Quantum Information Theory - 67749
Exercise 2, May 18, 2025

1 Submission Guidelines.

- Due date - May 29, 2025.

- Make sure your submission is clear. Unreadable assignments will get zero score.

- Using any Generative AI tool is forbidden but not enforced. Yet, please keep in mind that we might call you for an interview about your assignment.

2 AEP.

1. Reformaulate the classical AEP using the density matrices notation.

3 Fidelity.

1. When ρ and σ commute.

2. Betweem the mixed state and any pure state.

3. Use the construction presented in the proof of Uhlman's to calculate the fidelity between: $p\left|0\right\rangle\left\langle0\right| + (1-p)\left|+\right\rangle\left\langle+\right|$ and $(1-p)\left|0\right\rangle\left\langle0\right| + p\left|+\right\rangle\left\langle+\right|$.

4 Entropy.

Compute the entropy of the following densitiy matrices.

1. The super position over linear subspace. (purestate).

2. The uniform distribution over linear subspace.

5 Coding Theorem.

Let ρ be the density matrix: $p\left|\beta_{00}\right\rangle + \frac{1}{3}(1-p)\sum_{i\neq00}\left|\beta_{ij}\right\rangle$.

6 Quantum Teleportation.

Give a quantum circtus that compute the gate $\begin{bmatrix} 1 & 0 \\ 0 & e^{i\frac{\pi}{8}} \end{bmatrix}$ up to global phase using only pauli, clifford, and measurments.