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Deep Feature Interpolation for Image Content Change

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Motivation

Basic Idea

Motivation

- ▶ Right picture: add attribute in pixel-space



Motivation

- ▶ Right picture: add attribute in pixel-space
- ▶ New idea: add attribute in deep-feature-space



Basic Idea

How to get the attribute in deep-feature-space?

Basic Idea

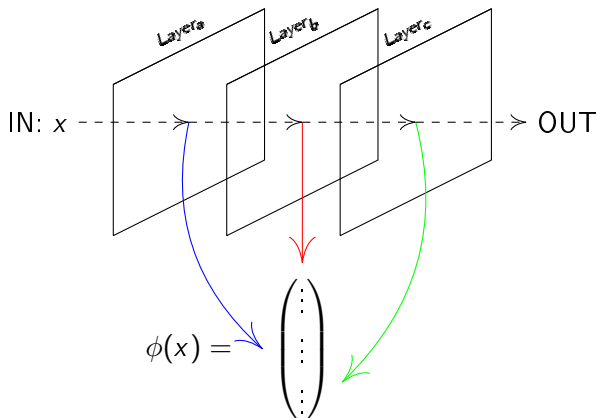
How to get the attribute in deep-feature-space?

- ▶ Let $\phi(x)$ be the mapping from pixel-space into deep-feature-space by concatenating an arbitrary number of layers

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- ▶ Take k nearest neighbor images with existing attribute: S^+
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- ▶ Build the mean $\overline{\phi^+}$ and $\overline{\phi^-}$

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- ▶ Take k nearest neighbor images with missing attribute: S^-
- ▶ $\phi^+ = \phi(S^+)$ and $\phi^- = \phi(S^-)$
- ▶ Build the mean $\overline{\phi^+}$ and $\overline{\phi^-}$
- ▶ Representation of attribute: $w = \overline{\phi^+} - \overline{\phi^-}$

Basic Idea

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- ▶ $\phi(z) = \phi(x) + \alpha w$
- ▶ Reverse mapping of $\phi(z)$ into pixel space:

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- ▶ $\phi(z) = \phi(x) + \alpha w$
- ▶ Reverse mapping of $\phi(z)$ into pixel space:
 - ▶ $\tilde{z} = \operatorname{argmin}_{\tilde{z}} \frac{1}{2} \|\phi(z) - \phi(\tilde{z})\|_2^2 + \lambda R_\beta(\tilde{z})$
 - ▶ with $R_\beta(\tilde{z}) = \sum_{i,j} ((\tilde{z}_{i,j+1} - \tilde{z}_{i,j})^2 + (\tilde{z}_{i+1,j} - \tilde{z}_{i,j})^2)^{\frac{\beta}{2}}$

Practical

- ▶ Model VGG19 pretrained on IMAGENET dataset
- ▶ $\phi(x)$ using the third, fourth and fifth Relu Layer
- ▶ $\beta = 2$ and $\lambda = 0.001$ for the regularization term
- ▶ Tests on LFW dataset