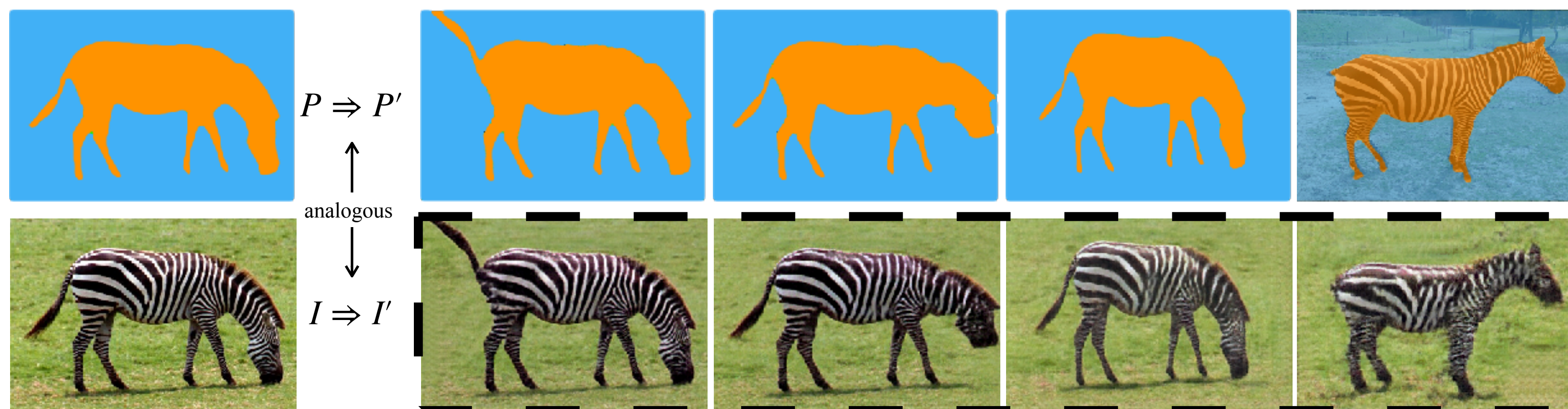


Semantic Image Analogy with a Conditional Single-Image GAN

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ACM MM 2020



中国科学技术大学
University of Science and Technology of China



National Engineering Laboratory for Brain-Inspired
Intelligence Technology and Application



Visual Information
Discovery And Recovery

Image Analogy

$$A : A' :: B : B'$$



A



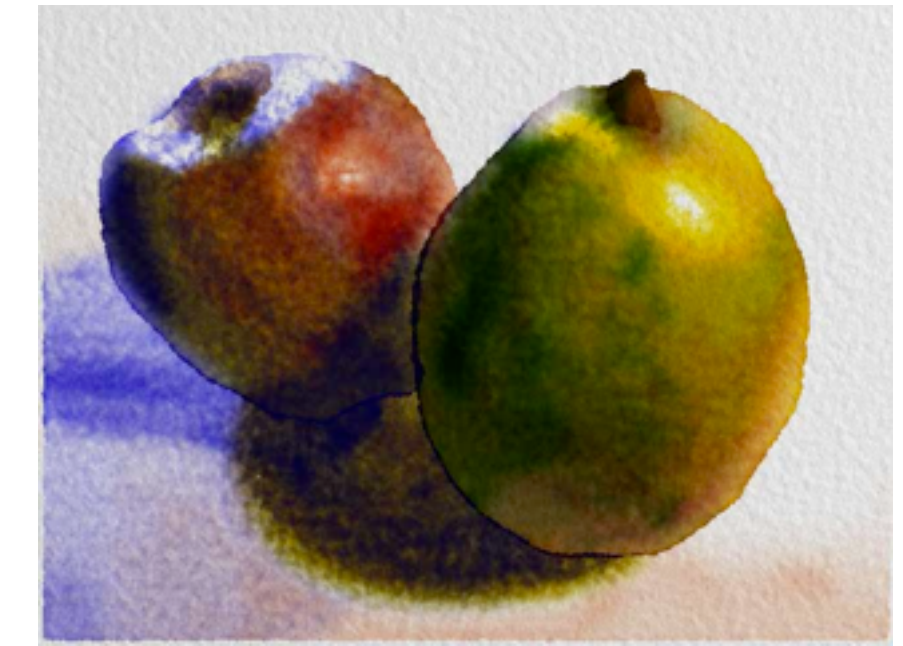
A'

:

::



A



A'

:

::



B



B'

:



B

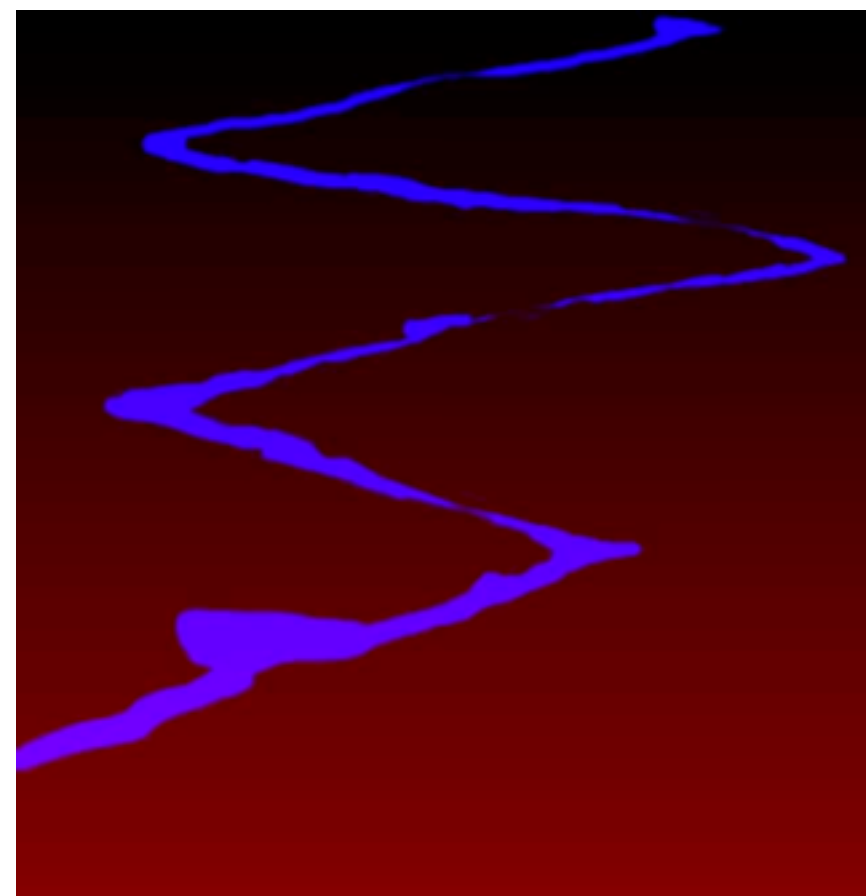


B'

:

Image Analogy

$$A : A' :: B : B'$$



A



A'

:

::



B



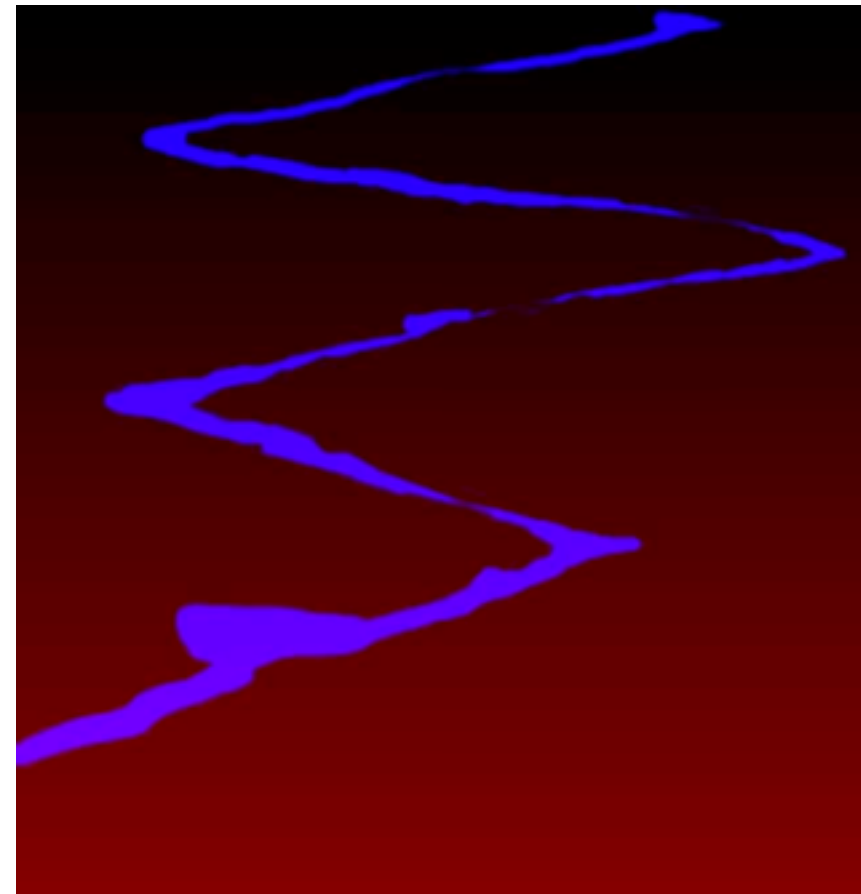
B'

:

Semantic Image Analogy

$$P \Rightarrow P' :: I \Rightarrow I'$$

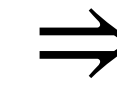
Segmentation
Domain



P

P'

Image
Domain

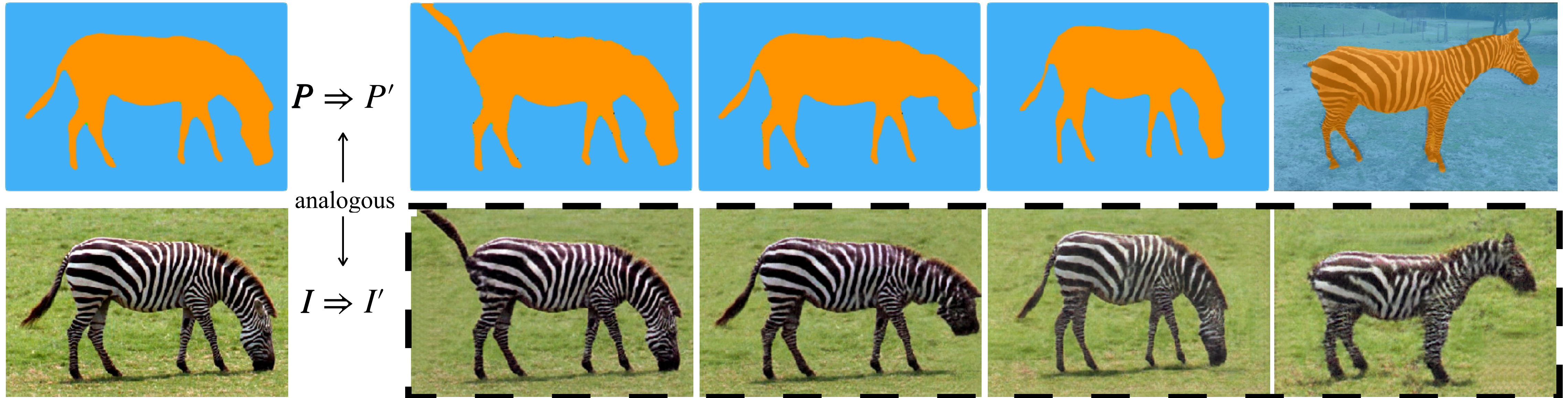


I

I'

Semantic Image Analogy

$$P \Rightarrow P' :: I \Rightarrow I'$$



ADE20k
Cityscapes
COCO
CelebA
...



