PHYSICS 102
CLASSICAL MECHANICS LAB
FALL 2015

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 ω (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_* 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 $k_* = 5.2$.

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.)