# Task 1 Final Report: Dataset Preparation for Image Segmentation

## Objective of Task 1:

Preparing a clean, modular preprocessing pipeline that converts COCO-style annotations into multi-class pixel-level segmentation masks suitable for training deep learning models.

## Decisions Made

### Dataset Choice: COCO

1. Chosen over Cityscapes due to diverse object classes and complex annotation formats (polygon + RLE).
2. Allows demonstrating edge case handling, generalization, and multi-class segmentation.

### Mask Format: Multi-Class PNG

1. Chosen because multi-class over binary to align with COCO's multiple category setup.
2. Used uint8 PNG masks with class indices for each pixel.

### Tools & Libraries

1. pycocotools: Decode COCO-style segmentation (polygon, RLE).
2. OpenCV: Efficient reading/saving of image and mask files.
3. argparse: CLI compatibility.
4. logging: Logs skipped/malformed annotations.
5. uv: Ensures reproducibility across Linux environments.

## Pipeline Summary

1. Load Annotations:  
 a. Parse instances\_train2017.json safely.  
 b. Mapped image id to annotations for quick lookup.  
  
2. Mask Generation:  
 a. Converted polygons and RLEs to pixel masks using pycocotools.  
 b. Handled overlapping masks by assigning class index priority.  
 c. Applied .squeeze() to broadcast (H, W, 1) masks.  
  
3. Edge Case Handling:  
 a. Skipped malformed iscrowd=1 masks (Expected bytes, got list).  
 b. Logged missing annotation entries and out-of-bounds coordinates.  
 c. Defaulted unknown category IDs to 0 (background).

4. Testing:  
 a. Used a COCO-mini subset (100 images).  
 b. Pipeline scaled to 3K–8K samples if needed.

## Sample Outputs



