

Probabilistic Joint Image Segmentation and Labeling

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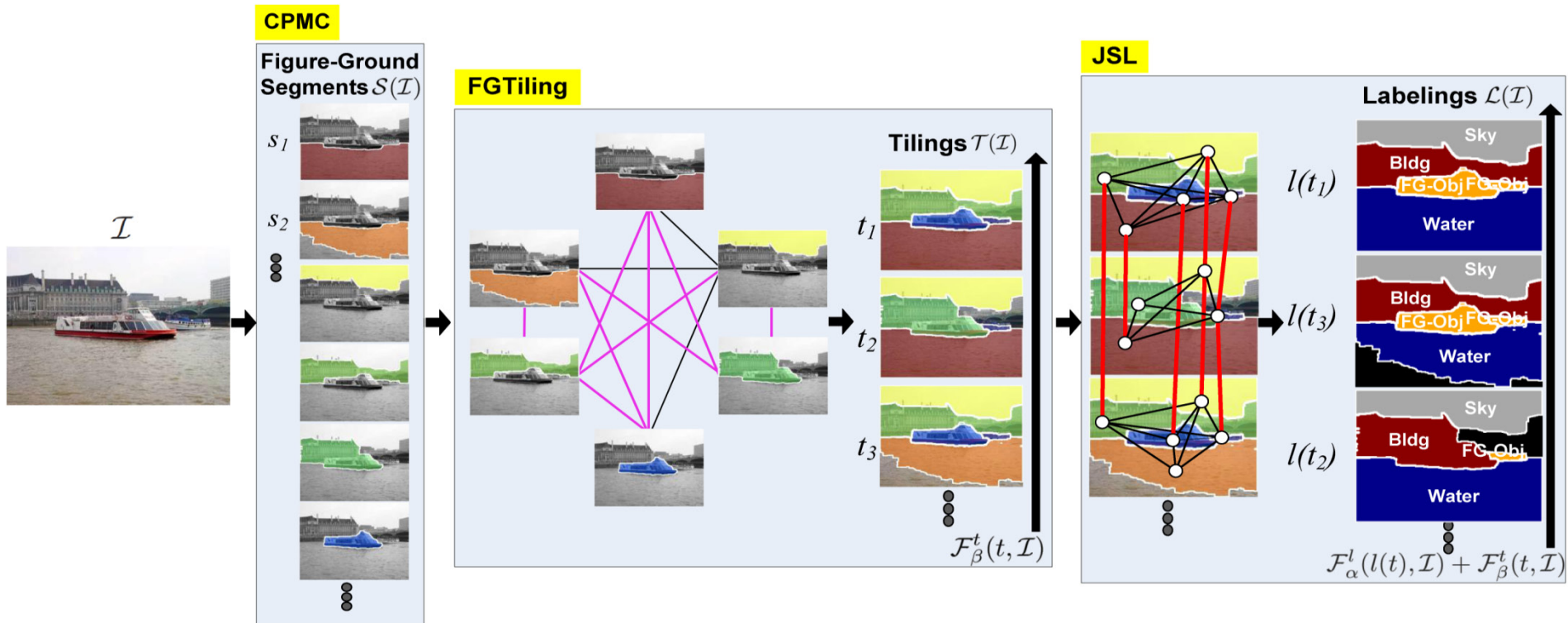
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How to segment and how to label images?

- Image segmentation and labeling are inter-dependent
 - At pixel level recognition is poorly defined for many semantic categories, e.g. people, chairs...
 - Given regions with sufficiently large spatial support, reliable recognition is possible
- Low-level segmentation can produce useful spatial support hypotheses, but these are rarely accurate in any single segmentation
- A recognition model should allow segment recombination and produce semantic label distributions rather than point estimates

Model and Computational Principle



We explore figure/ground methods to generate large segment pools, then recombine and recognize subsets, within a sound statistical framework

