

MILHD

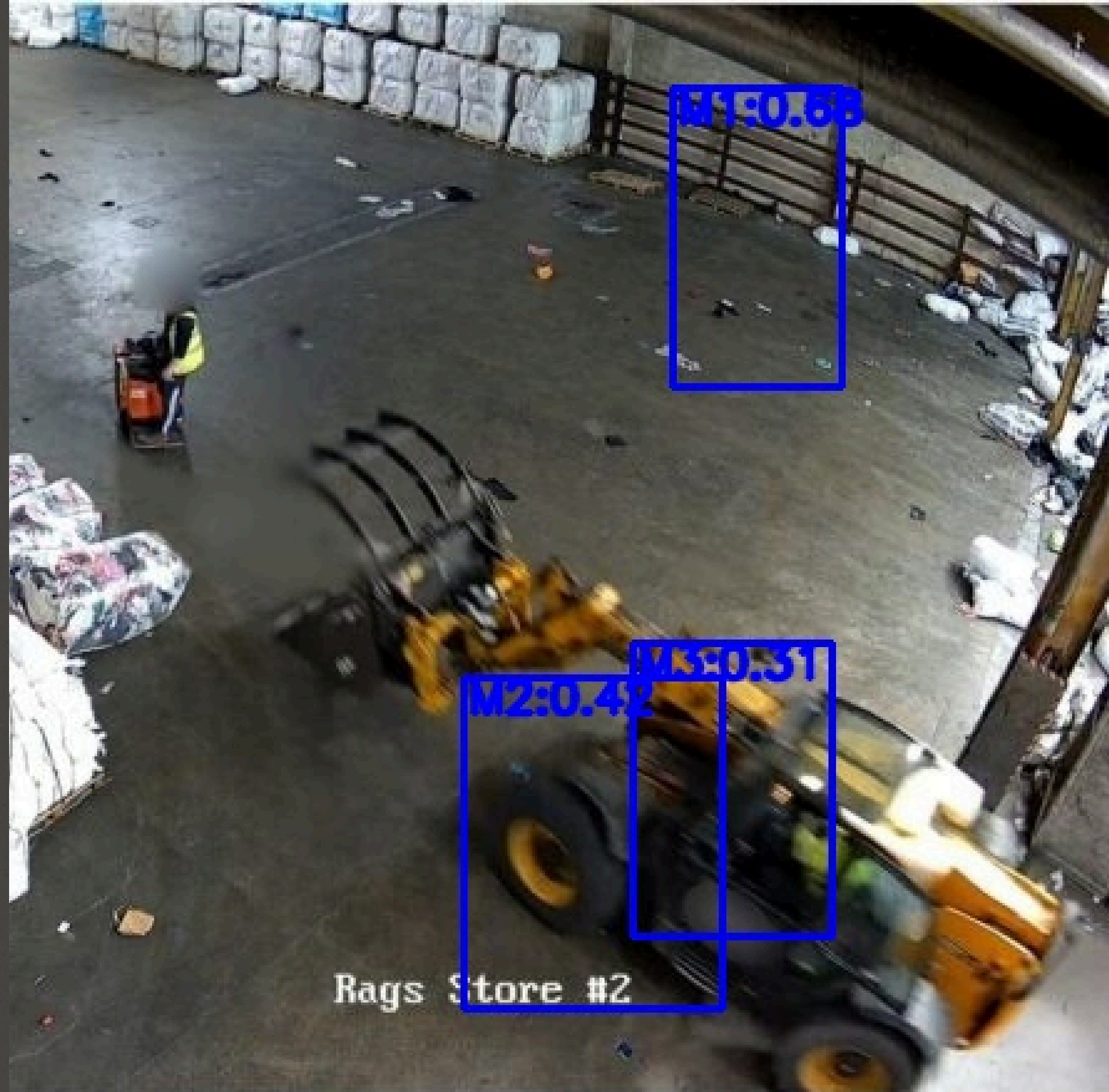
keeping workers safe

PRESENTED BY:
Daveed, Lucas, Darius

200,000 annual deaths

Problem

- CCTV footage rarely analyzed in real time
- Low light, low resolution, motion blur, occlusions
- General-purpose detectors fail in factory environment

