

12 Mar 2023

Newton School x Newton School x New Tab x How to Multiply Matrices x +

mathsisfun.com/algebra/matrix-multiplying.html

But to multiply a matrix **by another matrix** we need to do the "**dot product**" of rows and columns ... what does that mean? Let us see with an example:

To work out the answer for the **1st row** and **1st column**:

$A \begin{matrix} m \times p \\ 5 \times 3 \end{matrix} * B \begin{matrix} p \times n \\ 3 \times 7 \end{matrix} = C \begin{matrix} m \times n \\ 2 \times 2 \end{matrix}$

$\begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \end{bmatrix} \times \begin{bmatrix} 7 & 8 \\ 9 & 10 \\ 11 & 12 \end{bmatrix} = \begin{bmatrix} 58 \\ 64 \end{bmatrix}$

"Dot Product"

The "Dot Product" is where we **multiply matching members**, then sum up:

$(1, 2, 3) \cdot (7, 9, 11) = 1 \times 7 + 2 \times 9 + 3 \times 11 = 58$

We match the 1st members (1 and 7), multiply them, likewise for the 2nd members (2 and 9) and the 3rd members (3 and 11), and finally sum them up.

Want to see another example? Here it is for the 1st row and **2nd column**:

$\begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \end{bmatrix} \times \begin{bmatrix} 7 & 8 \\ 9 & 10 \\ 11 & 12 \end{bmatrix} = \begin{bmatrix} 58 & 64 \end{bmatrix}$

$(1, 2, 3) \cdot (8, 10, 12) = 1 \times 8 + 2 \times 10 + 3 \times 12 = 64$

$$\begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \end{bmatrix} \begin{matrix} 2 \times 3 \\ = \end{matrix} * \begin{bmatrix} 7 & 8 \\ 9 & 10 \\ 11 & 12 \end{bmatrix} \begin{matrix} 3 \times 2 \\ = \end{matrix}$$

$$= \begin{bmatrix} 1+18+33 & 8+20+36 \\ 28+45+66 & 32+50+72 \end{bmatrix}$$

$$= \begin{bmatrix} 58 & 64 \\ 139 & 154 \end{bmatrix} \begin{matrix} 2 \times 2 \\ = \end{matrix}$$

Matrix A

$$\begin{bmatrix} 1 & 4 & 6 & 10 \\ 2 & 7 & 5 & 3 \end{bmatrix}$$

2×4

Matrix B

$$\begin{bmatrix} 1 & 4 & 6 & 10 \\ 2 & 7 & 5 & 3 \\ 9 & 0 & 11 & 8 \end{bmatrix}$$

3×4

$A \times B \rightarrow \text{not possible}$

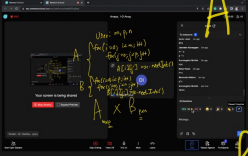
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$$\begin{array}{c}
 \begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \end{bmatrix} \times \begin{bmatrix} 7 \\ 8 \\ 9 \end{bmatrix} = \begin{bmatrix} (1)(7)+(2)(8)+(3)(9) \\ (4)(7)+(5)(8)+(6)(9) \end{bmatrix} = \begin{bmatrix} 7+16+27 \\ 28+40+54 \end{bmatrix} = \begin{bmatrix} 50 \\ 122 \end{bmatrix} \\
 \begin{array}{ccc} 2 \times 3 & 3 \times 1 & \\ \text{columns on 1st = rows on 2nd} & & \end{array} \\
 \begin{array}{ccc} 2 \times 1 & 2 \times 1 & 2 \times 1 \end{array}
 \end{array}$$

The number of rows in the 1st matrix and the number of columns in the 2nd matrix, make the dimensions of the final matrix

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42:56 41

Arrays, 1-D Array



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User: m, p, n

```

for(i=0; i<m; i++)
    for(j=0; j<p; j++)
        A[i][j] = sc.nextInt()

for(i=0; i<p; i++)
    for(j=0; j<n; j++)
        B[i][j] = sc.nextInt()

```

DI

$A \times B_{p \times n}$

$m \times p$

Chat

To everyone

nena tiwari 3m ago

M*p

Jasmeen Kansagara 3m ago

m * p

p * n

Arunangshu Mullick 3m ago

ooo

Naha Tiwari 3m ago

P*n

Munendra Mishra 3m ago

p*n

Arunangshu Mullick just now

Himm

28 Reactions

YES 25 NO 0

Message...

