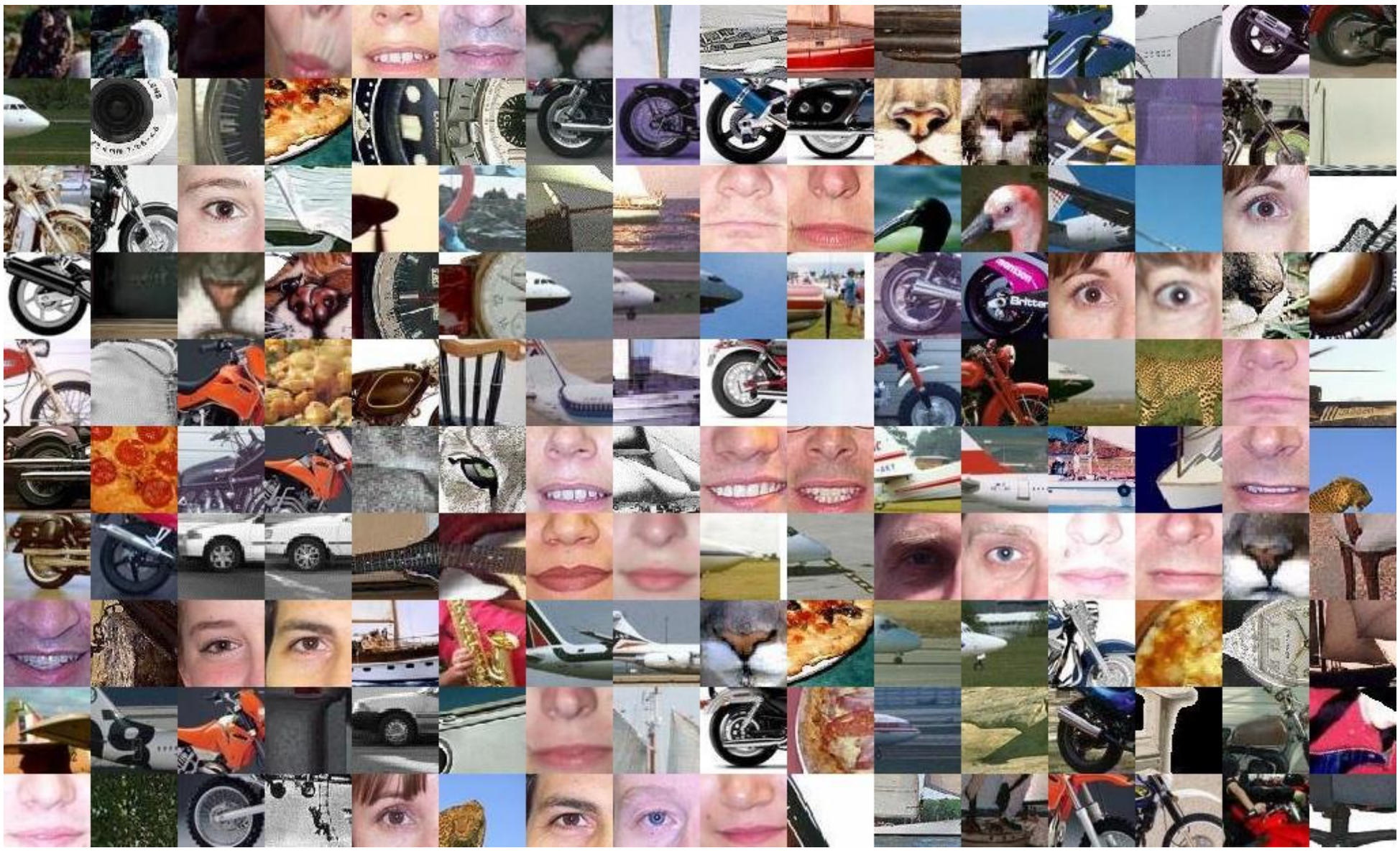
Feature detectors and descriptors



http://16385.courses.cs.cmu.edu/

16-385 Computer Vision
Fall 2024, Lecture 6

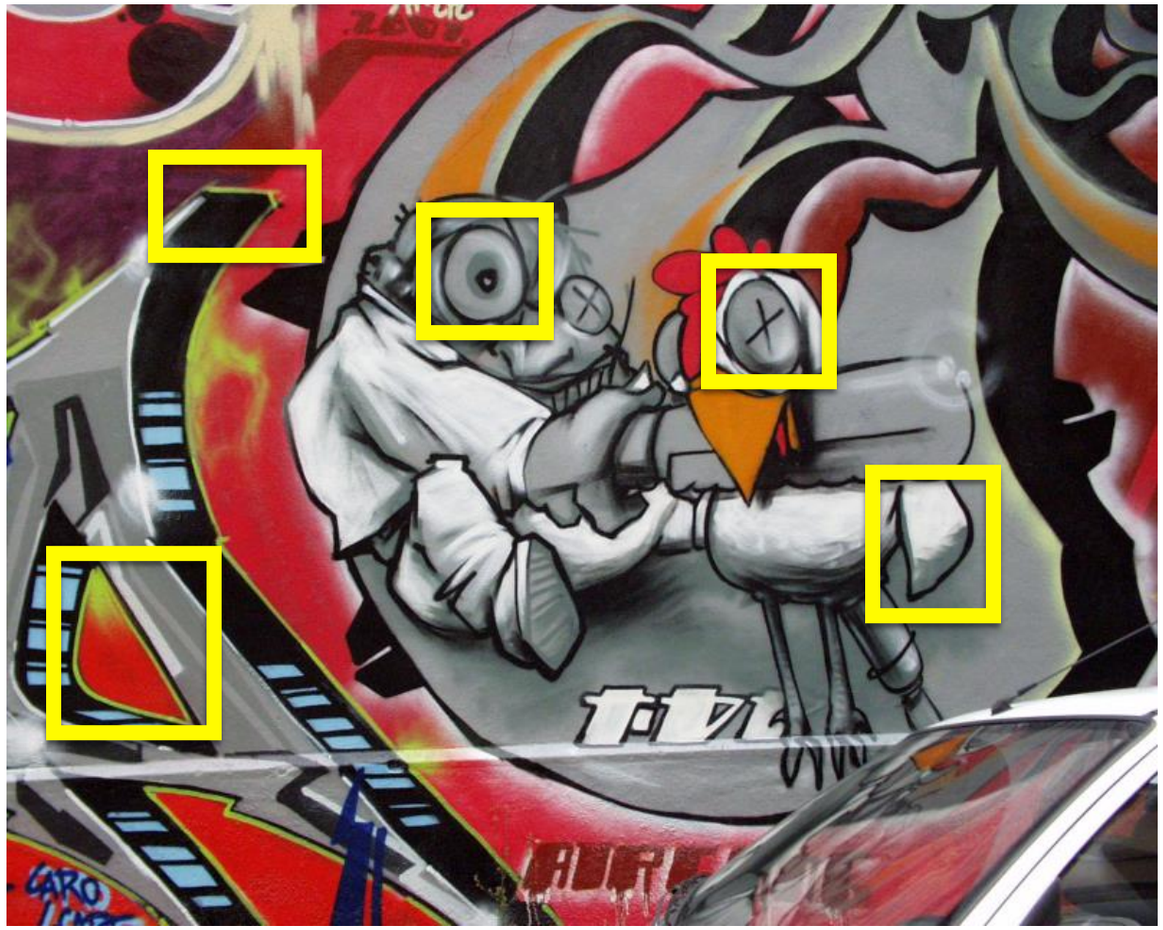
Overview of today's lecture

