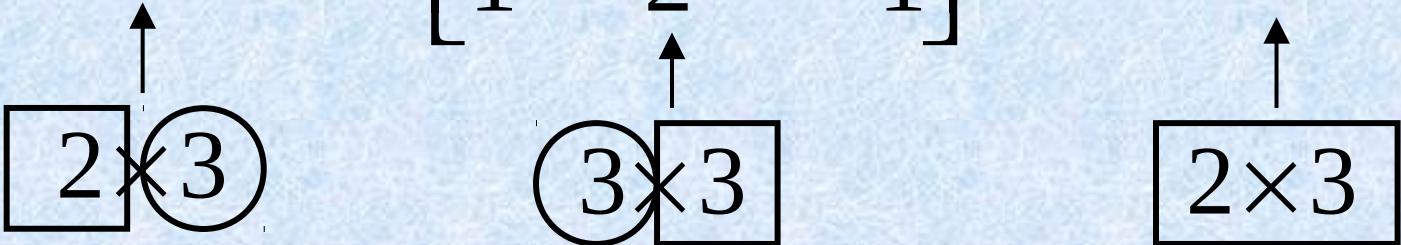


Matriisien kertolasku

$$\begin{bmatrix} 2 & 1 & 0 \\ -1 & -3 & 2 \end{bmatrix} \begin{bmatrix} 5 & -5 & 3 \\ 0 & 4 & 2 \\ 1 & 2 & -1 \end{bmatrix} = ?$$

Matriisien kertolasku

$$\begin{bmatrix} 2 & 1 & 0 \\ -1 & -3 & 2 \end{bmatrix} \begin{bmatrix} 5 & -5 & 3 \\ 0 & 4 & 2 \\ 1 & 2 & -1 \end{bmatrix} = \begin{bmatrix} \bullet & \bullet & \bullet \\ \bullet & \bullet & \bullet \end{bmatrix}$$



2x3 3x3 2x3

- 3 saraketta + 3 riviä -> kertolasku onnistuu
- tulos 2x3-matriisi

Matriisien kertolasku

$$\begin{bmatrix} 2 & 1 & 0 \\ -1 & -3 & 2 \end{bmatrix} \begin{bmatrix} 5 \\ 0 \\ 1 \end{bmatrix} = \begin{bmatrix} -5 & 3 \\ 4 & 2 \\ 2 & -1 \end{bmatrix}$$

1.s. ↓
1.r. → [? ⋮ ⋮]

$$2 \cdot 5 + 1 \cdot 0 + 0 \cdot 1 = 10$$

Matriisien kertolasku

$$\begin{bmatrix} 2 & 1 & 0 \\ -1 & -3 & 2 \end{bmatrix} \begin{bmatrix} 5 \\ 0 \\ 1 \end{bmatrix} = \begin{bmatrix} 10 \\ ? \\ \bullet \end{bmatrix}$$

Calculation steps:

- 1.r. (Row 1) \rightarrow $2 \cdot (-5) + 1 \cdot 4 + 0 \cdot 2 = -6$
- 2.s. (Row 2) \rightarrow $? = -1$

$$2 \cdot (-5) + 1 \cdot 4 + 0 \cdot 2 = -6$$

Matriisien kertolasku

$$\begin{bmatrix} 2 & 1 & 0 \\ -1 & -3 & 2 \end{bmatrix} \begin{bmatrix} 5 & -5 \\ 0 & 4 \\ 1 & 2 \end{bmatrix} \xrightarrow{\text{1.r.}} = \begin{bmatrix} 10 & -6 \\ \bullet & \bullet \\ \bullet & \bullet \end{bmatrix}$$

3.s.
↓

The diagram illustrates the calculation of the element in the third row and third column of the product matrix. The element is calculated as follows:

$$2 \cdot 3 + 1 \cdot 2 + 0 \cdot (-1) = 8$$

$$2 \cdot 3 + 1 \cdot 2 + 0 \cdot (-1) = 8$$

Matriisien kertolasku

$$\begin{bmatrix} 2 & 1 & 0 \\ -1 & -3 & 2 \end{bmatrix} \begin{bmatrix} 5 \\ 0 \\ 1 \end{bmatrix} = \begin{bmatrix} -5 & 3 \\ 4 & 2 \\ 2 & -1 \end{bmatrix}$$

2.r. \rightarrow

1.s.