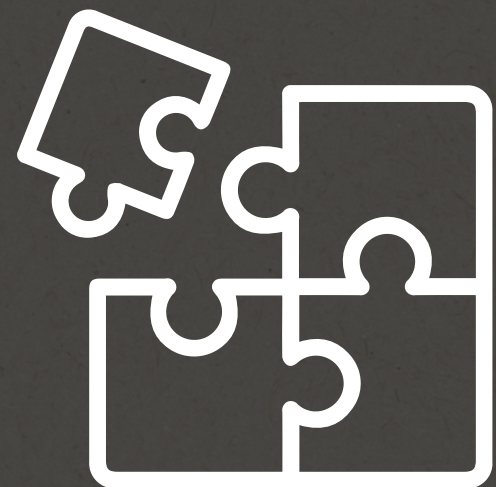
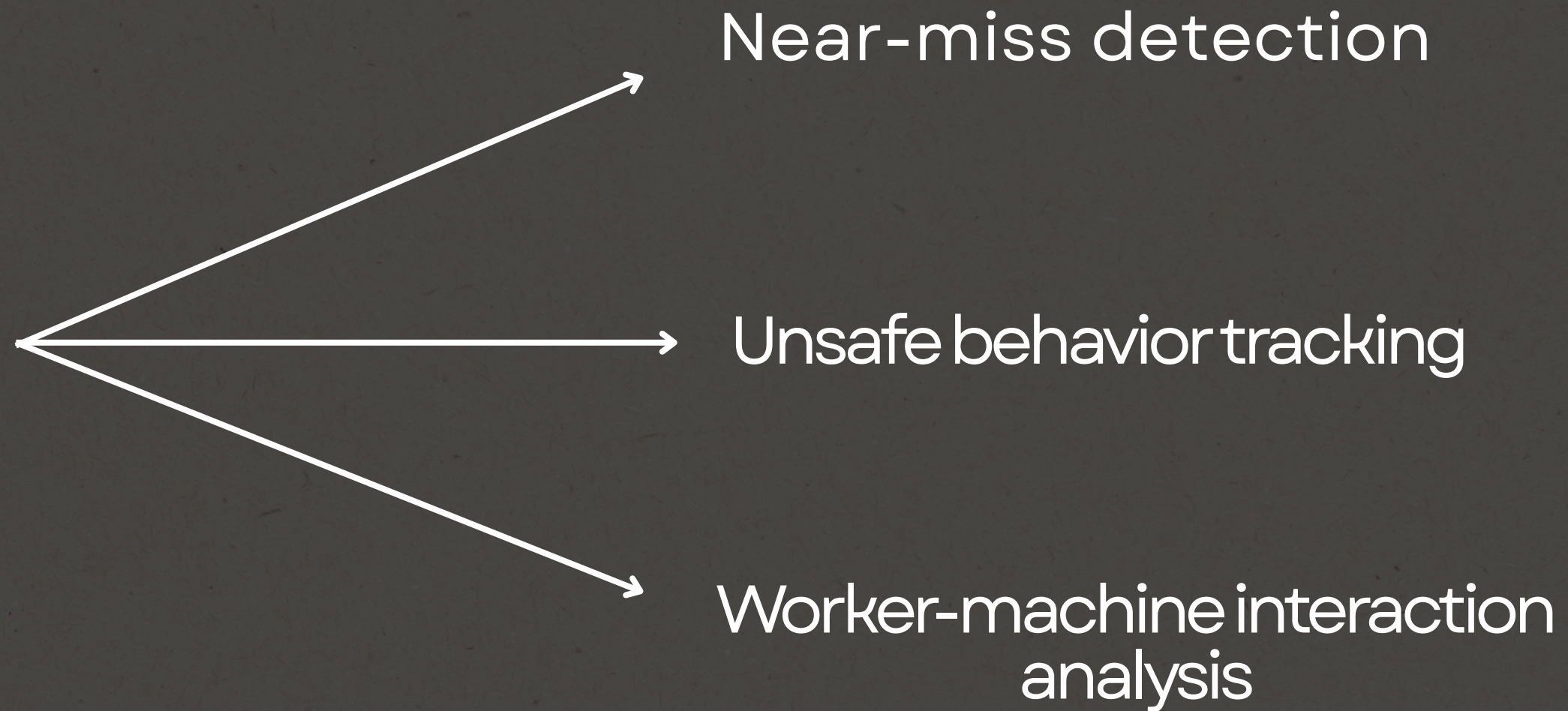


Proposal → MLHD

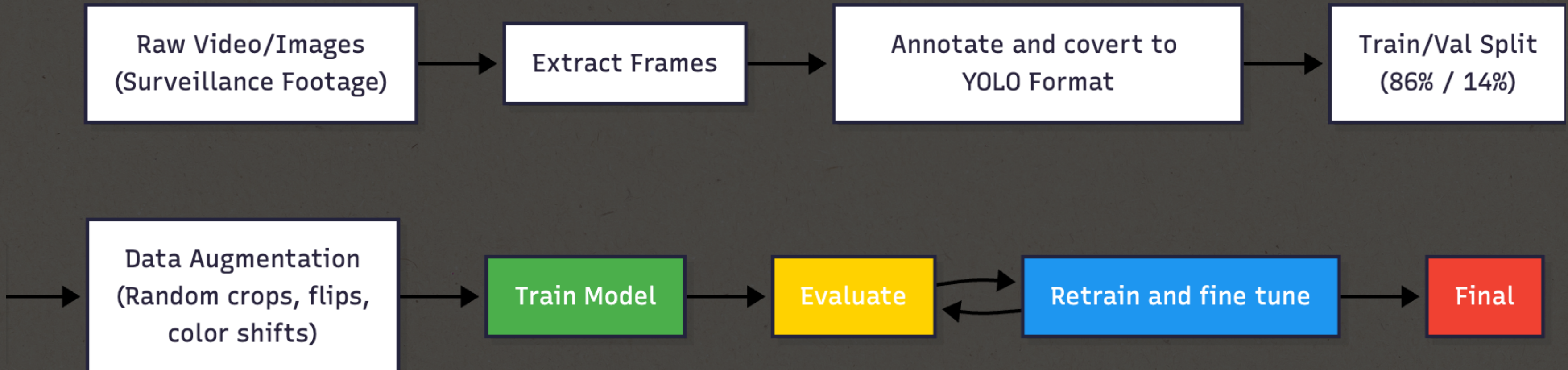
- Lightweight, domain-specific human detector
- Optimized for factory CCTV conditions
- Focused on locating people in frames

Why Human Detection?

