Politecnico di Torino
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PhD in Computer and Control Engineering
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ISTITUTO ITALIANO DI TECNOLOGIA

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Data-Efficient Incremental Learning in Image Segmentation

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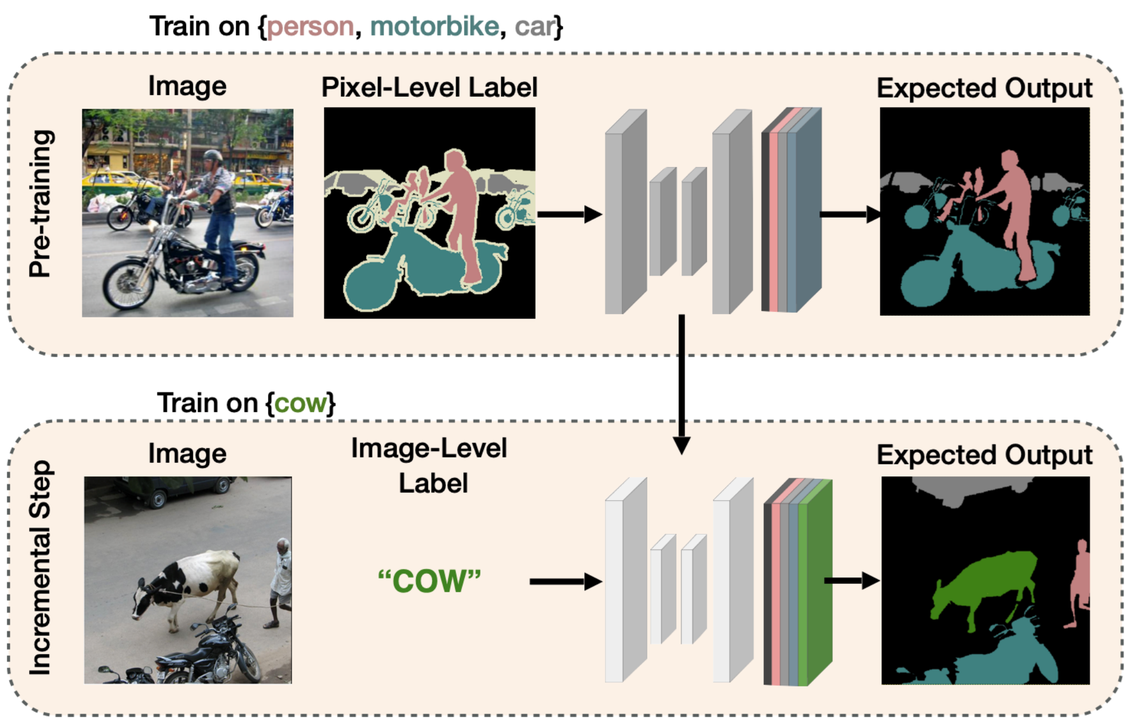
1. Task and Motivation

Segmentation is a fundamental task for computer vision. It consists in assigning every pixel of an image a class. It still lacks **two abilities**.

2. **Incremental Learning [1,2,3]**: learning new classes over time without forgetting;
3. **Weakly-Supervised Learning [1,2]**: learning from cheaper annotations, such as image tags or point.

This work aims to provide methods these abilities and **learn new classes over time using only cheap image-level labels**.

