Step-1

Consider the following subroutine that multiplies matrix *A* and vector *x*.

DO 10 $I=1,N$

DO 10 $J=1,N$

10 $B(I)=B(I)+A(I,J)\cdot X(J)$

Determine the multiplication is done by rows or columns.

Step-2

Consider the following matrices:

$$A=\begin{bmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{bmatrix}$$
$$X=\begin{bmatrix} x_1 \\ x_2 \end{bmatrix}$$

Step-3

Put values of *I* and *J* from 1 to 2 and solve the multiplication step. Initially consider $B(I)=0$.

For $I=1$

And $J=1$

$$\begin{aligned} B(I)&=B(I)+A(I,J)\cdot X(J) \\ B(1)&=B(1)+A(1,1)\cdot X(1) \\ &=0+a_{11}x_1 \end{aligned}$$

For $I=1$

And $J=2$

$$\begin{aligned} B(I)&=B(I)+A(I,J)\cdot X(J) \\ B(1)&=B(1)+A(1,2)\cdot X(2) \\ &=a_{11}x_1+a_{12}x_2 \end{aligned}$$

Above calculation shows that multiplication is done by taking rows of *A* with column of *x* or simply $\boxed{\text{row wise multiplication}}$.

Step-4

Consider another subroutine that multiplies matrix *A* and vector *x*.

DO 10 $J = 1, N$

DO 10 $I = 1, N$

10 $B(I) = B(I) + A(I,J) \cdot X(J)$

Determine the multiplication is done by rows or columns.

Step-5

Put *I* and *J* from 1 to 2 and solve the multiplication step. Initially consider $B(I) = 0$.

For $J = 1$

And $I = 1$

$$\begin{aligned} B(I) &= B(I) + A(I,J) \cdot X(J) \\ B(1) &= B(1) + A(1,1) \cdot X(1) \\ &= 0 + a_{11}x_1 \end{aligned}$$

For $J = 1$

And $I = 2$

$$\begin{aligned} B(I) &= B(I) + A(I,J) \cdot X(J) \\ B(2) &= B(1) + A(2,1) \cdot X(1) \\ &= a_{11}x_1 + a_{21}x_1 \end{aligned}$$

Above calculation shows that multiplication is done by taking column of *A* with row of *x* or simply $\boxed{\text{column wise multiplication}}$.