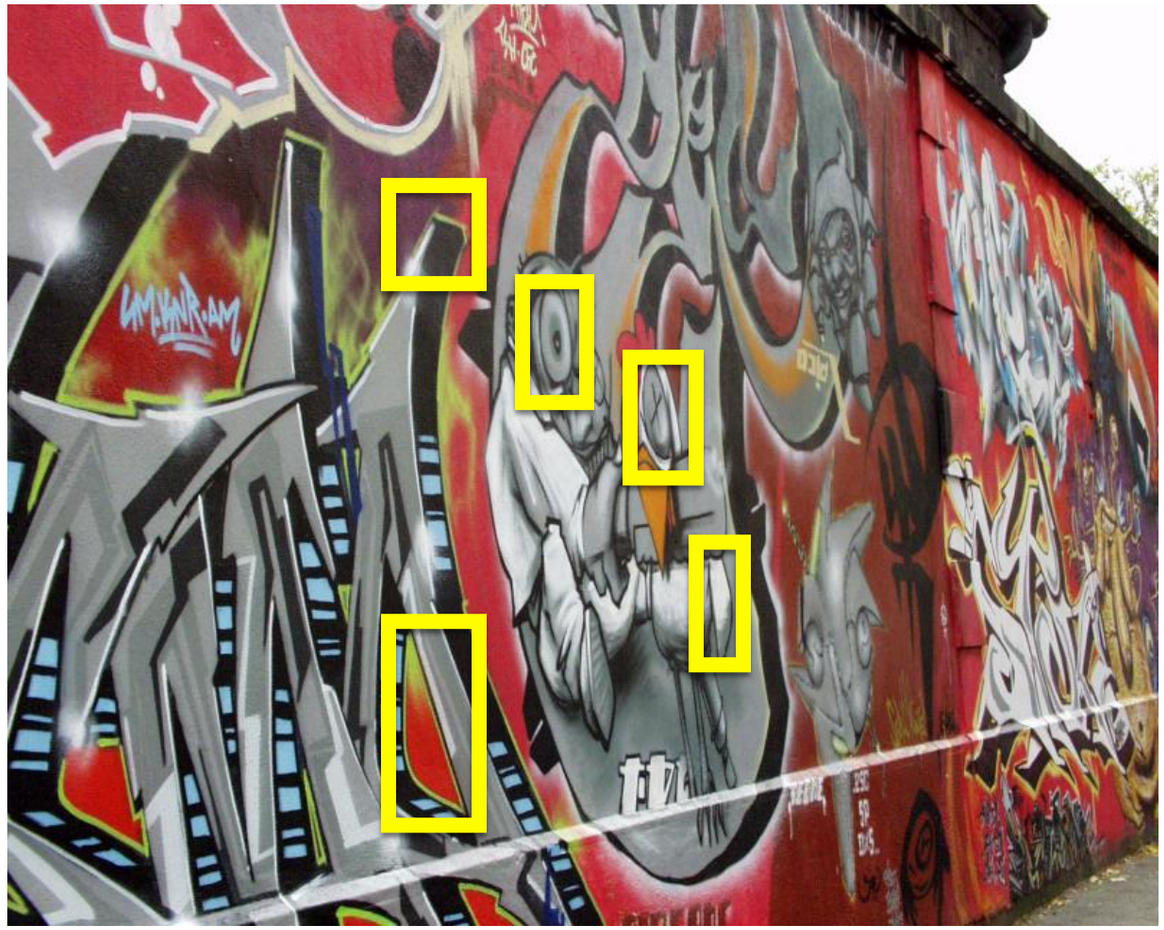
- Why do we need feature descriptors?
- Designing feature descriptors.
- MOPS descriptor.
- GIST descriptor.

Slide credits

Most of these slides were adapted from:

- Matt O'Toole (16-385, Spring 2024)
