

Designing Descriptors

16-385 Computer Vision (Kris Kitani)
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Feature matching is important for tasks like...

Object instance recognition



Schmid and Mohr 1997



Sivic and Zisserman, 2003

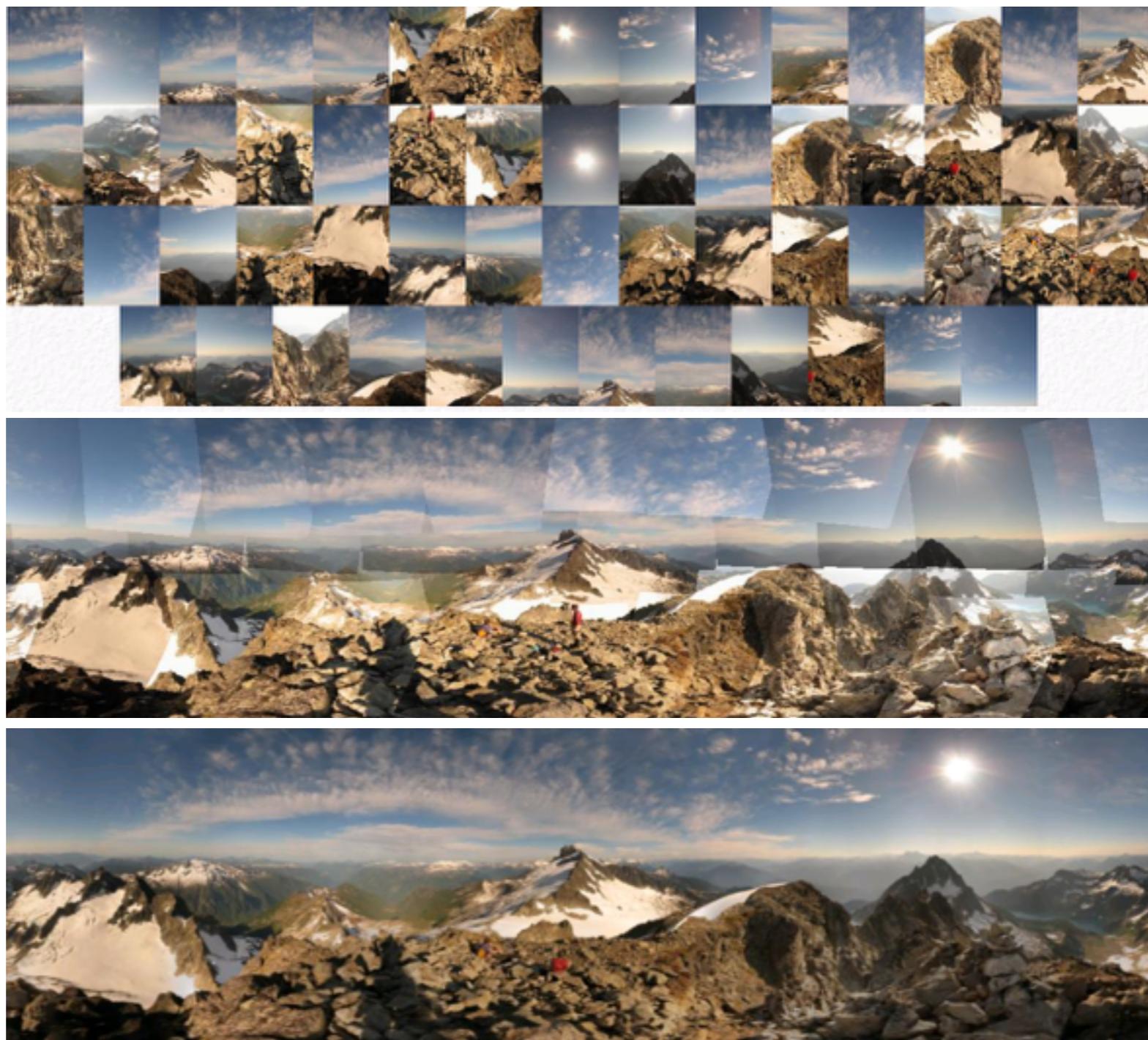


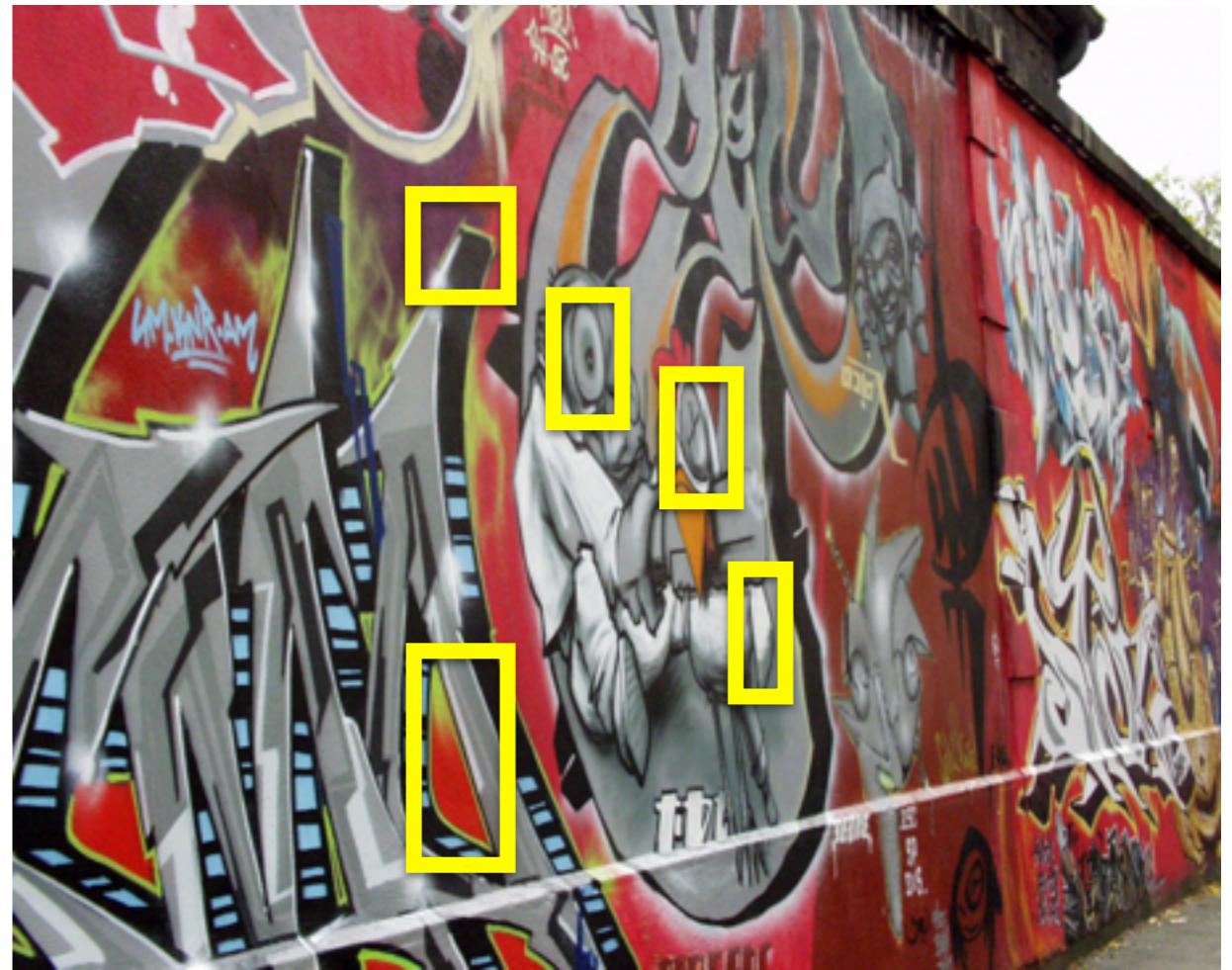
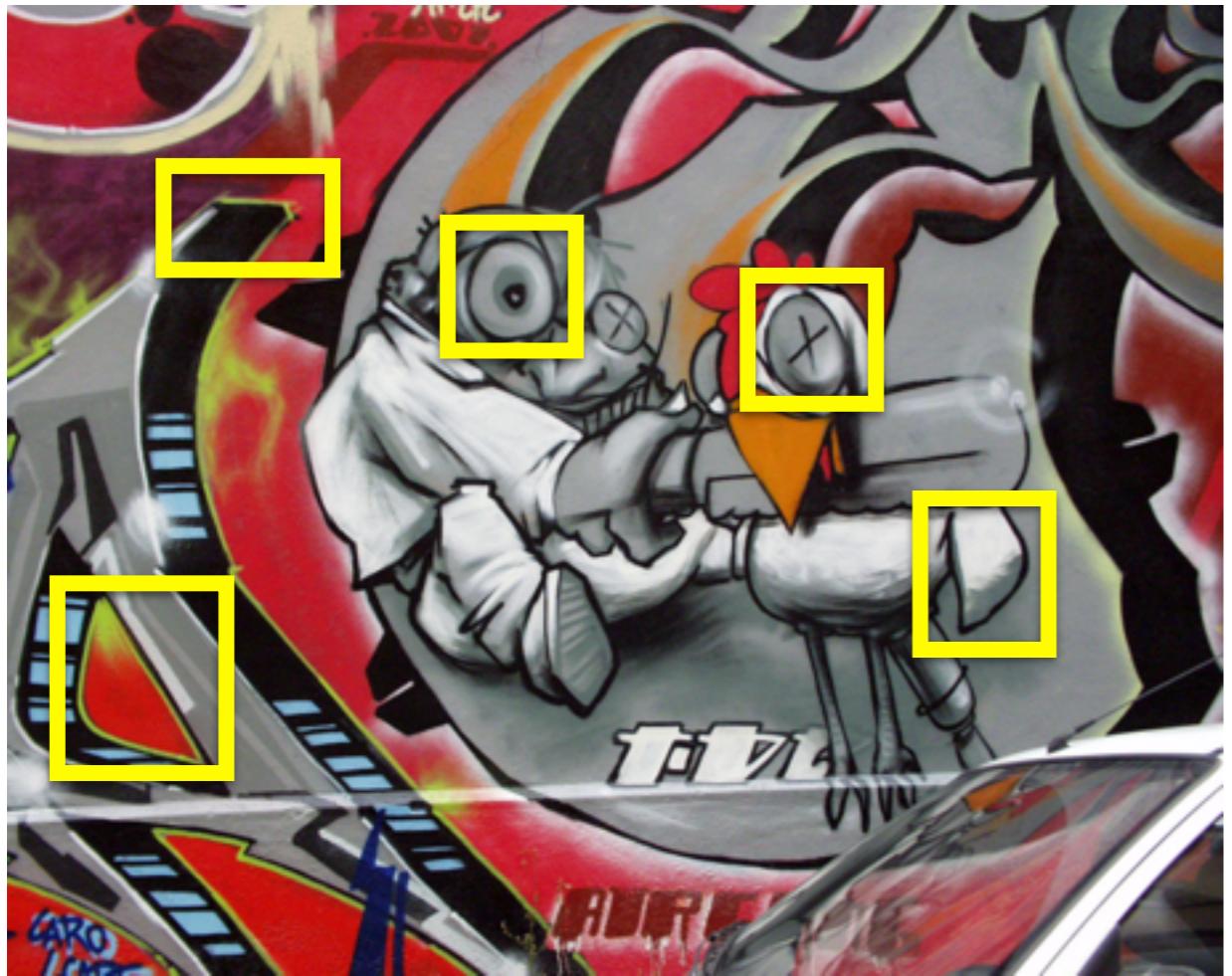
Rothganger et al. 2003



