Title: Internship Assignment Report - AI Software Engineer _ Labellerr (PEC)
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1. Introduction

This project implements an **end-to-end image segmentation and tracking pipeline** using YOLOv8-Seg, ByteTrack, and Labellerr.
The aim was to simulate a real-world ML lifecycle: dataset creation, annotation, model training, evaluation, debugging, and deployment.

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2. Dataset Preparation

- Collected ~200 images of vehicles & pedestrians.
- Annotated ~100 training images using Labellerr with polygon masks.
- Created a test set of ≤50 unseen images.
- Mixed **real, synthetic, and self-captured data** to avoid bias.

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3. Model Training

- Model: YOLOv8n-Seg.
- Platform: Google Colab (GPU).
- Training: 100 epochs, batch size = 16, image size = 640.
- Metrics tracked: IoU, mAP (50–95), confusion matrix, PR curve.

Results:

- Issues: imbalance in pedestrian class & overfitting.
- Fixes: applied augmentations (mosaic, random scaling, color jitter).

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4. Inference & Evaluation

- Inference run on test images.
- Predictions uploaded to Labellerr SDK as **pre-annotations**.
- Verified predictions through Labellerr UI.
- Evaluated performance using IoU & PR curve.

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5. Object Tracking with ByteTrack

- Integrated YOLOv8-Seg with ByteTrack for multi-object tracking.
- Built a demo **Flask/Streamlit web app**:
    - Upload video → run YOLO+ByteTrack → display results.
    - Export results to `results.json` (object ID, class, bounding box, frame number).

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6. Debugging & Improvements

- **Issue 1:** Model confused pedestrians with background.
    - Fix: increased pedestrian samples in dataset.
- **Issue 2:** JSON output missing frame indexing.
    - Fix: added frame counter in inference script.

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7. Conclusion

This project demonstrates an **end-to-end segmentation and tracking system** with:

- Data collection & annotation
- YOLOv8-Seg training & evaluation
- Labellerr integration for annotation + review
- Video tracking with ByteTrack
- Deployment as a demo web app

The workflow is **scalable** to larger datasets (1M+ images) by automating annotation with Labellerr's Segment Anything feature and using distributed training.

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8. References

- Ultralytics YOLOv8: https://github.com/ultralytics/ultralytics
- ByteTrack: https://github.com/ifzhang/ByteTrack
- Labellerr SDK Docs: https://docs.labellerr.com/sdk/getting-started
- Dataset sources listed in `Sources.md`.