

ASSIGNMENT 2

Implement three-loops matrix multiplication (with or without recursion) and Strassen's method from Chapter 4 and measure the performance against the bounds in the same Chapter.

1. Consider a matrix of $n \times n$ elements:

- (a) Initialize a matrix A using a random number generator between 0 and n. For example, when $n = 2$, each element will have a value between 0 and 2 generated randomly. Initialize another matrix B with same size.
- (b) Multiply A and B using the two algorithms. Run this for n from 2 to 210 doubling the n each time.
- (c) Measure the time in microseconds for each run of both algorithms for the $n \times n$ matrix. You will get ten runtime values for $n = 2$ through 210. Have these values output in a data file named <YourLastNameFirstInitial_1>.dat.
- (d) For every run of each algorithm, find the time per item by dividing the run time by n^2 , then averaging it for all runs of the algorithms. Thus, if the algorithm runs 10 times, the *Average_Item-runtime* is the average of all per item run times. This is the time that we consider as $\Theta(1)$.
- (e) In part (c), add a column for the theoretical bound for $\Theta(\cdot)$. In the book formulas for bounds, n is replaced by $n \times \text{Average_Item-runtime}$.
- (f) Now you have the actual run time versus n as well as the theoretical bounds.

2. As a result of the above steps, there are five columns in your data files; n , Runtime_SQUARE_MATRIX, Bound_SQUARE_MATRIX, Runtime_STRASSEN'S_METHOD, Bound_STRASSEN'S_METHOD.

3. Use gnuplot to plot the data in your data file using lines of different colors and proper labels. The plot title should be Strassen's Method versus Regular Matrix Multiplication. There should be a key for all the four graph titles.

4. In a file named <YourLastNameFirstInitial_1.PDF> have the sample program output (the product matrix for both algorithms for $n = 4$), and the plot showing all the four graphs.

5. Compress the two files <YourLastNameFirstInitial_1.cpp>, and <YourLastNameFirstInitial_1.PDF> into one file <YourLastNameFirstInitial_1.zip> or something such and submit this compressed file as your assignment.