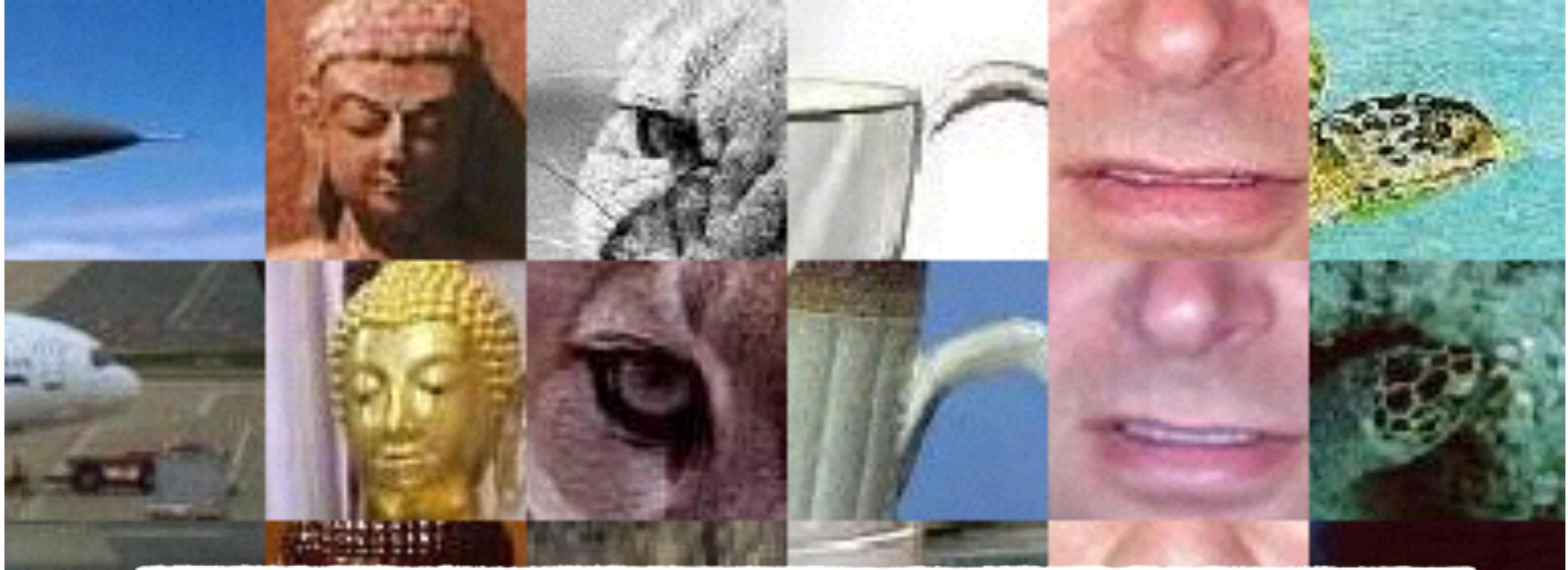
Lowe 2002

Image mosaicing



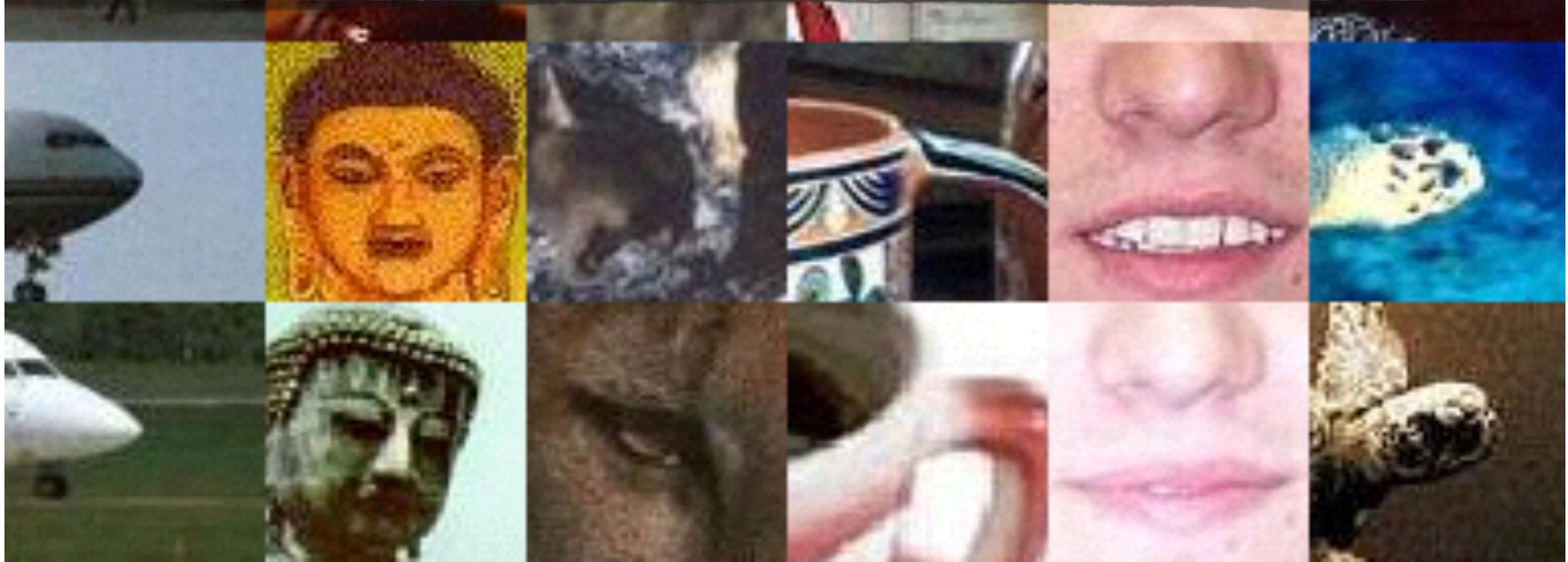


If we know where the good features are,
how do we match them?



How do we describe an image patch?

Patches with similar content should have similar descriptors.

