Numerical Linear Algebra Program Assignment 3a Report

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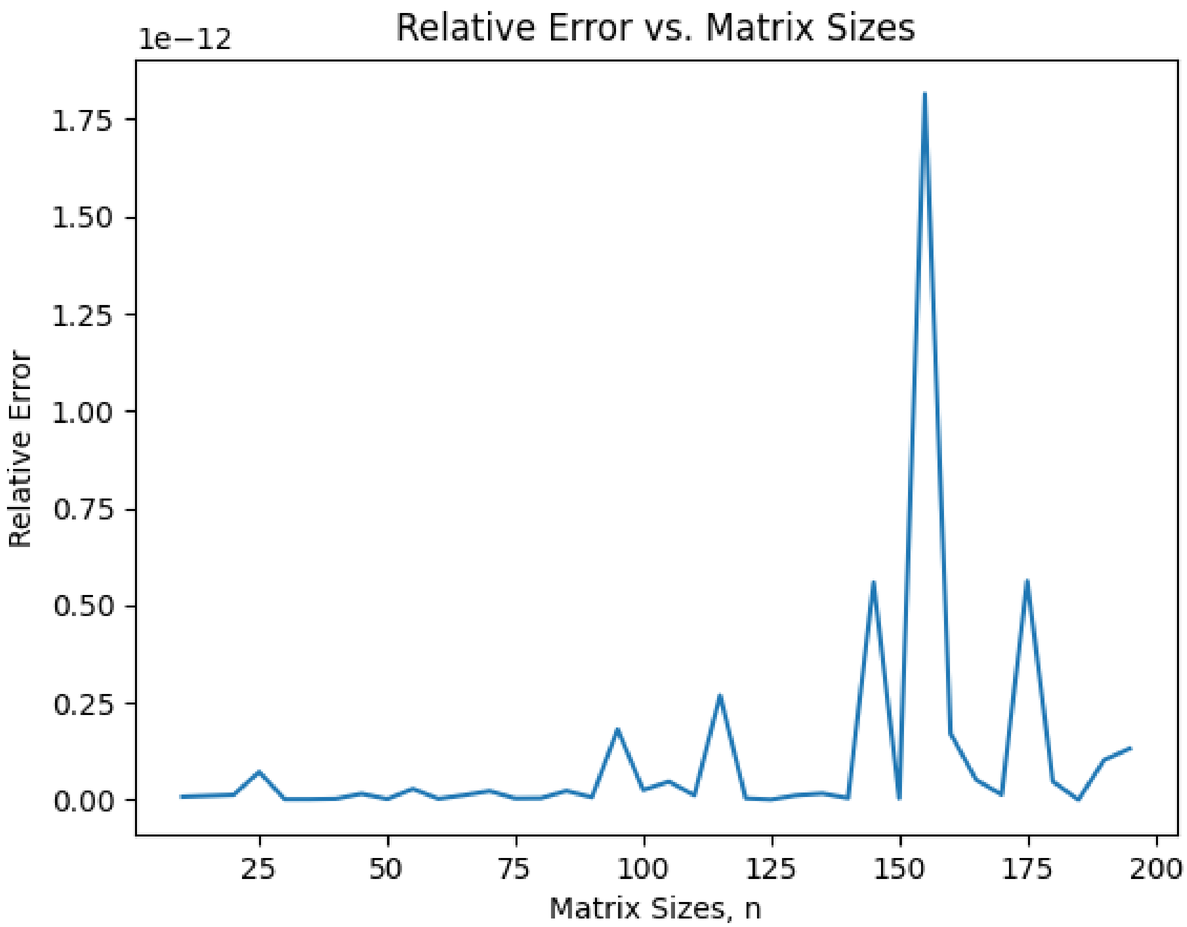
Due: March 29, 2024 @ 11:59PM

