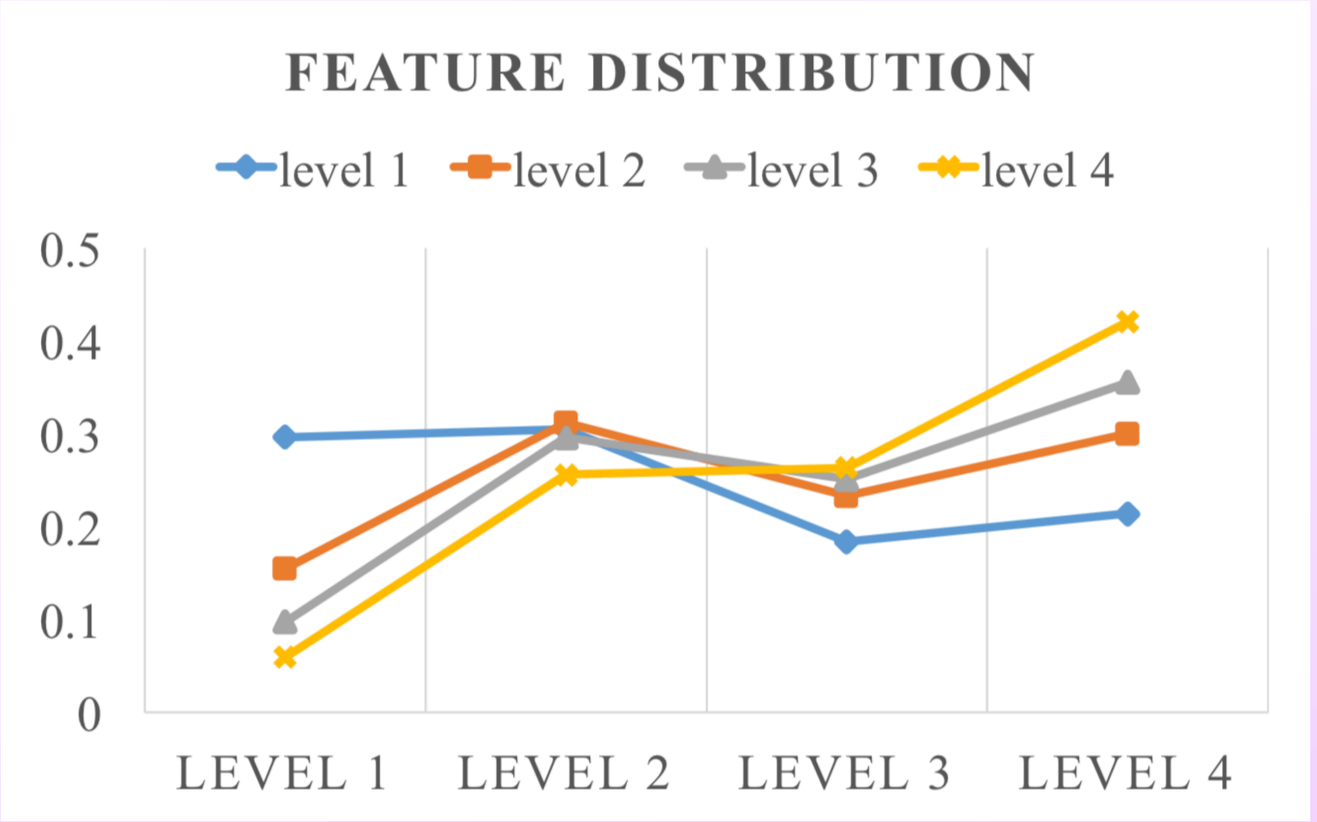
Method	AP	AP_{50}	AP_{75}	AP_S	AP_M	AP_L	Backbone
Champion 2016 [33]	37.6	59.9	40.4	17.1	41.0	56.0	6×ResNet-101
Mask R-CNN [21]+FPN [35]	35.7	58.0	37.8	15.5	38.1	52.4	ResNet-101
Mask R-CNN [21]+FPN [35]	37.1	60.0	39.4	16.9	39.9	53.5	ResNeXt-101
PANet / PANet [ms-train]	36.6 / 38.2	58.0 / 60.2	39.3 / 41.4	16.3 / 19.1	38.1 / 41.1	53.1 / 52.6	ResNet-50
PANet / PANet [ms-train]	40.0 / **42.0**	62.8 / **65.1**	43.1 / **45.7**	18.8 / **22.4**	42.3 / **44.7**	57.2 / **58.1**	ResNeXt-101