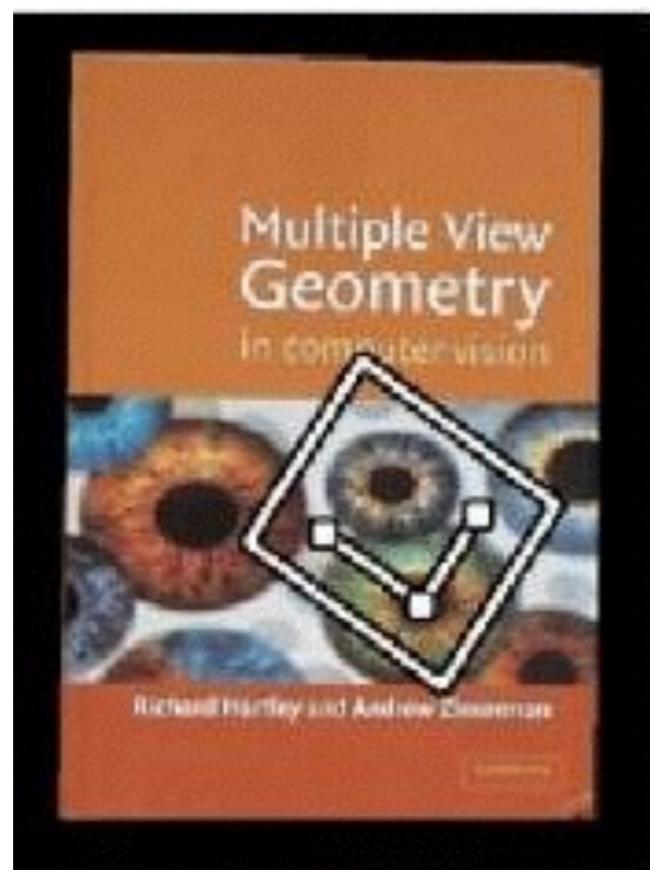


Challenges of designing a feature descriptor

Photometric transformations



Geometric transformations



objects will appear at different scales,
translation and rotation

Designing a feature descriptor

(the search for image invariants)



What is the best descriptor for an image feature?