- Kris Kitani (16-385, Spring 2017)





If we know where the <u>good</u> features are,
how do we <u>match</u> them?

How do we describe an image patch?

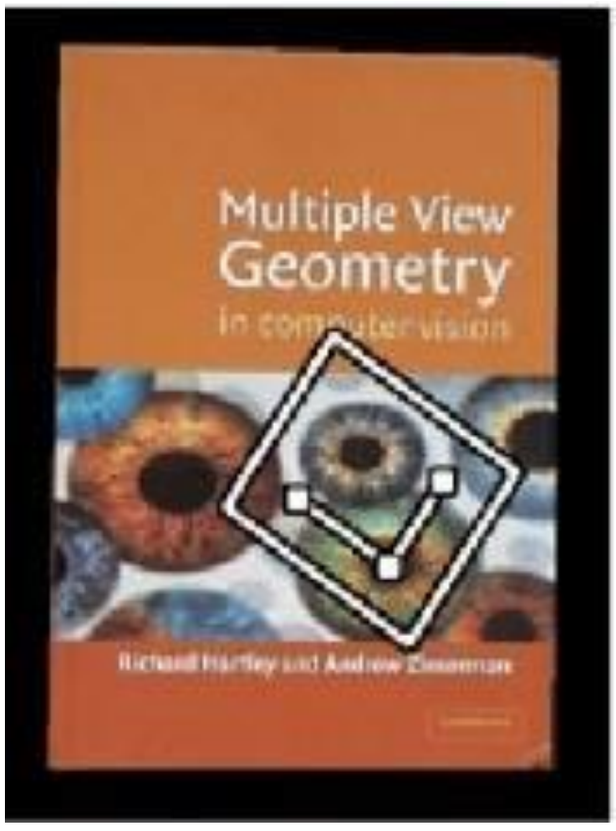
Patches with similar content should have similar descriptors.

