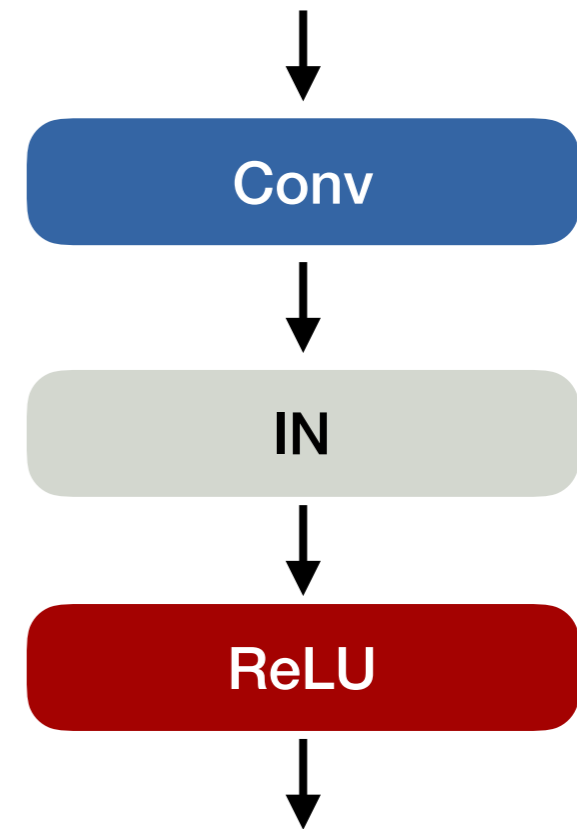


# Instance normalization

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# Instance normalization

- Batch norm per input



Ulyanov, Dmitry, Andrea Vedaldi, and Victor Lempitsky. "Instance normalization: The missing ingredient for fast stylization." arXiv 2016.

# Instance normalization

$$\mathbf{Z} \in \mathbb{R}^{B \times W \times H \times C}$$



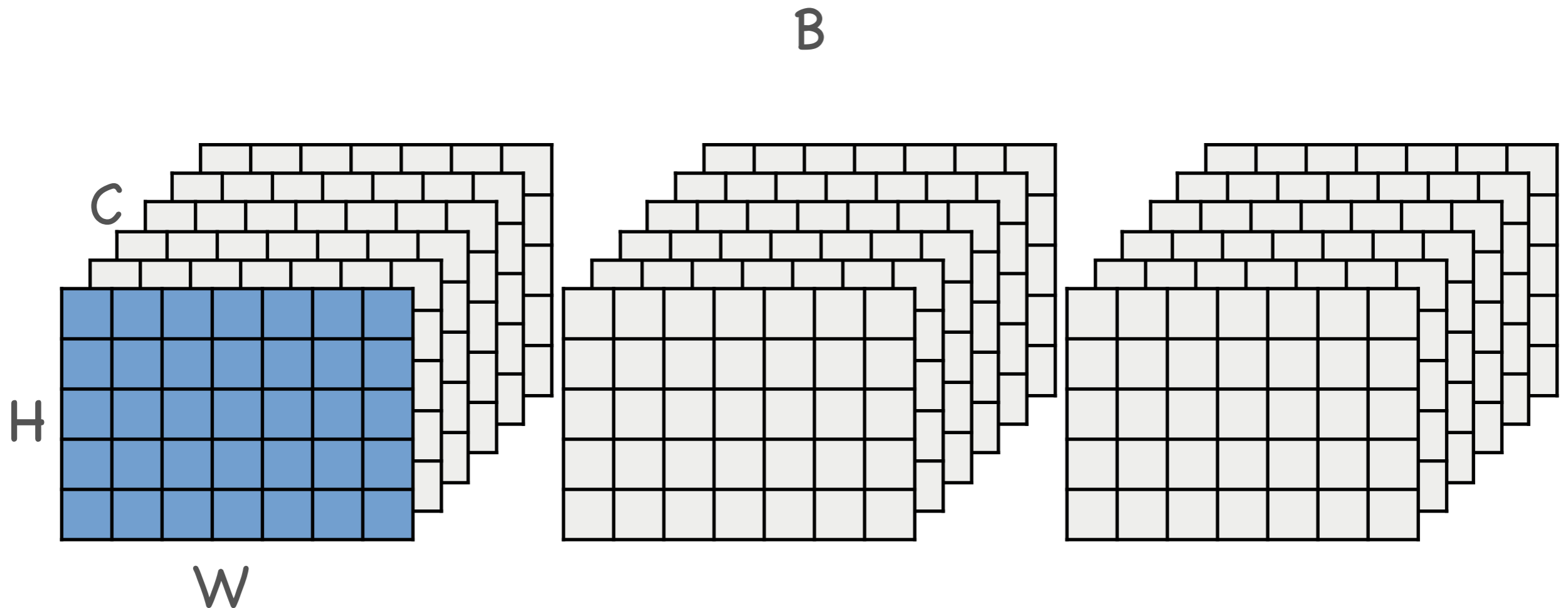
$$\frac{\mathbf{Z}_{k,x,y,c} - \mu_{kc}}{\sigma_{kc}}$$

