More Features

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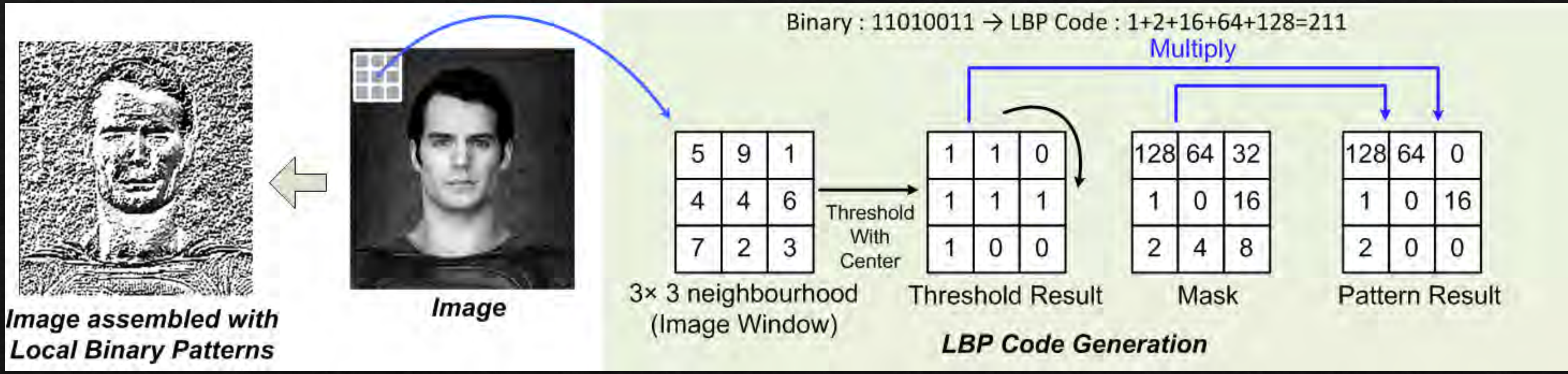
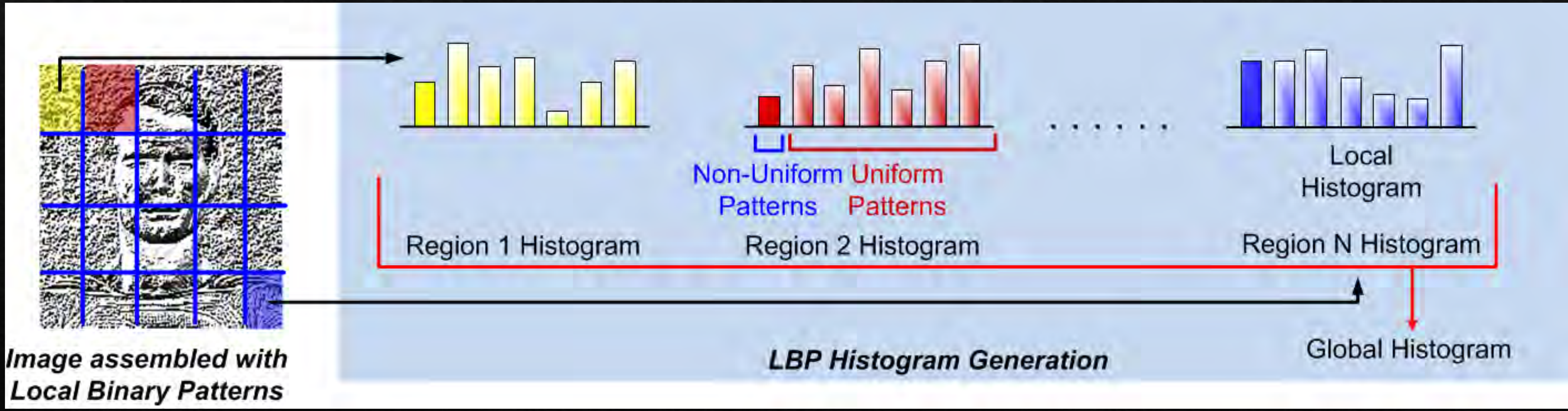
Local Binary Patterns (LBP)

