Unsupervised Part Discovery from Contrastive Reconstruction




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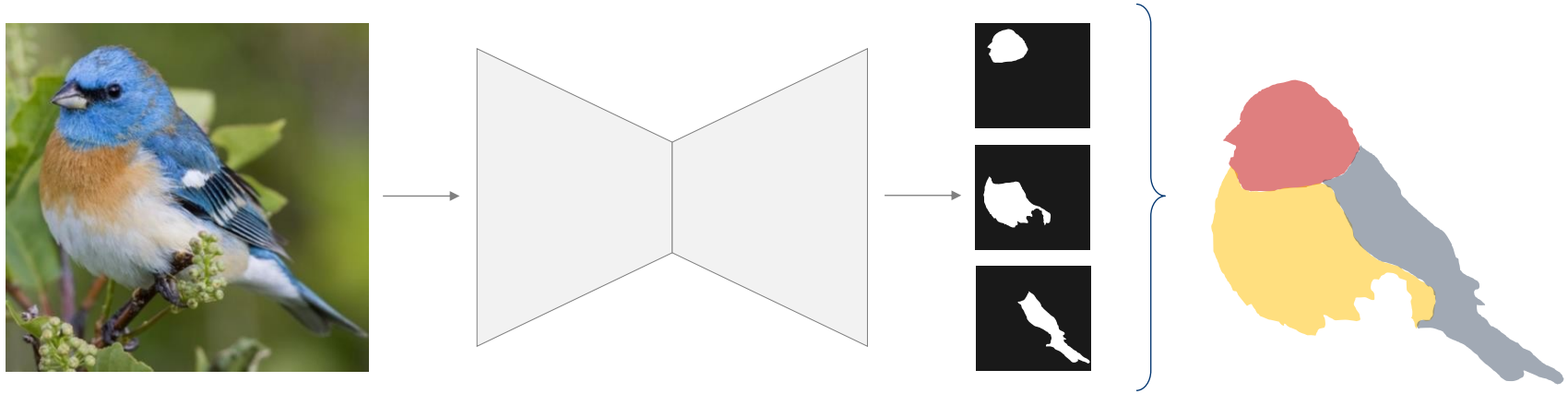
https://www.robots.ox.ac.uk/~vgg/research/unsup-parts/

Object part segmentation

- More invariant to variations in camera, lighting, object appearance and pose
- Useful in analyzing objects in higher-level tasks, e.g. fine-grained recognition, robotic manipulation etc.
- But acquiring dense annotation is expensive, and there exists a plentiful number of objects in nature

Object part segmentation



Image

Segmentation Network

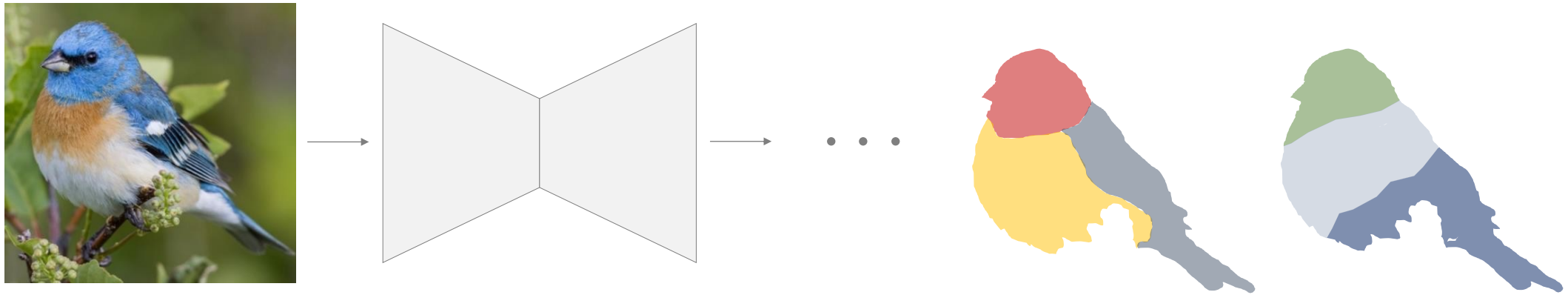
Part Masks

Self-Supervised
Proxy Task

No Labels

Object part segmentation

What is a part?



