

## Quantum Mechanics II

### Homework Assignment 2

1. There are two matrices here.

$$\begin{pmatrix} 2 & 1+i \\ 1+i & 1 \end{pmatrix} \quad (1), \quad \begin{pmatrix} 2 & 1+i \\ 1-i & 1 \end{pmatrix}. \quad (2)$$

- a. Are those the Hermite matrices?
- b. Find the eigenvalues for (1) and (2).
- c. State the quantum mechanical interpretations from the results in a. and b.
2. Think about the one-dimensional anharmonic oscillator. The perturbation Hamiltonian is  $H' = x^2$ . (Assume that  $x^2$  is very small.)
- a. Find the first energy correction by using raising and lowering operators. (Use the rules, like  $a^*|n\rangle = \sqrt{n+1}|n+1\rangle$ .)
- b. Recall the elements of  $a^*$  and  $a$  and calculate  $x^2 = \frac{\hbar}{2m\omega}(a^* + a)^2$  first. Then find the  $E_n^{(1)}$ .