- Divide the examined window into cells (e.g. 16x16 pixels for each cell).
- Compare each pixel in a cell (say *p*) to each of its 8 neighbors along a circle.
- If the neighbor's value < *p*, write 0, else write 1, giving an 8-bit binary number.
- Compute the histogram, over the cell, of the frequency of each number
- Concatenate (normalized) histograms of all cells. This gives a feature vector for the entire window.
- https://ckyrkou.medium.com/object-detection-using-local-binary-patterns-50b165658368

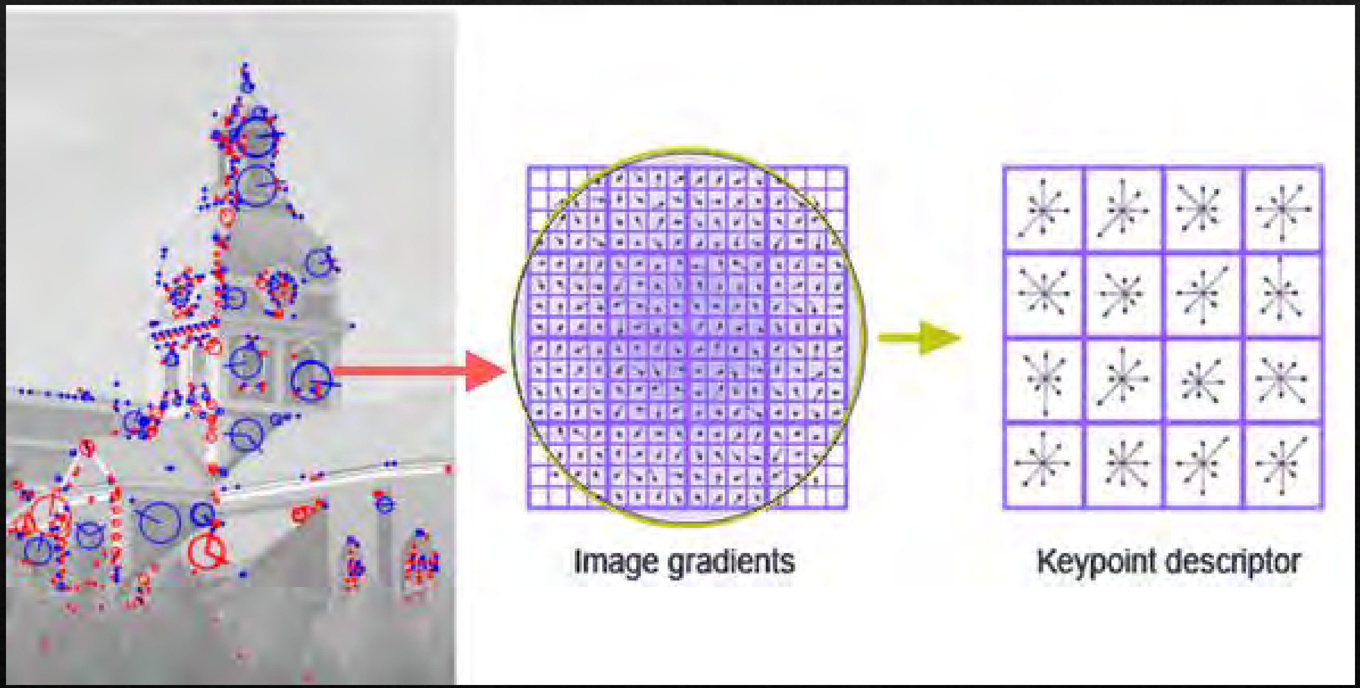
Local Binary Patterns (LBP)