Conditional GANs

Semantic Image Synthesis

In-the-wild
Images



Single-Image GANs

Retargeting
Super-Resolution
Unconditional Sampling
...



ADE20k
Cityscapes
COCO
CelebA
...

Conditional GANs

Semantic Image Synthesis

Can we achieve the best from both worlds?

In-the-wild
Images

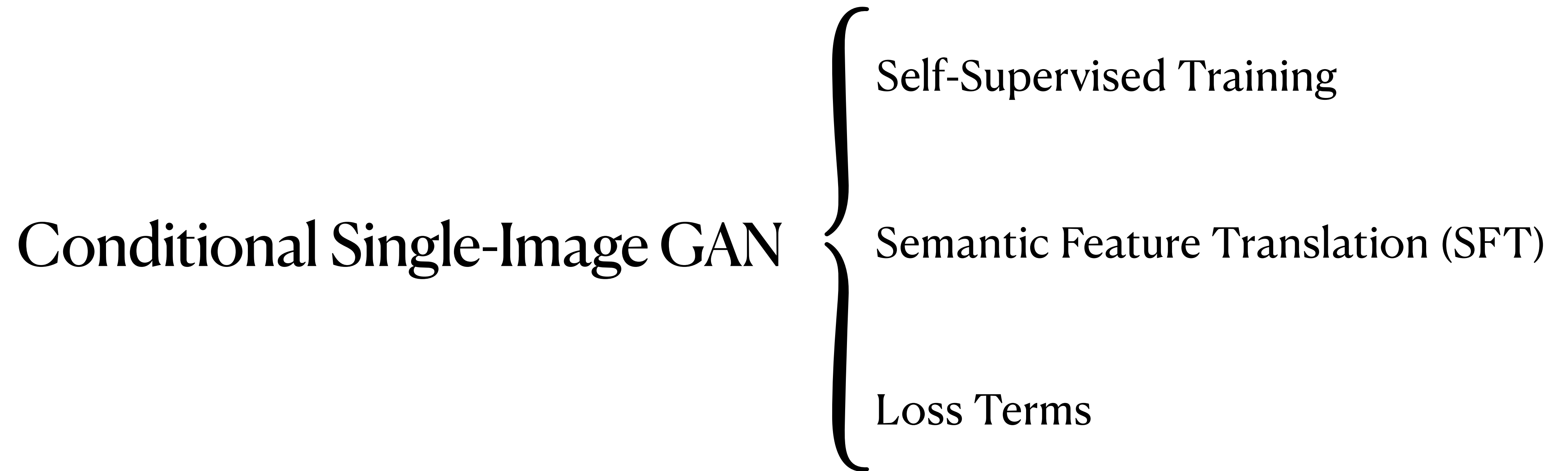


Unconditional sampling

...

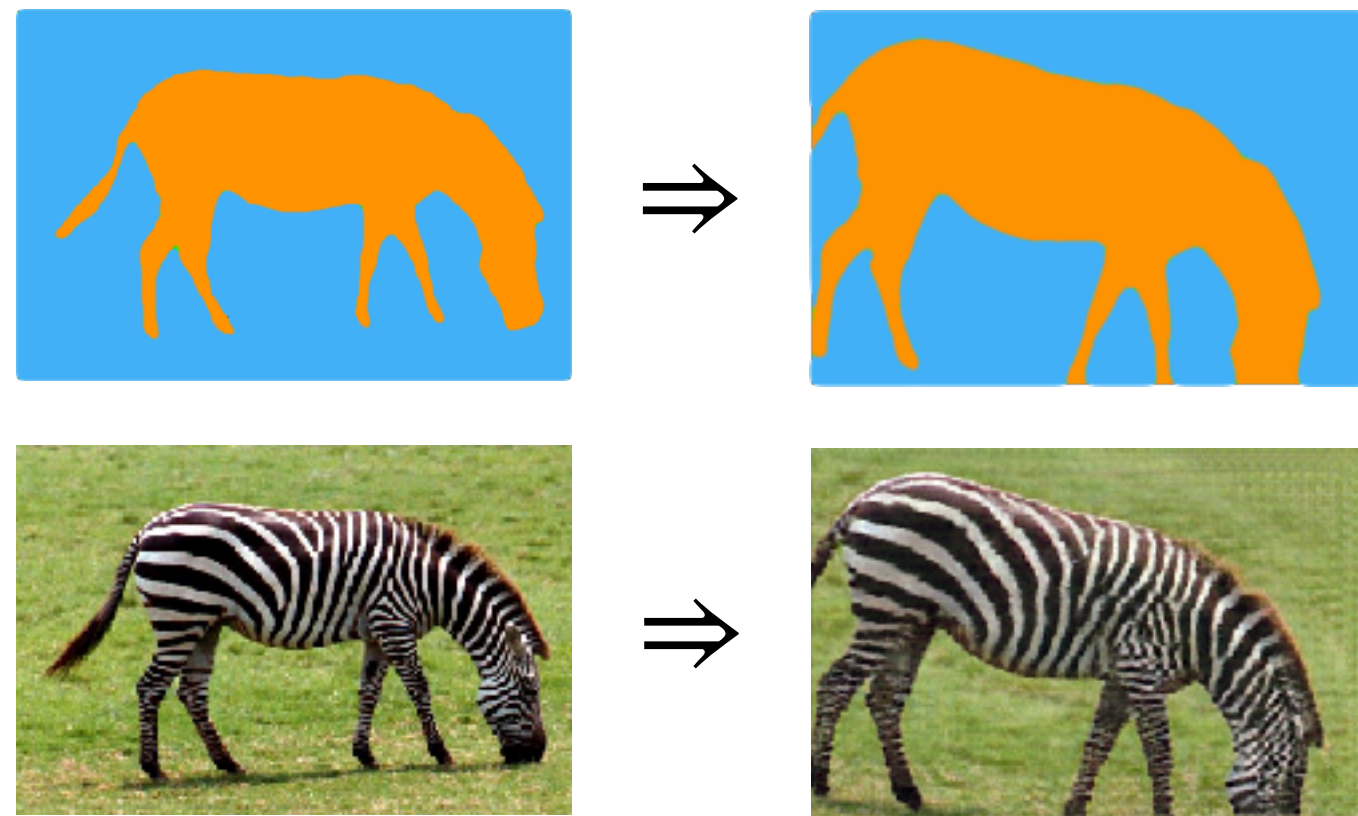
T. Park, *et al.* 2019. Semantic Image Synthesis With Spatially-Adaptive Normalization. In CVPR.
T. Shaham, *et al.* 2019. SinGAN: Learning a Generative Model From a Single Natural Image. In ICCV.

Can we achieve the best from both worlds?



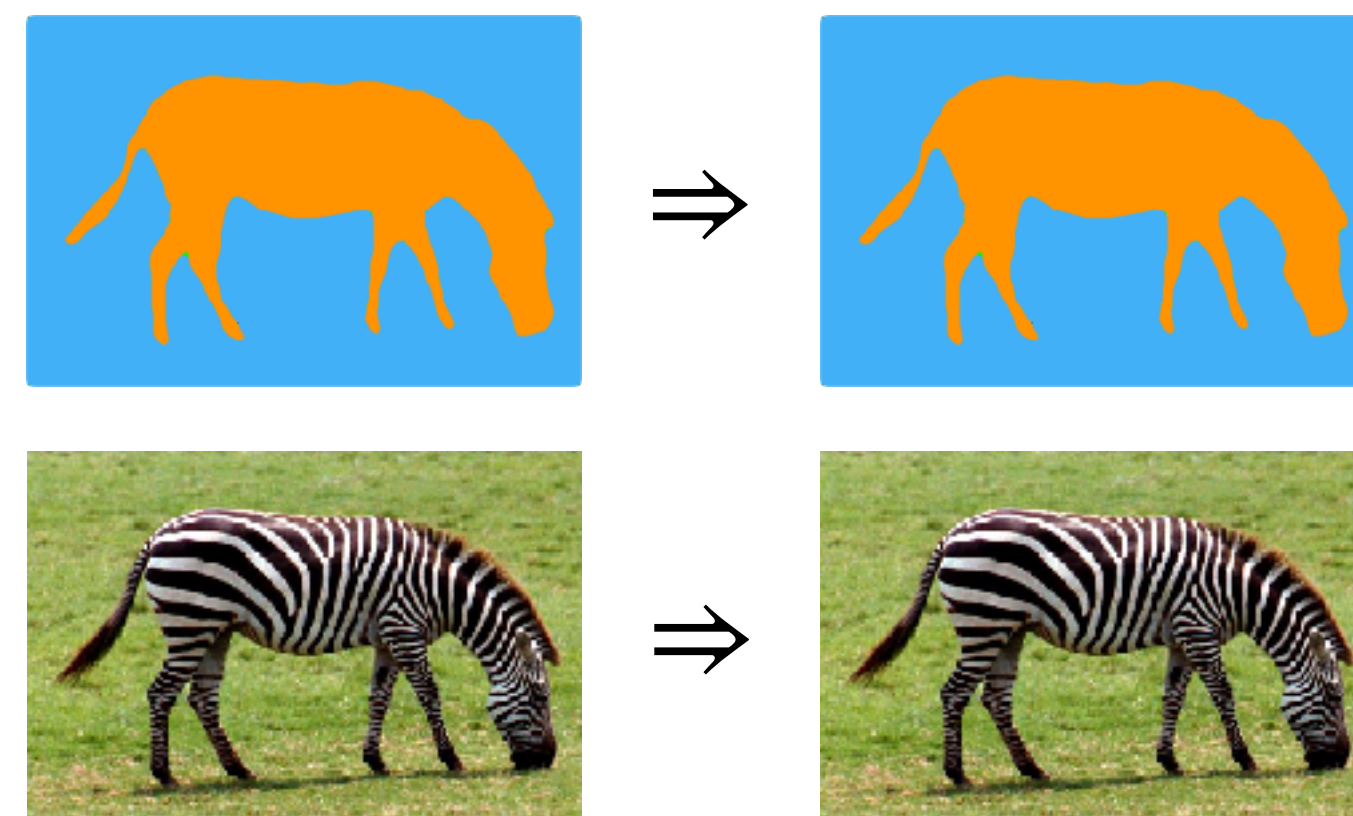
Self-Supervised Learning: Alternating Optimization

