

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 $J=1$

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

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

For $I=1$

And $J=2$

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

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

Above calculation shows that multiplication is done by taking rows of A with column of x or simply 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 $I=1$

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

$$B(1) = B(1) + A(1,1) \cdot X(1)$$

$$= 0 + a_{11}x_1$$

For $J=1$

And $I=2$

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

$$B(2) = B(1) + A(2,1) \cdot X(1)$$

$$= a_{21}x_1 + a_{22}x_1$$

Above calculation shows that multiplication is done by taking column of A with row of x or simply column wise multiplication.