**Assignment 8**

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**Section: B2**

**Question:** Explore the correctness and efficiency of Strassen's matrix multiplication algorithm. Compare its performance with simple matrix multiplication in terms of best, average, and worst-case complexity.

Ans.

**def strassen\_matrix\_multiply(A, B):**

**n = len(A)**

**if n == 1:**

**return [[A[0][0] \* B[0][0]]]**

**mid = n // 2**

**A11, A12, A21, A22 = A[:mid], A[mid:], A[:mid], A[mid:]**

**B11, B12, B21, B22 = B[:mid], B[mid:], B[:mid], B[mid:]**

**m1 = strassen\_matrix\_multiply(A11, sub\_matrix(B12, B22))**

**m2 = strassen\_matrix\_multiply(add\_matrix(A11, B12), B22)**

**m3 = strassen\_matrix\_multiply(add\_matrix(A21, A22), B11)**

**m4 = strassen\_matrix\_multiply(A22, sub\_matrix(B21, B11))**

**m5 = strassen\_matrix\_multiply(add\_matrix(A11, A22), add\_matrix(B11, B22))**

**m6 = strassen\_matrix\_multiply(sub\_matrix(A12, A22), add\_matrix(B21, B22))**

**m7 = strassen\_matrix\_multiply(sub\_matrix(A11, A21), add\_matrix(B11, B12))**

**k11 = add\_matrix(sub\_matrix(add\_matrix(m5, m4), m2), m6)**

**k12 = add\_matrix(m1, m2)**

**k21 = add\_matrix(m3, m4)**

**k22 = add\_matrix(sub\_matrix(sub\_matrix(add\_matrix(m5, m1), m3), m7), m2)**

**result = [[0] \* n for \_ in range(n)]**

**for i in range(mid):**

**for j in range(mid):**

**result[i][j] = k11[i][j]**

**result[i][j + mid] = k12[i][j]**

**result[i + mid][j] = k21[i][j]**

**result[i + mid][j + mid] = k22[i][j]**

**return result**

**def add\_matrix(A, B):**

**n = len(A)**

**return [[A[i][j] + B[i][j] for j in range(n)] for i in range(n)]**

**def sub\_matrix(A, B):**

**n = len(A)**

**return [[A[i][j] - B[i][j] for j in range(n)] for i in range(n)]**

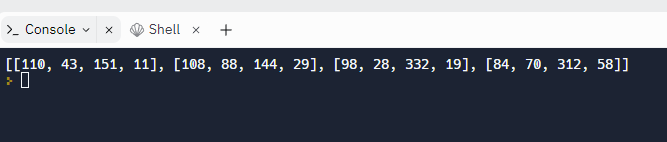
**A = [[2, 3, 3, 4], [7, 7, 11, 10], [10, 1, 2, 3], [2, 2, 7, 10]]**

**B = [[4, 9, 6, 2], [2, 6, 6, 7], [8, 3, 4, 11], [1, 3, 1, 5]]**

**C = strassen\_matrix\_multiply(A,B)**

**print(C)**

**Output:**

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**Time complexity of Strassen matrix multiplication: O(n^log7) = O(n^2.8074)**

**Time complexity of General method of Matrix Multiplication: O(n^3)**