$\begin{bmatrix} 10 & -6 & 8 \\ ? & \bullet & \bullet \end{bmatrix}$

The diagram illustrates the calculation of the element in the first row and second column of the resulting matrix. It shows the matrices and their multiplication, with specific rows and columns circled to highlight the calculation process.

$$-1 \cdot 5 + (-3) \cdot 0 + 2 \cdot 1 = -3$$

Matriisien kertolasku

$$\begin{bmatrix} 2 & 1 & 0 \\ -1 & -3 & 2 \end{bmatrix} \begin{bmatrix} 5 \\ 0 \\ 1 \end{bmatrix} = \begin{bmatrix} 10 \\ -3 \\ ? \end{bmatrix}$$

2.r. → 

2.s.
↓

$$-1 \cdot (-5) + (-3) \cdot 4 + 2 \cdot 2 = -3$$

Matriisien kertolasku

$$\begin{bmatrix} 2 & 1 & 0 \\ -1 & -3 & 2 \end{bmatrix} \begin{bmatrix} 5 & -5 \\ 0 & 4 \\ 1 & 2 \end{bmatrix} \xrightarrow{\text{2.r.}} = \begin{bmatrix} 10 & -6 & 8 \\ -3 & -3 & ? \end{bmatrix}$$

3.s.
↓

The diagram shows the multiplication of two matrices. The first matrix has a circled minor $\begin{bmatrix} -1 & -3 & 2 \end{bmatrix}$. The second matrix has circled elements 3 , 2 , and -1 in its third row. An arrow labeled "2.r." indicates the second row of the second matrix is being multiplied by this minor. The result is a 2x3 matrix with the third column question mark.

$$-1 \cdot 3 + (-3) \cdot 2 + 2 \cdot (-1) = -11$$

Matriisien kertolasku

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

Matriisien kertolasku

$$\begin{bmatrix} 2 & 1 & 0 \\ -1 & -3 & 2 \\ \bullet & \bullet & \bullet \\ \bullet & \bullet & \bullet \end{bmatrix} \begin{bmatrix} 5 & -5 & 3 \\ 0 & 4 & 2 \\ 1 & 2 & -1 \end{bmatrix} = \begin{bmatrix} 10 & -6 & 8 \\ -3 & -3 & -11 \\ \bullet & \bullet & \bullet \\ \bullet & \bullet & \bullet \end{bmatrix}$$

- 1. matriisin rivien lkm = tulosmatriisin rivien lkm

Matriisien kertolasku

$$\begin{bmatrix} 2 & 1 & 0 \\ -1 & -3 & 2 \end{bmatrix} \begin{bmatrix} 5 & -5 & 3 \\ 0 & 4 & 2 \\ 1 & 2 & -1 \end{bmatrix} \begin{bmatrix} \bullet \\ \bullet \\ \bullet \\ \bullet \end{bmatrix}$$
$$= \begin{bmatrix} 10 & -6 & 8 \\ -3 & -3 & -11 \end{bmatrix} \begin{bmatrix} \bullet \\ \bullet \\ \bullet \\ \bullet \end{bmatrix}$$

- 2. matriisin sarakkeiden lkm = tulosmatriisin sarakkeiden lkm

Matriisien kertolasku

Esim.

$$\begin{bmatrix} 2 & 1 & 0 \\ 1 & 3 & 2 \\ \vdots & \vdots & \vdots \\ 1 & 2 & 3 \end{bmatrix} \begin{bmatrix} 5 & -5 & 3 & \cdots & \cdots \\ 0 & 4 & 2 & \cdots & \cdots \\ 1 & 2 & -1 & \cdots & \cdots \\ 10 & -6 & 8 & \cdots & \cdots \\ -3 & -3 & -11 & \cdots & \cdots \\ \vdots & \vdots & \vdots & \ddots & \ddots \\ \vdots & \vdots & \vdots & ? & \ddots \end{bmatrix}$$

$$1 \cdot 3 + 2 \cdot 2 + 3 \cdot (-1) = 4$$