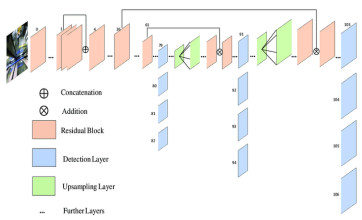
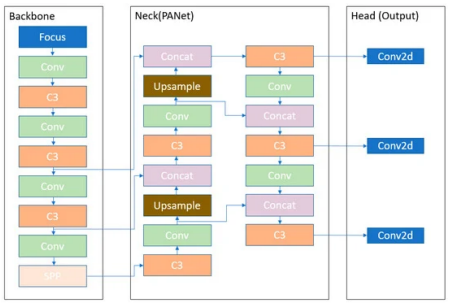
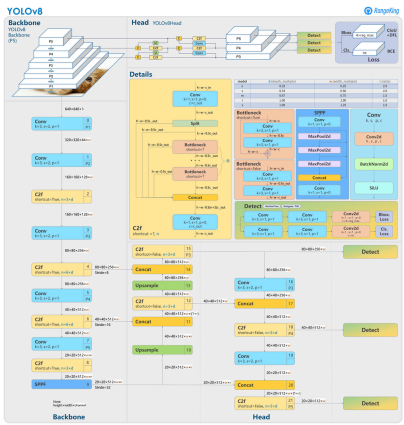
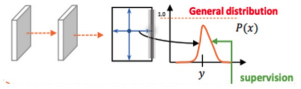
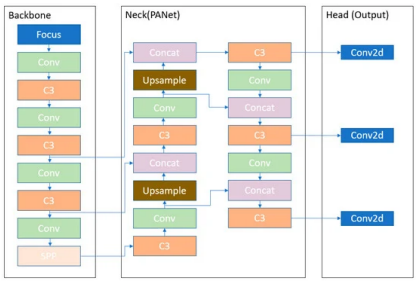
Compare three different Yolo Versions V3, V5, and the latest version:

Models	**YOLOv3**	**YOLOv5**	**Latest YOLOv.**
[5 pt] Comparison between these Models.			
Deploying year	**2018**	**2020**	**Jan. 2023**
Architecture			
Prediction scales	**YOLOv3u makes predictions at three different scales with strides 32, 16, and 8. Then, it combines the results to get the final detection.**	**YOLOV5n makes a four-scale prediction head. It is modified to capture objects with a large-scale variation. An additional prediction scale is added to the prediction head of the proposed detection model.**	**YOLOv8n predict mode can generate predictions for various tasks, returning either a list of Results objects or a memory-efficient generator of Results objects when using the streaming mode.**