Sampling Mode



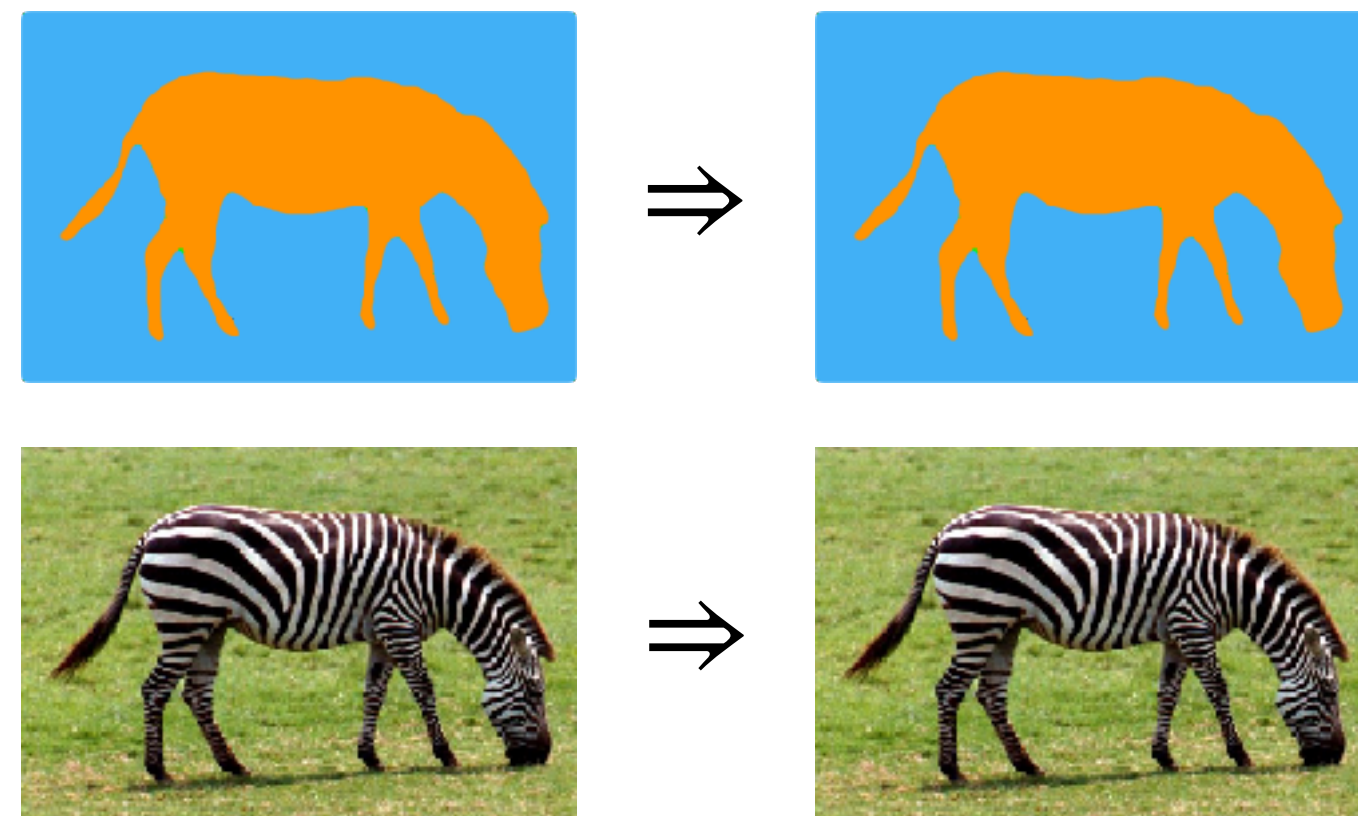
$$P_{source} \Rightarrow P_{aug} :: I_{source} \Rightarrow I_{aug}$$

Reconstruction Mode

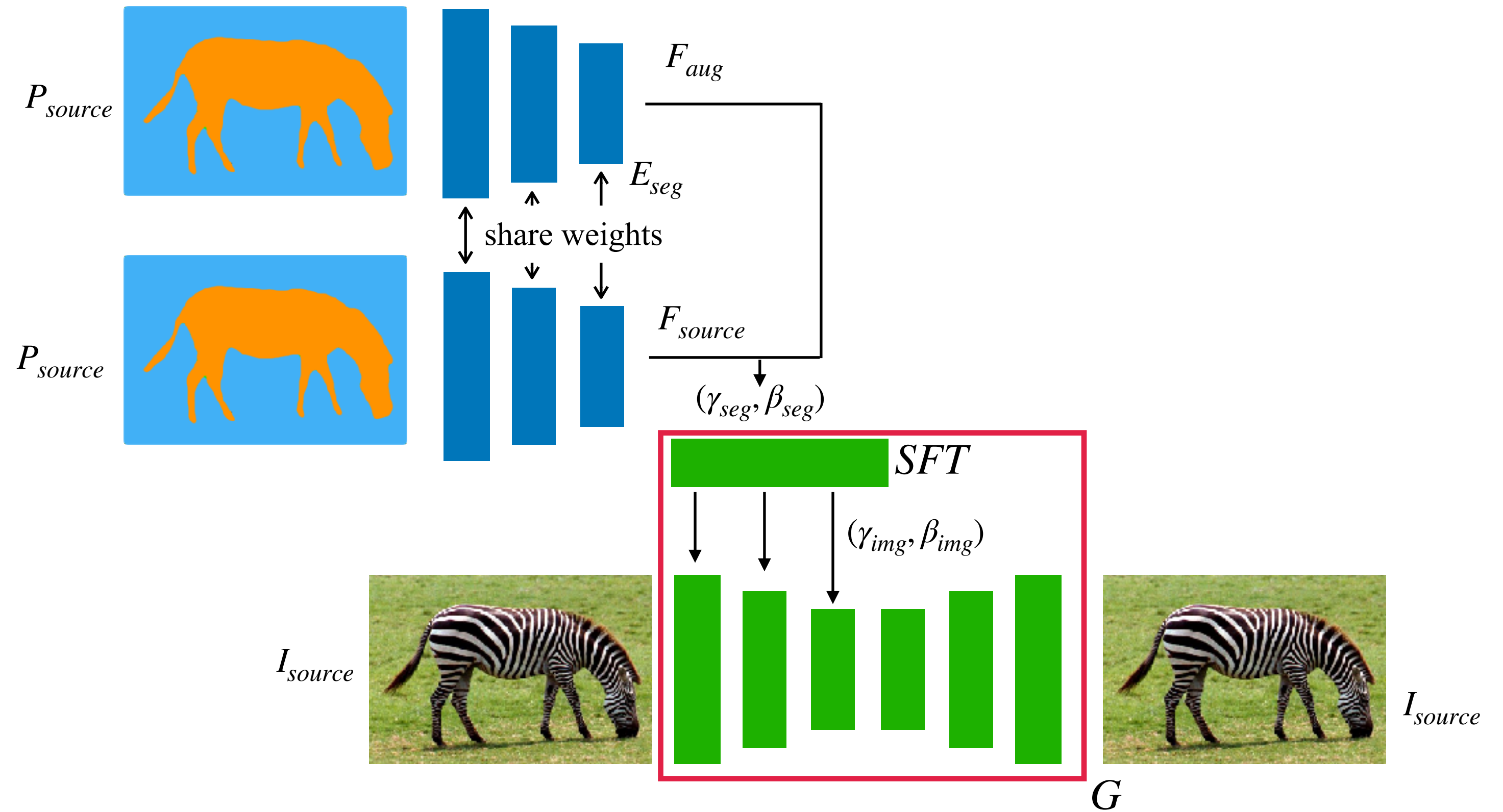


$$P_{source} \Rightarrow P_{source} :: I_{source} \Rightarrow I_{source}$$

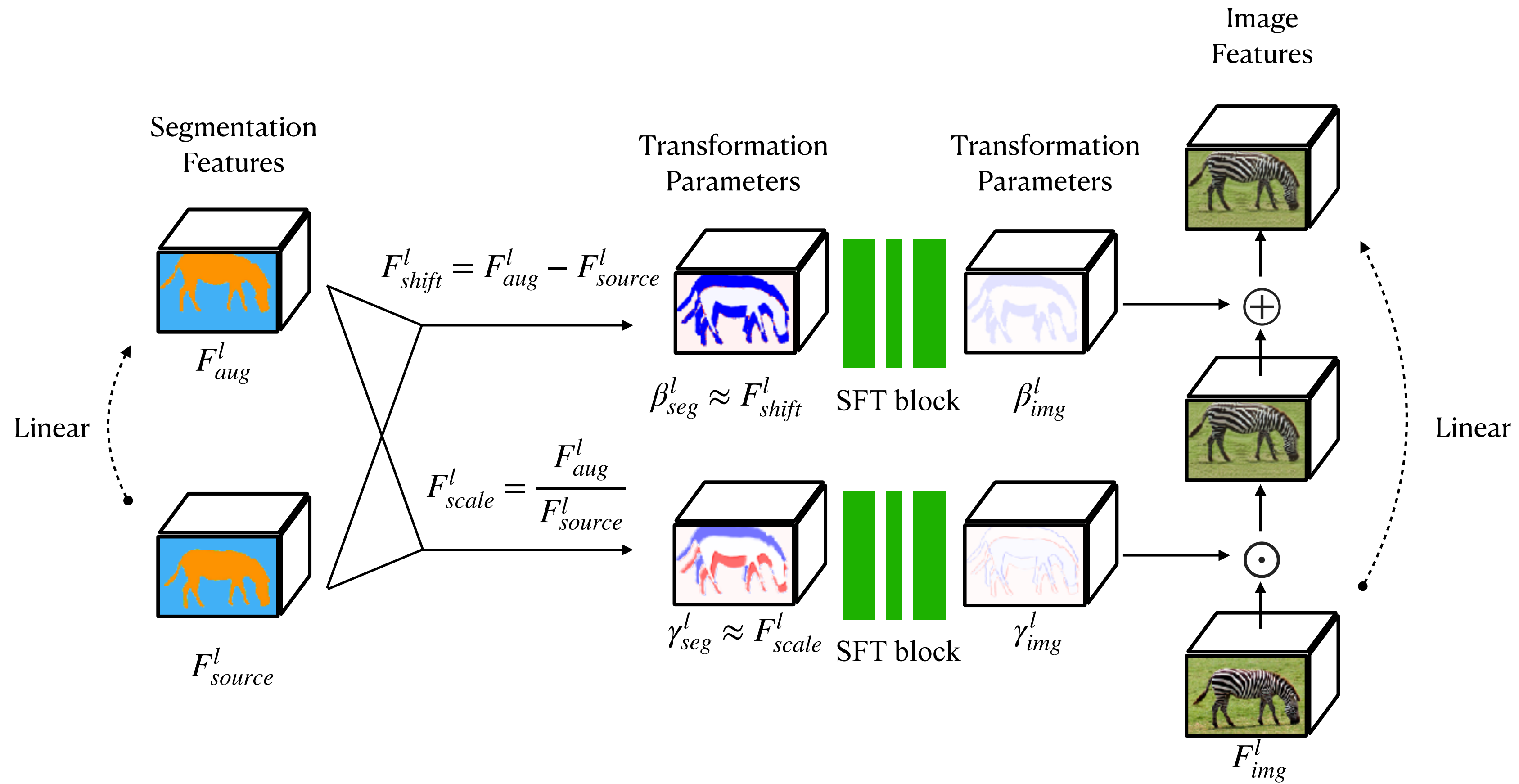
Self-Supervised Learning: Reconstruction Mode



