Minor-1
CSL7360 - Computer Vision

NOTE:

1. **Maximum Points:** 40, **Total Time:** 1 Hour,

2. If there is anything not clear in problems, go ahead with your own assumption but state it clearly. No doubts will be entertained during the exam.

3. Be precise. Verbosity will be penalized.

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1. Ishan, a computer vision student developed an image retrieval scheme. He gets the following results: **Query1:** +1, +1, -1, -1, +1, +1, -1, -1, -1, +1
   Query2: +1, +1, +1, -1, -1, -1, -1, +1, -1, +1
   Here +1 and -1 denote correct and incorrect retrieval respectively. Suppose for both queries the number of positive images is 5. Then compute mean precision and mean recall at 5. [**5 Points**]

2. **(TRUE or FALSE)** (i) If there is a class imbalance, one should prefer accuracy over the f1-score. (ii) Harris corner detector is scale invariant. (iii) Direction of the gradient in an image will be in the direction of from brighter to darker area. (iv) Low thresholds in Canny produces broken edges. (v) Convolving with the derivative of Gaussian gives peak at edges. [**5 Points**]

3. Design five features to represent a binary image. Write down their dimension and actually calculate them for a $m \times n$ binary image containing ones in both diagonal (like X), and zeros elsewhere. [**5 Points**]

4. Explain qualitatively what effect the following transformations will have on the Discrete Fourier Transform of an image: (a) the random shuffling of the intensity values of the image pixels, (b) addition of zero mean Gaussian noise with some standard deviation σ to the image. [**5 Points**]

5. Given a dataset consisting of Brain Tree of IIT J images captured by 100 different visitors across the last six months, your task is to learn a classifier to detect the Brain Tree in new photos. You implement principle component analysis to reduce the dimensionality of your data, but your performance in detecting the Brain Tree significantly drops compared to your method on the original input data. Why is the performance suffering? [**5 points**]

6. Prove that: $F(x, y) * \delta(x, y) = F(x, y)$. Where $*$ is convolution and $\delta(x, y)$ is 2-D Dirac Delta Function. Write down all the steps. [**5 Points**]

7. (Integral Image) [**5 Points**] Find the integral image for the following image:

10	20	24	34
105	105	205	14
55	5	105	11
45	49	29	19

Figure 1: Figure for Problem 7

8. Given two binary images (pixel values: 0 or 255 for darker region and lighter regions respectively) shown below: (a) Comment about histograms of images
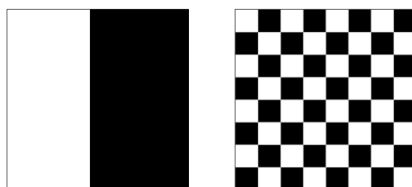
Figure 2: Figure for Problem 8

on the left and right. (b) Comment about the histogram of the average of two images. [**5 Points**]

End of Paper