Designing feature descriptors

What properties do you want for an image feature?

Invariant to photometric transformations

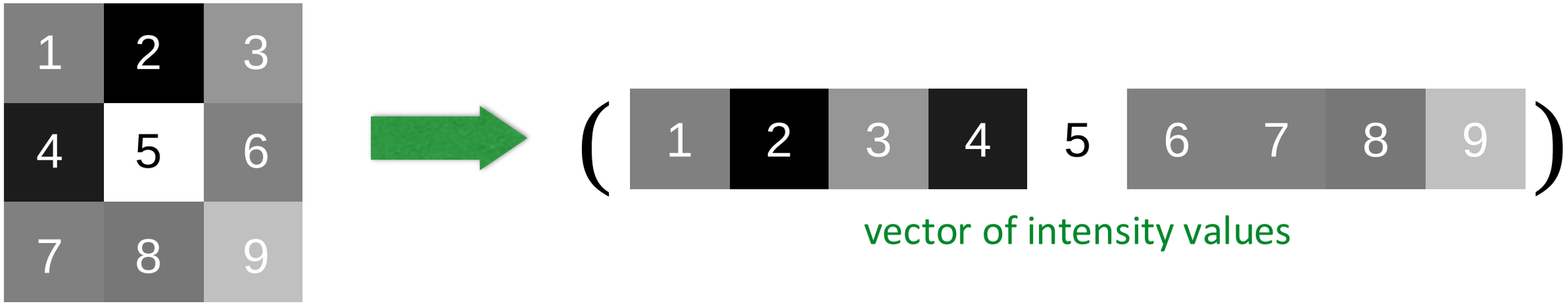
Invariant to geometric transformations



objects will appear at different scales, translation and rotation

Image patch

Just use the pixel values of the patch!

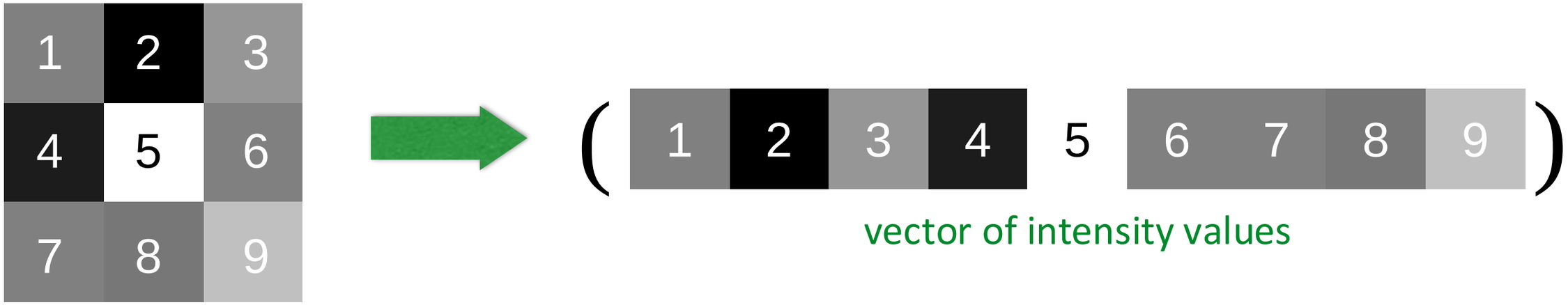


Perfectly fine if geometry and appearance is unchanged

(a.k.a. template matching)

Image patch

Just use the pixel values of the patch!



