

# Measuring YOLOv8 Performance on Diverse Object Detection Datasets

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Faculty of Mathematics and Computer Science  
Babeș-Bolyai University



Advanced Methods in Data Analysis  
Research Report 1

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Group: 246 / 2

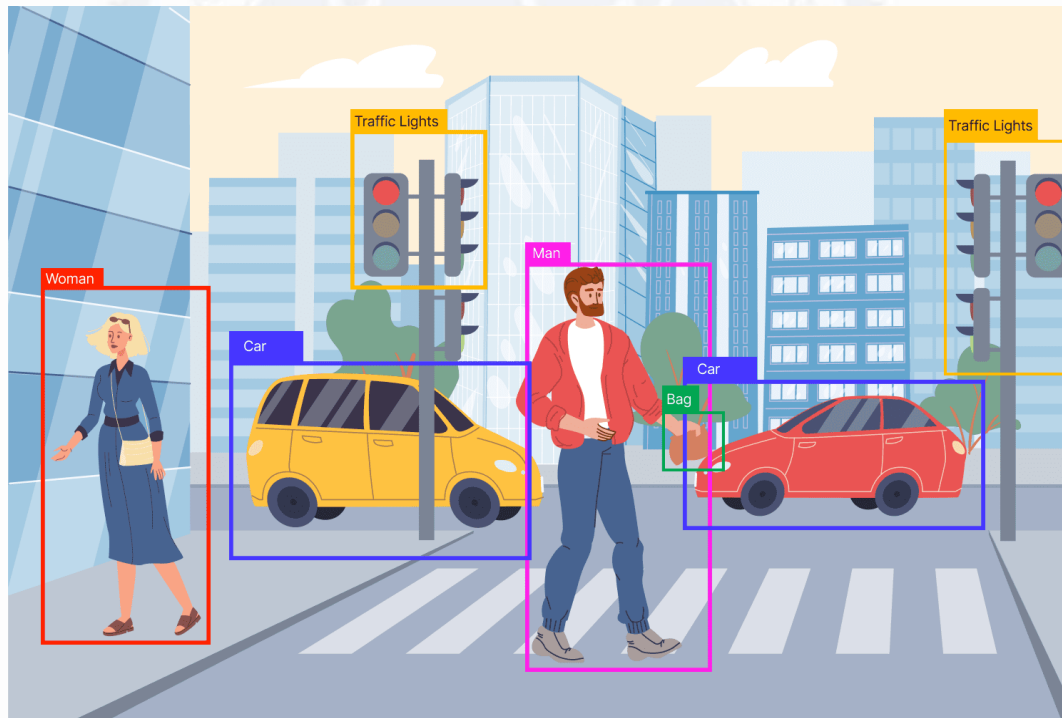
# Content

1. Introduction to Object Detection & YOLO
2. Preprocessing & Evaluation
3. SkyFusion: Aerial Objects Detection
4. Traffic Signs Detection
5. Multilabel Fruits Detection
6. Datasets comparison
7. Conclusion & Future Work

# Object Detection

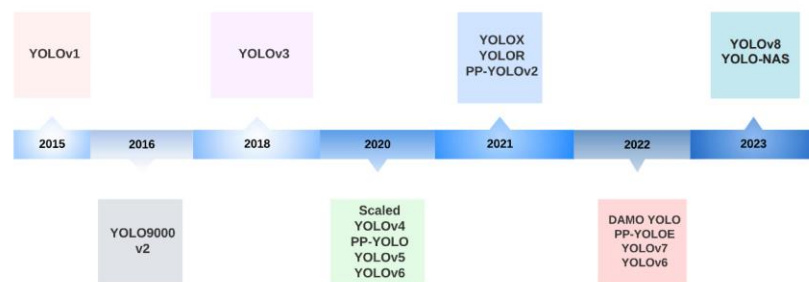
Computer Vision task that solves 2 problems:

1. **Localize** objects in a frame.
2. **Classify** objects in a frame.



