Tyree McCloud
Module 4

GitHub: https://github.com/TyreeMcCloud/cv-module4-segmentation

This experiment compares a classical OpenCV-based segmentation pipeline with the SAM2 (Segment Anything Model 2) developed by Meta AI for segmenting an animal in a thermal infrared image. The classical method consisted of Gaussian blurring for noise reduction, Otsu thresholding for foreground extraction, morphological operations for mask refinement, edge detection, and largest-contour selection to obtain the animal boundary. The results were quantitatively evaluated against SAM2 using Intersection over Union (IoU) and Dice coefficient. The classical and SAM2 segmentations achieved an IoU score of 0.6502 and a Dice score of 0.7880. An IoU of 0.65 indicates moderate overlap between the two masks, meaning the classical method successfully captured most of the animal region but differed in boundary precision. The Dice score of 0.7880 further confirms strong overall agreement, as Dice tends to reward overlapping regions more generously than IoU. These values suggest that the classical computer vision approach performs reasonably well compared to a modern foundation segmentation model. From a personal visual perspective, the classical OpenCV segmentation produced a clean, solid silhouette of the dog and effectively captured the global shape of the animal. However, it slightly over-segmented certain areas and missed some finer contour details, particularly around the head and body curvature. The SAM2 segmentation preserved more subtle structural variations but introduced visible noise artifacts in the thermal domain. This is likely due to domain mismatch, as SAM2 is primarily trained on natural RGB imagery rather than thermal infrared data. Runtime comparison highlights a major trade-off. The classical method completed in 0.0186 seconds, while SAM2 required 6.1998 seconds, making SAM2 approximately 333 times slower on CPU. This demonstrates that while foundation models provide strong generalization and fine boundary modeling, classical image processing techniques remain highly efficient and competitive for domain-specific tasks.