YOLO V5

v6.1

官方源码仓库：https://github.com/ultralytics/yolov5

推荐博文：https://blog.csdn.net/qq_37541097/article/details/123594351

YOLO V5

glenn-jocher commented on 7 Oct 2021 • edited ▾ Member

@besmaGuesmi we are targeting a paper release by the start of PyTorch Dev day, December 1st.

If the YOLOv5 paper is not published by then I will eat my hat.

25 4 22 11 2 3 12

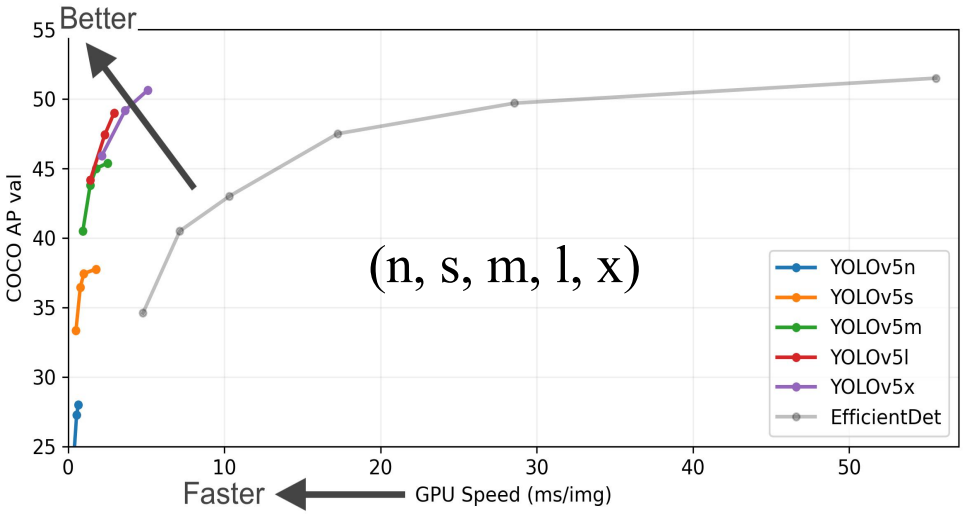
MaKaNu commented on 11 Dec 2021

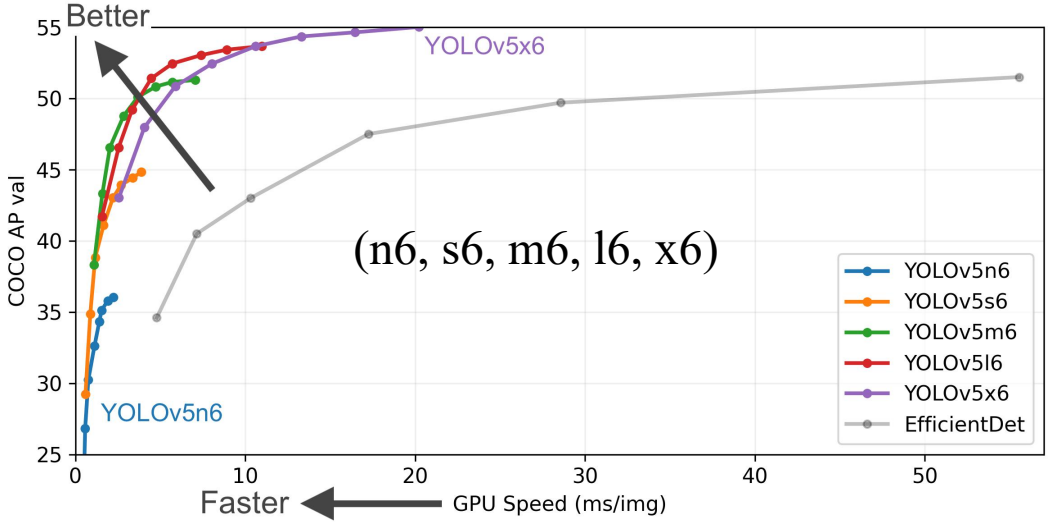
@glenn-jocher I prepared it for you:

Sorry I had to do it ;)

5 32 8

YOLO V5


Better
COCO AP val
(n, s, m, l, x)
YOLOv5n
YOLOv5s
YOLOv5m
YOLOv5l
YOLOv5x
EfficientDet
Faster
GPU Speed (ms/img)


Better
YOLOv5x6
COCO AP val
(n6, s6, m6, l6, x6)
YOLOv5n6
YOLOv5s6
YOLOv5m6
YOLOv5l6
YOLOv5x6
EfficientDet
YOLOv5n6
Faster
GPU Speed (ms/img)

