Assignment Eight
Due Wednesday, December 4, 7:00 pm.

[1.] Go to the course website and follow the “Instructions for compilation and use” under “Diagonalization Routines”. Verify you reproduce the indicated results for the matrix in input.txt.

[2.] Modify input.txt so that it stores the matrix which for a one dimensional periodic boundary condition chain of \( N = 32 \) masses and springs with mass \( m = 3.1 \) and spring constant \( k = 1.7 \). Verify your eigenvalues agree with the ones from class. Check the eigenvectors for largest and smallest eigenvalue are correct. Make a plot of the frequencies \( \omega \) (eg by sorting them from smallest to largest).

**NOTE:** Obviously it is going to be a pain to type the 1024 entries of the 32x32 matrix into input.txt. You have two better options: (i) write a short auxiliary program which writes the matrix to a file for you; or (ii) make a copy of jacobi_test.c and instead of having it scan the matrix in, replace those loops with something which computes the entries of the matrix. I think option (ii) is better.

[3.] (Extra credit!) Consider a linear (1D) mass-spring system in which one of the springs (a “defect”) has a value \( k_\ast \) which is different from all the others, which have value \( k \). Assume all masses \( m \) are equal. Diagonalize the matrix numerically. Choose number of masses \( N = 64 \), spring constant \( k = 1.9 \), mass \( m = 1.1 \), and defect spring \( k_\ast = 5.2 \).

What do you notice about the eigenvalues?

If you are really ambitious, take a look at the eigenvectors to see if one of them ‘looks different’ from the others. (I can also tell you a cute method to make the notion of ‘looking different’ more precise numerically.)