Image

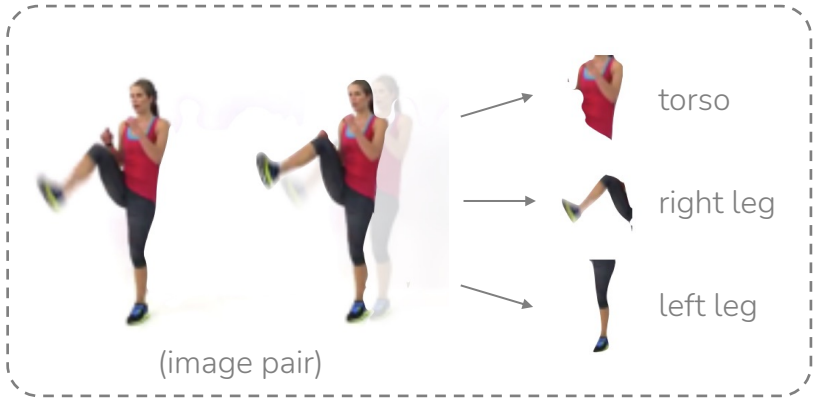
Segmentation Network

Good parts?

Good parts?

What is a part?

Motion-based



Semantic correspondence-based

Sabour et al. “Unsupervised Part Representation by Flow Capsules”, ICML 2021

Xu et al. “Unsupervised Discovery of Parts, Structure, and Dynamics”, ICLR 2021

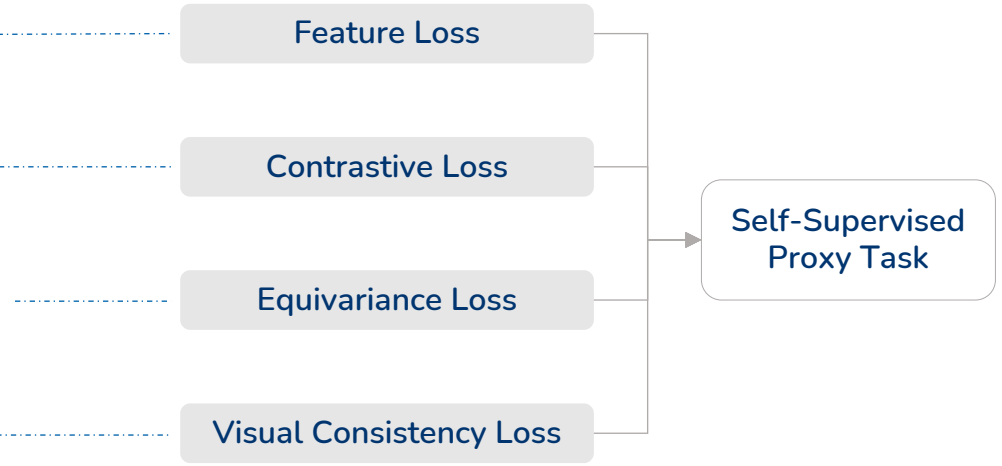
Hung et al. “SCOPS: Self-Supervised Co-Part Segmentation”, CVPR 2019

Braun et al. “Unsupervised Part Discovery by Unsupervised Disentanglement”, GCPR 2020

Our Method

What is a Part?

