Matrix Theory Assignment 1

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Abstract— **This document contains the procedure to get image of a point in a line.**

I. PROBLEM

Find the image of the point $\begin{pmatrix} 3 \\ 8 \end{pmatrix}$ $with respect to the line$

$$(1 \quad 3)\mathbf{x} = 7 \tag{1}$$

II. SOLUTION

For this problem, I am considering the general case. Let the Equation of line be a*x + b*y = c and let the coordinates of,
P(given point) be (x1, y1)
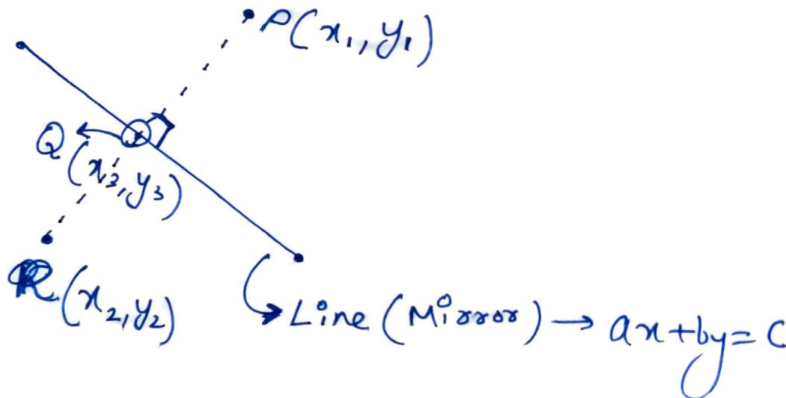Q(image point) be (x2, y2)
R(point on mirror) be (x3, y3)

Let the slope of perpendicular lines be m1, m2. Hence,

$$m1 * m2 = -1. \tag{2}$$

Now, m1 = $\frac{y2-y1}{x2-x1}$ and m2 = $\frac{-a}{b}$

Hence upon substituting the value of m1 and m2 in Equation 2 we get,

$$a * y2 - b * x2 = a * y1 - b * x1 \tag{3}$$

By property in Figure 1, the line PR bisects the mirror equation perpendicularly. Hence, PQ = QR.

Hence, x3 = $\frac{(x1+x2)}{2}$ and y3 = $\frac{(y1+y2)}{2}$ Now, clearly from the Figure 1, point Q lies on the line equation a*x + b*y = c. Hence substituting the point Q(x3,y3) in the line equation we get,

$$b * y2 + a * x2 = -b * y1 - a * x1 + 2 * c \tag{4}$$

Solving equation (1) and (2) for x2 and y2 we get,

$$x2 = \frac{2 * a * c - 2 * a * b * y1 - x1 * (a^2 - b^2)}{a^2 + b^2} \tag{5}$$

$$y2 = \frac{2 * b * c - 2 * a * b * x1 + y1 * (a^2 - b^2)}{a^2 + b^2} \tag{6}$$

Hence, substituting the value of x1 = 3, y1 = 8, a = 1, b = 3 and c = 7 in equations (5) and (6) we get,

$$x2 = -1 \tag{7}$$

$$y2 = -4 \tag{8}$$

Hence, it is the required answer for image of P in line (1 3) x =7.