



Lecture 6. Feature Descriptors

HoG

Juan Carlos Niebles and Jiajun Wu

CS131 Computer Vision: Foundations and Applications



What will we learn today?

- HoG: another image and feature descriptor





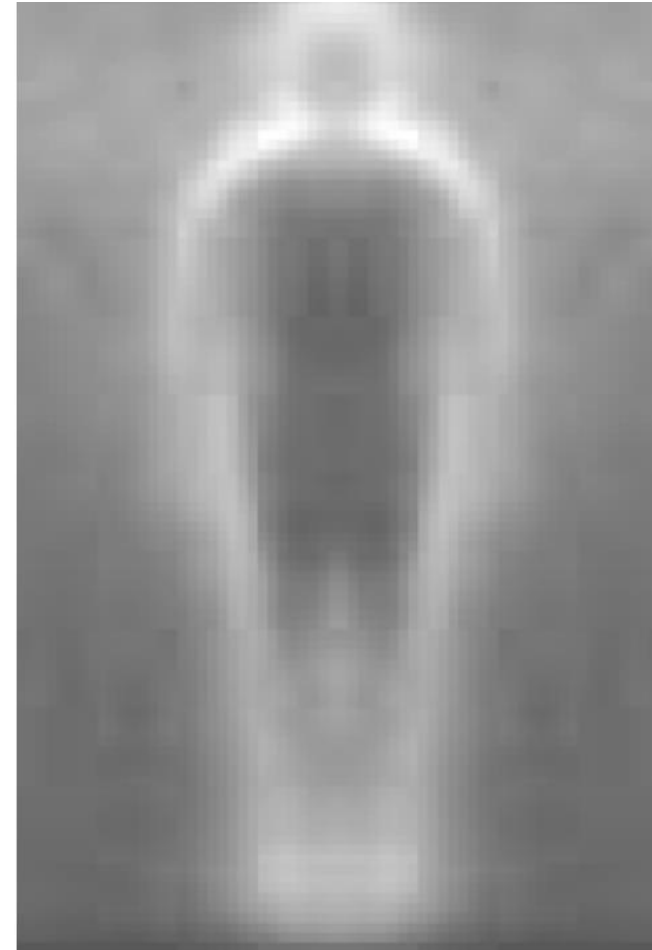
Feature descriptors

- Find robust feature set that allows object form to be discriminated.
- Challenges
 - Wide range of pose and large variations in appearances
 - Cluttered backgrounds under different illumination
 - “Speed” for mobile vision
- Histogram of Oriented Gradients (HoG)
 - [1] N. Dalal and B. Triggs. Histograms of Oriented Gradients for Human Detection. In CVPR, pages 886-893, 2005
 - [2] Chandrasekhar et al. CHoG: Compressed Histogram of Gradients - A low bit rate feature descriptor, CVPR 2009



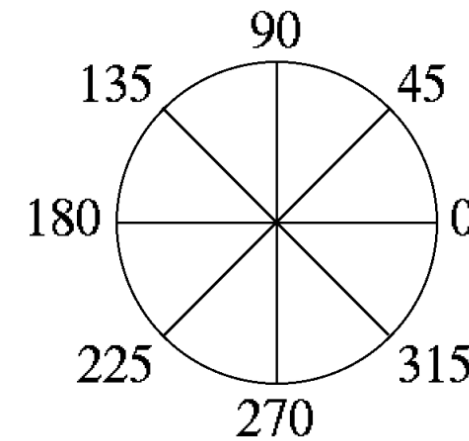
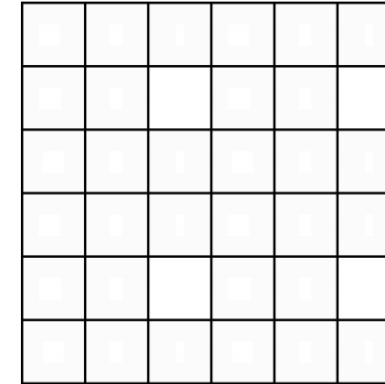
Histogram of Oriented Gradients

- Local object appearance and shape can often be characterized rather well by the distribution of local intensity gradients or edge directions.

