AI CAMP

school of ai Algiers

Hello and Welcome to AI Camp

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Image Segmentation

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Definition:

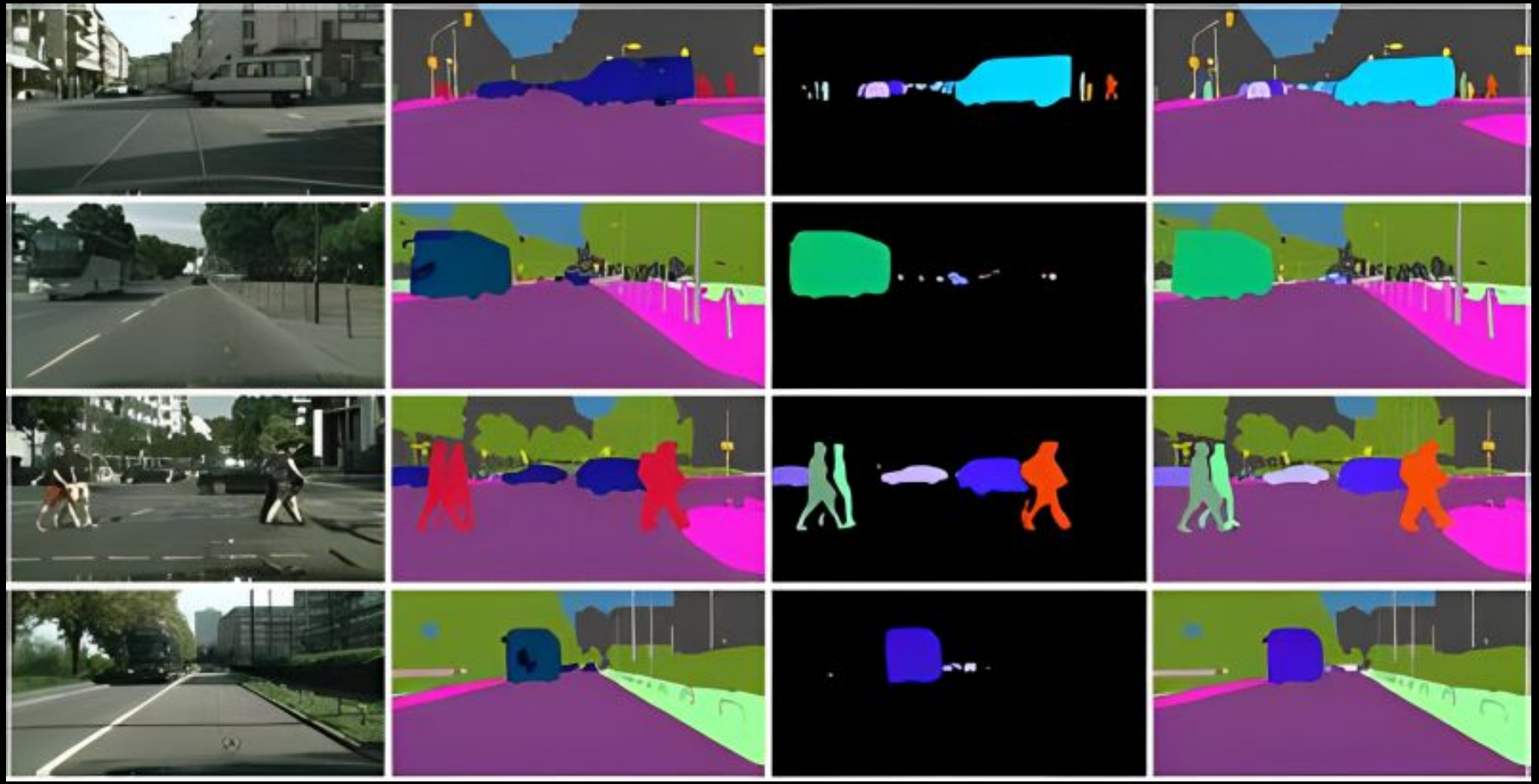
Image Segmentation is the process of partitioning a digital image into multiple segments to simplify or change the representation of an image. Crucial for object recognition, medical imaging analysis, and many other computer vision tasks.

Objective

To understand the fundamentals of image segmentation, explore various techniques, and apply knowledge to a practical example.

Basics of image segmentation:

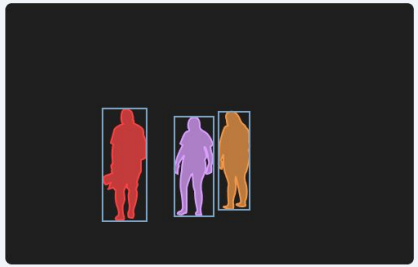
- Semantic Segmentation: Classifies all pixels of an image into meaningful classes of objects.
- Instance Segmentation: Identifies each instance of each object class separately.
- Panoptic Segmentation: Combines both semantic and instance segmentation.



Semantic Segmentation vs. Instance Segmentation vs. Panoptic Segmentation

(a) Image

(b) Semantic Segmentation



(c) Instance Segmentation

(d) Panoptic Segmentation

V7 Labs

Applications

- Medical Imaging: Used for tumor detection, organ segmentation, etc.
- Autonomous Vehicles: For pedestrian and obstacle detection.
- Satellite Imaging: Land cover classification and environmental monitoring.

Types of Image Segmentation

- Thresholding: Simplest way to segment objects by pixel intensity.
- Clustering: K-means clustering to partition pixel intensities.
- Edge Detection: Identify boundaries using algorithms like Canny edge detector.
- Watershed Algorithm: Used for separating touching objects in an image.

Deep Learning for Image Segmentation

- CNNs: Convolutional Neural Networks are pivotal in learning image features for segmentation.
- U-Net: A CNN architecture with a U-shaped network designed for medical image segmentation.
- Mask R-CNN: An extension of Faster R-CNN for instance segmentation.

Dataset and Tools

- Datasets: COCO, PASCAL VOC, and Decathlon for diverse segmentation tasks.
- Tools: TensorFlow, PyTorch for model building; OpenCV for image processing.

Dataset preparation

- Annotation: Tools like Labelbox or VIA for labeling images.
- Preprocessing: Resizing, normalizing, augmenting images for training.

Evaluation metrics

- IoU (Intersection over Union): IoU = Area of Overlap / Area of Union.
- Dice Coefficient: Dice = 2 * (Prediction ∩ Ground Truth) / (Prediction + Ground Truth).
- Pixel Accuracy: Percentage of pixels correctly classified.

Practical Demonstration

Let’s go into the notebook, a practical case with pytorch on spleen segmentation with pytorch

Challenge:

Adapt a new model for the spleen dataset, compare with it in terms of loss and speed of training.

Useful resources:

- https://github.com/AakashKumarNain/annotated_research_papers/blob/master/segmentation/segment_anything.pdf
- https://github.com/AakashKumarNain/annotated_research_papers/blob/master/segmentation/decoder_denoising_pretraining.pdf
- https://github.com/AakashKumarNain/annotated_research_papers/blob/master/segmentation/axial_deeplab.pdf

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Thank you for attending

any questions ?