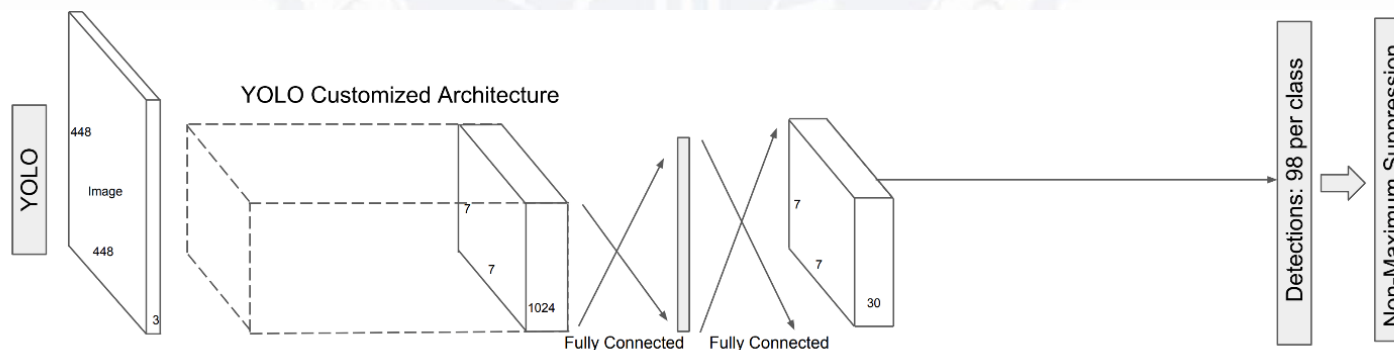
# YOLO (You Only Look Once)

- Real time Deep Object Detection Model.
- CNN that predicts:
  - position of the bounding box (regression)
  - size of the bounding box (regression)
  - class of a bounding box (classification)
  - confidence of the bounding box (regression)
- Uses NMV to merge overlaying bounding boxes.



