

# Machine learning and vision laboratory

Dr H.Mohammad Zadeh



دانشگاه صنعتی شریف

department: Electrical Engineering

Amirreza Velae 400102222  
github [repository](#)

Pre-Lab 7

December 2, 2024



## HOG method

Explain what benefit normalizing the feature vector has in the HOG method.

### Solution

Normalizing the feature vector in the HOG (Histogram of Oriented Gradients) method improves robustness by reducing the influence of variations in illumination and contrast. Mathematically:

$$\mathbf{v}_{\text{norm}} = \frac{\mathbf{v}}{\|\mathbf{v}\|_2 + \epsilon}$$

where  $\mathbf{v}$  is the feature vector,  $\|\mathbf{v}\|_2$  is its Euclidean norm, and  $\epsilon$  is a small constant to avoid division by zero. Normalization ensures the feature vector focuses on local gradients rather than absolute intensity values.

## LBP method

In the LBP method, when they want to reduce the length of the feature vector, they use a method called Uniform Pattern. Study this method and explain it.

### Solution

In the Local Binary Patterns (LBP) method, the Uniform Pattern technique is used to reduce the length of the feature vector while retaining critical texture information. A uniform pattern is defined as a binary pattern where there are at most two transitions between 0 and 1 or vice versa when traversing the binary string circularly.

For example:

- Uniform patterns: '00000000', '11111111', '00111000'
- Non-uniform patterns: '01010101', '11010011'

Uniform patterns are assigned specific labels, while all non-uniform patterns are grouped into a single label. This reduces the number of possible patterns from  $2^P$  to  $P(P-1)+2$ , where  $P$  is the number of sampling points in the neighborhood.

The feature vector is constructed by counting the occurrences of uniform patterns and the "others" category, resulting in a more compact representation that still captures essential texture characteristics.