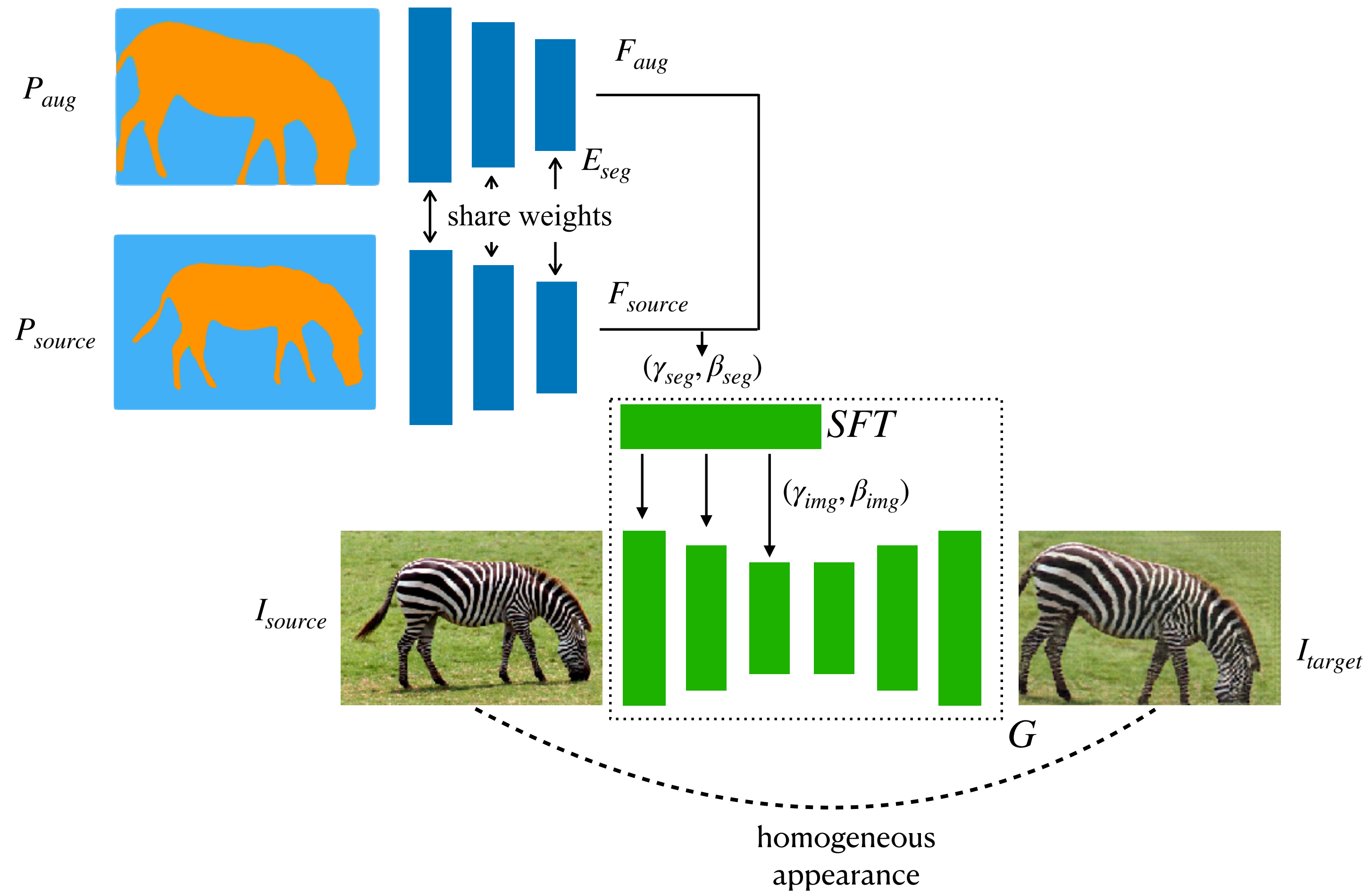
$$P_{source} \Rightarrow P_{source} :: I_{source} \Rightarrow I_{source}$$



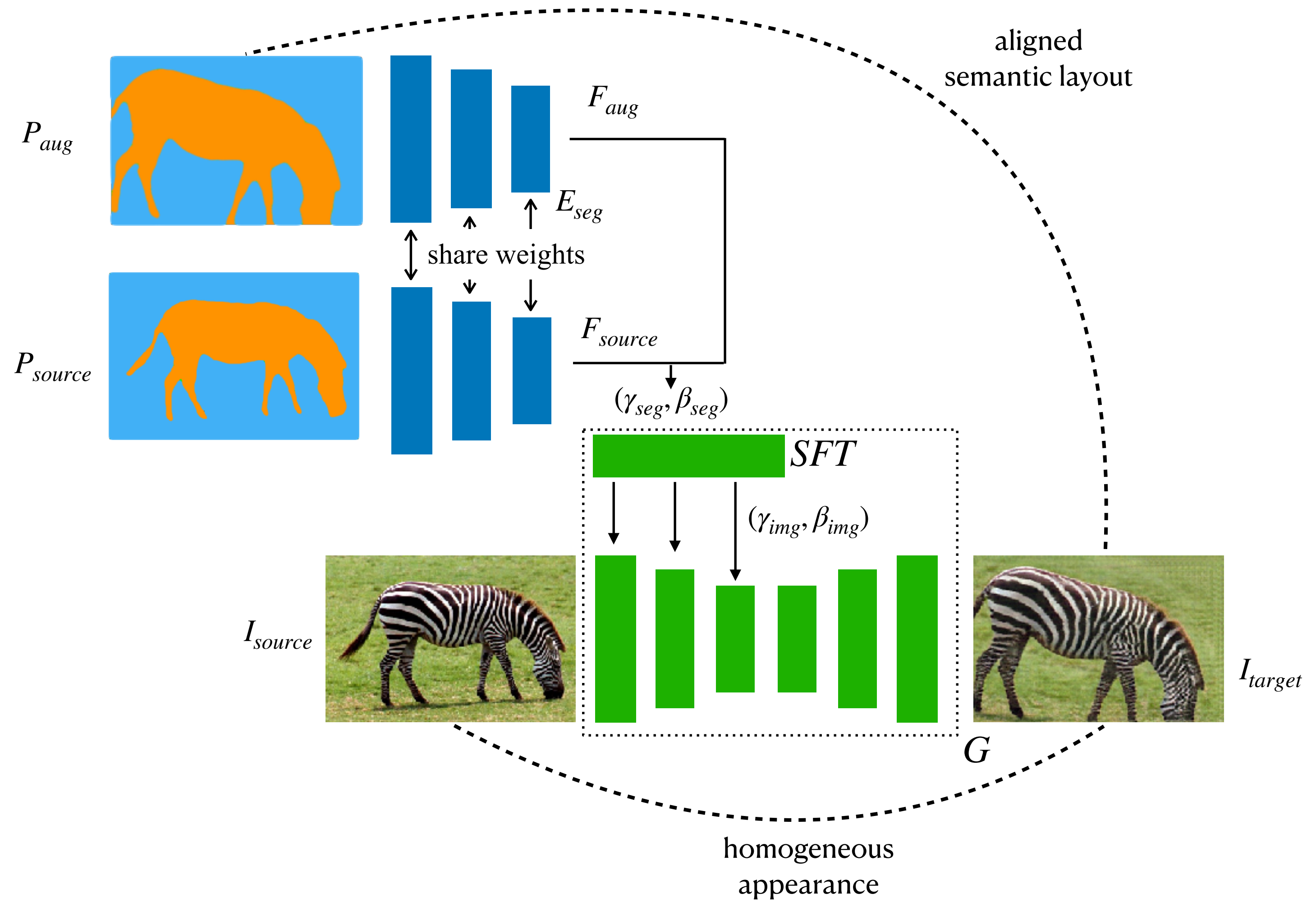
Semantic Feature Translation (SFT) Module



