Matrix theory Assignment 1

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Abstract—**This document contains the procedure to get a equation of a line that is equidistant from the two parallel lines.**

Download the python code from the below link. Go through the README file in the reposotory.

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https://github.com/Sreeakanth/EE5609/
    Assignment_1/code.py
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1 Problem

Find the equation of the line which is equidistant from two parallel lines.

$$\begin{pmatrix} 9 & 7 \end{pmatrix}\mathbf{x} = 7 \tag{1.0.1}$$

$$\begin{pmatrix} 3 & 2 \end{pmatrix}\mathbf{x} = -6 \tag{1.0.2}$$

I think there is a typo in the problem , I think they are non parallel lines, However the procedure is similar.

Assume that an arbitrary point $\begin{pmatrix} x' & y' \end{pmatrix}$ is on the resultant line. Then the Idea of computing the line that is equidistant from two other lines is compute the distant between an arbitrary point $\begin{pmatrix} x' & y' \end{pmatrix}$ to both lines and equate then with opposite signs.

the distance from arbitrary point $\begin{pmatrix} x' & y' \end{pmatrix}$ to line L1 is same as L2 with opposite sign. Let's $ax+by+c = 0$ and $dx + ey + f = 0$ be the two given lines then

$$\frac{ax' + by' + c}{\sqrt{a^2 + b^2}} = -\frac{dx' + ey' + f}{\sqrt{d^2 + e^2}} \tag{1.0.3}$$

When we reformulate the above equation to the general form of linear equation we will get.

$$\left(\frac{a}{\sqrt{a^2 + b^2}} + \frac{d}{\sqrt{d^2 + e^2}}\right)(x') + \left(\frac{b}{\sqrt{a^2 + b^2}} + \frac{e}{\sqrt{d^2 + e^2}}\right)(y') + \left(\frac{c}{\sqrt{a^2 + b^2}} + \frac{f}{\sqrt{d^2 + e^2}}\right) = 0 \tag{1.0.4}$$

So the coefficients of the results line gx'+hy'+i=0 are

$$g = \left(\frac{a}{\sqrt{a^2 + b^2}} + \frac{d}{\sqrt{d^2 + e^2}}\right) \tag{1.0.5}$$

$$h = \left(\frac{b}{\sqrt{a^2 + b^2}} + \frac{e}{\sqrt{d^2 + e^2}}\right) \tag{1.0.6}$$

$$i = \left(\frac{c}{\sqrt{a^2 + b^2}} + \frac{f}{\sqrt{d^2 + e^2}}\right) \tag{1.0.7}$$

When we substitute the given data in the above equations we will get the answer. given data is $a = 9$,$b = 7$,$c = -7$ and $d = 3$,$e = 2$,$f = 6$ so the answer is

$$g = 1.62 \tag{1.0.8}$$

$$h = 1.168 \tag{1.0.9}$$

$$i = 1.05 \tag{1.0.10}$$

I also took parallel lines and then compute the line which is equidistant from the two parallel lines

$$\begin{pmatrix} 2 & 4 \end{pmatrix}\mathbf{x} = 8 \tag{1.0.11}$$

$$\begin{pmatrix} 2 & 4 \end{pmatrix}\mathbf{x} = 16 \tag{1.0.12}$$

Now the coefficient of the line gx+hy+i=0 as mentioned by the above procedure is.

$$g = 0.89 \tag{1.0.13}$$

$$h = 1.78 \tag{1.0.14}$$

$$i = -5.36 \tag{1.0.15}$$

You can see the slopes of all the three lines in the above examples are similar (-0.5).