Task 1

Algorithm 1

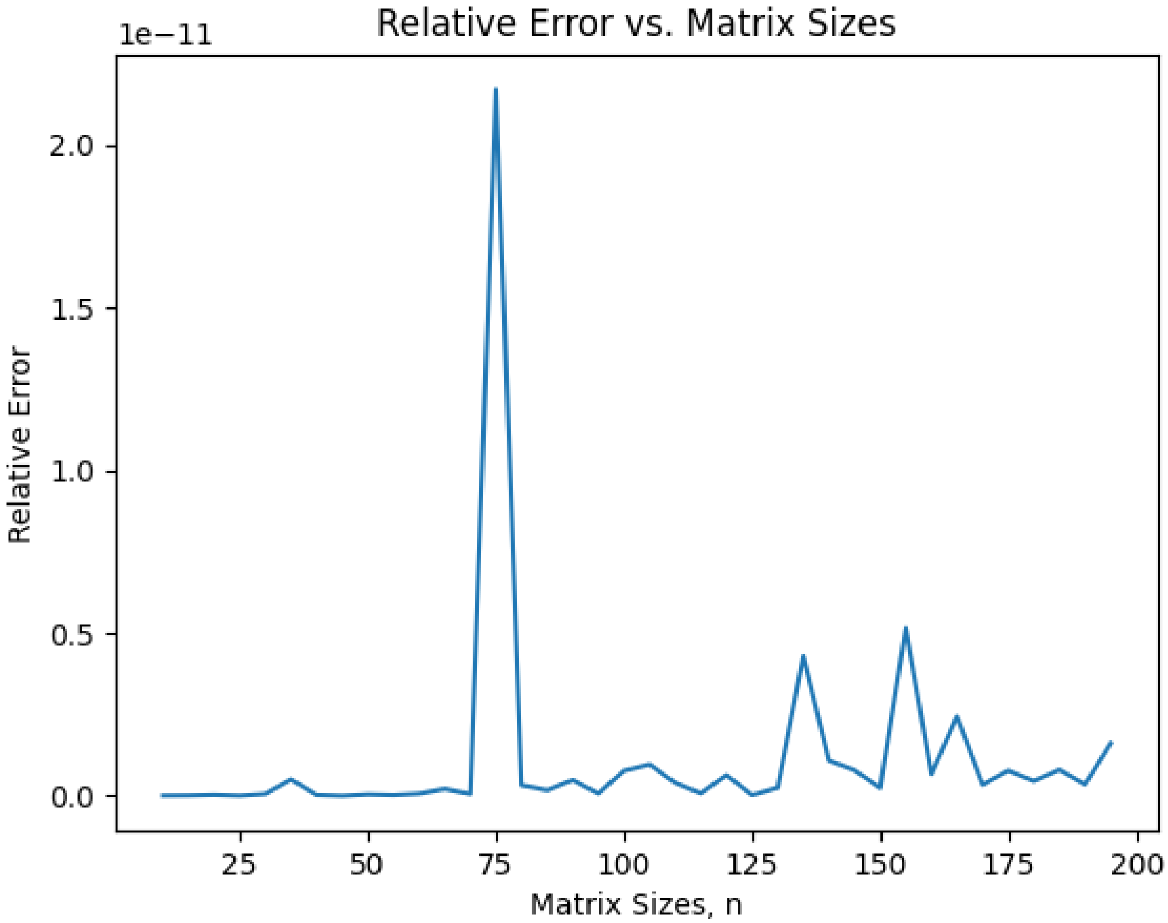
The purpose of Algorithm 1 is to solve the linear least squares using household reflectors to convert a matrix A to form R (an upper right triangular matrix). Upon doing this, we can multiply the same household reflectors against a vector b in order to find the solution to our problem.

We begin by testing our algorithm on square nonsingular matrices with sizes ranging from 10 to 200 showing relative error vs. matrix size, n. The relative error is compared against the np.linalg.lstsq method as "true x".