MLHD



Pipeline

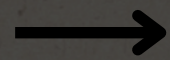


Data - Acquisition

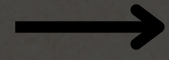


Data - Preprocessing

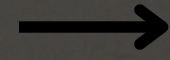
Augmentation



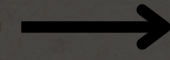
Letterbox-Resize



Normalize



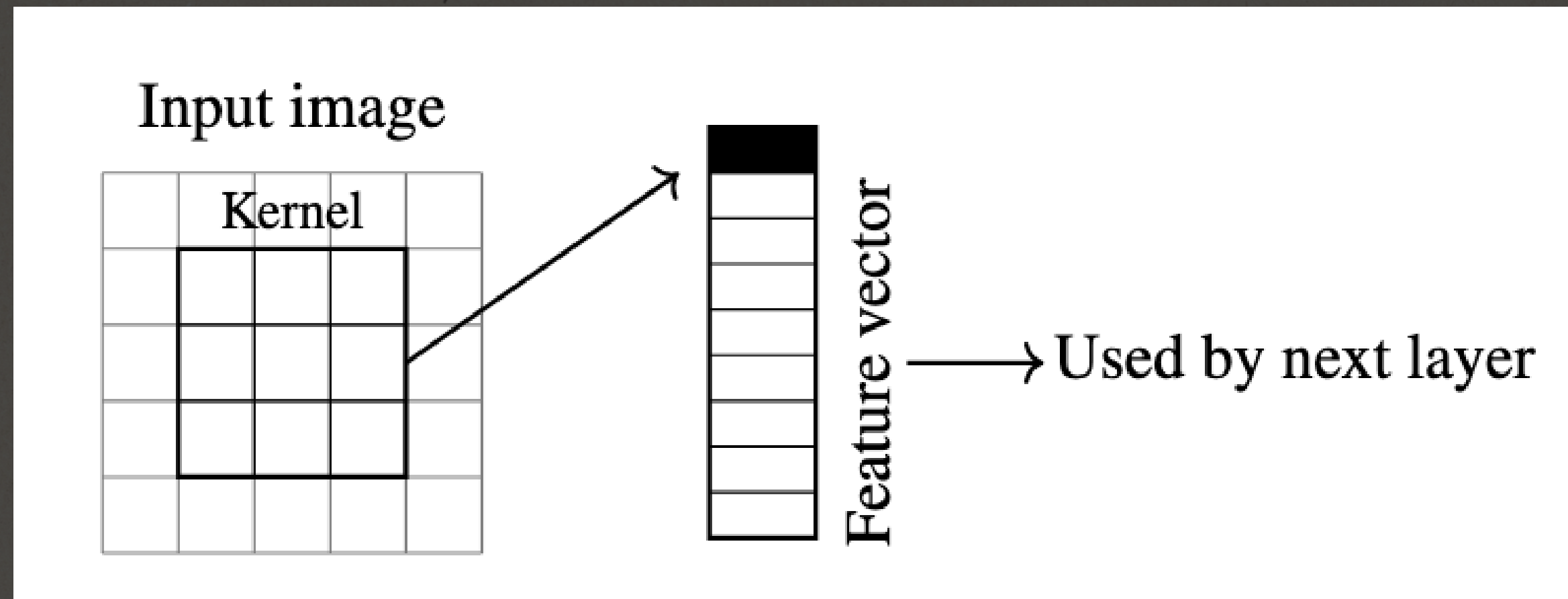
Target Encoding



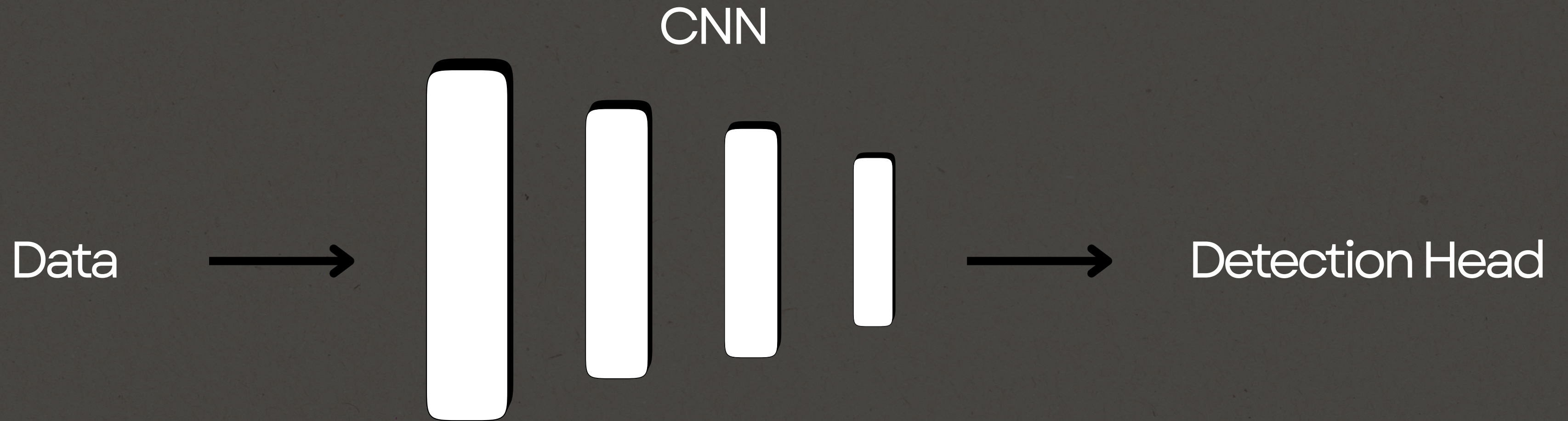
Batch Loading

What is a CNN?

CNN takes pixels → simple patterns → complex shapes → final prediction.

