Course: Design and analysis of algorithm Lab (3CS351)

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Week 4 Assignment

Part: 2

Divide and conquer strategy

Strassen's Matrix Multiplication

A) Implement **Naive Method** multiply two matrices. and justify Complexity is $O(n^3)$

B) Implement **Divide and Conquer** multiply tow matrices . and justify Complexity is $O(n^3)$

$$\begin{bmatrix} a & b \\ c & d \end{bmatrix} \times \begin{bmatrix} e & f \\ g & h \end{bmatrix} = \begin{bmatrix} ae + bg & af + bh \\ ce + dg & cf + dh \end{bmatrix}$$

$$\qquad A \qquad\qquad\qquad B \qquad\qquad\qquad\qquad C$$

A, B and C are square metrices of size N x N
a, b, c and d are submatrices of A, of size N/2 x N/2
e, f, g and h are submatrices of B, of size N/2 x N/2

C) Implement **Strassen's Matrix Multiplication** and justify Complexity is $O(n^{2.8})$

$$p1 = a(f - h) \qquad\qquad p2 = (a + b)h$$
$$p3 = (c + d)e \qquad\qquad p4 = d(g - e)$$
$$p5 = (a + d)(e + h) \qquad p6 = (b - d)(g + h)$$
$$p7 = (a - c)(e + f)$$

The A x B can be calculated using above seven multiplications.
Following are values of four sub-matrices of result C

$$\begin{bmatrix} a & b \\ c & d \end{bmatrix} \times \begin{bmatrix} e & f \\ g & h \end{bmatrix} = \begin{bmatrix} p5 + p4 - p2 + p6 & p1 + p2 \\ p3 + p4 & p1 + p5 - p3 - p7 \end{bmatrix}$$

$$\qquad A \qquad\qquad\quad B \qquad\qquad\qquad\qquad C$$

A, B and C are square metrices of size N x N
a, b, c and d are submatrices of A, of size N/2 x N/2
e, f, g and h are submatrices of B, of size N/2 x N/2
p1, p2, p3, p4, p5, p6 and p7 are submatrices of size N/2 x N/2