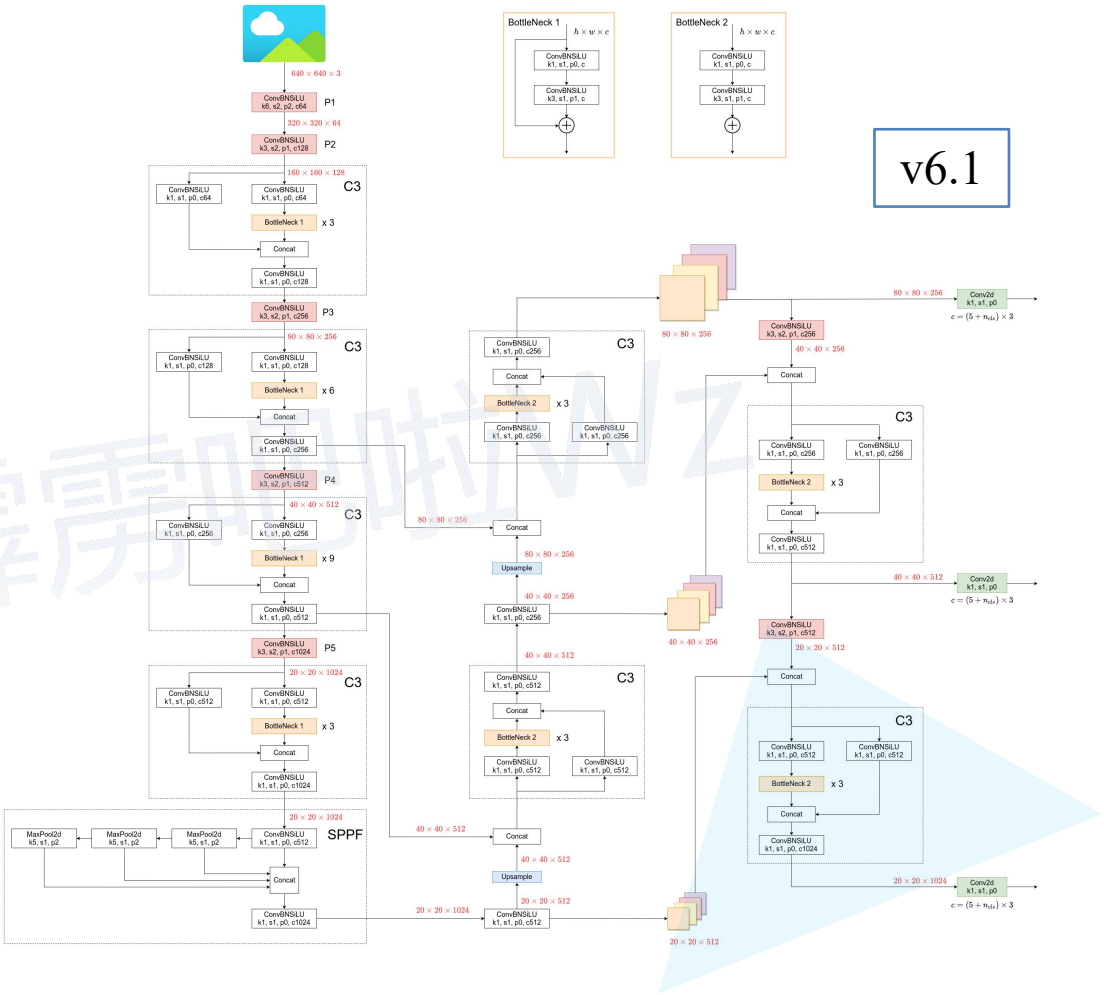
YOLO V5

v6.1

Model	size (pixels)	mAP^{val} 0.5:0.95	mAP^{val} 0.5	Speed CPU b1 (ms)	Speed V100 b1 (ms)	Speed V100 b32 (ms)	params (M)	FLOPs @640 (B)
YOLOv5n	640	28.0	45.7	**45**	**6.3**	**0.6**	**1.9**	**4.5**
YOLOv5s	640	37.4	56.8	98	6.4	0.9	7.2	16.5
YOLOv5m	640	45.4	64.1	224	8.2	1.7	21.2	49.0
YOLOv5l	640	49.0	67.3	430	10.1	2.7	46.5	109.1
YOLOv5x	640	50.7	68.9	766	12.1	4.8	86.7	205.7
YOLOv5n6	1280	36.0	54.4	153	8.1	2.1	3.2	4.6
YOLOv5s6	1280	44.8	63.7	385	8.2	3.6	12.6	16.8
YOLOv5m6	1280	51.3	69.3	887	11.1	6.8	35.7	50.0
YOLOv5l6	1280	53.7	71.3	1784	15.8	10.5	76.8	111.4
YOLOv5x6 + TTA	1280 1536	55.0 **55.8**	72.7 **72.7**	3136 -	26.2 -	19.4 -	140.7 -	209.8 -

YOLO V5

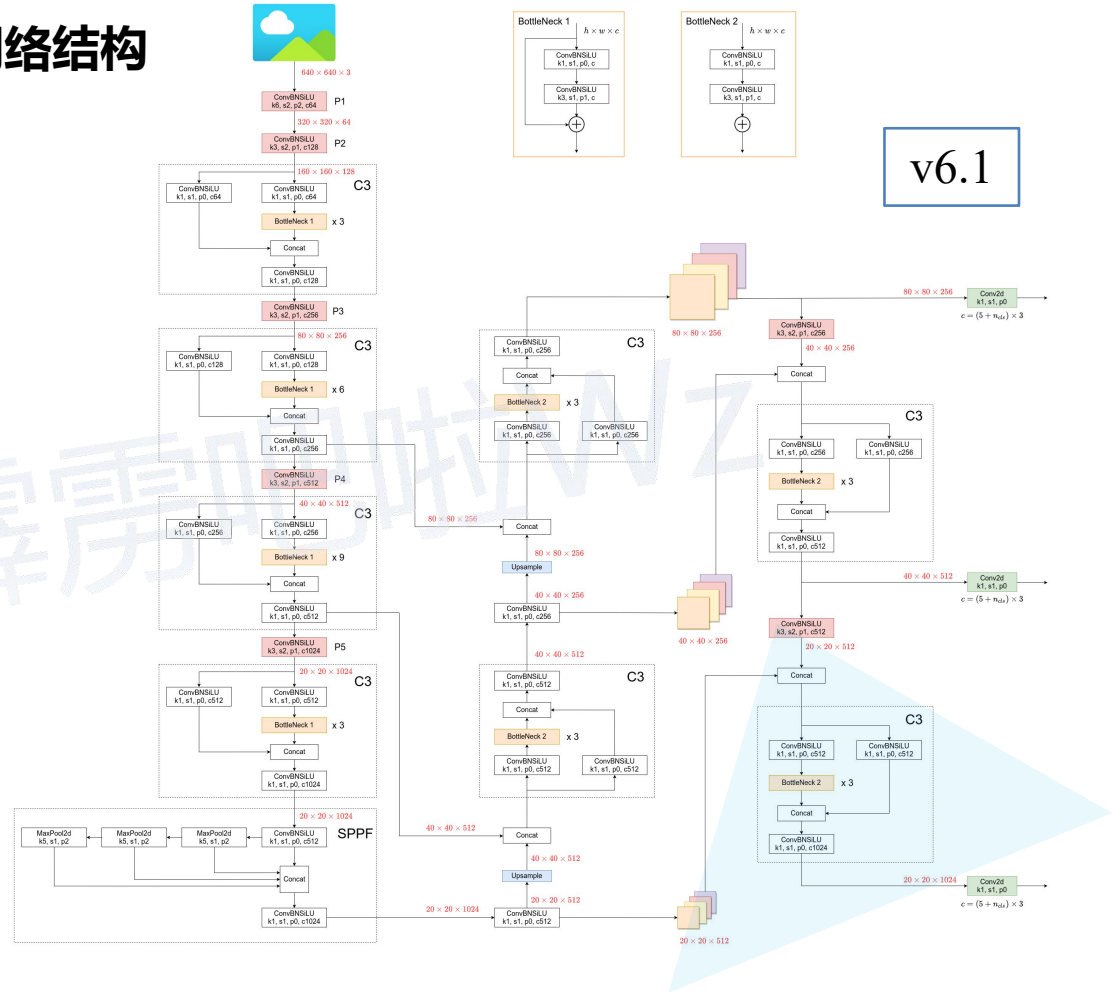
目录：



YOLO V5

网络结构

- **Backbone**: New CSP-Darknet53
- **Neck**: SPPF, New CSP-PAN
- **Head**: YOLOv3 Head

