Matrices

A Matrix is an array of numbers:

$$\begin{bmatrix} 6 & 4 & 24 \\ 1 & -9 & 8 \end{bmatrix}$$

A Matrix

(This one has 2 Rows and 3 Columns)

> We talk about one **matrix**, or several **matrices**.

There are many things we can do with them ...

Adding

To add two matrices: add the numbers in the matching positions:

3+4=7

$$\begin{bmatrix} 3 & 8 \\ 4 & 6 \end{bmatrix} + \begin{bmatrix} 4 & 0 \\ 1 & -9 \end{bmatrix} = \begin{bmatrix} 7 & 8 \\ 5 & -3 \end{bmatrix}$$

These are the calculations:

3+4=7	8+0=8
4+1=5	6-9=-3

The two matrices must be the same size, i.e. the rows must match in size, and the columns must match in size.

> Example: a matrix with **3 rows** and **5 columns** can be added to another matrix of **3 rows** and **5 columns**.
>
> But it could not be added to a matrix with **3 rows** and **4 columns** (the columns don't match in size)

Negative

The negative of a matrix is also simple:

$$\overset{-(2)=-2}{}$$
$$-\begin{bmatrix}2 & -4\\7 & 10\end{bmatrix} = \begin{bmatrix}-2 & 4\\-7 & -10\end{bmatrix}$$

These are the calculations:

-(2)=-2	-(-4)=+4
-(7)=-7	-(10)=-10

Subtracting

To subtract two matrices: subtract the numbers in the matching positions:

$$\overset{3-4=-1}{}$$
$$\begin{bmatrix}3 & 8\\4 & 6\end{bmatrix} - \begin{bmatrix}4 & 0\\1 & -9\end{bmatrix} = \begin{bmatrix}-1 & 8\\3 & 15\end{bmatrix}$$

These are the calculations:

3-4=-1	8-0=8
4-1=3	6-(-9)=15

*Note: subtracting is actually defined as the **addition** of a negative matrix: A + (-B)*

Multiply by a Constant

We can multiply a matrix by some value:

$$\overset{2\times4=8}{}$$
$$2\times\begin{bmatrix}4 & 0\\1 & -9\end{bmatrix} = \begin{bmatrix}8 & 0\\2 & -18\end{bmatrix}$$

These are the calculations:

2×4=8	2×0=0
2×1=2	2×-9=-18

We call the constant a **scalar**, so officially this is called "scalar multiplication".

Multiplying by Another Matrix

To **multiply two matrices together** is a bit more difficult ... read Multiplying Matrices to learn how.

Dividing

And what about division? Well we **don't** actually divide matrices, we do it this way:

$$A/B = A \times (1/B) = A \times B^{-1}$$

where $\mathbf{B^{-1}}$ means the "inverse" of B.

So we don't divide, instead we **multiply by an inverse**.

And there are special ways to find the Inverse ...

... learn more about the Inverse of a Matrix.

Transposing

To "transpose" a matrix, swap the rows and columns. We put a "T" in the top right-hand corner to mean transpose:

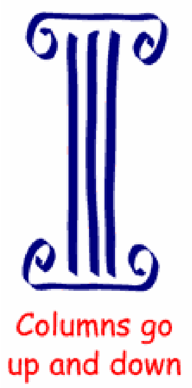
$$\begin{bmatrix} 6 & 4 & 24 \\ 1 & -9 & 8 \end{bmatrix}^T = \begin{bmatrix} 6 & 1 \\ 4 & -9 \\ 24 & 8 \end{bmatrix}$$

Notation

A matrix is usually shown by a **capital letter** (such as A, or B)

Each entry (or "element") is shown by a **lower case letter** with a "subscript" of **row,column**:

$$A = \begin{bmatrix} a_{1,1} & a_{1,2} & a_{1,3} \\ a_{2,1} & a_{2,2} & a_{2,3} \end{bmatrix}$$



Rows and Columns

So which is the row and which is the column?

- Rows go **left-right**
- Columns go **up-down**

To remember that rows come before columns use the word **"arc"**:

$$a_{r,c}$$

Example:

$$\mathbf{B} = \begin{bmatrix} 6 & 4 & 24 \\ 1 & -9 & 8 \end{bmatrix}$$

Here are some sample entries:

$b_{1,1} = 6$ *(the entry at row 1, column 1 is 6)*

$b_{1,3} = 24$ *(the entry at row 1, column 3 is 24)*

$b_{2,3} = 8$ *(the entry at row 2, column 3 is 8)*

Your turn: Question 1 Question 2 Question 3 Question 4 Question 5
Question 6 Question 7 Question 8 Question 9 Question 10

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