CSC373 Worksheet 1 Solution

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1. **Notes:**

   - Strassen's method for matrix multiplication
     - Reduces the time complexity of matrix multiplication from $O(n^3)$ to $O(n^{\log_2 7}) = O(n^{2.81})$
     - Has four steps

       1) Divide the input matrics A and B and output matrix C into $n/2 \times n/2$ submatrices

       $$A = \begin{pmatrix} A_{11} & A_{12} \\ A_{21} & A_{22} \end{pmatrix}, \quad B = \begin{pmatrix} B_{11} & B_{12} \\ B_{21} & B_{22} \end{pmatrix}, \quad C = \begin{pmatrix} C_{11} & C_{12} \\ C_{21} & C_{22} \end{pmatrix},$$

       2) Create 10 matrices, $S_1, S_2, ..., S_{10}$ each of which is $n/2 \times n/2$ and is the sum or difference of two matrices created in step 1

       $S_1 = B_{12} - B_{22}$
       $S_2 = A_{11} + A_{12}$
       $S_3 = A_{21} + A_{22}$
       $S_4 = B_{21} - B_{11}$
     - Is not preferred in practical purposes

       1) The constants used in Strassen's method are high and for a typical application Naive method works better.
       2) For Sparse matrices, there are better methods especially designed for them.
       3) The submatrices in recursion take extra space.
       4) Because of the limited precision of computer arithmetic on noninteger values, larger errors accumulate in Strassen's algorithm than in Naive Method

   References:

   1) GeeksForGeeks, Divide and Conquer — Set 5 (Strassen's Matrix Multiplication), link

   - Regular matrix multiplication
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