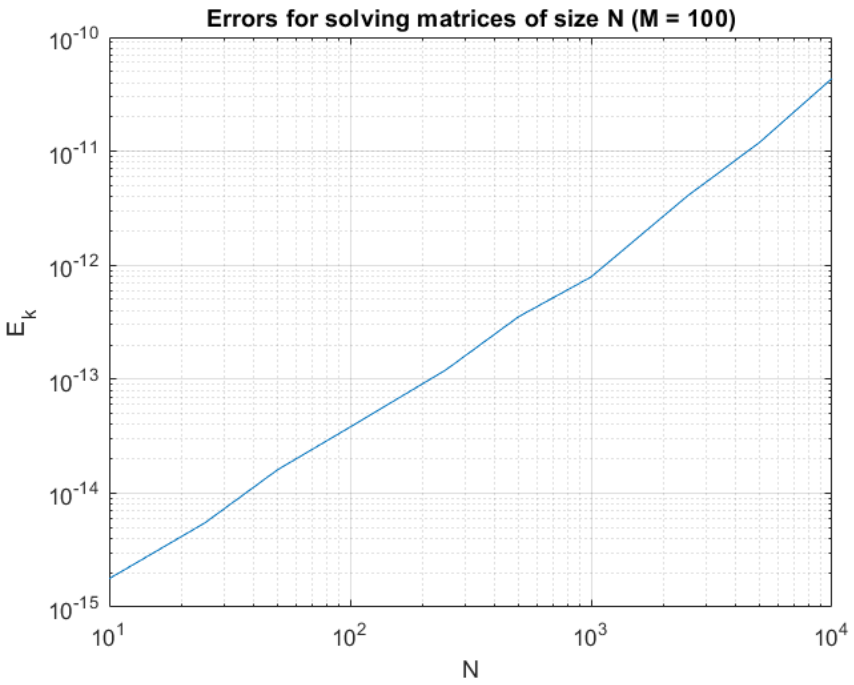
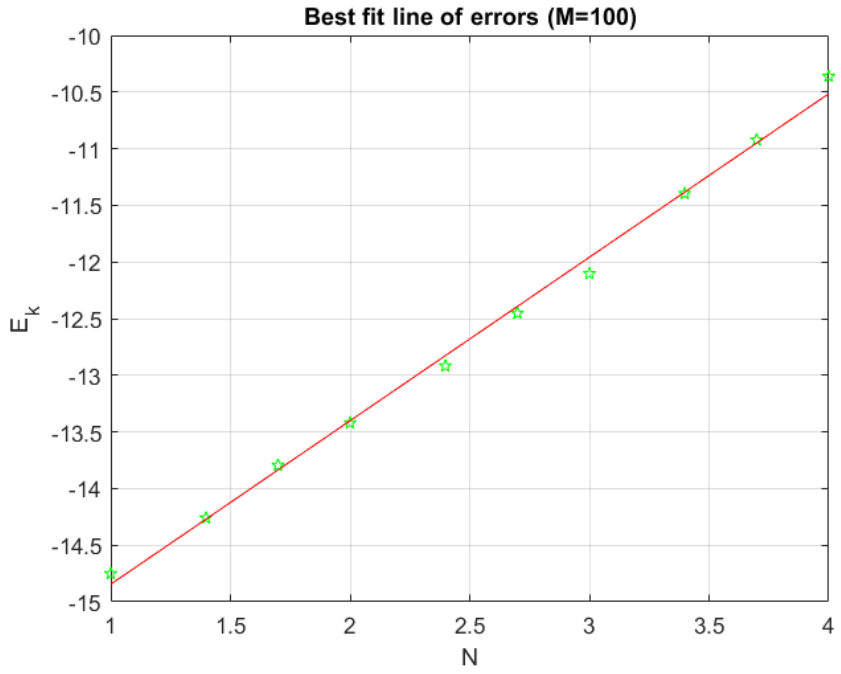
Rajan Grewal 301335629

MACM 316 – A4

The largest value of N I could choose which didn't appear to take an absurdly long time to compute was N=10,000. After that I chose 9 more N values which decreased in size by roughly 2.25x down to N = 10. I did this manually. With such values of N, I believed an accurate extrapolation could be obtained. There would be no need to go lower than N = 10 because the error difference would be indifferentiable. Furthermore, allowing N to decrease by roughly 2.25x per step shouldn't allow for overly large error differences per step. I used M = 100 because any larger would result in lengthy computation times, forcing me to use smaller N, increasing extrapolation error. A smaller M would yield less accurate error estimates due to a smaller number of matrix-solving samples, so I found M = 100 to be ideal.



The extrapolation can be done through the equation E = mN + b <-> E = (N-b)/m for the best fit line. MATLAB provides us m and b through the polyfit function, and we want E to be 1. Since the best fit line is operating on a log graph, we want to extrapolate it for values log(E) and log(N), giving N = 10^((log(1)-b)/m). Plugging in m=1.443296372106925 and b=-16.287938608951094, we get N*=1.928567809250406e11.



```
Nlist = [10000, 5000, 2500, 1000, 500, 250, 100, 50, 25, 10];
Elist = [4.3541e-11, 1.1945e-11, 4.0203e-12, 7.8892e-13, 3.53118e-13, ...
    1.2090e-13, 3.8025e-14, 1.6043e-14, 5.4956e-15, 1.7764e-15]
loglog(Nlist, Elist)
title 'Errors for solving matrices of size N (M = 100)'
xlabel 'N'
ylabel 'E_k'
grid on
p = polyfit(log10(Nlist), log10(Elist), 1)
yp = polyval(p, log10(Nlist))
plot(log10(Nlist), log10(Elist),'pg')
hold on
plot(log10(Nlist), yp, '-r')
grid on
xlabel 'N'
ylabel 'E_k'
title 'Best fit line of errors (M=100)'
hold off
a = 10.^((0-p(2))/p(1))
```