Path Aggregation Network

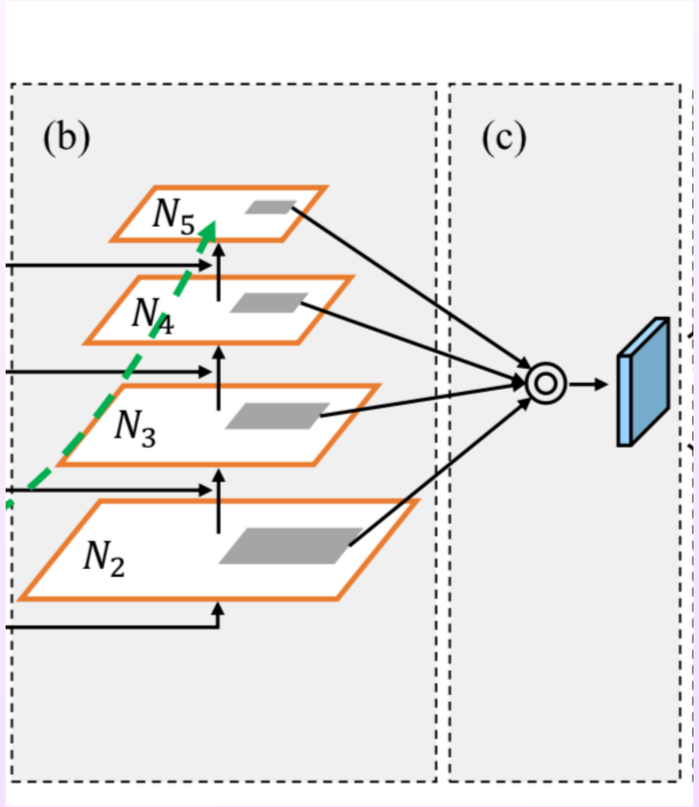


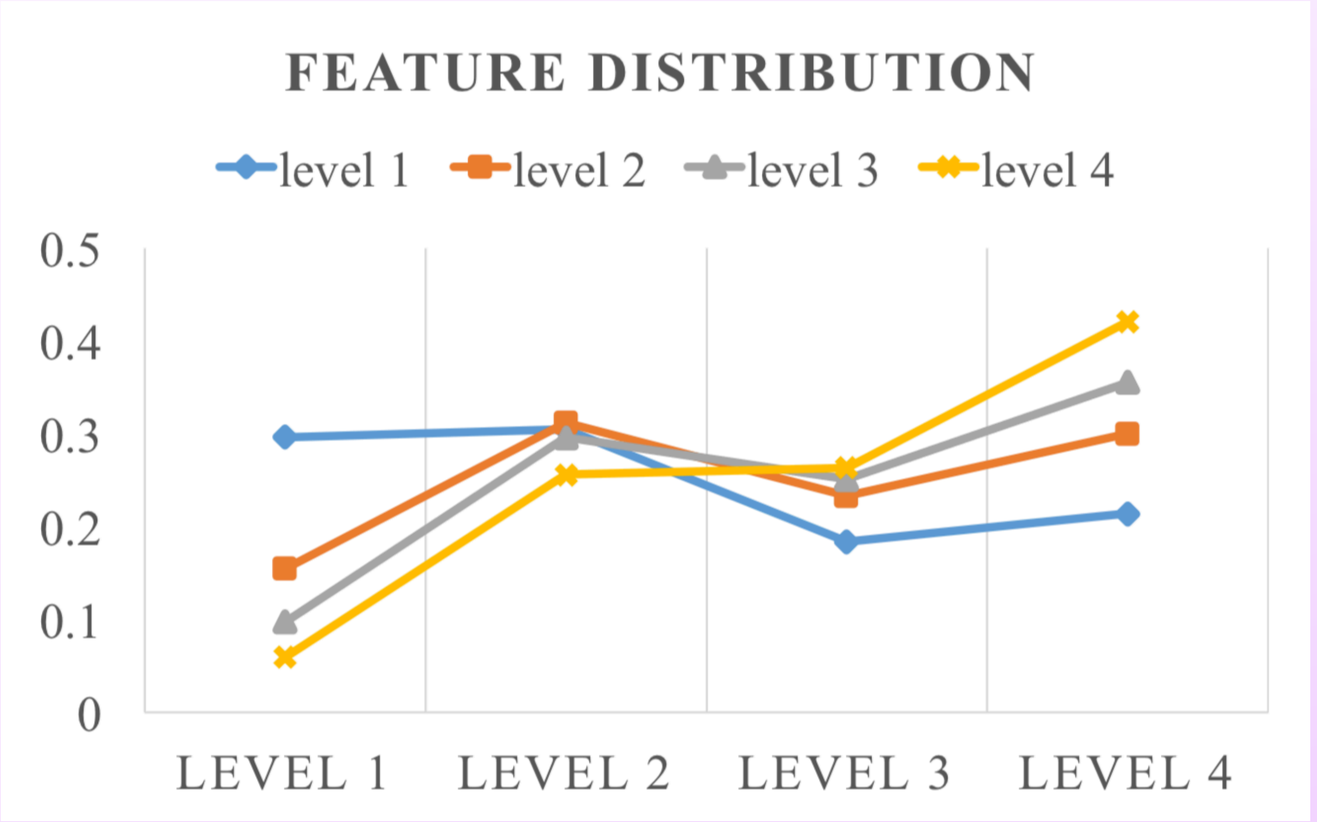
Path Aggregation Network