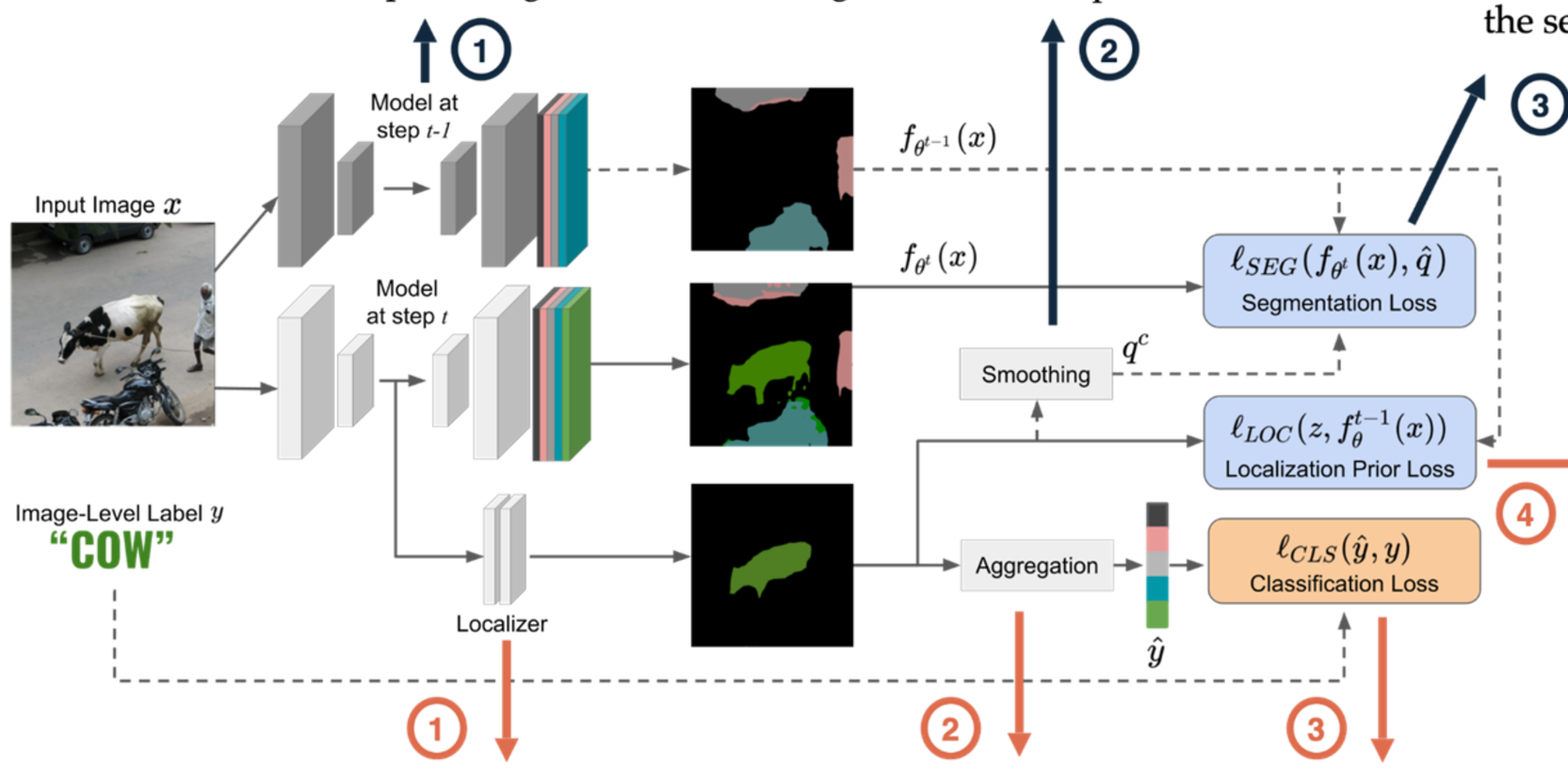


2. Method

Knowledge Distillation: to avoid catastrophic forgetting, we use the old model output to regularize the training.

Soft-Pseudo Labels: we smooth the localizer output to reduce the noise in the pseudo-labels.

Segmentation Loss: we use the old model and the soft-pseudo labels to finally train the segmentation model.



Localization Prior
(i) provides information on the location of previous classes and
(ii) acts a salient prior to extract better object boundaries.

Localizer: takes in input the image features and output a per-pixel score for each class (both old and new).

Aggregation: we use normalized Global Avg. Pooling to transform the per-pixel scores.

Classification Loss: the localizer is trained using the multi-label soft margin loss.

3. Results

The table compares sota methods in terms of mIoU on the **Pascal-VOC** dataset, using **15 base** and **5 new** classes.
While being cheaper, the proposed method is competitive or superior to methods relying on expensive pixel-level labels.

Sup.	Method	Disjoint			Overlap		
		1-15	16-20	All	1-15	16-20	All
Pixel	Joint	75.5	73.5	75.4	75.5	73.5	75.4
	MIB [2]	81.8	43.3	64.7	75.5	49.4	69.0
	PLOP	71.0	42.8	64.3	75.7	51.7	70.1
	SDR	73.5	47.3	67.2	75.4	52.6	69.9
	RECALL	69.2	52.9	66.3	67.7	54.3	65.6
Image	CAM	69.3	26.1	59.4	69.9	25.6	59.7
	SEAM	71.0	33.1	62.7	68.3	31.8	60.4
	SS	71.6	26.0	61.5	72.2	27.5	62.1
	EPS	72.4	38.5	65.2	69.4	34.5	62.1
	Ours	**73.6**	**43.8**	**67.3**	**74.2**	**41.7**	**67.2**

3. References

1. Incremental learning in semantic segmentation from image labels, Cermelli et al., CVPR-22
2.Modeling the Background for Incremental and Weakly-Supervised Semantic Segmentation, Cermelli et al, T-PAMI
3.Prototype-based Incremental Few-Shot Segmentation, Cermelli et al, BMVC-21