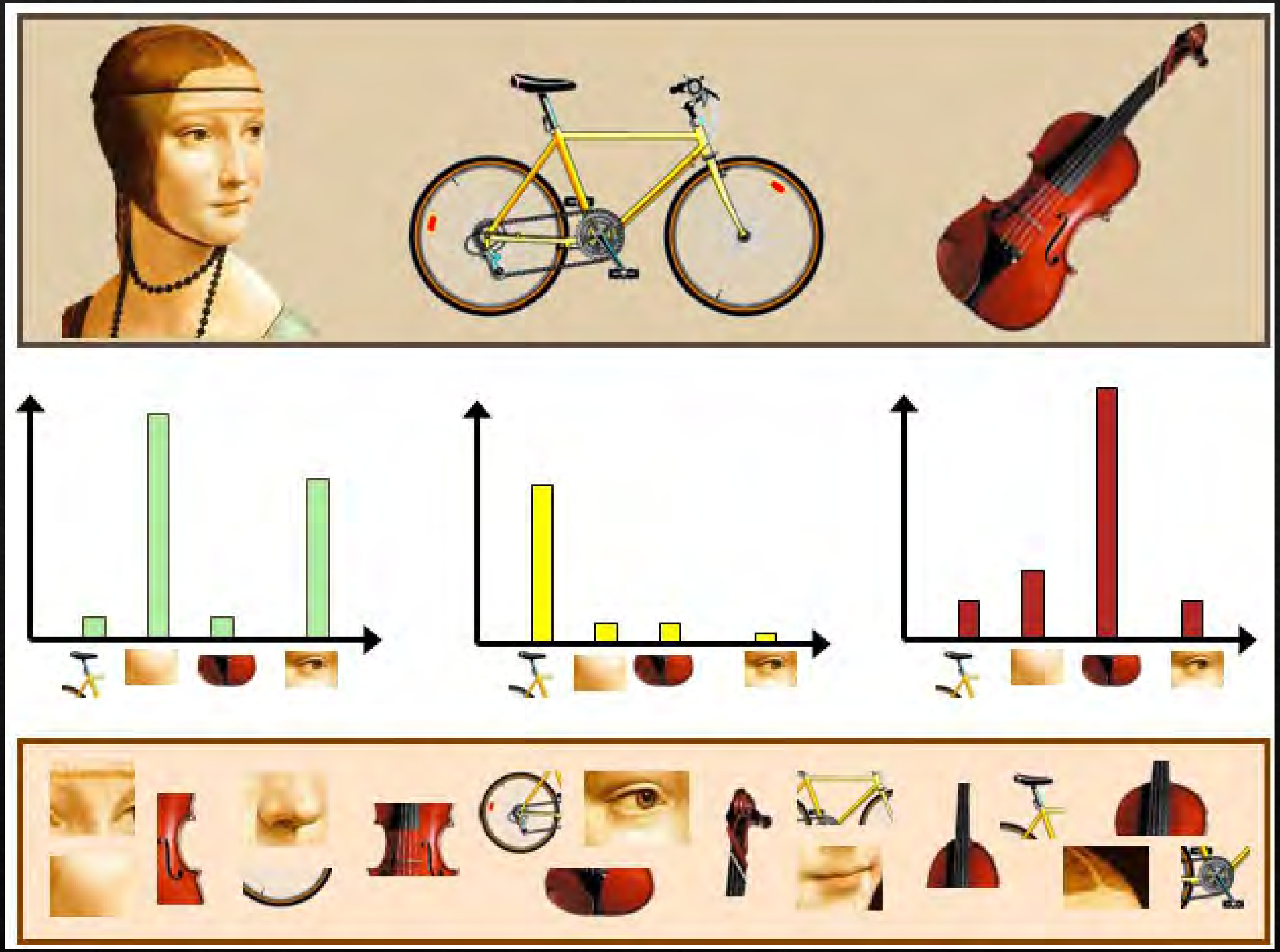
Scale Invariant Feature Transform (SIFT)

- SIFT is used for describing local features
- Uses Difference of Gaussian (DoG) to detect keypoints
- Uses HOG-like gradient histograms centered at these points
- https://www.codeproject.com/Articles/619039/Bag-of-Features-Descriptor-on-SIFT-Features-with-O



