Physics 4350 Computational Physics

1. (Linear regression) Code the linear regression routine that utilizes matrix inversion as we derived in class. Fit the function $y = mx + b$ to the following data points: (1,1), (2,1), (3,3.5), (4,5), (5,4), (6, 8), (7,4), (8,7), (9,12). Give the value of m and b to three decimal places.

2. (Linear regression of CO_2 data) Garcia, chapter 5, problem 12.

3. One method to solve the Schrodinger equation (SE) is the explicit matrix method we showed in class. If we discretize the second derivative in the SE, with a step size of a, we find

$$\frac{-\hbar^2}{2ma^2}\left(\psi_{n+1} + \psi_{n-1} - 2\psi_n\right) + V_n\psi_n = E\psi_n$$

where ψ_n is a column vector. Use this method to calculate the ground state and first excited state energies and wave functions. Compare your calculated energies with the analytical formula $E_n = (n + \frac{1}{2})\hbar\omega$. Show a graph of the calculated wavefunctions as well.