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White Paper One {TRL100}
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Abstract:

In this research monograph, an algorithm to compute large sized determinants in a novel fashion is presented.

Theory

For a matrix of size 3X3, say

\[
A = \begin{bmatrix}
a_{11} & a_{12} & a_{13} \\
a_{21} & a_{22} & a_{23} \\
a_{31} & a_{32} & a_{33}
\end{bmatrix}
\]

we know the general formula for determinant of size 3X3 is given by

\[
\text{det}(A) = a_{11}(a_{22}a_{33} - a_{23}a_{32}) - a_{12}(a_{21}a_{33} - a_{23}a_{31}) + a_{13}(a_{21}a_{32} - a_{22}a_{31})
\]

We re-write it in the fashion

\[
\text{det}(A) = a_{11}a_{22}a_{33} - a_{11}a_{23}a_{32} - a_{12}a_{21}a_{33} + a_{12}a_{23}a_{31} + a_{13}a_{21}a_{32} - a_{13}a_{22}a_{31}
\]

We again re-write using a rule that in any term the first indexes of each of the Product Forming Element of Every Term are in ascending order

\[
\text{det}(A) = a_{11}a_{22}a_{33} - a_{11}a_{23}a_{32} - a_{12}a_{21}a_{33} + a_{12}a_{23}a_{31} + a_{13}a_{21}a_{32} - a_{13}a_{22}a_{31}
\]

We now inspect the first indexes of each of the three Product Terms of the first term and second indexes of each of the three Product Terms of the first term and we inspect the same for all the 6 terms.
We can note from the above table that whenever, we are not going along the consecutive order of indexes (i.e., cyclic order) for the Second Index, we get a negative sign.

And the number of terms are that many as many formed by the size factorial, i.e., here 3! = 6.
Example: If we wish to find the determinant of size 10X10, we have to consider 10! Terms and they should be gotten like above, i.e., the control index (the first indices) will be

1 2 3 4 5 6 7 8 9 10

and the second, third, …., ninth, tenth indices will be all (positional) permutations of the above ten indices.

And we consider the terms with the second index order as thusly

1 2 3 4 5 6 7 8 9 10
2 3 4 5 6 7 8 9 10 1
3 4 5 6 7 8 9 10 1 2
4 5 6 7 8 9 10 1 2 3
5 6 7 8 9 10 1 2 3 4
6 7 8 9 10 1 2 3 4 5
7 8 9 10 1 2 3 4 5 6
8 9 10 1 2 3 4 5 6 7
9 10 1 2 3 4 5 6 7 8
10 1 2 3 4 5 6 7 8 9

as positive and all other (10!-10) terms to be negative. In these (10!-10) terms every index violates the cyclicity, i.e., consecutiveness order and therefore its term becomes negative. Using these indices, we can concoct our terms and hence the determinant. In this fashion, we can compute the determinant of any large size, especially, we can do such computations in symbolic realm as well with ease.

Moral

The Man Who Removes Mountains Starts By Picking Small Pebbles.
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Dedication

All of the aforementioned Research Works, inclusive of this One are Dedicated to Lord Shiva.