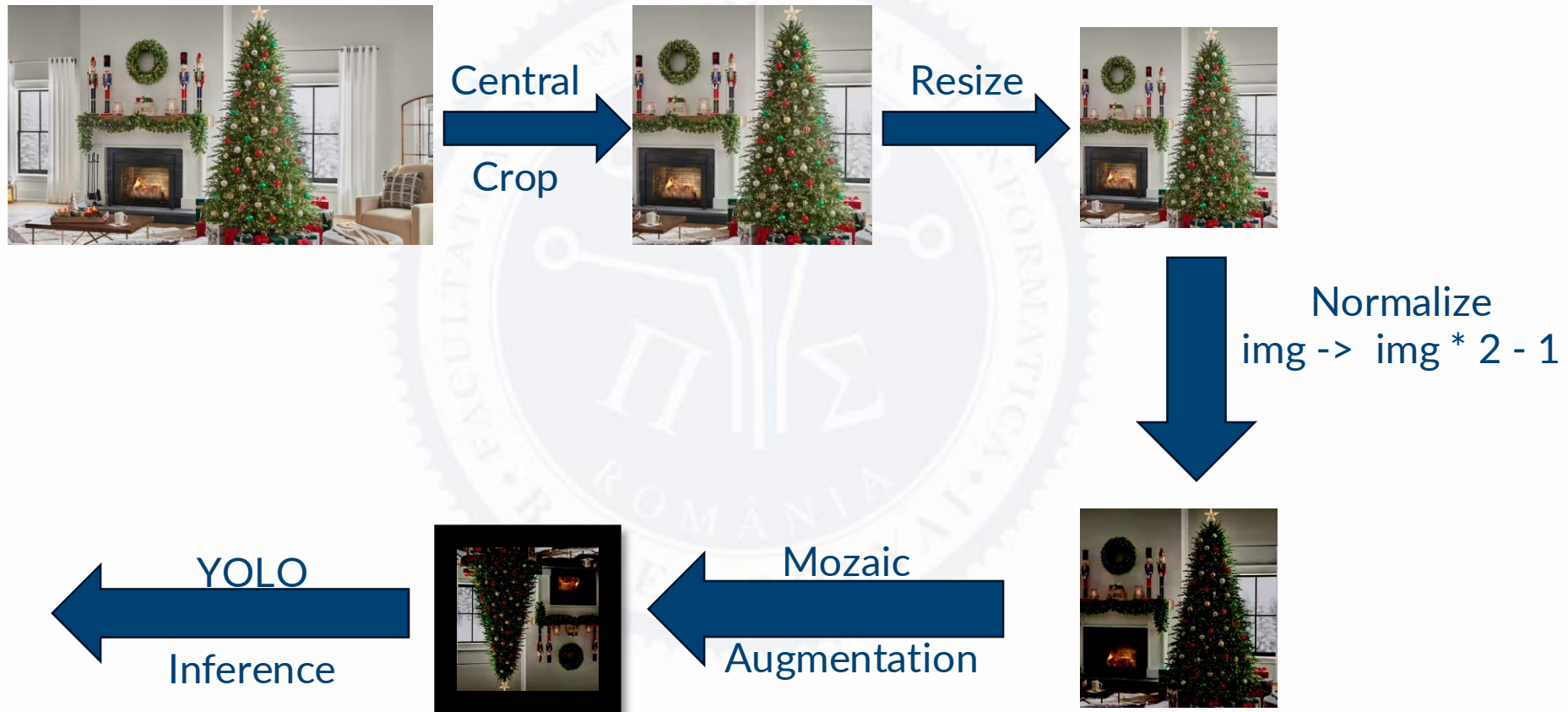
## YOLOv8

- Improved speed ←
- Improved accuracy ←
- Improved loss functions ←



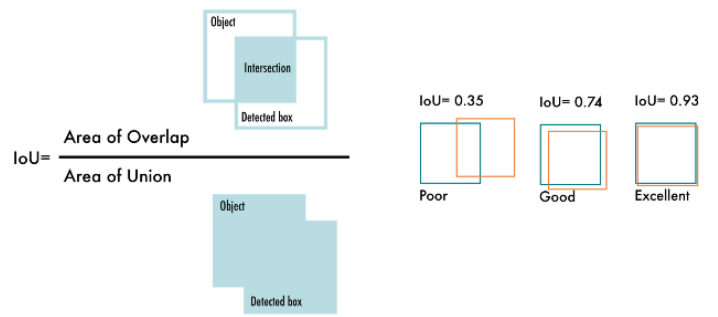


# Preprocessing



# Evaluation

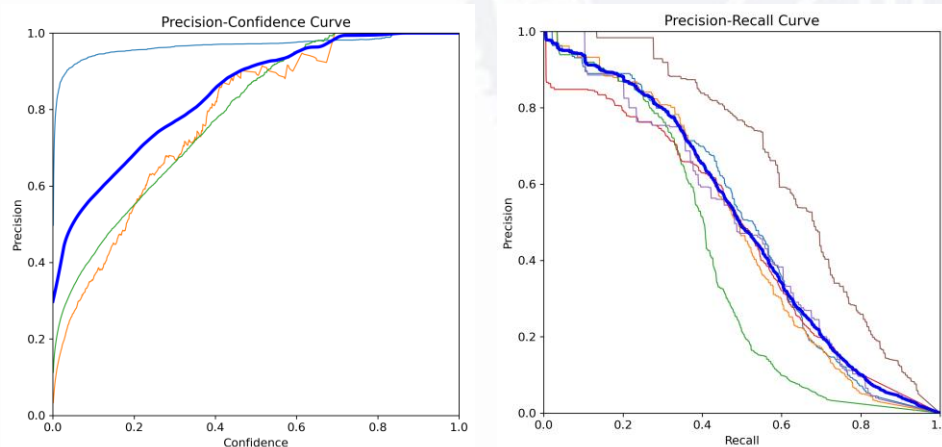