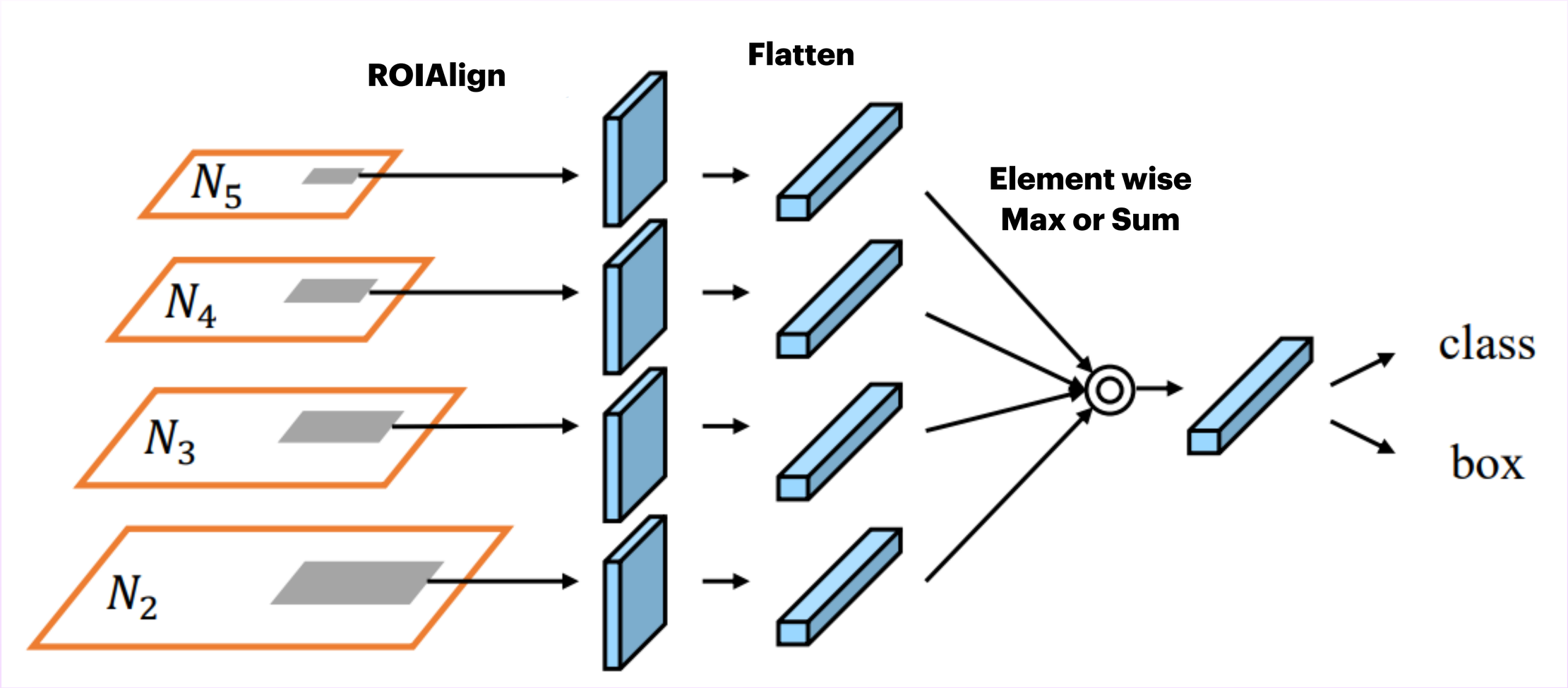


Path Aggregation Network

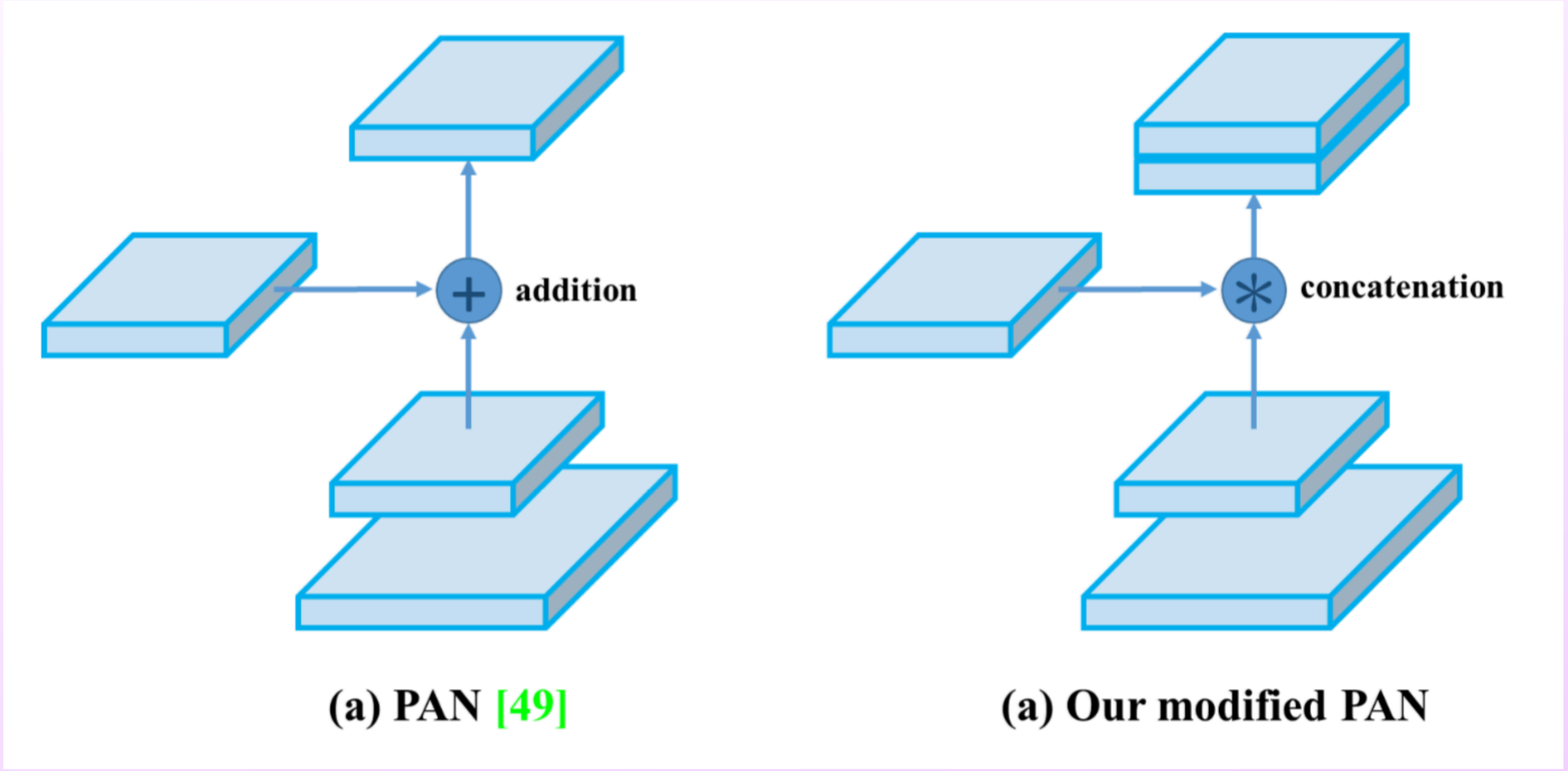