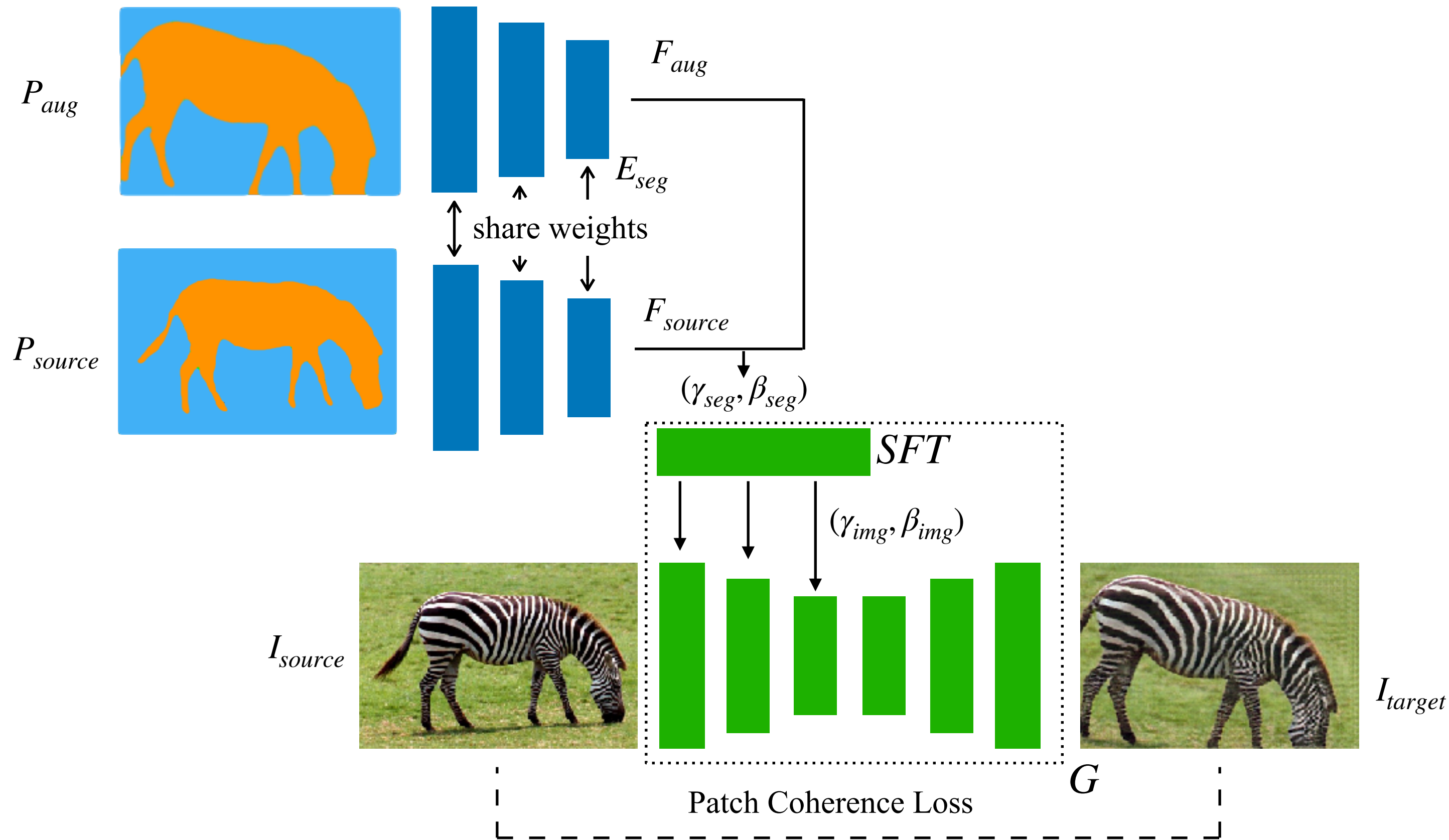
Loss Terms



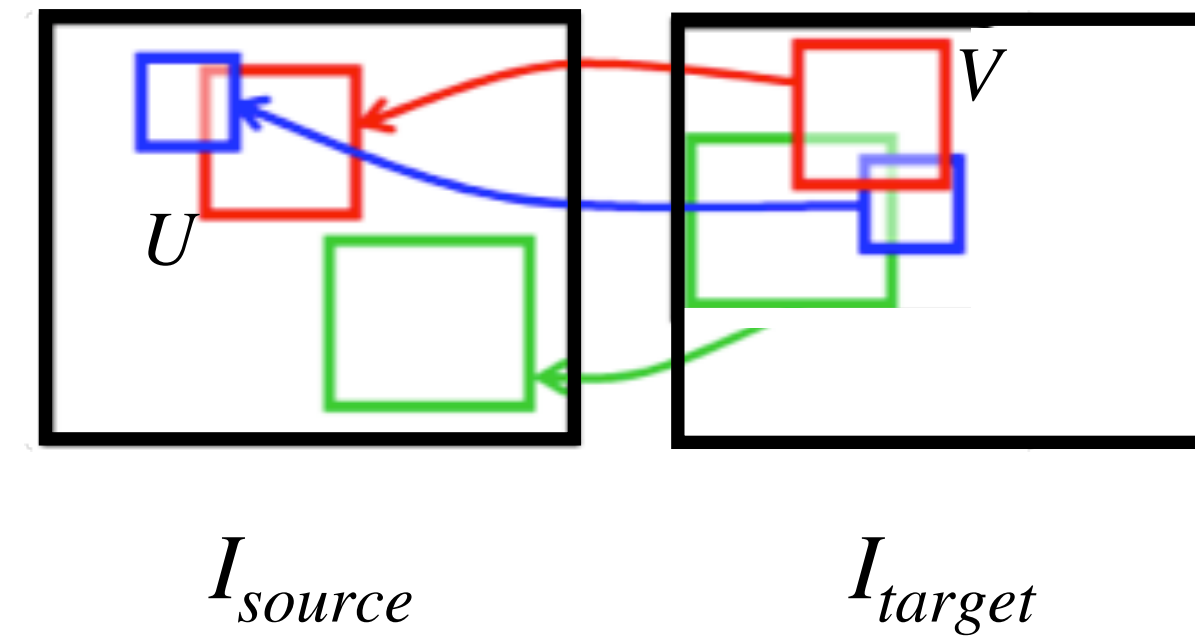
Loss Terms



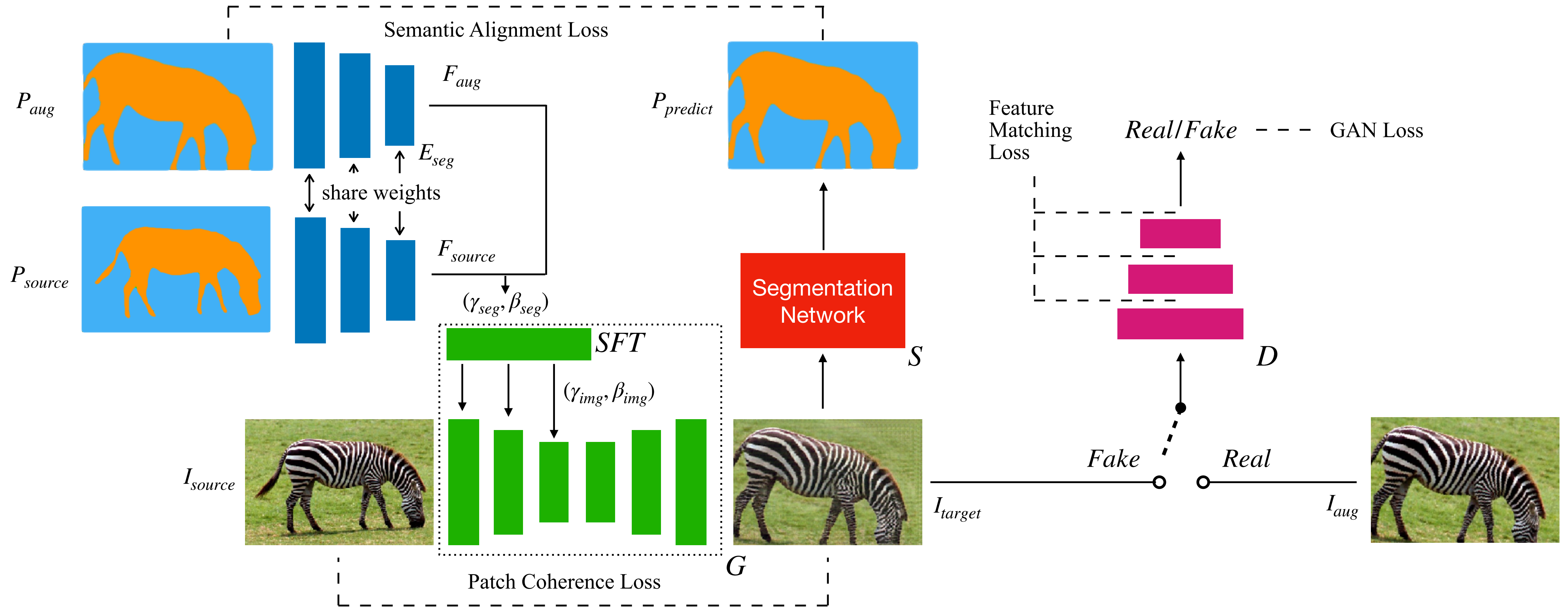
Loss Terms



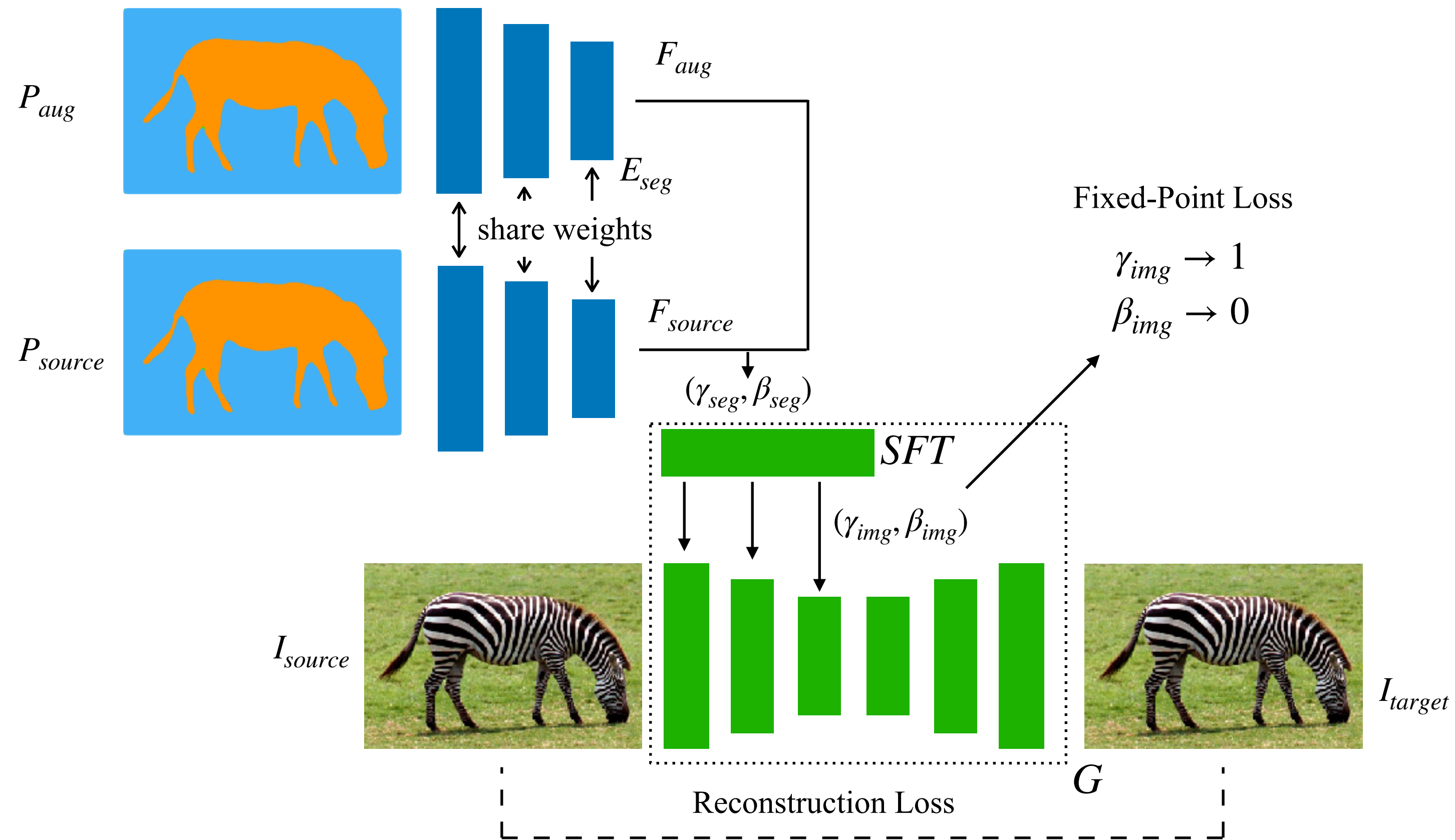
$$\frac{1}{N} \sum_{V \subset I_{target}} \min_{U \subset I_{source}} d(V, U)$$



