## MULTIPLICATION OF MATRICES

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## Multiplication of a Matrix by a Scalar



When a matrix is multiplied by a scalar then each element of that matrix is multiplied by the scalar. In general, we can say, if $\mathrm{A}=$ [aij]m x $n$ is a matrix and ' $k$ ' is a scalar, then $k A$ is another matrix which is obtained by multiplying each element of A by ' $k$ '.
For example: If $A=\left(\begin{array}{ccc}2 & 3 & 4 \\ 0 & -7 & 1\end{array}\right)$
then, 5 A is obtained by multiplying each element by 5
$5 A=\left(\begin{array}{ccc}10 & 15 & 20 \\ 0 & -35 & 5\end{array}\right)$

## Properties of Scalar Multiplication

i) If $A$ and $B$ are matrices and $k$ is a scalar then $k(A+B)=k A+k B$
ii) If A is a matrix and k and 1 are scalars then $(\mathrm{k}+\mathrm{l}) \mathrm{A}=\mathrm{kA}+1 \mathrm{~A}$

## Multiplication of Matrices

The product of two matrices $A$ and $B$ is defined if the number of columns of $A$ is equal to the number of rows of $B$. Let $A=[a i j]$ be $m x n$ matrix and $B=[b j k]$ be an $n x p$ matrix. Then, the product of $A$ and $B$ is a matrix $C$ of order $m x p$.
For example: Find $A B$, if $A=\left[\begin{array}{cc}3 & -2 \\ 4 & 7\end{array}\right]$ and $B=\left[\begin{array}{ccc}1 & -3 & 4 \\ 0 & 2 & 5\end{array}\right]$
Solution: Matrix A has 2 columns and B has 2 rows, so number of columns of 1 st matrix is same as number of rows of 2 nd matrix, hence it is conformable for multiplication.

$$
\begin{aligned}
& \mathrm{AB}=\left[\begin{array}{lcc}
3 \times 1+(-2) \times 0 & 3 \times(-3)+(-2) \times 2 & 3 \times 4+(-2) \times 5 \\
4 \times 1+7 \times 0 & 4 \times(-3)+7 \times 2 & 4 \times 4+7 \times 5
\end{array}\right] \\
&=\left[\begin{array}{lcc}
3-0 & -9-4 & 12-10 \\
4+0 & -12+14 & 16+35
\end{array}\right] \\
&=\left[\begin{array}{ccr}
3 & -13 & 2 \\
4 & 2 & 51
\end{array}\right] \\
& \text { Order of } \mathrm{A}=2 \times 2 \text { and order of } \mathrm{B}=2 \times 3 \text {, so order of } \mathrm{AB}=2 \times 3
\end{aligned}
$$

## Properties of Multiplication of Matrices

i) Associative Law: For any three matrices A, B and C, we have
$(\mathrm{AB}) \mathrm{C}=\mathrm{A}(\mathrm{BC})$, whenever both sides of equality are defined.
ii) Distributive law: For three matrices $\mathrm{A}, \mathrm{B}$ and C
a) $A(B+C)=A B+A C$
b) $(\mathrm{A}+\mathrm{B}) \mathrm{C}=\mathrm{AC}+\mathrm{BC}$
iii) Existence of multiplicative identity: For every square matrix A, there exists an identity matrix of same order such that IA = AI = A

$$
\begin{aligned}
& \text { For example: Find } A^{2}-5 A+6 I \text {, if } A=\left(\begin{array}{ccc}
2 & 0 & 1 \\
2 & 1 & 3 \\
1 & -1 & 0
\end{array}\right) \\
& \begin{aligned}
& A^{2}=\left(\begin{array}{ccc}
2 & 0 & 1 \\
2 & 1 & 3 \\
1 & -1 & 0
\end{array}\right) \times\left(\begin{array}{ccc}
2 & 0 & 1 \\
2 & 1 & 3 \\
1 & -1 & 0
\end{array}\right) \\
&=\left(\begin{array}{ccc}
4+0+1 & 0+0-1 & 2+0+0 \\
4+2+3 & 0+1-3 & 2+3+0 \\
2-2+0 & 0-1-0 & 1-3+0
\end{array}\right) \\
&=\left(\begin{array}{ccc}
5 & -1 & 2 \\
9 & -2 & 5 \\
0 & -1 & -2
\end{array}\right)
\end{aligned} \\
& 5 A=\left(\begin{array}{ccc}
10 & 0 & 5 \\
10 & 5 & 15 \\
5 & -5 & 0
\end{array}\right) \\
& 6 \mathrm{I}=\left(\begin{array}{lll}
6 & 0 & 0 \\
0 & 6 & 0 \\
0 & 0 & 6
\end{array}\right) \\
& A^{2}-5 A+6 I=\left(\begin{array}{ccc}
5 & -1 & 2 \\
9 & -2 & 5 \\
0 & -1 & -2
\end{array}\right)-\left(\begin{array}{ccc}
10 & 0 & 5 \\
10 & 5 & 15 \\
5 & -5 & 0
\end{array}\right)+\left(\begin{array}{lll}
6 & 0 & 0 \\
0 & 6 & 0 \\
0 & 0 & 6
\end{array}\right) \\
& =\left(\begin{array}{ccc}
1 & -1 & -3 \\
-1 & -1 & -10 \\
-5 & 4 & 4
\end{array}\right)
\end{aligned}
$$

iv) Matrix multiplication is not commutative. If $A$ and $B$ are any two matrices then $A B$ ? $B A$

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## Reference Links:

- http://en.wikipedia.org/wiki/Matrix_(mathematics)
- http://en.wikipedia.org/wiki/Scalar_(mathematics)
- http://www.mathwords.com/r/row_of_a_matrix.htm
- http://www.mathwords.com/c/column_of_a_matrix.htm
- http://en.wikipedia.org/wiki/Associativity
- http://en.wikipedia.org/wiki/Distributivity
- http://dictionary.reference.com/browse/multiplicative+identity

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