Path Aggregation Network



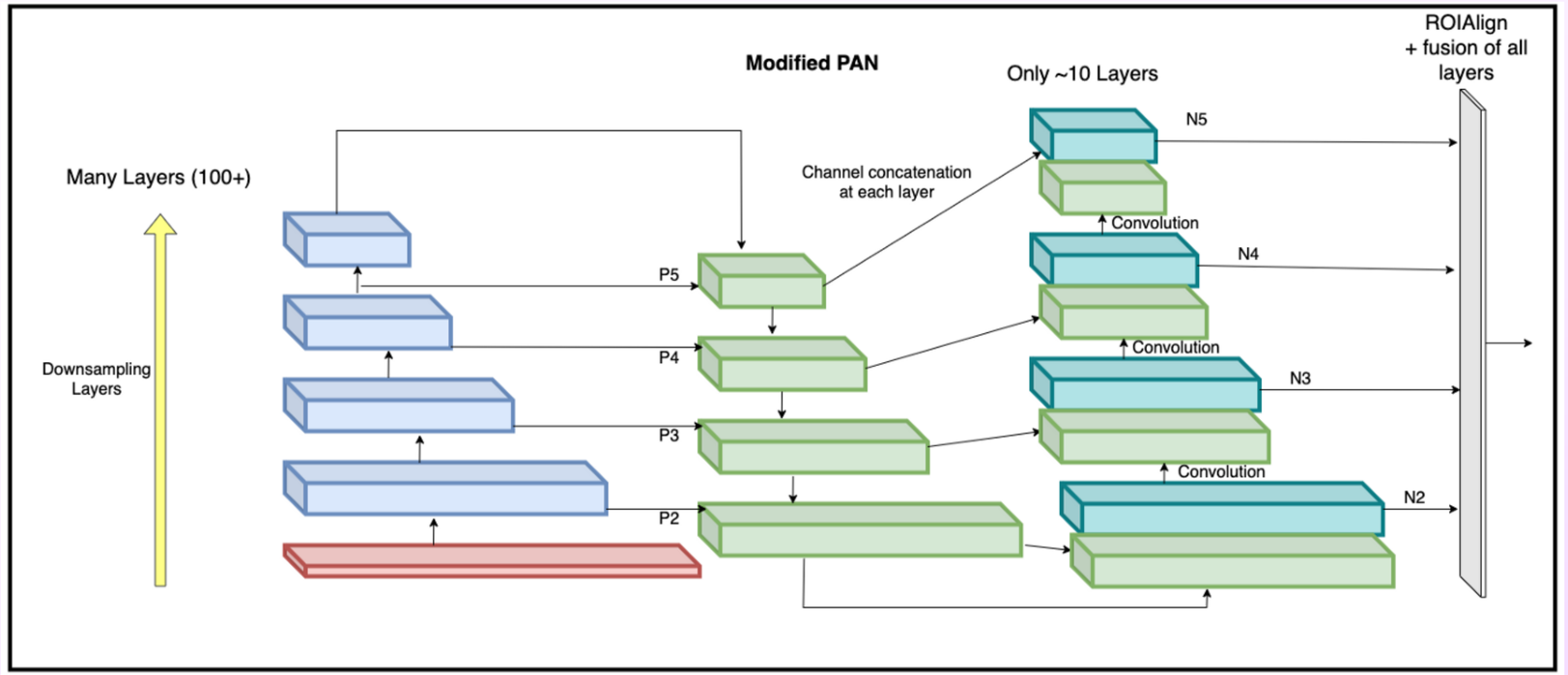
Modified PAN

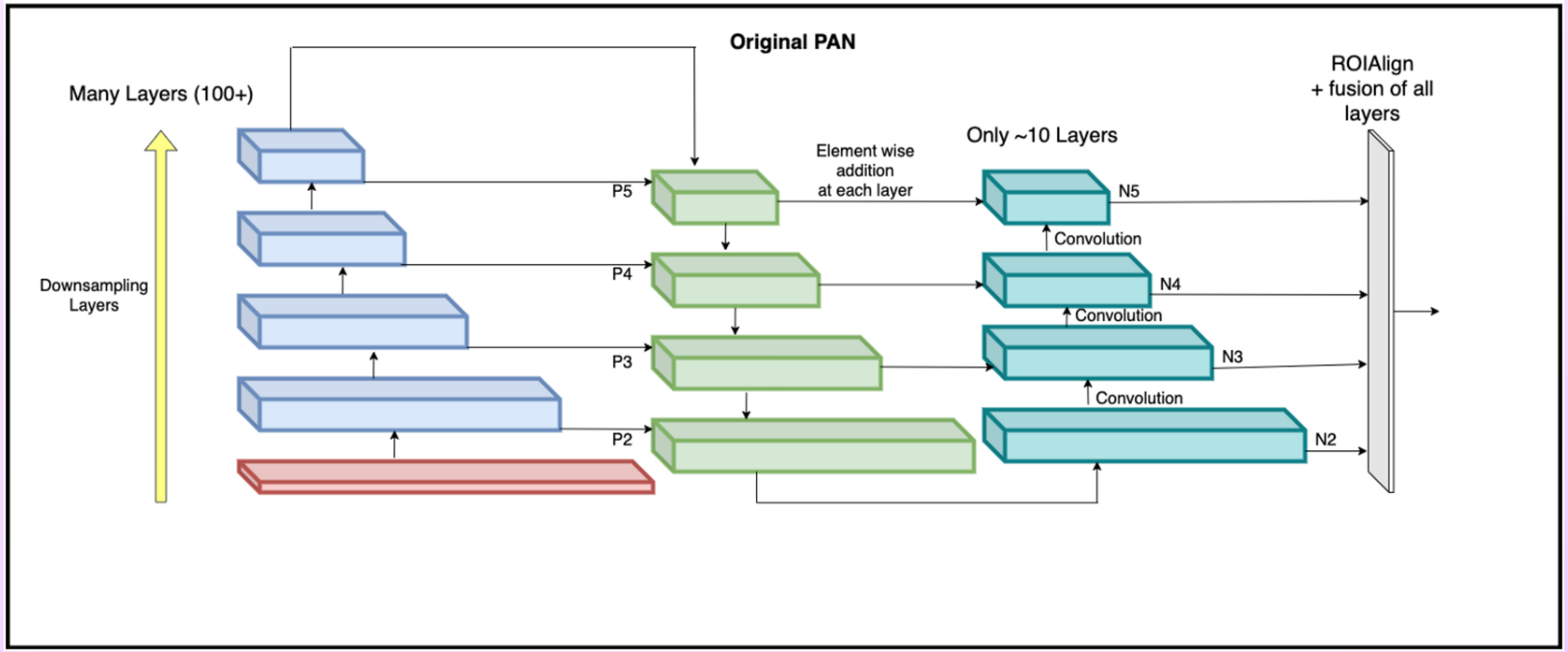


(a) PAN [49]