## 1. Intersection Over Union



## 2. Classification Metrics

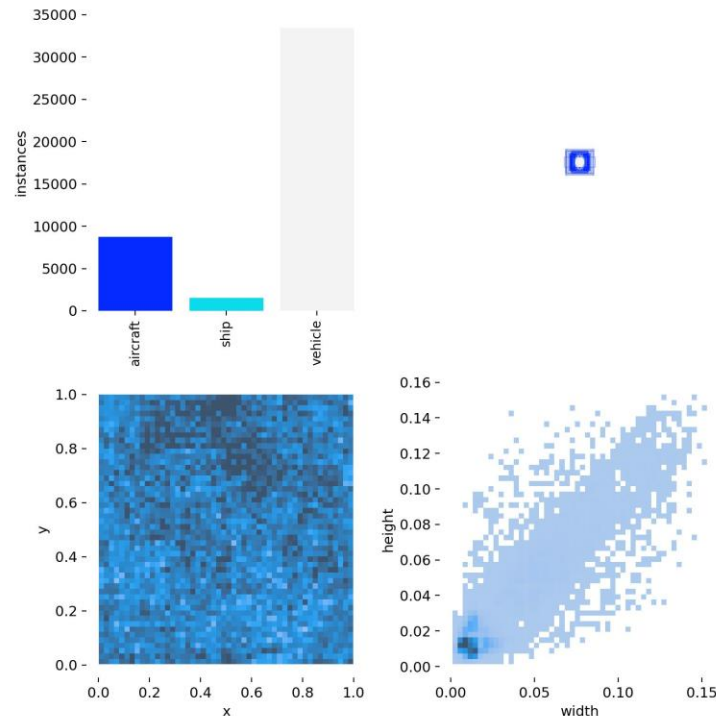
$$\begin{aligned} \text{precision} &= \frac{TP}{TP + FP} \\ \text{recall} &= \frac{TP}{TP + FN} \\ F1 &= \frac{2 \times \text{precision} \times \text{recall}}{\text{precision} + \text{recall}} \end{aligned}$$

## 3. Classification Curvers



## 4. Mean Pixel Accuracy

$$\int_0^1 \text{Precision}(r) dr,$$



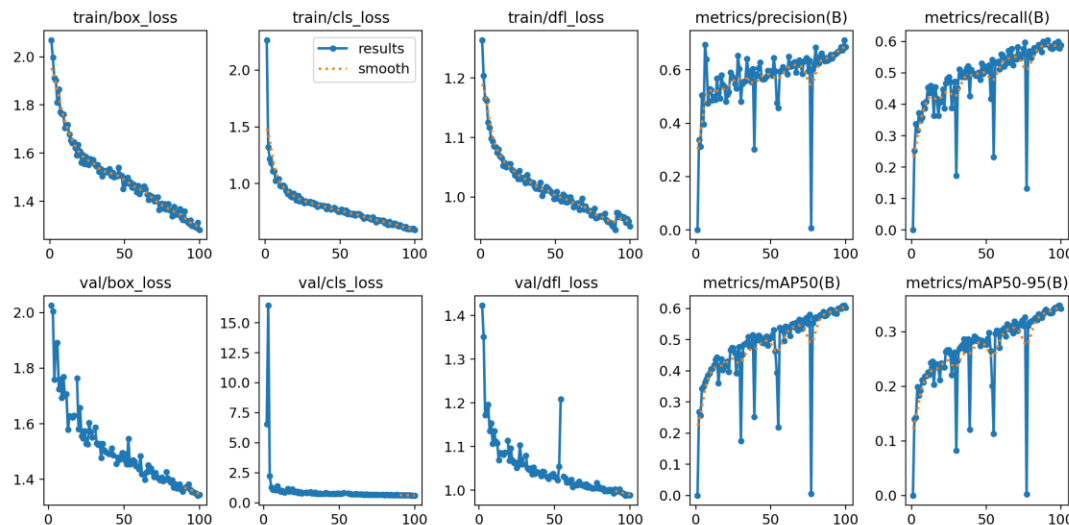
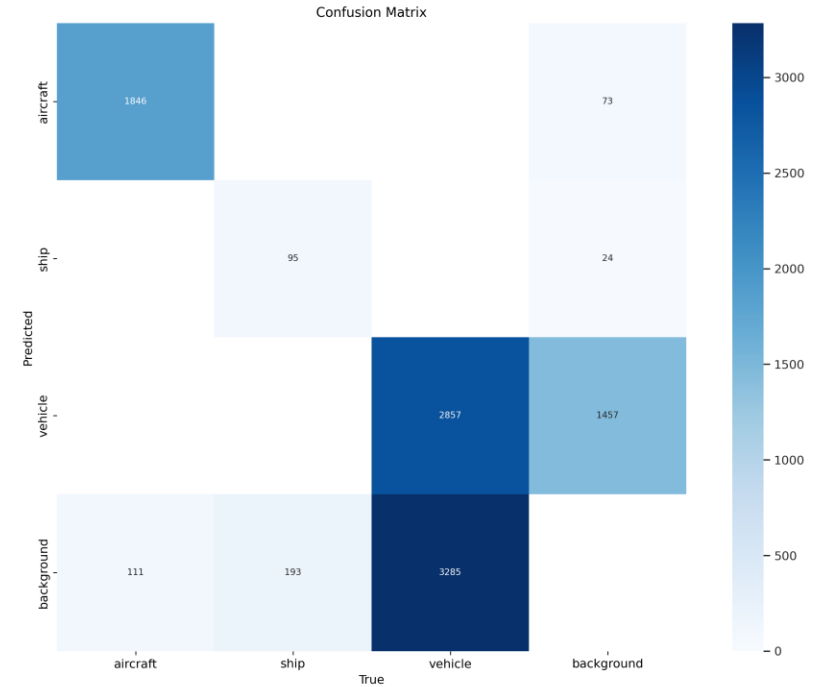