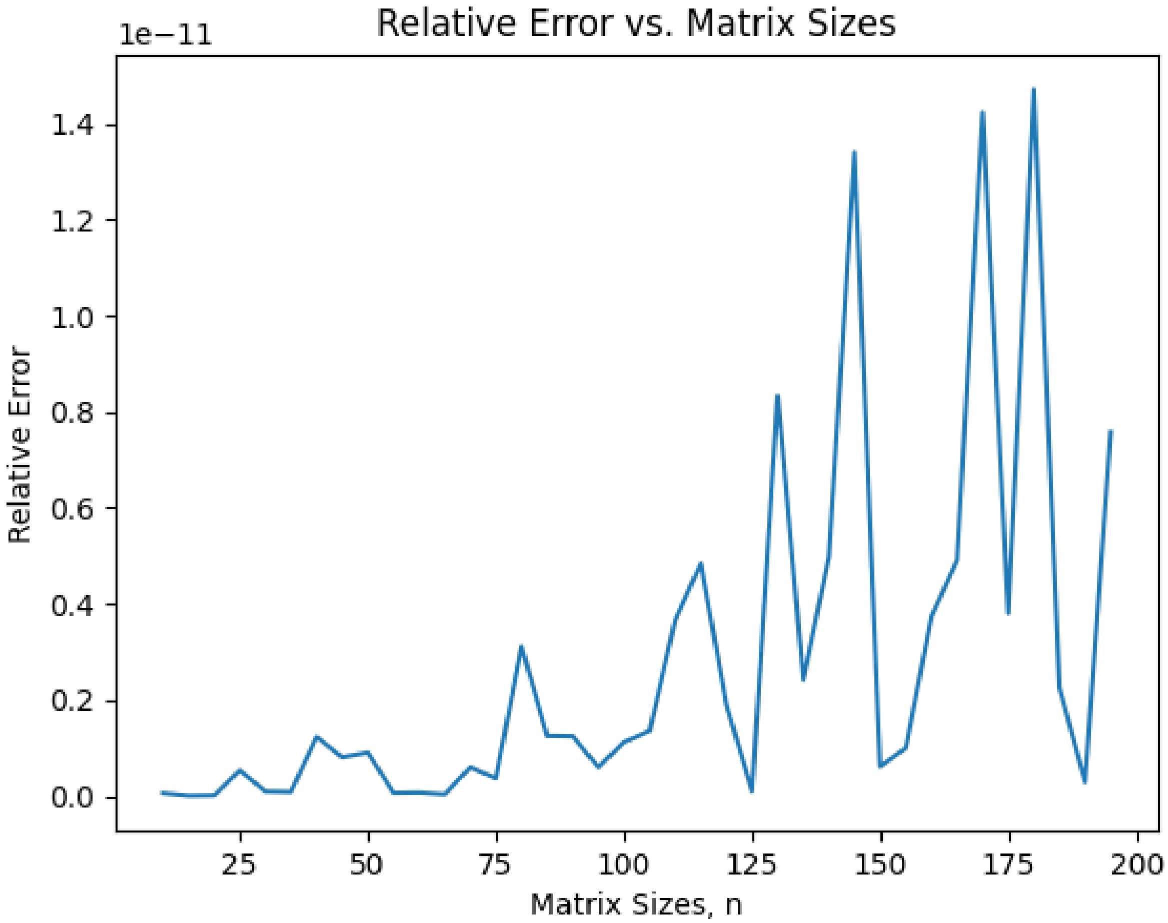
We see that as our matrix size increases, we start to get more and more unstable errors, which is expected.

We now test our algorithm on rectangular full column rank matrices A such that $n > k$ and $b \in \mathcal{R}(A)$.



We see that we have a few spikes, but for the most part our errors are low.

Finally, our last test is on rectangular full column rank matricies A such that $n > k$ and $b \notin \mathcal{R}(A)$ and $b = b_1 + b_2$ where $b_1 \in \mathcal{R}(A)$ and $b_2 \notin \mathcal{R}(A)$ that define a linear least squares problem with a nonzero residual $r_{\min = b_2 = b - Ax_{\min}}$.



We see that our results are similar to those from test 1, with the larger matrix sizes resulting in larger relative errors.