Number of Anchors	**YOLOv3u in particular has 3 anchors.**	**YOLOv5n has 9 anchor boxes and the number of clusters is 9.**	**YOLOv8n is an anchor-free model. This means it predicts directly the center of an object instead of the offset from a known anchor box.**
Number of params	**YOLOv3u has 8,861,918 learnable parameters and 13 Convolution layers.**	**YOLOv5n model has 1.9 million different parameters**	**YOLOv8n has nearly 5 million parameters.**
Loss Function	$\lambda_{\text{coord}} \sum_{i=0}^{S^2} \sum_{j=0}^{B} \mathbb{1}_{ij}^{\text{obj}} \left[(x_i - \hat{x}_i)^2 + (y_i - \hat{y}_i)^2 \right]$ $+ \lambda_{\text{coord}} \sum_{i=0}^{S^2} \sum_{j=0}^{B} \mathbb{1}_{ij}^{\text{obj}} \left[\left(\sqrt{w_i} - \sqrt{\hat{w}_i} \right)^2 + \left(\sqrt{h_i} - \sqrt{\hat{h}_i} \right)^2 \right]$ $+ \sum_{i=0}^{S^2} \sum_{j=0}^{B} \mathbb{1}_{ij}^{\text{obj}} \left(C_i - \hat{C}_i \right)^2$ $+ \lambda_{\text{noobj}} \sum_{i=0}^{S^2} \sum_{j=0}^{B} \mathbb{1}_{ij}^{\text{noobj}} \left(C_i - \hat{C}_i \right)^2$ $+ \sum_{i=0}^{S^2} \mathbb{1}_{i}^{\text{obj}} \sum_{c \in \text{classes}} (p_i(c) - \hat{p}_i(c))^2$	$LOSS = L_{classification} + L_{confidence} + L_{CIoU}$ $L_{classification} = \sum_{i=0}^{s^2} \ell_i^{obj} \sum_{j=0}^{B} \left[\left(p_i(c) - \hat{p_i}(c) \right)^2 \right]$ $L_{confidence} = \sum_{i=0}^{s^2} \sum_{j=0}^{B} \ell_i^{obj} \left[\left(C_i - \hat{C_i} \right)^2 \right] + \lambda_{noobj}$ $\sum_{i=0}^{s^2} \sum_{j=0}^{B} \ell_i^{noobj} \left[\left(C_i - \hat{C_i} \right)^2 \right]$	**YOLOv8n uses VFL Loss as classification loss and DFL Loss+CIOU Loss as classification loss.** $\text{VFL}(p, q) = \begin{cases} -q(q\log(p) + (1-q)\log(1-p)) & q > 0 \\ -\alpha p^{\gamma} \log(1-p) & q = 0, \end{cases}$  $\text{DFL}(S_i, S_{i+1}) = -((y_{i+1} - y)\log(S_i) + (y - y_i)\log(S_{i+1}))$.
[5 pt]Test video on the previous models.			
Number of objects	**2614**	**2272**	**2483**
speed(Detection Time) **Cpu**	**597224.87 msec = 597 sec**	**26018.24 msec = 26 sec**	**28207.86 msec = 28 sec**
[2 pt] Bonus: Repeat the comparison for the next models.			

Models	**yolov5n**	**yolov5s**	**yolov5m**	**yolov5l**	**yolov5x**

Deploying year	**2020**				
Architecture					
Prediction scales	**YOLOV5 makes a four-scale prediction head. It is modified to capture objects with a large-scale variation. An additional prediction scale is added to the prediction head of the proposed detection model.**				
Number of Anchors	**YOLOv5n has 9 anchor boxes and the number of clusters is 9.**				
Number of params	**YOLOv5n model has 1.9 million different parameters.**	**YOLOv5s model has 7.2 million different parameters.**	**YOLOv5m model has 21.2 million different parameters.**	**YOLOv5l model has 46.5 million different parameters.**	**YOLOv5x model has 86.7 million different parameters**

Loss Function	$$LOSS = L_{classification} + L_{confidence} + L_{CIoU}$$ $$L_{classification} = \sum_{i=0}^{s^2} \ell_i^{obj} \sum_{j=0}^{B} \left[\left(p_i(c) - \hat{p_i}(c) \right)^2 \right]$$ $$L_{confidence} = \sum_{i=0}^{s^2} \sum_{j=0}^{B} \ell_i^{obj} \left[\left(C_i - \hat{C_i} \right)^2 \right] + \lambda_{noobj} \sum_{i=0}^{s^2} \sum_{j=0}^{B} \ell_i^{noobj} \left[\left(C_i - \hat{C_i} \right)^2 \right]$$				
Test video on the previous models.					
Number of objects	**2272**	**2428**	**2583**	**2668**	**2719**
speed(Detection Time) **Cpu**	**26217.75 msec** **= 26 sec**	**63514.08 msec** **= 63 sec**	**154673.03 msec** **= 154 sec**	**300879.21 msec** **= 300 sec**	**535098.98 msec** **= 535 sec**

Assumptions:

For the comparison, I have used Yolo 3u, 5n, and 8n.

Referefneece:

[1] https://blog.roboflow.com/yolov5-improvements-and-evaluation/
[2] https://blog.roboflow.com/whats-new-in-yolov8/
[3]https://www.mdpi.com/2077-1312/10/9/1230#:~:text=To%20suppress%20the%20effect%20of,of%20the%20proposed%20detection%20model.
[4]https://www.coursera.org/learn/programming-languages?fbclid=IwAR1ao8Y4y6DIiZRQziiU_nX_XRVt6qQdkfcLGNP3Qicp9uGq2ICYJkg5Ulo
[5] https://blog.csdn.net/qq_29788741/article/details/128626422
[6] https://github.com/ultralytics/yolov5