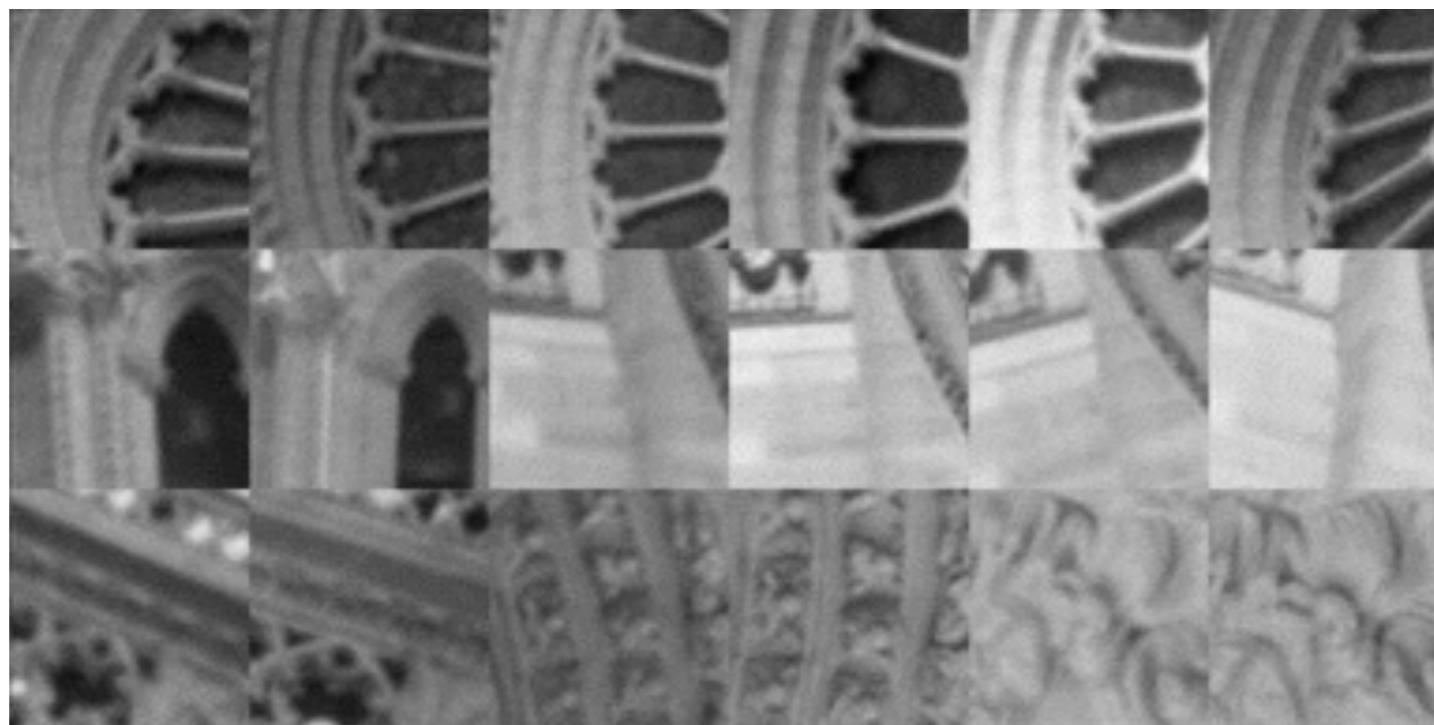


Image patch

Just use the pixel values of the patch



Perfectly fine if geometry and appearance is unchanged
(a.k.a. template matching)

What are the problems?

Image patch

Just use the pixel values of the patch



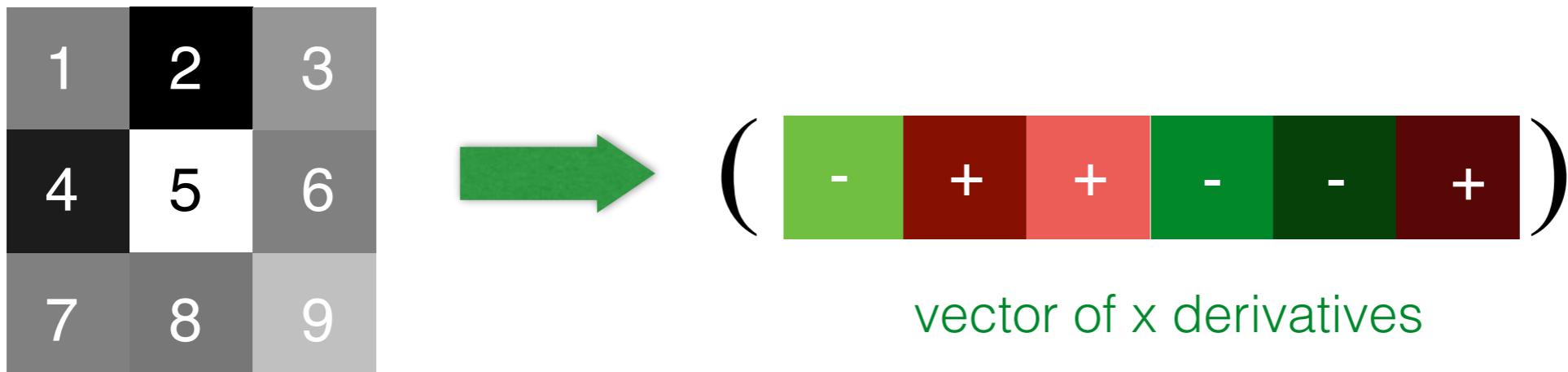
Perfectly fine if geometry and appearance is unchanged
(a.k.a. template matching)

What are the problems?

How can you be less sensitive to absolute intensity values?