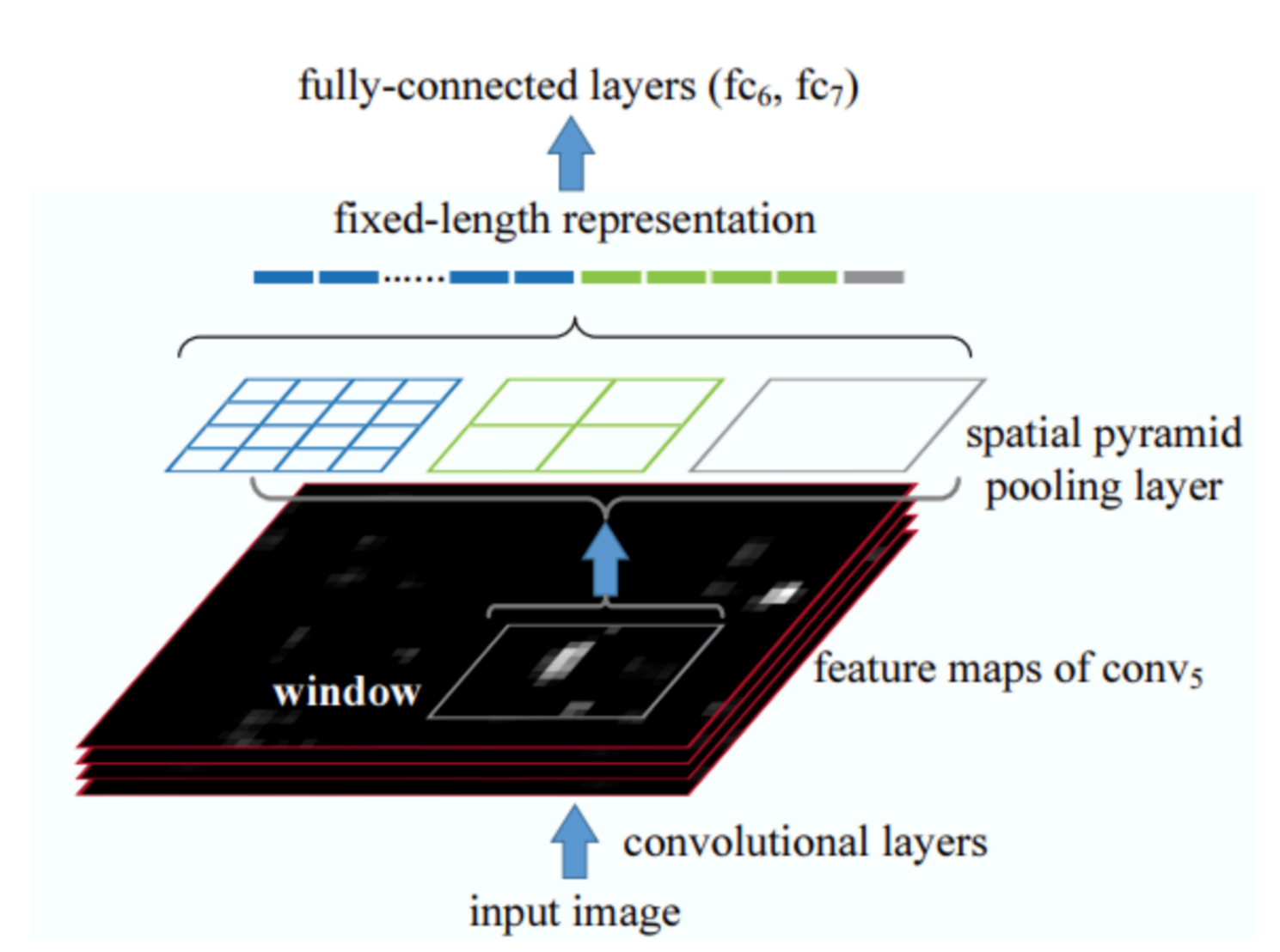
(a) Our modified PAN

Modified PAN

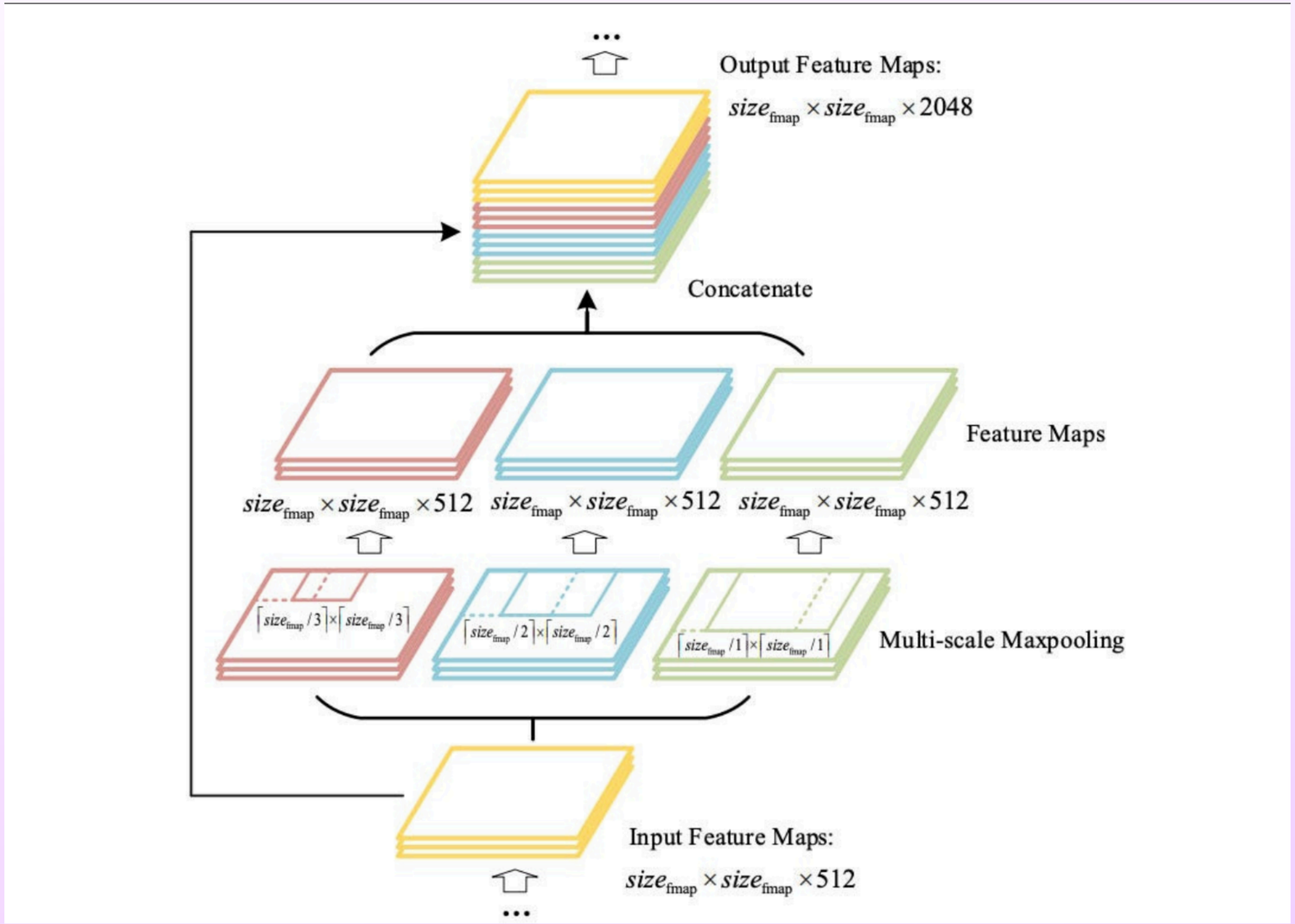