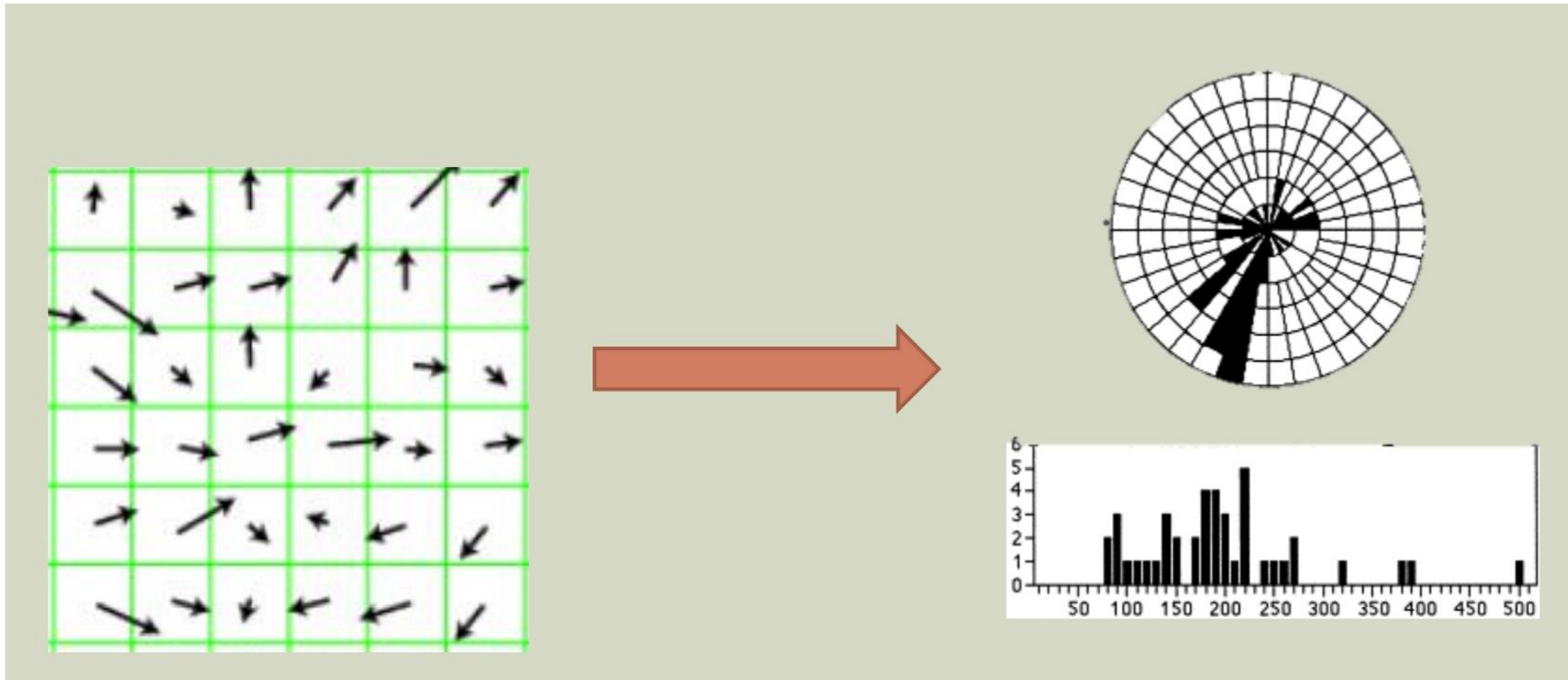


Histogram of Oriented Gradients

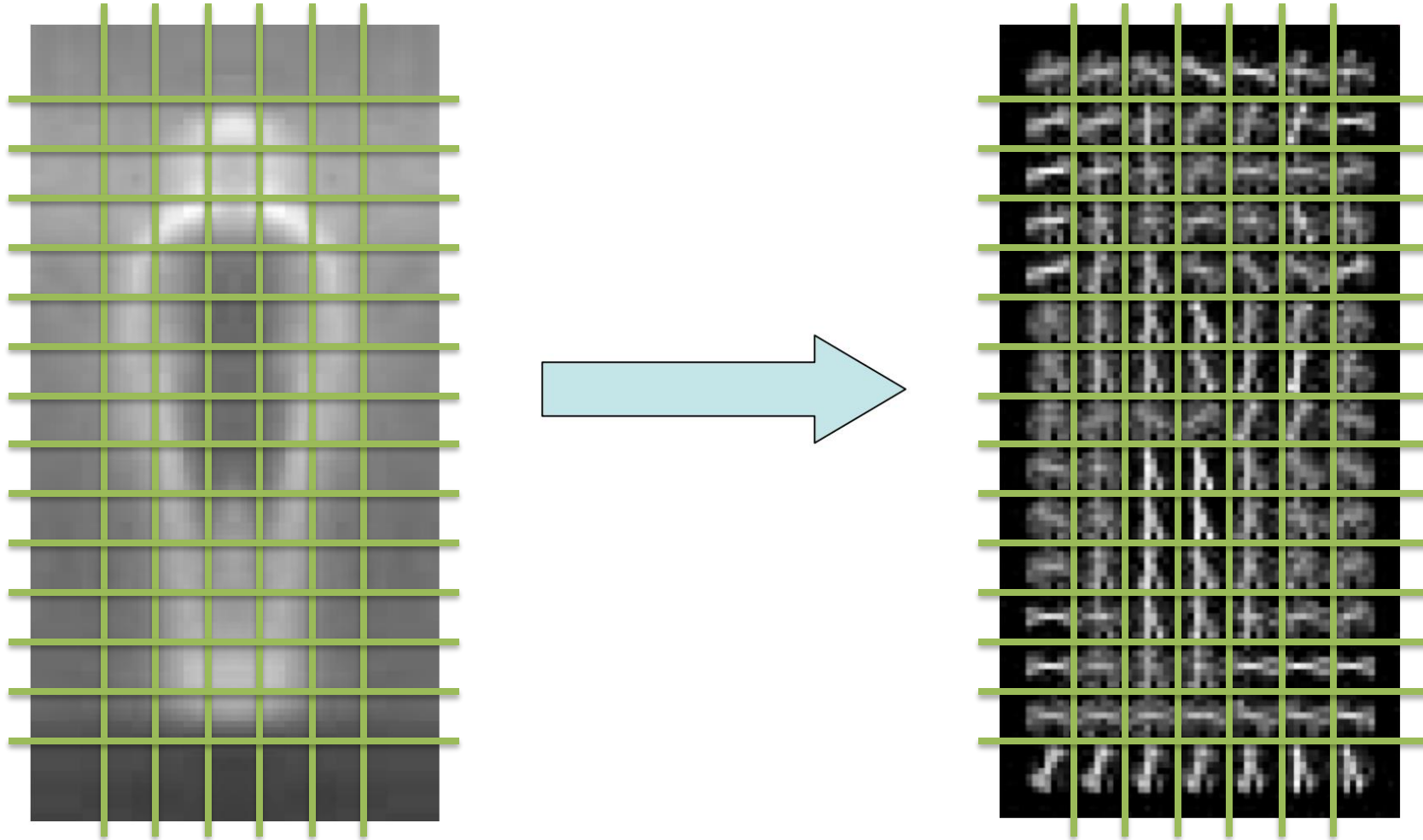
- Dividing the image window into small spatial regions (cells)
- Cells can be either rectangle or radial.