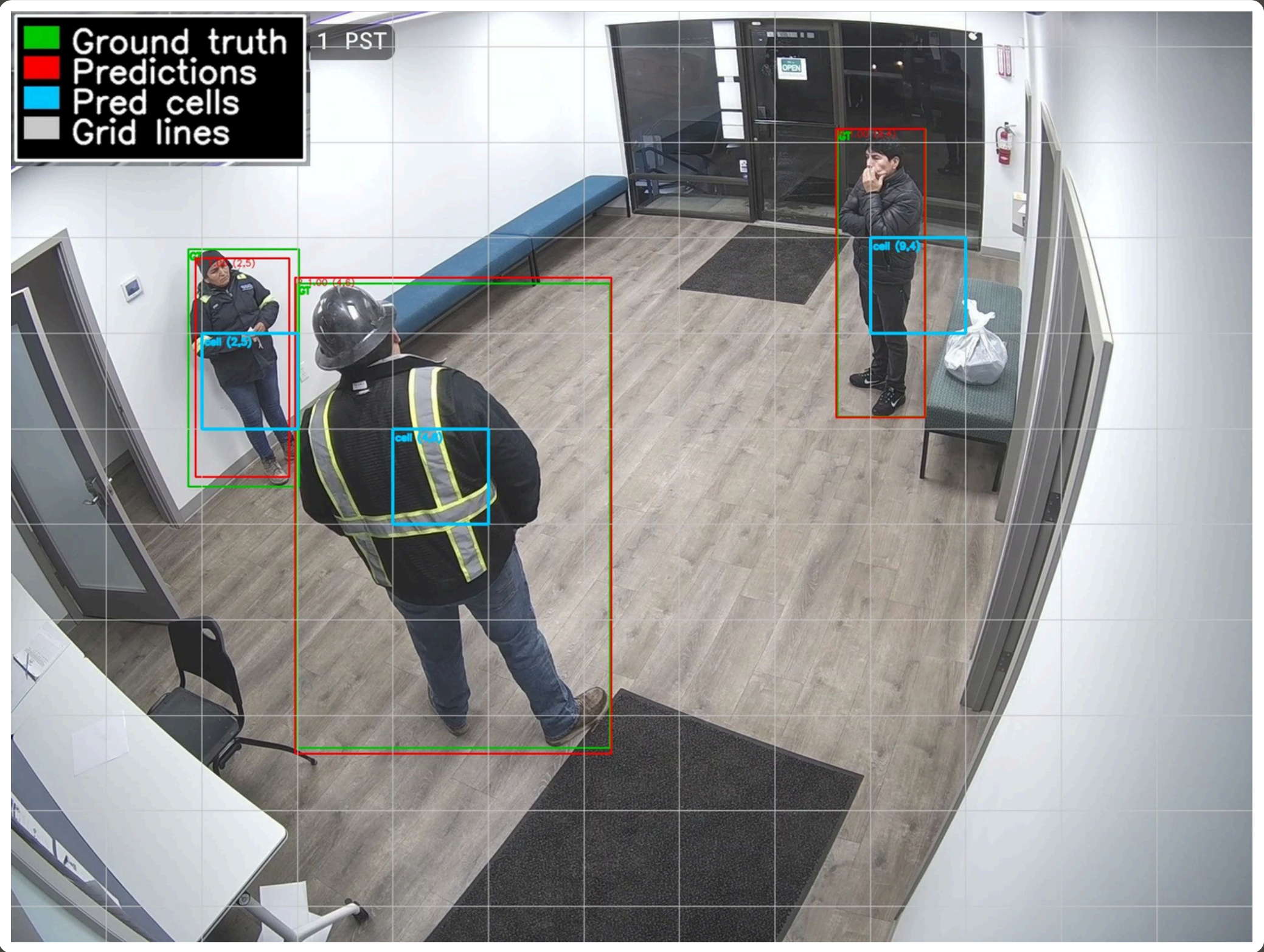


Model - Backbone



416 → 208 → 104 → 52 → 26 → 13

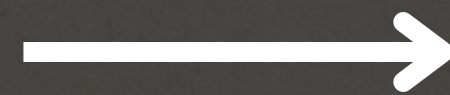
Model - Backbone



Model - Detection Head

[Feature Tensor]

(B, 13, 13, 512)



[$t_x, t_y, t_w, t_h, t_{\beta_j}$]

(B, 13, 13, 5)