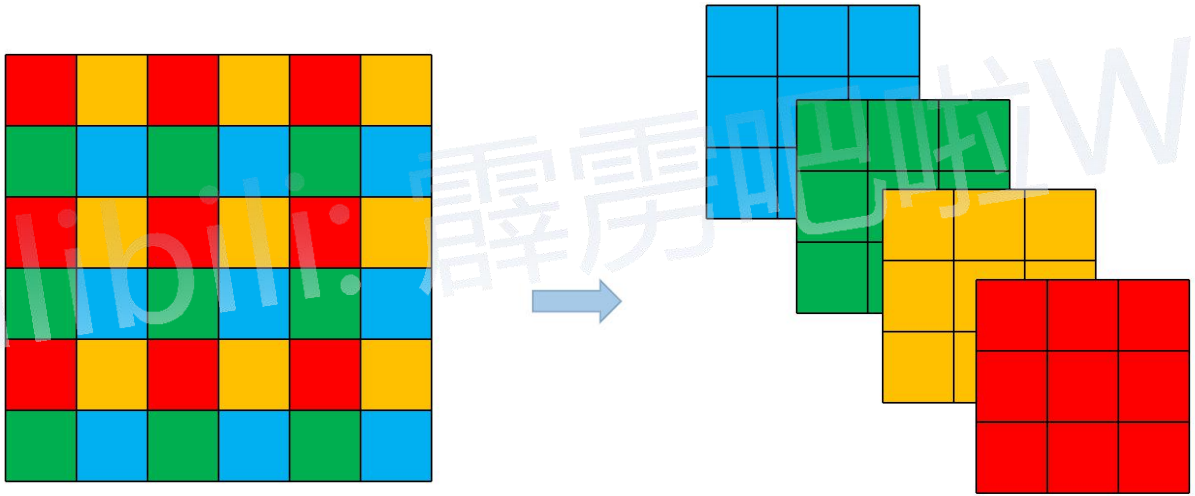


YOLO V5

网络结构

v6.1

将Focus模块替换成了6x6的普通卷积层。
两者功能相同，但后者效率更高。

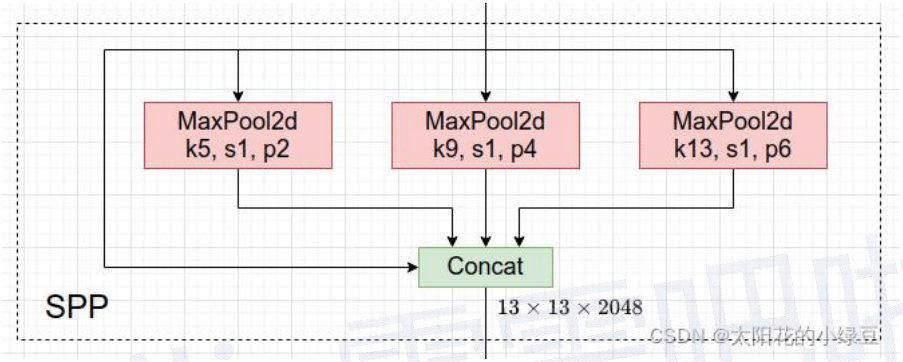


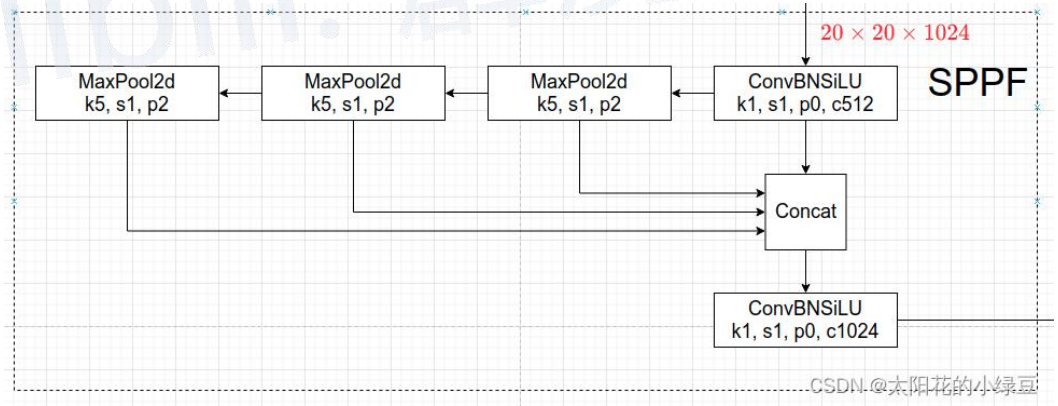
https://github.com/ultralytics/yolov5/issues/4825