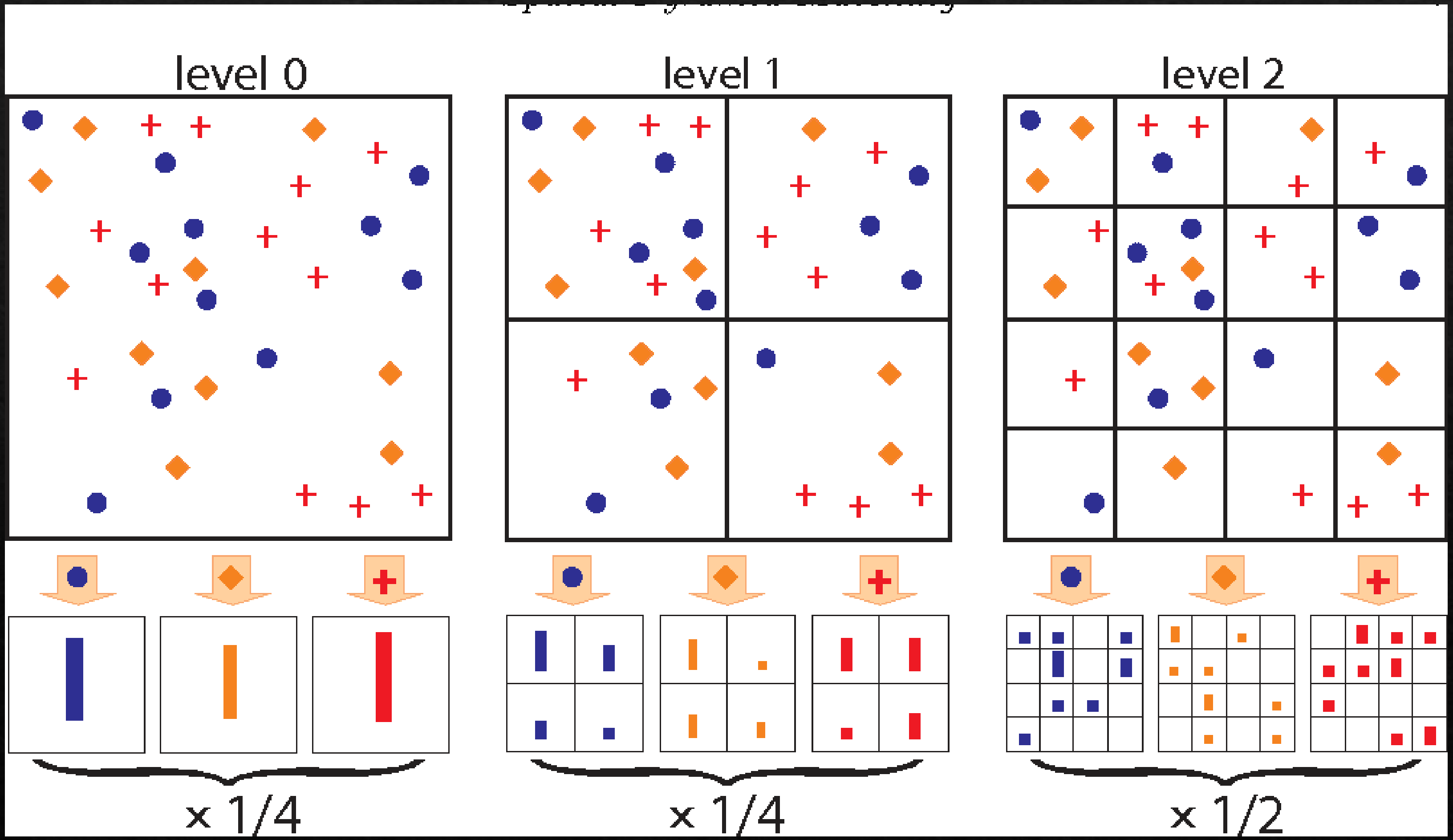
The Bag of Words Model

- Ensures image descriptor lengths are independent of image size or content
- Steps:
  - Local feature extraction (dense or sparse)
  - Clustering (quantization)
  - Histogram building