# SkyFusion: Aerial Objects Detection. Results

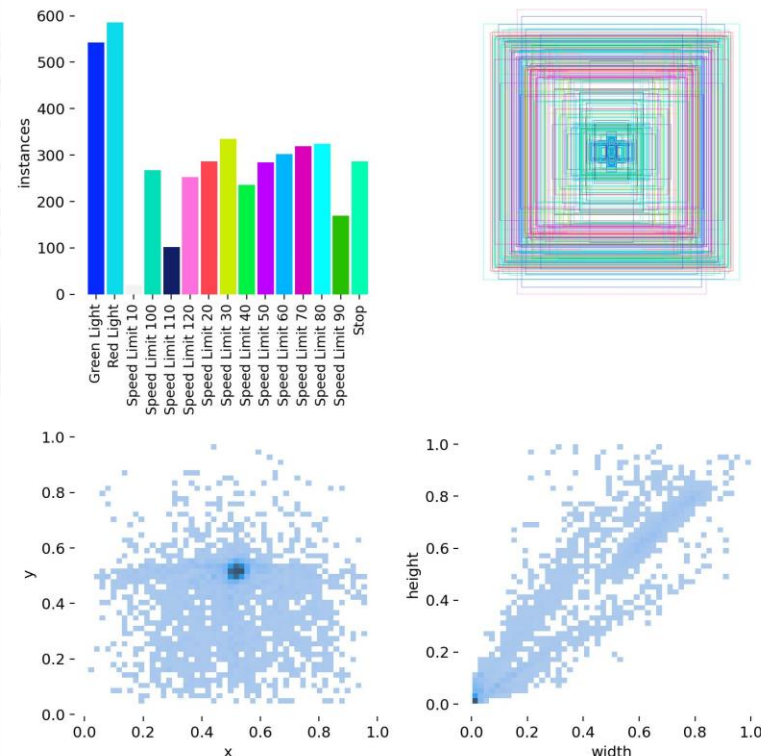




# SkyFusion: Aerial Objects Detection. Results



# Traffic Lights Detection. Analysis

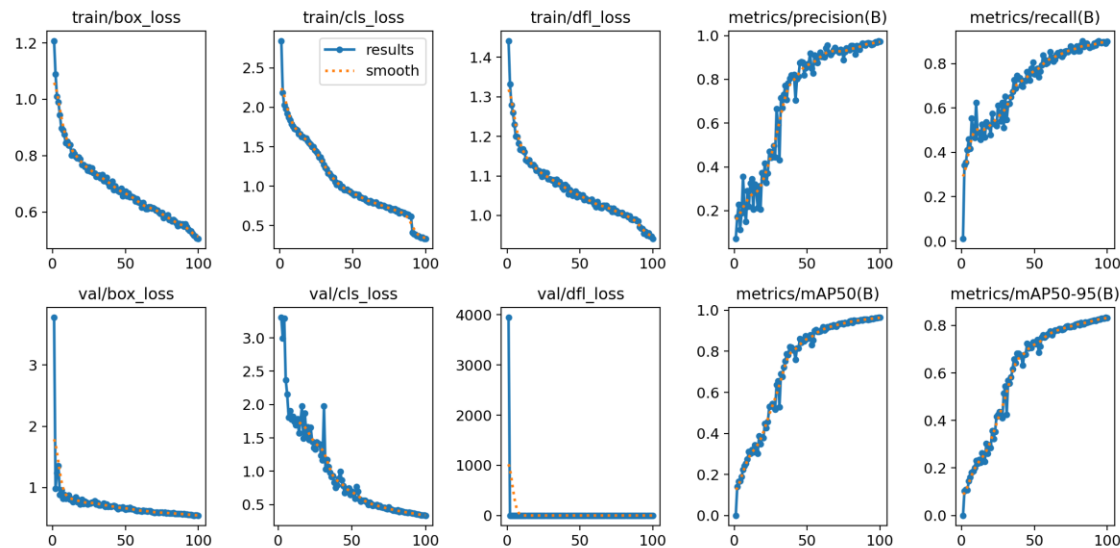
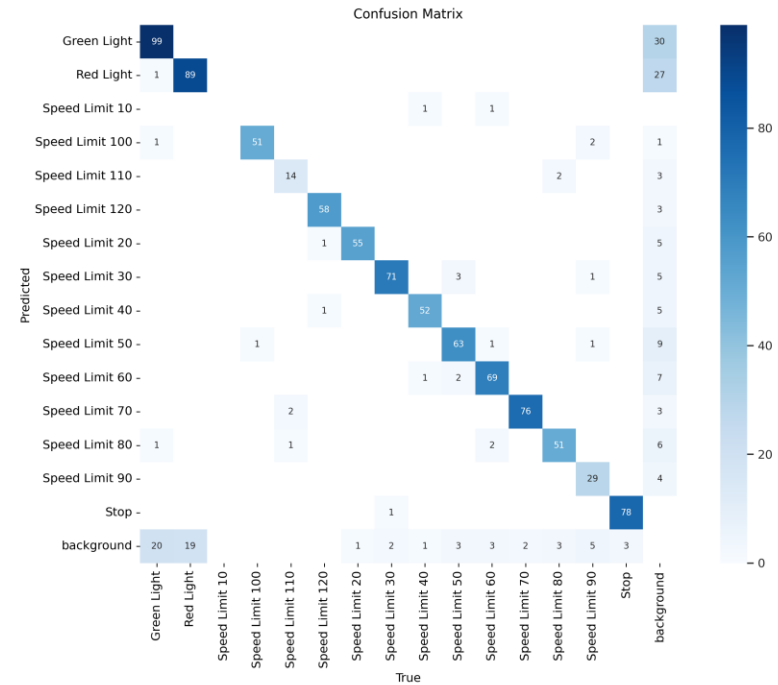