- Normalize by spatial mean  $\mu_{kc}$  and standard deviation  $\sigma_{kc}$

$$\mu_{kc} = \frac{1}{WH} \sum_{x,y} \mathbf{Z}_{k,x,y,c}$$

$$\sigma_{kc}^2 = \frac{1}{WH} \sum_{x,y} (\mathbf{Z}_{k,x,y,c} - \mu_{kc})^2$$

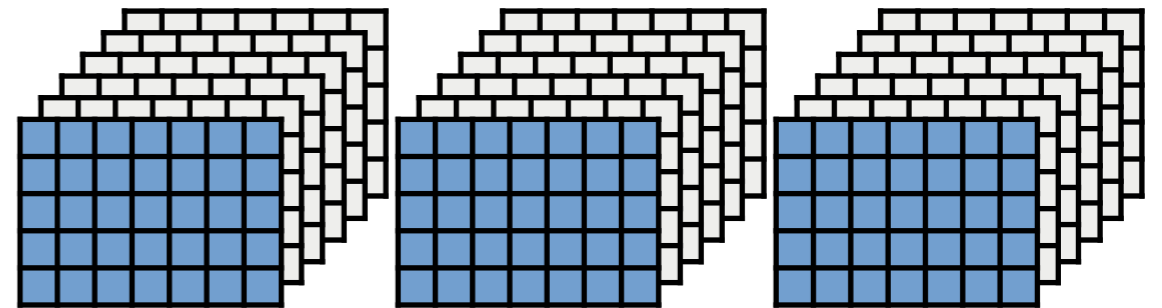
# What does instance normalization do?



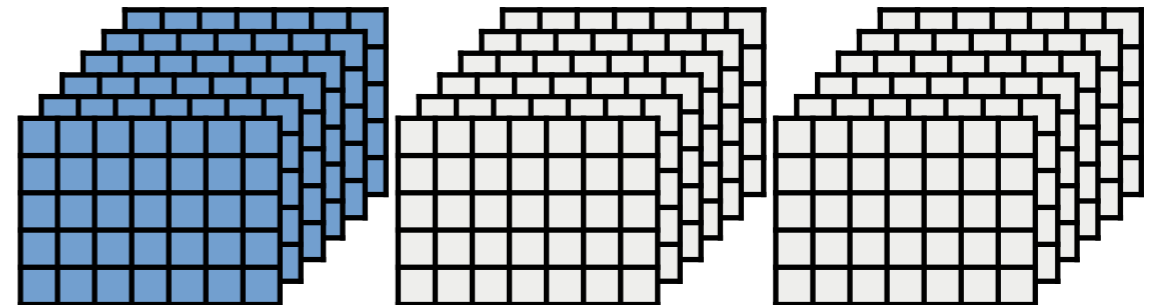
# Comparison to batch norm

- No summing over batches
- Works well for graphics applications
- Not used much in recognition
  - Unstable statistics

batch norm



layer norm



instance norm