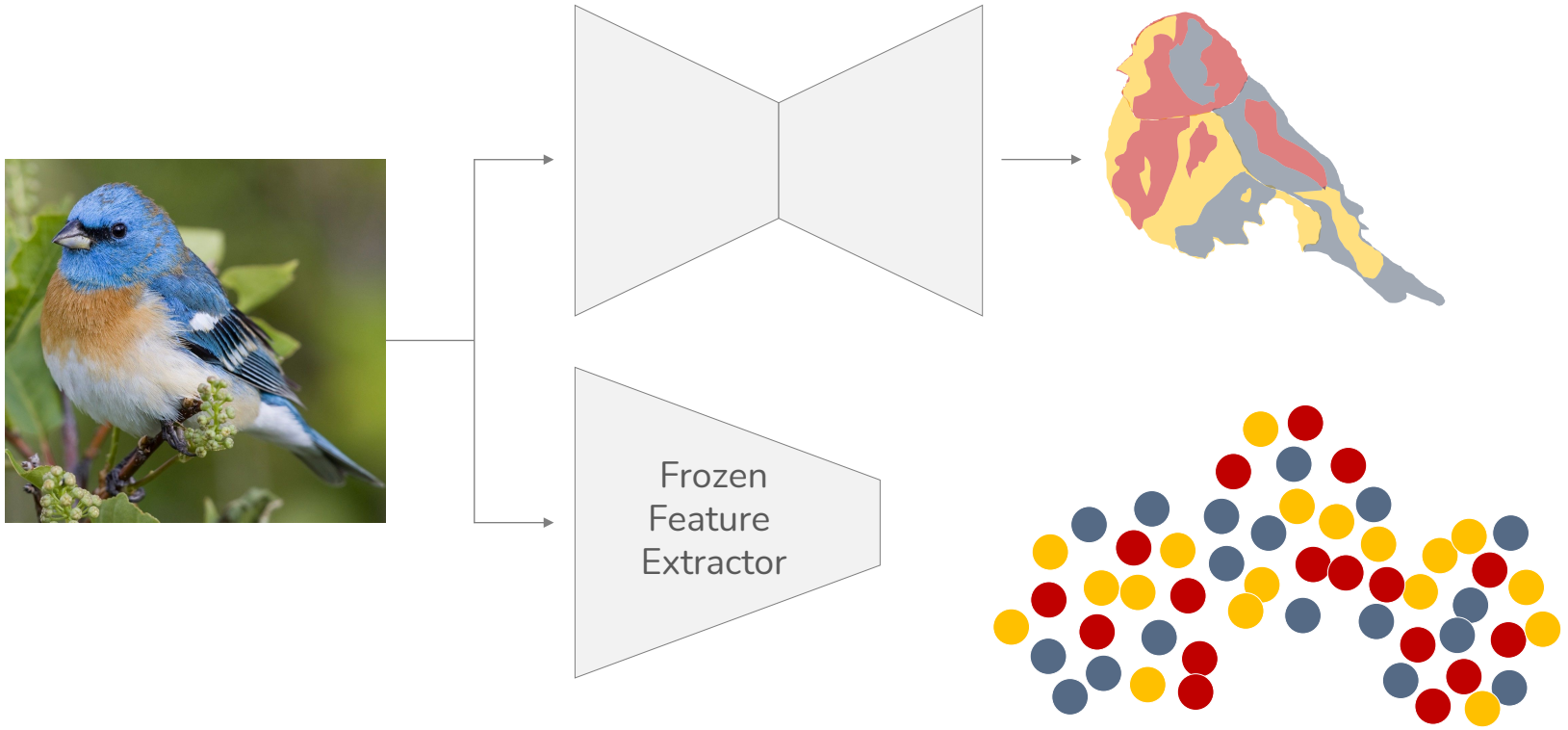
- Parts should have uniform feature information
- Parts should be consistent across images and distinct from other parts
- Parts should be invariant to geometric and photometric transformations
- Parts should be visually consistent



