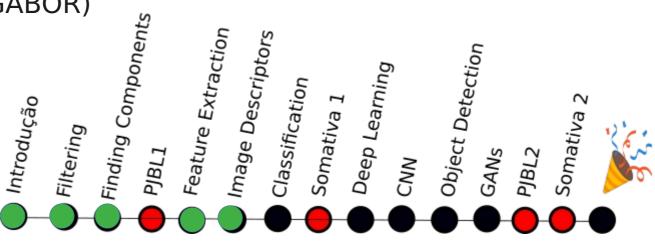
Lecture 07 - Image Descriptors

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Topics

- Discussion of Lecture #06
 - Feature Vector
 - Horizontal and Vertical Projections
- Image Descriptors
 - Shape (HoG)
 - Textures (LBP, GABOR)
- Classification
 - K-NN
- Practice



Computer Vision & Pattern Recognition Pipeline

PATTERN RECOGNITION SYSTEM

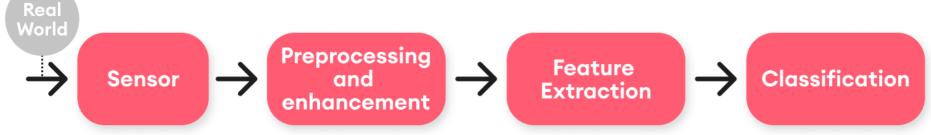


Image Descriptors - Shape

Moments

- Values that carry both spatial and intensity informatic
 - Weighted average of all pixel's intensities
 - I(x,y) □ pixel coordinates of input
 - Powers, p and q, are the weights of the horizontal and vertical dimensions

HuMoments (Hu 1962)

$$\begin{split} h_1 &= \eta_{20} + \eta_{02} \\ h_2 &= (\eta_{20} - \eta_{02})^2 + 4(\eta_{11})^2 \\ h_3 &= (\eta_{30} - 3\eta_{12})^2 + 3(\eta_{03} - 3\eta_{21})^2 \\ h_4 &= (\eta_{30} + \eta_{12})^2 + (\eta_{03} + \eta_{21})^2 \\ h_5 &= (\eta_{30} - 3\eta_{12})(\eta_{30} + \eta_{12})[(\eta_{30} + \eta_{12})^2 - 3(\eta_{03} + \eta_{21})^2] + (3\eta_{21} - \eta_{03})(\eta_{03} + \eta_{21})[3(\eta_{30} + \eta_{12})^2 - (\eta_{03} + \eta_{21})^2] \\ h_6 &= (\eta_{20} - \eta_{02})[(\eta_{30} + \eta_{12})^2 - 7(\eta_{03} + \eta_{21})^2] + 4\eta_{11}(\eta_{30} + \eta_{12})(\eta_{03} + \eta_{21}) \\ h_7 &= (3\eta_{21} - \eta_{03})(\eta_{30} + \eta_{12})[(\eta_{30} + \eta_{12})^2 - 3(\eta_{03} + \eta_{21})^2] + (\eta_{30} - 3\eta_{12})(\eta_{03} + \eta_{21})[3(\eta_{30} + \eta_{12})^2 - (\eta_{03} + \eta_{21})^2] \end{split}$$

Image Descriptors - Shape

- HoG Histogram of Oriented Gradients
 - Computes the gradient and orientation of edges
 - Use a kernel to compute the Gradients (i.e 9x1)
 - Patch-Based Histogram (8x8, 16x16..)

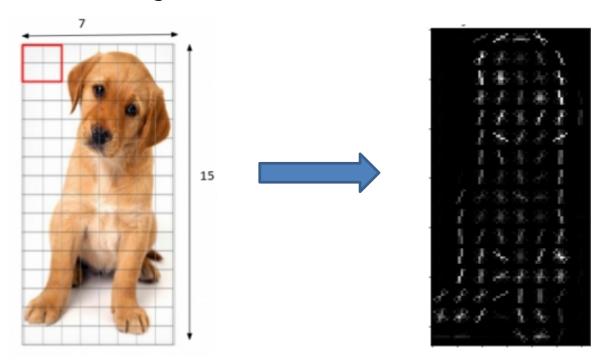
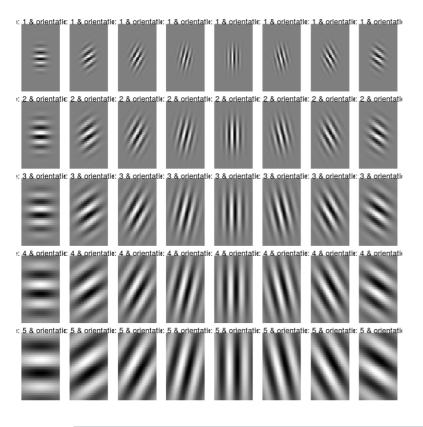


Image Descriptors - Texture

- Gabor Filters
 - Convolves the image using several Gaussian Kernels (Kernel Bank)





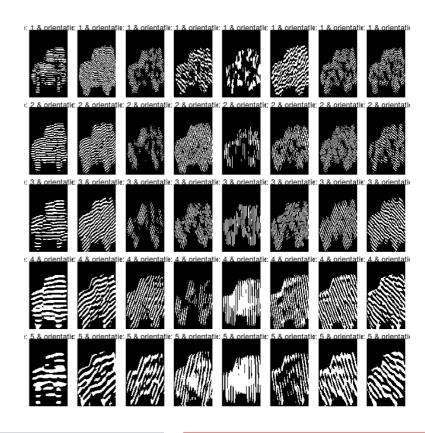
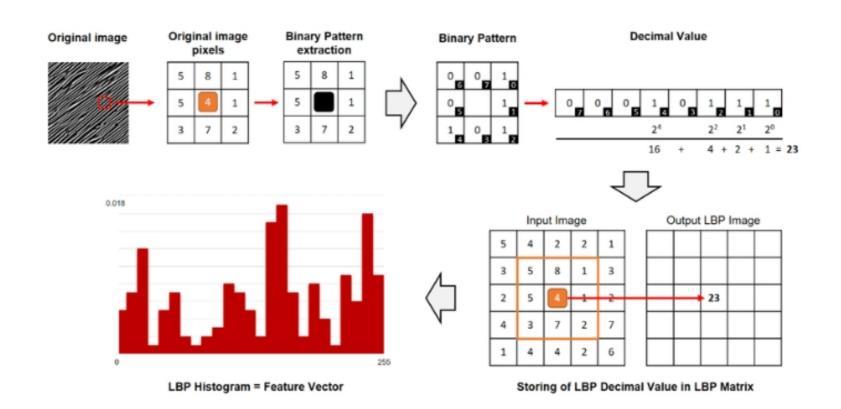


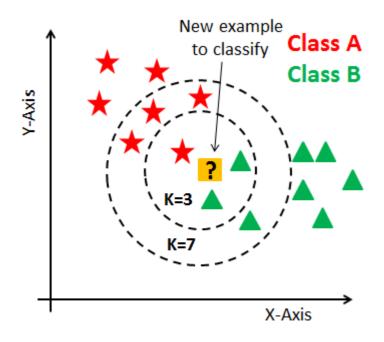
Image Descriptors - Texture

- Local Binary Patterns
 - Convolves the image using a Circular Kernel
 - The resulting pixel is computed in the binary neighborhood



Classification

- KNN
 - Computes the similarity in a feature space (Euclidian Distance, Manhattan....)
 - The K-Nearest Neighbors determines the class (Majority Vote)



$$d(x,y) = \sqrt{\sum_{i=1}^{n} (y_i - x_i)^2}$$

Let's Code

• <u>LINK</u>