The second part of this lab is a sequence of instructions and questions. All responses requesting a written response ***should be written with complete sentences and typed***. Please use the Equation tool in Word for clear communication with mathematical notation. Please work in pairs for this analysis portion of the lab and create only a single submission. You may use the 'best data' between you and your partner. Clarity and brevity is important.

Analysis

Our analyses will be based on empirical data, but will be grounded in a mathematical analysis. Our methodology for doing this begins by assuming that the asymptotic running time, $t(n)$, is a function of the input size, n, of the following form:

$$t(n) = an^b \text{ with } a > 0 \text{ and } b > 0.$$

1. Using $\boldsymbol{t(n) = an^b}$, show $\boldsymbol{\log t(n) = b \log n + \log a}$. Be clear in your manipulations.

2. With logarithms we often assume a base that is positive and greater than 1. Common bases of logarithms are 2, 10, and e. State the change of base formula for converting a logarithm of base p to a logarithm of base q.

3. In question 1, the base of the logarithm was not specified. Does that matter? Explain. For our analyses, what base for the logarithm seems most appropriate?

4. $\boldsymbol{\log t(n) = b \log n + \log a}$ is the equation of a line. Based on the equation, state an expression for the slope and $\boldsymbol{y}$-intercept of the line.

Slope: _____ y-intercept: _____

5. When acquiring Matrix data, you executed your source code on increasing sizes of matrices. Transform your data according to the logarithmic expression from question **4**: $\boldsymbol{\log t(n)}$ and $\boldsymbol{\log n}$. Clearly label each column and row of the table. Provide a screenshot or the actual table of your data.

<Insert table here>

6. Using a tool like Excel (or some online tool), compute the line of best fit for your transformed data. That is, input the raw data into excel, transform it logarithmically, plot a scatterplot, and find a trendline. The resulting scatterplot is often referred to as a ***log-log plot***. Report your line of best fit for both operations.

	Matrix Addition	**Matrix Multiplication**
Slope coefficient		
y-intercept		
Line of best fit		

7. Consider the slopes of your log-log plots, do they align with the theoretical algorithm efficiency for each algorithm? Explain.

8. Explain how we might expand our experiments with these operations.

9. If our Matrix operation was theoretically $n^2 \log n$, is it accurate to perform a log-log analysis? Explain.

Submitting

Please submit a PDF (`File > Export > Create PDF`) of your findings via Moodle. The names of both team members should be at the top of the document.

Please be reminded that following instructions explicitly and submitting well-formatted documents (with consistent fonts and typeset equations) in an important part of professionalism.