DSE314-Computer Vision Internal Assessment-1

1. Find the value of f(2) using linear interpolation method. Given that f(0) = 2 and f(3) =5. (2)

2. A vector (7,3,2) is rotated around Z-axis by 90° and then rotated around Y-axis by 90° and translated by (4,-3,7).
Find the new coordinates of the vector. Express the final result in homogeneous coordinate. Preferably using computer code (4)

3. A camera matrix is given as follows:

$$P = \begin{bmatrix} 0.7679 & -0.4938 & -0.0234 & 0.0067 \\ -0.0852 & -0.0915 & -0.9065 & -0.0878 \\ 0.1827 & 0.2988 & -0.0742 & 1.0000 \end{bmatrix}$$

Find the decomposition of the matrix M, where M=KR and recover the translation vector 't'. Preferably using computer code (4)

4. A subset of pixel values are given below from 2 images (A & B). Compute 'C' such that C=((s*A)-B)+p, where s=10, p=2. (1)

A

10	90	16	16
0	11	11	11
18	30	33	33
18	18	18	18

B

10	90	16	16
0	13	17	11
18	34	31	33
18	17	19	18

5. Given is a grayscale image and the corresponding pixel values. For clarity, the third image is blown up to be able to see the pixel values clearly. Assuming that the top-left corner is (0,0) coordinate position, answer the following (6):

i)What are the coordinates of pixel value (15) marked by blue box?

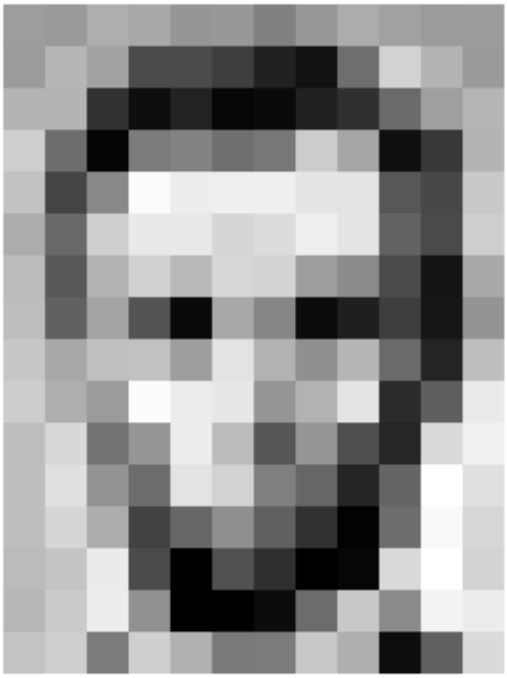
ii) The 4- neighbourhood pixels marked in violet (pixel value of 207) are?

iii)The 8- neighbourhood pixels marked by green box (pixel value of 191) are?

iv) The mean Euclidean distances between pixel in green box (value 191), red box (value 211) and maroon box (value 227) is:

v)If the image is applied with a threshold value of 190,
What will be the new values at each of the (6) marked boxes?

vi) which values of pixels are the 4X3 neighbours of the green box (pixel value of 191) and their coordinate positions?



157	153	174	168	150	152	129	151	172	161	155	156
155	182	163	74	75	62	33	17	110	210	180	154
180	180	50	14	34	6	10	33	48	105	159	181
206	109	5	124	131	111	120	204	166	15	56	180
194	68	137	251	237	239	239	228	227	87	71	201
172	105	207	233	233	214	220	239	228	98	74	206
188	88	179	209	185	215	211	158	139	75	20	169
189	97	165	84	10	168	134	11	31	62	22	148
199	168	191	193	158	227	178	143	182	105	36	190
205	174	155	252	236	231	149	178	228	43	95	234
190	216	116	149	236	187	86	150	79	38	218	241
190	224	147	108	227	210	127	102	36	101	255	224
190	214	173	66	103	143	95	50	2	109	249	215
187	196	235	75	1	81	47	0	6	217	255	211
183	202	237	145	0	0	12	108	200	138	243	236
195	206	123	207	177	121	123	200	175	13	96	218

(0,0)