YOLO V5

网络结构

v6.1

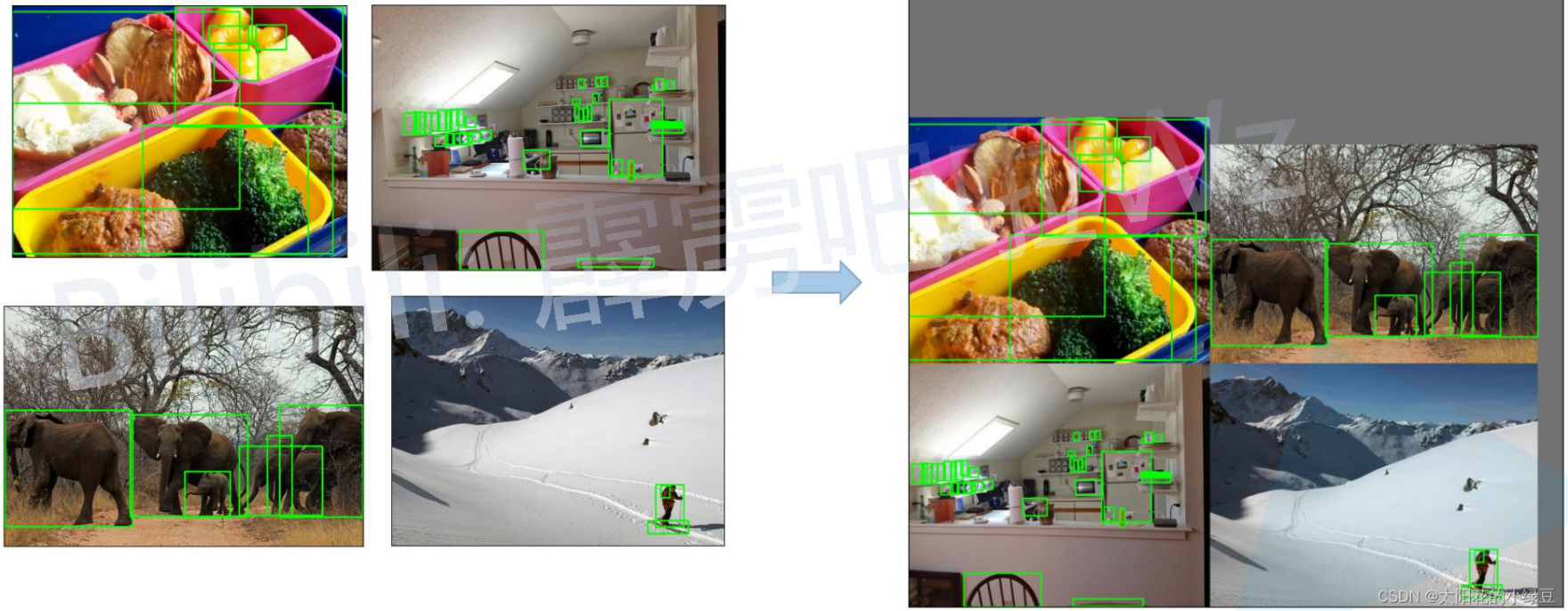




YOLO V5

数据增强 - Mosaic

v6.1



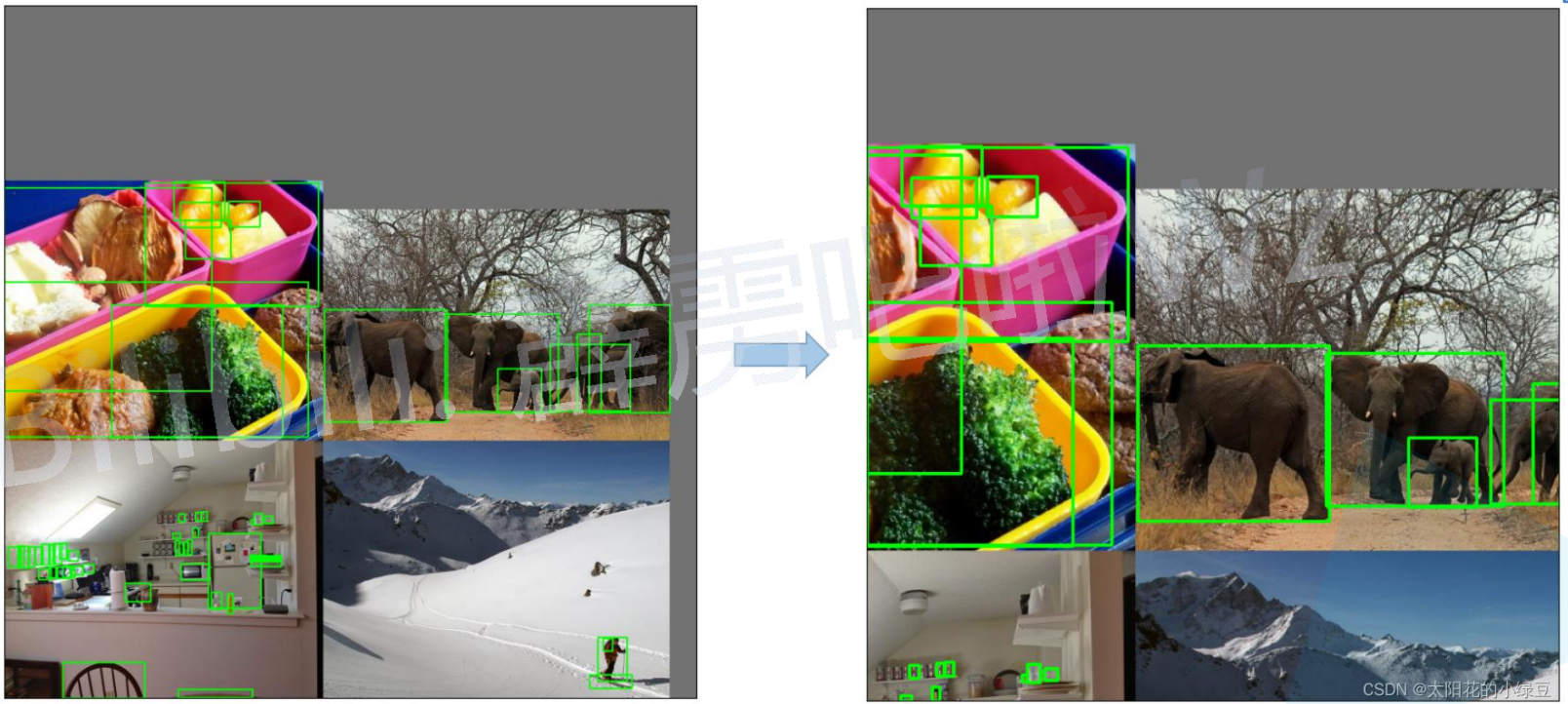
YOLO V5

数据增强 - Copy paste

v6.1

数据增强 - Random affine

v6.1

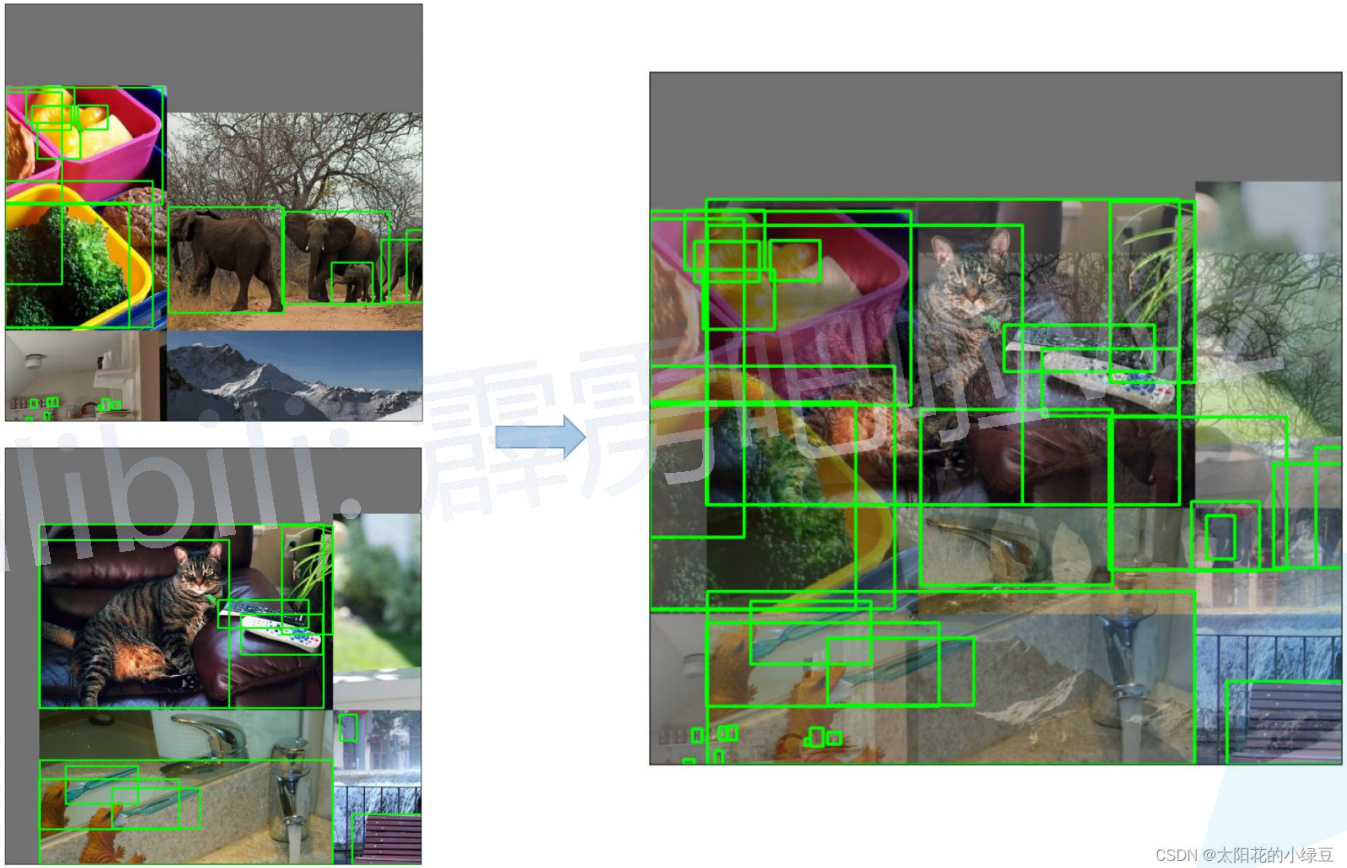