Objectives

1. Feature Loss

- Parts should have uniform information



Objectives

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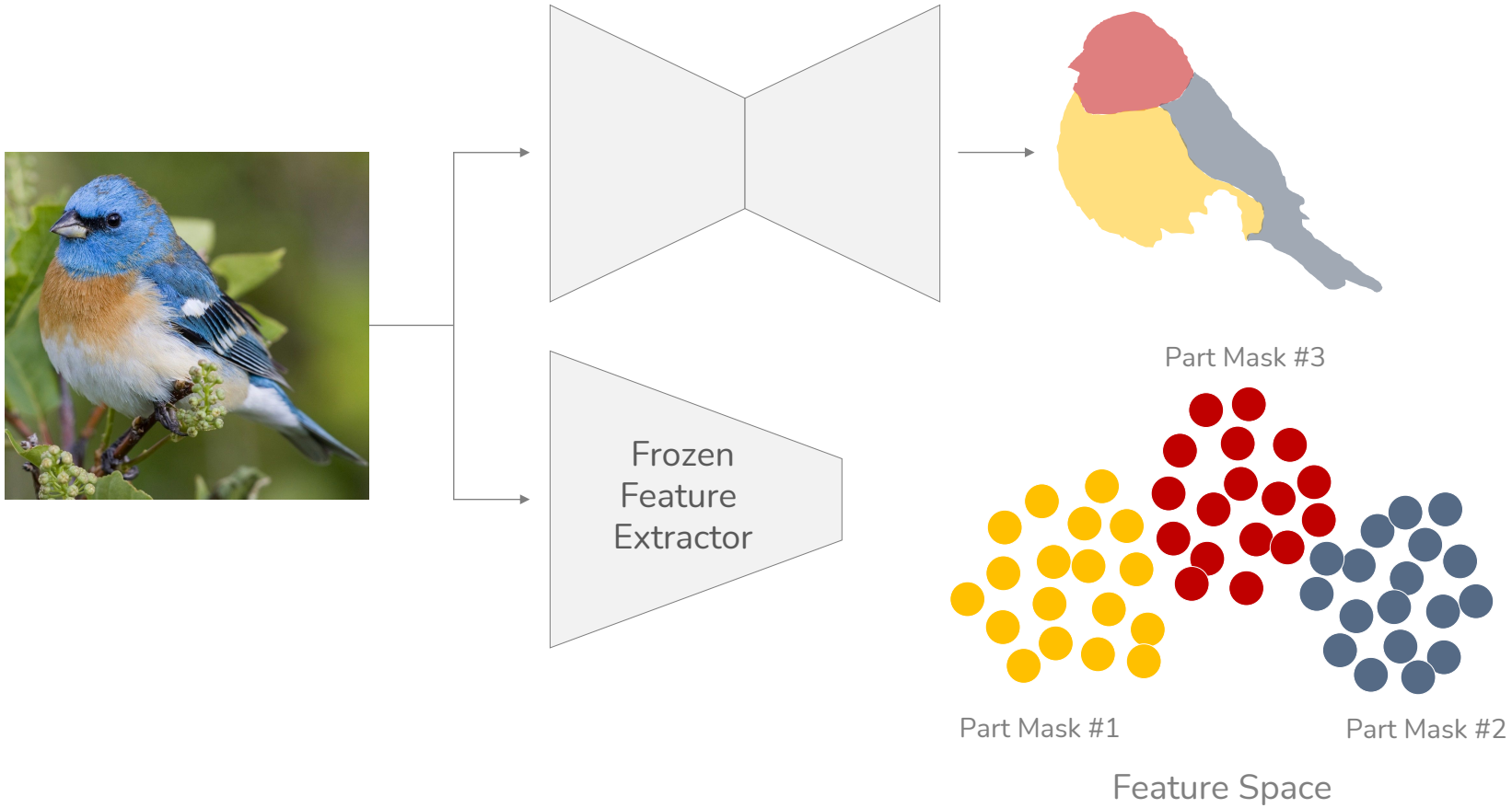
- Parts should have uniform information



