(1) **Permutation** of n different object is an arrangement of these objects in some order without omissions or repetitions. In our case, we discuss about permutation of the set of integers $\{1, 2, 3, \cdots, n\}$. For the set $\{1, 2, 3, \cdots, n\}$ integers, there are $n!$ different permutations.

Ex.: permutation of $\{1, 2, 3\}$.

(2) **Inversion** occur in a permutation whenver a larger integer precedes a smaller one.
Ex.: $\{1, 2, 3\}$: zero inversion.
Ex.: $\{3, 2, 1\}$: 3 inversions.
Ex.: $\{6, 1, 3, 4, 5, 2\}$: 8 inversions.

(3) **Def.:** a permutation is even if the number of inversions is an even integer and odd if the number of inversions is an odd integer.

(4) **Elementary product** of an $n \times n$ matrix A is product of form $a_{1j_1} a_{2j_2} a_{3j_3} \cdots a_{nj_n}$ where $(j_1, j_2, j_3 \cdots j_n)$ is a permutation of $\{1, 2, 3, \cdots, n\}$.

Signed elementary product is an elementary product multiply by 1 if the permutation is even and by -1 if the permutation is odd.

(5) **Determinant** of an $n \times n$ matrix A is the sum of all signed elementary products from A.

Ex.:

$$A = \begin{bmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{bmatrix} \qquad B = \begin{bmatrix} a_{11} & a_{12} & a_{13} \\ a_{21} & a_{22} & a_{23} \\ a_{21} & a_{22} & a_{33} \end{bmatrix}$$