(Rotation, **Scale**, **Translation** and Shear)

YOLO V5

数据增强 - MixUp

v6.1



数据增强 - Albumentations

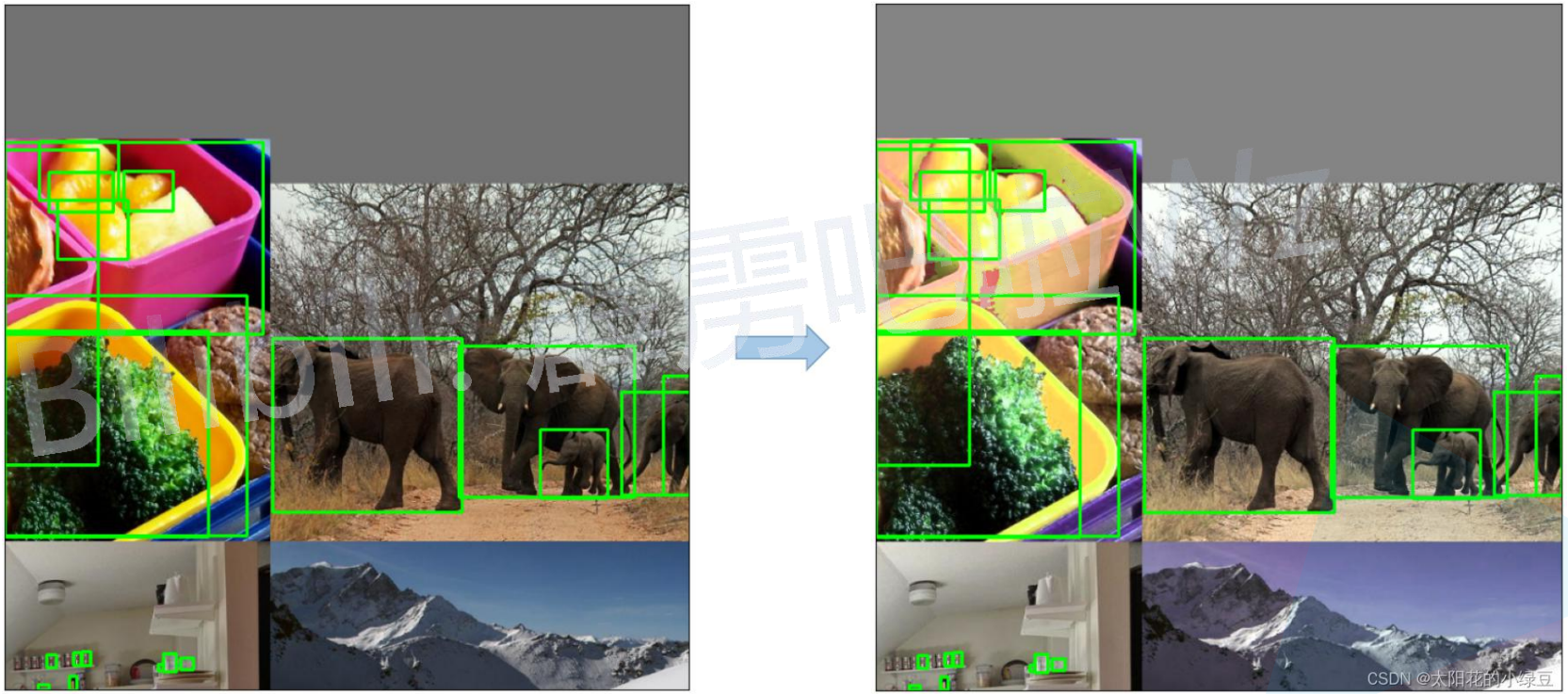
v6.1

滤波、直方图均衡化以及改变图片质量等等

YOLO V5

数据增强 - Augment HSV (Hue, Saturation, Value)