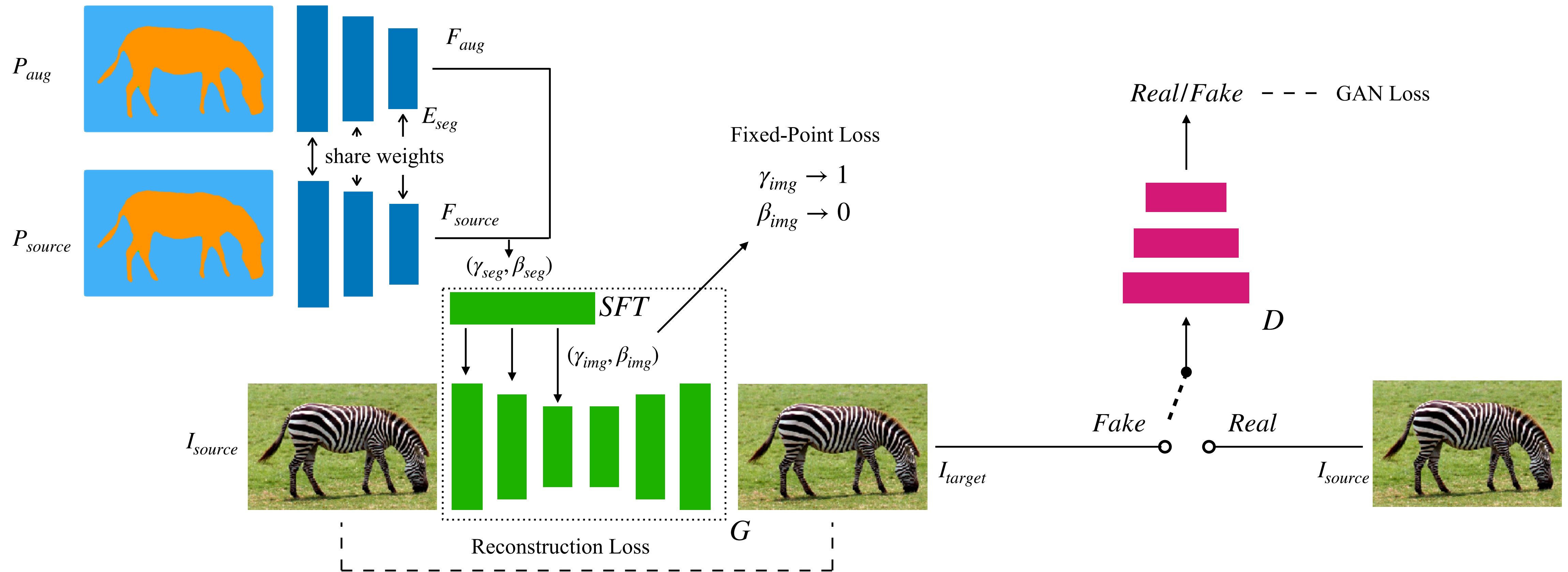
Loss Terms



Loss Terms

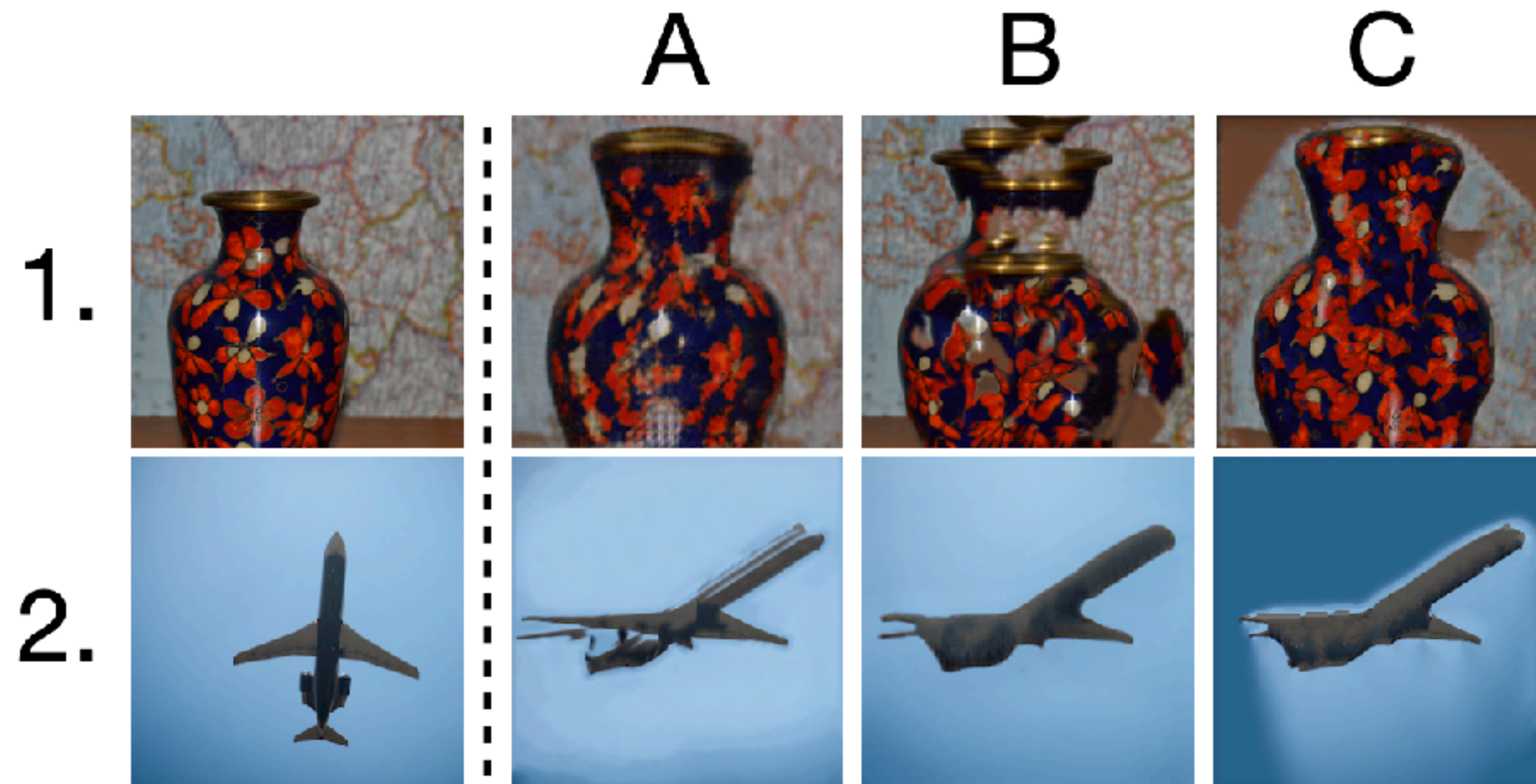


Loss Terms



Evaluation

User Study Interface



Please rank A, B and C by appearance similarity with the left side image.

01

Drag the right sort

- 1 B
- 2 A
- 3 C

02

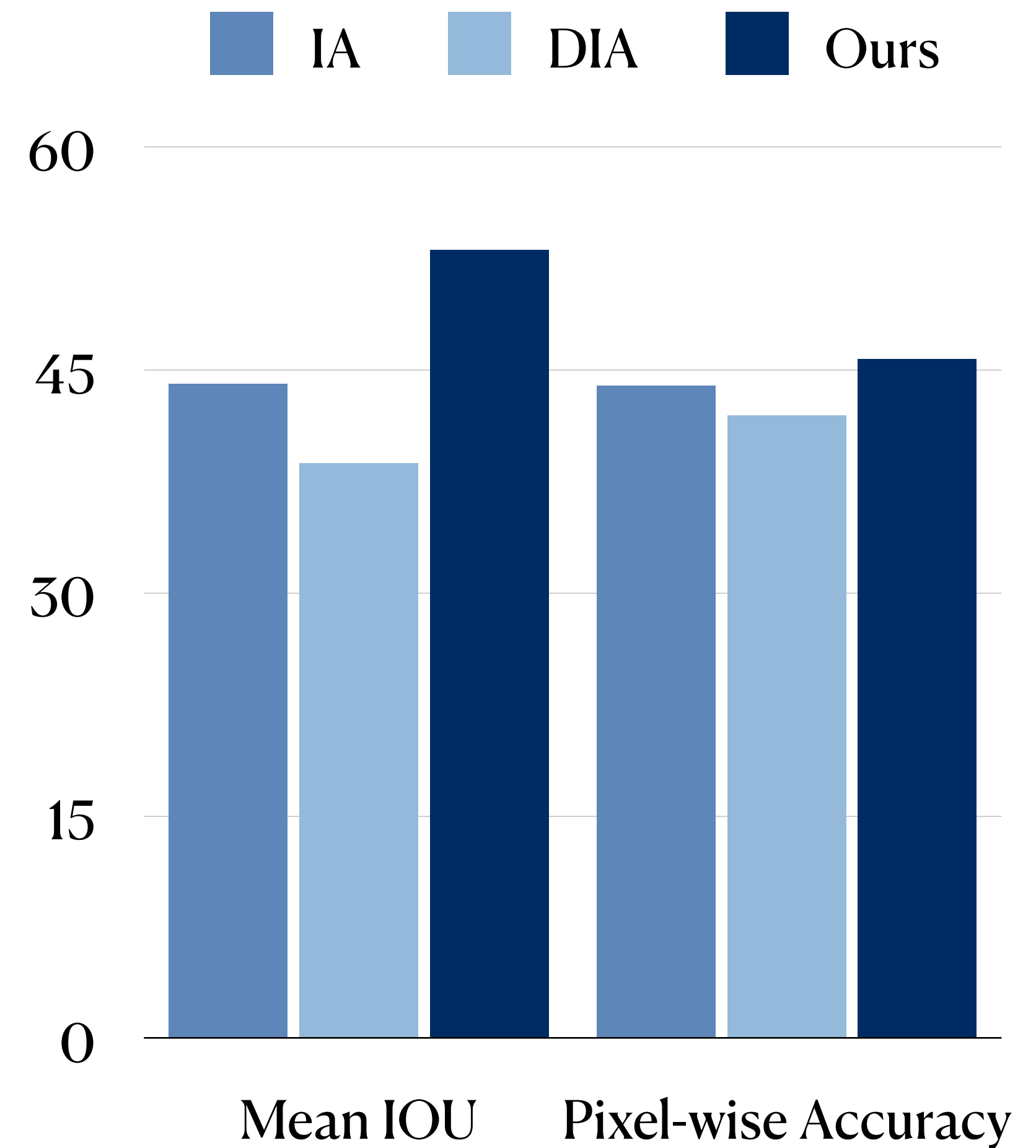
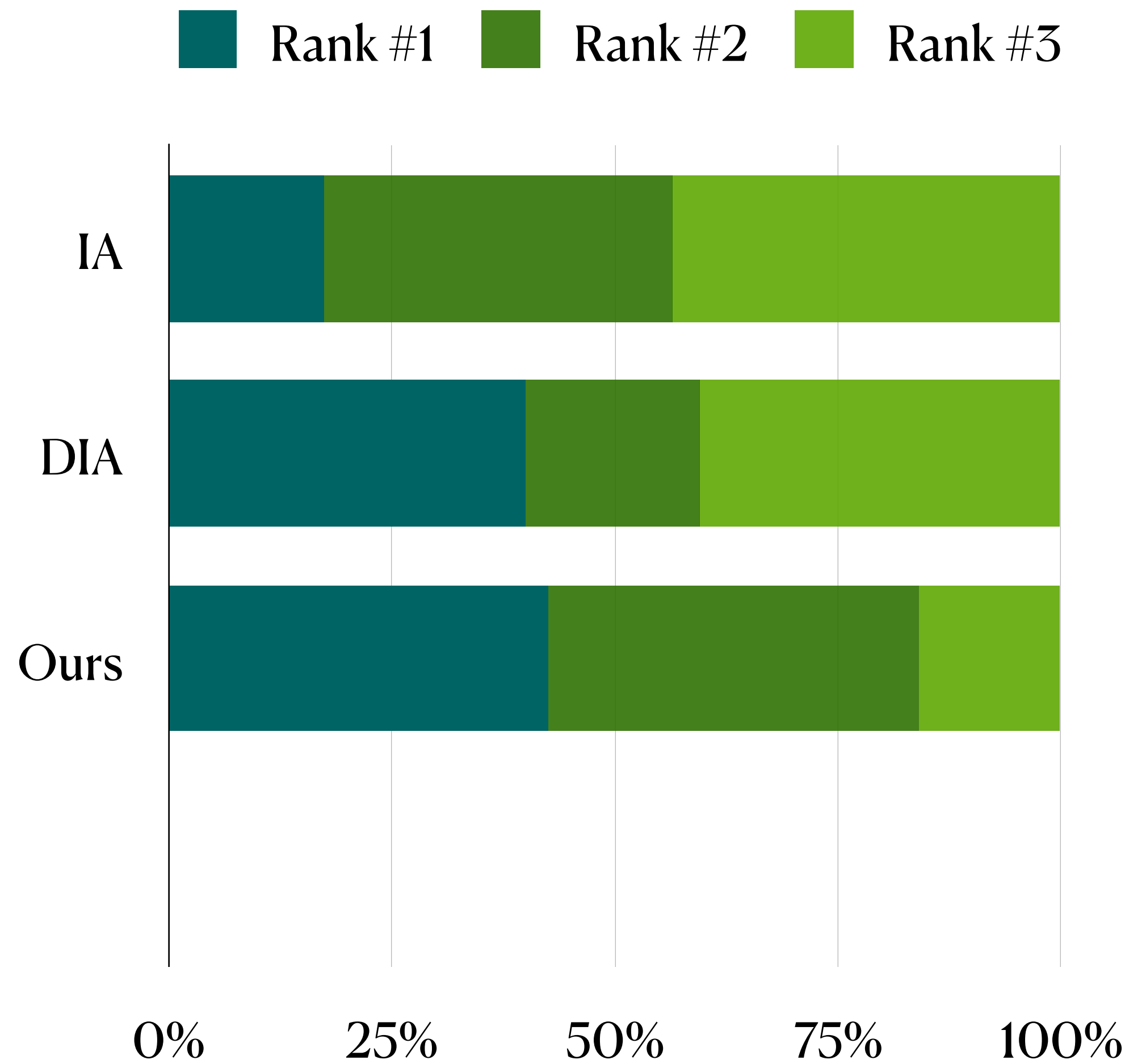
Drag the right sort

