

CS 5001 Homework - 4

Instructor Avah Banerjee

Due: May 1, 2024 (12 Noon CST)

Problem 1 (30 pts) Let $H = X_1 \otimes X_2 - Z_1 \otimes Y_2$ be a Hamiltonian of a bi-level system of two interacting particles. Write down the unitary that describes the evolution of the system for a duration of 1 sec using the Trotter approximation.

Problem 2 (20 pts) Determine the unitary U such that $UHU^\dagger = Z$.

Problem 3 (50 pts) For the 4 particle interaction graph given below construct a Qiskit program that, given a time input t , determines the state after time t starting from the all-zero state ($|0^n\rangle$). In Qiskit, there is a function which will directly generate a circuit corresponding to the Hamiltonian operator. You may use it or build on your own (10 bonus points).

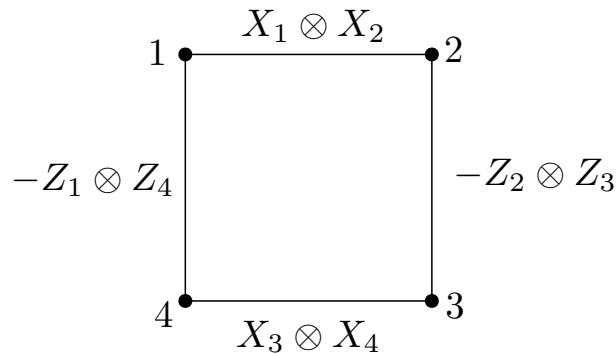


Figure 1: Interaction graph of a cycle of 4-spins