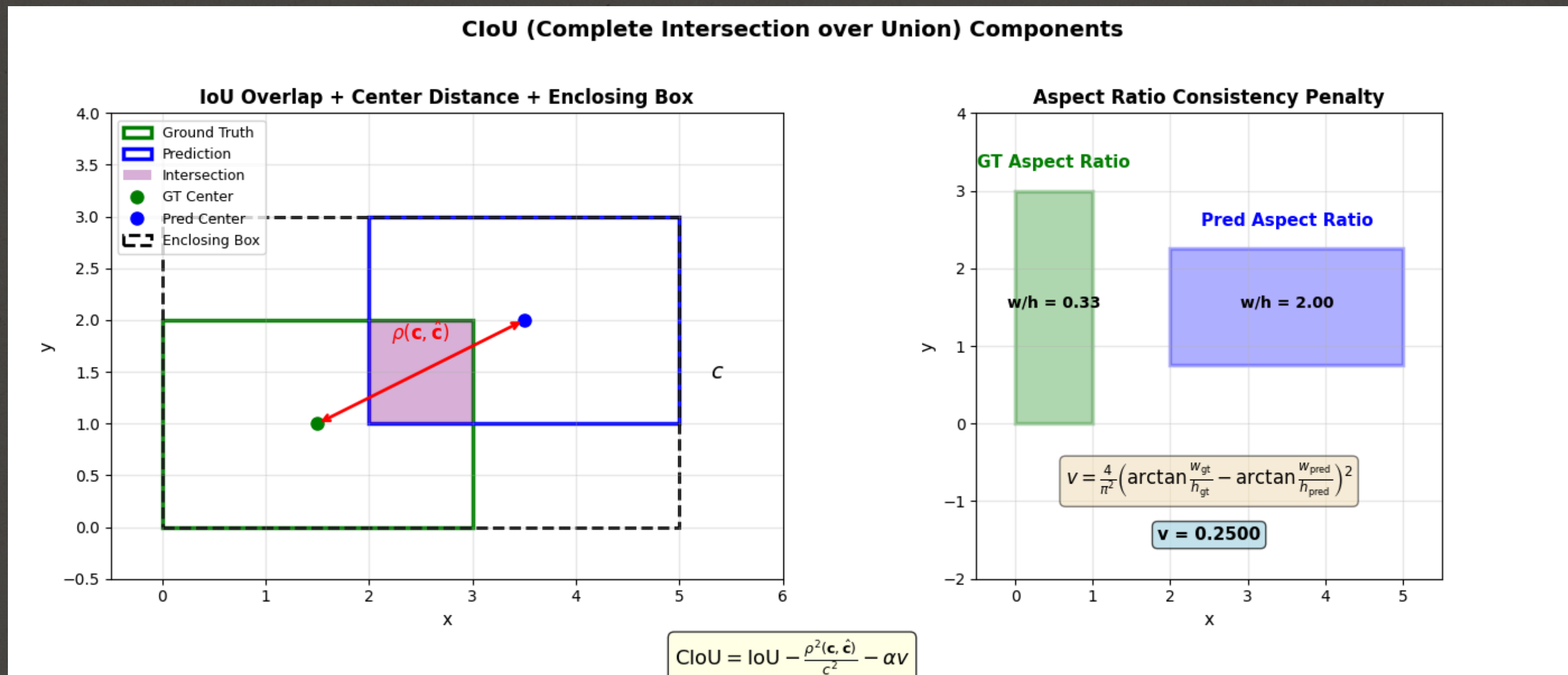
Model - Loss Function

CloU •-----• BCE

Overlap Quality

Center Distance Penalty

Aspect Ratio Penalty

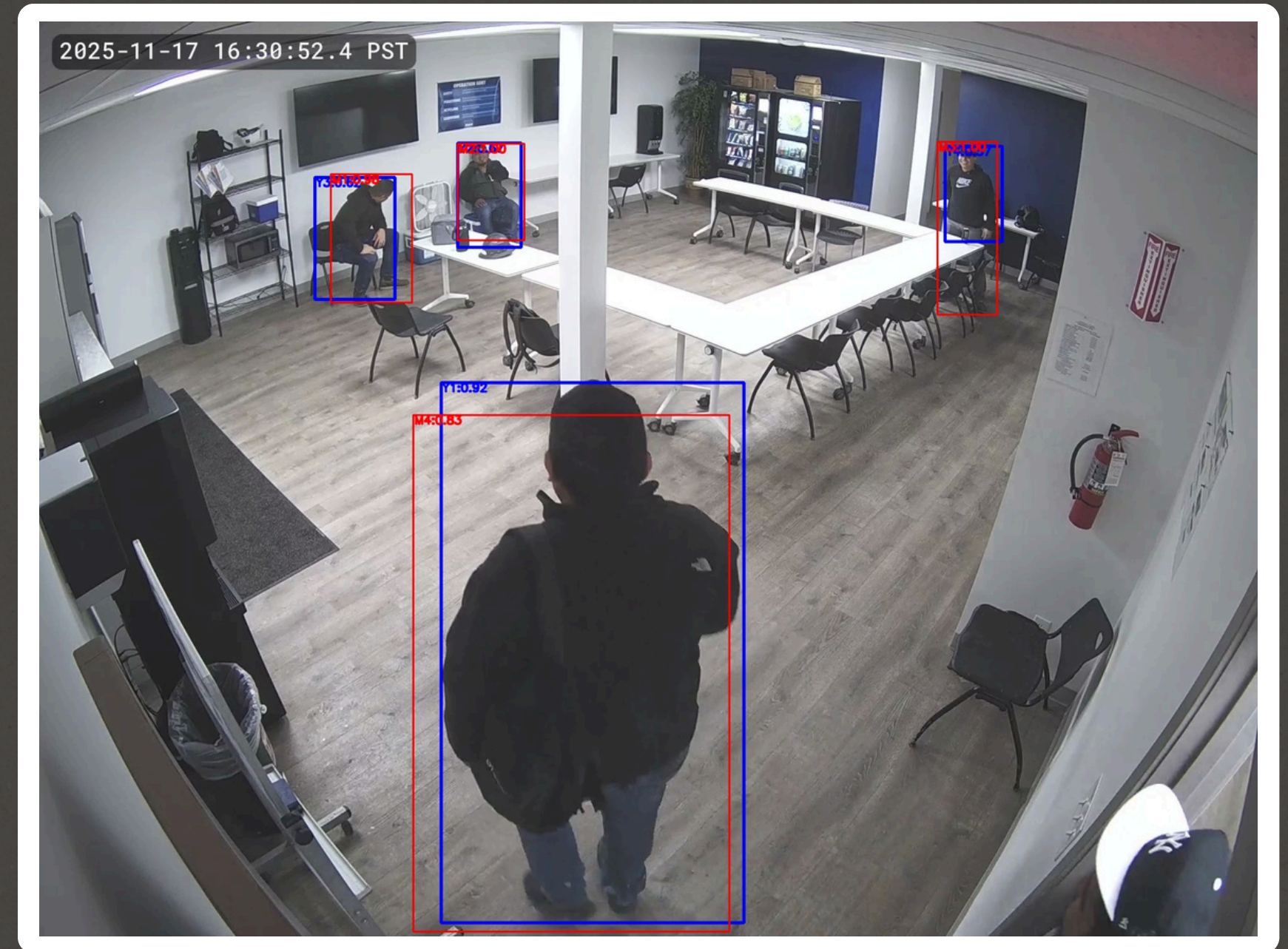


Training

- Larger dataset
- Grid size 26x26 → 13x13
- Weight for CloU = 7.5
- Weight for negative objectness = 0.7
- EPOCHS = 100
- Early stopping (patience = 7)