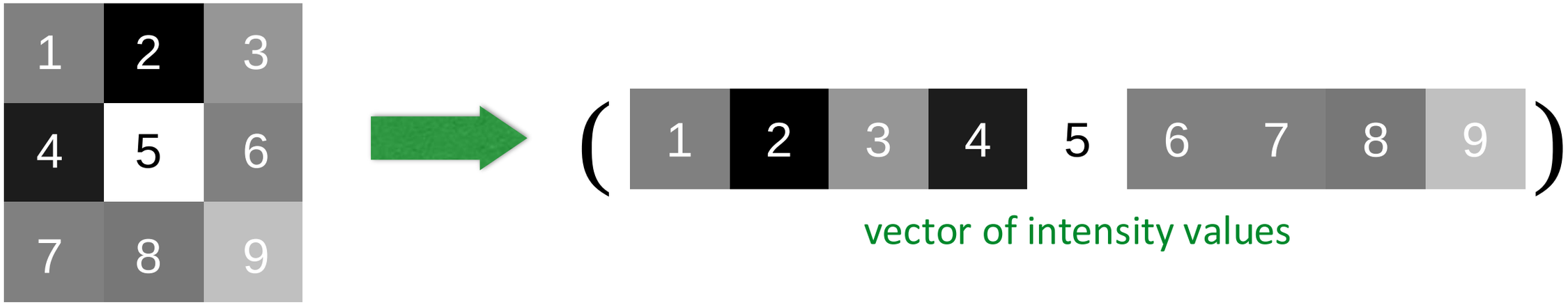
Perfectly fine if geometry and appearance is unchanged

(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

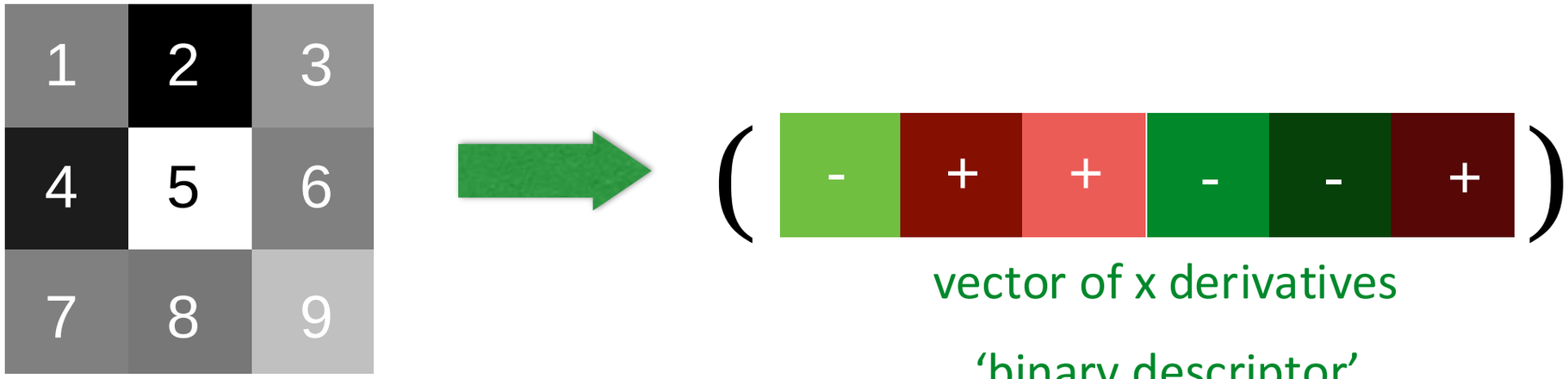
(a.k.a. template matching)

What are the problems?

How can you be less sensitive to absolute intensity values?