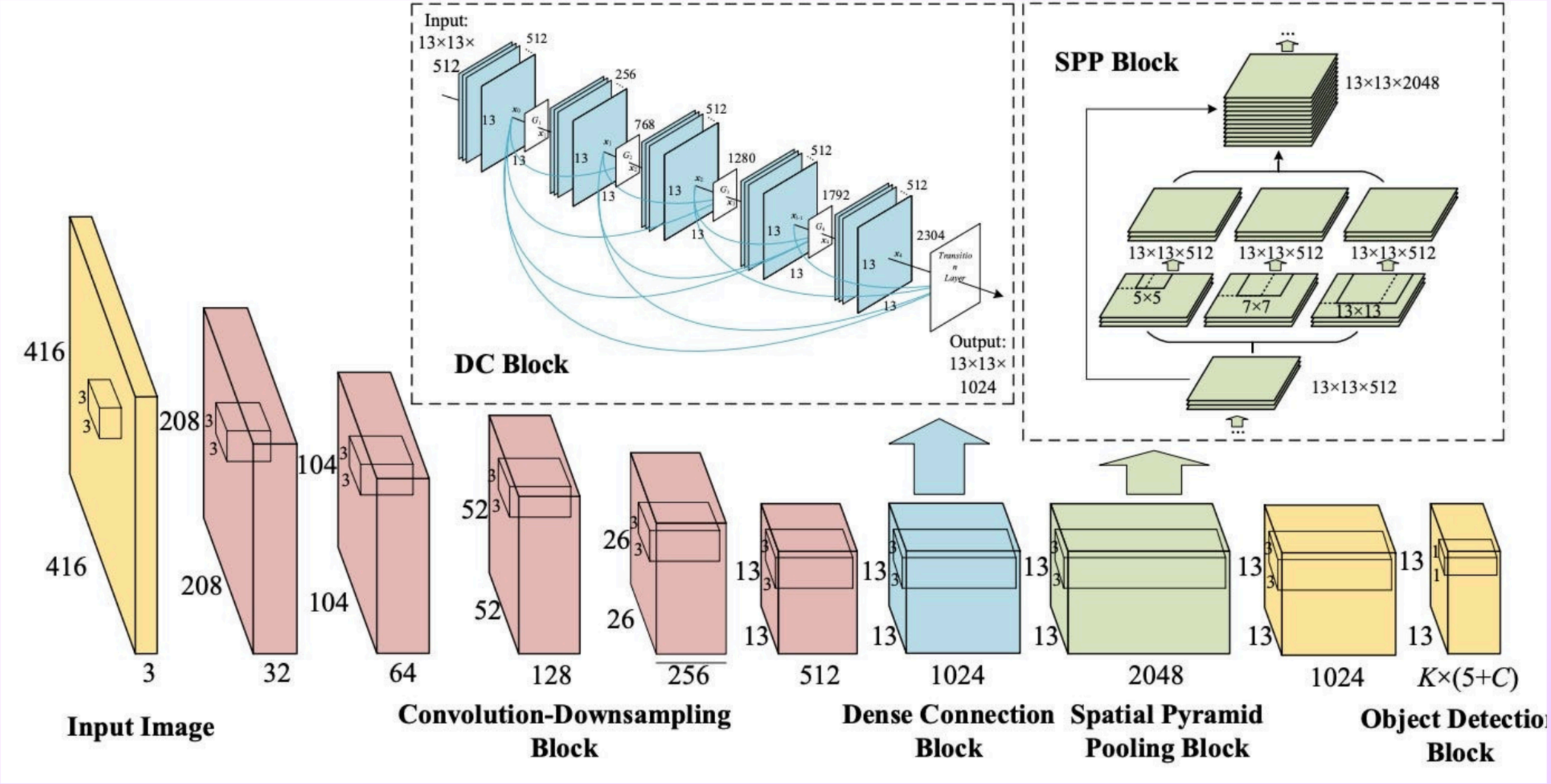
Spatial Pyramid Pooling (SPP)



