PHYS4300 Numerical Methods and Scientific Computing

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HW 4
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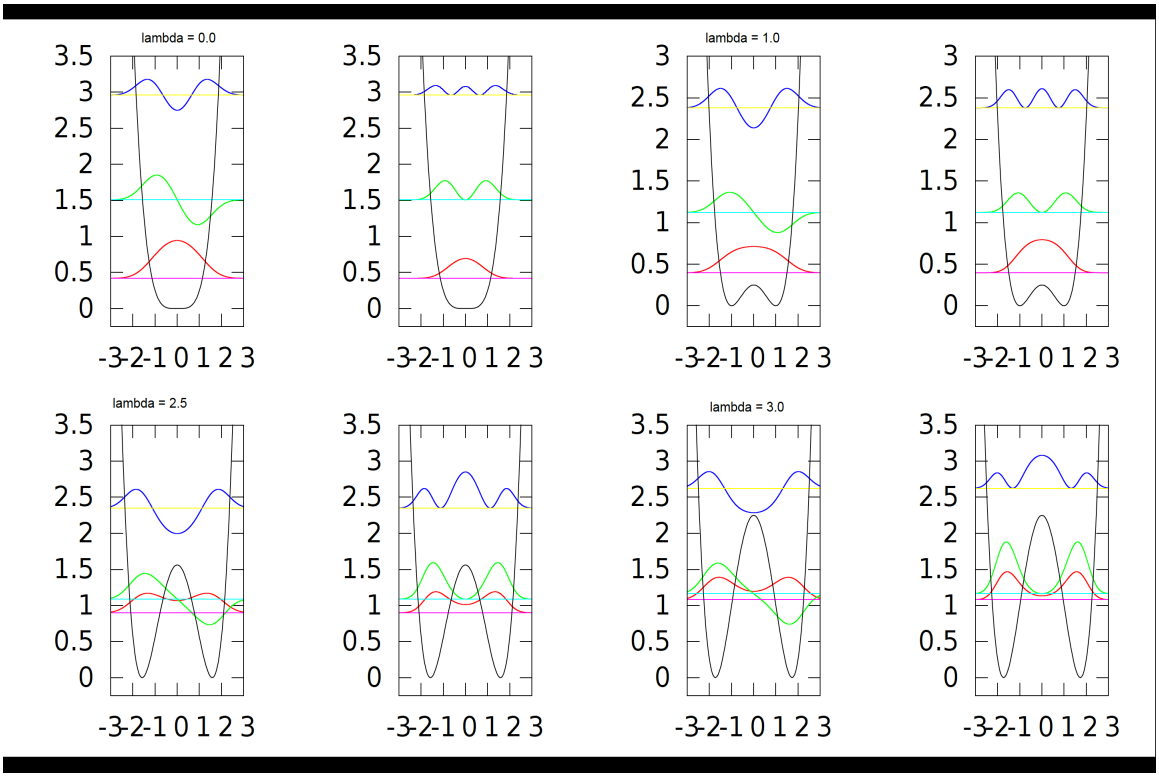
Solution. This program uses the Verlet method to solve for the eigenvalues of the a quantum oscillator with potential defined by $V(x) = \frac{1}{4}(x^4 + \lambda^2) - \frac{\lambda}{2}(x^2)$.

The first program entitled *qosclamallcases.C* solves for the first three eigenvalue energies for each λ case by running a loop over the $\lambda = 0.0, 1.0, 2.5, 3.0$ values, and within that loop, a loop over the energy with increments of 0.0001 and printing only the energies where the wave function psi, ψ, trends to 0 at the end of the Verlet evolution. It takes a few minutes for the code to run. Note that this really prints neighborhoods of the eigenvalues, which can be manipulated by changing the limit values in the if statements. You can then take these neighborhoods and run a loop from the minimum energy to the maximum with smaller increments to get a more precise measurement of the eigenvalues.

The *qoscx*4.*C* file iterates the wave function solutions and probability solutions for the eigenvalue energies solved for in the first few files. Here is the final output for each case of the potential, eigenvalues, their respective wavefunctions, and the wavefunctions squared (probabilities). □


lambda = 0.0
lambda = 1.0
lambda = 2.5
lambda = 3.0
-3-2-1 0 1 2 3