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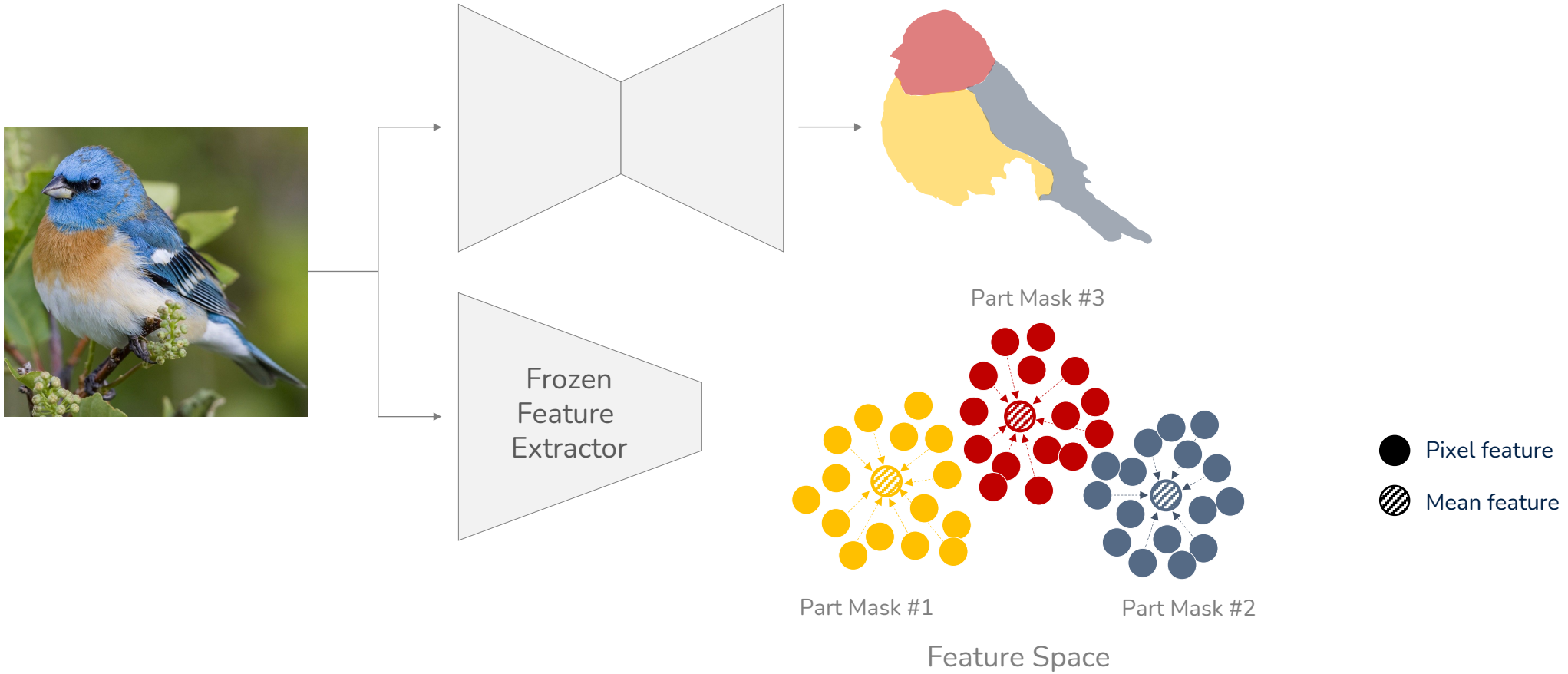
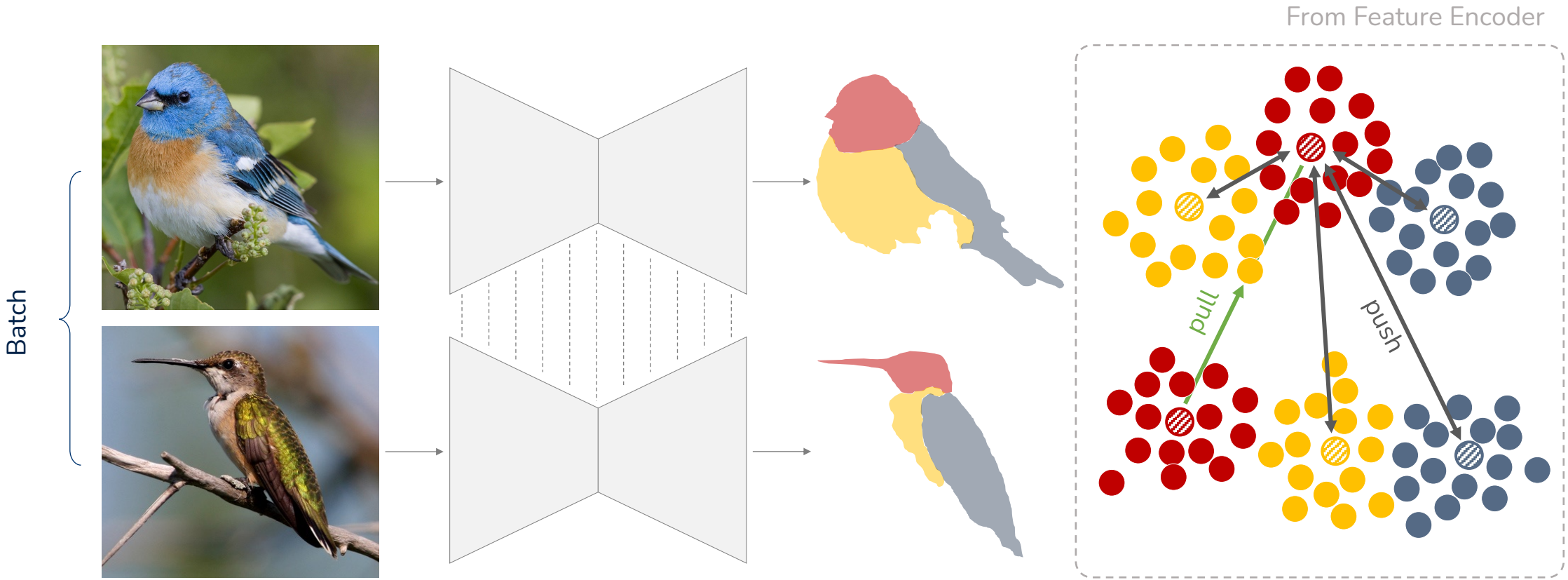
- Parts should have uniform information