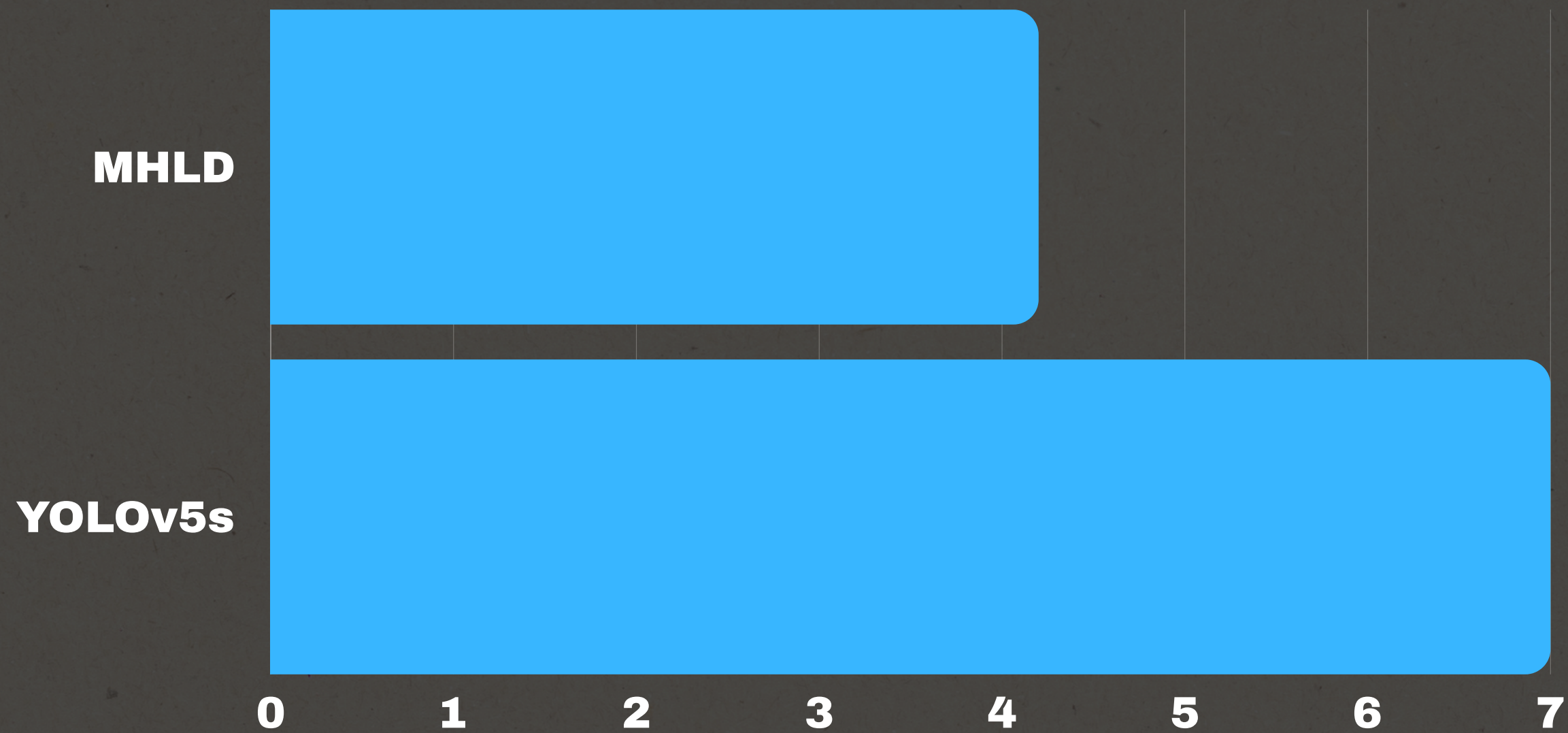
Results

Metric	IoU = 0.5	IoU = 0.85
Precision	0.962	0.490
Recall	0.915	0.466
mIoU	0.836	0.925
F1	0.938	0.478
AP	0.880	0.228