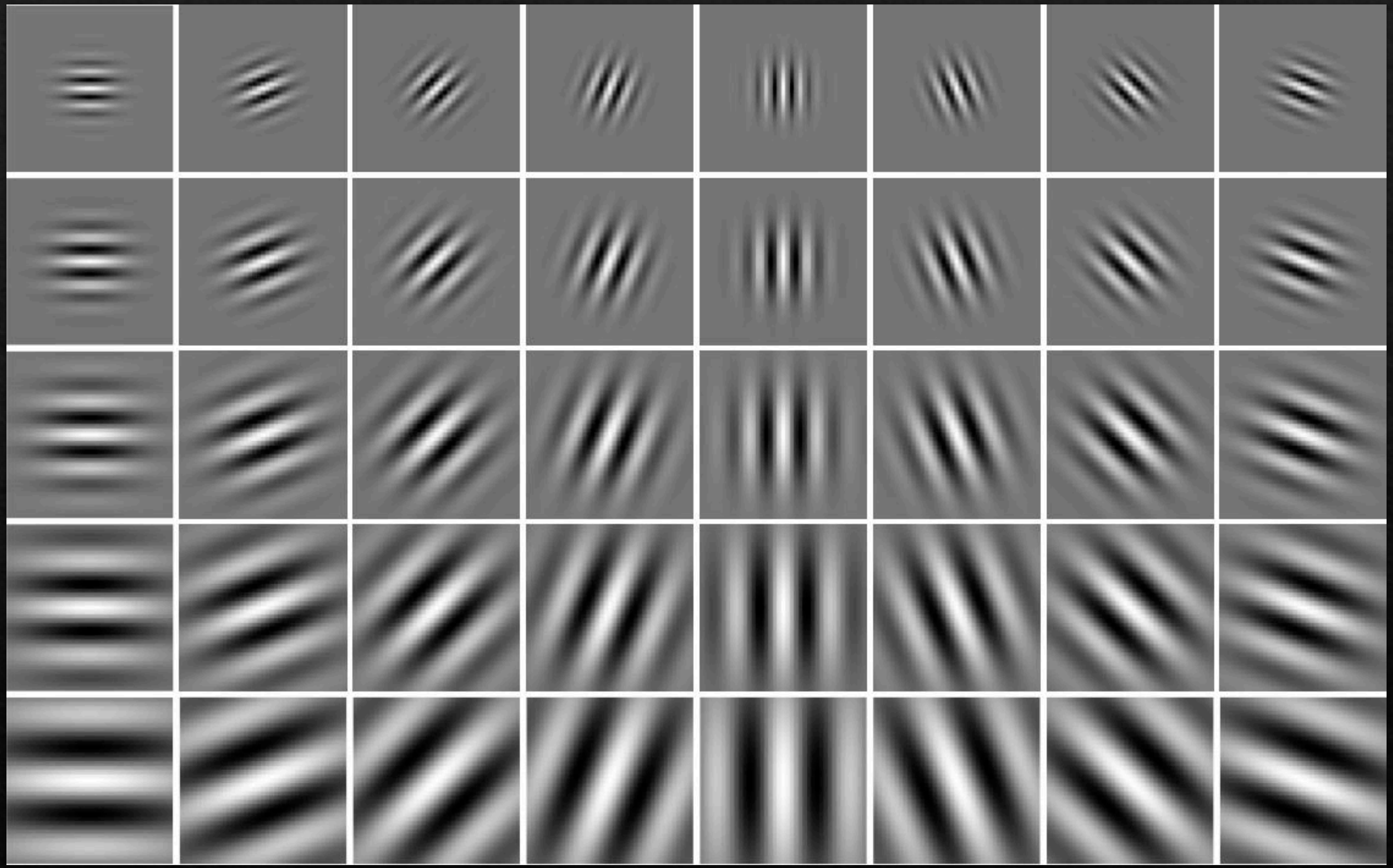
Spatial Pyramid

- The BoW model destroys spatial information
- This technique preserves some of it
- http://slazebni.cs.illinois.edu/publications/pyramid_chapter.pdf



Gabor Filters

- A set of filters of several scales and orientations
- Each 2D Gabor filter is a Gaussian kernel function modulated by a sinusoidal plane wave
- Similar to simple cells in the visual cortex of mammalian brains
- A precursor of neural networks



The GIST Descriptor

- Gives a rough description (the gist) of the scene
- Convolve the image with 32 Gabor filters at 4 scales, 8 orientations
- Divide each feature map into 16 regions (by a 4x4 grid), and average pool.
- Concatenate the 16 averaged values of all 32 feature maps, resulting in a 16x32=512 GIST descriptor.
- Reference:
  Modeling the shape of the scene: a holistic representation of the spatial envelope

Deformable Part Models (DPM)

- Complex descriptors for non-rigid bodies
- Treats objects as a combination of parts
- One of the most popular object recognition methods before CNNs
- https://www.cs.ucf.edu/~bagci/teaching/computervision16/Lec21.pdf