Quantum Computing

Exercises 2: Quantum Physics

1 (Susskind & Friedman Ex. 5.2)**.** *For any observables* $\mathbf{A}$ *and* $\mathbf{B}$*, and state* $|\psi\rangle$*, derive Heisenberg's uncertainty relation:* $\Delta\mathbf{A} \cdot \Delta\mathbf{B} \geq \frac{1}{2}|\langle\psi|[A,B]|\psi\rangle|$*, where* $(\Delta\mathbf{A})^2 = \sum_a (a - \langle\mathbf{A}\rangle)^2 P(a)$*, is the standard deviation of the operator* $\mathbf{A}$.

2. *Show that two matrices,* $\mathbf{A}$ *and* $\mathbf{B}$*, are simultaneously diagonalizable (diagonalizable in the same basis) if and only if they commute, that is,* $[A,B] = 0$.

3. *Derive the evolution operator:* $U(t) = e^{-\frac{i}{\hbar}Ht}$*, by solving the Schrödinger equation:* $i\hbar\frac{d|\psi(t)\rangle}{dt} = H|\psi(t)\rangle$.