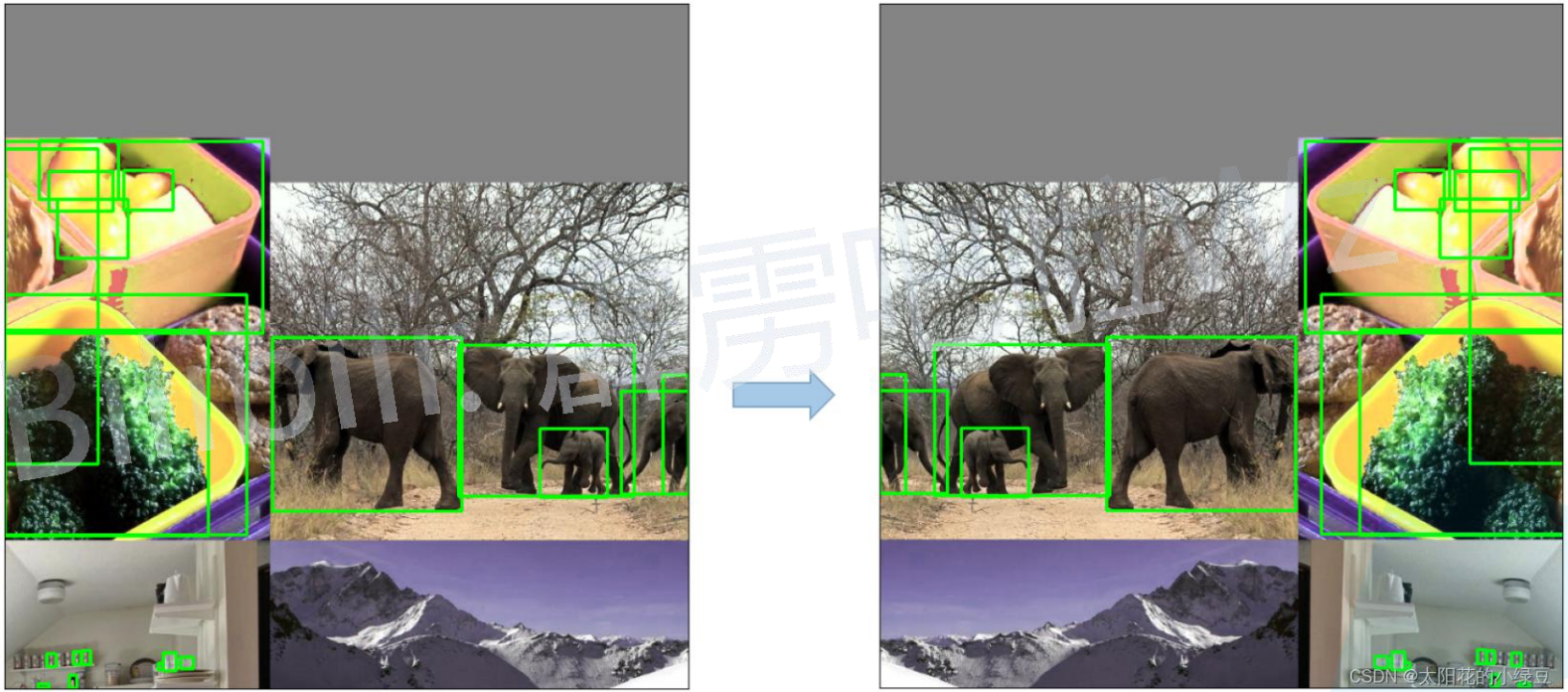
v6.1



YOLO V5

数据增强 - Random horizontal flip

v6.1



YOLO V5

训练策略

- Multi-scale training(0.5~1.5x)
- AutoAnchor(For training custom data)
- Warmup and Cosine LR scheduler
- EMA(Exponential Moving Average)
- Mixed precision
- Evolve hyper-parameters

损失计算

YOLOv5的损失主要由三个部分组成：

- **Classes loss**，分类损失，采用的是BCE loss，注意只计算正样本的分类损失。
- **Objectness loss**，obj损失，采用的依然是BCE loss，注意这里的obj指的是网络预测的目标边界框与GT Box的CIoU。这里计算的是所有样本的obj损失。
- **Location loss**，定位损失，采用的是CIoU loss，注意只计算正样本的定位损失。

$$Loss = \lambda_1 L_{cls} + \lambda_2 L_{obj} + \lambda_3 L_{loc}$$

平衡不同尺度损失

针对三个预测特征层（P3, P4, P5）上的obj损失采用不同的权重。

$$L_{obj} = 4.0 \cdot L_{obj}^{small} + 1.0 \cdot L_{obj}^{medium} + 0.4 \cdot L_{obj}^{large}$$

YOLO V5

消除Grid敏感度

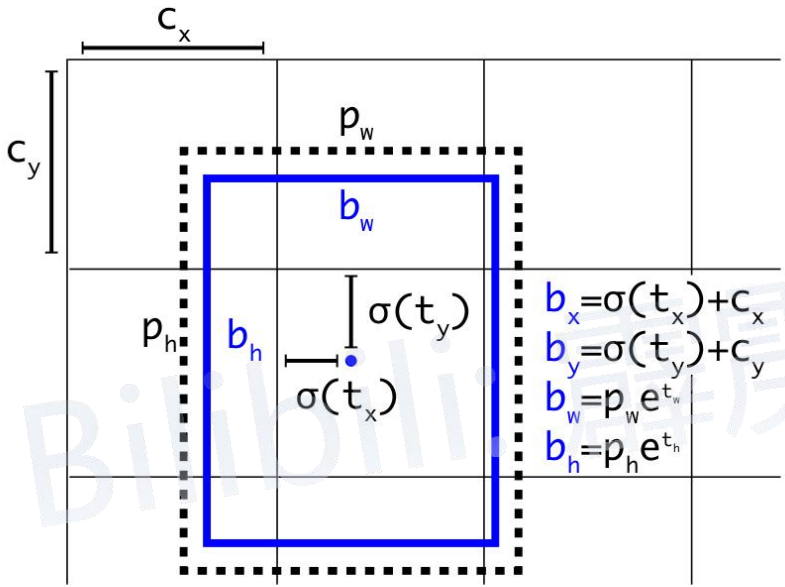
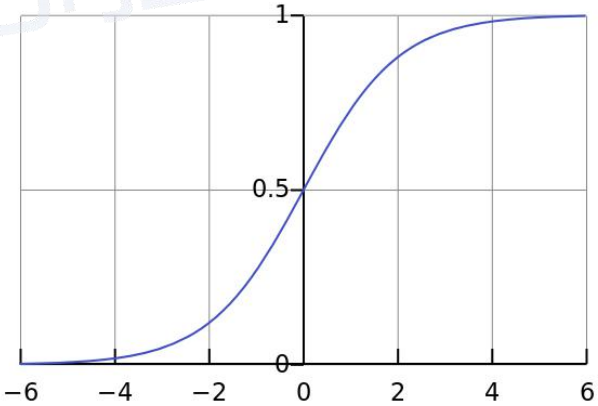


