Universal Weakly Supervised Segmentation by Pixel-to-Segment Contrastive Learning

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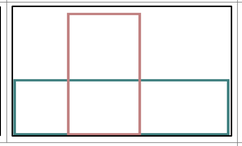
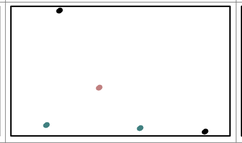
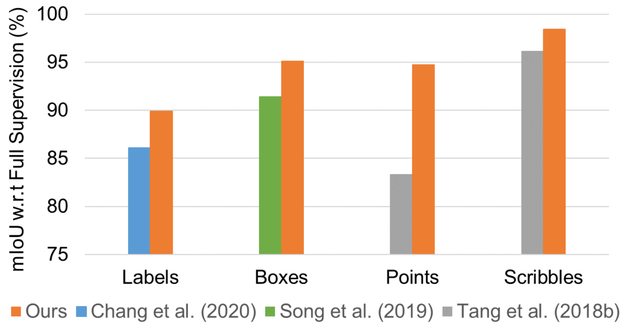
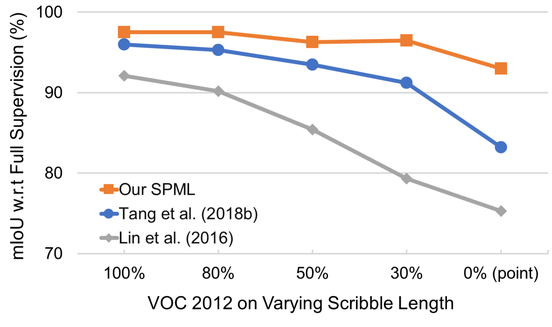
ICSI

A Unified Approach for 4 Kinds of Weak Annotations

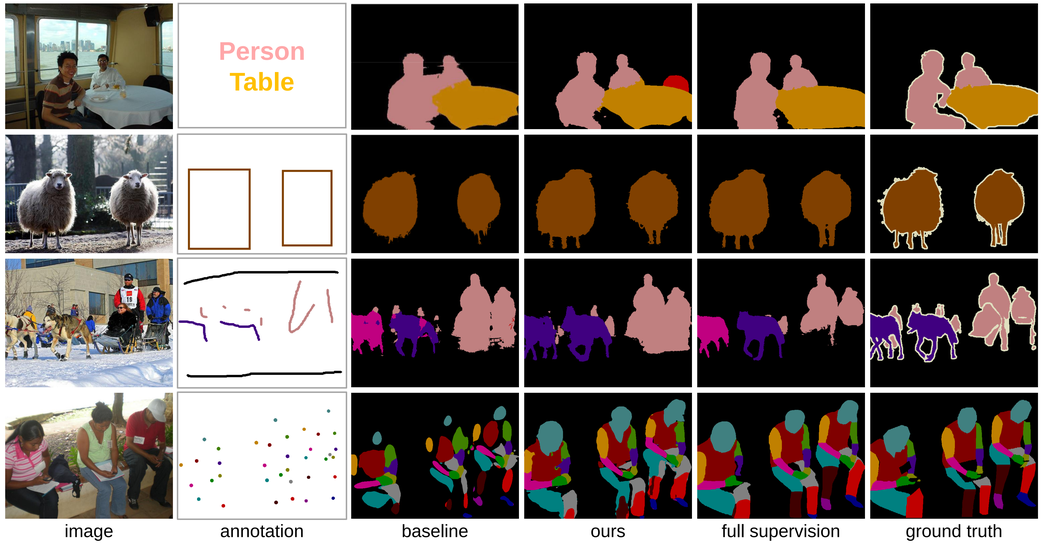
Image	Image Tags	Boxes	Points	Scribbles
	Person Motorbike			
Supervision	Coarse		Sparse	
Current Methods	Class Activation Maps		Conditional Random Fields	
Our Method	**single pixel-to-segment contrastive learning loss formulation**			

Outperforms the State-of-The-Art over All Weak Annotations

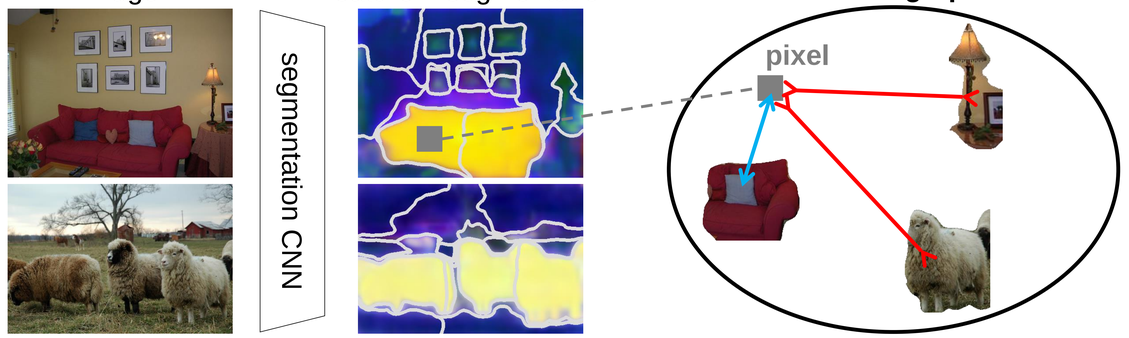




Our Results Get Closer to Fully Supervised Counterparts



Our SPML: Contrasts Pixels with Segments on 4 Types of Relationships



For pixel i with positive segments $\mathcal{C}^+$, negative segments $\mathcal{C}^-$:

$$L_{\text{SegSort}^+}(i, \mathcal{C}^+, \mathcal{C}^-) = -\log \frac{\sum_{l \in \mathcal{C}^+} \exp(\kappa \boldsymbol{p}_l^\top \boldsymbol{e}_i)}{\sum_{l \in \mathcal{C}^+ \cup \mathcal{C}^- \setminus \{s\}} \exp(\kappa \boldsymbol{p}_l^\top \boldsymbol{e}_i)}$$

Overall loss:

$$L(i) = \lambda_I L_{\text{SegSort}^+}(i, \mathcal{V}^+, \mathcal{V}^-) + \lambda_C L_{\text{SegSort}^+}(i, \mathcal{C}^+, \mathcal{C}^-) + \lambda_O L_{\text{SegSort}^+}(i, \mathcal{O}^+, \mathcal{O}^-) + \lambda_A L_{\text{SegSort}^+}(i, \hat{\mathcal{C}}^+, \hat{\mathcal{C}}^-)$$