Assignment 9

Jayati Dutta

***Abstract*—This is a simple document explaining how to express a matrix by the linear combination of the rows of another matrix.**

Download all and latex-tikz codes from

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svn co https://github.com/gadepall/school/trunk/
    ncert/geometry/figs
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1 Problem

Let $A = \begin{pmatrix} 1 & -1 \\ 2 & 2 \\ 1 & 0 \end{pmatrix}$ and $B = \begin{pmatrix} 3 & 1 \\ -4 & 4 \end{pmatrix}$ Is there any matrix C such that $CA = B$?

2 Explanation

The matrix B is obtained by multiplying the matrix A with matrix C. B is a 2×2 matrix and A is a 3×2 matrix. so matrix C must be a 2×3 matrix. Let the matrix C is:

$$C = \begin{pmatrix} a_1 & b_1 & c_1 \\ a_2 & b_2 & c_2 \end{pmatrix} \tag{2.0.1}$$

So, after multiplying with A matrix we get,

$$\begin{pmatrix} a_1 & b_1 & c_1 \\ a_2 & b_2 & c_2 \end{pmatrix} \begin{pmatrix} 1 & -1 \\ 2 & 2 \\ 1 & 0 \end{pmatrix} = \begin{pmatrix} a_1 + 2b_1 + c_1 & -a_1 + 2b_1 \\ a_2 + 2b_2 + c_2 & -a_2 + 2b_2 \end{pmatrix} \tag{2.0.2}$$

Matrix A is a rectangular matrix, so pseodo inverse of matrix A exists. Now, Considering CA $=B$ and by transposing both side,

$$(CA)^T = B^T \tag{2.0.3}$$
$$\implies A^T C^T = B^T \tag{2.0.4}$$
$$\implies PC^T = B^T \tag{2.0.5}$$
$$\implies P^T PC^T = B^T \tag{2.0.6}$$
$$\implies C^T = (P^T P)^{-1} B^T \tag{2.0.7}$$

where $P = A^T$. But $\det(P^T P) = 0$