Quantum info in TCS: Homework 2

Guideline

- Deadline: December 1, midnight

- Each question is worth the same number of points. If your score is x out of 100, it will be rounded to $\lceil x/20 \rceil * 20$.

- You should submit your solutions in groups of three or four members. Group assignments will be randomly selected and provided to you.

Problems

1. Problem 6.8 here

2. An n qubit state $|\phi\rangle$ is called a stabilizer state if there exists an Abelian subgroup S of Pauli group of size 2^n such that $g|\phi\rangle = |\phi\rangle$ for all $g \in S$. Let $|\phi\rangle$ be an n qubit stabilizer state and Π a projection onto *arbitrary* stabilizer code subspace. Show that $\Pi|\phi\rangle$ is either zero or proportional to another stabilizer state.

3. Prove that every CSS quantum code is a stabilizer code.

4. Exercise 7.3 here.

5. Let $|\phi\rangle$ be a uniformly distributed $n+m$ qubit state. Set ρ as the density operator corresponding to the first n qubits of $|\phi\rangle\langle\phi|$. For an arbitrary projection P onto r dimensional subspace of $(\mathbb{C}^2)^{\otimes n}$, find

$$\mathrm{E}_{|\phi\rangle}\big[(\mathrm{tr}(P\rho))^3\big]. \tag{1}$$

You can use tensor diagrams in your calculations.