Figure 3: Bounding boxes with dimension priors and location prediction. We predict the width and height of the box as offsets from cluster centroids. We predict the center coordinates of the box relative to the location of filter application using a sigmoid function.

$$\sigma(x) = \frac{1}{1 + e^{-x}}$$

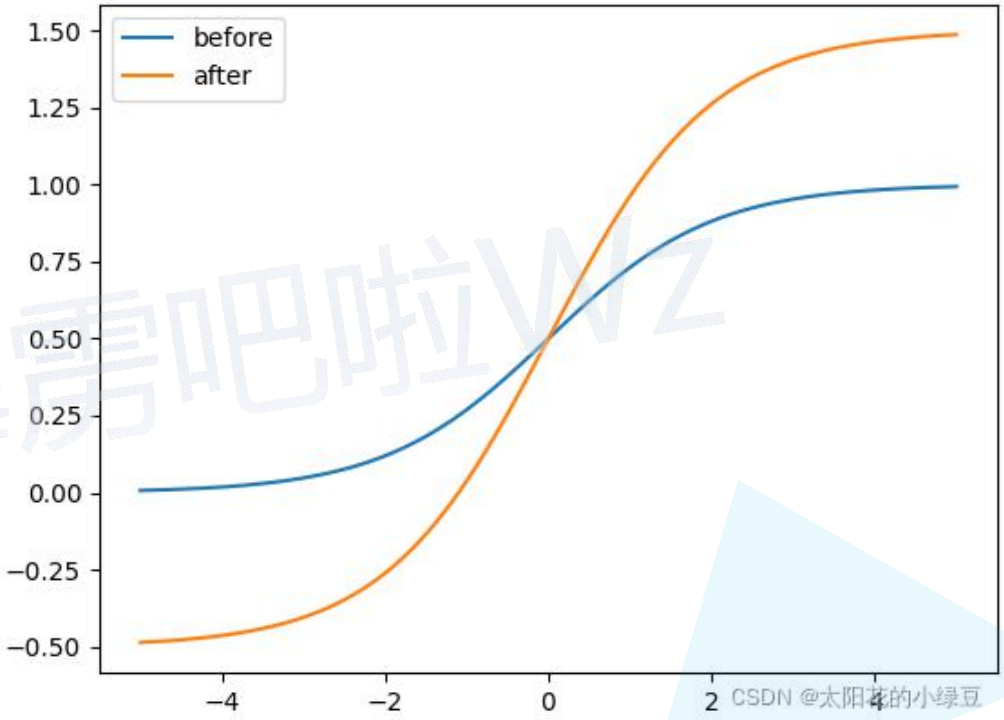


YOLO V5

消除Grid敏感度

$$b_x = \sigma(t_x) + c_x$$
$$b_y = \sigma(t_y) + c_y$$

$$b_x = (2 \cdot \sigma(t_x) - 0.5) + c_x$$
$$b_y = (2 \cdot \sigma(t_y) - 0.5) + c_y$$