- 1 A
- 2 C
- 3 B

A. Hertzmann, *et al.* 2001. Image analogies. ACM Trans. Graph.

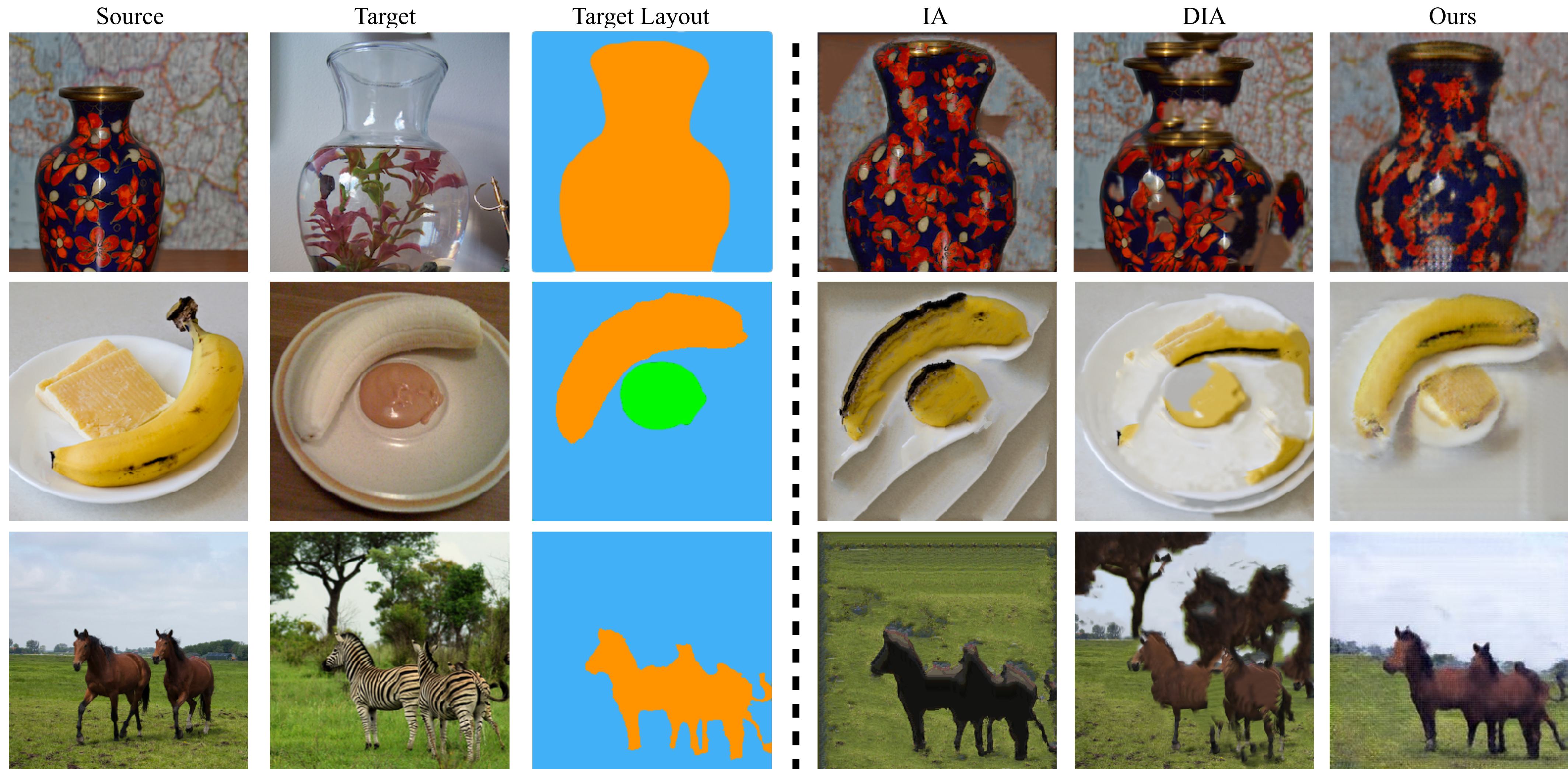
J. Liao, *et al.* 2001. Visual attribute transfer through deep image analogy. ACM Trans. Graph.

Quantitative Comparisons



A. Hertzmann, *et al.* 2001. Image analogies. ACM Trans. Graph.
J. Liao, *et al.* 2001. Visual attribute transfer through deep image analogy. ACM Trans. Graph.

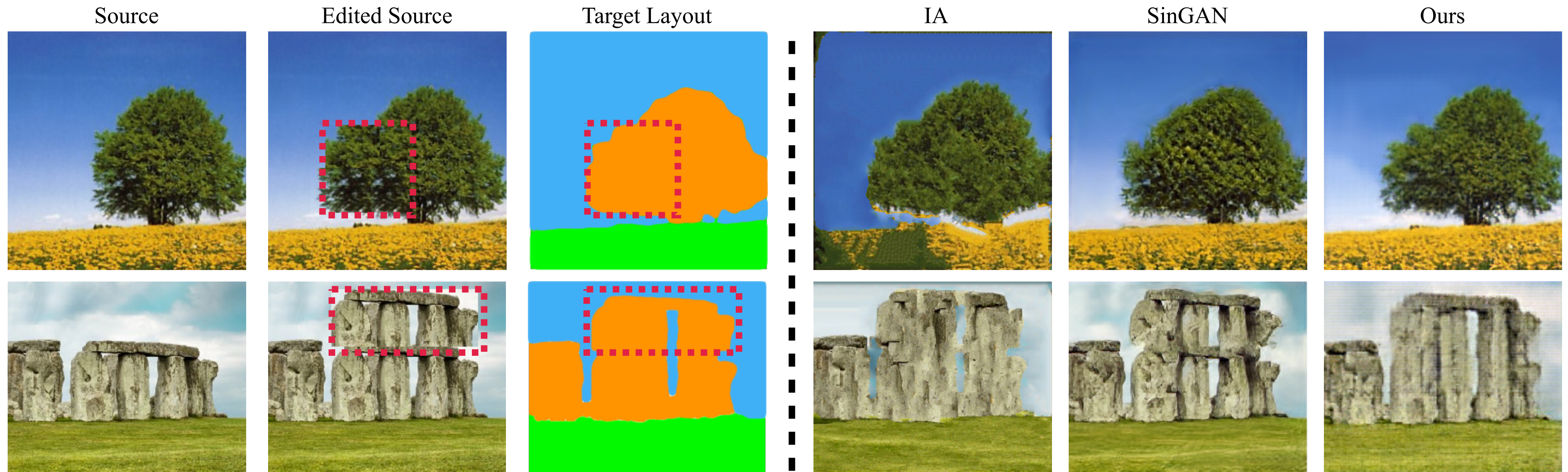
Comparisons with Previous Image Analogies



