MACM 316 - Computing Report #1

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(a) Obtain values $\varepsilon_{res}(N)$ for several values of N.

I chose values

$$N = \{ \ n \times 2^4 \mid n \in \mathbb{N}, 1 \leq n \leq 64 \ \} \text{ and } N_{ex} = 10,000$$

since I started the assignment pretty late. I needed to both compute $\varepsilon_{res}(N)$ and finish this assignment within an hour or two.

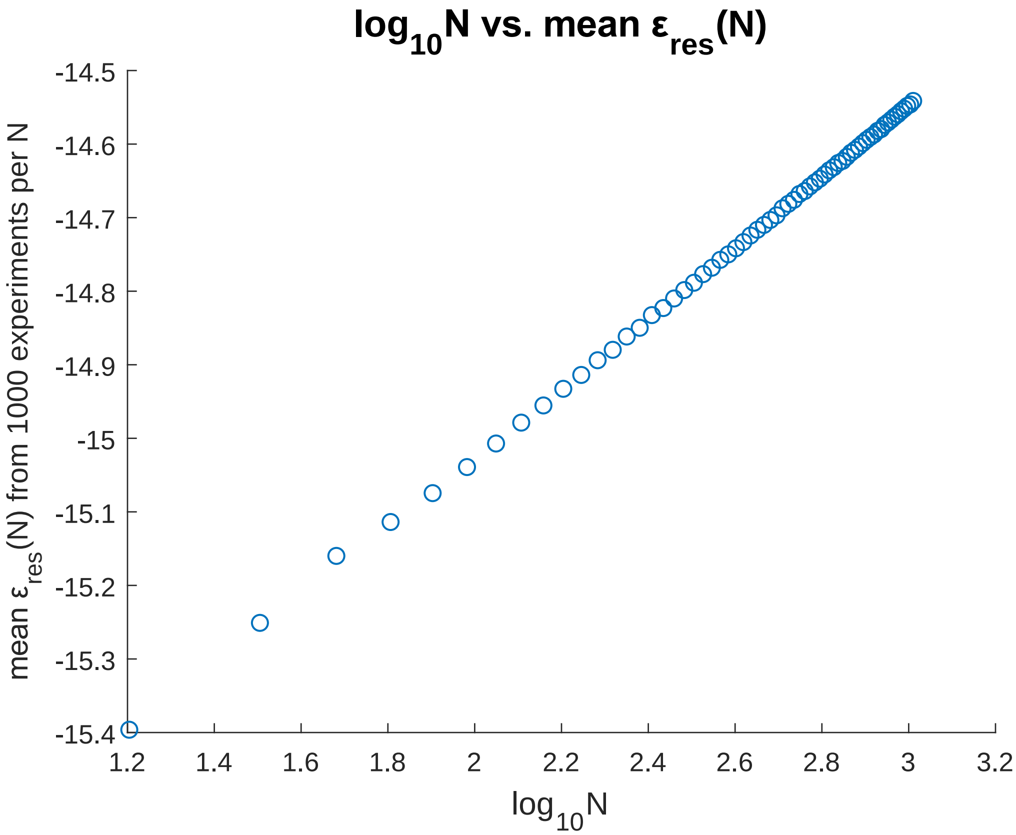
I decided on multiples of $2^4 = 16$ since they gave me a decent amount of data points to work with, while also growing at a fast enough rate that would work within my time constraints.

Accuracy, Robustness, and Efficiency

Of course I'd like to have more accuracy by setting a higher bound for n, but Gaussian Elimination grows at $O(n^3)$. Computing a square matrix of size $(64 \times 2^4)^3 = 1024$ takes 1.07×10^9 operations, so if I double the higher bound of n, then the number of operations required to solve a 2048x2048 matrix is increased by a factor of $2^3 = 8$, almost a factor of ten. Solving matrices sized 2048x2048 already takes my computer a few minutes when $N_{ex} = 10,000$, so this increased cost is unaffordable.

I try to get around the lack of gargantuan-sized matrices in my dataset by increasing the number of datapoints, and by taking $N_{ex} = 10,000$. I've found that this large value of N_{ex} results in normally distributed samples of $\varepsilon_{res}(N)$ for each matrix sized $N \times N$.

(b) Include a plot of the points $(log_{10}N, \varepsilon_{res}(N))$.



(c) Use your plot from (b) to argue for your value of an estimated value N^* where $\varepsilon_{res}(N^*) \approx 0$. You only need to present a rough order of magnitude here, and you should indicate how achievable, or not, your value of N$*$ is.

The plot from (b) suggests a linear relationship between $log_{10}N$ and $\varepsilon_{res}(N)$. If I take the points $P_0 = (x_0, y_0)$ and $P_1 = (x_1, y_1)$, then