YOLO V5

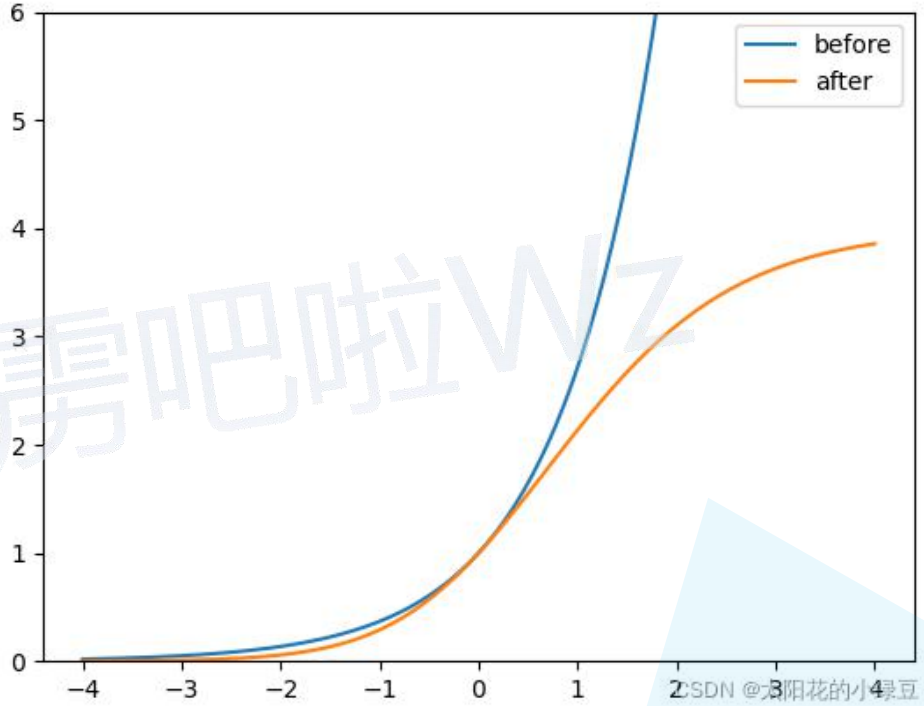
消除Grid敏感度

$$b_w = p_w \cdot e^{t_w}$$

$$b_h = p_h \cdot e^{t_h}$$

$$b_w = p_w \cdot (2 \cdot \sigma(t_w))^2$$

$$b_h = p_h \cdot (2 \cdot \sigma(t_h))^2$$



https://github.com/ultralytics/yolov5/issues/471

YOLO V5

匹配正样本

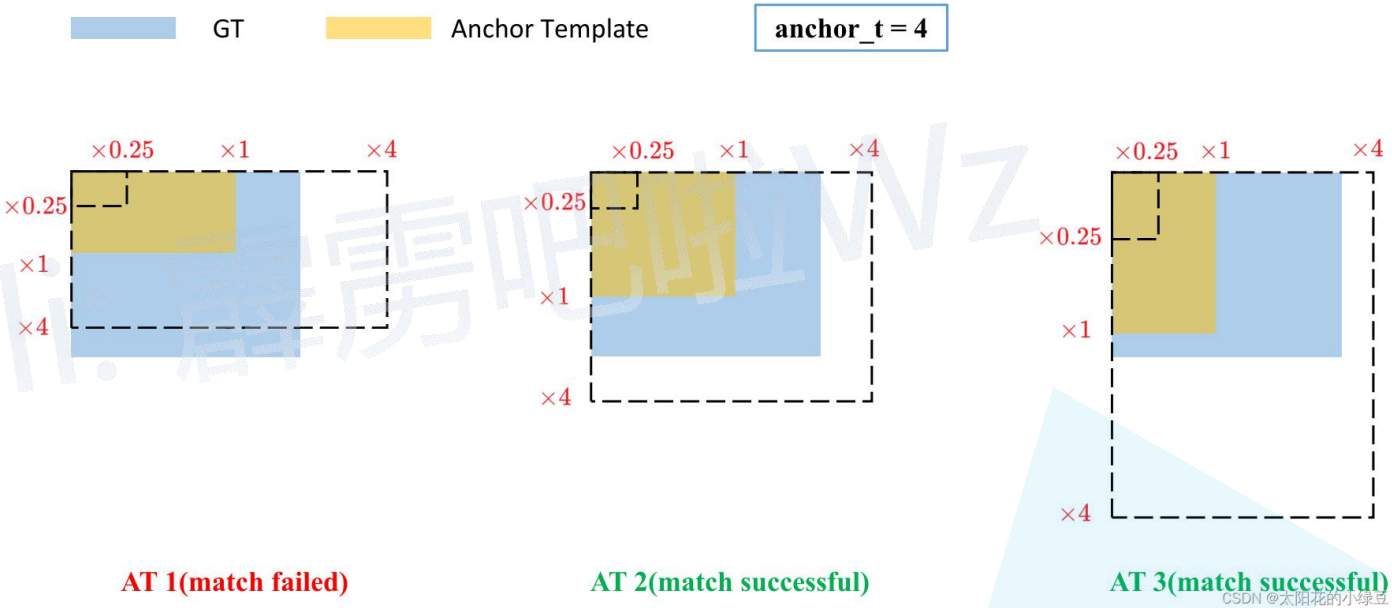
$$r_w = w_{gt} / w_{at}$$

$$r_h = h_{gt} / h_{at}$$

$$r_w^{\max} = \max(r_w, 1/r_w)$$

$$r_h^{\max} = \max(r_h, 1/r_h)$$

$$r^{\max} = \max(r_w^{\max}, r_h^{\max})$$



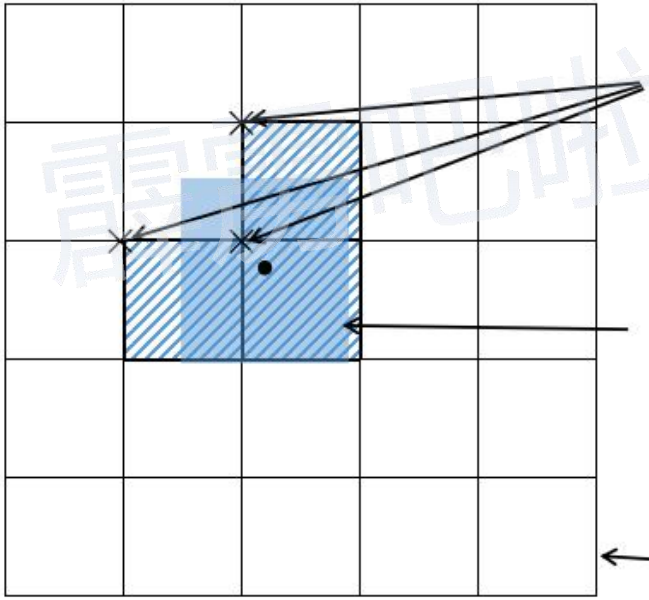
YOLO V5

匹配正样本

Anchor Template

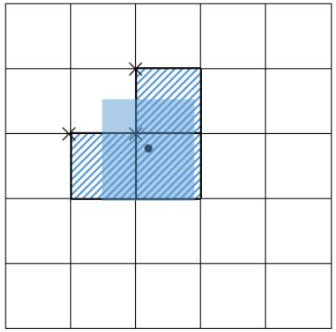
AT 2(match successful)

AT 3(match successful)



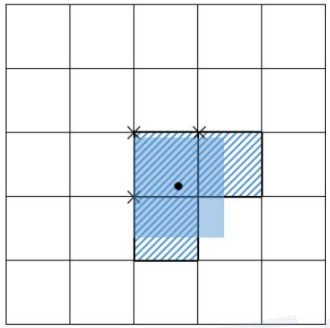
YOLO V5

匹配正样本



$GT_x^{center} \% 1 < 0.5$

$GT_y^{center} \% 1 < 0.5$



$GT_x^{center} \% 1 > 0.5$

$GT_y^{center} \% 1 > 0.5$

GT Boxes

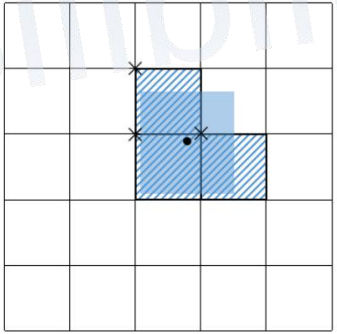
Center of GT Boxes

Grid Cell

Upper Left Corner of Grid

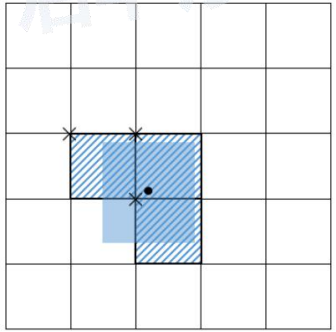
In Cell, Anchor as Positive Sample

Meet (ratio < Anchor_t)



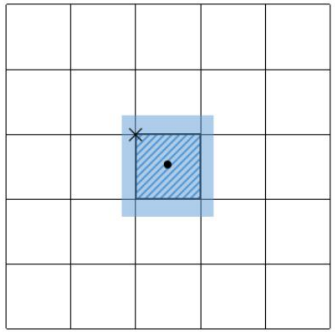
$GT_x^{center} \% 1 > 0.5$

$GT_y^{center} \% 1 < 0.5$



$GT_x^{center} \% 1 < 0.5$

$GT_y^{center} \% 1 > 0.5$



$GT_x^{center} \% 1 == 0.5$

$GT_y^{center} \% 1 == 0.5$