Image gradients

Use pixel differences

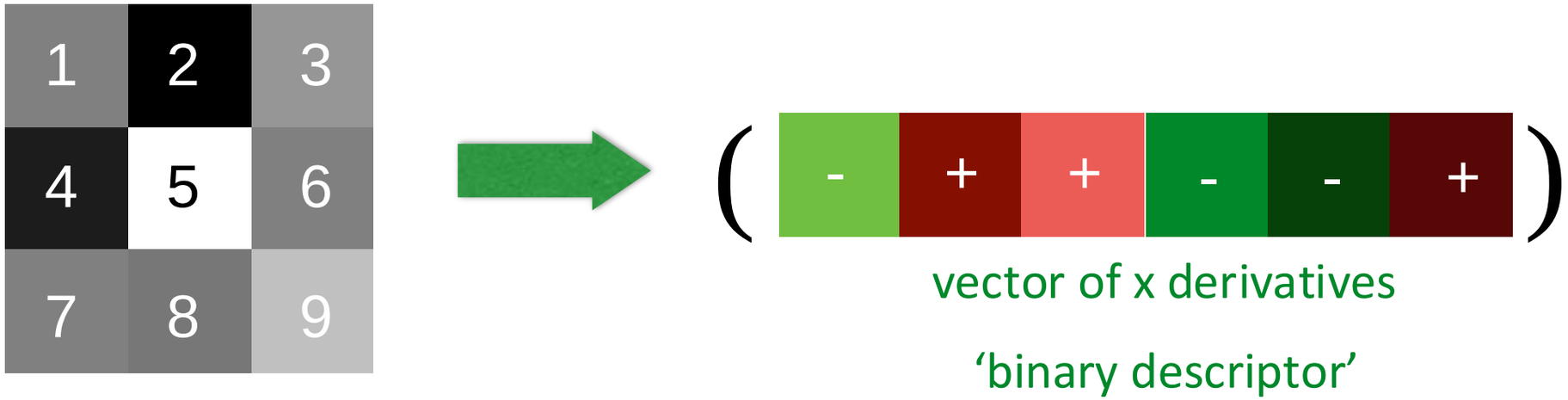


Feature is invariant to absolute intensity values

What are the problems?

Image gradients

Use pixel differences



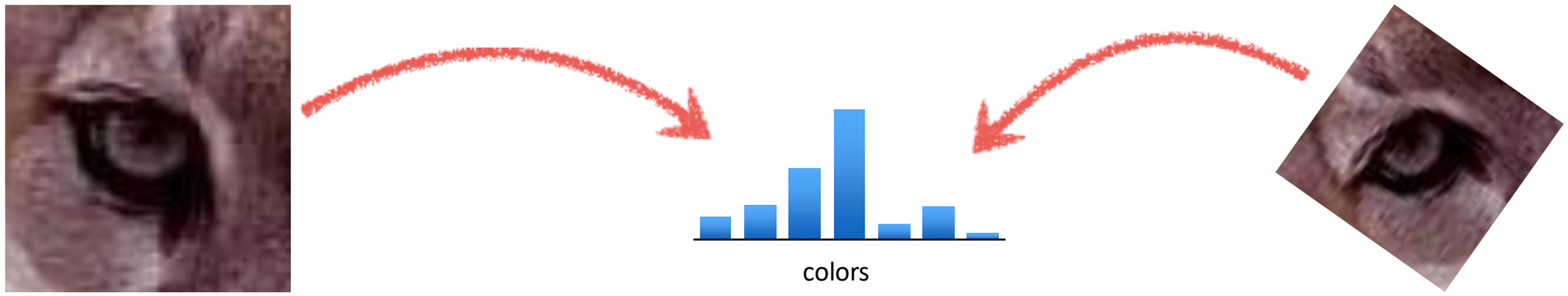
Feature is invariant to absolute intensity values

What are the problems?

How can you be less sensitive to deformations?

Color histogram

Count the colors in the image using a histogram

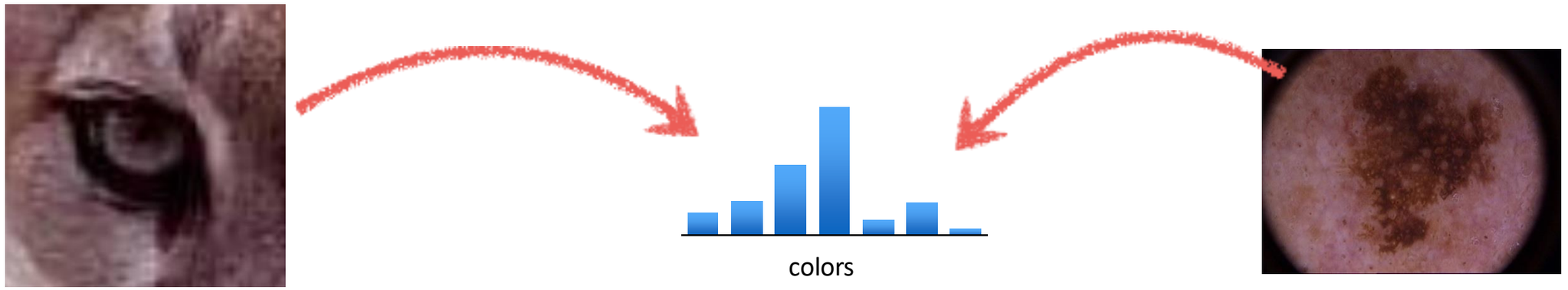


Invariant to changes in scale and rotation

What are the problems?