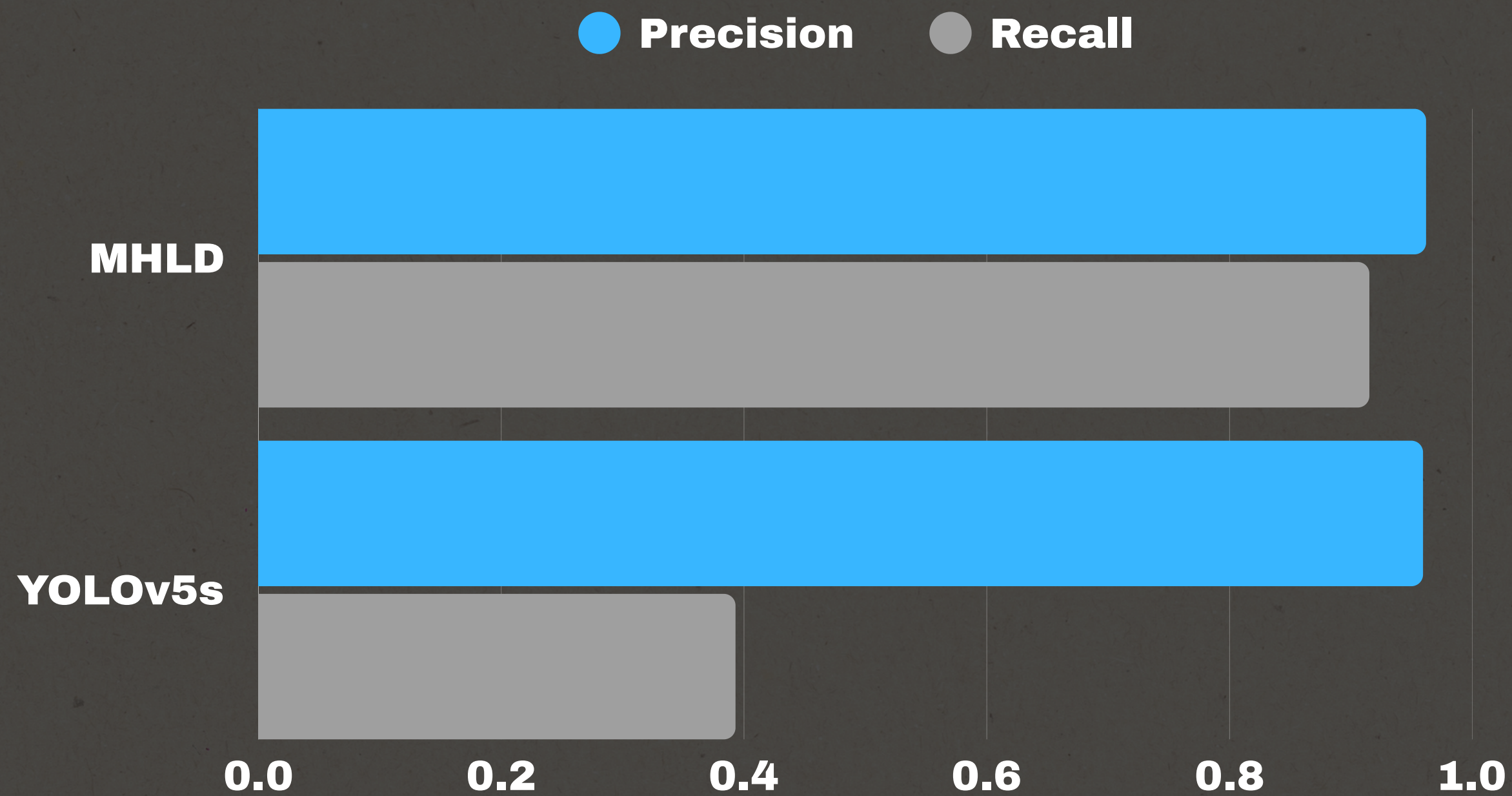


Comparison to YOLO Baseline

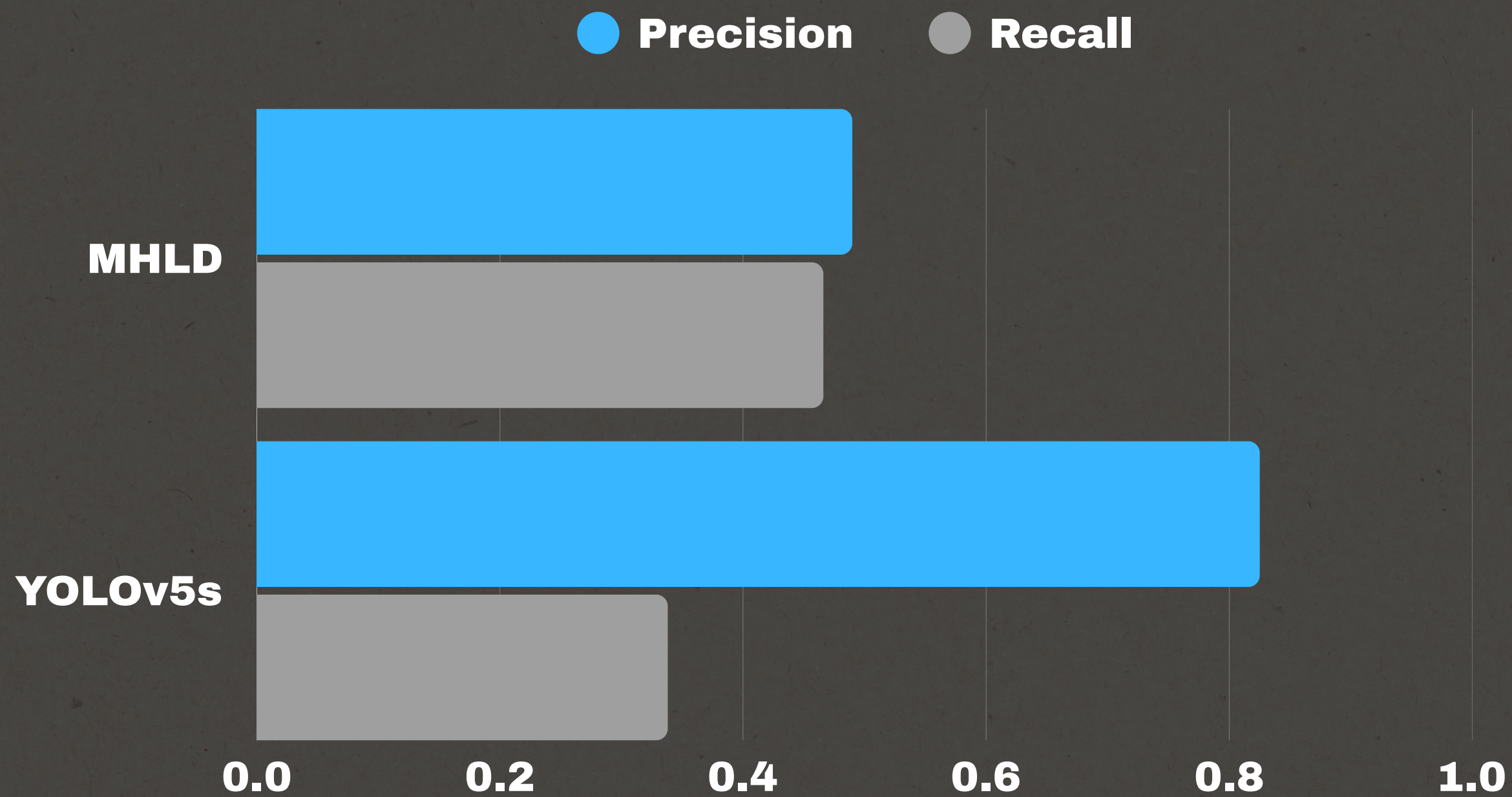
● Parameters (Millions)



