Project Proposal
Computing Course, Dr. Sourendu Gupta

$\mathcal{O}(N^{2.807})$ Matrix multiplication

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Matrices play a huge role in solving equations numerically, in a systematic way. The matrix can be huge for a particular problem of interest and in such cases the time complexity and numerical stability of the algorithm used, is of utmost importance. Matrix manipulations usually can be reduced to multiplication and addition of matrices. Normally, the matrix multiplication has a time complexity of $\mathcal{O}(N^3)$.

This project will study fast matrix multiplication algorithm and its time order, specifically the *Strassen algorithm*, that reduces the time complexity of matrix multiplication to $\mathcal{O}(N^{2.807})$. The algorithm achives this by recursively partitioning the matrix into 2X2 submatrices and effectively reducing the number of multiplication with increase in additions and subtractions.

However,the *Strassen algorithm* achives this speedup by compromizing on numerical stability. This project will also probe into the numerical stability and propagation of error in the algorithm and compare with the standard matrix multiplication.

Finally,the project will also intend to study the complexities of basic matrix manipulation like matrix inversion using *Strassen algorithm* and look at the feasibility of using the algorithm in scientific calculations, on the basis of numerical stability and its reduced time complexity.

References: "Is Matrix Inversion an N^3 Process?", Numerical recipes: art of scientific computing, William H. Press