Color histogram

Count the colors in the image using a histogram

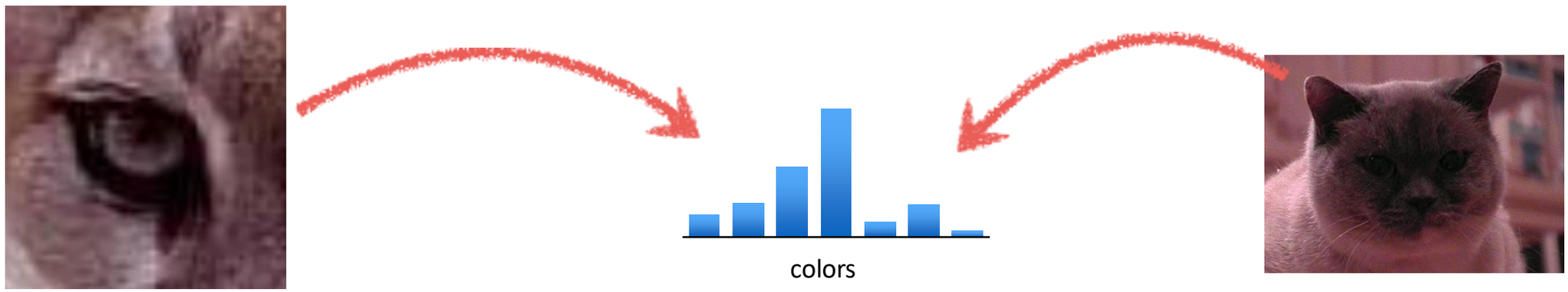


Invariant to changes in scale and rotation

What are the problems?

Color histogram

Count the colors in the image using a histogram



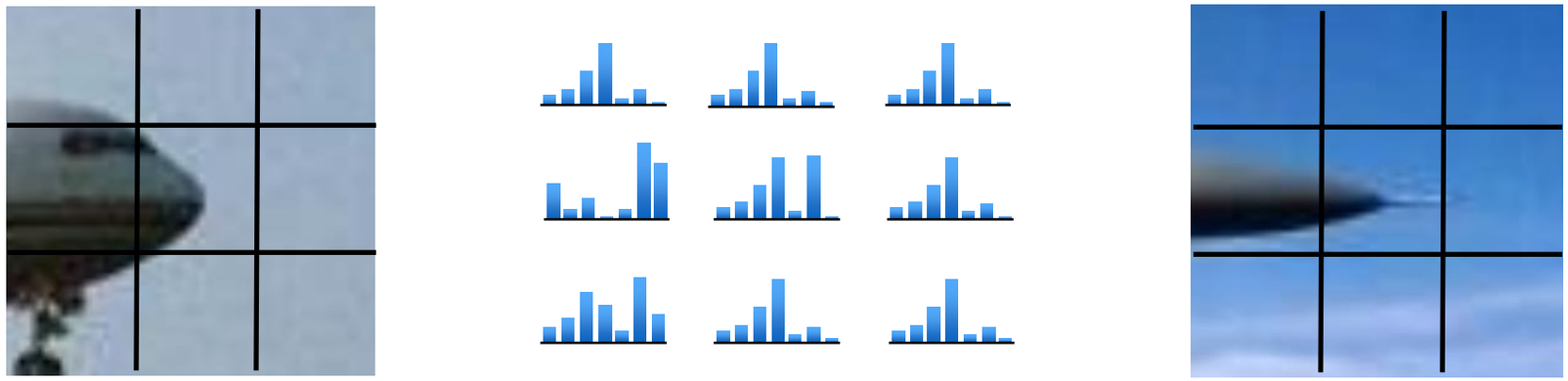
Invariant to changes in scale and rotation

What are the problems?

How can you be more sensitive to spatial layout?