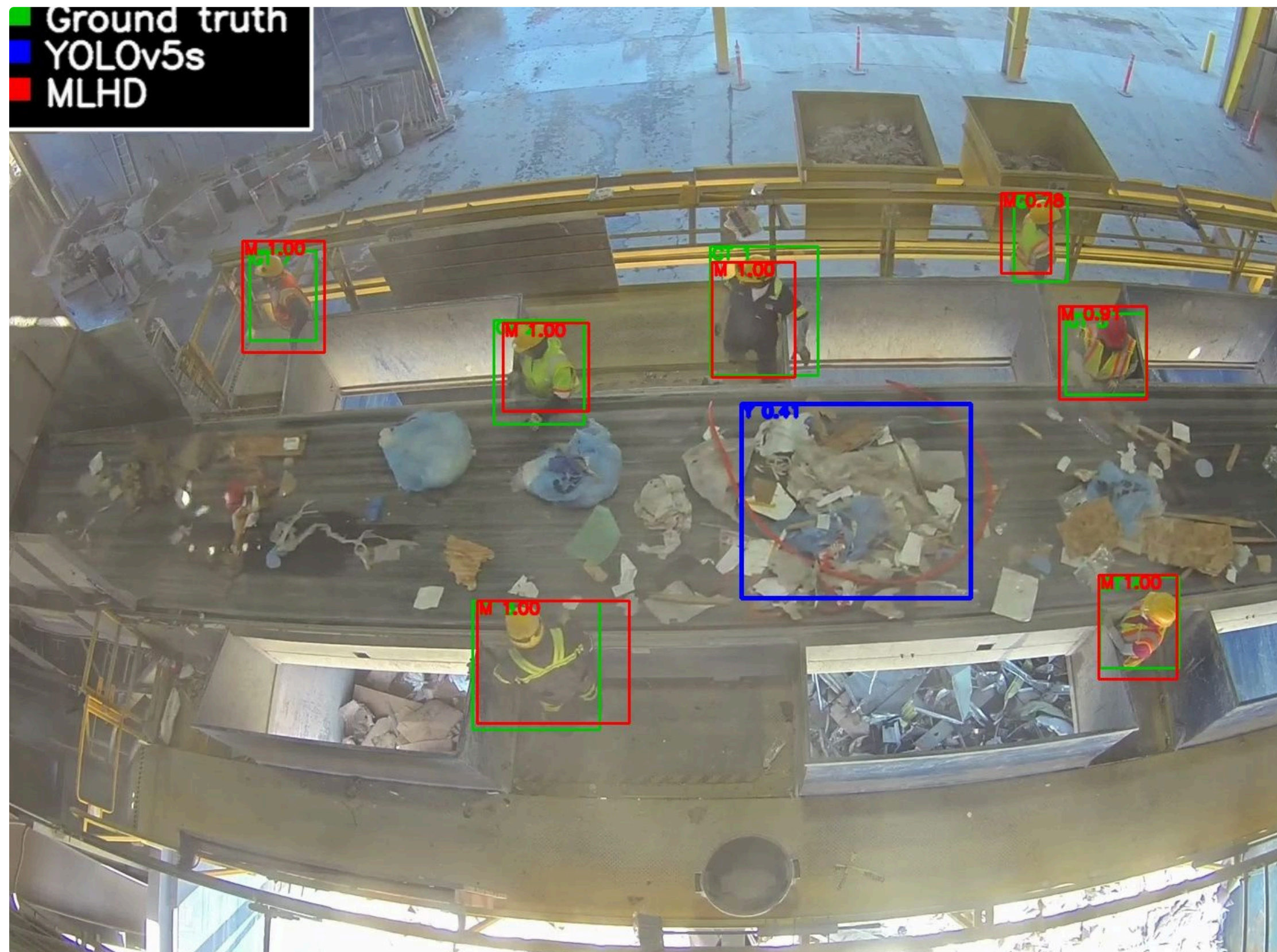
Comparison to YOLO Baseline @ IoU 0.5



Comparison to YOLO Baseline @ IoU 0.85



Comparison to YOLO Baseline



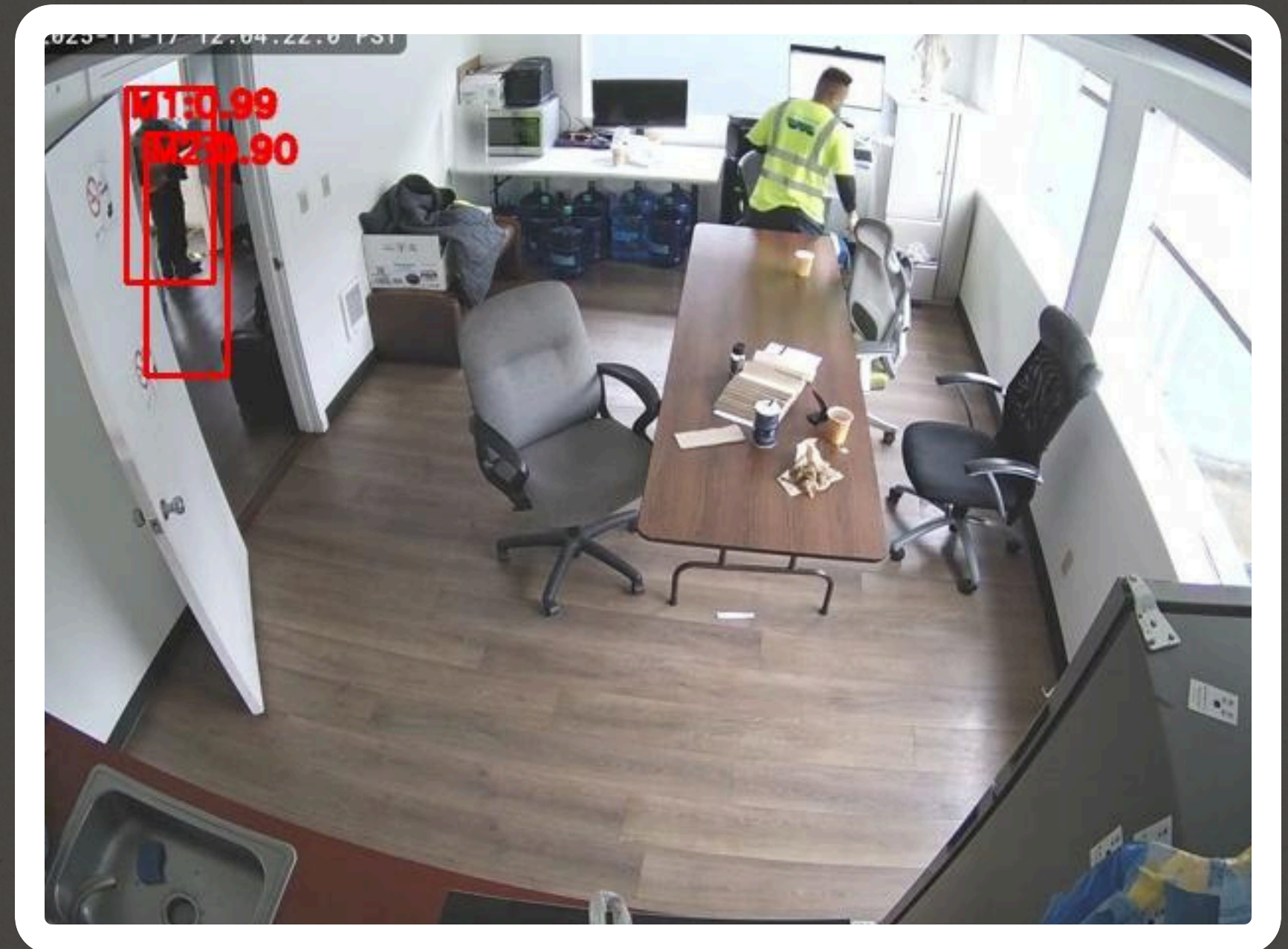
Strengths

- Simple grid encoding
- Lightweight CNN
- Domain-specific design
- Low complexity



Limitations

- Poor localization at IoU 0.85
- Single-person-per-cell
- No temporal reasoning



Future Work

- Add multi-person, multi-scale detection
- Integrate action recognition
- Add temporal modeling
- Evolve toward full proactive safety analytics



Conclusion



MLHD

Keep Workers Safe!