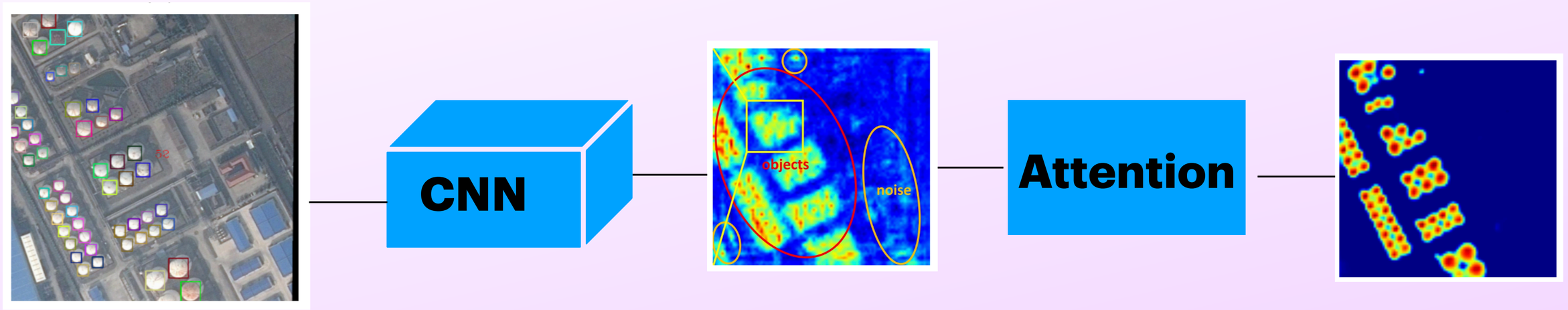
YOLO with SPP



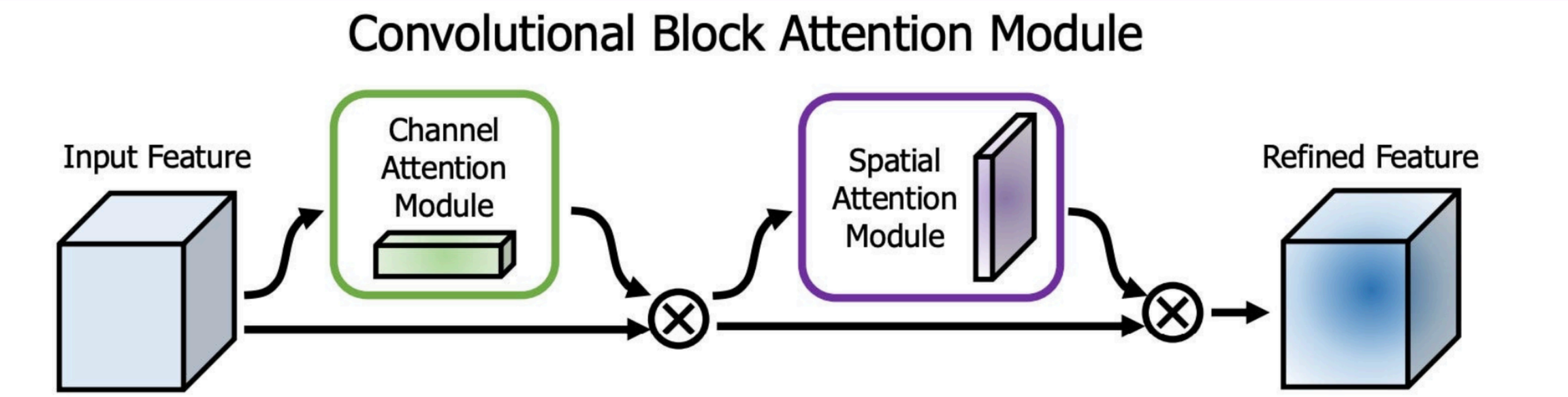
YOLO with SPP



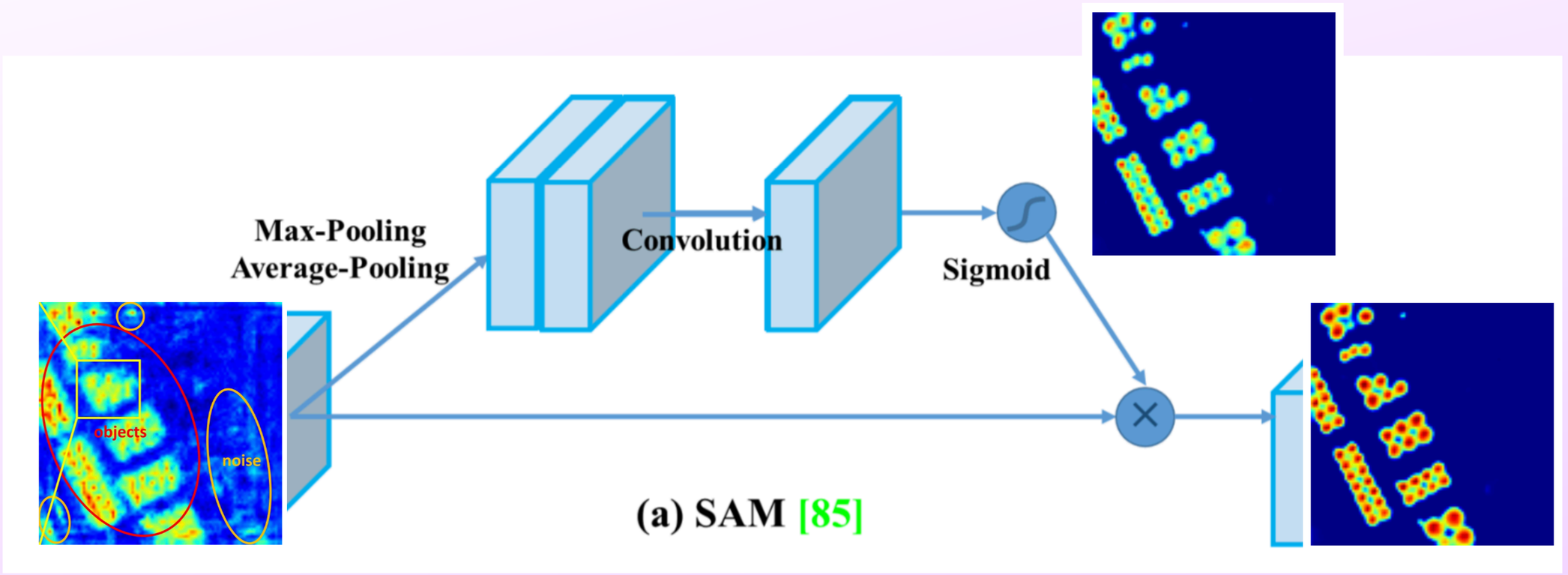
Attention Module