A. Hertzmann, *et al.* 2001. Image analogies. ACM Trans. Graph.

J. Liao, *et al.* 2001. Visual attribute transfer through deep image analogy. ACM Trans. Graph.

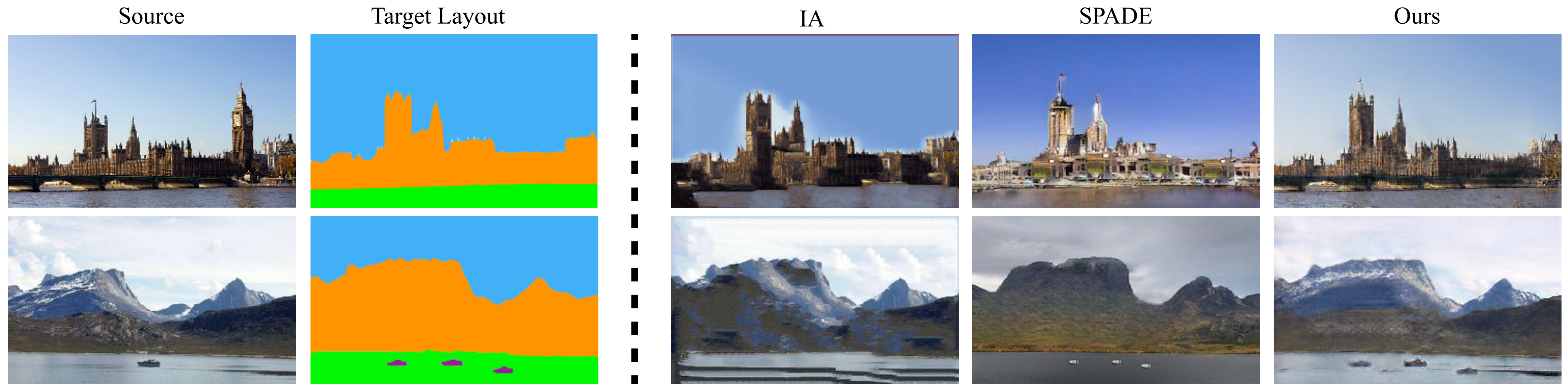
Comparisons with Single-Image GANs



A. Hertzmann, *et al.* 2001. Image analogies. ACM Trans. Graph.

T. Shaham, *et al.* 2019. SinGAN: Learning a Generative Model From a Single Natural Image. In ICCV.

Comparisons with Conditional GANs



A. Hertzmann, *et al.* 2001. Image analogies. ACM Trans. Graph.

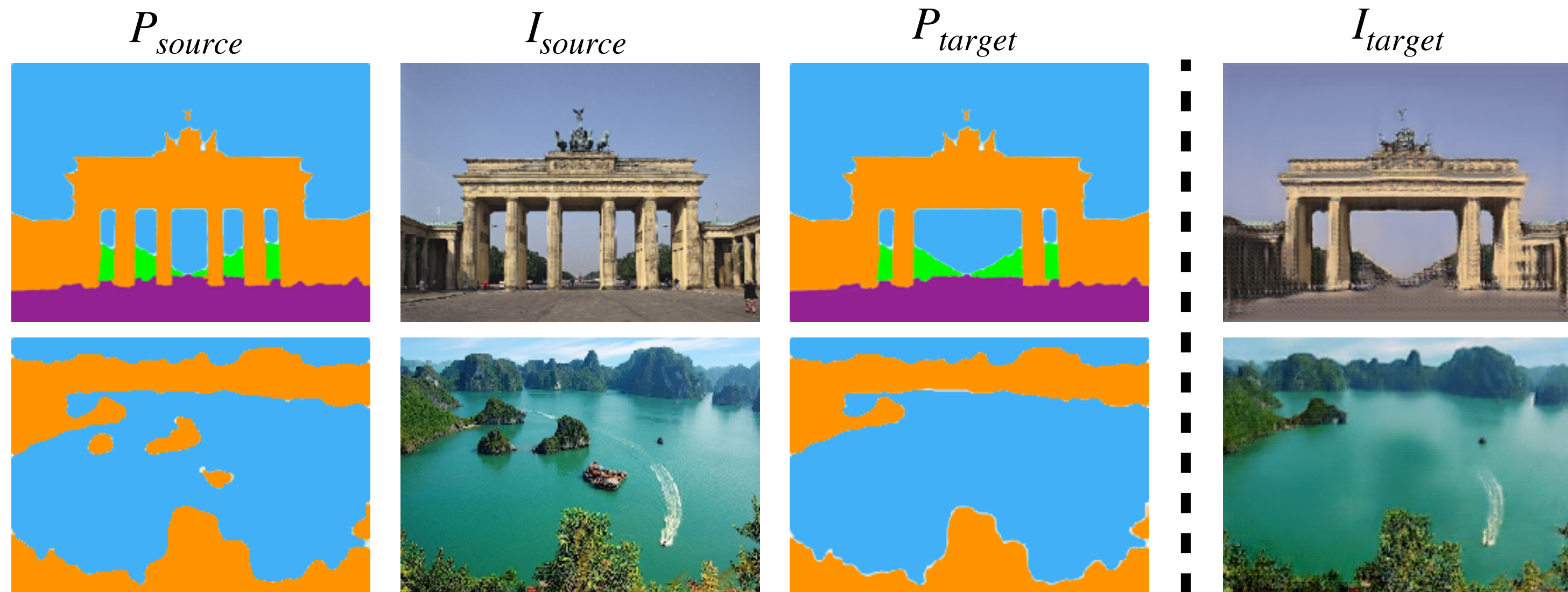
T. Park, *et al.* 2019. Semantic Image Synthesis With Spatially-Adaptive Normalization. In CVPR.

Semantic Manipulation Results



Applications

Object Removal Results



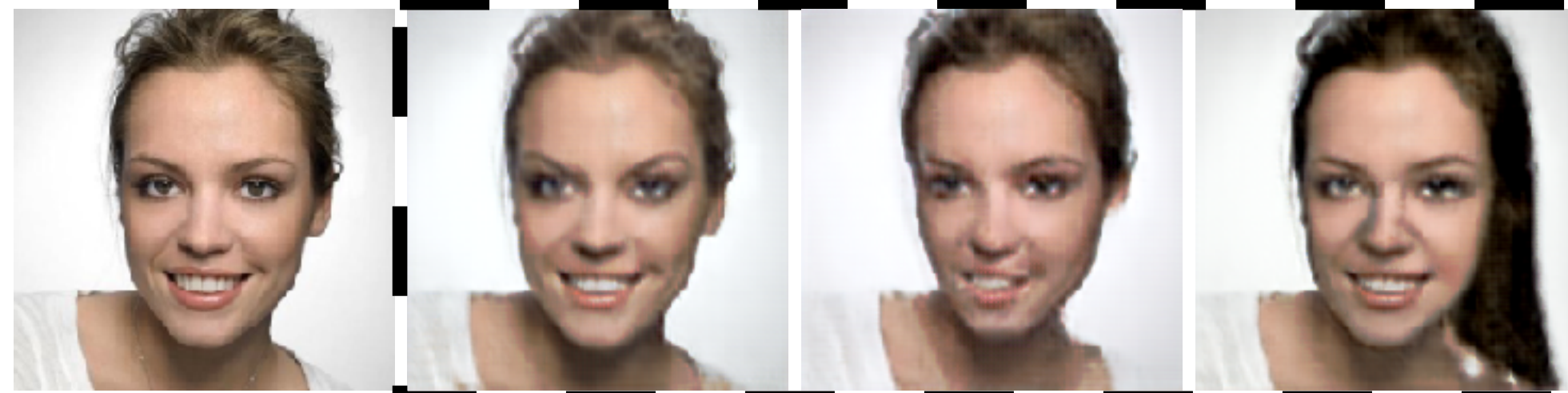
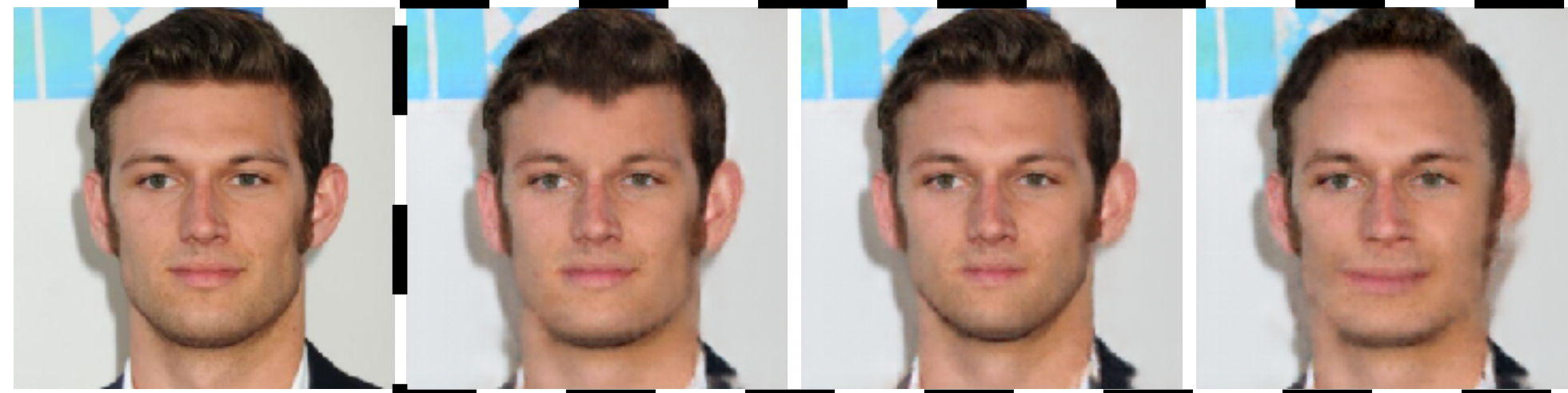
Face Editing Results

Source

Target #1

Target #2

Target #3



Sketch-to-Image Synthesis Results

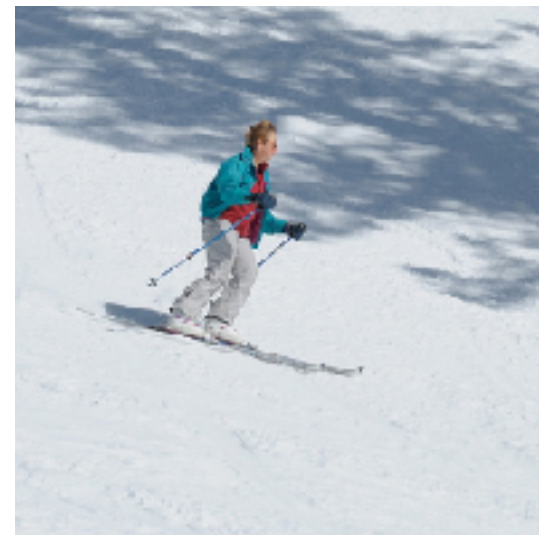


Failure Cases

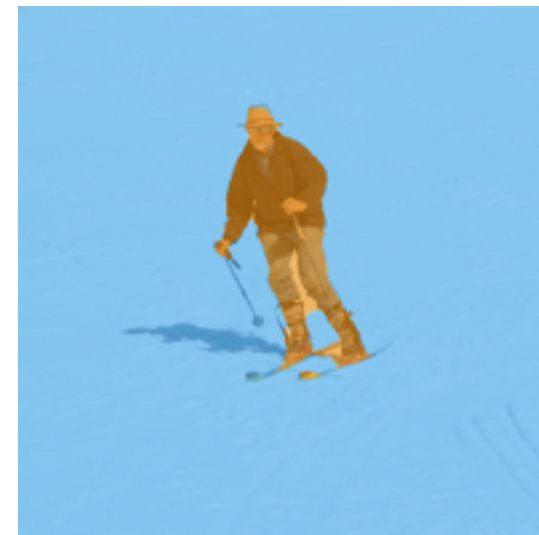
P_{source}



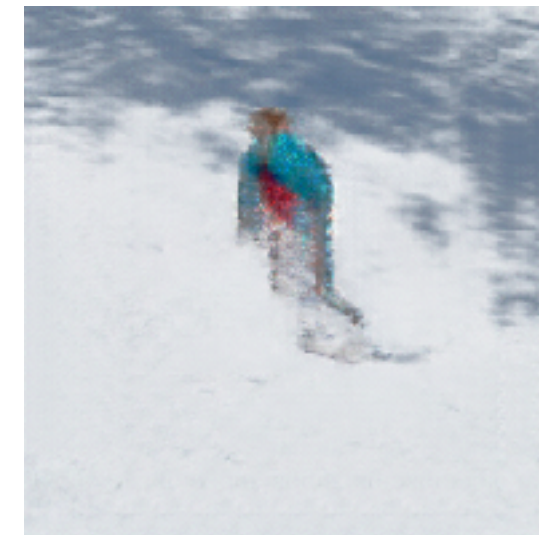
I_{source}



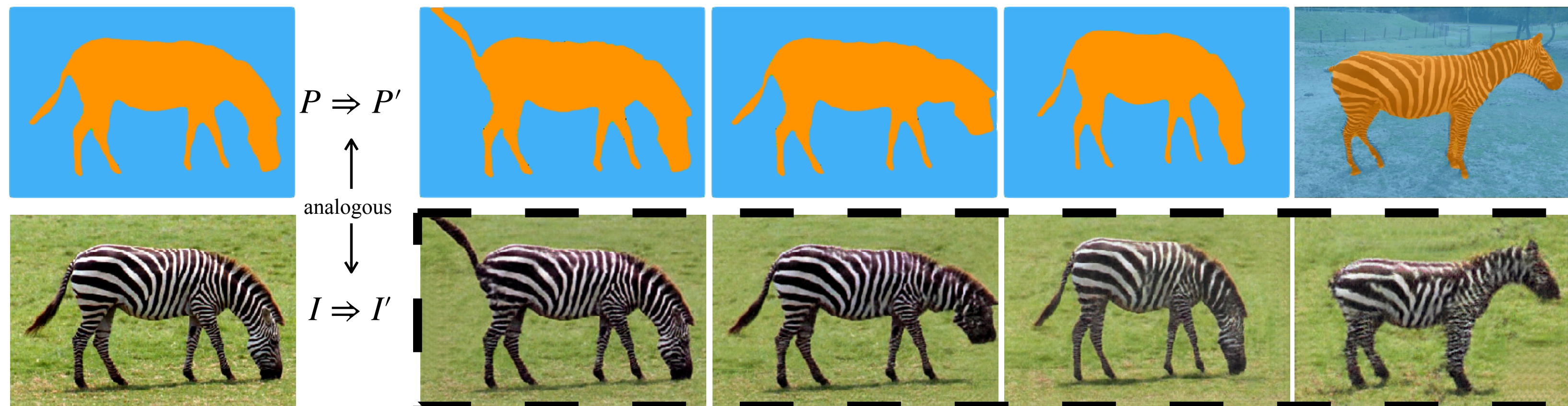
P_{target}



I_{target}



Thank you!



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