- Each cell accumulating a weighted local 1-D histogram of gradient directions over the pixels of the cell.



Histogram of Oriented Gradients

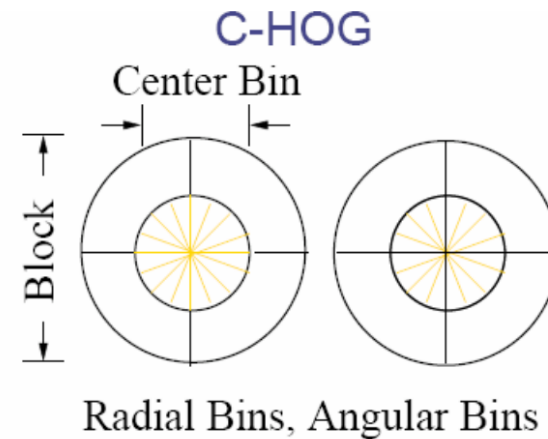
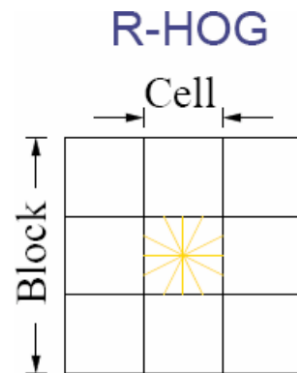


