EECS 442 Discussion

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Announcements

- Project Progress Reports due 11/19
Thanks!

Volume: I’ll try to speak louder and repeat questions/answers

Questions in discussion / explanation of content

Solutions to MATLAB examples / questions on piazza

More visuals / details in the slides
Descriptors for Images

- Why use a descriptor?
Histogram of Oriented Gradients

- Key idea: capture the local gradient pattern in image
Histogram of Oriented Gradients

- Key idea: capture the local gradient pattern in image
Compute Gradients

- Find X and Y gradient of image
- Convert this to polar (magnitude and direction of gradient)
Orientation Binning

- Divide image into “cells” and “blocks”
- Each cell contains a small number of pixels, and each block contains a small number of cells
- In each cell, compute a histogram of orientations
Orientation Binning

- Goal: Create a histogram of orientations for each cell
- What are the possible orientations?

- Divide 0 - 180 into N bins (9 is typical)
- Each pixel votes in the histogram according to the magnitude of its gradient
- To address discretization, each bin can vote for multiple pixels based on linear interpolation
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  0 - 360 (or 0 - 180 if we ignore sign)
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Orientation Binning: Example

- Histogram from 0 to 180 with 9 bins (centered at 10, 30, 50, ...)
- Pixel with $\theta = 25, u = 10$
Orientation Binning: Example

- Histogram from 0 to 180 with 9 bins (centered at 10, 30, 50, ...)
- Pixel with $\theta = 25$, $u = 10$
- Which bins?

Which bins? bin 1 (centered at 10) and bin 2 (centered at 30)

What are the votes for each bin?

- $30 - \theta = 5$
- $180/N = 5/20 = 0.25$
- $u = 2.5$
- $0.75u = 7.5$

2.5 to bin 1 (centered at 10), 7.5 to bin 2 (centered at 30)
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\[
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0.25u = 2.5 \\
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\]

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Blocks

- Group cells into overlapping blocks
- For each 2x2 set of cells, concatenate the four cells histograms together into a single block feature $b$
- Normalize $b$
Final Descriptor

- Concatenate all block histograms together into a single descriptor $h$
- Normalize $h$
- Threshold all values of $h$ so that all elements of $h$ are below a threshold $\tau$ (0.2 is typical)
- Renormalize $h$
- Why?
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- Why? To prevent strong gradients from dominating the whole image
MATLAB

- Go to CTools → Resources → Discussion → 11_18_matlab.zip
- Given an image, compute the HOG descriptor