Screen - Dr. Darsha... (you)

Logic:

```

J Main.java x
J Main.java > Main > main(String[])
23 System.out.println("Enter the B Array elements row-wise:");
24 for(i=0; i<p; i++)
25     for(j=0; j<n; j++)
26         B[i][j] = sc.nextInt();
27
28 for(i=0; i<m; i++)
29     for(j=0; j<n; j++)
30     {
31         C[i][j] = 0;
32         for(k=0; k<p; k++)
33             C[i][j] += A[i][k] * B[k][j];
34     }
35
36 → System.out.println("A Array elements are as follows:\n");
37 for(i=0; i<m; i++)
38     {

```

Matrix A (2x3):

0	1	2
1	2	3
4	5	6

Matrix B (3x2):

0	1
7	8
9	10
11	12

Matrix C (2x2):

0	1
0	1

Handwritten calculations for C:

$$C[0][0] = 0 + (1 \times 7) + (2 \times 9) + (3 \times 11) = 0 + 7 + 18 + 33 = 58$$

$$C[0][1] = 0 + (1 \times 8) + (2 \times 10) + (3 \times 12) = 0 + 8 + 20 + 36 = 64$$

$$C[1][0] = 0 + (4 \times 7) + (5 \times 9) + (6 \times 11) = 0 + 28 + 45 + 66 = 139$$

$$C[1][1] = 0 + (4 \times 8) + (5 \times 10) + (6 \times 12) = 0 + 32 + 50 + 72 = 154$$

Terminal output:

```

1 2 3
4 5 6
B Array elements are as follows:
7
8
9
C Array elements i.e. Matrix Multiplication, is as follows:
58
122
(base) ingledarshan@192 NS 12 Mar %

```

Ln 34, Col 14 Spaces: 4 UTF-8 LF () Java

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Arrays, 1-D Array

REC

$A_{m \times p} \times B_{p \times n} = C_{m \times n}$

$C:$

for(i=0 to m)

for(j=0 to n)

{

$C[i][j] = 0;$

for(k=0 to p)

$C[i][j] += A[i][k] * B[k][j];$

}

DI

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Screen - Dr. Darsha... (you)

Chat

To everyone

Arunangshu Mullick 20m ago

Okay sir

Neha Tiwari 20m ago

Ok

Yogesh G. Rajpayle 19m ago

ok sir

Arunangshu Mullick 14m ago

Ha

Yogesh G. Rajpayle 13m ago

yes sir

Jasmeen Kansagara 13m ago

Yes Sir

26 Reactions

YES 18 NO 7

Message...

Start Open Session Stop Sharing Video Off Mic On More Leave Chat Today's Agenda Participants Polls

j	1	2	3	4	i	$j \leq (n-i)$ #Spaces	$j \leq i$ #Stars
1				*	1	3	1
2			*	**	2	2	2
3		*	**	***	3	1	3
4	*	**	***	****	4	0	4

$n=4$

```

J Main.java •
J Main.java > Main > main(String[])
74 public static void main(String[] args)
75 {
76     Scanner sc = new Scanner(System.in);
77     int n, i, j;
78     System.out.print("Enter n: ");
79     n = sc.nextInt();
80     for(i=1; i<=n; i++)
81     {
82         for(j=1; j<=(n-i); j++)
83             System.out.print(" ");
84         for(j=1; j<=i; j++)
85             System.out.print("*");
86         System.out.println();
87     }
88 }
89 }

PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL
Enter n: 10
*
**
***
****
*****
*****
*****
*****
*****
*****
(base) ingledarshan@192 NS 12 Mar %
Ln 84, Col 28 (7 selected) Spaces: 4 UTF-8 LF () Java

```

i	j				
		1	2	3	4
1		*	*	*	*
2			*	*	*
3				*	*
4					*

$n=4$

i	$j \leq (i-1)$ # Spaces	$j \leq (n-i+1)$ # Stars
1	0	4
2	1	3
3	2	2
4	3	1

①

②

H/w' ① Mat Mult ^{Code} Rev.
 ② Develop table
 for ① and ②.

				*				
			*	*	*			
		*	*	*	*	*		
	*	*	*	*	*	*	*	
*	*	*	*	*	*	*	*	*

_____ X _____