# Traffic Lights Detection. Results





# Traffic Lights Detection. Results



# Multilabel Fruits Detection. Analysis

Data point 12



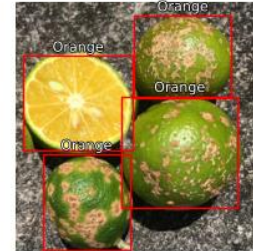
Data point 13



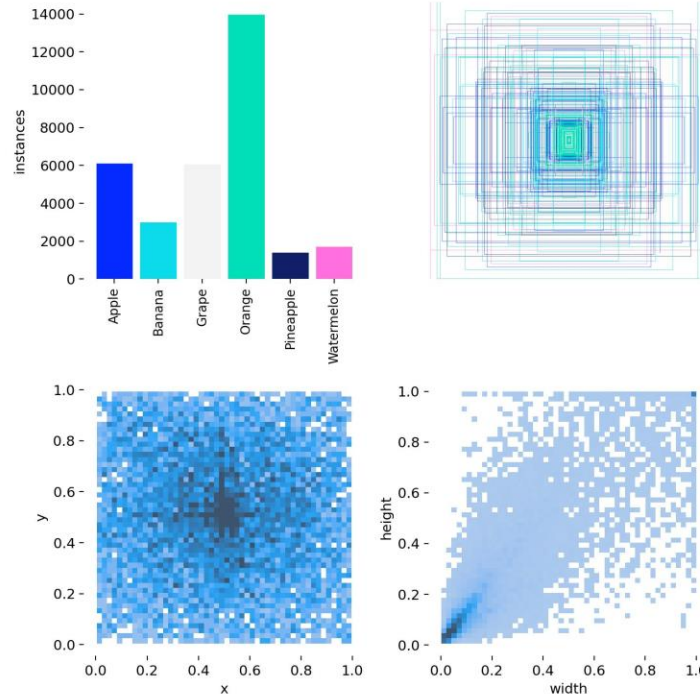
Data point 14



Data point 15

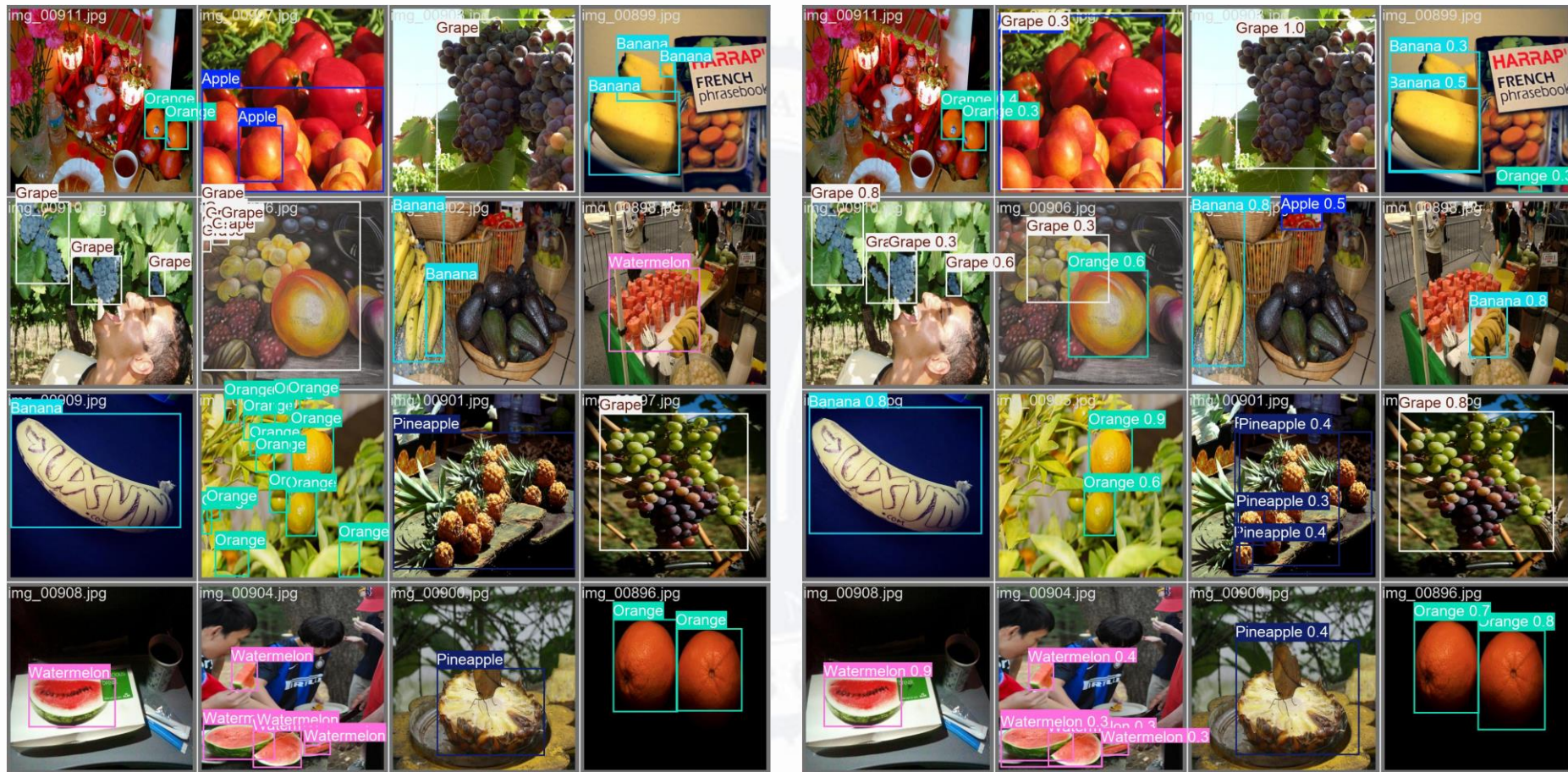


Data point 16



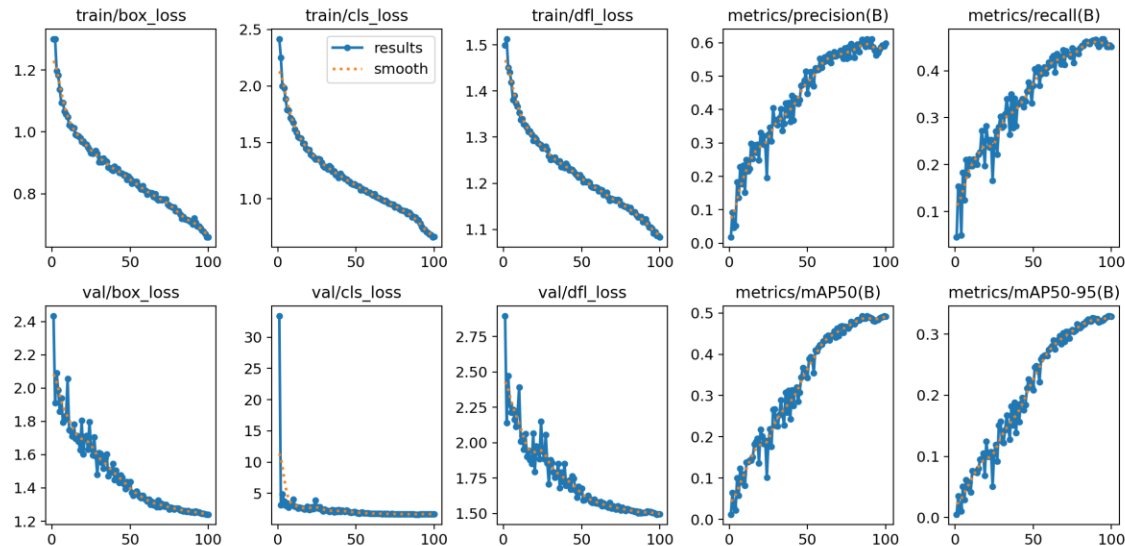
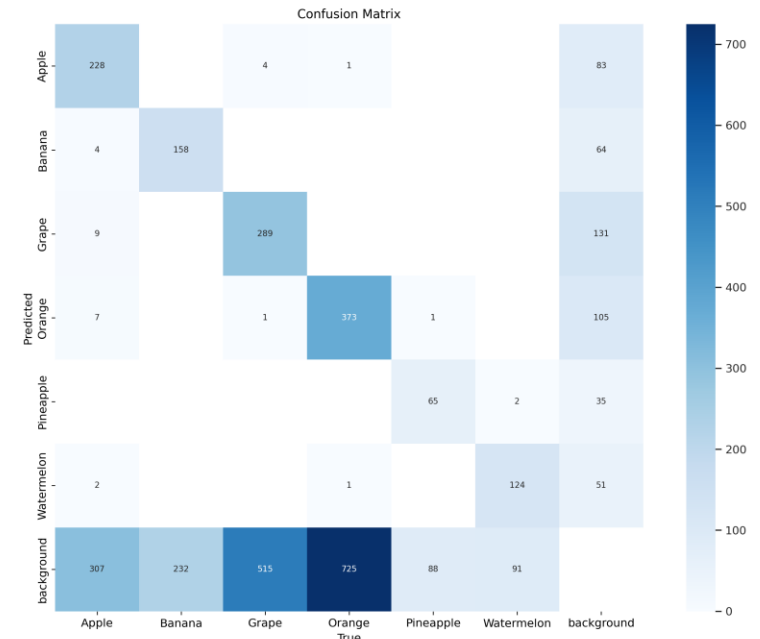


# Multilabel Fruits Detection. Results





# Multilabel Fruits Detection. Results



# Results comparison

Dataset	Classes	Training Samples	Validation Samples	Precision	Recall	mAP50	mAP50+90
SkyFusion	3	2094 (82.3%)	450 (17.7%)	0.686	0.588	0.601	0.342
Traffic Signs	15	3530 (81.5%)	801 (18.5%)	<b>0.972</b>	<b>0.899</b>	<b>0.965</b>	<b>0.832</b>
Fruits	6	7108 (88.6%)	914 (11.4%)	0.598	0.450	0.491	0.329

# Conclusions

- Performance varied across datasets
- Struggled with small objects
- Strong on balanced datasets
- Issues with class imbalance
- Challenges with similar classes

# Future Work

- Oversample underrepresented classes
- Improve tiny object detection
- Use advanced data augmentation





**Thank you for your attention!**

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# Bibliography

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