157	153	174	168	150	152	129	151	172	161	155	156
155	182	163	74	75	62	33	17	110	210	180	154
180	180	50	14	34	6	10	33	48	106	159	181
206	109	5	124	131	111	120	204	166	15	56	180
194	68	137	251	237	239	239	228	227	87	71	201
172	105	207	233	233	214	220	239	228	98	74	206
188	88	179	209	185	215	211	158	139	75	20	169
189	97	165	84	10	168	134	11	31	62	22	148
199	168	191	193	158	227	178	143	182	106	36	190
205	174	155	252	236	231	149	178	228	43	95	234
190	216	116	149	236	187	86	150	79	38	218	241
190	224	147	108	227	210	127	102	36	101	255	224
190	214	173	66	103	143	96	50	2	109	249	215
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6. Express the point (4,7) in homogeneous coordinates. (1)

7. A 3D point A=(2,3,9) is translated by a vector T=[8 0 5]^{T} by a scale factor=2. Express the result in homogeneous coordinates. Write the 4 × 4 matrix A of the transformation in the Homogenous coordinate system that translates point A by the vector T. (2)

8. Consider the lines x + y – 5 = 0 and 4x – 5y + 7 = 0. Find their intersection in homogeneous coordinates and express the results also in Euclidean coordinates. (2)

9. Given the rotation matrix R and the centre of camera in world coordinates, Compute the extrinsic parameter matrix (3).

$$R = \begin{bmatrix} 0.9 & 0.4 & 0.1732 \\ -0.4183 & 0.9043 & 0.0854 \\ -0.1225 & -0.1493 & 0.9812 \end{bmatrix} \quad \mathbf{C}_w = (-1, -2, -3)^\top$$

10. What is the intrinsic parameter matrix for a camera, if its focal length is 1050 pixels, and principal point is offset from the center $(0, 0)^\top$ of the image plane to the location $(10, -5)^T$ (2).

11.Find the convolution and correlation results between the kernel (w) and image function f centred at the encircled points (shown in red). Show all the workings. (6)

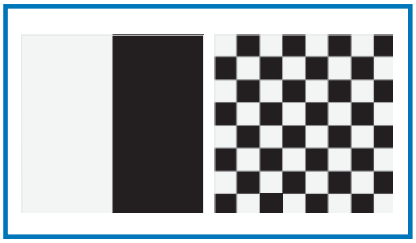
$$w = \begin{bmatrix} 1 & 2 & 1 \\ 2 & 4 & 2 \\ 1 & 2 & 1 \end{bmatrix} \quad f = \begin{bmatrix} 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 \end{bmatrix}$$

$$w = \begin{bmatrix} 1 & 2 & 1 \\ 2 & 4 & 2 \\ 1 & 2 & 1 \end{bmatrix} \quad f = \begin{bmatrix} 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 \end{bmatrix}$$

12.You want to design a 2D-elliptical Gaussian filter kernel to smooth an image, such that you have more smoothing in the vertical than the horizontal. Express in terms of the parameters to obtain such a filter. (2)

13.The grey level image is given as follows. Sketch the gray-level profile, 1st derivative and the 2nd derivative of the image and explain briefly (with equations).(2)

14. The two images shown in the following figure are quite different (1st is half white half-black and the second is check-board pattern), but their histograms are the same. Suppose that each image is blurred using a 3×3 box kernel. Would the histograms of the blurred images still be equal? Explain. (2)



15. Sketch the 1D Gaussian functions (approximately) for σ= 1, 4. (1)

16. Given are two lines: x+2y+1=0and3x+6y−2=0. (3)

i) What is the relationship between these two lines in the Euclidean plane? ii) In projective geometry, how is the point of intersection referred as? compute the point of intersection in homogeneous coordinates.

17. What is the net effect of transforming an arbitrary point x of the initial object to the corresponding point x' after the following transformations such that

x' = Hx, where H= DCBA .

i) Let scale in the x-direction using a scale factor 5 (i.e., making it five times larger) be matrix A

ii) this is followed by a rotation about z-axis 30° (B).

iii) Followed by a shear transformation in x- and y-direction with shearing factor 2 and 3, respectively (matrix C).

iv) And finally by a transformation moving the point in the direction of [2, 1, 2] (matrix D)

Write all the matrices using H.C. You may use computer code for finding value of H. (4)

18. De-noise the grayscale image as a first step and then compute the image derivative with an operator of your choice, using a computer code. Show the magnitude and direction images. Convert the image to grayscale first (if not) so that all the operations work correctly. (3)