DSE312-Computer Vision Practise session2: 27th August 2022

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

2. A vector (3,2) is rotated around Z-axis by 30° and then translated by (5,7). Find the new coordinates using computer code.

3. Interpolation of a polynomial of the form: $p(x) = a_2x^2 + a_1x + a_0$

Three coefficients of the parabola that passes through the distinct (non-collinear) points $(x_1, f(x_1))$, $(x_2, f(x_2))$ and $(x_3, f(x_3))$ are unique and are the solution of the system of three linear equations of the form:

$$f(x_1) = a_2{x_1}^2 + a_1x_1 + a_0$$
$$f(x_2) = a_2{x_2}^2 + a_1x_2 + a_0$$
$$f(x_3) = a_2{x_3}^2 + a_1x_3 + a_0$$

Write down the system of equations in the matrix form.
Then, for a parabolic function:

$f(x) = \frac{x^2}{10} - 2\sin(x)$, given: $x_1 = 0, x_2 = 1 \text{ and } x_3 = 2.$

Write the matrix form for this specific problem. Solve for the coefficients using computer code. Predict the value of $f(x)$, at $x =$ 1.5.

4. Express the point (5,7) in homogeneous coordinates.

Think about questions 5 and 6 regarding intersection (from our class discussion).

5. Fill in: Two intersecting planes always form : a. line; b. plane; c. point?
Find the intersecting _____ for the following set of plane equations: $2x+y-z=3$; $x-y+z=3$?
Also find a point on the _____ of intersection (hint: set $z=0$).

6. Given are two lines: $3x+2y+1=0$and $6x+4y-2=0$.
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 using computer code. Express the point in E.C. also.

6. 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 $H= ABCD$.
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. Please use computer code for finding value of H.

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.

8. A vector (5,9,4) is rotated around Z-axis by 30° and then rotated around Y-axis by 90° and then around X-axis by 180° . Finally is translated by (4,-3,7). Find the new coordinates of the vector. Express the final result in homogeneous coordinate. Preferably using computer code.

9. From the slides (Lectures7-8):
Use the points to compute projection matrix (P).
Then perform the decomposition of the projection matrix P into intrinsic and extrinsic parameters (follow the steps in lecture-8). Use computer codes.

10. Given the projection matrix M, compute the image plane coordinate of a point at the world coordinate (4,0,0).

$$M=\begin{bmatrix} 512 & -800 & 0 & 800 \\ 512 & 0 & -800 & 1600 \\ 1 & 0 & 0 & 0 \end{bmatrix}$$