Assignment 3

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Abstract—**This document explains the concept of matrix multiplication**

Download all latex-tikz codes from

https://github.com/venkateshelangovan/IIT−
Hyderabad−Assignments/tree/master/
Assignment3_Matrix_Theory

1 PROBLEM

If F(x)=$\begin{pmatrix} \cos x & -\sin x & 0 \\ \sin x & \cos x & 0 \\ 0 & 0 & 1 \end{pmatrix}$,show that

F(x)F(y) = F(x+y)

2 SOLUTION

Given,

$$F(x) = \begin{pmatrix} \cos x & -\sin x & 0 \\ \sin x & \cos x & 0 \\ 0 & 0 & 1 \end{pmatrix} \qquad (2.0.1)$$

Replacing x with y in above equation 2.0.1 F(y) is given as,

$$F(y) = \begin{pmatrix} \cos y & -\sin y & 0 \\ \sin y & \cos y & 0 \\ 0 & 0 & 1 \end{pmatrix} \qquad (2.0.2)$$

From the problem statement,
Consider the LHS,
F(x)F(y)

$$= \begin{pmatrix} \cos x & -\sin x & 0 \\ \sin x & \cos x & 0 \\ 0 & 0 & 1 \end{pmatrix} \begin{pmatrix} \cos y & -\sin y & 0 \\ \sin y & \cos y & 0 \\ 0 & 0 & 1 \end{pmatrix} \qquad (2.0.3)$$

$$= \begin{pmatrix} \cos x \cos y - \sin x \sin y & -\cos x \sin y - \sin x \cos y & 0 \\ \sin x \cos y + \cos x \sin y & -\sin x \sin y + \cos x \cos y & 0 \\ 0 & 0 & 1 \end{pmatrix}$$
$$(2.0.4)$$

$$= \begin{pmatrix} \cos(x+y) & -\sin(x+y) & 0 \\ \sin(x+y) & \cos(x+y) & 0 \\ 0 & 0 & 1 \end{pmatrix} \qquad (2.0.5)$$

$$= F(x+y) \qquad (2.0.6)$$

Equation 2.0.5 is F(x+y) i.e RHS of the problem statement. Here we arrived at RHS by solving the LHS F(x)F(y)
Therefore,

$$F(x)F(y) = F(x+y) \qquad (2.0.7)$$

Hence Proved