$$A = \begin{bmatrix} A_{11} & A_{12} & A_{13} \\ A_{21} & A_{22} & A_{23} \\ A_{31} & A_{32} & A_{33} \end{bmatrix} \text{ and } B = \begin{bmatrix} B_{11} & B_{12} & B_{13} \\ B_{21} & B_{22} & B_{23} \\ B_{31} & B_{32} & B_{33} \end{bmatrix}$$

$$A\ .*\ B = \begin{bmatrix} A_{11}B_{11} & A_{12}B_{12} & A_{13}B_{13} \\ A_{21}B_{21} & A_{22}B_{22} & A_{23}B_{23} \\ A_{31}B_{31} & A_{32}B_{32} & A_{33}B_{33} \end{bmatrix} \qquad A\ ./\ B = \begin{bmatrix} A_{11}/B_{11} & A_{12}/B_{12} & A_{13}/B_{13} \\ A_{21}/B_{21} & A_{22}/B_{22} & A_{23}/B_{23} \\ A_{31}/B_{31} & A_{32}/B_{32} & A_{33}/B_{33} \end{bmatrix}$$

- Element-by-element operations can be done <u>only with arrays of the **same size**</u>.

$$\mathbf{A}\ .\hat{}\ n = \begin{bmatrix} (A_{11})^n & (A_{12})^n & (A_{13})^n \\ (A_{21})^n & (A_{22})^n & (A_{23})^n \\ (A_{31})^n & (A_{32})^n & (A_{33})^n \end{bmatrix}$$

ARRAY MULTIPLICATION

- The multiplication operation * is executed by MATLAB according to the rules of linear algebra
- the operation **A*B** can be carried out **only if the number of columns in matrix A is equal to the number of rows in matrix B.**
- **The result** is a matrix that has the same number of **rows as A** and the same number of **columns as B**.

If A (4, 3) , B (3, 2) ➔ then the matrix that is obtained with the operation A*B has dimensions (4,2)

EX: A numerical example for a(3,3) * b(3,2) = c(3,2)

$$\begin{bmatrix} 1 & 4 & 3 \\ 2 & 6 & 1 \\ 5 & 2 & 8 \end{bmatrix} \begin{bmatrix} 5 & 4 \\ 1 & 3 \\ 2 & 6 \end{bmatrix} = \begin{bmatrix} (1\cdot5+4\cdot1+3\cdot2) & (1\cdot4+4\cdot3+3\cdot6) \\ (2\cdot5+6\cdot1+1\cdot2) & (2\cdot4+6\cdot3+1\cdot6) \\ (5\cdot5+2\cdot1+8\cdot2) & (5\cdot4+2\cdot3+8\cdot6) \end{bmatrix} = \begin{bmatrix} 15 & 34 \\ 18 & 32 \\ 43 & 74 \end{bmatrix}$$

$$C_{i,j} = \sum_{k=1}^{n} a_{i,k} . b_{k,j}$$

Dot Product

- The dot product is a scalar computed from **two vectors of the same size**. The scalar is the sum of the products of the values in corresponding positions in the vectors.
- dot product= A*B=$\sum_{i=1}^{n} a_i . b_i$

EX: A=[2 5 1] , B=[3; 1; 4]

>> A = 2 5 1

B =3

1

4

>> A*B >> ans =15

Dot product of two vectors

>> B*A >> ans = 6 15 3

2 5 1

8 20 4

EX: Use loops to find a*b , if a = [2 -1 3;-1 2 0;3 -5 2], b = [3 1 1].

Ans : $a = \begin{bmatrix} 2 & -1 & 3 \\ -1 & 2 & 0 \\ 3 & -5 & 2 \end{bmatrix} \rightarrow a(3,3)$ $\quad b = [\,3\ 1\ 1\,] \rightarrow b' = \begin{bmatrix} 3 \\ 1 \\ 1 \end{bmatrix} \quad b=(3)$

```
File   Edit   Text   Go   Cell   Tools   Debug   Desktop   Window   Help

clc
a=[2 -1 3;-1 2 0;3 -5 2]
b=[3 1 1]'
[n m]=size(a);
[k z]=size(b);
if m ~= k
disp('Cannot perform this matrix multiplication')
break
for i=1:n
    x(i)=0;
    for j=1: z
        x(i)=x(i)+ a(i,j)*b(j);
    end
end
end
disp(x')
```

```
ans =

     8
    -1
     6

>>
```

<u>Built-in functions for handling arrays :</u>

- **Size(A)** → Returns a row vector [m, n], where **m and n are the size mxn** of the array A. >> [m,n]=size(a) >> m= 3 , n= 3
- **length(A)**→ Returns the number of elements in the vector A.