Numerical Computing S'18
HW 7
Due April 23

The Assignment: 8.2; 8.5(b)-(d)*; 8.12; 8.24; 8.33

8.33 This problem concerns solving $\mathbf{Ax} = \mathbf{b}$, where $\mathbf{A}$ is the tridiagonal, symmetric, and positive definite matrix

$$\mathbf{A} = \begin{pmatrix} 2 & -1 & & & & \\ -1 & 2 & -1 & & & \\ & -1 & 2 & -1 & & \\ & & \ddots & \ddots & \ddots & \\ & & & & & -1 \\ & & & & -1 & 2 \end{pmatrix}.$$

For $\mathbf{b}$, take $\mathbf{b} = \mathbf{Ax}$, where $\mathbf{x} = (1, 1, \cdots, 1)^T$.
a) Use MATLAB to fill out the table below. Note that $\mathbf{x}_c$ is the solution computed using the CGM, and the computing time is how long it takes to execute the CGM algorithm.
b) Based on your results, can you predict the number of iterations when $n = 4000$? What about predicting the computing time?
c) Using the MATLAB command `ones(k*1000,k*1000);` determine the smallest integer value of k where MATLAB states there is an **Error using ones** and that the **array exceeds maximum array size preference****. With this, run your CGM code with $n = (k-1) * 1000$ and report on the value of n you used, the number of iterations, and the computing time***. Next, in your CGM code, right after $\mathbf{A}$ is defined, insert the command `A=sparse(A);` and then run the code. Report what happens.

* For problems 8.5(c) and (d), plot the curve and data (in a similar manner as done for Figures 8.12 and 8.13)

** If you have x GB of RAM, then the value of k should be about $11.6\sqrt{x}$.

*** If your code takes longer than 60 seconds, you can stop it and report that the computing time is more than a minute.

n	$\frac{\|\|\mathbf{x} - \mathbf{x}_c\|\|_\infty}{\|\|\mathbf{x}\|\|_\infty}$	$\kappa_\infty(\mathbf{A})$	Number of Iterations	Computing Time
100				
500				
1000				
2000				