Histogram of Oriented Gradients

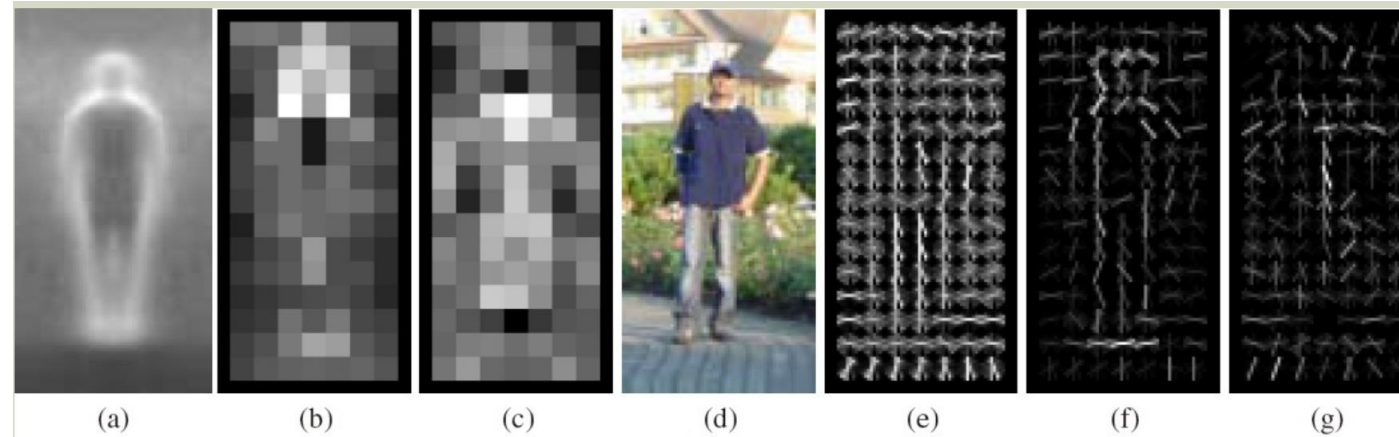


Normalization

- For better invariance to illumination and shadowing, it is useful to contrast-normalize the local responses before using them.
- Accumulate local histogram “energy” over a larger regions (“blocks”) to normalize all of the cells in the block.



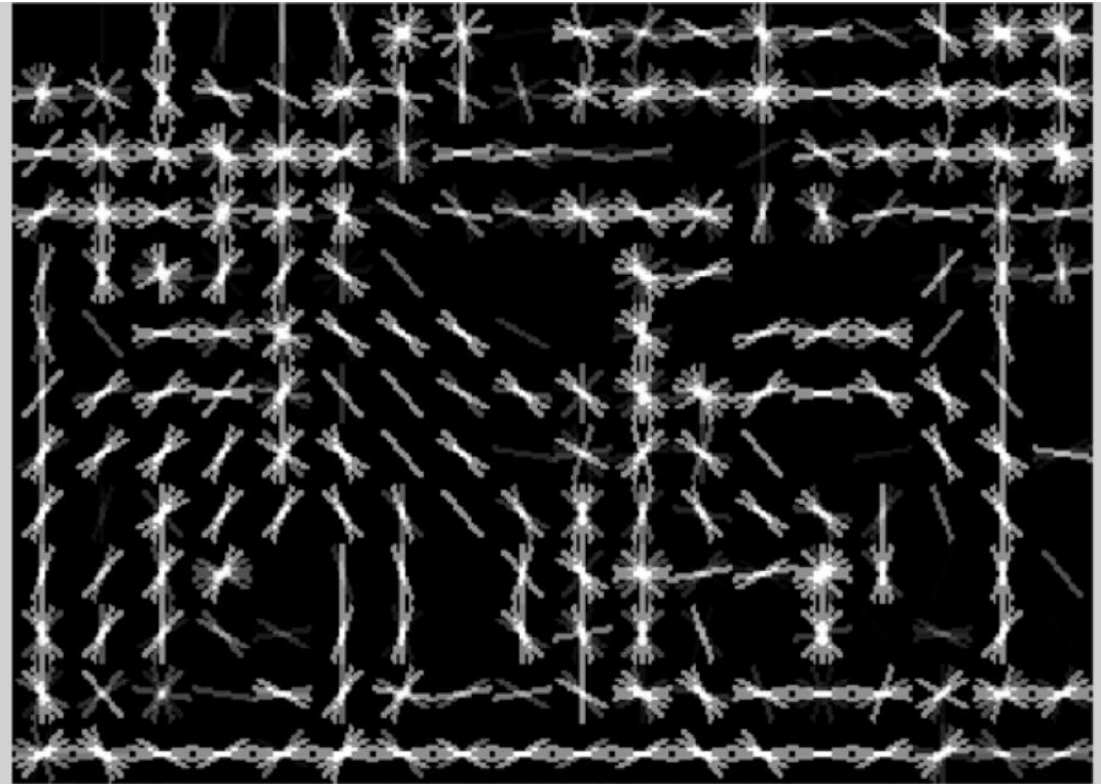
Visualizing HoG



- a. Average gradient over positive examples
- b. Maximum positive weight in each block
- c. Maximum negative weight in each block
- d. A test image
- e. It's R-HOG descriptor
- f. R-HOG descriptor weighted by positive weights
- g. R-HOG descriptor weighted by negative weights



Visualizing HoG





Difference between HoG and SIFT

- HoG is usually used to describe larger image regions. SIFT is used for key point matching
- SIFT histograms are normalized with respect to the dominant gradient. HoG is not.
- HoG gradients are normalized using neighborhood bins.

Summary

- HoG:
 - Descriptor calculation
 - Comparison with SIFT

