CS/IT 441 Computer Vision
End-semester Examination
Dr. Gitam Shikkenawis

Duration : 3 hours
Marks : 45

Date: 15/11/2022

Note: Please scan and upload the answer-sheets on Google classroom for the course.

Useful values: $\cos 45 = 0.70; \sin 45 = 0.70$

1. [5 + 4 + 3 = 12 Marks] Compute the following:

a) [5 Marks] Compute transformation of the following vector in both inhomogeneous and homogenous coordinate system.

$t_x = 2.5 \quad t_y = 6$
rotation with $= 45$
scaling factor s =
$S = 3$

$\begin{bmatrix} 9 \\ -2 \end{bmatrix}$

4
[2

b) [2 + 2 = 4 Marks] Comment on the output images after using following filters :

A		
0	1	0
0	0	0
0	0	0

B		
1	1	0
1	0	-1
0	-1	-1

c) [3 Marks] Estimate the depth (the image is perfectly focused) given the following parameters:
sensor location : 52.30 mm
focal length : 50 mm

2. [3 + 3 + 3 + 3 =12 Marks]

a) Explain edge detection using 2nd order derivative. Write down the filter mask for the same.

b) What is foreshortening? How the surface normal and viewing direction affect it?

c) Suppose we take the (full) SVD of a size 15000 x 85 matrix **A**. Give the sizes and special properties of the resulting matrices.

d) How are the strongest Eigenvectors selected in Locality Preserving Projection (LPP) and why?

3. [4 + 4 + 4 + 4 = 16 Marks]

a) What is Reflectance Map? Explain iso-reflectance contours. Can the shape be recovered from one reflectance map?

b) Explain surface and body reflectance with diagram. Discuss properties of such surfaces with example.

c). In Photometric Stereo, how many images are required to recover shape for ideal Lambertian and Specular surfaces?

Discuss the scenarios when Photometric Stereo will not work for ideal Lambertian surfaces using minimum number of images.

d) Why is the mapping from Gradient space to Stereographic space required? Explain stereographic mapping.

4. [5 Marks]   A dataset that consists of face images in unconstrained environment is given. You want to use Principal Component Analysis (PCA / Eigenface) followed by the nearest neighbor to build a classifier that predicts the person in the image. Few sample face images from training dataset are given in Figure 1.

- In order to get reasonable performance from the Eigenface, algorithm, what preprocessing steps will be required on these images?
- Write down steps to obtain Eigenfaces (PCA basis vectors) for the given data.
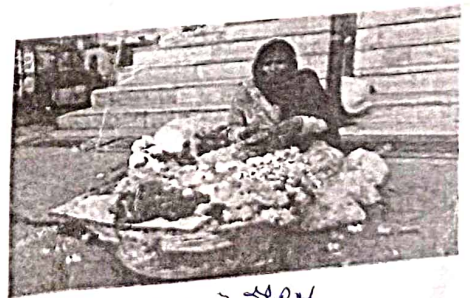
Figure 1. Sample face images from training dataset