Image gradients

Use pixel differences

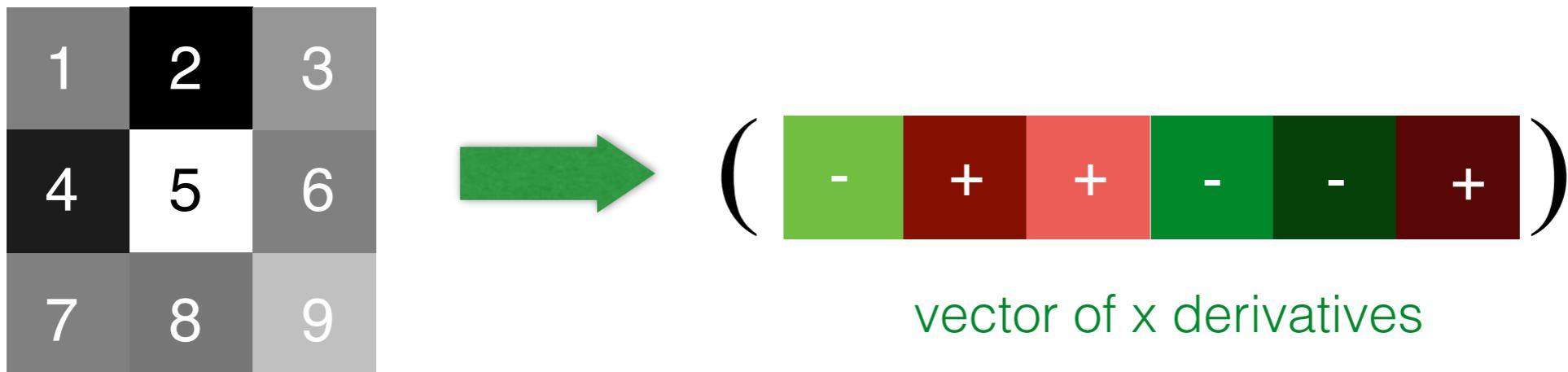


Feature is invariant to absolute intensity values

What are the problems?

Image gradients

Use pixel differences



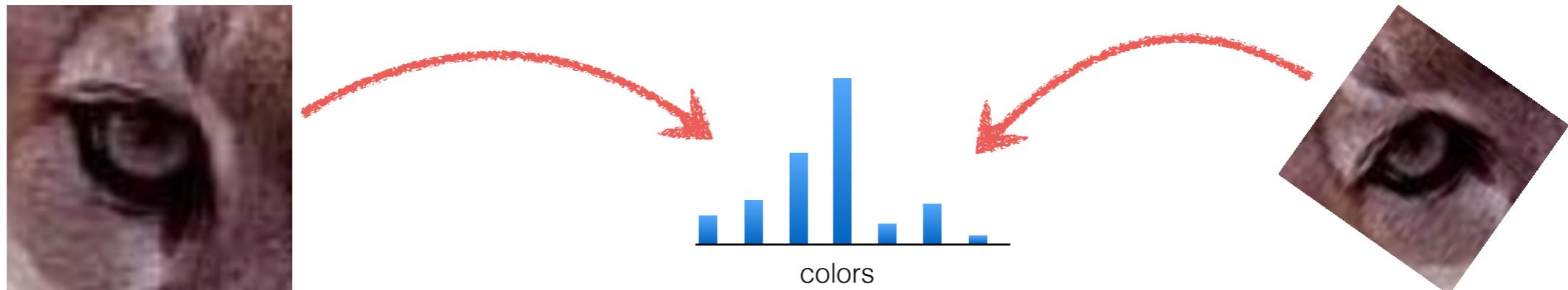
Feature is invariant to absolute intensity values

What are the problems?

How can you be less sensitive to deformations?

Color histogram

Count the colors in the image using a histogram

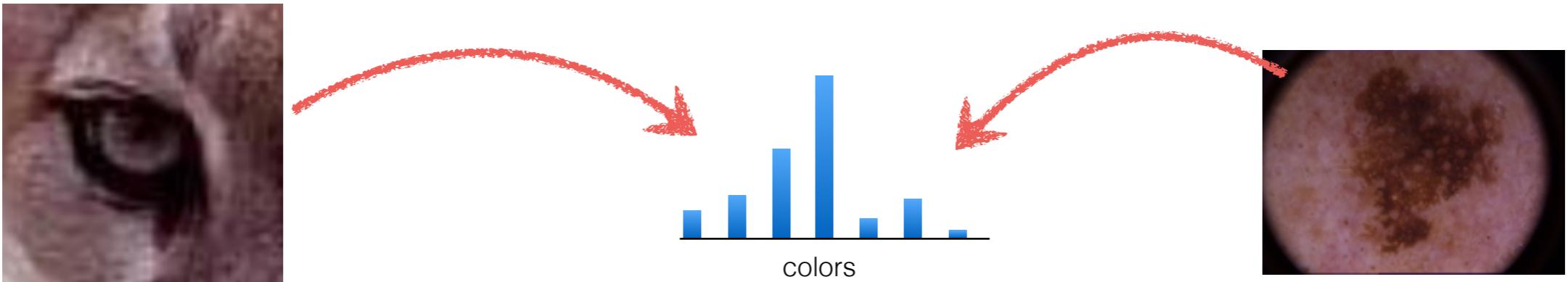


Invariant to changes in scale and rotation

What are the problems?

