Assignment 1: CS 663, Fall 2023

Darshan Makwana, Vignesh Nayak, Harsh Kavediya

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Q2. The idea is to use an affine tranformation matrix A which can convert the coordinates from matlab to the coordinate system of the graph. To learn the matrix A we will have to sample n points from the graph for which the coordinates (x_2, y_2) can be manually seen, then use the inpixelinfo in matlab to get the coordinate values (x_1, y_1) in the coordiante system of matlab. The linear system of equations for their transformation can be represented by

$$\begin{bmatrix} x_{21} & x_{22} & .. & x_{2n} \\ y_{21} & y_{22} & .. & y_{2n} \\ 1 & 1 & .. & 1 \end{bmatrix} = \begin{bmatrix} A_{11} & A_{12} & t_x \\ A_{21} & A_{22} & t_y \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} x_{11} & x_{12} & .. & x_{1n} \\ y_{11} & y_{12} & .. & y_{1n} \\ 1 & 1 & .. & 1 \end{bmatrix}$$

$$X_2 = AX_1$$

To solve for A we will multiply by X_1^T after which we get $X_2X_1^T = AX_1X_1^T$. If we take the utmost care that the n points sampled are not collinear then X_1 is invertible and $X_1X_1^T$ also becomes invertible. Now A can be obtained by multiplying by $(X_1X_1^T)^{-1}$

$$A = (X_2X_1^T)(X_1X_1^T)^{-1}$$

Now to convert any point (x_m, y_m) from the coordinate system of matlab to that of the graph (x_g, y_g) we can simply apply the affine transformation matrix A

$$\begin{bmatrix} x_g \\ y_g \\ 1 \end{bmatrix} = A \begin{bmatrix} x_g \\ y_g \\ 1 \end{bmatrix}$$