Spatial histograms

Compute histograms over spatial ‘cells’



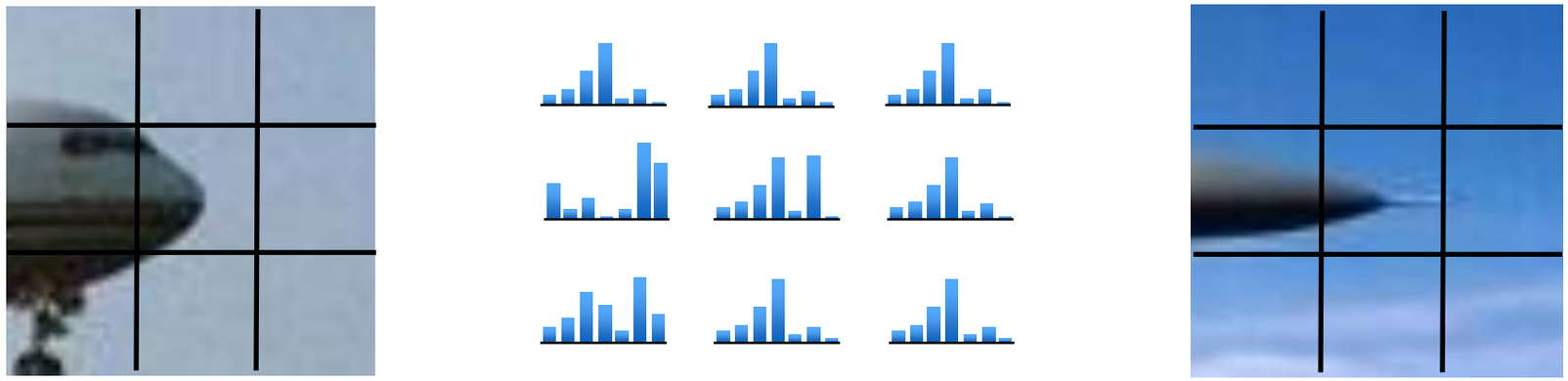
Retains rough spatial layout

Some invariance to deformations

What are the problems?

Spatial histograms

Compute histograms over spatial ‘cells’



Retains rough spatial layout

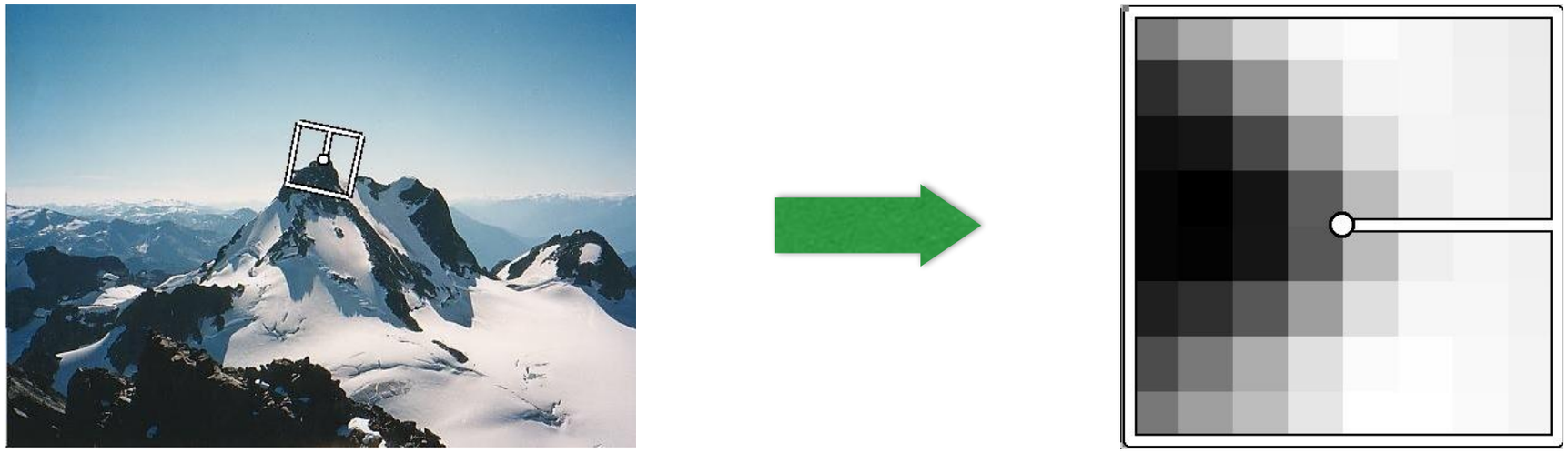
Some invariance to deformations

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)