University at Buffalo
Department of Computer Science and Engineering
CSE 473/573 - Computer Vision and Image Processing

Fall 2024

Homework #4
Due Date: 12/4/2024, 11:59PM

Instructions

- Answer the questions below and provide as much of your work as necessary.

- Export or scan your homework and store it as a PDF version before submitting online to UB-Learns.

1   Local Binary Patterns (20 points)

Local binary patterns are a feature that can be used to describe textures. They are efficient to compute and can be formed to describe many common texton-like features. Given the process for computing LBPs in a local neighborhood consisting of the 8 pixels around a pixel, consider the assumptions and the questions below.

Assume that dark pixels have a lower value then light pixels, and X is dark in the figure (**in this question, we use the figure of Q2**). We want to compute the LBP feature for X. Assume the pixel directly to the right of X is the least significant bit and proceed counterclockwise.

i) What is the numeric value of the LBP feature of X according to these assumptions? (10 points)

ii) What is the numeric value of the LBP feature if X was light? (10 points)

2 Texture Synthesis (50 points)
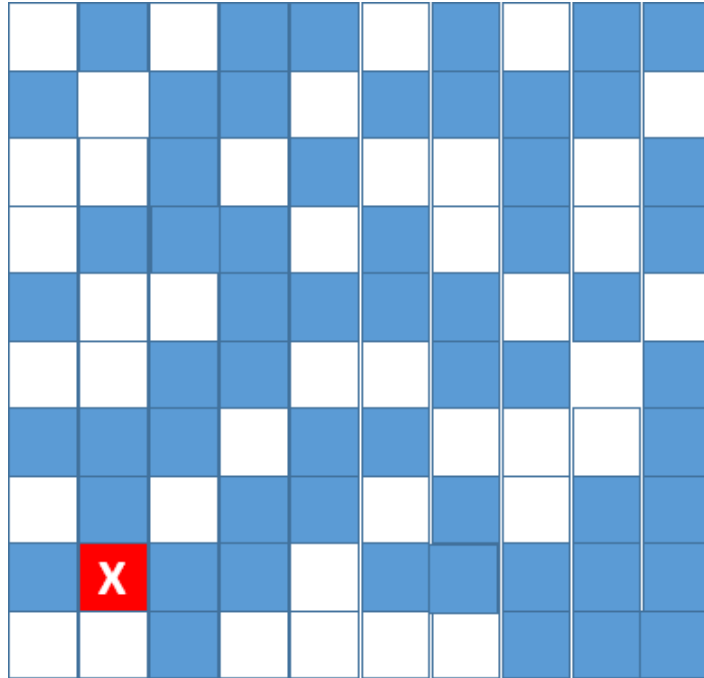
An image that is generated with texture synthesis has a distribution of local patterns. Given this image below (**the blue pixel is dark, and the white pixel is light**), where color of the pixel under the red box with the X is unknown:

- **a)** How many pixels (other than X) have a 3x3 neighborhood that matches the neighborhood of the 3x3 neighborhood of X? (10 points)

- **b)** What is the probability of X being Dark given its neighborhood in question **a**? Briefly justify how you computed this result. (15 points)

- **c)** For question **a**, how many pixels match if the neighborhood consists only of the four pixels above, below, left, and right of X? (10 points)

- **d)** What is the probability of X being Light given its neighborhood in question **c**? Briefly justify how you computed this result. (15 points)

3 Precision and Recall (30 points)

Consider this scenario wherein you have developed a classifier that can detect whether an processed image contains a vehicle or not, which you intend to use it in your autonomous vehicle project pipeline.

 Upon running some tests, on your algorithm (Classifier) with properly human annotated 100 processed images, which is found to be 100% accurate, you have observed the following:

I.   DATA SET INFORMATION: 100 images, 50 of them contain Vehicle, and the rest do not contain any Vehicle.

II.   The Model classified 65 images as containing vehicles and among the detected 65 images only 45 of them are correct.

Find the values of the following: Precision, Recall, True Negatives (10 points/each)

Note: No partial Credits, Highlight the final answer don't make us search around for the answer.