Objectives

2. Contrastive Loss

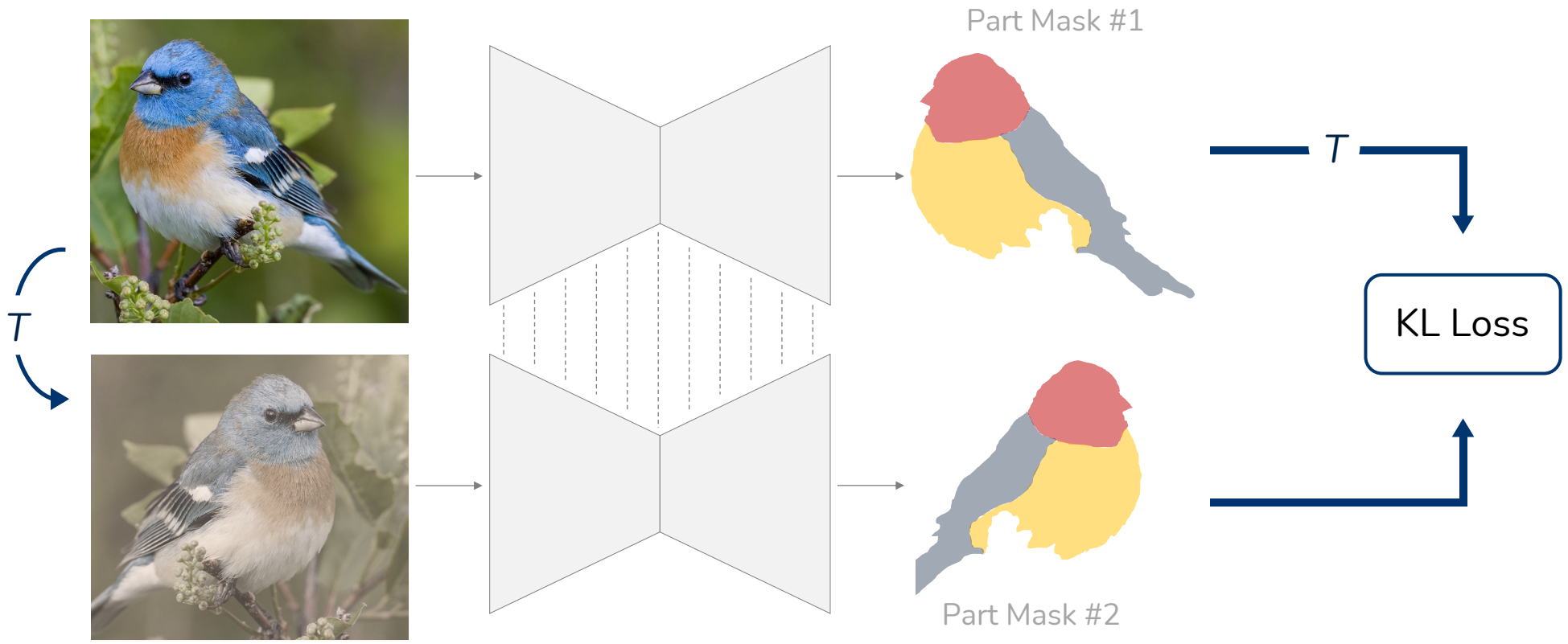
Parts should be consistent across images and distinct from other parts