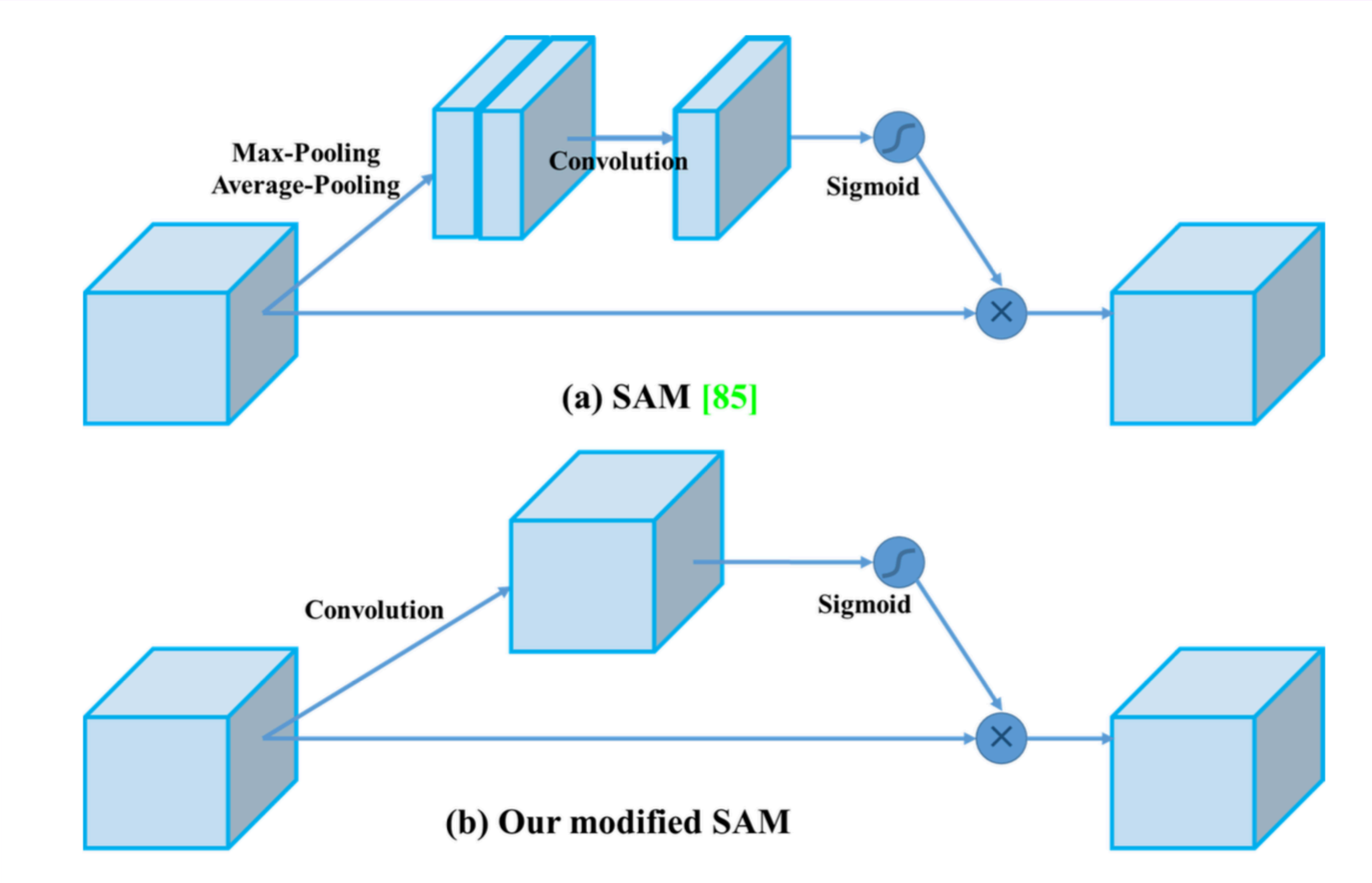
Attention Module



Spatial Attention Module (SAM)



Modified SAM



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Thank You!