SCOPS: Self-Supervised Co-Part Segmentation

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A end-to-end trainable method that learns object part segmentation without pixel-wise annotation.

### Object Part Segmentation

**Advantages**
- Natural dense representation for non-rigid objects.
- Landmarks are sometimes ill-defined around part boundaries.

**Proposed Method – Self-Supervised Co-Part Segmentation**
- Given an image collection of an object category, the objective is to discover consistent part segments across images.

### Desirable Properties as Loss Functions

- Geometric concentration.
- Robustness to variations.
- Semantic consistency.
- Objects as union of parts.

### Concentration and Equivariance Loss

**Concentration Loss**
- Penalize part responses in areas far from part-centric:

\[ L_c = \sum_{i} \log \left( 1 + \exp \left( -R(u, v)_{i}x_{i} \right) \right) \]

**Equivariance Loss**
- Segmentation should be consistent w.r.t. perturbation.
- Proposed in unsupervised landmark estimation, we extend it to segmentation.

### Semantic Consistency Loss

\[ L_s = \sum_{i} \left( V(u, v)_{i} - \sum \frac{R(u, v)_{i} w_{j}}{ || w_{j} ||^2 } \right)^2 \]

Push semantic part basis \( w_j \) to be an orthonormal basis.

### Results Visualization

Ablation Studies

Common Objects

### Experimental Results

Landmarks on CelebA (Faces)

Landmarks on CUB (Birds)

### References


Code: https://varunjampani.github.io/scops/