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Count the colors in the image using a histogram

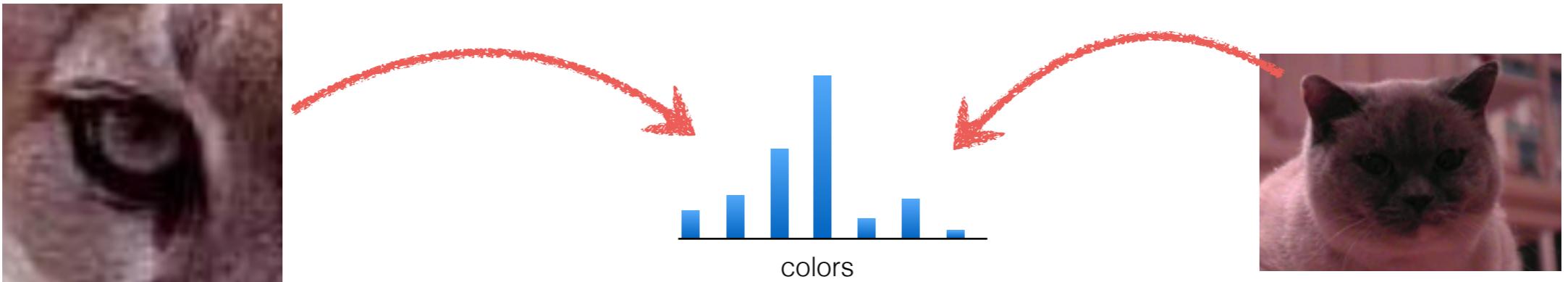


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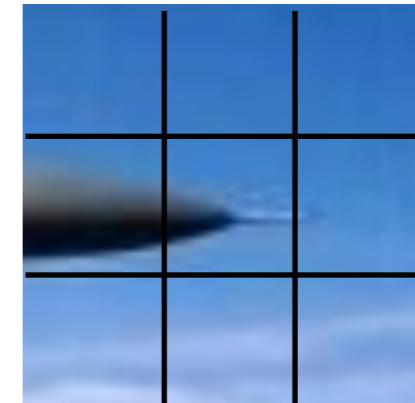
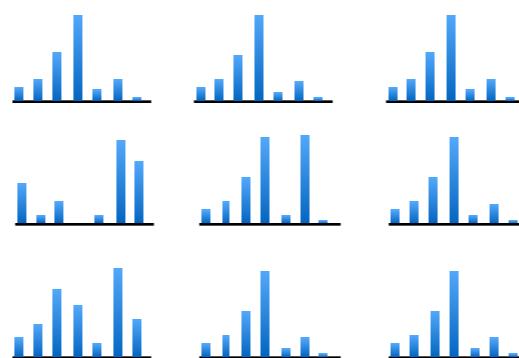
Invariant to changes in scale and rotation

What are the problems?

How can you be more sensitive to spatial layout?

Spatial histograms

Compute histograms over spatial ‘cells’

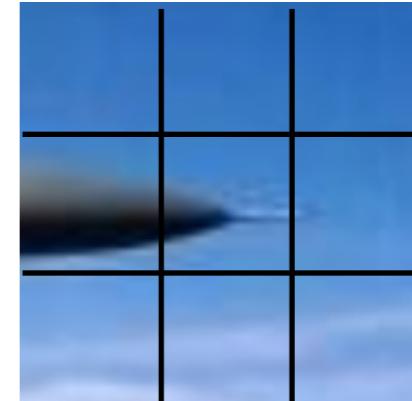


Retains rough spatial layout
Some invariance to deformations

What are the problems?

Spatial histograms

Compute histograms over spatial ‘cells’



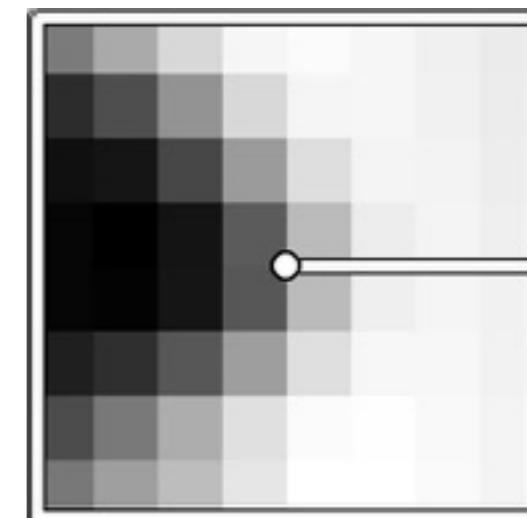
Retains rough spatial layout
Some invariance to deformations

What are the problems?

How can you be completely invariant to rotation?

Orientation normalization

Use the dominant image gradient direction to normalize the orientation of the patch



save the orientation angle θ along with (x, y, s)

What are the problems?