Matrix Multiplication by Partitioning

Linear Algebra and Random Processes (CS6015)
Assignment 1

1 Problem Statement

Given a pair of large matrices i.e. $A \in \mathbb{R}^{m \times n}$; $B \in \mathbb{R}^{n \times p}$, compute $C \in \mathbb{R}^{m \times p}$ such that $AB = C$. Apply a matrix multiplication method that partitions the matrix into blocks, for computing the matrix product. Analyze the computational time for each method. Can you recursively apply matrix partitioning to reduce the computational time further?.

2 Input

Matrices $A \in \mathbb{R}^{m \times n}$ and $B \in \mathbb{R}^{n \times p}$ with random numbers as elements.
Assumption. The dimensions of matrices A,B are very large and comprises of floating point numbers i.e. $m, n, p \gg 1000$, $-100 \leq a_{ij}, b_{ij} \leq 100$

3 Output

1. T_F - Time taken to compute product using naive method

2. T_P - Time taken to compute product by partitioning (Single level)

3. T_{RP} - Time taken to compute product by recursive partitioning

4. $\|C_N - C_{RP}\|_F$ - The Frobenius norm of the difference between the matrix product computed using the naive method and the product computed using recursive partitioning

4 References

- Golub, Gene H., and Charles F. Van Loan. Matrix computations. Vol. 3. JHU Press, 2012. (Section 1.3)
- V. Strassen. Gaussian elimination is not optimal. Numer. Math., 13:354356, 1969.