Objectives

3. Equivariance Loss

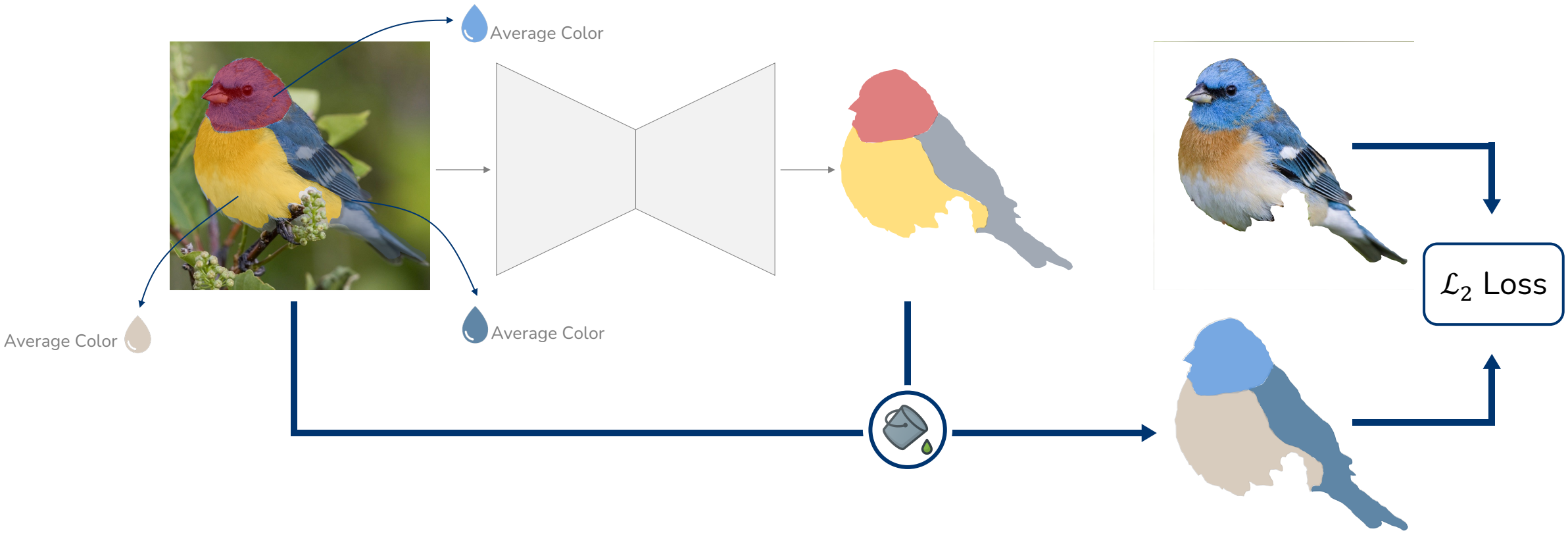
Parts should be equivariant to geometric and photometric transformations



Objectives

4. Visual Consistency Loss

Parts should be visually consistent



Datasets

CUB-200-2011 [1]

Category: Bird

DeepFashion [2]

Category: Human

PASCAL-Parts [3]

Category: Total 10 (horse, sheep, bus, car, cat etc.)