Joint Segmentation and Labeling Model

$$p_{\theta}(l(t), t, I) = \frac{1}{Z_{\theta}(I)} \exp F_{\theta}(l(t), t, I)$$

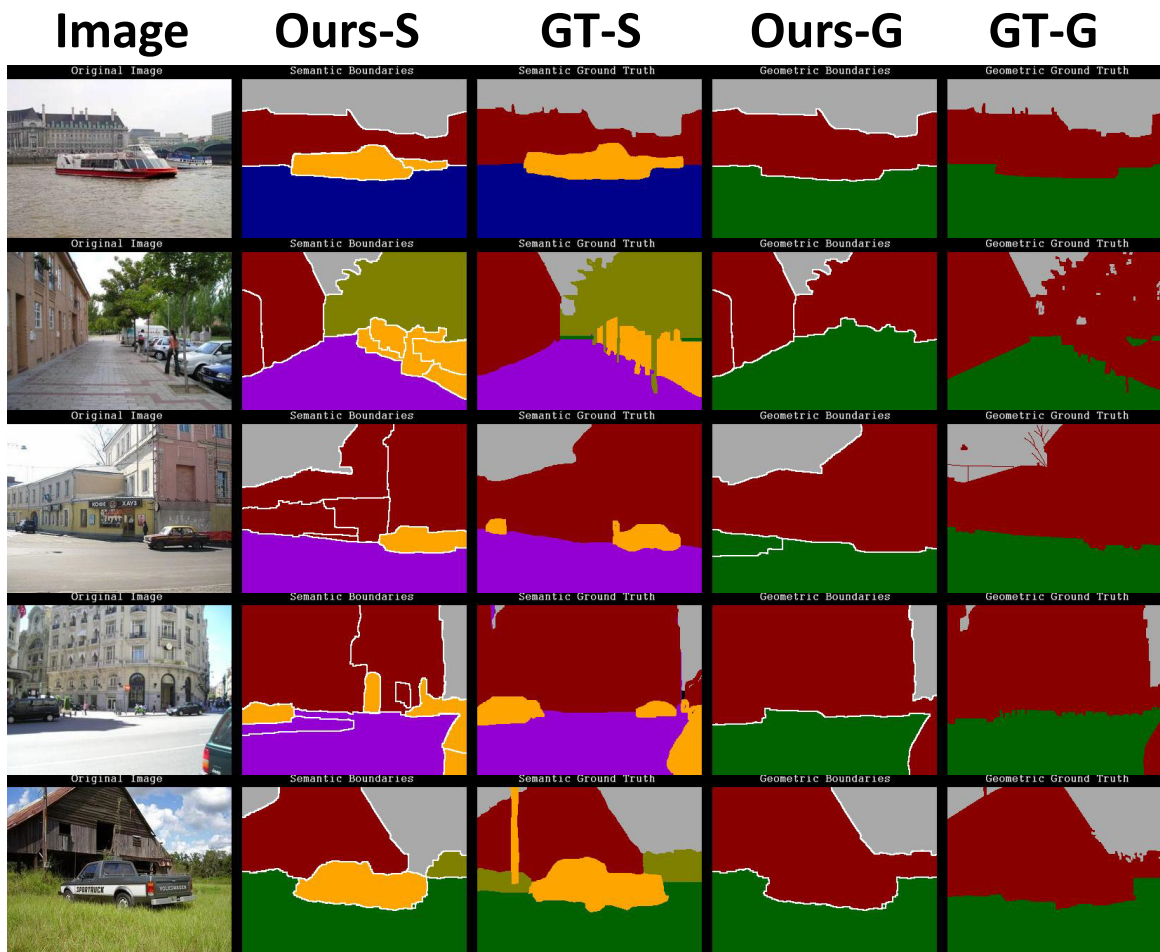
$$Z_{\theta}(I) = \sum_t \sum_{l(t)} F_{\theta}(l(t), t, I)$$

$$F_{\theta}(l(t), t, I) = \underbrace{F_{\alpha}^l(l(t), I)}_{\text{category dependent}} + \underbrace{F_{\beta}^t(t, I)}_{\text{category independent}}$$

- Learn parameters using Maximum Likelihood
- Novel incremental partition function estimation
 - Sum over subset of configurations (multiple cliques, labeled)
 - Include incorrect configurations the model rates probable

Qualitative Scene Geometry

(Stanford class + geometry)



	Semantic
Ours	75.6
Gould et al.	76.4
	Geometry
Ours	88.8
Gould et al.	91.0

sky
 tree
 road
 grass
 water
 bldg
 mntn
 fg obj.
 sky
 horz.
 vert.

Pascal VOC 2010

Segmentation and object class recognition



	Average score
Ours	41.7
CVC-HARMONY-DET	40.1
UOCTTI_LSVM_MDPM	31.8
BROOKES_AHCRF	30.3
STANFORD_REGLABEL	29.1

