

# Probabilistic Joint Image Segmentation and Labeling

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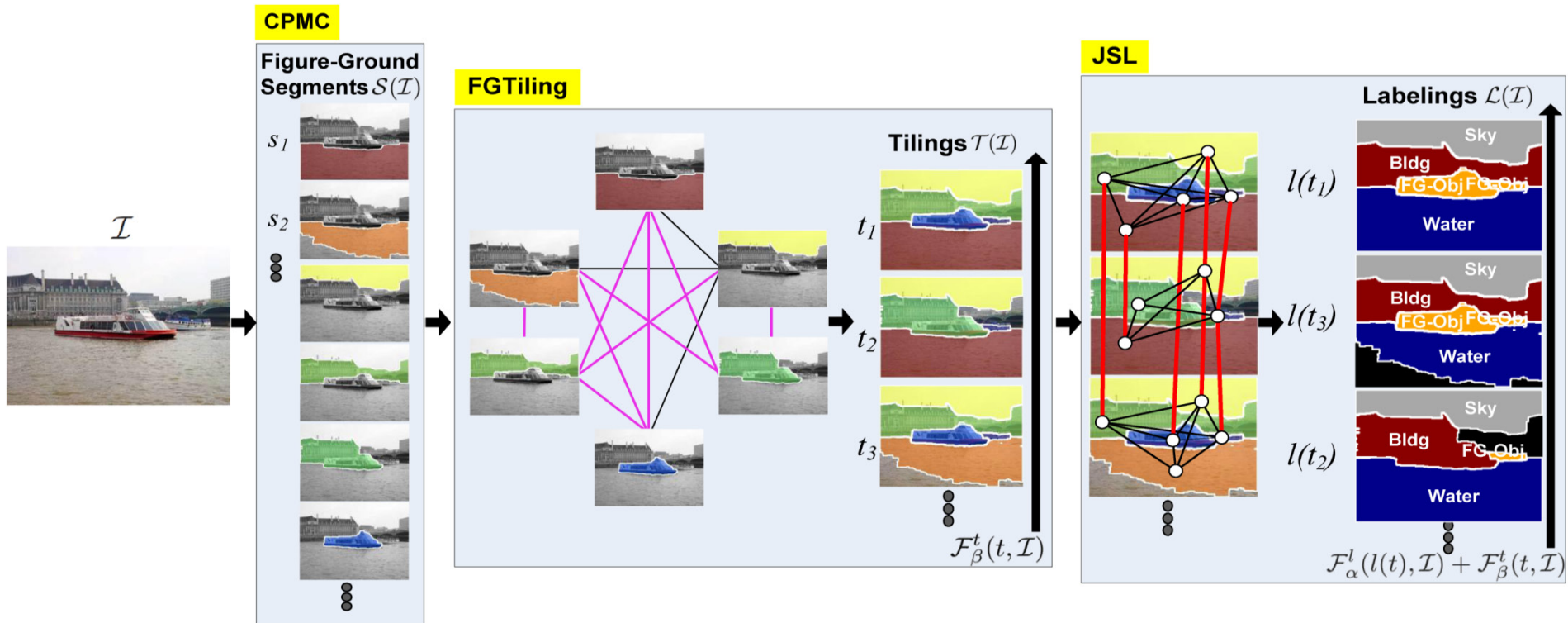
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# How to segment and how to label images?

- 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

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

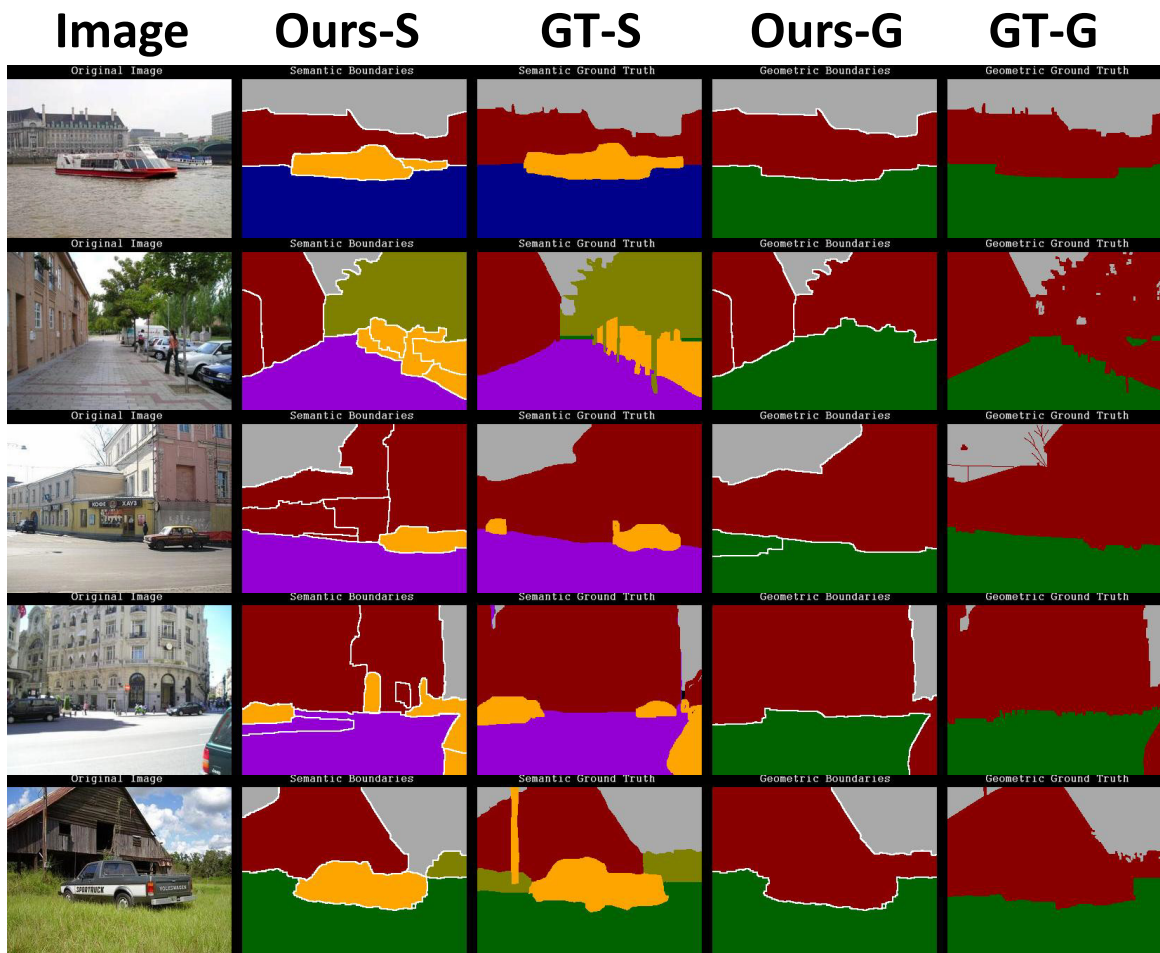
$$Z_{\theta}(I) = \sum_t \sum_{l(t)} F_{\theta}(l(t), t, I)$$

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

- 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
<b>Ours</b>	<b>41.7</b>
CVC-HARMONY-DET	40.1
UOCTTI_LSVM_MDPM	31.8
BROOKES_AHCRF	30.3
STANFORD_REGLABEL	29.1