[1] Wah et al. “The Caltech-UCSD Birds-200-2011 Dataset”, Technical Report 2011

[2] Liu et al. “DeepFashion: Powering Robust Clothes Recognition and Retrieval with Rich Annotations”, CVPR 2016

[3] Chen et al. “Detect What You Can: Detecting and Representing Objects using Holistic Models and Body Parts”, CVPR 2014

Qualitative Results

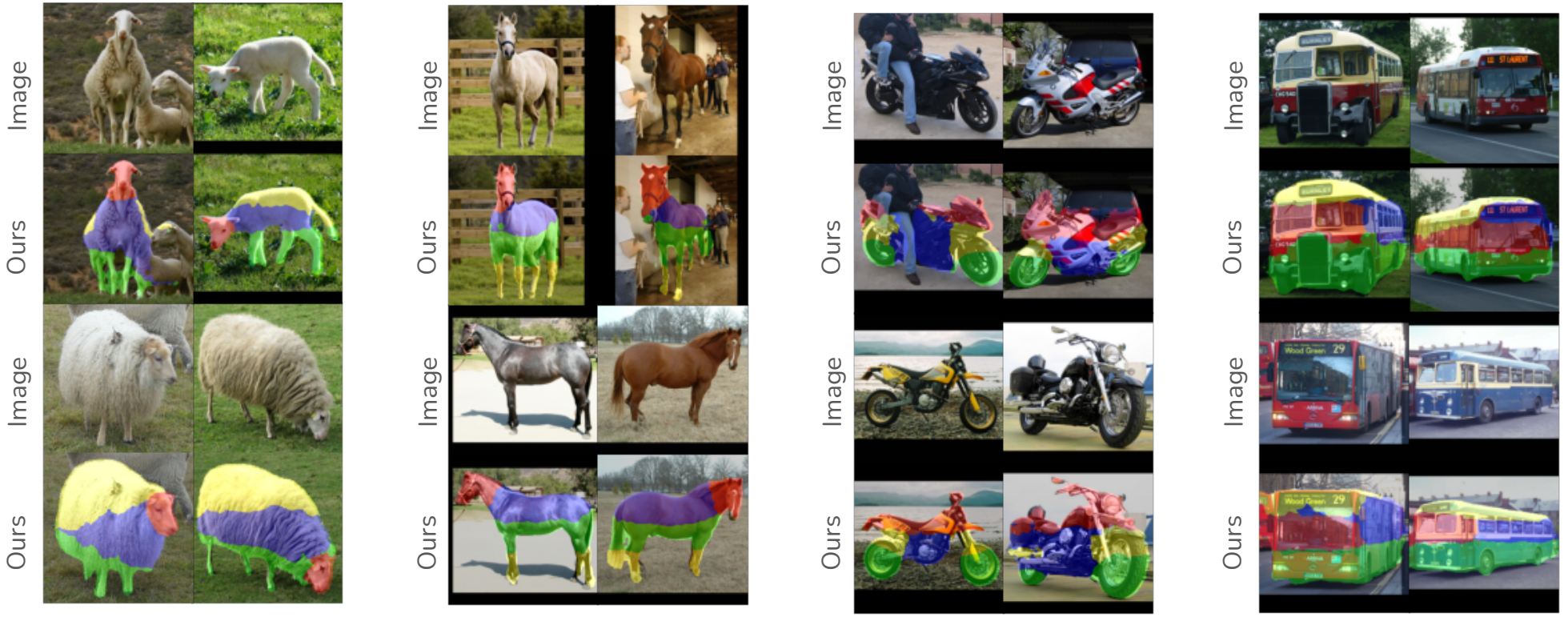
CUB-200-2011

Qualitative Results

DeepFashion

[1] Hung et al. “SCOPS: Self-Supervised Co-Part Segmentation”, CVPR 2019

Qualitative Results



PASCAL-Parts

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Thank you!

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